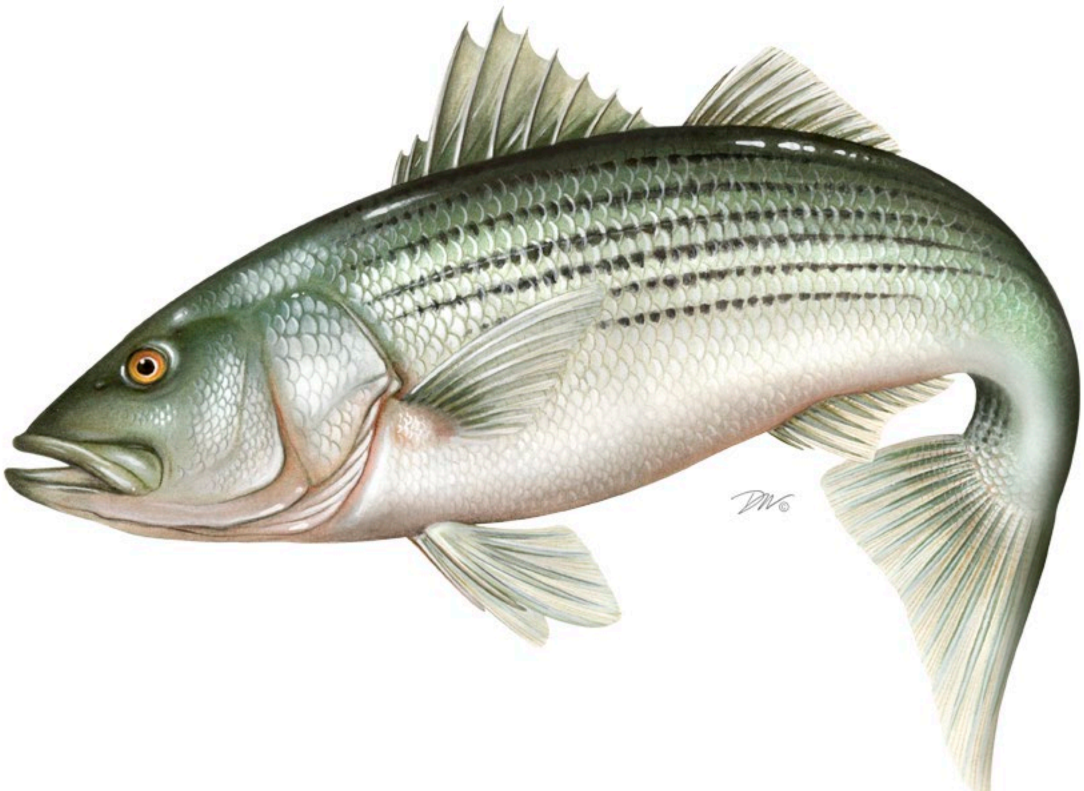
Atlantic States Marine Fisheries Commission

2024 Atlantic Striped Bass Stock Assessment Update Report



Sustainable and Cooperative Management of Atlantic Coastal Fisheries

Atlantic States Marine Fisheries Commission

Atlantic Striped Bass Stock Assessment Update

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A publication of the Atlantic States Marine Fisheries Commission pursuant to National Oceanic and Atmospheric Administration Award No. NA20NMF4740012.

EXECUTIVE SUMMARY

The time series of striped bass removals and indices from the 2022 assessment update were extended to include data from 2022-2023. Total removals from 2022-2023 averaged 6.18 million fish, a 20% increase from 2021, the terminal year of the last assessment. From 2022-2023, recreational release mortality made up 40% of total removals, with recreational harvest making up 49%, commercial harvest making up 10%, and commercial discards making up 0.5% of the total. This is a change from 2018-2021, where recreational release mortality made up 50% of total removals and recreational harvest accounted for 37%.

The single-stock statistical catch-at-age (SCA) model was updated through 2023. The model parameterization was the same as in the 2022 assessment update, including the new selectivity block starting in 2020 in the Bay and Ocean fleets to account for the regulation changes from Addendum VI to Amendment 6. A sensitivity run was conducted to look at the effect of adding a new selectivity block for 2023 to account for the Emergency Action, but the estimated selectivity curves for the 2023 block did not align with the expected change in selectivity based on the regulation changes, likely due to the difficulty in estimating the selectivity pattern from a single year of data. For the reference points and the projections, an empirically-derived selectivity curve was used to better capture the effects of the Emergency Action in 2023 and Addendum II in 2024.

Because the recruitment trigger in Amendment 7 was tripped based on 2021-2023 data for the New Jersey, Maryland, and Virginia juvenile abundance indices, the biological reference points were calculated using the low recruitment regime assumption. This resulted in a lower *F* target and *F* threshold compared to the benchmark assessment.

In 2023, the Atlantic striped bass stock was overfished. Fishing mortality was above the *F* target, but below the *F* threshold, indicating overfishing was not occurring. Female spawning stock biomass in 2023 was estimated at 86,536 metric tons (191 million pounds) which is below the updated SSB threshold of 89,513 metric tons (197 million pounds), and below the updated SSB target of 111,892 metric tons (247 million pounds). Total fishing mortality in 2023 was estimated at 0.18 which is below the updated *F* threshold of 0.21 per year, but above the updated *F* target of 0.17 per year. Although the stock is not experiencing overfishing, these results trip the *F* target trigger in Amendment 7 since *F* has exceeded the *F* target for two consecutive years while SSB is below the SSB target.

The retrospective pattern remained moderate to low in magnitude for the 2024 assessment update, with the model underestimating *F* and overestimating SSB in the most recent peels. The retrospective-adjusted estimates of *F* and SSB were within the 90% confidence intervals of the unadjusted estimates, so correcting for retrospective pattern was not necessary for status determination or projections.

Projections were run to determine the probability of SSB being at or above the SSB target by 2029, the rebuilding deadline. If *F* is reduced to the *F* target by 2025, and *F* target is maintained through 2029, there is less than a 5% chance that the stock will be rebuilt in 2029.

The *F* rate necessary to have a 50% chance of being above the SSB target in 2029 ($F_{rebuild}$) depends on the extent of the reductions realized by Addendum II, implemented in 2024. The TC initially predicted that the Add. II measures would result in a 13.7% reduction in total removals relative to 2022, equivalent to 5.86 million fish, slightly higher than the 2023 total removals. In this scenario, *F* in 2024 is estimated to be 0.20, while $F_{rebuild}$=0.11 for 2025 onward. To achieve $F_{rebuild}$ in 2025, total removals would have to be reduced to 3.16 million fish, a 46% reduction from the predicted removals in 2024. However, the preliminary MRIP numbers for 2024 Waves 2-3 are 36% lower than the Waves 2-3 numbers for 2023. Expanding the preliminary 2024 Waves 2-3 estimates to the full year, based on the proportion of total landings that occurred in those waves in earlier years, and accounting for a 7% decrease in commercial removals relative to 2023 due to the quota reduction, resulted in estimated total removals of 3.89 million fish in 2024. In this scenario, *F* in 2024 is estimated to be 0.13, and fishing at this rate each year through 2029 would result in a 50% probability of being above the SSB target in 2029. In order to maintain this *F* rate in 2025, a 4% reduction from estimated 2024 removals would be needed. The TC considers the low 2024 removals scenario based on preliminary MRIP numbers to be more likely than the high 2024 removals scenario.

However, in 2025, the above-average 2018 year-class will be age-7, the same age the strong 2015 year-class was in 2022, and just entering the 28-31" slot in the ocean fishery. When the 2015 year-class entered the ocean slot, total removals increased by 32% from 2021 to 2022, and *F* in 2022 was 39% higher than 2021. Although total removals decreased in 2023, *F* in 2023 under the Emergency Action slot limit was still 17% higher than in 2021. If *F* in 2025 increases by the same percentage seen in 2022 or 2023 and remains there, the probability of rebuilding under that *F* rate is well under 50%. Historically, an increase in *F* due to a strong year-class recruiting to the fishery has been followed by a decrease in subsequent years, although the rate of change has been variable. If *F* increases only in 2025 and decreases to the level estimated for 2024 as the 2018 year-class moves out of the slot, the probability of rebuilding by 2029 is 43%.

The level of removals and *F* in 2024, 2025, and subsequent years is a major source of uncertainty in these projections. Although predicted removals for 2024 based on preliminary 2024 MRIP data for Waves 2-3 can support rebuilding by 2029, it is likely that removals will increase in 2025 and the Board should be prepared to respond to this eventuality.

	Target	Threshold	2023 Value	Status
Fishing Mortality	0.17	0.21	0.18	Not overfishing
Female SSB	111,892 mt (247 million lbs)	89,513 mt (197 million lbs)	86,536 mt (191 million lbs)	Overfished

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TERMS OF REFERENCE (TOR) REPORT

TOR 1. Update fishery-dependent data (landings, discards, catch-at-age, etc.) that were used in the previous peer-reviewed and accepted benchmark stock assessment.

The time series of striped bass recreational and commercial removals from the 2022 assessment update (ASMFC 2022) was extended to include data from 2022-2023. This included recreational harvest, recreational release mortalities, commercial harvest, and commercial discards.

Total removals from 2022-2023 averaged 6.18 million fish, a 20% increase from 2021, the terminal year of the last assessment (Table 1, Figure 1). Approximately 76% of the removals came from the ocean fleet over that time period, while 24% came from the Chesapeake Bay fleet, which is a higher than average percentage from the ocean fleet, reflecting the availability of the strong 2015-year class in the ocean and the weak year-classes available to the Chesapeake Bay fleet (Table 1, Figure 1).

From 2022-2023, recreational release mortality made up 40% of total removals, with recreational harvest making up 49%, commercial harvest making up 10%, and commercial discards making up 0.5% of the total (Figure 2). This is a change from 2018-2021, where recreational release mortality made up 50% of total removals and recreational harvest accounted for 37%.

The MRIP CPUE index of abundance was updated with data through 2023. The index was developed using the same species associations identified in the previous benchmark. Imputed records were excluded from the intercept data pull for 2020. The index declined somewhat from 2018-2021 but was relatively stable from 2022-2023 (Figure 3).

TOR 2. Update fishery-independent data (abundance indices, age-length data, etc.) that were used in the previous peer-reviewed and accepted benchmark stock assessment.

Where possible, the fishery independent age-1+ and recruitment indices used in the most recent benchmark assessment (Table 2) were updated through 2023.

The assessment used seven fishery independent indices of age-1+ abundance: the Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP), the Maryland Spawning Stock Survey (MDSSN), the Delaware Spawning Stock Electrofishing Survey (DESSN), the Delaware 30’ Bottom Trawl Survey (DE30), the New York Ocean Haul Seine (NYOHS), the New Jersey Bottom Trawl Survey (NJTRL), and the Connecticut Long Island Sound Trawl Survey (CT LISTS). The NJ Trawl did not operate from 2019-2021 due to COVID and vessel issues, but operated as usual for 2022-2023. ChesMMAP changed vessels in 2018 and the calibration process was completed in time for this assessment update, so calibrated estimates were available for the full time-series. Age-1+ surveys with data through 2023 showed mixed trends, with some surveys increasing since 2021 and some decreasing (Figure 3).

The assessment uses four age-0 juvenile abundance indices (JAI) and two age-1 indices as recruitment indices: the MD, VA, NJ, and NY JAIs and the MD and NY age-1 indices. The MD and VA JAIs were combined into a single composite JAI for Chesapeake Bay using the Conn (2010) method. The NJ, MD, and VA JAIs all tripped the recruitment trigger based on 2021-2023 data, with each index having three consecutive years below the Amendment 7 recruitment threshold[1].

TOR 3. Tabulate or list the life history information used in the assessment and/or model parameterization (M, age plus group, start year, maturity, sex ratio, etc.) and note any differences (e.g., new selectivity block, revised M value) from benchmark.

Model equations are shown in Appendix 2 Table 1. The model parameterization was the same as used in the 2022 assessment update (ASMFC 2022), including the new selectivity block starting in 2020 in the Bay and Ocean fleets to account for the regulation changes from Addendum VI (Table 3). A sensitivity run was conducted to look at the effect of adding a new selectivity block for 2023 to account for the Emergency Action.

Re-weighting of survey indices was required with the addition of two years of removal data and missing index data for several surveys. Survey CVs were adjusted to bring the RMSE close to one and effective sample sizes were adjusted once by using the Francis multipliers (Francis 2011). The RMSEs, CV weights and effective samples from the 2019 benchmark and 2022 assessment models are given in Table 2 in Appendix 2. The largest change in CV weight occurred for the NJ Trawl survey, where the correct CV time series was substituted for the incorrect values input in the benchmark.

No changes were made to the life history information used in the assessment (Table 4).

TOR 4. Update accepted model(s) or trend analyses and estimate uncertainty. Include sensitivity runs and retrospective analysis if possible and compare with the benchmark assessment results. Include bridge runs to sequentially document each change from the previously accepted model to the updated model.

Model Fit

The model fit the observed total catches and catch age compositions of all fleets well (Appendix 3). The model fit the MDYOY (1970-1981) and MD & VA composite indices very well and the MD Age-1, NYOHS, and MDSSN poorly. It fit the other indices reasonably well (Appendix 3).
The predicted trends matched the observed trends in age composition of survey indices reasonably well for NYOHS, MDSSN, MRIP, CTLIST, and ChesMMAP. The model fit the age composition of NJTrawl, DESSN, and DE30FT survey adequately. Resulting contributions to total likelihood are listed in Table 3 of Appendix 3. Estimates of fully-recruited fishing mortality for each fleet and total fishing mortality, recruitment, parameters of the selectivity functions for

[1] Threshold = 25th percentile of respective JAI from 1992-2006.

the selectivity periods, catchability coefficients for all surveys, and parameters of the survey selectivity functions are given in Table 4 of Appendix 3.

Estimates of the catch selectivity patterns for each fleet showed that, although the patterns varied over time with changes in regulation, selectivity was dome-shaped for Chesapeake Bay and primarily flat-topped for the Ocean over time (Figure 6). There was a steep shift in the descending limb of the selectivity pattern in 2020-2023 for Chesapeake Bay compared to the previous selectivity block, and a shift in the selectivity for the Ocean to a more dome-shaped pattern, as would be expected with the implementation of a slot limit for 2020-2023 (Figure 6).

Fishing Mortality

Fully-recruited annual fishing mortality in 2023 for the Bay and Ocean was 0.05 and 0.15 (Figure 7), and peaked at ages 5 and 7, respectively (Appendix 3 Table X5). Total fully-recruited *F* in 2023 was 0.18 (Table 5, Figure 7) and peaked at age 7. Coefficients of variation indicated region-specific and total fishing mortality estimates were precise (CVs mostly less than 0.20) (Appendix 3 Table X4).

Recruitment

Recruit numbers increased steadily through 1993 (Figure 8). Large recruitment events occurred in 1994, 1997, 2002, and 2004 as the large Chesapeake Bay 1993, 1996, 2001 and 2003 year-classes became age-1. Average to below-average year-classes were produced during 2004-2010, which resulted in a decline of age-1 numbers. Subsequently, strong year-classes were produced in 2011 and 2015. After 2016, recruit abundance fluctuated slightly and has averaged 112.6 million age-1 fish (Table 5, Figure 8). Six of the last seven year-classes since 2015 have been below average, although generally not as low as the levels seen in the 1980s; the 2018 year-class was above average (Table 5, Figure 8). The below-average 2022 and 2023 recruits will start contributing to female SSB in 2029 and 2030 as those fish approach full maturity.

Population Abundance (January 1)

Striped bass abundance (ages 1+) increased steadily from 1982 through 1997 when it peaked around 423.5 million fish (Table 5, Figure 9). Total abundance fluctuated without trend through 2004. From 2005-2009, age 1+ abundance declined to about 187.1 million fish. Total abundance spiked again in 2012 and 2016 as a result of two large year-classes (2011 and 2015) entering the age-1+ population (Table 5, Figure 9). Total abundance declined from 2019-2022, but ticked upward slightly in 2023 to 177.9 million fish (Figure 9).

Abundance of striped bass age 8+ increased steadily through 2004 to 17.2 million fish, but then declined to 11.9 million fish through 2010 (Table 5, Figure 9). A small increase in 8+ abundance occurred in 2011 as the 2003 year-class became age 8 (Table 5, Figure 9). Abundance of age 8+ fish declined steadily through 2018 but has increased recently to 11.6 million fish in 2023 as the 2011 and 2015 year-classes recruited to the age-8+ group (Table 5, Figure 9).

Spawning Stock Biomass and Total Biomass

Female SSB grew steadily from 1982 through 2003 when it peaked at about 120,000 metric tons (Table 5, Figure 10). Female SSB declined steadily from 107,053 metric tons in 2010 to 60,808 metric tons in 2018, but in recent years, has steadily increased (Table 5, Figure 10). SSB in 2023 was 86,536 metric tons. Estimates of female spawning stock biomass were very precise (CVs less than 0.14; Table 8 of Appendix 3).

Exploitable biomass (January 1) increased from 36,012 metric tons in 1982 to its peak at 341,699 metric tons in 1999 but declined steadily through 2015 (Figure 10). Since 2016, exploitable biomass steadily increased albeit at a slow pace.

Retrospective Analysis

Moderate retrospective patterning was evident in the more recent estimates of fully-recruited total *F* and female SSB (Figure 11). The retrospective pattern suggested that fishing mortality is likely slightly under-estimated by 2.5% and female spawning biomass is over-estimated by less than 10%. Recruitment appeared to be over-estimated in most years, although underestimation did occur in a few years (Figure 11). The Mohn's rho values for fishing mortality, female SSB and recruitment were estimated to be -0.025, 0.007 and 0.09, respectively.

