draft working paper for peer review only

White hake

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 white hake (Urophycis tenuis) stock is an Management Track update of the 2019 operational assessment (NEFSC 2022) and the last benchmark assessment (NEFSC 2013). Based on the previous assessment the stock was overfished and overfishing was not occurring. This assessment updates commercial fishery catch data, research survey indices of biomass, adds an additional survey, and updates the ASAP assessment model and reference points through 2021. Stock projections have been updated through 2025.

State of Stock: Based on this updated assessment, the white hake (*Urophycis tenuis*) stock is not overfished and overfishing is not occurring (Figures 1-2). Retrospective adjustments were made to the model results. Spawning stock biomass (SSB) in 2021 was estimated to be 19,497 (mt) which is 69% of the biomass target (SSB_{MSY} *proxy* = 28,191; Figure 1). The 2021 fully selected fishing mortality was estimated to be 0.104 which is 65% of the overfishing threshold proxy (F_{MSY} *proxy* = 0.1605; Figure 2).

Table 1: Catch and ASAP results table for white hake. All weights are in (mt) recruitment is in (000s) and F_{Full} is the fishing mortality on fully selected ages (ages 6 - 9+). Model results are from the current ASAP assessment.

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
					Data					
Commercial discards	50	38	33	24	33	36	29	30	31	32
Commercial landings	2,771	2,235	1,887	1,632	1,325	1,976	1,969	1,975	1,990	1,871
Canadian landings	83	43	35	25	39	32	45	24	83	48
Other landings	0	0	0	0	0	0	0	0	0	0
Catch for Assessment	2,903	2,316	1,955	1,680	1,396	2,043	2,044	2,029	2,104	1,951
					Model Results					
Spawning Stock Biomass	21,919	21,867	20,783	19,143	22,186	23,673	19,359	21,276	25,059	23,670
F_{Full}	0.15	0.12	0.1	0.09	0.07	0.09	0.11	0.1	0.09	0.09
Recruits (age 1)	1,991	2,502	2,720	3,082	2,521	2,757	2,975	2,630	1,912	1,740

Table 2: Comparison of reference points estimated in the 2019 assessment and from the current assessment update. An $F_{40\%}$ proxy was used for the overfishing threshold and SSB_{MSY} was based on long-term stochastic projections which sampled from a cumulative distribution function of recruitment estimates from ASAP from 1963-2019. The annual fishery selectivity, maturity ogive, and mean weights at age used in the projection are the most recent 5 year averages.

	2019	2022
F_{MSY} *proxy*	0.1677	0.1605
SSB_{MSY} (mt)	31,828	28,191 (22,616 - 35,424)
MSY (mt)	4,601	4,186 (3,345 - 5,279)
Median recruits (age 1) (000s)	4,471	4,232
Overfishing	No	No
Overfished	Yes	No

Projections: Short term projections of catch and SSB were derived by sampling from a cumulative distribution function of recruitment estimates from ASAP from 1995-2019. The mean weights at age used in the projection are the 2017-2019+2020 averages. The numbers-at-age used to start the projections were adjusted for retrospective bias using age-specific rho estimates.

Table 3: Short term projections of total fishery catch and spawning stock biomass for white hake based on a harvest scenario of fishing at F_{MSY} *proxy* between 2023 and 2025. Catch in 2022 was assumed to be 1,964 (mt) which is 56% of the 2022 OFL.

Year	Catch (mt)	SSB (mt)	F_{Full}
2022	1,964	17,978 (15,553 - 20,679)	0.116

Year	Catch (mt)	SSB (mt)	F_{Full}
2023	2,650	17,679 (15,212 - 20,216)	0.1605
2024	2,535	17,139 (14,914 - 19,381)	0.1605
2025	2,547	17,326 (15,360 - 19,302)	0.1605

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).

