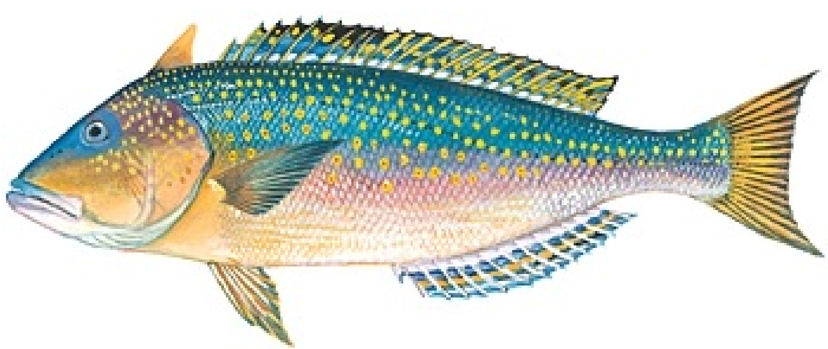
# Stock Assessment of Golden Tilefish off the Southeastern United States

## Revision of the 2016 SEDAR25–Update Assessment



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## Contents

## List of Tables

## List of Figures

# 1 Executive Summary

This assessment provides a revision to the 2016 SEDAR25-Update assessment of golden tilefish (*Lopholatilus chamaelonticeps*) off the southeastern United States. The primary objectives were to replace the robust multinomial likelihood with the Dirichlet-multinomial for fitting composition data, and to conduct new stock projections, as requested by the South Atlantic Fishery Management Council. Otherwise, data and modeling methods were identical to those in the SEDAR25-Update.

The assessment period was 1962–2014. Available data on this stock include indices of abundance, landings, and samples of annual length and age compositions from fishery dependent and independent sources. Two indices of abundance were fitted by the model: one from the commercial longline fleet, and one from a fishery independent survey. Data on landings were available from commercial and recreational fleets.

Analyses were conducted using the Beaufort Assessment Model (BAM), a statistical catch-age formulation. A base run of BAM was configured to provide estimates of key management quantities, such as stock and fishery status. Uncertainty in estimates from the base run was evaluated through a mixed Monte Carlo/Bootstrap (MCB) procedure. Median values from the uncertainty analysis were also provided. Stock status was evaluated by measuring the 2014 spawning biomass against the minimum stock size threshold ($\mathrm{MSST}$). The current definition of $\mathrm{MSST}$ is $\mathrm{MSST} = 75\%\mathrm{SSB}_{\mathrm{MSY}}$.

Spawning stock declined in the 1980s, remained low but stable from the mid-1990s to the mid-2000s, then increased over the last decade, rising above $\mathrm{MSST}$ since 2009. The terminal (2014) base-run estimate of spawning stock biomass was above $\mathrm{MSST}$ in the base run ($\mathrm{SSB}_{2014}/\mathrm{MSST}$ =1.09), but not in the median of MCBs ($\mathrm{SSB}_{2014}/\mathrm{MSST}$ =0.86). In both the base run and median of MCBs, spawning stock biomass was below $\mathrm{SSB}_{\mathrm{MSY}}$ (base:$\mathrm{SSB}_{2014}/\mathrm{SSB}_{\mathrm{MSY}}$ =0.81; median: $\mathrm{SSB}_{2014}/\mathrm{SSB}_{\mathrm{MSY}}$ =0.65). About 59% of MCB runs found that the stock is overfished ($\mathrm{SSB}_{2014}/\mathrm{MSST} < 1.0$).

Estimated fishing mortality rates began increasing in the early 1980s, peaked in the early 1990s, displayed another smaller peak around 2000, then declined steadily until 2012 when rates began to increase again. The base-run estimate of fishing mortality ($F$), represented by the geometric mean of the last three years (2012-2014), exceeded the $\mathrm{MFMT}$ ($F_{2012-2014}/F_{\mathrm{MSY}} = 1.35$) as did the median of the MCB estimates ($F_{2012-2014}/F_{\mathrm{MSY}} = 2.49$). About 79% of MCB runs found that overfishing is occurring ($F_{2012-2014}/F_{\mathrm{MSY}} > 1.0$).

Thus, this assessment finds that the stock is experiencing overfishing, and may also be overfished.

The estimated trends of this assessment are similar to those from the SEDAR25-Update. However, that assessment concluded that the stock is not overfished, with 53% of MCB runs in support of that conclusion. Here, that conclusion is reversed, but with a similar level of uncertainty; the overfished status was supported by 59% of MCB runs, and not by the base run. In both assessments, the status of overfishing was more certain, supported by 66% of MCB runs in the SEDAR25-Update and 79% in this assessment.

In this assessment, the Dirichlet-multinomial likelihood was not straightforward to implement. A simple replacement of the robust multinomial likelihood resulted in a model that did not converge, and additional steps were required to obtain a working model. This may be due to small sample sizes of composition data. Whatever the reason, we urge caution before adopting results of this assessment for use in management, and recommend that more research is needed to better understand the limitations of using the Dirichlet-multinomial likelihood in stock assessments.

## 2 Overview

In 2016, the SEDAR25 benchmark assessment was updated (SEDAR25 2011; SEDAR25-Update 2016). The update assessment applied the Beaufort Assessment Model (BAM, Williams and Shertzer 2015), as did the benchmark assessment. Within the BAM framework, the SEDAR25-Update assessment used the robust multinomial likelihood to fit age and length composition data. In a memorandum dated June 22, 2017 from Gregg Waugh to Dr. Bonnie Ponwith, the South Atlantic Fishery Management Council requested that the SEDAR25-Update assessment be revised using the Dirichlet-multinomial likelihood instead of the robust multinomial. In addition, the memorandum requested new stock projections. This current report fulfills those requests.

### 2.1 Data Review

In this assessment, the BAM was fitted to the same data as in SEDAR25-Update (SEDAR25-Update 2016), without modification. The assessment period spanned 1962–2014, and data sources were the following:

- Landings: commercial handline, commercial longline, and general recreational
- Indices of abundance: commercial longline CPUE and MARMAP longline survey
- Length compositions: commercial handline landings, commercial longline landings, and general recreational landings
- Age compositions: commercial handline landings, commercial longline landings, and MARMAP longline survey.

### 2.2 Model Revision

The BAM configuration was identical to that described in SEDAR25-Update (2016), with the exception that the Dirichlet-multinomial likelihood was used to fit composition data. The SEDAR25-Update applied a robust version of the multinomial likelihood, as recommended by Francis (2011). More recent work has questioned the use of the multinomial distribution in stock assessment models (Francis 2014), and has recommended the Dirichlet-multinomial as an alternative (Francis 2017; Thorson et al. 2017). A chief advantage of the Dirichlet-multinomial is that it is self-weighting through estimation of an additional variance inflation parameter for each composition component, making iterative re-weighting (e.g., Francis 2011) unnecessary. In addition, it can better account for intra-haul correlations (i.e., fish caught in the same set are more alike in length or age than fish caught in a different set). A possible disadvantage is that the Dirichlet-multinomial is relatively new to stock assessment, and as such, its performance is not yet well tested. The addition of a variance inflation parameter for each composition component raises potential issues about parsimony and identifiability. Nonetheless, the Dirichlet-multinomial has recently been implemented in Stock Synthesis (Methot and Wetzel 2013; Thorson et al. 2017) and in the BAM, and was used successfully in a recent assessment of South Atlantic red grouper (SEDAR53 2017).

### 2.3 Projection Scenarios

As requested, projections were run through the year 2024, based on $P^{\star}$ values of 30%, 40%, and 45%, or at $F = 75\% F_{\mathrm{MSY}}$. These values were assumed to take effect in 2019, and because the terminal year of the assessment was 2014, this left a four-year interim period. In 2015 and 2016, $F = F_{\mathrm{current}}$, with $F_{\mathrm{current}}$ as estimated from the assessment. In 2017, it was assumed that an ACL of 558,036 lb gutted weighted would be met. In 2018, the projections assumed that either the 2017 ACL would remain in place or would be reduced to 323,000 lb gutted weight.

Thus, this report contains a total of eight projections scenarios:

- Scenario 1: $P^{\star} = 0.30$ with status quo 2018 ACL
- Scenario 2: $P^{\star} = 0.30$ with reduced 2018 ACL
- Scenario 3: $P^{\star} = 0.40$ with status quo 2018 ACL
- Scenario 4: $P^{\star} = 0.40$ with reduced 2018 ACL
- Scenario 5: $P^{\star} = 0.45$ with status quo 2018 ACL
- Scenario 6: $P^{\star} = 0.45$ with reduced 2018 ACL
- Scenario 7: $F = 75\% F_{\mathrm{MSY}}$ with status quo 2018 ACL
- Scenario 8: $F = 75\% F_{\mathrm{MSY}}$ with reduced 2018 ACL

## 3 Model Development

Revising the assessment model required more development than simply replacing the robust multinomial with the Dirichlet-multinomial (DM); we report here on ten different exploratory model configurations (Table 1). In addition to general fits to data, each of the models was evaluated based on whether it converged and whether it maintained fidelity to the primary index of abundance (commercial longline). Convergence was assessed by whether the model achieved a positive definite Hessian matrix and a maximum gradient that did not exceed the specified tolerance ($\tau = 0.0001$). Index fidelity was assessed by the overall fit to the commercial longline index, as measured by mean squared error. Ideally, the fit to this index should be at least as good as in the 2016 SEDAR25-Update.

The exploratory model configurations were the following:

- Model 1: Simple replacement of robust multinomial likelihood with the DM. Weights on indices equaled 1.0.
- Model 2: Simple replacement of robust multinomial likelihood with the DM. Weights on indices set equal to those from the SEDAR25-Update (commercial longline=3.0 and MARMAP=1.4). In all subsequent models, these weights were applied, unless otherwise indicated in the model description.
- Model 3: Normal priors on the DM variance inflation parameters were put into effect. These priors had means determined by likelihood profiling and $CV = 0.2$. These priors were used in all subsequent models, except Model 7.
- Model 4: Commercial longline index weight increased twofold.
- Model 5: Commercial longline index weight increased fourfold.
- Model 6: Commercial longline index weight increased sixfold.
- Model 7: DM variance inflation parameters fixed at values to mimic the average effective sample size ($N_{\mathrm{eff}}$) of each composition component applied in the SEDAR25-Update.
- Model 8: Composition likelihoods scaled by the SEDAR25-Update weights.
- Model 9: Composition likelihoods scaled by one tenth of the SEDAR25-Update weights.
- Model 10: Composition likelihoods all scaled by 0.01.

For Model 7, the DM parameters ($\theta$) were fixed using the equation for effective sample size (Thorson et al. 2017), rearranged such that $\theta = (N_{\mathrm{eff}} - 1)/(N - N_{\mathrm{eff}})$, where $N$ represents the average sample size of a composition component and $N_{\mathrm{eff}}$ equals $N$ times the component weight from SEDAR25-Update. The intent of Model 8 was to maintain the overall scale of composition likelihoods from SEDAR25-Update, and to impose partial relative weights that matched the SEDAR25-Update weighting scheme (*partial* because the DM parameters were additionally estimated). Model 9 was similar to Model 8, but with reduced scaling. The intent of Model 10 was to allow relative weights to be determined by the DM parameters alone, but with reduced overall scaling of the composition components.

For Models 1 and 2, most DM variance inflation parameters were not identifiable (flat response in the likelihood surface), which was the rationale for priors in subsequent models. Models 1–8 did not converge properly and, with the exception of Models 5 and 6, their fits to the commercial longline index were degraded (Table 1). Problems with convergence in Models 1–8 appeared to be related primarily to component scaling issues. Thus, those models were not considered further, and the remaining focus is on Models 9 and 10. Because Model 10 relies solely on the DM likelihood, without dependence on the SEDAR25-Update iterative re-weighting of the robust multinomial, it seems more in line with the Council's request for this exercise, and thus Model 10 is used here as the base configuration. Results of Model 9 are presented as a sensitivity run.

# 4 Stock Assessment Results — Model 10

## 4.1 Measures of Overall Model Fit

In general, the Beaufort Assessment Model (BAM) fit well to the available data. Predicted length compositions from each fishery were reasonably close to observed data in most years, as were predicted age compositions (Figure 1). The model was configured to fit observed commercial and recreational landings closely (Figures 2–4). Fits to indices of abundance generally captured the observed trends but not all annual fluctuations (Figures 5–6).

## 4.2 Parameter Estimates

Estimates of all parameters from the BAM are shown in Appendix A. Estimates of management quantities and some key parameters, such as those of the spawner-recruit model, are reported in sections below.

## 4.3 Stock Abundance and Recruitment

Estimated abundance declined starting in the 1970s, exhibited a smaller peak in the 1980s, then continued the decline until the mid-1990s, with moderate increase since (Figure 7). Older ages appear to have been significantly truncated by the late 1980s (Table 2). Moderate expansion of population age structure began again in the mid-2000s; however fish ages 17+ are still relatively rare in the population.

Annual estimated number of recruits is shown in Table 2 (age-1 column) and in Figure 8.

## 4.4 Total and Spawning Biomass

Estimated biomass at age followed a similar pattern as abundance at age (Figure 9; Table 3). Total biomass and spawning biomass showed similar trends—general decline until 1990, general increase since the early 2000s, and relatively stable since about 2010 (Figure 10; Table 4).

### 4.5 Selectivity

Selectivity estimates of the commercial handline landings and MARMAP survey were similar, and those of the commercial longlines and recreational were somewhat similar (Figures 11 – 12). Fish were estimated to be near fully selected by age 6 for the commercial handline fleet and MARMAP survey, and by age 8 for the commercial longline and recreational fleets.

Average selectivities of landings were computed from $F$-weighted selectivities in the most recent period (Figure 13). These average selectivities were used to compute benchmarks and central-tendency projections. All selectivities, including average selectivity, are tabulated in Table 5.

### 4.6 Fishing Mortality and Landings

Estimated fishing mortality rates ($F$) began increasing in the early 1980s, peaked in the mid-1990s, displayed another smaller peak around 2000, then declined steadily until 2012 when rates began to increase again (Figure 14, Table 6). The commercial longline fleet dominates total $F$ (Table 7). In any given year, the maximum $F$ at age (i.e., apical $F$) may be less than that year's sum of fully selected $F$s across fleets. This inequality is due to full selection occurring at different ages among gears in the estimated selectivities.

Table 8 shows total predicted landings in weight and Table 9 shows total predicted landings in numbers by fleet. Estimated landings at age in weight and numbers are provided in Tables 10 and 11. Harvest has increased in both commercial fleets since the SEDAR25 assessment. During the same time period, recreational harvest increased for two years and then declined. In general, the majority of estimated landings were from the commercial longline fleet (Figures 15, 16; Table 8).

### 4.7 Spawner-Recruitment Parameters

The estimated Beverton–Holt spawner-recruit curve is shown in Figure 17, along with the effect of density dependence on recruitment, depicted graphically by recruits per spawner as a function of spawners. Values of recruitment-related parameters were as follows: assumed steepness $h = 0.84$, unfished age-1 recruitment $\widehat{R_0} = 355,007$, unfished spawning biomass per recruit $\phi_0 = 0.00028$, and standard deviation of recruitment residuals in log space $\sigma = 0.25$ (which resulted in bias correction $\varsigma = 1.03$). The empirical standard deviation of recruitment residuals in log space was $\widehat{\sigma} = 0.24$. Uncertainty in these quantities was estimated through the Monte Carlo/bootstrap (MCB) analysis (Figure 18).

### 4.8 Per Recruit and Equilibrium Analyses

Yield per recruit and spawning potential ratio were computed as functions of $F$ (Figure 19). As in computation of MSY-related benchmarks, per recruit analyses applied the most recent selectivity patterns averaged across fisheries, weighted by $F$ from the last three years (2012–2014). The $F$s that provide 30%, 40%, and 50% SPR are 0.18, 0.11, and 0.07, respectively (Table 12).

As in per recruit analyses, equilibrium landings and spawning biomass were computed as functions of $F$ (Figures 20). By definition, the $F$ that maximizes equilibrium landings is $F_{\mathrm{MSY}}$, and the corresponding landings and spawning biomass are $\mathrm{MSY}$ and $\mathrm{SSB}_{\mathrm{MSY}}$. Equilibrium landings and discards could also be viewed as functions of biomass $B$, which itself is a function of $F$ (Figure 21).

### 4.9 Benchmarks / Reference Points

Biological reference points (benchmarks) were derived analytically assuming equilibrium dynamics, corresponding to the expected spawner-recruit curve (Figure 17). Reference points estimated were $F_{\rm MSY}$, MSY, $F/F_{\rm MSY}$,$B_{\rm MSY}$, $\rm SSB_{MSY}$, and SSB/MSST. Based on $F_{\rm MSY}$, three possible values of $F$ at optimum yield (OY) were considered—$F_{\rm OY} = 65\%F_{\rm MSY}$, $F_{\rm OY} = 75\%F_{\rm MSY}$, and $F_{\rm OY} = 85\%F_{\rm MSY}$—and for each, the corresponding yield was computed. Standard errors of benchmarks were approximated as those from Monte Carlo/bootstrap analysis.

Estimates of benchmarks are summarized in Table 12. Point estimates of MSY-related quantities were $F_{\rm MSY} = 0.25\ \rm y^{-1}$, $\rm MSY = 537.4$ gutted klb, $B_{\rm MSY} = 2468.3$ mt, $\rm SSB_{MSY} = 20.9$ mt, and $\rm SSB/MSST = 1.09$. Distributions of these benchmarks are shown in Figure 22.

### 4.10 Status of the Stock and Fishery

Estimated time series of stock status (SSB/MSST) shows decline in the early 1980s, and then increase since the mid-2000s, (Figure 23, Table 4). Base-run estimates of spawning biomass remained below MSST throughout the 1990s and most of the 2000s, then rose above MSST during 2009 to 2014. Current stock status in the base run was estimated to be $\rm SSB_{2014}/MSST = 1.09$ (Table 12). MCB analysis suggests that the stock status determination of being not overfished (i.e., $\rm SSB > MSST$) has a high degree of uncertainty (Figures 24, 25). About 59% of MCB runs showed SSB below MSST in the terminal year.

The estimated time series of $F/F_{\rm MSY}$ suggests that overfishing has occurred throughout a large potion of the assessment period (Figure 23, Table 4). Spikes in the early 1980s through 2004 are due primarily to the longline fleet (Figure 14). Current fishery status in the terminal year, with current $F$ represented by the geometric mean from 2012–2014, is estimated in the base run to be $F_{2012-2014}/F_{\rm MSY} = 1.35$ (Table 12). This estimate indicates that overfishing is occurring and appears robust across MCB trials (Figures 24, 25). In about 79% of MCB runs, $F$ was above $F_{\rm MSY}$.

### 4.11 Comparison to Previous Assessment

Results of this assessment were generally similar to those from the 2016 SEDAR25-Update assessment (Figures 26–29). The estimated scales and patterns of recruitment and abundance were quite similar (Figure 26), as were the time series of relative status indicators (Figure 29). The main differences were in estimated selectivity patterns of commercial handline and recreational fleets, and of the MARMAP survey (Figure 28). However, the estimated selectivity patterns of the commercial longline fleet were similar, and because this was the dominant fleet, the average selectivities used for projections and to compute MSY-related benchmarks were also similar (Figure 27).

### 4.12 Sensitivity Run

In this assessment, Model 10 was used as a base run configuration (models described in §3). Model 9, an alternative configuration, provided similar results to Model 10 (Figure 30). The primary difference was in the scale and timing of strong recruitment classes. Estimates of stock status, however, were nearly identical.

## 5 Projections

Projection results are tabulated in Tables 13–20, and shown graphically in Figures 31–46. In all projection scenarios, the probability that spawning biomass was above MSST exceeded 0.5 by the year 2024. In general, that probability was lower for scenarios with higher fishing rates or with the status quo ACL in 2018.

# 6 Discussion

## 6.1 Comments on the Assessment

The base run of the BAM indicated that the stock is not overfished ($\mathrm{SSB}_{2014}/\mathrm{MSST} = 1.09$), but is below $\mathrm{SSB}_{\mathrm{MSY}}$, and that overfishing is occurring ($F_{2012-2014}/F_{\mathrm{MSY}} = 1.35$). These results were in qualitative agreement with the SEDAR25-Update. Median values from the MCB analyses were also in qualitative agreement with the overfishing status ($F_{2012-2014}/F_{\mathrm{MSY}} = 2.49$); however, the median value of stock status suggested that the stock is overfished ($\mathrm{SSB}_{2014}/\mathrm{MSST} = 0.86$). Across all MCB runs, about 79% found that overfishing is occurring, and about 59% found the stock to be overfished.

The primary index of abundance for this assessment was from the commercial longline fleet. In general, fishery dependent indices of abundance may not track actual abundance well, because of factors such as hyperdepletion or hyperstability. This situation amplifies the importance of fishery independent sampling. Although this stock assessment did include a fishery independent index, it was not particularly informative, with CVs on the order of 100–200%. Increased sampling in deep water would benefit the stock assessment of golden tilefish, as well as other deep-water species such as blueline tilefish and snowy grouper.

Most assessed stocks in the southeast U.S. have shown histories of heavy exploitation. High rates of fishing mortality can lead to adaptive responses in life-history characteristics, such as growth and maturity schedules. Such adaptations can affect expected yield and stock recovery, and thus resource managers might wish to consider possible evolutionary effects of fishing in their management plans (Dunlop et al. 2009; Enberg et al. 2009).

The motivation for this revised golden tilefish assessment was to examine application of the Dirichlet-multinomial (DM) likelihood for fitting composition data. Unfortunately, a simple substitution of the DM likelihood for the robust multinomial resulted in a model (Model 1) that did not converge and the DM variance inflation parameters were not identifiable. The identifiability issue suggests that the DM parameters were not well informed by the composition data. This may have been because sample sizes in composition data were small relative to the number of length bins (23) and age bins (25) used in the assessment. The average sample sizes of composition data were the following: commercial handline lengths = 4.1, commercial longline lengths = 30.0, recreational lengths = 6.25, commercial handline ages = 10.2, commercial longline ages = 34.2, and MARMAP ages = 86.6. Likelihood profiling of the DM parameters revealed flat responses in all cases except the MARMAP age composition data, which had a relatively well defined minimum (also the largest average sample size). Of the models examined in this assessment, only two of ten converged properly (Table 1). Problems with convergence in Models 1–8 appeared to be related primarily to component scaling issues. Whatever the reason, we urge caution before using results of this revised assessment for management.

## 6.2 Comments on the Projections

As usual, projections should be interpreted in light of the model assumptions and key aspects of the data. Some major considerations are the following:

- In general, projections of fish stocks are highly uncertain, particularly in the long term (e.g., beyond 5–10 years).
- Although projections included many major sources of uncertainty, they did not include structural (model) uncertainty. That is, projection results are conditional on one set of functional forms used to describe population dynamics, selectivity, recruitment, etc.

- Fisheries were assumed to continue fishing at their estimated current proportions of total effort, using the estimated current selectivity patterns. New management regulations that alter those proportions or selectivities would likely affect projection results.
- Projections apply the Baranov catch equation to relate $F$ and landings using a one-year time step, as in the assessment. The catch equation implicitly assumes that mortality occurs throughout the year. This assumption is violated when seasonal closures are in effect, introducing additional and unquantified uncertainty into the projection results.
- The projections assumed that the estimated spawner-recruit relationship applies in the future and that past residuals represent future uncertainty in recruitment. If future recruitment is characterized by runs of large or small year classes, possibly due to environmental or ecological conditions, stock projections may be affected.

### 6.3 Research Recommendations

More work is needed to better understand use of the Dirichlet-multinomial distribution in stock assessment. Although several authors have recommended its use (Francis 2017; Thorson et al. 2017), the benefits and limitations under various circumstances have not been fully explored.

The fishery independent index used in this assessment was highly uncertain, with CVs exceeding 100%. A survey designed to sample deepwater fishes could improve the stock assessment of golden tilefish.

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## 8 Tables

*Table 1. Model variations considered. The 2016 SEDAR25-Update used the robust multinomial likelihood for composition data, and Models 1–10 used the Dirichlet-multinomial (DM) likelihood. Unless otherwise indicated, weights on the indices were equal to those in the 2016 update (commercial longline = 3.0, MARMAP = 1.4). Models 3–10 applied normal priors on DM parameters with means determined by likelihood profiling. Convergence was assessed by whether the model achieved a positive definite Hessian matrix and a maximum gradient that did not exceed the specified tolerance ($\tau = 0.0001$). MSE represents mean squared error of the commercial longline index.*

| Model | Description | Converge? | MSE |
|---|---|---|---|
| 0. | 2016 SEDAR25-Update | Y | 0.024 |
| 1. | No priors on DM parameters, CPUE weights = 1 | N | 0.168 |
| 2. | No priors on DM parameters | N | 0.037 |
| 3. | Priors from likelihood profiling | N | 0.037 |
| 4. | Commercial index weight increased twofold | N | 0.027 |
| 5. | Commercial index weight increased fourfold | N | 0.020 |
| 6. | Commercial index weight increased sixfold | N | 0.009 |
| 7. | DM parameters fixed to mimic $N_{eff}$ in 2016 Update | N | 0.060 |
| 8. | Composition likelihoods scaled by 2016 Update weights | N | 0.027 |
| 9. | Composition likelihoods scaled by one tenth of 2016 Update weights | Y | 0.013 |
| 10. | Composition likelihoods all scaled by 0.01 | Y | 0.014 |

*Table 2. Estimated total abundance at age (1000 fish) at start of year.*

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1962 | 364.43 | 270.84 | 217.92 | 182.32 | 156.09 | 135.63 | 119.07 | 105.15 | 92.75 | 82.03 | 72.77 | 64.72 | 57.68 |
| 1963 | 364.43 | 270.84 | 217.92 | 182.32 | 156.09 | 135.63 | 119.07 | 105.31 | 93.50 | 82.82 | 73.48 | 65.35 | 58.24 |
| 1964 | 364.66 | 270.84 | 217.92 | 182.32 | 156.09 | 135.63 | 119.07 | 105.31 | 93.64 | 83.48 | 74.19 | 65.99 | 58.81 |
| 1965 | 364.80 | 271.01 | 217.92 | 182.32 | 156.09 | 135.63 | 119.07 | 105.32 | 93.66 | 83.62 | 74.80 | 66.64 | 59.40 |
| 1966 | 364.93 | 271.12 | 218.05 | 182.32 | 156.08 | 135.60 | 119.04 | 105.26 | 93.49 | 83.46 | 74.76 | 67.04 | 59.85 |
| 1967 | 365.04 | 271.22 | 218.14 | 182.43 | 156.08 | 135.62 | 119.05 | 105.28 | 93.59 | 83.47 | 74.76 | 67.14 | 60.32 |
| 1968 | 365.16 | 271.30 | 218.22 | 182.51 | 156.18 | 135.62 | 119.06 | 105.27 | 93.56 | 83.50 | 74.72 | 67.09 | 60.37 |
| 1969 | 365.26 | 271.38 | 218.28 | 182.57 | 156.24 | 135.71 | 119.06 | 105.29 | 93.58 | 83.51 | 74.78 | 67.08 | 60.36 |
| 1970 | 365.36 | 271.46 | 218.35 | 182.63 | 156.30 | 135.76 | 119.14 | 105.29 | 93.61 | 83.54 | 74.80 | 67.15 | 60.36 |
| 1971 | 365.45 | 271.53 | 218.41 | 182.68 | 156.34 | 135.81 | 119.18 | 105.35 | 93.57 | 83.52 | 74.79 | 67.13 | 60.38 |
| 1972 | 365.52 | 271.60 | 218.47 | 182.74 | 156.39 | 135.84 | 119.20 | 105.37 | 93.56 | 83.43 | 74.71 | 67.06 | 60.32 |
| 1973 | 365.58 | 271.65 | 218.53 | 182.79 | 156.44 | 135.89 | 119.24 | 105.41 | 93.63 | 83.47 | 74.68 | 67.04 | 60.31 |
| 1974 | 365.63 | 271.70 | 218.57 | 182.83 | 156.47 | 135.89 | 119.25 | 105.37 | 93.45 | 83.32 | 74.52 | 66.84 | 60.13 |
| 1975 | 365.62 | 271.74 | 218.61 | 182.87 | 156.50 | 135.87 | 119.18 | 105.24 | 93.04 | 82.77 | 74.02 | 66.38 | 59.65 |
| 1976 | 317.65 | 271.72 | 218.63 | 182.90 | 156.52 | 135.81 | 119.06 | 105.01 | 92.44 | 81.89 | 73.08 | 65.53 | 58.88 |
| 1977 | 316.77 | 236.08 | 218.63 | 182.92 | 156.54 | 135.82 | 119.01 | 104.91 | 92.26 | 81.38 | 72.32 | 64.70 | 58.13 |
| 1978 | 316.23 | 235.43 | 189.95 | 182.91 | 156.56 | 135.81 | 118.99 | 104.94 | 92.63 | 81.72 | 72.32 | 64.43 | 57.76 |
| 1979 | 313.84 | 235.02 | 189.42 | 158.91 | 156.44 | 135.26 | 118.33 | 104.29 | 91.92 | 81.36 | 72.01 | 63.88 | 57.03 |
| 1980 | 311.53 | 233.24 | 189.10 | 158.47 | 135.96 | 135.46 | 118.19 | 103.98 | 91.45 | 80.79 | 71.74 | 63.65 | 56.58 |
| 1981 | 309.26 | 231.53 | 187.66 | 158.20 | 135.45 | 117.02 | 117.42 | 102.91 | 89.94 | 79.20 | 70.19 | 62.48 | 55.55 |
| 1982 | 308.86 | 229.84 | 186.28 | 156.98 | 134.91 | 115.02 | 99.59 | 99.34 | 82.72 | 71.57 | 63.19 | 56.14 | 50.07 |
| 1983 | 304.25 | 229.54 | 184.92 | 155.78 | 133.23 | 111.25 | 93.98 | 77.14 | 59.46 | 46.55 | 40.28 | 35.64 | 31.73 |
| 1984 | 295.21 | 226.12 | 184.68 | 154.67 | 132.67 | 112.15 | 93.44 | 75.46 | 49.60 | 36.26 | 28.40 | 24.63 | 21.84 |
| 1985 | 282.59 | 219.40 | 181.93 | 154.47 | 131.75 | 111.81 | 94.36 | 75.46 | 49.73 | 31.15 | 22.79 | 17.89 | 15.55 |
| 1986 | 281.04 | 210.02 | 176.52 | 152.17 | 131.68 | 111.56 | 94.57 | 75.49 | 47.18 | 29.35 | 18.39 | 13.49 | 10.61 |
| 1987 | 421.39 | 208.87 | 168.98 | 147.66 | 129.71 | 111.47 | 94.30 | 74.85 | 43.66 | 25.29 | 15.72 | 9.88 | 7.26 |
| 1988 | 518.06 | 313.17 | 168.05 | 141.37 | 126.30 | 112.11 | 97.09 | 81.19 | 59.66 | 34.23 | 19.87 | 12.38 | 7.79 |
| 1989 | 183.11 | 385.02 | 251.97 | 140.59 | 120.81 | 108.55 | 96.86 | 81.59 | 58.94 | 41.87 | 24.06 | 14.00 | 8.74 |
| 1990 | 240.50 | 136.09 | 309.78 | 210.77 | 119.93 | 102.75 | 92.38 | 78.10 | 50.59 | 34.32 | 24.38 | 14.04 | 8.19 |
| 1991 | 242.49 | 178.74 | 109.49 | 259.13 | 179.78 | 101.93 | 87.30 | 73.41 | 45.09 | 27.04 | 18.33 | 13.05 | 7.53 |
| 1992 | 239.85 | 180.22 | 143.81 | 91.59 | 221.00 | 152.69 | 86.41 | 67.27 | 36.25 | 19.98 | 11.95 | 8.12 | 5.79 |
| 1993 | 313.13 | 178.25 | 145.00 | 120.29 | 78.10 | 187.47 | 128.85 | 62.24 | 23.70 | 10.71 | 5.87 | 3.52 | 2.40 |
| 1994 | 277.83 | 232.72 | 143.42 | 121.25 | 101.95 | 63.85 | 149.96 | 79.15 | 11.73 | 3.33 | 1.49 | 0.82 | 0.49 |
| 1995 | 204.21 | 206.48 | 187.24 | 119.94 | 103.00 | 84.54 | 52.10 | 96.60 | 17.86 | 2.04 | 0.57 | 0.26 | 0.14 |
| 1996 | 217.51 | 151.76 | 166.13 | 156.59 | 101.94 | 85.69 | 69.43 | 35.33 | 27.58 | 4.12 | 0.47 | 0.13 | 0.06 |
| 1997 | 169.98 | 161.66 | 122.11 | 138.97 | 133.66 | 86.99 | 72.98 | 52.06 | 14.86 | 10.07 | 1.50 | 0.17 | 0.05 |
| 1998 | 261.33 | 126.33 | 130.06 | 102.15 | 118.66 | 114.27 | 74.25 | 54.88 | 22.80 | 5.71 | 3.86 | 0.57 | 0.07 |
| 1999 | 383.37 | 194.22 | 101.64 | 108.81 | 87.27 | 101.83 | 98.20 | 57.81 | 27.01 | 10.03 | 2.51 | 1.70 | 0.25 |
| 2000 | 398.11 | 284.92 | 156.26 | 85.02 | 92.90 | 74.59 | 86.89 | 73.33 | 23.63 | 9.53 | 3.52 | 0.88 | 0.60 |
| 2001 | 241.70 | 295.88 | 229.24 | 130.71 | 72.46 | 78.54 | 62.51 | 58.94 | 19.50 | 4.99 | 1.99 | 0.74 | 0.19 |
| 2002 | 225.31 | 179.63 | 238.05 | 191.76 | 111.50 | 61.60 | 66.50 | 45.85 | 22.99 | 6.52 | 1.66 | 0.67 | 0.25 |
| 2003 | 295.66 | 167.45 | 144.52 | 199.11 | 163.30 | 93.83 | 51.46 | 48.06 | 17.48 | 7.50 | 2.12 | 0.54 | 0.22 |
| 2004 | 339.80 | 219.73 | 134.73 | 120.91 | 170.22 | 140.68 | 81.00 | 40.47 | 26.01 | 8.67 | 3.72 | 1.05 | 0.27 |
| 2005 | 276.97 | 252.54 | 176.79 | 112.71 | 103.32 | 146.30 | 120.96 | 62.94 | 21.89 | 12.96 | 4.32 | 1.85 | 0.53 |
| 2006 | 227.20 | 205.84 | 203.19 | 147.90 | 96.27 | 88.53 | 125.28 | 94.03 | 35.36 | 11.46 | 6.78 | 2.26 | 0.97 |
| 2007 | 280.82 | 168.86 | 165.62 | 169.98 | 126.43 | 82.91 | 76.47 | 100.39 | 55.91 | 19.64 | 6.36 | 3.77 | 1.26 |
| 2008 | 280.06 | 208.71 | 135.86 | 138.54 | 145.15 | 108.19 | 71.20 | 63.68 | 72.19 | 38.90 | 13.68 | 4.44 | 2.64 |
| 2009 | 287.41 | 208.14 | 167.92 | 113.66 | 118.42 | 124.94 | 93.65 | 60.00 | 46.47 | 50.96 | 27.50 | 9.69 | 3.15 |
| 2010 | 293.04 | 213.60 | 167.47 | 140.48 | 97.19 | 102.17 | 108.45 | 79.01 | 44.04 | 33.06 | 36.31 | 19.64 | 6.94 |
| 2011 | 297.59 | 217.78 | 171.86 | 140.10 | 120.12 | 83.81 | 88.64 | 91.59 | 58.19 | 31.45 | 23.65 | 26.03 | 14.11 |
| 2012 | 301.01 | 221.17 | 175.23 | 143.78 | 119.83 | 103.79 | 72.90 | 75.06 | 68.07 | 42.01 | 22.74 | 17.14 | 18.91 |
| 2013 | 302.22 | 223.71 | 177.95 | 146.57 | 122.55 | 101.41 | 87.82 | 59.64 | 52.47 | 45.91 | 28.37 | 15.40 | 11.63 |
| 2014 | 300.89 | 224.61 | 179.99 | 148.86 | 125.09 | 104.51 | 86.66 | 72.11 | 40.44 | 34.03 | 29.80 | 18.46 | 10.04 |
| 2015 | 297.78 | 223.62 | 180.71 | 150.53 | 126.47 | 103.83 | 86.17 | 68.26 | 45.61 | 24.28 | 20.44 | 17.95 | 11.14 |

*Table 2. (Continued) Estimated total abundance at age (1000 fish) at start of year.*

| Year | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1962 | 51.49 | 46.03 | 41.18 | 36.88 | 33.05 | 29.64 | 26.59 | 23.86 | 21.42 | 19.23 | 17.27 | 152.76 | 2420.81 |
| 1963 | 51.99 | 46.47 | 41.58 | 37.24 | 33.37 | 29.92 | 26.84 | 24.09 | 21.63 | 19.42 | 17.44 | 154.24 | 2429.24 |
| 1964 | 52.50 | 46.92 | 41.99 | 37.60 | 33.70 | 30.21 | 27.10 | 24.32 | 21.84 | 19.61 | 17.61 | 155.74 | 2437.08 |
| 1965 | 53.02 | 47.39 | 42.40 | 37.97 | 34.03 | 30.51 | 27.37 | 24.57 | 22.05 | 19.80 | 17.79 | 157.29 | 2444.49 |
| 1966 | 53.43 | 47.76 | 42.73 | 38.27 | 34.30 | 30.75 | 27.59 | 24.76 | 22.22 | 19.96 | 17.92 | 158.51 | 2449.22 |
| 1967 | 53.94 | 48.22 | 43.14 | 38.64 | 34.63 | 31.05 | 27.85 | 25.00 | 22.44 | 20.15 | 18.10 | 160.04 | 2455.32 |
| 1968 | 54.34 | 48.65 | 43.53 | 38.99 | 34.94 | 31.33 | 28.10 | 25.22 | 22.64 | 20.33 | 18.26 | 161.48 | 2460.37 |
| 1969 | 54.40 | 49.03 | 43.94 | 39.35 | 35.27 | 31.62 | 28.37 | 25.46 | 22.86 | 20.52 | 18.43 | 163.01 | 2465.37 |
| 1970 | 54.39 | 49.09 | 44.29 | 39.73 | 35.60 | 31.93 | 28.64 | 25.70 | 23.07 | 20.72 | 18.61 | 164.56 | 2470.08 |
| 1971 | 54.37 | 49.06 | 44.32 | 40.02 | 35.92 | 32.22 | 28.90 | 25.94 | 23.28 | 20.91 | 18.78 | 166.06 | 2473.93 |
| 1972 | 54.35 | 48.99 | 44.26 | 40.02 | 36.16 | 32.48 | 29.14 | 26.15 | 23.47 | 21.08 | 18.93 | 167.42 | 2476.66 |
| 1973 | 54.33 | 49.01 | 44.23 | 39.99 | 36.19 | 32.71 | 29.40 | 26.38 | 23.69 | 21.27 | 19.10 | 168.93 | 2479.88 |
| 1974 | 54.17 | 48.87 | 44.13 | 39.86 | 36.06 | 32.65 | 29.53 | 26.55 | 23.83 | 21.40 | 19.22 | 169.99 | 2480.23 |
| 1975 | 53.75 | 48.49 | 43.79 | 39.58 | 35.77 | 32.39 | 29.33 | 26.54 | 23.87 | 21.43 | 19.25 | 170.24 | 2475.92 |
| 1976 | 53.00 | 47.82 | 43.18 | 39.03 | 35.30 | 31.93 | 28.91 | 26.20 | 23.71 | 21.33 | 19.16 | 169.43 | 2418.13 |
| 1977 | 52.32 | 47.16 | 42.59 | 38.50 | 34.82 | 31.51 | 28.51 | 25.83 | 23.41 | 21.20 | 19.07 | 168.67 | 2373.07 |
| 1978 | 51.98 | 46.84 | 42.27 | 38.21 | 34.56 | 31.27 | 28.32 | 25.63 | 23.23 | 21.06 | 19.07 | 168.95 | 2341.06 |
| 1979 | 51.21 | 46.15 | 41.63 | 37.59 | 34.01 | 30.78 | 27.86 | 25.24 | 22.85 | 20.72 | 18.79 | 167.77 | 2302.30 |
| 1980 | 50.60 | 45.49 | 41.04 | 37.05 | 33.48 | 30.30 | 27.44 | 24.85 | 22.52 | 20.39 | 18.49 | 166.57 | 2268.37 |
| 1981 | 49.46 | 44.29 | 39.86 | 35.99 | 32.51 | 29.40 | 26.62 | 24.11 | 21.85 | 19.80 | 17.93 | 162.81 | 2221.43 |
| 1982 | 44.59 | 39.76 | 35.64 | 32.10 | 29.00 | 26.22 | 23.72 | 21.48 | 19.47 | 17.64 | 15.99 | 146.02 | 2106.14 |
| 1983 | 28.35 | 25.28 | 22.56 | 20.24 | 18.25 | 16.49 | 14.92 | 13.50 | 12.23 | 11.09 | 10.05 | 92.32 | 1789.03 |
| 1984 | 19.48 | 17.42 | 15.55 | 13.89 | 12.47 | 11.25 | 10.17 | 9.21 | 8.33 | 7.55 | 6.85 | 63.24 | 1630.55 |
| 1985 | 13.81 | 12.33 | 11.05 | 9.87 | 8.82 | 7.92 | 7.15 | 6.47 | 5.85 | 5.30 | 4.81 | 44.61 | 1526.90 |
| 1986 | 9.24 | 8.21 | 7.34 | 6.58 | 5.88 | 5.26 | 4.73 | 4.27 | 3.86 | 3.50 | 3.17 | 29.53 | 1443.64 |
| 1987 | 5.72 | 4.99 | 4.44 | 3.97 | 3.56 | 3.19 | 2.85 | 2.56 | 2.31 | 2.09 | 1.90 | 17.74 | 1514.36 |
| 1988 | 5.74 | 4.53 | 3.95 | 3.52 | 3.15 | 2.83 | 2.53 | 2.27 | 2.04 | 1.84 | 1.67 | 15.62 | 1740.95 |
| 1989 | 5.51 | 4.06 | 3.21 | 2.80 | 2.50 | 2.24 | 2.01 | 1.80 | 1.61 | 1.45 | 1.31 | 12.30 | 1556.91 |
| 1990 | 5.12 | 3.23 | 2.39 | 1.89 | 1.65 | 1.47 | 1.32 | 1.18 | 1.06 | 0.95 | 0.85 | 8.03 | 1450.94 |
| 1991 | 4.40 | 2.76 | 1.74 | 1.29 | 1.02 | 0.89 | 0.79 | 0.71 | 0.64 | 0.57 | 0.51 | 4.80 | 1363.44 |
| 1992 | 3.35 | 1.96 | 1.23 | 0.78 | 0.57 | 0.45 | 0.40 | 0.35 | 0.32 | 0.29 | 0.26 | 2.38 | 1277.25 |
| 1993 | 1.71 | 0.99 | 0.58 | 0.36 | 0.23 | 0.17 | 0.13 | 0.12 | 0.11 | 0.09 | 0.09 | 0.78 | 1264.91 |
| 1994 | 0.33 | 0.24 | 0.14 | 0.08 | 0.05 | 0.03 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.12 | 1189.06 |
| 1995 | 0.09 | 0.06 | 0.04 | 0.02 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 1075.25 |
| 1996 | 0.03 | 0.02 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 1016.84 |
| 1997 | 0.02 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 965.11 |
| 1998 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1014.97 |
| 1999 | 0.03 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1174.68 |
| 2000 | 0.09 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1290.30 |
| 2001 | 0.13 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1197.52 |
| 2002 | 0.06 | 0.04 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1152.40 |
| 2003 | 0.08 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1191.37 |
| 2004 | 0.11 | 0.04 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1287.42 |
| 2005 | 0.13 | 0.05 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1294.30 |
| 2006 | 0.28 | 0.07 | 0.03 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1245.47 |
| 2007 | 0.54 | 0.15 | 0.04 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1259.19 |
| 2008 | 0.89 | 0.38 | 0.11 | 0.03 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1284.65 |
| 2009 | 1.88 | 0.63 | 0.27 | 0.08 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1314.80 |
| 2010 | 2.26 | 1.35 | 0.45 | 0.20 | 0.06 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1345.73 |
| 2011 | 4.99 | 1.63 | 0.97 | 0.33 | 0.14 | 0.04 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1373.05 |
| 2012 | 10.27 | 3.64 | 1.19 | 0.71 | 0.24 | 0.10 | 0.03 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 1397.82 |
| 2013 | 12.85 | 6.98 | 2.48 | 0.81 | 0.48 | 0.16 | 0.07 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 | 1399.51 |
| 2014 | 7.59 | 8.40 | 4.57 | 1.62 | 0.53 | 0.32 | 0.11 | 0.05 | 0.01 | 0.00 | 0.00 | 0.00 | 1398.71 |
| 2015 | 6.07 | 4.60 | 5.09 | 2.77 | 0.98 | 0.32 | 0.19 | 0.07 | 0.03 | 0.01 | 0.00 | 0.00 | 1376.94 |

