Potential Effects of Eliminating the ASMFC Summer Survey on the Northern Shrimp Stock Assessment

April 2022

Introduction

Funding for the ASMFC-NOAA Summer "Shrimp" Survey is in jeopardy, and it is likely that the survey will be eliminated in the next few years. The Summer Survey is the longest time series with the best information on the Gulf of Maine northern shrimp population, but there are other surveys that provide information on northern shrimp, the NEFSC Fall Bottom Trawl Survey and the ME-NH Spring Inshore Trawl Survey, that can support the model in the future. The NEFSC Fall Trawl Survey is currently included in the model, but the data are generally not available for the terminal year of the assessment, as the assessment is run while the survey is taking place. The ME-NH Inshore Survey is not currently included in the assessment, but the spring data would be available for the terminal year of the assessment. All three surveys have shown similar trends over the years, with the exception of a period between 2007-2010 where the Summer Survey and the NEFSC Bottom Trawl Survey were declining and the ME-NH Inshore Trawl Survey was increasing (Figure 1). The ME-NH Trawl Survey peaked in 2010, while the other two surveys peaked in 2006, but after 2010, the ME-NH Trawl Survey declined precipitously and joined the other surveys at time-series lows from 2013-2021.

Note that this report does not address species other than northern shrimp, although several other species assessments use Summer Survey data.

Methods

To look at potential effects of losing information from the Summer Survey in the near term, the Northern Shrimp Technical Committee (NSTC) compared the results from the current northern shrimp stock assessment model that used different configurations of input data that included truncating the Summer Survey from 2018-2021. The scenarios explored were:

1. Base case: all years of Summer Survey (1984-2021) and NEFSC Fall Bottom Trawl (1986-2019)
2. Base case + ME-NH: all years of Summer Survey (1984-2021) and NEFSC Fall Bottom Trawl (1986-2019), plus all years of the ME-NH Spring Inshore Trawl Survey (2003-2021)
3. Shorter Summer Survey: Remove 2018-2021 from the Summer Survey time series, include all years of the NEFSC Fall Bottom Trawl
4. Shorter Summer Survey + ME-NH: Remove 2018-2021 from the Summer Survey time series, include all years of the NEFSC Fall Bottom Trawl and all years of the ME-NH Spring Inshore Trawl Survey
5. No Summer Survey at all + ME-NH: Drop the Summer Survey time series entirely and fit the model with only the NEFSC Fall Bottom Trawl and the ME-NH Spring Inshore Trawl Survey

In addition, the NSTC was interested in looking at the potential impacts of survey changes during a time period of conflicting information in the indices, so a series of runs with a terminal year of 2011 was also conducted. Those scenarios included:

6. Base case, end in 2011: Summer Survey (1984-2011) and NEFSC Fall Bottom Trawl Survey (1986-2010)
7. Base case + ME-NH, end in 2011: Summer Survey (1984-2011), NEFSC Bottom Trawl Survey (1986-2010), and ME-NH Spring Inshore Trawl Survey (2003-2011)
8. Shorter Summer Survey + ME-NH, end in 2011: Remove 2009-2011 from the Summer Survey time series, include all years of the ME-NH Spring and NEFSC Fall surveys

In addition to comparing the model estimates of spawning stock biomass, *F*, and recruitment from the different scenarios, a set of short term projections were run using Scenario 4 (shortened Summer Survey with the ME-NH Spring and NEFSC Fall surveys, terminal year 2021).

Results

Terminal Year 2021 Runs

Overall, losing a few years of the Summer Survey data did not significantly impact the results of the stock assessment. However, without the Summer Survey, the model was more optimistic about the stock trajectory in recent years. The scenario that dropped the Summer Survey entirely was the most optimistic, both historically and in recent years. Without the Summer Survey, population trends were generally similar, but the model estimated a slightly higher SSB and recruitment and lower *F* at the beginning of the time series (although not in all years), and SSB did not decline as significantly as the base model run from 2012-2021 (Figure 2-4). The shortened Summer Survey without the addition of the ME-NH Spring Survey was the most optimistic of the runs that did include the Summer Survey, showing higher recruitment (Figure 2) and a more rapidly increasing trend in SSB (Figure3) from 2018-2021 compared to the base model. Adding the ME-NH Spring Inshore Trawl Survey to the run with the shortened Summer Survey brought those estimates of recruitment and SSB more in line with the estimates of the base run with the full Summer Survey. The 2020 estimate of recruitment for that scenario was still very high compared to the base run and the 2019 and 2021 estimates; however, none of the surveys were conducted in 2020, and that was the second to last year of the time series, so there was very little information to help inform that data point. Estimates of average *F* were very similar across the runs as well (Figure 4).

Terminal Year 2011 Runs

The model struggled to converge somewhat with the terminal year of 2011, but the configurations that did converge showed very similar results across all scenarios, in comparison to the base case with the terminal year of 2011 (Figures 5-7). The base case with the terminal year of 2021 had lower *F* and higher SSB during this time period, the effect of adding more years of data to the model. Although the trend in the ME-NH Spring Inshore Trawl Survey differed from the trend in the other surveys, the additional information from the catch-at-length supported the trend in the other surveys and the model was not strongly influenced by the ME-NH Spring Inshore Trawl Survey trend.

