7 Southern New England-Mid Atlantic yellowtail flounder

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This assessment of the Southern New England-Mid Atlantic yellowtail flounder (Limanda ferruginea) stock is an operational assessment update of the existing 2012 benchmark assessment (NEFSC 2012). Based on the last operational assessment (Alade 2015), the stock was overfished and overfishing was occurring. This assessment updates commercial fishery catch data, research survey indices of abundance, weights at age and the analytical ASAP assessment model and reference points through 2016. Additionally, stock projections have been updated through 2020. This report reflects decisions made during the Peer review meeting on September 12, 2017.

State of Stock: Based on this updated assessment, Southern New England-Mid Atlantic yellowtail flounder (*Limanda ferruginea*) stock is overfished and overfishing is occurring (Figures 34-35). Retrospective adjustments were made to the model results. Spawning stock biomass (SSB) in 2016 was estimated to be 152 (mt) which is 8% of the biomass target (SSB_{MSY} *proxy* = 1,860; Figure 34). The 2016 fully selected fishing mortality was estimated to be 1.09 which is 320% of the overfishing threshold proxy (F_{MSY} *proxy* = 0.341; Figure 35).

Table 23: Catch and model results for Southern New England-Mid Atlantic yellowtail flounder. All weights are in (mt) recruitment is in (000s) and F_{Full} is the average fishing mortality on ages (ages 4 and 5). Model results are from the current updated ASAP assessment. Note: Terminal year estimates of SSB and F reflect the unadjusted values for retrospective error.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
				Data						
Commercial discards	296	391	268	177	145	221	185	109	53	26
Commercial landings	205	192	185	113	243	342	461	516	284	126
Total Catch for Assessment	502	583	453	291	388	563	646	625	337	152
				Model Results						
Spawning Stock Biomass	1,433	1,533	1,480	1,614	1,712	1,671	1,437	942	541	300
F_{Full}	0.58	0.51	0.38	0.24	0.32	0.53	0.7	0.84	0.77	0.58
Recruitment (age 1)	2,592	3,981	3,550	3,279	6,502	1,665	1,384	521	326	902

Table 24: Comparison of reference points estimated in an earlier assessment and from the current assessment update. An $F_{40\%}$ proxy was used for the overfishing threshold and was based on long-term stochastic projections.

	2015	2017
F_{MSY} *proxy*	0.349	0.341
SSB_{MSY} (mt)	1,959	1,860 (1,149 - 2,725)
MSY (mt)	541	511 (319 - 742)
Median recruitment (age 1) (000s)	7,634	7,242
Overfishing	Yes	Yes
Overfished	Yes	Yes

Projections: Short term projections of biomass were derived by sampling from an empirical cumulative distribution function of 26 recruitment estimates from the ASAP model results. Following the previous and accepted benchmark formulation, recruitment was based on recent estimates of recruitments from the model time series (i.e. corresponding to year classes 1990 through 2015) to reflect the low recent pattern of recruitment in the stock. The annual fishery selectivity, maturity ogive, and mean weights at age used in projection are the most recent 5 year averages; retrospective adjustments were applied in the projections.

Table 25: Short term projections of total fishery catch and spawning stock biomass for Southern New England-Mid Atlantic yellowtail flounder based on a harvest scenario of fishing at F_{MSY} *proxy* between 2019 and 2020. Catch in 2017 was assumed to be 90 (mt).

Year	Catch (mt)	SSB (mt)	F_{Full}
2017	90	187 (127 - 272)	0.541

Year	Catch (mt)	SSB (mt)	F_{Full}
2018	45 (28 - 69)	151 (93 - 235)	0.341
2019	81 (44 - 145)	406 (179 - 819)	0.341
2020	186 (84 - 356)	912 (381 - 1,737)	0.341

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).

