*draft working paper for peer review only*

# Atlantic Spiny Dogfish

## *2023 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 Atlantic Spiny Dogfish (Squalus acanthias) stock is an update of the research track assessment completed in 2022, which used 2019 as the terminal year. This assessment updates commercial and recreational fishery catch data, research survey indices of abundance, and the analytical assessment models through 2022. Additionally, the initial year for this assessment is 1924 compared to 1989 for the research track assessment, and stock projections have been updated through 2026*

**State of Stock:** Based on this updated assessment, the Atlantic Spiny Dogfish (*Squalus acanthias*) stock is not overfished and overfishing is not occurring (Figures 1-2). Retrospective adjustments were not made to the model results. Spawning Output in 2022 was estimated to be 190.8 (million pups) which is 101% of its target ($SSB_{MSY}$ *proxy* = 188; Figure 1). The 2022 fully selected fishing mortality was estimated to be 0.02 which is 81% of the overfishing threshold proxy ($F_{MSY}$ *proxy* = 0.0246; Figure 2).

Table 1: Catch and status table for Atlantic Spiny Dogfish. All weights are in (mt) recruitment is in (million pups) and $F_{Full}$ is the fishing mortality on fully selected ages. Model results are from the current SS3 model with lambda=6.

| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | *Data* | | | | | |
| Commercial landings | 7,373 | 10,734 | 8,687 | 12,158 | 8,789 | 6,923 | 7,947 | 8,828 | 4,780 | 4,969 |
| Recreational landings | 219 | 120 | 67 | 205 | 141 | 51 | 56 | 101 | 215 | 19 |
| Commercial discards | 10,226 | 10,368 | 6,803 | 7,078 | 6,609 | 5,402 | 6,964 | 7,422 | 5,955 | 3,884 |
| Recreational discards | 5,685 | 13,327 | 2,698 | 4,277 | 2,032 | 2,038 | 3,798 | 1,815 | 3,524 | 1,965 |
| Catch for Assessment | 13,222 | 18,242 | 12,350 | 16,289 | 12,403 | 9,854 | 12,059 | 12,683 | 8,490 | 7,122 |
| | | | | | *Model Results* | | | | | |
| Spawning Output | 311.4 | 283.3 | 253.8 | 233.5 | 212.6 | 200 | 193.6 | 188.9 | 186.6 | 190.8 |
| $F_{Full}$ | 0.03 | 0.046 | 0.033 | 0.044 | 0.038 | 0.031 | 0.042 | 0.042 | 0.027 | 0.02 |
| Recruits | 81.8 | 230.7 | 70.4 | 99.5 | 104.1 | 78.3 | 193.5 | 189.3 | 186.6 | 136.2 |

Table 2: Comparison of reference points estimated in the research track assessment and from the current assessment update. A 60% SPR proxy was used for the overfishing threshold.

| | 2019 | 2023 |
|---|---|---|
| $F_{MSY}$ *proxy* | 0.025 | 0.025 |
| $SSB_{MSY}$ (million pups) | 371 | 188 (148- 227) |
| MSY (mt) | N/C | 7134 (5631 - 8636) |
| Recruits (million pups) | N/C | 109.9 |
| *Overfishing* | Yes | No |
| *Overfished* | No | No |

**Projections:** Short term projections of biomass were obtained using the SS3 forecast module.

Table 3: Short term projections of total fishery catch and spawning output for Atlantic Spiny Dogfish based on a harvest scenario of fishing at $F_{MSY}$ *proxy* between 2024 and 2026. The catch in 2023, 7,751 (mt) is the 2023 ACL/ACT

| Year | Catch (mt) | SSB (million pups) | $F_{Full}$ |
|---|---|---|---|
| 2023 | 7751 | 196.9 (167.6 - 226.3) | 0.025 |

| Year | Catch (mt) | SSB (million pups) | $F_{Full}$ |
|---|---|---|---|
| 2024 | 7818 | 202.8 (171.9 - 233.7) | 0.025 |
| 2025 | 7956 | 208.3 (177 - 239.6) | 0.025 |
| 2026 | 8085 | 212.5 (180.9 - 244) | 0.025 |