*Table 3. Estimated biomass at age (1000 lb) at start of year*

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1962 | 129.4 | 266.8 | 411.2 | 540.6 | 644.2 | 718.5 | 765.0 | 785.7 | 781.3 | 760.4 | 728.8 | 690.0 | 647.1 |
| 1963 | 129.4 | 266.8 | 411.2 | 540.6 | 644.2 | 718.5 | 765.0 | 786.8 | 787.5 | 767.9 | 735.9 | 696.7 | 653.2 |
| 1964 | 129.4 | 266.8 | 411.2 | 540.6 | 644.2 | 718.5 | 765.0 | 786.8 | 788.8 | 774.0 | 743.0 | 703.5 | 659.6 |
| 1965 | 129.6 | 267.0 | 411.2 | 540.6 | 644.2 | 718.5 | 765.0 | 787.0 | 789.0 | 775.4 | 749.1 | 710.5 | 666.2 |
| 1966 | 129.6 | 267.0 | 411.4 | 540.6 | 644.2 | 718.5 | 764.8 | 786.6 | 787.5 | 773.8 | 748.7 | 714.7 | 671.3 |
| 1967 | 129.6 | 267.2 | 411.6 | 540.8 | 644.2 | 718.5 | 764.8 | 786.6 | 788.4 | 773.8 | 748.7 | 715.8 | 676.6 |
| 1968 | 129.6 | 267.2 | 411.6 | 541.0 | 644.6 | 718.5 | 764.8 | 786.6 | 788.2 | 774.3 | 748.2 | 715.4 | 677.3 |
| 1969 | 129.6 | 267.4 | 411.8 | 541.2 | 644.9 | 718.9 | 764.8 | 786.8 | 788.4 | 774.3 | 748.9 | 715.2 | 677.0 |
| 1970 | 129.9 | 267.4 | 411.8 | 541.5 | 645.1 | 719.4 | 765.4 | 786.8 | 788.6 | 774.5 | 749.1 | 715.8 | 677.0 |
| 1971 | 129.9 | 267.4 | 412.0 | 541.7 | 645.3 | 719.6 | 765.7 | 787.3 | 788.2 | 774.3 | 748.9 | 715.6 | 677.3 |
| 1972 | 129.9 | 267.6 | 412.0 | 541.9 | 645.5 | 719.6 | 765.9 | 787.3 | 788.2 | 773.4 | 748.2 | 715.0 | 676.6 |
| 1973 | 129.9 | 267.6 | 412.3 | 541.9 | 645.7 | 719.8 | 766.1 | 787.7 | 788.6 | 773.8 | 747.8 | 714.7 | 676.4 |
| 1974 | 129.9 | 267.6 | 412.3 | 542.1 | 645.7 | 720.0 | 766.1 | 787.3 | 787.3 | 772.5 | 746.3 | 712.5 | 674.4 |
| 1975 | 129.9 | 267.6 | 412.5 | 542.1 | 646.0 | 719.8 | 765.7 | 786.4 | 783.7 | 767.4 | 741.4 | 707.7 | 669.1 |
| 1976 | 112.9 | 267.6 | 412.5 | 542.3 | 646.0 | 719.6 | 765.0 | 784.6 | 778.7 | 759.3 | 731.9 | 698.6 | 660.5 |
| 1977 | 112.4 | 232.6 | 412.5 | 542.3 | 646.0 | 719.6 | 764.6 | 784.0 | 777.1 | 754.4 | 724.4 | 689.8 | 652.1 |
| 1978 | 112.2 | 231.9 | 358.3 | 542.3 | 646.2 | 719.6 | 764.3 | 784.2 | 780.2 | 757.7 | 724.2 | 687.0 | 647.9 |
| 1979 | 111.6 | 231.5 | 357.4 | 471.1 | 645.7 | 716.5 | 760.2 | 779.3 | 774.3 | 754.2 | 721.1 | 681.0 | 639.8 |
| 1980 | 110.7 | 229.7 | 356.7 | 469.8 | 561.1 | 717.6 | 759.3 | 776.9 | 770.3 | 748.9 | 718.5 | 678.6 | 634.7 |
| 1981 | 109.8 | 228.0 | 354.1 | 468.9 | 559.1 | 619.9 | 754.2 | 769.0 | 757.7 | 734.4 | 702.8 | 666.0 | 623.0 |
| 1982 | 109.8 | 226.4 | 351.4 | 465.4 | 556.9 | 609.4 | 639.8 | 742.3 | 696.7 | 663.6 | 632.7 | 598.6 | 561.7 |
| 1983 | 108.0 | 226.2 | 348.8 | 461.9 | 549.8 | 589.5 | 603.8 | 576.5 | 500.9 | 431.4 | 403.4 | 380.1 | 356.0 |
| 1984 | 104.9 | 222.7 | 348.3 | 458.6 | 547.6 | 594.1 | 600.3 | 563.9 | 417.8 | 336.2 | 284.4 | 262.6 | 244.9 |
| 1985 | 100.3 | 216.1 | 343.3 | 457.9 | 543.7 | 592.4 | 606.3 | 563.9 | 418.9 | 288.8 | 228.2 | 190.7 | 174.4 |
| 1986 | 99.9 | 206.8 | 333.1 | 451.3 | 543.4 | 591.1 | 607.6 | 564.2 | 397.5 | 272.1 | 184.1 | 143.7 | 119.0 |
| 1987 | 149.7 | 205.7 | 318.8 | 437.8 | 535.3 | 590.6 | 605.8 | 559.3 | 367.7 | 234.6 | 157.4 | 105.4 | 81.4 |
| 1988 | 184.1 | 308.4 | 317.0 | 419.1 | 521.2 | 593.9 | 623.7 | 606.7 | 502.4 | 317.2 | 199.1 | 132.1 | 87.5 |
| 1989 | 65.0 | 379.2 | 475.3 | 416.9 | 498.7 | 575.2 | 622.1 | 609.6 | 496.5 | 388.2 | 241.0 | 149.3 | 98.1 |
| 1990 | 85.3 | 134.0 | 584.4 | 625.0 | 494.9 | 544.3 | 593.5 | 583.6 | 426.2 | 318.1 | 244.1 | 149.7 | 91.9 |
| 1991 | 86.2 | 176.1 | 206.6 | 768.3 | 742.1 | 539.9 | 560.9 | 548.5 | 379.9 | 250.7 | 183.6 | 139.1 | 84.4 |
| 1992 | 85.1 | 177.5 | 271.4 | 271.6 | 912.1 | 808.9 | 555.1 | 502.7 | 305.3 | 185.2 | 119.7 | 86.6 | 65.0 |
| 1993 | 111.1 | 175.5 | 273.6 | 356.7 | 322.3 | 993.2 | 827.8 | 465.2 | 199.7 | 99.4 | 58.9 | 37.5 | 26.9 |
| 1994 | 98.8 | 229.3 | 270.5 | 359.6 | 420.9 | 338.2 | 963.4 | 591.5 | 98.8 | 30.9 | 15.0 | 8.8 | 5.5 |
| 1995 | 72.5 | 203.5 | 353.2 | 355.6 | 425.1 | 448.0 | 334.7 | 721.8 | 150.4 | 19.0 | 5.7 | 2.6 | 1.5 |
| 1996 | 77.2 | 149.5 | 313.5 | 464.3 | 420.6 | 453.9 | 446.0 | 263.9 | 232.4 | 38.1 | 4.6 | 1.3 | 0.7 |
| 1997 | 60.4 | 159.2 | 230.4 | 412.0 | 551.6 | 461.0 | 468.9 | 389.1 | 125.2 | 93.3 | 15.0 | 1.8 | 0.4 |
| 1998 | 92.8 | 124.3 | 245.4 | 302.9 | 489.6 | 605.4 | 477.1 | 410.1 | 192.0 | 52.9 | 38.6 | 6.2 | 0.7 |
| 1999 | 136.2 | 191.4 | 191.8 | 322.5 | 360.2 | 539.5 | 630.7 | 431.9 | 227.5 | 93.0 | 25.1 | 18.1 | 2.9 |
| 2000 | 141.3 | 280.6 | 294.8 | 252.0 | 383.4 | 395.3 | 558.2 | 547.8 | 199.1 | 88.4 | 35.3 | 9.5 | 6.6 |
| 2001 | 85.8 | 291.5 | 432.5 | 387.6 | 299.2 | 416.2 | 401.5 | 440.5 | 164.2 | 46.3 | 20.1 | 7.9 | 2.0 |
| 2002 | 80.0 | 177.0 | 449.1 | 568.6 | 460.1 | 326.3 | 427.3 | 342.6 | 193.6 | 60.4 | 16.5 | 7.1 | 2.9 |
| 2003 | 104.9 | 164.9 | 272.7 | 590.4 | 674.0 | 497.1 | 330.7 | 359.1 | 147.3 | 69.4 | 21.2 | 5.7 | 2.4 |
| 2004 | 120.6 | 216.5 | 254.2 | 358.5 | 702.6 | 745.4 | 520.3 | 302.5 | 219.1 | 80.5 | 37.3 | 11.2 | 3.1 |
| 2005 | 98.3 | 248.7 | 333.6 | 334.2 | 426.4 | 775.1 | 777.1 | 470.2 | 184.3 | 120.2 | 43.2 | 19.8 | 6.0 |
| 2006 | 80.7 | 202.8 | 383.4 | 438.5 | 397.3 | 468.9 | 804.9 | 702.6 | 297.8 | 106.3 | 67.9 | 24.3 | 11.0 |
| 2007 | 99.6 | 166.2 | 312.4 | 504.0 | 521.8 | 439.4 | 491.2 | 750.2 | 470.9 | 182.1 | 63.7 | 40.3 | 14.1 |
| 2008 | 99.4 | 205.7 | 256.4 | 410.7 | 599.0 | 573.2 | 457.5 | 475.8 | 608.0 | 360.7 | 136.9 | 47.4 | 29.5 |
| 2009 | 102.1 | 205.0 | 316.8 | 337.1 | 488.8 | 661.8 | 601.6 | 448.4 | 391.5 | 472.5 | 275.4 | 103.4 | 35.3 |
| 2010 | 104.1 | 210.3 | 315.9 | 416.5 | 401.0 | 541.2 | 696.7 | 590.4 | 371.0 | 306.4 | 363.5 | 209.4 | 77.8 |
| 2011 | 105.6 | 214.5 | 324.3 | 415.4 | 495.8 | 444.0 | 569.5 | 684.3 | 490.1 | 291.7 | 236.8 | 277.6 | 158.3 |
| 2012 | 106.9 | 217.8 | 330.5 | 426.4 | 494.5 | 549.8 | 468.3 | 560.9 | 573.4 | 389.6 | 227.7 | 182.8 | 212.1 |
| 2013 | 107.4 | 220.5 | 335.8 | 434.5 | 505.7 | 537.3 | 564.2 | 445.6 | 442.0 | 425.7 | 284.2 | 164.2 | 130.5 |
| 2014 | 106.9 | 221.3 | 339.5 | 441.4 | 516.3 | 553.8 | 556.7 | 538.8 | 340.6 | 315.5 | 298.5 | 196.9 | 112.7 |
| 2015 | 105.8 | 220.2 | 340.8 | 446.2 | 522.1 | 550.1 | 553.6 | 510.1 | 384.3 | 225.1 | 204.8 | 191.4 | 125.0 |

*Table 3. (Continued) Estimated biomass at age (1000 lb) at start of year*

| Year | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1962 | 602.1 | 556.7 | 512.1 | 469.1 | 428.6 | 390.2 | 354.5 | 321.4 | 291.2 | 263.2 | 237.9 | 2114.2 | 14410.5 |
| 1963 | 607.8 | 562.2 | 517.2 | 473.8 | 432.5 | 394.0 | 358.0 | 324.7 | 293.9 | 265.9 | 240.3 | 2134.7 | 14508.8 |
| 1964 | 613.8 | 567.5 | 522.1 | 478.4 | 437.0 | 397.7 | 361.6 | 327.8 | 296.7 | 268.5 | 242.5 | 2155.5 | 14600.8 |
| 1965 | 619.9 | 573.2 | 527.3 | 483.3 | 441.1 | 401.7 | 365.1 | 331.1 | 299.8 | 271.2 | 244.9 | 2176.8 | 14688.5 |
| 1966 | 624.8 | 577.6 | 531.5 | 487.0 | 444.7 | 405.0 | 368.0 | 333.6 | 302.0 | 273.2 | 246.9 | 2193.8 | 14746.5 |
| 1967 | 630.7 | 583.1 | 536.6 | 491.6 | 448.9 | 408.7 | 371.5 | 336.9 | 305.1 | 275.8 | 249.3 | 2215.0 | 14819.7 |
| 1968 | 635.4 | 588.4 | 541.5 | 496.0 | 453.0 | 412.5 | 374.8 | 340.0 | 307.8 | 278.4 | 251.5 | 2235.0 | 14881.2 |
| 1969 | 636.0 | 593.0 | 546.5 | 500.7 | 457.2 | 416.5 | 378.3 | 343.0 | 310.6 | 281.1 | 253.8 | 2256.0 | 14942.3 |
| 1970 | 636.0 | 593.7 | 550.7 | 505.5 | 461.6 | 420.4 | 381.8 | 346.3 | 313.7 | 283.7 | 256.2 | 2277.6 | 14999.6 |
| 1971 | 635.6 | 593.5 | 551.2 | 509.3 | 465.8 | 424.2 | 385.4 | 349.4 | 316.6 | 286.2 | 258.6 | 2298.3 | 15047.0 |
| 1972 | 635.4 | 592.6 | 550.5 | 509.3 | 468.7 | 427.7 | 388.7 | 352.3 | 319.0 | 288.6 | 260.8 | 2317.1 | 15081.6 |
| 1973 | 635.2 | 592.8 | 550.1 | 508.8 | 469.1 | 430.8 | 392.0 | 355.6 | 321.9 | 291.2 | 263.0 | 2338.0 | 15121.3 |
| 1974 | 633.4 | 591.1 | 548.7 | 507.1 | 467.6 | 429.9 | 393.7 | 357.8 | 324.1 | 293.0 | 264.8 | 2352.6 | 15127.9 |
| 1975 | 628.5 | 586.4 | 544.5 | 503.5 | 463.9 | 426.4 | 391.1 | 357.6 | 324.5 | 293.4 | 265.2 | 2356.1 | 15080.5 |
| 1976 | 619.7 | 578.3 | 537.0 | 496.5 | 457.7 | 420.4 | 385.6 | 353.2 | 322.3 | 292.1 | 263.9 | 2344.8 | 14950.6 |
| 1977 | 611.8 | 570.3 | 529.8 | 489.9 | 451.5 | 414.9 | 380.3 | 348.1 | 318.3 | 290.1 | 262.6 | 2334.3 | 14813.5 |
| 1978 | 607.8 | 566.6 | 525.6 | 486.1 | 448.0 | 411.8 | 377.7 | 345.5 | 315.7 | 288.4 | 262.6 | 2338.2 | 14729.9 |
| 1979 | 598.8 | 558.2 | 517.6 | 478.4 | 440.9 | 405.2 | 371.5 | 340.2 | 310.6 | 283.5 | 258.8 | 2321.9 | 14529.3 |
| 1980 | 591.5 | 550.3 | 510.4 | 471.3 | 434.1 | 399.0 | 366.0 | 334.9 | 306.0 | 279.1 | 254.6 | 2305.4 | 14335.8 |
| 1981 | 578.3 | 535.7 | 495.8 | 457.9 | 421.5 | 387.1 | 354.9 | 325.0 | 297.0 | 271.2 | 246.9 | 2253.3 | 13971.6 |
| 1982 | 521.4 | 480.8 | 443.1 | 408.5 | 375.9 | 345.2 | 316.4 | 289.5 | 264.6 | 241.6 | 220.2 | 2021.0 | 12782.6 |
| 1983 | 331.6 | 305.8 | 280.6 | 257.5 | 236.6 | 217.2 | 198.9 | 181.9 | 166.2 | 151.7 | 138.5 | 1277.6 | 9280.1 |
| 1984 | 227.7 | 210.8 | 193.3 | 176.8 | 161.6 | 148.2 | 135.6 | 124.1 | 113.3 | 103.4 | 94.4 | 875.2 | 7550.8 |
| 1985 | 161.6 | 149.3 | 137.3 | 125.4 | 114.4 | 104.3 | 95.2 | 87.1 | 79.6 | 72.5 | 66.1 | 617.3 | 6535.6 |
| 1986 | 108.0 | 99.4 | 91.3 | 83.8 | 76.3 | 69.2 | 63.1 | 57.5 | 52.5 | 47.8 | 43.7 | 408.7 | 5714.6 |
| 1987 | 66.8 | 60.4 | 55.1 | 50.5 | 46.1 | 41.9 | 37.9 | 34.6 | 31.5 | 28.7 | 26.0 | 245.6 | 5074.8 |
| 1988 | 67.0 | 54.7 | 49.2 | 44.8 | 40.8 | 37.3 | 33.7 | 30.4 | 27.8 | 25.1 | 22.9 | 216.3 | 5462.6 |
| 1989 | 64.4 | 49.2 | 39.9 | 35.7 | 32.4 | 29.5 | 26.9 | 24.3 | 21.8 | 19.8 | 18.1 | 170.2 | 5547.0 |
| 1990 | 60.0 | 39.0 | 29.8 | 24.0 | 21.4 | 19.4 | 17.6 | 15.9 | 14.3 | 13.0 | 11.7 | 111.1 | 5252.3 |
| 1991 | 51.4 | 33.3 | 21.6 | 16.3 | 13.2 | 11.7 | 10.6 | 9.7 | 8.6 | 7.9 | 7.1 | 66.4 | 4924.0 |
| 1992 | 39.2 | 23.6 | 15.2 | 9.9 | 7.5 | 6.0 | 5.3 | 4.9 | 4.4 | 4.0 | 3.5 | 32.8 | 4502.3 |
| 1993 | 20.1 | 11.9 | 7.3 | 4.6 | 3.1 | 2.2 | 1.8 | 1.5 | 1.5 | 1.3 | 1.1 | 10.8 | 4014.8 |
| 1994 | 4.0 | 2.9 | 1.8 | 1.1 | 0.7 | 0.4 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 1.8 | 3444.1 |
| 1995 | 1.1 | 0.7 | 0.4 | 0.2 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 3097.1 |
| 1996 | 0.4 | 0.2 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2867.5 |
| 1997 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2969.0 |
| 1998 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3038.6 |
| 1999 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3171.3 |
| 2000 | 1.1 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3193.6 |
| 2001 | 1.5 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2996.5 |
| 2002 | 0.7 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3112.9 |
| 2003 | 0.9 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3241.2 |
| 2004 | 1.3 | 0.4 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3573.2 |
| 2005 | 1.5 | 0.7 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3839.8 |
| 2006 | 3.3 | 0.9 | 0.4 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3990.8 |
| 2007 | 6.4 | 1.8 | 0.4 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4065.1 |
| 2008 | 10.4 | 4.6 | 1.3 | 0.4 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4277.2 |
| 2009 | 22.0 | 7.7 | 3.3 | 0.9 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4473.8 |
| 2010 | 26.5 | 16.3 | 5.7 | 2.4 | 0.7 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4656.6 |
| 2011 | 58.4 | 19.6 | 12.1 | 4.2 | 1.8 | 0.4 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4804.7 |
| 2012 | 119.9 | 44.1 | 14.8 | 9.0 | 3.1 | 1.3 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4933.5 |
| 2013 | 150.1 | 84.4 | 30.9 | 10.4 | 6.2 | 2.2 | 0.9 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 4882.8 |
| 2014 | 88.8 | 101.6 | 56.9 | 20.7 | 6.8 | 4.2 | 1.3 | 0.7 | 0.2 | 0.0 | 0.0 | 0.0 | 4820.0 |
| 2015 | 71.0 | 55.6 | 63.3 | 35.3 | 12.8 | 4.2 | 2.6 | 0.9 | 0.4 | 0.2 | 0.0 | 0.0 | 4625.5 |

*Table 4. Estimated time series of status indicators, fishing mortality, and biomass. Fishing mortality rate is apical F. Total biomass (B, mt) is at the start of the year, and spawning biomass (SSB, female gonad weight mt) at the end of July (time of peak spawning). The MSST is defined by* $MSST = 0.75 \times SSB_{MSY}$ *with constant* $M = 0.1$. *SPR is the static spawning potential ratio.*

| Year | F | $F/F_{\mathrm{MSY}}$ | B | $B/B_{\mathrm{unfished}}$ | SSB | $\mathrm{SSB}/\mathrm{SSB}_{\mathrm{MSY}}$ | SSB/MSST | SPR |
|---|---|---|---|---|---|---|---|---|
| 1962 | 0.00 | 0.00 | 6536 | 0.92 | 91 | 4.34 | 5.78 | 1.00 |
| 1963 | 0.00 | 0.00 | 6581 | 0.92 | 92 | 4.39 | 5.85 | 1.00 |
| 1964 | 0.00 | 0.00 | 6623 | 0.93 | 93 | 4.42 | 5.90 | 1.00 |
| 1965 | 0.00 | 0.01 | 6663 | 0.93 | 93 | 4.45 | 5.94 | 0.97 |
| 1966 | 0.00 | 0.00 | 6689 | 0.94 | 94 | 4.48 | 5.97 | 0.99 |
| 1967 | 0.00 | 0.00 | 6722 | 0.94 | 94 | 4.51 | 6.01 | 0.99 |
| 1968 | 0.00 | 0.00 | 6750 | 0.95 | 95 | 4.53 | 6.04 | 0.99 |
| 1969 | 0.00 | 0.00 | 6778 | 0.95 | 95 | 4.56 | 6.08 | 0.99 |
| 1970 | 0.00 | 0.00 | 6804 | 0.95 | 96 | 4.58 | 6.11 | 0.99 |
| 1971 | 0.00 | 0.01 | 6825 | 0.96 | 96 | 4.60 | 6.13 | 0.98 |
| 1972 | 0.00 | 0.00 | 6841 | 0.96 | 97 | 4.62 | 6.16 | 0.99 |
| 1973 | 0.00 | 0.02 | 6859 | 0.96 | 97 | 4.63 | 6.17 | 0.96 |
| 1974 | 0.01 | 0.03 | 6862 | 0.96 | 97 | 4.62 | 6.17 | 0.90 |
| 1975 | 0.01 | 0.06 | 6840 | 0.96 | 96 | 4.60 | 6.13 | 0.84 |
| 1976 | 0.01 | 0.06 | 6781 | 0.95 | 95 | 4.56 | 6.08 | 0.85 |
| 1977 | 0.01 | 0.03 | 6719 | 0.94 | 95 | 4.53 | 6.04 | 0.90 |
| 1978 | 0.02 | 0.07 | 6681 | 0.94 | 94 | 4.50 | 6.00 | 0.81 |
| 1979 | 0.02 | 0.07 | 6590 | 0.92 | 93 | 4.45 | 5.93 | 0.83 |
| 1980 | 0.03 | 0.13 | 6503 | 0.91 | 92 | 4.37 | 5.83 | 0.70 |
| 1981 | 0.12 | 0.47 | 6337 | 0.89 | 86 | 4.12 | 5.50 | 0.38 |
| 1982 | 0.47 | 1.90 | 5798 | 0.81 | 68 | 3.26 | 4.35 | 0.15 |
| 1983 | 0.38 | 1.57 | 4209 | 0.59 | 48 | 2.28 | 3.04 | 0.18 |
| 1984 | 0.35 | 1.45 | 3425 | 0.48 | 37 | 1.75 | 2.33 | 0.19 |
| 1985 | 0.42 | 1.70 | 2965 | 0.42 | 29 | 1.39 | 1.85 | 0.17 |
| 1986 | 0.51 | 2.10 | 2592 | 0.36 | 23 | 1.10 | 1.46 | 0.15 |
| 1987 | 0.13 | 0.54 | 2302 | 0.32 | 21 | 0.99 | 1.32 | 0.38 |
| 1988 | 0.24 | 0.99 | 2478 | 0.35 | 21 | 1.02 | 1.35 | 0.25 |
| 1989 | 0.43 | 1.76 | 2516 | 0.35 | 20 | 0.96 | 1.27 | 0.17 |
| 1990 | 0.52 | 2.11 | 2382 | 0.33 | 18 | 0.86 | 1.14 | 0.16 |
| 1991 | 0.71 | 2.88 | 2234 | 0.31 | 16 | 0.76 | 1.01 | 0.13 |
| 1992 | 1.12 | 4.55 | 2042 | 0.29 | 13 | 0.63 | 0.85 | 0.11 |
| 1993 | 1.86 | 7.61 | 1821 | 0.26 | 10 | 0.50 | 0.67 | 0.09 |
| 1994 | 1.65 | 6.73 | 1562 | 0.22 | 9 | 0.42 | 0.56 | 0.09 |
| 1995 | 1.37 | 5.57 | 1405 | 0.20 | 8 | 0.36 | 0.48 | 0.10 |
| 1996 | 0.90 | 3.68 | 1301 | 0.18 | 8 | 0.36 | 0.48 | 0.12 |
| 1997 | 0.85 | 3.47 | 1347 | 0.19 | 8 | 0.39 | 0.52 | 0.13 |
| 1998 | 0.71 | 2.91 | 1378 | 0.19 | 9 | 0.42 | 0.56 | 0.14 |
| 1999 | 0.94 | 3.82 | 1439 | 0.20 | 9 | 0.42 | 0.57 | 0.12 |
| 2000 | 1.45 | 5.93 | 1449 | 0.20 | 8 | 0.37 | 0.50 | 0.10 |
| 2001 | 0.99 | 4.04 | 1359 | 0.19 | 7 | 0.35 | 0.46 | 0.12 |
| 2002 | 1.02 | 4.14 | 1412 | 0.20 | 8 | 0.36 | 0.48 | 0.11 |
| 2003 | 0.59 | 2.42 | 1470 | 0.21 | 9 | 0.42 | 0.55 | 0.15 |
| 2004 | 0.59 | 2.40 | 1621 | 0.23 | 10 | 0.48 | 0.64 | 0.15 |
| 2005 | 0.54 | 2.20 | 1742 | 0.24 | 11 | 0.54 | 0.72 | 0.15 |
| 2006 | 0.48 | 1.95 | 1810 | 0.25 | 12 | 0.58 | 0.78 | 0.17 |
| 2007 | 0.25 | 1.03 | 1844 | 0.26 | 13 | 0.64 | 0.85 | 0.24 |
| 2008 | 0.24 | 0.97 | 1940 | 0.27 | 15 | 0.70 | 0.94 | 0.26 |
| 2009 | 0.23 | 0.94 | 2029 | 0.28 | 16 | 0.76 | 1.01 | 0.26 |
| 2010 | 0.23 | 0.92 | 2112 | 0.30 | 17 | 0.81 | 1.08 | 0.27 |
| 2011 | 0.21 | 0.88 | 2179 | 0.31 | 18 | 0.85 | 1.14 | 0.28 |
| 2012 | 0.28 | 1.15 | 2238 | 0.31 | 18 | 0.87 | 1.16 | 0.22 |
| 2013 | 0.32 | 1.32 | 2215 | 0.31 | 18 | 0.85 | 1.14 | 0.21 |
| 2014 | 0.40 | 1.63 | 2186 | 0.31 | 17 | 0.81 | 1.09 | 0.17 |
| 2015 | . | . | 2098 | 0.29 | 19 | 0.90 | 1.20 | . |

*Table 5. Selectivity at age for commercial handline (cH) landings, commercial longlines (cL) landings, recreational (rA) landings, the MARMAP longline survey (mm), and selectivity of landings averaged across fleets (L.avg). TL is total length.*

| Age | TL(mm) | TL(in) | cH | cL | rA | mm | L.avg |
|---|---|---|---|---|---|---|---|
| 1 | 256.5 | 10.1 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | 354.4 | 14.0 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 |
| 3 | 435.5 | 17.1 | 0.007 | 0.000 | 0.000 | 0.017 | 0.001 |
| 4 | 502.6 | 19.8 | 0.124 | 0.000 | 0.000 | 0.225 | 0.014 |
| 5 | 558.1 | 22.0 | 0.747 | 0.000 | 0.002 | 0.834 | 0.086 |
| 6 | 604.1 | 23.8 | 0.984 | 0.008 | 0.033 | 0.989 | 0.120 |
| 7 | 642.2 | 25.3 | 0.999 | 0.159 | 0.408 | 0.999 | 0.262 |
| 8 | 673.7 | 26.5 | 1.000 | 0.825 | 0.933 | 1.000 | 0.847 |
| 9 | 699.7 | 27.5 | 1.000 | 0.992 | 0.996 | 1.000 | 0.993 |
| 10 | 721.3 | 28.4 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 11 | 739.2 | 29.1 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 12 | 754.0 | 29.7 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 13 | 766.2 | 30.2 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 14 | 776.4 | 30.6 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 15 | 784.8 | 30.9 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 16 | 791.7 | 31.2 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 17 | 797.5 | 31.4 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 18 | 802.2 | 31.6 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 19 | 806.2 | 31.7 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 20 | 809.4 | 31.9 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 21 | 812.1 | 32.0 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 22 | 814.4 | 32.1 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 23 | 816.2 | 32.1 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 24 | 817.7 | 32.2 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 25 | 819.0 | 32.2 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |

*Table 6. Estimated instantaneous fishing mortality rate (per yr) at age*

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1962 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1963 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1964 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1965 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 |
| 1966 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1967 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| 1968 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| 1969 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1970 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| 1971 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 |
| 1972 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| 1973 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.003 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 |
| 1974 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.001 | 0.002 | 0.007 | 0.008 | 0.009 | 0.009 | 0.009 | 0.009 |
| 1975 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.002 | 0.004 | 0.012 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 |
| 1976 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.002 | 0.004 | 0.012 | 0.014 | 0.015 | 0.015 | 0.015 | 0.015 |
| 1977 | 0.000 | 0.000 | 0.000 | 0.000 | 0.002 | 0.002 | 0.003 | 0.007 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 |
| 1978 | 0.000 | 0.000 | 0.000 | 0.001 | 0.006 | 0.008 | 0.009 | 0.015 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 |
| 1979 | 0.000 | 0.000 | 0.000 | 0.001 | 0.004 | 0.005 | 0.007 | 0.014 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 |
| 1980 | 0.000 | 0.000 | 0.000 | 0.002 | 0.010 | 0.013 | 0.016 | 0.028 | 0.031 | 0.031 | 0.031 | 0.031 | 0.031 |
| 1981 | 0.000 | 0.000 | 0.000 | 0.004 | 0.023 | 0.031 | 0.044 | 0.101 | 0.115 | 0.116 | 0.116 | 0.116 | 0.116 |
| 1982 | 0.000 | 0.000 | 0.000 | 0.009 | 0.052 | 0.072 | 0.133 | 0.396 | 0.462 | 0.465 | 0.465 | 0.465 | 0.465 |
| 1983 | 0.000 | 0.000 | 0.000 | 0.005 | 0.032 | 0.044 | 0.097 | 0.325 | 0.382 | 0.384 | 0.384 | 0.385 | 0.385 |
| 1984 | 0.000 | 0.000 | 0.000 | 0.005 | 0.031 | 0.043 | 0.091 | 0.300 | 0.352 | 0.355 | 0.355 | 0.355 | 0.355 |
| 1985 | 0.000 | 0.000 | 0.000 | 0.004 | 0.026 | 0.037 | 0.100 | 0.353 | 0.414 | 0.417 | 0.418 | 0.418 | 0.418 |
| 1986 | 0.000 | 0.000 | 0.000 | 0.004 | 0.026 | 0.038 | 0.111 | 0.430 | 0.510 | 0.514 | 0.514 | 0.514 | 0.514 |
| 1987 | 0.000 | 0.000 | 0.000 | 0.001 | 0.005 | 0.008 | 0.027 | 0.110 | 0.130 | 0.131 | 0.132 | 0.132 | 0.132 |
| 1988 | 0.000 | 0.000 | 0.000 | 0.002 | 0.011 | 0.016 | 0.051 | 0.203 | 0.241 | 0.243 | 0.243 | 0.243 | 0.243 |
| 1989 | 0.000 | 0.000 | 0.000 | 0.004 | 0.021 | 0.031 | 0.093 | 0.361 | 0.428 | 0.431 | 0.431 | 0.431 | 0.431 |
| 1990 | 0.000 | 0.000 | 0.000 | 0.004 | 0.022 | 0.033 | 0.107 | 0.432 | 0.513 | 0.517 | 0.518 | 0.518 | 0.518 |
| 1991 | 0.000 | 0.000 | 0.000 | 0.004 | 0.023 | 0.035 | 0.138 | 0.588 | 0.701 | 0.707 | 0.707 | 0.707 | 0.707 |
| 1992 | 0.000 | 0.000 | 0.000 | 0.004 | 0.024 | 0.040 | 0.205 | 0.926 | 1.106 | 1.115 | 1.115 | 1.115 | 1.115 |
| 1993 | 0.000 | 0.000 | 0.001 | 0.010 | 0.061 | 0.093 | 0.364 | 1.552 | 1.850 | 1.864 | 1.865 | 1.865 | 1.865 |
| 1994 | 0.000 | 0.000 | 0.000 | 0.008 | 0.047 | 0.073 | 0.317 | 1.372 | 1.635 | 1.648 | 1.649 | 1.649 | 1.649 |
| 1995 | 0.000 | 0.000 | 0.000 | 0.007 | 0.044 | 0.067 | 0.266 | 1.136 | 1.354 | 1.365 | 1.365 | 1.365 | 1.365 |
| 1996 | 0.000 | 0.000 | 0.000 | 0.003 | 0.018 | 0.030 | 0.165 | 0.749 | 0.895 | 0.902 | 0.902 | 0.902 | 0.902 |
| 1997 | 0.000 | 0.000 | 0.000 | 0.003 | 0.016 | 0.028 | 0.162 | 0.709 | 0.843 | 0.849 | 0.850 | 0.850 | 0.850 |
| 1998 | 0.000 | 0.000 | 0.000 | 0.002 | 0.012 | 0.021 | 0.128 | 0.592 | 0.708 | 0.714 | 0.714 | 0.714 | 0.714 |
| 1999 | 0.000 | 0.000 | 0.000 | 0.003 | 0.017 | 0.028 | 0.169 | 0.777 | 0.929 | 0.936 | 0.937 | 0.937 | 0.937 |
| 2000 | 0.000 | 0.000 | 0.000 | 0.004 | 0.027 | 0.047 | 0.265 | 1.208 | 1.443 | 1.454 | 1.455 | 1.455 | 1.455 |
| 2001 | 0.000 | 0.000 | 0.000 | 0.004 | 0.022 | 0.036 | 0.187 | 0.824 | 0.982 | 0.990 | 0.990 | 0.990 | 0.990 |
| 2002 | 0.000 | 0.000 | 0.000 | 0.005 | 0.032 | 0.050 | 0.202 | 0.847 | 1.007 | 1.015 | 1.015 | 1.015 | 1.015 |
| 2003 | 0.000 | 0.000 | 0.000 | 0.001 | 0.009 | 0.017 | 0.117 | 0.497 | 0.588 | 0.593 | 0.593 | 0.593 | 0.593 |
| 2004 | 0.000 | 0.000 | 0.000 | 0.002 | 0.011 | 0.021 | 0.130 | 0.497 | 0.583 | 0.587 | 0.587 | 0.588 | 0.588 |
| 2005 | 0.000 | 0.000 | 0.000 | 0.002 | 0.014 | 0.025 | 0.129 | 0.459 | 0.534 | 0.538 | 0.538 | 0.538 | 0.538 |
| 2006 | 0.000 | 0.000 | 0.000 | 0.001 | 0.009 | 0.016 | 0.099 | 0.403 | 0.475 | 0.479 | 0.479 | 0.479 | 0.479 |
| 2007 | 0.000 | 0.000 | 0.000 | 0.003 | 0.015 | 0.022 | 0.060 | 0.213 | 0.250 | 0.252 | 0.252 | 0.252 | 0.252 |
| 2008 | 0.000 | 0.000 | 0.000 | 0.002 | 0.010 | 0.014 | 0.048 | 0.198 | 0.235 | 0.237 | 0.237 | 0.237 | 0.237 |
| 2009 | 0.000 | 0.000 | 0.000 | 0.001 | 0.007 | 0.011 | 0.047 | 0.192 | 0.227 | 0.229 | 0.229 | 0.229 | 0.229 |
| 2010 | 0.000 | 0.000 | 0.000 | 0.001 | 0.008 | 0.012 | 0.046 | 0.189 | 0.224 | 0.225 | 0.226 | 0.226 | 0.226 |
| 2011 | 0.000 | 0.000 | 0.000 | 0.001 | 0.006 | 0.009 | 0.044 | 0.180 | 0.213 | 0.214 | 0.215 | 0.215 | 0.215 |
| 2012 | 0.000 | 0.000 | 0.000 | 0.004 | 0.026 | 0.037 | 0.078 | 0.241 | 0.281 | 0.283 | 0.283 | 0.283 | 0.283 |
| 2013 | 0.000 | 0.000 | 0.000 | 0.003 | 0.019 | 0.027 | 0.074 | 0.271 | 0.320 | 0.322 | 0.322 | 0.322 | 0.322 |
| 2014 | 0.000 | 0.000 | 0.000 | 0.008 | 0.046 | 0.063 | 0.116 | 0.341 | 0.397 | 0.400 | 0.400 | 0.400 | 0.400 |