  Recruitment remains a major source of uncertainty in this assessment. The choice of recruitment assumption (i.e. historical recruitment values or contemporary recruitment values) will influence stock status determination and short-term forecast of the stock. Although, contemporary recruitment is likely to reflect curent conditions for the stock, the underlying mechanism for the recent low recruitment is not clearly understood. Another source of uncertainty is the retrospective pattern that has persisted since the last operational

assessment. It should be noted that this operational assessment resulted in a reduction of retrospective bias(22% for F and 42% for SSB) due to the revision of the 2009-2014 NEFSC survey indices.

- 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}; see Table 8).

  The 7-year Mohn's ρ, relative to SSB, was 1.06 in the 2015 assessment and was 0.98 in 2016. The 7-year Mohn's ρ, relative to F, was -0.53 in the 2015 assessment and was -0.47 in 2016. There was a major retrospective pattern for this assessment because the ρ adjusted estimates of 2016 SSB (SSB_{ρ}=152) and 2016 F (F_{ρ}=1.09) were outside the approximate 90% confidence region around SSB (217 - 459) and F (0.362 - 0.843).

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

  Following the panel's recommendation from the 2015 operational assessment to use the Rho unadjusted projections as an upper bound for estimating OFL, the performance of the population projections for Southern New England-Mid Atlantic yellowtail flounder cannot be determined due to different approaches used in the projections for this assessment and the previous operational assessment. Projections in this assessment were Rho adjusted to account for a major retrospective pattern, and therefore is not comparable to the panel's recommendation from 2015 operational assessment.

- 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.

  In addition to data updates through 2016, this assessment revises the NEFSC fall and spring survey data for years 2009-2014 to be consistent with the NEFSC level of acceptable survey tow criteria. The revision to the NEFSC survey indices resulted in a slight upward scaling of estimated spawning stock biomass and a downward scaling of fishing mortality estimates for the recent years in the model (2008-2014). Further, sensitivity analyses were conducted to relax the input variance in the catch data time series as a scalar from a CV = 0.1 to CV = 0.2 to better account for the level of uncertainty in the catch data. Input effective sample sizes for both the catch and survey indices were also modified (See Supplemental information in the data Portal) in attempt to improve the quality of the model fit to the observed data. Overall, the changes in the sensitivity assessment model resulted in an improved model diagnostic (i.e. reduced retrospective bias but minimal difference in model parameter precision estimates). The sensitivity analyses were brought forward to the peer review panel for consideration, but due to the minimal influence of the sensitivity analyses on the assessment results and stock status determination, the panel agreed to accept the base model without changes as basis for catch advice. It was recognized that the range of changes made in the sensitivity model were outside of the scope of permissible changes in an operational assessment framework. However, the panel recommended that future work on the sensitivity analyses (i.e. determinnng the appropriate model weighting) should be pursued as an avenue to potentially improve model disgnostics.

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

  Stock status for Southern New England-Mid Atlantic yellowtail flounder remains

unchanged since the last 2015 operational assessment as overfished and overfishing occuring. Recruitment of young fish continues to be low, resulting in declining trends in the SSB.

- Provide qualitative statements describing the condition of the stock that relate to stock status.

  Fishing mortality has been declining in recent years but still above the fishing reference point. Recent below average recruitment has resulted in declining Spawning Stock Biomass(SSB) with 2016 SSB lowest in the time series. Spawning Stock Biomass is projected to decrease in the short term, even at current level of catches (Note: 2016 catches was estimated to be second lowest in the time series).

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

  Recruitment of Southern New England-Mid Atlantic yellowtail flounder continues to be weak. Should this pattern of poor recruitment continue into the future, the ability of the stock to recover could be compromised. Therefore, future studies should build on current knowledge to further investigate some of the underlying ecological mechanisms of poor recruitment in the stock as it may relate to the physical environment. Recent studies on evaluating environmental effects on Southern New England yellowtail stock productivity suggest that oceanographic features, such as the cold pool and Gulf Stream are likely important predictors of recruitment (Miller et al.2016, Xu et al. 2017), however the mechanisms driving these predictions are not well known. Other areas of future work should continue to address the retrospective bias, including further work on the sensitivity analyses (i.e. determination of appropriate input data weighting by evaluating the CV and effective sample sizes in the model).