The current retrospective trends are consistent with the 2022 update, but are different from what was observed in the 2019 benchmark and earlier assessments (NEFSC 2019). The past retrospective patterns showed that female SSB was typically under-estimated and fishing mortality was over-estimated.

Sensitivity Runs

An additional sensitivity run was made to explore the effects of adding a new selectivity block in 2023 to account for the changes due to the Emergency Action. In this run, the Ocean fleet had a new selectivity block for 2020-2022 reflecting Addendum VI changes, and a new block in 2023, while the Bay fleet had a single block from 1996-2022, since no size limit changes were implemented through Addendum VI, and a new block in 2023. Full results and diagnostics for this sensitivity run is presented in Appendix 3. Overall, diagnostics were very similar for both runs. The sensitivity run results were similar to the base run, with a higher estimate of *F* in 2023 and slightly lower estimates of SSB from 2020-2023 (Figure 12). The TC did not consider the estimated selectivity curves for the 2023 block reliable, as they did not align with the expected change in selectivity based on the regulation changes. For both the Ocean and the Bay fleet, the 2023 selectivity curve was significantly lower for ages 13-15+, even though the majority of those fish were already outside of the 28-35" slot in the ocean and thus not likely to be affected by the change to a 28-31" slot or the imposition of a 31" maximum size in the Bay (Figure 13). In addition, for the Ocean fishery, the selectivity on fish ages 3-7 was lower in the 2023 block than in the 2020-2022 block, even though the Emergency Action did not change the minimum size in the ocean (Figure 13). This was likely due to the difficulty in estimating the selectivity pattern from a single year of data.

Comparison of Results from the 2019 Benchmark Assessment and the 2022 Assessment Update with the 2024 Assessment Update

Fully-recruited fishing mortality and female spawning stock biomass estimates from the 2024 update, the 2022 update, and benchmarks assessment are shown in Figure 14 and are generally very similar. The 2024 assessment produced lower estimates of fishing mortality from 1996-2017 compared to the benchmark and 2022 updates, and slightly higher estimates of female spawning stock biomass from 1992-2010 compared to the benchmark and 2022 update. From 2015 onward, the 2024 update estimate of SSB was lower than the benchmark but higher than the 2022 update.

TOR 5. Update the biological reference points or trend-based indicators/metrics for the stock. Determine stock status.

The fishing mortality and spawning stock biomass reference points were updated using the same methods as the benchmark assessment (NEFSC 2019), with the exception of the selectivity curve. Because the estimates of the selectivity curve for 2023 as a separate block were considered unreliable, a hybrid selectivity pattern (Appendix 4) was developed for 2024 and subsequent years based on the selectivity curve estimated for 2020-2022 and the regulations for 2024, which includes the extension of the Emergency Action regulations for the Ocean fleet and a more restrictive slot for the Bay fleet. The spawning stock biomass threshold is the 1995 estimate of SSB from the current assessment and the SSB target is 125% of the threshold. The fishing mortalities associated with the SSB target and threshold in the long term were determined using a stochastic projection method. Empirical estimates of recruitment, selectivity, and the starting population came from the SCA model results. The selectivity pattern used in the projections was the empirically derived hybrid selectivity pattern (Figure 15). Estimates of recruitment were restricted to 2008-2023 to represent the "low" recruitment regime. The population was projected for 100 years and fully-recruited *F* was adjusted until the median of the projected SSB reached the SSB target or threshold.

The updated SSB reference points and associated fishing mortalities are:

$SSB_{threshold}$ = 89,513 metric tons	**$F_{threshold}$ = 0.21**
SSB_{target} = 111,892 metric tons	**F_{target} = 0.17**

Status of the Stock

Before stock status can proceed, analyses must be done to determine if the estimates of F and SSB in 2023 should be corrected for the apparent pattern observed in the retrospective analyses. Here we used the National Marine Fisheries Service standard procedure in which the estimates are adjusted for the retrospective pattern using Mohn's rho values (average of proportion differences over five-year peels) and then compared to the unadjusted estimates and their associated 90% confidence intervals. If either retrospective-adjusted value falls outside an unadjusted value's 90% confidence intervals, then the retrospective-adjusted values are used. If not, the unadjusted values are sufficient for stock determination. Figure 16 shows a bivariate plot of the unadjusted estimates and their associated 90% confidence interval along with the retrospective-adjusted values. Because the retrospective-adjusted values fall within the 90% confidence intervals, retrospective adjustment is not needed.

In 2023, the Atlantic striped bass stock was overfished. Fishing mortality was above the *F* target, but below the *F* threshold, indicating overfishing was not occurring. Female spawning stock biomass in 2023 was estimated at 86,536 metric tons (191 million pounds) which is below the updated SSB threshold of 89,513 metric tons (197 million pounds), and below the updated SSB target of 111,892 metric tons (247 million pounds) (Table 6, Figure 17). When accounting for the uncertainty in these estimates, there is a 60% probability that the 2023 female SSB estimate is below the SSB threshold and a 99% probability that the 2023 estimate is below the target.

Total fishing mortality in 2023 was estimated at 0.18 which is below the updated F threshold of 0.21 per year, but above the updated *F* target of 0.17 per year (Table 6, Figure 17). There is a 26% probability that the 2023 fully-recruited fishing mortality is above the fishing mortality threshold, and a 63% probability that *F* is above the F target.

The estimate of *F* in 2023 was higher for the sensitivity run with a new selectivity block in 2023, equal to the *F* threshold. However, stock status relative to the *F* triggers in the FMP was the same for both runs: *F* was above the target in both of the last two years and the stock was overfished in both years.

TOR 6. Conduct short term projections when appropriate. Discuss assumptions if different from the benchmark and describe alternate runs.

The projections used the same methods as the benchmark assessment (NEFSC 2019), with the exception of the use of the hybrid selectivity pattern to better account for the management changes in 2023 and 2024, and the application of the “low” recruitment regime. Because the retrospective adjusted values of *F* and SSB fell within the 90% confidence intervals of the unadjusted estimates, retrospective-adjustment was not needed.

The model begins in year 2023 with the estimates of January-1 abundance-at-age and associated standard errors from the SCA assessment model. The observed 2023 catch-at-age and natural mortality at age are used to calculate the 2024 January-1 abundance-at-age for ages 2-15+; recruitment in 2024 is predicted from the MD young-of-year survey value for 2023. The predicted 2024 total removals, the hybrid selectivity pattern, and natural mortality are used to calculate the 2025 January-1 abundance-at-age. For the remaining years, the January-1 abundance-at-age is projected and is calculated by using the previous year’s abundance-at-age, the scenario fully-recruited F, and natural mortality following the standard exponential decay model. Female spawning stock biomass is calculated using the average Rivard weights-at-age from 2019-2023 along with proportion of female by age and maturity-at-age.

The TC initially predicted that the Add. II measures adopted by the Board would result in a 13.7% reduction in total removals relative to 2022, equivalent to 5.86 million fish in 2024, slightly higher than the 2023 total removals (high removals scenario). However, the preliminary

MRIP numbers for Waves 2-3 are 36% lower than the Waves 2-3 numbers for 2023. Expanding the preliminary Waves 2-3 estimates to the full year, based on the proportion of total landings that occurred in those waves in earlier years, and accounting for a 7% decrease in commercial removals relative to 2023 due to the quota reduction, results in estimated total removals of 3.89 million fish in 2024 (low removals scenario). The TC considers the low removals scenario based on preliminary MRIP numbers to be more likely than the high removals scenario for 2024. Projections were run for both the high and low 2024 removals scenarios assuming the F in 2024 was maintained each year through 2029.

Another source of uncertainty for the rebuilding trajectory is the effect of the above-average 2018 year-class becoming age-7 in 2025 and entering the 28-31" slot in the ocean fishery. When the strong 2015 year-class was age-7 in 2022, total removals increased by 32% from 2021 to 2022, and F in 2022 was 39% higher than 2021 (Table 7). With the implementation of the Emergency Action slot limit in 2023, total removals in 2023 decreased relative to 2022, but were still 8% higher in 2023 than in 2021 and F was 17% higher in 2023 than in 2021. Additional projections were conducted with a constant F for 2025 forward assuming F increased from 2024 (low removals scenario) to 2025 by either the rate seen in 2023 relative to 2021 (17%) or the rate seen in 2022 relative to 2021 (39%), reflecting the potential progression of the 2018 year-class through the fishery in 2024-2025 (Table 8). Historically, an increase in F due to a strong year-class recruiting to the fishery has been followed by a decrease in subsequent years, although the rate of change has been variable. Therefore, a fourth projection was done where F in 2025 increased by the rate seen in 2023 relative to 2021, but then decreased to F_{2024}.

For each year of the projection, the probability of SSB being above the SSB target and threshold reference points was calculated from 10,000 simulations using function *pgen* in R package *fishmethods*.

Projection Results

The base run with the single 2020-2023 selectivity block and the sensitivity run with a new selectivity block in 2023 produced similar results, with both models having a low probability of rebuilding by 2029 under F_{2023} or under F_{target} (Appendix 3).

The F rate necessary to have a 50% chance of being above the SSB target in 2029 ($F_{rebuild}$) depended on the extent of the reductions realized by Addendum II, implemented in 2024. In the high 2024 removals scenario, F in 2024 is estimated to be 0.20, which would have a less than 1% chance of rebuilding by 2029 (Table 9, Figure 18) if that rate was maintained in subsequent years. For the high 2024 removals scenario, $F_{rebuild}$=0.11; to achieve $F_{rebuild}$ in 2025, total removals in 2025 would have to be reduced to 3.16 million fish, a 46% reduction from the predicted removals in 2024 (Appendix 4 Table 6). In the low 2024 removals scenario, F in 2024 is estimated to be 0.13, and fishing at this rate would result in a 50% probability of being above the SSB target in 2029 (Table 9, Figure 18). In order to maintain this F rate in 2025, a 4% reduction from estimated 2024 removals would be needed. For both the low and high removal scenarios, fishing at F_{target} would have a less than 50% chance of rebuilding.

If *F* in 2025 increases by the same amount seen in 2022 or 2023 and remains there, the probability of rebuilding under that *F* rate is well under 50% (Table 10, Figure 19). If *F* increases in 2025 as the 2018 year-class enters the slot by the same amount seen in 2023, but then decreases to the F_{2024} and remains there, the probability of rebuilding by 2029 is 43% (Table 10, Figure 19). If *F* decreases further after 2025, the probability of rebuilding will be higher, but if it remains above 2024 levels, the probability will be lower.

The level of removals and *F* in 2024, 2025, and subsequent years is a major source of uncertainty in these projections. Although predicted removals for 2024 based on preliminary 2024 MRIP data for Waves 2-3 are sustainable and can support rebuilding by 2029, it is likely that removals will increase in 2025 and the Board should be prepared to respond to this eventuality. Further TC-SAS discussion on the likelihood of various projection scenarios and the implications for rebuilding are presented in Appendix 1.

TOR 7. Comment on research recommendations from the benchmark stock assessment and note which have been addressed or initiated. Indicate which improvements should be made before the stock undergoes a benchmark assessment.

The research recommendations identified in the benchmark assessment (NEFSC 2019) remain relevant, particularly the research recommendations on enhanced collection of life history and biological information including paired scale-otolith samples, migration rates, and sex ratio data. Additional work on refining migration rates and stock composition estimates as well as incorporating tagging data into the spatial statistical catch-at-age model will be required before the next benchmark assessment; modeling work on this is underway through Virginia Tech and University of Maryland, the results of which should be available to incorporate into the 2027 benchmark assessment.

Given the uncertainty around removals in 2024, 2025, and subsequent years, the TC recommended prioritizing improvements in methods to estimate removals as a function of regulations, year-class strength, and, to the extent possible, angler behavior, during the next benchmark, to better predict future removals and improve projections.

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List of Appendices

Appendix 1: TC-SAS Memo on projections and management options

Appendix 2: Model structure

Appendix 3. Diagnostic plots, detailed results, and projections for the base model and the sensitivity run

Appendix 4. Reference point and rebuilding projections using the hybrid selectivity approach

TABLES

Table 1. Total removals by fleet in numbers of fish

Year	Bay Fleet	Ocean Fleet	Total Removals
1982	228,561	676,621	905,183
1983	337,753	709,655	1,047,408
1984	478,219	357,273	835,492
1985	71,726	853,576	925,301
1986	133,255	306,878	440,133
1987	61,787	231,254	293,041
1988	122,906	331,754	454,660
1989	139,941	519,632	659,573
1990	663,107	570,887	1,233,994
1991	793,117	927,558	1,720,675
1992	996,912	1,245,235	2,242,148
1993	947,652	1,088,687	2,036,339
1994	1,336,923	1,580,166	2,917,089
1995	1,984,773	3,045,596	5,030,369
1996	2,512,795	3,757,970	6,270,765
1997	3,155,158	4,234,674	7,389,832
1998	2,944,305	4,980,353	7,924,657
1999	3,192,950	4,870,978	8,063,929
2000	3,434,057	4,953,092	8,387,149
2001	2,594,109	5,184,562	7,778,672
2002	2,680,649	5,517,119	8,197,768
2003	3,333,218	5,531,943	8,865,161
2004	3,324,511	6,196,845	9,521,356
2005	2,976,513	6,136,660	9,113,172
2006	4,092,180	6,983,100	11,075,279
2007	3,163,519	5,131,913	8,295,432
2008	2,627,393	5,591,747	8,219,139
2009	3,149,853	4,879,861	8,029,714
2010	2,937,163	5,433,710	8,370,873
2011	2,519,531	5,038,365	7,557,897
2012	2,677,220	4,413,404	7,090,624
2013	2,756,433	5,754,209	8,510,642
2014	3,230,107	3,840,484	7,070,591
2015	2,786,524	3,313,254	6,099,778
2016	3,593,612	3,598,628	7,192,240
2017	2,497,355	4,553,408	7,050,763
2018	2,366,960	3,419,948	5,786,908
2019	2,116,191	3,342,474	5,458,665
2020	2,013,480	3,075,104	5,088,584
2021	1,639,919	3,508,423	5,148,342
2022	1,577,381	5,215,422	6,792,803
2023	1,418,439	4,163,671	5,582,110

Table 2. Summary of indices used in the striped bass stock assessment model.

Index Name	Index Metric	Design	Time of Year	Years	Age
MRIP Total Catch Rate Index	Total catch per unit effort	Stratified random	Mar-Dec	1982-2023	1+
Connecticut Long Island Sound Trawl Survey (CTLISTS)	Mean number per tow	Stratified random	Apr-Jun	1984-2023	1+
New York Ocean Haul Seine (NYOHS)	Geometric mean per haul	Fixed station	Sep-Oct	1987-2006	1+
New York Young-of-the-Year (NYYOY)	Geometric mean per haul	Fixed station	Jul-Nov	1985-2023	YOY
New York Western Long Island Beach Seine Survey (NY Age-1)	Geometric mean per haul	Fixed station	May-Aug	1984-2023	1
New Jersey Bottom Trawl Survey (NJTRL)	Stratified mean per tow	Stratified random	April	1990-2023	1+
New Jersey Young-of-the-Year Survey (NJYOY)	Geometric mean per haul	Fixed station	Aug-Oct	1982-2023	YOY
Delaware Spawning Stock Electrofishing Survey (DESSN)	Geometric mean per tow	Fixed station	Apr-Jun	1996-2023	1+
Delaware 30’ Bottom Trawl Survey (DE30)	Geometric mean per tow	Fixed station	Nov-Dec	1990-2023	1+
Maryland Spawning Stock Survey (MDSSN)	Selectivity-corrected CPUE	Stratified random	Mar-May	1985-2023	1+
Maryland Young-of-the-Year and Yearlings Surveys (MDYOY and MD Age-1)	Geometric mean per haul	Fixed station	Jul-Sep	1954-2023	0-1
Virginia Young-of-the-Year Survey (VAYOY)	Geometric mean per haul	Fixed station	Jul-Sep	1980-2023	YOY
Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP)	Stratified mean per tow	Stratified random	Mar-Nov	2002-2023	1+

Table 3. Model structure summary for the 2024 striped bass update.

	Value(s)
Years in Model	1982-2023
Size/Age Plus Group	15+
Fleets	2 (Bay and Ocean)
Selectivity blocks	Bay fleet: 1982-1984, 1985-1989, 1990-1995, 1996-2019, 2020-2023 Ocean fleet: 1982-1984, 1985-1989, 1990-1996, 1997-2019, 2020-2023

Table 4. Striped bass life history information used in the 2024 stock assessment update.

Age	Proportion Mature	Proportion Female	Natural Mortality
1	0	0.53	1.13
2	0	0.56	0.68
3	0	0.56	0.45
4	0.09	0.52	0.33
5	0.32	0.57	0.25
6	0.45	0.65	0.19
7	0.84	0.73	0.15
8	0.89	0.81	0.15
9	1	0.88	0.15
10	1	0.92	0.15
11	1	0.95	0.15
12	1	0.97	0.15
13	1	1	0.15
14	1	1	0.15
15+	1	1	0.15

Table 5. Population estimates from the 2024 striped bass assessment update.

