*draft working paper for peer review only*

# Atlantic Bluefish

## *2023 Management Track Assessment Report*

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*This assessment of the Atlantic Bluefish (Pomatomus saltatrix) stock is a management track update assessment of the existing 2022 research track assessment (NEFSC 2022). Stock status for bluefish from the research track assessment (data through 2021) found the stock was not overfished, and overfishing was not occurring. The current assessment updates commercial fishery catch data, recreational fishery catch data, research survey indices of abundance, and the analytical state-space WHAM assessment model and reference points through 2022. Additionally, stock projections have been updated through 2025*

**State of Stock:** Based on this updated assessment, the Atlantic Bluefish (*Pomatomus saltatrix*) stock is not overfished and overfishing is not occurring (Figures 1-2). Retrospective bias in model results was considered minor and retrospective adjustments were not necessary. Spawning stock biomass (SSB) in 2022 was estimated to be 52,747 (mt) which is 60% of the biomass target ($SSB_{MSY}$ *proxy* = 88,131 (mt); Figure 1). The 2022 fully selected fishing mortality was estimated to be 0.152 which is 64% of the overfishing threshold ($F_{MSY}$ *proxy* = 0.239; Figure 2).

Table 1: Catch and status table for Atlantic Bluefish. All weights are in (mt) recruitment is in (000s) and $F_{Full}$ is the fishing mortality on fully selected ages (age 2). Model results are from the current updated WHAM assessment.

| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | *Data* | | | | | |
| Recreational landings | 15,732 | 12,324 | 13,725 | 10,634 | 15,620 | 5,857 | 6,800 | 5,923 | 5,471 | 5,002 |
| Recreational discards | 2,472 | 2,880 | 3,690 | 1,838 | 1,794 | 1,578 | 1,702 | 1,253 | 1,391 | 1,400 |
| Commercial landings | 1,977 | 2,251 | 1,917 | 1,946 | 1,876 | 1,105 | 1,359 | 1,112 | 1,090 | 1,025 |
| Commercial discards | 12 | 18 | 14 | 14 | 7 | 8 | 10 | 7 | 12 | 9 |
| Catch for Assessment | 20,194 | 17,473 | 19,345 | 14,431 | 19,297 | 8,548 | 9,871 | 8,294 | 7,963 | 7,436 |
| | | | | | *Model Results* | | | | | |
| Spawning Stock Biomass | 67,325 | 53,698 | 46,283 | 43,981 | 41,153 | 35,152 | 41,702 | 42,811 | 44,979 | 52,747 |
| Ffull | 0.34 | 0.353 | 0.438 | 0.345 | 0.495 | 0.232 | 0.231 | 0.196 | 0.19 | 0.152 |
| Recruits (age 0) | 136,314 | 120,570 | 101,743 | 69,713 | 112,997 | 111,734 | 68,541 | 74,543 | 97,120 | 137,139 |

Table 2: Comparison of reference points estimated in the 2022 research track assessment and from the current assessment update. An $F_{35\%}$ proxy was used for the overfishing threshold and was based on SPR calculations. The SSBMSY is calculated using the value of SPR35% and mean recruitment.

| | 2022 | 2023 |
|---|---|---|
| $F_{MSY}$ *proxy* | 0.249 | 0.239 (0.199 - 0.287) |
| $SSB_{MSY}$ (mt) | 91,987 | 88,131 (65,576 - 118,445) |
| MSY (mt) | 19,618 | 18,979 (14,025 - 25,684) |
| Median recruits (age 0) (000s) | 103,133 | 108,035 |
| *Overfishing* | No | No |
| *Overfished* | No | No |

**Projections:** Short-term projections were conducted in WHAM, and incorporate model uncertainty, auto-regressive processes and uncertainty in recruitment and numbers-at-age. Removals in 2023 were assumed to be equal to the 2023 ABC (13,890 MT), and projections were carried forward for years 2024-2025 at Frebuild = 0.183. The MAFMC council risk policy (CV = 100%) was used to develop ABC values in each year, and the projection was re-iterated using these values as annual removals in place of Frebuild. Projected ABC catch in 2024 and 2025 based on this approach is 7,929 MT and 9,903 MT, respectively.

