SEDAR

Southeast Data, Assessment, and Review

SEDAR 100

Gulf Gray Triggerfish

SECTION III: Assessment Report

July 2026

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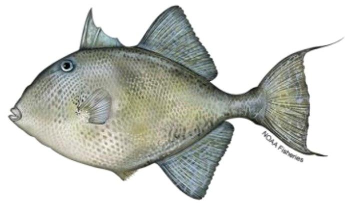

SEDAR 100 Gulf of America Gray Triggerfish Stock Assessment

Gulf Fisheries Branch
Sustainable Fisheries Division
NOAA Fisheries - Southeast Fisheries Science Center

July 2026

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1. Introduction

This document summarizes the Southeast Data Assessment and Review (SEDAR) 100 Gulf of America (Gulf) Gray Triggerfish (*Balistes capriscus*) Assessment as implemented in the Stock Synthesis (version 3.30.21.00) modeling framework (Methot and Wetzel 2013). The last completed assessment for Gulf Gray Triggerfish was the SEDAR 43 Standard Assessment with data through 2013 (SEDAR 2015).

Where practicable, the SEDAR 100 Assessment Process (AP) Model used the same data sets as the SEDAR 43 Standard Model with time series updated through 2024. However, notable changes include:

- revised age data from new ageing protocols and updated growth, natural mortality, and ageing error estimates
- switched to modeling maturity as a function of length rather than age given ageing issues
- updated the time series of commercial landings by reviewing the SEDAR 43 methodology (assumptions and decisions) and making improvements where warranted
- updated the time series of commercial discards using the catch-per-unit-effort (CPUE)-expansion approach used since SEDAR 61 in Gulf stock assessments
- updated the time series of recreational landings and discards from the National Marine Fisheries Service's (NMFS) Marine Recreational Fisheries Statistics Survey (MRFSS) estimates to the Marine Recreational Information Program Fishing Effort Survey (MRIP-FES)-based estimates and using fully-calibrated Texas Parks and Wildlife Department and Louisiana Creel Survey estimates
- incorporated more error in landings and discard estimates to better reflect uncertainties in removals
- updated discard mortality estimates based on recent research
- updated time series of shrimp effort and shrimp bycatch estimates
- re-evaluated indices of relative abundance for inclusion in the assessment
- separated the Southeast Area Monitoring and Assessment Program (SEAMAP) Trawl Survey into two time periods based on differing survey designs and included length compositions
- standardized the relative abundance and length compositions of the Combined Video Survey to account for differences in habitat and survey footprints of the three surveys
- fitted to all available length composition data (discards, landings, and surveys) and used weighted length compositions where possible
- inputted conditional age-at-length compositions for fishing fleets to enable the internal estimation of growth within Stock Synthesis
- re-evaluated recruitment parameters including steepness and *SigmaR* and fixed them at 0.99 and 0.6, respectively
- applied a Dirichlet-Multinomial internal re-weighting approach to age and length compositions

These changes reflect improvements in data inputs and parameterization compared with SEDAR 43. A more comprehensive description of these changes is detailed in subsequent sections of the assessment report. Assessment methods, results, model diagnostics, stock status determination criteria and projections are also provided through this report.

1.1. Workshop Time and Place

The SEDAR 100 Assessment was developed internally by the Southeast Fisheries Science Center (SEFSC). No SEDAR-led meetings were conducted during this stage. The Assessment Process included internal meetings between January and May to review modeling modifications from SEDAR 43 and make recommendations towards a base model.

1.2. Terms of Reference

Assessment Process Terms of Reference

1. Evaluate and document the following specific changes in input data or deviations from the previous assessment model.

2. Consider continuity model stratification and data structure and suggest any recommended revisions.

    a. Re-evaluate whether commercial and recreational fleets should be separated by East and West by reviewing all available data (landings, discards, indices, compositions).
    b. Provide estimates of uncertainty around each set of landings and discard estimates.
    c. Review ageing validation and ageing structures studies and consider their appropriateness for inclusion in the assessment model.
        i. Update life history data/analyses (e.g., maximum age, growth, mortality, ageing error matrix, reproduction) given revised age data following recent ageing studies as needed
    d. Explore the use of a combined video index from the FWRI, Pascagoula, and Panama City video surveys (e.g., G-FISHER). Recommend modifications needed to inform differences in catchability and selectivity of the surveys.
    e. Evaluate the start year and initial Fs used in the assessment model.
    f. Explore shrimp trawl bycatch magnitude and age-structure, if data are available using new effort and bycatch methodologies (e.g., SEAMAP Summer and Fall Groundfish trawls and shrimp observer data).
    g. Explore fleet-specific length compositions and remote sensing data for sargassum coverage as a potential index of recruitment.
    h. Consider recent discard mortality studies and analytical results and incorporate updated discard mortality rate(s) as appropriate.

3. Document any revisions or corrections made to the input data sets and provide updated input data tables. Provide commercial and recreational landings and discards in numbers and weight (pounds). Describe the fraction of catch by fleet that is discarded.

4. Generate model parameter estimates and their variances, estimates of model uncertainties, and estimates of stock status and management benchmarks. In addition to

the base model, conduct sensitivity analysis to address uncertainty in data inputs and model configuration and consider runs that represent plausible, alternate hypotheses about key parameters.

a. Use the following status determination criteria (SDC):
   i. MSY proxy = yield at F_{MSY} or proxy ($F_{30\%SPR}$, Amendment 48)
   ii. Provide model outputs using alternative MSY proxies as justified by the life history and data available for the stock
   iii. If overfished, MSY proxy = $F_{Rebuild}$
   iv. MSST = 0.5*SSB_{MSY} (Amendment 44)
   v. MFMT = F_{MSY} and $F_{Rebuild}$ (if overfished)
   vi. OY = 90% of MSY or proxy (Amendment 48)
   vii. If different SDC are recommended, provide outputs for both the current and recommended SDC.
b. Unless otherwise recommended, use the geometric mean of the previous three years' fishing mortality to determine $F_{Current}$. If an alternative approach is recommended, provide justification and outputs for the current and alternative approach.
c. Provide yield and spawning stock biomass streams for the overfishing limit and acceptable biological catch in pounds:
   i. Annually for five years
   ii. Under a "constant catch" scenario for both three and five years
   iii. For the equilibrium yield at F_{MSY}, when estimable

5. Develop a stock assessment report to address these Terms of Reference and fully document the input data and results of the stock assessment model.

1.3. Documents Prepared for the Assessment Process

Document #	Title	Authors	Date Submitted
Documents Prepared for the Assessment Process			
SEDAR100-AP-01	Gray Triggerfish Post-Release Mortality (SEDAR 100)	S100 Ad Hoc Discard Mortality Working Group	23-Apr-26

2. Data Review and Update

A variety of data sources were used in the SEDAR 100 Assessment following the SEDAR 43 Standard Assessment (terminal year of 2013) and the attempted but never completed SEDAR 62 Standard Assessment (terminal year of 2017). Where practicable, the SEDAR 100 AP Model used the same data sets as the SEDAR 43 Standard Model with an updated time series though

2024. However, given the length of time since the last completed assessment (SEDAR 43), there were a number of new or revised data sets provided for consideration including:

1. Updated morphometric conversions
2. Revised age estimates based on improved ageing procedures for reading and advancing age estimates
3. Updated growth curve and natural mortality estimates
4. An ageing error matrix accompanying the revised age data
5. Commercial landings and discard estimates
6. National Marine Fisheries Service's (NMFS) Marine Recreational Information Program Fishing Effort Survey (MRIP-FES) catch and discard time series along with fully calibrated Texas Parks and Wildlife Department and Louisiana Creel Survey estimates
7. Annual estimates of uncertainty accompanying landings and discard estimates
8. Updated estimates of shrimp effort, shrimp bycatch, and proxy bycatch length compositions
9. Commercial and recreational length compositions weighted by landings where possible
10. Commercial and recreational conditional age-at-length compositions
11. Mean length-at-age of Gray Triggerfish landed by each fleet (for checking model predictions only, the model is not fitting to these data inputs)
12. Updated discard mortality estimates based on recent research
13. Separated the Southeast Area Monitoring and Assessment Program (SEAMAP) Trawl Survey into two time periods based on differing survey design and included length compositions
14. Standardized the relative abundance and length compositions of the Combined Video Survey to account for differences in habitat and spatial footprints of the three video surveys

These new data series were considered because they had not previously been available for the SEDAR 43 Standard Assessment or represented improved data inputs for use in the SEDAR 100 Assessment. The data utilized in the SEDAR 100 AP Model are summarized below and illustrated in **Figure 1** along with their corresponding temporal scale. Comprehensive descriptions of individual data components are provided within each subsection below.

1. Life history
    a. Morphometrics
    b. Age and growth
    c. Natural mortality
    d. Maturity
    e. Fecundity
2. Discard mortality rates (based on numbers of fish)
    a. Recreational
    b. Commercial Vertical Line
3. Landings
    a. Recreational: 1945-2024 (1,000s of fish)

   b. Commercial Vertical Line: 1945-2024 (metric tons whole weight)
   c. Commercial Longline: 1979-2024 (metric tons whole weight)
4. Mean weight (kg, whole weight) of landings
   a. Recreational: 1981-2024
5. Shrimp Effort
   a. Shrimp Effort: 1945-2024
6. Discards
   a. Recreational: 1981-2024 (1,000s of fish)
   b. Commercial Vertical Line: 2000-2024 (1,000s of fish)
   c. Shrimp Bycatch: median value of 1947-2023 assumed representative for 1946-2023 (1,000s of fish)
7. Length composition of landings (2 to 74 cm Fork Length (cm FL), 2 cm FL bins)
   a. Recreational: 1981-2024
   b. Commercial Vertical Line: 1990-2024
   c. Commercial Longline: 1990-2024
8. Length composition of discards (2 to 74 cm FL, 2 cm FL bins)
   a. Recreational: 2009-2024 (Florida, Alabama, and Mississippi At-Sea Observer Programs)
   b. Commercial Vertical Line: 2010-2024 (NMFS Reef Fish Observer Program)
   c. Shrimp Bycatch: 1984-2023 (Proxy based on SEAMAP Trawl Survey)
9. Conditional age-at-length of landings (1-year age bins, plus group ages 10 and older)
   a. Recreational: 2003-2024
   b. Commercial Vertical Line: 2003-2024
   c. Commercial Longline: 2003-2022
10. Mean length-at-age of landings
   a. Recreational: 2003-2024
   b. Commercial Vertical Line: 2003-2024
   c. Commercial Longline: 2003-2022
11. Abundance indices
   a. Fishery-independent:
      i. SEAMAP Trawl Early Survey: 1987-2008
      ii. SEAMAP Trawl Late Survey: 2009-2024
      iii. Combined Video Survey: 1993-2024
   b. Fishery-dependent:
      i. Recreational (Southeast Region Headboat Survey, SRHS) CPUE: 1986-2007
12. Length composition of surveys (2 to 74 cm FL, 2 cm FL bins)
   a. SEAMAP Trawl Early Survey: 1987-2008
   b. SEAMAP Trawl Late Survey: 2009-2024
   c. Combined Video Survey: 1996-2024

A summary listing of all data sets included in the assessment, along with any revisions to the contact information for who provided the analysis, has been compiled below. This will be the source of data information for the next assessment.

Data Type	Contributing Organization	Data Providers	Contact Information
Life History			
Raw length data	GulfFIN	Gregg Bray	Gregg.Bray@gsmfc.org
Raw age and length data	GulfFIN	Gregg Bray	Gregg.Bray@gsmfc.org
Raw age and length data	FWRI	Justin Lewis	Justin.Lewis@MyFWC.com
Raw age and length data	MSU	Amanda Jargowsky	aej279@msstate.edu
Raw age, length, reproduction data	SEFSC	Ashley Pacicco	ashley.pacicco@noaa.gov
Raw reproduction data	USM	Nancy Brown Peterson	nancy.brown-peterson@usm.edu
Compiled age, length, and reproduction data	SEFSC	Ashley Pacicco	ashley.pacicco@noaa.gov
Natural mortality estimate	SEFSC	Ashley Pacicco	ashley.pacicco@noaa.gov
Growth curves	SEFSC	Ashley Pacicco Steve Garner	ashley.pacicco@noaa.gov steven.garner@noaa.gov
Morphometric conversions	SEFSC	Ashley Pacicco	ashley.pacicco@noaa.gov
Ageing error matrix	SEFSC	Steve Garner	steven.garner@noaa.gov
Fishery-Dependent			
Raw commercial size data (sample size)	SEFSC	Larry Beerkircher	lawrence.r.beerkircher@noaa.gov
Raw commercial size data	SEFSC	Larry Beerkircher	lawrence.r.beerkircher@noaa.gov
Raw recreational size data	SEFSC	Samantha Binion-Rock	samantha.binion-rock@noaa.gov
Raw recreational size data - SE Region Headboat Survey	SEFSC	Rob Cheshire	rob.cheshire@noaa.gov

Data Type	Contributing Organization	Data Providers	Contact Information
Fishery-Dependent			
Raw commercial logbook catch and effort	SEFSC	Sydney Alhale	sydney.alhale@noaa.gov
Raw commercial discard logbook data	SEFSC	Sydney Alhale	sydney.alhale@noaa.gov
Raw commercial observer program data	SEFSC	Gary Decossas	gary.decossas@noaa.gov
Raw recreational discard size data	FWRI	Ellie Corbett	Ellie.Corbett@MyFWC.com
Raw recreational discard size data	SEFSC	Matt Nuttall	matthew.nuttall@noaa.gov
Raw recreational discard size data	ADCNR	John Mareska	John.Mareska@dcnr.alabama.gov
Commercial mean weights	SEFSC	Michaela Pawluk	michaela.pawluk@noaa.gov
Commercial landings	SEFSC	Sarina Atkinson Michaela Pawluk	sarina.atkinson@noaa.gov michaela.pawluk@noaa.gov
Commercial length compositions	SEFSC	Michaela Pawluk	michaela.pawluk@noaa.gov
Commercial age compositions	SEFSC	Michaela Pawluk	michaela.pawluk@noaa.gov
Commercial mean length at age	SEFSC	Michaela Pawluk	michaela.pawluk@noaa.gov
Commercial conditional age-at-length	SEFSC	Michaela Pawluk	michaela.pawluk@noaa.gov
Recreational catch (landings + discards) estimates and effort estimates	SEFSC	Samantha Binion-Rock	samantha.binion-rock@noaa.gov
Recreational private mode estimates (MRIP-FCAL to SRFS calibrations & SRFS catch estimates)	FWRI	Maria McGirl	Maria.McGirl@MyFWC.com
SE Region Headboat Survey catch and effort	SEFSC	Rob Cheshire	rob.cheshire@noaa.gov

Data Type	Contributing Organization	Data Providers	Contact Information
Fishery-Dependent			
Headboat discards prior to SRHS	SEFSC	Matt Nuttall	matthew.nuttall@noaa.gov
Compiled recreational catch (landings + discards) estimates	SEFSC	Matt Nuttall Samantha Binion-Rock	matthew.nuttall@noaa.gov samantha.binion-rock@noaa.gov
Recreational historical landings estimates	SEFSC	Samantha Binion-Rock	samantha.binion-rock@noaa.gov
Recreational length compositions	SEFSC	Samantha Binion-Rock	samantha.binion-rock@noaa.gov
Recreational age compositions	SEFSC	Samantha Binion-Rock	samantha.binion-rock@noaa.gov
Recreational mean length at age	SEFSC	Samantha Binion-Rock	samantha.binion-rock@noaa.gov
Recreational conditional age-at-length	SEFSC	Samantha Binion-Rock	samantha.binion-rock@noaa.gov
Recreational discard length compositions - Florida only	FWRI	Ellie Corbett	Ellie.Corbett@MyFWC.com
Recreational discard length compositions - MS to FL	SEFSC	Samantha Binion-Rock	samantha.binion-rock@noaa.gov
Commercial discards estimates	SEFSC	Sarina Atkinson Kevin Thompson	sarina.atkinson@noaa.gov kevin.thompson@noaa.gov
Commercial discard length compositions	SEFSC	Sarina Atkinson Kevin Thompson	sarina.atkinson@noaa.gov kevin.thompson@noaa.gov
Shrimp effort	SEFSC	Kyle Dettloff	kyle.dettloff@noaa.gov
Shrimp bycatch estimates and length compositions	SEFSC	Steve Smith Cheston Peterson	steven.smith@noaa.gov cheston.peterson@noaa.gov
Headboat index (East, West, Gulf-wide)	SEFSC	Matt Nuttall	matthew.nuttall@noaa.gov
Commercial vertical line index (East, West, Gulf-wide)	SEFSC	Kevin Thompson	kevin.thompson@noaa.gov

Data Type	Contributing Organization	Data Providers	Contact Information
Fishery-Independent			
G-FISHER index	SEFSC	Kate Overly	katherine.overly@noaa.gov
G-FISHER length compositions	SEFSC	Kate Overly	katherine.overly@noaa.gov
SEAMAP Summer-Fall Trawl Survey index	SEFSC	Adam Pollack	adam.pollack@noaa.gov
SEAMAP Summer-Fall Trawl Survey age compositions	SEFSC	Adam Pollack	adam.pollack@noaa.gov
SEAMAP Summer-Fall Trawl Survey length compositions	SEFSC	Adam Pollack	adam.pollack@noaa.gov

2.1. Stock Structure and Management Unit

No new literature was identified during SEDAR 100; therefore, the stock definition was unchanged from previous assessments. Gray Triggerfish has been considered a single unit stock throughout the Gulf because of their prolonged and indeterminate pelagic phase and the potential of wide dispersal (SEDAR 2006). The management unit for Gulf Gray Triggerfish extends from the United States (US)–Mexico border in the West through the northern Gulf and west of the Dry Tortugas and the Florida Keys (north of US Highway 1).

2.2. Life History Parameters

Life history data used in the assessment included length-weight and length-length relationships, age and growth, natural mortality, maturity, and fecundity. Some of the life history data were input to the assessment model as fixed values, while other life history parameters were estimated. Sex ratio at birth was assumed to be 1:1 as in SEDAR 43.

2.2.1. Morphometric and Conversion Factors

Morphometric conversion factors developed during the SEDAR 43 Standard Assessment were updated during the SEDAR 100 Assessment because of the large increase in sample sizes for analyses. The relationship between whole weight (wwt; in kilograms) and fork length (FL; in centimeters) for both sexes combined was used as a fixed model input (**Table 1**, **Figure 2A**). The total length (TL) to FL conversion was used to convert the minimum size limit in 1999 for input into the model retention functions (**Section 3.1.8**).

2.2.2. Age and Growth

Age data for SEDAR 100 were collected between 2003 and 2024 by federal and state sampling programs and submitted by the Panama City Laboratory of the SEFSC, the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute (FWRI; SEDAR100-DW13), the Gulf States Marine Fisheries Commission Fisheries Information Network (GulfFIN), and Dauphin Island Sea Lab/University of South Alabama (detailed in SEDAR100-DW14). Age data from the commercial and recreational fisheries were input into the assessment (**Sections 2.3.9-2.3.10**).

While preparing for the SEDAR 100 Assessment, major improvements to ageing procedures were made following recent research on Gray Triggerfish ageing. Specifically, previous methods for ageing spines led to age estimates biased low because of the difficulty in distinguishing translucent zones near the edge of the spines. Potts et al. (2023) developed a protocol which increased magnification on spines and led to less biased age estimates, results of which were later validated by Chamberlain et al. (2024 [SEDAR100-RD03]). The increased magnification revealed the presence of compacted growth zones near the margin of the dorsal spine sections of age-5 or older specimens; therefore, for SEDAR 100, all Gray Triggerfish aged 5 or older were re-aged using the updated protocol. While these updates led to a greatly improved age data set for consideration, there remains considerable variability in size-at-age. For example, a 40 cm FL Gray Triggerfish can range anywhere from 2 to 15 years old (**Figure 3**).

The SEDAR 100 Life History Working Group uncovered an issue at the Data Workshop with how age assignments were being adjusted based on the settlement mark and a previously defined algorithm (Allman et al. 2019 [SEDAR62-WP09]). These issues were alleviated partly by the primary reader re-ageing all fish with annuli counts of 0 or 1 that were caught from September through December and were < 25 cm FL, along with outlier fish with an annuli count of 2 that were caught from April through May with a FL > 40 cm. In addition, the Life History Working Group developed an age slicing algorithm using Electronic Length Frequency Analysis (ELEFAN) to assign calendar age for samples with annuli counts of 0 or 1, however, this approach was not recommended beyond age 1 as modes became less distinct with age (**Figure 2.14.7 in Data Workshop Report**). Gray Triggerfish with two annuli counts re-aged by the primary reader ranged from 3 to 7 years old, further highlighting the difficulty in ageing, which remains a key uncertainty for this species.

Growth was modeled using a single size-modified von Bertalanffy growth curve for both sexes combined (**Table 2**, **Figure 2B**). The SEDAR 100 Data Workshop recommended a constant coefficient of variation (CV)-at-age (CV = 0.14). Growth curves were estimated by sex to evaluate whether the SEDAR 100 data supported sexually-dimorphic growth, however no notable differences were detected (**Section 2.5 of Data Workshop Report**). This finding differs from previous studies (summarized in Jefferson et al. 2019 [SEDAR62-RD01]; Chamberlain et al. 2025 [SEDAR100-RD04]), although many of the older studies referenced likely suffered from biased age estimates obtained using the old spine ageing protocol.

To account for uncertainty in the ageing process (e.g., due to different readers; SEDAR100-DW14), standard deviations (SD)-at-age were calculated and used as a measure of ageing error in the assessment model. Ageing error estimates were estimated by fitting a single error model to all three sets of age estimates for the reference set. The best fit model based on Akaike's

Information Criterion (AIC) values estimated linear bias and assumed a curvilinear SD (**Section 2.6 in Data Workshop Report**). Uncertainty in age estimates increased with age (**Table 3**), with wider distributions of observed ages evident for older Gray Triggerfish (**Figure 4**).

2.2.3. Natural Mortality

As in SEDAR 43, natural mortality (*M*) was modeled using a Lorenzen function, i.e. a size-dependent mortality schedule (Lorenzen 2000; Lorenzen et al. 2022) in which the instantaneous mortality rate-at-age is inversely proportional to length-at-age (**Table 4**, **Figure 2C**). Parameters required for this approach include the age at full recruitment to the fishery, a target *M* point estimate for the species representing the cumulative mortality rate over the range of exploited ages, and growth curve parameter estimates.

Following review of the updated age data, the SEDAR 100 Life History Working Group maintained the maximum age (*tmax*) of 15 years used in SEDAR 43. An updated point estimate for *M* was derived using the *M* estimator developed by Hamel and Cope (2022):

$$M = 5.4/tmax$$

This study evaluated Then et al.'s (2015) updated data set of *M* and maximum age with a more appropriate transformation than was used by Then et al. (2015) (see Hamel and Cope 2022 for more detail on the approach). Applying the Hamel and Cope (2022) estimator using a maximum age of 15 years yielded an updated *M* point estimate of 0.36, an increase from the SEDAR 43 estimate of 0.28 based on Hoenig (1983).

2.2.4. Maturity

Maturity parameters developed during the SEDAR 43 Standard Assessment were not updated during the SEDAR 100 Assessment because no new analyses were conducted. While new reproduction data from Alabama waters spanning 2016 through 2019 (N = 406) were submitted by the University of Southern Mississippi/Alabama Department of Conservation and Natural Resources, the majority of data were collected outside of the time period used in SEDAR 43 analyses (June through August) and no age estimates were provided. Previously, SEDAR 43 recommended modeling maturity as a function of age (Fitzhugh et al. 2015 [SEDAR43-WP03]). However, given the ageing concerns particularly for ages 1-2 discussed in **Section 2.2.2** and also noted in SEDAR100-DW20, maturity was modeled as a function of length for SEDAR 100 using the values provided for SEDAR 43. The slope was estimated at -0.232 and the length at 50% maturity was predicted around 15.26 cm FL (**Figure 2D**). The first age mature was 2 years based on SEDAR 43 (Fitzhugh et al. 2015 [SEDAR43-WP03]), although this should be revisited given changes to the age estimates.

2.2.5. Fecundity

Fecundity parameters used during the SEDAR 43 Standard Assessment (i.e., $eggs = aLength^b$; Lang and Fitzhugh 2015 [SEDAR62-RD05]) were not updated during the SEDAR 100 Assessment because no new data were provided. However, given concerns over the limited fecundity data from SEDAR 43 (N = 73 spanning an incomplete size range of 26 to 39 cm FL) combined with the lack of uncertainty accounted for in the relationship within the assessment model, SEDAR 100 used female-only spawning stock biomass (SSB) as a measure of reproductive potential (i.e., SSB equivalent to female body weight, **Figure 2E**).

2.2.6. Discard Mortality

Discard mortality estimates were updated from those recommended for the SEDAR 43 Standard Assessment (5% with 10% as a sensitivity) based on a synthesis of recent studies and analyses (SEDAR100-AP01). The discard mortality rate for the Recreational fleet was 40%, which was obtained from a synthesis of current discard mortality research from tagging and acoustic telemetry studies (Runde et al. 2019 [SEDAR100-RD05], Bohaboy et al. 2020 [SEDAR100-RD01], Patterson et al. 2020 [SEDAR100-RD02]) and a Bayesian discrete-time survival analysis by Hyman et al. (SEDAR100-DW17; but updated in Hyman et al. 2026). Additional discard mortality estimates of 26% and 60% were recommended for sensitivity runs by the Ad-Hoc Discard Mortality Working Group, with these values representing the lower and upper bounds based on the studies reviewed (SEDAR100-AP01). Given the lack of data to evaluate discard mortality for the Commercial Vertical Line fleet, discard mortality was assumed similar between the Recreational and Commercial Vertical Line fleets because of similar fishing practices.

2.3. Fishery-Dependent Data

2.3.1. Commercial Landings

Commercial landings data (1945-2024) used in the assessment are presented in **Table 5** and **Figure 5**. Commercial landings for Gray Triggerfish were constructed using data housed in NOAA's SEFSC's Accumulated Landings System (ALS) and from state trip ticket programs when available: Texas 2014+, Louisiana 2000+, Mississippi 2015+, Alabama 2002+, and Florida 1986+ (**Table 6**). The earliest year with commercial landings data was 1949 (SEDAR100-DW05), and therefore estimates prior to 1948 were interpolated down to an assumed start in 1945 following SEDAR 43 (**Table 5**). For the assessment, commercial landings were partitioned into two fleets that represent the two main commercial harvesting gears: (1) Vertical Line or Handline and (2) Longline (**Section 3.1.6**). For SEDAR 100, landings by trap and other gears (~6% overall) were lumped into the Commercial Vertical Line fleet.

Commercial landings have been predominantly by vertical line gears, which increased considerably throughout the late 1980s and peaked in 1993 (**Figure 5**). Comparatively, Longline landings have remained relatively low, with the exception of a small peak in 1990.

Commercial landings were reported in pounds wwt and converted to metric tons for input into the assessment model. Uncertainty estimates for landings were not provided during the SEDAR 43 Standard Assessment, which fit the landings as known (log-scale standard error (SE) of 0.05). Uncertainty estimates based on expert opinion were developed during the SEDAR 68 Gulf Scamp Grouper Research Track Assessment by state (**Table 6**; SEDAR 2021). Since Gray Triggerfish are caught across the Gulf, state-specific error estimates were multiplied by state landings to produce a weighted-error estimate for annual landings by fleet (**Table 5**). These error estimates included more uncertainty for the earlier years of the time series (**Table 5**).

Although numerous updates and improvements to methodology have been made between SEDAR 100 and SEDAR 43, the commercial landings estimates were very similar since 1963. Historical landings estimates revealed the largest difference (>10%; **Table 7**), primarily because

SEDAR 43 interpolated commercial landings from 1945 to 1962 whereas commercial landings estimates were provided for SEDAR 100 beginning in 1949. SEDAR 100 showed a notable increase in landings in the early 1950s.

2.3.2. Recreational Landings

Recreational landings data (1945-2024) used in the assessment are presented in **Table 8**. Recreational landings of Gray Triggerfish were estimated using fully calibrated estimates from the Marine Recreational Information Program (MRIP) using the Fishing Effort Survey (FES) and the redesigned Access Point Angler Intercept Survey (APAIS; SEDAR100-DW02), Texas Parks and Wildlife Department estimates calibrated to MRIP-FES units (SEDAR100-DW02), Louisiana Creel Survey estimates calibrated to MRIP-FES units (SEDAR100-DW02), and the Southeast Region Headboat Survey (SRHS; SEDAR100-DW01). While estimates from the Florida State Reef Fish Survey (SRFS) were reviewed during the Data Workshop (SEDAR100-DW12), their inclusion was ultimately not recommended because landings were more spread throughout the Gulf.

Historical recreational landings (1955-1980) were estimated using the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (FHWAR) approach (SEDAR100-DW03), whereas the estimates prior to 1955 were interpolated down to an assumed start in 1945 following SEDAR 43 (**Table 8**). For the assessment, recreational landings were included for a single fleet encompassing charter, private and headboat modes (**Section 3.1.6**). Following SEDAR 43, the shore mode was excluded because it comprised <1% of overall recreational landings and estimates tend to be very sporadic and highly uncertain.

Recreational landings were substantially higher than commercial landings throughout the time series (**Figure 5**). Recreational landings peaked in the early 1990s and also exhibited smaller peaks in the early 1980s and mid-2000s, before declining to relatively lower values in the most recent years.

The large differences between SEDAR 100 and SEDAR 43 recreational landings estimates are expected, primarily because SEDAR 100 used estimates from the MRIP-FES survey which are much larger than previous estimates provided for SEDAR 43 (**Table 9**). In addition, SEDAR 100 included Texas and Louisiana recreational estimates which were calibrated to MRIP-FES units.

Recreational landings data were also provided in wwt (**Table 10**). Weight estimates were developed by the SEFSC and used the MRIP (Matter and Nuttall 2020 [SEDAR68-DW13]) sample data to obtain a mean weight of landed Gray Triggerfish by strata using the following hierarchy (from coarsest to finest): species, region, year, state, mode, wave, and area (Matter and Rios 2013). Mean weight of landed Gray Triggerfish was then multiplied by the landings estimates in numbers to obtain estimates of landings in weight (SEDAR100-DW02). Fishery managers use these landings estimates in weights for Annual Catch Limit (ACL) monitoring.

Recreational landings in 1,000s of fish were input into the assessment model (**Table 8**; **Figure 5**). Numbers were ultimately preferred as the input (as opposed to weights) because they are the native units of data collection by the MRIP program (and other state sampling programs). Uncertainty estimates (CV) were provided for the Recreational fleet, averaging 0.25 and ranging from 0.12 in 1999 to 0.55 in 2017 (SEDAR100-DW02). Only one year (2017) had a landings CV estimate that exceeded 0.5 (**Section 3.4.7**).

Along with recreational landings in numbers, the mean weight (in kilograms) of Gray Triggerfish landed by the Recreational fleet was also included in the assessment model (**Table 11**). The mean weight was obtained by dividing the estimates of recreational landings in weights by the recreational landings in numbers to get an average size (**Table 11**). The SE was calculated from trip-level summaries of raw weight data (mean(weight) by vessel) to account for any correlation in fish sizes sampled from the same intercept (SEDAR100-DW02). Accompanying uncertainty estimates (CV) for mean weight of Gray Triggerfish landed by the Recreational fleet averaged 0.13 (range: 0.06-0.34; **Table 11**). Inclusion of this data source allows a comparison between the expected mean weight by the assessment model and the mean weight of Gray Triggerfish landed by the Recreational fleet.

2.3.3. Commercial Discards

Commercial discards (2000-2024) for the Vertical Line fleet used in the assessment are presented in **Table 12**. The commercial discards were estimated using CPUE from the NMFS Reef Fish Observer Program and total fishing effort from the NMFS Commercial Reef Logbook Program (SEDAR100-DW06). Estimates begin in 2000 because it was assumed that discards were negligible prior to the implementation of a federal size limit of 12 inches TL in 1999 (SEDAR100-DW06). A full description of the CPUE-expansion estimation procedure is given in SEDAR100-DW06. Overall, discards by the Vertical Line fleet accounted for a very variable proportion of the total catch (kept + discards), with substantially larger discards since 2009 due to increased regulations (SEDAR100-DW06). No discard estimates were provided for the Commercial Longline fleet.

Compared to recreational discards and shrimp bycatch, commercial discards are very minor (**Figure 6**). The discard estimates reported in numbers were input into the assessment as 1,000s of fish. This input was preferred to the approach used in SEDAR 43, which input discards as a fraction using a fixed error of 0.2 and modeled three time blocks to account for various fishing regulations. Annual estimates were input along with their corresponding log-scale SEs which averaged 0.25 (range: 0.12-0.37; **Table 12**). A discard mortality rate of 40% was used for the Vertical Line fleet (**Section 2.2.6**).

2.3.4. Recreational Discards

Recreational discards (1981-2024) used in the assessment are presented in **Table 13**. The recreational discards were estimated using fully calibrated estimates from MRIP using FES and the redesigned Access Point Angler Intercept Survey (APAIS; SEDAR100-DW02), Texas Parks and Wildlife Department estimates calibrated to MRIP-FES units (SEDAR100-DW02), Louisiana Creel Survey estimates calibrated to MRIP-FES units (SEDAR100-DW02), SRHS estimates (SEDAR100-DW01), and proxy headboat discard estimates (1986-2007) using the Super-Ratio approach (SEDAR100-DW08).

Recreational discard estimates have increased substantially in recent years (**Figure 6**), primarily due to increased regulations. The discard estimates reported in numbers were input into the assessment as 1,000s of fish with corresponding log-scale SEs which averaged 0.31 (range: 0.13-0.75; **Table 13**). The years 1981-1987 had CV estimates that exceeded 0.5 (**Section 3.4.7**). A discard mortality rate of 40% was used for the Recreational fleet (**Section 2.2.6**).

2.3.5. Shrimp Bycatch Discards

A technical review of the shrimp bycatch input data sources, data processing procedures, and estimation methods used in prior Gulf assessments, including SEDAR 43, concluded that the previous methodology was no longer appropriate for estimating bycatch in the shrimp trawl fishery. As a result, a new approach to estimating bycatch was developed by the SEFSC. This methodology was first applied to SEDAR 98 Gulf Red Snapper (*Lutjanus campechanus*) and successfully passed a Center for Independent Experts (CIE) technical review (Smith et al. 2025 [SEDAR98-DW25]). Unfortunately, this approach was not feasible for Gray Triggerfish because they were not consistently recorded within the Shrimp Observer Program since mandatory reporting began in 2007. Gray Triggerfish was not on the list of 22 species for which data were to be recorded during “Evaluation Protocol” observer trips. Gray Triggerfish have been documented to occur in shrimp bycatch (SEDAR100-DW22), although the magnitude of bycatch has been uncertain given how reporting issues in the observer data may have biased previous results (Scott-Denton et al. 2012 [SEDAR100-RD06]).

For Gray Triggerfish, a stop-gap approach was applied in the interim to develop estimates of shrimp bycatch for use in the SEDAR 100 Assessment. Bycatch estimation was applied to proxy species for Gray Triggerfish based on a co-occurrence analysis of SEAMAP trawl data, which were filtered to reflect commercial shrimping grounds/habitat as accurately as possible. The proxy species chosen were Lane Snapper (*Lutjanus synagris*) and Red Snapper depending upon the strata examined. Annual bycatch estimates (1984-2023) were then calculated using the same methodology applied to Red Snapper in SEDAR 98 and calibrated based on catch-per-unit-effort (CPUE) ratios of Gray Triggerfish and the proxy species in the filtered SEAMAP trawl data set. Additional details on the data filtering process applied to the SEAMAP trawl data set, determining co-occurring species for use as a proxy, and the methodology are discussed in SEDAR100-DW22.

Estimates of Gray Triggerfish caught by shrimp trawlers from 1984 to 2023 were made available during SEDAR 100 using the approach discussed above (**Table 14**). Estimates of shrimp bycatch prior to 1984 were based on two different methods. For 1960 through 1983, the relative trend in shrimp effort (**Table 15**; **Figure 7**) was used to back-calculate shrimp bycatch estimates, assuming that the trend in effort would reflect the trend in bycatch estimates. For 1947-1959, a simple interpolation was used which gradually reduced the estimated bycatch to a starting value of 26,000 fish in 1947 (assumed start based on first year of data from SEDAR 43).

Shrimp bycatch estimates increased until reaching a peak in 1987, and have declined substantially in recent years (**Table 14**; **Figure 6**) due to economic challenges facing the fishery (Liese et al. 2026).

Shrimp bycatch estimates between SEDAR 100 and SEDAR 43 differed considerably, with far less inter-annual variability observed in the SEDAR 100 estimates (**Figure 8**). Estimates provided for SEDAR 43 began in 1972, with prior values back-calculated using an unverified approach. Overall, shrimp bycatch estimates for SEDAR 100 were considerably lower, peaking around 3.6 million fish compared to over 12 million fish estimated for SEDAR 43 (**Figure 8**).

Because of the large uncertainty in the annual estimates of shrimp bycatch, the bycatch discards were input as a single super-period, where the median value for all available years (1947-2023) of 1,612,310 was assumed representative for the time period 1946-2023. The log-scale SE for the mean discard numbers was set to 0.121 which was the estimated SE for 1984. The median bycatch estimate was then scaled annually by a time series of shrimp effort (**Table 15**; **Figure 7**), which was scaled to a mean of 1 for input into the assessment model.

2.3.6. Commercial Size Composition

Annual length compositions were combined into 2-cm Fork Length interval bins (2 to 74 cm FL). For each commercial fleet, length data of landed or retained Gray Triggerfish from the commercial trip intercept program (TIP) and GulfFIN were aggregated into two major sub-regions (East and West) and weighted based on the distribution of landings estimates between sub-regions. For years where weighting was not possible, nominal compositions were used (Vertical Line: 2006, 2008-2011; Longline: all years). A detailed description of the revised methodology, data filtering, results and data limitations for developing compositions are discussed in SEDAR100-DW07. Length data from the NMFS Reef Fish Observer Program were used to characterize the length compositions from commercial discards (SEDAR100-DW06). Annual discards-at-length were computed by multiplying the relative proportion at a length bin and annual estimates of total discards.

Overall, length compositions of Gray Triggerfish landed and discarded by the Commercial Vertical Line fleet peaked around 36 and 32 cm FL, respectively (**Figure 9**). Annual Commercial Vertical Line length compositions of Gray Triggerfish landed (1990-2024) are presented in **Figure 10** along with input sample sizes which averaged 106 trips (range: 22-244). Annual Commercial Vertical Line length compositions of Gray Triggerfish discarded (2010-2024) are presented in **Figure 11** along with sample sizes in number of trips which averaged 30 trips (range: 10-96).

Overall, length compositions of Gray Triggerfish landed by the Commercial Longline fleet peaked around 50 cm FL (**Figure 9**). Annual Commercial Longline length compositions of Gray Triggerfish landed (1990-2024) are presented in **Figure 12**. Input sample sizes averaged 25 trips (range: 10-46).

Annual length compositions were input into the assessment model along with input sample sizes reflective of the number of trips (≥ 10). Year-fleet combinations with less than 10 trips sampled were excluded from the assessment model (Vertical Line landings: 1989; Vertical Line discards: 2007-2009, 2020; Longline landings: 1992, 1994-1995, 1997, 2000, 2004, 2009-2010, 2012, 2020-2021).

SEDAR 43 did not include length compositions as a data input into the assessment model. For SEDAR 43, length compositions of landings were used in conjunction with an age-length key to develop annual age compositions for input into the assessment model. Given the concerns discussed previously in **Section 2.2.2** regarding the age data for Gray Triggerfish, as well as to address an explicit Term of Reference for SEDAR 100, length compositions of both landed and discarded Gray Triggerfish were input directly into the SEDAR 100 AP Model.

2.3.7. Recreational Size Composition

Annual length compositions were combined into 2-cm Fork Length interval bins (2 to 74 cm FL). For the Recreational fleet, length data of landed Gray Triggerfish were obtained from MRIP (formerly MRFSS), Texas Parks and Wildlife Department, SRHS and GulfFIN. Length data were aggregated into two major sub-regions (East and West) and weighted based on the distribution of landings estimates between sub-regions. For years where weighting was not possible, nominal compositions were used (1981-1982, 2010, 2017-2021, 2024). A detailed description of the revised methodology, data filtering, results and data limitations for developing compositions are discussed in SEDAR100-DW04. Length composition samples provided by Florida's FWRI At-Sea Observer Program (SEDAR100-DW11), Alabama's At-Sea Observer Program, and Mississippi's At-Sea Observer Program were used for characterizing the discards for the Recreational fleet (**Section 4.6.2 in Data Workshop Report**). Length data were aggregated into two major sub-regions (North [Mississippi - Florida panhandle] and South [Florida peninsula]) and weighted based on the distribution of discard estimates between sub-regions. While the SEDAR 100 Recreational Working Group explored additional weighting schemes (e.g., by mode), they recommended using the spatial weighting because there were more pronounced spatial differences in discard length compositions than among modes (**Section 4.6.2 of Data Workshop Report**).

Overall, length compositions of Gray Triggerfish landed and discarded by the Recreational fleet peaked at 30 (smaller peak at 36) and around 32 cm FL, respectively (**Figure 9**). Annual Recreational length compositions of Gray Triggerfish landed (1981-2024) are presented in **Figure 13** along with input sample sizes which averaged 463 trips (range: 30-802). Annual Recreational length compositions of Gray Triggerfish discarded (2009-2024) are presented in **Figure 14** along with sample sizes in number of trips which averaged 164 trips (range: 29-274).

Annual length compositions were input into the assessment model along with input sample sizes reflective of the number of trips (≥ 10).

2.3.8. Shrimp Discards Size Composition

Annual length compositions were combined into 2-cm Fork Length interval bins (2 to 74 cm FL). For the Shrimp Bycatch fleet, length data of discarded Gray Triggerfish were assumed representative of the distribution obtained from the filtered SEAMAP trawl length frequencies and calculated based on the estimates of bycatch. A detailed description of these proxy compositions is provided in SEDAR100-DW22.