- Are there other important issues?

  None.

7.1 Reviewer Comments: Southern New England-Mid Atlantic yellowtail flounder

Assessment Recommendation:

The panel concluded that the operational assessment with adjustments for retrospective bias was acceptable as a scientific basis for management advice. The panel received an initial presentation for this stock exploring sensitivity to data-weighting in the model. However, the panel felt that these changes exceeded what was stated as permissible in this operational assessment cycle. Further, the results of the two methods were nearly identical; thus, the panel recommends the original base model be used for management advice.

Alternative Assessment Approach:

Not applicable

Status Recommendation:

Based on this operational assessment, the panel agrees with the conclusion that the Southern New England-Mid Atlantic yellowtail flounder stock is overfished and overfishing is occurring. Recent below average recruitment has resulted in declining spawning stock biomass. Spawning stock biomass is projected to decrease in the short term, even at current level of catches (2016 catch was estimated to be the second lowest in the time series). Recruitment of Southern New England-Mid Atlantic yellowtail flounder continues to be weak and if this pattern of poor recruitment continues into the future, the ability of the stock to recover could be compromised.

Key Sources of Uncertainty:

Underlying mechanisms for the recent low recruitment is not clearly understood. Another source of uncertainty is the retrospective pattern that has persisted since the last operational assessment. Catchability is a source of uncertainty. Catchability estimates derived from the cooperative research study are substantially different from those estimated in this assessment.

Research Needs:

The panel recommends future studies that build on current knowledge to further investigate some of the underlying ecological mechanisms of poor recruitment in the stock as it may relate to the physical environment. Recent studies that evaluated environmental effects on Southern New England yellowtail productivity suggest that oceanographic features, such as the cold pool and Gulf Stream are likely important predictors of recruitment. Future work should continue to address the retrospective bias, including the proposed changes to the catch CV and effective sample sizes that were provided in the initial assessment presentation, among other factors. Finally, the panel recommends further research and consideration of survey catchability estimates.

References:

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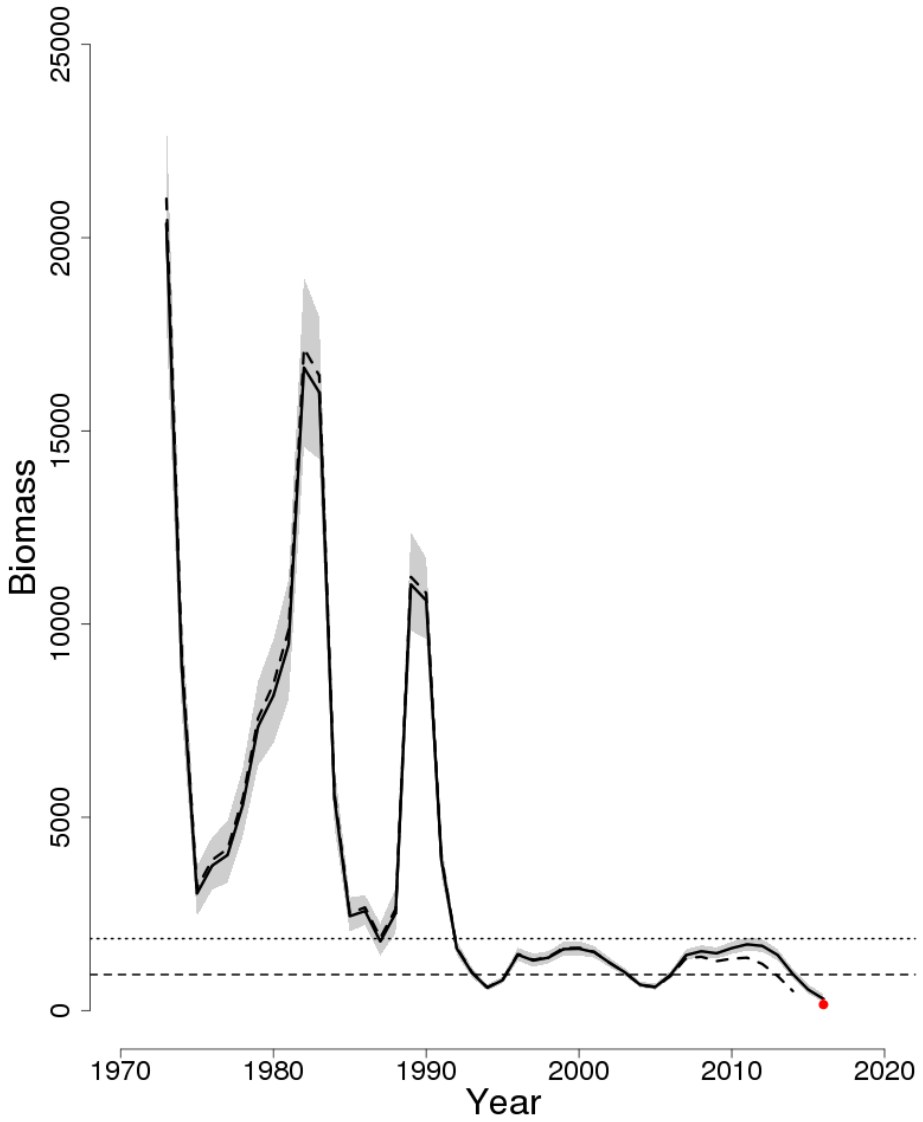