The projection uses 5-year averages for natural mortality, maturity, fishery selectivity and weights-at-age. The

5-year average was selected for those parameters to capture the most recent conditions while still smoothing some interannual variability. Projections were not retrospectively adjusted, as the adjusted terminal year estimates of F and SSB fell within the 90% confidence intervals of the unadjusted values.

Table 3: Short term projections of total fishery catch and spawning stock biomass for Atlantic Bluefish based on a harvest scenario assuming annual ABC values calculated from Frebuild (0.183) and the MAFMC risk policy between 2024 and 2025. Catch in 2023 was assumed to be the previously establised ABC value of 13,890 (mt).

| Year | Catch (mt) | SSB (mt) | Ffull |
|---|---|---|---|
| 2023 | 13890 | 59135 (39120 - 89391) | 0.239 |

| Year | Catch (mt) | SSB (mt) | Ffull |
|---|---|---|---|
| 2024 | 7929 | 66706 (41439 - 107379) | 0.121 |
| 2025 | 9903 | 75757 (43303 - 132534) | 0.137 |

**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).

  *Some of the important sources of uncertainty relate to asessment data inputs and the availabilty of information that would help better understand the dynamics of bluefish. Research recommendations from the recent research track assessment fully detail these uncertaintities and data needs. A list of some of the research ideas designed to improve the bluefish stock assessment and reduce some of the uncertainties include:*

  *1. Expanding the collection of recreaional release length frequency data. The bluefish assessment stratifies recreational release lengths by region, and data in the southern region is lacking. These southern fish tend to be smaller and improved information pertaining to the size distribution of the southern fish would help refine the estimate of recreational disard weight.*

  *2. Addressing the uncertainty around temporal availability of bluefish to the fisheries and surveys. The research track assessment made significant advancements in developing an index of bluefish availability based on forage fish in the diets of bluefish like predators. This forage fish index was incorporated into a companion assessment model as a covariate on MRIP CPUE catchability. Further developing this index will help improve the assessment model fit to the MRIP CPUE information, which is an important index that helps scale biomass estimates from the model.*

  *3. Develop fishery dependent or independent sampling programs to provide information on larger, older bluefish. The dynamics of this size class are not well sampled or understood.*

  *4. Develop an updated recreational release mortality study to derive a more informed estimate of recreational discard mortality. Recreational discards are a significant proportion of the total catch so reducing the uncertainty around the release mortality is important.*

- 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 $F_{Full}$).

  *The 7-year Mohn's $\rho$, relative to SSB, was 0.14 in the 2022 assessment and was 0.22 in 2022. The 7-year Mohn's $\rho$, relative to F, was 0.10 in the 2022 assessment and was 0.14 in 2022. This is considered a minor retrospective pattern for both SSB and F because the $\rho$ adjusted estimates of 2022 SSB ($SSB_{\rho}$=43235) and 2022 F ($F_{\rho}$=0.177) were within the approximate 90% confidence regions around SSB (36,194 - 76,871) and F (0.105 - 0.219).*

- 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 Atlantic Bluefish are reasonably well determined. Shifting to WHAM for model projections has allowed for the incorporation of model uncertainty, auto-regressive processes, and the uncertainty in recruitment and numbers-at-age. The retrospective pattern in F and SSB is considered minor (within the 90% CI of both F and SSB), however, the rho values of F and SSB have increased when compared to the previous research track assessment.*

  *TheAtlantic Bluefish stock is in a rebuilding plan with a rebuild date of 2028. Frebuild was re-calculated using a projection that assumes a constant F strategy, such that biomass in 2028 has a 50% chance of exceeding the SSBmsy proxy; Frebuild was calculated to be 0.183. The MAFMC risk policy was applied using this Frebuild strategy in short term projections to generate ABC values that are consistent with the rebuilding schedule for the next two years.*

- 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.