Overall, length compositions of Gray Triggerfish discarded by the Shrimp Bycatch fleet peaked around 10 cm FL (**Figure 9**). Annual length compositions of Gray Triggerfish in the shrimp bycatch (1984-2023) are presented in **Figure 15**. The number of trips was not available, and therefore the input sample sizes were set to 1.

Annual length compositions were input into the model but were excluded from model fitting because they served as proxies and were obtained from the SEAMAP Trawl Survey, which was modeled separately (**Section 2.4.1**).

2.3.9. Commercial Age Composition

Conditional age-at-length compositions of Gray Triggerfish landed by the Commercial Vertical Line and Commercial Longline fleets were developed and ultimately used in the assessment model (**Figures 16-17**). Age observations were assumed to be conditional on length and input as conditional-age-at-length data with sample sizes specified as the number of fish (SEDAR100-

DW07). For SEDAR 100, this data input was selected over age composition because using conditional age-at-length avoids double use of fish for both age and length compositions, especially when age compositions are weighted by length compositions (as presented in SEDAR100-DW07). This approach was used because the Trip Interview Sampling program measures lengths from all randomly selected fish (randomly selected from each market size category where necessary; Saari and Beerkircher 2014). This linkage allows more detailed information on the size-age relationship to be incorporated into the growth model fitting process and improves estimates of variance of size-at-age (Methot et al. 2023). A mean length-at-age vector for each year and fleet was included in the model for comparison between the expected length-at-age by the assessment model and the observed length-at-age.

SEDAR 43 did not include actual age compositions as a data input within the stock assessment model and instead input age compositions that were obtained from length compositions in conjunction with an age-length key. For SEDAR 100, the conditional age-at-length approach was used to include the best available information available (i.e., maximizing the use of weighted length compositions) while also incorporating the age data in the most appropriate manner given the concerns discussed in **Section 2.2.2**. Uncertainty in the age data remains an issue, as no strong cohorts are evident in the age compositions (SEDAR100-DW07), likely due to the highly variable and weak relationship between length and age (**Figure 3**).

Year-fleet combinations with less than 30 fish per year were excluded from the assessment model (Vertical Line landings: 2004, 2006-2008, 2010; Longline landings: 2004, 2009-2010, 2012, 2020, 2023-2024). For the Commercial Vertical Line fleet, input sample sizes averaged 21 Gray Triggerfish and ranged from 1 to 120, with 30% of observations having fewer than 5 Gray Triggerfish. For the Commercial Longline fleet, input sample sizes averaged 5 Gray Triggerfish and ranged from 1 to 27, with 58% of observations having fewer than 5 Gray Triggerfish.

2.3.10. Recreational Age Composition

Conditional age-at-length compositions of Gray Triggerfish landed by the Recreational fleet were developed and ultimately used in the assessment model (**Figure 18**). Age observations were assumed to be conditional on length and input as conditional-age-at-length data with sample sizes specified as the number of fish (SEDAR100-DW04). Year-fleet combinations with less than 30 fish per year were excluded from the assessment model (2015). Input sample sizes averaged 30 Gray Triggerfish and ranged from 1 to 453, with 33% of observations having fewer than 5 Gray Triggerfish. A mean length-at-age vector for each year was included in the model for comparison between the expected length-at-age by the assessment model and the observed length-at-age. The same uncertainties and lack of cohorts are observed in the recreational age data (SEDAR100-DW04).

2.3.11. Commercial Catch-Per-Unit-Effort Indices of Abundance

While the Commercial Vertical Line CPUE index from the NMFS Commercial Reef Logbook Program data was used in past assessments and developed for SEDAR 100 (SEDAR100-DW15), the Index and Bycatch Working Group did not recommend its inclusion for SEDAR 100. This decision was largely based on the numerous management regulations, particularly in the more recent years, which likely results in the index not being reflective of trends in the population (**Section 5.5.2 of the Data Workshop Report**).

2.3.12. Recreational Catch-Per-Unit-Effort Indices of Abundance

The Recreational CPUE index, obtained from the SRHS, was recommended during the SEDAR 100 Assessment for use in the assessment (SEDAR100-DW09) because of its long and consistent time series and large spatial coverage (**Figure 19**). However, the index was truncated in 2007 due to the implementation of regulations such as circle hooks in 2008 (GMFMC 2007) and other recreational regulations thereafter (e.g., size limits and bag limits). Annual CVs were converted to log-scale SEs (**Section 3.2**) and are presented in **Table 16**. Recreational CPUE increased rapidly from 1987-1990, reaching its highest value in 1990 before gradually declining until its lowest value in 2001. CPUE increased until 2005 and then declined (**Figure 19**).

An analysis by Fitzpatrick and Williams (2022) conducted on Atlantic Gray Triggerfish concluded: “changing regulations, changing targeting, advances in fishing technology, and changing environmental conditions through time” render the proportionality between stock abundance and MRIP CPUE assumption invalid. For these reasons, the MRIP index was not considered for inclusion in the SEDAR 100 assessment.

2.4. Fishery-Independent Surveys

2.4.1. SEAMAP Groundfish Trawl Survey

Standardized trawl surveys have been conducted in the Gulf since 1972 and continued under the Southeast Area Monitoring and Assessment Program (SEAMAP) in 1982 and 1987 for the summer and fall, respectively. The primary objective of this trawl survey conducted semi-annually is to collect data on the abundance and distribution of demersal organisms in the Gulf. Prior to 2009, the summer survey did not sample from Mobile Bay, Alabama eastward to Florida. Full survey details can be found in Nichols (2004).

The recommendation from SEDAR 43 was to include one abundance index derived from the SEAMAP Groundfish Trawl Survey for fall only, because of the assumption that Gray Triggerfish caught in fall were most likely age-0 fish. However, following current best practices the time series was split when the survey design was changed in 2008 and two indices were produced for Gray Triggerfish (SEDAR100-DW16). The first index (SEAMAP Trawl Early Survey) spans the time period from 1987-2008 covering the northwestern and central Gulf and the second index (SEAMAP Trawl Late Survey) from 2009-2024 covers the entire Gulf. Additionally, after exploring length and age compositions (N = 519 from 2008-2024; **Figure 20**) of Gray Triggerfish caught in both seasons, which was not available for review during SEDAR 43, considerable overlap in length distributions was evident as well as Gray Triggerfish older than age-0 (SEDAR100-DW16). As a result, the Index and Bycatch Working Group recommended combining summer and fall data for index and composition development for SEDAR 100. A detailed description of the data, limitations, methodology and results can be found in SEDAR100-DW16.

The standardized indices for the SEAMAP Trawl Early Survey and SEAMAP Trawl Late Survey are summarized in **Table 16** and **Figure 19**. Annual CVs were converted to log-scale SEs (**Section 3.2**) and are presented in **Table 16**. Relative abundance during the SEAMAP Trawl Early Survey was highly variable throughout the time series, with the highest and lowest values separated by three years (**Figure 19**). Relative abundance during the SEAMAP Trawl Late

Survey also showed considerable interannual variability, along with a trend of relatively high CPUE occurring roughly every 2-4 years, with the highest values observed in 2022-2023 (**Figure 19**).

Length compositions of Gray Triggerfish peaked around 12 cm FL for both the SEAMAP Trawl Early Survey and the SEAMAP Trawl Late Survey, with very few (<4%) Gray Triggerfish observed larger than 30 cm FL (**Figure 21**). Survey length compositions of Gray Triggerfish for the SEAMAP Trawl Early Survey (1987-2008) and SEAMAP Trawl Late Survey (2009-2024) are presented in **Figures 22-23**. Input sample sizes for the SEAMAP Trawl Early Survey averaged 81 stations (range: 15-159) and for the SEAMAP Trawl Late Survey averaged 94 stations (range: 42-140), respectively.

Annual length compositions were input into the assessment model along with input sample sizes reflective of the number of stations (≥ 10).

2.4.2. Video Survey

The Combined Video Survey used in SEDAR 43 represented three independent stationary video surveys that have historically been conducted in the Gulf to derive fishery-independent abundance estimates of reef fish stocks. The longest running survey was the SEAMAP Reef Fish Video Survey initiated by the NMFS Mississippi Laboratory in 1992 (e.g., Campbell et al. 2018 [SEDAR62-WP02]), followed in 2006 by the NMFS Panama City Laboratory (PC) Survey (e.g., Overly and Gardner 2019 [SEDAR62-WP06]), and finally Florida's FWRI Video Survey, which started in 2010. This survey has recently been updated to integrate the three surveys into a unified design beginning in 2020. This updated survey program is known as G-FISHER (Gulf Fishery Independent Survey of Habitat and Ecosystem Resources; Switzer et al. 2023). A habitat-area weighting approach was used to develop both the index of relative abundance and the annual length compositions. This approach accounts for both differences in habitat classes sampled by each survey and the overall survey footprints (Thompson et al. 2022). A full description of this updated survey can be found in SEDAR100-DW18.

The standardized index for the Combined Video Survey is summarized in **Table 16** and **Figure 19**. Annual CVs were converted to log-scale SEs (**Section 3.2**) and are presented in **Table 16**. Relative abundance varied throughout the time series, with the lowest values at the beginning of the time series and relatively higher abundance during 1998, 2006-2009 and 2020-2023 (**Figure 19**).

Overall, length compositions of Gray Triggerfish encountered by the Combined Video Survey peaked around 32 cm FL (**Figure 21**). Input sample sizes averaged 108 stations (range: 21-279), and annual length compositions generally covered a wide size range and were very jagged throughout the time period (**Figure 24**).

2.4.3. SEAMAP Fall Larval Survey

The SEAMAP Fall Ichthyoplankton/Larval Survey was previously used as an index of spawning stock biomass in SEDAR 43. During SEDAR 100, additional data including the lengths of Gray Triggerfish encountered by the survey revealed that the majority of Gray Triggerfish were juveniles (~78%) and not larvae as previously thought (SEDAR100-DW19). As a result, the Index and Bycatch Working Group recommended that the SEAMAP Fall Larval Survey not be used as a larval index for spawning stock biomass. While the Index and Bycatch Working Group also discussed treating this survey as an index of juveniles for consideration in the assessment, this would be redundant of the SEAMAP Groundfish Trawl survey which samples juvenile Gray Triggerfish once they have settled and recruited to the population. Further, the Index and Bycatch Working Group voiced concerns that an index of relative abundance derived from neuston nets primarily represent the recruitment of juvenile fishes to Sargassum habitat, and not necessarily the recruitment of juveniles to the Gray Triggerfish population.

2.5. Environmental Considerations

2.5.1. Sargassum

SEAMAP ichthyoplankton surveys began to consistently document and quantify the amount of Sargassum collected in neuston samples starting in 2006 (SEDAR100-DW19). Examination of these data revealed that the proportion of positive occurrence and CPUE of Gray Triggerfish were found to be greatly dependent on the occurrence of Sargassum. However, a clear pattern of increasing Gray Triggerfish CPUE with increasing Sargassum CPUE for fish greater than 5 mm body length was not apparent in the available data.

Sargassum has been hypothesized to be an important nursery habitat for Gulf fishes such as Gray Triggerfish (Wells and Rooker 2004). After hatching, Gray Triggerfish may choose to inhabit structure in surface waters until suitable demersal habitat is found, and may be pelagic from a few weeks to several months (Simmons and Szedlmayer 2011 [SEDAR62-RD10]). Gray Triggerfish associate with Sargassum spp. patches and other flotsam during their pelagic phase. A NOAA Restore Science Program project was funded from 2017-2022 which set out to explore the link between Sargassum and juvenile life stages of fishes (i.e., recruitment). The project used field surveys, remote sensing, and modeling approaches to evaluate the nursery function and fisheries importance of Sargassum. One output of the project was the development of Sargassum Abundance Indices at multiple temporal and spatial scales using time series of vessel-based and remote sensing observations of Sargassum.

For SEDAR 100, no indices of Sargassum were submitted for consideration. The indices discussed above are limited in utility because they do not span a large enough spatial domain to capture Gulf-wide trends in Sargassum distribution or abundance. In addition, estimates of uncertainty are not available at this time. Current Sargassum data collection protocols in the SEAMAP Larval Survey only record liters of Sargassum taken in the net and do not collect information on the type of Sargassum aggregation, relative density at the surface, at depth and patchiness along or near the neuston tow. The use of satellite imagery products is being examined to provide a more detailed measurement of Sargassum abundance.

2.5.2. Red Tide

No evidence of red tide mortality was presented during the SEDAR 100 Assessment for Gray Triggerfish. A review of the literature highlighted no mention of Gray Triggerfish in red tide fish kills (Driggers et al. 2016) or as potential species vulnerable to red tides according to local ecological knowledge interviews (Blake et al. 2022) or fishermen feedback (SEDAR100-DW21). Gray Triggerfish were reported in fish kills observed after the 1971 red tide, but Smith (1975) noted that Gray Triggerfish survived in greater numbers and hypothesized that was because they are not restricted to the bottom waters and can move out of affected areas. Red tide mortality for Gray Triggerfish was estimated by the West Florida Shelf Ecospace model (Vilas et al. 2023 via the Shiny app) but the results were uncertain and would require additional vetting of Gray Triggerfish data inputs and Ecospace model predictions. Collectively, this information suggests that red tides likely do not have a major impact on the Gray Triggerfish population.

2.5.3. Deepwater Horizon Oil Spill

Negative effects of the Deepwater Horizon oil spill have been hypothesized on marine resources due to the vast amount of oil spilled and the subsequent use of oil dispersant into the affected areas, and this concern was noted for Gray Triggerfish in SEDAR100-DW10. Monitoring of reef fish communities in the region pre- and post-Deepwater Horizon found no significant difference in the occurrence or density of Gray Triggerfish, although the density estimates were quite variable (Lewis et al. 2020). Murawski et al. (2018) only collected two Gray Triggerfish in their offshore longline surveys conducted for 2011-2017.

3. Stock Assessment Model Configuration and Methods

3.1. Stock Synthesis Model Configuration

The assessment model used was Stock Synthesis, version 3.30.21.00. Descriptions of algorithms and options are available in the User's Manual (Methot et al. 2023), the NOAA Fisheries Toolbox website (*http://nft.nefsc.noaa.gov/*), and Methot and Wetzel (2013). Stock Synthesis is a widely used integrated statistical catch-at-age model that has been tested for stock assessments in the United States, particularly on the West Coast and in the Southeast, and also throughout the world (see Dichmont et al. 2016 for review). Statistical catch-at-age models consist of three closely linked modules: the population dynamics module, an observation module, and a likelihood function. Input biological parameters (**Section 2.2**) are used to propagate abundance and biomass forward from initial conditions (population dynamics model) and Stock Synthesis develops expected data sets based on estimates of fishing mortality (F), selectivity, and catchability (the observation model). The observed and expected data are compared (the likelihood module) to determine best fit parameter estimates using a statistical maximum likelihood framework (detailed in Methot and Wetzel [2013]). Because many inputs are correlated, the concept behind Stock Synthesis is that processes should be modeled together, which helps to ensure that uncertainties in the input data are properly accounted for in the assessment.

The Stock Synthesis modeling framework provides estimates for key derived quantities including: time series of recruitment (units: 1,000s of age-0 recruits), abundance (units: 1,000s of fish), biomass (units: metric tons), SSB (units for Gray Triggerfish: SSB in metric tons), and exploitation or harvest rate (F; units for Gray Triggerfish: total biomass killed all ages / total biomass age 1+). The r4ss software (Taylor et al. 2021) was utilized extensively to develop various graphics for model outputs and was also used to summarize various output files and perform diagnostic runs. The ss3diags software (Carvalho et al. 2021) was also used to perform additional diagnostics.

3.1.1. Initial Conditions

The assessment begins in 1945 and has a terminal year of 2024. While minor removals of Gray Triggerfish are assumed to have occurred in the Gulf prior to 1945, the stock was assumed to be at or close to virgin fishing conditions in 1945. The start year of 1945 was supported by the SEDAR 43 Assessment Panel, but a re-evaluation of this decision was requested during SEDAR 100. Therefore, we considered various start years for this assessment:

Year	Pros	Cons
1945	- Consistent with previous assessment	- High uncertainty in historical estimates (recreational 1955-1980, commercial 1949-1986) and no shrimp information before 1960
	- Starts at virgin conditions	- Need to back-calculate landings and shrimp bycatch using interpolation back to start
1963	- No landings interpolation needed	- Still high uncertainty in historical landings (recreational 1963-1980 and commercial 1963-1986)
	- Shrimp effort started in 1960	- Need to scale back shrimp bycatch estimates for 1963-1983 (using trend in effort)
		- Starts in fished conditions, need to approximate initial conditions
1981	- No landings interpolation needed	- Still high uncertainty in recreational removals (1981-1985) and commercial landings (1981-1985)
	- More confidence in available data	- Need to scale back shrimp bycatch estimates for 1981-1983 (using trend in effort)
		- Starts in fished conditions, need to approximate initial conditions
1986	- No landings interpolation needed	- Missing contrast in the data, basically a one-way trip
	- Most confidence in available data	- Starts in fished conditions, need to approximate initial conditions

Ultimately, a start year of 1945 was maintained for the SEDAR 100 AP Model for the following reasons. First, beginning an assessment during fished conditions makes a strong assumption about the starting depletion level of the stock, which is further complicated due to the need to specify initial conditions for the Shrimp Bycatch fleet. Second, initializing the assessment model in the 1980s leads to a one-way trip and limited contrast in the data. Extensive sensitivity explorations were conducted for different start years which revealed minimal differences in recent population trajectories where stock status is determined (**Section 4.8.7**).

3.1.2. Temporal Structure

The Gray Triggerfish population was modeled from age-0 (Stock Synthesis starts at age-0; Methot et al. 2023) through age-15, with data bins spanning age-0 through age-10+, with the last age representing a plus group. The population was modeled through the maximum age of 15 years, however the vast majority of data available were for ages 10 or younger (98.7%). Settlement was specified as July 1st to coincide with peak spawning (Allman et al. 2018; Kelly-Stormer et al. 2017). Data collection and fishing activities were assumed relatively continuous throughout the year; therefore, inclusion of a seasonal component to the removals was not deemed necessary. The fishing season was assumed to be continuous and homogeneously distributed throughout the year.

3.1.3. Spatial Structure

A single area model was implemented where recruits are assumed to homogeneously settle across the Gulf.

During SEDAR 43, a fleets-as-areas approach was used which separated fishing fleets and all of their associated data inputs (landings, discards, CPUE indices, and compositions) into East and West. The East encompassed NMFS statistical grids 1-12 whereas the West encompassed NMFS statistical grids 13-21 (SEDAR100-DW05). This fleets-as-areas approach has been used since SEDAR 9 (terminal year of 2004) to account for regional differences in fishing pressure and fishery selectivity. While fleets-as-areas were initially included to match model structure from SEDAR 43, this decision was re-evaluated during SEDAR 100 along with whether to develop a true two-area model. Shrimp bycatch and fishery-independent surveys were not split and were considered Gulf-wide as in previous assessments.

After examining all data submitted for SEDAR 100, no strong support was found for maintaining the fleets-as-areas approach. No large differences in length or age compositions were noted between East and West (SEDAR100-DW04, SEDAR100-DW07), suggesting that selectivities of the fleets remained similar between regions. The vast majority of data came from the East including recreational landings (91%) and discards (96%), recreational landings length (81%) and age (95%) samples, recreational discard length samples (100%), commercial landings (72%) and discards (85%), and commercial length samples of landings (63%) and discards (93%). Exceptions where data primarily came from the West included commercial landings age samples (67%) and shrimp effort (75%) and bycatch estimates (93%). Composition data were particularly limiting in the West, leading to a vast majority of years not recommended for inclusion in the assessment if data remained split by region based on sample size cutoffs not implemented during SEDAR 43 (**Sections 2.8-2.9 in Data Workshop Report**).

SEDAR 100 also re-evaluated whether data supported separating the stock into East and West populations. SEDAR 100 found no differences in growth between East and West (**Section 2.5 in the Data Workshop Report**) and therefore the stock was modeled as a single unit stock throughout the Gulf. In addition, no estimates of movement between regions were available to parameterize movement within a two-area model. Gray Triggerfish exhibit high site fidelity based on tagging studies (Ingram and Patterson 2001; Herbig and Szedlmayer 2016 [SEDAR62-RD08]).

3.1.4. Life History

A fixed length-weight relationship was used to convert body length (cm FL) to body weight (kg wwt; **Table 1, Figure 2A**). Stock Synthesis moves fish among age classes and length bins on January 1st of each modeled year starting from birth at age-0. Because the 'true' birth date often does not occur on January 1st, with peak spawning occurring around July 1st (Allman et al. 2018; Kelly-Stormer et al. 2017), settlement was specified as July 1st, which allowed Stock Synthesis to internally convert between input calendar ages and real age when estimating growth and natural mortality-at-age (both in terms of real age).

Growth within Stock Synthesis was modeled with a three parameter von Bertalanffy equation: (1) L_{Amin} (cm FL), the mean size at A_{min} (growth age for L_{Amin}; age-0.5 for Gray Triggerfish); (2) L_{Amax} (cm FL), the mean size at maximum aged Gray Triggerfish; and (3) K ($year^{-1}$), the growth coefficient. In Stock Synthesis, when fish recruit at the real age of 0.0 they have a body size equal to the lower limit of the first population bin (2 cm FL for Gray Triggerfish). Fish then grow linearly until they reach a real age equal to the input value of A_{min} and have a size equal to L_{Amin}. As they age further, they grow according to the von Bertalanffy growth equation (**Figure 2B**). L_{Amax} was specified as equivalent to $L\infty$. Two additional parameters are used to describe the variability in size-at-age and represent the CV in length-at-age at A_{min} (age-0.5) and A_{max} (age-15). For intermediate ages, a linear interpolation of the CV on mean size-at-age is used.

The von Bertalanffy growth model parameters (L_{Amin}, L_{Amax} [i.e., $L\infty$], and K) and the variance parameters CV_{Amin} and CV_{Amax} were re-estimated internally to Stock Synthesis using length and conditional age-at-length compositions. Starting values were obtained from the SEDAR 100 Assessment Data Workshop recommendations (**Table 2**). We explored using these values as priors, however the $L\infty$ estimate of 46 cm FL seemed low compared to the available age-length data (**Figure 3**). Given this in combination with the concerns over the age data (**Section 2.2.2**), we allowed Stock Synthesis to freely estimate all five growth parameters internally. Ultimately, the variance parameters CV_{Amin} (0.437) and CV_{Amax} (0.124) were fixed at the model estimated values to reduce the number of moderate correlations (> 0.7) between model parameters when all five growth parameters were estimated freely.

The natural mortality rate (M) was assumed constant over time but decreasing with age. Target M was set at the Hamel and Cope (2022) point estimate of 0.36 per year (based on a maximum age of 15) and scaled internally using the Lorenzen function over the range of fully recruited ages (3-15 years) to derive an age-specific vector of M (**Table 4, Figure 2C**).

The assessment model was set-up with both sexes combined. Immature females transitioned to mature females based on a fixed logistic function of length (**Figure 2D**) for the reasons discussed in **Section 2.2.4**. Reproductive potential was defined in terms of female-only SSB (i.e., SSB equivalent to body weight; **Figure 2E**) for the reasons discussed in **Section 2.2.5**.

3.1.5. Recruitment Dynamics

A Beverton-Holt stock-recruit function was used to parameterize the relationship between spawning output and resulting recruitment of age-0 fish. The stock-recruit function (representing the arithmetic mean stock-recruit levels) requires three parameters: (1) steepness characterizes the initial slope of the ascending limb (i.e., the fraction of virgin recruits produced at 20% of the equilibrium spawning biomass); (2) the virgin recruitment (R_0, estimated in log space; ln(R_0)) represents the asymptote or virgin recruitment levels; and (3) the variance or recruitment variability term (*SigmaR*) which is the SD of the log of recruitment (it both penalizes deviations from the stock-recruit curve and defines the offset between the arithmetic mean stock-recruit curve and the expected geometric mean from which the deviations are calculated).

The SEDAR 43 Standard Model estimated steepness (0.459), *SigmaR* (0.358), and ln(R_0). These decisions were re-evaluated during SEDAR 100, and ultimately steepness was fixed at 0.99 and *SigmaR* was fixed at 0.6. Fixing steepness at 0.99 is a computational convenience to estimate average recruitment rather than those from a stock-recruit curve; it does not imply perfect compensation in the population. This decision was made because of concerns over the model's ability to estimate steepness (0.422; **Section 4.8.7**). The likelihood profile did appear to show a minimum (**Section 4.8.2**), but data conflicts were persistent. The SEDAR 43 Standard Model also estimated a low steepness of 0.459, and the likelihood profile suggested that the parameter was poorly estimated as values between 0.4-0.45 and 0.6-0.65 were approximately within 2 likelihood units. The SEDAR 9 Assessment Process panel concluded that using the median value of 0.8 from a meta-analysis was appropriate after failing to find evidence that steepness was estimable. A value of 0.97 for Gray Triggerfish was recommended from the FishLife R package, which was used during SEDAR 68 to develop a biologically plausible value for steepness (SEDAR 2021). FishLife synthesizes life history data and produces estimates of life history inputs (such as steepness) based on available studies of the target species and congeners (Thorson et al. 2017a) and was strongly recommended by the CIE reviewers of that assessment as a best practice if steepness cannot be estimated. *SigmaR* was re-evaluated and fixed at 0.6 after reviewing diagnostics such as the likelihood profile which showed the parameter was poorly estimated (**Section 4.8.2**). This value of *SigmaR* is commonly used as a fixed input in other stock assessments to reflect an acceptable level of variability in recruitment.

Annual deviations from the stock-recruit function were estimated in Stock Synthesis as a vector of deviations forced to sum to zero and assuming a lognormal error structure. During model building, the constraint of forcing the deviations to sum to zero was explored by applying a slightly different stock recruitment function methodology. However, this method has not been previously applied in the Gulf and more research is needed to understand the effects on the model results. A lognormal bias adjustment factor was applied to recruitment estimates as recommended by Methot et al. (2023).

For the SEDAR 100 AP Model, main period (i.e., data rich, when representative length or age composition data are available) recruitment deviations spanned 1981-2024. No recruitment deviations were estimated in the early period (i.e., pre-1981) because their estimation led to highly uncertain parameters (CV > 1), suggesting little information was available in the early composition data to inform the earlier age structure. Full bias adjustment was used only from 1998 to 2022. Bias adjustment was phased in linearly, from no bias adjustment prior to 1937 (note the model starts in 1945) to full bias adjustment in 1998. Bias adjustment was phased out in 2022, decreasing from full bias adjustment to no bias adjustment by 2024. The years selected for full bias adjustment were estimated following the methods of Methot and Taylor (2011).

3.1.6. Fleet Structure and Surveys

Four fishing fleets were modeled and had associated length and/or conditional age-at-length compositions. The fleets were: Recreational (Rec_1; includes charter, private, and headboat modes), Commercial Vertical Line (ComVL_2; vertical line + trap + other gears), Commercial Longline (ComLL_3), and Shrimp Bycatch (Shrimp_Bycatch_4). Fleet structure was re-evaluated during SEDAR 100 and recommended based on the availability of length and age composition data, comparisons of length distributions among gears (commercial) or modes (recreational), and resulting sample sizes. A single recreational fleet was maintained because no large differences in selectivity were evident, as length and age compositions were very similar among modes (SEDAR100-DW04, SEDAR100-DW13). The Commercial Longline fleet was treated separately from the other commercial gears because it selected for much larger and older Gray Triggerfish (SEDAR100-DW07).

One fishery-dependent CPUE index was included in the SEDAR 100 AP Model: Recreational CPUE derived from the SRHS (Recreational (SRHS) CPUE; HB_Surv_5; units: numbers per angler hour). CPUE was treated as an index of abundance where the observed standardized CPUE time series was assumed to reflect annual variation in population trajectories. The CPUE index was of landings only, and the selectivity was assumed identical to the Recreational fleet.

Three fishery-independent surveys were modeled and had associated length compositions. The surveys were: SEAMAP Trawl Early Survey (1987-2008; TrawlEarly_6, units: fish per trawl hour), SEAMAP Trawl Late Survey (2009-2024; TrawlLate_7, units: fish per trawl hour), and Combined Video Survey (Video_8, units: MaxN). For each survey, the length composition was fit directly based on the estimated length-based selectivity functions (**Section 3.1.7.1**).

The Shrimp Bycatch fleet was modeled as a bycatch-only fishery with the catch driven by an effort time series and fitted to the median estimate of Gray Triggerfish bycatch (1,612,310 fish with a CV of 0.121) using the "super-period" feature in Stock Synthesis. No age/length data were available directly for that fleet, but proxy length compositions were provided alongside the shrimp bycatch estimates (SEDAR100-DW22). These length compositions were included as a check on model predicted length compositions (i.e., they were not fit to within the assessment model). Selectivity was mirrored to that of the SEAMAP Trawl Early Survey due to similarities in gear and area fished. Discards from the Shrimp Bycatch fleet were included in the search for Maximum Sustainable Yield (MSY).

3.1.7. Selectivity

Selectivity represents the probability of capture by age or length for a given fleet or survey and represents the net result of multiple interrelated factors (e.g., gear type, targeting, and availability of fish due to spatial and temporal constraints). Stock Synthesis allows users to specify length-based selectivity, age-based selectivity, or both. The final selectivity curve governing each fleet/survey reflects the additive effect of both age- and length- based processes.

For SEDAR 100, length-based selectivity was estimated given the inclusion and reliance on length composition data (discards, landings, and surveys) because of concerns over the reliability of age data (**Section 2.2.2**). In addition, most of the factors that affect selectivity (hook size, fishing location, fishing method) operate largely upon size or length rather than on fish age. This deviates from SEDAR 43 where age-based selectivity was used because that model only fit to age compositions (derived using age-length keys and length compositions).

Selectivity patterns were assumed to be constant over time for the Shrimp Bycatch fleet and SEAMAP trawl surveys. Time-varying selectivity was used for the Combined Video Survey to capture differences during three time blocks corresponding to the introduction of additional sampling programs: 2006-2009 for Panama City, 2010-2019 for FWRI, and 2020-2024 for G-FISHER. The Gulf Gray Triggerfish fishery has experienced changes in management regulations over time such as size limits, commercial trip limits and recreational bag limits (**Figure 25**) along with reduced open season lengths for both commercial and recreational fisheries since 2012 (**Figure 26**). Time-varying selectivity was used for the directed fishing fleets to account for the mandatory implementation of circle hooks in 2008 which may have altered selectivity patterns in the reef fish fishery. By comparing hook and line catches with ROV sampling, Garner et al. (2017 [SEDAR62-RD02]) found that peak selectivity shifted about 8 cm smaller using circle hooks. This parameterization for each fleet led to improved model fits to the composition data. In addition to allowing for time-varying selectivity, changes due to management regulations were also accounted for in the assessment model using time-varying retention patterns (**Section 3.1.8**) and by modeling discards explicitly (**Section 3.1.10**).

3.1.7.1. Length-based Selectivity

Length-based selectivity patterns were specified for each fleet and survey and were characterized as one of two functional forms:

1. a two-parameter logistic function - a logistic curve implies that fish below a certain size range are not vulnerable, but then gradually increase in vulnerability with increasing size until all fish are fully vulnerable (asymptotic selectivity curve). Two parameters describe logistic selectivity: (1) the length at 50% selectivity, and (2) the difference between the length at 95% selectivity and the length at 50% selectivity.

2. the six-parameter double normal function - the double normal has the feature that it allows for domed or logistic selectivity and is a combination of two normal distributions; the first describes the ascending limb, while the second describes the descending limb. A line segment joins the maximum selectivity of the two functions. However, the double normal functional form can be more unstable than other selectivity functions due to the increased number of parameters. When robust length or age compositions are available with sufficient numbers of larger or older fish, it may be appropriate to freely estimate all parameters (especially the descending limb). If that is not the case, certain parameters can be fixed to improve model stability as long as fixing the parameter does not largely influence the point estimates of the remaining selectivity parameters. Unless strong evidence exists for domed selectivity, it is generally advisable to use the logistic function.

In the SEDAR 100 AP Model, length-based selectivity patterns were defined for each fleet/survey: 1) Recreational (double normal), 2) Commercial Vertical Line (logistic), 3) Commercial Longline (logistic), 4) SEAMAP Trawl Early Survey (double normal, mirrored to Shrimp Bycatch), 5) SEAMAP Trawl Late Survey (double normal), and 6) Combined Video Survey (double normal). Selectivity for the Recreational (SRHS) CPUE was mirrored to the

Recreational fleet and selectivity for the Shrimp Bycatch fleet was mirrored to the SEAMAP Trawl Early Survey given similarity in gear and geographical coverage.

Double normal selectivity was implemented for the Recreational fleet because it could be limited by maximum depth fished and previous research supported dome-shaped selectivity for recreational gears (Garner et al. 2017 [SEDAR62-RD02]). Time-varying parameters estimated included the peak, descending width, and the end logit parameters for the 2008-2024 time block (the estimated top-logit and ascending width parameters did not differ if allowed to be time-varying). All parameters were freely estimated with the exception of the starting logit parameter which was fixed and allowed Stock Synthesis to decay the small fish selectivity according to the ascending width parameter. The model was not sensitive to the starting logit parameter over a range of values.

Logistic selectivity was modeled for both the Commercial Vertical Line and Commercial Longline fleets. Initial explorations estimated dome-shaped selectivity, however model fits did not differ substantially from the simpler 2-parameter logistic curve. Time-varying parameters estimated for each fleet included the inflection and 95% width parameters for the 2008-2024 time block. All parameters were freely estimated.

Dome-shaped selectivity was modeled for both the SEAMAP Trawl Early Survey/Shrimp Bycatch fleet and the SEAMAP Trawl Late Survey which trawl at the shallowest depths inhabited by Gray Triggerfish and occasionally captures large Gray Triggerfish. All selectivity parameters were freely estimated for each survey. This represents a departure from SEDAR 43 which assumed that only age-0 Gray Triggerfish were selected.

Dome-shaped selectivity was modeled for the Combined Video Survey after model explorations identified this pattern as the best fitting to the length composition data (compared to logistic and cubic splines). Time-varying parameters estimated included the peak for the 2006-2009, 2010-2019, and 2020-2024 time blocks. The base peak parameter was fixed at the model estimate because it was well estimated but highly correlated with the time-varying peak estimates. The starting logit parameter was fixed at the model estimate (-14.9, near the lower bound) and the ending logit parameter was fixed at the upper bound. The model was not sensitive to either logit parameter over a range of values. The implementation of time-varying selectivity led to much improved fits to the index of relative abundance for the Combined Video Survey, particularly in the last few years.

3.1.7.2. Age-based Selectivity

Age-based selectivity was not specified for any of the fleets or surveys.

3.1.8. Retention

Discard estimates and associated length compositions were provided for the Recreational and Commercial Vertical Line fleets and were generally assumed to be regulatory discards (**Figure 25**). However, discard estimates for the Recreational fleet started in 1981, which was prior to the implementation of management regulations. Gray Triggerfish are not typically a targeted species (SEDAR100-DW10; SEDAR100-DW20) and are notoriously difficult to clean/filet (SEDAR100-DW10) and may have been discarded historically due to reduced desirability. The

SEDAR 82 Atlantic Gray Triggerfish Assessment identified an increase in desirability of Gray Triggerfish over time (SEDAR 2024), which may also pertain to the Gulf.

Time-varying retention functions are commonly used in Gulf stock assessments to allow for varying discards at size due to regulations. For Gray Triggerfish, time blocks were based on changes in the minimum size limits, commercial trip and recreational bag limits, and reduced open seasons (**Figures 25-26**). For each fleet, the retention function was specified as a logistic function consisting of four parameters: (1) the inflection point, (2) the slope, (3) the asymptote, and (4) the male offset inflection (not applicable to this model and assumed to be zero).

All time-varying inflection point and slope parameters were estimated freely in the model. The base inflection point and slope parameters for each fleet were fixed at the model estimate, and the model was not sensitive to these parameters over a range of values. Both the base asymptote and time-varying asymptote parameters for each fleet were estimated freely within the model, with discarding prior to 2011 assumed due to lower desirability and discarding from 2012-2024 assumed due to regulations (i.e., reduced open seasons, commercial trip limits, and recreational bag limits).

The parameters for the time varying retention blocks for the Commercial Vertical Line fleet were treated as:

Time Block	Inflection	Slope	Asymptote
pre-1999	Fixed at model estimate	Fixed at model estimate	Estimated (due to low desirability)
1999-2007	Estimated; initially started at size limit of 12 inches TL	Estimated	
2008-2011	Estimated; initially started at size limit of 14 inches FL	Estimated	
2012-2024			Estimated (due to regulations)

The parameters for the time varying retention blocks for the Recreational fleet were treated as:

Time Block	Inflection	Slope	Asymptote
pre-1999	Fixed at model estimate	Fixed at model estimate	Estimated (due to low desirability)
1999-2007	Estimated; initially started at size limit of 12 inches TL	Estimated	
2008-2011	Estimated; initially started at size limit of 14 inches FL	Estimated	
2012-2017			Estimated (due to regulations)
2018-2024	Estimated; initially started at size limit of 15 inches FL	Estimated	

3.1.9. Landings and Compositions

Landings by fleet and associated length and conditional age-at-length compositions were estimated using fleet-specific continuous fishing mortality rates and length-specific selectivity curves following Baranov's catch equation. Fishing mortality was estimated using either the Stock Synthesis developer recommended fleet-specific continuous/hybrid approach (F method 4) or the *F* as a parameter approach (F method 2). Estimation of *F* in the latter approach is influenced by all data in the model, with the retained catch and discard catch having the greatest influence depending on the SE for these observations. The former approach allows some fleets to remain in hybrid where *F* is a tuned factor where the tuning is based on the retained catch for each fishing fleet.

The commercial landings were assumed the most representative and reliable data source in the model, especially over the most recent time period, because this information was collected in the form of a census as opposed to being collected as part of a survey. The commercial landings were assumed to have a lognormal error structure, with annual log-scale SEs obtained from regionally weighted estimates (**Section 2.3.1**). The recreational landings were less precise than the commercial landings, as evident by larger CVs (**Section 2.3.2**; **Table 8**). This allowed Stock Synthesis more freedom to deviate from the observed recreational landings. All CVs were converted to a log-scale SE (see **Section 3.2**). While the actual log-scale SEs that accompanied the recreational landings were initially used in model development, and have been considered in a sensitivity analysis (**Section 3.4.7**), any log-scale SE that exceeded 0.25 was capped at 0.25 in the SEDAR 100 AP Model (1945-1985, 1987, 2013-2015, and 2017-2020).

A new feature available for fitting composition data in Stock Synthesis is the Dirichlet-Multinomial which differs from the standard multinomial in that it includes an estimable parameter (theta) which scales the input sample size (Thorson et al. 2017b; Methot et al. 2023).

The Dirichlet-Multinomial is self-weighting, which avoids the potential for subjectivity as when the Francis re-weighting procedure is applied (Francis 2011). This approach also allows for observed zeros in the data, and the effective sample sizes calculated are directly interpretable. The Dirichlet-Multinomial uses the input sample sizes directly, adjusted by an estimated variance inflation factor, which adjusts the overall weight of data for each fleet relative to one another based on model fit to reduce the potential for particular data sources to have a disproportionate effect on total model fit. The more positive the inflation factor, the more weight the data carry in the likelihood. The Dirichlet-Multinomial is considered an improved practice and recommended for use by the Stock Synthesis model developers. A normal prior was used on the Dirichlet-Multinomial parameters of 0 (SD = 1.813), which is recommended to counteract the effect of the logistic transformation between the Dirichlet-Multinomial parameter and the data weighting (Methot et al. 2023).

For SEDAR 100, the length and/or conditional age-at-length composition data for each fleet/survey were assumed to follow a Dirichlet-Multinomial error structure where input sample sizes were number of trips for commercial and recreational length composition data, number of fish for conditional age-at-length data and number of stations for fishery-independent surveys. Number of trips or stations were used instead of number of fish for length compositions because it was thought to better reflect relative effective sample size in each year, as samples are rarely truly random or independent (Hulson et al. 2012).

3.1.10. Discards and Associated Length Compositions

Discard data for the Recreational and Commercial Vertical Line fleets were directly fit in the model using size-based retention functions, and a lognormal error structure was assumed. The model estimated total discards based on the selectivity and retention functions, then calculated dead discards based on the discard mortality rate of 40% assumed for each fleet (**Section 2.2.6**). For the Shrimp Bycatch fleet, a lognormal error structure was assumed and all fish selected for were assumed dead. Length compositions of discards for the Recreational and Commercial Vertical Line fleets were input specifying annual sample sizes as number of trips and using the Dirichlet Multinomial approach for weighting.

3.1.11. Indices

The indices are assumed to have a lognormal error structure. For all indices of relative abundance, input CVs were those obtained through index standardization. The CVs provided by the index standardization were converted to log-scale SEs required for input to Stock Synthesis for lognormal error structures (**Section 3.2**). The fishery-dependent Recreational (SRHS) CPUE index had a much larger mean log-scale SE (0.27) compared to the SEAMAP Trawl Early Survey (0.17), SEAMAP Trawl Late Survey (0.14), and Combined Video Survey (0.17). While error estimates were provided for part of the shrimp effort time series (1984-2024; **Table 15**), the Shrimp Effort Index was assumed to have a log-scale SE of 0.2 throughout the time series to allow the assessment model to deviate if supported by other data streams.

3.2. Goodness of Fit and Assumed Error Structure

A maximum likelihood approach was used to assess goodness of model fit to each of the data sources (e.g., catch, indices, compositions, etc.). For each separate data set, an assumed error distribution and an associated likelihood component was specified, the value of which was determined by the difference in observed and expected values along with the assumed variance of the error distribution. The total likelihood was the sum of each individual component. A nonlinear iterative search algorithm was used to minimize the total negative log-likelihood across the multidimensional parameter space to determine the parameter values that provide the best fit to the data. With this type of integrated modeling approach, data weighting (i.e., the variance associated with each data set) can affect model results, particularly if the various data sets indicate differing population trends.