Figure 34: Trends in spawning stock biomass of Southern New England-Mid Atlantic yellowtail flounder between 1973 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ SSB_{MSY} *proxy*; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY} *proxy*; horizontal dotted line) based on the 2017 assessment. Biomass was adjusted for a retrospective pattern and the adjustment is shown in red. The approximate 90% lognormal confidence intervals are shown.

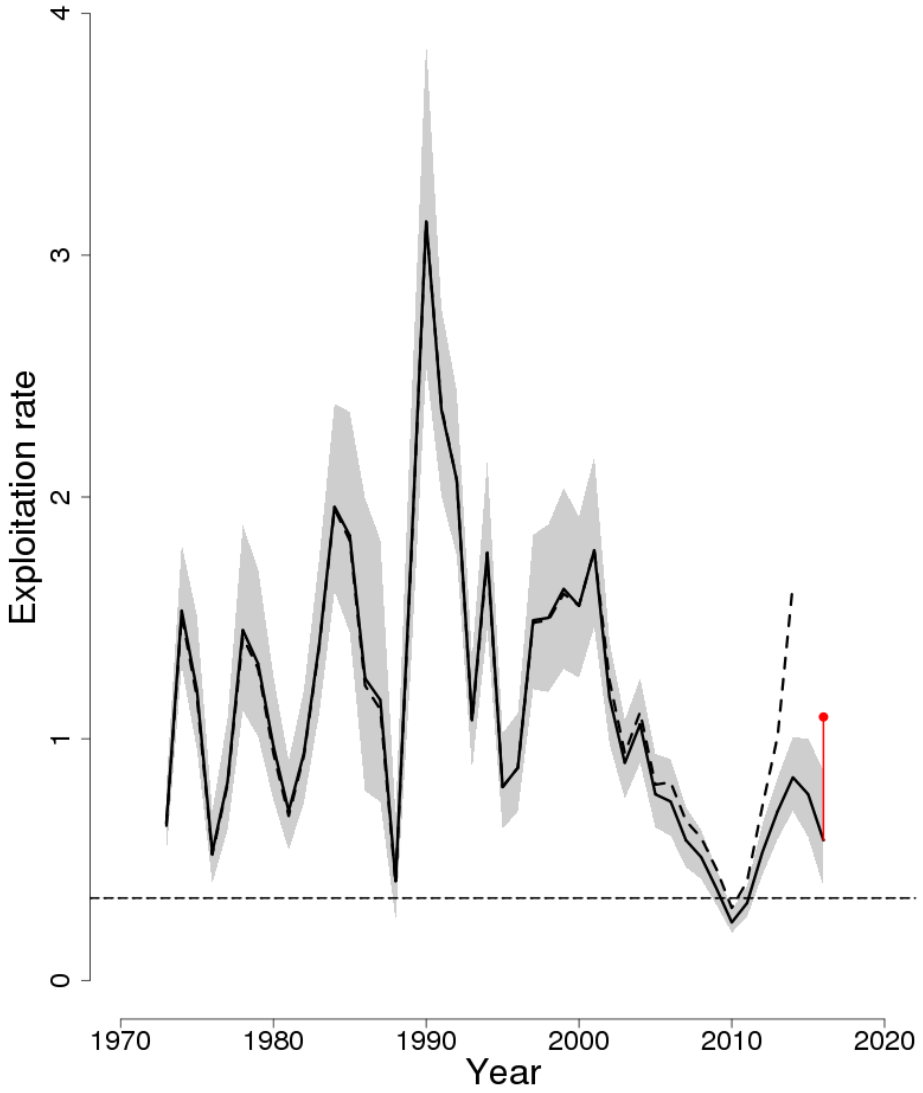

Figure 35: Trends in the fully selected fishing mortality (F_{Full}) of Southern New England-Mid Atlantic yellowtail flounder between 1973 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY} *proxy*=0.341; horizontal dashed line). F_{Full} was adjusted for a retrospective pattern and the adjustment is shown in red based on the 2017 assessment. The approximate 90% lognormal confidence intervals are shown.