*Table 6. (Continued) Estimated instantaneous fishing mortality rate (per yr) at age*

| Year | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1962 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1963 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1964 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1965 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 |
| 1966 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1967 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| 1968 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| 1969 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1970 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| 1971 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 |
| 1972 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| 1973 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 |
| 1974 | 0.009 | 0.009 | 0.009 | 0.009 | 0.009 | 0.009 | 0.009 | 0.009 | 0.009 | 0.009 | 0.009 | 0.009 |
| 1975 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 |
| 1976 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 |
| 1977 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 |
| 1978 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 |
| 1979 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 |
| 1980 | 0.031 | 0.031 | 0.031 | 0.031 | 0.031 | 0.031 | 0.031 | 0.031 | 0.031 | 0.031 | 0.031 | 0.031 |
| 1981 | 0.116 | 0.116 | 0.116 | 0.116 | 0.116 | 0.116 | 0.116 | 0.116 | 0.116 | 0.116 | 0.116 | 0.116 |
| 1982 | 0.465 | 0.465 | 0.465 | 0.465 | 0.465 | 0.465 | 0.465 | 0.465 | 0.465 | 0.465 | 0.465 | 0.465 |
| 1983 | 0.385 | 0.385 | 0.385 | 0.385 | 0.385 | 0.385 | 0.385 | 0.385 | 0.385 | 0.385 | 0.385 | 0.385 |
| 1984 | 0.355 | 0.355 | 0.355 | 0.355 | 0.355 | 0.355 | 0.355 | 0.355 | 0.355 | 0.355 | 0.355 | 0.355 |
| 1985 | 0.418 | 0.418 | 0.418 | 0.418 | 0.418 | 0.418 | 0.418 | 0.418 | 0.418 | 0.418 | 0.418 | 0.418 |
| 1986 | 0.514 | 0.514 | 0.514 | 0.514 | 0.514 | 0.514 | 0.514 | 0.514 | 0.514 | 0.514 | 0.514 | 0.514 |
| 1987 | 0.132 | 0.132 | 0.132 | 0.132 | 0.132 | 0.132 | 0.132 | 0.132 | 0.132 | 0.132 | 0.132 | 0.132 |
| 1988 | 0.243 | 0.243 | 0.243 | 0.243 | 0.243 | 0.243 | 0.243 | 0.243 | 0.243 | 0.243 | 0.243 | 0.243 |
| 1989 | 0.431 | 0.431 | 0.431 | 0.431 | 0.431 | 0.431 | 0.431 | 0.431 | 0.431 | 0.431 | 0.431 | 0.431 |
| 1990 | 0.518 | 0.518 | 0.518 | 0.518 | 0.518 | 0.518 | 0.518 | 0.518 | 0.518 | 0.518 | 0.518 | 0.518 |
| 1991 | 0.707 | 0.707 | 0.707 | 0.707 | 0.707 | 0.707 | 0.707 | 0.707 | 0.707 | 0.707 | 0.707 | 0.707 |
| 1992 | 1.115 | 1.115 | 1.115 | 1.115 | 1.115 | 1.115 | 1.115 | 1.115 | 1.115 | 1.115 | 1.115 | 1.115 |
| 1993 | 1.865 | 1.865 | 1.865 | 1.865 | 1.865 | 1.865 | 1.865 | 1.865 | 1.865 | 1.865 | 1.865 | 1.865 |
| 1994 | 1.649 | 1.649 | 1.649 | 1.649 | 1.649 | 1.649 | 1.649 | 1.649 | 1.649 | 1.649 | 1.649 | 1.649 |
| 1995 | 1.365 | 1.365 | 1.365 | 1.365 | 1.365 | 1.365 | 1.365 | 1.365 | 1.365 | 1.365 | 1.365 | 1.365 |
| 1996 | 0.902 | 0.902 | 0.902 | 0.902 | 0.902 | 0.902 | 0.902 | 0.902 | 0.902 | 0.902 | 0.902 | 0.902 |
| 1997 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 | 0.850 |
| 1998 | 0.714 | 0.714 | 0.714 | 0.714 | 0.714 | 0.714 | 0.714 | 0.714 | 0.714 | 0.714 | 0.714 | 0.714 |
| 1999 | 0.937 | 0.937 | 0.937 | 0.937 | 0.937 | 0.937 | 0.937 | 0.937 | 0.937 | 0.937 | 0.937 | 0.937 |
| 2000 | 1.455 | 1.455 | 1.455 | 1.455 | 1.455 | 1.455 | 1.455 | 1.455 | 1.455 | 1.455 | 1.455 | 1.455 |
| 2001 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 |
| 2002 | 1.015 | 1.015 | 1.015 | 1.015 | 1.015 | 1.015 | 1.015 | 1.015 | 1.015 | 1.015 | 1.015 | 1.015 |
| 2003 | 0.593 | 0.593 | 0.593 | 0.593 | 0.593 | 0.593 | 0.593 | 0.593 | 0.593 | 0.593 | 0.593 | 0.593 |
| 2004 | 0.588 | 0.588 | 0.588 | 0.588 | 0.588 | 0.588 | 0.588 | 0.588 | 0.588 | 0.588 | 0.588 | 0.588 |
| 2005 | 0.538 | 0.538 | 0.538 | 0.538 | 0.538 | 0.538 | 0.538 | 0.538 | 0.538 | 0.538 | 0.538 | 0.538 |
| 2006 | 0.479 | 0.479 | 0.479 | 0.479 | 0.479 | 0.479 | 0.479 | 0.479 | 0.479 | 0.479 | 0.479 | 0.479 |
| 2007 | 0.252 | 0.252 | 0.252 | 0.252 | 0.252 | 0.252 | 0.252 | 0.252 | 0.252 | 0.252 | 0.252 | 0.252 |
| 2008 | 0.237 | 0.237 | 0.237 | 0.237 | 0.237 | 0.237 | 0.237 | 0.237 | 0.237 | 0.237 | 0.237 | 0.237 |
| 2009 | 0.229 | 0.229 | 0.229 | 0.229 | 0.229 | 0.229 | 0.229 | 0.229 | 0.229 | 0.229 | 0.229 | 0.229 |
| 2010 | 0.226 | 0.226 | 0.226 | 0.226 | 0.226 | 0.226 | 0.226 | 0.226 | 0.226 | 0.226 | 0.226 | 0.226 |
| 2011 | 0.215 | 0.215 | 0.215 | 0.215 | 0.215 | 0.215 | 0.215 | 0.215 | 0.215 | 0.215 | 0.215 | 0.215 |
| 2012 | 0.283 | 0.283 | 0.283 | 0.283 | 0.283 | 0.283 | 0.283 | 0.283 | 0.283 | 0.283 | 0.283 | 0.283 |
| 2013 | 0.322 | 0.322 | 0.322 | 0.322 | 0.322 | 0.322 | 0.322 | 0.322 | 0.322 | 0.322 | 0.322 | 0.322 |
| 2014 | 0.400 | 0.400 | 0.400 | 0.400 | 0.400 | 0.400 | 0.400 | 0.400 | 0.400 | 0.400 | 0.400 | 0.400 |

*Table 7. Estimated time series of fully selected fishing mortality rates for commercial handlines (F.cH), commercial longline (F.cL), and recreational (F.rA) fleets. Also shown is apical F, the maximum F at age summed across fleets.*

| Year | F.cH | F.cL | F.rA | Apical F |
|---|---|---|---|---|
| 1962 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1963 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1964 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1965 | 0.000 | 0.002 | 0.000 | 0.002 |
| 1966 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1967 | 0.000 | 0.001 | 0.000 | 0.001 |
| 1968 | 0.000 | 0.001 | 0.000 | 0.001 |
| 1969 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1970 | 0.000 | 0.001 | 0.000 | 0.001 |
| 1971 | 0.000 | 0.002 | 0.000 | 0.002 |
| 1972 | 0.000 | 0.001 | 0.000 | 0.001 |
| 1973 | 0.000 | 0.003 | 0.000 | 0.004 |
| 1974 | 0.001 | 0.007 | 0.000 | 0.009 |
| 1975 | 0.002 | 0.013 | 0.000 | 0.015 |
| 1976 | 0.002 | 0.013 | 0.000 | 0.015 |
| 1977 | 0.002 | 0.006 | 0.000 | 0.008 |
| 1978 | 0.008 | 0.009 | 0.000 | 0.017 |
| 1979 | 0.005 | 0.011 | 0.000 | 0.016 |
| 1980 | 0.013 | 0.018 | 0.000 | 0.031 |
| 1981 | 0.031 | 0.085 | 0.000 | 0.116 |
| 1982 | 0.070 | 0.395 | 0.000 | 0.465 |
| 1983 | 0.042 | 0.342 | 0.000 | 0.385 |
| 1984 | 0.041 | 0.313 | 0.001 | 0.355 |
| 1985 | 0.034 | 0.363 | 0.020 | 0.418 |
| 1986 | 0.035 | 0.480 | 0.000 | 0.514 |
| 1987 | 0.007 | 0.124 | 0.000 | 0.132 |
| 1988 | 0.015 | 0.227 | 0.001 | 0.243 |
| 1989 | 0.029 | 0.403 | 0.000 | 0.431 |
| 1990 | 0.030 | 0.488 | 0.000 | 0.518 |
| 1991 | 0.030 | 0.676 | 0.000 | 0.707 |
| 1992 | 0.032 | 1.078 | 0.005 | 1.115 |
| 1993 | 0.081 | 1.784 | 0.000 | 1.865 |
| 1994 | 0.062 | 1.575 | 0.011 | 1.649 |
| 1995 | 0.058 | 1.308 | 0.000 | 1.365 |
| 1996 | 0.024 | 0.872 | 0.007 | 0.902 |
| 1997 | 0.021 | 0.791 | 0.037 | 0.850 |
| 1998 | 0.016 | 0.696 | 0.001 | 0.714 |
| 1999 | 0.022 | 0.907 | 0.008 | 0.937 |
| 2000 | 0.036 | 1.403 | 0.016 | 1.455 |
| 2001 | 0.029 | 0.940 | 0.021 | 0.990 |
| 2002 | 0.043 | 0.953 | 0.020 | 1.015 |
| 2003 | 0.011 | 0.526 | 0.055 | 0.593 |
| 2004 | 0.014 | 0.476 | 0.097 | 0.588 |
| 2005 | 0.018 | 0.407 | 0.112 | 0.538 |
| 2006 | 0.012 | 0.416 | 0.052 | 0.479 |
| 2007 | 0.020 | 0.219 | 0.012 | 0.252 |
| 2008 | 0.013 | 0.224 | 0.000 | 0.237 |
| 2009 | 0.010 | 0.209 | 0.011 | 0.229 |
| 2010 | 0.010 | 0.208 | 0.008 | 0.226 |
| 2011 | 0.007 | 0.194 | 0.013 | 0.215 |
| 2012 | 0.035 | 0.233 | 0.014 | 0.283 |
| 2013 | 0.025 | 0.289 | 0.009 | 0.322 |
| 2014 | 0.061 | 0.335 | 0.004 | 0.400 |

*Table 8. Estimated time series of landings in gutted weight (1000 lb) for commercial handlines (cH), commercial longlines (cL), and recreational (rA).*

| Year | Year | cH | cL | rA | Total |
|---|---|---|---|---|---|
| 1 | 1962 | 0.47 | 2.93 | 0.00 | 3.40 |
| 2 | 1963 | 0.44 | 2.78 | 0.00 | 3.22 |
| 3 | 1964 | 0.14 | 0.86 | 0.00 | 1.00 |
| 4 | 1965 | 3.21 | 20.10 | 0.00 | 23.31 |
| 5 | 1966 | 0.60 | 3.77 | 0.00 | 4.37 |
| 6 | 1967 | 1.43 | 8.93 | 0.00 | 10.36 |
| 7 | 1968 | 0.87 | 5.47 | 0.00 | 6.34 |
| 8 | 1969 | 0.71 | 4.47 | 0.00 | 5.18 |
| 9 | 1970 | 1.41 | 8.85 | 0.00 | 10.26 |
| 10 | 1971 | 2.62 | 16.40 | 0.00 | 19.02 |
| 11 | 1972 | 1.56 | 9.78 | 0.00 | 11.34 |
| 12 | 1973 | 5.47 | 34.26 | 0.00 | 39.73 |
| 13 | 1974 | 12.43 | 77.85 | 0.00 | 90.28 |
| 14 | 1975 | 21.57 | 134.01 | 0.00 | 155.58 |
| 15 | 1976 | 21.93 | 129.83 | 0.00 | 151.76 |
| 16 | 1977 | 25.74 | 62.77 | 0.00 | 88.50 |
| 17 | 1978 | 91.58 | 92.16 | 0.00 | 183.74 |
| 18 | 1979 | 55.87 | 114.27 | 0.00 | 170.13 |
| 19 | 1980 | 148.67 | 177.89 | 0.00 | 326.57 |
| 20 | 1981 | 334.78 | 785.62 | 0.41 | 1120.81 |
| 21 | 1982 | 597.99 | 2800.31 | 0.02 | 3398.33 |
| 22 | 1983 | 263.52 | 1639.46 | 0.59 | 1903.57 |
| 23 | 1984 | 202.85 | 1112.58 | 4.45 | 1319.87 |
| 24 | 1985 | 142.85 | 989.31 | 58.27 | 1190.43 |
| 25 | 1986 | 120.61 | 985.10 | 0.17 | 1105.87 |
| 26 | 1987 | 23.83 | 233.77 | 0.23 | 257.83 |
| 27 | 1988 | 50.14 | 453.91 | 2.43 | 506.48 |
| 28 | 1989 | 92.62 | 746.84 | 0.01 | 839.48 |
| 29 | 1990 | 86.05 | 760.85 | 0.35 | 847.25 |
| 30 | 1991 | 82.23 | 824.92 | 0.41 | 907.55 |
| 31 | 1992 | 81.39 | 883.12 | 5.00 | 969.51 |
| 32 | 1993 | 170.57 | 860.31 | 0.02 | 1030.90 |
| 33 | 1994 | 105.29 | 685.70 | 7.56 | 798.54 |
| 34 | 1995 | 82.87 | 594.87 | 0.02 | 677.77 |
| 35 | 1996 | 33.80 | 316.67 | 3.21 | 353.68 |
| 36 | 1997 | 33.83 | 327.37 | 20.35 | 381.55 |
| 37 | 1998 | 28.53 | 336.10 | 0.75 | 365.37 |
| 38 | 1999 | 37.70 | 473.51 | 5.78 | 516.99 |
| 39 | 2000 | 54.11 | 659.95 | 9.79 | 723.85 |
| 40 | 2001 | 38.47 | 390.05 | 11.49 | 440.02 |
| 41 | 2002 | 57.45 | 369.11 | 10.11 | 436.68 |
| 42 | 2003 | 18.41 | 223.00 | 29.45 | 270.86 |
| 43 | 2004 | 29.04 | 232.79 | 61.95 | 323.78 |
| 44 | 2005 | 41.17 | 263.66 | 97.07 | 401.90 |
| 45 | 2006 | 26.48 | 375.01 | 58.82 | 460.31 |
| 46 | 2007 | 49.62 | 259.26 | 16.66 | 325.54 |
| 47 | 2008 | 33.86 | 300.35 | 0.02 | 334.23 |
| 48 | 2009 | 27.35 | 299.62 | 18.20 | 345.17 |
| 49 | 2010 | 30.16 | 332.74 | 13.93 | 376.84 |
| 50 | 2011 | 22.89 | 348.13 | 25.46 | 396.47 |
| 51 | 2012 | 108.36 | 424.81 | 28.38 | 561.55 |
| 52 | 2013 | 75.02 | 489.60 | 16.04 | 580.66 |
| 53 | 2014 | 175.54 | 521.25 | 7.01 | 703.80 |

*Table 9. Estimated time series of landings in number (1000 fish) for commercial handlines (cH), commercial longlines (cL), and recreational (rA).*

| Year | Year | cH | cL | rA | Total |
|---|---|---|---|---|---|
| 1 | 1962 | 0.05 | 0.28 | 0.00 | 0.33 |
| 2 | 1963 | 0.05 | 0.26 | 0.00 | 0.31 |
| 3 | 1964 | 0.02 | 0.08 | 0.00 | 0.10 |
| 4 | 1965 | 0.36 | 1.90 | 0.00 | 2.25 |
| 5 | 1966 | 0.07 | 0.36 | 0.00 | 0.42 |
| 6 | 1967 | 0.16 | 0.84 | 0.00 | 1.00 |
| 7 | 1968 | 0.10 | 0.52 | 0.00 | 0.61 |
| 8 | 1969 | 0.08 | 0.42 | 0.00 | 0.50 |
| 9 | 1970 | 0.16 | 0.83 | 0.00 | 0.99 |
| 10 | 1971 | 0.29 | 1.54 | 0.00 | 1.83 |
| 11 | 1972 | 0.17 | 0.92 | 0.00 | 1.09 |
| 12 | 1973 | 0.60 | 3.22 | 0.00 | 3.82 |
| 13 | 1974 | 1.37 | 7.30 | 0.00 | 8.67 |
| 14 | 1975 | 2.38 | 12.57 | 0.00 | 14.95 |
| 15 | 1976 | 2.42 | 12.18 | 0.00 | 14.60 |
| 16 | 1977 | 2.84 | 5.89 | 0.00 | 8.73 |
| 17 | 1978 | 10.12 | 8.65 | 0.00 | 18.77 |
| 18 | 1979 | 6.17 | 10.73 | 0.00 | 16.91 |
| 19 | 1980 | 16.36 | 16.72 | 0.00 | 33.08 |
| 20 | 1981 | 36.89 | 73.96 | 0.04 | 110.88 |
| 21 | 1982 | 67.87 | 264.87 | 0.00 | 332.74 |
| 22 | 1983 | 31.93 | 157.37 | 0.06 | 189.36 |
| 23 | 1984 | 26.21 | 109.62 | 0.45 | 136.29 |
| 24 | 1985 | 19.66 | 100.94 | 6.17 | 126.78 |
| 25 | 1986 | 17.75 | 104.98 | 0.02 | 122.74 |
| 26 | 1987 | 3.62 | 26.03 | 0.03 | 29.68 |
| 27 | 1988 | 7.60 | 51.56 | 0.29 | 59.45 |
| 28 | 1989 | 14.20 | 85.98 | 0.00 | 100.18 |
| 29 | 1990 | 13.71 | 89.08 | 0.04 | 102.83 |
| 30 | 1991 | 14.17 | 98.68 | 0.05 | 112.90 |
| 31 | 1992 | 15.01 | 109.60 | 0.65 | 125.26 |
| 32 | 1993 | 31.38 | 115.81 | 0.00 | 147.19 |
| 33 | 1994 | 19.37 | 98.60 | 1.14 | 119.11 |
| 34 | 1995 | 15.62 | 83.54 | 0.00 | 99.16 |
| 35 | 1996 | 6.49 | 43.59 | 0.46 | 50.54 |
| 36 | 1997 | 6.51 | 45.15 | 2.93 | 54.60 |
| 37 | 1998 | 5.36 | 46.04 | 0.11 | 51.50 |
| 38 | 1999 | 6.85 | 64.77 | 0.83 | 72.45 |
| 39 | 2000 | 9.88 | 90.88 | 1.41 | 102.17 |
| 40 | 2001 | 7.13 | 53.80 | 1.65 | 62.58 |
| 41 | 2002 | 11.09 | 50.49 | 1.44 | 63.03 |
| 42 | 2003 | 3.65 | 30.31 | 4.17 | 38.13 |
| 43 | 2004 | 5.60 | 31.39 | 8.80 | 45.79 |
| 44 | 2005 | 7.46 | 35.90 | 13.89 | 57.25 |
| 45 | 2006 | 4.59 | 50.74 | 8.27 | 63.60 |
| 46 | 2007 | 8.46 | 34.06 | 2.25 | 44.77 |
| 47 | 2008 | 5.69 | 37.79 | 0.00 | 43.48 |
| 48 | 2009 | 4.46 | 36.74 | 2.32 | 43.51 |
| 49 | 2010 | 4.76 | 40.53 | 1.76 | 47.05 |
| 50 | 2011 | 3.56 | 42.08 | 3.17 | 48.82 |
| 51 | 2012 | 16.78 | 50.38 | 3.46 | 70.63 |
| 52 | 2013 | 11.70 | 57.25 | 1.94 | 70.90 |
| 53 | 2014 | 27.78 | 61.18 | 0.85 | 89.81 |

*Table 10. Estimated landings at age in gutted weight (1000 lb)*

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1962 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.06 | 0.20 | 0.24 | 0.23 | 0.22 | 0.21 | 0.20 |
| 1963 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.06 | 0.19 | 0.22 | 0.22 | 0.21 | 0.20 | 0.19 |
| 1964 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.06 | 0.07 | 0.07 | 0.07 | 0.06 | 0.06 |
| 1965 | 0.00 | 0.00 | 0.00 | 0.02 | 0.12 | 0.18 | 0.40 | 1.35 | 1.59 | 1.57 | 1.52 | 1.45 | 1.36 |
| 1966 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.07 | 0.25 | 0.30 | 0.29 | 0.28 | 0.27 | 0.26 |
| 1967 | 0.00 | 0.00 | 0.00 | 0.01 | 0.05 | 0.08 | 0.18 | 0.59 | 0.70 | 0.69 | 0.67 | 0.64 | 0.61 |
| 1968 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.05 | 0.11 | 0.36 | 0.42 | 0.42 | 0.41 | 0.39 | 0.37 |
| 1969 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.04 | 0.09 | 0.29 | 0.35 | 0.34 | 0.33 | 0.32 | 0.30 |
| 1970 | 0.00 | 0.00 | 0.00 | 0.01 | 0.05 | 0.08 | 0.17 | 0.58 | 0.68 | 0.67 | 0.65 | 0.63 | 0.59 |
| 1971 | 0.00 | 0.00 | 0.00 | 0.01 | 0.09 | 0.14 | 0.32 | 1.07 | 1.26 | 1.24 | 1.21 | 1.15 | 1.09 |
| 1972 | 0.00 | 0.00 | 0.00 | 0.01 | 0.05 | 0.08 | 0.19 | 0.63 | 0.75 | 0.74 | 0.72 | 0.69 | 0.65 |
| 1973 | 0.00 | 0.00 | 0.00 | 0.03 | 0.19 | 0.30 | 0.66 | 2.22 | 2.61 | 2.58 | 2.50 | 2.39 | 2.27 |
| 1974 | 0.00 | 0.00 | 0.00 | 0.06 | 0.43 | 0.67 | 1.50 | 5.03 | 5.91 | 5.85 | 5.66 | 5.41 | 5.13 |
| 1975 | 0.00 | 0.00 | 0.00 | 0.10 | 0.76 | 1.18 | 2.61 | 8.70 | 10.18 | 10.06 | 9.73 | 9.30 | 8.80 |
| 1976 | 0.00 | 0.00 | 0.00 | 0.11 | 0.78 | 1.20 | 2.61 | 8.55 | 9.96 | 9.79 | 9.45 | 9.03 | 8.55 |
| 1977 | 0.00 | 0.00 | 0.01 | 0.13 | 0.91 | 1.38 | 2.12 | 5.04 | 5.72 | 5.60 | 5.38 | 5.13 | 4.85 |
| 1978 | 0.00 | 0.00 | 0.02 | 0.45 | 3.27 | 4.85 | 6.19 | 10.56 | 11.58 | 11.31 | 10.83 | 10.28 | 9.70 |
| 1979 | 0.00 | 0.00 | 0.01 | 0.24 | 2.01 | 3.01 | 4.42 | 9.78 | 11.04 | 10.83 | 10.37 | 9.80 | 9.21 |
| 1980 | 0.00 | 0.00 | 0.03 | 0.66 | 4.73 | 8.08 | 10.54 | 18.99 | 20.89 | 20.44 | 19.63 | 18.56 | 17.37 |
| 1981 | 0.00 | 0.00 | 0.06 | 1.57 | 11.25 | 16.79 | 29.15 | 66.03 | 73.85 | 72.08 | 69.11 | 65.55 | 61.37 |
| 1982 | 0.00 | 0.00 | 0.14 | 3.52 | 25.03 | 37.41 | 70.78 | 217.13 | 231.17 | 221.70 | 211.72 | 200.42 | 188.23 |
| 1983 | 0.00 | 0.00 | 0.09 | 2.12 | 15.16 | 22.64 | 49.56 | 142.80 | 142.40 | 123.60 | 115.71 | 109.10 | 102.27 |
| 1984 | 0.00 | 0.00 | 0.08 | 2.02 | 14.51 | 21.91 | 46.42 | 130.52 | 111.06 | 90.05 | 76.29 | 70.52 | 65.84 |
| 1985 | 0.00 | 0.00 | 0.07 | 1.71 | 12.25 | 19.23 | 51.49 | 149.82 | 127.41 | 88.49 | 70.04 | 58.59 | 53.62 |
| 1986 | 0.00 | 0.00 | 0.07 | 1.70 | 12.36 | 19.46 | 56.82 | 176.54 | 142.53 | 98.30 | 66.63 | 52.07 | 43.13 |
| 1987 | 0.00 | 0.00 | 0.01 | 0.34 | 2.54 | 4.17 | 14.33 | 51.85 | 40.22 | 25.87 | 17.40 | 11.64 | 9.01 |
| 1988 | 0.00 | 0.00 | 0.03 | 0.66 | 5.01 | 8.40 | 27.66 | 99.56 | 96.35 | 61.35 | 38.53 | 25.59 | 16.96 |
| 1989 | 0.00 | 0.00 | 0.08 | 1.29 | 9.32 | 15.61 | 48.94 | 165.10 | 154.96 | 122.08 | 75.88 | 47.06 | 30.94 |
| 1990 | 0.00 | 0.00 | 0.10 | 2.00 | 9.58 | 15.53 | 53.65 | 183.18 | 153.55 | 115.47 | 88.73 | 54.45 | 33.44 |
| 1991 | 0.00 | 0.00 | 0.04 | 2.53 | 14.81 | 16.46 | 64.35 | 218.64 | 172.07 | 114.36 | 83.84 | 63.61 | 38.65 |
| 1992 | 0.00 | 0.00 | 0.05 | 0.94 | 19.14 | 27.83 | 91.76 | 272.85 | 184.32 | 112.43 | 72.76 | 52.66 | 39.56 |
| 1993 | 0.00 | 0.00 | 0.13 | 3.12 | 16.81 | 78.27 | 225.53 | 331.44 | 152.74 | 76.27 | 45.20 | 28.87 | 20.69 |
| 1994 | 0.00 | 0.00 | 0.10 | 2.42 | 16.96 | 21.18 | 233.39 | 398.49 | 72.07 | 22.62 | 10.93 | 6.40 | 4.05 |
| 1995 | 0.00 | 0.00 | 0.12 | 2.23 | 15.98 | 25.64 | 69.59 | 441.46 | 100.89 | 12.76 | 3.88 | 1.85 | 1.07 |
| 1996 | 0.00 | 0.00 | 0.04 | 1.21 | 6.66 | 12.00 | 60.45 | 124.91 | 123.70 | 20.45 | 2.51 | 0.75 | 0.36 |
| 1997 | 0.00 | 0.00 | 0.03 | 0.96 | 7.85 | 11.37 | 62.54 | 177.18 | 64.15 | 48.15 | 7.74 | 0.94 | 0.28 |
| 1998 | 0.00 | 0.00 | 0.02 | 0.54 | 5.34 | 11.37 | 50.85 | 164.18 | 87.59 | 24.32 | 17.77 | 2.82 | 0.34 |
| 1999 | 0.00 | 0.00 | 0.02 | 0.76 | 5.20 | 13.42 | 87.45 | 209.55 | 123.99 | 50.99 | 13.79 | 9.94 | 1.56 |
| 2000 | 0.00 | 0.00 | 0.06 | 0.99 | 9.13 | 15.94 | 115.99 | 346.27 | 137.55 | 61.32 | 24.52 | 6.55 | 4.67 |
| 2001 | 0.00 | 0.00 | 0.07 | 1.22 | 5.72 | 13.13 | 61.02 | 222.07 | 92.57 | 26.22 | 11.34 | 4.48 | 1.18 |
| 2002 | 0.00 | 0.00 | 0.11 | 2.62 | 12.80 | 14.01 | 69.64 | 175.86 | 110.81 | 34.79 | 9.58 | 4.09 | 1.60 |
| 2003 | 0.00 | 0.00 | 0.02 | 0.73 | 5.12 | 7.36 | 32.60 | 125.89 | 58.79 | 27.95 | 8.54 | 2.32 | 0.98 |
| 2004 | 0.00 | 0.00 | 0.02 | 0.56 | 6.76 | 13.63 | 56.27 | 106.14 | 86.91 | 32.11 | 14.88 | 4.49 | 1.21 |
| 2005 | 0.00 | 0.00 | 0.04 | 0.67 | 5.26 | 16.91 | 83.72 | 155.03 | 68.51 | 44.96 | 16.20 | 7.41 | 2.21 |
| 2006 | 0.00 | 0.00 | 0.03 | 0.56 | 3.10 | 6.70 | 67.33 | 208.35 | 101.07 | 36.30 | 23.25 | 8.27 | 3.75 |
| 2007 | 0.00 | 0.00 | 0.04 | 1.12 | 7.02 | 8.55 | 25.56 | 128.28 | 93.22 | 36.32 | 12.73 | 8.05 | 2.84 |
| 2008 | 0.00 | 0.00 | 0.02 | 0.56 | 5.00 | 7.13 | 19.19 | 76.24 | 114.08 | 68.22 | 25.96 | 8.98 | 5.62 |
| 2009 | 0.00 | 0.00 | 0.02 | 0.35 | 3.09 | 6.60 | 24.69 | 69.91 | 71.27 | 86.74 | 50.63 | 19.02 | 6.52 |
| 2010 | 0.00 | 0.00 | 0.02 | 0.46 | 2.69 | 5.63 | 28.02 | 90.59 | 66.56 | 55.45 | 65.88 | 37.97 | 14.12 |
| 2011 | 0.00 | 0.00 | 0.01 | 0.34 | 2.46 | 3.62 | 21.59 | 100.45 | 84.09 | 50.44 | 41.03 | 48.13 | 27.47 |
| 2012 | 0.00 | 0.00 | 0.07 | 1.63 | 11.36 | 17.64 | 31.31 | 107.28 | 125.68 | 86.01 | 50.37 | 40.46 | 46.99 |
| 2013 | 0.00 | 0.00 | 0.05 | 1.18 | 8.28 | 12.70 | 35.98 | 94.59 | 108.40 | 105.22 | 70.35 | 40.68 | 32.35 |
| 2014 | 0.00 | 0.00 | 0.12 | 2.92 | 20.36 | 29.88 | 54.24 | 139.17 | 100.05 | 93.31 | 88.41 | 58.36 | 33.42 |

*Table 10. (Continued) Estimated landings at age in gutted weight (1000 lb)*

| Year | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1962 | 0.18 | 0.17 | 0.16 | 0.14 | 0.13 | 0.12 | 0.11 | 0.10 | 0.09 | 0.08 | 0.07 | 0.65 |
| 1963 | 0.17 | 0.16 | 0.15 | 0.14 | 0.12 | 0.11 | 0.10 | 0.09 | 0.08 | 0.08 | 0.07 | 0.61 |
| 1964 | 0.05 | 0.05 | 0.05 | 0.04 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 | 0.19 |
| 1965 | 1.26 | 1.17 | 1.08 | 0.99 | 0.90 | 0.82 | 0.75 | 0.68 | 0.61 | 0.55 | 0.50 | 4.45 |
| 1966 | 0.24 | 0.22 | 0.20 | 0.19 | 0.17 | 0.15 | 0.14 | 0.13 | 0.12 | 0.10 | 0.09 | 0.84 |
| 1967 | 0.56 | 0.52 | 0.48 | 0.44 | 0.40 | 0.37 | 0.33 | 0.30 | 0.27 | 0.25 | 0.22 | 1.99 |
| 1968 | 0.35 | 0.32 | 0.30 | 0.27 | 0.25 | 0.23 | 0.20 | 0.19 | 0.17 | 0.15 | 0.14 | 1.22 |
| 1969 | 0.28 | 0.26 | 0.24 | 0.22 | 0.20 | 0.19 | 0.17 | 0.15 | 0.14 | 0.12 | 0.11 | 1.00 |
| 1970 | 0.56 | 0.52 | 0.48 | 0.44 | 0.40 | 0.37 | 0.33 | 0.30 | 0.27 | 0.25 | 0.22 | 2.00 |
| 1971 | 1.03 | 0.96 | 0.89 | 0.82 | 0.75 | 0.69 | 0.62 | 0.57 | 0.51 | 0.46 | 0.42 | 3.72 |
| 1972 | 0.61 | 0.57 | 0.53 | 0.49 | 0.45 | 0.41 | 0.37 | 0.34 | 0.31 | 0.28 | 0.25 | 2.23 |
| 1973 | 2.13 | 1.99 | 1.84 | 1.71 | 1.57 | 1.45 | 1.32 | 1.19 | 1.08 | 0.98 | 0.88 | 7.85 |
| 1974 | 4.82 | 4.50 | 4.18 | 3.86 | 3.56 | 3.28 | 3.00 | 2.73 | 2.47 | 2.23 | 2.02 | 17.94 |
| 1975 | 8.27 | 7.72 | 7.17 | 6.64 | 6.11 | 5.62 | 5.16 | 4.72 | 4.28 | 3.87 | 3.50 | 31.09 |
| 1976 | 8.02 | 7.49 | 6.96 | 6.44 | 5.94 | 5.45 | 5.00 | 4.58 | 4.18 | 3.79 | 3.43 | 30.44 |
| 1977 | 4.56 | 4.25 | 3.95 | 3.65 | 3.37 | 3.10 | 2.84 | 2.60 | 2.38 | 2.17 | 1.96 | 17.43 |
| 1978 | 9.11 | 8.50 | 7.88 | 7.29 | 6.72 | 6.18 | 5.67 | 5.19 | 4.74 | 4.33 | 3.95 | 35.13 |
| 1979 | 8.63 | 8.05 | 7.47 | 6.90 | 6.36 | 5.85 | 5.37 | 4.91 | 4.49 | 4.10 | 3.74 | 33.55 |
| 1980 | 16.20 | 15.08 | 13.99 | 12.93 | 11.91 | 10.95 | 10.04 | 9.19 | 8.40 | 7.67 | 6.99 | 63.30 |
| 1981 | 56.99 | 52.82 | 48.90 | 45.18 | 41.61 | 38.22 | 35.06 | 32.09 | 29.33 | 26.78 | 24.40 | 222.61 |
| 1982 | 174.82 | 161.33 | 148.74 | 137.12 | 126.26 | 115.94 | 106.25 | 97.28 | 88.91 | 81.16 | 74.02 | 679.24 |
| 1983 | 95.29 | 87.94 | 80.74 | 74.13 | 68.10 | 62.53 | 57.29 | 52.40 | 47.91 | 43.73 | 39.88 | 368.18 |
| 1984 | 61.23 | 56.69 | 52.05 | 47.59 | 43.54 | 39.89 | 36.55 | 33.42 | 30.52 | 27.87 | 25.41 | 235.88 |
| 1985 | 49.67 | 45.90 | 42.28 | 38.66 | 35.22 | 32.14 | 29.37 | 26.86 | 24.52 | 22.37 | 20.40 | 190.30 |
| 1986 | 39.16 | 36.04 | 33.14 | 30.39 | 27.69 | 25.16 | 22.91 | 20.90 | 19.08 | 17.40 | 15.85 | 148.55 |
| 1987 | 7.40 | 6.68 | 6.12 | 5.60 | 5.12 | 4.65 | 4.22 | 3.83 | 3.49 | 3.18 | 2.90 | 27.26 |
| 1988 | 13.02 | 10.63 | 9.54 | 8.70 | 7.94 | 7.24 | 6.56 | 5.94 | 5.39 | 4.90 | 4.46 | 42.06 |
| 1989 | 20.34 | 15.52 | 12.61 | 11.27 | 10.24 | 9.32 | 8.47 | 7.67 | 6.93 | 6.28 | 5.70 | 53.88 |
| 1990 | 21.81 | 14.25 | 10.81 | 8.75 | 7.79 | 7.06 | 6.41 | 5.82 | 5.26 | 4.74 | 4.29 | 40.55 |
| 1991 | 23.55 | 15.26 | 9.92 | 7.50 | 6.04 | 5.37 | 4.85 | 4.40 | 3.99 | 3.60 | 3.24 | 30.49 |
| 1992 | 23.85 | 14.43 | 9.31 | 6.02 | 4.54 | 3.65 | 3.23 | 2.92 | 2.64 | 2.39 | 2.15 | 20.09 |
| 1993 | 15.42 | 9.24 | 5.56 | 3.57 | 2.30 | 1.73 | 1.39 | 1.23 | 1.11 | 1.00 | 0.90 | 8.37 |
| 1994 | 2.88 | 2.13 | 1.27 | 0.76 | 0.49 | 0.31 | 0.23 | 0.19 | 0.17 | 0.15 | 0.13 | 1.24 |
| 1995 | 0.67 | 0.48 | 0.35 | 0.21 | 0.12 | 0.08 | 0.05 | 0.04 | 0.03 | 0.03 | 0.02 | 0.22 |
| 1996 | 0.20 | 0.13 | 0.09 | 0.07 | 0.04 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.05 |
| 1997 | 0.13 | 0.07 | 0.05 | 0.03 | 0.02 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.02 |
| 1998 | 0.10 | 0.05 | 0.03 | 0.02 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| 1999 | 0.19 | 0.05 | 0.03 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2000 | 0.73 | 0.09 | 0.03 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2001 | 0.84 | 0.13 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2002 | 0.42 | 0.30 | 0.05 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2003 | 0.38 | 0.10 | 0.07 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2004 | 0.51 | 0.20 | 0.05 | 0.04 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2005 | 0.59 | 0.25 | 0.09 | 0.02 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2006 | 1.11 | 0.29 | 0.12 | 0.05 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2007 | 1.27 | 0.38 | 0.10 | 0.04 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2008 | 1.97 | 0.88 | 0.26 | 0.07 | 0.03 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2009 | 4.05 | 1.41 | 0.62 | 0.18 | 0.05 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2010 | 4.80 | 2.96 | 1.02 | 0.45 | 0.13 | 0.03 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2011 | 10.14 | 3.42 | 2.10 | 0.72 | 0.32 | 0.09 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2012 | 26.61 | 9.76 | 3.28 | 2.00 | 0.69 | 0.30 | 0.09 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 |
| 2013 | 37.28 | 20.97 | 7.65 | 2.56 | 1.56 | 0.53 | 0.23 | 0.07 | 0.02 | 0.01 | 0.00 | 0.00 |
| 2014 | 26.36 | 30.19 | 16.90 | 6.14 | 2.05 | 1.24 | 0.42 | 0.19 | 0.05 | 0.01 | 0.01 | 0.00 |