Where lognormal error structures were used, annual CVs associated with each of the data sources were converted to log-scale SEs where necessary using the approximation: $log_e(SE) = \sqrt{(log_e(1 + CV^2))}$ provided in Methot et al. (2023).

Weak penalty functions were implemented to keep parameter estimates from hitting their bounds (Methot et al. 2023). Parameter bounds were set to be relatively wide and were unlikely to truncate the search algorithm.

Uncertainty in parameter estimates was quantified by computing asymptotic SEs for each parameter. Asymptotic SEs are calculated by inverting the Hessian matrix (i.e., the matrix of second derivatives) after the model fitting process (Methot and Wetzel, 2013). Asymptotic SEs provide a minimum estimate of uncertainty in parameter values.

3.3. Estimated Parameters

In total, 305 parameters were estimated for the SEDAR 100 AP Model, of which 268 were active parameters (**Tables 17 and A1**). These parameters include: the three von Bertalanffy growth parameters (L_{Amin}, L_{Amax} [i.e., $L\infty$] and K), one stock-recruit relationship parameter (ln(R_0)), the stock-recruit deviations for the data-rich time period (1981-2024), year specific (1945-2024) F for the Recreational and Shrimp Bycatch fleets, catchability parameters for each index, extra SD parameters for each index of relative abundance, length-based selectivity parameters for each fleet and survey, length-based retention parameters for the Recreational and Commercial Vertical Line fleets, and 6 parameters informing the Dirichlet-Multinomial length and conditional age-at-length composition weightings.

3.4. Model Diagnostics

3.4.1. Residual Analysis

The main approach used to address model fit and performance was residual analysis of model fit to each of the data sets (e.g., catch, indices, length/age compositions). Any temporal trends in model residuals (or trends with age or length for composition data) can be indicative of model misspecification and poor performance. It is not expected that any model will perfectly fit any of the observed data sets, but ideally, residuals will be randomly distributed and conform to the assumed error structure for that data source. Any extreme patterns of positive or negative residuals are indicative of poor model performance and potential unaccounted for process or observation error.

3.4.2. Correlation Analysis

High correlation between parameters can lead to flat likelihood response surfaces and poor model stability. By performing a correlation analysis, modeling assumptions that lead to inadequate model parameterizations can be highlighted. Because of the highly parameterized nature of stock assessment models, it is expected that some parameters will always be correlated (e.g., stock-recruit parameters or growth parameters). However, a large number of extremely correlated parameters warrant reconsideration of modeling assumptions and parameterization. A correlation analysis was carried out and correlations with an absolute value greater than 0.7 were reported.

3.4.3. Likelihood Profiles

Likelihood profiles are used to examine the change in negative log-likelihood for each data source in order to address the stability of a given parameter estimate, and to see how each individual data source influences the estimate. The analysis is performed by holding the given parameter at a constant value and rerunning the model. This is repeated for a range of reasonable parameter values. Ideally, the graph of negative log-likelihood values against parameter values will give a well-defined minimum, indicating that data sources agree. When a given parameter is not well estimated, the profile plot may show conflicting signals across the data sources. The resulting total likelihood surface will often be flat, indicating that multiple parameter values are equally likely given the data. In such instances, the model assumptions need to be reconsidered.

Typically, profiling is carried out for a few key parameters, particularly those defining the stock-recruit relationship. Profiles were carried out for the five growth parameters (L_{Amin}, L_{Amax} [i.e., $L\infty$], K, CV_{Amin}, and CV_{Amax}), $\ln(R_0)$, *SigmaR*, and steepness.

3.4.4. Jitter Analysis

Jitter analysis is a relatively simple method that can be used to assess model stability and to determine whether a global as opposed to a local minimum has been found by the search algorithm. The premise is that all of the starting values are randomly altered (or 'jittered') by an input constant value and the model is rerun from the new starting values. If the resulting population trajectories across a number of runs converge to the same final solution, it can be reasonably assumed that a global minimum has been obtained. This process is not fault-proof and no guarantee can ever be made that the 'true' solution has been found or that the model does not contain misspecification. However, if the jitter analysis results are consistent, it provides additional support that the model is performing well and has come to a stable, global solution.

For this assessment, a jitter value of 0.1 (10%) was applied to the starting values and 100 runs were completed.

3.4.5. Retrospective Analysis

Retrospective analysis evaluates the consistency of terminal year model estimates as it sequentially removes a year of data at a time and reruns the model. Mohn's Rho can be used to determine retrospective bias, with values between -0.15 to 0.2 considered acceptable for longer-lived species and values outside that range indicate of an undesirable retrospective pattern (Mohn 1999; Hurtado-Ferro et al. 2015; Carvalho et al. 2021). If the resulting estimates of derived quantities such as SSB or recruitment differ significantly, particularly if there is serial over- (+ Mohn's Rho) or underestimation (- Mohn's Rho) of any important quantities, it can indicate that the model has some unidentified process error, and requires reassessing model assumptions. It is expected that removing data will lead to slight differences between the new terminal year estimates and the updated estimates for that year in the model with the full data. Oftentimes additional data, especially compositional data, will improve estimates in years prior to the new terminal year, because the information on cohort strength becomes more reliable. Therefore, slight differences are expected between model runs as more years of data are peeled away. Ideally, the difference in estimates will be slight and more or less randomly distributed above and below the estimates from the model with the complete data sets.

A five-year retrospective analysis was carried out. Retrospective forecasts were also evaluated to determine consistency between forward projections and subsequent updates with newly available data added one year at a time (Carvalho et al. 2021).

3.4.6. Additional Diagnostics

Additional diagnostics using the R package 'SS3Diags' are presented following the recommendations of Carvalho et al. (2021). Joint residual plots were used to assess goodness of model fit by identifying conflicting time series and auto-correlation of residual patterns via a Loess smoother (Winker et al. 2018; Carvalho et al. 2021). Undesirably high root mean squared error (RMSE) were values which exceeded 30%. Model misspecification was evaluated by exploring patterns in residuals of indices and compositions using a runs test, which indicates the presence of nonrandom variation (Carvalho et al. 2021). In addition, outlier data points were identified via the 3-sigma limit, where any points beyond this limit would be unlikely given random process error in the observed residual distribution (Carvalho et al. 2021).

Prediction skill of the model was tested using the hindcasting cross-validation approach of Kell et al. (2021). The mean absolute scaled error (MASE; Hyndman and Koehler 2006) was calculated for a 5-year period for each data input where available. The mean absolute scaled error scales the mean absolute error of forecasts (i.e., prediction residuals) to the mean absolute error of a naïve in-sample prediction (Carvalho et al. 2021). A skilled model would improve the model forecast compared to the baseline (i.e., random walk), with a mean absolute scaled error value of 0.5 indicative of a forecast being twice as accurate as the baseline and values >1 indicative of average model forecasts worse than the baseline (Carvalho et al. 2021; Kell et al. 2021).

3.4.7. SEDAR 100 AP Model Sensitivity Runs

Sensitivity runs were conducted with the SEDAR 100 AP Model to investigate critical uncertainty in data and reactivity to modeling assumptions. An exhaustive evaluation of model uncertainty was not carried out, but the aspects of model uncertainty judged to be the most important for model performance and accuracy were investigated.

Only the most important sensitivity runs are presented below, but many additional exploratory runs were also implemented. The order in which they are presented is not intended to reflect their importance; each run included here provided important information for developing or evaluating the base case model and alternate states of nature. Focus of the sensitivity runs was on population trajectories, improvements in fit and important parameter estimates (e.g., recruitment).

Recreational removals - Recreational removals (i.e., landings and discards) remain a key area of uncertainty for Gulf fish stocks. To evaluate the sensitivity of results to alternative data streams or uncertainty estimates, we conducted five sensitivity runs:

1. *Replaced uncertain recreational landings estimates*. Replaced any yearly landings estimates that have a CV>=0.5 with the average of the two neighboring years following MRIP guidance. This was done solely for 2017 where the point estimate of 84,842 fish was replaced with an estimated 174,416 fish.

2. *Excluded uncertain recreational discard estimates*. Excluded recreational discard estimates for 1981-1987 where CVs exceeded 0.5 given the inability to replace these values with neighboring year estimates.

3. *Reduced recreational removals by 40%*. Assumed that recreational removals were 40% lower than provided to mimic the MRIP-FES pilot study results (Andrews 2022). Preliminary results from the pilot study suggested that the MRIP-FES overestimated private effort by 30-40%, which translates into overestimates of removals.

4. *Used actual error estimates for recreational landings*. Implemented the log-scale SEs converted from CVs provided for recreational landings (**Table 8**).

5. *Used log-scale SE of 0.05 for recreational landings*. Treated the recreational landings as known, as was done during SEDAR 43.

Discard mortality rate - Discard mortality remains an active area of research for Gray Triggerfish, with more recent studies suggesting higher values than used in previous assessments or supported by fishermen (SEDAR100-DW10). To evaluate the sensitivity of results to alternative values, we conducted two sensitivity runs:

1. *26% for all fleets*. Used alternative value recommended by the ad-hoc Discard Mortality Working Group, which is based on the lower limit of the range identified in the literature review and corroborated by the Bayesian analysis (SEDAR100-AP01).

2. *60% for all fleets*. Used alternative value recommended by the ad-hoc Discard Mortality Working Group, which is based on the upper limit of the range identified in the literature review and corroborated by the Bayesian Analysis (SEDAR100-AP01).

Shrimp Bycatch - The estimation of bycatch in the shrimp fishery is difficult to determine given the lack of coverage of Gray Triggerfish in the Shrimp Observer Program through 2024. To evaluate the influence of these removals on model results, we conducted three sensitivity runs:

1. *Excluded shrimp bycatch*. Assumed shrimp bycatch is zero, although this is not supported by the available data which identify Gray Triggerfish in the bycatch (see Appendix 1 in

SEDAR100-DW22 and Scott-Denton et al. 2012 [SEDAR100-RD06]).

2. *Reduced shrimp bycatch estimates by 50%*. Assumed shrimp bycatch is half what has been estimated.

3. *Fit to the median shrimp bycatch estimate for only 1984-2023 (1,290,110) using the super-period approach*. Avoided fitting to the back-calculated or interpolated shrimp bycatch estimates.

Growth - The use of platoons mimics the effect of size selectivity on the distribution of size-at-age fish surviving the fishery. To evaluate the influence of size-dependent survivorship on model results, we conducted two sensitivity runs:

1. *Three platoons*. Assumed three platoons that follow a normal approximation.

2. *Five platoons*. Assumed five platoons that follow a normal approximation.

Steepness - Steepness is generally one of the most uncertain parameters estimated in a stock assessment model and is a critical quantity to stock assessment. To evaluate sensitivity of results to this parameter, we conducted one sensitivity run:

1. *Freely estimate steepness without a prior*. Steepness was estimated without a prior as in SEDAR 43.

Estimation of *F* and uncertainty estimates - Enabled estimation of annual *F* for each fleet for compatibility with the SEFSC's projection approach that maintains fleet allocations throughout the projection period (**Section 6**). To evaluate the influence of these specifications on model results, we conducted one sensitivity run:

1. *Annual Fs for each fleet using uncertainty*. Estimated annual Fs for all fishing fleets and used the uncertainty estimates provided.

Age-Structured Production Model (ASPM) - This simpler model is used as a diagnostic to detect misspecification of key systems-modeled processes that control the shape of the production function (Carvalho et al. 2017). To evaluate sensitivity of results to alternative model structures, we conducted two sensitivity runs:

1. *ASPM without recruitment deviations*. Evaluated whether the net effect between surplus production and observed catches alone could explain trends in the indices of abundance.

2. *ASPM with recruitment deviations*. Evaluated if composition data are needed to estimate the variability in recruitment (Minte-Vera et al., 2017).

Combining Landings and Dead Discards - A simpler approach to characterizing removals is to add dead discards to landings, which removes the need to parameterize length-based retention and explicitly model discards. To evaluate the sensitivity of results to this alternative model structure, we conducted one sensitivity run:

1. *Lumped dead discards with landings*. Added dead discards to the landings estimates for the Recreational and Commercial Vertical Line fleets and assumed that selectivities were identical for discarded and landed fish. For the Recreational fleet, the total number of discards (**Table 13**) was multiplied by the discard mortality rate of 40% and then added to the landings estimates. For the Commercial Vertical Line fleet, the total weight of discards (**Table 11 in SEDAR100-DW06**) was multiplied by the discard mortality rate of 40% and then added to the landings estimates.

Start Year - Historical data are particularly uncertain, but it can be equally as challenging to start the model in a fished condition because of the need to specify initial depletion at the start of the model. Typically, initial equilibrium catches are set equal to the average landings from the first 5 years for each fleet, from which a set of initial *F*s is estimated. This approach is not feasible for shrimp bycatch, which requires a more complex approach because initial conditions are defined based on an initial *F*. Following an approach first used during SEDAR 81 Gulf Spanish Mackerel (*Scomberomorus maculatus*) (SEDAR 2023), a search for optimal initial equilibrium catches was done by taking the following steps:

a. Each fleet's initial equilibrium catches were set to the mean landings over the first five years of the time series and initial equilibrium *F* for the Shrimp Bycatch fleet was set to 0.084 for 1963 and 0.129 for 1981. These estimates were based on the 1958-1962 and 1977-1981 averages obtained from the SEDAR 100 AP Model estimates.

b. Each initial catch (+ the Shrimp Bycatch initial *F*) was multiplied by a series of scalars ranging from 0.1 to 4.9 in 0.2 increments (i.e. where 0.1 would cut the equilibrium catches by 90% and 1.9 would nearly double them) and the model was re-run.

c. A likelihood profile of each model run was plotted to determine the most likely scalar (i.e. lowest negative log likelihood) given the information present in the model.

To evaluate the influence of starting in a later year on model results, while also accounting for the potential complications of specifying initial conditions as described above, we conducted two sensitivity runs:

1. *Start in 1963*. Started model in 1963 in a fished condition and used a prior on Shrimp Bycatch initial *F* of 0.084 as described above. Starting in 1963 corresponds to the start of commercial landings data and removes some uncertainty and the need to interpolate landings data.

2. *Start in 1981*. Started model in 1981 in a fished condition and used a prior on Shrimp Bycatch initial *F* of 0.129 as described above. Starting in 1981 corresponds to the start of the recreational data, and removes a lot of the uncertainty and need to back-calculate or interpolate data streams.

Jackknife of indices of abundance - The goal of these sensitivity runs was to determine if any single index of abundance was having undue influence on the model and causing tension with other data in terms of estimating parameters. The approach can be especially useful for identifying indices that may be giving conflicting abundance trend signals compared to the other indices. If removing a data set leads to dramatically different results, it suggests that the data set should be reexamined to determine if the sampling procedures are consistent and appropriate (e.g., an index may only be sampling a sub-unit of the stock and resulting abundance signals may only reflect a local sub-population and not the trend in the entire stock). Each index was removed and the model rerun. Other data sets (i.e., landings and compositional data) were deemed fundamentally necessary to stabilize the assessment and therefore their exclusion was not included in the jack-knife analysis (i.e., a full jackknife was not conducted).

4. Stock Assessment Model - Results

4.1. Estimated Parameters

Most parameter estimates and variances were reasonably well estimated (i.e., CV < 1) for the SEDAR 100 AP Model (**Tables 17 and A1**). Of the 268 active parameters, 20 exhibited CVs above 1 and were poorly estimated, including 15 (of 44) recruitment deviations, the top logit parameter of the Recreational fleet and the SEAMAP Trawl Early Survey/Shrimp Bycatch fleet selectivity curves, the parameters defining the top logit and descending limb of the Combined Video Survey selectivity curve, and the asymptote of the 2012-2024 Recreational fleet retention curve. No parameters were estimated near bounds.

Figure 27 shows parameter distribution plots along with starting values and priors.

The Dirichlet-Multinomial parameters for the Recreational and Commercial Vertical Line/Commercial Longline length compositions were estimated >5 (i.e. a weight of >99% through inverse logit transformation), indicating no need for down-weighting the input sample sizes for these fleets. Four of the Dirichlet-Multinomial parameters were estimated below 5:

- Recreational conditional age-at-length compositions (62%)
- Commercial Vertical Line/Commercial Longline conditional age-at-length compositions (62%)
- SEAMAP Trawl Early Survey/SEAMAP Trawl Late Survey length compositions (46%)
- Combined Video Survey length compositions (40%)

4.2. Fishing Mortality

The exploitation rate (*F*; total biomass killed all ages / total biomass age 1+) for the entire stock is provided in **Table 18** and **Figure 28** and by fleet is provided in **Table 19** and **Figure 29**. Given the substantial differences in data inputs, particularly the recreational removals and the shrimp bycatch estimates, the magnitude of annual *F* estimated overall and by fleet were very different compared to the estimates from the SEDAR 43 Standard Model (**Table 18**; **Figures 28-29**).

F for the stock increased gradually until 1979, declined to a low in 1984 for the recent time period (1981-2024), increased to the largest estimate in 1993, and was highly variable thereafter (**Figure 28**). With the exception of the second highest estimate in 2013, *F* trended downward since 1993. Since 1945, *F* for the stock has averaged around 0.173, and ranged between 0.0002 in 1945 to 0.44 in 1993 (**Figure 28**). More recently since 1981, *F* for the stock has averaged around 0.237 (range: 0.094-0.44). For this recent time period, *F* remained above the recent (1981-2024) time series mean in most years between 1987 and 2013, but has since declined to below mean values. The terminal year (2024) *F* for the entire stock was 0.21, which is slightly below the recent time series mean.

For SEDAR 100, *F* was primarily driven by the Recreational fleet throughout the time series, which contrasts the dominance of exploitation by the Shrimp Bycatch fleet in SEDAR 43 (**Table 19**; **Figure 29**). *F* for the Recreational fleet was largest on average (0.12; recent mean of 0.17) and has varied considerably throughout the time series, ranging from 0.0001 in 1945 to 0.384 in 2013. After peaking in 2013, *F* dropped considerably in 2014 and 2015, and has generally remained above the time series mean in recent years (**Figure 29**). The Shrimp Bycatch fleet exhibited the next highest exploitation on average (0.043; recent mean of 0.049), which peaked in the late 1980s and again in the late 1990s and has remained well below the time series mean since 2004 (**Figure 29**). Both the Commercial Vertical Line and Commercial Longline fleets exhibited much lower *F*s (average of 0.01 and 0.001, respectively), with exploitation peaking in the early 1990s for both fleets (**Figure 29**). The Commercial Vertical Line fleet exhibited variable levels of exploitation throughout the time series, with higher levels during the 1990s and 2000s, and declining to relatively stable estimates since 2014 (**Figure 29**). *F*s for the Commercial Longline fleet remained consistently low since this deep-water fishery began in the late 1970s (Prytherch 1983), with the exception of a slight peak in 1990. The terminal year (2024) *F*s for the Recreational, Commercial Vertical Line, Commercial Longline, and Shrimp Bycatch fleets were 0.192, 0.004, 0.0007, and 0.013, respectively (**Table 19**).

4.3. Selectivity

Selectivity parameter estimates and associated uncertainty are listed in **Table 17** with the Label prefix "Size". Most selectivity parameters appeared well estimated (CV < 1; **Table 17**), with the exception of the top logit parameter defining the Recreational fleet and SEAMAP Trawl Early Survey/Shrimp Bycatch fleet selectivity curves, and the parameters defining the top logit and descending limb of the Combined Video Survey selectivity curve. Since length-based selectivity was not used in the SEDAR 43 Standard Model, no comparisons can be made.

Gray Triggerfish were fully selected (> 95%) for at larger sizes for the Commercial Longline fleet compared to the Commercial Vertical Line and Recreational fleets (**Figure 30**). The Commercial Longline fleet reached 50% selection around 48 cm FL, with full selection by 54 cm FL (**Figure 30**). In contrast, the Commercial Vertical Line fleet reached 50% selection around 38 cm FL, with full selection by 48 cm FL (**Figure 30**). The Recreational selectivity curve was estimated as dome-shaped and reached 50% selection around 30 cm FL, with full selection by 34 cm FL before declining and leveling off at 29.9% around 46 cm FL or larger (**Figure 30**).

The derived age-based selectivity patterns illustrate that the Recreational fleet selects for younger fish, with the Recreational fleet generally selecting Gray Triggerfish 6-9 years (selectivity > 50%; **Figure 31**). In contrast, the Commercial Vertical Line and Commercial Longline fleets generally select for Gray Triggerfish 8+ years and 14+ years, respectively. None of the directed fleets reached full selectivity (i.e., 95%). Selectivity for the Commercial Vertical Line and Commercial Longline fleets peaked at 91.5% for age-15 and 62.9% for age-15, respectively

(**Figure 31**). Selectivity for the Recreational fleet peaked at 54.2% for age-7 and then declined slightly for older ages (**Figure 31**).

Shifts in selectivity patterns assumed due to regulations such as the implementation of circle hooks in 2008 were evident for all three directed fleets (**Figure 32**). The selectivity curves for both the Recreational and Commercial Vertical Line fleets shifted towards larger fish in the 2008-2024 time period. For the 1945-2007 time block, the Commercial Vertical Line fleet reached 50% selection around 30 cm FL, with full selection by 36 cm FL (**Figure 32**). The Recreational selectivity curve for the 1945-2007 time block was slightly less domed, and reached 50% selection around 24 cm FL, with full selection by 28 cm FL before declining and leveling off at 42% around 50 cm FL or larger (**Figure 32**). In contrast, the selectivity curve for the Commercial Longline fleet shifted towards smaller fish in the 2008-2024 time period. For the 1945-2007 time block, the Commercial Longline fleet reached 50% selection around 56 cm FL, with full selection by 66 cm FL (**Figure 32**).

The SEAMAP Trawl Early Survey/Shrimp Bycatch fleet selectivity curve was estimated as dome-shaped and reached 50% selection for Gray Triggerfish around 8 cm FL, with selectivity leveling off at 39.5% around 22 cm FL or larger (**Figure 30**). This translated into maximum selection of 65.7 by age-1, with selection declining with age until leveling off around 39.5 by age-12 (**Figure 31**). The SEAMAP Trawl Late Survey also selected for smaller Gray Triggerfish (6 cm FL), with selectivity leveling off at 57.8% for Gray Triggerfish around 22 cm FL or larger (**Figure 30**). This also translated into maximum selection for age-1 of 76%, which then declined with age until leveling off around 57.8% by age-7 (**Figure 31**).

The Combined Video Survey selected for larger Gray Triggerfish and reached 50% selection around 44 cm FL, with full selection by 54 cm FL (**Figure 30**). This translated into selection (>50%) by age-10 and then increased to a max of 75.8% by age 15 (**Figure 31**). Shifts in selectivity were included to account for differences in the surveys, and estimated selectivity curves revealed differences among time periods. Selectivity curves were similar between the 1993-2005 and 2010-2019 time periods, where selectivity reached 50% selection around 46 cm FL, with full selection by 58 cm FL (**Figure 32**). Selectivity curves were similar between the 2006-2009 and 2020-2024 time blocks, where both shifted towards smaller Gray Triggerfish where selectivity reached 50% selection around 42 cm FL, with full selection by 54 cm FL (**Figure 32**).

4.4. Retention

Retention parameter estimates and associated uncertainty are listed in **Table 17** with the Label prefix "Retain". Most retention parameters appeared well estimated (CV < 1; **Table 17**), with the exception of the asymptote for the 2012-2024 Recreational fleet retention curve.

Fleet-specific terminal year (2024) selectivity, retention, discard mortality (constant at 40%) and fraction of fish kept, dead and discarded for the Recreational fleet are shown in **Figure 33**. Retention curves changed considerably with management regulations, as they shifted towards larger fish with increasing size limits (**Figure 34**). The majority of Gray Triggerfish encountered were retained in the early period (1945-2011), whereas the 2012-2024 retention curve only reached an asymptote of 46.7% retention due to more strict management regulations (**Figures 25-26**).

Fleet-specific terminal year (2024) selectivity, retention, discard mortality (constant at 40%) and fraction of fish kept, dead and discarded for the Commercial Vertical Line fleet are shown in **Figure 35**. Changes in retention patterns were largely due to changes in size limits, as retention curves shifted towards larger fish with increasing size limits (**Figure 36**). Almost all Gray Triggerfish encountered were retained in the early period (1945-2011), whereas the 2012-2024 retention curve only reached an asymptote of 82.9% retention due to more strict management regulations (**Figures 25-26**).

Fleet-specific terminal year (2024) selectivity, retention, discard mortality (constant at 100%) and fraction of fish dead and discarded for the Shrimp Bycatch fleet are shown in **Figure 37**. All Gray Triggerfish selected for were discarded dead.

4.5. Recruitment

As noted in **Section 3.1.5**, steepness was fixed at 0.99 and *SigmaR* was fixed at 0.6 which differs from SEDAR 43 where both were estimated. The corresponding Beverton-Holt stock recruit relationship is shown in **Figure 38**. The SEDAR 100 AP Model estimated an ln(R_0) at 11.469 (0.004) (**Table 17**), which equates to 95.74 million age-0s.

Estimated annual recruitment of age-0s from 1945 to 2024 are provided in **Table 20** and shown in comparison to SEDAR 43 in **Figures 38-39**. The highest recruitments estimated by the SEDAR 100 AP Model occurred during 1981 (219.29 million age-0s), 1987 (185.73 million age-0s), 2013 (173.09 million age-0s), 2017 (168.77 million age-0s), and 1988 (148.57 million age-0s). Between 1981 and 2024 (when recruitment deviations were estimated), estimated recruitment averaged 90.06 million age-0s and was lowest in 2023 at 30.07 million age-0s (**Figures 38-39**). Estimated recruits were very variable throughout the 1980s and 1990s, were relatively low during the early 2000s, and highly variable since the mid 2010s (**Figure 39**). Estimated recruitment for the last 10 years averaged 99.89 million age-0s, which was about 10% higher than the 1981-2024 mean. Recruitment trajectories were very different than those estimated in SEDAR 43 due to the combination of changes to input data and model settings for recruitment (**Figure 39**).

Recruitment deviations were much more variable for the SEDAR 100 AP Model and were fairly randomly distributed with a few noticeable trends of negative deviations (1982-1984, 2000-2006) and positive deviations (2011-2014, 2017-2019). Recruitment deviations were characterized by a period of higher than average recruitment in recent years, although the confidence intervals for some years were very large and overlapped with 0 (**Figure 40**). Recruitment deviations were generally well estimated (CV < 1) in the SEDAR 100 AP Model with the exceptions of 1982, 1985-1986, 1993, 1996, 2000-2001, 2007, 2009, 2015-2016, 2019-2021, and 2024 (**Table 17**). The asymptotic SEs for recruitment deviations averaged 0.2 between 1981 and 2024, and ranged from 0.08 in 2013 to 0.58 in 2024 (**Figure 41**). Variability in recruitment was much higher in the SEDAR 100 AP Model because *SigmaR* was fixed at 0.6 whereas it was estimated at 0.358 in the SEDAR 43 Standard Model. The estimated (and applied) recruitment bias adjustment ramp is shown in **Figure 42**.

4.6. Biomass and Abundance Trajectories

The estimated annual total biomass (metric tons), exploitable biomass (ages 1+, metric tons), SSB (metric tons), SSB ratio (SSB/SSB_0 where SSB_0 is virgin or unfished SSB) and exploitable abundance (ages 1+) from 1945 to 2024 are provided in **Table 20**. Total biomass averaged 5,883 metric tons, and ranged from 2,810 metric tons in 2006 to 9,967 metric tons in 1945. Total biomass declined gradually, reached the lowest value in the mid 2000s, and has since increased to levels similar to the early 1980s (**Figure 43**). The magnitude of estimated total biomass differed considerably from SEDAR 43, particularly in the earliest years (**Figure 43**). Exploitable (ages 1+) biomass and numbers averaged 5,681 metric tons and 37.89 million, respectively. Exploitable biomass was lowest in 2007 at 2,660 metric tons whereas exploitable numbers were lowest in 2006 at 20.02 million. Exploitable biomass peaked at 9,758 metric tons in 1945 whereas exploitable numbers were highest in 1982 at 67.89 million (**Table 20**). SSB averaged 4,846 metric tons and ranged from 2,096 metric tons in 2008 to 8,817 metric tons in 1945 (**Table 20**). A comparison of SSB in terms of magnitude was not possible between assessments because SEDAR 43 used the number of eggs and not metric tons as used in SEDAR 100.

The SSB ratio averaged 0.55, and ranged from 0.24 in 2007-2008 to 1 in 1945 (**Table 20**). The estimated SSB ratio declined gradually throughout the first half of the time series, increased slightly in the early 1980s, declined to its lowest level at 24% in 2008, and has since increased to 55% in 2024 (**Table 20**; **Figure 43**). The SSB ratio from SEDAR 43 showed a similar declining trend over time, but reached its lowest value in 2013 (**Figure 43**).

The mean age of Gray Triggerfish generally remained around 0.5 year throughout the time series for the SEDAR 100 AP Model, which is younger than observed for the SEDAR 43 Standard Model (**Figure 44**). The most abundant age class was age-0 in all years. At virgin conditions, age-0 and age-10+ Gray Triggerfish dominated in numbers and biomass, respectively (**Figure 45**).

4.7. Model Fit and Residual Analysis

4.7.1. Landings

Given the large log-scale SEs assigned to the Recreational landings (up to 0.25), differences were observed between input and expected landings in numbers (**Table 21**, **Figure 46**). The model expected lower Recreational landings in the 1970s and throughout some of the 1980s and 1990s, whereas the model expected considerably higher landings in 1998 and around 2007 (**Figure 46**). The landings for the Commercial Vertical Line and Commercial Longline fleets were fit almost exactly as these fleets generally had relatively small log-scale SEs, especially since 1986 (**Tables 22-23**, **Figure 46**; see **Section 3.4.7** for sensitivity run using these uncertainty estimates). The overwhelming majority of landings came from the Recreational fleet (**Figure 47**).

The majority of years showed good agreement between expected and observed mean body weight of the Recreational landings, with the exception of 1983-1985, 1990-1991, 1997, and 2000 where the expected values fell outside the confidence intervals (**Figure 48**). The mean weight landed over time by the Recreational fleet averaged 2.2 pounds wwt and ranged from 1.6 pounds wwt in 1990 to 3.7 pounds wwt since 2023 (**Table 21**).

The mean weight landed over time by the Commercial Vertical Line fleet averaged 3.2 pounds wwt and ranged from 2.4 pounds wwt in 1990 and 1995 to 4.5 pounds wwt since 2022 (**Table 22**). The Commercial Longline fleet retained larger Gray Triggerfish, with the mean weight landed over time averaging 6.6 pounds wwt and ranging from 5.9 pounds wwt in 2015-2017 to 7.5 pounds wwt in 1988 (**Table 23**).

4.7.2. Discards

Since 2009, the majority of discards have come from the Recreational fleet (**Figure 49**). Throughout almost all years of the time series, the Recreational fleet was responsible for the majority of total catch (landings + all discards; **Figure 50**) and total removals (landings + dead discards; **Figure 51**). The discard fraction increased considerably for the Recreational and Commercial Vertical Line fleets in 2013 (**Figure 52**) due to regulations (**Figures 25-26**), which was not evident in SEDAR 43 because of its terminal year of 2013.

For the Recreational fleet, discard estimates were provided beginning in 1981 (**Figure 53**). Because of how retention was parameterized, the assessment model expected small (relative to those in 1981+) amounts of discards prior to 1981 (mean: 131,737; **Table 24**). The model generally fit well to the discard observations, with only a few years showing predictions falling beyond the confidence limits of the data. The model expected an especially high discard estimate in 2013, which corresponded with reductions in season length and the implementation of a Gray Triggerfish bag limit (**Figures 25-26**). Compared to landings, dead discards in terms of biomass and numbers accounted for far less removals (mean: 17% of biomass, 26% of numbers; **Figure 54**). However, dead discards have made up the majority of removals since 2009 (**Figure 54**). Expected total discards averaged 0.51 million (0.21 million dead) and 0.74 million pounds wwt (0.3 million pounds wwt dead), and peaked at 3.08 million (1.23 million dead) and 5.36 million pounds wwt (2.14 million pounds wwt dead) in 2013. The mean weight of Gray Triggerfish discarded over time by the Recreational fleet averaged 1 pound wwt and ranged from 0.7 pounds wwt in 1999-2007 to 1.9 pounds wwt in 2022-2023 (**Table 24**).

For the Commercial Vertical Line fleet, discard estimates were provided beginning in 2000 (**Figure 55**). The assessment model expected very small amounts of discards from 1945-1999 (mean: 198; **Table 25**). The model fit the discard observations well as all values remained within the confidence limits of the data. Compared to landings, dead discards in terms of biomass and numbers accounted for far less removals (mean: 4% of biomass, 6% of numbers; **Figure 56**), although they did make up a larger proportion since 2009 (**Figure 56**). Expected total discards averaged 2,914 Gray Triggerfish (1,165 dead) and 6,450 pounds wwt (2,580 pounds wwt dead), and peaked at 19,345 Gray Triggerfish (7,738 dead) in 2011 and 46,604 pounds wwt (18,642 pounds wwt dead) in 2012. The mean weight of Gray Triggerfish discarded over time by the Commercial Vertical Line fleet averaged 0.9 pounds wwt and ranged from 0.4 pounds wwt throughout some of the 1980s and 1990s to 2.7 pounds wwt in 2022-2023 (**Table 25**).

4.7.3. Shrimp Bycatch

Overall, the expected discards by the Shrimp Bycatch fleet were much smaller in SEDAR 100 compared to SEDAR 43 (**Figure 49**), and were smaller than recreational removals in nearly all years (**Figure 51**). The model estimated a lower median bycatch value (1,420,330), but this estimate remained within the confidence intervals of the input value of 1,612,310 (**Figure 57**).

Expected shrimp bycatch averaged 1.4 million and 0.49 million pounds wwt, and peaked at 3.77 million and 0.96 million pounds wwt in 1989. The mean weight discarded over time by the Shrimp Bycatch fleet averaged 0.4 pounds wwt and ranged from 0.2 pounds wwt in 1982, 1988, and 2013-2014 to 0.6 pounds wwt in 1985 (**Table 26**).

4.7.4. Indices

Observed and expected shrimp effort are provided in **Table 27** and **Figure 58**. Observed and expected values were nearly identical (RMSE = 0.027), with the exception of the late 1970s and early 1980s where the model slightly underestimated effort.

Observed and expected indices of relative abundance are provided in **Tables 28-29** and **Figures 59-62**.

The model fit best to the Combined Video Survey index (RMSE = 0.294, extra SD parameter = 0.117; **Table 17**) where expected relative abundance generally tracked observed abundance (**Figure 62**). Relative abundance was expected to remained below average until around 2016 and has increased well above the average since 2020. The implementation of time-varying selectivity for this survey substantially improved model fit for this index (RMSE = 0.406 without), specifically by enabling the index to fit the trend from 2006-2009 and since 2020. This index exhibited a relatively moderate correlation of 0.55 with the expected SSB.

The model fit for the Recreational (SRHS) CPUE index was variable (RMSE = 0.323, extra SD parameter = 0.074; **Table 17**), as it fit better during the earlier part of the time series. This index exhibited the second highest correlation of 0.4 with the expected SSB. Expected relative abundance matched the increasing trend in the late 1980s, peaked in 1990 along with the observed index, and then remained around the time series mean until 2005 where it increased slightly then declined (**Figure 59**).

The poorest fits were evident for the SEAMAP Trawl Early Survey index (RMSE = 0.694, extra SD parameter = 0.414; **Table 17**) and the SEAMAP Trawl Late Survey index (RMSE = 0.371, extra SD parameter = 0.231; **Table 17**). The SEAMAP Trawl Early Survey index was highly variable and uncertain. The expected index did not track the observed trends well, as the expected index peaked in the late 1980s whereas the observed index was highest in 2001 (**Figure 60**). The SEAMAP Trawl Late Survey index was much less variable, but the model still fit poorly and did not track the trends in the observed index well, with the expected index peaking in 2014 but the observed index peaking in 2022 (**Figure 61**). Both indices were poorly correlated with the expected SSB (Trawl Early = -0.14; Trawl Late = 0.33), although this is expected given that both indices primarily track juveniles and not adults.

4.7.5. Fishery Length Compositions

Aggregated across years, the expected length compositions were generally similar to the observed compositions for most fleets and data types (**Figure 63**). Fits to retained length compositions were often better than to discarded length compositions, although sample sizes were notably smaller for discard length compositions (discussed below).

Annual fits to retained length compositions for the Recreational fleet were generally good, with expected and observed peaks corresponding in many years (**Figure 64**). Some early years exhibited small sample sizes and therefore jagged compositions differing from the expected compositions. The Pearson residuals were very variable (min = -7.32, max = 64.14), with clear patterns evident such as underpredicting smaller Gray Triggerfish (large positive residuals) in the early 1980s and since 2009 and underpredicting the largest Gray Triggerfish around 2000 (**Figure 64**). While sample sizes were relatively small for the discard compositions, resulting in poor fits in some years such as 2020, Pearson residuals did not show any concerning magnitudes (min = -2.99, max = 4.91) or patterns (**Figure 65**). When estimated, the Dirichlet parameter for recreational length compositions exceeded 5 (**Table 17**) and did not result in very different sample sizes from the inputs, suggested that input sample sizes were appropriate.

Annual fits to retained length compositions for the Commercial Vertical Line fleet were variable, but in general expected and observed peaks corresponded in many years (**Figure 66**). Poorer fits were noted for years which exhibited smaller sample sizes and therefore jagged compositions differing from the expected compositions, such as the early 1990s and 2006-2012. The Pearson residuals were relatively large (min = -2.61, max = 29.71) and patterns were evident. The model underpredicted larger Gray Triggerfish in the early 1990s, Gray Triggerfish around 34 cm FL in the 2010s, and Gray Triggerfish around 50 cm FL in the late 2010s. Given limited sample sizes in most years, the agreement between expected and observed discard compositions was poor (**Figure 67**), but residuals did not reveal any concerning magnitudes (min = -2.72, max = 5.81) or strong patterns. When estimated, the Dirichlet parameter for commercial length compositions exceeded 5 (**Table 17**) and did not result in very different sample sizes from the inputs, suggested that input sample sizes were appropriate.

Annual fits to retained length compositions for the Commercial Longline fleet showed more variability due to data quality and quantity, with many years showing poor correspondence and jagged compositions (**Figure 68**). The Pearson residuals were relatively small (min = -1.34, max = 6.39) and did not show any strong patterns. While the overall fit showed a slight mismatch in the peak of the expected distribution, the overall aggregated fit was adequate (**Figure 63**).

Although the model did not fit directly to the proxy length compositions for the Shrimp Bycatch fleet, overall there was good agreement between the expected and observed compositions in most years (**Figure 69**). The Pearson residuals were relatively small (min = -0.22, max = 0.92), but did show some pattern from 2014 onward where the model underpredicted Gray Triggerfish around 6 cm FL.

4.7.6. Survey Length Compositions

Aggregated across years, the expected length compositions were generally similar to the observed compositions for the surveys (**Figure 70**).

Annual fits to length compositions for the SEAMAP Trawl Early Survey showed more variability in quality and very variable sample sizes among years (**Figure 71**). Some years showed considerably more spread in the observed compositions such as 1990, 1998, and 2006. The Pearson residuals were relatively small (min = -2.09, max = 9.58) and did not show any strong patterns. The estimated Dirichlet parameter of -0.18 for the trawl surveys led to lower sample sizes compared to the inputs (DM adjusted mean = 37 fish, range: 7-73). Even though the overall fit showed a slight mismatch in the expected distribution for larger fish ~ 30 cm FL, the overall aggregated fit was adequate (**Figure 70**).

Annual fits to length compositions for the SEAMAP Trawl Late Survey also showed high variability in the underlying data and sample sizes across years (**Figure 72**). As observed above, some years showed considerably more spread in the observed compositions such as 2016, 2020, and 2024. The Pearson residuals were relatively small (min = -2.64, max = 9.7) and did not show any strong patterns. The estimated Dirichlet parameter of -0.18 for the trawl surveys led to lower sample sizes compared to the inputs (DM adjusted mean = 43 fish, range: 20-64).

Annual fits to length compositions for the Combined Video Survey were quite variable with many years exhibiting a jagged distribution (**Figure 73**). While most years showed considerable spread in the observed compositions (e.g., 20-60 cm FL), in general the model tended to fit the composition well. The Pearson residuals were relatively small (min = -2.18, max = 13.44) and did not show any strong patterns. The estimated Dirichlet parameter of -0.39 for the video survey led to lower sample sizes compared to the inputs (DM adjusted mean = 44 fish, range: 9-113). The expected distribution was slightly shifted towards larger fish, but overall the aggregated fit was adequate (**Figure 70**).

4.7.7. Fishery Age Compositions

The model fits to the conditional age-at-length for the Recreational fleet are shown in **Figure 74**. The Pearson residuals were relatively small (min = -2.85, max = 18.44) and occasionally showed some clusters such as underpredicting smaller and older Gray Triggerfish in 2009. The estimated Dirichlet parameter of 0.47 for the recreational age data resulted in lower sample sizes (DM adjusted mean = 19 fish, range: 1-279). Differences in observed and expected mean age were variable for the Recreational fleet, with expected mean age ranging between 3.75 and 5.5 years and the observed mean age varying between 3.5 and 6 years (**Figure 75**). The expected mean age generally increased throughout the time series and remained within the 95% confidence intervals for about half of the years. Most years revealed good agreement between observed and expected mean length-at-age, with some years displaying fairly variable observed mean length-at-age due to lower sample sizes (**Figure 76**).