  *A change to the way the age-length keys (ALKs) were developed from the research track, which used full multin-nomial age-length keys, was implemented for this Atlantic Bluefish assessment update. Instead of using full multi-nomial age-length keys, a hybrid approach was used, and the holes in the ALKs were filled with the multi-nomial model fits. This approach to filling ALK holes is now consistent with the methodology used for other NEFSC stock assessments and with the NEFSC STOCKEFF program. This new method resulted in minor changes to the results of SSB and F compared to the 2022 research track assessment results.*

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

  *Stock status of Atlantic Bluefish has not changed from the status determined in the research track assessment.*

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

  *The Atlantic Bluefish stock has experienced a slight increase in SSB over the past 5 years, coinciding with a decrease in F. Recruitment has increased each year since 2019, and the terminal year recruitment (137 million fish) is the highest value since 2005. Both commercial and recreational fisheries have had low catches since 2018, all well below the time series average of 26,386 MT. With the low catches since 2018, fishing mortality has decreased and remained well below FMSY (0.239). The low catches in recent years are partially a result of bag limit implementation as part of the rebuilding plan. However, these lower catches could also be due to decreased bluefish availability. Anecdotal evidence suggests larger bluefish stayed offshore and inaccessible to most of the recreational fishery in recent years.*

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

  *The recent bluefish research track identified several new research recommendations that would improve out understanding of bluefish dynamics and help better assess the population through the current or future models. These recommendations include: expand collection of recreational release length frequency data, continue development and refinement of the forage fish / availability index as well as incorporation of this index in to a base model for bluefish management advice, initiate additional fisheries-independent surveys or fishery-dependent sampling programs to provide information on larger, older bluefish, continue coastwide collection of length and age samples from fishery-independent and -dependent sources, refinement and development of indices of abundance, and develop a recreational demand model.*

- Are there other important issues?

  *WHAM allows for incorporation of environmental covariates on the catchability of survey indices, and a companion model was developed for the research track that leveraged this capability. The companion model investigated a forage fish index as a covariate on catchability of the MRIP CPUE and showed promise for* *continued development. The covariate led to an overall decreasing trend in catchability over time. This model will be further developed leading up to the 2025 management track assessment, at which time it could be considered for the primary model.*

**References:**

Northeast Fisheries Science Center. 2022. 2022 Bluefish Research Track Assessment NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. TBD; 116 p. https://apps-nefsc.fisheries.noaa.gov/saw/sasi.php