Projections

The scenario with the shortened Summer Survey time series and the ME-NH Spring Inshore Trawl Survey included were more optimistic in the first two years of the projections than the base run (Figures 8-9). This was most likely due to the higher estimates of SSB and recruitment in the most recent few years, especially the high 2020 recruitment value. However, under the recent M and recent recruitment conditions, SSB declined after that and even under zero fishing mortality, the probability of SSB being above SSB in 2021 was very low.

Discussion

While removing the last few years of data from the Summer Survey did not significantly change our perception of stock status in recent years – the stock was still depleted compared to the historical abundance, and SSB in 2021 was still below the 20th percentile of 1984-2017 (Figure 10) – the models were all more optimistic about SSB and recruitment for those years without the Summer Survey data. Including the ME-NH Spring Inshore Trawl Survey with the shortened Summer Survey produced results that were more similar to the base run than to the run with only the shortened Summer Survey and the NEFSC Fall Bottom Trawl Survey. Similarly, projections indicated that under current M and recruitment conditions, even very low or zero fishing pressure will cause the stock to decline in a few years.

The runs with the terminal year of 2011 had more difficulty converging, which may have been due to the difference in trends between the ME-NH Spring Inshore Trawl Survey and the NEFSC Fall Bottom Trawl Survey during this time or may have been due to the pattern in the other indices, which showed a sharp increase followed by a sharp decrease over approximately a single shrimp generation. Adding the 2011 data from the NEFSC Fall Survey was required to get these runs to converge; in a real assessment, those data would not have been available during the usual assessment timeline. This suggests that conflicting data in future years may cause problems with convergence or may require a delay in the assessment timeline to incorporate the NEFSC Fall Bottom Trawl Survey data, but the degree to which that affects the results will depend on how significant the divergence is between the data sources.

The NEFSC Fall Bottom Trawl Survey and the ME-NH Spring Inshore Trawl Survey can still inform the stock assessment model in the absence of the Summer Survey in the near term. However, results should be interpreted cautiously, as they were more optimistic than the results of the model with the Summer Survey. A full simulation study would be necessary to evaluate the degree of this bias and long term consequences of the loss of the Summer Survey.

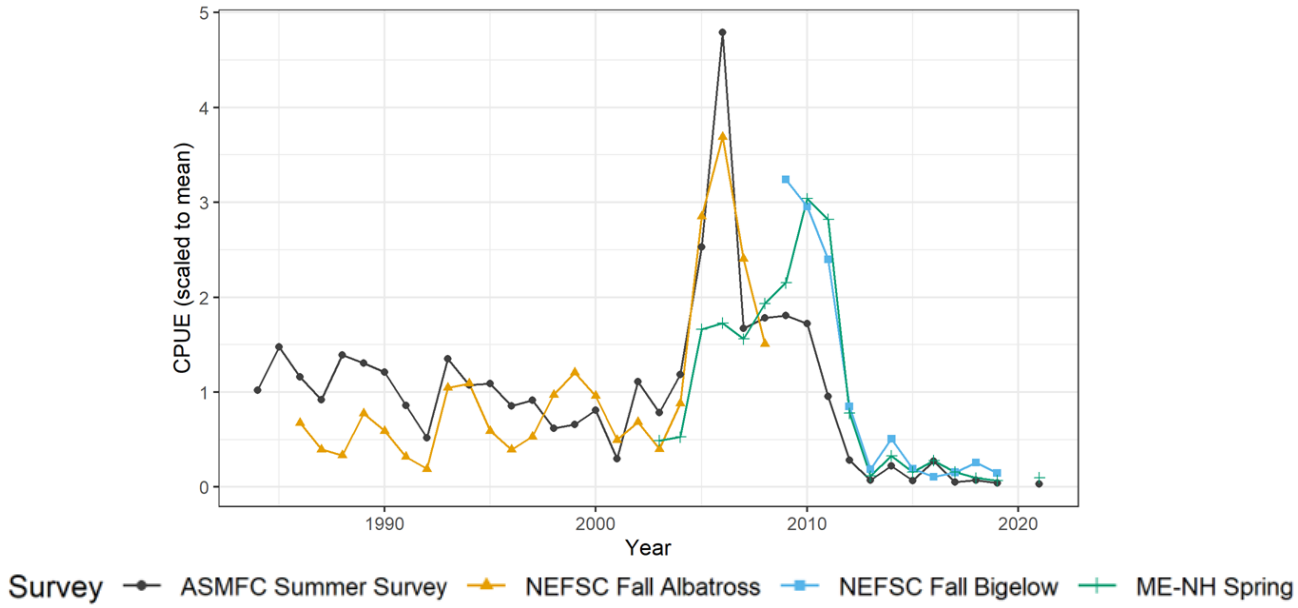

Figure 1. Standardized survey indices of abundance for Gulf of Maine northern shrimp for 1984-2021.