**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 lack of age and growth data induces considerable uncertainty, particularly when there is evidence that the growth parameters have changed over time. Spiny dogfish discards are uncertain, and are highly uncertain for the period before observer data was available as well as during the first years with observer data due to low sample sizes. Additionally, there is uncertainty in the assumed discard mortality rates. Results also depend on the value of weighting of the survey index (lambda), which also causes substantial uncertainty.*

- 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 had only a minor retrospective pattern. No retrospective adjustment of spawning output or fishing mortality in 2022 was required.*

- 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 Spiny Dogfish, are reasonably well determined particularly because of the longevity and slow growth of this stock. This 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 weighting for the survey index was increased to lambda = 6. This both induced a better fit to the survey data and also allowed the model to match the Albatross/Bigelow calibration at large sizes.*

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

  *The overfishing status of Atlantic Spiny Dogfish changed because of reduced catches in 2022 compared to the previous terminal year of 2019. This caused F to be below the overfishing threshold in 2022. Overfishing was occuring in 2019 in both the previous and current models.*

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

  *Female Atlantic Spiny Dogfish have a truncated size structure, with large females being a much smaller percentage of the population than was observed historically. Although overfishing was not occurring in 2022, it was occurring during every year from 2012-2021. Because the ACL/ACT for 2023 was above the SS3 estimated OFL for that year, and projected discards are likely underestimated, it is probable that overfishing is occurring in 2023 as well.*

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

  *The Atlantic Spiny Dogfish assessment could be improved with age and growth data, as well as more studies regarding discard mortality.*

- Are there other important issues?

**References:**

Chang, J-H., Sosebee, K., Hart, D.R. 2023. Stock Synthesis For Atlantic Spiny Dogfish. Appendix to this report.

Spiny Dogfish Research Track Working Group. Research Track Assessment of Northwest Atlantic Spiny Dogfish. NEFSC Center Reference Document, in press.