The model fits to the conditional age-at-length for the Commercial Vertical Line fleet are shown in **Figure 77**. The Pearson residuals were relatively small (min = -3.8, max = 11.34) and sometimes revealed patterns such as overpredicting age-5 and age-6 Gray Triggerfish across lengths in 2014-2017 and 2019. The estimated Dirichlet parameter of 0.5 for the commercial age data resulted in lower sample sizes (DM adjusted mean = 14 fish, range: 1-75). Differences in observed and expected mean age were variable for the Commercial Vertical Line fleet, with expected mean age ranging between 4 and 6 years and the observed mean age varying between 3.5 and 7 years (**Figure 78**). The expected mean age generally increased throughout the time series, and while the expected mean age followed the same trend as the observed mean age, many of the expected values fell outside 95% confidence intervals. Most years revealed good agreement between observed and expected mean length-at-age, with some years displaying fairly variable observed mean length-at-age due to lower sample sizes (**Figure 79**).

The model fits to the conditional age-at-length for the Commercial Longline fleet are shown in **Figure 80**. The Pearson residuals were relatively small (min = -1.88, max = 8.01) and did not show any strong patterns. The estimated Dirichlet parameter of 0.5 for the commercial age data resulted in lower sample sizes (DM adjusted mean = 3 fish, range: 1-17). Differences in observed and expected mean age were variable for the Commercial Longline fleet, with expected mean age ranging between 5.75 and 7 years and the observed mean age varying between 6 and 8.25 years (**Figure 81**). The expected mean age gradually decreased from 2006 to 2016 and increased thereafter, and generally has remained within the 95% confidence intervals for about half of the years. Most years revealed good agreement between observed and expected mean length-at-age, with some years displaying fairly variable observed mean length-at-age due to lower sample sizes (**Figure 82**).

4.8. Model Diagnostics

4.8.1. Correlation Analysis

Given the highly parameterized nature of the SEDAR 100 AP Model, some parameters were mildly correlated (correlation coefficient > 70%) but no combinations displayed a strong correlation (> 95%; **Table 30**). Moderate correlations occurred between some time-varying retention parameters for each fleet, some selectivity parameters for fleets and surveys, and the von Bertalanffy growth parameters. Correlation between many of these parameters is not surprising, especially for the selectivity parameters, because the parameters of selectivity functions are inherently correlated (i.e., as the value of one parameter changes the other value will compensate). The same can be said for the von Bertalanffy growth parameters, which are by their very nature correlated.

4.8.2. Likelihood Profiles

The total likelihood component from the ln(R_0) likelihood profile indicates that the global solution for this parameter is approximately 11.45 (**Figure 83**), with the SEDAR 100 AP Model estimating ln(R_0) at 11.469 (**Table 17**). Conflicts were evident, particularly between the length composition data and indices which favored lower values around 11.25 and the mean weight of recreational landings and the age data which supported higher values around 12.

The total likelihood component from the *SigmaR* likelihood profile indicates that the global solution for this parameter is approximately 0.8 (**Figure 84**). However, values between 0.48 and 0.8 remained within 2 negative log-likelihood units, suggesting this parameter was not well estimated. *SigmaR* was fixed in the SEDAR 100 AP Model at 0.6 (see **Section 3.1.5**). Recruitment supported lower values than the total minimum, whereas most other data inputs supported higher values around 0.8.

The total likelihood component from the steepness likelihood profile (not using a prior) supported a minimum around 0.43 (**Figure 85**), but values between 0.39-0.41 and 0.45-0.47 remained within 2 negative log-likelihood units. Conflicts were evident, particularly between the mean weight of recreational landings and age data which favored lower values around 0.31, the discard data which supported higher values around 0.51, and recruitment which favored 0.59.

The total likelihood component from the L_{Amin} growth parameter indicates that the global solution for this parameter is approximately 8 cm FL (**Figure 86**), with the SEDAR 100 AP Model estimate of 8.353 cm FL (**Table 17**). Other values which remained within 2 negative log-likelihood units included 9 cm FL. The data sources were generally in close agreement (~8 cm FL) with the exception of catch which favored around 5 cm FL.

The total likelihood component from the L_{Amax} [i.e., $L\infty$] growth parameter indicates that the global solution for this parameter is approximately 54 cm FL (**Figure 87**), with the SEDAR 100 AP Model estimate of 53.804 cm FL (**Table 17**). Other values which remained within 2 negative log-likelihood units included 53 and 55 cm FL. Conflicts were evident, as the catch, indices, and age data supported lower values between 49-52 and mean weight of recreational landings and discard data supported higher values around 57 and 60 cm FL, respectively.

The total likelihood component from the *K* growth parameter indicates that the global solution for this parameter is approximately 0.15 (**Figure 88**), with the SEDAR 100 AP Model estimate of 0.153 (**Table 17**). Other values which remained within 2 negative log-likelihood units included 0.14-0.145 and 0.155-0.165. While the catch data and recruitment supported higher values around 0.2, the discard data supported lower values around 0.1.

The total likelihood component from the CV_{Amin} growth parameter indicates that the global solution for this parameter is approximately 0.44 (**Figure 89**), with the SEDAR 100 AP Model estimate of 0.437 (**Table 17**). Other values which remained within 2 negative log-likelihood units included 0.42-0.43 and 0.45-0.46. The indices, mean weight of recreational landings, length data and recruitment supported lower values around 0.25.

The total likelihood component from the CV_{Amax} growth parameter indicates that the global solution for this parameter is approximately 0.12 (**Figure 90**), with the SEDAR 100 AP Model estimate of 0.124 (**Table 17**). Other values which remained within 2 negative log-likelihood units included 0.1-0.11 and 0.13-0.15. The indices and recruitment supported lower values around 0.05 whereas the catch and discard data favored higher values around 0.2.

4.8.3. Jitter Analysis

No jitter runs demonstrated a lower negative log-likelihood solution than the SEDAR 100 AP Model, and 42% and 90% of runs converged to the same likelihood solution or within 25 negative log-likelihood units, respectively (**Figure 91**). For the remaining runs for the SEDAR 100 AP Model, given that the total negative log-likelihood values were much higher than that of the SEDAR 100 AP Model, it is probable that non-optimal solutions were found (i.e., the model search was stuck in local minima). However, the recruitment parameter estimates (**Figure 92**) and the estimates of SSB, recruitment, and *F* were fairly consistent across runs (**Figure 93**). Given these results, the jitter analysis indicates that the SEDAR 100 AP Model is relatively stable and reached the global solution.

4.8.4. Retrospective Analysis

Mohn's Rho, which measures the severity of retrospective patterns, was equal to -0.07 and -0.005 for the SSB and *F* time series (**Table 31**), respectively, which are within the acceptable range (-0.15 to +0.20; see Hurtado-Ferro et al. (2015)). For comparison, the SEDAR 43 Standard Model revealed retrospective patterns with Mohn's Rho for SSB of 0.383 (forecast bias = 0.437) but not for *F* of -0.112 (forecast bias = 3.005). As the last few years of data are peeled off, the model estimates of SSB and *F* in each successive terminal year do not change by a large margin and generally remain within the confidence intervals (**Figure 94**). Differences were noted for SSB and *F* where Mohn's Rho fell outside the acceptable range for a terminal year of 2020 and 2019, respectively (**Table 31**). While recent trends remained relatively similar, it is important to highlight that the early trajectories for SSB and *F* did differ (i.e., fell outside the confidence intervals) for terminal years of 2022, 2020, and 2019. These models estimated considerably lower ln(R_0) values (**Figure 95**) and more closely tracked recent trends in relative abundance for the SEAMAP Trawl Late Survey.

Annual recruitment estimates varied considerably as more years of data are peeled off, and estimates were extremely high and very uncertain for a terminal year of 2022, 2020, and 2019, leading to an unacceptable Mohn's Rho of 6.5. This uncertainty in recruitment is expected because the model is missing key composition data inputs that capture those cohorts (**Figure 96**). A retrospective pattern for age-0 recruits was also noted in SEDAR 43 (Mohn's Rho = 1.16). This volatile behavior in estimated recruitment likely led to the poor forecast bias in *F* (**Table 31**; **Figure 94**). These issues with recruitment appear to be exacerbated by the Shrimp Bycatch fleet, as the sensitivity run with shrimp bycatch excluded (**Section 4.8.7**) led to much lower but still undesirable Mohn's Rho for recruitment (0.59) and forecast bias in *F* (0.27).

4.8.5. Additional Diagnostics

The SEDAR 100 AP Model displayed acceptable RMSE (<30%) for the joint residuals for mean length data sources, conditional age-at-length, but not for the indices (**Table 32**). Residuals revealed some conflict for each data source (evident by colored vertical lines in opposite directions) and trends in the residuals (evident by Loess smoothed line; **Figure 97**). The SEDAR 43 Standard Model revealed similarly poor diagnostics for the indices, where seven of the eight indices of relative abundance exhibited a RMSE above 30%.

Runs test results revealed evidence of non-randomly distributed residuals for the Recreational (SRHS) CPUE, SEAMAP Trawl Early Survey, and Combined Video Survey indices of abundance, Commercial Vertical Line conditional age-at-length, and Recreational, Commercial Vertical Line, and SEAMAP Trawl Early Survey length compositions (**Table 33**; **Figure 98**). Outliers (evident by red points) were identified in the residuals for the Recreational (SRHS) CPUE and Combined Video Survey indices of abundance, conditional age-at-length for the commercial fleets, and residuals for length compositions for all fleets and surveys except the SEAMAP Trawl Late Survey (**Figure 98**). The SEDAR 43 Standard Model revealed similarly poor diagnostics for the indices, where five of the eight indices of relative abundance failed the runs test.

Superior prediction skill (<1) was not evident in any of the indices of relative abundance (**Figure 99**), but was observed for mean length for the commercial fleets and SEAMAP Trawl Late Survey (**Figure 100**; **Table 34**). Of the eight indices of relative abundance included in the SEDAR 43 Standard Model, only two (commercial East CPUE and commercial West CPUE) revealed good prediction skill.

4.8.6. Bridging Analysis

The general flow of model building runs that led to the SEDAR 100 AP Model is shown in **Tables 35-36**. Changes in estimated quantities starting from the SEDAR 43 Standard Model are shown in **Figures 101-104**.

Model building occurred in phases, starting with converting the original SEDAR 43 Standard Model (Step 1) from Stock Synthesis version 3.24 to 3.30 (Step 2). Model results were identical (**Tables 35-36**). Step 3 involved updating all data streams with the exception of the composition data (i.e., SEDAR 43 age compositions remained through 2013) and maintaining the model structure of the SEDAR 43 Standard Model ("Continuity" model). Additional years of data shifted SSB and recruitment estimates higher since the 1980s and SSB increased to virgin conditions by 2023 (**Figure 101**). Steepness bounded at 1 in the "Continuity" model (**Table 36**). Changes in data streams (e.g., inclusion or exclusion of indices) and the lack of composition data updates likely drove these differences.

Step 4 served as an updated "Continuity Model" which incorporated the best available age data by adding in the nominal age compositions, the ageing error matrix, Dirichlet-Multinomial parameters for the composition data, and also incorporating the SEAMAP Trawl Late Survey which was not split during SEDAR 43. Recruitment deviation estimation was also adjusted to begin in 1993 to better match the availability of the age data (which began in 2003). This model had poor convergence and bounding issues (**Table 35**), exhibited much larger estimates of *SigmaR* and ln(R_0) (**Table 36**), and showed substantially more uncertainty in SSB, SSB ratio, and recruitment (**Figure 101**), with the ending SSB ratio exceeding 1 (i.e., SSB in 2024 > SSB_0; **Table 36**).

Step 5 switched to a length-focused model which fit to all available length compositions (of discards, landings, and surveys), used length-based selectivity for fleets and the Combined Video Survey, used Dirichlet-Multinomial parameters for composition data, and added in the SEAMAP Trawl Late Survey. This intermediate model served as a "Revamped Continuity Model for SEDAR 43" given the uncertainties in the ageing data that are now known (**Section 2.2.2**), and was presented to the Gulf Council's Scientific and Statistical Committee meeting in February 2026. This model also had poor convergence and bounding issues (**Table 35**), with steepness bounding at 1 (**Table 36**). Largely due to the inclusion of length composition data, this change led to very different recruitment estimates, a lower ln(R_0) (**Table 36**), and consistently lower estimates of virgin and annual SSB (**Figure 101**). Estimates of *F* were consistently larger for this model, particularly in the 1990s, and SSB ratio increased to 73% in 2024 (**Figure 101**).

Step 6 updated natural mortality, which led to a slight reduction in NLL (**Table 35**) and an upward shift in annual SSB ratio and lower *F* estimates since 1960 (**Figure 102**). Step 7 updated the growth parameters and fixed them at the Data Workshop recommended values, which reduced the NLL by ~1,700 units and led to 10 fewer parameters with CV > 1 (**Table 35**). Steepness was estimated much lower at 0.36 (**Table 36**) and the fits to the length compositions and nominal age compositions were greatly improved. Updating the growth parameters shifted virgin and annual SSB and recruitment estimates much higher from 1945 to around 1980, which led to noticeably lower SSB ratios since the 1990s (**Figure 102**). The trend in recruitment differed considerably since 1981 and *F* was much lower throughout the time series.

Step 8 updated morphometrics, switched maturity to length-based, switched fecundity from eggs to SSB in metric tons, and implemented length-based selectivity for the SEAMAP Trawl Early Survey (mirrored by the SEAMAP Trawl Late Survey and Shrimp Bycatch fleet). The model results were identical for the life history changes, with the exception of the raw SSB which switched units during this step (**Figure 102**). Modeling length-based selectivity for the SEAMAP Trawl Early Survey/SEAMAP Trawl Late Survey/Shrimp Bycatch fleet greatly improved the fits to their length compositions, shifted SSB higher throughout the time series, and led to slightly higher historical *F* until 1980 (**Figure 102**). Recruitment estimates prior to 1980 were consistently higher, but have remained similar since 1980 (**Figure 102**). Step 9 updated the discard mortality rate to 40% for the Recreational and Commercial Vertical Line fleets, which led to similar key model parameter estimates (**Table 36**) and relatively higher SSB ratios, recruitment, and *F* estimates, which were more pronounced over the last 10 years.

Step 10 implemented a number of changes to retention parameters, such as estimating the inflection points and allowing the width parameters and asymptote parameters to also be time-varying in addition to the inflection point. These changes reduced the NLL by about 1,400 units at the expense of more parameters (**Table 35**) and reduced $\ln(R_0)$ (**Table 36**), but fits to compositions and discards were noticeably improved. Annual estimates of SSB, recruitment and *F* generally remained within the confidence limits of Step 9 (**Figure 102**). Step 11 replaced the nominal age compositions for fishing fleets with conditional age-at-length, which led to a slightly lower *SigmaR* value (**Table 36**) but did not result in large changes to time series of SSB, recruitment or *F* (**Figure 102**).

Step 12 estimated all five growth parameters, with priors for L_{Amin}, L_{Amax} [i.e., $L\infty$], and *K* based on the Data Workshop recommendations. This change led to improved fits to the length compositions for most fleets and surveys, reduced the NLL by about 900 units (**Table 35**), and resulted in higher and more variable recruitment estimates and slightly lower SSB estimates (**Figure 102**). Step 13 separated out the Commercial Longline fleet from the Commercial Vertical Line fleet, which increased the $\ln(R_0)$ and resulted in consistently larger recruitment estimates and lower *F* estimates until the mid-2000s (**Figure 102**).

Step 14 substantially modified the model structure by collapsing the commercial and recreational fleets-as-areas so each fleet operated across the entire Gulf, which greatly reduced the number of model parameters (**Table 35**). Virgin and annual SSB estimates were noticeably higher until about 1990, recruitment was higher from 1945-1980 but very similar thereafter, and *F* was slightly lower until 1980 (**Figure 103**). Step 15 input the discard data as numbers of fish (with uncertainty as provided) instead of fractions, and the model fit well to the inter-annual estimates of discards. This change led to higher *F* in the 1990s and lower estimates around 2010, and also noticeable shifts towards larger recruitment estimates and SSB ratios in the more recent years.

Step 16 allowed time-varying selectivity for the Recreational fleet, which led to better fits to the composition data. Virgin and annual estimates of SSB and recruitment were considerably higher until 1980, which reduced SSB ratio in recent years, and estimates of *F* were slightly lower until about 2000 (**Figure 103**). Enabling time-varying selectivity for the Commercial Vertical Line and Commercial Longline fleets in Steps 17 and 18 also led to improved fits to their respective compositions. Within Step 17, selectivity for the Commercial Vertical Line fleet was switched to logistic which did not affect model results. Considerably larger recruitment estimates were evident for Step 18, but time series of SSB and *F* remained very similar (**Figure 103**). Overall these steps reduced the NLL by about 200 units (**Table 35**) and did not lead to large deviations in key model parameter estimates (**Table 36**).

Step 19 fit to the mean weight of landings for the Recreational fleet, lowered the SD on the L_{Amin} parameter from 0.8 to 0.3 (to prevent it from bounding out at 5 cm FL), and estimated extra SD parameters for each index of relative abundance. Fitting to the mean weight of Recreational landings had very little difference on model results, whereas reducing the SD on the L_{Amin} parameter led to consistently lower recruitment estimates throughout the time series (**Figure 103**). Estimating extra SD parameters had a relatively large effect on the SSB ratio in the most recent years, which declined to the lowest estimate of 0.29 of any model building runs (**Figure 103**).

Steps 20 and 21 fixed steepness at 0.99 and *SigmaR* at 0.6, respectively, which reduced the number of parameters with CVs > 1 (**Table 35**). Fixing steepness at 0.99 substantially shifted estimated SSB lower in the first half of the time series, which led to a higher SSB ratio in recent years (**Figure 104**). The $\ln(R_0)$ estimate decreased with each step (**Table 36**), and annual SSB ratios shifted slightly larger when *SigmaR* was fixed at 0.6. No large differences in F or recruitment (since 1981) were evident (**Figure 104**). During model building Step 19, we implemented the recruitment deviations option which does not constrain the sum of recruitment deviations to be zero after the model results did not differ greatly with this modification. However, after Steps 20 and 21, this recruitment setting had a large impact on model results. Therefore, in Step 22 we constrained the sum of the recruitment deviations to equal zero because their sum was very negative (-14) and not close to zero as is expected (within Step 19 they had summed to -2). This change substantially shifted estimated recruitment and SSB lower in the first half of the time series, which led to a higher SSB ratio in recent years up to 82% in 2024 (**Figure 104**).

Step 23 eliminated annual F parameters for the commercial fleets (**Table 35**) and implemented time-varying selectivity for the Combined Video Survey. Switching to the hybrid F method for the commercial fleets did not alter model results, whereas allowing time-varying selectivity for the Combined Video Survey did have a noticeable impact on model results. This selectivity change greatly improved the fit to the index of abundance, particularly in the last few years where the model now captured the decline in relative abundance. This reduced SSB and recruitment estimates in recent years (**Figure 104**). Step 24 re-evaluated retention parameters and estimated base values for the Recreational fleet to improve fits to compositions and discards, but overall this change had very little impact on key model results (**Table 36**) and time series of SSB, recruitment, or F (**Figure 104**).

Step 25 capped any years where the log-scale SE of recreational landings exceeded 0.25 at 0.25, which had no appreciable impact on key model parameter estimates (**Table 36**). This change led to slightly higher F in the late 1970s and lower F in 2018, which also led to small reductions in SSB in those years (**Figure 104**). Steps 26 and 27 allowed other selectivity parameters to be time-varying for the Recreational fleet and commercial fleets to improve fits to compositions, but no noticeable differences were evident in key model parameter estimates (**Table 36**) or time series of SSB, recruitment, or F (**Figure 104**). Collectively, these changes reduced the NLL by about 130 units (**Table 35**).

In the last step, Step 28, all five growth parameters were estimated without using priors, separate length-based selectivities were estimated for the SEAMAP Trawl Early Survey/Shrimp Bycatch fleet and SEAMAP Trawl Early Survey, and a few parameters were fixed at their model estimates including the CV_{Amin}, CV_{Amax}, the base peak and top-logit parameters for the Combined Video Survey, and the base retention inflection and width parameters for the Recreational and Commercial Vertical Line fleets. Estimating the growth parameters without priors led to considerably better fits to the composition data and fixing a few parameters at their estimates helped reduce the number of moderately correlated parameters but had no effect on model results. Estimating separate selectivity patterns for the SEAMAP Trawl Early Survey/Shrimp Bycatch fleet and SEAMAP Trawl Late Survey improved the fits to their respective length compositions. Collectively, these changes in Step 28 shifted SSB estimates lower and recruitment and *F* estimates higher throughout the time series (**Figure 104**).

4.8.7. SEDAR 100 AP Model Sensitivity Runs

Results for the sensitivity runs summarized in **Section 3.4.7** for the SEDAR 100 AP Model are presented in **Tables 37-38** and discussed below.

Recreational Data and Uncertainty

Replacing the highly uncertain 2017 recreational landings estimate and excluding the 1981-1987 recreational discard estimates did not appreciably alter model results for key model parameters (**Tables 37-38**) or trajectories of SSB, SSB ratio, recruitment, or *F* (**Figure 105**). Using the recreational landings uncertainty estimates as provided (i.e., not capping at 0.25) also did not change model results substantially. Reducing recreational removals by 40% led to much lower virgin and annual estimates of SSB and recruitment (**Table 38**; **Figure 105**). However, the SSB ratio and *F* time series showed less divergence and remained within the confidence intervals of the SEDAR 100 AP Model results. Treating recreational landings as known, as done in SEDAR 43, led to noticeable differences in *F* in many years, but the time series of SSB, SSB ratio, and recruitment generally remained within the confidence intervals of the SEDAR 100 AP Model results (**Figure 105**). The 2024 estimates of SSB ratio at 55% and *F* at 0.21 from the SEDAR 100 AP Model fell within the range of values from these sensitivity runs (SSB ratio: 53-56%; *F*: 0.19-0.21).

Discard Mortality Rate

Alternative values of discard mortality rates had little effect on model fits (**Table 37**) but shifted the virgin and annual estimates of SSB and recruitment, particularly from the start to the early 1980s and from the mid-2000s to the most recent years (**Table 38**; **Figure 106**). A higher discard mortality rate of 60% scaled SSB and recruitment estimates upwards, whereas a lower discard mortality rate shifted SSB and recruitment downwards. However, the SSB ratio and *F* time series generally remained within the confidence interval of the SEDAR 100 AP Model results. The 2024 estimates of SSB ratio at 55% and *F* at 0.21 from the SEDAR 100 AP Model fell within the range of values from the sensitivity runs (SSB ratio: 53-57%; *F*: 0.18-0.24).

Shrimp Bycatch

Reducing shrimp bycatch by 50% and fitting only to the 1984-2023 median value using the super-period approach did not appreciably alter model results for key model parameters (**Tables 37-38**) or for time series of SSB, SSB ratio, recruitment, or *F* (**Figure 107**). The exclusion of shrimp bycatch led to lower virgin and annual estimates of SSB and recruitment, with differences most pronounced in the first half of the time series and more recently. In general, estimates of *F* fell within the confidence intervals of the SEDAR 100 AP Model results, whereas the SSB ratio showed more divergence (**Figure 107**). The 2024 estimates of SSB ratio at 55% and *F* at 0.21 from the SEDAR 100 AP Model fell just outside and within the range of values for SSB ratio (56-61%) and *F* (0.2-0.25), respectively.

Platoons

Enabling size-dependent survivorship led to similar virgin SSB and recruitment estimates (**Tables 37-38**) but very different trajectories, particularly in the last few years, of SSB, SSB ratio, recruitment, and *F* (**Figure 108**). In the recent years, the sensitivity runs estimated much lower recruitment, particularly in 2022. When 3 platoons were enabled, the model estimated a very large $L\infty$ at 68.327 cm FL (CV = 0.022; **Figure 109**). When 5 platoons were enabled, the model estimated an $L\infty$ at 59.73 cm FL (CV = 0.016; **Figure 110**). These estimates seem implausible given the range of age-length data submitted for the assessment (**Figure 3**), as only 0.17% of lengths exceeded 59 cm FL. Both sensitivity runs showed greater expected declines in the recent years for the Combined Video Survey compared to the SEDAR 100 AP Model, which was more pronounced for 5 platoons (**Figures 109-110**). Overall, estimates of SSB ratio in 2024 were substantially lower at 25-32% than the SEDAR 100 AP Model estimate of 55%, and estimates of *F* in 2024 were considerably larger (0.32-0.39) than the SEDAR 100 AP Model estimate of 0.21.

Steepness

Allowing the model to estimate steepness, as done in SEDAR 43, had a very significant impact on the results and led to a slightly better model fit (**Table 37**). Steepness was estimated at 0.422 (CV = 0.049) without a prior, which is close to the SEDAR 43 Standard Model estimate of 0.459 (**Table 38**). This lower steepness value led to much larger estimates of SSB and recruitment at virgin conditions and in the first half of the time series, and consequently much lower SSB ratios starting in the early 1980s, falling well below the confidence interval of the SEDAR 100 AP Model. The SSB ratio was substantially lower in 2024 at 0.18 (**Table 38**), whereas *F* was higher at 0.27 (**Figure 111**). The corresponding Beverton-Holt stock recruit relationship is shown in **Figure 112**.

Estimation of *F* and uncertainty estimates

Estimating annual *F* parameters for the commercial fleets and using the uncertainty estimates for commercial landings resulted in nearly identical key model parameters (**Tables 37-38**) and derived quantities (**Figure 113**).

Age-structured Production Model

Simpler models fitting only to the indices of abundance resulted in similar estimates of $\ln(R_0)$ and virgin SSB (**Tables 37-38**) and trends which generally followed the time series of SSB, SSB ratio, recruitment, and *F* estimates from the SEDAR 100 AP Model (**Figure 114**). As expected, time series of SSB and recruitment were more similar when recruitment deviations were estimated, although there were noticeable differences, suggesting that the composition data provided additional information to support these estimates. In the absence of recruitment deviations, the fits to indices of abundance were worse for all indices except the Combined Video Survey (**Figure 115**). The inclusion of recruitment deviations resulted in similar fits to most indices compared to the SEDAR 100 AP Model, and slightly better fits to the indices for the SEAMAP Trawl Early Survey and SEAMAP Trawl Late Survey. Estimates of SSB ratio in 2024 ranged between 51% and 59%, with the SEDAR 100 AP Model estimate of 55% falling within that range, while estimates of *F* in 2024 were identical to the SEDAR 100 AP Model estimate of 0.21.

Combining Dead Discards and Landings

Lumping dead discards into landings estimates for the Recreational and Commercial Vertical Line fleets led to fewer parameters estimated but more uncertain selectivity parameters (CV > 1; **Table 37**). Estimates of virgin SSB and recruitment were larger, with annual SSB estimates consistently larger and annual recruitment estimates generally larger with the exception of a few years (**Figure 116**). The biggest difference occurred in the 2010s where a much smaller *F* in 2013 led to much larger subsequent estimates of SSB, which were also affected by substantially larger recruitment estimates from 2011 through 2019. SSB and the SSB ratio dropped considerably in the last few years, with the SSB ratio in 2024 identical to the SEDAR 100 AP Model estimate of 55% whereas the *F* estimate in 2024 was slightly higher at 0.25 than the SEDAR 100 AP Model estimate of 0.21.

Start Year

Alternative start years, which started in a fished condition, generally led to similar key model parameters (**Tables 37-38**) and trajectories of SSB ratio, recruitment, and *F* for the more recent years (**Figure 117**). Estimates of SSB ratio in 2024 were similar to the SEDAR 100 AP Model estimate of 55% and ranged between 52% and 55%, whereas *F* estimates in 2024 ranged from 0.21 to 0.23. Large differences were identified towards the beginning of each time series due to the initial conditions. More uncertainty in the first few years was evident when the model started in 1963, as the likelihood profiling of the scalar value on initial equilibrium catches for fleets and Shrimp Bycatch initial *F* revealed indistinguishable results as almost all runs fell within 2 NLL units (**Figure 118**). This range of scalar values resulted in a large swath of SSB ratios in the earliest years, however they all converged to a similar SSB ratio by the end of the time series (**Figure 119**). The 1963 model estimated a very large and highly uncertain Shrimp Bycatch initial *F* of 0.397 (CV 0.915), which reduced the starting SSB ratio to 28% (**Figure 117**). The results were less uncertain when starting the model in 1981, as the likelihood profile analysis identified the lowest scalar value of 0.1 as the best fitting run (**Figure 120**). The 1981 model estimated a highly uncertain Shrimp Bycatch initial *F* of 0.011 (CV = 1.003), and started at an SSB ratio of 79%. The range of scalar values led to considerable variability in SSB ratios in the earliest years, but SSB ratios in more recent years did not vary greatly (**Figure 121**).

Jackknife Indices

The removal of the Recreational (SRHS) CPUE and SEAMAP Trawl Early Survey did not result in noticeable differences in key model parameters (**Tables 37-38**) nor annual estimates of SSB, SSB ratio, recruitment, or *F* (**Figure 122**). The removal of the SEAMAP Trawl Late Survey led to lower SSB, SSB ratio and higher *F* in the most recent years. In contrast, the removal of the Combined Video Survey led to much higher SSB, SSB ratio, and recruitment estimates, as this model better fit to the SEAMAP Trawl Late Survey which increased in recent years (**Figure 123**). Overall, estimates of SSB ratio in 2024 ranged between 47% and 85%, with the SEDAR 100 AP Model estimate of 55% falling within that range, whereas estimates of *F* in 2024 ranged from 0.13 to 0.25, which included the SEDAR 100 AP Model estimate of 0.21.

5. Discussion

The Gulf Gray Triggerfish Assessment implemented a number of new or improved procedures and methodologies including: revised age data using new ageing protocols and updated growth, natural mortality, and ageing error estimates; modeled maturity as a function of length; revised estimates of commercial landings and discards; revised estimates of recreational landings and discards based on MRIP-FES and fully-calibrated estimates for Texas Parks and Wildlife Department and Louisiana Creel Survey; incorporated more error in landings and discard estimates to better reflect uncertainties in removals; updated discard mortality estimates based on recent research; updated time series of shrimp effort and shrimp bycatch estimates; re-evaluated indices of relative abundance for inclusion in the assessment; separated the SEAMAP Trawl Survey into two time periods based on differing survey designs and included length compositions; standardized the relative abundance and length compositions of the Combined Video Survey to account for differences in habitat and survey footprints of the three surveys; fitted to all available length composition data (discards, landings, and surveys) and used weighted length compositions where possible; inputted conditional age-at-length compositions for fishing fleets to enable the internal estimation of growth within the assessment model; re-evaluated recruitment parameters including steepness and *SigmaR*; and utilized the Dirichlet-multinomial internal re-weighting approach for composition data. Further, switching to a newer Stock Synthesis version allowed more flexibility in handling a number of processes including data weighting and projections, which were not available during SEDAR 43 when Stock Synthesis (version 3.24P) was first applied to this stock. Collectively, these changes to data inputs and model parameterization greatly affected the assessment results and improved many aspects of model performance.

Overall, the SEDAR 100 AP Model appears to perform well and exhibited some noticeable improvements in performance over the SEDAR 43 Standard Model, including fewer correlated and uncertain parameters and better diagnostics such as less retrospective bias in SSB and *F*. Likelihood profiles provided support for the SEDAR 100 AP Model estimates of $\ln(R_0)$ and the growth parameters. The SEDAR 100 AP Model fit most of the data sources well although some did exhibit residual patterns. The dominant data inputs were the length and conditional age-at-length compositions, as these produced the greatest impact on the model fit (as measured in the total likelihood). Time-varying selectivity and retention were implemented for fishing fleets to help improve model fits to discards and compositions, however residual patterns remained evident in some data streams, with the worst pattern observed for the length compositions of landings for the Recreational fleet. Patterns in residuals for fisheries data could be related to regulations for species other than Gray Triggerfish, especially since they are not generally a targeted species. This assessment, as well as other Gulf assessments, would greatly benefit from a better understanding of changes in management regulations for other species (e.g., Red Snapper) that fall within the multi-species fisheries in the Gulf, and how these regulations may affect the species under assessment (e.g., selectivity, catchability, etc.).

In addition to the vast number of data changes discussed above, this assessment also re-evaluated foundational model configuration decisions including: which composition data to include (length and/or age) and how to model selectivity (i.e., length- or age-based); whether a true two-area model was justified based on differences in biology; whether to maintain the fishing fleets-as-areas approach or collapse the recreational and commercial fleets into Gulf-wide fleets based on gears; and the start year of the model and specification of initial conditions if starting in a fished condition. Although not reflected in this report, which summarizes the SEDAR 100 AP Model and its Gulf-wide data inputs, all data products were provided for West, East, and Gulf-wide (detailed in their respective working papers) to enable reconsideration of the spatial structure of the assessment. Model building began from the SEDAR 43 Standard Model which implemented fleets-as-areas, but after reviewing all of the information collectively and comparing model runs (**Section 4.8.6**), we chose to simplify the model structure by collapsing fleets-as-areas and modeling fishing fleets Gulf-wide by gear. As a result of these major changes in model configuration, combined with the various changes to data streams, traditional comparisons of data inputs and model fits with the SEDAR 43 Standard Model were not possible. Further, the revised age estimates for SEDAR 100 based on updated protocols for reading spines to reduce bias also complicates comparisons of the results to past Gray Triggerfish assessment outcomes. All previous age estimates submitted to past assessments (and used in age-growth studies based on spines) were biased low for ages 5+ (SEDAR100-DW14).

While the SEDAR 100 Assessment used the best available age data and alleviated some of the past concerns over the age data, ageing remains a key challenge for assessing Gray Triggerfish (**Section 2.2.2**). Huge variability remains in the length-at-age distribution (**Figure 3**), and this uncertainty degrades the ability of the assessment model to track cohorts through time because the age data lack any cohort signals (SEDAR100-DW04, SEDAR100-DW07). In addition to this variability, inconsistencies in how Gray Triggerfish are aged across laboratories may also contribute to the uncertainty within age estimates, as uncovered during the Data Workshop. Calendar ages were reviewed and adjusted for age-0 and age-1 fish, but similar adjustments were not feasible for older Gray Triggerfish (2+ years). While including an ageing error matrix can help account for some uncertainty in age estimates, it will not counter the underlying issues with potentially biased age estimates due to differences in age advancements or readings. Hopefully, ongoing research looking at obtaining age estimates from epigenetic clocks will help improve the age data provided for future assessments of Gray Triggerfish.

Recent research by Chamberlain et al. (2025) re-iterated the importance of including sexually dimorphic growth within the assessment model to more realistically capture the larger sizes of males compared to females (also supported by multiple studies reviewed in Jefferson et al. 2019 [SEDAR62-RD01]). Surprisingly, no difference in growth between sexes was evident based on the age data submitted for SEDAR 100, therefore a single growth curve was used in the SEDAR 100 AP Model. Additionally, the lack of sex-specific data (e.g., landings, compositions) complicates development of a two-sex model to model growth separately. The von Bertalanffy growth estimates recommended for each assessment have diverged greatly, particularly for the asymptotic length parameter $L\infty$. Recommendations have dropped from 87 cm FL for the SEDAR 9 Update (SEDAR 2011), to 59 cm FL for SEDAR 43 (SEDAR 2015), and now to 46 cm FL for SEDAR 100 (also noting that 46 cm FL was recommended for SEDAR 62 using otoliths rather than spines by Patterson et al. 2019 [SEDAR62-WP17]). Using the length data and age data conditional on length, the SEDAR 100 AP Model estimated $L\infty$ around 54 cm FL, but much larger estimates (60-68 cm FL) were estimated when implementing platoons to account for size-dependent survivorship. Additional investigation is needed to determine whether poor data quality (e.g., the highly variable age-length relationship) may be causing these seemingly unrealistic results.

Historical estimates of removals (i.e., pre-1963 for commercial and pre-1981 for recreational) remain very uncertain due to the assumptions and limited data used in their development. Although we increased the error surrounding historical landings estimates, the model essentially fits those historical landings estimates regardless of error estimates since no other data are informing those earlier years. For shrimp bycatch, we fit to the median of all available data using the super-period approach to remove the influence of interannual variability within bycatch estimates. As requested in the SEDAR 100 AP Terms of Reference (**Section 1.2**), we re-evaluated the start year for the model and considered two alternative years: 1963 (start of commercial data) and 1981 (start of recreational data). The challenge of starting the model in a fished state is this requires the specification of initial conditions for the fishing fleets and shrimp bycatch, which we explored by profiling across different scalars on initial equilibrium catches for fishing fleets and Shrimp Bycatch initial *F* (as done in SEDAR 81; SEDAR 2023). Sensitivity runs highlighted high uncertainty specifying initial conditions for the Shrimp Bycatch fleet when starting in 1963 and to a lesser extent when starting in 1981. The model results in the more recent years were generally very similar and remained within the confidence intervals of the results from the SEDAR 100 AP Model, suggesting that stock status would be similar among runs. Given the concerns with initial conditions and similarity in model results, we retained the start year of 1945 in the SEDAR 100 AP Model and used the best available historical reconstruction of removals.

Shrimp bycatch of Gray Triggerfish has remained a controversial topic, particularly whether bycatch is substantial enough to warrant consideration in the assessment (it has been incorporated since SEDAR 9 in 2006). The absence of Gray Triggerfish on Shrimp Observer Program data forms prior to 2025 prevented the application of the recently CIE-approved approach for estimating shrimp bycatch that was implemented for Red Snapper in SEDAR 98 (Smith et al. 2025). In 2025, Gray Triggerfish were explicitly included on the Shrimp Observer Program data form and comprised 7% of positive tows and 30% of positive trips, further supporting that bycatch is an important source of removals. Sensitivity runs explored the influence of the shrimp bycatch estimates on the SEDAR 100 AP Model. In the most extreme case, excluding shrimp bycatch generally showed similar trends in SSB ratio and *F*, but much lower projected short-term and equilibrium yields (**Section 6.3.1**). During SEDAR 100, the availability of length composition and age composition of Gray Triggerfish from the SEAMAP Trawl Survey enabled a thorough investigation of the sizes and ages potentially impacted by the shrimp trawl. Previously, the SEDAR 43 Standard Model restricted data to fall only and assumed the survey only captured age-0s, but review of data at the SEDAR 100 Data Workshop showed similar length compositions between the summer and fall surveys and that ages 1+ were encountered in the Trawl survey, particularly in the East which has more natural reefs. Based on these insights unique to SEDAR 100, we fit to the length compositions and used length-based selectivity for the SEAMAP Trawl Surveys.

The G-FISHER video survey has become one of the most widely used fishery-independent indices in the Gulf for both stock assessments and interim analyses. However, concerns remain over its development given how the different surveys have been combined over time, the challenges of sampling in the West due to turbidity and limited coverage (**Table 11 in SEDAR100-DW18**), and poor habitat scores dominating the West. This index is especially important for the Gray Triggerfish assessment because it is tracking the adult population and its removal had a large effect on model results. The index shows a recent decline, which conflicts with the increased abundance observed in the SEAMAP Trawl Late Survey primarily tracking juveniles. Although considerable efforts have gone into developing a continuous standardized index of relative abundance (and weighted length compositions) from these surveys using a habitat-based approach (Thompson et al. 2022), the SEDAR 100 AP Model needed time-varying selectivity for this survey to better capture the trends in abundance and identified differences in the selectivity curves across time periods. A similar approach was explored as a sensitivity during the SEDAR 88 Gulf Red Grouper (*Epinephelus morio*) assessment and demonstrated a similar outcome where time-varying selectivity altered the recent model trend, but ultimately was not incorporated into the SEDAR 88 Base Model (SEDAR 2025). Collectively, these results suggest that additional steps may be needed in the standardization process to ensure a continuous index of abundance and composition from this survey.

A key modeling uncertainty for the Gulf Gray Triggerfish stock assessment and most assessment models in general, is the stock-recruit relationship. Initial model building runs for SEDAR 100 estimated steepness and *SigmaR* as in the SEDAR 43 Standard Model, but ultimately steepness was fixed at 0.99 and *SigmaR* was fixed at 0.6 in the SEDAR 100 AP Model. The likelihood profile for steepness provided support for values between 0.38 and 0.47, which is similar to the value of 0.435 estimated by the SEDAR 43 Standard Model. However, given the uncertainty and concerns over the estimated steepness, we fixed steepness at the upper bound of 0.99. For this assessment report, benchmarks were determined through projections (see **Section 6**) using average recruitment (by fixing steepness at 0.99) rather than those from a stock-recruit curve. Since MSY-based reference points are not supported by the results, it may be more appropriate to use proxy reference points using spawning potential ratio (SPR) such as 30% as specified in the SEDAR 100 AP Terms of Reference (**Section 1.2**).

From an ecosystem perspective, additional research is needed to determine how Sargassum affects Gray Triggerfish recruitment, which could help reduce some of the uncertainty in recruitment estimates currently based solely on SEAMAP trawl data. For incorporating Sargassum as an environmental linkage into the stock assessment, it will be critical to identify the exact mechanism and life stage (larvae? age-0? juveniles?) that is affected. Further, a better understanding of interspecies interactions could help elucidate how other species affect Gray Triggerfish population dynamics and vice versa. For example, Gray Triggerfish abundance has been hypothesized to affect the catchability of Red Snapper, with more Gray Triggerfish preventing hooks from getting to target species such as Red Snapper (Gervasi et al. 2025; SEDAR100-DW21). Negative impacts were noted by lower growth rates of Red Snapper when held with Gray Triggerfish during laboratory experiments (Simmons and Szedlmayer 2018 [SEDAR62-RD07]) and aggressive behavior during the spawning season (Simmons and Szedlmayer 2012 [SEDAR62-RD11]). Red Snapper have been hypothesized to be important predators of Gray Triggerfish juveniles and eggs (SEDAR100-DW21), with increased Red Snapper abundance in the West suggested to correlate to the lack of Gray Triggerfish (SEDAR100-DW20).