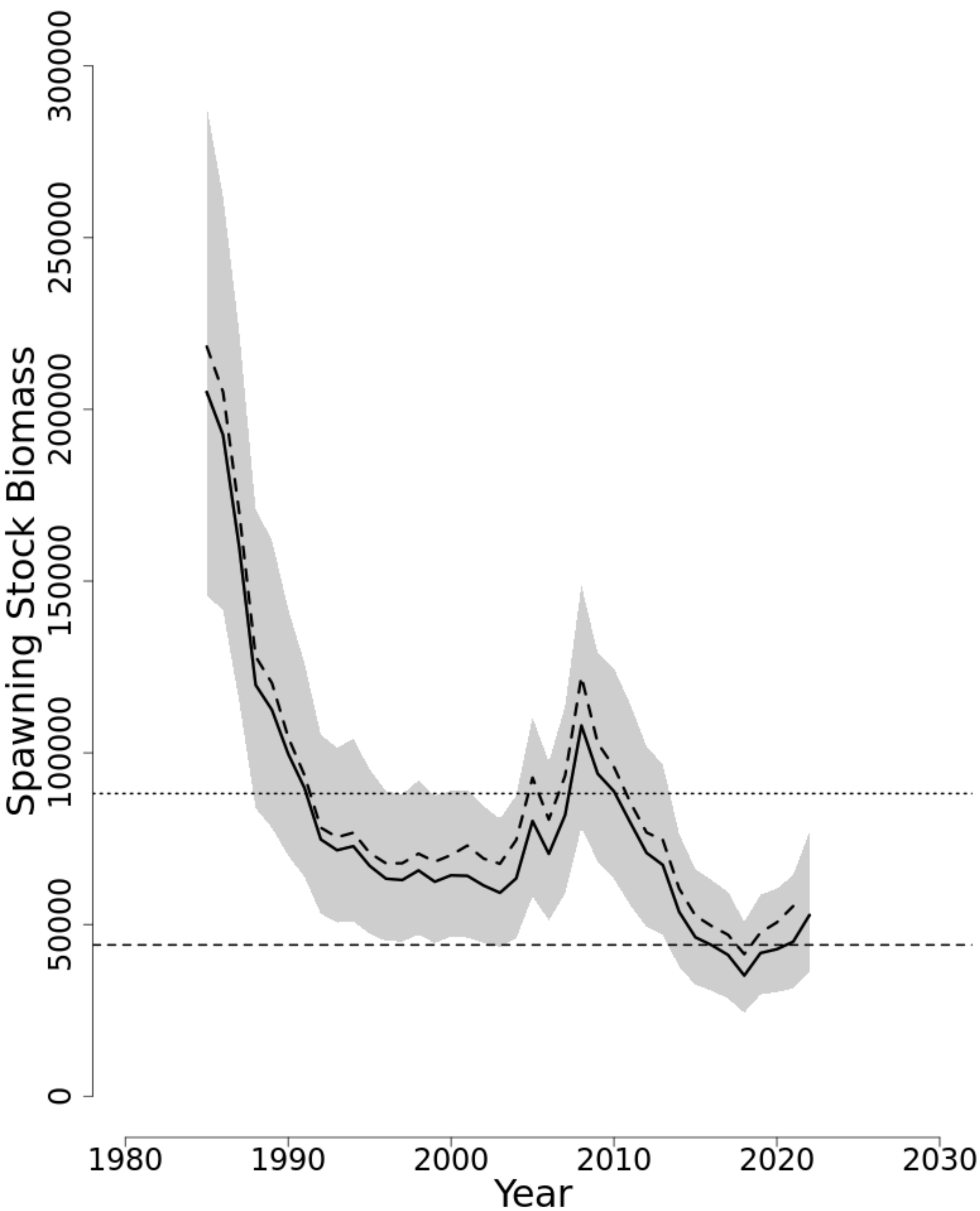


Figure 1: Trends in spawning stock biomass of Atlantic Bluefish between 1985 and 2022 from the current (solid line) and previous (dashed line) research track assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ $SSB_{MSY}$ *proxy*; horizontal dashed line) as well as $SSB_{Target}$ ($SSB_{MSY}$ *proxy*; horizontal dotted line) based on the 2023 assessment. The approximate 90% lognormal confidence intervals are shown.