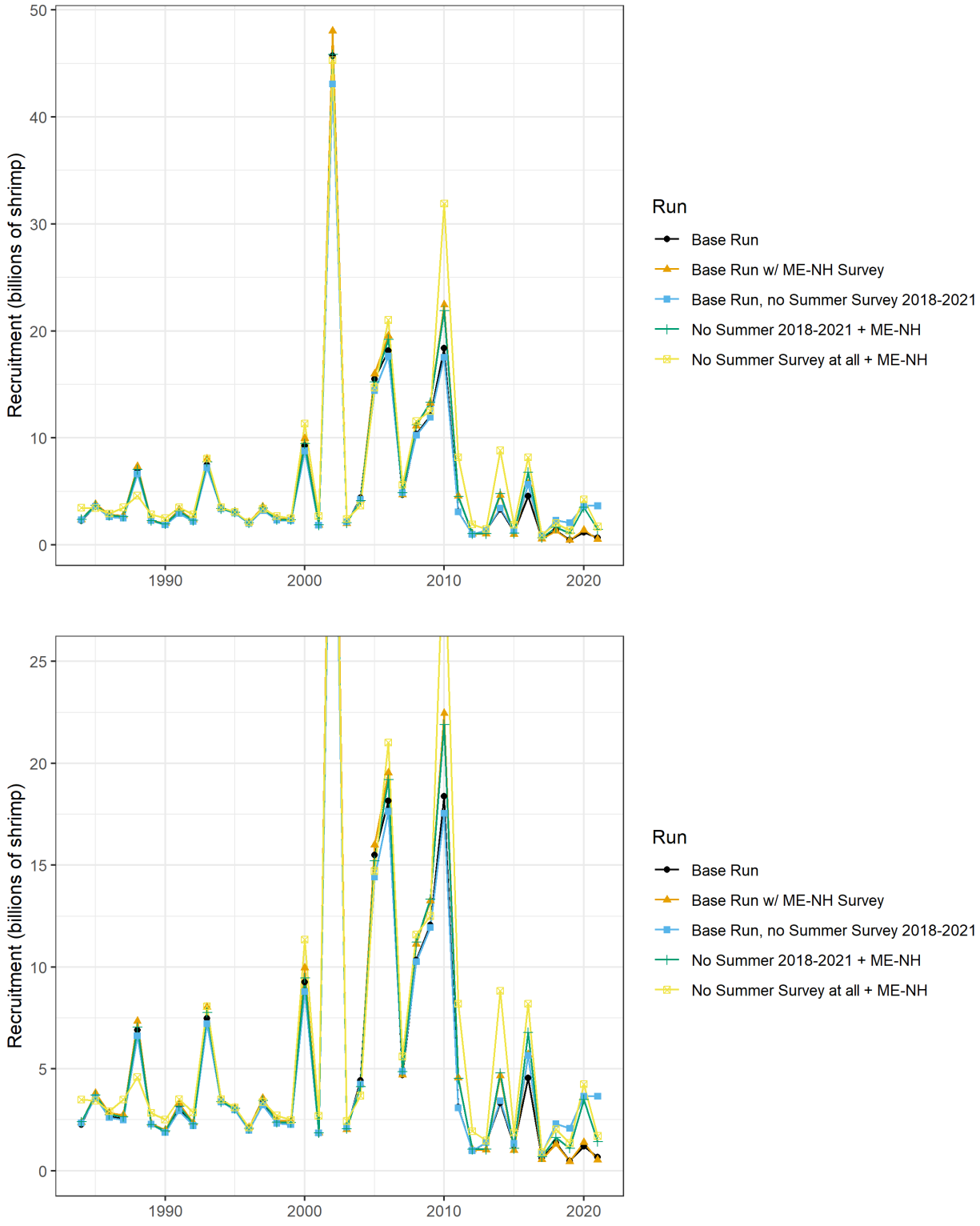

Figure 2. Recruitment estimates under different survey scenarios for the model with a terminal year of 2021. Y-axis has been truncated to show detail in lower figure.

