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Southern New England-Mid Atlantic yellowtail flounder

2019 Assessment Update Report

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, Massachusetts

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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 2017), 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 2018. Additionally, stock projections have been updated through 2022.

State of Stock: Based on this updated assessment, Southern New England-Mid Atlantic yellowtail flounder (*Limanda ferruginea*) stock is overfished and overfishing is not occurring (Figures 1-2). Retrospective adjustments were made to the model results. Spawning stock biomass (SSB) in 2018 was estimated to be 90 (mt) which is 5% of the biomass target (SSB_{MSY} *proxy* = 1,779; Figure 1). The 2018 fully selected fishing mortality was estimated to be 0.259 which is 73% of the overfishing threshold proxy (F_{MSY} *proxy* = 0.355; Figure 2).

Table 1: 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.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Data										
Commercial discards	268	177	145	221	185	109	53	26	16	8
Commercial landings	185	113	243	342	461	516	284	126	48	11
Total Catch for Assessment	453	291	388	563	646	625	337	152	64	19
Model Results										
Spawning Stock Biomass	1,645	1,752	1,823	1,831	1,454	956	504	235	135	147
F_{Full}	0.363	0.227	0.307	0.527	0.678	0.811	0.791	0.714	0.522	0.178
Recruitment (age 1)	3,511	3,208	6,326	1,646	1,209	274	125	105	775	905

Table 2: 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.

	2017	2019
F_{MSY} *proxy*	0.347	0.355
SSB_{MSY} (mt)	1,986	1,779 (993 - 2,725)
MSY (mt)	547	492 (277 - 749)
Median recruitment (age 1) (000s)	7,242	6,562
Overfishing	Yes	No
Overfished	Yes	Yes

Projections: Short term projections of biomass were derived by sampling from an empirical cumulative distribution function of 28 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 2017) 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 3: 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 2021 and 2022. Catch in 2019 was assumed to be 16 (mt).

Year	Catch (mt)	SSB (mt)	F_{Full}
2019	16	95 (73 - 129)	0.227

Year	Catch (mt)	SSB (mt)	F_{Full}
2020	31 (23 - 41)	111 (84 - 151)	0.355
2021	69 (33 - 127)	405 (112 - 905)	0.355
2022	173 (60 - 339)	878 (288 - 1,636)	0.355

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 persistence of retrospective patterns remains a source of unceratinty in this assessment. This has resulted in a decrease in adult biomass and recruitment and an increase in fishing mortality when more years of data are added. Although the magnitude of these retrospective patterns continue to show a notably decrease for F and SSB relative to previous assessments (F by 33% and SSB by 36% relative to 2017 OA), rho adjusted projections were still conducted, which resulted in a reduction of starting abundance at age by approximately 61%.

- 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 **??**).

  The 7-year Mohn's ρ, relative to SSB, was 0.98 in the 2017 assessment and was 0.63 in 2018. The 7-year Mohn's ρ, relative to F, was -0.47 in the 2017 assessment and was -0.31 in 2018. There was a major retrospective pattern for this assessment because the ρ adjusted estimates of 2018 SSB (SSB_{ρ}=90) and 2018 F (F_{ρ}=0.259) were outside the approximate 90% confidence region around SSB (113 - 200) and F (0.12 - 0.25).

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

  Population projections for Southern New England-Mid Atlantic yellowtail flounder are uncertain for reasons associated with the retrospective bias in this updated assessment. The 2018 estimates of SSB however are well within the bounds of the projected SSB in 2017. In contrast to SSB, total yield in the fishery is not within the bounds of the projected 2017 catch *estimates. The stock is in a rebuilding plan with a rebuilding date of 2029. Estimated SSB in 2018 is below the* $SSB_{Threshold}$.

- 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 Southern New England-Mid Atlantic yellowtail flounder assessment for this update. However, additional model explorations were carried out to examine the influence of the catchability estimates from the Cooperative Research chain sweep experiment in the ASAP model. Further details can be found in final bullet of this section on important issues relative to the assessment.