*Table 11. Estimated total landings at age in numbers (1000 fish)*

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1962 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 |
| 1963 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 |
| 1964 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| 1965 | 0.00 | 0.00 | 0.00 | 0.01 | 0.03 | 0.04 | 0.07 | 0.19 | 0.20 | 0.18 | 0.16 | 0.14 | 0.13 |
| 1966 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 | 0.02 |
| 1967 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.03 | 0.08 | 0.09 | 0.08 | 0.07 | 0.06 | 0.06 |
| 1968 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.02 | 0.05 | 0.05 | 0.05 | 0.04 | 0.04 | 0.03 |
| 1969 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.04 | 0.04 | 0.04 | 0.04 | 0.03 | 0.03 |
| 1970 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.03 | 0.08 | 0.09 | 0.08 | 0.07 | 0.06 | 0.06 |
| 1971 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.05 | 0.15 | 0.16 | 0.14 | 0.13 | 0.11 | 0.10 |
| 1972 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.03 | 0.09 | 0.09 | 0.08 | 0.08 | 0.07 | 0.06 |
| 1973 | 0.00 | 0.00 | 0.00 | 0.01 | 0.05 | 0.06 | 0.11 | 0.31 | 0.33 | 0.29 | 0.26 | 0.24 | 0.21 |
| 1974 | 0.00 | 0.00 | 0.00 | 0.02 | 0.11 | 0.13 | 0.25 | 0.71 | 0.74 | 0.67 | 0.60 | 0.54 | 0.48 |
| 1975 | 0.00 | 0.00 | 0.00 | 0.04 | 0.19 | 0.24 | 0.43 | 1.23 | 1.28 | 1.15 | 1.03 | 0.92 | 0.83 |
| 1976 | 0.00 | 0.00 | 0.00 | 0.04 | 0.20 | 0.24 | 0.43 | 1.21 | 1.25 | 1.12 | 1.00 | 0.90 | 0.81 |
| 1977 | 0.00 | 0.00 | 0.00 | 0.05 | 0.23 | 0.28 | 0.35 | 0.71 | 0.72 | 0.64 | 0.57 | 0.51 | 0.46 |
| 1978 | 0.00 | 0.00 | 0.01 | 0.16 | 0.84 | 0.97 | 1.02 | 1.50 | 1.46 | 1.29 | 1.14 | 1.02 | 0.92 |
| 1979 | 0.00 | 0.00 | 0.01 | 0.09 | 0.52 | 0.60 | 0.73 | 1.39 | 1.39 | 1.24 | 1.10 | 0.97 | 0.87 |
| 1980 | 0.00 | 0.00 | 0.02 | 0.23 | 1.21 | 1.62 | 1.74 | 2.69 | 2.63 | 2.33 | 2.08 | 1.84 | 1.64 |
| 1981 | 0.00 | 0.00 | 0.04 | 0.56 | 2.89 | 3.36 | 4.81 | 9.36 | 9.28 | 8.23 | 7.31 | 6.51 | 5.79 |
| 1982 | 0.00 | 0.00 | 0.08 | 1.26 | 6.42 | 7.48 | 11.67 | 30.77 | 29.06 | 25.32 | 22.39 | 19.91 | 17.77 |
| 1983 | 0.00 | 0.00 | 0.05 | 0.76 | 3.89 | 4.53 | 8.17 | 20.24 | 17.90 | 14.12 | 12.23 | 10.84 | 9.65 |
| 1984 | 0.00 | 0.00 | 0.05 | 0.72 | 3.72 | 4.38 | 7.65 | 18.50 | 13.96 | 10.29 | 8.07 | 7.00 | 6.22 |
| 1985 | 0.00 | 0.00 | 0.04 | 0.61 | 3.14 | 3.84 | 8.49 | 21.23 | 16.02 | 10.11 | 7.41 | 5.82 | 5.06 |
| 1986 | 0.00 | 0.00 | 0.04 | 0.61 | 3.17 | 3.89 | 9.37 | 25.02 | 17.92 | 11.23 | 7.04 | 5.17 | 4.07 |
| 1987 | 0.00 | 0.00 | 0.01 | 0.12 | 0.65 | 0.83 | 2.36 | 7.35 | 5.06 | 2.95 | 1.84 | 1.16 | 0.85 |
| 1988 | 0.00 | 0.00 | 0.02 | 0.24 | 1.28 | 1.68 | 4.56 | 14.11 | 12.11 | 7.01 | 4.07 | 2.54 | 1.60 |
| 1989 | 0.00 | 0.00 | 0.04 | 0.46 | 2.39 | 3.12 | 8.07 | 23.40 | 19.48 | 13.94 | 8.02 | 4.67 | 2.92 |
| 1990 | 0.00 | 0.00 | 0.06 | 0.71 | 2.46 | 3.10 | 8.84 | 25.96 | 19.30 | 13.19 | 9.38 | 5.41 | 3.16 |
| 1991 | 0.00 | 0.00 | 0.02 | 0.91 | 3.80 | 3.29 | 10.61 | 30.98 | 21.63 | 13.06 | 8.86 | 6.32 | 3.65 |
| 1992 | 0.00 | 0.00 | 0.03 | 0.34 | 4.91 | 5.56 | 15.12 | 38.67 | 23.17 | 12.84 | 7.69 | 5.23 | 3.73 |
| 1993 | 0.00 | 0.00 | 0.07 | 1.12 | 4.31 | 15.64 | 37.18 | 46.97 | 19.20 | 8.71 | 4.78 | 2.87 | 1.95 |
| 1994 | 0.00 | 0.00 | 0.06 | 0.86 | 4.35 | 4.23 | 38.47 | 56.47 | 9.06 | 2.58 | 1.16 | 0.64 | 0.38 |
| 1995 | 0.00 | 0.00 | 0.07 | 0.80 | 4.10 | 5.12 | 11.47 | 62.56 | 12.68 | 1.46 | 0.41 | 0.18 | 0.10 |
| 1996 | 0.00 | 0.00 | 0.02 | 0.43 | 1.71 | 2.40 | 9.96 | 17.70 | 15.55 | 2.34 | 0.27 | 0.07 | 0.03 |
| 1997 | 0.00 | 0.00 | 0.02 | 0.34 | 2.01 | 2.27 | 10.31 | 25.11 | 8.06 | 5.50 | 0.82 | 0.09 | 0.03 |
| 1998 | 0.00 | 0.00 | 0.01 | 0.19 | 1.37 | 2.27 | 8.38 | 23.27 | 11.01 | 2.78 | 1.88 | 0.28 | 0.03 |
| 1999 | 0.00 | 0.00 | 0.01 | 0.27 | 1.33 | 2.68 | 14.41 | 29.70 | 15.59 | 5.82 | 1.46 | 0.99 | 0.15 |
| 2000 | 0.00 | 0.00 | 0.03 | 0.35 | 2.34 | 3.19 | 19.12 | 49.07 | 17.29 | 7.00 | 2.59 | 0.65 | 0.44 |
| 2001 | 0.00 | 0.00 | 0.04 | 0.44 | 1.47 | 2.62 | 10.06 | 31.47 | 11.64 | 3.00 | 1.20 | 0.44 | 0.11 |
| 2002 | 0.00 | 0.00 | 0.06 | 0.94 | 3.28 | 2.80 | 11.48 | 24.92 | 13.93 | 3.97 | 1.01 | 0.41 | 0.15 |
| 2003 | 0.00 | 0.00 | 0.01 | 0.26 | 1.31 | 1.47 | 5.37 | 17.84 | 7.39 | 3.19 | 0.90 | 0.23 | 0.09 |
| 2004 | 0.00 | 0.00 | 0.01 | 0.20 | 1.74 | 2.72 | 9.28 | 15.04 | 10.92 | 3.67 | 1.57 | 0.45 | 0.11 |
| 2005 | 0.00 | 0.00 | 0.02 | 0.24 | 1.35 | 3.38 | 13.80 | 21.97 | 8.61 | 5.14 | 1.71 | 0.74 | 0.21 |
| 2006 | 0.00 | 0.00 | 0.01 | 0.20 | 0.79 | 1.34 | 11.10 | 29.53 | 12.71 | 4.15 | 2.46 | 0.82 | 0.35 |
| 2007 | 0.00 | 0.00 | 0.02 | 0.40 | 1.80 | 1.71 | 4.21 | 18.18 | 11.72 | 4.15 | 1.35 | 0.80 | 0.27 |
| 2008 | 0.00 | 0.00 | 0.01 | 0.20 | 1.28 | 1.43 | 3.16 | 10.80 | 14.34 | 7.79 | 2.74 | 0.89 | 0.53 |
| 2009 | 0.00 | 0.00 | 0.01 | 0.12 | 0.79 | 1.32 | 4.07 | 9.91 | 8.96 | 9.91 | 5.35 | 1.89 | 0.62 |
| 2010 | 0.00 | 0.00 | 0.01 | 0.16 | 0.69 | 1.12 | 4.62 | 12.84 | 8.37 | 6.33 | 6.97 | 3.77 | 1.33 |
| 2011 | 0.00 | 0.00 | 0.01 | 0.12 | 0.63 | 0.72 | 3.56 | 14.24 | 10.57 | 5.76 | 4.34 | 4.78 | 2.59 |
| 2012 | 0.00 | 0.00 | 0.04 | 0.58 | 2.91 | 3.53 | 5.16 | 15.20 | 15.80 | 9.82 | 5.33 | 4.02 | 4.44 |
| 2013 | 0.00 | 0.00 | 0.03 | 0.42 | 2.13 | 2.54 | 5.93 | 13.40 | 13.63 | 12.02 | 7.44 | 4.04 | 3.05 |
| 2014 | 0.00 | 0.00 | 0.07 | 1.04 | 5.22 | 5.97 | 8.94 | 19.72 | 12.58 | 10.66 | 9.35 | 5.80 | 3.15 |

*Table 11. (Continued) Estimated total landings at age in numbers (1000 fish)*

| Year | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1962 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 |
| 1963 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.05 |
| 1964 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| 1965 | 0.11 | 0.10 | 0.09 | 0.08 | 0.07 | 0.07 | 0.06 | 0.05 | 0.05 | 0.04 | 0.04 | 0.34 |
| 1966 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.06 |
| 1967 | 0.05 | 0.05 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 | 0.15 |
| 1968 | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.09 |
| 1969 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.08 |
| 1970 | 0.05 | 0.05 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 | 0.15 |
| 1971 | 0.09 | 0.08 | 0.08 | 0.07 | 0.06 | 0.06 | 0.05 | 0.04 | 0.04 | 0.04 | 0.03 | 0.28 |
| 1972 | 0.06 | 0.05 | 0.05 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.17 |
| 1973 | 0.19 | 0.17 | 0.16 | 0.14 | 0.13 | 0.12 | 0.10 | 0.09 | 0.08 | 0.08 | 0.07 | 0.60 |
| 1974 | 0.44 | 0.39 | 0.36 | 0.32 | 0.29 | 0.26 | 0.24 | 0.21 | 0.19 | 0.17 | 0.16 | 1.37 |
| 1975 | 0.75 | 0.68 | 0.61 | 0.55 | 0.50 | 0.45 | 0.41 | 0.37 | 0.33 | 0.30 | 0.27 | 2.38 |
| 1976 | 0.73 | 0.66 | 0.59 | 0.54 | 0.48 | 0.44 | 0.40 | 0.36 | 0.33 | 0.29 | 0.26 | 2.33 |
| 1977 | 0.41 | 0.37 | 0.34 | 0.30 | 0.27 | 0.25 | 0.23 | 0.20 | 0.19 | 0.17 | 0.15 | 1.33 |
| 1978 | 0.82 | 0.74 | 0.67 | 0.61 | 0.55 | 0.50 | 0.45 | 0.41 | 0.37 | 0.34 | 0.30 | 2.69 |
| 1979 | 0.78 | 0.70 | 0.64 | 0.57 | 0.52 | 0.47 | 0.43 | 0.39 | 0.35 | 0.32 | 0.29 | 2.57 |
| 1980 | 1.47 | 1.32 | 1.19 | 1.08 | 0.97 | 0.88 | 0.80 | 0.72 | 0.65 | 0.59 | 0.54 | 4.84 |
| 1981 | 5.16 | 4.62 | 4.16 | 3.76 | 3.40 | 3.07 | 2.78 | 2.52 | 2.28 | 2.07 | 1.88 | 17.03 |
| 1982 | 15.83 | 14.12 | 12.66 | 11.41 | 10.31 | 9.32 | 8.44 | 7.64 | 6.93 | 6.28 | 5.69 | 51.97 |
| 1983 | 8.63 | 7.70 | 6.87 | 6.17 | 5.56 | 5.03 | 4.55 | 4.12 | 3.73 | 3.38 | 3.07 | 28.17 |
| 1984 | 5.55 | 4.96 | 4.43 | 3.96 | 3.56 | 3.21 | 2.90 | 2.63 | 2.38 | 2.16 | 1.95 | 18.05 |
| 1985 | 4.50 | 4.02 | 3.60 | 3.22 | 2.88 | 2.58 | 2.33 | 2.11 | 1.91 | 1.73 | 1.57 | 14.56 |
| 1986 | 3.55 | 3.16 | 2.82 | 2.53 | 2.26 | 2.02 | 1.82 | 1.64 | 1.49 | 1.35 | 1.22 | 11.37 |
| 1987 | 0.67 | 0.58 | 0.52 | 0.47 | 0.42 | 0.37 | 0.33 | 0.30 | 0.27 | 0.25 | 0.22 | 2.09 |
| 1988 | 1.18 | 0.93 | 0.81 | 0.72 | 0.65 | 0.58 | 0.52 | 0.47 | 0.42 | 0.38 | 0.34 | 3.22 |
| 1989 | 1.84 | 1.36 | 1.07 | 0.94 | 0.84 | 0.75 | 0.67 | 0.60 | 0.54 | 0.49 | 0.44 | 4.12 |
| 1990 | 1.98 | 1.25 | 0.92 | 0.73 | 0.64 | 0.57 | 0.51 | 0.46 | 0.41 | 0.37 | 0.33 | 3.10 |
| 1991 | 2.13 | 1.34 | 0.84 | 0.62 | 0.49 | 0.43 | 0.39 | 0.35 | 0.31 | 0.28 | 0.25 | 2.33 |
| 1992 | 2.16 | 1.26 | 0.79 | 0.50 | 0.37 | 0.29 | 0.26 | 0.23 | 0.21 | 0.18 | 0.17 | 1.54 |
| 1993 | 1.40 | 0.81 | 0.47 | 0.30 | 0.19 | 0.14 | 0.11 | 0.10 | 0.09 | 0.08 | 0.07 | 0.64 |
| 1994 | 0.26 | 0.19 | 0.11 | 0.06 | 0.04 | 0.03 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.10 |
| 1995 | 0.06 | 0.04 | 0.03 | 0.02 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 |
| 1996 | 0.02 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1997 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1998 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1999 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2000 | 0.07 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2001 | 0.08 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2002 | 0.04 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2003 | 0.03 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2004 | 0.05 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2005 | 0.05 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2006 | 0.10 | 0.03 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2007 | 0.12 | 0.03 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2008 | 0.18 | 0.08 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2009 | 0.37 | 0.12 | 0.05 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2010 | 0.43 | 0.26 | 0.09 | 0.04 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2011 | 0.92 | 0.30 | 0.18 | 0.06 | 0.03 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2012 | 2.41 | 0.85 | 0.28 | 0.17 | 0.06 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2013 | 3.38 | 1.84 | 0.65 | 0.21 | 0.13 | 0.04 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2014 | 2.39 | 2.64 | 1.44 | 0.51 | 0.17 | 0.10 | 0.03 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |

*Table 12. Estimated status indicators, benchmarks, and related quantities from the base run of the Beaufort Assessment Model, conditional on estimated current selectivities averaged across fleets. Also presented are median values and measures of precision (standard errors, SE) from the Monte Carlo/Bootstrap analysis. Rate estimates (F) are in units of* $y^{-1}$*; status indicators are dimensionless; and biomass estimates are in units of metric tons or gutted pounds, as indicated. Spawning stock biomass (SSB) and minimum stock size threshold (MSST) are measured by total gonad weight of mature females. The definition of* MSST *is* $\text{MSST} = 75\%\text{SSB}_{\text{MSY}}$.

| Quantity | Units | Estimate | Median | SE |
|---|---|---|---|---|
| $F_{\text{MSY}}$ | $y^{-1}$ | 0.25 | 0.28 | 0.38 |
| $85\%F_{\text{MSY}}$ | $y^{-1}$ | 0.21 | 0.24 | 0.33 |
| $75\%F_{\text{MSY}}$ | $y^{-1}$ | 0.18 | 0.21 | 0.29 |
| $65\%F_{\text{MSY}}$ | $y^{-1}$ | 0.16 | 0.18 | 0.25 |
| $F_{30\%}$ | $y^{-1}$ | 0.18 | 0.24 | 0.37 |
| $F_{40\%}$ | $y^{-1}$ | 0.11 | 0.14 | 0.12 |
| $F_{50\%}$ | $y^{-1}$ | 0.07 | 0.09 | 0.06 |
| $B_{\text{MSY}}$ | mt | 2468.3 | 2736.1 | 1170.9 |
| $\text{SSB}_{\text{MSY}}$ | mt | 20.9 | 25.2 | 22.5 |
| MSST | mt | 15.7 | 18.9 | 16.9 |
| MSY | 1000 lb | 537.4 | 488.9 | 80.0 |
| $R_{\text{MSY}}$ | 1000 age-1 fish | 355.0 | 333.9 | 271.2 |
| Y at $85\%F_{\text{MSY}}$ | 1000 lb | 534.8 | 486.9 | 80.5 |
| Y at $75\%F_{\text{MSY}}$ | 1000 lb | 529.3 | 482.6 | 81.5 |
| Y at $65\%F_{\text{MSY}}$ | 1000 lb | 519.1 | 474.9 | 83.2 |
| $F_{2012-2014}/F_{\text{MSY}}$ | — | 1.35 | 2.49 | 2.04 |
| $\text{SSB}_{2014}/\text{MSST}$ | — | 1.09 | 0.86 | 1.06 |
| $\text{SSB}_{2014}/\text{SSB}_{\text{MSY}}$ | — | 0.81 | 0.65 | 0.80 |

*Table 13. Projection results for Scenario1: fishing mortality rate fixed to achieve* $P^{\star} = 0.30$ *starting in 2019, and with the status quo ACL in 2018. R = number of age-1 recruits (1000 fish), N = total stock abundance (1000 fish), F = fishing mortality rate (per year), S = spawning stock (mt), B = total stock biomass (mt), L = landings expressed in numbers (1000 fish) and gutted weight (w, in 1000* lb*), and pr.msst=proportion of stochastic projection replicates with* SSB $\geq$ MSST *using the 75% definition of* MSST*. All values except year and probabilities are medians from the stochastic projections.*

| Year | R | N | F | S(mt) | B(mt) | L(n) | L(w) | pr.msst |
|---|---|---|---|---|---|---|---|---|
| 2015 | 234 | 1324 | 0.871 | 13 | 1883 | 62 | 505 | 0.388 |
| 2016 | 227 | 1306 | 0.871 | 13 | 1872 | 59 | 478 | 0.386 |
| 2017 | 228 | 1296 | 1.236 | 12 | 1876 | 70 | 558 | 0.379 |
| 2018 | 223 | 1272 | 1.378 | 12 | 1838 | 73 | 558 | 0.374 |
| 2019 | 217 | 1247 | 0.148 | 13 | 1797 | 14 | 108 | 0.412 |
| 2020 | 223 | 1294 | 0.148 | 15 | 1958 | 19 | 162 | 0.489 |
| 2021 | 236 | 1336 | 0.148 | 16 | 2083 | 24 | 207 | 0.562 |
| 2022 | 248 | 1384 | 0.148 | 18 | 2187 | 27 | 239 | 0.621 |
| 2023 | 253 | 1419 | 0.148 | 19 | 2274 | 29 | 266 | 0.670 |
| 2024 | 258 | 1452 | 0.148 | 20 | 2349 | 31 | 288 | 0.714 |

*Table 14. Projection results for Scenario2: fishing mortality rate fixed to achieve* $P^{\star} = 0.30$ *starting in 2019, and with the reduced ACL in 2018. R = number of age-1 recruits (1000 fish), N = total stock abundance (1000 fish), F = fishing mortality rate (per year), S = spawning stock (mt), B = total stock biomass (mt), L = landings expressed in numbers (1000 fish) and gutted weight (w, in 1000* lb*), and pr.msst=proportion of stochastic projection replicates with* SSB $\geq$ MSST *using the 75% definition of* MSST*. All values except year and probabilities are medians from the stochastic projections.*

| Year | R | N | F | S(mt) | B(mt) | L(n) | L(w) | pr.msst |
|---|---|---|---|---|---|---|---|---|
| 2015 | 234 | 1324 | 0.871 | 13 | 1883 | 62 | 505 | 0.388 |
| 2016 | 227 | 1306 | 0.871 | 13 | 1872 | 59 | 478 | 0.386 |
| 2017 | 228 | 1296 | 1.236 | 12 | 1876 | 70 | 558 | 0.379 |
| 2018 | 223 | 1272 | 0.649 | 13 | 1838 | 41 | 323 | 0.404 |
| 2019 | 223 | 1286 | 0.148 | 14 | 1915 | 17 | 137 | 0.459 |
| 2020 | 232 | 1332 | 0.148 | 16 | 2056 | 22 | 188 | 0.536 |
| 2021 | 243 | 1374 | 0.148 | 17 | 2166 | 26 | 228 | 0.604 |
| 2022 | 253 | 1416 | 0.148 | 19 | 2258 | 29 | 258 | 0.657 |
| 2023 | 258 | 1448 | 0.148 | 20 | 2340 | 31 | 283 | 0.705 |
| 2024 | 262 | 1479 | 0.148 | 21 | 2407 | 33 | 302 | 0.746 |

*Table 15. Projection results for Scenario3: fishing mortality rate fixed to achieve $P^{\star} = 0.40$ starting in 2019, and with the status quo ACL in 2018. R = number of age-1 recruits (1000 fish), N = total stock abundance (1000 fish), F = fishing mortality rate (per year), S = spawning stock (mt), B = total stock biomass (mt), L = landings expressed in numbers (1000 fish) and gutted weight (w, in 1000* lb*), and pr.msst=proportion of stochastic projection replicates with* SSB $\geq$ MSST *using the 75% definition of* MSST*. All values except year and probabilities are medians from the stochastic projections.*

| Year | R | N | F | S(mt) | B(mt) | L(n) | L(w) | pr.msst |
|---|---|---|---|---|---|---|---|---|
| 2015 | 234 | 1324 | 0.871 | 13 | 1883 | 62 | 505 | 0.388 |
| 2016 | 227 | 1306 | 0.871 | 13 | 1872 | 59 | 478 | 0.386 |
| 2017 | 228 | 1296 | 1.236 | 12 | 1876 | 70 | 558 | 0.379 |
| 2018 | 223 | 1272 | 1.378 | 12 | 1838 | 73 | 558 | 0.374 |
| 2019 | 217 | 1247 | 0.215 | 13 | 1797 | 20 | 153 | 0.405 |
| 2020 | 222 | 1287 | 0.215 | 14 | 1928 | 26 | 219 | 0.468 |
| 2021 | 234 | 1319 | 0.215 | 16 | 2022 | 32 | 271 | 0.530 |
| 2022 | 245 | 1358 | 0.215 | 17 | 2097 | 35 | 305 | 0.581 |
| 2023 | 249 | 1384 | 0.215 | 17 | 2158 | 37 | 332 | 0.620 |
| 2024 | 253 | 1408 | 0.215 | 18 | 2208 | 39 | 353 | 0.655 |

*Table 16. Projection results for Scenario4: fishing mortality rate fixed to achieve $P^{\star} = 0.40$ starting in 2019, and with the reduced ACL in 2018. R = number of age-1 recruits (1000 fish), N = total stock abundance (1000 fish), F = fishing mortality rate (per year), S = spawning stock (mt), B = total stock biomass (mt), L = landings expressed in numbers (1000 fish) and gutted weight (w, in 1000* lb*), and pr.msst=proportion of stochastic projection replicates with* SSB $\geq$ MSST *using the 75% definition of* MSST*. All values except year and probabilities are medians from the stochastic projections.*

| Year | R | N | F | S(mt) | B(mt) | L(n) | L(w) | pr.msst |
|---|---|---|---|---|---|---|---|---|
| 2015 | 234 | 1324 | 0.871 | 13 | 1883 | 62 | 505 | 0.388 |
| 2016 | 227 | 1306 | 0.871 | 13 | 1872 | 59 | 478 | 0.386 |
| 2017 | 228 | 1296 | 1.236 | 12 | 1876 | 70 | 558 | 0.379 |
| 2018 | 223 | 1272 | 0.649 | 13 | 1838 | 41 | 323 | 0.404 |
| 2019 | 223 | 1286 | 0.215 | 14 | 1915 | 24 | 194 | 0.451 |
| 2020 | 231 | 1322 | 0.215 | 15 | 2020 | 30 | 252 | 0.514 |
| 2021 | 241 | 1355 | 0.215 | 16 | 2098 | 34 | 296 | 0.572 |
| 2022 | 250 | 1387 | 0.215 | 17 | 2160 | 37 | 328 | 0.615 |
| 2023 | 253 | 1410 | 0.215 | 18 | 2212 | 39 | 350 | 0.652 |
| 2024 | 257 | 1431 | 0.215 | 19 | 2258 | 40 | 367 | 0.687 |

*Table 17. Projection results for Scenario5: fishing mortality rate fixed to achieve $P^{\star} = 0.45$ starting in 2019, and with the status quo ACL in 2018. R = number of age-1 recruits (1000 fish), N = total stock abundance (1000 fish), F = fishing mortality rate (per year), S = spawning stock (mt), B = total stock biomass (mt), L = landings expressed in numbers (1000 fish) and gutted weight (w, in 1000* lb*), and pr.msst=proportion of stochastic projection replicates with* SSB $\geq$ MSST *using the 75% definition of* MSST*. All values except year and probabilities are medians from the stochastic projections.*

| Year | R | N | F | S(mt) | B(mt) | L(n) | L(w) | pr.msst |
|---|---|---|---|---|---|---|---|---|
| 2015 | 234 | 1324 | 0.871 | 13 | 1883 | 62 | 505 | 0.388 |
| 2016 | 227 | 1306 | 0.871 | 13 | 1872 | 59 | 478 | 0.386 |
| 2017 | 228 | 1296 | 1.236 | 12 | 1876 | 70 | 558 | 0.379 |
| 2018 | 223 | 1272 | 1.378 | 12 | 1838 | 73 | 558 | 0.374 |
| 2019 | 217 | 1247 | 0.257 | 13 | 1797 | 23 | 179 | 0.401 |
| 2020 | 222 | 1282 | 0.257 | 14 | 1910 | 30 | 250 | 0.455 |
| 2021 | 233 | 1310 | 0.257 | 15 | 1990 | 36 | 303 | 0.506 |
| 2022 | 243 | 1344 | 0.257 | 16 | 2049 | 39 | 337 | 0.551 |
| 2023 | 247 | 1364 | 0.257 | 17 | 2098 | 41 | 362 | 0.586 |
| 2024 | 250 | 1383 | 0.257 | 17 | 2138 | 43 | 380 | 0.616 |

*Table 18. Projection results for Scenario6: fishing mortality rate fixed to achieve $P^{\star} = 0.45$ starting in 2019, and with the reduced ACL in 2018. R = number of age-1 recruits (1000 fish), N = total stock abundance (1000 fish), F = fishing mortality rate (per year), S = spawning stock (mt), B = total stock biomass (mt), L = landings expressed in numbers (1000 fish) and gutted weight (w, in 1000* lb*), and pr.msst=proportion of stochastic projection replicates with* SSB $\geq$ MSST *using the 75% definition of* MSST*. All values except year and probabilities are medians from the stochastic projections.*

| Year | R | N | F | S(mt) | B(mt) | L(n) | L(w) | pr.msst |
|---|---|---|---|---|---|---|---|---|
| 2015 | 234 | 1324 | 0.871 | 13 | 1883 | 62 | 505 | 0.388 |
| 2016 | 227 | 1306 | 0.871 | 13 | 1872 | 59 | 478 | 0.386 |
| 2017 | 228 | 1296 | 1.236 | 12 | 1876 | 70 | 558 | 0.379 |
| 2018 | 223 | 1272 | 0.649 | 13 | 1838 | 41 | 323 | 0.404 |
| 2019 | 223 | 1286 | 0.257 | 14 | 1915 | 28 | 228 | 0.448 |
| 2020 | 231 | 1318 | 0.257 | 15 | 1999 | 34 | 286 | 0.500 |
| 2021 | 240 | 1344 | 0.257 | 16 | 2061 | 38 | 331 | 0.549 |
| 2022 | 248 | 1372 | 0.257 | 17 | 2107 | 41 | 360 | 0.587 |
| 2023 | 251 | 1390 | 0.257 | 17 | 2148 | 43 | 380 | 0.617 |
| 2024 | 254 | 1406 | 0.257 | 18 | 2182 | 44 | 393 | 0.645 |

*Table 19. Projection results for Scenario7: fishing mortality rate $F = 0.75F_{\text{MSY}}$ starting in 2019, and with the status quo ACL in 2018. R = number of age-1 recruits (1000 fish), N = total stock abundance (1000 fish), F = fishing mortality rate (per year), S = spawning stock (mt), B = total stock biomass (mt), L = landings expressed in numbers (1000 fish) and gutted weight (w, in 1000* lb*), and pr.msst=proportion of stochastic projection replicates with* SSB $\geq$ MSST *using the 75% definition of* MSST*. All values except year and probabilities are medians from the stochastic projections.*

| Year | R | N | F | S(mt) | B(mt) | L(n) | L(w) | pr.msst |
|---|---|---|---|---|---|---|---|---|
| 2015 | 234 | 1324 | 0.871 | 13 | 1883 | 62 | 505 | 0.388 |
| 2016 | 227 | 1306 | 0.871 | 13 | 1872 | 59 | 478 | 0.386 |
| 2017 | 228 | 1296 | 1.236 | 12 | 1876 | 70 | 558 | 0.379 |
| 2018 | 223 | 1272 | 1.378 | 12 | 1838 | 73 | 558 | 0.374 |
| 2019 | 217 | 1247 | 0.210 | 13 | 1797 | 19 | 150 | 0.406 |
| 2020 | 223 | 1288 | 0.210 | 14 | 1931 | 26 | 215 | 0.469 |
| 2021 | 234 | 1320 | 0.210 | 16 | 2026 | 31 | 266 | 0.532 |
| 2022 | 245 | 1360 | 0.210 | 17 | 2103 | 34 | 301 | 0.584 |
| 2023 | 249 | 1386 | 0.210 | 18 | 2166 | 37 | 327 | 0.625 |
| 2024 | 254 | 1411 | 0.210 | 18 | 2217 | 39 | 349 | 0.660 |

*Table 20. Projection results for Scenario8: fishing mortality rate $F = 0.75F_{\text{MSY}}$ starting in 2019, and with the reduced ACL in 2018. R = number of age-1 recruits (1000 fish), N = total stock abundance (1000 fish), F = fishing mortality rate (per year), S = spawning stock (mt), B = total stock biomass (mt), L = landings expressed in numbers (1000 fish) and gutted weight (w, in 1000* lb*), and pr.msst=proportion of stochastic projection replicates with* SSB $\geq$ MSST *using the 75% definition of* MSST*. All values except year and probabilities are medians from the stochastic projections.*

| Year | R | N | F | S(mt) | B(mt) | L(n) | L(w) | pr.msst |
|---|---|---|---|---|---|---|---|---|
| 2015 | 234 | 1324 | 0.871 | 13 | 1883 | 62 | 505 | 0.388 |
| 2016 | 227 | 1306 | 0.871 | 13 | 1872 | 59 | 478 | 0.386 |
| 2017 | 228 | 1296 | 1.236 | 12 | 1876 | 70 | 558 | 0.379 |
| 2018 | 223 | 1272 | 0.649 | 13 | 1838 | 41 | 323 | 0.404 |
| 2019 | 223 | 1286 | 0.210 | 14 | 1915 | 23 | 190 | 0.452 |
| 2020 | 231 | 1323 | 0.210 | 15 | 2022 | 29 | 248 | 0.515 |
| 2021 | 241 | 1356 | 0.210 | 17 | 2102 | 33 | 292 | 0.575 |
| 2022 | 250 | 1389 | 0.210 | 17 | 2167 | 36 | 323 | 0.619 |
| 2023 | 254 | 1412 | 0.210 | 18 | 2221 | 38 | 346 | 0.657 |
| 2024 | 257 | 1434 | 0.210 | 19 | 2267 | 40 | 363 | 0.692 |

# 9 Figures

*Figure 1. Observed (open circles) and estimated (solid line) annual length and age compositions by fleet or survey. In panels indicating the data set, lcomp refers to length compositions, acomp to age compositions, cH to commercial handlines, cL to commercial longlines, rA to recreational, and mm to MARMAP chevron trap. Effective N indicates the estimated effective sample size.*

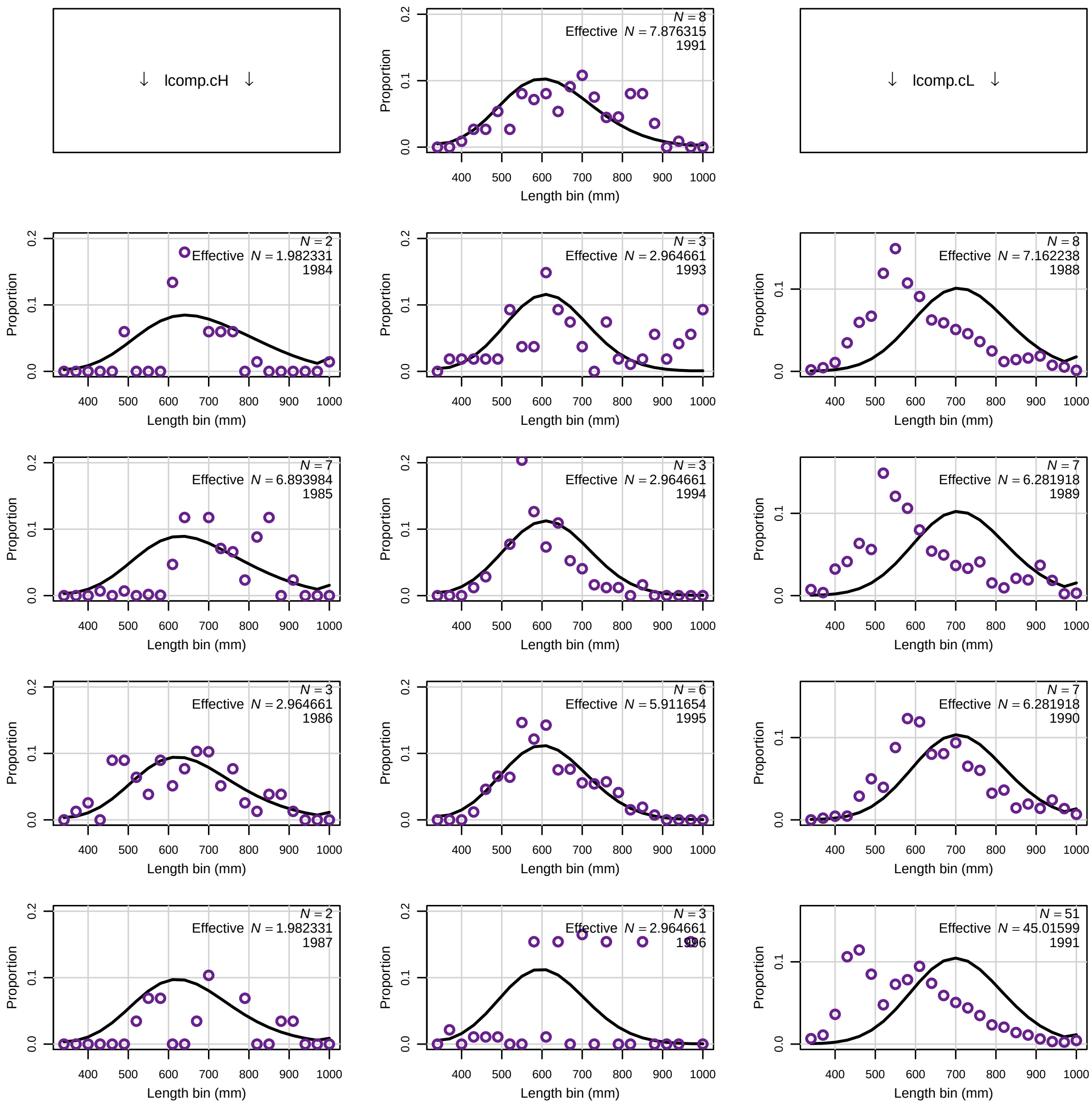


*Figure 1. (cont.) Observed (open circles) and estimated (solid line) annual length and age compositions by fleet or survey.*

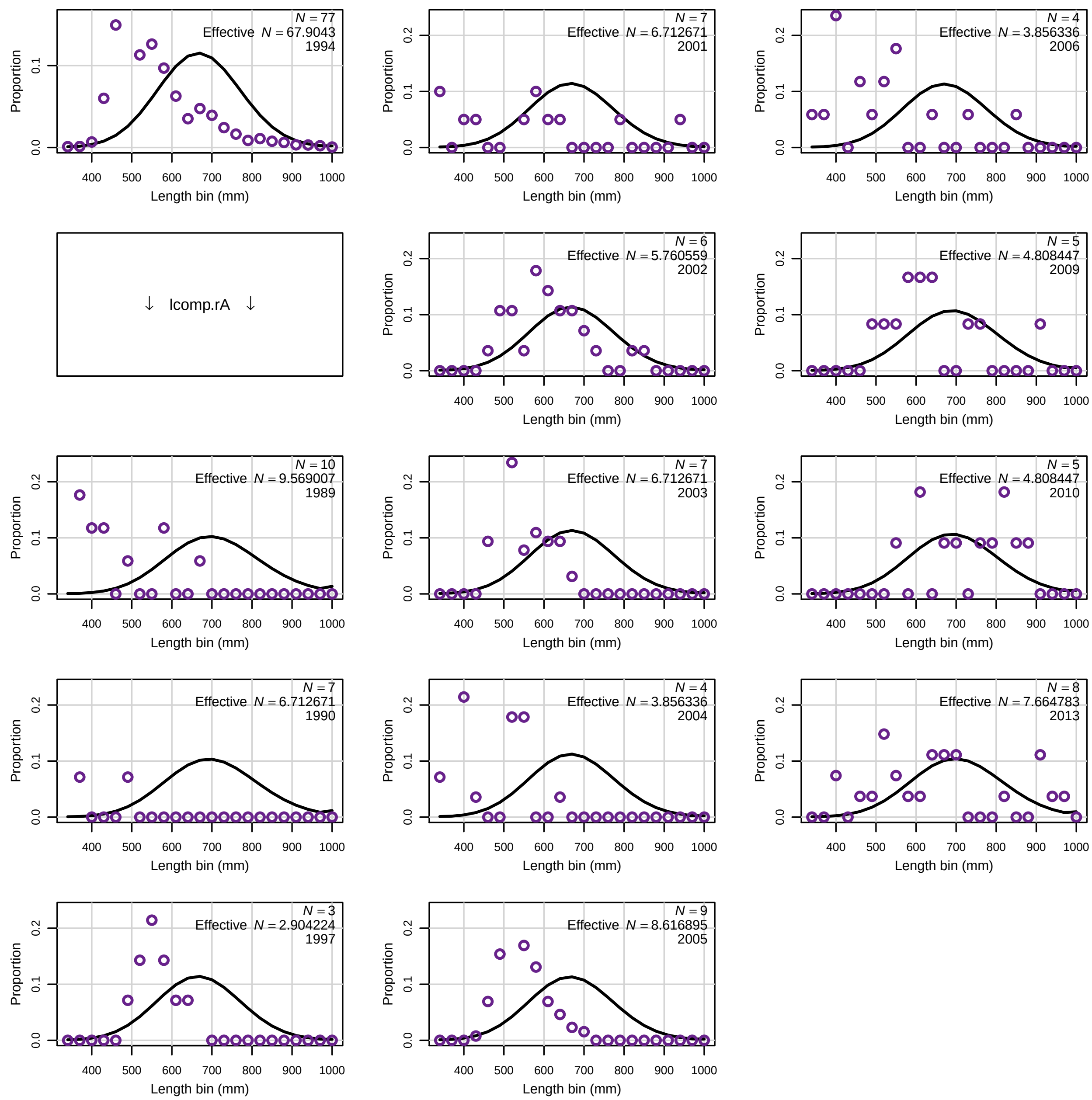


*Figure 1. (cont.) Observed (open circles) and estimated (solid line) annual length and age compositions by fleet or survey.*

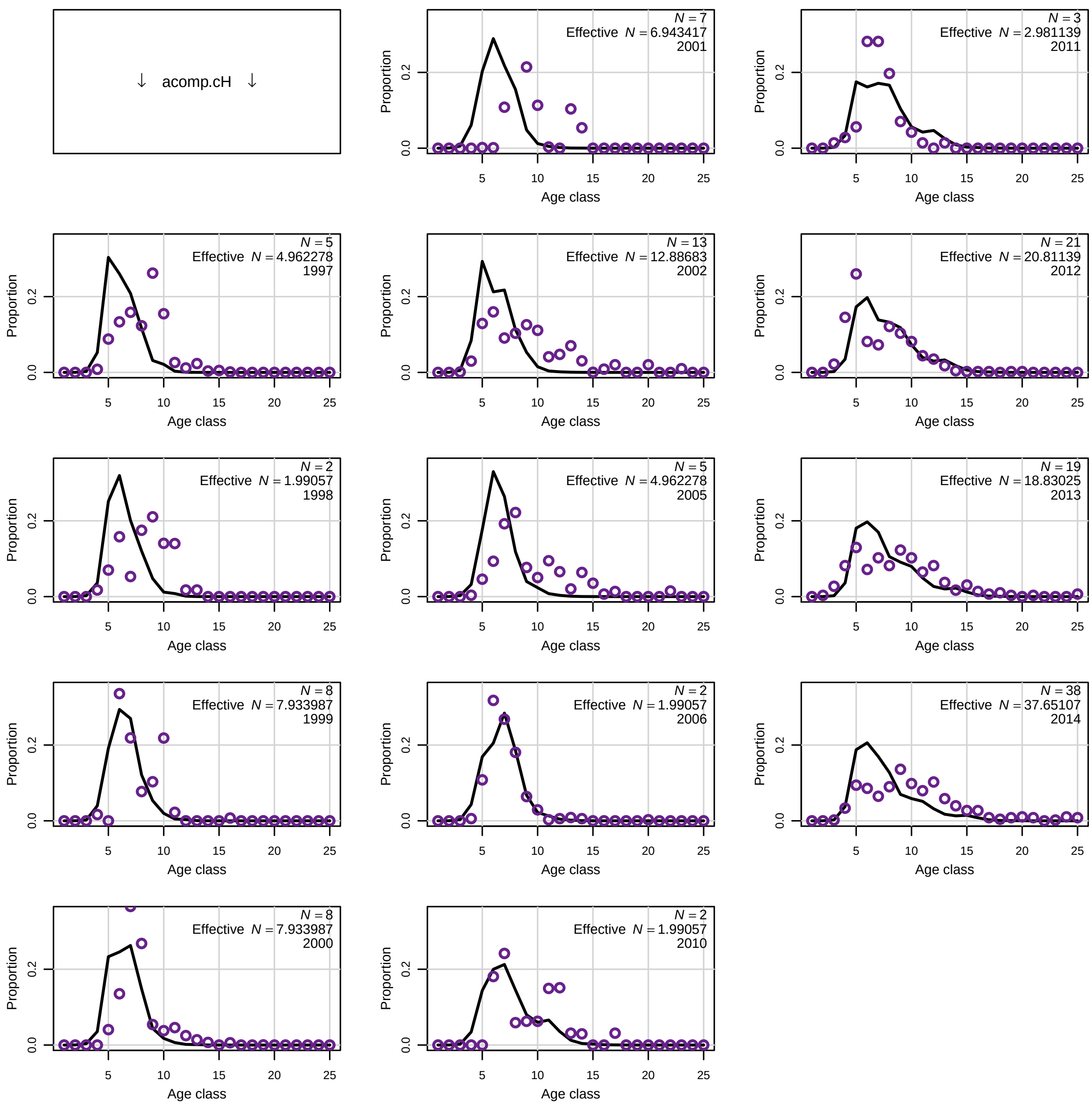


*Figure 1. (cont.) Observed (open circles) and estimated (solid line) annual length and age compositions by fleet or survey.*

