draft working paper for peer review only

Butterfish

2022 Management Track Assessment Report

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National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, Massachusetts

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This assessment of the butterfish (Peprilus triacanthus) stock is a level-1 management track assessment of the existing 2021 research track assessment. Based on the previous research track, the stock was not overfished, and overfishing was not occurring. This assessment updates commercial fishery catch data, research survey indices of abundance, the analytical WHAM assessment model, and reference points through 2021. Additionally, stock projections have been updated through 2024

State of Stock: Based on this updated assessment, the butterfish (*Peprilus triacanthus*) stock is not overfished and overfishing is not occurring (Figures 1-2). Retrospective adjustments were not made to the model results. Spawning stock biomass (SSB) in 2021 was estimated to be 66,566 (mt) which is 169% of the biomass target (SSB_{MSY} *proxy* = 39,436; Figure 1). The 2021 fully selected fishing mortality was estimated to be 0.191 which is 3% of the overfishing threshold proxy (F_{MSY} *proxy* = 5.6; Figure 2).

Table 1: Catch and status table for butterfish. All weights are in (mt) recruitment is in (millions) and F_{Full} is the fishing mortality on fully selected ages (age 3). Model results are from the current updated WHAM assessment.

	2013	2014	2015	2016	2017	2018	2019	2020	2021
					Data				
Commercial landings	1,091	3,135	2,104	1,194	3,681	1,673	3,431	2,547	1,566
Commercial discards	441	1,054	830	1,537	948	1,388	1,655	2,430	1,755
Catch for Assessment	1,532	4,189	2,934	2,731	4,629	3,061	5,085	4,977	3,321
					Model Results				
Spawning Stock Biomass	49,417	79,537	79,274	95,457	57,722	84,363	87,645	50,304	66,566
F_{Full}	0.059	0.224	0.142	0.117	0.218	0.121	0.195	0.234	0.191
Recruits (age 0)	7,907	7,967	9,207	5,616	8,301	10,299	4,489	7,006	9,813

Table 2: Comparison of reference points estimated in the 2021 research track and from the current management track update. $F_{50\%SPR}$ and $B_{50\%SPR}$ were calculated internally in WHAM assuming: 1) average recruitment since 2011; and 2) average SSB per recruit inputs (i.e., selectivity, maturity and weight-at-age) over the last five model years (2017-2021). The mean and 95% confidence interval for $B_{50\%SPR}$ and MSY are shown.

	2021	2022
F_{MSY} *proxy*	6.68	5.60
B_{MSY} *proxy* (mt)	37,597 (25,998 - 54,391)	39,436 (28,508 - 54,553)
MSY (mt)	31,798 (21,998 - 45,964)	42,232 (30,520 - 58,437)
Median recruits (age 0) (millions)	7,950	8,293
Overfishing	No	No
Overfished	No	No

Projections: Short term projections of catch and SSB were derived by sampling from a cumulative distribution function of WHAM recruitment estimates for 2011-2021. The annual fishery selectivity, maturity ogive, and mean weights at age used in the projections are the most recent 5 year averages. Retrospective adjustments were not applied in the projections.

Table 3: Short term projections of total fishery catch and spawning stock biomass for butterfish based on a harvest scenario of fishing at the F_{MSY} *proxy* in 2023 and 2024. Catch in 2022 was assumed equal to the highest annual catch since the resumption of the directed fishery in 2013 (5085 mt). F in 2022 was specified to achieve the assumed catch. The mean and 95% confidence interval for catch and SSB are shown.

Year	Catch (mt)	SSB (mt)	F_{Full}
2022	5085	76,278 (43,316 - 134,322)	0.263

Year	Catch (mt)	SSB (mt)	F_{Full}
2023	67,900 (36,451 - 126,481)	45,573 (22,253 - 93,330)	5.596
2024	43,109 (22,001 - 84,468)	39,352 (18,230 - 84,948)	5.596

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 this assessment is the scale of the population. A q of 0.2 for the fall Albatross survey is required to reasonably scale the popluation size. This value of q is based on an analysis of habitat distribution to estimate availability to the survey. A q of 0.2 implies that 80% of the stock is not within the survey area, which seems potentially problematic given that butterfish are widely caught throughout the survey that covers most of their range. Another source of uncertainty is that the discard estimates prior to 2010 are highly variable and imprecise, with CVs > 0.3 in 17 of 21 years.

- 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}).

  This assessment has essentially no retrospective pattern, with Mohn's ρ of 0.014 and 0.032 for F and SSB, respectively.