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

  The status of fishing for Southern New England-Mid Atlantic yellowtail flounder has changed since the last 2017 operational assessment from overfishing occurring to overfishing NOT occurring. The biomass stock status however remains unchanged and is still overfished in this update. The 2018 total catch for Southern New England-Mid Atlantic yellowtail flounder was estimated to be the lowest on record at 19mt and approximately 29% of the ACL. The continued decline in total catch of Southern New England-Mid Atlantic yellowtail flounder since the last operational assessment in 2017 and the moderate incoming year class in 2017 and 2018 (but still estimated below avergae since the 1990's) partly supports the change in the overfishing status. In the short term, SSB is expected to increase, assuming recruitment remains at average levels since the 1990s, but the projected increase is still below the biomass reference point.

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

  Fishing mortality has been declining in recent years and is now below the fishing reference point. In 2017, the above 10yr average incoming year class has resulted in a moderate increase in Spawning Stock Biomass(SSB) in 2018, but remains well below SSBMSY. In the short term, SSB is projected to increase due to another estimated incoming year class in 2018.

- 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 compared to the pre-1990's. 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?

  The catchability (q) survey biomass from the Cooperative Research comparative chain sweep experiment showed that both fall and spring surveys are declining in trend. Similar to Cape Cod Gulf of Maine yellowtail, averages of the NEFSC spring and fall survey values were calculated to account for inter-survey variation and also to provide an estimate that could be considered for the start of the calendar year biomass. Using the q adjusted catch at length estimates from the chain sweep experiment, indices at age were derived for years 2009-2018 in Bigelow units for direct input to the ASAP model. Three model explorations were carried of which included a base model with just the fall and spring indices for direct comparison to the chain sweep study. The other two model runs explicitly incorporated the q adjusted indices at age and assuming a prior on q. The difference between the latter two model runs is in the estimation procedure for which one of the model runs assumed a fixed prior on q while the other allowed the model to freely estimate the q parameter. Biomass estimates from the three explorations were highly inconsistent in terms of scale and trends when compared to the biomass estimates from the chain sweep experiment (See the supplemental document for additional details). Although the total biomass estimates from the ASAP model explorations were estimated with high precision, the estimated catchabilities were substantially greater than one. The model diagnostics from explorations that explicitly accounted for the chain sweep catchabilities however deteriorated to some degree when compared to the base model formulation.

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Xu, H., T.J. Miller, S. Hameed, L.A. Alade, J. Nye. (2017). Evaluating the Utility of the Gulf Stream Index for Predicting Recruitment of Southern New England- Mid Atlantic yellowtail flounder. Fisheries Oceanography. DOI: 10.1111/fog.12236