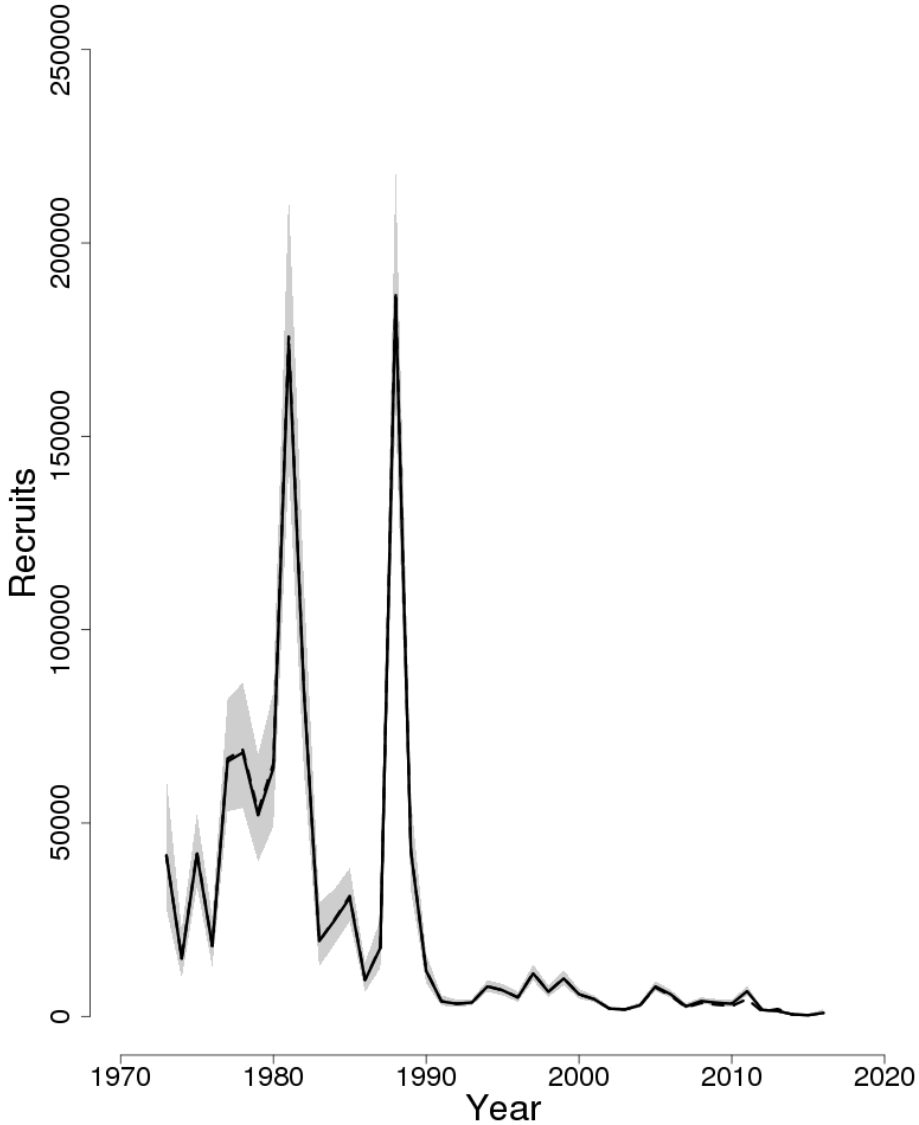

Figure 36: Trends in Recruitment (age 1) (000s) of Southern New England-Mid Atlantic yellowtail flounder between 1973 and 2016 from the current (solid line) and previous (dashed line) assessment. The approximate 90% lognormal confidence intervals are shown.