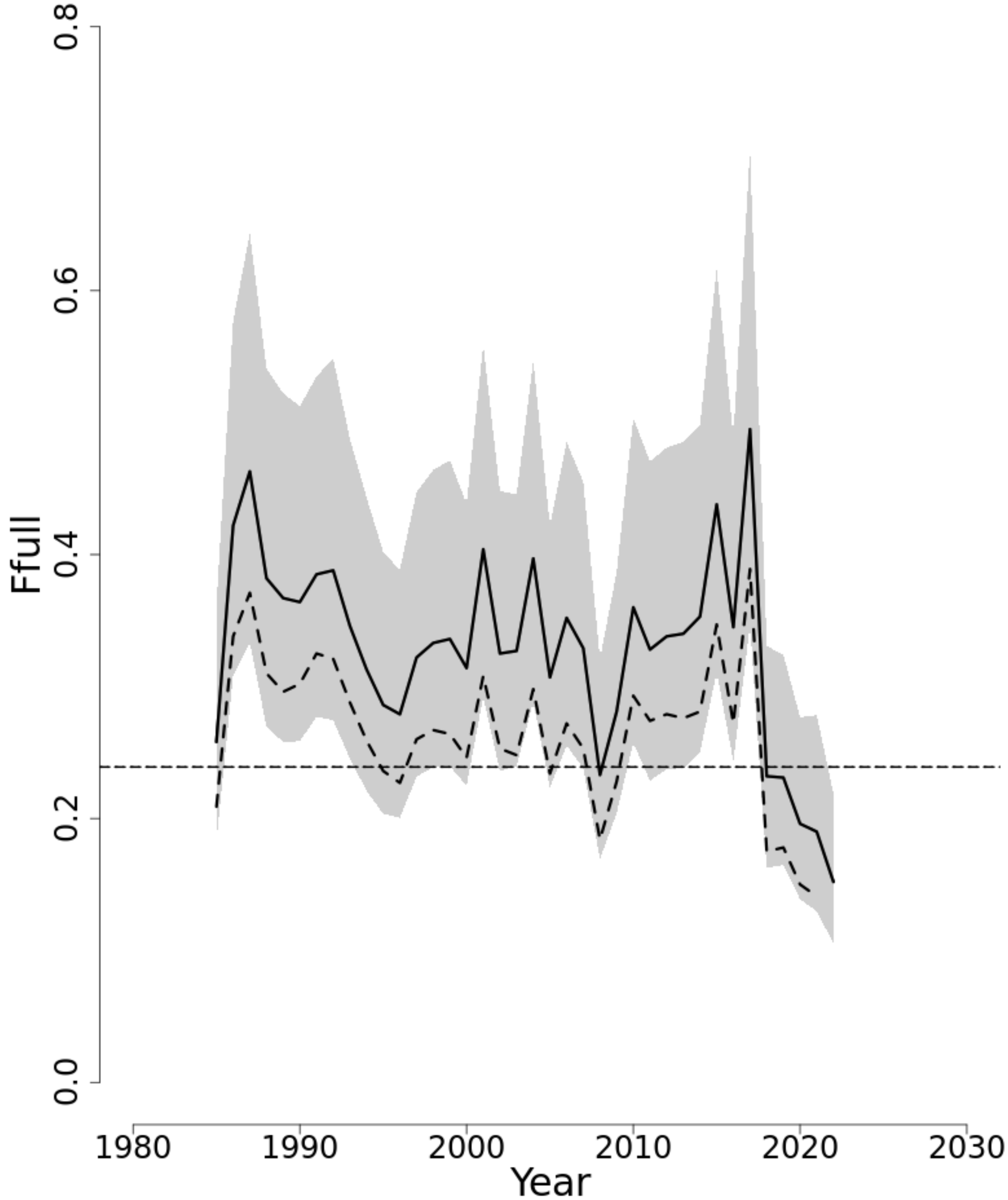


Figure 2: Trends in the fully selected fishing mortality ($F_{Full}$) of Atlantic Bluefish between 1985 and 2022 from the current (solid line) and previous (dashed line) research track assessment and the corresponding $F_{Threshold}$ ($F_{MSY}$ *proxy*=0.239; horizontal dashed line). The approximate 90% lognormal confidence intervals are shown.