  1. Catch at age information is not well characterized due to possible mis-identification of species in the commercial and observer data, particularly in early years, low sampling of commercial landings in some years, and sparse discard length data.

  2. Since the commercial catch is aged primarily with survey age/length keys, there is considerable augmentation required, mainly for ages 5 and older. The numbers at age and mean weights at age in the catch for these ages may therefore not be well specified.

  3. White hake may move seasonally into and out of the defined stock area.

  4. There are no commercial catch at age data prior to 1989 and the catchability of older ages in the surveys is very low. This results in a large uncertainty in starting numbers at age.

  5. Since 2003, dealers have been culling extra-large fish out of the large category. However, there was no market category for landings until June 2014. The length compositions are distinct from fish characterized as large and have been identified since 2011. This may bias the age composition of the landings, particularly in 2014 when 2000 of the 5000 large samples were these extra-large fish.

  6. A pooled age/length key is used for 1963-1981, fall 2003 survey data as well as the second half of the commercial key, and for the 2020 commercial CAA.

- 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 ρ, relative to SSB, was 0.31 in the 2019 assessment and was 0.21 in 2021. The 7-year Mohn's ρ, relative to F, was -0.22 in the 2019 assessment and was -0.17 in 2021. There was a major retrospective pattern for this assessment because the ρ adjusted estimate of 2021 SSB (SSB_{ρ}=19497) was outside the approximate 90% confidence regions around SSB (19,894 - 26,646). A retrospective adjustment was made for both the determination of stock status and for projections of catch in 2023. The retrospective adjustment changed the 2021 SSB from 23,670 to 19,497 and the 2021 F_{Full} from 0.09 to 0.104.

- 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 white hake are not well determined and projected biomass from the last assessment was near the edge the confidence bounds of the biomass estimated in the current assessment. The rebuilding deadline for this stock is now 2031 and the stock may rebuild.

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the affect these changes had on the assessment and stock status. In the 2022 assessment of white hake, the catch efficiency studies and data were not used because studies were not applicable to roundfish.

Minor changes to the catch-at-age for 2003 and 2015-2018 were made and made little difference to the model. The swept-area adjusted survey values for 2009-2018 were used as well as the bootstrap CVs. This lowered the estimates of SSB over that time period and slightly increased fishing mortality. In addition, one new survey was added to the ASAP model which reduced the retrospective pattern.

- If the stock status has changed a lot since the previous assessment, explain why this occurred.
  Stock status of white hake has changed from overfished to not overfished for at least two reasons. First, the retrospective pattern was reduced. Second, the biomass reference point was also reduced because of a lower mean recruitment.

- Provide qualitative statements describing the condition of the stock that relate to stock status.
  The white hake stock shows no truncation of age structure. Estimates of commercial landings and discards have decreased over time.

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.
  Age structures collected by the observer program are available and should be aged to augment the survey keys. The additional years of age structures from the ASMFC shrimp survey should also be aged and continue to be collected. There are two bottom longline surveys that should be monitored as the time series gets longer, and the otoliths aged and collected.

- Are there other important issues?
  None.

References:

NEFSC. 2013. 56^{th} Northeast Regional Stock Assessment Workshop (56^{th} SAW) Assessment Report.US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 13-10; 868 p. http://www.nefsc.noaa.gov/publications/crd/crd1310/

NEFSC. 2022. Operational Assessment of 14 Northeast Groundfish Stocks Updated Through 2018.US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 22-06; 227 p. http://www.nefsc.noaa.gov/publications/crd/crd2206/