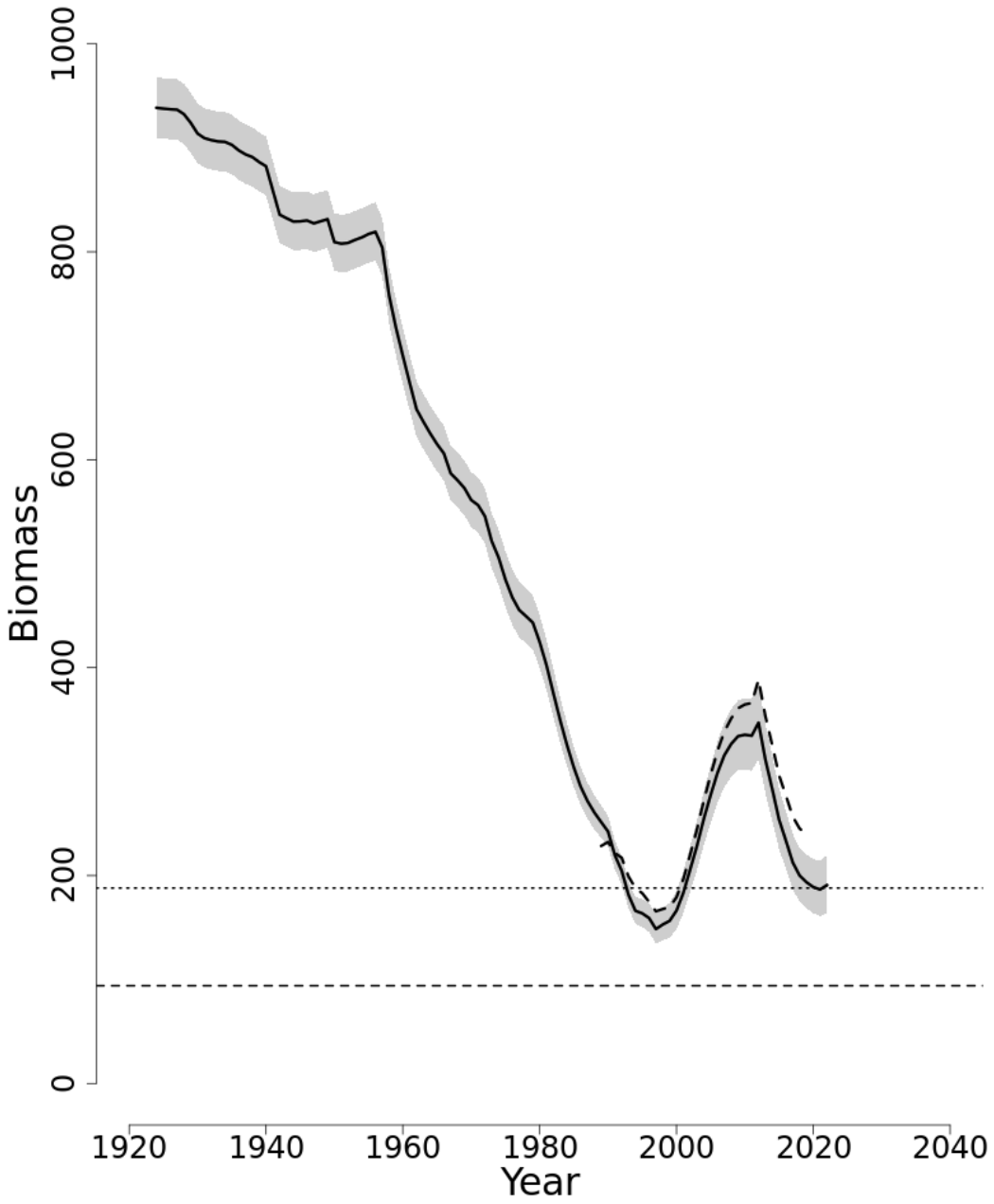


Figure 1: Trends in spawning output of Atlantic Spiny Dogfish between 1924 and 2022 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ $SSB_{MSY}$ *proxy*; horizontal dashed line) as well as $SSB_{Target}$ ($SSB_{MSY}$ *proxy*; horizontal dotted line) based on the 2023 assessment. The approximate 95% gamma confidence intervals are shown.