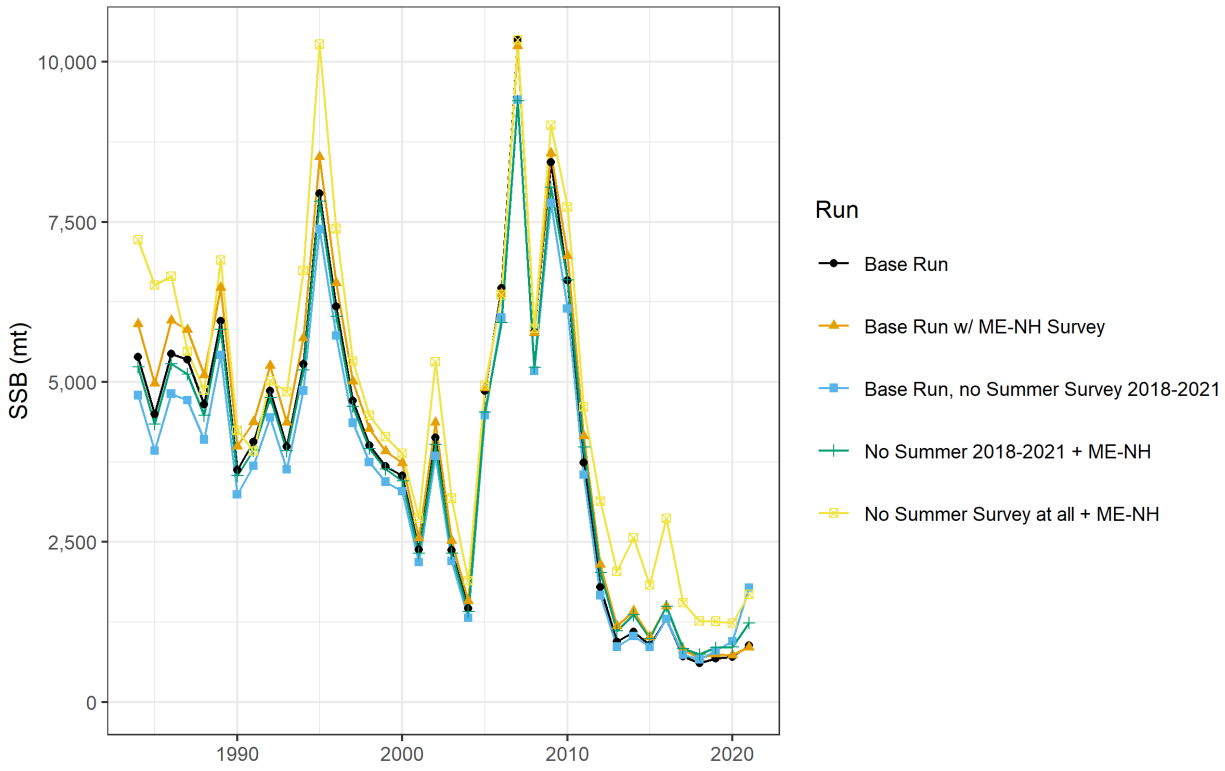

Figure 3. SSB estimates under different survey scenarios for the model with a terminal year of 2021.

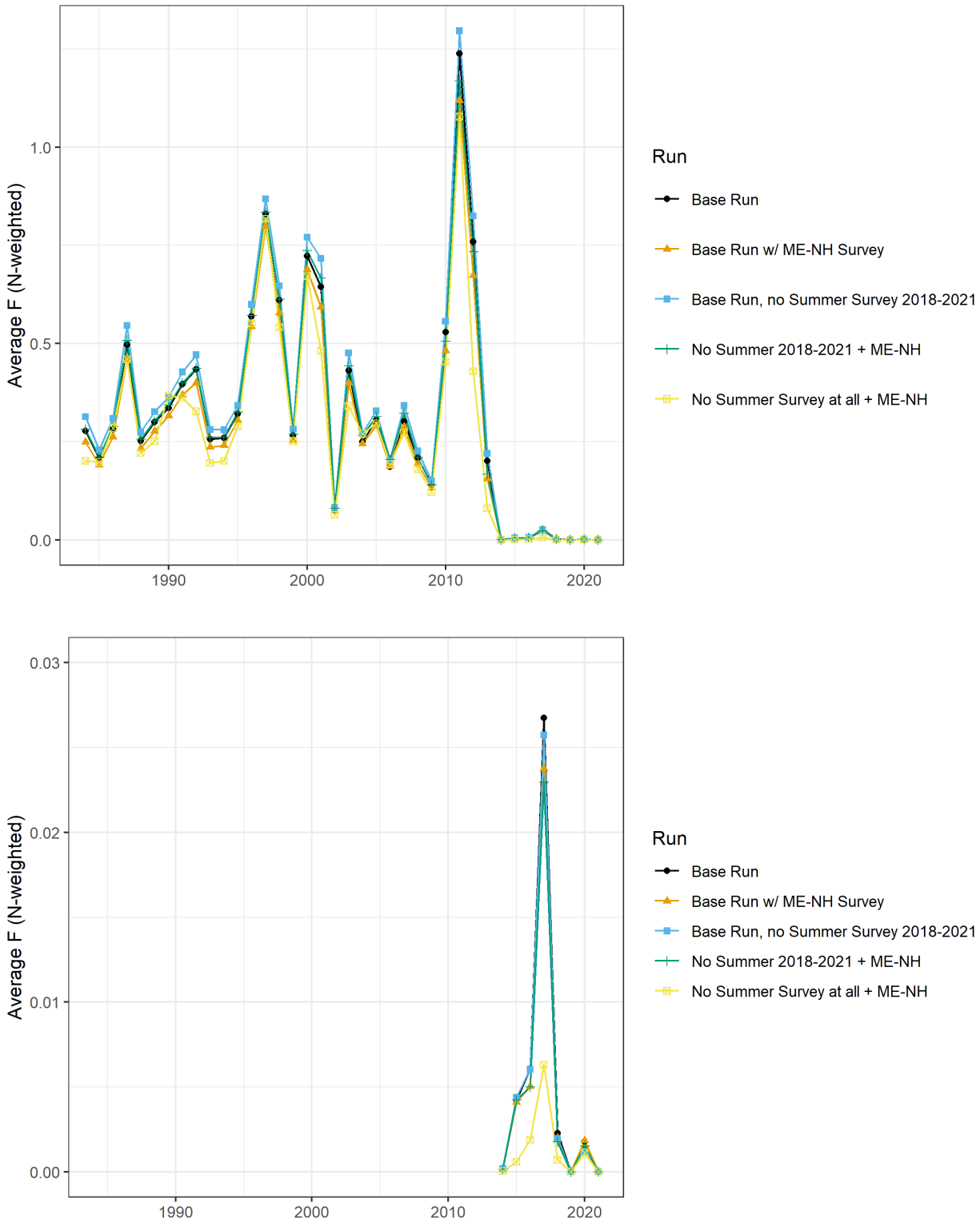

Figure 4. Average *F* estimates under different survey scenarios for the model with a terminal year of 2021. Y-axis has been truncated to show detail in lower figure.