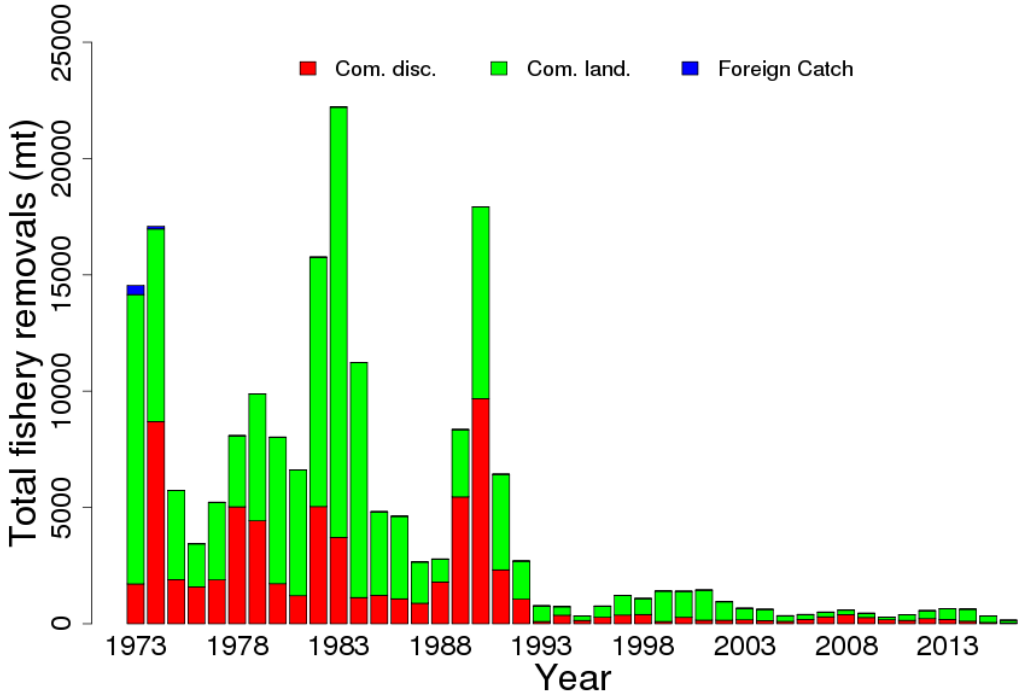

Figure 37: Total catch of Southern New England-Mid Atlantic yellowtail flounder between 1973 and 2016 by fleet (US domestic and foreign catch) and disposition (landings and discards).