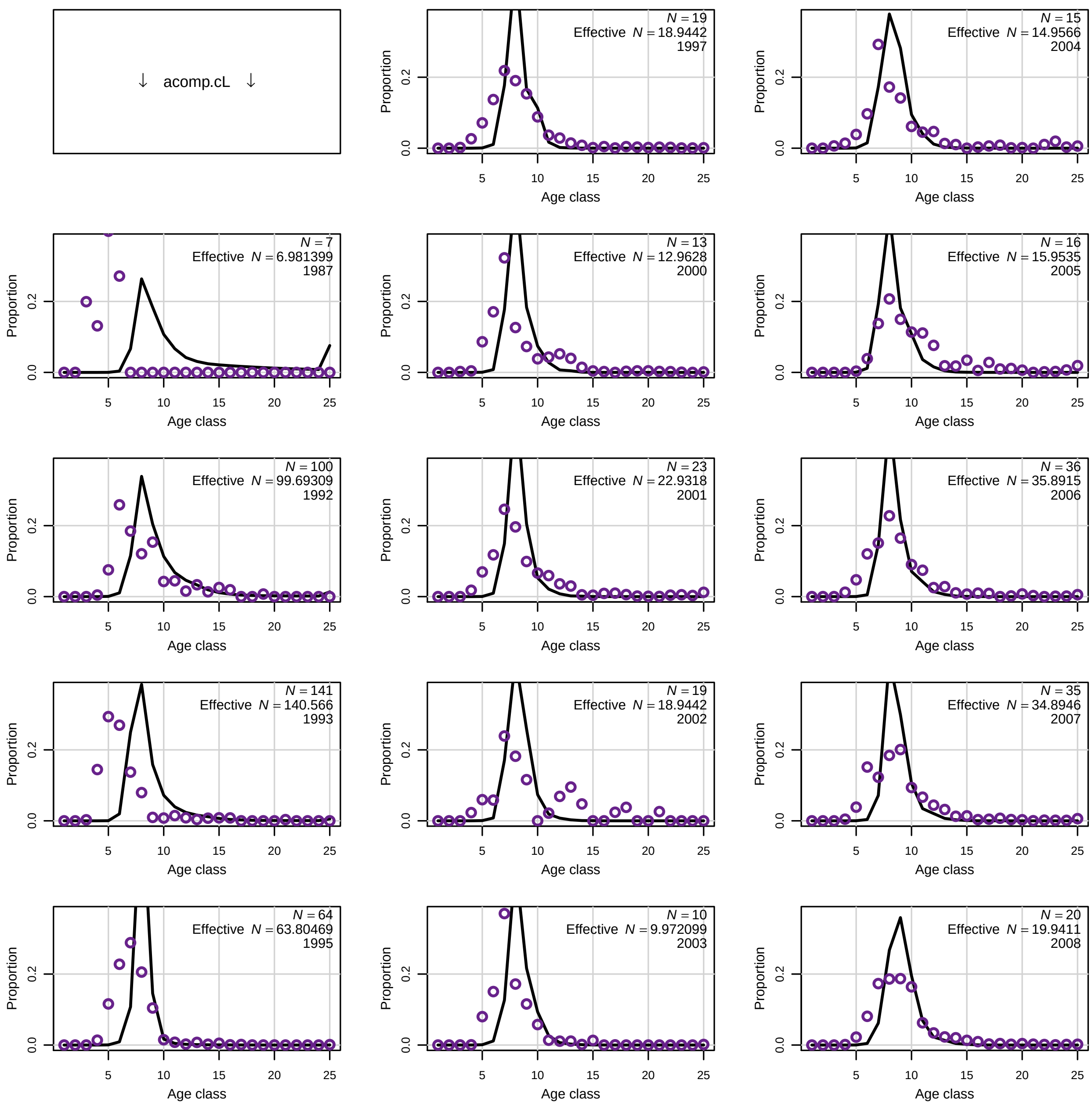


*Figure 1. (cont.) Observed (open circles) and estimated (solid line) annual length and age compositions by fleet or survey.*

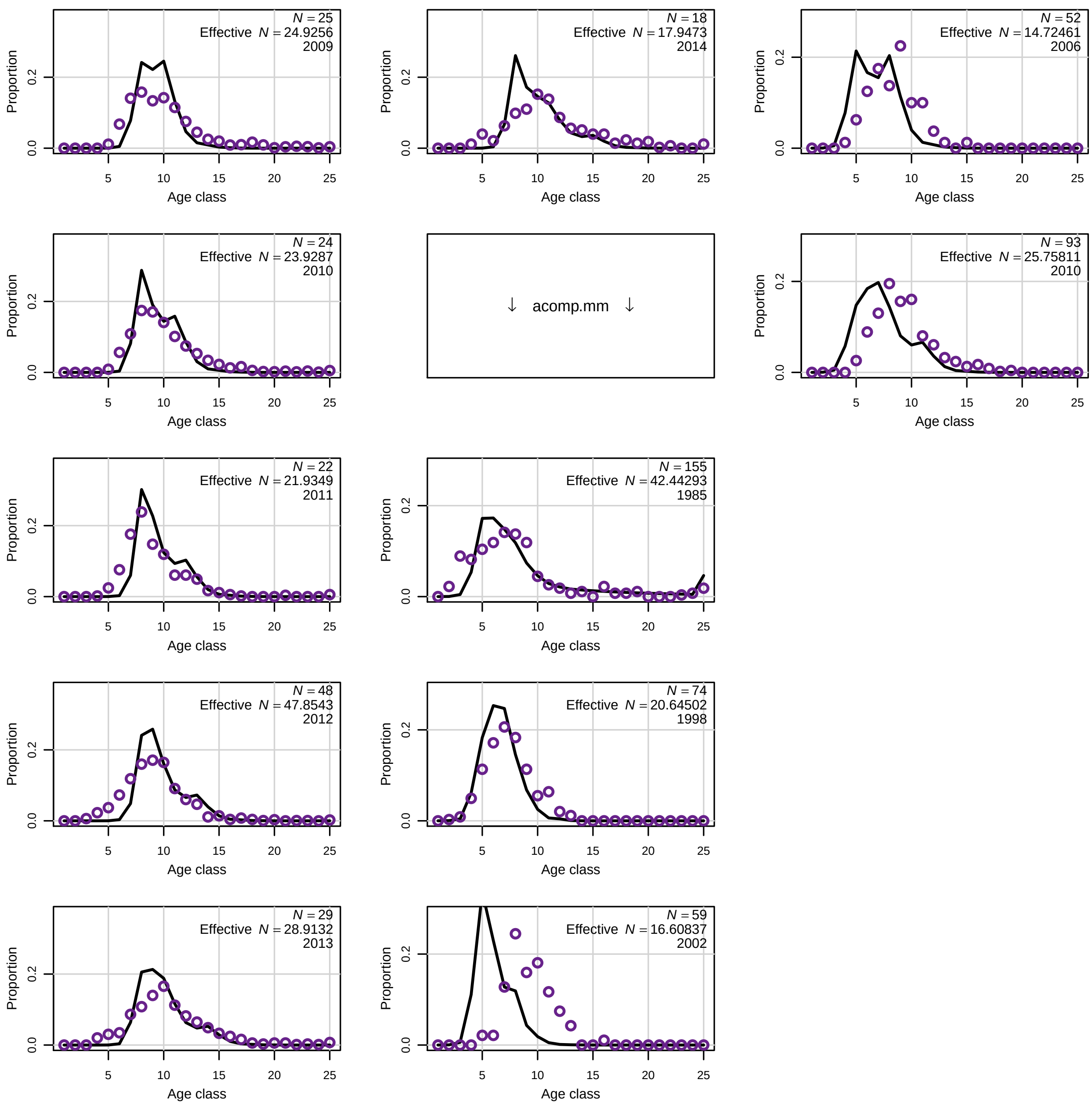


*Figure 2. Observed (open circles) and estimated (solid line, circles) commercial handline landings (1000 lb gutted weight). Open and solid circles may be indistinguishable in years with very close fits.*

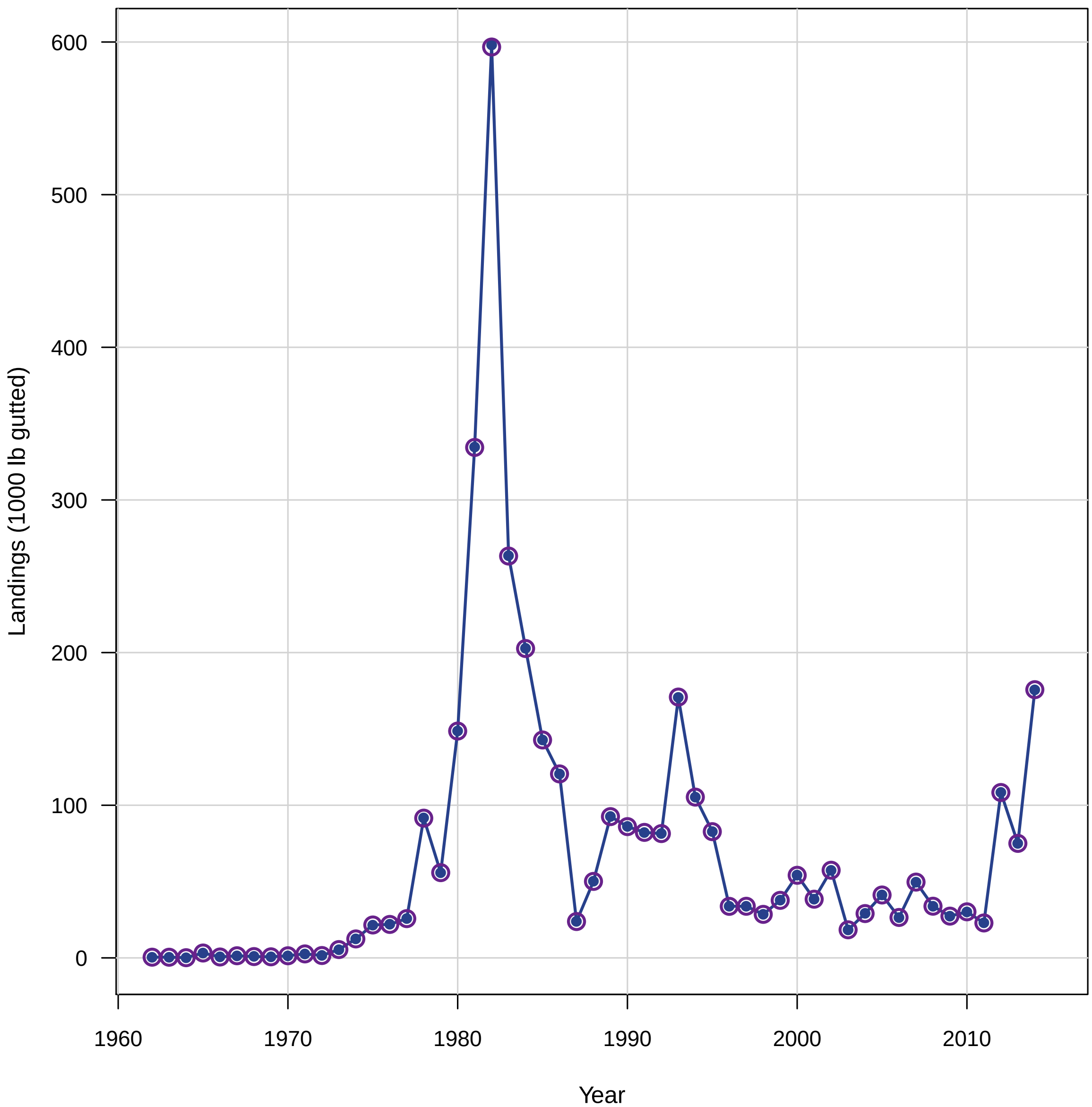


*Figure 3. Observed (open circles) and estimated (solid line, circles) commercial longline landings (1000 lb gutted weight). Open and solid circles may be indistinguishable in years with very close fits.*

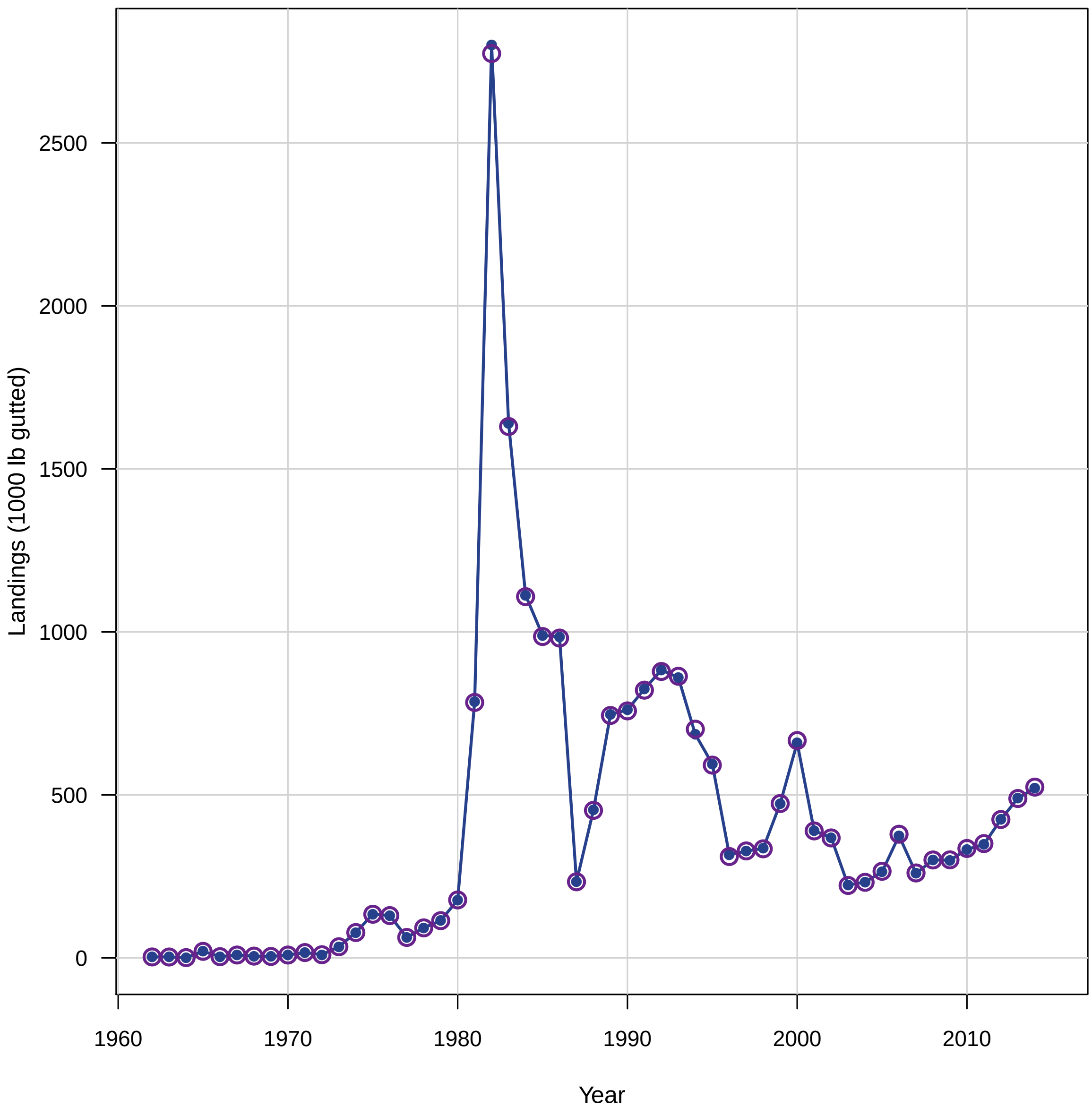


*Figure 4. Observed (open circles) and estimated (solid line, circles) recreational landings (1000 lb whole weight). Open and solid circles may be indistinguishable in years with very close fits.*

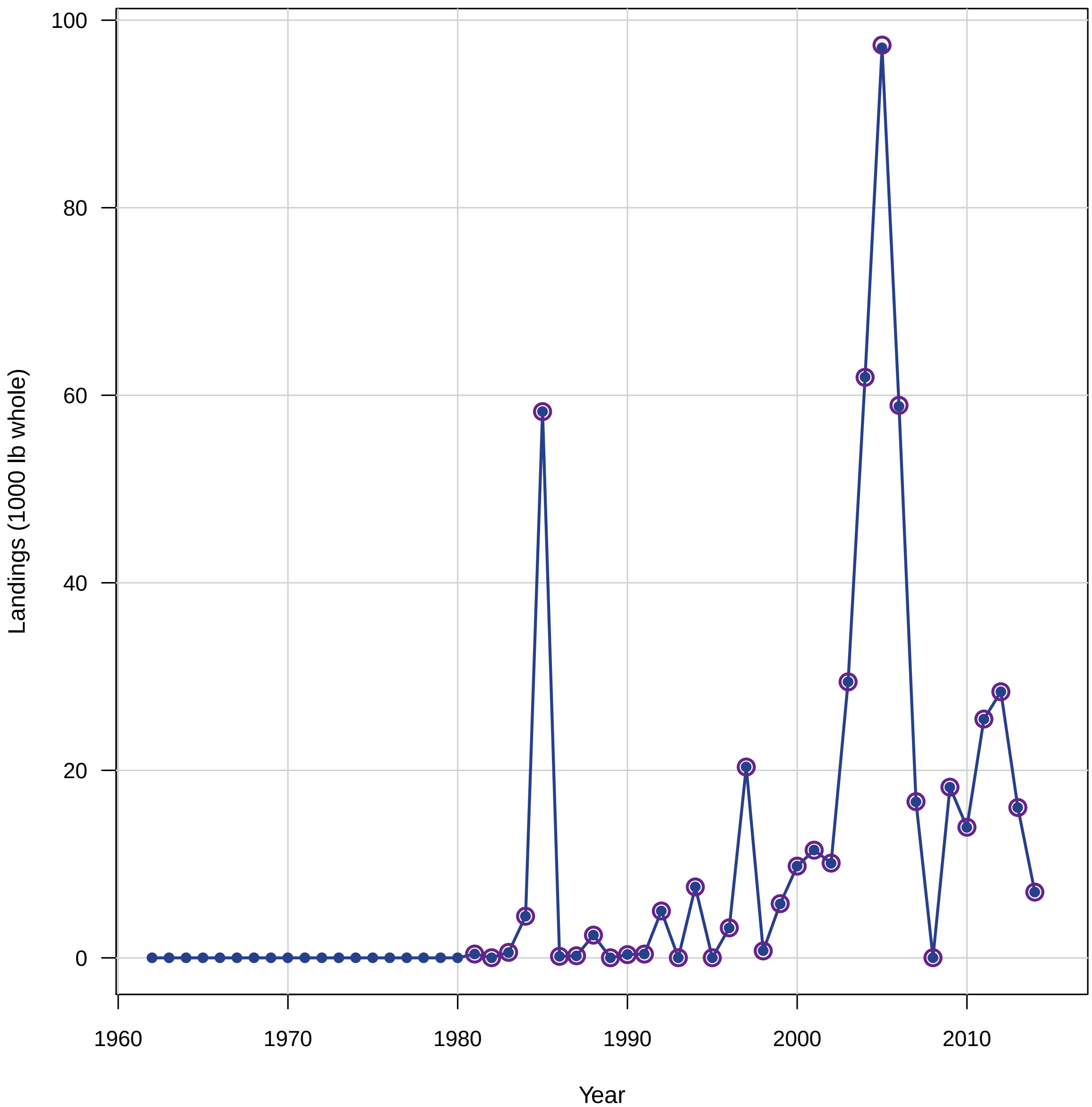


*Figure 5. Observed (open circles) and estimated (solid line, circles) index of abundance from the commercial handline fleet.*

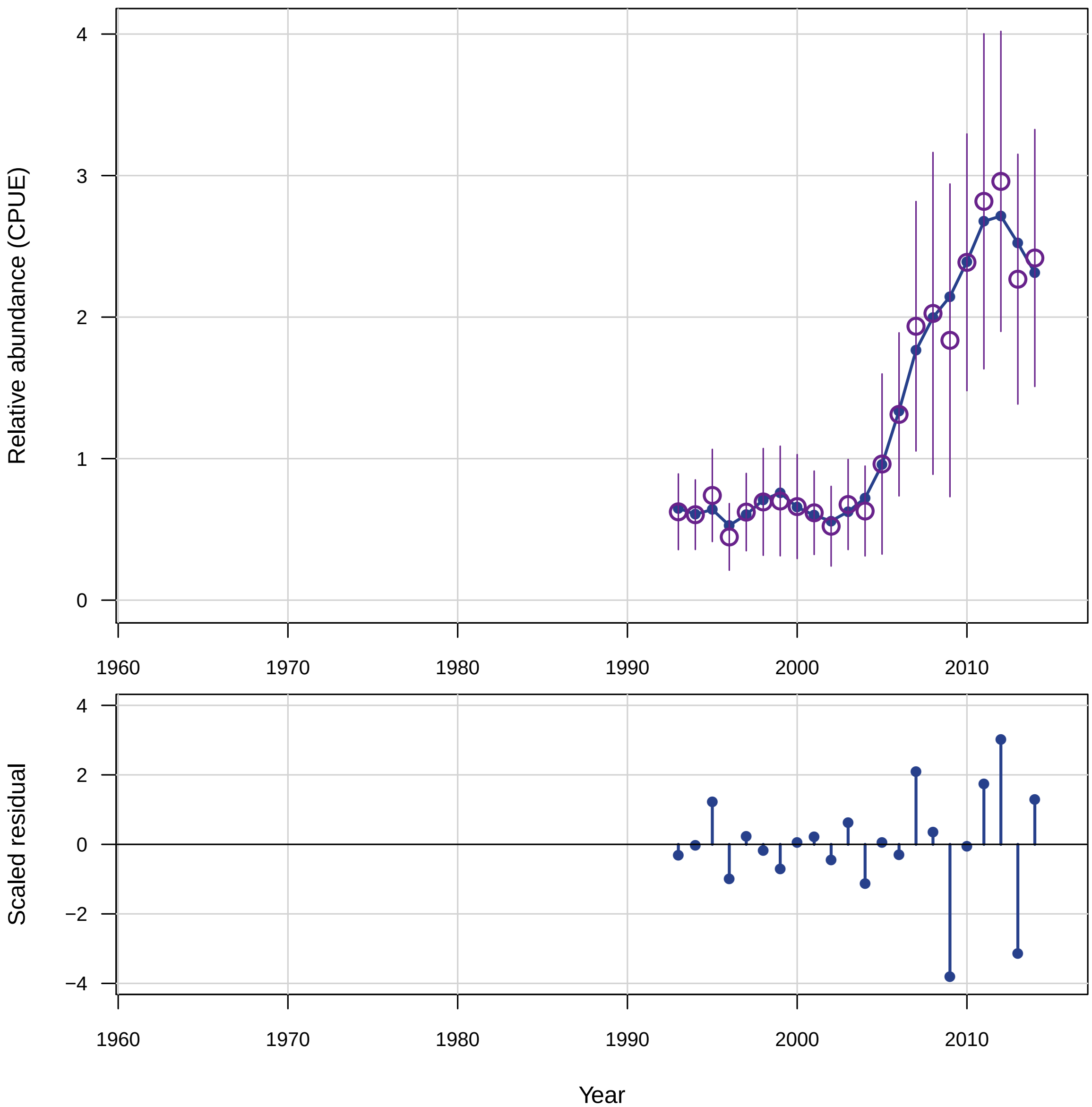


*Figure 6. Observed (open circles) and estimated (solid line, circles) index of abundance from the MARMAP chevron trap.*

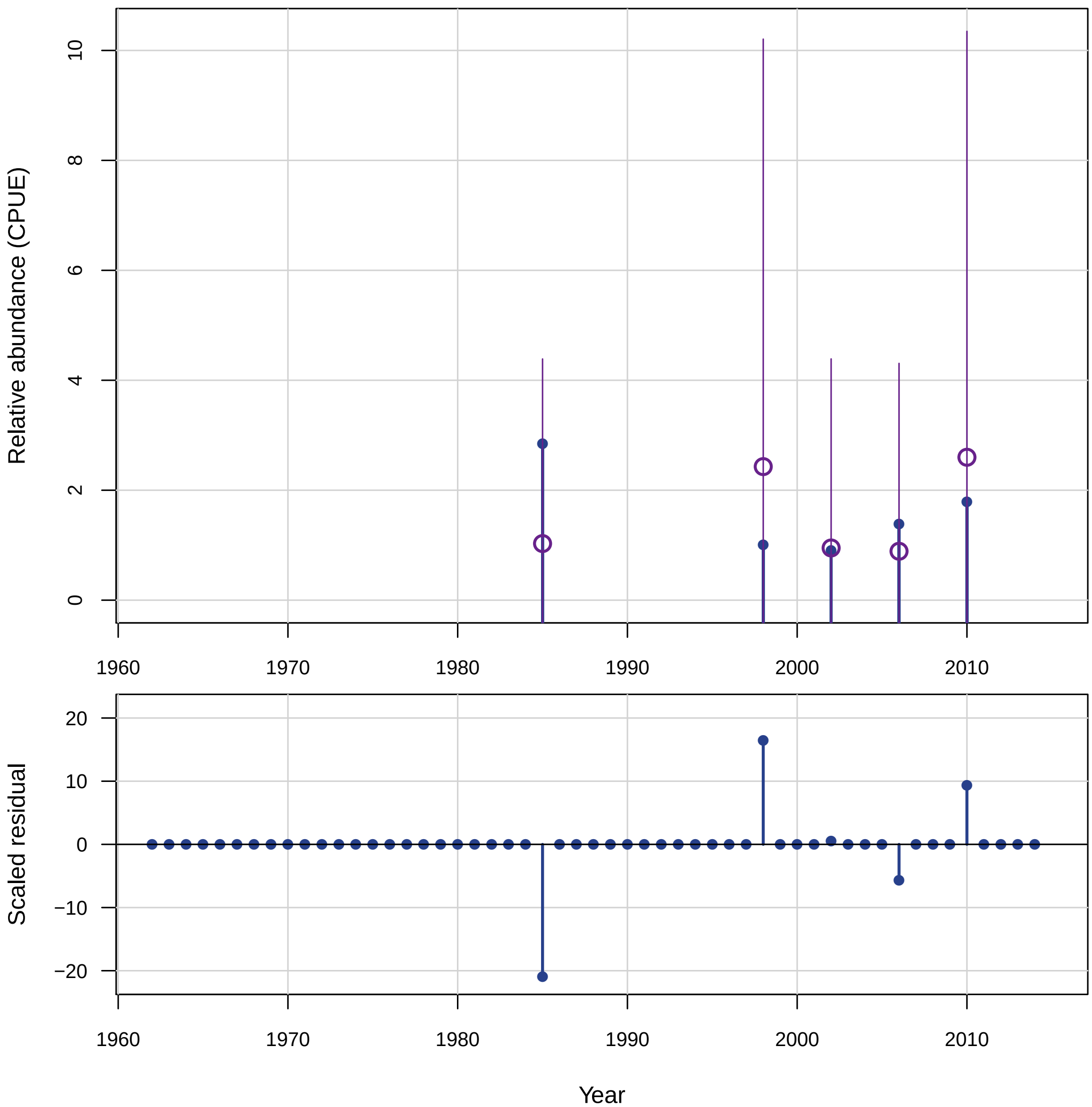


*Figure 7. Estimated abundance at age at start of year.*

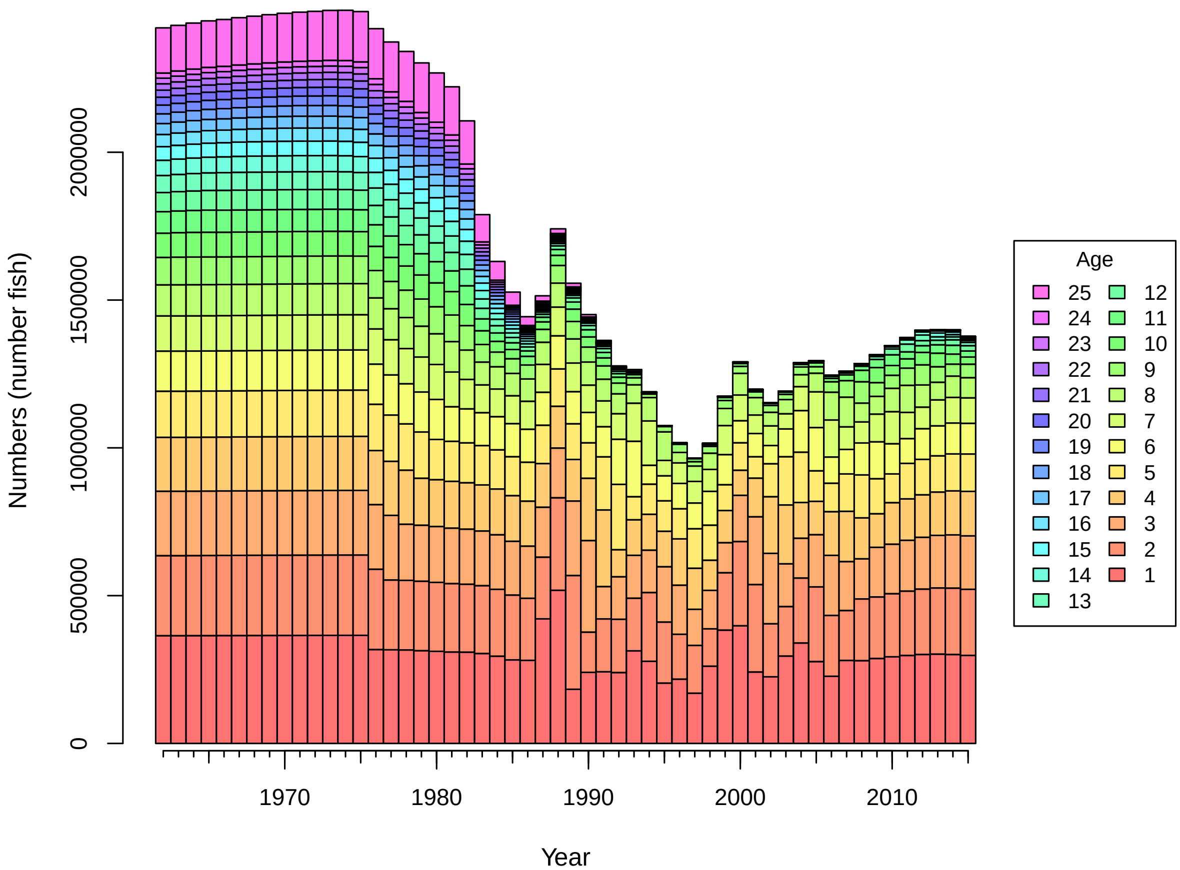


*Figure 8. Top panel: Estimated recruitment of age-1 fish. Horizontal dashed line indicates $R_{MSY}$. Bottom panel: log recruitment residuals. The residuals in 2008–2015 were not estimated, as recruitment in those years were uninformed by data on year-class strength. Thus, the 2008–2015 values shown in the top panel are those predicted from the spawner-recruit curve without deviation.*

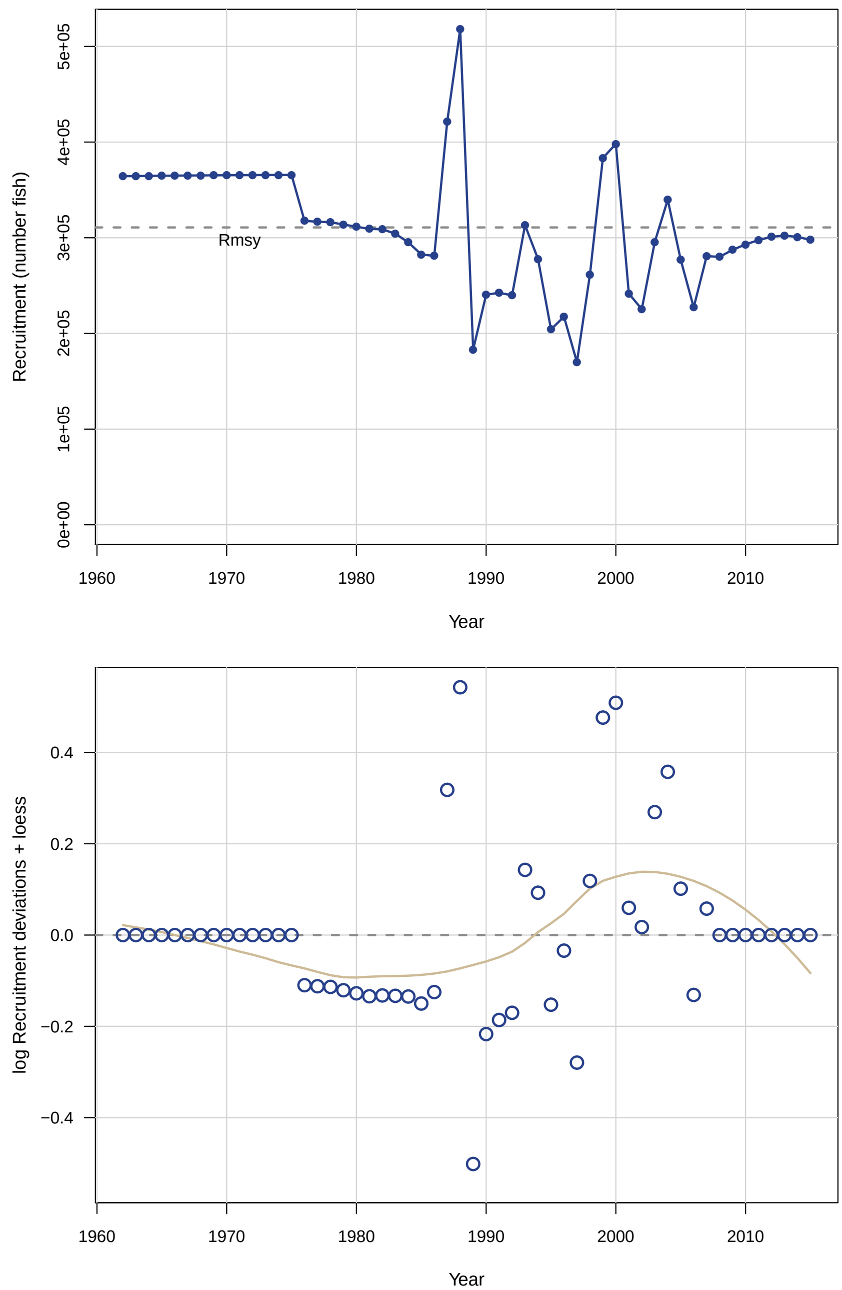


*Figure 9. Estimated biomass at age at start of year.*

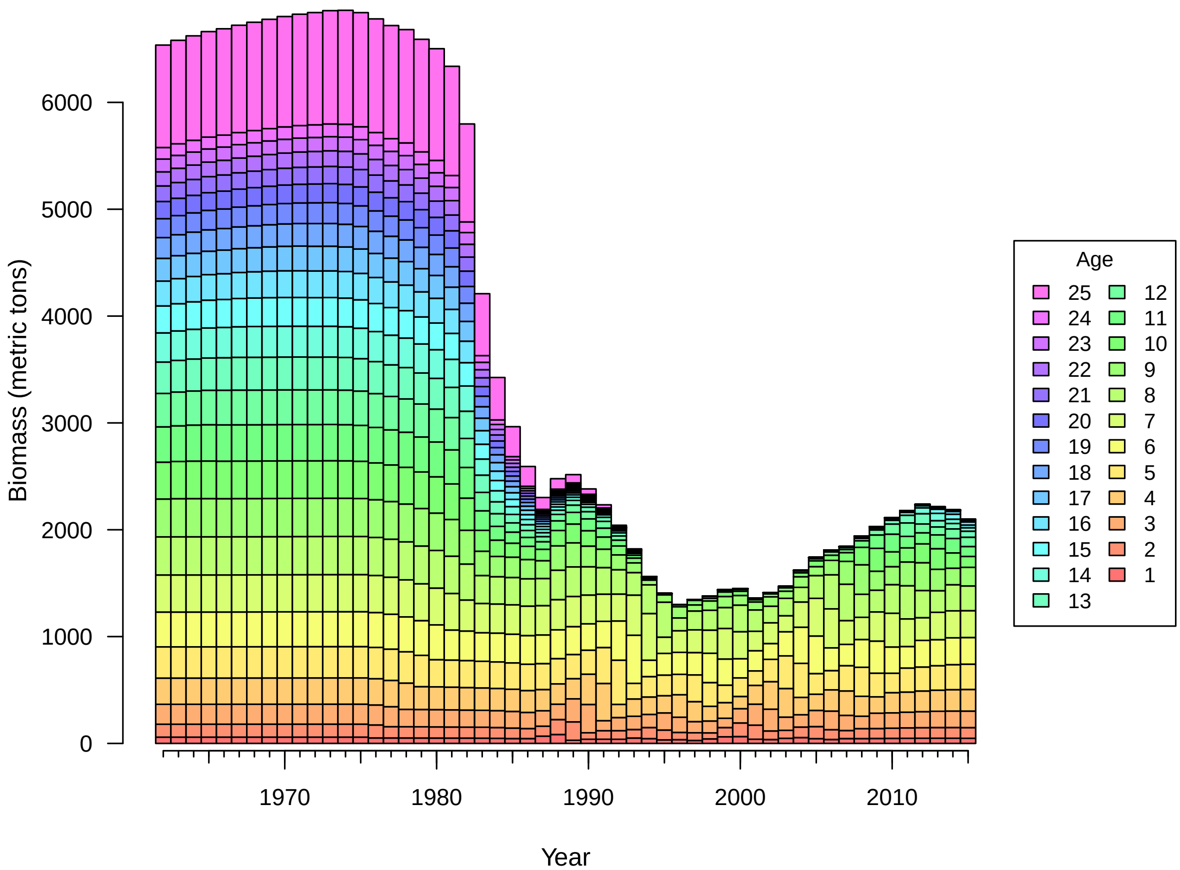


*Figure 10. Top panel: Estimated total biomass (metric tons) at start of year. Horizontal dashed line indicates* $B_{\mathrm{MSY}}$*. Bottom panel: Estimated spawning stock (mt, gonad biomass of mature females) at time of peak spawning.*

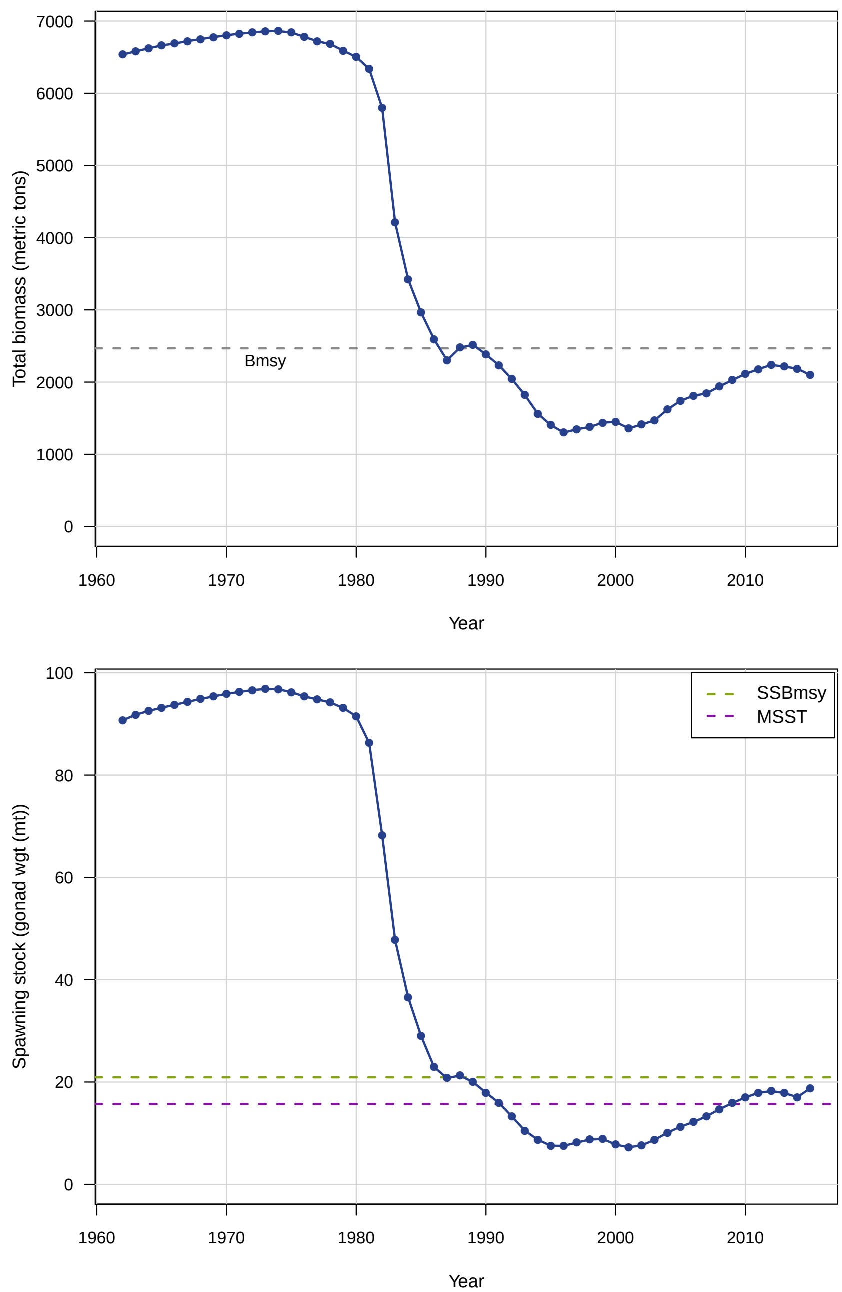


*Figure 11. Selectivities of commercial fleets, 1962–2014. Top panel: commercial handline, Bottom panel: commercial longline.*