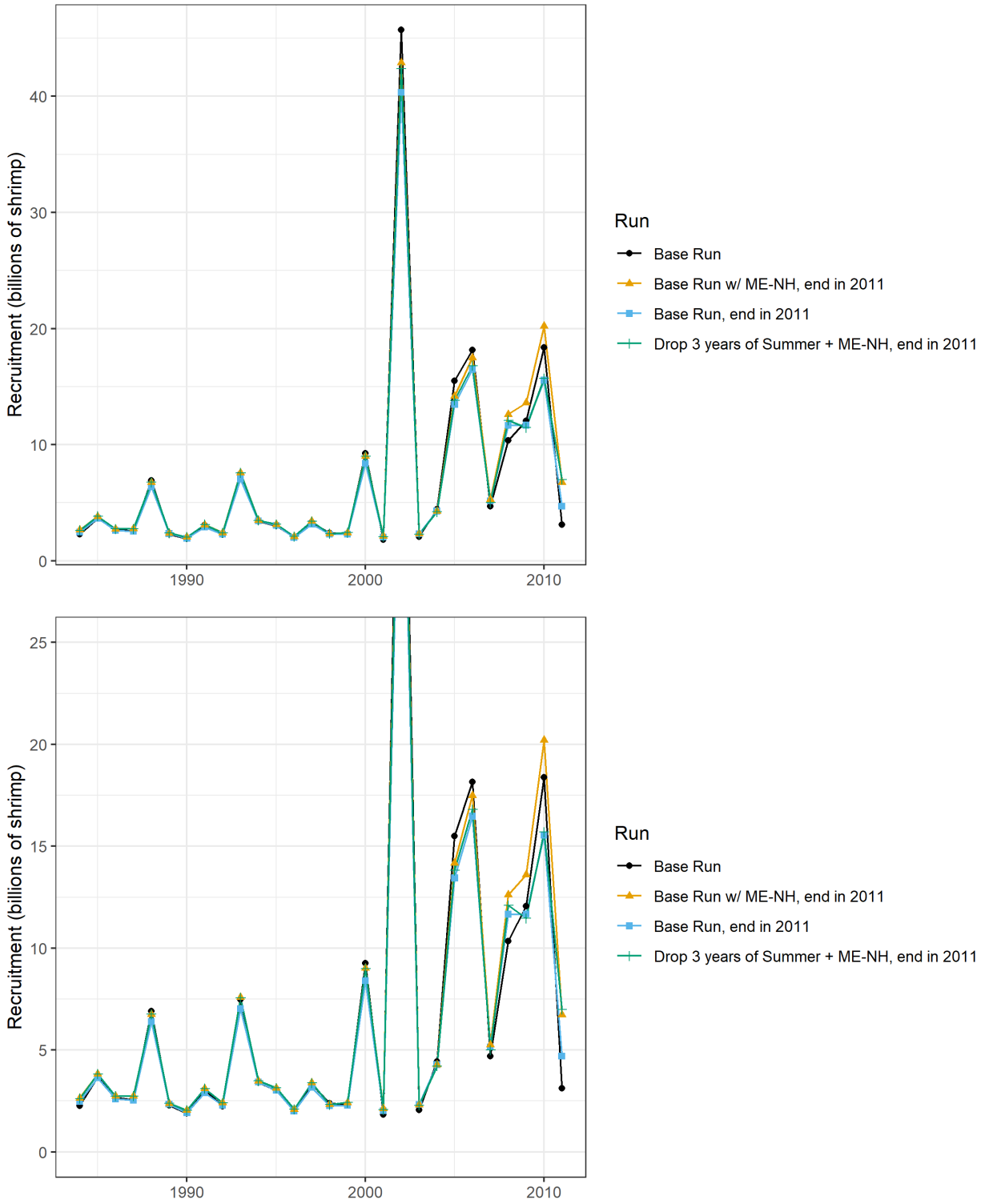

Figure 5. Recruitment estimates under different survey scenarios for the model with a terminal year of 2011. Y-axis has been truncated to show detail in lower figure.