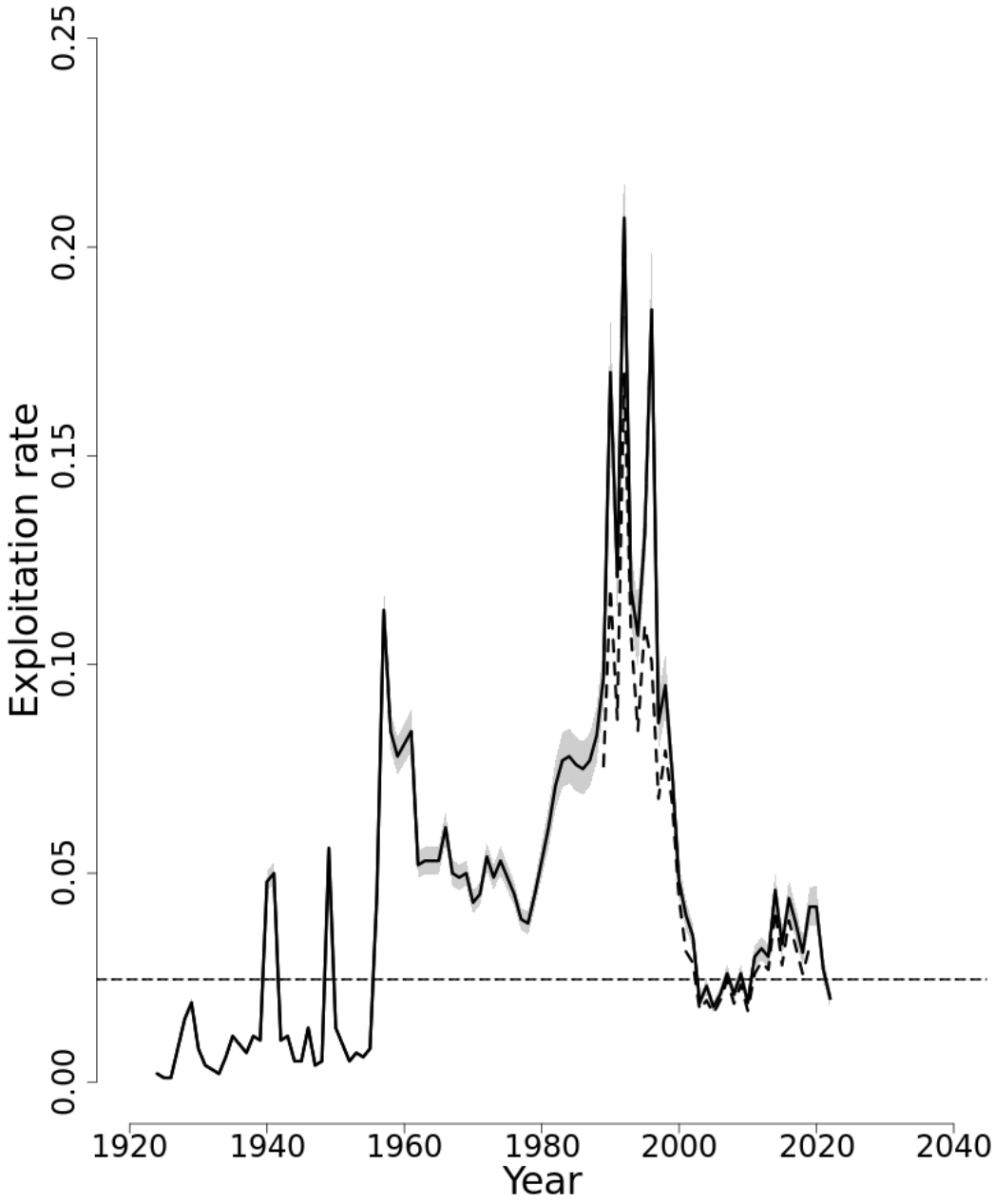


Figure 2: Trends in the fully selected fishing mortality ($F_{Full}$) of Atlantic Spiny Dogfish between 1924 and 2022 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ ($F_{MSY}$ *proxy*=0.0246; horizontal dashed line). based on the 2023 assessment. The approximate 95% gamma confidence intervals are shown.