Year	Full *F*	Recruitment (millions of age-1 fish)	Female SSB (mt)	Total Abundance (millions of fish)	Age 8+ Abundance (millions of fish)
1982	0.18	38.3	18,183	55.6	1.7
1983	0.15	77.3	15,260	99.6	1.5
1984	0.07	63.6	15,303	101.2	1.3
1985	0.20	69.3	15,889	110.8	1.4
1986	0.05	68.6	14,335	115.1	1.7
1987	0.03	73.9	17,833	124.1	1.9
1988	0.04	93.1	24,060	148.2	2.4
1989	0.05	107.2	36,685	171.8	3.3
1990	0.06	131.8	43,233	206.6	5.6
1991	0.09	105.3	51,104	193.9	6.8
1992	0.11	109.9	64,985	197.8	7.9
1993	0.09	134.8	73,416	224.9	8.4
1994	0.11	286.9	82,760	387.1	9.1
1995	0.21	187.6	89,513	342.0	10.0
1996	0.27	234.8	100,240	383.7	10.4
1997	0.20	259.5	95,367	423.6	10.7
1998	0.21	148.1	89,027	328.1	10.3
1999	0.19	153.1	88,543	306.5	10.0
2000	0.19	124.8	101,106	268.2	10.4
2001	0.19	196.9	104,898	325.2	14.3
2002	0.21	222.1	117,078	365.6	14.8
2003	0.22	127.9	118,927	285.5	16.0
2004	0.25	304.6	114,562	438.5	17.2
2005	0.24	158.2	113,787	337.3	15.0
2006	0.29	136.4	107,341	290.0	13.6
2007	0.22	89.2	105,029	223.5	11.4
2008	0.23	129.4	110,318	240.1	12.1
2009	0.22	76.4	108,198	187.1	13.1
2010	0.26	99.6	107,053	191.2	11.9
2011	0.27	128.6	99,623	216.6	14.4
2012	0.27	200.3	97,903	294.3	12.9
2013	0.36	68.9	87,353	188.3	11.3
2014	0.29	85.8	76,882	173.9	8.5
2015	0.25	157.1	67,520	237.1	7.8
2016	0.29	230.0	69,211	328.5	6.7
2017	0.32	111.2	62,436	240.9	6.1
2018	0.24	129.6	60,808	237.4	6.1
2019	0.21	164.8	62,544	270.7	7.9
2020	0.15	124.3	65,921	241.0	7.0
2021	0.16	86.7	69,791	196.4	7.2
2022	0.22	76.7	83,892	171.7	9.1
2023	0.18	94.9	86,536	177.9	11.6

Table 6. Updated biological reference points and 2023 estimates for *F* and female SSB compared with the estimates from the 2019 benchmark.

Metric	2019 Assessment Target	2019 Assessment Threshold	2024 Assessment Target	2024 Assessment Threshold	2023 Value
Fishing Mortality	0.20	0.24	0.17	0.21	0.18
Female SSB	114,295 mt (252 million lbs)	91,436 mt (202 million lbs)	111,892 mt (247 million lbs)	89,513 mt (197 million lbs)	86,536 mt (191 million lbs)

Table 7. Progression of the 2015 year-class through the slot limit, 2021-2023.

	2021	**2022**	**2023**
Ocean Slot limit	28-35”	28-35”	28-31” (mid-year)
2015 year-class age	6 years old	7 years old	8 years old
2015 year-class status	Most below slot	Within slot	Most above narrower slot
Fishing Mortality	0.16	0.22	0.18
Percent Change in F relative to 2021	--	+39%	+17%
Total Removals	5.15 million fish	6.79 million fish	5.58 million fish
Percent Change in Removals relative to 2021	--	+32%	+8%

Table 8. Potential progression of the 2018 year-class through the slot limit, 2024-2025.

	2024	**2025**
Ocean Slot limit	28-31”	(28-31”)
2018 year-class age	6 years old	7 years old
2018 year-class status	Below slot	Within current slot
Fishing Mortality	0.126 (low removals)	0.148 0.175
Percent Change in F relative to 2024	--	*Scenario 1:* +17% (same as 2021-2023) *Scenario 2:* +39% (same as 2021-2022)
Total Removals	3.89 million fish (low removals)	*Scenario 1:* 4.36 million fish *Scenario 2:* 5.10 million fish
Percent Change in Removals relative to 2024	--	*Scenario 1:* +12% *Scenario 2:* +31%
F rebuild	--	0.126
Removals under F rebuild	3.89 million fish	3.76 million fish

Table 9. Probability of SSB being at or above the SSB threshold or target under different constant *F* and estimated 2024 removals scenarios. Shaded row indicates 2029, the rebuilding deadline.

	High 2024 Removals Scenario				Low 2024 Removals Scenario			
Year	**F**	**Catch**	**Probability of being above the SSB threshold**	**Probability of being above the SSB target**	**F**	**Catch**	**Probability of being above the SSB threshold**	**Probability of being above the SSB target**
2024	0.20	5,862,189	34%	0%	0.13	3,890,793	37%	0%
2025	0.20	5,408,210	55%	0%	0.13	3,757,347	81%	2%
2026	0.20	5,153,984	61%	1%	0.13	3,646,236	96%	12%
2027	0.20	5,147,266	58%	1%	0.13	3,716,509	99%	30%
2028	0.20	5,350,692	47%	0%	0.13	3,885,103	100%	42%
2029	0.20	5,546,570	35%	0%	0.13	4,098,339	100%	50%
2030	0.20	5,689,808	24%	0%	0.13	4,235,455	100%	57%
2031	0.20	5,762,085	22%	0%	0.13	4,299,751	100%	64%
2032	0.20	5,824,269	19%	0%	0.13	4,361,570	100%	69%
2033	0.20	5,850,744	20%	0%	0.13	4,416,924	100%	73%
2034	0.20	5,863,982	22%	0%	0.13	4,432,941	100%	77%

Table 10. Probability of SSB being at or above the SSB target under different constant *F* scenarios if *F* increases in 2025. Shaded row indicates 2029, the rebuilding deadline.

	Low 2024 Removals Scenario							
	F=2023 Increase		*F*=2022 Increase		*F* Increase in 2025 Only		$F=F_{2024}$	
Year	F	Probability of being above the SSB target	F	Probability of being above the SSB target	F	Probability of being above the SSB target	F	Probability of being above the SSB target
2024	0.13	0%	0.13	0%	0.13	0%	0.13	0%
2025	0.15	2%	0.18	2%	0.15	2%	0.13	2%
2026	0.15	9%	0.18	5%	0.13	9%	0.13	12%
2027	0.15	16%	0.18	6%	0.13	24%	0.13	30%
2028	0.15	19%	0.18	5%	0.13	36%	0.13	42%
2029	0.15	19%	0.18	3%	0.13	43%	0.13	50%

FIGURES

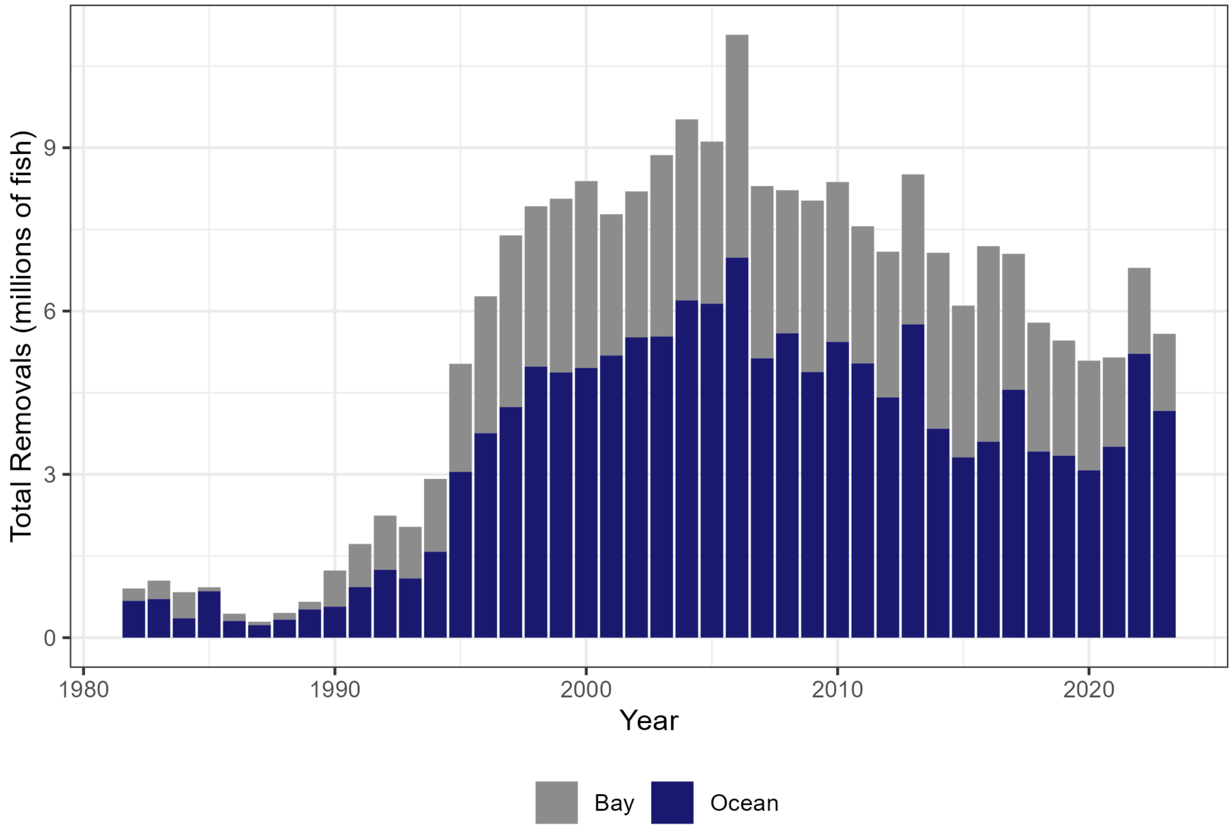


Figure 1. Total striped bass removals by fleet.

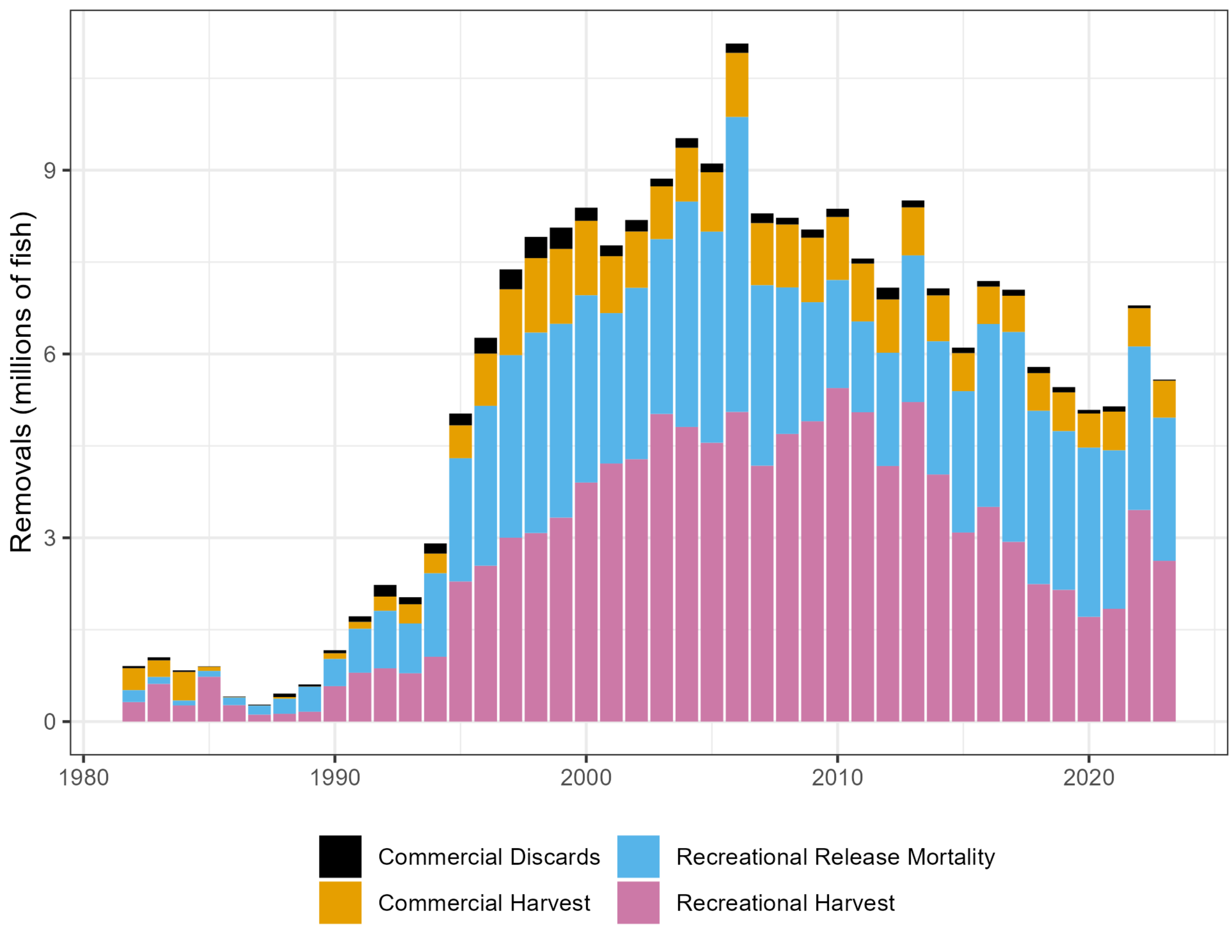


Figure 2.   Total striped bass removal by sector, 1982-2023.

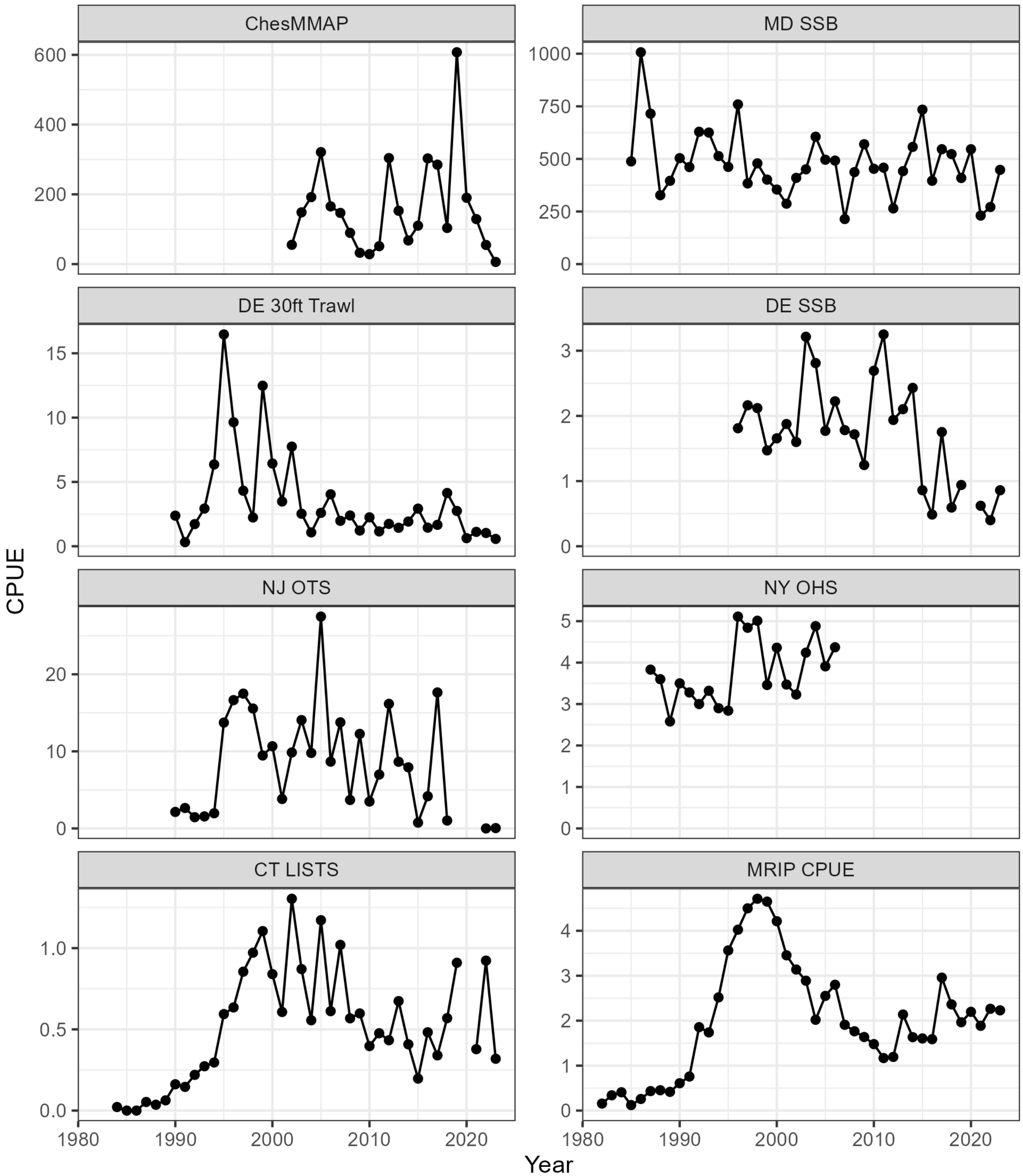


Figure 3. Indices of age-1+ abundance for striped bass, 1982-2023.