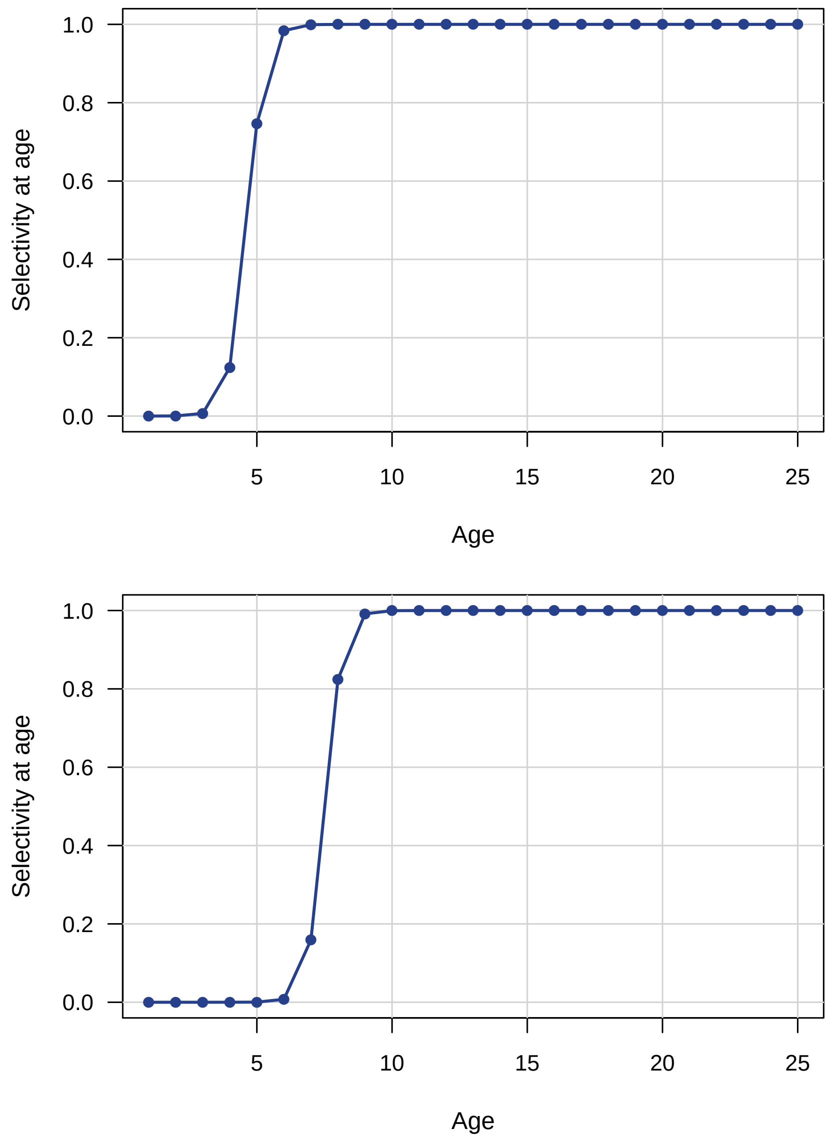


*Figure 12. Selectivities of the recreational fleet and MARMAP survey 1962–2014. Top panel: recreational, Bottom panel: MARMAP longline survey.*

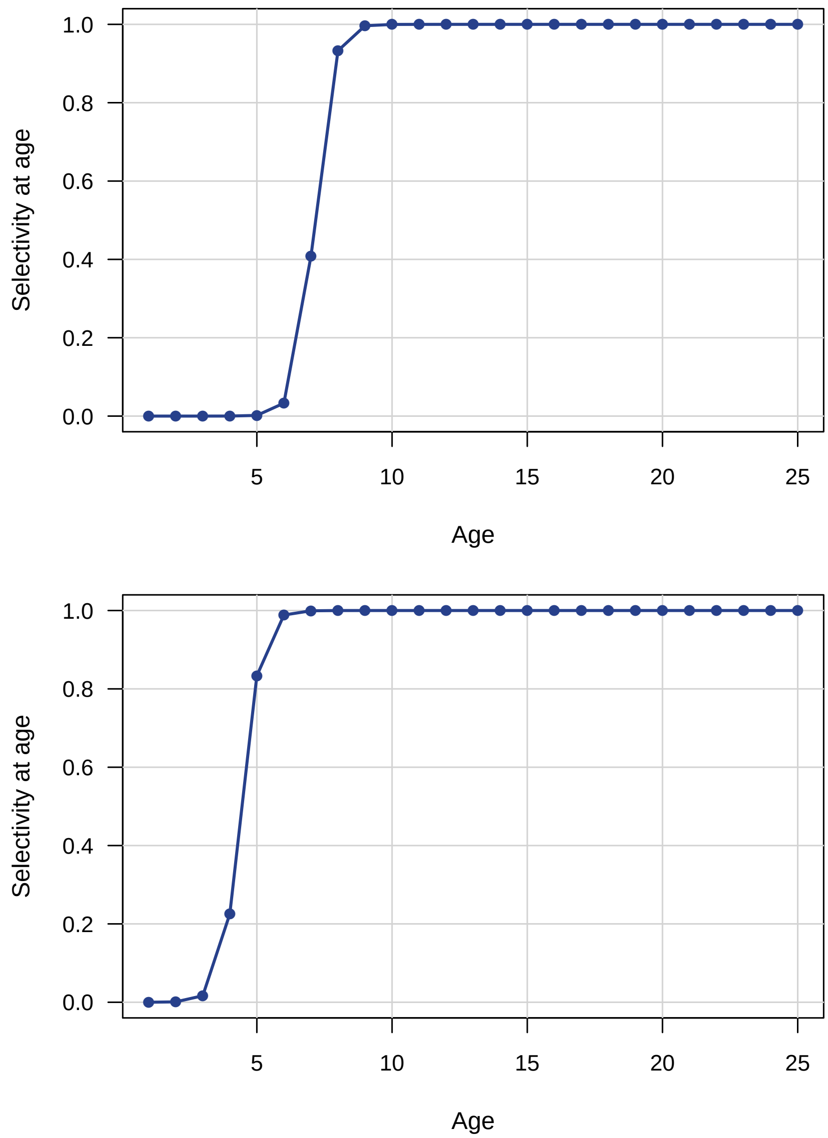


*Figure 13. Average selectivity across fleets weighted by geometric mean Fs from the last three assessment years, and used in computation of benchmarks and central-tendency projections.*

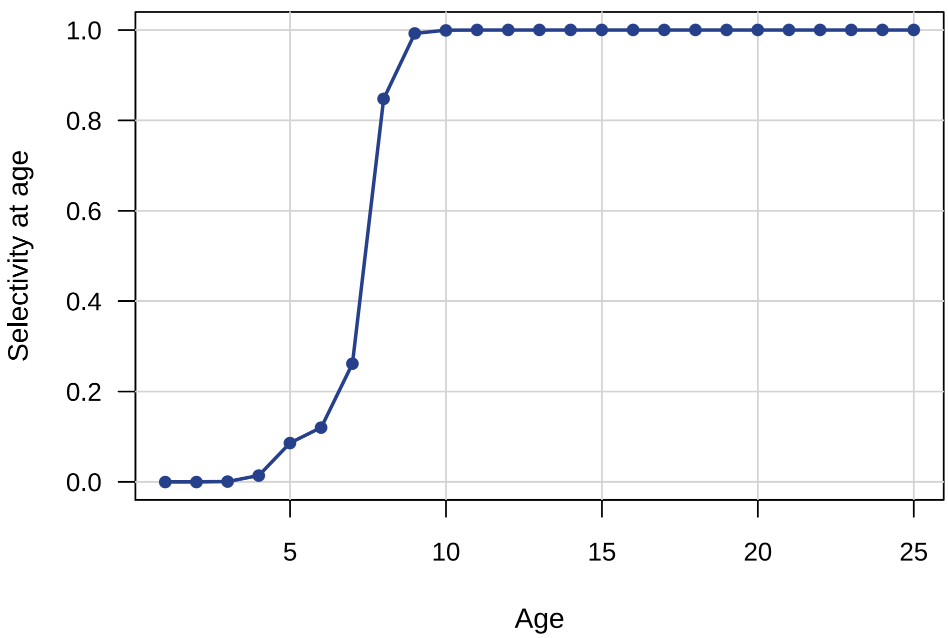


*Figure 14. Estimated fully selected fishing mortality rate (per year) by fishery. cL refers to commercial longline, cH to commercial handline, and rA to recreational.*

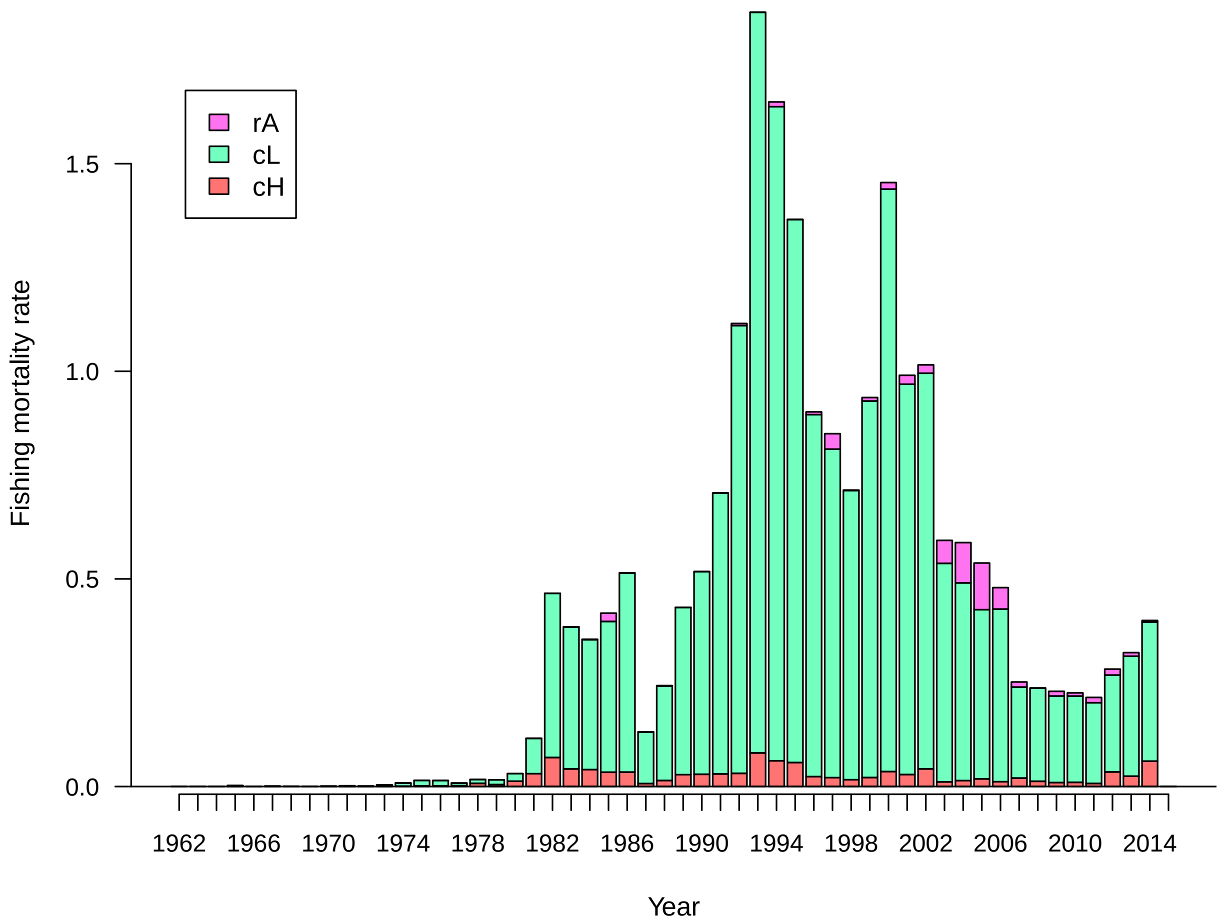


*Figure 15. Estimated landings in gutted weight by fishery from the catch-age model. cL refers to commercial longline, cH to commercial handline, and rA to recreational. Horizontal dashed line in the top panel corresponds to the point estimate of MSY.*

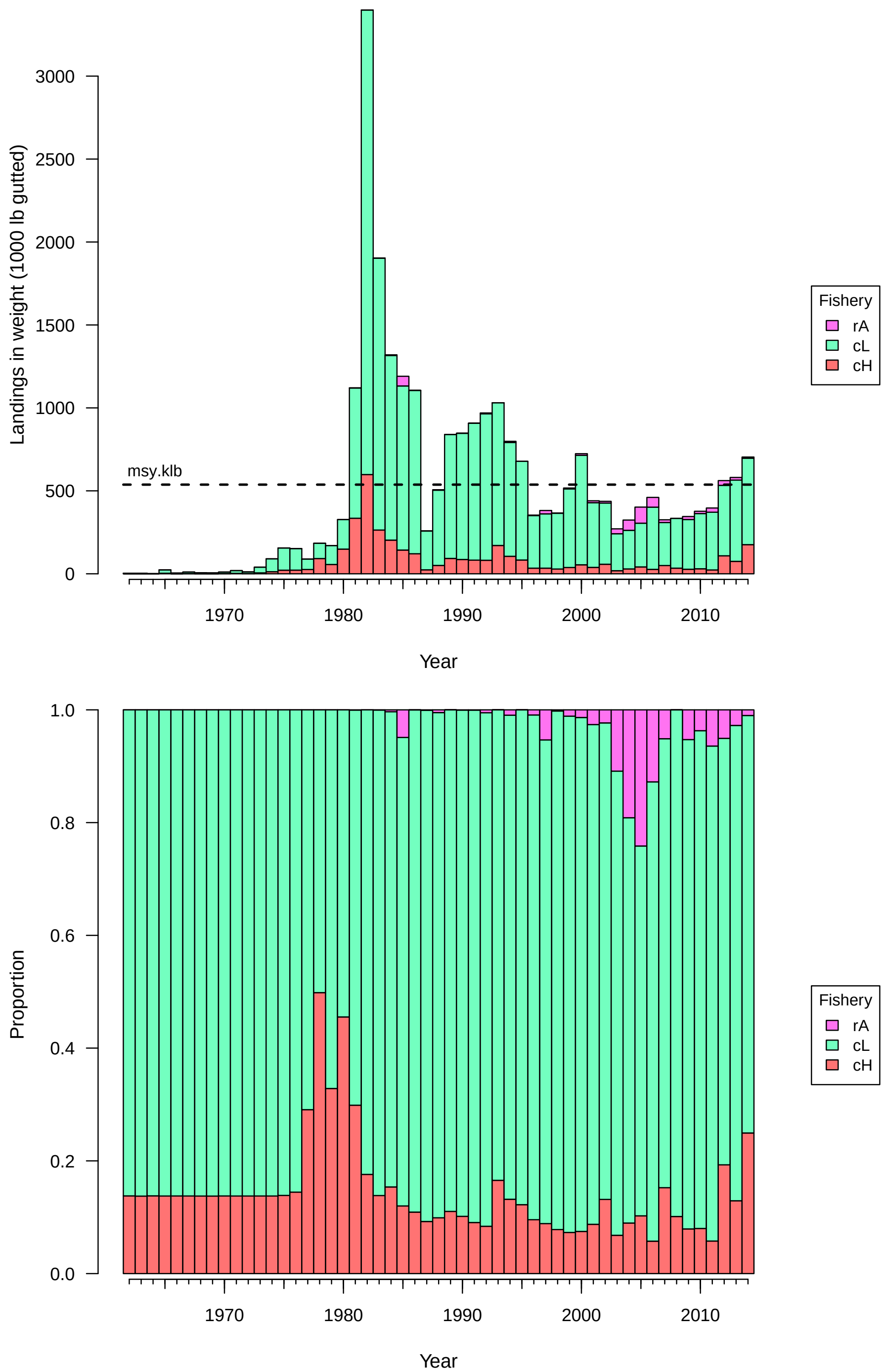


*Figure 16. Estimated landings in numbers by fishery from the catch-age model. cL refers to commercial longline, cH to commercial handline, and rA ro recreational.*

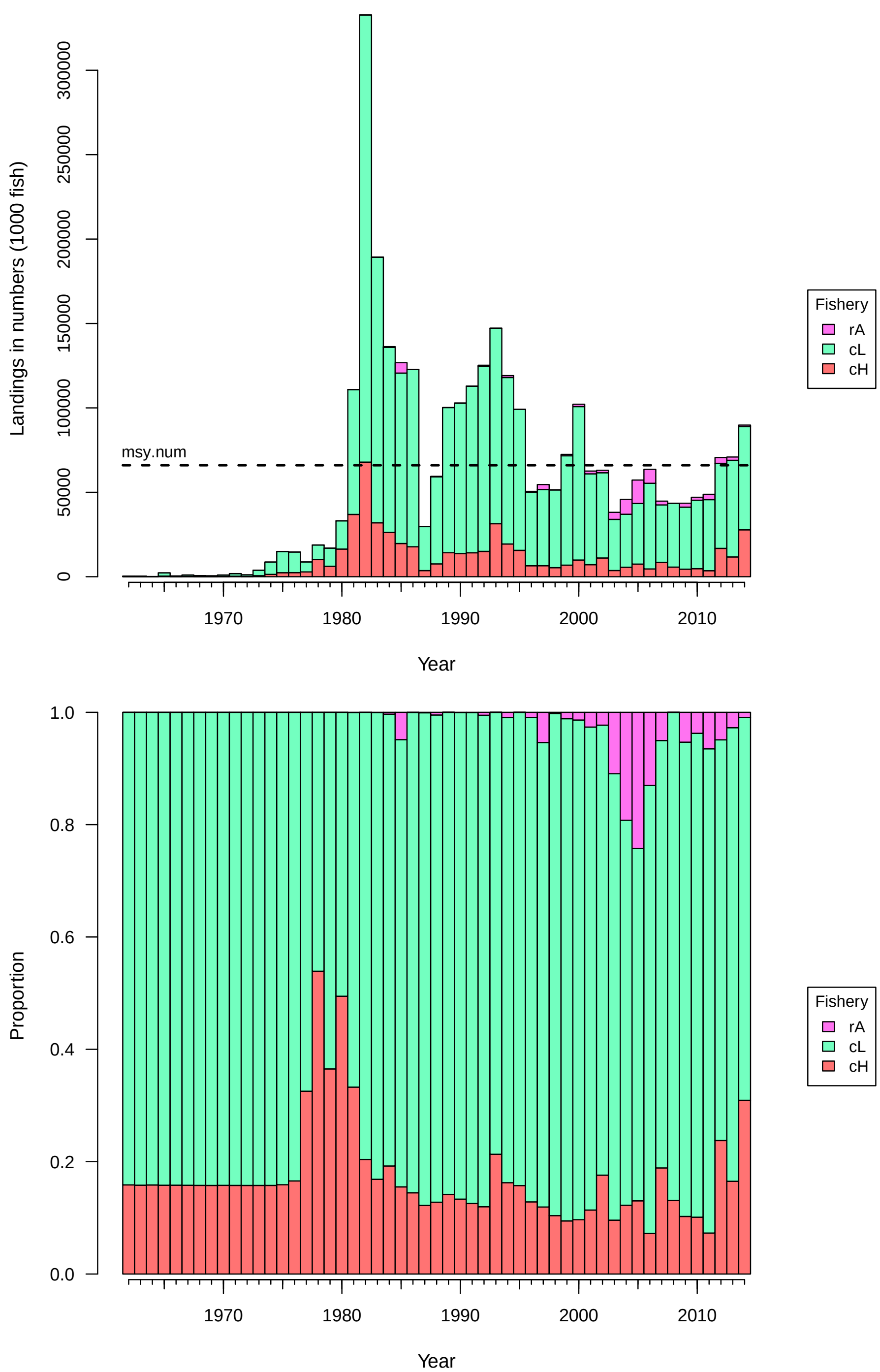


*Figure 17. Top panel: Beverton–Holt spawner-recruit curves, with and without lognormal bias correction. The expected (upper) curve was used for computing management benchmarks. Bottom panel: log of recruits (number age-1 fish) per spawner (mature female gonad weight) as a function of spawners. Years overlaid within panels indicate year of recruitment generated from spawning biomass one year prior.*

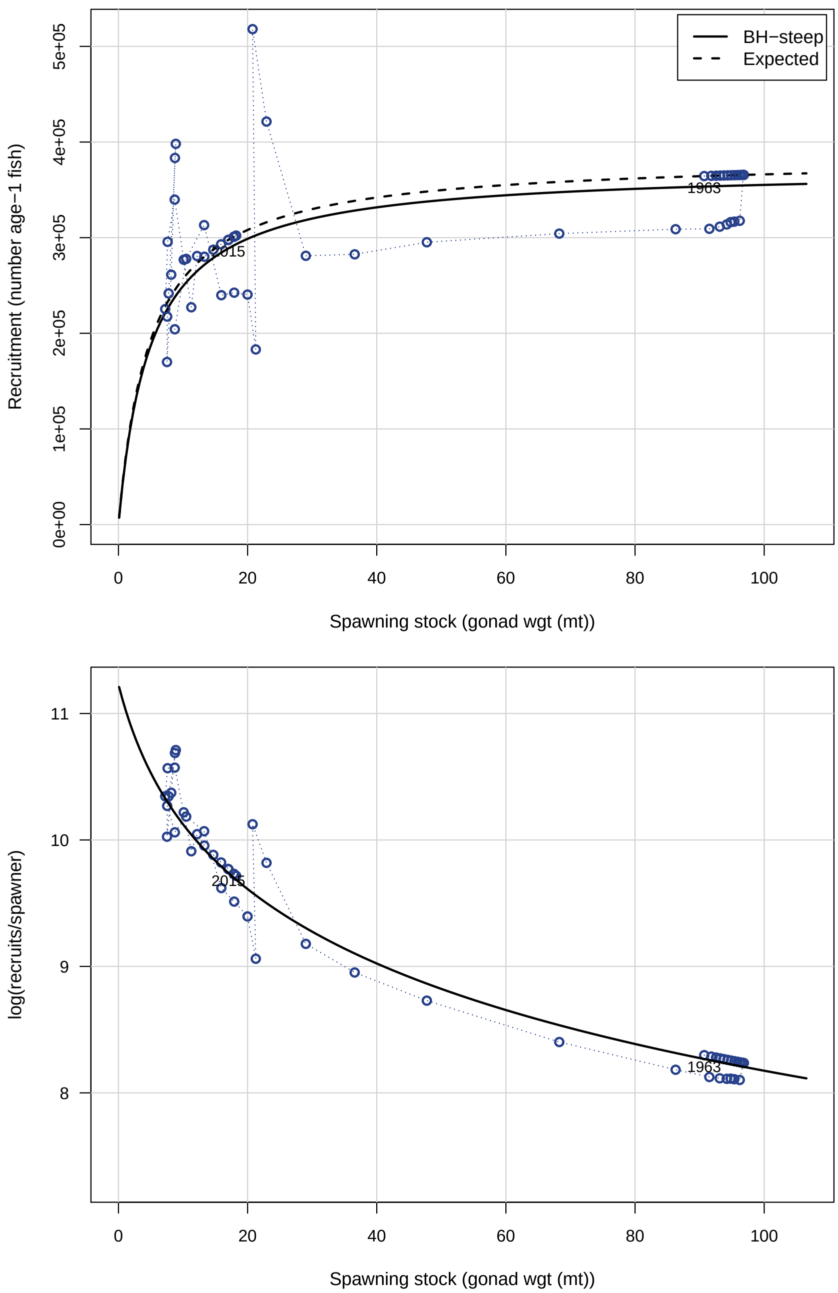


*Figure 18. Probability densities of spawner-recruit quantities R0 (unfished recruitment of age-1 fish), steepness, unfished spawners per recruit, and standard deviation of recruitment residuals in log space. Solid vertical lines represent point estimates or values from the base run; dashed vertical lines represent medians from the MCB runs.*

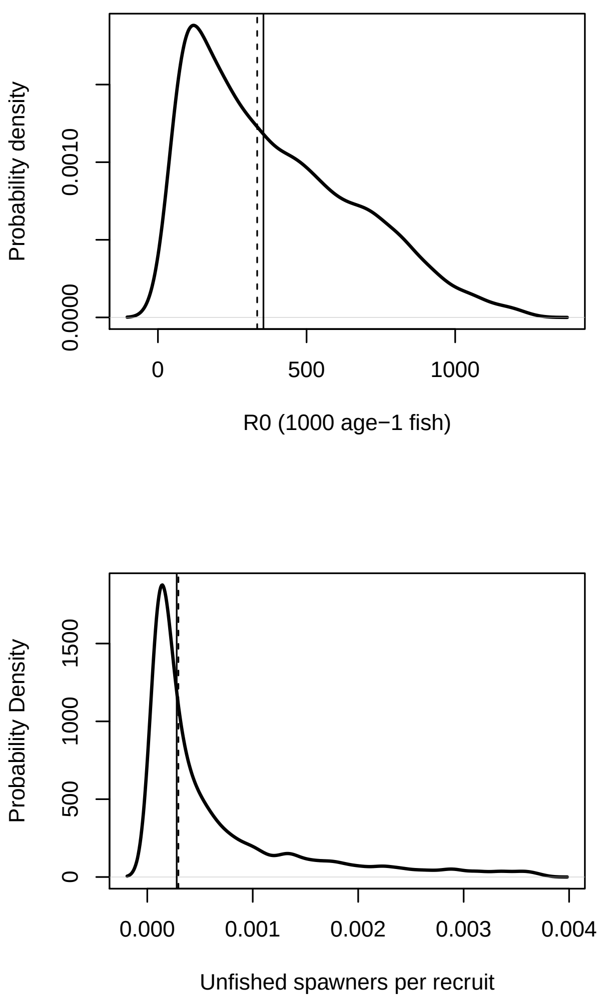


*Figure 19. Top panel: yield per recruit. Bottom panel: spawning potential ratio (spawning biomass per recruit relative to that at the unfished level), from which the y% levels provide* $F_{y\%}$. *Both curves are based on average selectivity from the end of the assessment period.*

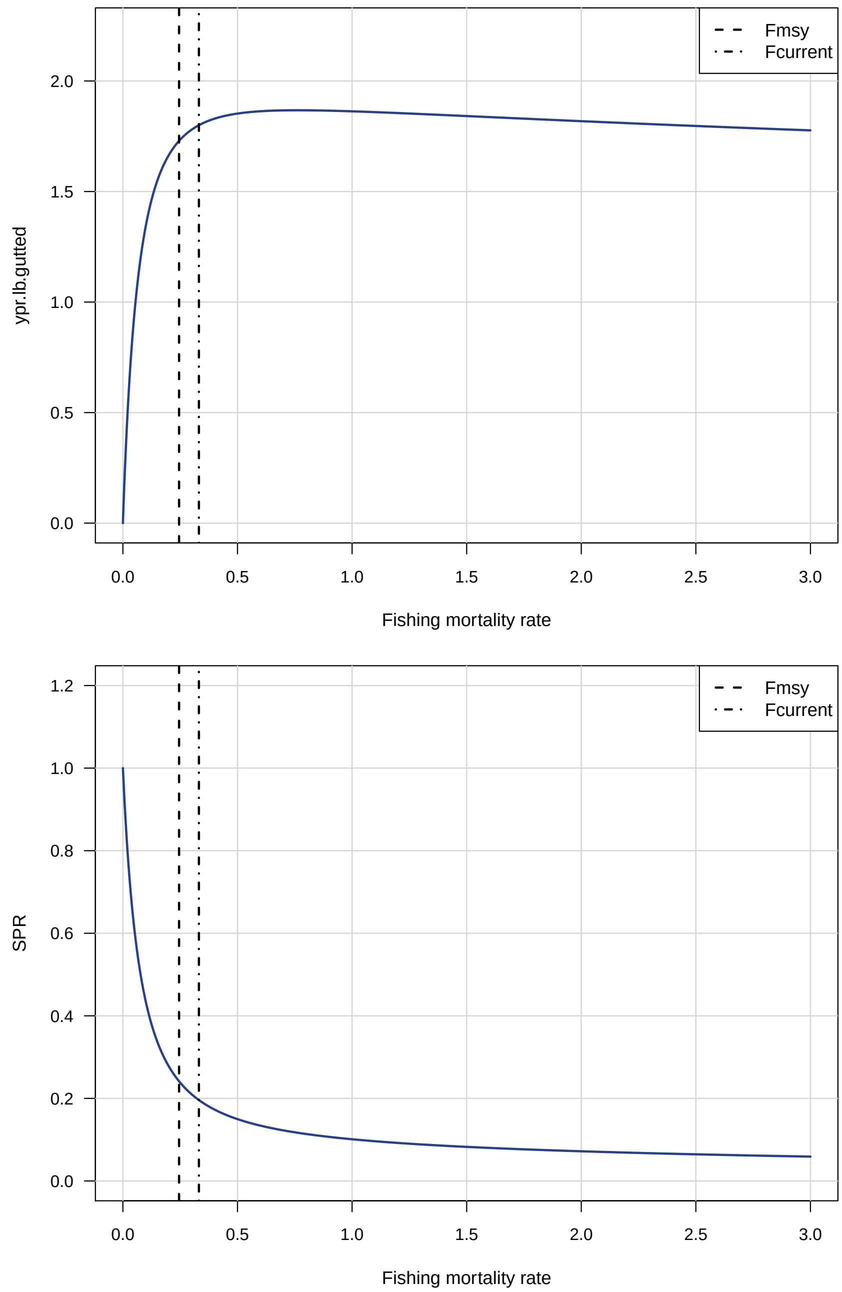
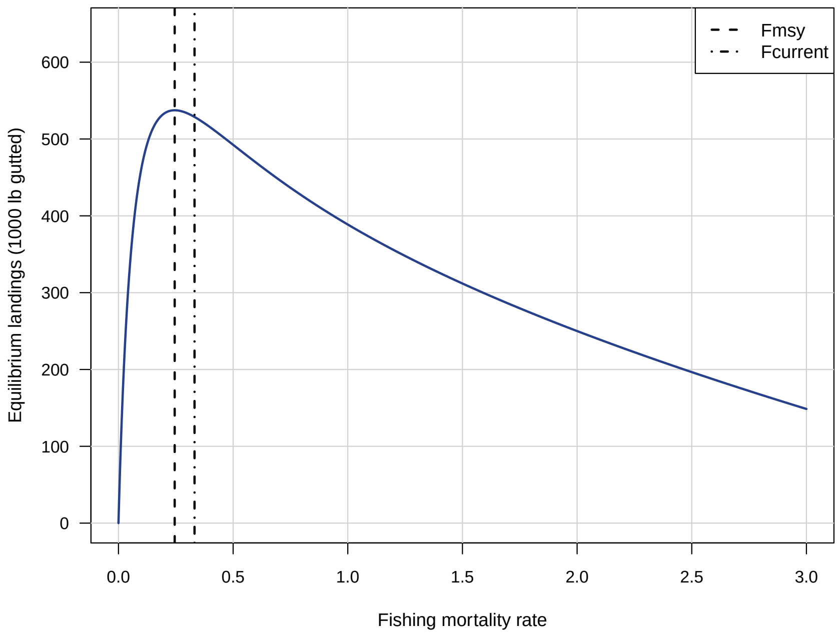


*Figure 20. Top panel: equilibrium landings. The peak occurs where fishing rate is* $F_{\mathrm{MSY}} = 0.25$ *and equilibrium landings are* MSY = 537.4 *(1000 lb gutted weight). Bottom panel: equilibrium spawning biomass. Both curves are based on average selectivity from the end of the assessment period.*



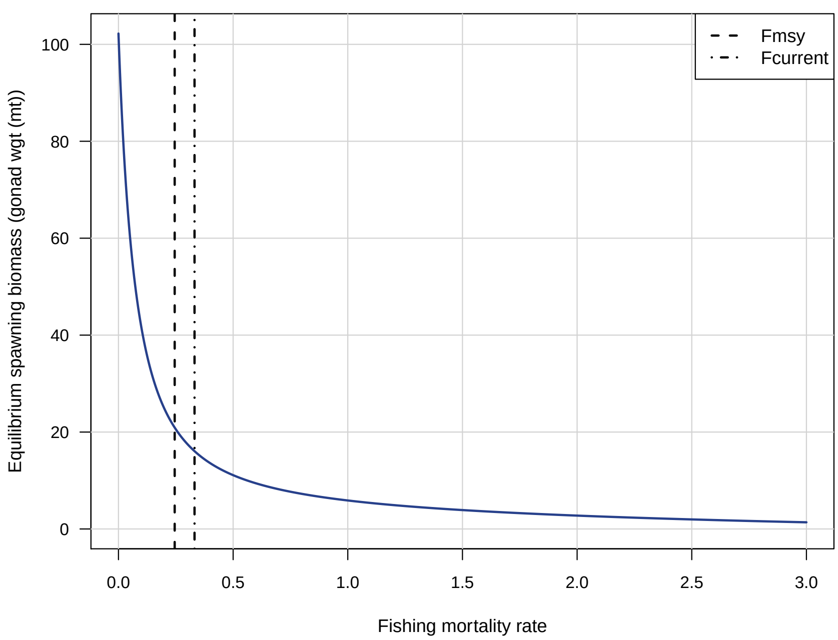



*Figure 21. Equilibrium landings as a function of equilibrium biomass, which itself is a function of fishing mortality rate. The peak occurs where equilibrium biomass is* $B_{\mathrm{MSY}} = 2468.3$ *mt and equilibrium landings are* MSY = 537.4 *(1000 lb gutted weight).*

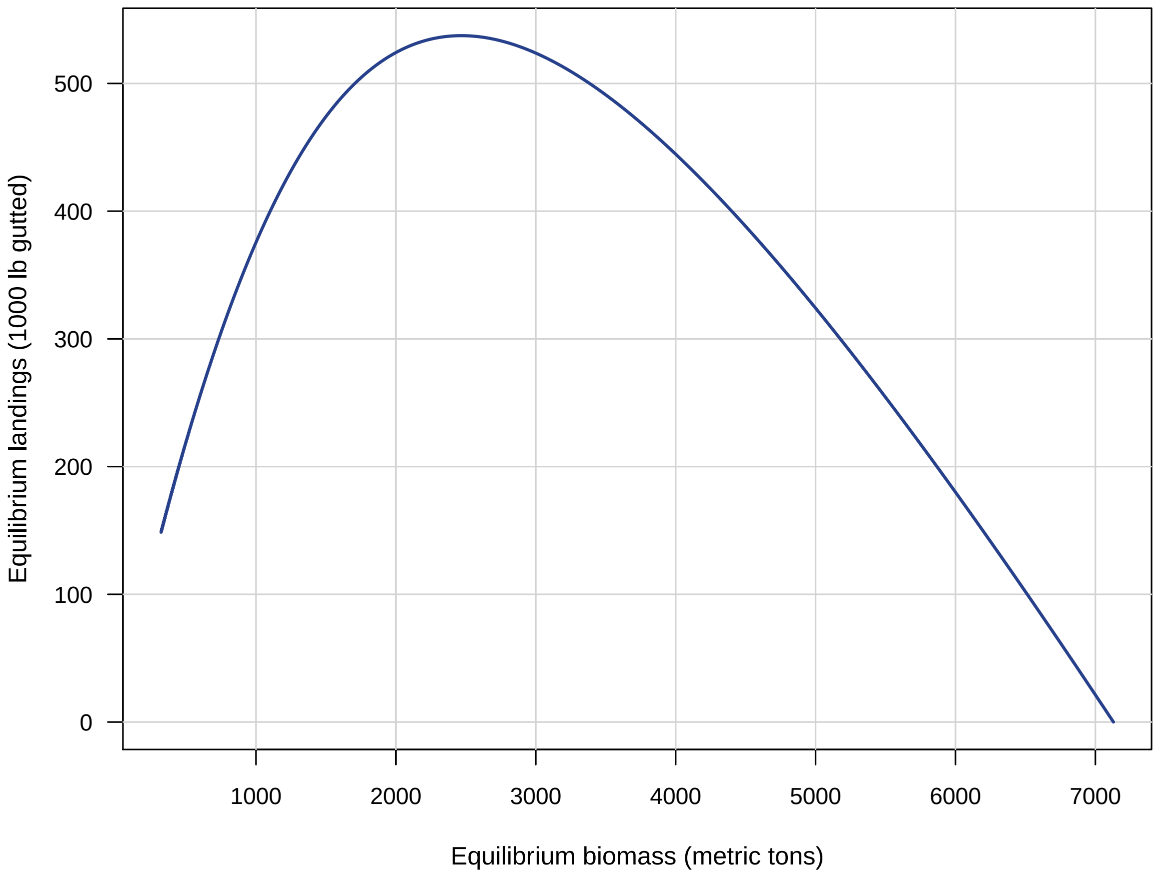


*Figure 22. Probability densities of MSY-related benchmarks from MCB analysis. Solid vertical lines represent point estimates or values from the base run; dashed vertical lines represent medians from the MCB runs.*

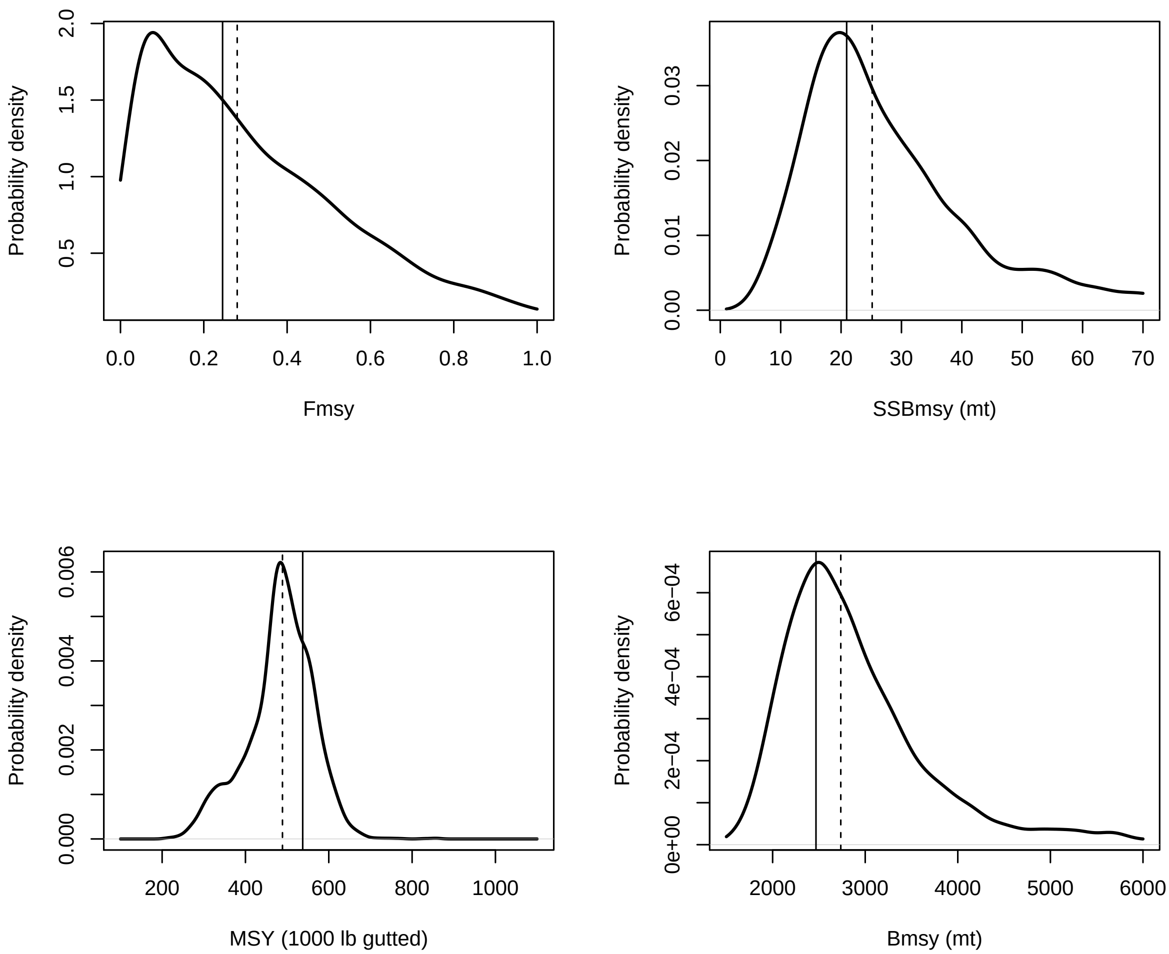


*Figure 23. Estimated time series of SSB and F relative to benchmarks. Solid line indicates estimates from base run; dashed lines represent median values; gray error bands indicate* $5^{th}$ *and* $95^{th}$ *percentiles of the MCB trials. Top panel: spawning biomass relative to the minimum stock size threshold (*MSST*). Bottom panel: F relative to* $F_{\mathrm{MSY}}$.