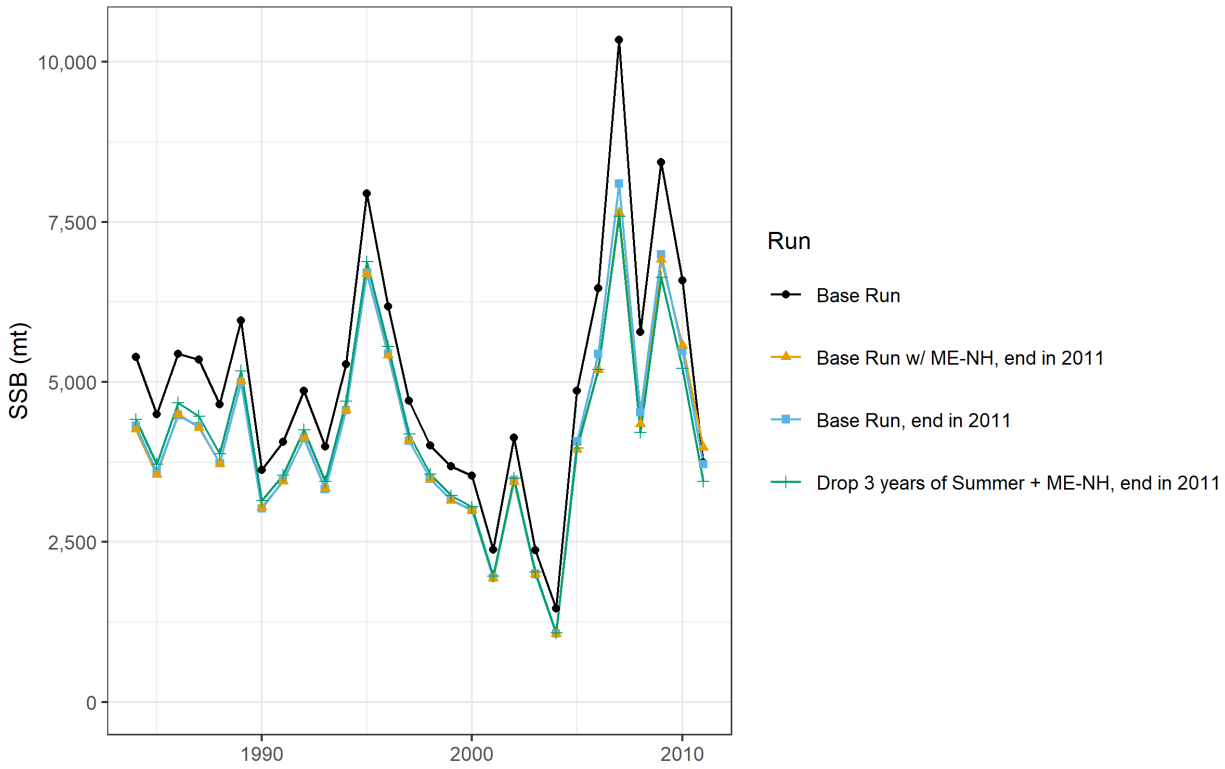

Figure 6. SSB estimates under different survey scenarios for the model with a terminal year of 2011.

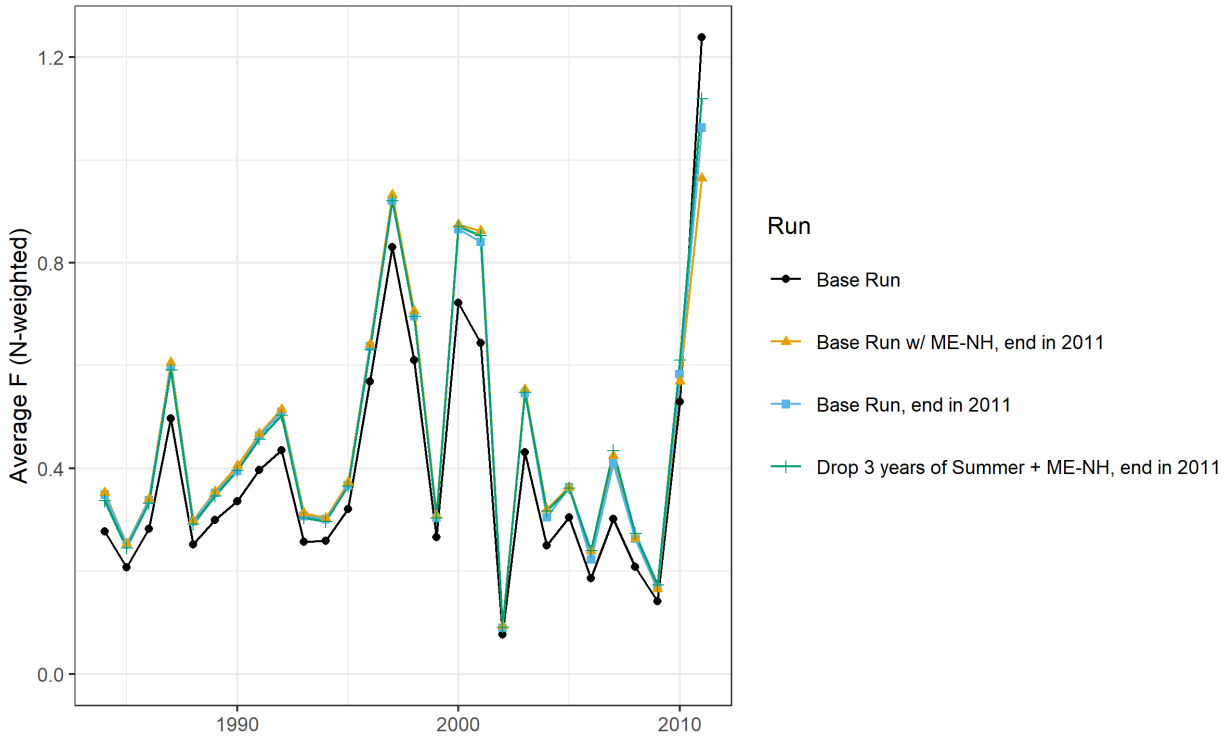

Figure 7. Average *F* estimates under different survey scenarios for the model with a terminal year of 2011.