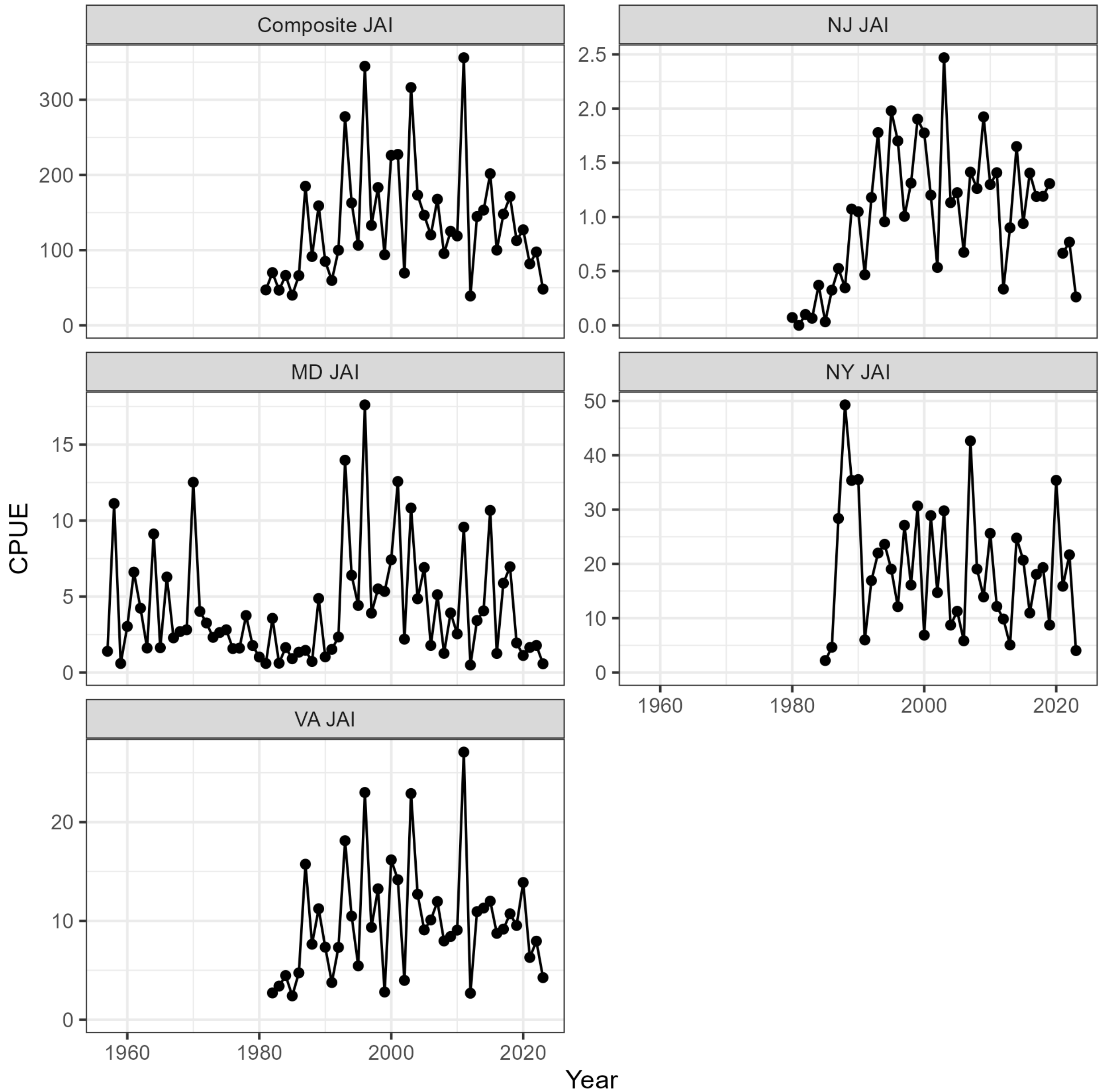


Figure 4. Striped bass juvenile abundance indices, including the composite Chesapeake Bay index (MD-VA), 1954-2023.

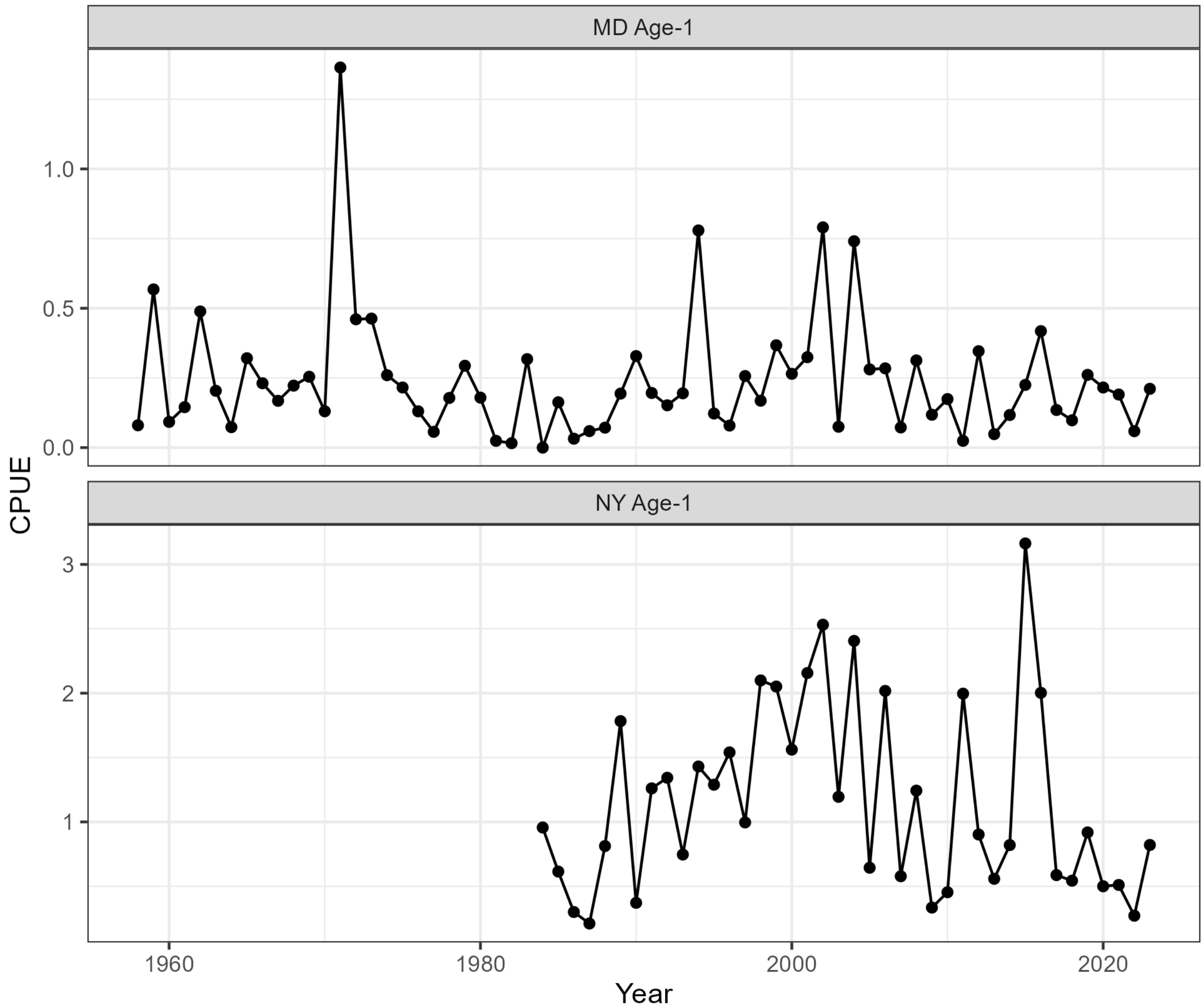
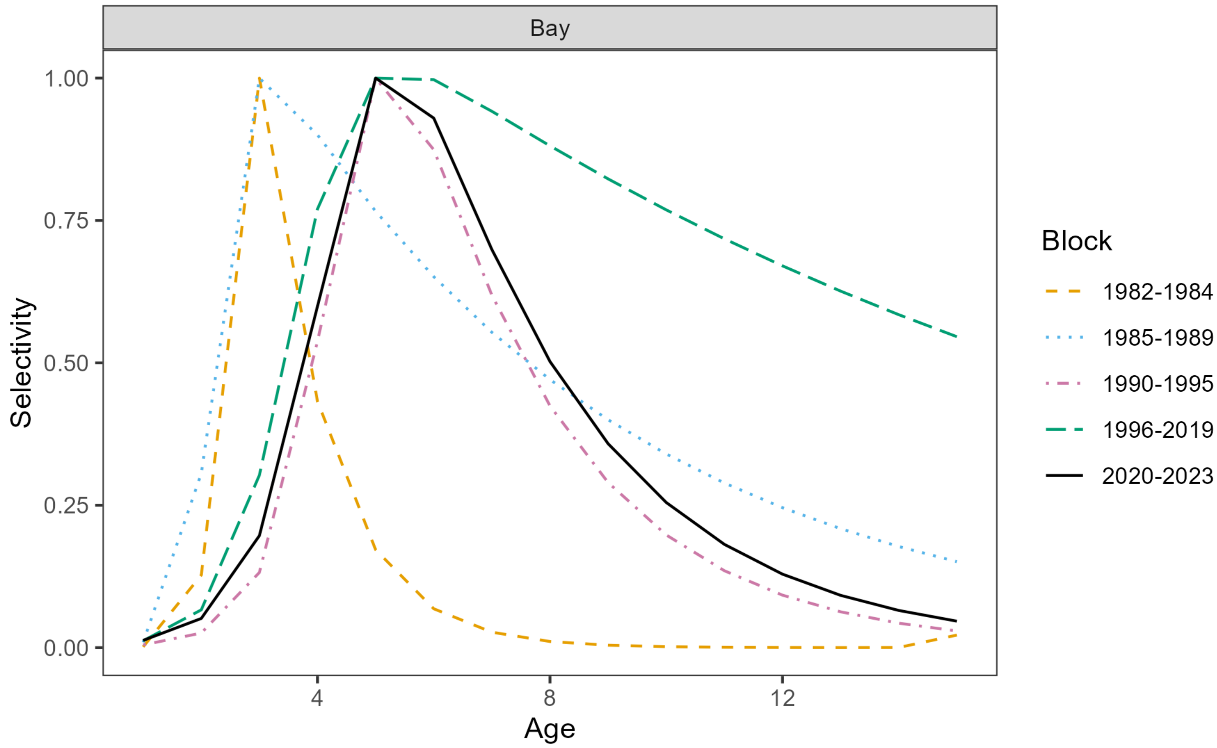


Figure 5. **Age-1 recruitment indices for striped bass, 1954-2023.**



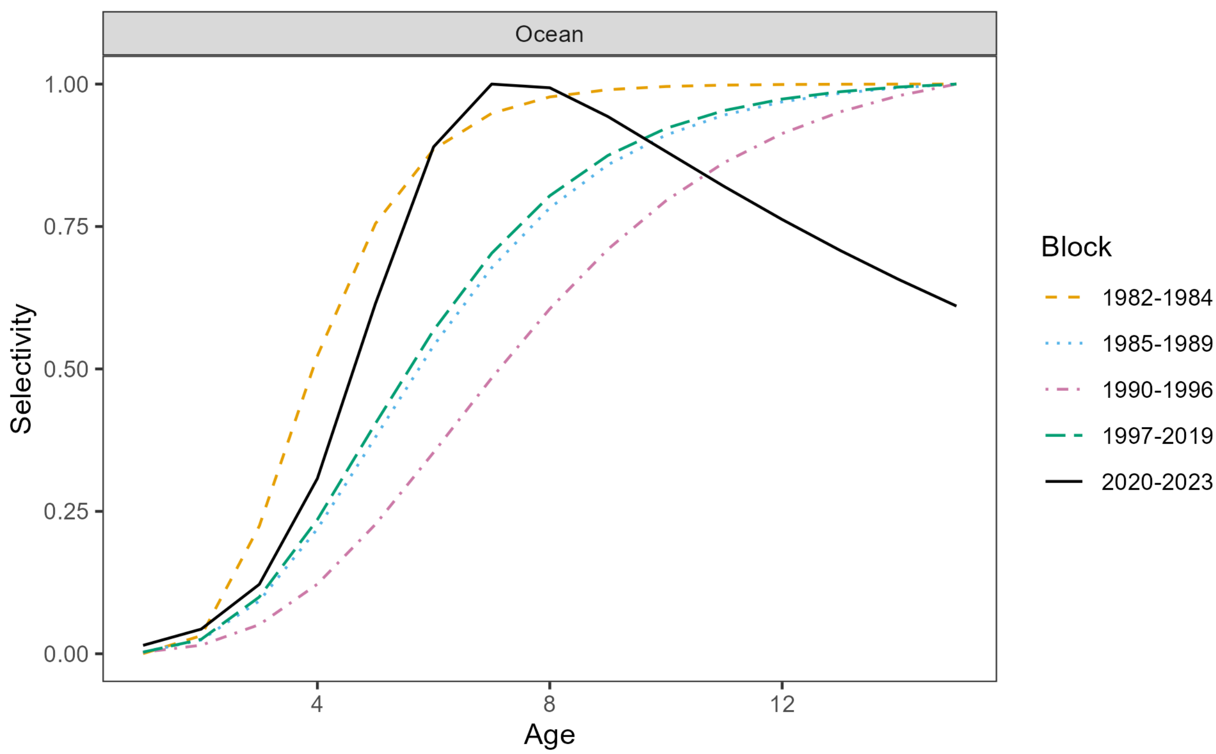


Figure 6. Selectivity patterns for the Bay fleet (top) and the Ocean fleet (bottom).

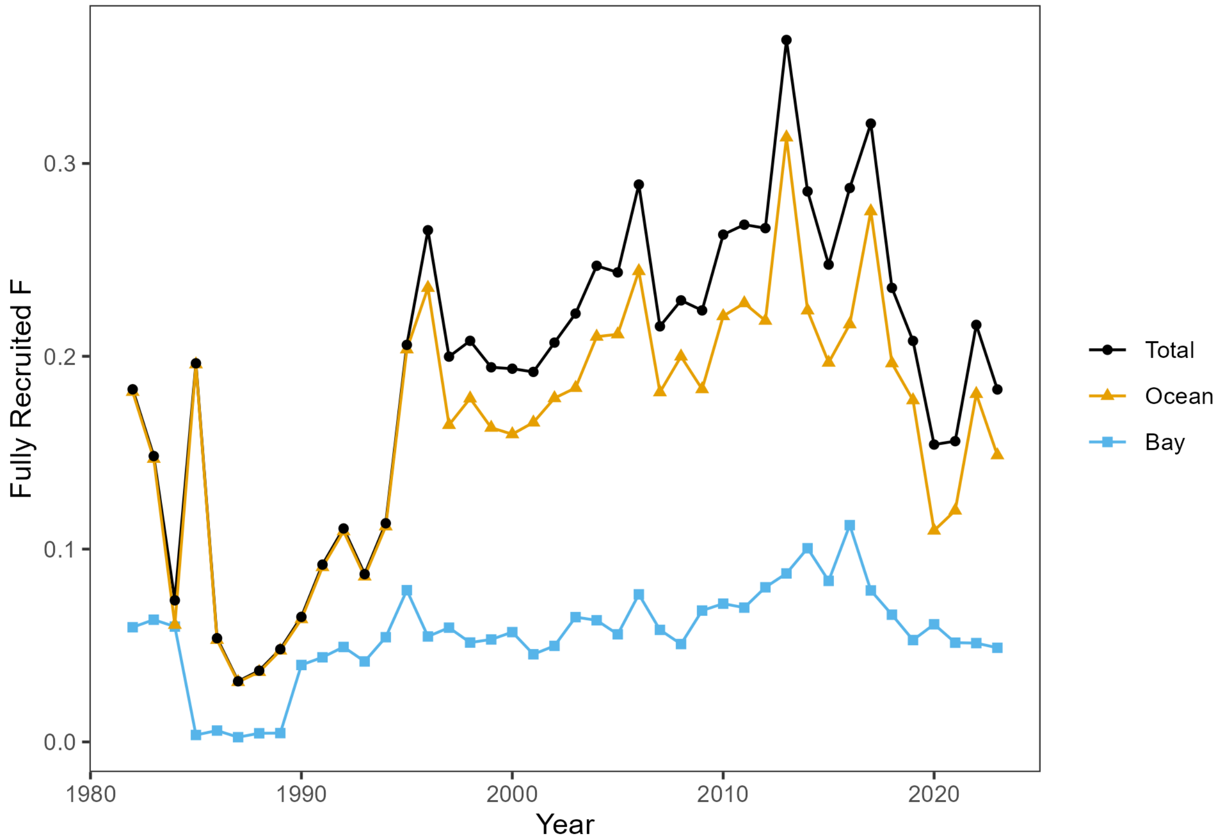


Figure 7. Fully recruited fishing mortality for the Bay and Ocean fleets plotted with the total fully recruited *F*.