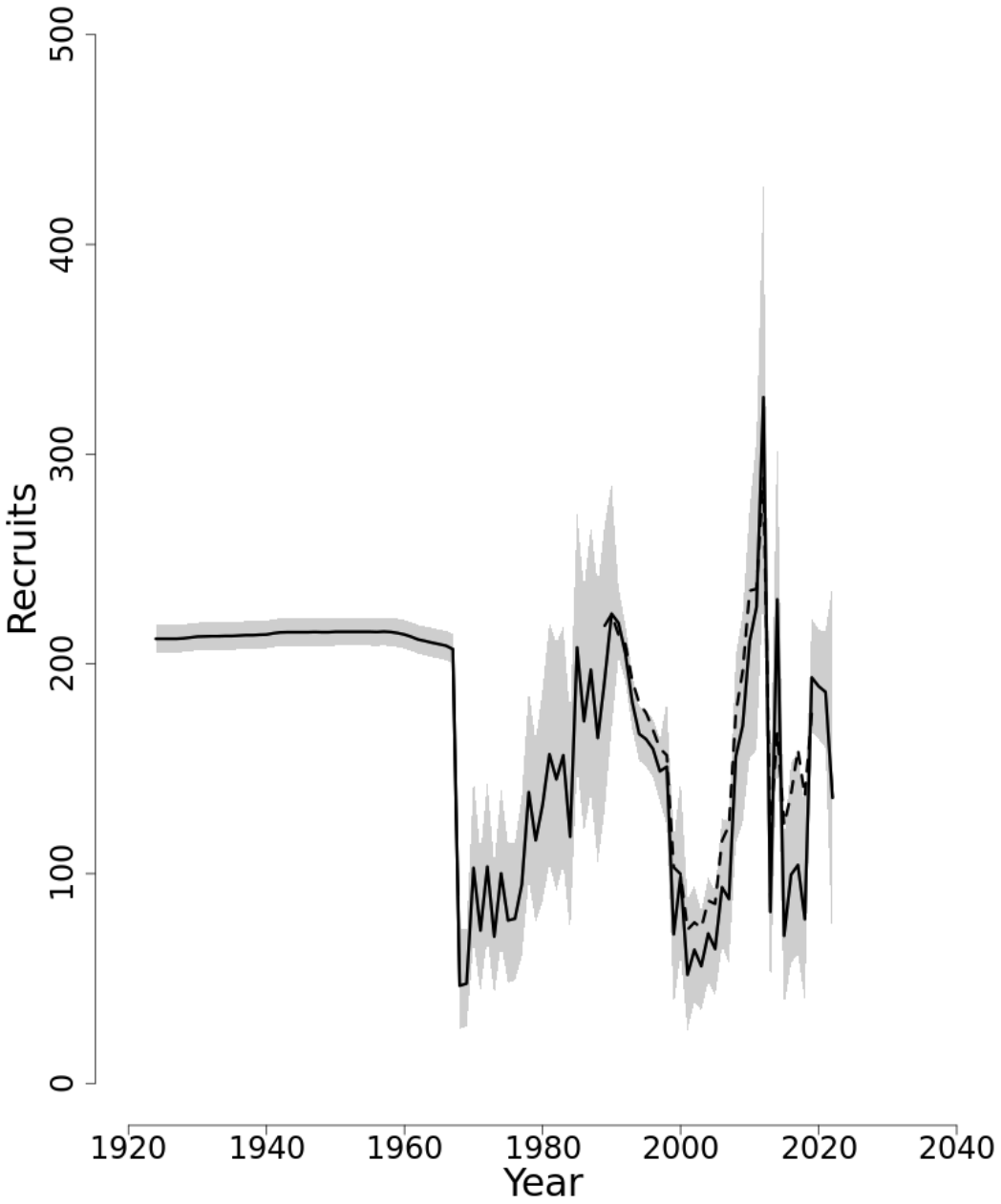


Figure 3: Trends in Recruits (million pups) of Atlantic Spiny Dogfish between 1924 and 2022 from the current (solid line) and previous (dashed line) assessment. The approximate 95% gamma confidence intervals are shown.

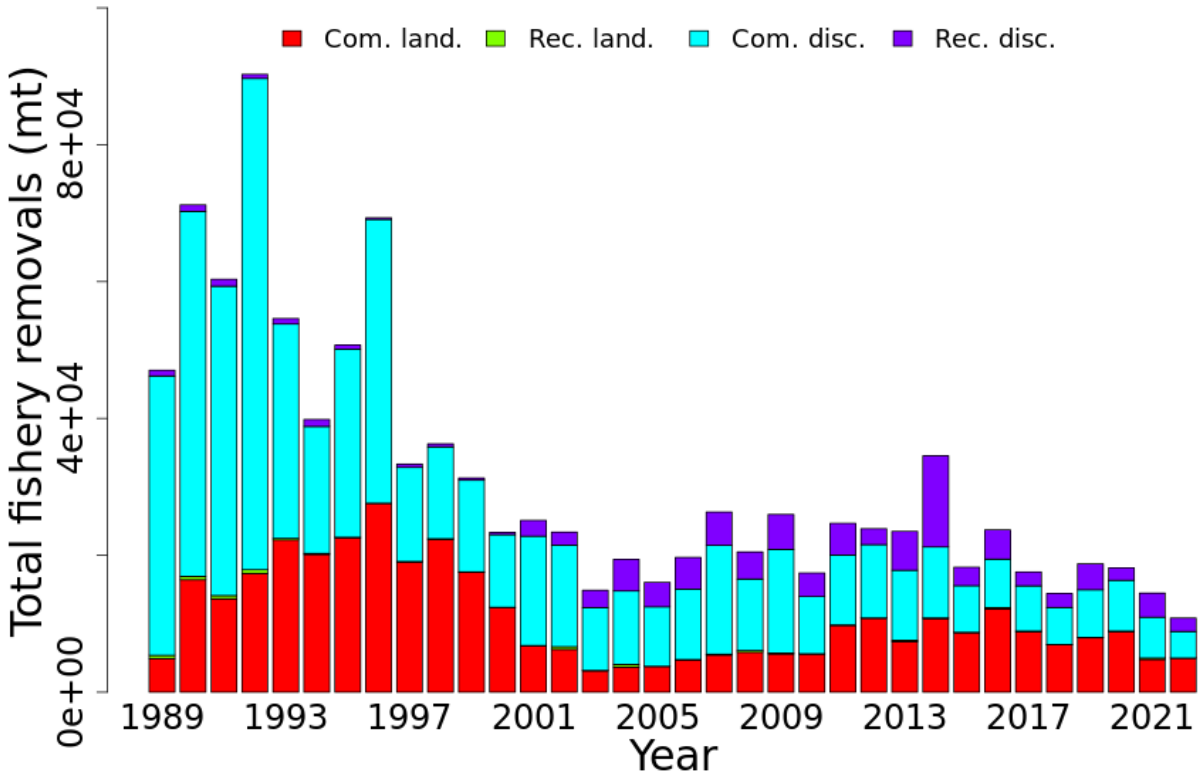


Figure 4: Total catch of Atlantic Spiny Dogfish between 1989 and 2022 by fleet (commercial, recreational, or Canadian) and disposition (landings and discards).