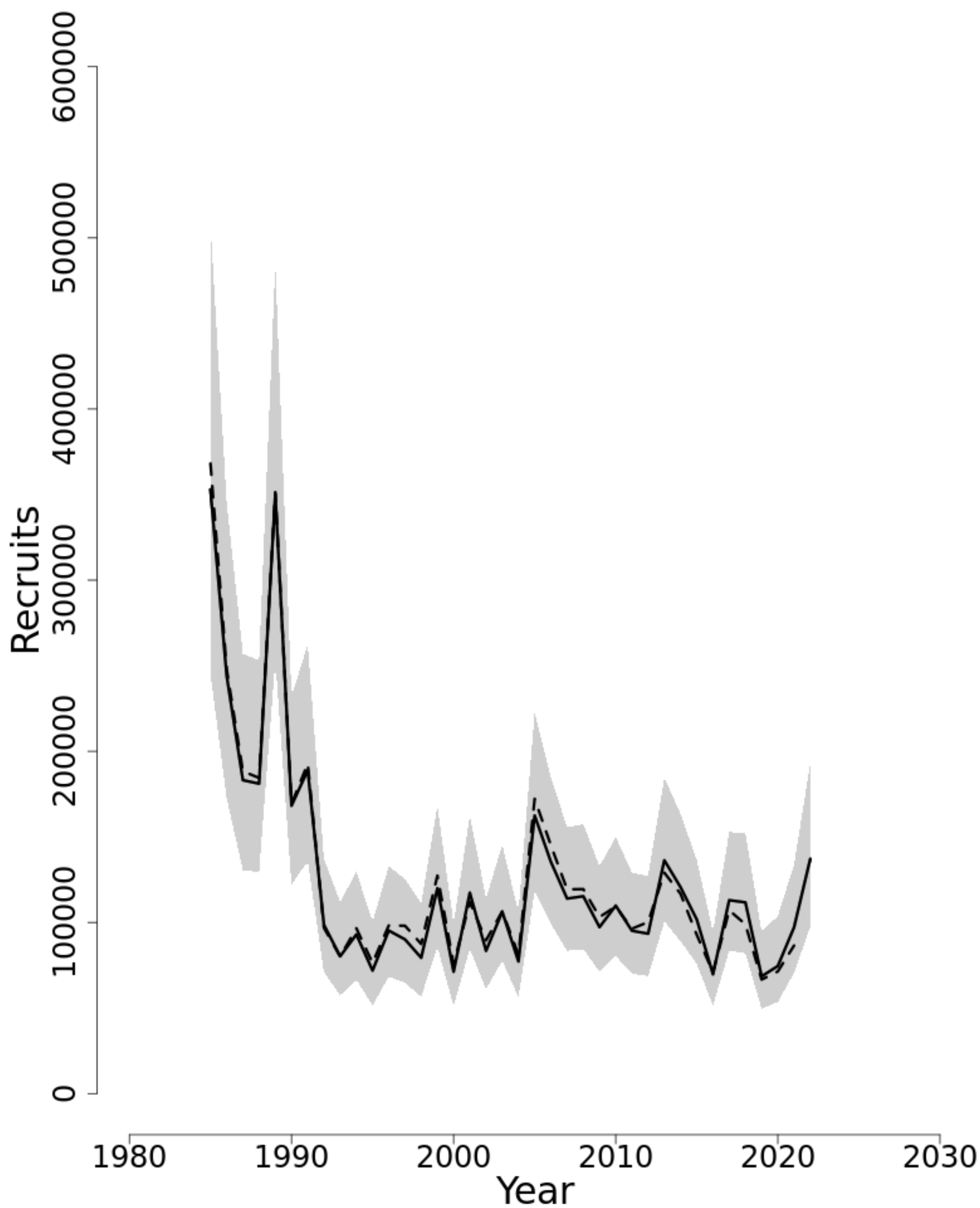


Figure 3: Trends in Recruits (age 0) (000s) of Atlantic Bluefish between 1985 and 2022 from the current (solid line) and previous (dashed line) research track assessment. The approximate 90% lognormal confidence intervals are shown.