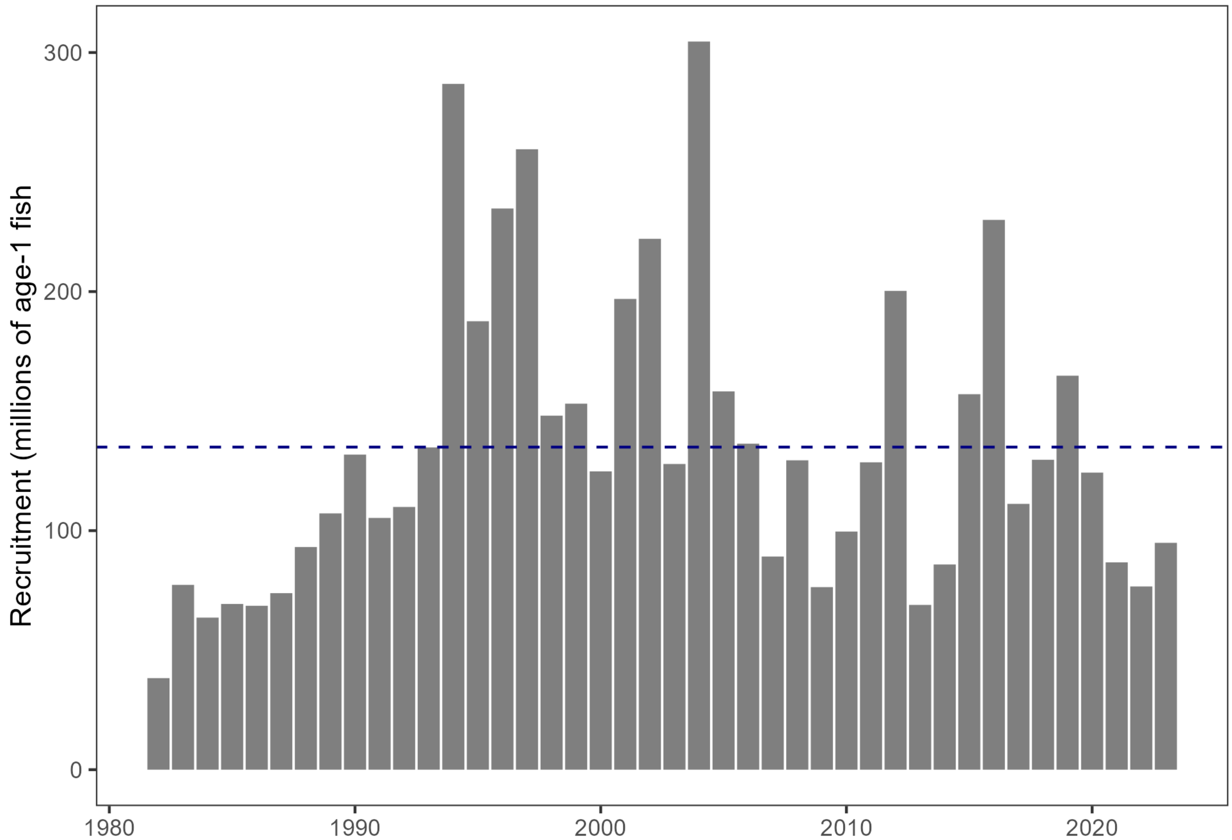


Figure 8. Estimates of striped bass recruitment plotted with the time series mean.

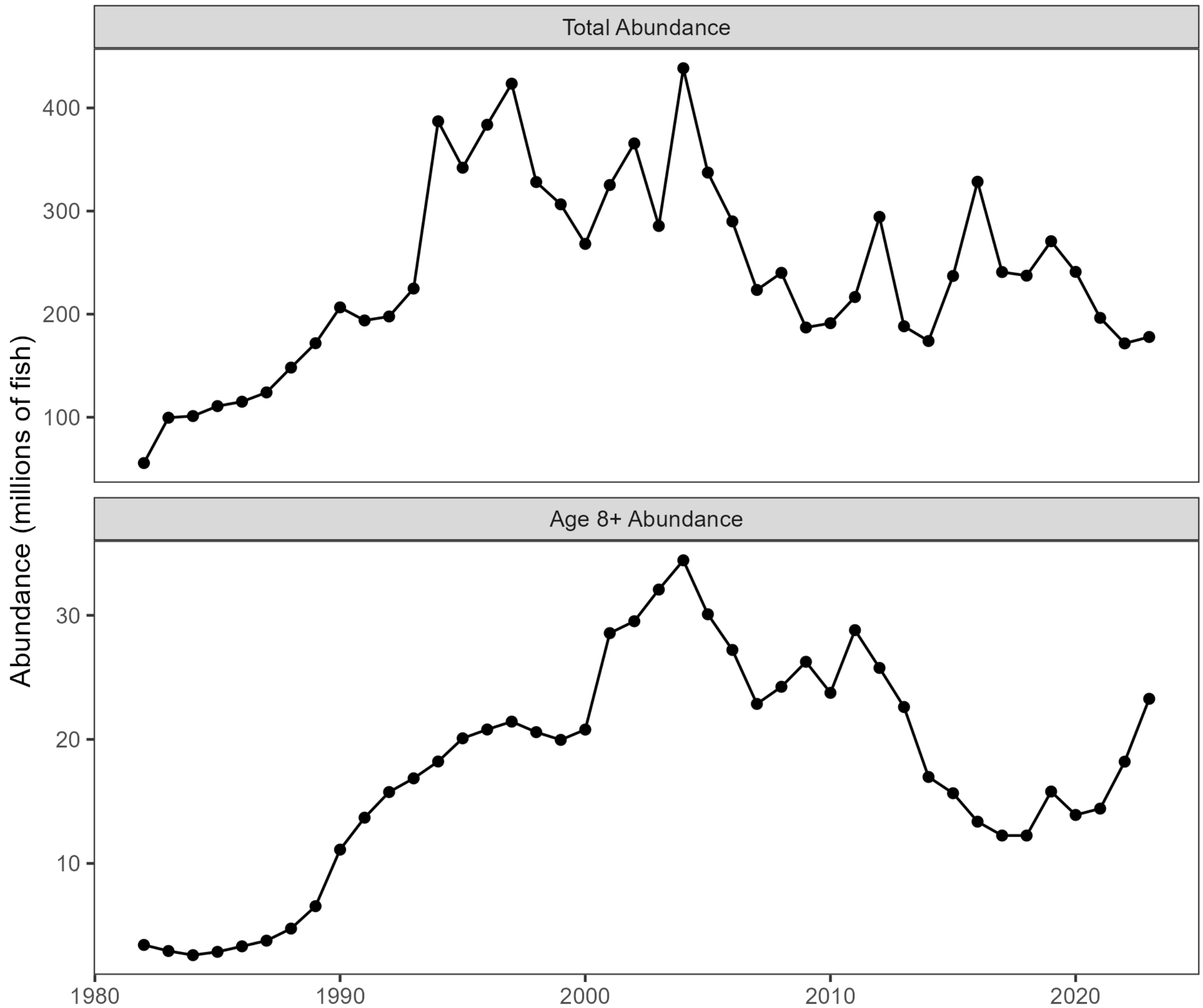


Figure 9. Total abundance (top) and age-8+ abundance (bottom) of striped bass over time.

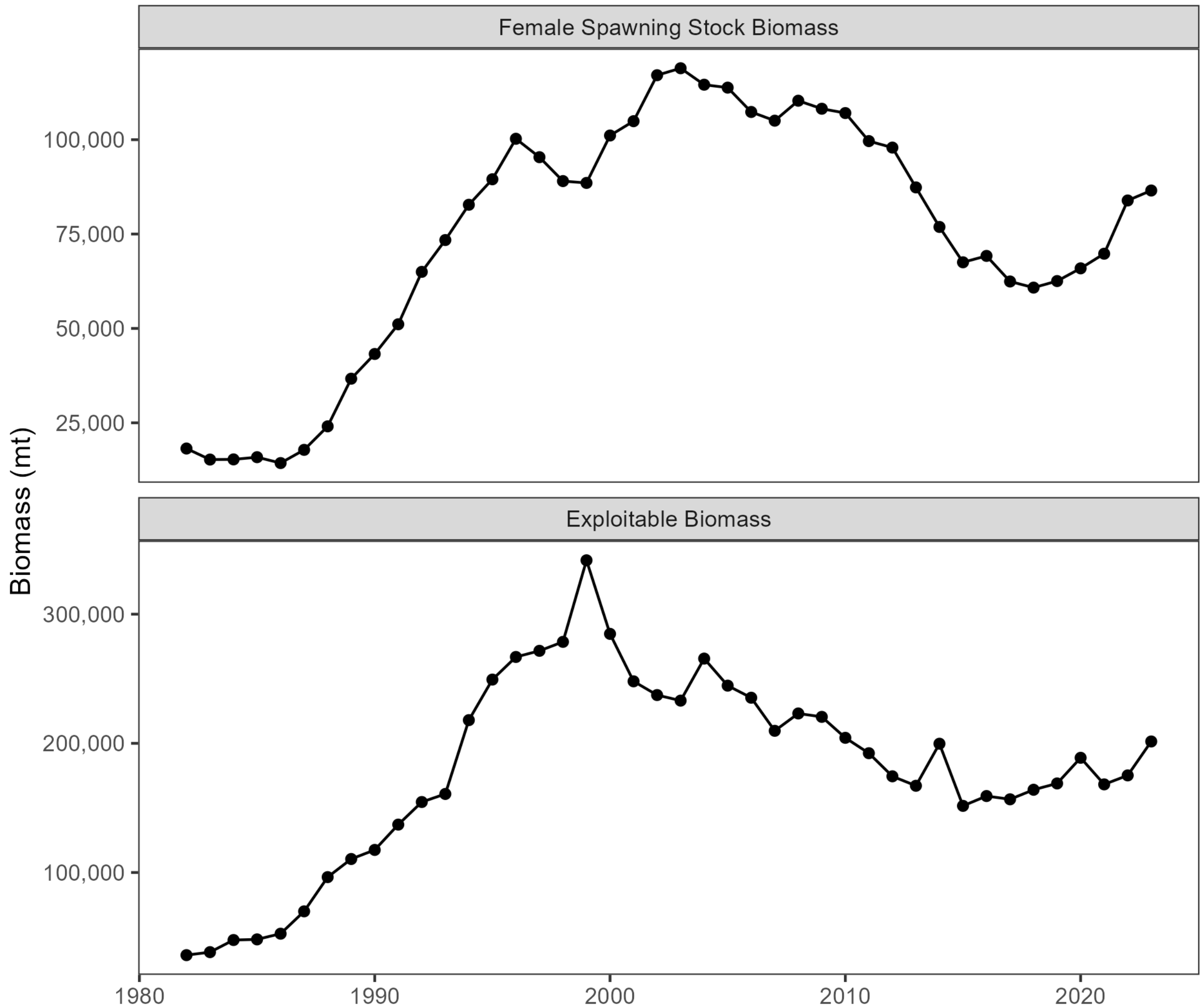


Figure 10. Female spawning stock biomass (top) and exploitable biomass (bottom) of striped bass over time.

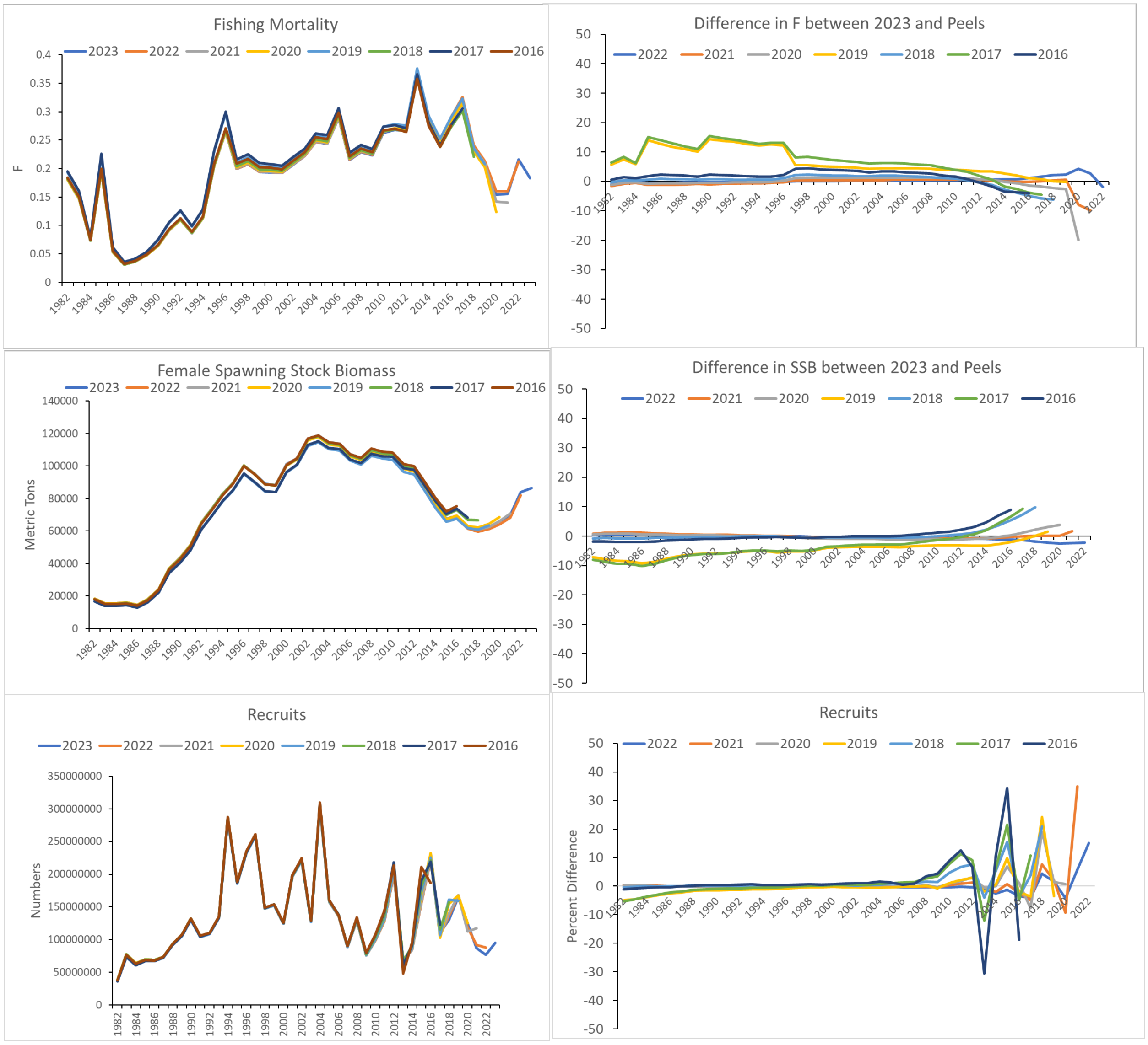


Figure 11. Retrospective plots of five-year peels for fishing mortality (top), female spawning stock biomass (middle), and recruitment (bottom).

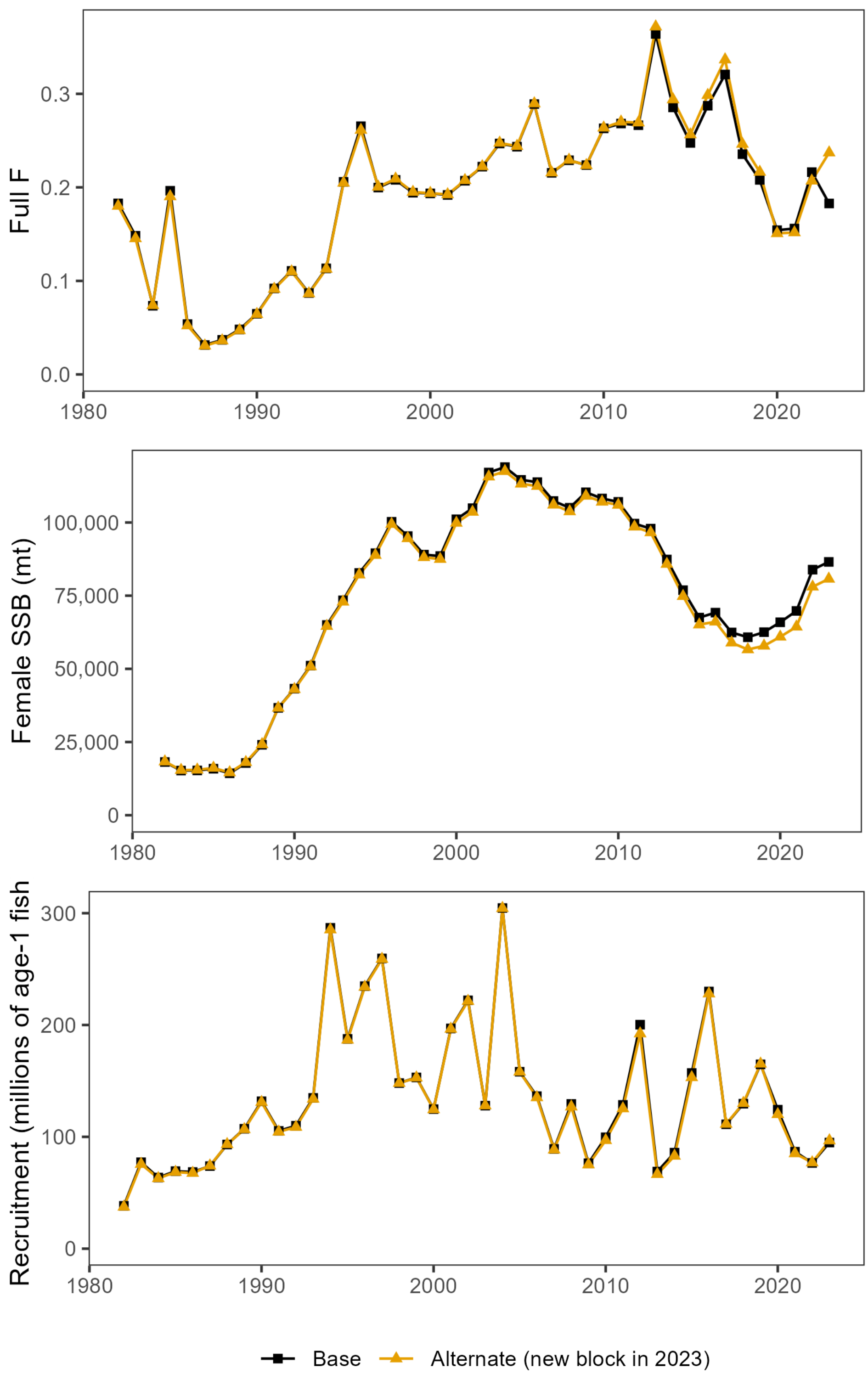


Figure 12. Comparison of fully-recruited fishing mortality (top), female SSB (middle) and recruitment (bottom) from the update assessment base model and sensitivity run with a new 2023 selectivity block for both fleets.