- 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 butterfish are well determined. The stock is not in a rebuilding plan.

- 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.

  The data source for commercial landings changed to the Catch Accounting and Monitoring System (CAMS) beginning in 2020. Supplemental Figure 20 was presented to the Assessment Oversight Panel (AOP) on April 11, 2022; the AOP concurred that there were no notable differences between the AA tables and CAMS.

  The time series of Bigelow indices was recalculated using station-specific swept areas. Supplemental Figure 21 was also presented to the AOP; the AOP agreed that differences were minor.

  The time series of NEAMAP indices were revised due to a change in the algorithm used to calculate the stratified means. Previously, the stratum weights were manually calculated and then applied to the stratum means, expanded up, etc., in SAS. The newer algorithm uses SAS Proc SurveyMeans to do similar calculations. Supplemental Figure 22 was presented to the AOP; the AOP agreed that differences were minor.

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

  Stock status has not changed since the previous assessment.

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

  Discards have accounted for roughly half of the catch in recent years. The NEFSC fall survey index continues to show large interannual swings in abundance.

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

  The peer-review panel from the 2021 research track identified a number of research recommendations, the most important one being a new evaluation of survey catchability to address the concerns described above.

- Are there other important issues?

  The ASAP4 natural mortality estimate from the 2020 management track (M = 1.278) was assumed in the 2021 research track and the current assessment update.

  Two 2017 bottom trawl surveys were treated as missing in the 2021 research track: the NEFSC fall survey (only 29 of 77 strata were sampled); and the NEAMAP spring survey (only 63 of 150 stations were sampled); this decision was carried forward for the current assessment.

  Three bottom trawl surveys used in this assessment were not conducted in 2020 due to COVID-19: the NEFSC spring and fall surveys, and the NEAMAP spring survey; these surveys were treated as missing for the current assessment.

  The young-of-the-year index combines state survey data from Maine-New Hampshire, Massachusetts, Rhode Island, Connecticut, New Jersey and the Delaware 30-ft headrope survey using the hierarchical method of Conn (2010).

References:

Conn PB. 2010. Hierarchical analysis of multiple noise abundance indices. Canadian Journal of Fisheries and Aquatic Sciences 67(1):108-120.