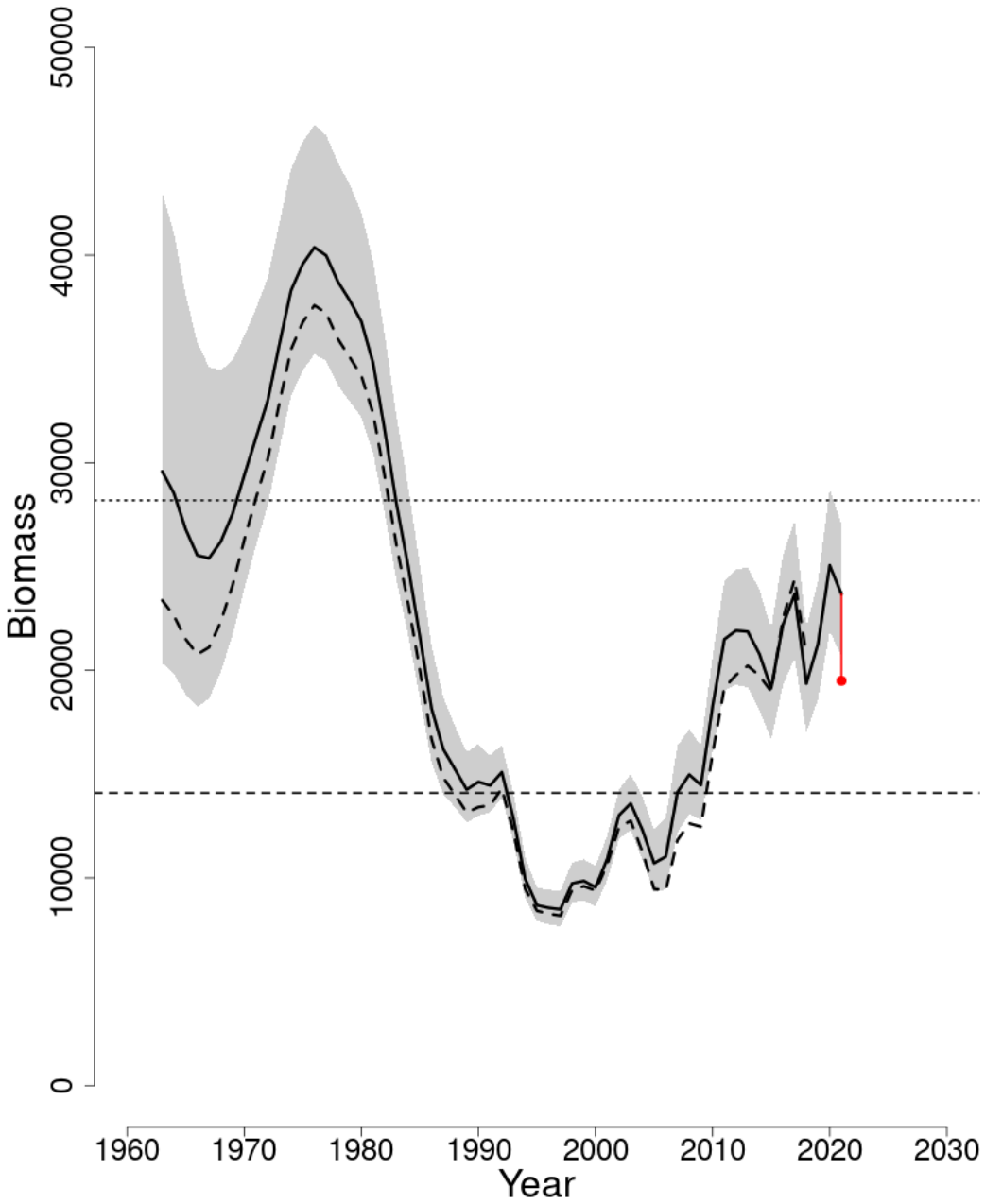

Figure 1: Trends in spawning stock biomass of white hake between 1963 and 2021 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ SSB_{MSY} *proxy*; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY} *proxy*; horizontal dotted line) based on the 2022 assessment. Biomass was adjusted for a retrospective pattern and the adjustment is shown in red. The approximate 90% lognormal confidence intervals are shown.