Overall, the SEDAR 100 AP Model is improved since the SEDAR 43 Standard Model, and it incorporates the best available data and addressed many of the issues evident in the SEDAR 43 Standard Assessment. According to the SEDAR 100 AP Model, the Gulf Gray Triggerfish resource is not overfished nor undergoing overfishing in 2024, a result which differs from previous Gray Triggerfish assessments, all of which concluded poor stock status at different points in time (Valle et al. 2001, Porch 2001, SEDAR 9 [SEDAR 2006], SEDAR 9 Update [SEDAR 2011], SEDAR 43 [SEDAR 2015]). However, the biased age data used in previous age-structured assessments (since SEDAR 9) likely affected previous model outcomes. For the SEDAR 100 AP Model, the recent average recruitment warrants careful consideration for management implementation, as recruitment estimates in the late years of the assessment are higher than the time series average (**Figure 39**). The assumed recruitment values in the future will have important implications for determination of short-term catch advice. Additional projection scenarios exploring recent mean recruitment estimates will be prepared and presented at the upcoming Gulf Council's Scientific and Statistical Committee meeting to demonstrate the effects of these projection specifications on forecasted yields and stock status. A number of research questions were raised during the SEDAR 100 AP, and the SEFSC strongly recommends that these topics (listed in **Section 8**) continue to be examined during future assessments.

6. Projections

6.1. Introduction

The SEDAR 100 projections were run for two key fishing mortality scenarios: $F_{MSYproxy}$ (for the Overfishing Limit; OFL) and 0.75 * Directed *F* at $F_{MSYproxy}$ (for the Acceptable Biological Catch; ABC). Both an MSY proxy of 30% SPR ($SPR_{30\%}$) and the Optimum Yield (OY; 0.9 * MSY proxy) were specified in Amendment 48 (GMFMC 2021) and were provided in the SEDAR 100 AP Terms of Reference (**Section 1.2**).

6.2. Projection Methods

The simulated dynamics used for projections assumed nearly identical parameter values and population dynamics as the SEDAR 100 AP Model. **Table 39** provides a summary of projection settings. Projections were run assuming that selectivity, retention, and discard mortality associated with the last three years (2022-2024) would remain the same into the future. Forecast recruitment values were derived from the Beverton-Holt stock-recruit relationship with steepness fixed at 0.99, essentially assuming mean recruitment.

The terminal year of SEDAR 100 was 2024 and the first year of management advice is anticipated to be 2028. Landings for the interim years (2025-2027) used the average of the last three years (2022-2024; **Table 39**). For the Shrimp Bycatch fleet, a fixed value of *F* (average over 2022-2024) was input for each year in the projection (0.034; **Figure 124**).

$F_{30\%SPR}$ was determined using a long-term 100-year projection assuming that equilibrium was obtained over the last 10 years (2115-2124). For the OFL projection, the $F_{30\%SPR}$ was applied to the stock starting in 2028. The fleet allocations for Gray Triggerfish are 21% commercial and 79% recreational per Amendment 30A (GMFMC 2008), and the projections assumed that those allocations would be achieved in every year of the projection.

The status determination criteria were updated in Amendment 48 (GMFMC 2021). The minimum stock size threshold (MSST) was determined by multiplying the reference spawning stock biomass, $SSB_{30\%SPR}$, by 0.5 (per Amendment 48 and the SEDAR 100 AP Terms of Reference) and was used to determine stock status (**Table 40**). The maximum fishing mortality threshold (MFMT) was equivalent to the harvest rate ($F_{30\%SPR}$; total biomass killed all ages / total biomass age 1+) that achieved $SSB_{30\%SPR}$, and was used to assess whether overfishing was occurring in a given year (**Table 40**). A stock is considered overfished when $SSB_{Current}$ < MSST and undergoing overfishing if $F_{Current}$ > MFMT, where $F_{Current}$ is defined as the geometric mean *F* over the most recent three years (2022-2024).

Once the proxy values were calculated, 2024 stock status was used to determine whether a rebuilding plan was required (i.e., if SSB < MSST then Gulf Gray Triggerfish would be considered overfished and a rebuilding plan would be required).

6.3. Projection Results

Benchmarks and reference points were calculated using SSB in metric tons.

6.3.1. Biological Reference Points

The status determination criteria based on an MSY proxy of 30% SPR were (**Table 40**; **Figure 125**):

- MSY proxy = yield at $F_{30\%SPR}$ = 1,014,183 pounds wwt
- MSST = 0.5*$SSB_{30\%SPR}$ = 1,315 metric tons
- MFMT = $F_{MSYproxy}$ ($F_{30\%SPR}$) = 0.567
- OY = 0.9*MSY proxy = 912,764 pounds wwt

A comparison of equilibrium yield estimates from this assessment to previous assessments is provided in **Table 41**. Estimates are also shown for projections for two sensitivity runs addressing critical data uncertainties: (1) reduced recreational removals based on the MRIP-FES pilot study results (Andrews 2022) and (2) excluding shrimp bycatch. Both of these data changes result in substantially lower equilibrium yield estimates.

6.3.2. Stock Status

Benchmarks and reference points are shown in **Table 40**. Detailed time series of derived quantities and benchmarks with SSB in metric tons are presented in **Table 42**. As of 2024, the Gulf Gray Triggerfish stock is not undergoing overfishing ($F_{Current}$ < MFMT) and is not overfished (SSB_{2024} > MSST) according to the SEDAR 100 AP Model (**Table 40**). The terminal year SSB (2024) is above $SSB_{30\%SPR}$ (**Figure 125**) at 184% of the biomass level needed to support MSY (**Table 42**). $F_{Current}$ was 0.214, which was equivalent to 38% of $F_{30\%SPR}$ (**Table 40**).

The Kobe plot (**Figure 126**) indicates that over the time horizon of the assessment (i.e., 1945-2024), the stock has not been overfished nor experienced overfishing in any year since 1945 (**Table 42**).

6.3.3. Overfishing Limit and Acceptable Biological Catch Projections

OFL and ABC projection results **assuming predicted recruitment follows the stock-recruit curve with steepness fixed at 0.99** are provided in **Tables 43-44** and **Figure 127**. Forecasts indicate that yields can increase in the near-term for both the OFL and the ABC projection scenarios (**Figure 127**). For the OFL projection, the 5-year (2028-2032) average was 1.399 million pounds wwt and the 3-year (2028-2030) average was 1.613 million pounds wwt. For the ABC projection, the 5-year (2028-2032) average was 1.232 million pounds wwt and the 3-year (2028-2030) average was 1.353 million pounds wwt.

These results are dependent upon the assumption of recruitment into the forecast period. Additional projection scenarios exploring recent mean recruitment estimates will be prepared and presented at an upcoming Gulf Council's Scientific and Statistical Committee meeting to demonstrate the effects of these projection specifications on forecasted yields and stock status. Compared to the average recruitment using a steepness of 0.99 (~95,000), the average recruitment over the last 10 years (2015-2024) and last 5 years (2020-2024) is 99,886 and 95,174, respectively.

7. Acknowledgements

The SEDAR 100 Assessment would not have been possible without the efforts of the numerous SEFSC, Southeast Regional Office (SERO), and Gulf Council staff along with the many state, academic, and research partners involved throughout the Gulf listed as data providers in **Section 2**. The following agencies contributed to the assessment and deserve notable attention and thanks for efforts extended to developing data inputs: NOAA SEFSC Fisheries Statistics Division (FSD) and Sustainable Fisheries Division (SFD), NOAA SEFSC Panama City Laboratory, NOAA SEFSC Mississippi Laboratories, NOAA SEFSC Beaufort Laboratory, FWRI, and the Gulf States Marine Fisheries Commission. We are especially grateful to the Panama City Life History team and other ageing partners for their diligent efforts improving the age data for this assessment, and to the shrimp bycatch team for their thorough analyses and assistance throughout the assessment.

8. Research Recommendations

Recommendations for considerations of future research are provided below and do not indicate any particular order of priority.

Age and Growth

- Investigate methods to better collect age structure samples randomly and systematically from all fishing sectors including surveys
- Continue collaboration with ageing facilities throughout the Gulf and South Atlantic. These efforts will include the annual reading of references sets for Gray Triggerfish and other reef fish, and annual meetings to review the interpretation of ageing structures and the timing of annual band deposition
- Explore epigenetic ageing to potentially improve age estimates

Natural Mortality

- Explore more direct approaches to estimating natural mortality (e.g., Mark-recapture approaches (conventional, telemetry, or close-kin))
- Explore ways to better reflect uncertainty around the mortality at age vector

Reproduction

- Continue data collection for maturity and fecundity
- Update maturity-at-age estimates to see whether the age data updates have changed our understanding of maturity

Discard Mortality

- Continue data collection from observer programs or electronic monitoring programs (e.g., Roberts and Neidig 2019 [SEDAR62-WP10]), particularly to get a better handle on discard mortality for the commercial fleets

Shrimp Bycatch

- Estimates of shrimp bycatch are highly uncertain and considered best available in the interim; further investigation is needed once observer data allow more advanced approaches for estimation

Selectivity and Catchability

- Further investigate and quantify changes in selectivity/catchability through time to improve fit to the length and age composition

Surveys

- Increase collection of length and age information for compositions
- Continue to improve upon standardized indices from the video survey to account for survey design changes through time and space to ensure trends are representative of relative abundance

Sargassum

- Improve our understanding of how sargassum affects Gray Triggerfish recruitment and which life stages are most affected
- Develop indices (with uncertainty estimates) to enable hypothesis testing of environmental linkages within the assessment model

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10. Tables

Table 1. Conversion factors used to convert fork length in centimeters (cm FL) to whole weight (wwt) in kilograms and total length (TL) in centimeters to fork length for sexes combined. Statistic refers to RSE for the weight-length equation or R^2 for the length-length equation.

Model	N	Statistic	Range
wwt = 1.704 E-05 x $FL^{3.070}$	11,332	175.4	FL (cm): 6.1-61.7; wwt (kg): 0.006-5.840
FL = Max_TL*0.788 + 23.541	6,322	0.96	Max_TL (cm): 1.6-75.3; FL (cm): 6.5-61.7

Table 2. Growth parameters (and associated standard deviation, SD) recommended during the SEDAR 100 Assessment.

Parameter	Value	SD
L_∞ (cm FL)	46.837	0.318
K (per year)	0.291	0.008
t_0 (year)	-0.900	
CV at age $\leq A_{min}$	0.140	0.454
CV at age $\geq A_{max}$	0.140	0.454

Table 3. Ageing error matrix (standard deviations associated with mean age) recommended for use in the SEDAR 100 Assessment to incorporate uncertainty at age.

Age	SEDAR 100
0	0.381
1	0.381
2	0.455
3	0.524
4	0.588
5	0.648
6	0.703
7	0.754
8	0.802
9	0.846
10	0.887
11	0.925
12	0.960
13	0.993
14	1.023
15	1.051

Table 4. Age-specific natural mortality (*M*, per year) estimated by Stock Synthesis. For implementing Lorenzen scaling in Stock Synthesis, the vulnerable ages were defined as ages 3-15 years and the target *M* (0.36) was obtained using Hamel and Cope (2022) and a maximum age of 15 yrs. The age-0 estimate accounts for settlement in July, corresponding to peak spawning, which leads to a reduced 6-month window of time for age-0s in the population.

Age	*M*
0	2.873
1	0.958
2	0.691
3	0.558
4	0.480
5	0.428
6	0.392
7	0.365
8	0.345
9	0.330
10	0.317
11	0.308
12	0.300
13	0.293
14	0.288
15	0.277

Table 5. Commercial vertical line (includes trap and other gears) and longline landings in pounds whole weight. In the absence of annual uncertainty estimates accompanying the submitted data, commercial landings for 1945-1985 were assigned a log-scale standard error (SE) based on expert opinion (**Table 6**). More recent estimates of uncertainty (1986-2024) are based on expert opinion values weighted by regional landings. "*" indicates confidential data.

Year	Vertical Line	Longline	Vertical Line SE	Longline SE	Methodology
1945	22		0.200		Assumed start
1946	3,592		0.200		Interpolated
1947	7,161		0.200		Interpolated
1948	10,730		0.200		Interpolated
1949	14,300		0.200		Estimated in DW05
1950	14,700		0.200		Estimated in DW05
1951	28,000		0.200		Estimated in DW05
1952	72,400		0.200		Estimated in DW05
1953	43,600		0.200		Estimated in DW05
1954	39,600		0.200		Estimated in DW05
1955	46,600		0.200		Estimated in DW05
1956	22,800		0.200		Estimated in DW05
1957	17,400		0.200		Estimated in DW05
1958	15,200		0.200		Estimated in DW05
1959	10,300		0.200		Estimated in DW05
1960	11,900		0.200		Estimated in DW05
1961	6,500		0.200		Estimated in DW05
1962	5,600		0.200		Estimated in DW05
1963	7,300		0.200		Estimated in DW05
1964	20,000		0.200		Estimated in DW05
1965	21,650		0.200		Estimated in DW05
1966	13,800		0.200		Estimated in DW05
1967	17,400		0.200		Estimated in DW05
1968	12,500		0.200		Estimated in DW05
1969	22,300		0.200		Estimated in DW05

Table 5 Continued. Commercial vertical line (includes trap and other gears) and longline landings in pounds whole weight. In the absence of annual uncertainty estimates accompanying the submitted data, commercial landings for 1945-1985 were assigned a log-scale standard error (SE) based on expert opinion (**Table 6**). More recent estimates of uncertainty (1986-2024) are based on expert opinion values weighted by regional landings. "*" indicates confidential data.

Year	Vertical Line	Longline	Vertical Line SE	Longline SE	Methodology
1970	24,051		0.200		Estimated in DW05
1971	40,400		0.200		Estimated in DW05
1972	62,600		0.200		Estimated in DW05
1973	53,200		0.200		Estimated in DW05
1974	53,552		0.200		Estimated in DW05
1975	78,000		0.200		Estimated in DW05
1976	84,500		0.200		Estimated in DW05
1977	59,386		0.100		Estimated in DW05
1978	58,823		0.100		Estimated in DW05
1979	97,484	3,919	0.100	0.100	Estimated in DW05
1980	92,776	3,700	0.100	0.100	Estimated in DW05
1981	82,101	7,759	0.100	0.100	Estimated in DW05
1982	81,633	15,040	0.100	0.100	Estimated in DW05
1983	59,836	13,583	0.100	0.100	Estimated in DW05
1984	*	11,683	0.100	0.100	Estimated in DW05
1985	75,563	17,063	0.100	0.100	Estimated in DW05
1986	88,853	8,149	0.060	0.098	Estimated in DW05
1987	124,185	642	0.062	0.100	Estimated in DW05
1988	193,745	2,589	0.063	0.098	Estimated in DW05
1989	309,534	10,543	0.061	0.097	Estimated in DW05
1990	402,653	*	0.061	0.060	Estimated in DW05
1991	423,456	20,887	0.062	0.081	Estimated in DW05
1992	447,129	23,028	0.063	0.077	Estimated in DW05
1993	*	15,293	0.067	0.052	Estimated in DW05
1994	385,853	19,424	0.071	0.051	Estimated in DW05

Table 5 Continued. Commercial vertical line (includes trap and other gears) and longline landings in pounds whole weight. In the absence of annual uncertainty estimates accompanying the submitted data, commercial landings for 1945-1985 were assigned a log-scale standard error (SE) based on expert opinion (**Table 6**). More recent estimates of uncertainty (1986-2024) are based on expert opinion values weighted by regional landings. "*" indicates confidential data.

Year	Vertical Line	Longline	Vertical Line SE	Longline SE	Methodology
1995	328,557	6,965	0.070	0.052	Estimated in DW05
1996	254,606	6,822	0.072	0.052	Estimated in DW05
1997	169,593	11,021	0.073	0.055	Estimated in DW05
1998	170,648	*	0.071	0.051	Estimated in DW05
1999	216,845	10,277	0.074	0.050	Estimated in DW05
2000	152,492	5,770	0.055	0.051	Estimated in DW05
2001	169,374	6,043	0.056	0.050	Estimated in DW05
2002	231,894	*	0.053	0.050	Estimated in DW05
2003	244,487	7,269	0.055	0.050	Estimated in DW05
2004	201,293	*	0.057	0.050	Estimated in DW05
2005	140,258	*	0.056	0.050	Estimated in DW05
2006	84,688	*	0.059	0.050	Estimated in DW05
2007	*	*	0.065	0.050	Estimated in DW05
2008	61,209	*	0.064	0.050	Estimated in DW05
2009	69,251	*	0.056	0.050	Estimated in DW05
2010	52,364	*	0.054	0.071	Estimated in DW05
2011	103,093	*	0.052	0.051	Estimated in DW05
2012	71,281	*	0.052	0.050	Estimated in DW05
2013	62,006	*	0.052	0.056	Estimated in DW05
2014	36,239	4,446	0.050	0.050	Estimated in DW05
2015	40,745	6,751	0.050	0.050	Estimated in DW05
2016	47,667	*	0.050	0.050	Estimated in DW05
2017	55,654	*	0.050	0.050	Estimated in DW05
2018	56,281	8,417	0.050	0.050	Estimated in DW05
2019	53,248	9,243	0.050	0.050	Estimated in DW05

Table 5 Continued. Commercial vertical line (includes trap and other gears) and longline landings in pounds whole weight. In the absence of annual uncertainty estimates accompanying the submitted data, commercial landings for 1945-1985 were assigned a log-scale standard error (SE) based on expert opinion (**Table 6**). More recent estimates of uncertainty (1986-2024) are based on expert opinion values weighted by regional landings. "*" indicates confidential data.

Year	Vertical Line	Longline	Vertical Line SE	Longline SE	Methodology
2020	48,923	3,857	0.050	0.050	Estimated in DW05
2021	37,384	*	0.050	0.050	Estimated in DW05
2022	37,164	8,117	0.050	0.050	Estimated in DW05
2023	47,316	7,543	0.050	0.050	Estimated in DW05
2024	43,340	8,264	0.050	0.050	Estimated in DW05

Table 6. Uncertainty estimates for commercial landings based on expert opinion derived from changes in reporting, following the approach taken in the South Atlantic and presented during the SEDAR 68 Gulf Scamp Grouper Research Track Assessment (SEDAR 2021). ALS = Accumulated Landings System.

Year Range	Texas (TX)	Louisiana (LA)	Mississippi (MS)	Alabama (AL)	Florida (FL)	Description
1962-1976	0.20	0.20	0.20	0.20	0.20	Annual state summaries
1977-1985	0.10	0.10	0.10	0.10	0.10	Monthly state summaries
1986-1999	0.10	0.10	0.10	0.10	0.05	FL starts state trip ticket in 1985; used starting in 1986
2000-2001	0.10	0.05	0.10	0.10	0.05	LA starts state trip ticket in 1997; used starting in 2000
2002-2013	0.10	0.05	0.10	0.05	0.05	AL starts state trip ticket and used starting in 2002
2014	0.05	0.05	0.10	0.05	0.05	TX starts state trip ticket in 2008; used starting in 2014
2015-Present	0.05	0.05	0.05	0.05	0.05	MS starts state trip ticket in 2012; used starting in 2015

Table 7. Percent difference (%Diff) in commercial landings between SEDAR 100 and SEDAR 43 for all commercial gears combined. Differences exceeding 10% are identified in red. “*” indicates confidential data for SEDAR 100 and hides SEDAR 43 and differences to maintain confidentiality.

Year	SEDAR 100	SEDAR 43	%Diff
1945	0.01	0.06	83.33
1946	1.63	0.19	-757.42
1947	3.25	0.37	-777.89
1948	4.87	0.55	-784.96
1949	6.49	0.73	-788.54
1950	6.67	0.92	-624.76
1951	12.70	1.11	-1044.2
1952	32.84	1.29	-2445.74
1953	19.78	1.48	-1236.26
1954	17.96	1.65	-988.62
1955	21.14	1.84	-1048.77
1956	10.34	2.02	-411.98
1957	7.89	2.21	-257.13
1958	6.89	2.40	-187.27
1959	4.67	2.57	-81.79
1960	5.40	2.76	-95.57
1961	2.95	2.94	-0.28
1962	2.54	3.13	18.85
1963	3.31	3.32	0.26
1964	9.07	9.07	-0.02
1965	9.82	9.84	0.2
1966	6.26	6.26	0
1967	7.89	7.90	0.09
1968	5.67	5.67	0
1969	10.12	10.11	-0.05
1970	10.91	10.98	0.64

Table 7 Continued. Percent difference (%Diff) in commercial landings between SEDAR 100 and SEDAR 43 for all commercial gears combined. Differences exceeding 10% are identified in red. "*" indicates confidential data for SEDAR 100 and hides SEDAR 43 and differences to maintain confidentiality.

Year	SEDAR 100	SEDAR 43	%Diff
1971	18.33	18.33	0.03
1972	28.39	28.41	0.05
1973	24.13	24.14	0.04
1974	24.29	24.09	-0.83
1975	35.38	35.39	0.03
1976	38.33	38.34	0.03
1977	26.94	26.95	0.05
1978	26.68	26.64	-0.16
1979	46.00	46.01	0.03
1980	43.76	43.75	-0.02
1981	40.76	40.77	0.02
1982	43.85	43.87	0.05
1983	33.30	33.31	0.02
1984	*	*	*
1985	42.01	42.02	0.01
1986	44.00	43.40	-1.38
1987	56.62	56.08	-0.96
1988	89.06	88.50	-0.63
1989	145.18	144.12	-0.74
1990	*	*	*
1991	201.55	201.69	0.07
1992	213.26	213.70	0.21
1993	*	*	*
1994	183.83	183.63	-0.11
1995	152.19	153.30	0.72
1996	118.58	121.38	2.30

Table 7 Continued. Percent difference (%Diff) in commercial landings between SEDAR 100 and SEDAR 43 for all commercial gears combined. Differences exceeding 10% are identified in red. "*" indicates confidential data for SEDAR 100 and hides SEDAR 43 and differences to maintain confidentiality.

Year	SEDAR 100	SEDAR 43	%Diff
1997	81.93	83.80	2.24
1998	*	*	*
1999	103.02	102.28	-0.72
2000	71.79	71.69	-0.13
2001	79.57	79.94	0.47
2002	*	*	*
2003	114.19	114.25	0.05
2004	*	*	*
2005	*	*	*
2006	*	*	*
2007	*	*	*
2008	*	*	*
2009	*	*	*
2010	*	*	*
2011	*	*	*
2012	*	*	*
2013	*	*	*

Table 8. Recreational landings in numbers and associated log-scaled standard errors (SE). Log-scale SEs were converted from CVs provided for landings in numbers (**Section 3.2**). These uncertainty estimates were used in the assessment model with the exception that any log-scale SEs > 0.25 were capped at 0.25.

Year	Headboat	Charter	Private	Recreational	Recreational SE	Methodology
1945				1,250	0.536	Assumed start
1946				24,709	0.536	Interpolated
1947				48,168	0.536	Interpolated
1948				71,627	0.536	Interpolated
1949				95,086	0.536	Interpolated
1950				118,545	0.536	Interpolated
1951				142,003	0.536	Interpolated
1952				165,462	0.536	Interpolated
1953				188,921	0.536	Interpolated
1954				212,380	0.536	Interpolated
1955				235,839	0.536	Estimated in DW03
1956				261,207	0.536	Estimated in DW03
1957				286,575	0.536	Estimated in DW03
1958				311,943	0.536	Estimated in DW03
1959				337,310	0.536	Estimated in DW03
1960				362,678	0.536	Estimated in DW03
1961				373,036	0.536	Estimated in DW03
1962				383,394	0.536	Estimated in DW03
1963				393,752	0.536	Estimated in DW03
1964				404,110	0.536	Estimated in DW03
1965				414,468	0.536	Estimated in DW03
1966				428,263	0.536	Estimated in DW03
1967				442,058	0.536	Estimated in DW03
1968				455,853	0.536	Estimated in DW03
1969				469,648	0.536	Estimated in DW03
1970				483,443	0.536	Estimated in DW03
1971				528,016	0.536	Estimated in DW03

Table 8 Continued. Recreational landings in numbers and associated log-scaled standard errors (SE). Log-scale SEs were converted from CVs provided for landings in numbers (**Section 3.2**). These uncertainty estimates were used in the assessment model with the exception that any log-scale SEs > 0.25 were capped at 0.25.

Year	Headboat	Charter	Private	Recreational	Recreational SE	Methodology
1972				572,590	0.536	Estimated in DW03
1973				617,163	0.536	Estimated in DW03
1974				661,736	0.536	Estimated in DW03
1975				706,310	0.536	Estimated in DW03
1976				708,678	0.536	Estimated in DW03
1977				711,046	0.536	Estimated in DW03
1978				713,414	0.536	Estimated in DW03
1979				715,782	0.536	Estimated in DW03
1980				718,150	0.536	Estimated in DW03
1981	69,711	85,258	439,552	594,521	0.380	Estimated in DW01,DW02
1982	465,437	736,728	108,800	1,310,965	0.306	Estimated in DW01,DW02
1983	71,368	87,911	484,624	643,902	0.437	Estimated in DW01,DW02
1984	61,015	76,749	16,421	154,184	0.317	Estimated in DW01,DW02
1985	52,910	74,547	137,495	264,952	0.416	Estimated in DW01,DW02
1986	45,042	451,982	81,962	578,985	0.185	Estimated in DW01,DW02
1987	38,730	283,117	560,014	881,861	0.428	Estimated in DW01,DW02
1988	68,561	233,918	521,492	823,971	0.239	Estimated in DW01,DW02
1989	80,509	375,297	925,818	1,381,625	0.181	Estimated in DW01,DW02
1990	130,901	895,732	768,209	1,794,842	0.156	Estimated in DW01,DW02
1991	89,247	1,055,24	135,100	1,279,590	0.230	Estimated in DW01,DW02
1992	110,676	576,125	684,824	1,371,625	0.154	Estimated in DW01,DW02
1993	102,971	414,588	493,901	1,011,461	0.188	Estimated in DW01,DW02
1994	110,179	457,219	335,432	902,830	0.135	Estimated in DW01,DW02
1995	97,666	634,058	366,412	1,098,136	0.197	Estimated in DW01,DW02
1996	76,524	143,237	237,264	457,025	0.137	Estimated in DW01,DW02
1997	63,685	153,169	242,261	459,115	0.115	Estimated in DW01,DW02
1998	53,188	152,559	456,806	662,554	0.176	Estimated in DW01,DW02

Table 8 Continued. Recreational landings in numbers and associated log-scaled standard errors (SE). Log-scale SEs were converted from CVs provided for landings in numbers (**Section 3.2**). These uncertainty estimates were used in the assessment model with the exception that any log-scale SEs > 0.25 were capped at 0.25.

Year	Headboat	Charter	Private	Recreational	Recreational SE	Methodology
1999	40,979	145,093	354,866	540,938	0.117	Estimated in DW01,DW02
2000	32,223	83,087	350,095	465,405	0.158	Estimated in DW01,DW02
2001	40,055	129,810	302,346	472,211	0.132	Estimated in DW01,DW02
2002	53,854	142,760	796,782	993,396	0.233	Estimated in DW01,DW02
2003	63,481	145,156	993,334	1,201,970	0.250	Estimated in DW01,DW02
2004	56,215	192,689	817,991	1,066,895	0.162	Estimated in DW01,DW02
2005	48,270	151,233	569,959	769,463	0.152	Estimated in DW01,DW02
2006	33,908	100,714	396,023	530,644	0.169	Estimated in DW01,DW02
2007	32,749	82,773	342,877	458,399	0.147	Estimated in DW01,DW02
2008	22,582	69,438	263,564	355,584	0.154	Estimated in DW01,DW02
2009	12,104	36,015	122,392	170,511	0.178	Estimated in DW01,DW02
2010	9,452	30,835	258,976	299,264	0.220	Estimated in DW01,DW02
2011	16,391	73,589	364,402	454,382	0.186	Estimated in DW01,DW02
2012	5,922	15,780	209,352	231,054	0.192	Estimated in DW01,DW02
2013	9,826	30,132	292,697	332,655	0.332	Estimated in DW01,DW02
2014	2,962	15,464	125,576	144,002	0.269	Estimated in DW01,DW02
2015	1,129	680	74,972	76,782	0.313	Estimated in DW01,DW02
2016	11,008	62,746	237,666	311,420	0.187	Estimated in DW01,DW02
2017	46	8,967	75,829	84,842	0.513	Estimated in DW01,DW02
2018	15,210	45,475	146,970	207,655	0.341	Estimated in DW01,DW02
2019	5,343	28,693	67,773	101,808	0.276	Estimated in DW01,DW02
2020	5,211	35,944	171,098	212,253	0.308	Estimated in DW01,DW02
2021	5,551	44,820	62,605	112,976	0.246	Estimated in DW01,DW02
2022	5,692	50,776	154,743	211,212	0.207	Estimated in DW01,DW02
2023	5,439	60,153	127,437	193,029	0.212	Estimated in DW01,DW02
2024	4,378	35,426	160,891	200,695	0.199	Estimated in DW01,DW02

Table 9. Percent difference (%Diff) in recreational landings in numbers between SEDAR 100 and SEDAR 43 for all recreational modes combined (headboat, charter, and private). Differences exceeding 10% are identified in red.

Year	SEDAR 100	SEDAR 43	%Diff
1945	1.25	1.25	0
1946	24.71	4.10	-502.66
1947	48.17	20.66	-133.15
1948	71.63	34.48	-107.73
1949	95.09	48.31	-96.82
1950	118.54	66.91	-77.17
1951	142.00	82.27	-72.61
1952	165.46	97.61	-69.51
1953	188.92	112.96	-67.25
1954	212.38	128.31	-65.52
1955	235.84	143.66	-64.16
1956	261.21	153.29	-70.40
1957	286.58	162.94	-75.88
1958	311.94	172.58	-80.75
1959	337.31	182.21	-85.12
1960	362.68	191.85	-89.04
1961	373.04	193.82	-92.47
1962	383.39	195.80	-95.81
1963	393.75	197.76	-99.11
1964	404.11	199.74	-102.32
1965	414.47	201.71	-105.48
1966	428.26	205.46	-108.44
1967	442.06	209.20	-111.31
1968	455.85	212.96	-114.06
1969	469.65	216.71	-116.72
1970	483.44	220.45	-119.30

Table 9 Continued. Percent difference (%Diff) in recreational landings in numbers between SEDAR 100 and SEDAR 43 for all recreational modes combined (headboat, charter, and private). Differences exceeding 10% are identified in red.

Year	SEDAR 100	SEDAR 43	%Diff
1971	528.02	225.66	-133.99
1972	572.59	242.43	-136.19
1973	617.16	260.28	-137.12
1974	661.74	266.28	-148.51
1975	706.31	276.23	-155.70
1976	708.68	288.10	-145.98
1977	711.05	312.91	-127.24
1978	713.41	325.15	-119.41
1979	715.78	336.31	-112.83
1980	718.15	343.69	-108.95
1981	594.52	722.29	17.69
1982	1,310.96	723.87	-81.10
1983	643.90	472.84	-36.18
1984	154.18	215.23	28.36
1985	264.95	183.71	-44.22
1986	578.98	423.45	-36.73
1987	881.86	263.83	-234.25
1988	823.97	847.89	2.82
1989	1,381.62	975.24	-41.67
1990	1,794.84	1,410.10	-27.28
1991	1,279.59	977.07	-30.96
1992	1,371.63	799.66	-71.53
1993	1,011.46	719.59	-40.56
1994	902.83	670.23	-34.70
1995	1,098.14	732.70	-49.88
1996	457.02	381.26	-19.87

Table 9 Continued. Percent difference (%Diff) in recreational landings in numbers between SEDAR 100 and SEDAR 43 for all recreational modes combined. Differences exceeding 10% are identified in red.

Year	SEDAR 100	SEDAR 43	%Diff
1997	459.12	354.96	-29.34
1998	662.55	344.28	-92.45
1999	540.94	291.69	-85.45
2000	465.40	250.71	-85.63
2001	472.21	307.67	-53.48
2002	993.40	419.68	-136.70
2003	1,201.97	507.96	-136.63
2004	1,066.90	617.38	-72.81
2005	769.46	419.95	-83.23
2006	530.64	268.61	-97.55
2007	458.40	282.86	-62.06
2008	355.58	209.05	-70.10
2009	170.51	141.42	-20.57
2010	299.26	117.13	-155.50
2011	454.38	187.27	-142.63
2012	231.05	92.38	-150.11
2013	332.65	177.71	-87.19

Table 10. Recreational landings in pounds whole weight and associated log-scaled standard errors (SE). Log-scale SEs were converted from CVs provided for landings in weights (**Section 3.2**).

Year	Headboat	Charter	Private	Recreational	Recreational SE
1981	106,820	142,757	1,014,15	1,263,728	0.420
1982	953,690	2,212,00	269,856	3,435,549	0.336
1983	159,361	208,530	2,082,64	2,450,539	0.486
1984	113,530	238,196	48,630	400,356	0.353
1985	142,017	352,605	359,393	854,014	0.379
1986	89,307	1,099,81	183,891	1,373,018	0.218
1987	63,363	776,302	1,544,09	2,383,764	0.448
1988	90,108	704,372	679,510	1,473,991	0.235
1989	151,514	884,496	1,248,76	2,284,775	0.201
1990	198,797	3,098,27	1,432,38	4,729,454	0.195
1991	153,051	2,719,42	291,989	3,164,462	0.254
1992	170,054	1,669,74	1,331,97	3,171,767	0.176
1993	183,068	1,160,46	1,091,64	2,435,177	0.211
1994	186,038	1,003,25	757,408	1,946,697	0.208
1995	171,742	1,182,54	671,986	2,026,272	0.214
1996	124,893	315,457	394,462	834,812	0.195
1997	109,032	616,626	452,437	1,178,095	0.158
1998	88,624	418,077	861,517	1,368,217	0.198
1999	69,481	382,512	802,399	1,254,392	0.159
2000	61,996	238,471	832,600	1,133,067	0.178
2001	67,529	297,777	542,420	907,726	0.150
2002	90,952	391,600	1,744,27	2,226,826	0.275
2003	104,410	411,549	1,865,38	2,381,339	0.354
2004	100,067	358,507	1,467,51	1,926,091	0.184
2005	84,130	285,722	1,037,33	1,407,185	0.204
2006	58,178	203,688	609,825	871,692	0.189

Table 10 Continued. Recreational landings in pounds whole weight and associated log-scaled standard errors (SE). Log-scale SEs were converted from CVs provided for landings in weights (**Section 3.2**).

Year	Headboat	Charter	Private	Recreational	Recreational SE
2007	62,685	179,213	578,250	820,149	0.175
2008	48,584	158,938	510,206	717,728	0.171
2009	34,615	97,515	338,764	470,893	0.220
2010	25,756	88,158	797,579	911,493	0.251
2011	50,449	204,583	1,011,64	1,266,681	0.202
2012	18,706	48,478	643,970	711,154	0.229
2013	27,112	97,865	1,115,02	1,240,001	0.358
2014	8,693	47,885	371,170	427,748	0.289
2015	4,112	1,568	161,518	167,197	0.342
2016	29,577	202,210	783,088	1,014,875	0.215
2017	96	28,534	186,525	215,155	0.504
2018	55,291	176,919	677,471	909,681	0.368
2019	21,256	132,027	373,603	526,886	0.296
2020	17,230	136,868	851,425	1,005,523	0.333
2021	14,813	199,552	224,142	438,507	0.251
2022	17,996	158,353	581,749	758,098	0.248
2023	20,893	204,985	463,081	688,960	0.231
2024	13,718	106,124	588,006	707,847	0.238

Table 11. Mean weight (kg, whole weight) landed by the recreational fleet and associated coefficient of variation (CV) input into the stock assessment model. Mean weight was obtained by dividing the estimated weights by the estimated numbers.

Year	Recreational	Recreational CV
1981	0.964	0.340
1982	1.189	0.206
1983	1.726	0.116
1984	1.178	0.094
1985	1.462	0.147
1986	1.076	0.144
1987	1.226	0.194
1988	0.811	0.175
1989	0.750	0.122
1990	1.195	0.156
1991	1.122	0.119
1992	1.049	0.115
1993	1.092	0.138
1994	0.978	0.222
1995	0.837	0.126
1996	0.829	0.191
1997	1.164	0.132
1998	0.937	0.137
1999	1.052	0.093
2000	1.104	0.085
2001	0.872	0.089
2002	1.017	0.105
2003	0.899	0.155
2004	0.819	0.079
2005	0.830	0.100
2006	0.745	0.103
2007	0.812	0.120

Table 11 Continued. Mean weight (kg, whole weight) landed by the recreational fleet and associated coefficient of variation (CV) input into the stock assessment model. Mean weight was obtained by dividing the estimated weights by the estimated numbers.

Year	Recreational	Recreational CV
2008	0.916	0.111
2009	1.253	0.119
2010	1.382	0.101
2011	1.264	0.069
2012	1.396	0.102
2013	1.691	0.141
2014	1.347	0.138
2015	0.988	0.198
2016	1.478	0.111
2017	1.150	0.061
2018	1.987	0.123
2019	2.347	0.123
2020	2.149	0.107
2021	1.761	0.111
2022	1.628	0.130
2023	1.619	0.090
2024	1.600	0.100

Table 12. Commercial discards in numbers with associated log-scale standard errors (SE) input into the stock assessment model. Discards refer to the total number of fish discarded before applying the discard mortality rate of 40%.

Year	Vertical Line	Vertical Line SE
2000	1,502	553
2001	1,632	601
2002	2,076	764
2003	2,264	834
2004	2,039	751
2005	1,565	576
2006	1,149	423
2007	1,078	397
2008	977	360
2009	15,977	4,619
2010	11,642	3,366
2011	14,944	4,320
2012	24,285	4,377
2013	13,827	1,668
2014	12,367	1,492
2015	12,920	1,558
2016	15,411	1,859
2017	13,869	1,673
2018	10,380	1,768
2019	11,735	1,999
2020	9,866	1,680
2021	9,729	1,657
2022	10,059	1,713
2023	11,630	1,981
2024	10,412	1,773

Table 13. Recreational discards in numbers with associated log-scale standard errors (SE) input into the assessment model. Discards refer to the total number of fish discarded before applying the discard mortality rate of 40%.

Year	Headboat	Charter	Private	Recreational	Recreational SE
1981	4,192	9,112	53,891	67,195	0.542
1982	4,448	16,476	202,264	223,188	0.545
1983	4,504	7,739	803,297	815,540	0.540
1984	29	334	221,570	221,934	0.604
1985	389	621	255,062	256,072	0.516
1986	249	4,320	114,603	119,173	0.745
1987	269	3,763	205,682	209,715	0.607
1988	213	1,942	248,862	251,017	0.416
1989	799	8,979	379,260	389,037	0.246
1990	24,426	216,343	292,823	533,592	0.332
1991	642	17,684	144,418	162,744	0.407
1992	2,277	20,520	259,067	281,864	0.174
1993	5,745	41,507	545,893	593,145	0.178
1994	689	12,240	162,598	175,527	0.202
1995	4,666	68,210	101,643	174,520	0.282
1996	7,728	31,457	212,977	252,162	0.363
1997	5,038	24,272	163,714	193,024	0.269
1998	14,303	55,109	523,085	592,497	0.294
1999	4,827	21,531	293,931	320,289	0.193
2000	2,273	8,147	157,183	167,603	0.308
2001	4,125	18,671	318,451	341,247	0.190
2002	2,980	17,879	711,247	732,106	0.387
2003	3,120	9,898	420,859	433,876	0.434
2004	5,007	22,979	623,400	651,386	0.293
2005	4,409	22,986	303,905	331,300	0.211
2006	2,395	10,697	243,681	256,773	0.295
2007	4,382	17,384	600,338	622,104	0.275

Table 13 Continued. Recreational discards in numbers with associated log-scale standard errors (SE) input into the assessment model. Discards refer to the total number of fish discarded before applying the discard mortality rate of 40%.

Year	Headboat	Charter	Private	Recreational	Recreational SE
2008	3,377	13,457	200,706	217,540	0.408
2009	11,406	65,816	339,199	416,421	0.153
2010	7,944	37,761	456,281	501,986	0.353
2011	15,909	112,695	379,318	507,923	0.238
2012	30,227	63,071	593,803	687,101	0.236
2013	37,348	85,770	709,812	832,930	0.453
2014	39,831	131,176	419,094	590,101	0.141
2015	85,781	202,416	1,545,99	1,834,189	0.234
2016	91,540	358,478	1,807,33	2,257,348	0.159
2017	152,119	475,491	2,890,26	3,517,873	0.157
2018	88,531	364,958	1,632,50	2,085,994	0.309
2019	84,247	296,379	1,616,88	1,997,506	0.179
2020	69,839	355,953	1,367,30	1,793,095	0.174
2021	126,832	489,164	1,875,38	2,491,379	0.241
2022	105,871	305,686	2,590,96	3,002,521	0.214
2023	116,672	507,539	1,543,80	2,168,014	0.131
2024	88,396	350,735	1,728,12	2,167,256	0.215

Table 14. Estimated shrimp bycatch in numbers with associated log-scale standard errors (SE) for the SEDAR 100 Assessment. All bycatch is assumed dead. The median value (1,612,310) was input into the assessment model and assumed reflective of the time period 1946-2023.

Year	Bycatch	Bycatch SE	Methodology
1947	26,000	0.121	Assumed start - first year of data for SEDAR 43
1948	152,257	0.121	Interpolated
1949	278,515	0.121	Interpolated
1950	404,772	0.121	Interpolated
1951	531,029	0.121	Interpolated
1952	657,287	0.121	Interpolated
1953	783,544	0.121	Interpolated
1954	909,802	0.121	Interpolated
1955	1,036,059	0.121	Interpolated
1956	1,162,316	0.121	Interpolated
1957	1,288,574	0.121	Interpolated
1958	1,414,831	0.121	Interpolated
1959	1,541,088	0.121	Interpolated
1960	1,667,346	0.121	Back-calculated using relative shrimp effort trend
1961	1,190,584	0.121	Back-calculated using relative shrimp effort trend
1962	1,446,184	0.121	Back-calculated using relative shrimp effort trend
1963	1,648,898	0.121	Back-calculated using relative shrimp effort trend
1964	1,783,632	0.121	Back-calculated using relative shrimp effort trend
1965	1,577,327	0.121	Back-calculated using relative shrimp effort trend
1966	1,494,624	0.121	Back-calculated using relative shrimp effort trend
1967	1,747,935	0.121	Back-calculated using relative shrimp effort trend
1968	1,795,857	0.121	Back-calculated using relative shrimp effort trend
1969	2,096,457	0.121	Back-calculated using relative shrimp effort trend
1970	1,772,486	0.121	Back-calculated using relative shrimp effort trend
1971	1,831,359	0.121	Back-calculated using relative shrimp effort trend
1972	2,179,223	0.121	Back-calculated using relative shrimp effort trend
1973	2,025,273	0.121	Back-calculated using relative shrimp effort trend

Table 14 Continued. Estimated shrimp bycatch in numbers with associated log-scale standard errors (SE) for the SEDAR 100 Assessment. All bycatch is assumed dead. The median value (1,612,310) was input into the assessment model and assumed reflective of the time period 1946-2023.