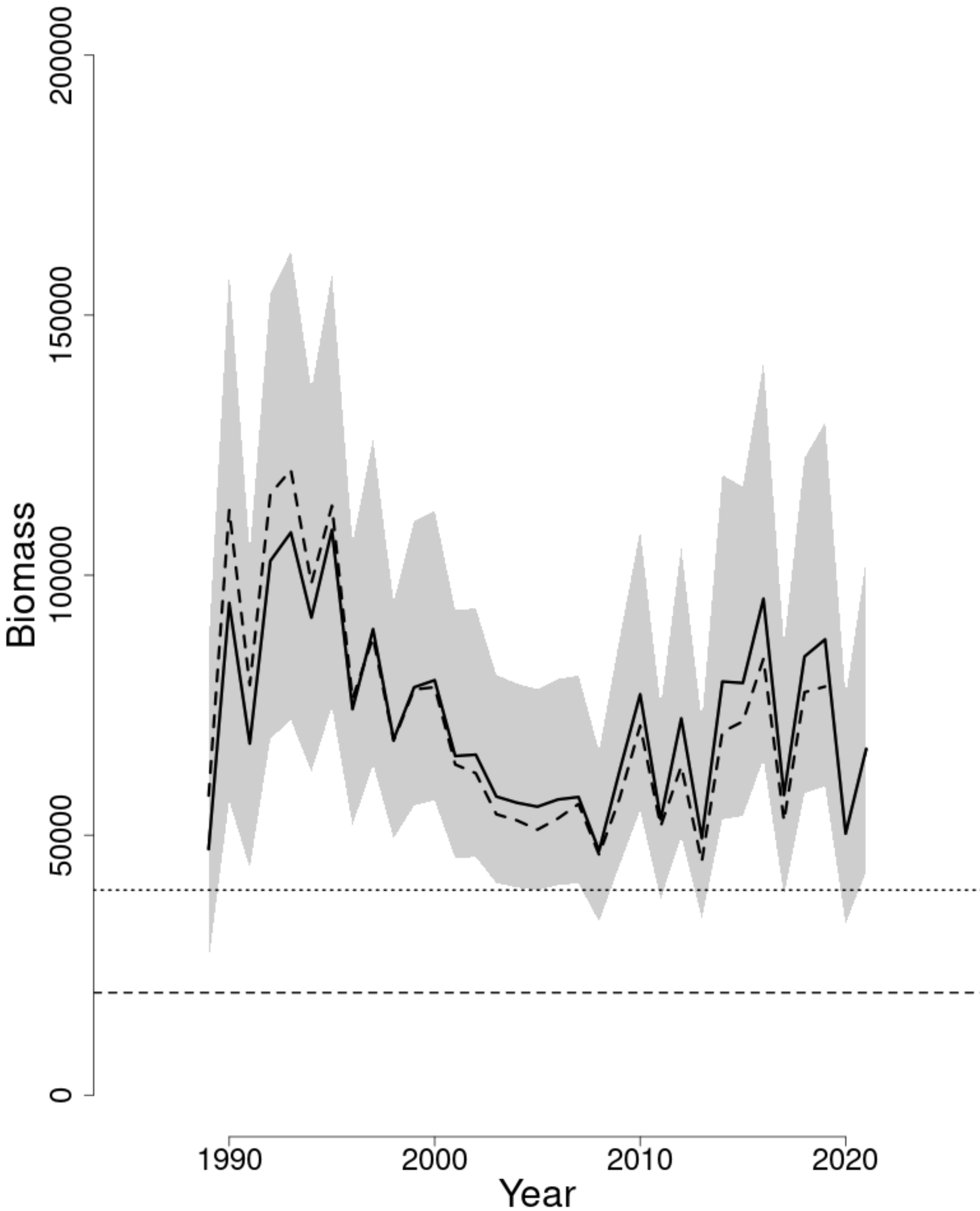

Figure 1: Trends in spawning stock biomass of butterfish between 1989 and 2021 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ SSB_{MSY} *proxy*; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY} *proxy*; horizontal dotted line) based on the 2022 assessment. Biomass was not adjusted for a retrospective pattern. The approximate 90% lognormal confidence intervals are shown.