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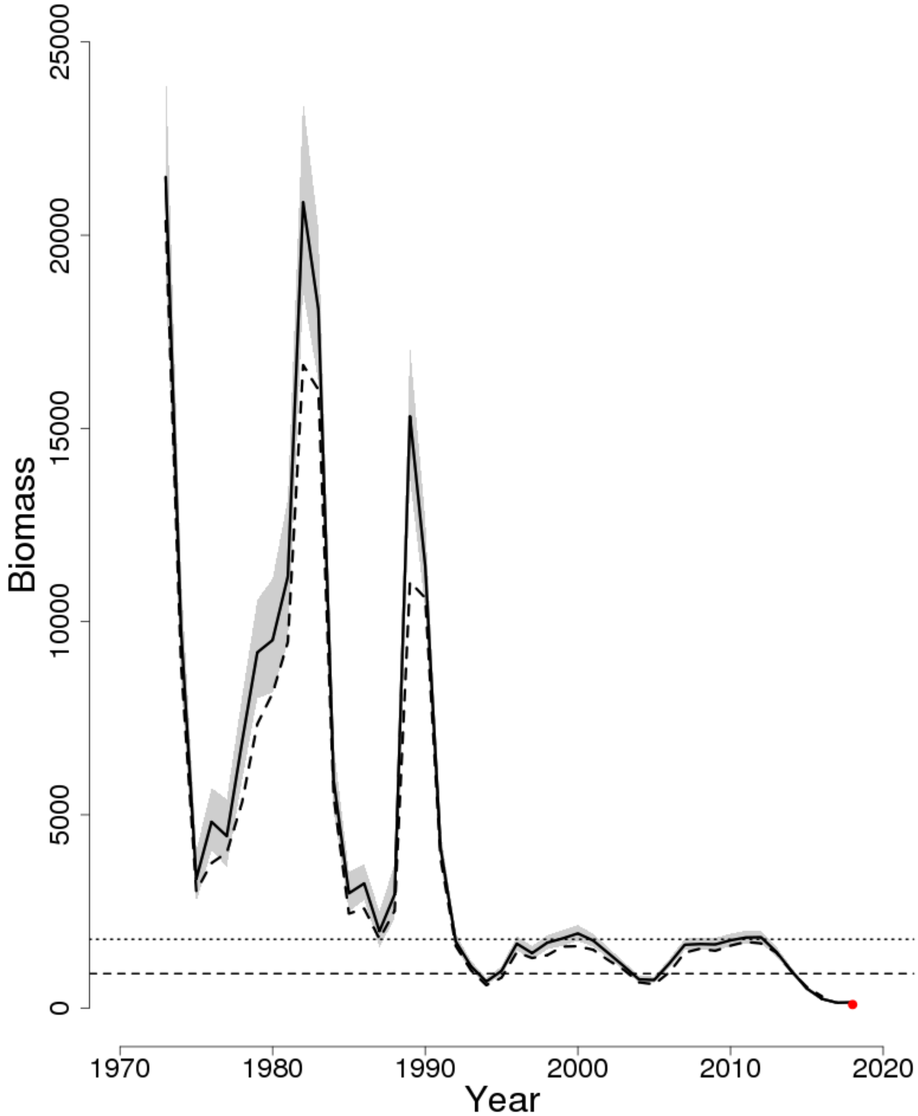

Figure 1: Trends in spawning stock biomass of Southern New England-Mid Atlantic yellowtail flounder between 1973 and 2018 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ SSB_{MSY} *proxy*; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY} *proxy*; horizontal dotted line) based on the 2019 assessment. Biomass was adjusted for a retrospective pattern and the adjustment is shown in red. The approximate 90% lognormal confidence intervals are shown.