Year	Bycatch	Bycatch SE	Methodology
1974	2,029,788	0.121	Back-calculated using relative shrimp effort trend
1975	1,781,703	0.121	Back-calculated using relative shrimp effort trend
1976	2,141,524	0.121	Back-calculated using relative shrimp effort trend
1977	2,305,558	0.121	Back-calculated using relative shrimp effort trend
1978	2,800,405	0.121	Back-calculated using relative shrimp effort trend
1979	2,932,028	0.121	Back-calculated using relative shrimp effort trend
1980	1,999,861	0.121	Back-calculated using relative shrimp effort trend
1981	2,450,006	0.121	Back-calculated using relative shrimp effort trend
1982	2,410,732	0.121	Back-calculated using relative shrimp effort trend
1983	2,374,921	0.121	Back-calculated using relative shrimp effort trend
1984	2,530,668	0.121	Estimated in DW22
1985	2,788,041	0.113	Estimated in DW22
1986	3,105,696	0.112	Estimated in DW22
1987	3,637,803	0.117	Estimated in DW22
1988	3,182,324	0.134	Estimated in DW22
1989	3,049,864	0.129	Estimated in DW22
1990	2,955,209	0.107	Estimated in DW22
1991	2,982,042	0.117	Estimated in DW22
1992	3,037,806	0.191	Estimated in DW22
1993	2,969,446	0.113	Estimated in DW22
1994	2,210,772	0.124	Estimated in DW22
1995	2,045,915	0.143	Estimated in DW22
1996	2,300,476	0.152	Estimated in DW22
1997	2,664,584	0.171	Estimated in DW22
1998	2,191,771	0.135	Estimated in DW22
1999	2,140,668	0.114	Estimated in DW22
2000	1,988,938	0.102	Estimated in DW22

Table 14 Continued. Estimated shrimp bycatch in numbers with associated log-scale standard errors (SE) for the SEDAR 100 Assessment. All bycatch is assumed dead. The median value (1,612,310) was input into the assessment model and assumed reflective of the time period 1946-2023.

Year	Bycatch	Bycatch SE	Methodology
2001	1,612,308	0.110	Estimated in DW22
2002	1,789,791	0.113	Estimated in DW22
2003	1,376,498	0.141	Estimated in DW22
2004	1,203,723	0.125	Estimated in DW22
2005	938,446	0.127	Estimated in DW22
2006	841,732	0.121	Estimated in DW22
2007	602,379	0.246	Estimated in DW22
2008	670,997	0.266	Estimated in DW22
2009	966,090	0.123	Estimated in DW22
2010	540,201	0.094	Estimated in DW22
2011	758,124	0.102	Estimated in DW22
2012	704,027	0.134	Estimated in DW22
2013	484,904	0.141	Estimated in DW22
2014	660,309	0.085	Estimated in DW22
2015	463,600	0.114	Estimated in DW22
2016	437,446	0.119	Estimated in DW22
2017	477,767	0.111	Estimated in DW22
2018	424,302	0.096	Estimated in DW22
2019	387,097	0.084	Estimated in DW22
2020	368,221	0.085	Estimated in DW22
2021	392,766	0.094	Estimated in DW22
2022	257,934	0.076	Estimated in DW22
2023	250,215	0.107	Estimated in DW22

Table 15. Shrimp effort estimates (days), associated log-scale standard errors (SE), and the relative index of shrimp effort (scaled to a mean of 1) for the Gulf shrimp fishery.

Year	Effort	Effort SE	Index	Methodology
1945			0.001	Assumed start
1946			0.068	Interpolated
1947			0.135	Interpolated
1948			0.202	Interpolated
1949			0.269	Interpolated
1950			0.336	Interpolated
1951			0.403	Interpolated
1952			0.470	Interpolated
1953			0.537	Interpolated
1954			0.604	Interpolated
1955			0.671	Interpolated
1956			0.738	Interpolated
1957			0.805	Interpolated
1958			0.872	Interpolated
1959			0.939	Interpolated
1960	111,233		1.006	Summed by region; no CV provided
1961	79,427		0.719	Summed by region; no CV provided
1962	96,479		0.873	Summed by region; no CV provided
1963	110,002		0.995	Summed by region; no CV provided
1964	118,991		1.077	Summed by region; no CV provided
1965	105,228		0.952	Summed by region; no CV provided
1966	99,710		0.902	Summed by region; no CV provided
1967	116,609		1.055	Summed by region; no CV provided
1968	119,806		1.084	Summed by region; no CV provided
1969	139,860		1.265	Summed by region; no CV provided
1970	118,247		1.070	Summed by region; no CV provided
1971	122,175		1.105	Summed by region; no CV provided

Table 15 Continued. Shrimp effort estimates (days), associated log-scale standard errors (SE), and the relative index of shrimp effort (scaled to a mean of 1) for the Gulf shrimp fishery.

Year	Effort	Effort SE	Index	Methodology
1972	145,381		1.315	Summed by region; no CV provided
1973	135,111		1.223	Summed by region; no CV provided
1974	135,412		1.225	Summed by region; no CV provided
1975	118,862		1.076	Summed by region; no CV provided
1976	142,867		1.293	Summed by region; no CV provided
1977	153,810		1.392	Summed by region; no CV provided
1978	186,822		1.690	Summed by region; no CV provided
1979	195,603		1.770	Summed by region; no CV provided
1980	133,416		1.207	Summed by region; no CV provided
1981	163,446		1.479	Summed by region; no CV provided
1982	160,826		1.455	Summed by region; no CV provided
1983	158,437		1.434	Summed by region; no CV provided
1984	168,827	0.014	1.528	Estimated in DW22
1985	174,594	0.014	1.580	Estimated in DW22
1986	201,708	0.015	1.825	Estimated in DW22
1987	222,895	0.014	2.017	Estimated in DW22
1988	191,953	0.015	1.737	Estimated in DW22
1989	202,466	0.019	1.832	Estimated in DW22
1990	204,359	0.023	1.849	Estimated in DW22
1991	200,384	0.023	1.813	Estimated in DW22
1992	198,979	0.026	1.800	Estimated in DW22
1993	183,700	0.033	1.662	Estimated in DW22
1994	145,046	0.044	1.312	Estimated in DW22
1995	124,407	0.023	1.126	Estimated in DW22
1996	142,167	0.023	1.286	Estimated in DW22
1997	164,074	0.021	1.485	Estimated in DW22
1998	195,135	0.020	1.766	Estimated in DW22

Table 15 Continued. Shrimp effort estimates (days), associated log-scale standard errors (SE), and the relative index of shrimp effort (scaled to a mean of 1) for the Gulf shrimp fishery.

Year	Effort	Effort SE	Index	Methodology
1999	190,994	0.021	1.728	Estimated in DW22
2000	169,299	0.019	1.532	Estimated in DW22
2001	132,347	0.033	1.198	Estimated in DW22
2002	149,444	0.026	1.352	Estimated in DW22
2003	119,127	0.023	1.078	Estimated in DW22
2004	99,557	0.023	0.901	Estimated in DW22
2005	79,109	0.023	0.716	Estimated in DW22
2006	72,296	0.027	0.654	Estimated in DW22
2007	76,075	0.069	0.688	Estimated in DW22
2008	62,172	0.026	0.563	Estimated in DW22
2009	77,307	0.020	0.699	Estimated in DW22
2010	50,312	0.024	0.455	Estimated in DW22
2011	62,641	0.017	0.567	Estimated in DW22
2012	62,655	0.020	0.567	Estimated in DW22
2013	70,604	0.071	0.639	Estimated in DW22
2014	76,287	0.013	0.690	Estimated in DW22
2015	75,871	0.012	0.687	Estimated in DW22
2016	74,268	0.011	0.672	Estimated in DW22
2017	76,821	0.011	0.695	Estimated in DW22
2018	71,519	0.010	0.647	Estimated in DW22
2019	67,130	0.010	0.607	Estimated in DW22
2020	70,638	0.013	0.639	Estimated in DW22
2021	68,888	0.020	0.623	Estimated in DW22
2022	45,618	0.025	0.413	Estimated in DW22
2023	36,900	0.032	0.334	Estimated in DW22
2024	35,462	0.038	0.321	Estimated in DW22

Table 16. Standardized indices of relative abundance (catch-per-unit-effort, CPUE) and associated log-scale standard errors (SE) converted from the CVs provided.

Year	Rec CPUE	Rec SE	Trawl Early CPUE	Trawl Early SE	Trawl Late CPUE	Trawl Late SE	Video CPUE	Video SE
1986	0.871	0.283						
1987	0.725	0.293	0.568	0.192				
1988	0.877	0.282	0.495	0.188				
1989	1.309	0.267	0.945	0.160				
1990	2.048	0.236	0.455	0.189				
1991	1.470	0.238	2.121	0.120				
1992	1.481	0.241	0.274	0.206				
1993	1.245	0.246	1.380	0.144			0.403	0.186
1994	1.271	0.259	1.454	0.128			0.907	0.454
1995	1.047	0.287	0.920	0.154			0.454	0.290
1996	1.122	0.285	0.655	0.184			0.365	0.155
1997	1.060	0.282	0.570	0.172			1.534	0.197
1998	0.942	0.272	0.105	0.312				
1999	1.000	0.264	1.237	0.139				
2000	0.542	0.292	1.961	0.124				
2001	0.448	0.299	2.971	0.137				
2002	0.624	0.294	0.942	0.150			0.876	0.613
2003	0.732	0.286	0.498	0.183				
2004	0.797	0.274	0.502	0.164			0.634	0.334
2005	1.022	0.258	0.835	0.149			0.611	0.212
2006	0.642	0.280	1.380	0.150			1.167	0.174
2007	0.726	0.282	0.770	0.164			1.016	0.188
2008			0.961	0.123			1.056	0.154
2009					0.619	0.116	1.448	0.135
2010					0.700	0.145	0.721	0.157
2011					0.906	0.139	0.818	0.148
2012					1.212	0.120	0.670	0.147

Table 16 Continued. Standardized indices of relative abundance (catch-per-unit-effort, CPUE) and associated log-scale standard errors (SE) converted from the CVs provided.

Year	Rec CPUE	Rec SE	Trawl Early CPUE	Trawl Early SE	Trawl Late CPUE	Trawl Late SE	Video CPUE	Video SE
2013					0.643	0.175	0.553	0.131
2014					0.930	0.127	0.648	0.104
2015					1.265	0.110	0.835	0.095
2016					0.479	0.175	1.231	0.065
2017					0.757	0.136	1.043	0.073
2018					0.985	0.123	1.013	0.083
2019					1.146	0.135	0.880	0.078
2020					0.781	0.202	1.820	0.166
2021					1.319	0.128	1.610	0.091
2022					1.863	0.125	1.776	0.083
2023					1.724	0.116	1.668	0.077
2024					0.670	0.162	1.242	0.076

Table 17. List of Stock Synthesis parameters. The list includes expected parameter values, lower and upper bounds of the parameters, associated standard deviations (SD) and coefficients of variation (CV), the prior type and densities (value, SD) if applicable, and phases. Parameters designated as fixed were held at their initial values and have no associated range or SD.

Label	Value	Range	SD	CV	Prior	Phase
NatM_Lorenzen_averageFem_GP_1	0.360	(0,1)				Fixed
L_at_Amin_Fem_GP_1	8.353	(5,25)	0.325	0.039		3
L_at_Amax_Fem_GP_1	53.804	(30,60)	0.617	0.011		5
VonBert_K_Fem_GP_1	0.153	(0.05,0.3)	0.007	0.048		5
CV_young_Fem_GP_1	0.437	(0.01,0.5)				Fixed
CV_old_Fem_GP_1	0.124	(0.01,0.5)				Fixed
Wtlen_1_Fem_GP_1	1.70e-05	(0,1)				Fixed
Wtlen_2_Fem_GP_1	3.070	(0,4)				Fixed
Mat50%_Fem_GP_1	15.259	(10,30)				Fixed
Mat_slope_Fem_GP_1	-0.232	(-1,0)				Fixed
Eggs_scalar_Fem_GP_1	1	(-1,1)				Fixed
Eggs_exp_wt_Fem_GP_1	1	(0,4)				Fixed
CohortGrowDev	1	(0.1,10)			Normal(1,1)	Fixed
FracFemale_GP_1	0.5	(1e-06,0.99)				Fixed
SR_LN(R0)	11.469	(3,20)	0.051	0.004		1
SR_BH_steep	0.99	(0.2,1)				Fixed
SR_sigmaR	0.6	(0.2,2)				Fixed
SR_regime	0	(-5,5)				Fixed
SR_autocorr	0	(0,0)				Fixed
Main_RecrDev_1981	0.954	(-5,5)	0.231	0.242		3
Main_RecrDev_1982	-0.224	(-5,5)	0.415	1.855		3
Main_RecrDev_1983	-0.591	(-5,5)	0.356	0.602		3
Main_RecrDev_1984	-0.705	(-5,5)	0.345	0.489		3
Main_RecrDev_1985	-0.037	(-5,5)	0.252	6.829		3
Main_RecrDev_1986	0.077	(-5,5)	0.261	3.410		3
Main_RecrDev_1987	0.805	(-5,5)	0.166	0.206		3
Main_RecrDev_1988	0.585	(-5,5)	0.196	0.335		3
Main_RecrDev_1989	-0.375	(-5,5)	0.299	0.799		3

Table 17 Continued. List of Stock Synthesis parameters. The list includes expected parameter values, lower and upper bounds of the parameters, associated standard deviations (SD) and coefficients of variation (CV), the prior type and densities (value, SD) if applicable, and phases. Parameters designated as fixed were held at their initial values and have no associated range or SD.

Label	Value	Range	SD	CV	Prior	Phase
Main_RecrDev_1990	0.235	(-5,5)	0.169	0.717		3
Main_RecrDev_1991	-0.684	(-5,5)	0.304	0.444		3
Main_RecrDev_1992	0.359	(-5,5)	0.149	0.414		3
Main_RecrDev_1993	-6.43e-04	(-5,5)	0.198	>>>1		3
Main_RecrDev_1994	-0.380	(-5,5)	0.25	0.660		3
Main_RecrDev_1995	0.294	(-5,5)	0.173	0.589		3
Main_RecrDev_1996	-0.145	(-5,5)	0.244	1.684		3
Main_RecrDev_1997	-0.524	(-5,5)	0.272	0.520		3
Main_RecrDev_1998	0.189	(-5,5)	0.161	0.849		3
Main_RecrDev_1999	0.367	(-5,5)	0.14	0.382		3
Main_RecrDev_2000	-0.060	(-5,5)	0.158	2.647		3
Main_RecrDev_2001	-0.039	(-5,5)	0.136	3.468		3
Main_RecrDev_2002	-0.187	(-5,5)	0.134	0.720		3
Main_RecrDev_2003	-0.483	(-5,5)	0.143	0.297		3
Main_RecrDev_2004	-0.508	(-5,5)	0.127	0.250		3
Main_RecrDev_2005	-0.495	(-5,5)	0.122	0.247		3
Main_RecrDev_2006	-0.212	(-5,5)	0.116	0.549		3
Main_RecrDev_2007	0.103	(-5,5)	0.109	1.063		3
Main_RecrDev_2008	-0.301	(-5,5)	0.132	0.439		3
Main_RecrDev_2009	-0.072	(-5,5)	0.107	1.489		3
Main_RecrDev_2010	-0.498	(-5,5)	0.124	0.249		3
Main_RecrDev_2011	0.121	(-5,5)	0.086	0.705		3
Main_RecrDev_2012	0.434	(-5,5)	0.08	0.184		3
Main_RecrDev_2013	0.768	(-5,5)	0.071	0.093		3
Main_RecrDev_2014	0.199	(-5,5)	0.1	0.503		3
Main_RecrDev_2015	-0.107	(-5,5)	0.123	1.144		3
Main_RecrDev_2016	-0.004	(-5,5)	0.127	>>>1		3
Main_RecrDev_2017	0.740	(-5,5)	0.097	0.131		3
Main_RecrDev_2018	0.305	(-5,5)	0.135	0.441		3

Table 17 Continued. List of Stock Synthesis parameters. The list includes expected parameter values, lower and upper bounds of the parameters, associated standard deviations (SD) and coefficients of variation (CV), the prior type and densities (value, SD) if applicable, and phases. Parameters designated as fixed were held at their initial values and have no associated range or SD.

Label	Value	Range	SD	CV	Prior	Phase
Main_RecrDev_2019	0.138	(-5,5)	0.154	1.114		3
Main_RecrDev_2020	-0.026	(-5,5)	0.183	7.150		3
Main_RecrDev_2021	0.065	(-5,5)	0.213	3.263		3
Main_RecrDev_2022	0.590	(-5,5)	0.211	0.357		3
Main_RecrDev_2023	-1.042	(-5,5)	0.369	0.354		3
Main_RecrDev_2024	0.372	(-5,5)	0.568	1.529		3
LnQ_base_Shrimp_Bycatch_4(4)	2.357	(-10,40)	0.104	0.044		1
LnQ_base_HB_Surv_5(5)	-7.974	(-25,25)				Fixed
Q_extraSD_HB_Surv_5(5)	0.074	(0,0.5)	0.049	0.669	Sym_Beta(0,1)	4
LnQ_base_TrawlEarly_6(6)	-9.533	(-25,25)				Fixed
Q_extraSD_TrawlEarly_6(6)	0.414	(0,0.5)	0.057	0.139	Sym_Beta(0,1)	4
LnQ_base_TrawlLate_7(7)	-9.823	(-25,25)				Fixed
Q_extraSD_TrawlLate_7(7)	0.231	(0,0.5)	0.066	0.288	Sym_Beta(0,1)	4
LnQ_base_Video_8(8)	-6.291	(-25,25)				Fixed
Q_extraSD_Video_8(8)	0.117	(0,0.5)	0.05	0.424	Sym_Beta(0,1)	4
Size_DblN_peak_Rec_1(1)	30.298	(10,60)	0.186	0.006		2
Size_DblN_top_logit_Rec_1(1)	-13.182	(-15,15)	34.97	2.653		3
Size_DblN_ascend_se_Rec_1(1)	3.641	(-15,15)	0.038	0.010		3
Size_DblN_descend_se_Rec_1(1)	4.226	(-15,15)	0.151	0.036		3
Size_DblN_start_logit_Rec_1(1)	-999	(-999,15)				Fixed
Size_DblN_end_logit_Rec_1(1)	-0.323	(-15,15)	0.146	0.450		4
Retain_L_infl_Rec_1(1)	25.722	(0,60)				Fixed
Retain_L_width_Rec_1(1)	2.598	(0,20)				Fixed
Retain_L_asymptote_logit_Rec_1(1)	4.981	(-10,10)	1.715	0.344		2
Retain_L_maleoffset_Rec_1(1)	0	(-1,2)				Fixed
DiscMort_L_infl_Rec_1(1)	-5	(-10,10)				Fixed
DiscMort_L_width_Rec_1(1)	1	(-1,2)				Fixed
DiscMort_L_level_old_Rec_1(1)	0.4	(0,2)				Fixed
DiscMort_L_male_offset_Rec_1(1)	0	(-1,2)				Fixed

Table 17 Continued. List of Stock Synthesis parameters. The list includes expected parameter values, lower and upper bounds of the parameters, associated standard deviations (SD) and coefficients of variation (CV), the prior type and densities (value, SD) if applicable, and phases. Parameters designated as fixed were held at their initial values and have no associated range or SD.

Label	Value	Range	SD	CV	Prior	Phase
Size_inflection_ComVL_2(2)	31.103	(10,60)	0.277	0.009		2
Size_95%width_ComVL_2(2)	5.354	(0.01,20)	0.273	0.051		3
Retain_L_infl_ComVL_2(2)	20.667	(0,60)				Fixed
Retain_L_width_ComVL_2(2)	1.073	(0,20)				Fixed
Retain_L_asymptote_logit_ComVL_2(2)	9.731	(-10,10)	7.331	0.753		2
Retain_L_maleoffset_ComVL_2(2)	0	(-1,2)				Fixed
DiscMort_L_infl_ComVL_2(2)	-5	(-10,10)				Fixed
DiscMort_L_width_ComVL_2(2)	1	(-1,2)				Fixed
DiscMort_L_level_old_ComVL_2(2)	0.4	(0,2)				Fixed
DiscMort_L_male_offset_ComVL_2(2)	0	(-1,2)				Fixed
Size_inflection_ComLL_3(3)	56.331	(10,60)	1.113	0.020		2
Size_95%width_ComLL_3(3)	10.470	(0.01,20)	0.438	0.042		3
Size_DblN_peak_Shrimp_Bycatch_4(4)	11.662	(5,20)	0.462	0.040		2
Size_DblN_top_logit_Shrimp_Bycatch_4(4)	-11.866	(-15,15)	50.946	4.294		3
Size_DblN_ascend_se_Shrimp_Bycatch_4(4)	2.748	(-15,15)	0.214	0.078		3
Size_DblN_descend_se_Shrimp_Bycatch_4(4)	2.659	(-15,15)	0.467	0.176		3
Size_DblN_start_logit_Shrimp_Bycatch_4(4)	-8.536	(-15,15)	0.756	0.089		2
Size_DblN_end_logit_Shrimp_Bycatch_4(4)	-0.427	(-15,15)	0.159	0.373		4
Size_DblN_peak_TrawlLate_7(7)	7.995	(5,20)	0.321	0.040		2
Size_DblN_top_logit_TrawlLate_7(7)	-2.906	(-15,15)	0.532	0.183		3
Size_DblN_ascend_se_TrawlLate_7(7)	0.788	(-15,15)	0.329	0.418		3
Size_DblN_descend_se_TrawlLate_7(7)	2.214	(-15,15)	1.162	0.525		3
Size_DblN_start_logit_TrawlLate_7(7)	-8.752	(-15,15)	1.012	0.116		2
Size_DblN_end_logit_TrawlLate_7(7)	0.315	(-15,15)	0.243	0.771		4
Size_DblN_peak_Video_8(8)	62.700	(10,72)				Fixed
Size_DblN_top_logit_Video_8(8)	-1.64e-07	(-15,15)	335.407	>>>1		3
Size_DblN_ascend_se_Video_8(8)	5.841	(-15,15)	0.041	0.007		3
Size_DblN_descend_se_Video_8(8)	1.84e-08	(-15,15)	335.407	>>>1		3
Size_DblN_start_logit_Video_8(8)	-14.900	(-15,15)				Fixed

Table 17 Continued. List of Stock Synthesis parameters. The list includes expected parameter values, lower and upper bounds of the parameters, associated standard deviations (SD) and coefficients of variation (CV), the prior type and densities (value, SD) if applicable, and phases. Parameters designated as fixed were held at their initial values and have no associated range or SD.

Label	Value	Range	SD	CV	Prior	Phase
Size_DblN_end_logit_Video_8(8)	999	(-15,999)				Fixed
ln(DM_theta)_Len_P1	7.858	(-5,10)	0.879	0.112	Normal(0,1.81)	6
ln(DM_theta)_Len_P2	5.503	(-5,10)	0.754	0.137	Normal(0,1.81)	6
ln(DM_theta)_Len_P3	-0.177	(-5,10)	0.107	0.606	Normal(0,1.81)	6
ln(DM_theta)_Len_P4	-0.394	(-5,10)	0.104	0.265	Normal(0,1.81)	6
ln(DM_theta)_Age_P5	0.471	(-5,10)	0.104	0.221	Normal(0,1.81)	6
ln(DM_theta)_Age_P6	0.503	(-5,10)	0.091	0.180	Normal(0,1.81)	6
Size_DblN_peak_Rec_1(1)_BLK4repl_2008	34.669	(10,60)	0.199	0.006		3
Size_DblN_descend_se_Rec_1(1)_BLK4repl_2008	2.716	(-15,15)	0.147	0.054		3
Size_DblN_end_logit_Rec_1(1)_BLK4repl_2008	-0.853	(-15,15)	0.096	0.113		4
Retain_L_infl_Rec_1(1)_BLK1repl_1999	26.412	(1,60)	0.136	0.005		3
Retain_L_infl_Rec_1(1)_BLK1repl_2009	37.152	(1,60)	0.257	0.007		3
Retain_L_infl_Rec_1(1)_BLK1repl_2018	38.470	(1,60)	0.129	0.003		3
Retain_L_width_Rec_1(1)_BLK1repl_1999	1.591	(0,20)	0.081	0.051		3
Retain_L_width_Rec_1(1)_BLK1repl_2009	2.190	(0,20)	0.078	0.035		3
Retain_L_width_Rec_1(1)_BLK1repl_2018	1.215	(0,20)	0.042	0.034		3
Retain_L_asymptote_logit_Rec_1(1)_BLK3repl_2012	-0.132	(-10,10)	0.133	1.009		3
Size_inflection_ComVL_2(2)_BLK4repl_2008	38.720	(10,60)	0.597	0.015		3
Size_95%width_ComVL_2(2)_BLK4repl_2008	9.094	(0.01,20)	0.386	0.042		3
Retain_L_infl_ComVL_2(2)_BLK2repl_1999	24.548	(1,60)	0.828	0.034		3
Retain_L_infl_ComVL_2(2)_BLK2repl_2009	38.121	(1,60)	0.483	0.013		3
Retain_L_width_ComVL_2(2)_BLK2repl_1999	1.467	(0,20)	0.497	0.339		3
Retain_L_width_ComVL_2(2)_BLK2repl_2009	3.004	(0,20)	0.244	0.081		3
Retain_L_asymptote_logit_ComVL_2(2)_BLK3repl_2012	1.577	(-10,10)	0.236	0.149		3
Size_inflection_ComLL_3(3)_BLK4repl_2008	47.703	(10,60)	0.501	0.011		3
Size_95%width_ComLL_3(3)_BLK4repl_2008	6.355	(0.01,20)	0.374	0.059		3
Size_DblN_peak_Video_8(8)_BLK5repl_2006	57.922	(10,72)	1.283	0.022		3
Size_DblN_peak_Video_8(8)_BLK5repl_2010	62.036	(10,72)	0.944	0.015		3
Size_DblN_peak_Video_8(8)_BLK5repl_2020	58.819	(10,72)	1.129	0.019		3

Table 18. Estimates of annual exploitation rate (total biomass killed all ages / total biomass age 1+) combined across all fleets, which was used as the proxy for annual fishing mortality rate. Estimates are provided for the SEDAR 100 Assessment and the SEDAR 43 Standard Assessment.

Year	SEDAR 100	SEDAR 43	Year	SEDAR 100	SEDAR 43
1945	0.0002	0.0003	1985	0.1207	0.1841
1946	0.0056	0.0002	1986	0.1796	0.2526
1947	0.0111	0.0012	1987	0.2372	0.2313
1948	0.0166	0.0019	1988	0.2314	0.2297
1949	0.0222	0.0038	1989	0.2781	0.2482
1950	0.0278	0.0093	1990	0.3562	0.2947
1951	0.0341	0.0130	1991	0.2867	0.2830
1952	0.0422	0.0163	1992	0.3311	0.2634
1953	0.0468	0.0179	1993	0.4402	0.2529
1954	0.0527	0.0236	1994	0.2823	0.2472
1955	0.0594	0.0247	1995	0.2908	0.2658
1956	0.0648	0.0312	1996	0.2150	0.2297
1957	0.0714	0.0365	1997	0.1970	0.2462
1958	0.0783	0.0462	1998	0.3078	0.2665
1959	0.0852	0.0507	1999	0.2684	0.2543
1960	0.0928	0.0523	2000	0.2039	0.2262
1961	0.0833	0.0370	2001	0.1965	0.2228
1962	0.0915	0.0562	2002	0.3111	0.2350
1963	0.0988	0.0633	2003	0.3270	0.2150
1964	0.1054	0.0736	2004	0.3670	0.2291
1965	0.1030	0.0543	2005	0.2962	0.1704
1966	0.1029	0.0481	2006	0.2423	0.1328
1967	0.1118	0.0554	2007	0.2908	0.1377
1968	0.1154	0.0631	2008	0.2431	0.1154
1969	0.1263	0.0689	2009	0.1596	0.0974
1970	0.1216	0.0543	2010	0.2160	0.0774
1971	0.1312	0.0607	2011	0.2487	0.1052
1972	0.1482	0.0991	2012	0.2105	0.0772
1973	0.1515	0.0892	2013	0.4229	0.1310

Table 18 Continued. Estimates of annual exploitation rate (total biomass killed all ages / total biomass age 1+) combined across all fleets, which was used as the proxy for annual fishing mortality rate. Estimates are provided for the SEDAR 100 Assessment and the SEDAR 43 Standard Assessment.

Year	SEDAR 100	SEDAR 43	Year	SEDAR 100	SEDAR 43
1974	0.1584	0.0992	2014	0.1169	
1975	0.1604	0.0963	2015	0.1316	
1976	0.1678	0.1132	2016	0.2120	
1977	0.1678	0.1275	2017	0.2245	
1978	0.1760	0.1426	2018	0.2088	
1979	0.1805	0.1514	2019	0.1855	
1980	0.1591	0.1511	2020	0.1895	
1981	0.1376	0.1652	2021	0.1696	
1982	0.1992	0.1776	2022	0.2298	
1983	0.1595	0.1646	2023	0.2019	
1984	0.0936	0.1632	2024	0.2102	

Table 19. Estimates of annual exploitation rate (total biomass killed all ages / total biomass age 1+) by fleet and combined across all fleets (Total), which was used as the proxy for annual fishing mortality rate.

Year	Recreational	Commercial Vertical Line	Commercial Longline	Shrimp Bycatch	Total
1945	0.0001	0.0000		0.0000	0.0002
1946	0.0027	0.0002		0.0028	0.0056
1947	0.0053	0.0003		0.0055	0.0111
1948	0.0079	0.0005		0.0082	0.0166
1949	0.0106	0.0007		0.0110	0.0222
1950	0.0134	0.0007		0.0137	0.0278
1951	0.0163	0.0014		0.0164	0.0341
1952	0.0194	0.0037		0.0192	0.0422
1953	0.0226	0.0023		0.0219	0.0468
1954	0.0259	0.0021		0.0247	0.0527
1955	0.0293	0.0026		0.0275	0.0594
1956	0.0332	0.0013		0.0304	0.0648
1957	0.0372	0.0010		0.0332	0.0714
1958	0.0414	0.0009		0.0360	0.0783
1959	0.0457	0.0006		0.0389	0.0852
1960	0.0502	0.0008		0.0418	0.0928
1961	0.0528	0.0004		0.0301	0.0833
1962	0.0545	0.0004		0.0366	0.0915
1963	0.0565	0.0005		0.0418	0.0988
1964	0.0588	0.0014		0.0452	0.1054
1965	0.0613	0.0015		0.0402	0.1030
1966	0.0638	0.0010		0.0382	0.1029
1967	0.0660	0.0012		0.0446	0.1118
1968	0.0687	0.0009		0.0458	0.1154
1969	0.0714	0.0016		0.0533	0.1263
1970	0.0746	0.0018		0.0452	0.1216
1971	0.0815	0.0031		0.0466	0.1312

Table 19 Continued. Estimates of annual exploitation rate (total biomass killed all ages / total biomass age 1+) by fleet and combined across all fleets (Total), which was used as the proxy for annual fishing mortality rate.

Year	Recreational	Commercial Vertical Line	Commercial Longline	Shrimp Bycatch	Total
1972	0.0885	0.0048		0.0549	0.1482
1973	0.0963	0.0042		0.0510	0.1515
1974	0.1031	0.0043		0.0509	0.1584
1975	0.1092	0.0064		0.0447	0.1604
1976	0.1079	0.0070		0.0529	0.1678
1977	0.1066	0.0050		0.0562	0.1678
1978	0.1046	0.0050		0.0664	0.1760
1979	0.1029	0.0085	0.0003	0.0688	0.1805
1980	0.1014	0.0082	0.0003	0.0491	0.1591
1981	0.0694	0.0072	0.0007	0.0603	0.1376
1982	0.1241	0.0064	0.0012	0.0676	0.1992
1983	0.0942	0.0045	0.0010	0.0598	0.1595
1984	0.0278	0.0046	0.0009	0.0604	0.0936
1985	0.0531	0.0062	0.0014	0.0600	0.1207
1986	0.1000	0.0078	0.0007	0.0711	0.1796
1987	0.1441	0.0120	0.0001	0.0811	0.2372
1988	0.1292	0.0187	0.0003	0.0832	0.2314
1989	0.1648	0.0273	0.0009	0.0850	0.2781
1990	0.2386	0.0361	0.0059	0.0757	0.3562
1991	0.1635	0.0416	0.0021	0.0796	0.2867
1992	0.2078	0.0483	0.0025	0.0725	0.3311
1993	0.3010	0.0650	0.0018	0.0724	0.4402
1994	0.1663	0.0520	0.0026	0.0614	0.2823
1995	0.1959	0.0445	0.0009	0.0495	0.2908
1996	0.1183	0.0335	0.0009	0.0623	0.2150
1997	0.1067	0.0210	0.0014	0.0679	0.1970
1998	0.2128	0.0212	0.0007	0.0731	0.3078

Table 19 Continued. Estimates of annual exploitation rate (total biomass killed all ages / total biomass age 1+) by fleet and combined across all fleets (Total), which was used as the proxy for annual fishing mortality rate.

Year	Recreational	Commercial Vertical Line	Commercial Longline	Shrimp Bycatch	Total
1999	0.1580	0.0289	0.0014	0.0802	0.2684
2000	0.1062	0.0195	0.0007	0.0774	0.2039
2001	0.1189	0.0202	0.0007	0.0567	0.1965
2002	0.2239	0.0264	0.0003	0.0604	0.3111
2003	0.2494	0.0299	0.0009	0.0468	0.3270
2004	0.3001	0.0274	0.0020	0.0375	0.3670
2005	0.2423	0.0221	0.0010	0.0307	0.2962
2006	0.1976	0.0144	0.0013	0.0290	0.2423
2007	0.2432	0.0149	0.0014	0.0313	0.2908
2008	0.2028	0.0101	0.0026	0.0276	0.2431
2009	0.1130	0.0122	0.0013	0.0330	0.1596
2010	0.1863	0.0083	0.0004	0.0210	0.2160
2011	0.2084	0.0157	0.0001	0.0245	0.2487
2012	0.1723	0.0116	0.0001	0.0265	0.2105
2013	0.3840	0.0091	0.0001	0.0297	0.4229
2014	0.0737	0.0050	0.0005	0.0377	0.1169
2015	0.0934	0.0046	0.0006	0.0330	0.1316
2016	0.1770	0.0049	0.0009	0.0291	0.2120
2017	0.1887	0.0057	0.0006	0.0295	0.2245
2018	0.1720	0.0056	0.0007	0.0306	0.2088
2019	0.1526	0.0050	0.0007	0.0272	0.1855
2020	0.1573	0.0046	0.0003	0.0273	0.1895
2021	0.1394	0.0035	0.0006	0.0261	0.1696
2022	0.2086	0.0036	0.0006	0.0170	0.2298
2023	0.1815	0.0046	0.0006	0.0152	0.2019
2024	0.1923	0.0044	0.0007	0.0129	0.2102

Table 20. Expected biomass (metric tons) for all and exploited Gray Triggerfish (1+ years), spawning stock biomass (SSB, metric tons), exploited numbers (1+ years), age-0 recruits, and SSB ratio (SSB/SSB_0) where SSB_0 = 8,816 metric tons.

Year	Biomass (all)	Biomass (exploited)	SSB	Abundance (exploited)	Recruits	SSB ratio
1945	9,967	9,758	8,817.32	43,358,700	95,743,800	1.00
1946	9,965	9,757	8,815.85	43,356,400	95,743,800	1.00
1947	9,915	9,707	8,768.12	43,259,200	95,742,500	0.99
1948	9,822	9,614	8,678.77	43,107,400	95,740,000	0.98
1949	9,693	9,485	8,553.69	42,921,100	95,736,400	0.97
1950	9,535	9,326	8,399.35	42,712,600	95,731,800	0.95
1951	9,354	9,145	8,222.98	42,490,300	95,726,400	0.93
1952	9,152	8,944	8,026.09	42,256,100	95,720,000	0.91
1953	8,926	8,718	7,804.73	42,007,000	95,712,500	0.88
1954	8,705	8,496	7,587.87	41,766,000	95,704,700	0.86
1955	8,481	8,273	7,369.04	41,525,300	95,696,300	0.84
1956	8,255	8,046	7,147.04	41,283,000	95,687,400	0.81
1957	8,035	7,827	6,931.99	41,046,500	95,678,100	0.79
1958	7,817	7,609	6,718.57	40,810,600	95,668,400	0.76
1959	7,601	7,393	6,507.03	40,575,300	95,658,100	0.74
1960	7,389	7,180	6,299.30	40,342,200	95,647,300	0.71
1961	7,179	6,971	6,094.22	40,110,000	95,635,900	0.69
1962	7,094	6,885	6,003.83	40,239,200	95,630,700	0.68
1963	6,985	6,777	5,896.86	40,130,300	95,624,200	0.67
1964	6,857	6,649	5,773.55	39,938,400	95,616,500	0.66
1965	6,720	6,511	5,640.37	39,738,400	95,607,800	0.64
1966	6,636	6,428	5,556.08	39,730,800	95,602,100	0.63
1967	6,582	6,373	5,500.26	39,752,000	95,598,200	0.62
1968	6,491	6,283	5,413.26	39,598,100	95,592,000	0.61
1969	6,402	6,194	5,327.36	39,476,300	95,585,700	0.60
1970	6,271	6,063	5,202.05	39,222,900	95,576,100	0.59
1971	6,206	5,998	5,135.17	39,252,800	95,570,800	0.58

Table 20 Continued. Expected biomass (metric tons) for all and exploited Gray Triggerfish (1+ years), spawning stock biomass (SSB, metric tons), exploited numbers (1+ years), age-0 recruits, and SSB ratio (SSB/SSB_0) where SSB_0 = 8,816 metric tons.

Year	Biomass (all)	Biomass (exploited)	SSB	Abundance (exploited)	Recruits	SSB ratio
1972	6,119	5,911	5,049.21	39,185,100	95,563,700	0.57
1973	5,969	5,761	4,905.35	38,915,100	95,551,400	0.56
1974	5,850	5,642	4,788.10	38,823,000	95,540,800	0.54
1975	5,740	5,532	4,679.01	38,734,200	95,530,500	0.53
1976	5,670	5,462	4,606.81	38,780,400	95,523,400	0.52
1977	5,583	5,376	4,523.90	38,626,100	95,514,900	0.51
1978	5,514	5,306	4,457.49	38,494,900	95,507,900	0.51
1979	5,412	5,204	4,362.52	38,224,200	95,497,600	0.50
1980	5,314	5,106	4,268.93	38,040,100	95,486,900	0.48
1981	5,625	5,147	4,301.04	38,367,900	219,287,00	0.49
1982	5,946	5,799	4,400.04	67,889,400	67,373,000	0.50
1983	6,095	5,994	4,983.84	41,852,200	46,541,600	0.56
1984	5,914	5,824	5,123.77	28,958,300	41,422,700	0.58
1985	5,721	5,545	5,020.90	22,992,200	80,581,600	0.57
1986	5,346	5,150	4,537.62	29,461,400	89,974,700	0.52
1987	5,107	4,703	4,003.87	33,104,300	185,729,00	0.45
1988	5,020	4,696	3,533.23	56,769,000	148,568,00	0.40
1989	5,263	5,140	3,898.12	56,326,800	56,781,900	0.44
1990	5,295	5,068	4,216.56	34,837,000	104,231,00	0.48
1991	4,709	4,619	3,774.40	38,534,100	41,425,700	0.43
1992	4,454	4,199	3,616.22	24,581,900	117,237,00	0.41
1993	4,000	3,822	3,037.12	37,660,000	81,486,900	0.34
1994	3,487	3,366	2,632.83	32,896,100	55,557,200	0.30
1995	3,590	3,353	2,745.89	26,113,400	108,730,00	0.31
1996	3,600	3,448	2,672.47	36,434,200	69,897,600	0.30
1997	3,763	3,659	2,958.58	30,804,700	47,729,500	0.34
1998	3,864	3,653	3,097.68	23,808,700	97,195,800	0.35

Table 20 Continued. Expected biomass (metric tons) for all and exploited Gray Triggerfish (1+ years), spawning stock biomass (SSB, metric tons), exploited numbers (1+ years), age-0 recruits, and SSB ratio (SSB/SSB_0) where SSB_0 = 8,816 metric tons.