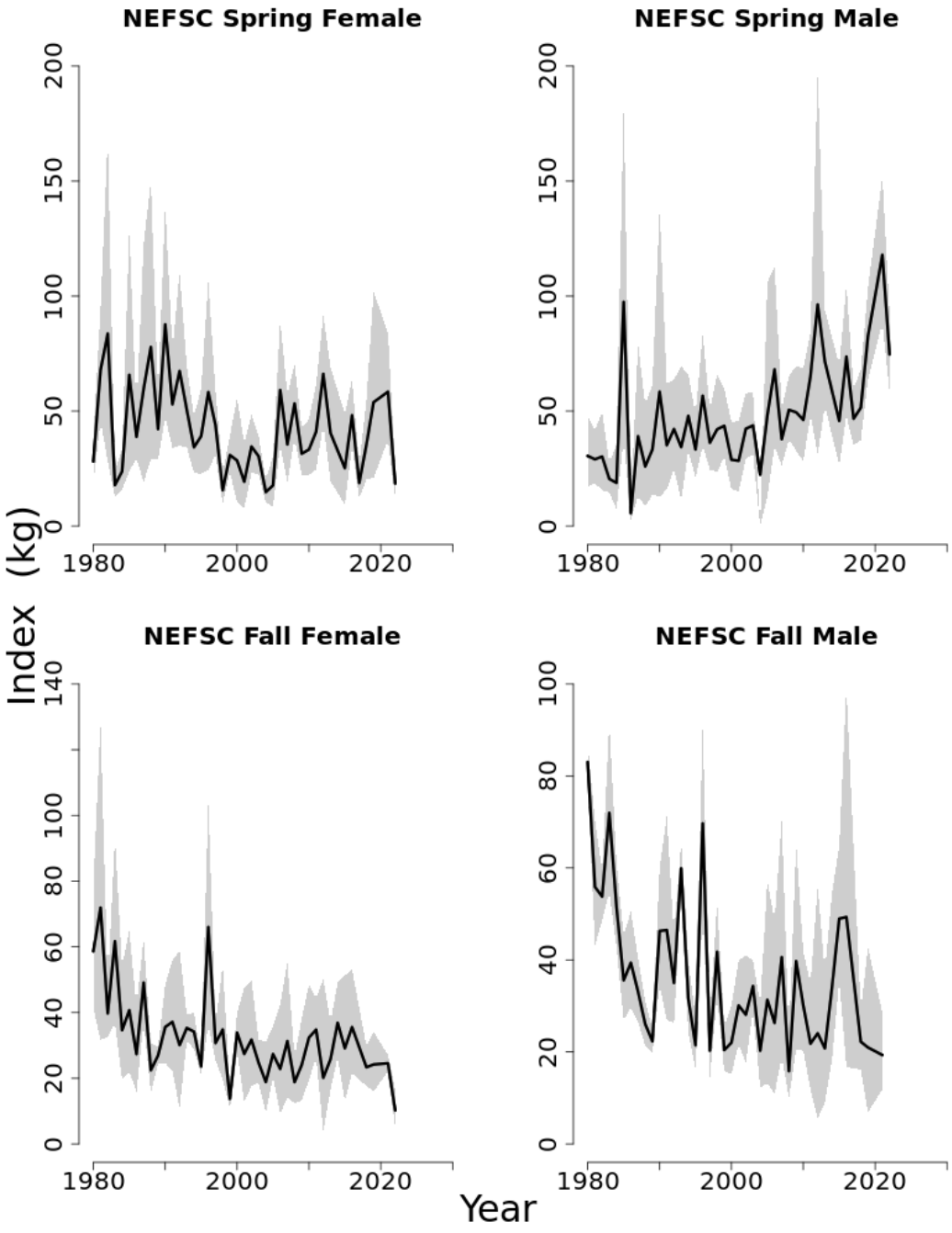


Figure 5: Indices of biomass for the Atlantic Spiny Dogfish between 1980 and 2022 for the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys; Females on the left, males on the right. The approximate 95% gamma confidence intervals are shown.