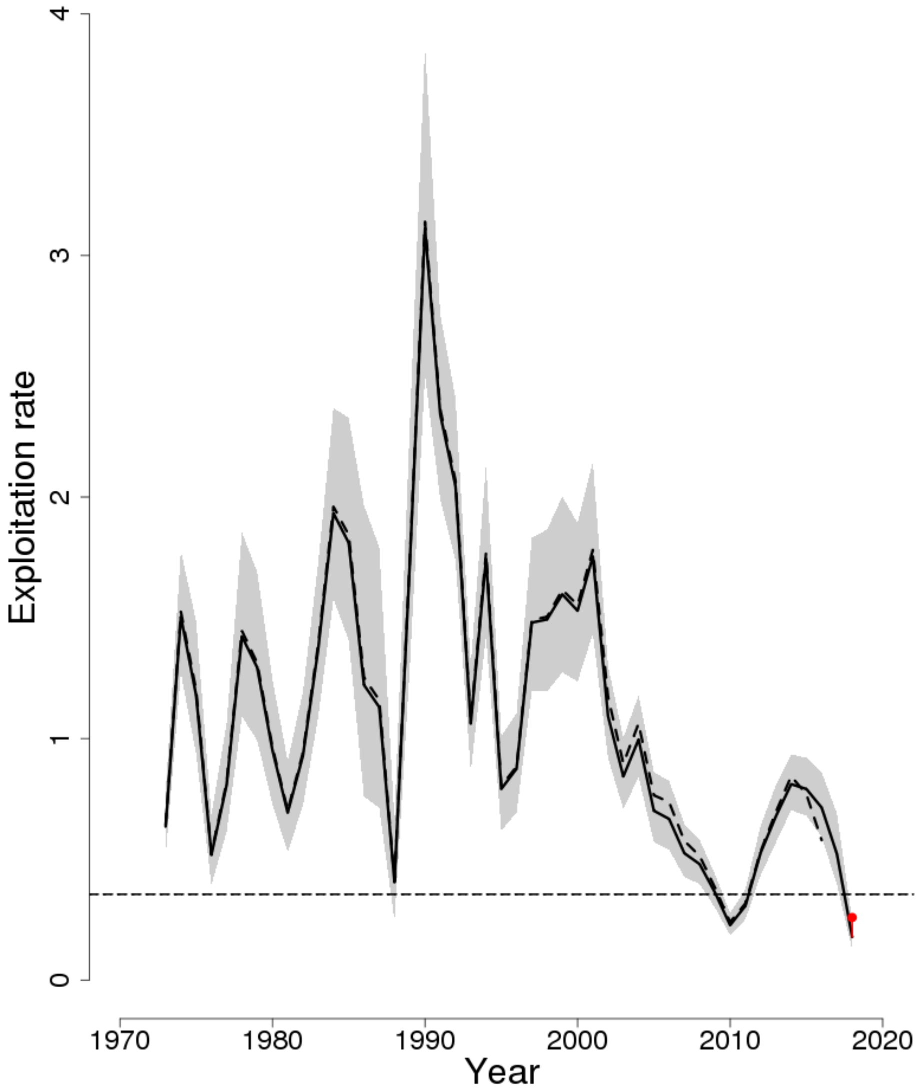

Figure 2: Trends in the fully selected fishing mortality (F_{Full}) of Southern New England-Mid Atlantic yellowtail flounder between 1973 and 2018 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY} *proxy*=0.355; horizontal dashed line). F_{Full} was adjusted for a retrospective pattern and the adjustment is shown in red based on the 2019 assessment. The approximate 90% lognormal confidence intervals are shown.