Year	Biomass (all)	Biomass (exploited)	SSB	Abundance (exploited)	Recruits	SSB ratio
1999	3,664	3,412	2,725.79	32,506,800	115,848,00	0.31
2000	3,721	3,557	2,708.77	39,769,200	75,594,800	0.31
2001	3,995	3,827	3,068.04	33,238,600	77,243,200	0.35
2002	4,143	3,998	3,277.88	31,956,300	66,689,800	0.37
2003	3,831	3,723	3,084.27	28,367,100	49,555,200	0.35
2004	3,452	3,347	2,820.29	23,017,700	48,300,600	0.32
2005	2,996	2,890	2,425.58	20,646,100	48,852,100	0.28
2006	2,810	2,669	2,223.93	20,025,000	64,816,100	0.25
2007	2,853	2,660	2,147.96	23,667,400	88,740,000	0.24
2008	2,878	2,749	2,096.19	30,515,900	59,226,400	0.24
2009	3,138	2,975	2,369.30	26,388,400	74,617,100	0.27
2010	3,433	3,326	2,681.52	29,012,700	48,780,200	0.30
2011	3,633	3,435	2,883.81	23,818,700	90,660,500	0.33
2012	3,785	3,515	2,832.97	31,809,000	123,901,00	0.32
2013	4,290	3,913	3,006.06	42,535,100	173,091,00	0.34
2014	4,402	4,189	2,956.48	57,686,500	97,942,100	0.34
2015	5,350	5,193	4,101.33	46,665,700	72,296,600	0.47
2016	5,872	5,698	4,813.20	37,385,500	80,200,000	0.55
2017	5,975	5,607	4,810.54	35,399,100	168,770,00	0.55
2018	5,954	5,716	4,565.39	55,231,700	109,249,00	0.52
2019	6,144	5,942	4,851.28	48,229,500	92,474,600	0.55
2020	6,258	6,087	5,110.58	42,505,300	78,527,200	0.58
2021	6,186	5,998	5,152.83	37,016,900	85,989,200	0.58
2022	6,186	5,869	5,056.32	36,664,100	145,332,00	0.57
2023	5,821	5,756	4,692.82	50,255,500	30,070,300	0.53
2024	5,846	5,550	4,851.16	27,984,400	135,949,00	0.55

Table 21. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational fleet in numbers (N) and biomass (B, pounds whole weight). The expected mean weight (pounds whole weight per fish) was determined by dividing the expected landings in weights by expected landings in numbers of fish.

Year	Input N SE	Input N	Exp N	Exp B	Exp Mean Weight
1945	0.25	1,250	1,250	2,787	2.2
1946	0.25	24,709	24,709	55,089	2.2
1947	0.25	48,168	48,167	107,356	2.2
1948	0.25	71,627	71,624	159,504	2.2
1949	0.25	95,086	95,081	211,394	2.2
1950	0.25	118,545	118,536	262,866	2.2
1951	0.25	142,003	141,990	313,750	2.2
1952	0.25	165,462	165,442	363,837	2.2
1953	0.25	188,921	188,892	413,053	2.2
1954	0.25	212,380	212,340	461,469	2.2
1955	0.25	235,839	235,783	508,989	2.2
1956	0.25	261,207	261,131	559,729	2.1
1957	0.25	286,575	286,473	609,588	2.1
1958	0.25	311,943	311,807	658,491	2.1
1959	0.25	337,310	337,130	706,426	2.1
1960	0.25	362,678	362,441	753,376	2.1
1961	0.25	373,036	372,739	768,308	2.1
1962	0.25	383,394	383,005	782,660	2.0
1963	0.25	393,752	393,239	798,169	2.0
1964	0.25	404,110	403,425	814,583	2.0
1965	0.25	414,468	413,538	830,831	2.0
1966	0.25	428,263	426,956	853,087	2.0
1967	0.25	442,058	440,201	875,106	2.0
1968	0.25	455,853	453,195	897,424	2.0
1969	0.25	469,648	465,810	919,106	2.0
1970	0.25	483,443	477,883	939,342	2.0
1971	0.25	528,016	519,011	1,014,806	2.0

Table 21 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational fleet in numbers (N) and biomass (B, pounds whole weight). The expected mean weight (pounds whole weight per fish) was determined by dividing the expected landings in weights by expected landings in numbers of fish.

Year	Input N SE	Input N	Exp N	Exp B	Exp Mean Weight
1972	0.250	572,590	558,288	1,085,207	1.9
1973	0.250	617,163	594,886	1,149,522	1.9
1974	0.250	661,736	627,923	1,204,944	1.9
1975	0.250	706,310	656,432	1,250,017	1.9
1976	0.250	708,678	644,372	1,218,059	1.9
1977	0.250	711,046	629,053	1,183,524	1.9
1978	0.250	713,414	610,690	1,145,785	1.9
1979	0.250	715,782	590,369	1,105,251	1.9
1980	0.250	718,150	572,402	1,068,167	1.9
1981	0.250	594,521	395,860	737,024	1.9
1982	0.250	1,310,960	803,064	1,477,492	1.8
1983	0.250	643,902	664,752	1,147,573	1.7
1984	0.250	154,184	185,531	333,802	1.8
1985	0.250	264,952	315,519	615,345	2.0
1986	0.185	578,985	520,251	1,081,644	2.1
1987	0.250	881,861	686,561	1,414,105	2.1
1988	0.239	823,971	652,961	1,246,869	1.9
1989	0.181	1,381,620	1,010,720	1,706,883	1.7
1990	0.156	1,794,840	1,491,140	2,446,775	1.6
1991	0.230	1,279,590	895,780	1,547,297	1.7
1992	0.154	1,371,630	1,013,240	1,792,830	1.8
1993	0.188	1,011,460	1,314,210	2,365,976	1.8
1994	0.135	902,830	671,381	1,133,986	1.7
1995	0.197	1,098,140	799,701	1,333,934	1.7
1996	0.137	457,025	484,813	833,241	1.7
1997	0.115	459,115	465,195	795,220	1.7
1998	0.176	662,554	914,029	1,593,219	1.7

Table 21 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational fleet in numbers (N) and biomass (B, pounds whole weight). The expected mean weight (pounds whole weight per fish) was determined by dividing the expected landings in weights by expected landings in numbers of fish.

Year	Input N SE	Input N	Exp N	Exp B	Exp Mean Weight
1999	0.117	540,938	603,826	1,113,479	1.8
2000	0.158	465,405	426,936	771,249	1.8
2001	0.132	472,211	530,301	925,469	1.7
2002	0.233	993,396	1,040,230	1,834,530	1.8
2003	0.250	1,201,970	1,067,210	1,907,942	1.8
2004	0.162	1,066,900	1,149,910	2,066,972	1.8
2005	0.152	769,463	795,064	1,444,308	1.8
2006	0.169	530,644	592,464	1,088,430	1.8
2007	0.147	458,399	725,977	1,331,269	1.8
2008	0.154	355,584	591,979	1,196,015	2.0
2009	0.178	170,511	148,566	433,181	2.9
2010	0.220	299,264	278,834	804,611	2.9
2011	0.186	454,382	325,900	947,215	2.9
2012	0.192	231,054	162,890	479,736	2.9
2013	0.250	332,655	395,823	1,169,672	3.0
2014	0.250	144,002	77,570	222,373	2.9
2015	0.250	76,782	121,177	341,500	2.8
2016	0.187	311,420	262,475	743,277	2.8
2017	0.250	84,842	287,640	839,067	2.9
2018	0.250	207,655	182,700	653,101	3.6
2019	0.250	101,808	161,332	586,777	3.6
2020	0.250	212,253	164,638	593,856	3.6
2021	0.246	112,976	148,704	534,874	3.6
2022	0.207	211,212	226,785	824,294	3.6
2023	0.212	193,029	195,647	720,051	3.7
2024	0.199	200,695	191,002	705,342	3.7

Table 22. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Vertical Line fleet in biomass (B, pounds whole weight) and number (N). The expected mean weight (pounds whole weight per fish) was determined by dividing the expected landings in weights by expected landings in numbers of fish. "*" indicates confidential data.

Year	Input B SE	Input B	Exp B	Exp N	Exp Mean Weight
1945	0.2	22	22	7	3.3
1946	0.2	3,592	3,592	1,075	3.3
1947	0.2	7,161	7,161	2,143	3.3
1948	0.2	10,731	10,731	3,213	3.3
1949	0.2	14,300	14,300	4,287	3.3
1950	0.2	14,700	14,700	4,415	3.3
1951	0.2	28,000	28,000	8,434	3.3
1952	0.2	72,400	72,400	21,895	3.3
1953	0.2	43,600	43,600	13,251	3.3
1954	0.2	39,600	39,600	12,104	3.3
1955	0.2	46,600	46,600	14,333	3.3
1956	0.2	22,800	22,800	7,061	3.2
1957	0.2	17,400	17,400	5,427	3.2
1958	0.2	15,200	15,200	4,777	3.2
1959	0.2	10,300	10,300	3,263	3.2
1960	0.2	11,900	11,900	3,801	3.1
1961	0.2	6,500	6,500	2,094	3.1
1962	0.2	5,600	5,600	1,821	3.1
1963	0.2	7,300	7,300	2,393	3.1
1964	0.2	20,000	20,000	6,600	3.0
1965	0.2	21,650	21,650	7,186	3.0
1966	0.2	13,800	13,800	4,608	3.0
1967	0.2	17,400	17,400	5,844	3.0
1968	0.2	12,500	12,500	4,219	3.0
1969	0.2	22,300	22,300	7,560	2.9
1970	0.2	24,051	24,051	8,187	2.9
1971	0.2	40,400	40,400	13,826	2.9

Table 22 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Vertical Line fleet in biomass (B, pounds whole weight) and number (N). The expected mean weight (pounds whole weight per fish) was determined by dividing the expected landings in weights by expected landings in numbers of fish. "*" indicates confidential data.

Year	Input B SE	Input B	Exp B	Exp N	Exp Mean Weight
1972	0.200	62,600	62,601	21,558	2.9
1973	0.200	53,200	53,201	18,441	2.9
1974	0.200	53,552	53,553	18,700	2.9
1975	0.200	78,000	78,002	27,465	2.8
1976	0.200	84,500	84,502	30,011	2.8
1977	0.100	59,386	59,388	21,230	2.8
1978	0.100	58,823	58,825	21,118	2.8
1979	0.100	97,484	97,488	35,104	2.8
1980	0.100	92,776	92,777	33,522	2.8
1981	0.100	82,101	82,102	29,751	2.8
1982	0.100	81,633	81,638	29,722	2.7
1983	0.100	59,836	59,837	22,903	2.6
1984	0.100	*	*	*	2.6
1985	0.100	75,563	75,563	27,277	2.8
1986	0.060	88,853	88,857	30,026	3.0
1987	0.062	124,185	124,205	40,837	3.0
1988	0.063	193,744	193,767	66,016	2.9
1989	0.061	309,533	309,586	117,662	2.6
1990	0.061	402,652	402,773	166,068	2.4
1991	0.062	423,455	423,494	172,036	2.5
1992	0.063	447,128	447,227	175,837	2.5
1993	0.067	*	*	*	2.6
1994	0.071	385,853	385,888	153,808	2.5
1995	0.070	328,557	328,588	135,309	2.4
1996	0.072	254,607	254,614	103,105	2.5
1997	0.073	169,593	169,598	68,040	2.5
1998	0.071	170,648	170,692	67,838	2.5

Table 22 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Vertical Line fleet in biomass (B, pounds whole weight) and number (N). The expected mean weight (pounds whole weight per fish) was determined by dividing the expected landings in weights by expected landings in numbers of fish. "*" indicates confidential data.

Year	Input B SE	Input B	Exp B	Exp N	Exp Mean Weight
1999	0.074	216,844	216,871	82,630	2.6
2000	0.055	152,492	152,498	57,921	2.6
2001	0.056	169,373	169,379	66,393	2.6
2002	0.053	231,893	231,948	91,717	2.5
2003	0.055	244,486	244,558	95,793	2.6
2004	0.057	201,293	201,406	78,380	2.6
2005	0.056	140,258	140,290	54,114	2.6
2006	0.059	84,688	84,697	32,185	2.6
2007	0.065	*	*	*	2.6
2008	0.064	61,209	61,224	17,385	3.5
2009	0.056	69,251	69,253	15,989	4.3
2010	0.054	52,364	52,370	12,325	4.2
2011	0.052	103,093	103,108	24,310	4.2
2012	0.052	71,281	71,286	16,640	4.3
2013	0.052	62,005	62,238	14,405	4.3
2014	0.050	36,239	36,239	8,545	4.2
2015	0.050	40,745	40,746	9,780	4.2
2016	0.050	47,667	47,670	11,534	4.1
2017	0.050	55,654	55,659	13,214	4.2
2018	0.050	56,281	56,287	12,933	4.4
2019	0.050	53,248	53,253	11,971	4.4
2020	0.050	48,923	48,927	11,052	4.4
2021	0.050	37,384	37,386	8,473	4.4
2022	0.050	37,163	37,170	8,334	4.5
2023	0.050	47,316	47,322	10,464	4.5
2024	0.050	43,340	43,347	9,536	4.5

Table 23. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Longline fleet in biomass (B, pounds whole weight) and number (N). The expected mean weight (pounds whole weight per fish) was determined by dividing the expected landings in weights by expected landings in numbers of fish. "*" indicates confidential data.

Year	Input B SE	Input B	Exp B	Exp N	Exp Mean Weight
1979	0.100	3,919	3,919	535	7.3
1980	0.100	3,700	3,701	506	7.3
1981	0.100	7,759	7,759	1,065	7.3
1982	0.100	15,040	15,041	2,072	7.3
1983	0.100	13,583	13,583	1,888	7.2
1984	0.100	11,683	11,683	1,643	7.1
1985	0.100	17,063	17,063	2,398	7.1
1986	0.098	8,149	8,149	1,126	7.2
1987	0.100	642	642	87	7.4
1988	0.098	2,589	2,589	345	7.5
1989	0.097	10,543	10,545	1,419	7.4
1990	0.060	*	*	*	7.1
1991	0.081	20,887	20,889	3,100	6.7
1992	0.077	23,028	23,034	3,473	6.6
1993	0.052	15,293	15,309	2,298	6.7
1994	0.051	19,424	19,426	2,918	6.7
1995	0.052	6,965	6,966	1,058	6.6
1996	0.052	6,822	6,822	1,048	6.5
1997	0.055	11,021	11,021	1,685	6.5
1998	0.051	*	*	*	6.6
1999	0.050	10,277	10,278	1,541	6.7
2000	0.051	5,770	5,770	855	6.7
2001	0.050	6,043	6,044	892	6.8
2002	0.050	*	*	*	6.7
2003	0.050	7,269	7,271	1,093	6.7
2004	0.050	*	*	*	6.6
2005	0.050	*	*	*	6.7

Table 23 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Longline fleet in biomass (B, pounds whole weight) and number (N). The expected mean weight (pounds whole weight per fish) was determined by dividing the expected landings in weights by expected landings in numbers of fish. "*" indicates confidential data.

Year	Input B SE	Input B	Exp B	Exp N	Exp Mean Weight
2006	0.050	*	*	*	6.7
2007	0.050	*	*	*	6.8
2008	0.050	*	*	*	6.2
2009	0.050	*	*	*	6.1
2010	0.071	*	*	*	6.0
2011	0.051	*	*	*	6.0
2012	0.050	*	*	*	6.0
2013	0.056	*	*	*	6.0
2014	0.050	4,446	4,446	742	6.0
2015	0.050	6,751	6,751	1,137	5.9
2016	0.050	*	*	*	5.9
2017	0.050	*	*	*	5.9
2018	0.050	8,417	8,418	1,401	6.0
2019	0.050	9,243	9,244	1,508	6.1
2020	0.050	3,857	3,857	625	6.2
2021	0.050	*	*	*	6.2
2022	0.050	8,117	8,119	1,315	6.2
2023	0.050	7,543	7,544	1,212	6.2
2024	0.050	8,264	8,265	1,318	6.3

Table 24. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational fleet in numbers (N) and biomass (B, pounds whole weight). Dead discards in numbers (discard mortality rate = 40%), dead discards in biomass, and mean weight (MW, pounds whole weight per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	Exp MW
1945			382	153	329	131	0.9
1946			7,550	3,020	6,496	2,598	0.9
1947			14,734	5,894	12,672	5,069	0.9
1948			21,967	8,787	18,877	7,551	0.9
1949			29,290	11,716	25,137	10,055	0.9
1950			36,734	14,694	31,473	12,588	0.9
1951			44,327	17,731	37,908	15,163	0.9
1952			52,106	20,843	44,463	17,785	0.9
1953			60,070	24,028	51,141	20,454	0.9
1954			68,194	27,277	57,924	23,168	0.8
1955			76,506	30,603	64,827	25,931	0.8
1956			85,621	34,248	72,375	28,949	0.8
1957			94,924	37,970	80,043	32,018	0.8
1958			104,438	41,775	87,850	35,139	0.8
1959			114,172	45,669	95,795	38,319	0.8
1960			124,131	49,652	103,886	41,555	0.8
1961			129,177	51,671	107,815	43,127	0.8
1962			134,114	53,645	111,732	44,694	0.8
1963			138,409	55,363	115,238	46,094	0.8
1964			142,651	57,060	118,648	47,459	0.8
1965			147,183	58,873	122,215	48,887	0.8
1966			153,104	61,241	126,924	50,770	0.8
1967			158,680	63,472	131,437	52,576	0.8
1968			163,940	65,576	135,701	54,280	0.8
1969			169,270	67,708	139,958	55,984	0.8
1970			174,748	69,899	144,235	57,693	0.8
1971			191,454	76,581	157,714	63,085	0.8

Table 24 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational fleet in numbers (N) and biomass (B, pounds whole weight). Dead discards in numbers (discard mortality rate = 40%), dead discards in biomass, and mean weight (MW, pounds whole weight per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	Exp MW
1972			207,557	83,023	170,721	68,288	0.8
1973			223,056	89,222	183,094	73,237	0.8
1974			238,036	95,214	194,897	77,960	0.8
1975			251,540	100,616	205,490	82,195	0.8
1976			248,939	99,576	203,103	81,240	0.8
1977			243,785	97,514	198,817	79,527	0.8
1978			237,162	94,865	193,317	77,327	0.8
1979			230,031	92,012	187,289	74,915	0.8
1980			224,543	89,817	182,461	72,984	0.8
1981	0.542	67,195	155,360	62,144	126,338	50,534	0.8
1982	0.545	223,188	354,306	141,722	272,685	109,074	0.8
1983	0.540	815,540	304,845	121,938	241,432	96,571	0.8
1984	0.604	221,934	67,377	26,951	57,490	22,996	0.9
1985	0.516	256,072	94,783	37,913	84,351	33,740	0.9
1986	0.745	119,173	153,244	61,297	132,932	53,173	0.9
1987	0.607	209,715	244,942	97,977	199,013	79,604	0.8
1988	0.416	251,017	302,936	121,174	227,486	90,993	0.8
1989	0.246	389,037	532,150	212,860	400,923	160,371	0.8
1990	0.332	533,592	684,770	273,910	549,127	219,646	0.8
1991	0.407	162,744	356,890	142,760	292,813	117,125	0.8
1992	0.174	281,864	395,220	158,090	326,800	130,721	0.8
1993	0.178	593,145	535,150	214,060	425,712	170,285	0.8
1994	0.202	175,527	324,317	129,727	250,147	100,059	0.8
1995	0.282	174,520	356,339	142,534	285,547	114,219	0.8
1996	0.363	252,162	209,084	83,634	165,686	66,275	0.8
1997	0.269	193,024	206,200	82,480	163,700	65,479	0.8
1998	0.294	592,497	366,101	146,441	301,352	120,542	0.8

Table 24 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational fleet in numbers (N) and biomass (B, pounds whole weight). Dead discards in numbers (discard mortality rate = 40%), dead discards in biomass, and mean weight (MW, pounds whole weight per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	Exp MW
1999	0.193	320,289	255,713	102,285	187,413	74,964	0.7
2000	0.308	167,603	216,324	86,530	153,298	61,319	0.7
2001	0.190	341,247	267,213	106,885	194,070	77,627	0.7
2002	0.387	732,106	469,690	187,870	347,748	139,098	0.7
2003	0.434	433,876	468,520	187,410	347,516	139,006	0.7
2004	0.293	651,386	495,120	198,050	369,596	147,833	0.7
2005	0.211	331,300	332,716	133,086	248,864	99,545	0.7
2006	0.295	256,773	249,219	99,688	185,382	74,152	0.7
2007	0.275	622,104	326,393	130,556	237,898	95,160	0.7
2008	0.408	217,540	87,435	34,974	82,658	33,063	0.9
2009	0.153	416,421	510,394	204,157	770,460	308,184	1.5
2010	0.353	501,986	910,236	364,094	1,404,418	561,764	1.5
2011	0.238	507,923	1,013,210	405,284	1,577,670	631,066	1.6
2012	0.236	687,101	1,197,270	478,910	2,138,426	855,366	1.8
2013	0.453	832,930	3,080,797	1,232,317	5,357,436	2,142,968	1.7
2014	0.141	590,101	689,578	275,831	1,144,780	457,911	1.7
2015	0.234	1,834,190	1,098,463	439,387	1,820,522	728,208	1.7
2016	0.159	2,257,350	2,144,005	857,605	3,701,546	1,480,612	1.7
2017	0.157	3,517,870	2,069,500	827,800	3,734,505	1,493,795	1.8
2018	0.309	2,085,990	2,048,400	819,360	3,785,152	1,514,060	1.8
2019	0.179	1,997,510	1,977,418	790,968	3,530,505	1,412,205	1.8
2020	0.174	1,793,090	2,129,542	851,822	3,793,051	1,517,217	1.8
2021	0.241	2,491,380	1,795,086	718,033	3,269,859	1,307,944	1.8
2022	0.214	3,002,520	2,520,045	1,008,015	4,686,484	1,874,580	1.9
2023	0.131	2,168,010	2,129,413	851,763	3,958,285	1,583,314	1.9
2024	0.215	2,167,260	2,279,388	911,758	4,118,146	1,647,252	1.8

Table 25. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Commercial Vertical Line fleet in numbers (N) and biomass (B, pounds whole weight). Dead discards in numbers (discard mortality rate = 40%), dead discards in biomass, and mean weight (MW, pounds whole weight per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	Exp MW
1945			0	0	0	0	0.5
1946			2	1	1	0	0.5
1947			5	2	2	1	0.5
1948			7	3	4	1	0.5
1949			10	4	5	2	0.5
1950			10	4	5	2	0.5
1951			19	8	10	4	0.5
1952			51	20	26	10	0.5
1953			31	12	16	6	0.5
1954			29	12	15	6	0.5
1955			35	14	17	7	0.5
1956			18	7	9	4	0.5
1957			14	6	7	3	0.5
1958			13	5	6	2	0.5
1959			9	4	4	2	0.5
1960			11	4	5	2	0.5
1961			6	2	3	1	0.5
1962			5	2	3	1	0.5
1963			7	3	3	1	0.5
1964			20	8	9	4	0.5
1965			22	9	10	4	0.5
1966			14	6	7	3	0.5
1967			18	7	9	3	0.5
1968			13	5	6	2	0.5
1969			24	10	11	4	0.5
1970			26	10	12	5	0.5
1971			45	18	21	8	0.5

Table 25 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Commercial Vertical Line fleet in numbers (N) and biomass (B, pounds whole weight). Dead discards in numbers (discard mortality rate = 40%), dead discards in biomass, and mean weight (MW, pounds whole weight per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	Exp MW
1972			71	29	33	13	0.5
1973			62	25	29	11	0.5
1974			64	26	30	12	0.5
1975			97	39	45	18	0.5
1976			107	43	49	20	0.5
1977			77	31	35	14	0.5
1978			77	31	35	14	0.5
1979			129	51	59	23	0.5
1980			125	50	57	23	0.5
1981			111	44	50	20	0.5
1982			156	62	65	26	0.4
1983			107	43	49	19	0.5
1984			63	25	32	13	0.5
1985			55	22	29	11	0.5
1986			69	27	33	13	0.5
1987			134	53	60	24	0.5
1988			376	151	154	62	0.4
1989			783	313	333	134	0.4
1990			783	313	362	143	0.5
1991			680	272	306	123	0.5
1992			612	245	289	117	0.5
1993			951	381	403	161	0.4
1994			871	348	377	152	0.4
1995			629	252	284	115	0.5
1996			503	202	214	86	0.4
1997			319	128	143	57	0.4
1998			251	100	117	47	0.5

Table 25 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Commercial Vertical Line fleet in numbers (N) and biomass (B, pounds whole weight). Dead discards in numbers (discard mortality rate = 40%), dead discards in biomass, and mean weight (MW, pounds whole weight per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	Exp MW
1999			2,188	875	1,742	697	0.8
2000	0.368	1,502	1,861	745	1,426	571	0.8
2001	0.368	1,632	2,244	898	1,763	705	0.8
2002	0.368	2,076	2,756	1,102	2,213	884	0.8
2003	0.368	2,264	2,743	1,097	2,209	884	0.8
2004	0.368	2,039	2,190	876	1,774	710	0.8
2005	0.368	1,565	1,452	581	1,179	472	0.8
2006	0.368	1,149	854	342	690	276	0.8
2007	0.368	1,078	929	372	734	294	0.8
2008	0.368	977	801	320	403	161	0.5
2009	0.289	15,977	13,383	5,353	26,740	10,696	2.0
2010	0.289	11,642	10,283	4,113	21,031	8,412	2.0
2011	0.289	14,944	19,345	7,738	40,331	16,132	2.1
2012	0.180	24,285	18,552	7,421	46,604	18,642	2.5
2013	0.121	13,827	16,606	6,642	40,500	16,200	2.4
2014	0.121	12,367	11,237	4,495	25,677	10,271	2.3
2015	0.121	12,920	13,225	5,290	30,260	12,104	2.3
2016	0.121	15,412	14,528	5,811	34,809	13,924	2.4
2017	0.121	13,869	14,742	5,897	37,345	14,938	2.5
2018	0.170	10,380	13,241	5,296	34,601	13,841	2.6
2019	0.170	11,735	12,476	4,991	32,088	12,835	2.6
2020	0.170	9,866	11,964	4,786	30,478	12,191	2.5
2021	0.170	9,729	8,868	3,547	23,090	9,236	2.6
2022	0.170	10,060	8,242	3,297	22,027	8,811	2.7
2023	0.170	11,630	10,107	4,043	27,181	10,872	2.7
2024	0.170	10,412	9,544	3,818	25,190	10,076	2.6

Table 26. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Shrimp Bycatch fleet in numbers (N) and biomass (B, pounds whole weight). All discards are assumed dead. Mean weight (MW, pounds whole weight per fish) was determined by dividing the expected discards in weights by the expected discards in numbers. Input and expected super-period median values are 1,612,310 and 1,314,100, respectively.

Year	Input N SE	Input N	Exp N	Exp B	Exp MW
1945			1,865	977	0.5
1946			114,652	60,030	0.5
1947	0.121	26,000	225,734	117,838	0.5
1948	0.121	152,257	336,089	174,437	0.5
1949	0.121	278,515	445,095	229,078	0.5
1950	0.121	404,772	552,665	281,404	0.5
1951	0.121	531,029	658,750	331,136	0.5
1952	0.121	657,287	763,183	377,839	0.5
1953	0.121	783,544	866,142	421,739	0.5
1954	0.121	909,802	967,723	463,208	0.5
1955	0.121	1,036,060	1,067,840	502,049	0.5
1956	0.121	1,162,320	1,166,560	538,494	0.5
1957	0.121	1,288,570	1,263,890	572,716	0.5
1958	0.121	1,414,830	1,359,790	604,599	0.4
1959	0.121	1,541,090	1,454,300	634,265	0.4
1960	0.121	1,667,350	1,547,390	661,767	0.4
1961	0.121	1,190,580	1,104,700	462,889	0.4
1962	0.121	1,446,180	1,342,420	555,992	0.4
1963	0.121	1,648,900	1,522,540	624,218	0.4
1964	0.121	1,783,630	1,636,080	663,015	0.4
1965	0.121	1,577,330	1,442,750	576,801	0.4
1966	0.121	1,494,620	1,367,620	541,137	0.4
1967	0.121	1,747,940	1,593,780	626,341	0.4
1968	0.121	1,795,860	1,628,040	634,388	0.4
1969	0.121	2,096,460	1,883,410	727,386	0.4
1970	0.121	1,772,490	1,586,270	604,604	0.4
1971	0.121	1,831,360	1,633,180	615,958	0.4

Table 26 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Shrimp Bycatch fleet in numbers (N) and biomass (B, pounds whole weight). All discards are assumed dead. Mean weight (MW, pounds whole weight per fish) was determined by dividing the expected discards in weights by the expected discards in numbers. Input and expected super-period median values are 1,612,310 and 1,314,100, respectively.

Year	Input N SE	Input N	Exp N	Exp B	Exp MW
1972	0.121	2,179,220	1,918,720	715,670	0.4
1973	0.121	2,025,270	1,766,100	648,024	0.4
1974	0.121	2,029,790	1,753,430	633,473	0.4
1975	0.121	1,781,700	1,532,930	545,465	0.4
1976	0.121	2,141,520	1,807,280	637,181	0.4
1977	0.121	2,305,560	1,904,840	666,344	0.3
1978	0.121	2,800,400	2,233,870	776,641	0.3
1979	0.121	2,932,030	2,291,190	788,729	0.3
1980	0.121	1,999,860	1,625,570	553,115	0.3
1981	0.121	2,450,010	2,011,100	684,169	0.3
1982	0.121	2,410,730	3,546,440	864,253	0.2
1983	0.121	2,374,920	2,165,420	790,579	0.4
1984	0.121	2,530,670	1,578,110	774,904	0.5
1985	0.113	2,788,040	1,299,200	733,389	0.6
1986	0.112	3,105,700	1,941,990	806,975	0.4
1987	0.117	3,637,800	2,445,090	840,586	0.3
1988	0.134	3,182,320	3,659,340	861,812	0.2
1989	0.129	3,049,860	3,770,700	963,598	0.3
1990	0.107	2,955,210	2,343,660	845,602	0.4
1991	0.117	2,982,040	2,602,190	810,546	0.3
1992	0.191	3,037,810	1,658,610	671,313	0.4
1993	0.113	2,969,450	2,339,710	610,018	0.3
1994	0.124	2,210,770	1,652,780	455,294	0.3
1995	0.143	2,045,920	1,123,520	365,872	0.3
1996	0.152	2,300,480	1,800,190	473,407	0.3
1997	0.171	2,664,580	1,745,950	547,658	0.3
1998	0.135	2,191,770	1,575,500	588,803	0.4

Table 26 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Shrimp Bycatch fleet in numbers (N) and biomass (B, pounds whole weight). All discards are assumed dead. Mean weight (MW, pounds whole weight per fish) was determined by dividing the expected discards in weights by the expected discards in numbers. Input and expected super-period median values are 1,612,310 and 1,314,100, respectively.

Year	Input N SE	Input N	Exp N	Exp B	Exp MW
1999	0.114	2,140,670	2,166,330	602,926	0.3
2000	0.102	1,988,940	2,396,270	607,170	0.3
2001	0.11	1,612,310	1,567,300	478,619	0.3
2002	0.113	1,789,790	1,673,260	532,447	0.3
2003	0.141	1,376,500	1,173,710	384,184	0.3
2004	0.125	1,203,720	789,037	276,748	0.4
2005	0.127	938,446	570,287	195,873	0.3
2006	0.121	841,732	513,234	170,527	0.3
2007	0.246	602,379	637,152	183,308	0.3
2008	0.266	670,997	668,989	167,287	0.3
2009	0.123	966,090	718,907	216,714	0.3
2010	0.094	540,201	510,544	153,907	0.3
2011	0.102	758,124	520,503	185,421	0.4
2012	0.134	704,027	708,740	205,284	0.3
2013	0.141	484,904	1,053,310	255,791	0.2
2014	0.085	660,309	1,553,650	348,125	0.2
2015	0.114	463,600	1,247,010	377,627	0.3
2016	0.119	437,446	962,309	365,870	0.4
2017	0.111	477,767	950,504	364,812	0.4
2018	0.096	424,302	1,397,910	385,057	0.3
2019	0.084	387,097	1,120,790	355,905	0.3
2020	0.085	368,221	1,023,340	366,963	0.4
2021	0.094	392,766	871,785	345,460	0.4
2022	0.076	257,934	577,763	220,541	0.4
2023	0.107	250,215	649,728	192,496	0.3
2024			342,475	157,931	0.5

Table 27. Observed (Obs) versus expected (Exp) standardized index of fishing effort for the Shrimp Bycatch fleet.

Year	Shrimp Effort (Obs)	Shrimp Effort (Exp)	Shrimp Effort (SE)
1945	0.001	0.001	0.2
1946	0.068	0.068	0.2
1947	0.135	0.135	0.2
1948	0.202	0.203	0.2
1949	0.269	0.270	0.2
1950	0.336	0.337	0.2
1951	0.403	0.405	0.2
1952	0.470	0.472	0.2
1953	0.537	0.539	0.2
1954	0.604	0.607	0.2
1955	0.671	0.675	0.2
1956	0.738	0.742	0.2
1957	0.805	0.810	0.2
1958	0.872	0.878	0.2
1959	0.939	0.945	0.2
1960	1.006	1.013	0.2
1961	0.719	0.722	0.2
1962	0.873	0.878	0.2
1963	0.995	1.001	0.2
1964	1.077	1.083	0.2
1965	0.952	0.957	0.2
1966	0.902	0.906	0.2
1967	1.055	1.059	0.2
1968	1.084	1.087	0.2
1969	1.266	1.267	0.2
1970	1.070	1.069	0.2
1971	1.105	1.101	0.2

Table 27 Continued. Observed (Obs) versus expected (Exp) standardized index of fishing effort for the Shrimp Bycatch fleet.

Year	Shrimp Effort (Obs)	Shrimp Effort (Exp)	Shrimp Effort (SE)
1972	1.315	1.302	0.2
1973	1.223	1.204	0.2
1974	1.225	1.199	0.2
1975	1.075	1.047	0.2
1976	1.293	1.238	0.2
1977	1.392	1.311	0.2
1978	1.690	1.552	0.2
1979	1.770	1.604	0.2
1980	1.207	1.130	0.2
1981	1.479	1.378	0.2
1982	1.455	1.379	0.2
1983	1.434	1.375	0.2
1984	1.528	1.481	0.2
1985	1.580	1.551	0.2
1986	1.825	1.789	0.2
1987	2.017	1.981	0.2
1988	1.737	1.704	0.2
1989	1.832	1.789	0.2
1990	1.849	1.852	0.2
1991	1.813	1.844	0.2
1992	1.800	1.858	0.2
1993	1.662	1.689	0.2
1994	1.312	1.333	0.2
1995	1.126	1.148	0.2
1996	1.286	1.308	0.2
1997	1.485	1.511	0.2
1998	1.766	1.814	0.2

Table 27 Continued. Observed (Obs) versus expected (Exp) standardized index of fishing effort for the Shrimp Bycatch fleet.

Year	Shrimp Effort (Obs)	Shrimp Effort (Exp)	Shrimp Effort (SE)
1999	1.728	1.787	0.2
2000	1.532	1.594	0.2
2001	1.198	1.246	0.2
2002	1.352	1.416	0.2
2003	1.078	1.116	0.2
2004	0.901	0.930	0.2
2005	0.716	0.739	0.2
2006	0.654	0.677	0.2
2007	0.688	0.707	0.2
2008	0.563	0.568	0.2
2009	0.699	0.706	0.2
2010	0.455	0.459	0.2
2011	0.567	0.574	0.2
2012	0.567	0.579	0.2
2013	0.639	0.646	0.2
2014	0.690	0.691	0.2
2015	0.686	0.694	0.2
2016	0.672	0.685	0.2
2017	0.695	0.712	0.2
2018	0.647	0.659	0.2
2019	0.607	0.604	0.2
2020	0.639	0.634	0.2
2021	0.623	0.623	0.2
2022	0.413	0.415	0.2
2023	0.334	0.336	0.2
2024	0.321	0.322	0.2

Table 28. Observed (Obs) versus expected (Exp) standardized fishery-dependent catch-per-unit-effort (CPUE) indices for the Recreational fleet (SRHS). SEs shown below include extra SD estimated (**Table 17**) and added to the input SE values for each year (**Table 16**).

Year	Recreational SRHS (Obs)	Recreational SRHS (Exp)	Recreational SRHS (SE)
1986	0.871	1.142	0.357
1987	0.725	0.987	0.367
1988	0.877	1.018	0.356
1989	1.309	1.290	0.341
1990	2.048	1.403	0.310
1991	1.470	1.244	0.312
1992	1.481	1.092	0.315
1993	1.245	0.863	0.320
1994	1.271	0.881	0.333
1995	1.047	0.935	0.361
1996	1.122	0.928	0.359
1997	1.060	1.012	0.356
1998	0.942	0.971	0.346
1999	1.000	0.853	0.337
2000	0.542	0.909	0.365
2001	0.448	1.063	0.373
2002	0.624	1.064	0.368
2003	0.732	0.971	0.360
2004	0.797	0.858	0.348
2005	1.022	0.754	0.332
2006	0.642	0.697	0.354
2007	0.726	0.664	0.356

Table 29. Observed (Obs) versus expected (Exp) standardized survey indices. SEs shown below include extra SD estimated (**Table 17**) and added to the input SE values for each year (**Table 16**).

Yr	Trawl Early (Obs)	Trawl Early (Exp)	Trawl Early (SE)	Trawl Late (Obs)	Trawl Late (Exp)	Trawl Late (SE)	Video (Obs)	Video (Exp)	Video (SE)
1987	0.568	0.903	0.606						
1988	0.495	1.571	0.602						
1989	0.945	1.547	0.573						
1990	0.455	0.931	0.603						
1991	2.121	1.036	0.534						
1992	0.274	0.656	0.619						
1993	1.380	1.012	0.558				0.403	0.580	0.303
1994	1.454	0.912	0.542				0.907	0.523	0.571
1995	0.920	0.720	0.568				0.454	0.529	0.407
1996	0.655	1.011	0.598				0.365	0.561	0.272
1997	0.570	0.852	0.586				1.534	0.607	0.314
1998	0.105	0.638	0.726						
1999	1.237	0.887	0.553						
2000	1.961	1.104	0.538						
2001	2.971	0.928	0.551						
2002	0.942	0.869	0.564				0.876	0.639	0.731
2003	0.498	0.774	0.597						
2004	0.502	0.625	0.577				0.634	0.537	0.452
2005	0.835	0.569	0.563				0.611	0.485	0.329
2006	1.380	0.559	0.563				1.167	0.879	0.291
2007	0.770	0.663	0.578				1.016	0.844	0.305
2008	0.961	0.869	0.537				1.056	0.866	0.271
2009				0.619	0.668	0.346	1.448	0.970	0.252
2010				0.700	0.731	0.376	0.721	0.606	0.274
2011				0.906	0.598	0.370	0.818	0.638	0.265
2012				1.212	0.798	0.351	0.670	0.664	0.264
2013				0.643	1.052	0.406	0.553	0.625	0.249

Table 29 Continued. Observed (Obs) versus expected (Exp) standardized survey indices. SEs shown below include extra SD estimated (**Table 17**) and added to the input SE values for each year (**Table 16**).

Yr	Trawl Early (Obs)	Trawl Early (Exp)	Trawl Early (SE)	Trawl Late (Obs)	Trawl Late (Exp)	Trawl Late (SE)	Video (Obs)	Video (Exp)	Video (SE)
2014				0.930	1.455	0.358	0.648	0.707	0.221
2015				1.265	1.183	0.340	0.835	0.910	0.212
2016				0.479	0.936	0.406	1.231	1.056	0.182
2017				0.757	0.883	0.366	1.043	1.098	0.190
2018				0.985	1.381	0.354	1.013	1.107	0.200
2019				1.146	1.218	0.366	0.880	1.132	0.195
2020				0.781	1.069	0.433	1.820	1.823	0.283
2021				1.319	0.932	0.359	1.610	1.859	0.208
2022				1.863	0.921	0.355	1.776	1.799	0.200
2023				1.724	1.267	0.346	1.668	1.742	0.194
2024				0.670	0.713	0.393	1.242	1.682	0.193

Table 30. Summary of correlated parameters with correlation coefficients exceeding 0.7 for the SEDAR 100 AP Model.

Parameter 1	Parameter 2	Correlation
Size_DblN_ascend_se_Shrimp_Bycatch_4(4)	Size_DblN_peak_Shrimp_Bycatch_4(4)	0.870
Size_DblN_ascend_se_TrawlLate_7(7)	Size_DblN_peak_TrawlLate_7(7)	0.866
Retain_L_asymptote_logit_ComVL_2(2)_BLK3repl_2012	Retain_L_infl_ComVL_2(2)_BLK2repl_2009	0.850
Size_95%width_ComVL_2(2)_BLK4repl_2008	Size_inflection_ComVL_2(2)_BLK4repl_2008	0.823
Size_DblN_peak_Rec_1(1)_BLK4repl_2008	Size_DblN_ascend_se_Rec_1(1)	0.768
Retain_L_width_Rec_1(1)_BLK1repl_2009	Retain_L_infl_Rec_1(1)_BLK1repl_2009	0.752
Retain_L_width_ComVL_2(2)_BLK2repl_2009	Retain_L_infl_ComVL_2(2)_BLK2repl_2009	0.737
Size_95%width_ComVL_2(2)	Size_inflection_ComVL_2(2)	0.731
Size_DblN_peak_Video_8(8)_BLK5repl_2010	Size_DblN_ascend_se_Video_8(8)	0.720
Size_DblN_descend_se_Rec_1(1)_BLK4repl_2008	Size_DblN_peak_Rec_1(1)_BLK4repl_2008	-0.762
VonBert_K_Fem_GP_1	L_at_Amin_Fem_GP_1	-0.849
VonBert_K_Fem_GP_1	L_at_Amax_Fem_GP_1	-0.850
Size_DblN_descend_se_TrawlLate_7(7)	Size_DblN_top_logit_TrawlLate_7(7)	-0.855
Retain_L_width_ComVL_2(2)_BLK2repl_1999	Retain_L_infl_ComVL_2(2)_BLK2repl_1999	-0.881

Table 31. Retrospective analysis and retrospective forecast spawning stock biomass (SSB, metric tons) and fishing mortality (F, total biomass killed all ages / total biomass age 1+) for the last five terminal years and combined (grey rows) for the SEDAR 100 AP Model. N = number of observations to compute each statistic. Values within -0.15 to 0.2 are highlighted in green and are considered acceptable levels of retrospective bias. Values outside the acceptable range of -0.15 to 0.2 for longer-lived species (Hurtado-Ferro et al. 2015) are highlighted in red and indicate an undesirable retrospective pattern. See Carvalho et al. (2021) for additional details.