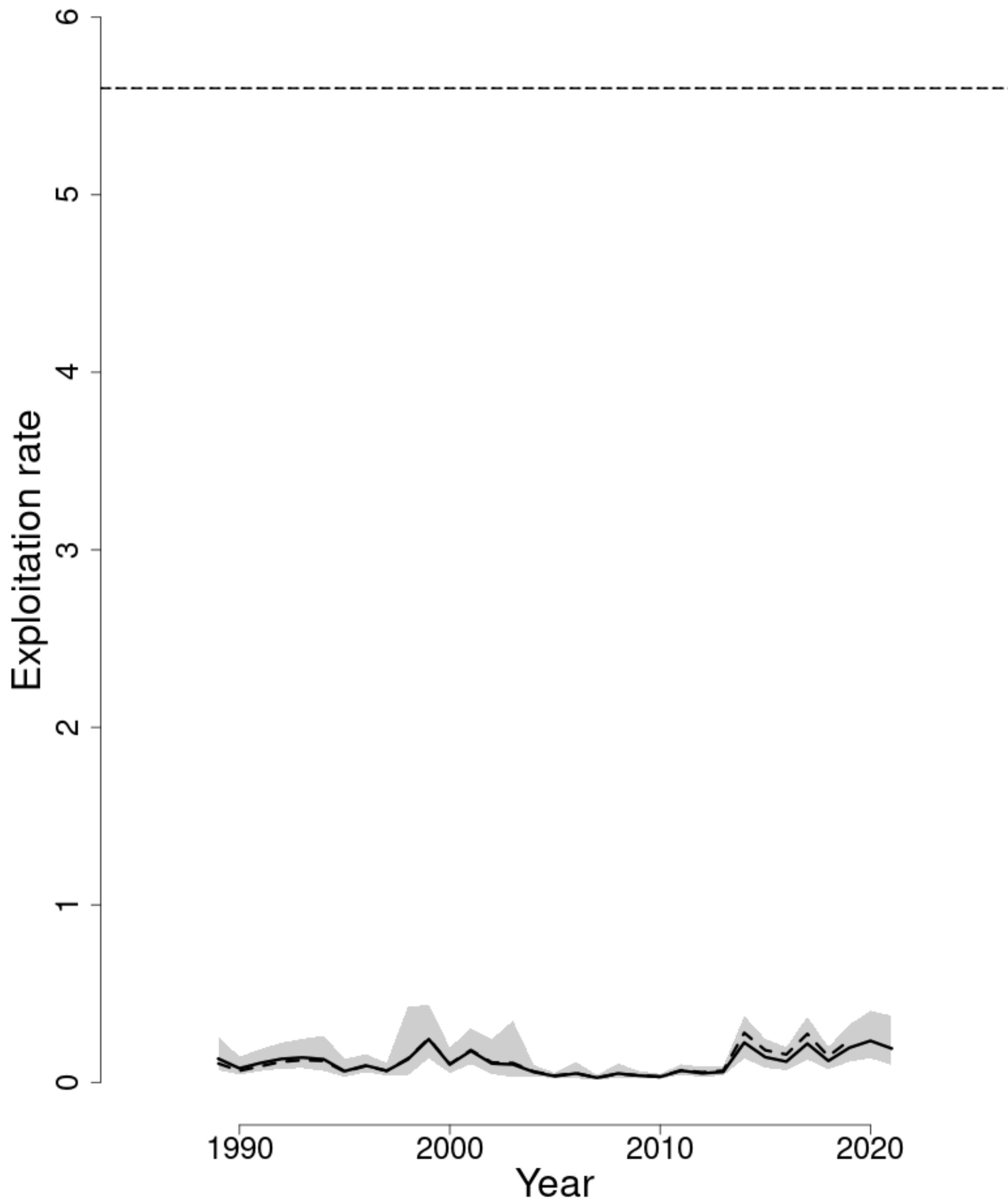

Figure 2: Trends in the fully selected fishing mortality (F_{Full}) of butterfish between 1989 and 2021 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY} *proxy*=5.6; horizontal dashed line). F_{Full} was not adjusted for a retrospective pattern. The approximate 90% lognormal confidence intervals are shown.