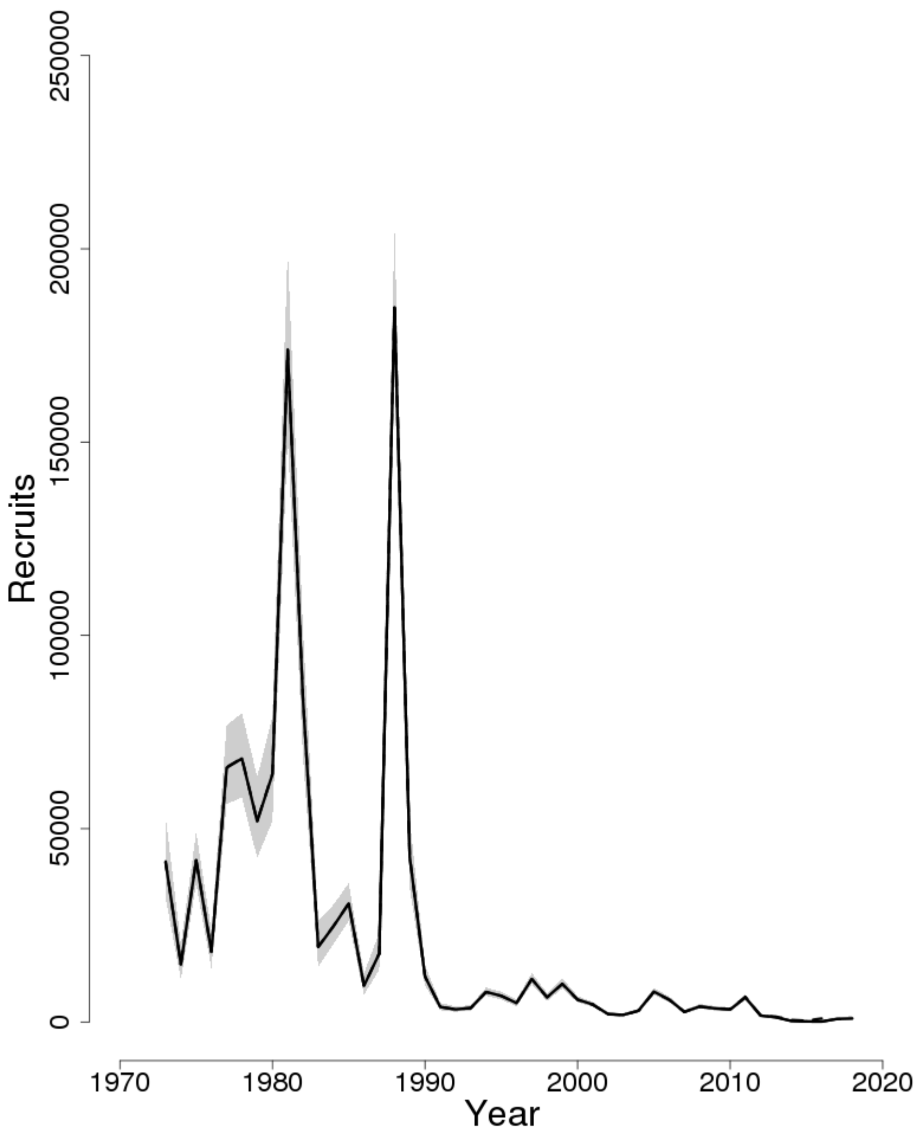

Figure 3: Trends in Recruitment (age 1) (000s) of Southern New England-Mid Atlantic yellowtail flounder between 1973 and 2018 from the current (solid line) and previous (dashed line) assessment. The approximate 90% lognormal confidence intervals are shown.

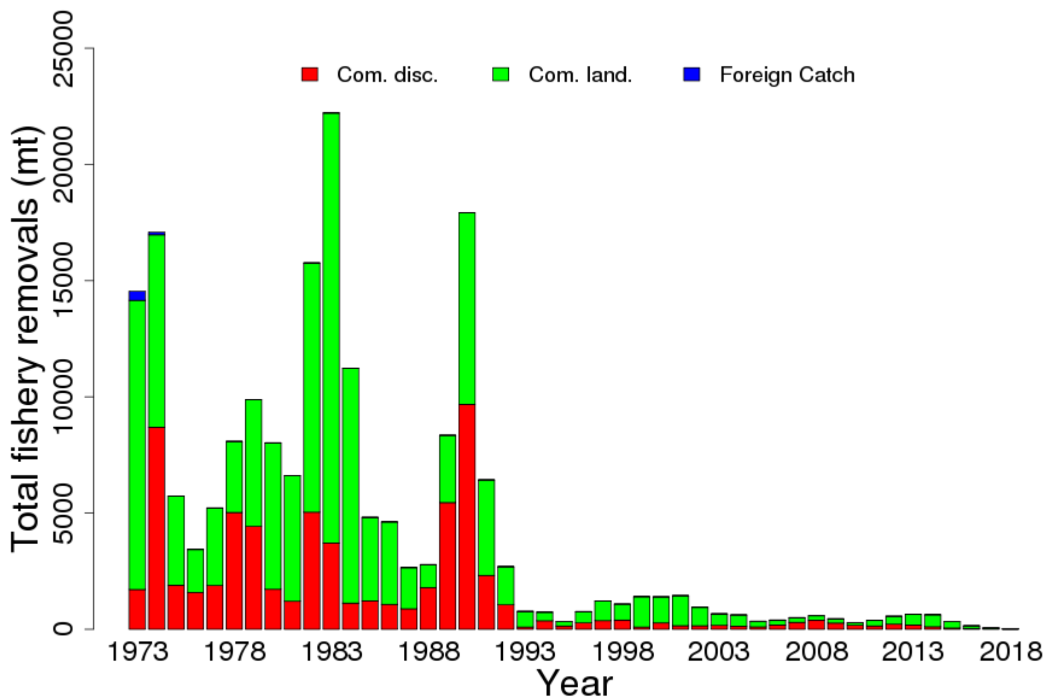

Figure 4: Total catch of Southern New England-Mid Atlantic yellowtail flounder between 1973 and 2018 by fleet (US domestic and foreign catch) and disposition (landings and discards).