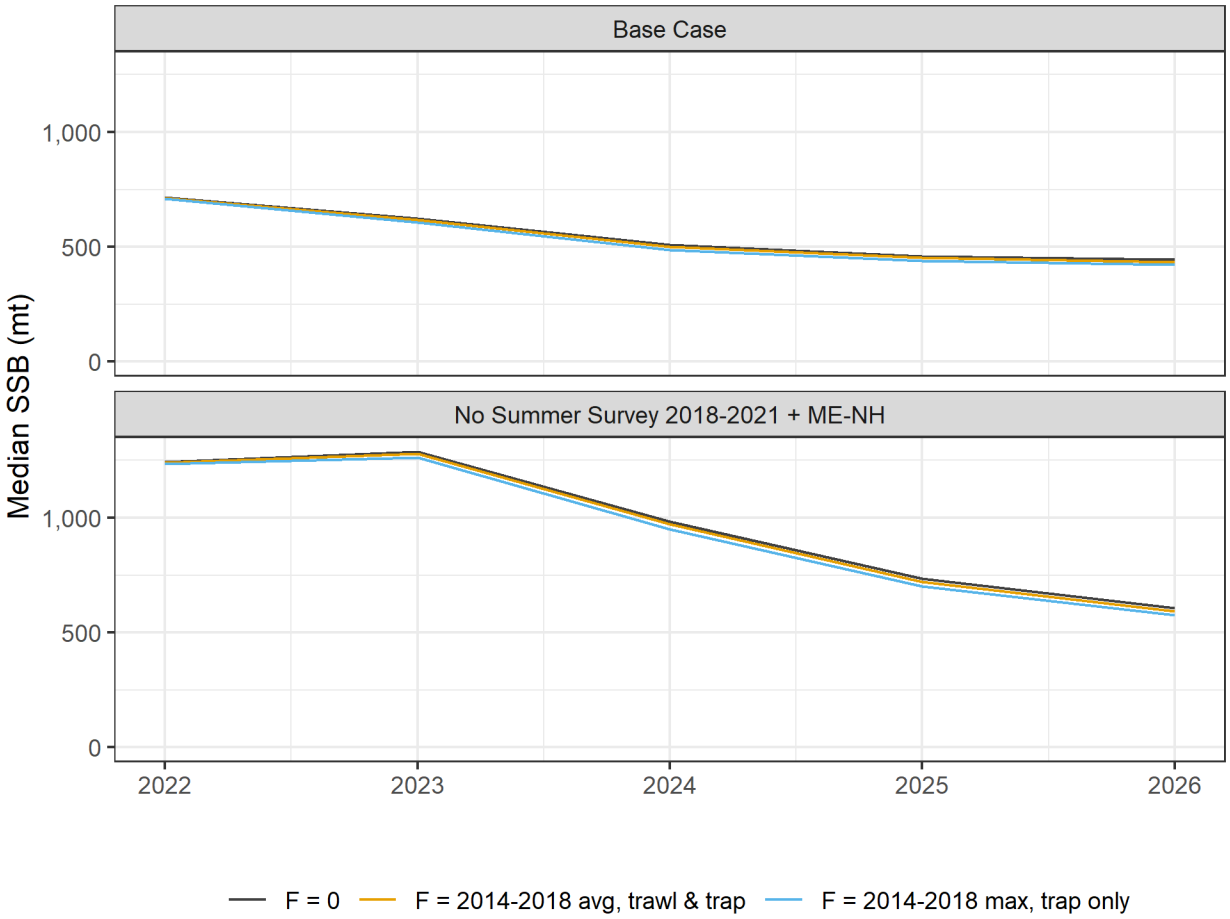

Figure 8. Median projected SSB under recent M and recruitment conditions and varying *F* rates for the base model run (top) and the run with the shortened Summer Survey and the ME-NH Spring and NEFSC Fall surveys (bottom).