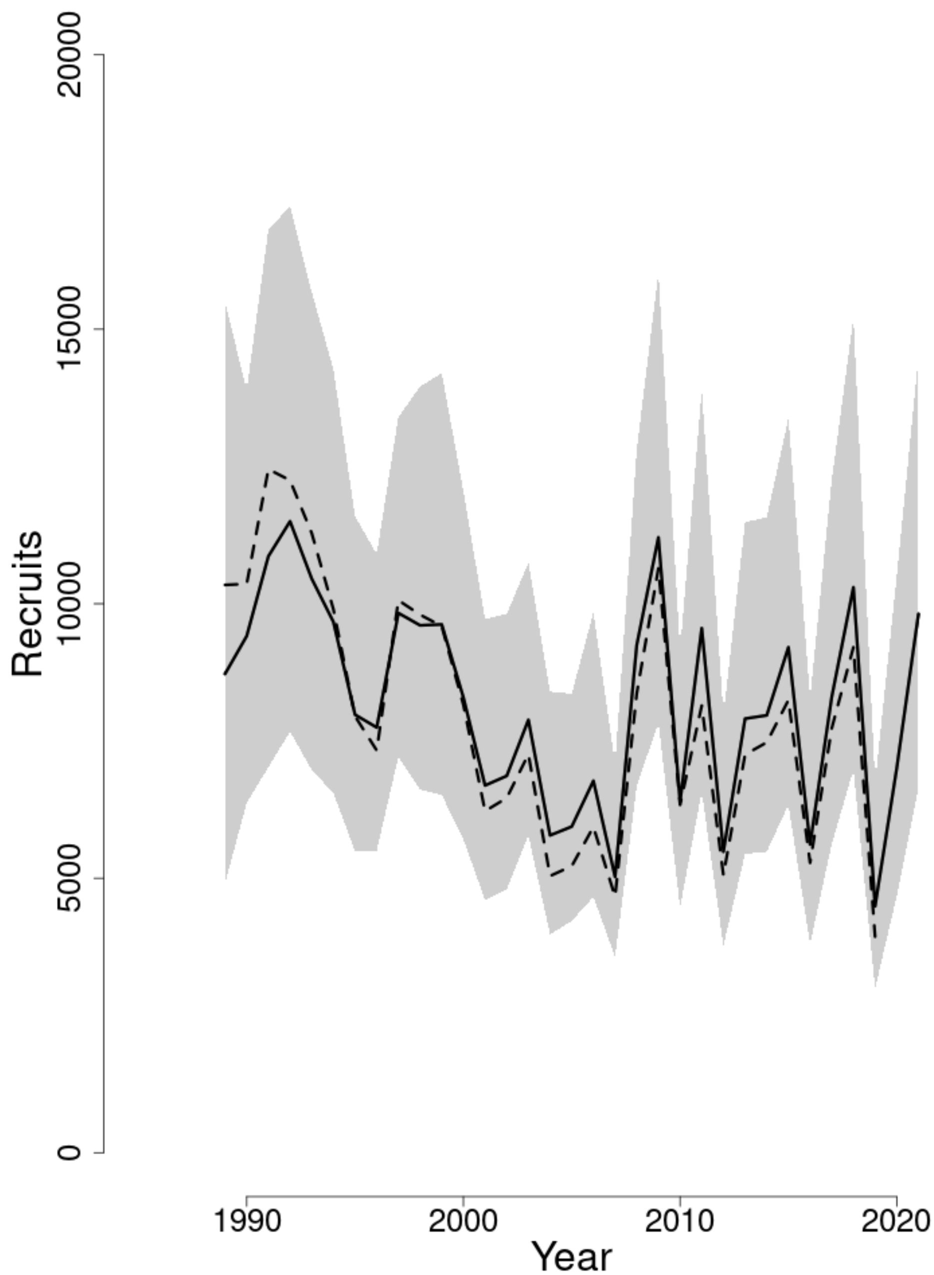

Figure 3: Trends in age 0 recruits (millions) of butterfish between 1989 and 2021 from the current (solid line) and previous (dashed line) assessment. The approximate 90% lognormal confidence intervals are shown.

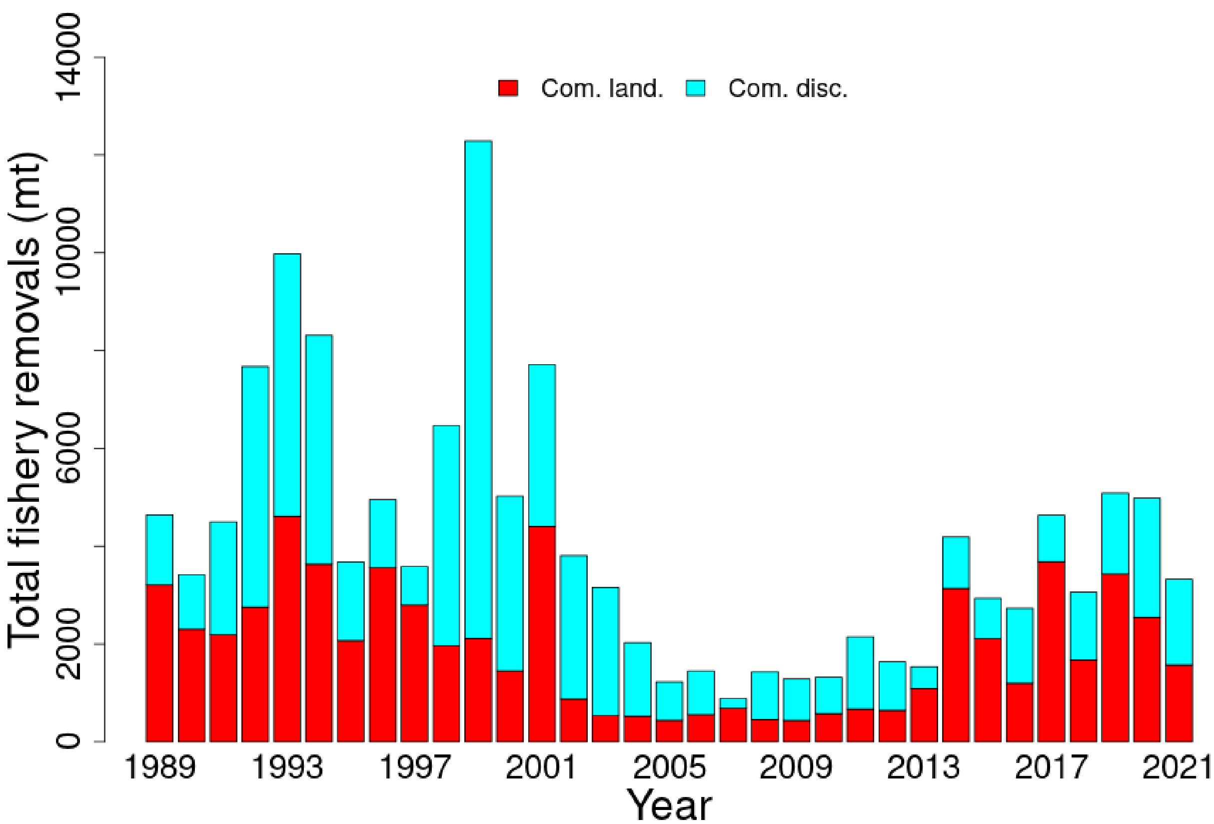

Figure 4: Total commercial catch of butterfish between 1989 and 2021 by disposition (landings and discards).