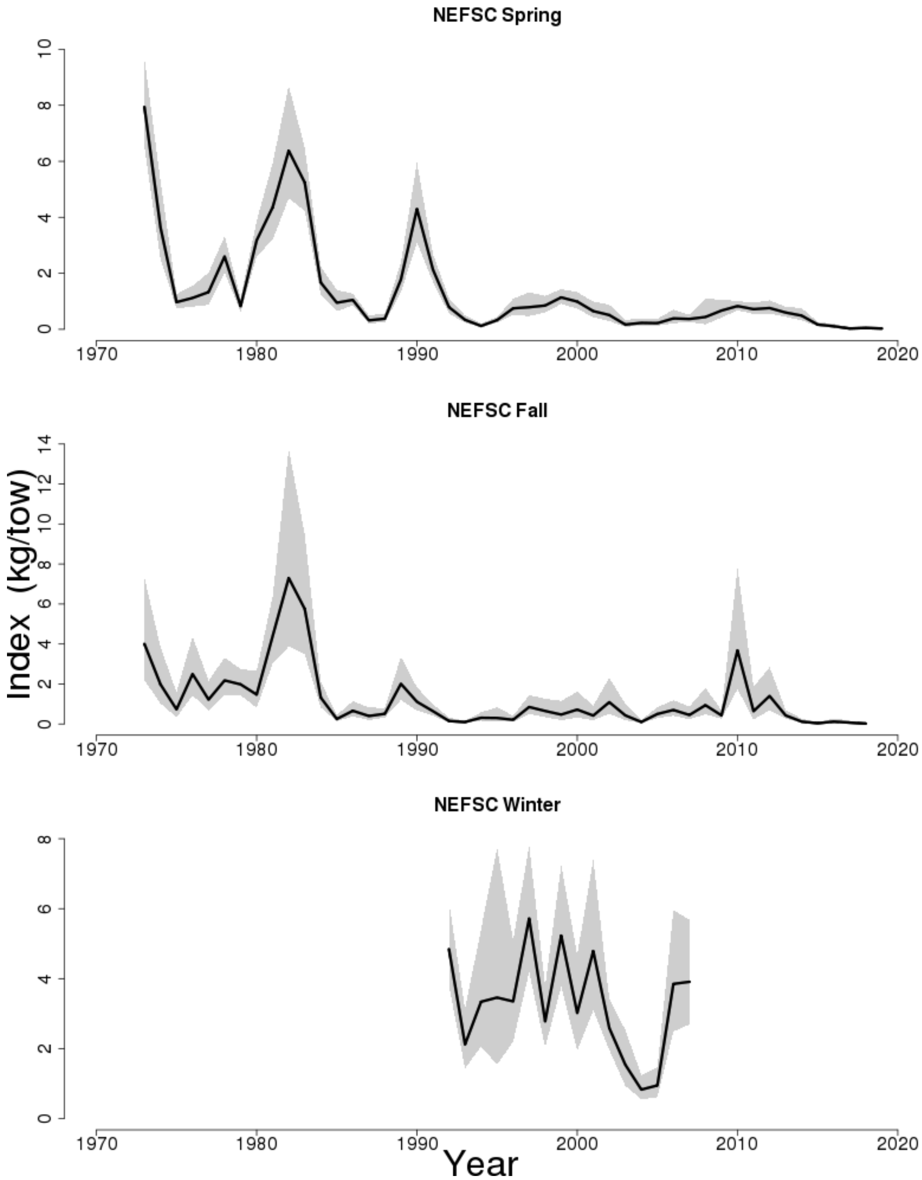

Figure 5: Indices of biomass for the Southern New England-Mid Atlantic yellowtail flounder between 1973 and 2019 for the Northeast Fisheries Science Center (NEFSC) spring, fall and winter bottom trawl surveys. The approximate 90% lognormal confidence intervals are shown. Note: Larval index based on Richardson et al (2009) was also used in this assessment and is available in the supplemental documentation.