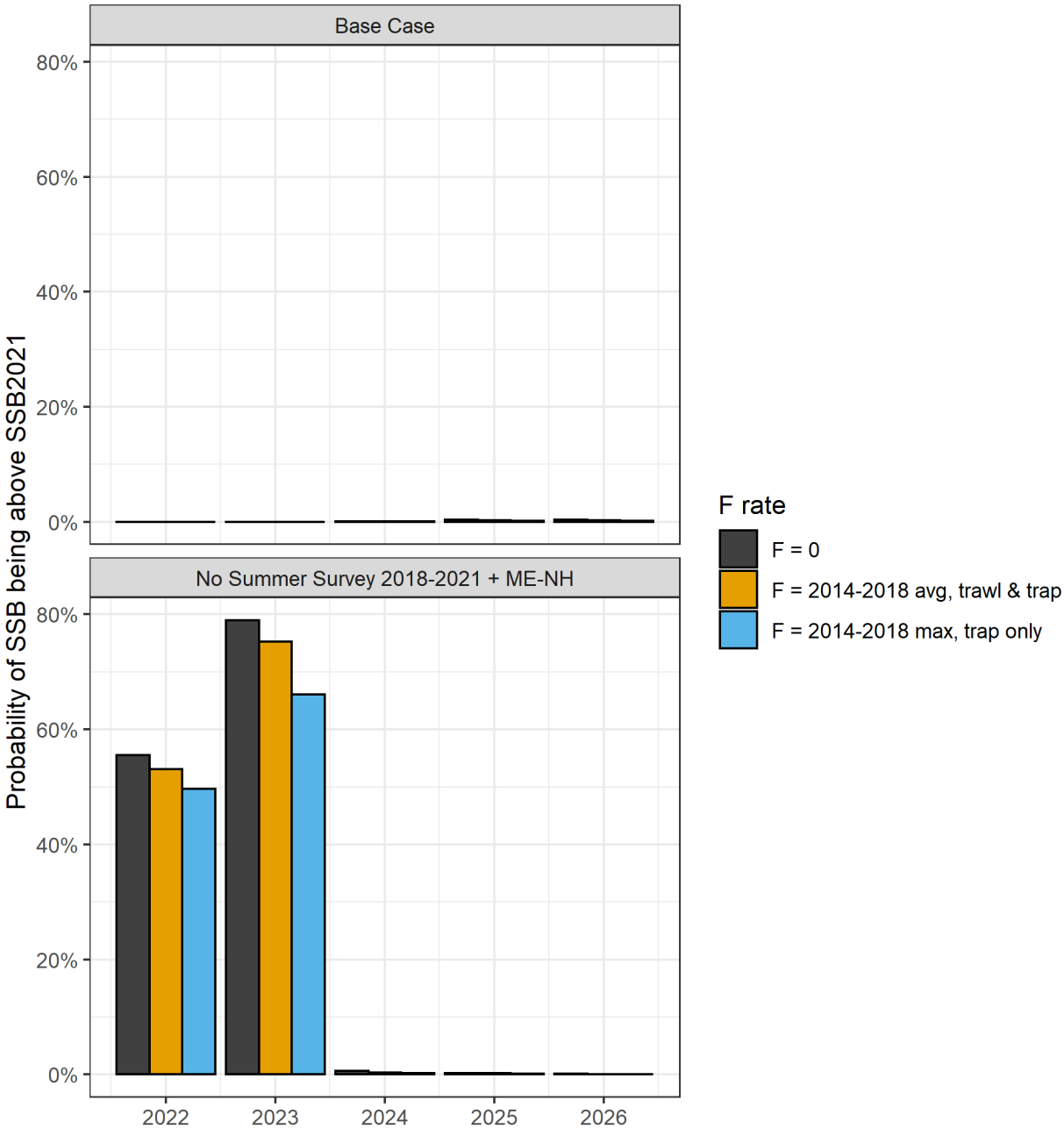

Figure 9. Probability of SSB being above SSB_{2021} under recent M and recruitment conditions and varying *F* rates for the base model run (top) and the run with the shortened Summer Survey and the ME-NH Spring and NEFSC Fall surveys (bottom).

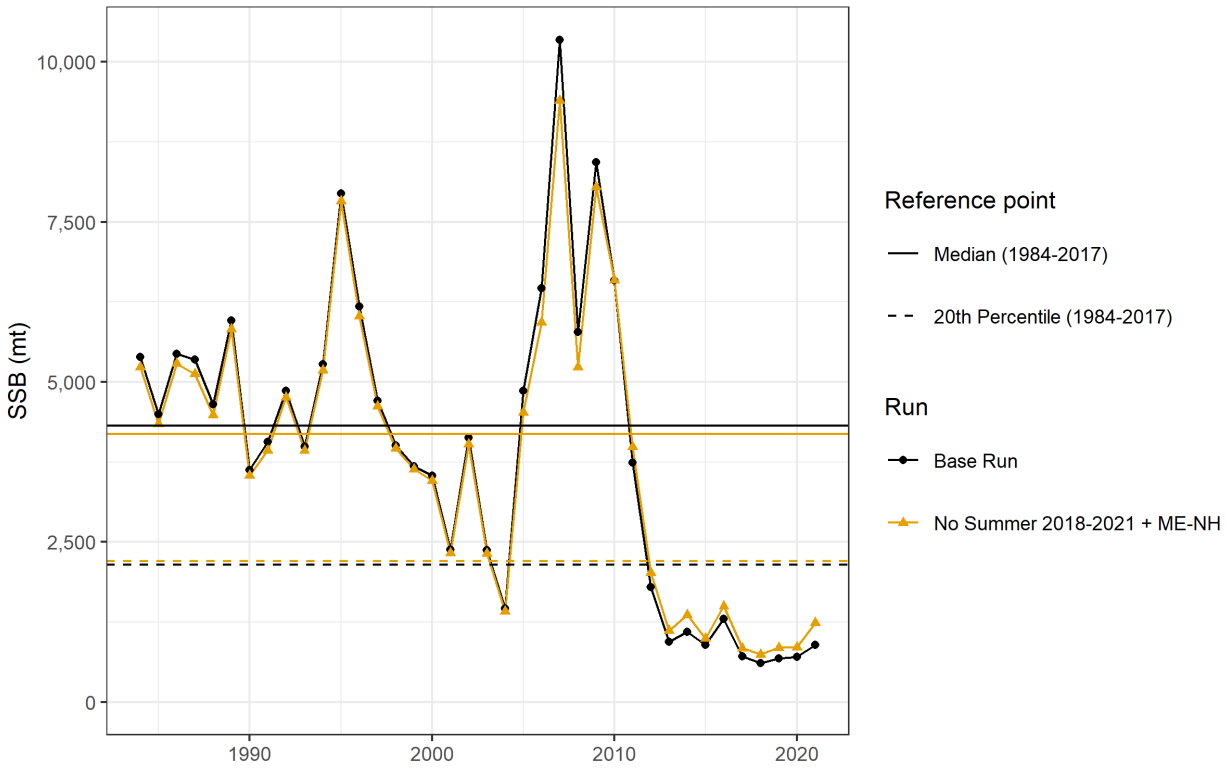

Figure 10. SSB from the base run and the run with the shortened Summer Survey and the ME-NH and NEFSC surveys plotted with the median and 20th percentile of SSB from 1984-2017 for each model.