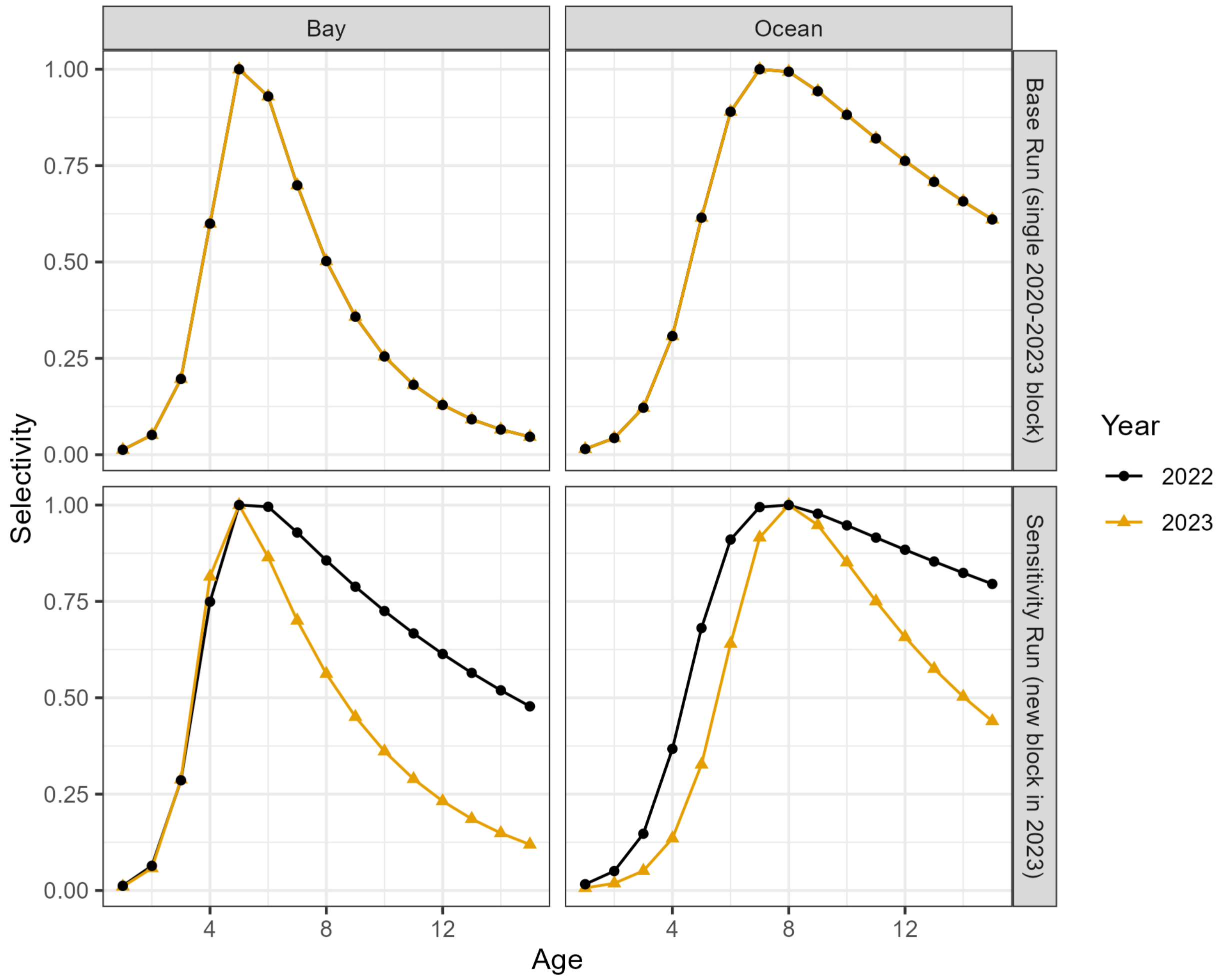


Figure 13. Selectivity curves for 2022 and 2023 for the Bay and Ocean fleets from the base run with a single 2020-2023 block (top row) and the sensitivity run with a new block in 2023 (bottom row).

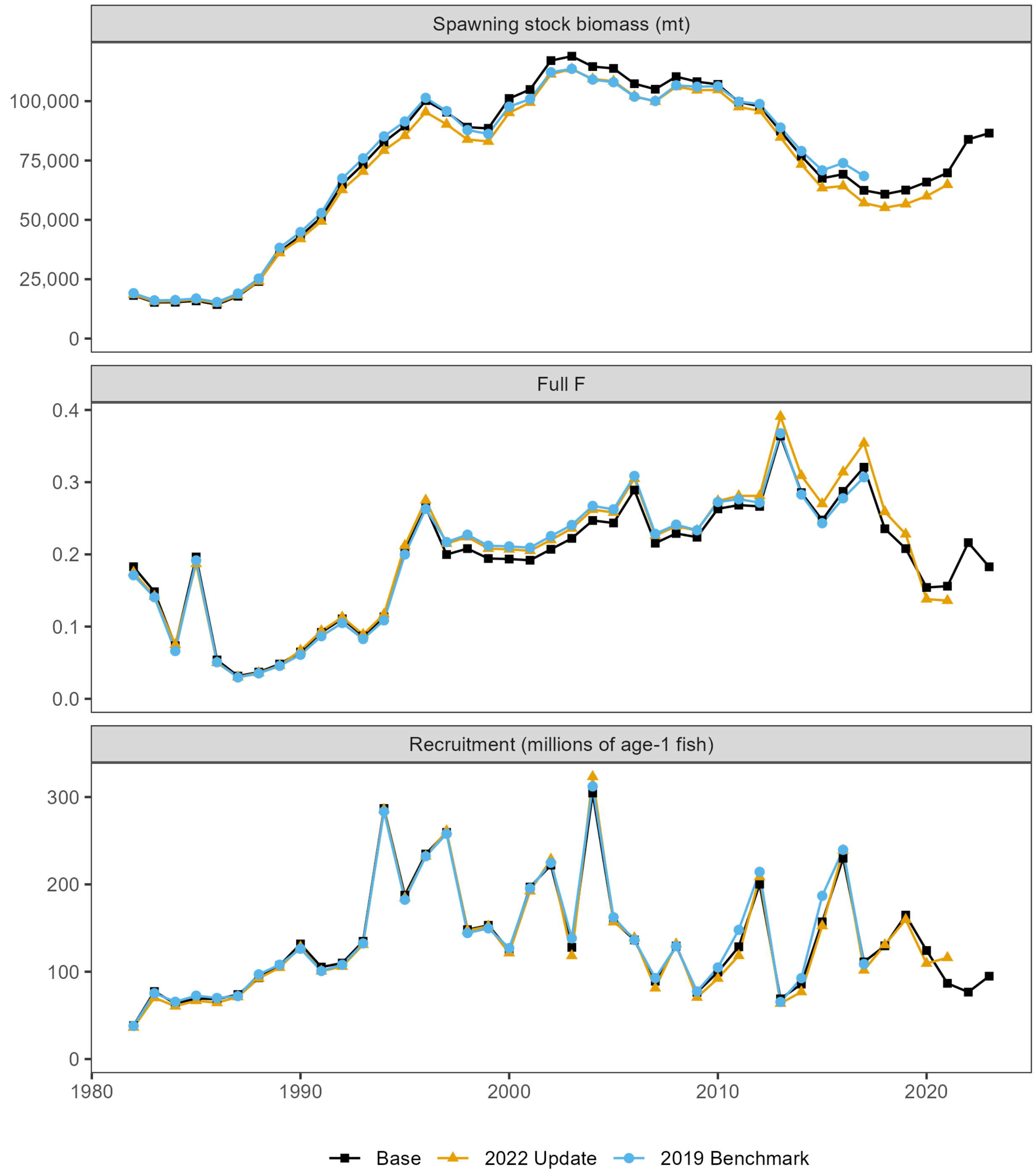


Figure 14. Comparison of estimates of female spawning stock biomass (top), total fishing mortality (middle), and recruitment (bottom) from the 2019 benchmark assessment, the 2022 assessment update, and the current assessment update.

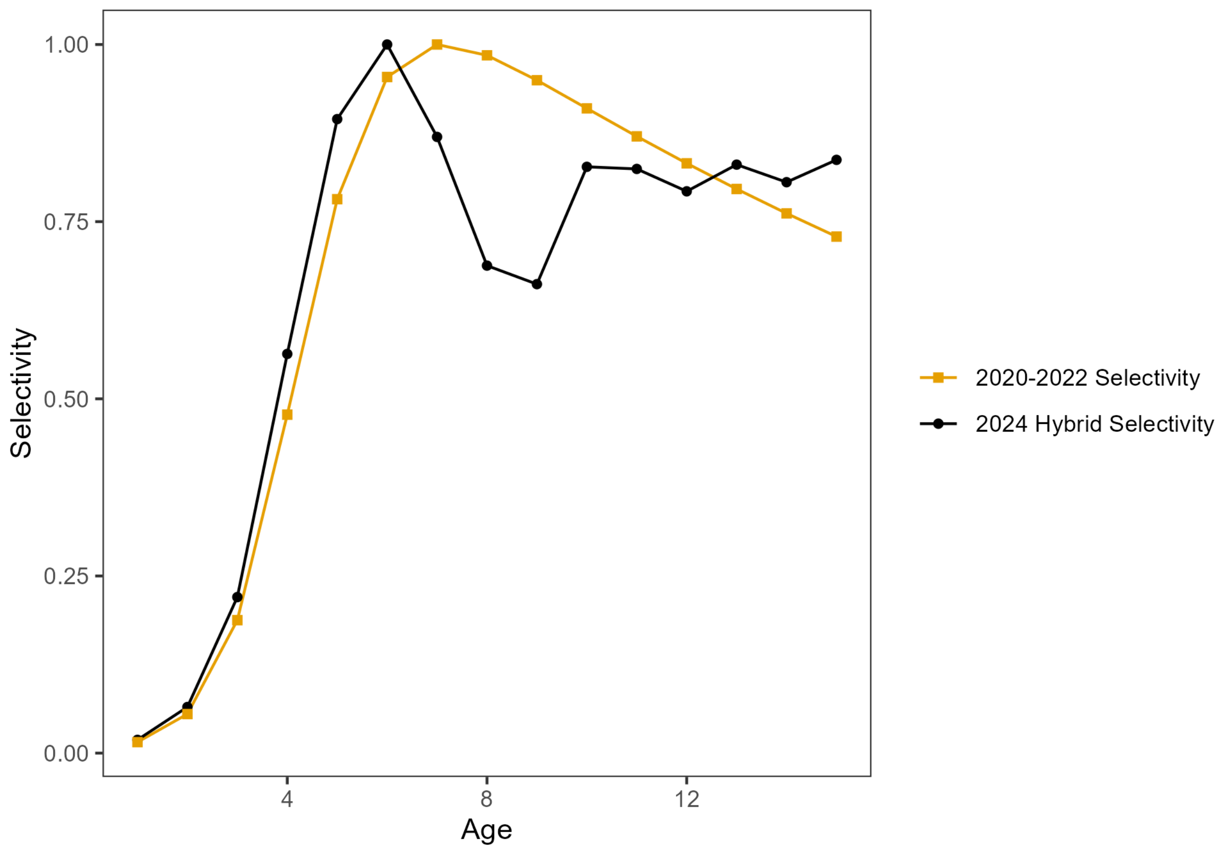


Figure 15. Hybrid selectivity pattern based on 2024 regulations used in the reference point calculations and rebuilding projections plotted with the 2020-2022 selectivity curve.

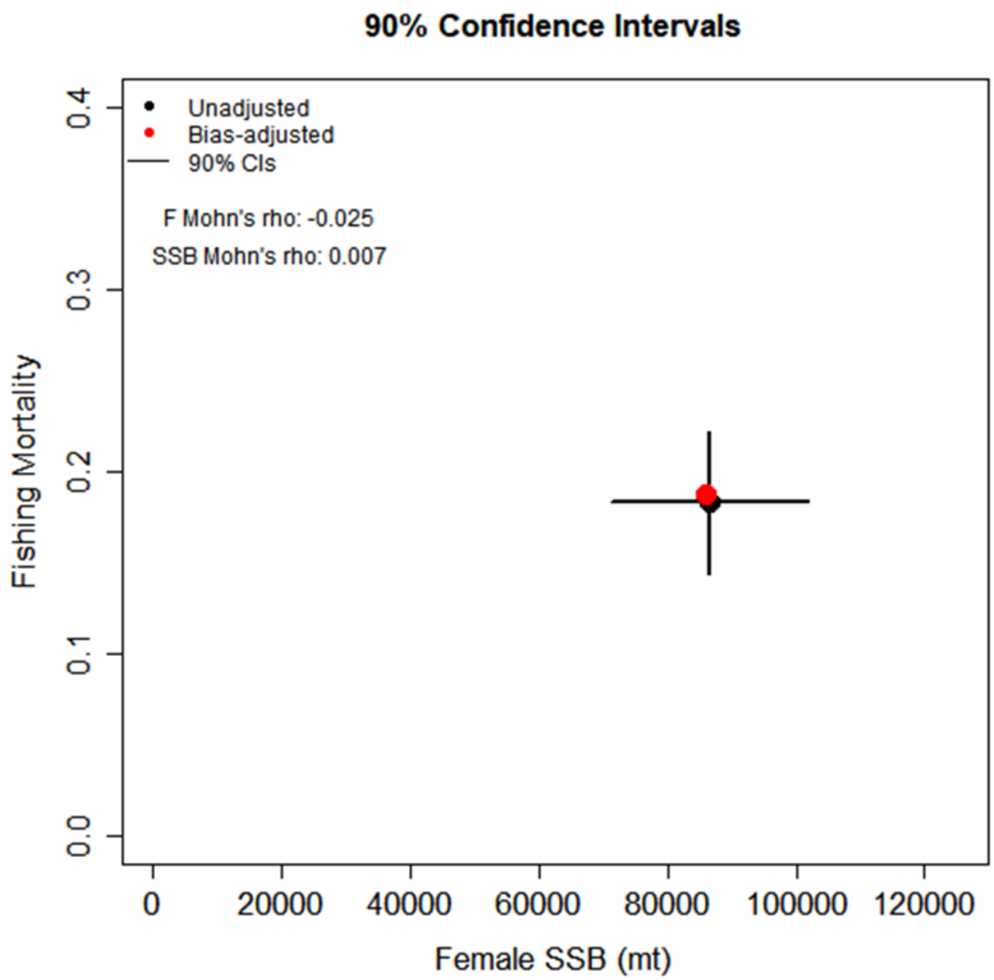


Figure 16. Plot comparing the 2023 retrospective-adjusted *F* and female SSB values with the unadjusted *F* and SSB estimates and their associated 90% confidence intervals.

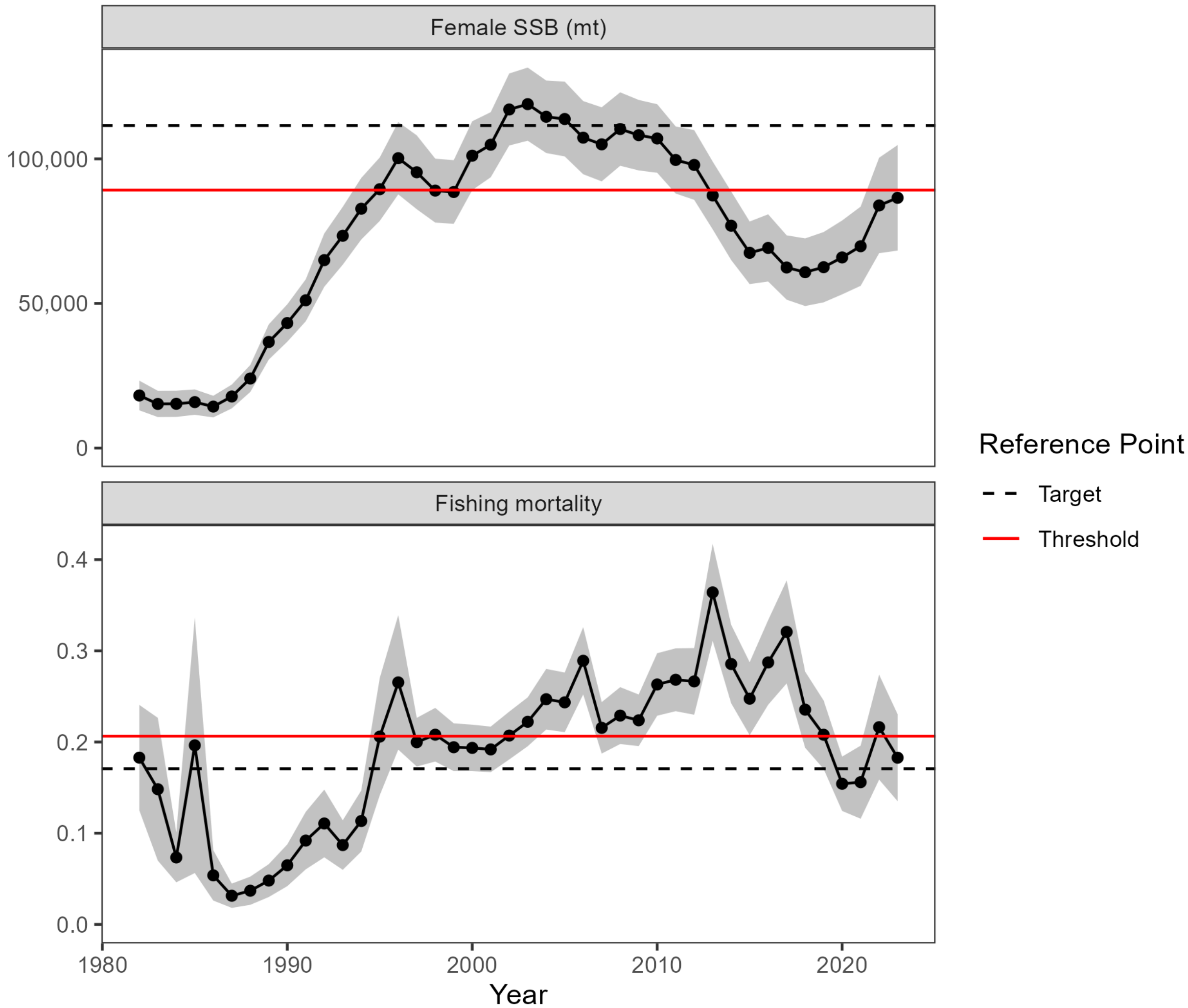


Figure 17. Female SSB (top) and total F estimates (bottom) plotted with their respective targets and thresholds. Shaded area indicates 95% confidence intervals of the estimates.