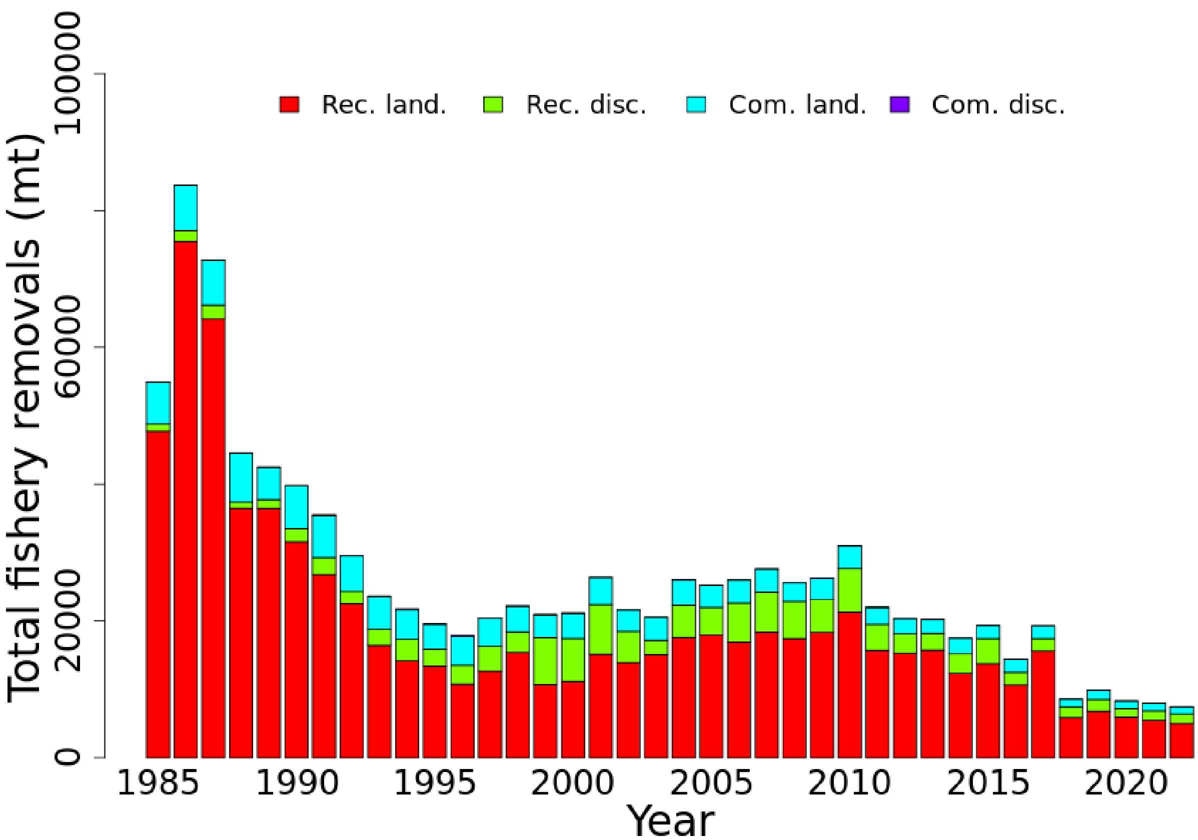


Figure 4: Total catch of Atlantic Bluefish between 1985 and 2022 by fleet (Recreational and Commercial) and disposition (landings and discards).

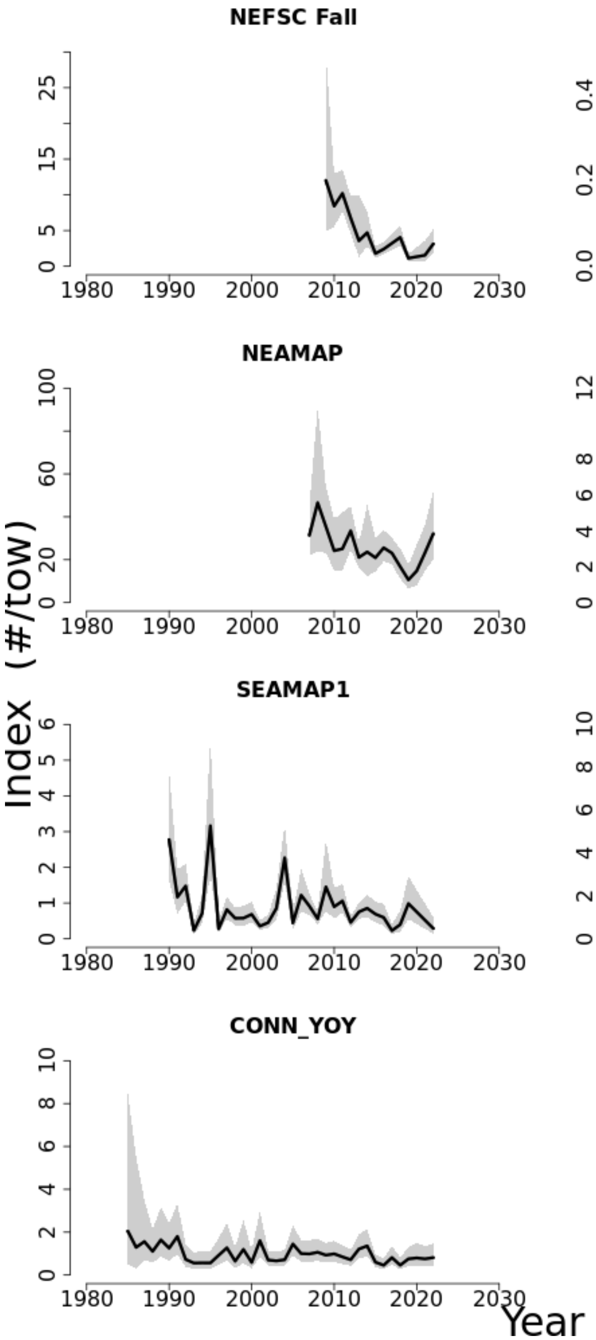


Figure 5: Atlantic Bluefish indices of abundance for the most important regional and state surveys. The approximate 90% lognormal confidence intervals are shown.