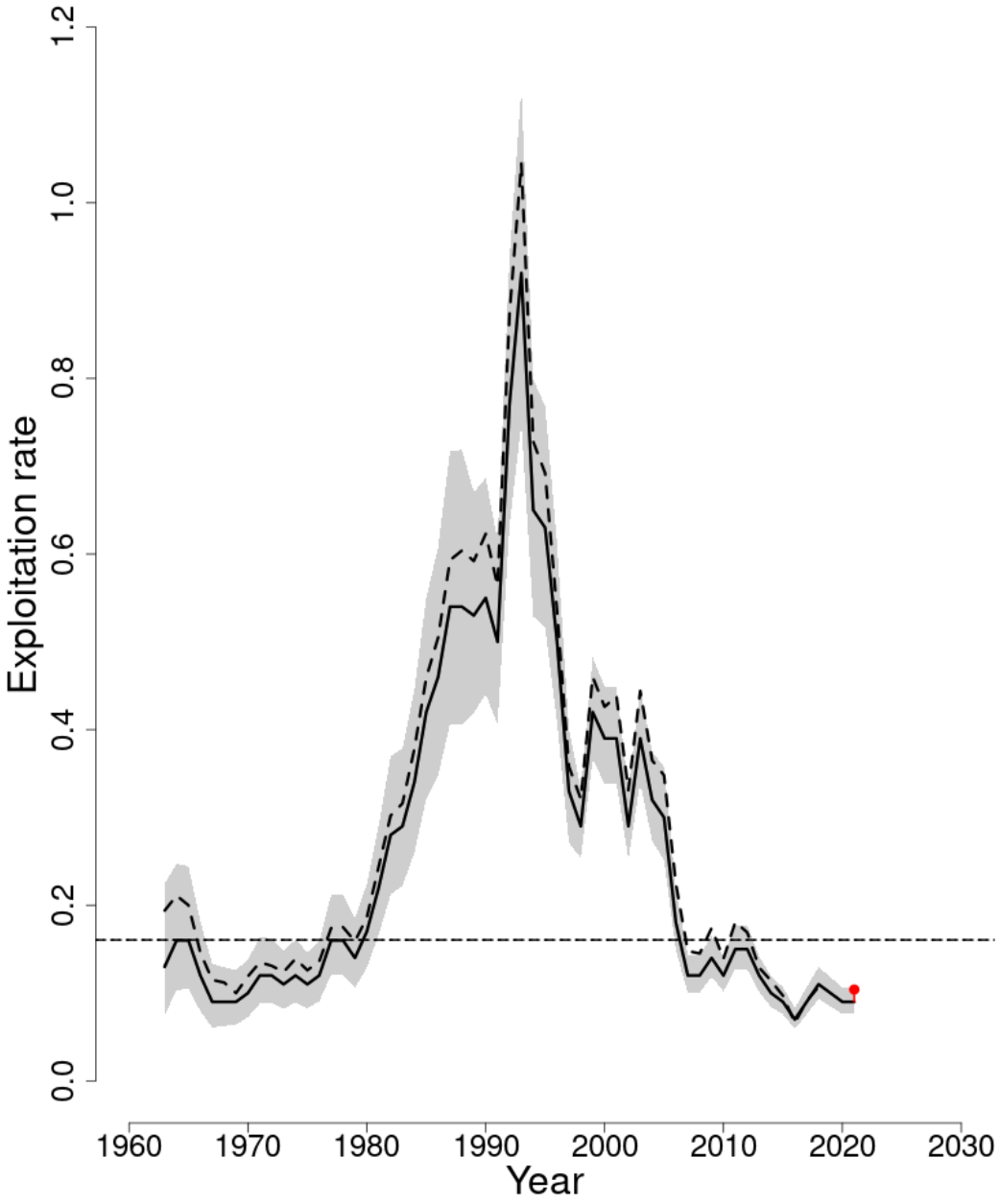

Figure 2: Trends in the fully selected fishing mortality (F_{Full}) of white hake between 1963 and 2021 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY} *proxy*=0.1605; horizontal dashed line). based on the 2022 assessment.The F_{Full} was adjusted for a retrospective pattern and the adjustment is shown in red. The approximate 90% lognormal confidence intervals are shown.