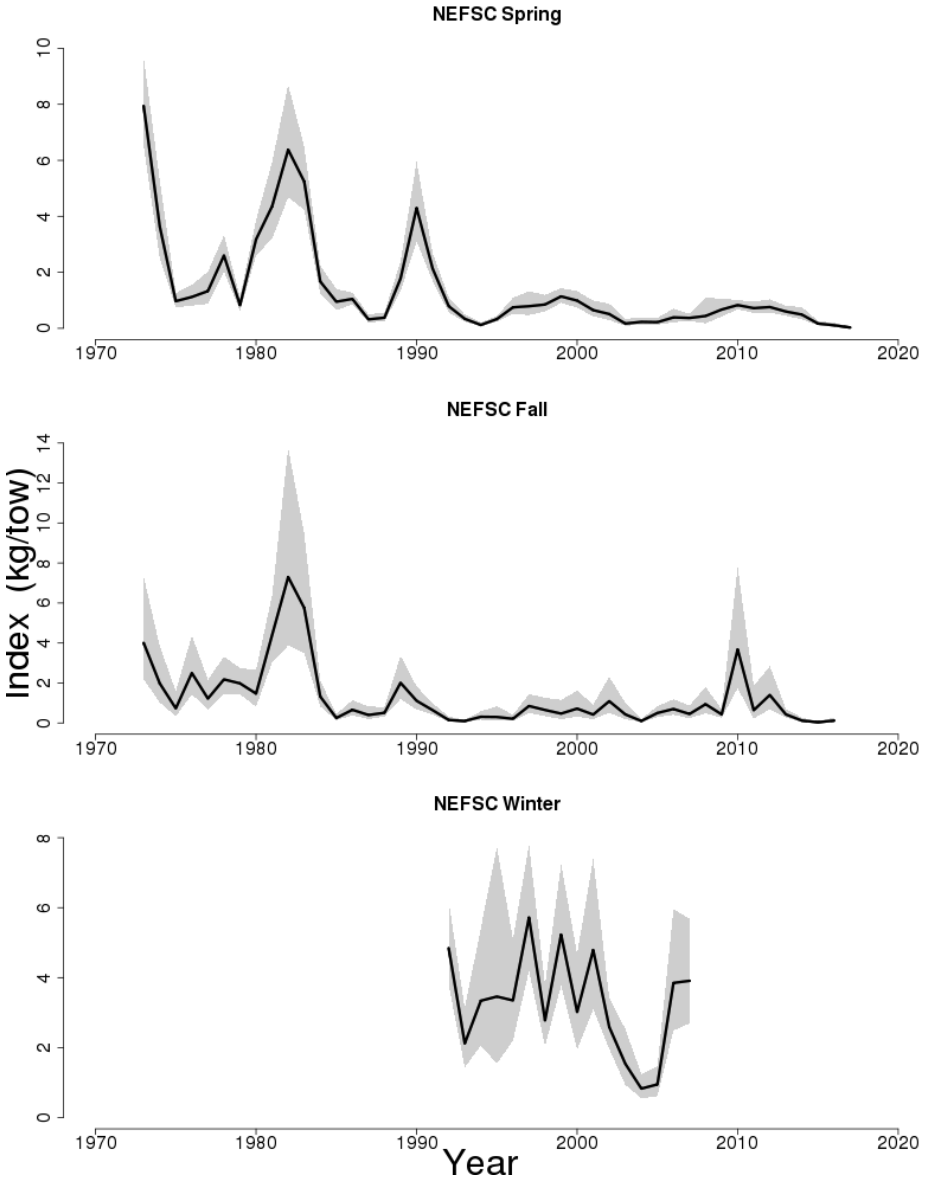

Figure 38: Indices of biomass for the Southern New England-Mid Atlantic yellowtail flounder between 1973 and 2017 for the Northeast Fisheries Science Center (NEFSC) spring, fall and winter bottom trawl surveys. The approximate 90% lognormal confidence intervals are shown. Note: Larval index based on Richardson et al (2009) was also used in this assessment and is available in the supplemental documentation.