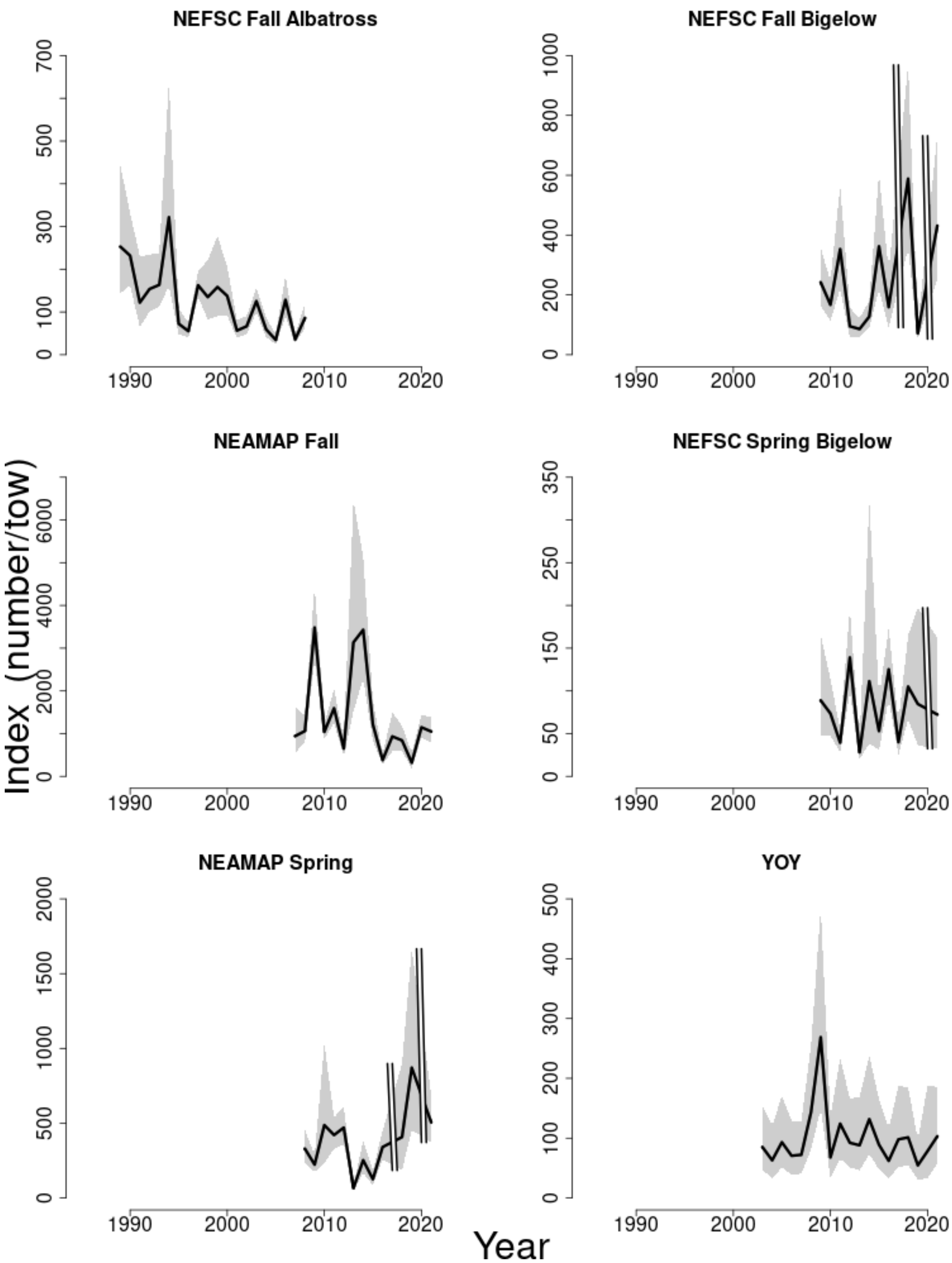

Figure 5: Indices of abundance for butterfish between 1989 and 2021 for the Northeast Fisheries Science Center (NEFSC) fall Albatross, fall Bigelow and spring Bigelow bottom trawl surveys, the Northeast Area Monitoring and Assessment Program (NEAMAP) fall and spring bottom trawl surveys, and the young-of-the-year (YOY) index. The approximate 90% lognormal confidence intervals are shown.