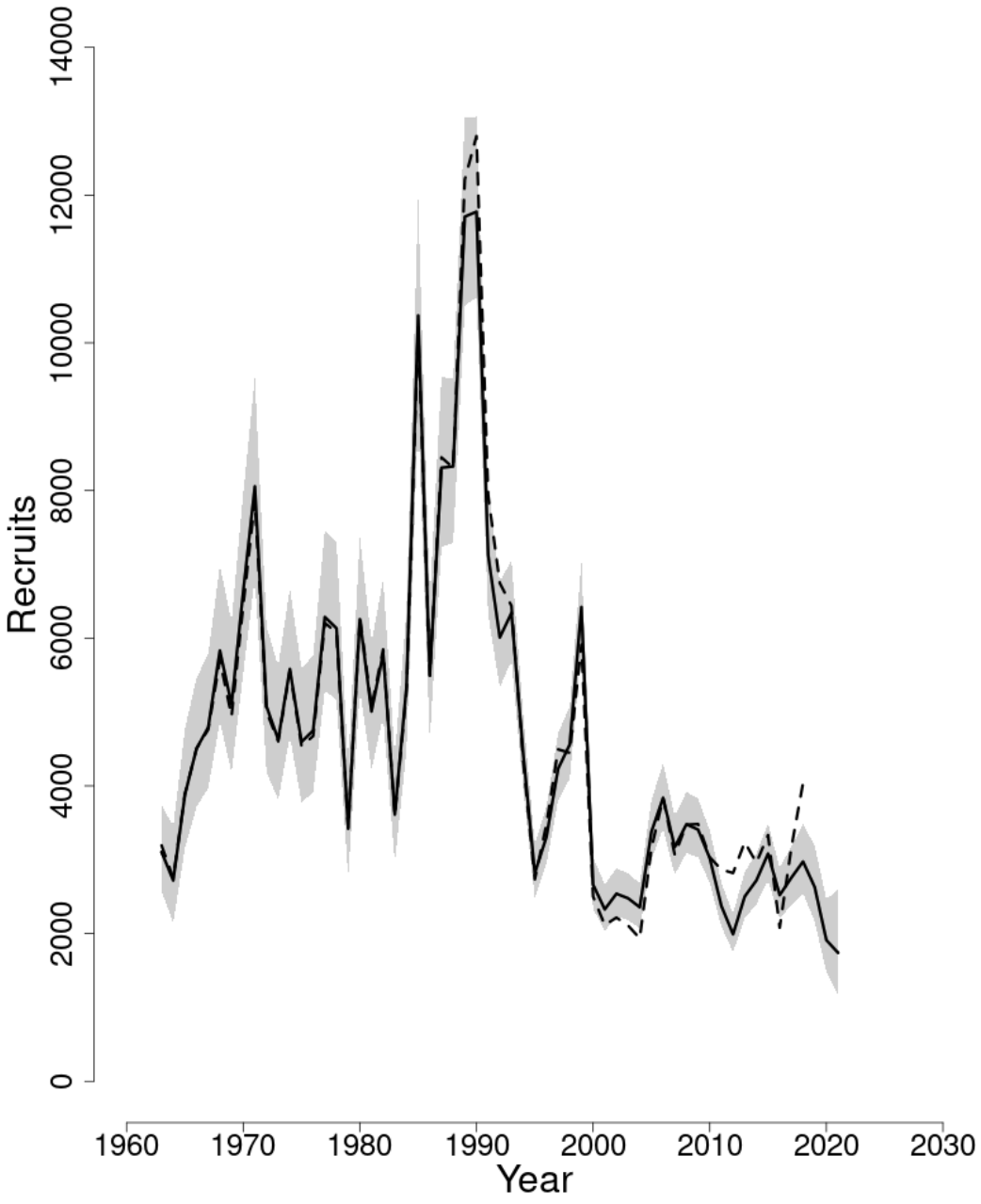

Figure 3: Trends in Recruits (age 1) (000s) of white hake between 1963 and 2021 from the current (solid line) and previous (dashed line) assessment. The approximate 90% lognormal confidence intervals are shown.