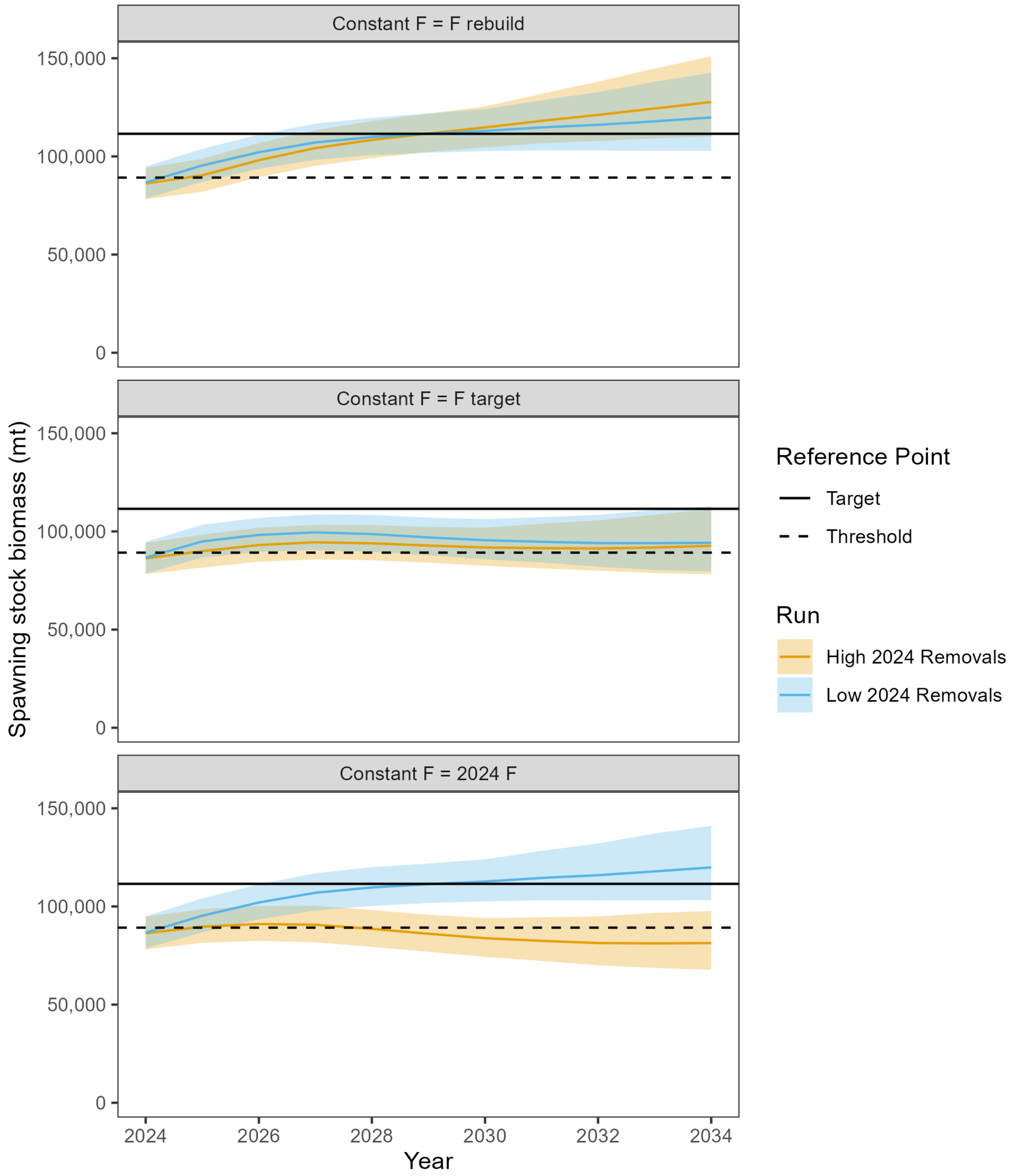


Figure 18. Projections of female spawning stock biomass through 2034 under constant *$F_{rebuild}$* (top), *F_{target}* (middle), and estimated 2024 *F* (bottom) under different 2024 removal scenarios.

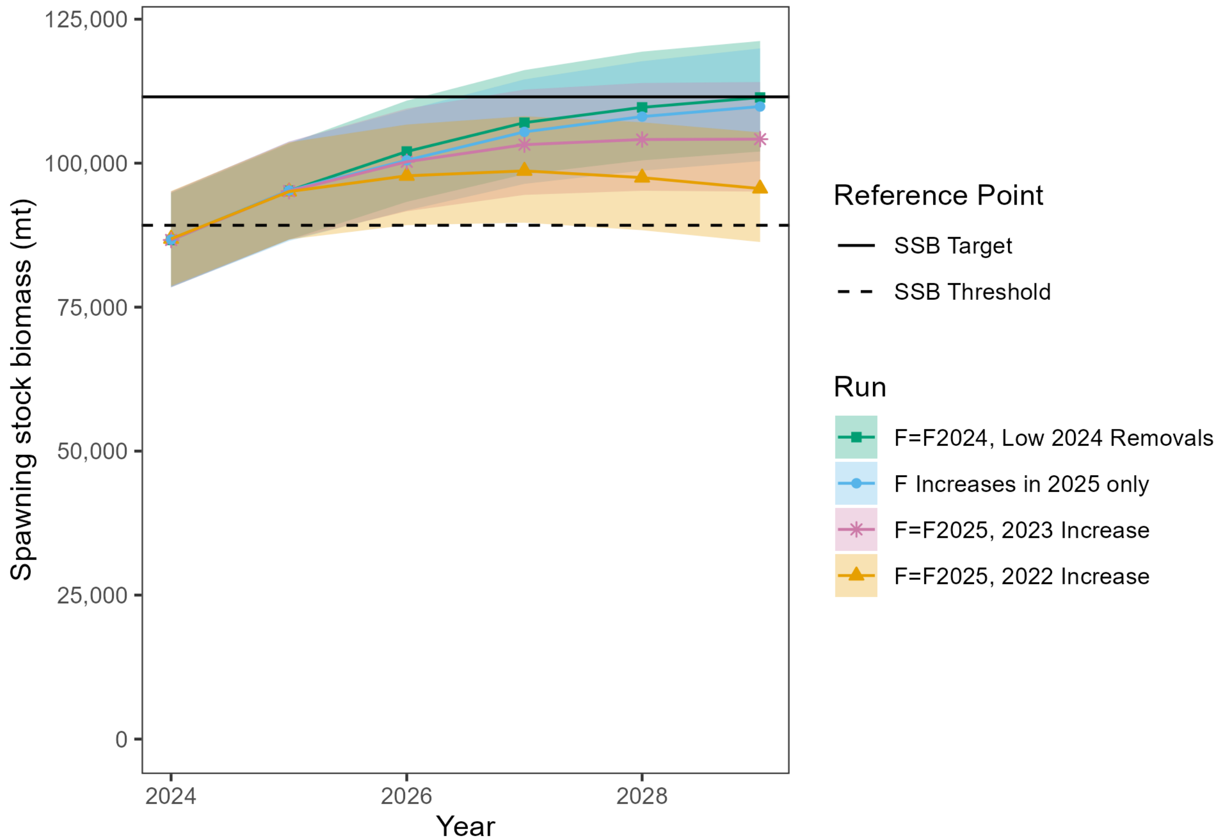


Figure 19. Projections of female spawning stock biomass through 2029 under different future *F* scenarios: assuming *F* stays the same as in 2024 under the low removals scenario (*F=F 2024)*, increases at a rate comparable to what was observed in 2022 (*F=F 2025, 2022 Increase)* or 2023 (*F=F2025, 2023 Increase)*, or increases in 2025 only and then returns to 2024 levels.

Atlantic States Marine Fisheries Commission

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MEMORANDUM

TO: **Striped Bass Management Board**

FROM: **Striped Bass Technical Committee and the Stock Assessment Subcommittee**

DATE: **October 16, 2024**

SUBJECT: **Discussion on 2024 Stock Assessment Projections and Considerations for Management**

The Striped Bass Technical Committee (TC) and Stock Assessment Subcommittee (SAS) met via webinar on October 2, 2024 to review the 2024 Stock Assessment Update Report, discuss the projection scenarios, and discuss options and considerations for potential management response. This memorandum summarizes TC-SAS discussion on the likelihood of the different projection scenarios and considerations for management.

The Assessment Report highlights several sources of uncertainty for the rebuilding trajectory, including 2024 removals and fishing mortality rates for 2025-2029.

2024 Removals

Projections were run for two scenarios of 2024 removals: high and low. The 2024 high removals scenario is 5.86 million fish based on the initial estimate using data through 2022 that Addendum II measures would achieve a 13.7% reduction relative to 2022 removals of 6.8 million fish. The 2024 low removals scenario is 3.89 million fish based on expanding preliminary 2024 MRIP catch estimates for Waves 2 and 3 (March-April and May-June) to the full year, based on the proportion of total removals that occurred in those Waves in earlier years, and accounting for an estimated 7% decrease in commercial removals due to the Addendum II quota reduction.

The TC-SAS considers the 2024 low removals scenario based on preliminary 2024 MRIP numbers to be more likely than the high removals scenario based on the initial Addendum II calculations. The low removals scenario is based on realized data through mid-2024, while the high removals scenario was projected before any 2024 data were available. While the high removals projection was the best information available prior to the 2024 season, realized catch estimates provide a better picture of what is happening in the fishery. Additionally, it is logical that catch would decrease in 2024 relative to 2023 (instead of increasing, as in the high removals scenario) since the age-9 2015 year-class is less available to the ocean slot limit in 2024 as compared to 2023. Preliminary MRIP numbers for 2024 Waves 2 and 3 are 36% lower than 2023 Waves 2 and 3 numbers (Figure 1), and in the previous five years, the proportion of total recreational removals from Waves 2 and 3 has been relatively consistent (Figure 2). Total

M24-91

removals in Waves 4-6 would have to increase significantly compared to what has been observed in the past to achieve the high removals estimate.

Fishing Mortality for 2025-2029

The Assessment Report presents five projection scenarios through 2029 resulting in varying probabilities of rebuilding the stock by the 2029 deadline (Figures 3-4). One scenario assumes high removals in 2024 and maintaining that constant fishing mortality (*F*) in 2025-2029. The TC-SAS considered the high 2024 removals scenario unlikely and used the low 2024 removals assumption for the rest of the scenarios. These four scenarios use the estimate of *F* in 2024 associated with the low 2024 removals scenario with varying assumptions for *F* in 2025-2029. The varying assumptions for *F* in 2025-2029 are intended to address the uncertainty of the effect of the above-average 2018 year-class entering the ocean fishery in 2025 and subsequently growing out of the ocean slot in the following years. All five scenarios are described below with input from the TC on which may be more likely than others.

Constant *F* at $F=F_{2024}$ for Low 2024 Removals: this scenario assumes *F* in 2025-2029 will be equal to the *F* in 2024 estimated under the low removals scenario. This is the best case scenario for the stock out of the scenarios considered; however, the TC-SAS considered it unlikely that *F* would remain constant from 2024 to 2025 with the 2018 year-class entering the ocean fishery. In this scenario, there is a 50% probability of rebuilding by 2029, but a 4% reduction in removals relative to 2024 would be needed to maintain *F* at F_{2024} in 2025.

F_{2024}=Low Removals, *F* Increases in 2025 Only and Returns to 2024 Low Levels: this scenario assumes the low removals scenario in 2024, a moderate increase in *F* in 2025, and a decrease and stabilization for *F* in 2026-2029 back to F_{2024}. The TC-SAS considers this scenario most likely relative to the other scenarios. The increase in F_{2025} corresponds to the above-average 2018 year-class entering the current ocean slot limit. The subsequent decrease of *F* in 2026 and stabilization through 2029 corresponds to the 2018 year-class growing out of the current ocean slot limit and the lack of strong year-classes behind it. The moderate increase in F_{2025} (+17%) is the same magnitude as the increase from 2021 to 2023 when part of the 2015 year-class was still in the newly reduced ocean slot limit, but this may be overestimating the magnitude of increase in 2025 since the 2018 year-class is not as strong as the 2015 year-class was. In this scenario, there is a 43% probability of rebuilding by 2029.

F_{2024}=Low Removals and Moderate Increase to Constant *F* for 2025-2029: this scenario assumes the low removals scenario in 2024 followed by a moderate increase in *F* in 2025, comparable to what was observed from 2021 to 2023 with the 2015 year-class, and *F* remaining constant at that increased rate for 2025-2029. The moderate increase in F_{2025} (+17%) is the same magnitude as the increase from 2021 to 2023 when the 2015 year-class was in the newly reduced ocean slot limit. This may be overestimating the magnitude of increase in 2025 since the 2018 year-class is not as strong as the 2015 year-class was. The TC-SAS considers it unlikely that *F* would remain at this elevated level from 2026 to 2029 because at some point, *F* would be expected to decrease as the 2018 year-class grows out of the current ocean slot. However, it is possible *F* could remain elevated due to decreasing stock abundance (i.e., lower removals but from a smaller population). In this scenario, there is a 19% probability of rebuilding by 2029.

F_{2024}=Low Removals and Large Increase to Constant *F* for 2025-2029: this scenario assumes the low removals scenario in 2024 followed by a large increase in *F* in 2025, comparable to what was observed from 2021 to 2022 with the 2015 year-class, and *F* remaining constant at that increased rate for 2025-2029. The large increase in *F* in 2025 (+39%) used in this scenario is the same magnitude as the increase from 2021 to 2022 when the 2015 year-class was in the previous Addendum VI ocean slot limit. This large increase is likely an overestimate of the magnitude of increase since the 2018 year-class is not as strong as the 2015 year-class was, and the 2022 slot limit was four inches wider than the current slot limit. The TC-SAS considers it unlikely that *F* would remain constant at this elevated level from 2026 to 2029 because at some point, *F* would be expected to decrease as the 2018 year-class grows out of the current ocean slot. In this scenario, there is a 3% probability of rebuilding by 2029.

Constant *F* with $F=F_{2024}$ for High 2024 Removals: this scenario assumes *F* in 2025-2029 is equal to the F_{2024} estimated under the high removals scenario. This is the worst case scenario and the TC-SAS considers the high 2024 removals scenario unlikely compared to the low 2024 removals scenarios. In addition, the TC-SAS considers it unlikely that *F* would remain constant at this high level from 2024 to 2029 with the 2018 year-class entering and then leaving the ocean slot limit. In this scenario, there is a 0% probability of rebuilding to the SSB target by 2029, although there is a 35% probability that SSB will be above the SSB threshold.

Considering Uncertainty in the Range of Projections

These projection scenarios convey a range of different potential outcomes under different assumptions about fishing mortality rates in the near future, some of which are more pessimistic than others. Although some projections aim to capture some component of changing effort and fish availability (i.e., increased *F* when strong year-classes are available), angler behavior and fish availability are still sources of uncertainty. While the TC-SAS considers the scenario where *F* increases in 2025 and then decreases to be the most likely, there is high uncertainty in the exact *F* values that will occur over this period even with constant regulations. In order to have a 50% or greater probability of rebuilding in this scenario, *F* will have to decline below the *F* estimated for 2024, which is already the lowest value since 1994, which may be the result of both the extremely narrow slot limit and the lack of a strong year class in that slot. The low year-classes following the 2018 year-class will result in lower availability of harvestable fish after 2025, which may result in a decline in effort and a lower *F*; however, if removals remain constant on these weaker year-classes, *F* may not decrease as much as expected.

The projections apply the 2024 selectivity curve to all years 2024-2029. The 2024 selectivity curve was developed using an alternative method to better capture the regulation change in 2024, but how well it represents actual fishery selectivity is uncertain. Additional years of data under the same management regulations would inform a better estimate of selectivity for upcoming assessments.

Potential Management Options

The TC-SAS calculated estimated reductions in total removals associated with a range of recreational size limit changes for 2025 and various recreational harvest closure options. Pending further guidance from the Board on what type of management response and level of reduction (if any) the Board may consider for 2025, a range of options is included for reference. Additional options could be analyzed after the Board determines next steps for management.

When considering possible management response for 2025 and beyond, the Board should consider its risk tolerance. The level of risk the Board is willing to accept is a management decision. In the coming months, the TC could provide updated projections incorporating realized 2024 removals once 2024 MRIP data are available in addition to other management options, if requested by the Board.

For size limit analysis, the TC-SAS used MRIP length frequency data from 2018 and 2011 for the ocean and Chesapeake Bay, respectively, to represent fish availability in 2025 when the above-average 2018 year-class will be age-7. 2018 data were used for the ocean since the 2011 year-class was age-7 that year. Additionally, there was no slot limit in place in 2018, so the length frequency data includes legal harvest of fish above 35”, which allows for analysis of slot limits or minimum sizes higher than the current regulations. However, because catch of fish shorter than the minimum length in 2018 was not legal in most areas of the ocean fishery, the 2018 length frequency data does not provide the data necessary to analyze slot limits lower with a minimum lower than the current regulation. Therefore, no reductions for slots of smaller fish are presented for the ocean. 2011 data were used for the Chesapeake Bay since there was not a prominent, strong year class available in the Bay fishery at that time, which will be the case in 2025. Estimated reductions for a range of size limits are presented for each region in Table 1.