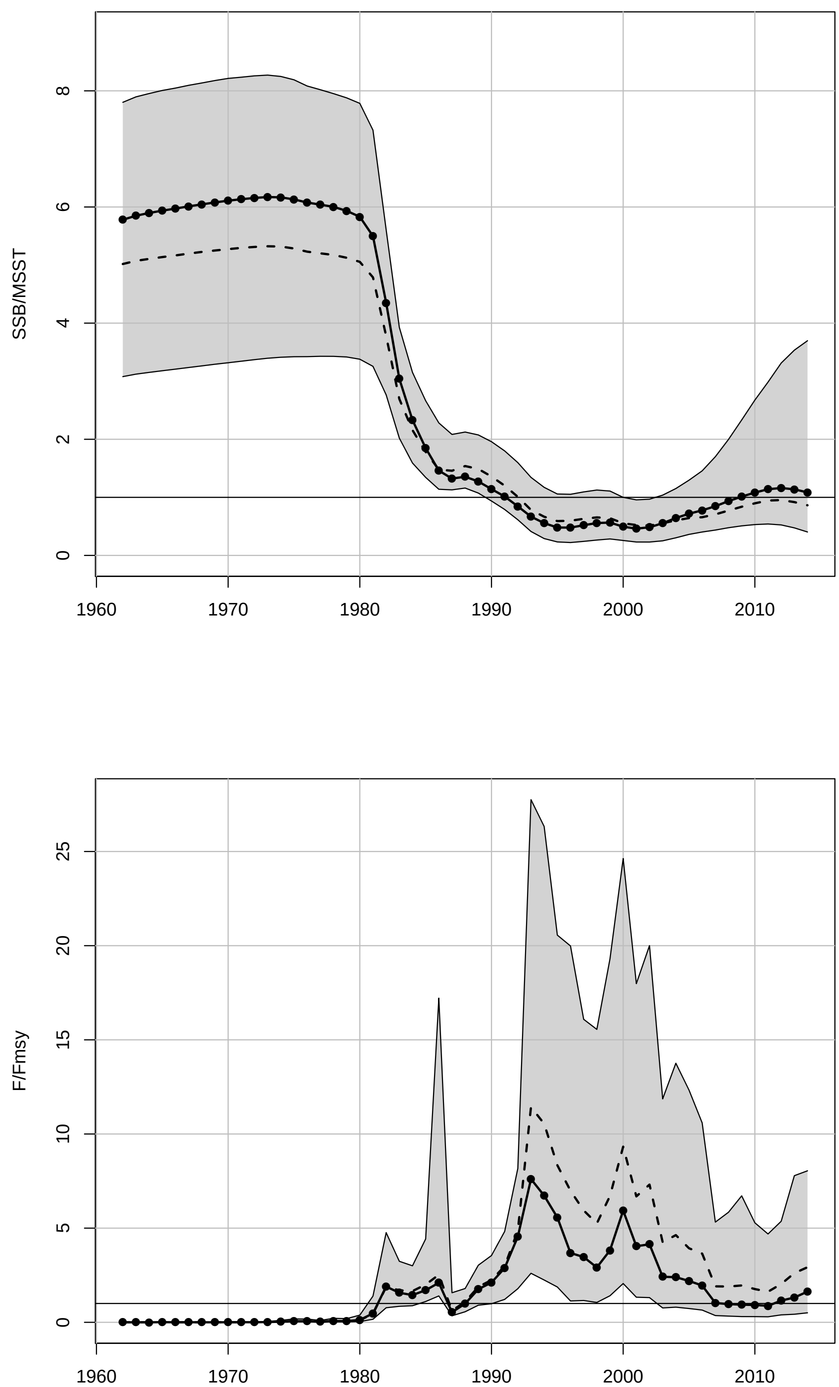


*Figure 24. Probability densities of terminal status estimates from MCB analysis. Vertical lines represent point estimates from the base run. Dashed lines represent median values.*

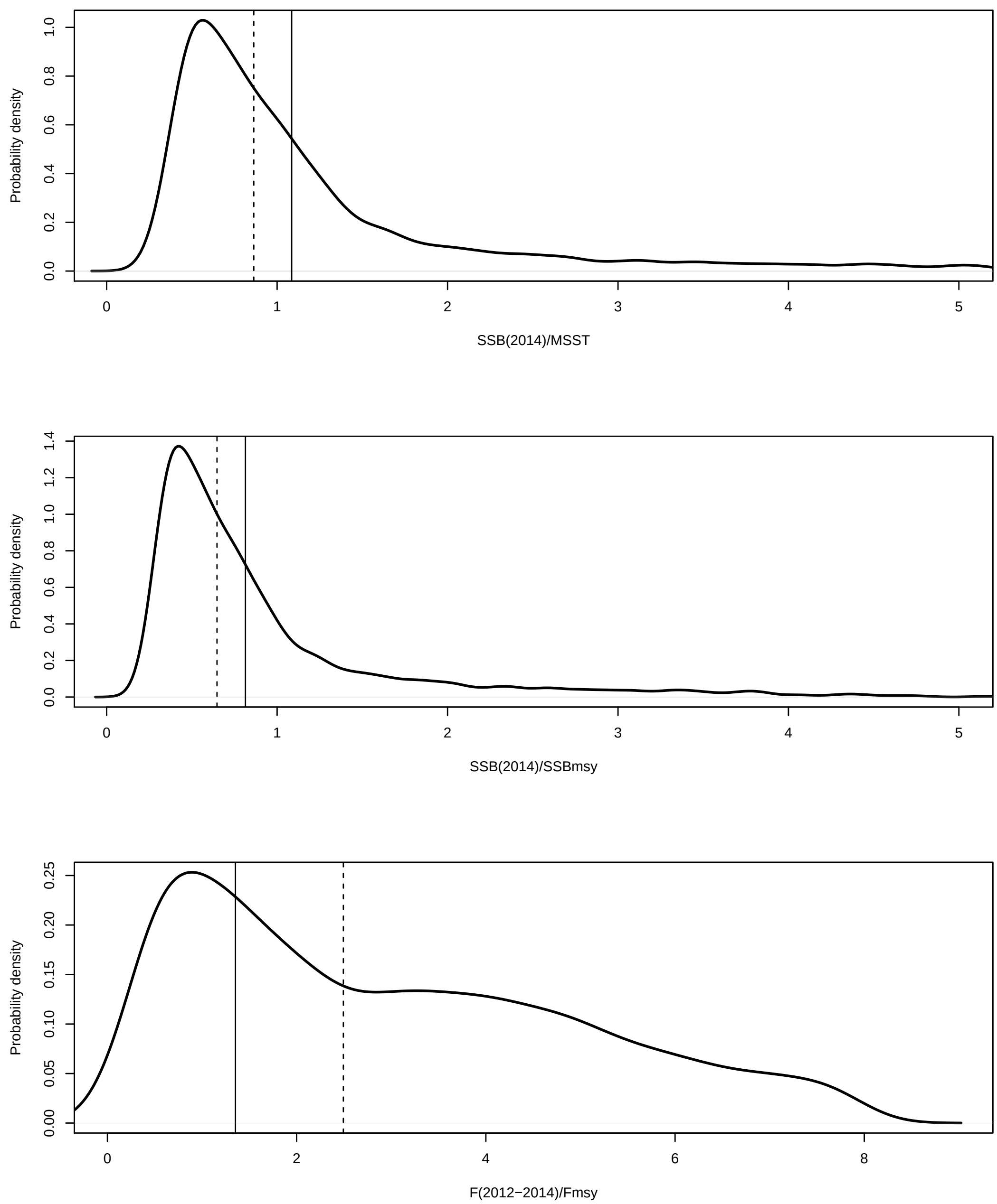


*Figure 25. Phase plot of terminal status estimates from MCB analysis. The intersection of crosshairs indicates estimates from the base run; lengths of crosshairs defined by* $5^{th}$ *and* $95^{th}$ *percentiles.*

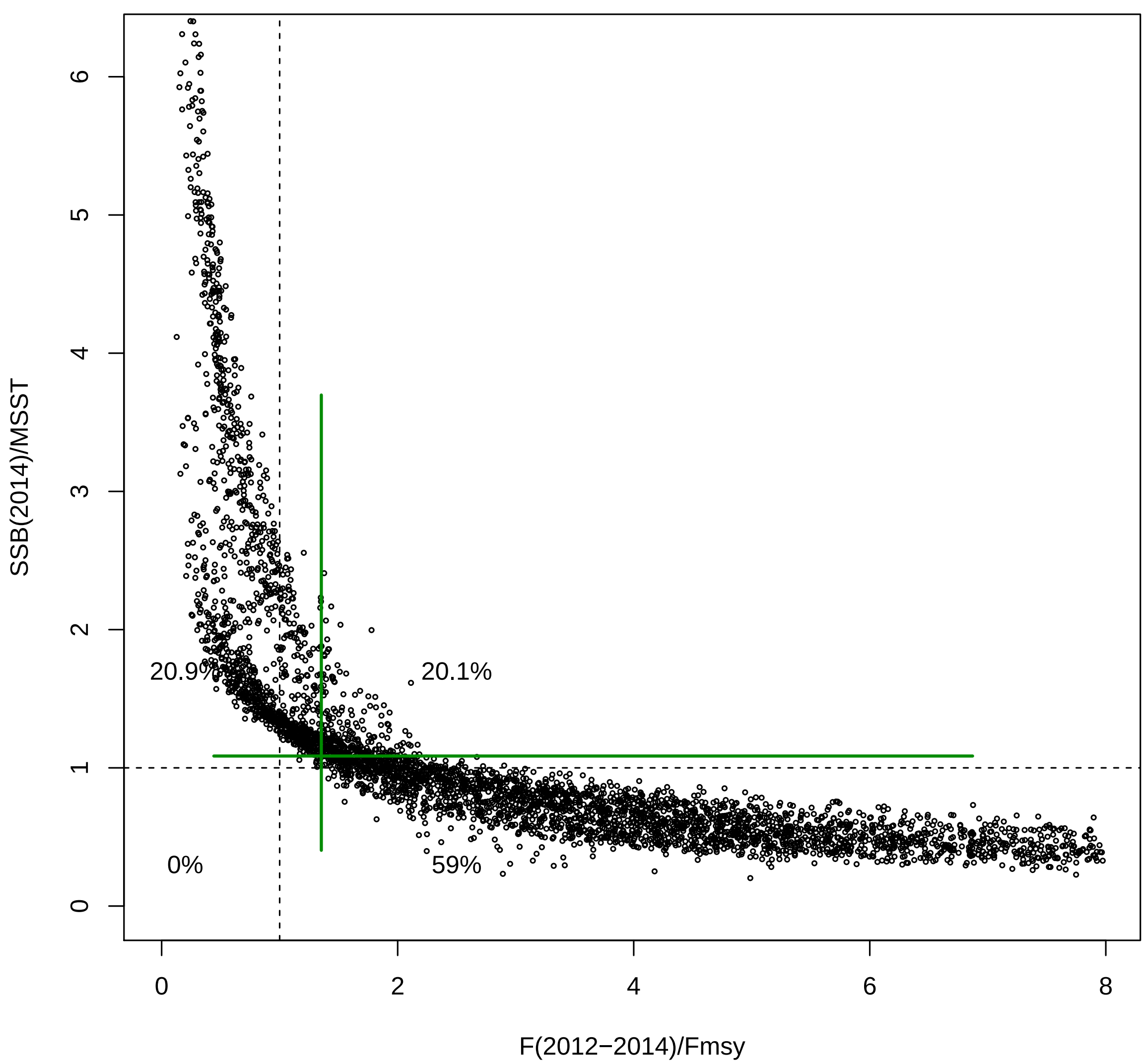
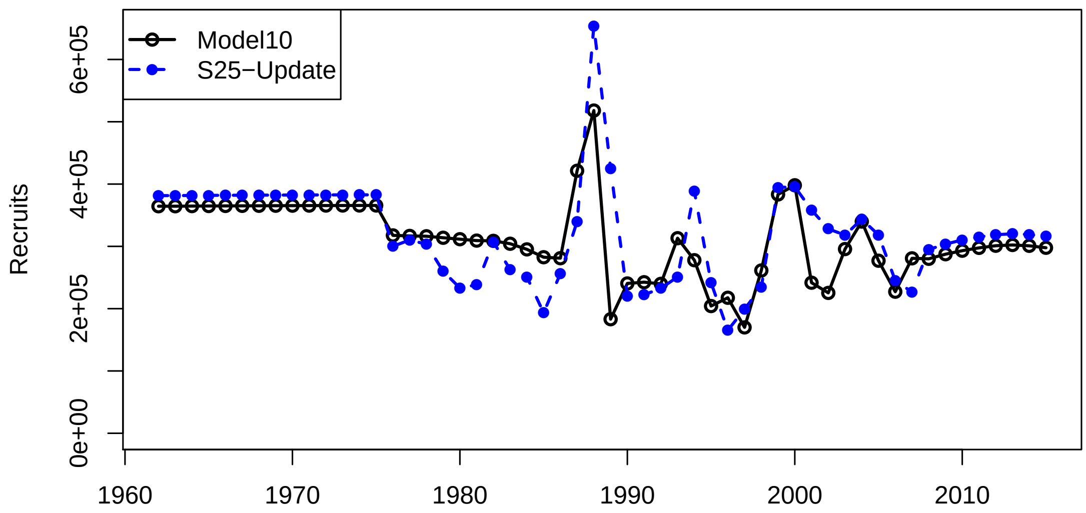


*Figure 26. Comparison of results from this revised assessment (Model10) with those from the 2016 SEDAR-Update assessment (S25-Update). Top panel: recruits. Bottom panel: abundance.*



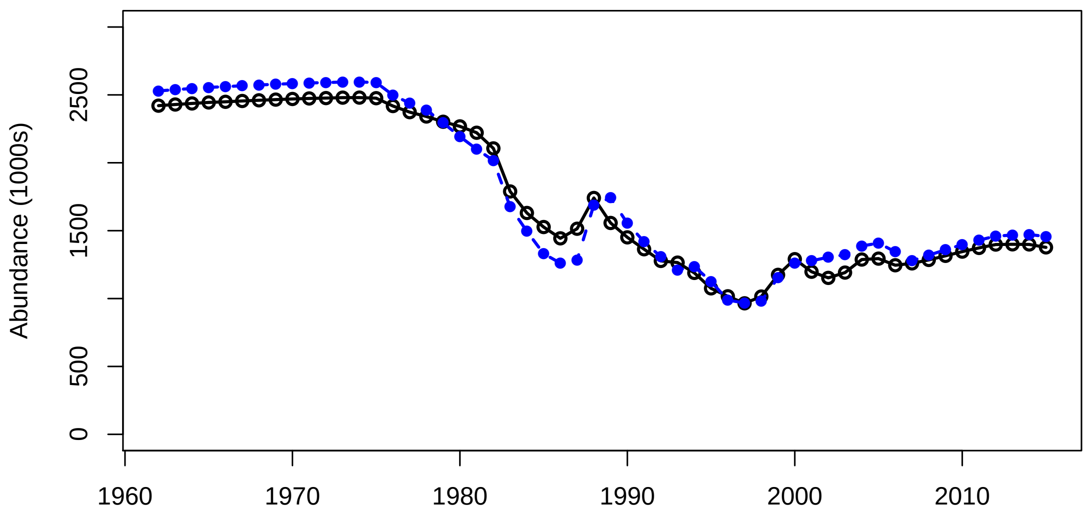
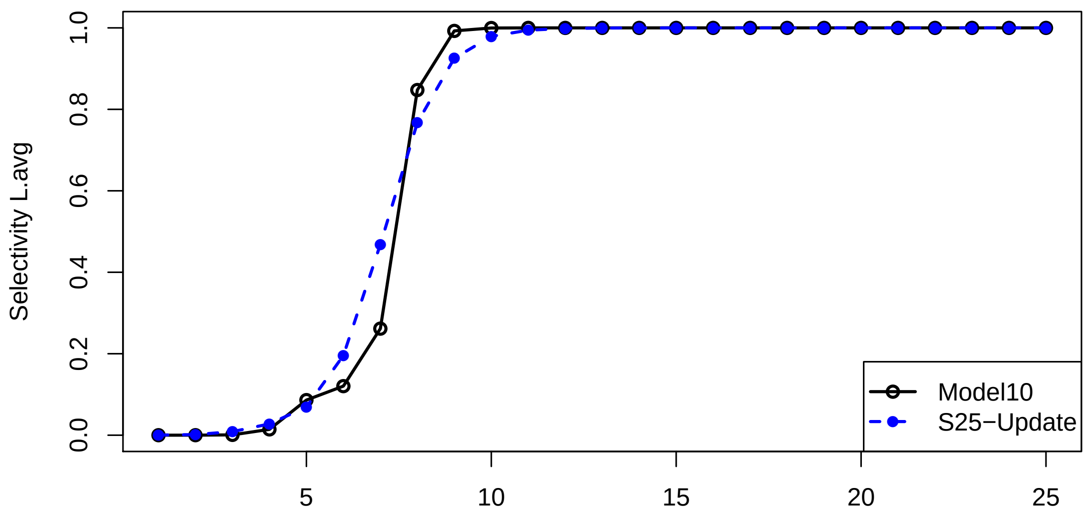



*Figure 27. Comparison of results from this revised assessment (Model10) with those from the 2016 SEDAR-Update assessment (S25-Update). Top panel: selectivity averaged across fleets. Bottom panel: fit to commercial longline index, with red circles representing the observed values.*



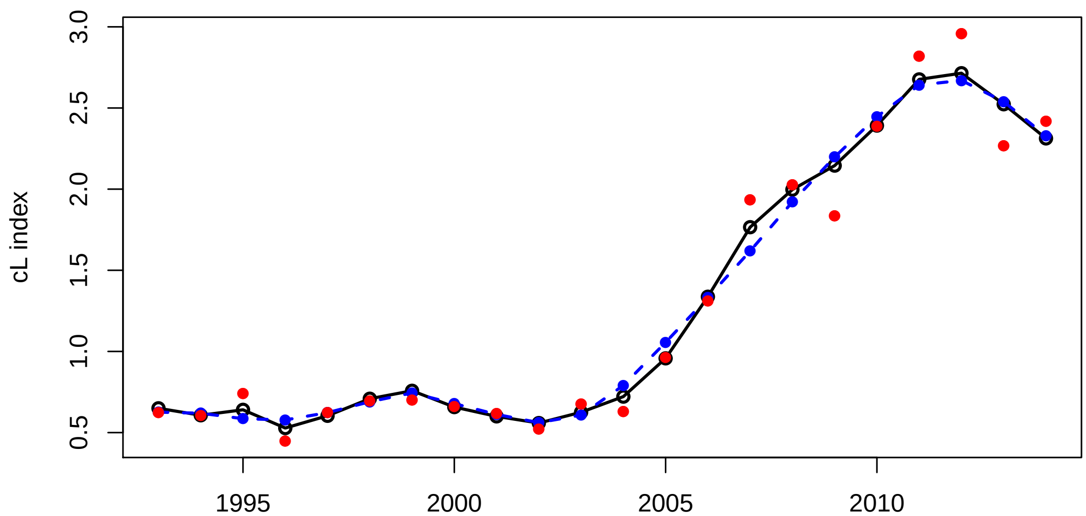



*Figure 28. Comparison of results from this revised assessment (Model10) with those from the 2016 SEDAR-Update assessment (S25-Update): cL indicates commercial longline, cH indicates commercial handline, mm indicates MARMAP survey, and rA indicates recreational.*

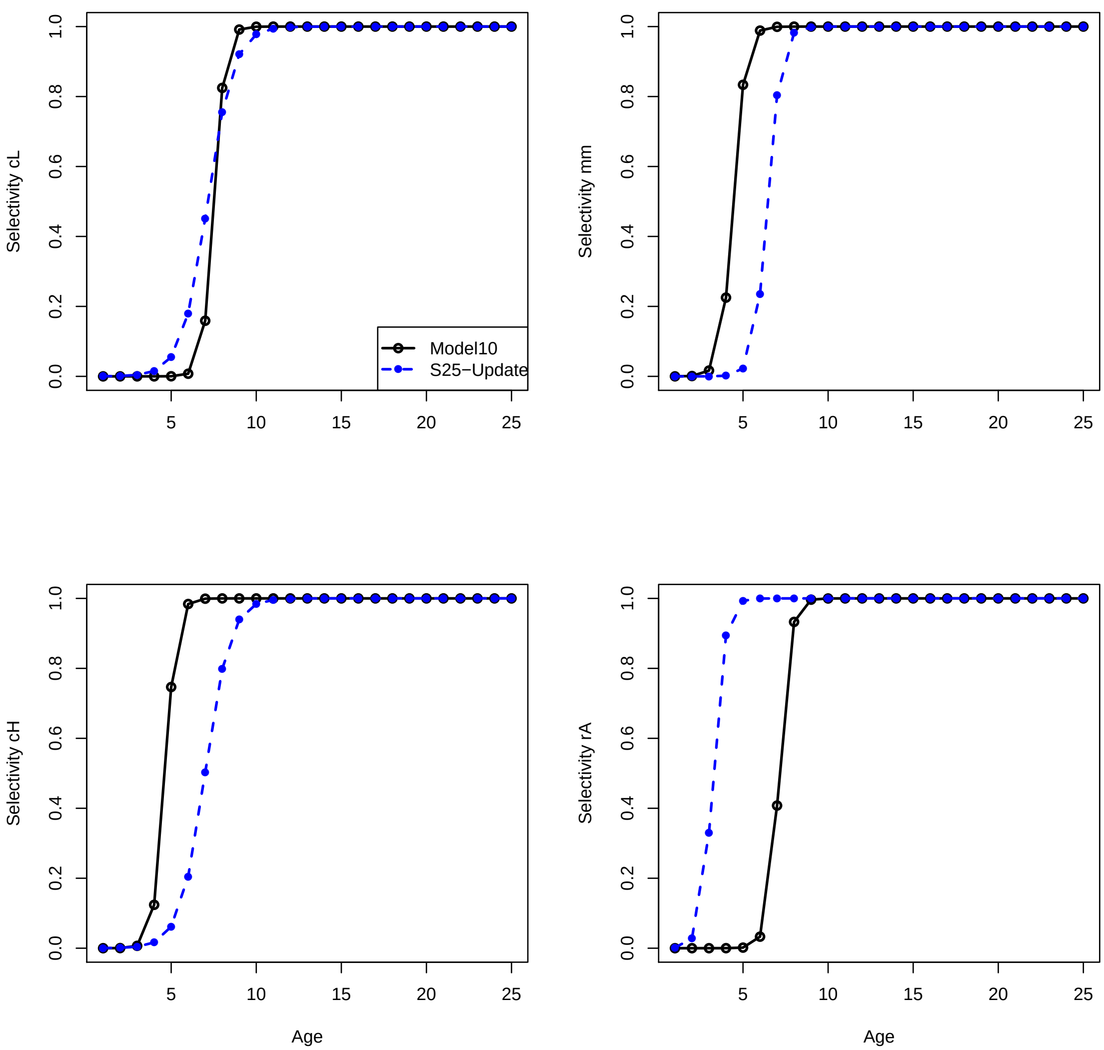


*Figure 29. Comparison of results from this revised assessment (Model10) with those from the 2016 SEDAR-Update assessment (S25-Update). Top panel: F relative to* $F_{\mathrm{MSY}}$*. Bottom panel: spawning biomass relative to* MSST*.*

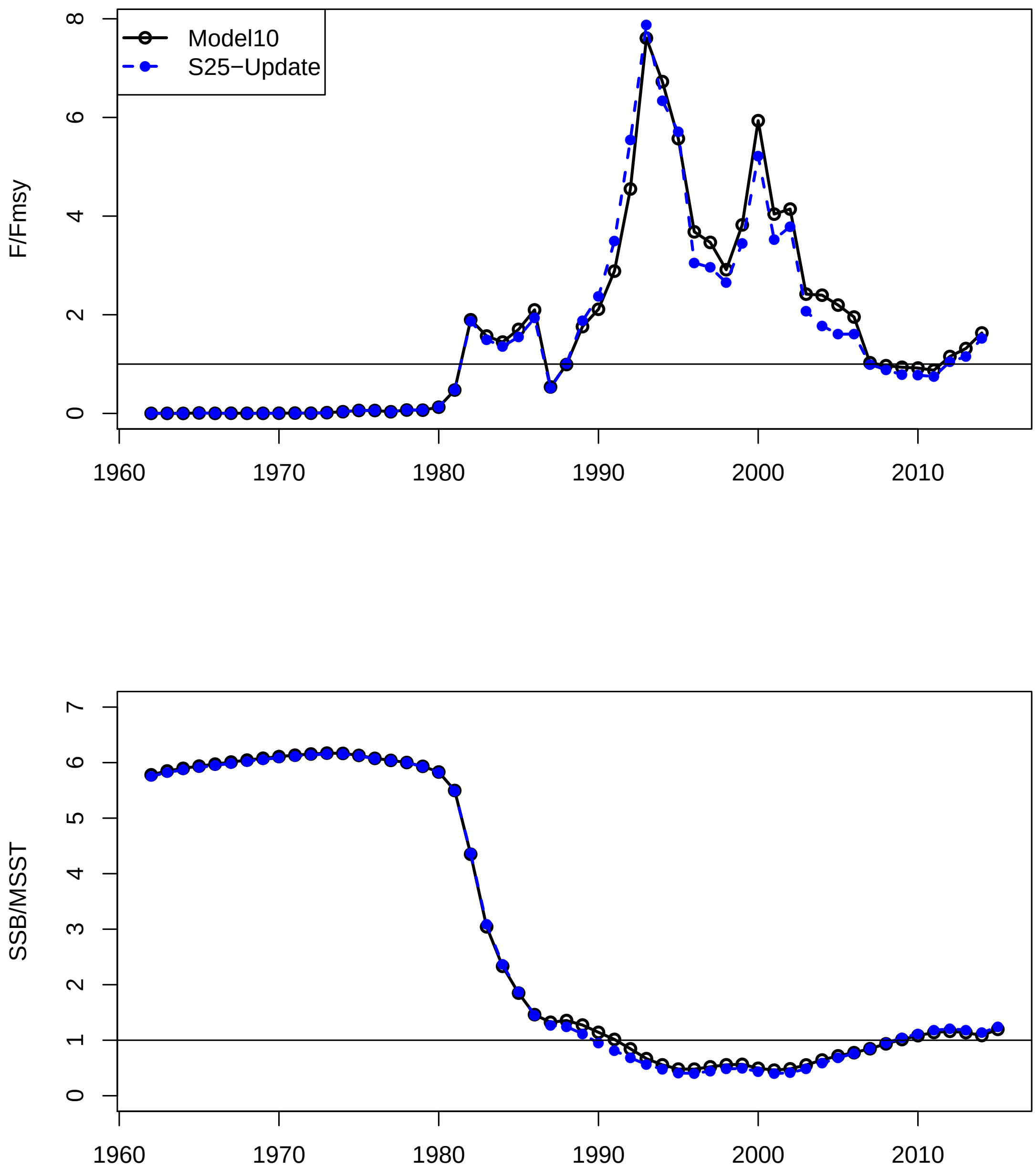


*Figure 30. Sensitivity run: comparison of results from Model 10 (base run of this revised assessment) with those from Model 9.*

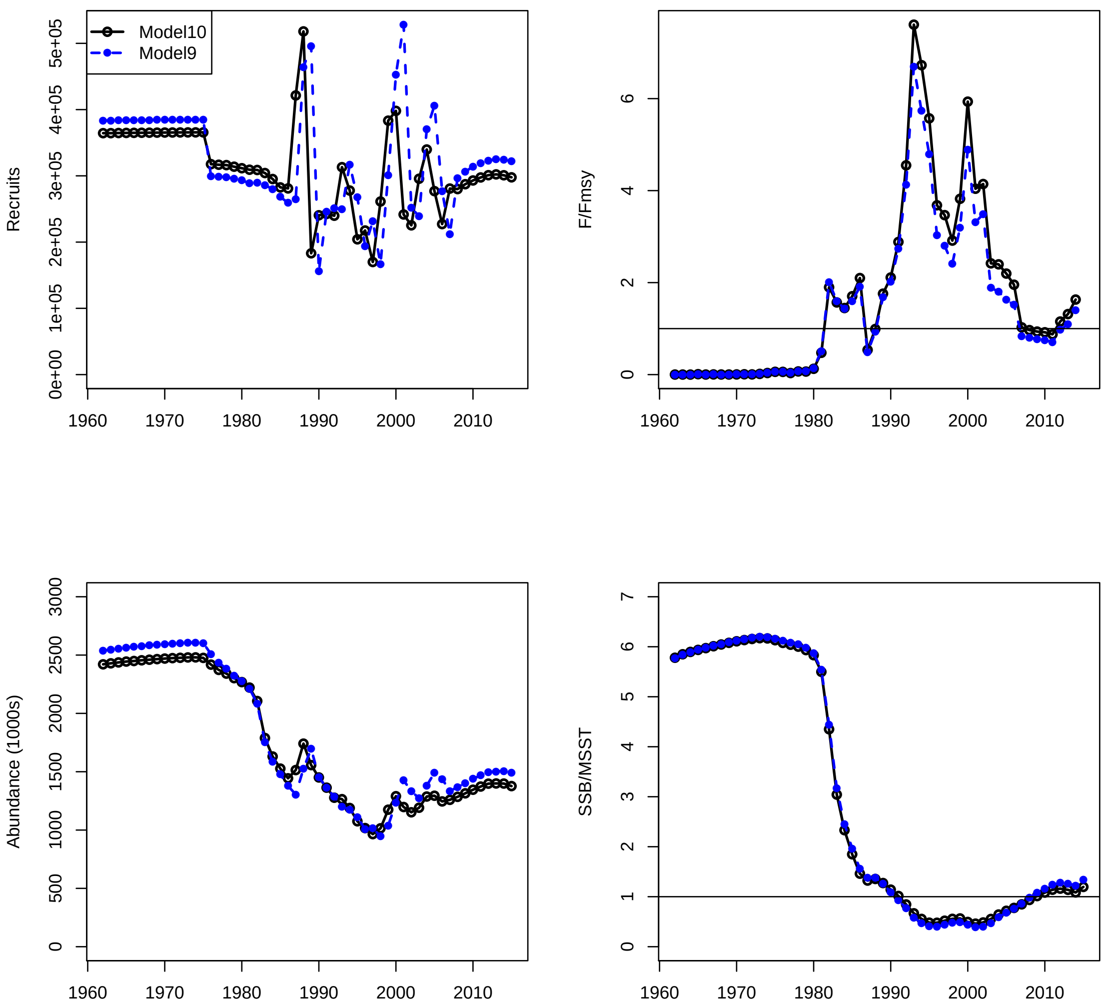


*Figure 31. Projection results for Scenario 1: fishing mortality rate fixed to achieve $P^{\star} = 0.30$ starting in 2019, and with the status quo ACL in 2018. In all panels, deterministic base-run values represented by solid lines with solid circles, medians of stochastic forecasts represented by dashed lines with open circles, and uncertainty represented by thin lines corresponding to $5^{th}$ and $95^{th}$ percentiles. Solid horizontal lines mark* MSY*-related quantities; dashed horizontal lines represent corresponding medians. Spawning stock (SSB) is at time of peak spawning.*

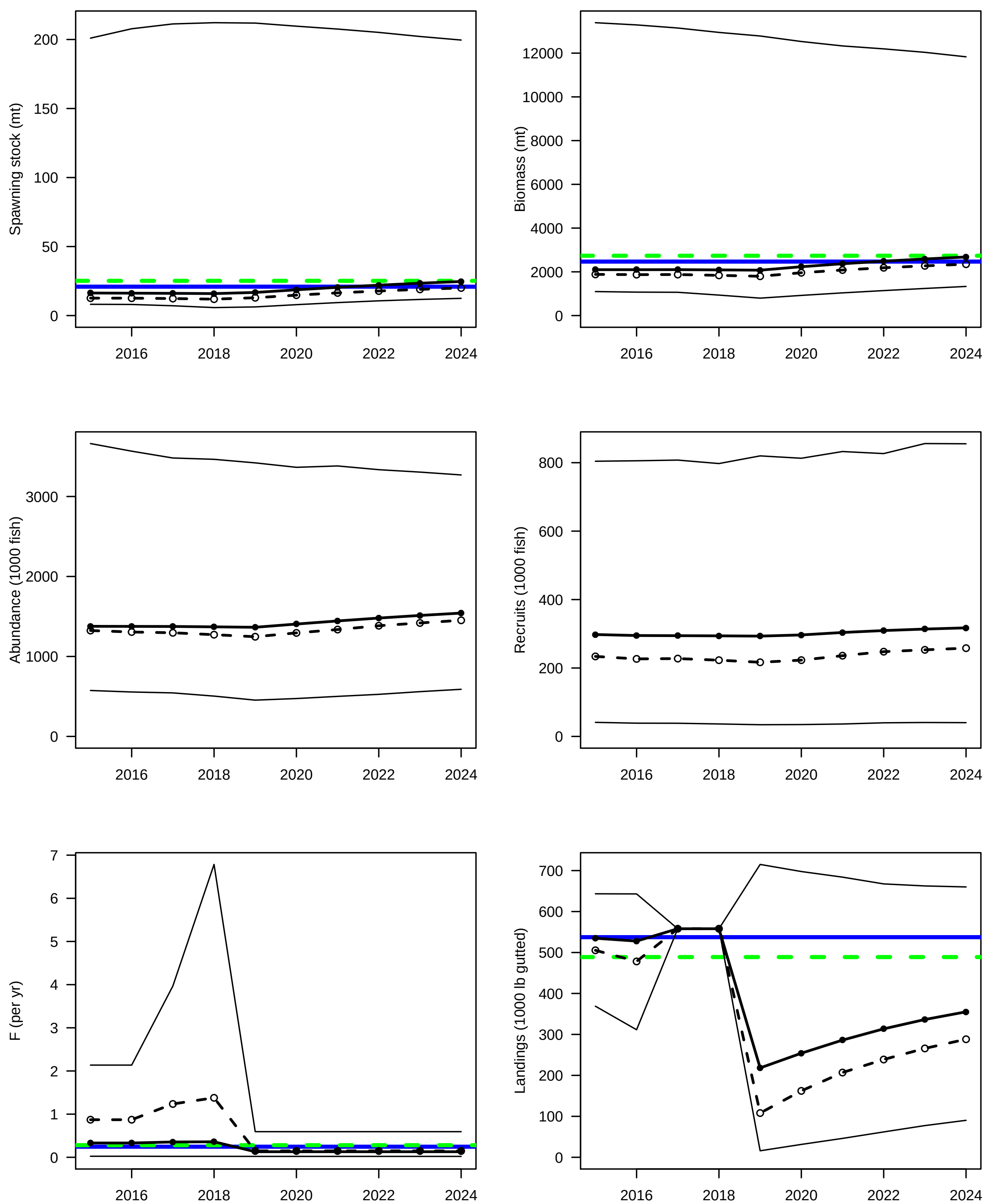


*Figure 32. Probability of being overfished under Projection Scenario 1: fishing mortality rate fixed to achieve* $Pstar = 0.30$ *starting in 2019, and with the status quo ACL in 2018. Curve represents the proportion of projection replicates for which SSB has reached the replicate-specific* MSST.

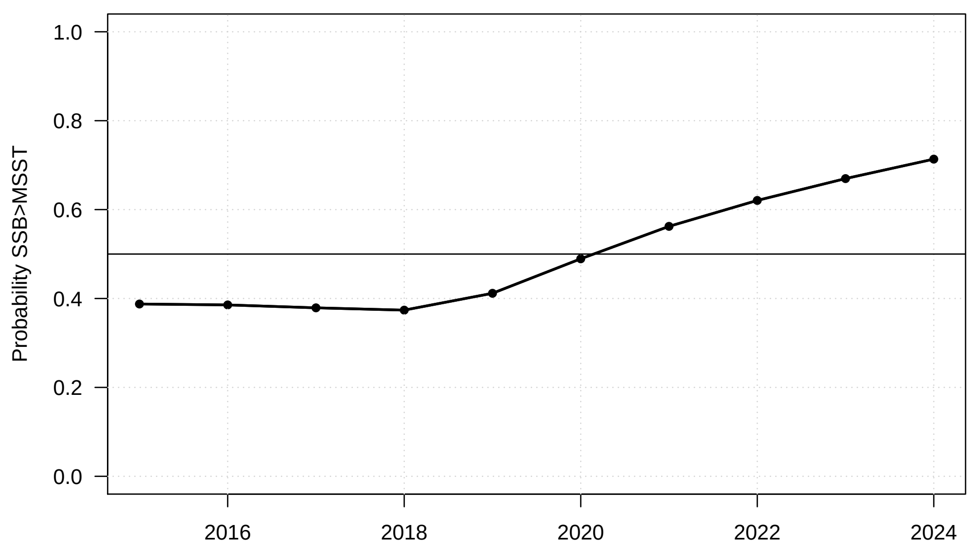


*Figure 33. Projection results for Scenario 2: fishing mortality rate fixed to achieve $P^\star = 0.30$ starting in 2019, and with the reduced ACL in 2018. In all panels, deterministic base-run values represented by solid lines with solid circles, medians of stochastic forecasts represented by dashed lines with open circles, and uncertainty represented by thin lines corresponding to $5^{th}$ and $95^{th}$ percentiles. Solid horizontal lines mark* MSY*-related quantities; dashed horizontal lines represent corresponding medians. Spawning stock (SSB) is at time of peak spawning.*

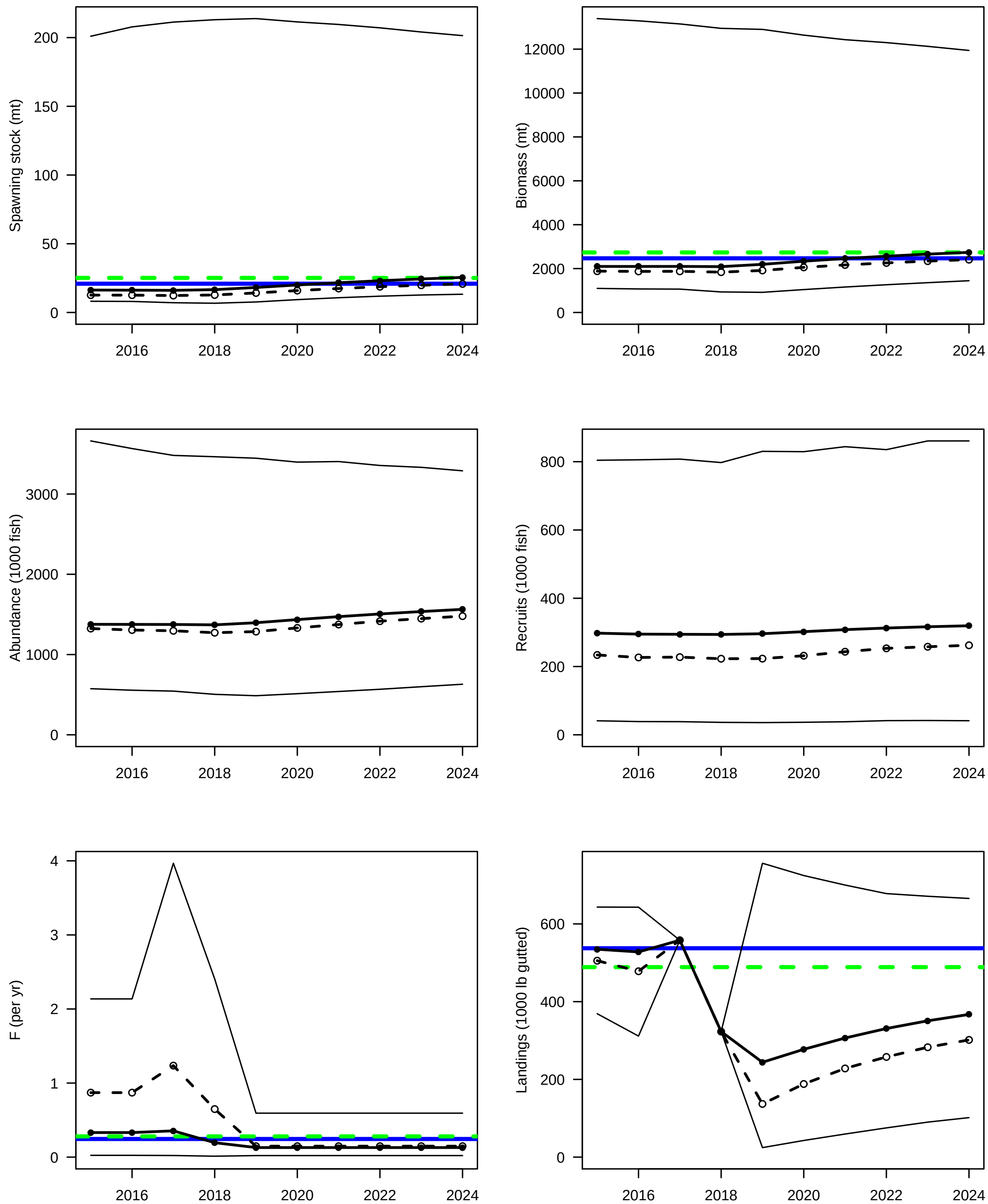


*Figure 34. Probability of being overfished under Projection Scenario 2: fishing mortality rate fixed to achieve* $Pstar = 0.30$ *starting in 2019, and with the reduced ACL in 2018. Curve represents the proportion of projection replicates for which SSB has reached the replicate-specific* MSST.