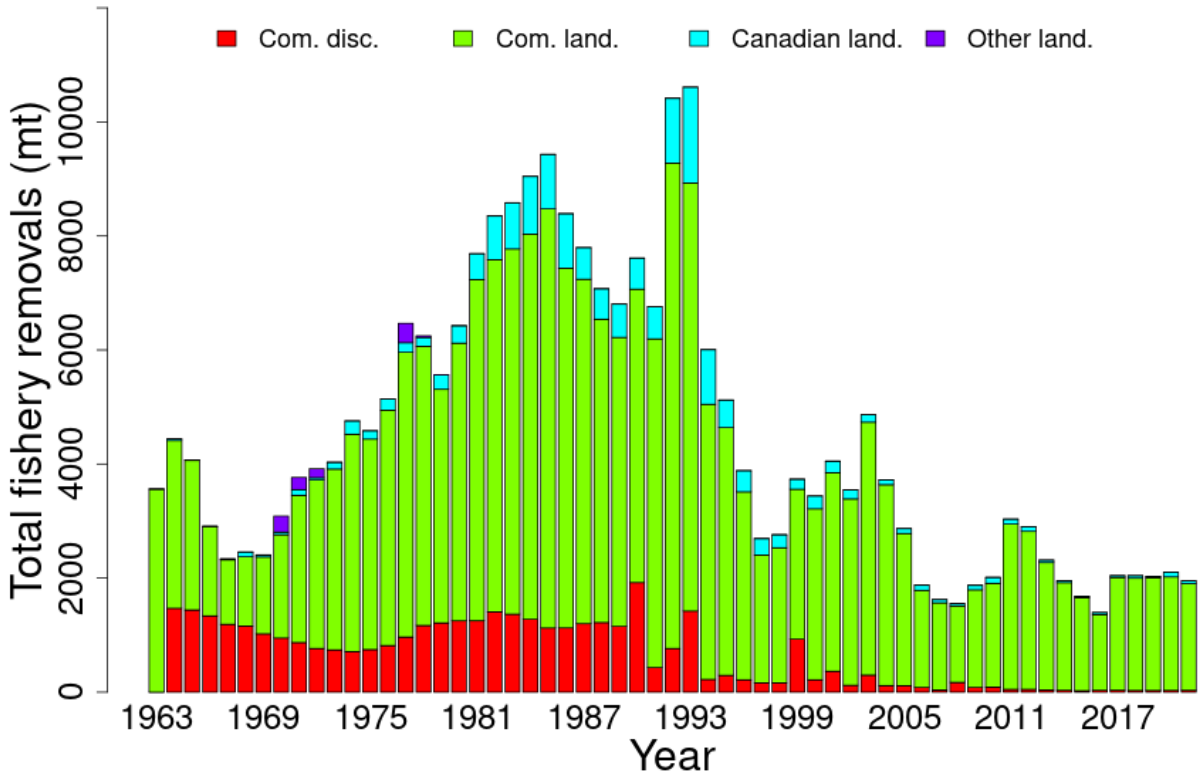

Figure 4: Total catch of white hake between 1963 and 2021 by fleet (commercial, recreational, or Canadian) and disposition (landings and discards).