For harvest closure analysis, 2021-2022 MRIP data were pooled to capture recent years under the slot limit, including Chesapeake Bay closures that were implemented through Addendum VI. A constant daily harvest rate was calculated by Wave for each state and some combinations of states in each region to estimate reductions from various seasonal harvest closures (Table 2).

The TC-SAS discussed tradeoffs of changing the size limit to allow harvest of larger fish in the ocean vs. maintaining the current slot limit targeting smaller fish. If ocean harvest remains in the current 28-31” slot, the remaining larger 2015s will be protected but the incoming 2018 year-class will be subject to harvest. If harvest is shifted to larger fish, the incoming 2018s would be protected but the larger 2015s would then be subject to harvest, the very fish recent measures were designed to protect. The TC-SAS also discussed the idea of an ocean size limit below 28”, which has been the minimum size in the ocean since the stock was rebuilt. Targeting fish smaller than 28” could shift harvest away from both the 2015 and the 2018 year-classes and may be desirable by some stakeholders from a management perspective, but harvest of immature fish would increase, resulting in a loss of spawning potential for the stock. It is unclear whether the biological benefit of reducing harvest of the remaining 2015s and 2018s would outweigh the biological risk of targeting immature fish. To calculate an estimated reduction for any size limit under 28” for the ocean, the TC-SAS would need to pursue alternative data sources (e.g., state logbooks).

The TC-SAS notes that most size limits evaluated, particularly in the ocean, are estimated to achieve less than a 6% reduction. The TC didn’t believe that a regulation change designed to achieve such a reduction would be meaningful. That is, given the typical sources of uncertainty in these analyses, such a low estimated level of reduction would likely not result in a meaningful change in removals if implemented[1]. While a size limit change could be combined with a seasonal closure for a higher estimated cumulative reduction, the benefit of changing to a size limit with such a small estimated reduction may be limited.

Finally, regarding how a potential reduction should be allocated between sectors, the Board was interested in a range of options to split the reduction, and those are provided in Table 3.

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[1] For example, a credible range of recreational removals (95% CI) in 2023 is between 4.18 and 5.76 million fish (or the point estimate ± 16%).

Tables

Table 1. Estimated reduction in total removals for various size limits in 2025 for the ocean and Chesapeake Bay.

Ocean		Chesapeake Bay	
Size Limit	**Estimated Reduction Relative to Current 28-31" Slot**	**Size Limit**	**Estimated Reduction Relative to Current 19-24" Slot**
28-30" slot limit	-4.7%	19-23" slot limit	-4.3%
32-35" slot limit	-1.8%	19-22" slot limit	-14.8%
33-36" slot limit	-3.8%	19-21" slot limit	-26.0%
35" minimum size	0%	20-25" slot limit	-1.6%
38" minimum size	-5.4%	20-24" slot limit	-8.4%
40" minimum size	-5.8%	20-23" slot limit	-12.7%

Table 2. Estimated reduction in total removals for 14-day harvest closures occurring during various Waves for states in the ocean and Chesapeake Bay.

Waves in which Ocean Closure (14 days) Occurs by State	**Estimated Reduction for 14-day Harvest Closure**	**Waves in which Chesapeake Bay Closure Occurs (14 days) by State**	**Estimated Reduction for 14-day Harvest Closure**
Wave 3 All States	-1.8%	Wave 3 MD-VA	-4.4%
Wave 4 All States	-1.7%	Wave 4 MD-VA	-3.9%
Wave 5 All States	-1.6%	Wave 5 MD-VA	-4.2%
Wave 6 All States	-3.1%	Wave 6 MD-VA	-3.8%
Wave4ME-CT; Wave6NY-NC	-4.3%	Wave4MD; Wave3VA	-4.9%
Wave4ME-MA; Wave6RI-NC	-4.1%	Wave4MD; Wave5VA	-4.1%
Wave4ME-MA; Wave3RI-NC	-2.4%	Wave4MD; Wave6VA	-4.5%
Wave4ME-NH; Wave5MA-NJ; Wave6DE-NC	-1.6%	Wave5MD; Wave3VA	-5.0%
		Wave5MD; Wave6VA	-4.6%

Table 3. Potential sector reductions for different sector splits under the best case scenario for 2025 (4% reduction to maintain $F=F_{2024}$ in 2025) and the worst case scenario for 2025 (46% reduction to achieve $F_{rebuild}$ in 2025).

	Even Reductions		**No Commercial Reduction**		**Reductions Based on Sector Contribution to Total Removals**	
Total Reduction	Comm.	Rec.	Comm.	Rec.	Comm.	Rec.
-4%	-4%	-4%	0%	-4.5%	-0.4%	-4.5%
-46%	-46%	-46%	0%	-51.7%	-5.1%	-49.1%

Figures

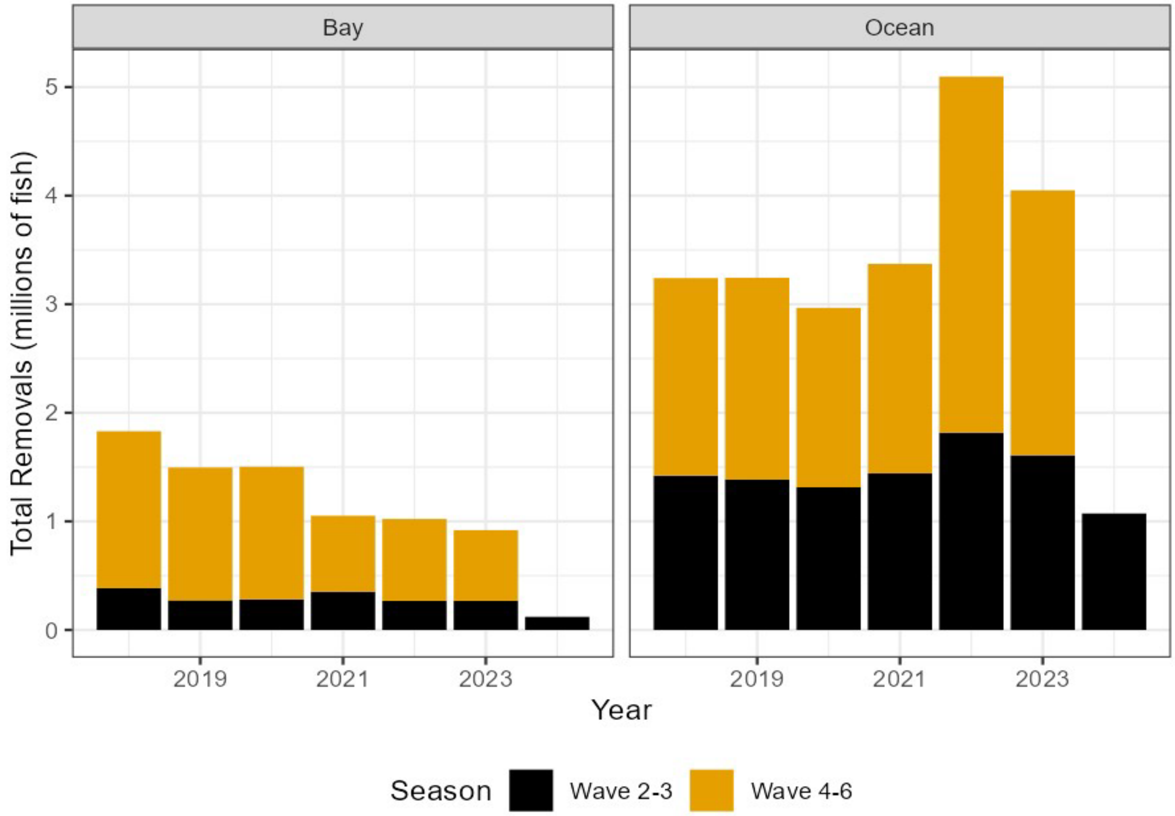

Figure 1. Total recreational removals by region separated into Waves 2-3 and 4-6. Source: MRIP.

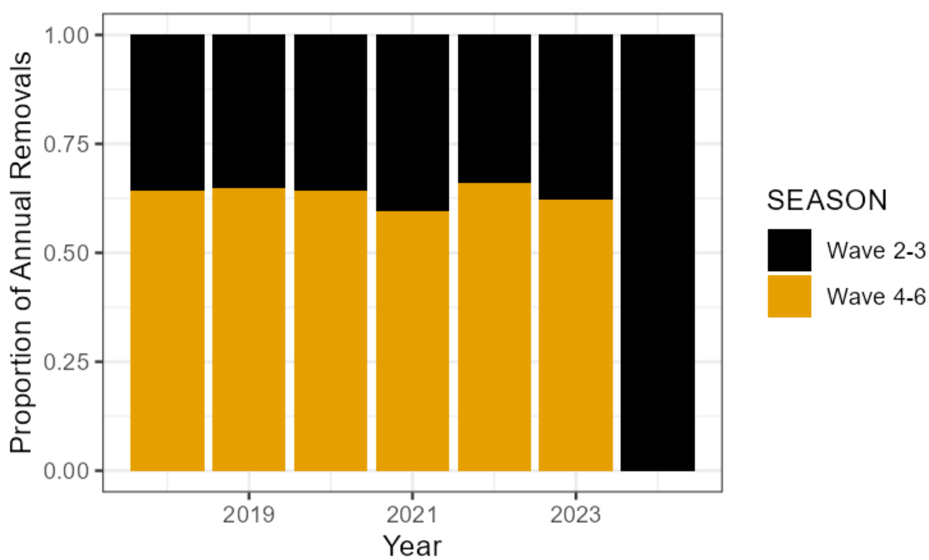

Figure 2. Proportion of total recreational removals for 2018-2024 that came from Waves 2-3 and 4-6. Source: MRIP

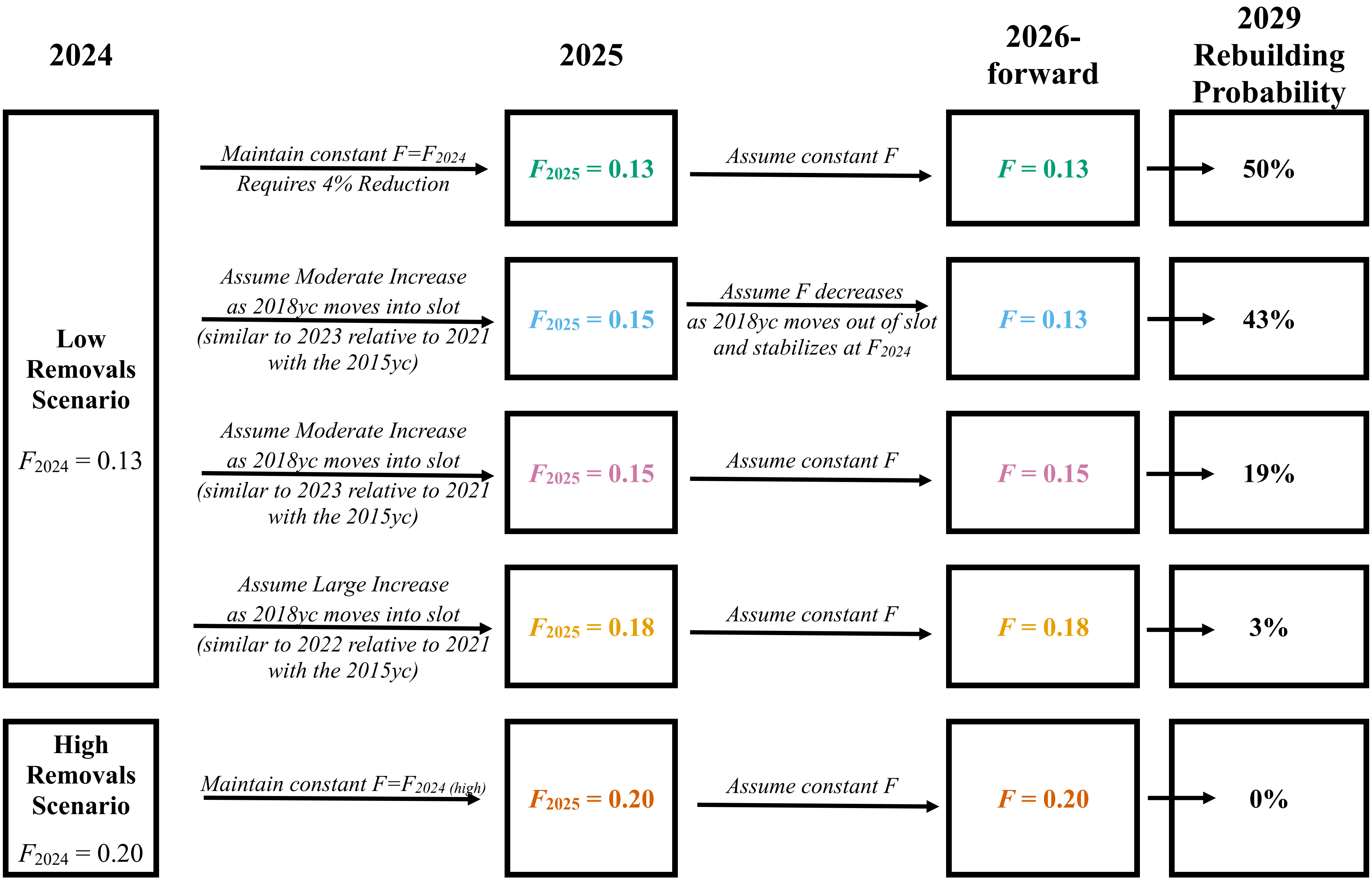

Figure 3. Projection scenarios and resulting probability of rebuilding the stock by 2029.

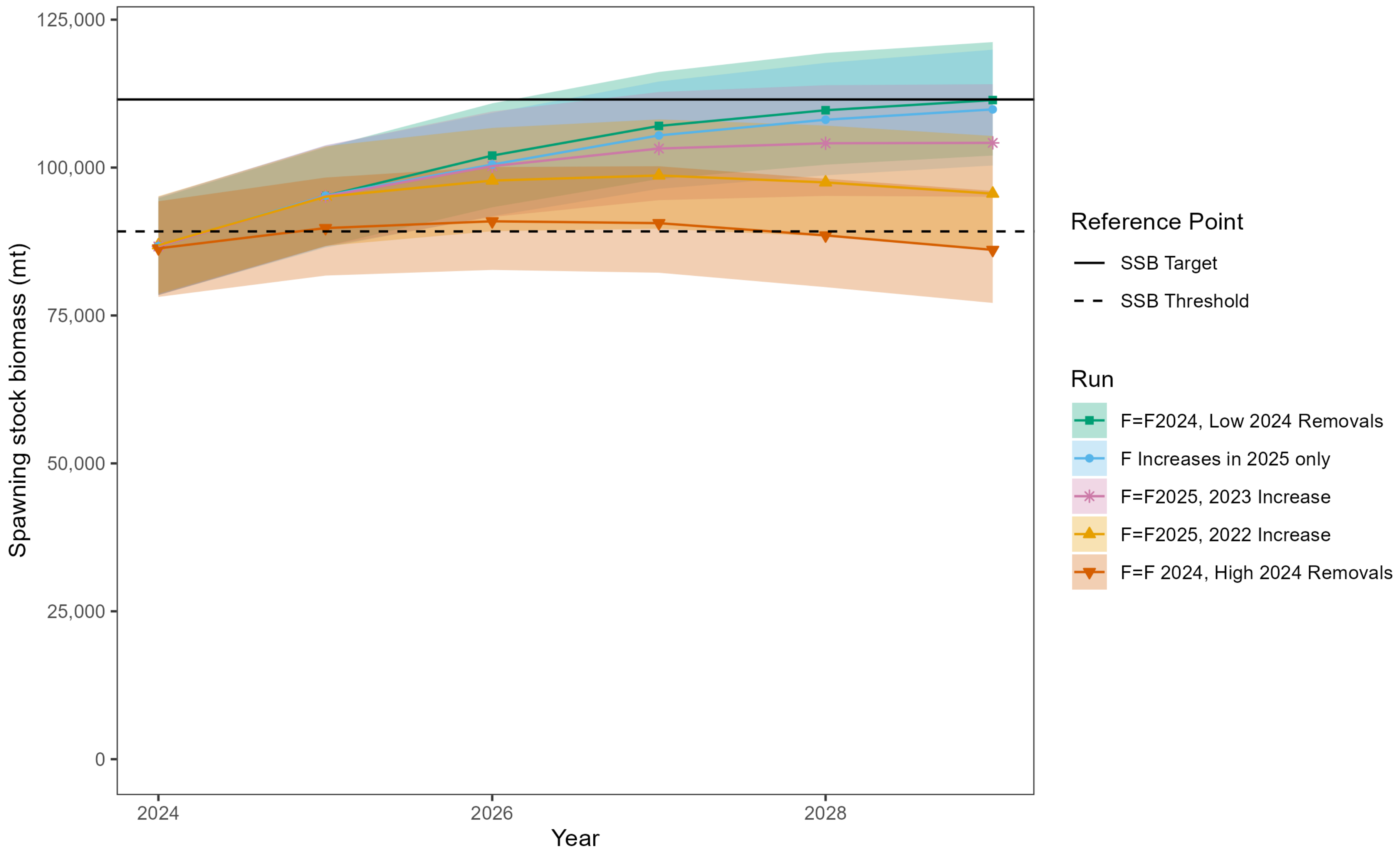

Figure 4. Projections of female spawning stock biomass through 2029 under different future *F* scenarios: assuming *F* stays the same as in 2024 under the low removals scenario (*F=F* 2024), increases in 2025 only and then returns to 2024 levels, increases at a rate comparable to what was observed in 2022 (*F=F* 2025, 2022 Increase) or 2023 (*F=F*2025, 2023 Increase), or assuming *F* stays the same as in 2024 under the high removals scenario (*F=F* 2024, High Removals).