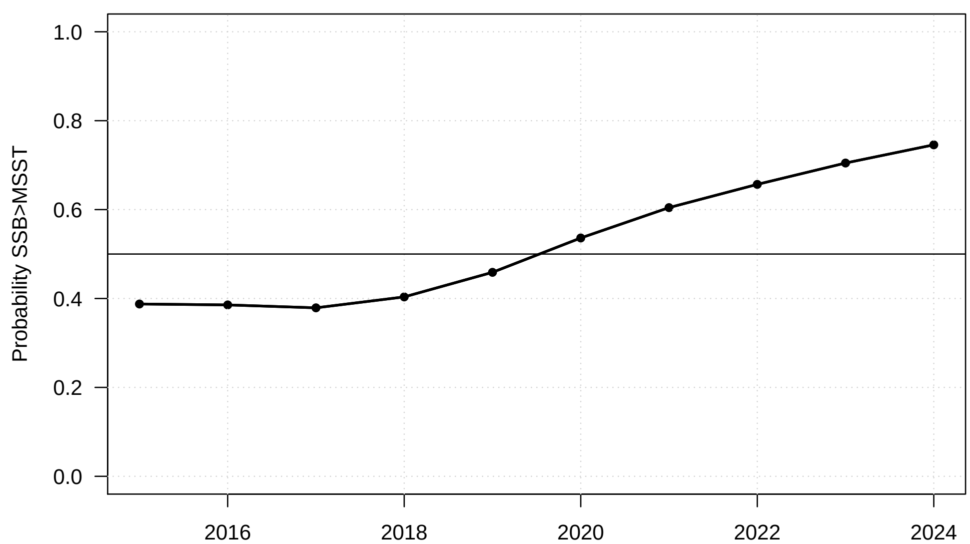


*Figure 35. Projection results for Scenario 3: fishing mortality rate fixed to achieve $P^{\star} = 0.40$ starting in 2019, and with the status quo ACL in 2018. In all panels, deterministic base-run values represented by solid lines with solid circles, medians of stochastic forecasts represented by dashed lines with open circles, and uncertainty represented by thin lines corresponding to $5^{th}$ and $95^{th}$ percentiles. Solid horizontal lines mark* MSY*-related quantities; dashed horizontal lines represent corresponding medians. Spawning stock (SSB) is at time of peak spawning.*

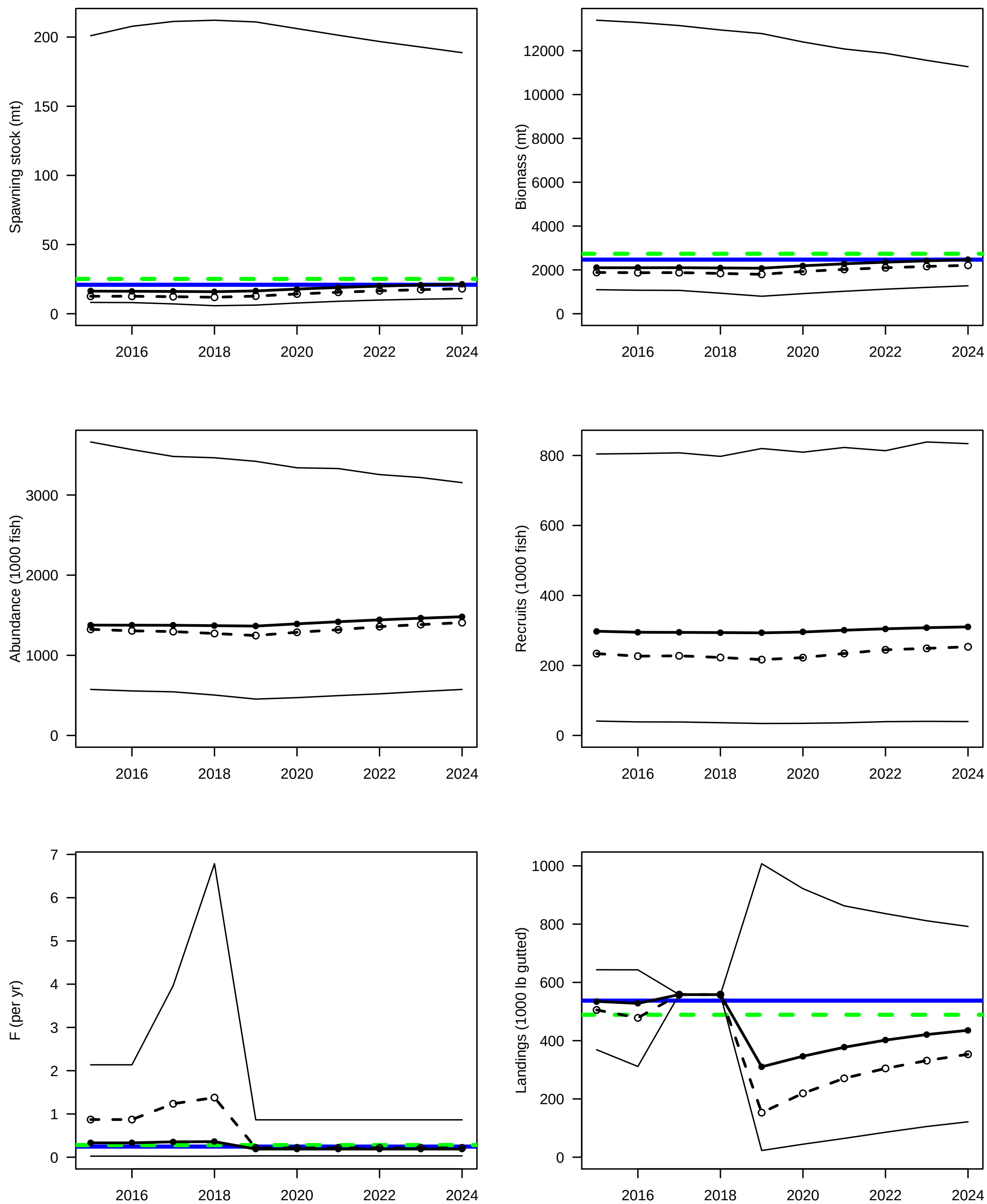


*Figure 36. Probability of being overfished under Projection Scenario 3: fishing mortality rate fixed to achieve $Pstar = 0.40$ starting in 2019, and with the status quo ACL in 2018. Curve represents the proportion of projection replicates for which SSB has reached the replicate-specific* MSST.

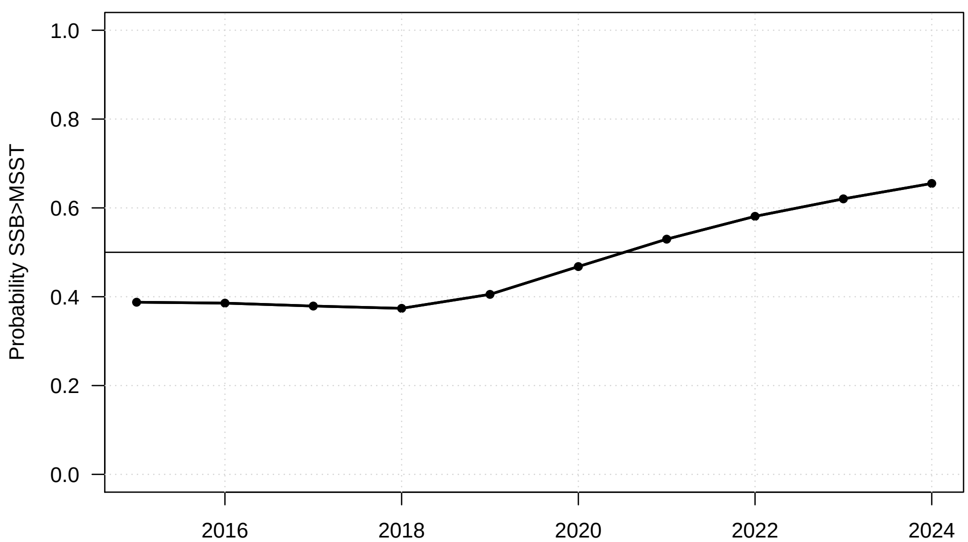


*Figure 37. Projection results for Scenario 4: fishing mortality rate fixed to achieve* $P^{\star} = 0.40$ *starting in 2019, and with the reduced ACL in 2018. In all panels, deterministic base-run values represented by solid lines with solid circles, medians of stochastic forecasts represented by dashed lines with open circles, and uncertainty represented by thin lines corresponding to* $5^{th}$ *and* $95^{th}$ *percentiles. Solid horizontal lines mark* MSY*-related quantities; dashed horizontal lines represent corresponding medians. Spawning stock (SSB) is at time of peak spawning.*

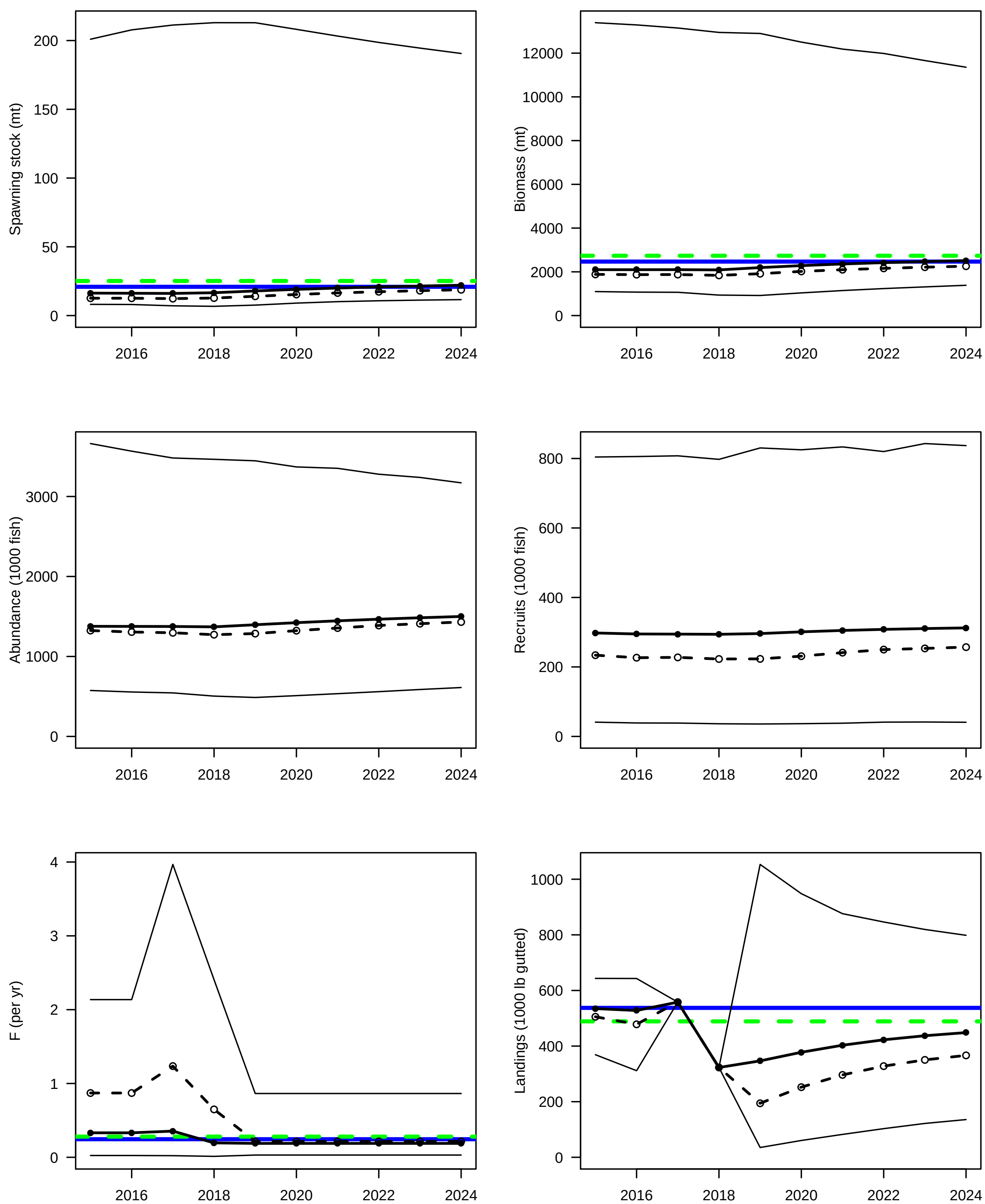


*Figure 38. Probability of being overfished under Projection Scenario 4: fishing mortality rate fixed to achieve $Pstar = 0.40$ starting in 2019, and with the reduced ACL in 2018. Curve represents the proportion of projection replicates for which SSB has reached the replicate-specific* MSST.

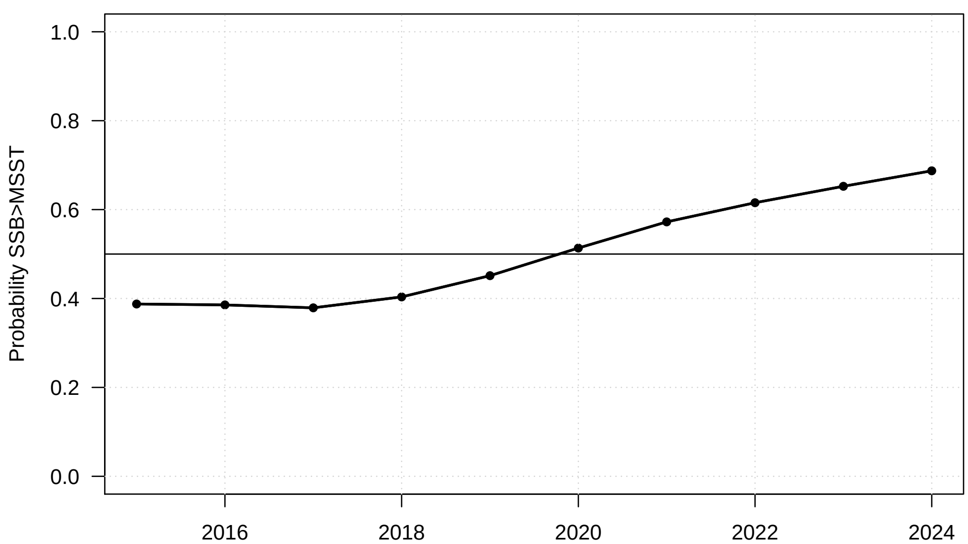


*Figure 39. Projection results for Scenario 5: fishing mortality rate fixed to achieve $P^\star = 0.45$ starting in 2019, and with the status quo ACL in 2018. In all panels, deterministic base-run values represented by solid lines with solid circles, medians of stochastic forecasts represented by dashed lines with open circles, and uncertainty represented by thin lines corresponding to $5^{th}$ and $95^{th}$ percentiles. Solid horizontal lines mark* MSY*-related quantities; dashed horizontal lines represent corresponding medians. Spawning stock (SSB) is at time of peak spawning.*

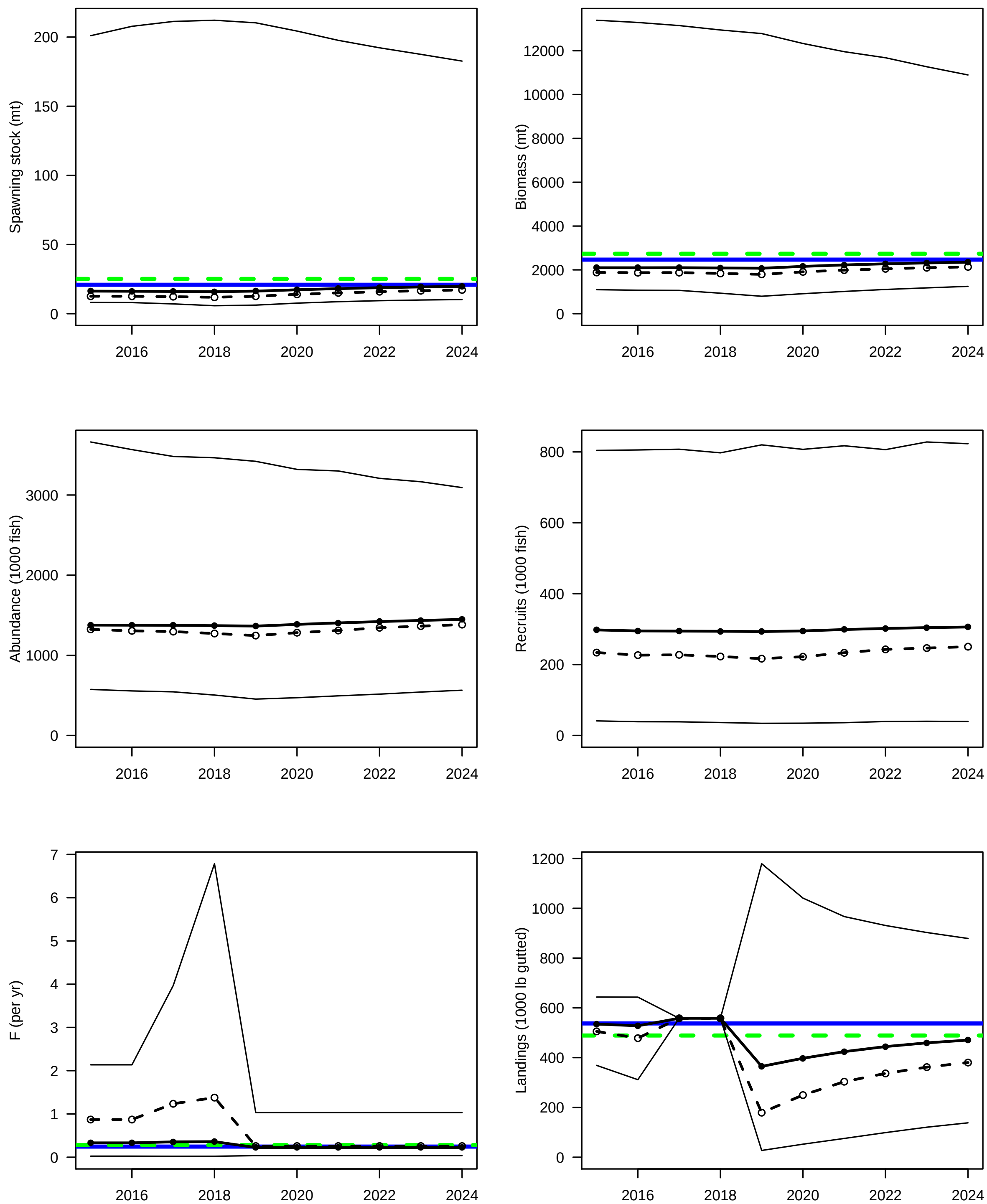


*Figure 40. Probability of being overfished under Projection Scenario 5: fishing mortality rate fixed to achieve* $Pstar = 0.45$ *starting in 2019, and with the status quo ACL in 2018. Curve represents the proportion of projection replicates for which SSB has reached the replicate-specific* MSST.

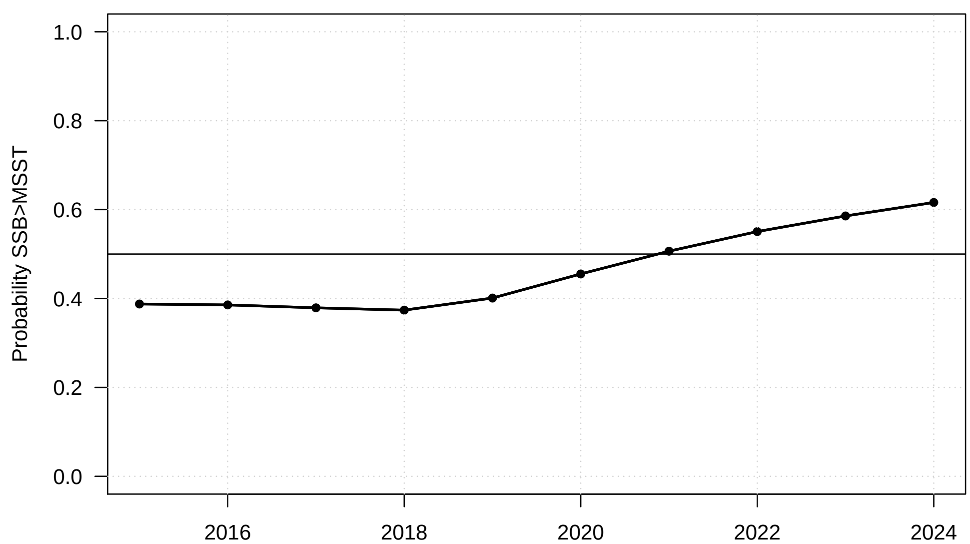


*Figure 41. Projection results for Scenario 6: fishing mortality rate fixed to achieve $P^{\star} = 0.45$ starting in 2019, and with the reduced ACL in 2018. In all panels, deterministic base-run values represented by solid lines with solid circles, medians of stochastic forecasts represented by dashed lines with open circles, and uncertainty represented by thin lines corresponding to $5^{th}$ and $95^{th}$ percentiles. Solid horizontal lines mark* MSY*-related quantities; dashed horizontal lines represent corresponding medians. Spawning stock (SSB) is at time of peak spawning.*

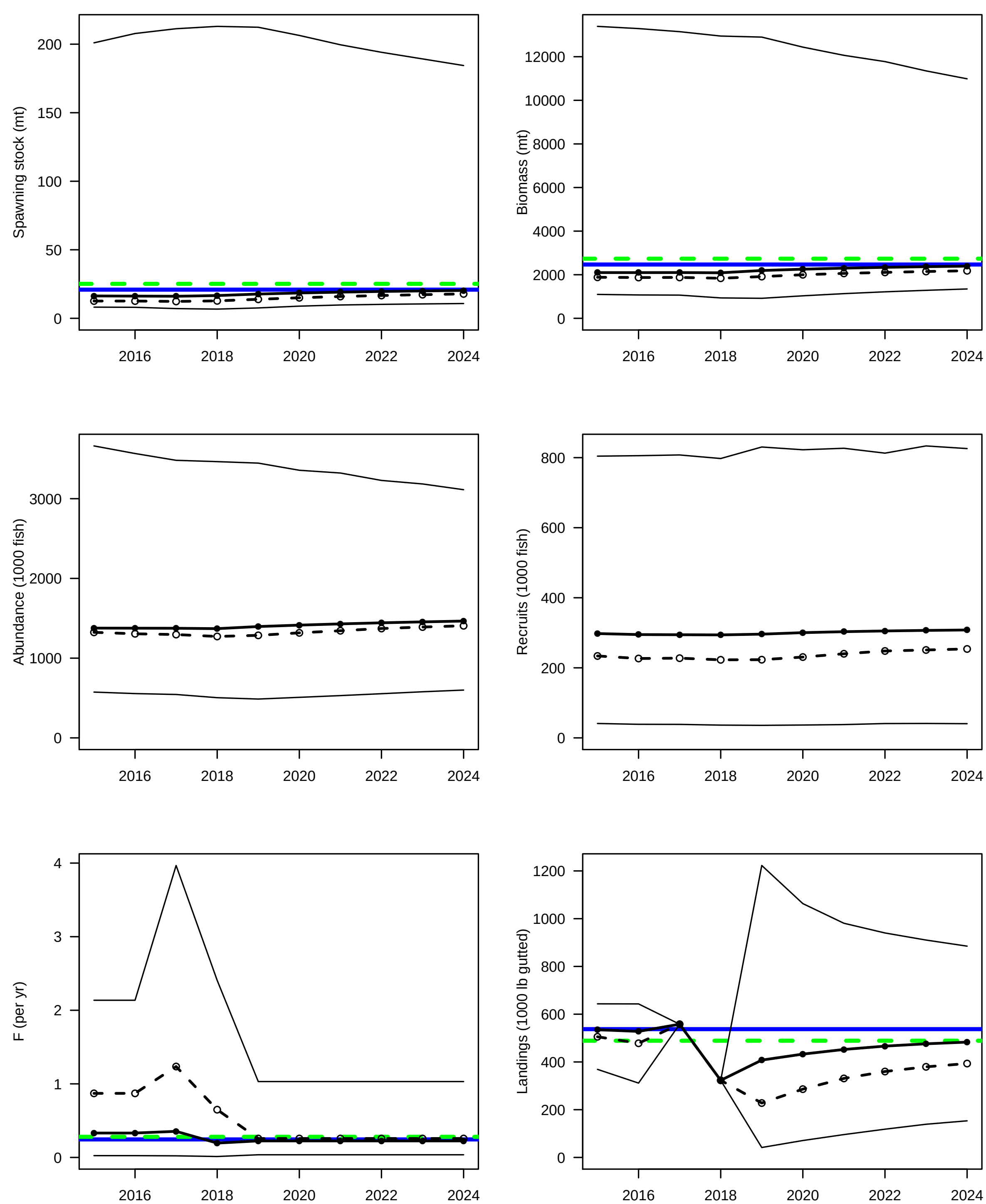


*Figure 42. Probability of being overfished under Projection Scenario 6: fishing mortality rate fixed to achieve* $Pstar = 0.45$ *starting in 2019, and with the reduced ACL in 2018. Curve represents the proportion of projection replicates for which SSB has reached the replicate-specific* MSST.

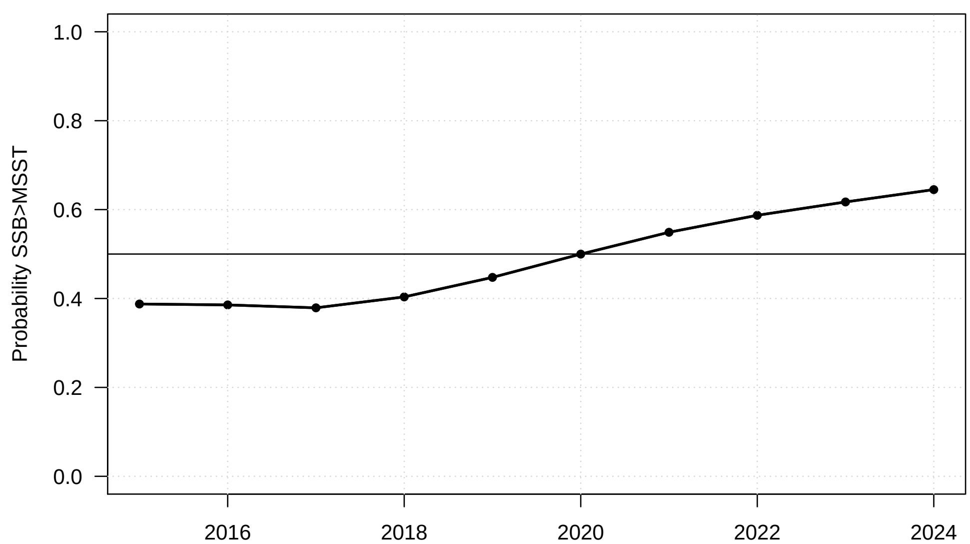


*Figure 43. Projection results for Scenario 7: fishing mortality rate* $F = 0.75F_{\mathrm{MSY}}$ *starting in 2019, and with the status quo ACL in 2018. In all panels, deterministic base-run values represented by solid lines with solid circles, medians of stochastic forecasts represented by dashed lines with open circles, and uncertainty represented by thin lines corresponding to* $5^{th}$ *and* $95^{th}$ *percentiles. Solid horizontal lines mark* MSY*-related quantities; dashed horizontal lines represent corresponding medians. Spawning stock (SSB) is at time of peak spawning.*

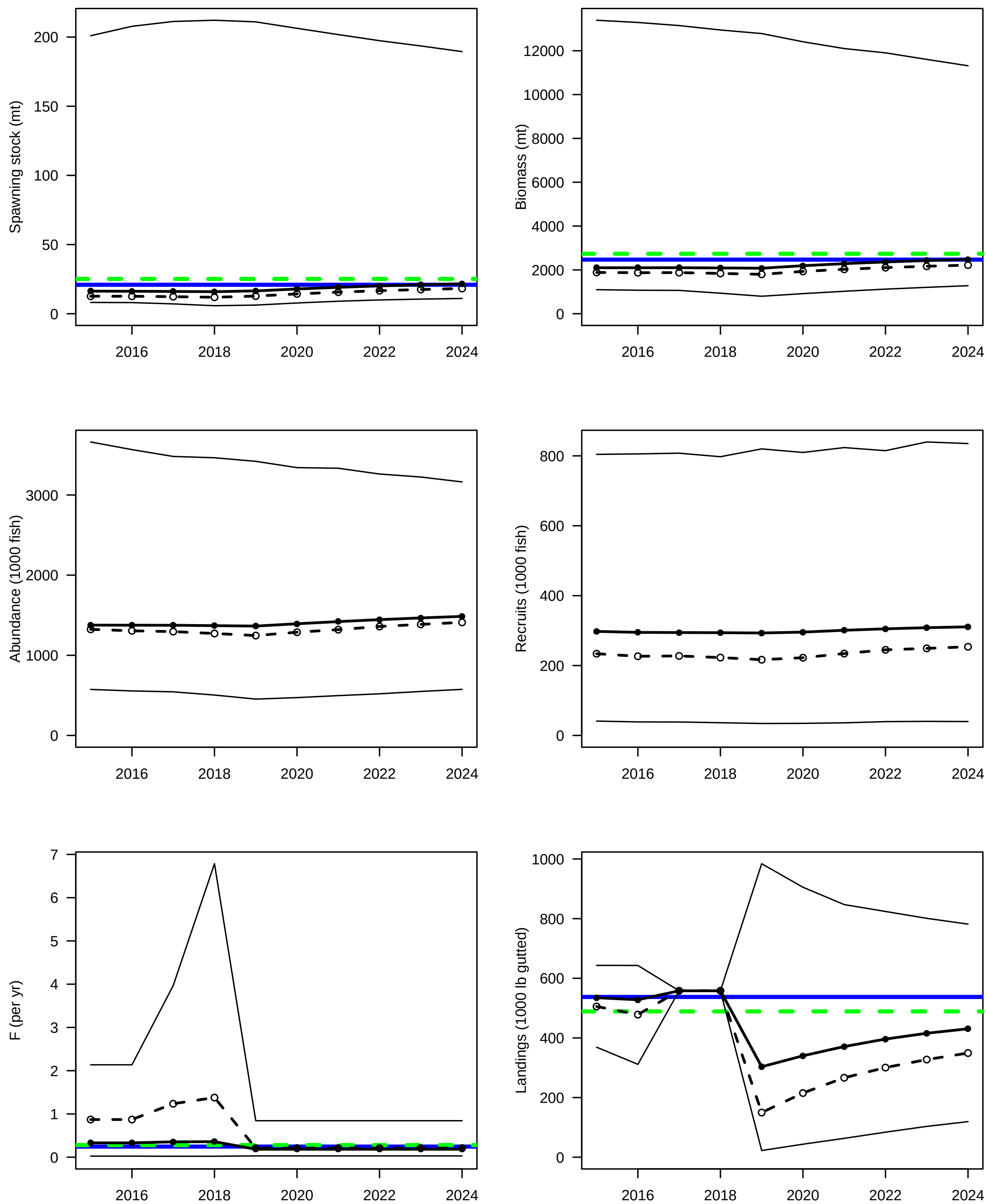


*Figure 44. Probability of being overfished under Projection Scenario 7: fishing mortality rate* $F = 0.75F_{\mathrm{MSY}}$ *starting in 2019, and with the status quo ACL in 2018. Curve represents the proportion of projection replicates for which SSB has reached the replicate-specific* MSST.

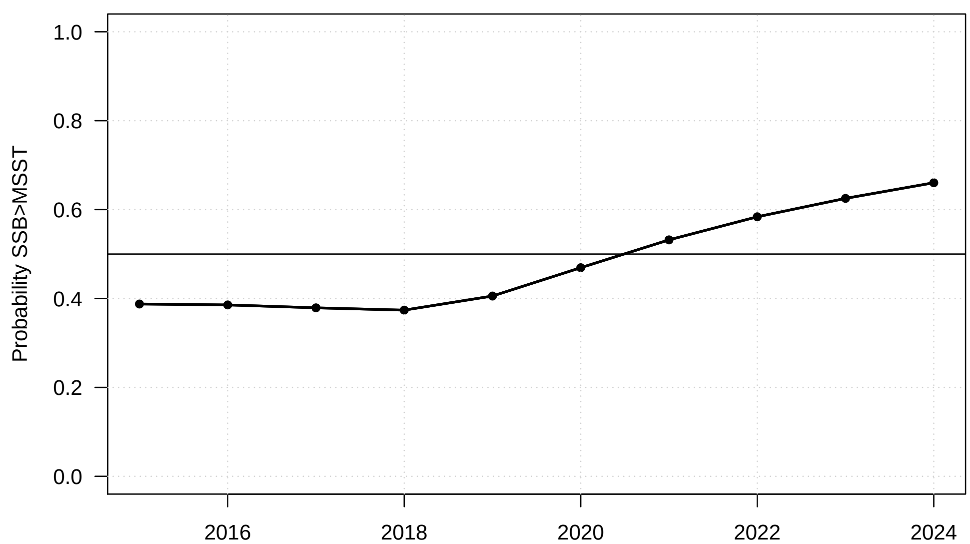


*Figure 45. Projection results for Scenario 8: fishing mortality rate $F = 0.75F_{\mathrm{MSY}}$ starting in 2019, and with the reduced ACL in 2018. In all panels, deterministic base-run values represented by solid lines with solid circles, medians of stochastic forecasts represented by dashed lines with open circles, and uncertainty represented by thin lines corresponding to $5^{th}$ and $95^{th}$ percentiles. Solid horizontal lines mark MSY-related quantities; dashed horizontal lines represent corresponding medians. Spawning stock (SSB) is at time of peak spawning.*

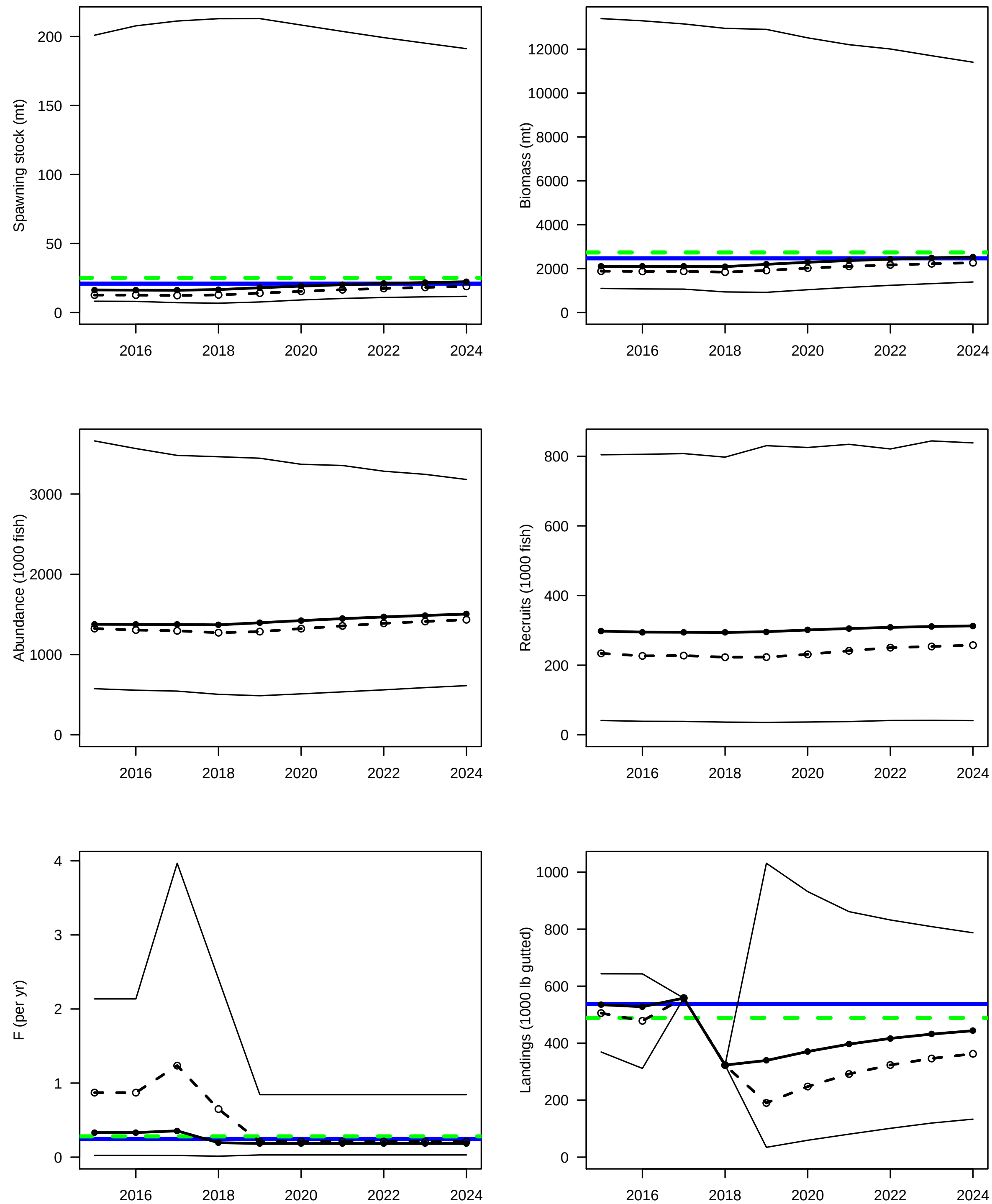
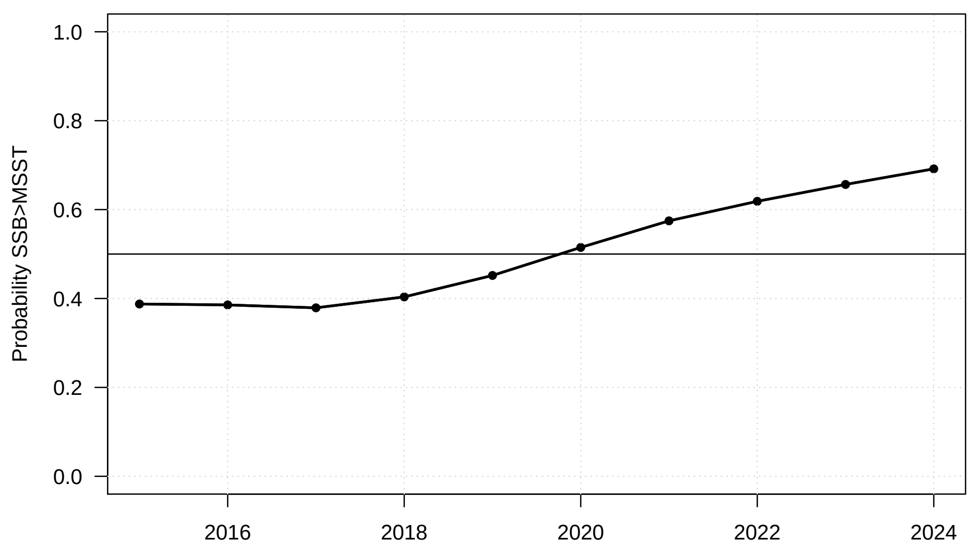


*Figure 46. Probability of being overfished under Projection Scenario 8: fishing mortality rate* $F = 0.75F_{\text{MSY}}$ *starting in 2019, and with the reduced ACL in 2018. Curve represents the proportion of projection replicates for which SSB has reached the replicate-specific* MSST.



# Appendix A Parameter estimates from the Beaufort Assessment Model

```
# Number of parameters = 194  Objective function value = 28.6134  Maximum gradient component = 1.83826e-008
# Linf (fixed):
825.100000000
# K (fixed):
0.189000000000
# t0 (fixed):
-0.470000000000
# Linf_f (fixed):
806.300000000
# K_f (fixed):
0.167000000000
# t0_f (fixed):
-0.470000000000
# len_cv_val:
0.150451788934
# log_Nage_dev:
 0.00000000000 0.00000000000 0.00000000000 0.00000000000 0.00000000000 0.00000000000 0.00000000000 0.00000000000
 0.00000000000 0.00000000000 0.00000000000 0.00000000000 0.00000000000 0.00000000000 0.00000000000 0.00000000000
 0.00000000000 0.00000000000 0.00000000000 0.00000000000 0.00000000000 0.00000000000 0.00000000000 0.00000000000
# log_R0:
12.7798915564
# steep:
0.840000000000
# rec_sigma:
0.247168978576
# R_autocorr:
0.00000000000
# log_rec_dev:
 -0.109792599949 -0.112130499322 -0.113543389184 -0.120825627366 -0.127618466727 -0.134057245221 -0.132254250634
 -0.133081201189 -0.134593693285 -0.150001493457 -0.124889394291 0.318137423410 0.542953672173 -0.501539789984
 -0.216896005080 -0.186061238459 -0.170307589146 0.142861576436 0.0927912754749 -0.152497165023 -0.0340895979267
 -0.279409702730 0.118627123849 0.476532741682 0.508985406298 0.0597409636636 0.0175135098330 0.269356025784
 0.357627973667 0.101669253000 -0.131143067394 0.0579350710990
# log_dm_cH_lc:
4.01810169886
# log_dm_cL_lc:
1.99546119534
# log_dm_rA_lc:
2.98981407807
# log_dm_cH_ac:
4.65433620804
# log_dm_cL_ac:
5.77321658924
# log_dm_mm_ac:
-0.999143221545
# selpar_L50_cH:
4.64395212551
# selpar_slope_cH:
3.03568303851
# selpar_L50_cL:
7.51827858879
# selpar_slope_cL:
3.21404944593
# selpar_L50_rA:
7.12424087490
# selpar_slope_rA:
3.00436508406
# selpar_L50_mm:
4.43400789831
# selpar_slope_mm:
2.84668729544
# log_q_cL:
-6.55981450962
# log_q_mm:
-7.47766908346
# M_constant:
0.108300000000
# log_avg_F_cH:
-5.24488663012
# log_F_dev_cH:
 -4.87234724052 -4.93546047198 -6.11203013743 -2.96880629068 -4.64667691957 -3.79007825435 -4.28575315259
 -4.49258523021 -3.81205499634 -3.19885222112 -3.71882015290 -2.46664714740 -1.64445143101 -1.08669019248
 -1.06198233604 -0.896931755747 0.378455561619 -0.106017044066 0.892189227612 1.76794912139 2.58485924708
 2.08483786756 2.04512871691 1.87807276023 1.88735092689 0.307287172044 1.01700720489 1.68884088497
 1.72264219412 1.75158571621 1.79732577677 2.73100885707 2.46423150599 2.39479735671 1.51092748798 1.40047039820
 1.13447514584 1.41538503451 1.92240499926 1.70225989775 2.08677626138 0.757933638157 0.997569016317
 1.25236537458 0.789590329013 1.35731770293 0.875878974603 0.591541566218 0.654443656167 0.348131224499
 1.89903799131 1.55552829207 2.45057788557
# log_avg_F_cL:
-2.77453019157
# log_F_dev_cL:
 -5.34004163934 -5.40154759590 -6.58324031906 -3.43849130626 -5.11822327024 -4.26203199456 -4.75771034274
 -4.96489680613 -4.28652101414 -3.67328540646 -4.19350688646 -2.94186899190 -2.11934905796 -1.56921119681
 -1.59130217534 -2.31212597236 -1.92138583595 -1.69614953186 -1.23695740401 0.312083466870 1.84660535919
 1.70146362470 1.61210873804 1.76142474554 2.03963404052 0.688900214177 1.29319643853 1.86516041312 2.05671427991
 2.38333664010 2.84989020862 3.35324751467 3.22893417457 3.04272214002 2.63724816494 2.54033711485 2.41274858918
 2.67664014693 3.11294721305 2.71266576462 2.72627570207 2.13252998950 2.03248780255 1.87666741904 1.89696443767
 1.25647718602 1.28055896972 1.20690788227 1.20300789950 1.13607016590 1.31906525045 1.53288293514 1.67994211549
# log_avg_F_rA:
```

```
-6.26559729330
# log_F_dev_rA:
 -3.77696731002 -6.64620439588 -2.77263843634 -0.471350148546 2.35353189955 -3.24123635133 -2.85275854038
 -0.543974505792 -5.62892498104 -2.24750171135 -1.86953977408 0.986294255783 -4.17079167090 1.79972632893
 -3.99695136032 1.24921966663 2.97257490471 -0.468202153340 1.47914363407 2.11727078376 2.42416409663
 2.35695687787 3.37050433683 3.93316992692 4.08006408292 3.30166529048 1.85885108749 -4.95594488260
 1.77493037084 1.39385466076 1.90757886807 2.01859803166 1.50858644608 0.756300671929
# F_init (fixed):
0.0100000000000
```