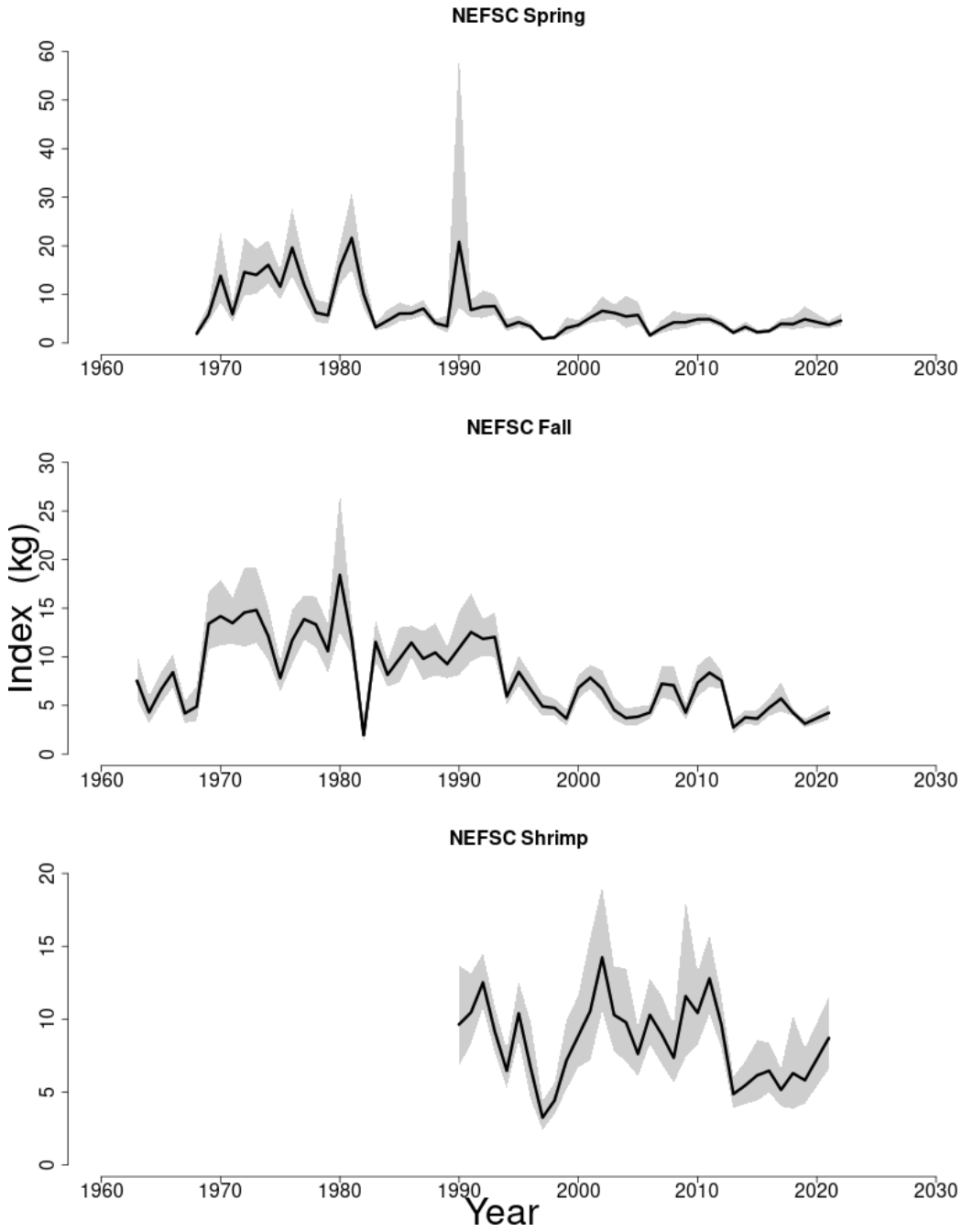

Figure 5: Indices of biomass for white hake between 1963 and 2022 for the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys and the ASMFC shrimp survey. The approximate 90% lognormal confidence intervals are shown.