Quantity	Statistic	Value	N
SSB (-2023)	Mohn's Rho	0.043	1
SSB (-2022)	Mohn's Rho	-0.125	1
SSB (-2021)	Mohn's Rho	-0.064	1
SSB (-2020)	Mohn's Rho	-0.210	1
SSB (-2019)	Mohn's Rho	0.028	1
SSB (-Combined)	Mohn's Rho	-0.065	5
SSB (-2023)	Forecast bias	0.079	1
SSB (-2022)	Forecast bias	0.015	1
SSB (-2021)	Forecast bias	0.018	1
SSB (-2020)	Forecast bias	-0.219	1
SSB (-2019)	Forecast bias	0.051	1
SSB (-Combined)	Forecast bias	-0.011	5
F (-2023)	Mohn's Rho	-0.059	1
F (-2022)	Mohn's Rho	0.015	1
F (-2021)	Mohn's Rho	0.117	1
F (-2020)	Mohn's Rho	0.142	1
F (-2019)	Mohn's Rho	-0.240	1
F (-Combined)	Mohn's Rho	-0.005	5
F (-2023)	Forecast bias	-0.066	1
F (-2022)	Forecast bias	4.437	1
F (-2021)	Forecast bias	1.274	1
F (-2020)	Forecast bias	5.787	1
F (-2019)	Forecast bias	4.518	1
F (-Combined)	Forecast bias	3.190	5

Table 32. Joint residual summary statistics for the SEDAR 100 AP Model. N = number of observations to compute each statistic. RMSE = root mean squared error (as a percentage), with values above 30% for individual or joint residuals (grey rows) highlighted in red if present and acceptable values below 30% highlighted in green. See Carvalho et al. (2021) for additional details.

Quantity	Statistic	Value	N
Index			
Shrimp Effort	RMSE(%)	2.7	80
Recreational SRHS CPUE	RMSE(%)	32.3	22
Trawl Early Survey	RMSE(%)	69.4	22
Trawl Late Survey	RMSE(%)	37.1	16
Combined Video Survey	RMSE(%)	29.4	27
Combined	RMSE(%)	32.3	167
Conditional Age-at-Length			
Recreational	RMSE(%)	8.9	21
Commercial Vertical Line	RMSE(%)	11.5	17
Commercial Longline	RMSE(%)	12.3	14
Combined	RMSE(%)	10.8	52
Length			
Recreational	RMSE(%)	1.6	44
Commercial Vertical Line	RMSE(%)	4.4	35
Commercial Longline	RMSE(%)	5	24
Shrimp Bycatch	RMSE(%)	17.1	40
Trawl Early Survey	RMSE(%)	10.8	22
Trawl Late Survey	RMSE(%)	17.1	16
Combined Video Survey	RMSE(%)	8.7	23
Combined	RMSE(%)	10.4	204

Table 33. Runs tests summary statistics for the SEDAR 100 AP Model. N = number of observations to compute each statistic. P-values greater than 0.05% (in green) provide support for randomly distributed residuals whereas p-values less than 0.05% (in red) indicate non-randomly distributed residuals. See Carvalho et al. (2021) for additional details.

Quantity	Statistic	Value	N
Index			
Shrimp Effort	p-value	0	80
Recreational SRHS CPUE	p-value	0.042	22
Trawl Early Survey	p-value	0.042	22
Trawl Late Survey	p-value	0.203	16
Combined Video Survey	p-value	0.002	27
Conditional Age-at-Length			
Recreational	p-value	0.066	14
Commercial Vertical Line	p-value	0.047	17
Commercial Longline	p-value	0.658	21
Length			
Recreational	p-value	0	44
Commercial Vertical Line	p-value	0.002	35
Commercial Longline	p-value	0.89	24
Shrimp Bycatch	p-value	0.001	40
Trawl Early Survey	p-value	0.036	22
Trawl Late Survey	p-value	0.609	16
Combined Video Survey	p-value	0.619	23

Table 34. Hindcast cross-validation summary statistics for the SEDAR 100 AP Model. N = number of observations to compute each statistic. MASE = mean absolute scaled error, with individual or joint values (grey rows) < 1 (in green) indicative of superior prediction skill over a naïve baseline forecast (random walk) and values > 1 (in red) indicative of poor prediction skill. See Carvalho et al. (2021) for additional details.

Quantity	Statistic	Value	N
Index			
Shrimp Effort	MASE	43.21	5
Recreational SRHS CPUE	MASE		0
Trawl Early Survey	MASE		0
Trawl Late Survey	MASE	2.061	5
Combined Video Survey	MASE	2.796	5
Joint	MASE	9.332	15
Length			
Recreational	MASE	1.148	5
Commercial Vertical Line	MASE	0.778	5
Commercial Longline	MASE	0.836	3
Shrimp Bycatch	MASE	5.711	4
Trawl Early Survey	MASE		0
Trawl Late Survey	MASE	0.92	5
Combined Video Survey	MASE	2.758	5
Joint	MASE	1.483	27

Table 35. Summary of key model building steps towards the SEDAR 100 AP Model and associated convergence diagnostics (NLL = negative log-likelihood; CV = coefficient of variation). Note that steps within each model progression are not shown due to the vast number of intermediate runs conducted.

Model Name	Description	NLL	Gradient	Estimated Parameters (Bounded)	Parameters with CV>1
1_SEDAR43	SEDAR 43 Base Model	225	0.0331	410 (0)	28
2_SEDAR43_3.3	SEDAR 43 Base Model converted to 3.30.21	225	0.0035	411 (0)	28
3_Continuity	Step 2 + update all data streams (except age composition)	313	0.0019	477 (1)	22
4_3+UpdatedAge	Step 3 + updated age data	920	11.4730	467 (3)	24
5_4+LengthData&Sel	Step 4 + use length data & length-based selectivity	12,679	247.005	489 (3)	34
6_5+UpdateM	Step 5 + update natural mortality	12,647	0.4127	489 (1)	36
7_6+UpdateGrowth	Step 6 + update growth	10,880	0.0403	489 (2)	26
8_7+ShrimpSel	Step 7 + estimate length-based selectivity for shrimp	10,630	0.6675	495 (2)	32
9_8+DiscMort	Step 8 + update discard mortality to 40%	10,643	0.3269	495 (2)	31
10_9+TVRetention	Step 9 + allow time-varying retention parameters	9,287	0.2434	515 (2)	30
11_10+CAAL	Step 10 + switch to conditional age-at-length	15,696	0.6513	515 (2)	25
12_11+EstGrowth (priors)	Step 11 + estimate Growth (priors on L_{Amin}, $L\infty$, and K)	14,820	0.2044	520 (0)	25
13_12+SepLongline	Step 12 + separate commercial longline	15,922	0.0660	568 (0)	26
14_13+CollapseFleets	Step 13 + collapse fleets-as-areas	13,819	0.0203	382 (0)	22
15_14+DiscNums	Step 14 + fit to discards in numbers	14,112	0.0280	382 (1)	20

Table 35 Continued. Summary of key model building steps towards the SEDAR 100 AP Model and associated convergence diagnostics (NLL = negative log-likelihood; CV = coefficient of variation). Note that steps within each model progression are not shown due to the vast number of intermediate runs conducted.

Model Name	Description	NLL	Gradient	Estimated Parameters (Bounded)	Parameters with CV>1
16_15+TVRecSel	Step 15 + fit time-varying recreational selectivity (peak)	14,074	0.0413	383 (2)	18
17_16+TVComVL Sel	Step 16 + fit time-varying commercial vertical line selectivity (inflection)	13,987	0.1617	380 (1)	21
18_17+TVComLLSel	Step 17 + fit time-varying commercial longline selectivity (inflection)	13,892	0.0152	381 (2)	18
19_18+ExtraSD Indices	Step 18 + estimate extra SD for indices of abundance	13,536	0.0253	384 (0)	22
20_19+FixSteep0.99	Step 19 + fix steepness as 0.99	13,543	0.0617	383 (0)	18
21_20+FixSigmaR0.6	Step 20 + fix SigmaR at 0.6	13,551	0.0380	382 (0)	15
22_21+RecDevSum Zero	Step 21 + constrain recruitment deviations to sum to 0	13,654	0.1010	382 (0)	23
23_22+TVVideoSel	Step 22 + time-varying video selectivity (peak)	13,503	0.0384	256 (0)	18
24_23+EstBase RecRet	Step 23 + estimate base recreational retention	13,768	0.0023	261 (0)	19
25_24+CapRec LandingsSE	Step 24 + cap large recreational landings SE	13,788	0.0858	261 (0)	18
26_25+TVRecSel (other)	Step 25 + time-varying recreational retention (estimate other parameters)	13,715	0.0127	270 (1)	20
27_26+TVComSel (other)	Step 26 + time-varying commercial retention (estimate other parameters)	13,652	0.0055	272 (0)	21
28_27+EstGrowth (no_priors)	Step 27 + estimate growth without priors	13,582	0.0054	268 (0)	20

Table 36. Summary of key model building steps towards the SEDAR 100 AP Model and associated key estimates and derived quantities. ln(R_0) = virgin recruitment (log-scale), SSB defined in number of eggs for steps 1-7 and metric tons (mt) thereafter, Recr = recruitment. SSB ratio was calculated as annual SSB divided by SSB_0. Note that steps within each model progression are not shown due to the vast number of intermediate runs conducted.

Model Name	Steep-ness	*SigmaR*	ln(R_0)	Virgin SSB	Virgin Recr (1,000s)	SSB ratio Start	SSB ratio End
1_SEDAR43	0.46	0.36	9.76	3.24E+10	17,340	1	0.19
2_SEDAR43_3.3	0.46	0.36	9.76	3.24 E+10	17,340	1	0.19
3_Continuity	1.00	0.40	9.67	2.97 E+10	15,898	1	0.99
4_3+UpdatedAge	0.48	0.81	10.72	8.42 E+10	45,025	1	1.19
5_4+LengthData&Sel	0.99	0.42	8.97	1.47 E+10	7,876	1	0.73
6_5+UpdateM	1.00	0.42	9.15	1.51 E+10	9,426	1	0.80
7_6+UpdateGrowth	0.36	0.57	10.81	2.69 E+10	49,306	1	0.42
8_7+ShrimpSel	0.35	0.45	11.06	27,075	63,531	1	0.33
9_8+DiscMort	0.40	0.43	11.08	27,648	64,876	1	0.43
10_9+TVRetention	0.52	0.44	10.50	15,505	36,383	1	0.50
11_10+CAAL	0.52	0.38	10.50	15,439	36,228	1	0.50
12_11+EstGrowth (priors)	0.59	0.36	10.78	12,103	48,210	1	0.60
13_12+SepLongline	0.52	0.39	11.11	15,143	66,941	1	0.58
14_13+CollapseFleets	0.42	0.43	11.38	20,042	87,242	1	0.43
15_14+DiscNums	0.47	0.42	11.25	17,736	76,597	1	0.54
16_15+TVRecSel	0.43	0.46	11.43	20,383	92,394	1	0.50
17_16+TVComVLSel	0.40	0.46	11.46	21,819	94,744	1	0.44

Table 36 Continued. Summary of key model building steps towards the SEDAR 100 AP Model and associated key estimates and derived quantities. ln(R_0) = virgin recruitment (log-scale), SSB defined in number of eggs for steps 1-7 and metric tons (mt) thereafter, Recr = recruitment. SSB ratio was calculated as annual SSB divided by SSB_0. Note that steps within each model progression are not shown due to the vast number of intermediate runs conducted.

Model Name	Steep-ness	*SigmaR*	ln(R_0)	Virgin SSB	Virgin Recr (1,000s)	SSB ratio Start	SSB ratio End
18_17+TVComLLSel	0.41	0.54	12.14	22,164	187,007	1	0.41
19_18+ExtraSDIndices	0.39	0.50	11.57	23,864	105,541	1	0.29
20_19+FixSteep0.99	0.99	0.83	11.26	17,250	77,877	1	0.47
21_20+FixSigmaR0.6	0.99	0.60	11.05	14,260	62,683	1	0.56
22_21+RecDevSumZero	0.99	0.60	10.82	11,166	49,778	1	0.82
23_22+TVVideoSel	0.99	0.60	11.09	11,529	65,174	1	0.67
24_23+EstBaseRecRet	0.99	0.60	11.04	10,738	62,462	1	0.61
25_24+CapRecLandings SE	0.99	0.60	11.04	10,674	62,291	1	0.62
26_25+TVRecSel(other)	0.99	0.60	11.00	10,420	60,023	1	0.59
27_26+TVComSel (other)	0.99	0.60	11.02	10,206	61,230	1	0.60
28_27+EstGrowth (no_priors)	0.99	0.60	11.47	8,817	95,744	1	0.55

Table 37. Summary of sensitivity runs conducted for the SEDAR 100 AP Model and associated convergence diagnostics (NLL = negative log-likelihood; CV = coefficient of variation).

Description	NLL	Gradient	Estimated Parameters (Bounded)	Parameters with CV>1
SEDAR 100 AP Model	13,582	0.0054	268 (0)	20
Recreational Removals				
Replace uncertain landings estimates	13,572	0.0472	268 (0)	20
Exclude uncertain discard estimates	13,577	0.0024	268 (0)	20
Reduce removals by 40%	13,590	0.0008	268 (0)	18
Use landings log-scale SE as provided	13,565	0.0003	268 (0)	19
Landings log-scale SE of 0.05	13,717	0.1407	268 (0)	21
Discard Mortality				
26% for all fleets	13,585	0.1634	268 (0)	19
60% for all fleets	13,580	0.0267	268 (0)	20
Shrimp Bycatch				
None	13,695	0.0147	187 (0)	21
Reduced by 50%	13,574	0.1710	268 (0)	18
Fit to super-period of 1984-2023	13,578	0.0379	268 (0)	19
Jackknife Indices				
No Recreational (SRHS) CPUE	13,594	0.0248	268 (0)	20
No Trawl Early Survey	13,579	0.0055	268 (0)	23
No Trawl Late Survey	13,589	0.0207	268 (0)	19
No Video Survey	13,589	0.0213	268 (0)	14

Table 37 Continued. Summary of sensitivity runs conducted for the SEDAR 100 AP Model and associated convergence diagnostics (NLL = negative log-likelihood; CV = coefficient of variation).

Description	NLL	Gradient	Estimated Parameters (Bounded)	Parameters with CV>1
Platoons				
Estimate 3 platoons	13,627	0.0756	268 (0)	26
Estimate 5 platoons	13,534	0.0293	268 (0)	21
Steepness				
Estimate steepness without prior	13,559	0.0409	269 (0)	17
Fishing Mortality				
Estimate annual Fs for all fleets and use uncertainty estimates	13,581	0.1651	394 (0)	20
Age-structured Production Model				
No recruitment deviations	1,794	0.0000	2 (0)	0
With recruitment deviations	619	0.0000	46 (0)	9
Combining Dead Discards and Landings				
Lumped dead discards and landings	13,341	0.0047	254 (0)	23
Start Year				
Start 1963	13,610	0.0126	235 (1)	21
Start 1981	13,624	0.0002	200 (1)	20

Table 38. Summary of sensitivity runs conducted for the SEDAR 100 AP Model and associated key estimates and derived quantities. ln(R_0) = virgin recruitment (log-scale), SSB defined in metric tons (mt), Recr = recruitment. SSB ratio was calculated as annual SSB divided by SSB_0.

Description	Steep-ness	*SigmaR*	ln(R_0)	Virgin SSB (mt)	Virgin Recr (1,000s)	SSB ratio Start	SSB ratio End
SEDAR 100 AP Model	0.99	0.6	11.47	8,817	95,744	1	0.55
Recreational Removals							
Replace uncertain landings estimates	0.99	0.6	11.47	8,867	96,018	1	0.55
Exclude uncertain discard estimates	0.99	0.6	11.47	8,822	95,808	1	0.56
Reduce removals by 40%	0.99	0.6	11.13	6,310	68,118	1	0.53
Use landings log-scale SE as provided	0.99	0.6	11.47	8,812	95,334	1	0.55
Landings log-scale SE of 0.05	0.99	0.6	11.59	9,792	108,419	1	0.56
Discard Mortality							
26% for all fleets	0.99	0.6	11.37	8,117	86,511	1	0.53
60% for all fleets	0.99	0.6	11.58	9,733	107,441	1	0.57
Shrimp Bycatch							
None	0.99	0.6	11.13	6,327	68,322	1	0.61
Reduced by 50%	0.99	0.6	11.33	7,712	83,569	1	0.57
Fit to super-period of 1984-2023	0.99	0.6	11.39	8,182	88,786	1	0.56
Jackknife Indices							
No Recreational (SRHS) CPUE	0.99	0.6	11.47	8,829	95,689	1	0.54
No Trawl Early Survey	0.99	0.6	11.47	8,850	96,200	1	0.55
No Trawl Late Survey	0.99	0.6	11.44	8,583	93,172	1	0.47
No Video Survey	0.99	0.6	11.55	9,614	104,014	1	0.85

Table 38 Continued. Summary of sensitivity runs conducted for the SEDAR 100 AP Model and associated key estimates and derived quantities. ln(R_0) = virgin recruitment (log-scale), SSB defined in metric tons (mt), Recr = recruitment. SSB ratio was calculated as annual SSB divided by SSB_0.

Description	Steep-ness	*SigmaR*	ln(R_0)	Virgin SSB (mt)	Virgin Recr (1,000s)	SSB ratio Start	SSB ratio End
Platoons							
Estimate 3 platoons	0.990	0.6	11.42	8,872	90,778	1.00	0.32
Estimate 5 platoons	0.990	0.6	11.46	8,861	95,052	1.00	0.25
Steepness							
Estimate steepness without prior	0.422	0.6	12.29	19,799	217,028	1.00	0.18
Fishing Mortality							
Estimate annual Fs for all fleets and use uncertainty estimates	0.990	0.6	11.47	8,816	95,747	1.00	0.55
Age-structured Production Model							
No recruitment deviations	0.990	0.6	11.41	8,323	90,373	1.00	0.51
With recruitment deviations	0.990	0.6	11.49	8,983	97,546	1.00	0.59
Combining Dead Discards and Landings							
Lumped dead discards and landings	0.990	0.6	11.71	11,270	121,679	1.00	0.55
Start Year							
Start 1963	0.990	0.6	11.46	8,706	94,511	0.28	0.55
Start 1981	0.990	0.6	11.42	8,317	90,774	0.79	0.52

Table 39. Settings used for projections.

Parameter	Value	Comment
Relative *F*		Not used due to allocations below
Selectivity	Average from 2022-2024	Fleet specific selectivity estimated over terminal three years of model
Retention	Average from 2022-2024	Fleet specific retention estimated over terminal three years of model
Recruitment	Average recruitment	Derived from the Beverton-Holt stock-recruit relationship with steepness fixed at 0.99
Interim Landings (2025-2027)	201.64 numbers (Recreational); 19.33 metric tons (Commercial Vertical Line); 3.62 metric tons (Commercial Longline)	For 2025 through 2027, used 3-year average of landings (2022-2024)
Shrimp bycatch *F*	0.034	Average F over 2022-2024
Allocation Ratio	21:79	Commercial:Recreational

Table 40. Summary of Magnuson-Stevens Reauthorization Act benchmarks and reference points **assuming mean recruitment (i.e., steepness fixed at 0.99) throughout the projection period**. Spawning Stock Biomass (SSB) is in metric tons, whereas *F* is a harvest rate (total biomass killed all ages / total biomass age 1+). An SPR proxy of 30% was specified in the SEDAR 100 AP Terms of Reference (**Section 1.2**).

Criteria	Definition	Value
Base *M*	Target *M* for fully selected ages in the Lorenzen scaling	0.36
Steepness	Steepness of the Beverton-Holt stock-recruit relationship (fixed)	0.99
Unfished Recruitment (R_0)	Unfished recruitment (1,000s)	95,750
Generation Time	Fecundity-weighted mean age	7.12
Unfished SSB (SSB_0)	Unfished spawning stock biomass (metric tons)	8,816
	Mortality Rate Criteria	
$F_{MSYproxy}$	Equilibrium *F* that achieves SPR30%	0.567
MFMT	$F_{MSYproxy}$	0.567
$F_{Current}$	Geometric mean of the last 3 years of the assessment ($F_{2022\text{-}2024}$), including shrimp bycatch fleet	0.214
$F_{Current}$/MFMT	Current stock status based on MFMT	0.377
	Biomass Criteria	
$SSB_{MSYproxy}$	Equilibrium SSB at $F_{SPR\ 30\ \%}$	2,629
MSST	0.5 * $SSB_{SPR30\%}$	1,315
$SSB_{Current}$	SSB in 2024	4,849
$SSB_{Current}/SSB_{FMSYproxy}$	Current stock status based on $SSB_{SPR30\%}$ (Equil)	1.84
$SSB_{Current}$/MSST	Current stock status based on MSST	3.69
$SSB_{Current}/SSB_0$	SSB ratio in 2024	0.55

Table 41. Comparison of equilibrium yield (million pounds whole weight) estimated from previous Gray Triggerfish assessments, the SEDAR 100 AP Model, and the two sensitivity runs which reduced recreational removals by 40% (to mimic the MRIP-FES pilot study results; Andrews 2022) and excluded shrimp bycatch. The type of assessment model used is also provided for context.

Assessment (Reference)	Model	Yield
SEDAR 9 (SEDAR 2006)	State Space Age-Structured Production Model (SS-ASPM)	1.638
SEDAR 9 Update (SEDAR 2011)	State Space Age-Structured Production Model (SS-ASPM)	0.984
SEDAR 43 (SEDAR 2015)	Stock Synthesis	2.230
SEDAR 100 AP Model	Stock Synthesis	1.014
SEDAR 100 Sensitivity Runs		
Reduced Recreational Removals by 40%	Stock Synthesis	0.718
No Shrimp Bycatch	Stock Synthesis	0.785

Table 42. Time series of fishing mortality (*F*) and SSB relative to associated biological reference points **assuming mean recruitment (i.e., steepness fixed at 0.99) throughout the projection period**. SSB is in metric tons, whereas *F* is a harvest rate (total biomass killed all ages / total biomass age 1+). Reference points include $F_{30\%SPR}$ = 0.567, $SSB_{F30\%SPR}$ = 2,629 metric tons, and $MSST_{F30\%SPR}$ = 1,315 metric tons which was calculated as (0.5) * $SSB_{F30\%SPR}$. SSB ratio was calculated as annual SSB divided by SSB_0 where SSB_0 = 8,816 metric tons. Red indicates overfishing and/or overfished states if present. An SPR proxy of 30% was specified in the SEDAR 100 AP Terms of Reference (**Section 1.2**).

Year	F	$F/F_{30\%SPR}$	SSB	$SSB/SSB_{30\%SPR}$	SSB/MSST	SSB ratio
1945	0.000	0.000	8,816	3.353	6.706	1.000
1946	0.006	0.010	8,815	3.353	6.705	1.000
1947	0.011	0.020	8,767	3.334	6.669	0.994
1948	0.017	0.029	8,678	3.300	6.601	0.984
1949	0.022	0.039	8,553	3.253	6.506	0.970
1950	0.028	0.049	8,398	3.194	6.388	0.953
1951	0.034	0.060	8,222	3.127	6.254	0.933
1952	0.042	0.074	8,025	3.052	6.104	0.910
1953	0.047	0.082	7,804	2.968	5.936	0.885
1954	0.053	0.093	7,587	2.886	5.771	0.861
1955	0.059	0.105	7,368	2.802	5.605	0.836
1956	0.065	0.114	7,146	2.718	5.436	0.811
1957	0.071	0.126	6,931	2.636	5.272	0.786
1958	0.078	0.138	6,718	2.555	5.110	0.762
1959	0.085	0.150	6,506	2.475	4.949	0.738
1960	0.093	0.164	6,299	2.396	4.791	0.714
1961	0.083	0.147	6,094	2.318	4.635	0.691
1962	0.092	0.161	6,003	2.283	4.566	0.681
1963	0.099	0.174	5,896	2.242	4.485	0.669
1964	0.105	0.186	5,773	2.196	4.391	0.655

Table 42 Continued. Time series of fishing mortality (*F*) and SSB relative to associated biological reference points **assuming mean recruitment (i.e., steepness fixed at 0.99) throughout the projection period**. SSB is in metric tons, whereas *F* is a harvest rate (total biomass killed all ages / total biomass age 1+). Reference points include $F_{30\%SPR}$ = 0.567, $SSB_{F30\%SPR}$ = 2,629 metric tons, and $MSST_{F30\%SPR}$ = 1,315 metric tons which was calculated as (0.5) * $SSB_{F30\%SPR}$. SSB ratio was calculated as annual SSB divided by SSB_0 where SSB_0 = 8,816 metric tons. Red indicates overfishing and/or overfished states if present. An SPR proxy of 30% was specified in the SEDAR 100 AP Terms of Reference (**Section 1.2**).

Year	F	$F/F_{30\%SPR}$	SSB	$SSB/SSB_{30\%SPR}$	SSB/MSST	SSB ratio
1965	0.103	0.182	5,640	2.145	4.290	0.640
1966	0.103	0.182	5,555	2.113	4.226	0.630
1967	0.112	0.197	5,500	2.092	4.183	0.624
1968	0.115	0.204	5,413	2.059	4.117	0.614
1969	0.126	0.223	5,327	2.026	4.052	0.604
1970	0.122	0.215	5,201	1.978	3.956	0.590
1971	0.131	0.231	5,135	1.953	3.906	0.582
1972	0.148	0.261	5,049	1.920	3.840	0.573
1973	0.151	0.267	4,905	1.865	3.731	0.556
1974	0.158	0.279	4,788	1.821	3.642	0.543
1975	0.160	0.283	4,678	1.779	3.559	0.531
1976	0.168	0.296	4,606	1.752	3.504	0.522
1977	0.168	0.296	4,523	1.720	3.441	0.513
1978	0.176	0.310	4,457	1.695	3.390	0.506
1979	0.180	0.318	4,362	1.659	3.318	0.495
1980	0.159	0.281	4,268	1.623	3.247	0.484
1981	0.138	0.243	4,301	1.636	3.271	0.488
1982	0.199	0.351	4,400	1.673	3.347	0.499
1983	0.160	0.281	4,983	1.895	3.791	0.565
1984	0.094	0.165	5,123	1.948	3.897	0.581

Table 42 Continued. Time series of fishing mortality (*F*) and SSB relative to associated biological reference points **assuming mean recruitment (i.e., steepness fixed at 0.99) throughout the projection period**. SSB is in metric tons, whereas *F* is a harvest rate (total biomass killed all ages / total biomass age 1+). Reference points include $F_{30\%SPR}$ = 0.567, $SSB_{F30\%SPR}$ = 2,629 metric tons, and $MSST_{F30\%SPR}$ = 1,315 metric tons which was calculated as (0.5) * $SSB_{F30\%SPR}$. SSB ratio was calculated as annual SSB divided by SSB_0 where SSB_0 = 8,816 metric tons. Red indicates overfishing and/or overfished states if present. An SPR proxy of 30% was specified in the SEDAR 100 AP Terms of Reference (**Section 1.2**).

Year	F	$F/F_{30\%SPR}$	SSB	$SSB/SSB_{30\%SPR}$	SSB/MSST	SSB ratio
1985	0.121	0.213	5,020	1.909	3.819	0.569
1986	0.180	0.317	4,537	1.726	3.451	0.515
1987	0.237	0.418	4,003	1.523	3.045	0.454
1988	0.231	0.408	3,533	1.344	2.687	0.401
1989	0.278	0.490	3,898	1.482	2.965	0.442
1990	0.356	0.628	4,217	1.604	3.207	0.478
1991	0.287	0.505	3,775	1.436	2.871	0.428
1992	0.331	0.584	3,617	1.376	2.751	0.410
1993	0.440	0.777	3,038	1.155	2.311	0.345
1994	0.282	0.498	2,633	1.001	2.003	0.299
1995	0.291	0.513	2,746	1.044	2.088	0.311
1996	0.215	0.379	2,672	1.016	2.032	0.303
1997	0.197	0.348	2,957	1.125	2.250	0.335
1998	0.308	0.543	3,096	1.178	2.355	0.351
1999	0.269	0.474	2,724	1.036	2.072	0.309
2000	0.204	0.360	2,707	1.029	2.059	0.307
2001	0.196	0.346	3,066	1.166	2.332	0.348
2002	0.311	0.548	3,277	1.246	2.493	0.372
2003	0.327	0.576	3,084	1.173	2.346	0.350
2004	0.367	0.647	2,821	1.073	2.146	0.320

Table 42 Continued. Time series of fishing mortality (*F*) and SSB relative to associated biological reference points **assuming mean recruitment (i.e., steepness fixed at 0.99) throughout the projection period**. SSB is in metric tons, whereas *F* is a harvest rate (total biomass killed all ages / total biomass age 1+). Reference points include $F_{30\%SPR}$ = 0.567, $SSB_{F30\%SPR}$ = 2,629 metric tons, and $MSST_{F30\%SPR}$ = 1,315 metric tons which was calculated as (0.5) * $SSB_{F30\%SPR}$. SSB ratio was calculated as annual SSB divided by SSB_0 where SSB_0 = 8,816 metric tons. Red indicates overfishing and/or overfished states if present. An SPR proxy of 30% was specified in the SEDAR 100 AP Terms of Reference (**Section 1.2**).

Year	F	$F/F_{30\%SPR}$	SSB	$SSB/SSB_{30\%SPR}$	SSB/MSST	SSB ratio
2005	0.296	0.522	2,427	0.923	1.846	0.275
2006	0.242	0.427	2,225	0.846	1.693	0.252
2007	0.291	0.513	2,149	0.817	1.635	0.244
2008	0.243	0.429	2,097	0.798	1.595	0.238
2009	0.160	0.282	2,370	0.901	1.803	0.269
2010	0.216	0.381	2,682	1.020	2.040	0.304
2011	0.249	0.438	2,884	1.097	2.194	0.327
2012	0.211	0.372	2,834	1.078	2.156	0.321
2013	0.423	0.747	3,006	1.143	2.287	0.341
2014	0.117	0.206	2,955	1.124	2.248	0.335
2015	0.132	0.232	4,100	1.559	3.119	0.465
2016	0.212	0.374	4,812	1.830	3.660	0.546
2017	0.224	0.396	4,809	1.829	3.658	0.546
2018	0.209	0.368	4,565	1.736	3.473	0.518
2019	0.185	0.327	4,853	1.846	3.691	0.550
2020	0.189	0.334	5,113	1.945	3.889	0.580
2021	0.169	0.299	5,155	1.961	3.922	0.585
2022	0.230	0.405	5,058	1.924	3.847	0.574
2023	0.202	0.356	4,693	1.785	3.570	0.532
2024	0.210	0.371	4,849	1.844	3.688	0.550

Table 43. Results of the OFL projection (fishing set at $F_{30\%SPR}$) **assuming mean recruitment (i.e., steepness fixed at 0.99) throughout the projection period**. Recruitment (Recr) is in 1,000s of age-0 fish, *F* is a harvest rate (total biomass killed all ages / total biomass age 1+), SSB is in metric tons, and OFL is the overfishing limit in millions of pounds whole weight. Reference points include $F_{30\%SPR}$ = 0.567, $SSB_{F30\%SPR}$ = 2,629 metric tons, and $MSST_{F30\%SPR}$ = 1,315 metric tons which was calculated as (0.5) * $SSB_{F30\%SPR}$. SSB ratio was calculated as annual SSB divided by SSB_0 where SSB_0 = 8,816 metric tons. An SPR proxy of 30% was specified in the SEDAR 100 AP Terms of Reference (**Section 1.2**).

Year	Recr	F	$F/F_{30\%SPR}$	SSB	$SSB/SSB_{30\%SPR}$	SSB/ MSST	SSB ratio	OFL
2028	95,511	0.567	1	4,463	1.697	3.394	0.506	2.081
2029	95,373	0.567	1	3,456	1.314	2.629	0.392	1.522
2030	95,275	0.567	1	2,978	1.133	2.265	0.338	1.236
2031	95,222	0.567	1	2,770	1.053	2.107	0.314	1.104
2032	95,198	0.567	1	2,686	1.021	2.043	0.305	1.050
2033	95,188	0.567	1	2,653	1.009	2.018	0.301	1.029

Table 44. Results of the ABC projection (directed *F* = 0.75 * Directed *F* at $F_{30\%SPR}$ (0.567)) **assuming mean recruitment (i.e., steepness fixed at 0.99) throughout the projection period**. Recruitment (Recr) is in 1,000s of age-0 fish, *F* is a harvest rate (total biomass killed all ages / total biomass age 1+), SSB is in metric tons, and yield in millions of pounds whole weight. Reference points include $F_{30\%SPR}$ = 0.567, $SSB_{F30\%SPR}$ = 2,629 metric tons, and $MSST_{F30\%SPR}$ = 1,315 metric tons which was calculated as (0.5) * $SSB_{F30\%SPR}$. SSB ratio was calculated as annual SSB divided by SSB_0 where SSB_0 = 8,816 metric tons. An SPR proxy of 30% was specified in the SEDAR 100 AP Terms of Reference (**Section 1.2**).

Year	Recr	F	$F/F_{30\%SPR}$	SSB	$SSB/SSB_{30\%SPR}$	SSB/ MSST	SSB ratio	Yield
2028	95,511	0.425	0.75	4,463	1.697	3.394	0.506	1.571
2029	95,437	0.425	0.75	3,861	1.468	2.937	0.438	1.322
2030	95,383	0.425	0.75	3,511	1.335	2.671	0.398	1.166
2031	95,348	0.425	0.75	3,321	1.263	2.526	0.377	1.075
2032	95,330	0.425	0.75	3,226	1.227	2.454	0.366	1.026
2033	95,320	0.425	0.75	3,180	1.210	2.419	0.361	1.003

11. Figures

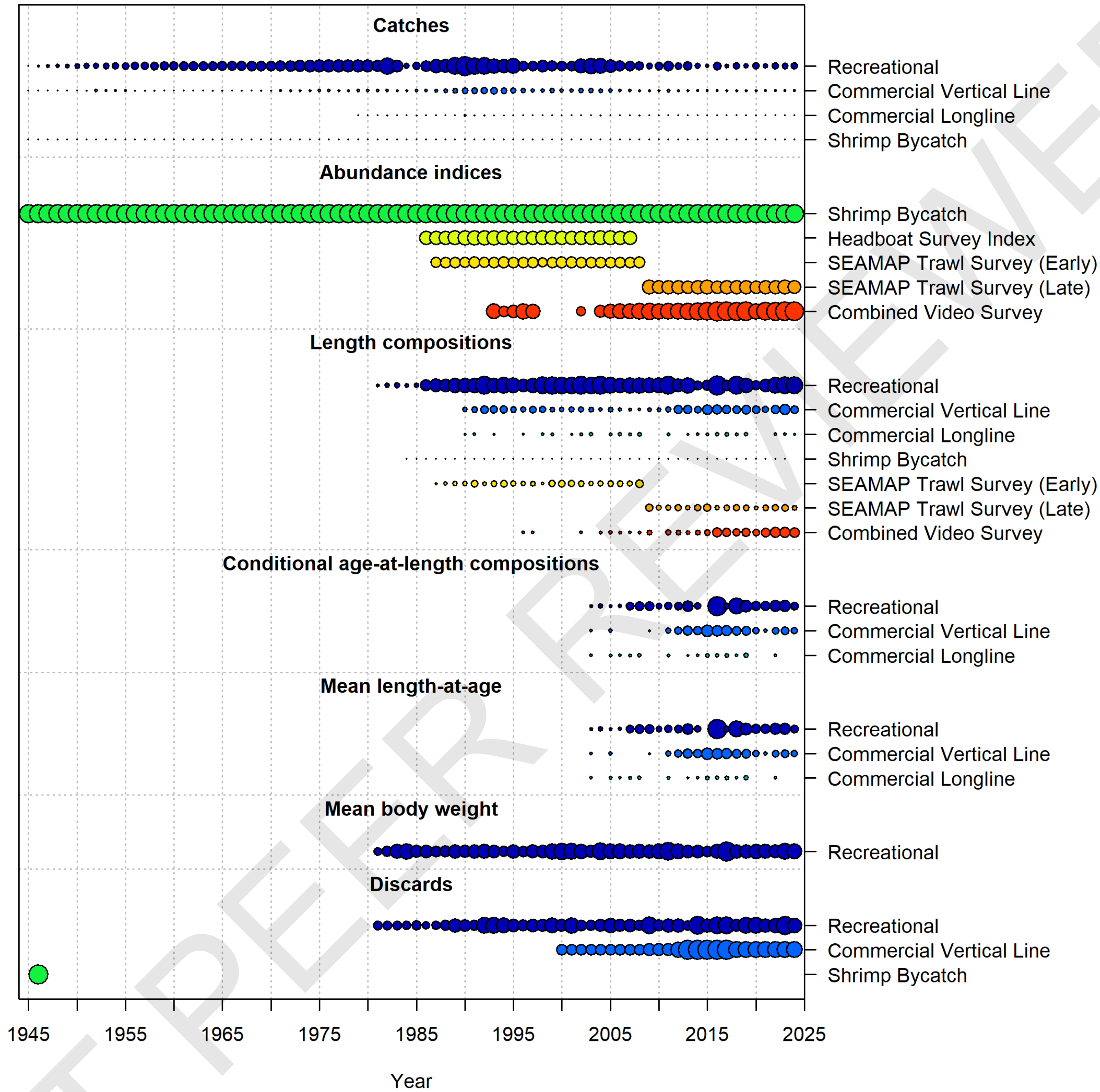


Figure 1. Data sources used in the Stock Synthesis assessment model. Circle area is relative within a data type. Circles are proportional to total catch for catches; to precision for indices, discards, and mean body weight observations; and to total sample size for compositions or mean length-at-age observations. Note that since the circles are scaled relative to the maximum within each type, the scaling between separate data types should not be compared. Shrimp bycatch estimates were aggregated and input using the super-period approach.

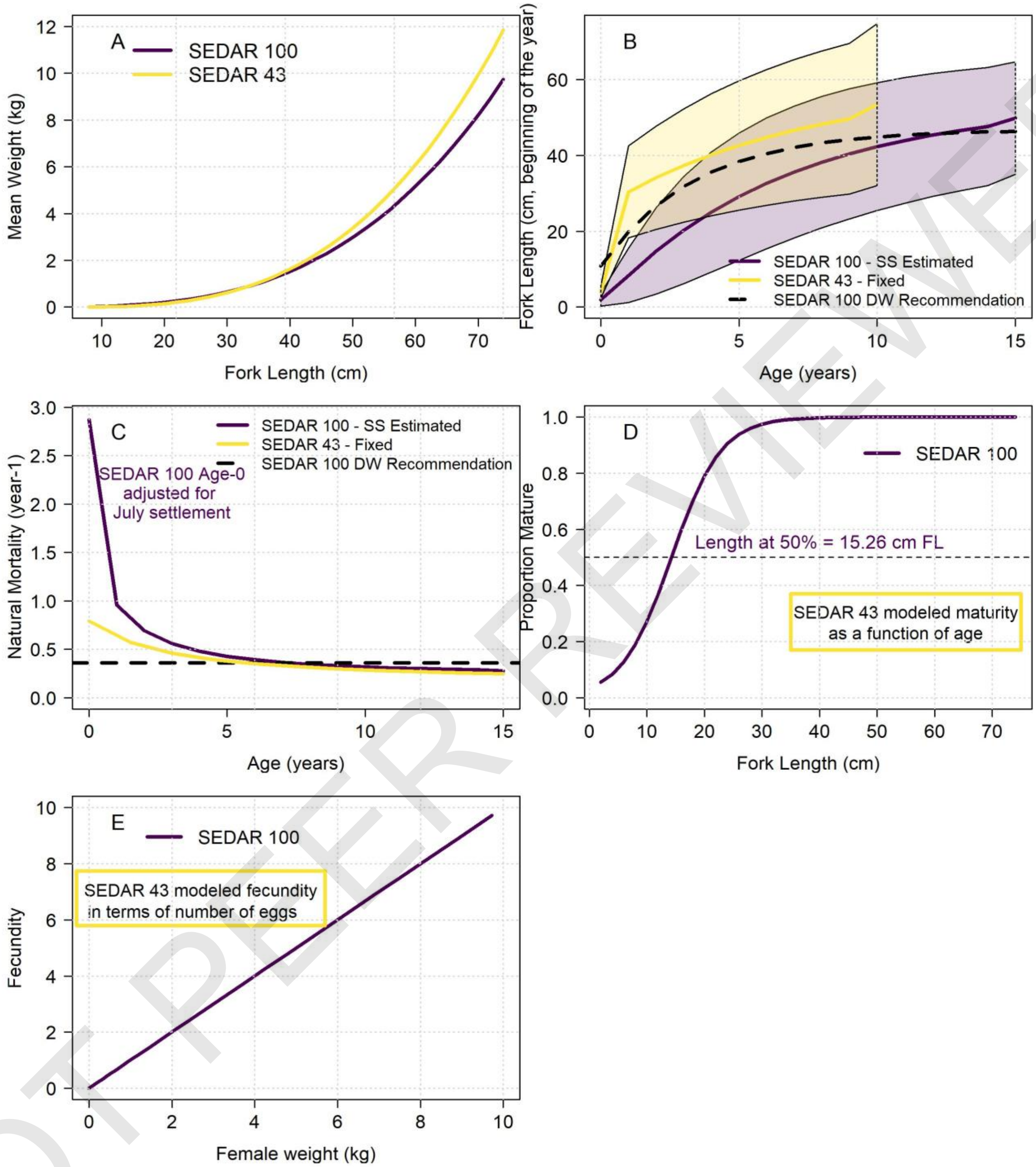


Figure 2. Comparison of life history relationships between SEDAR 100 and SEDAR 43. (A) mean weight-at-length, (B) recommended (SEDAR 100) and estimated growth curves (shaded area indicates the 95% distribution of length-at-age), (C) recommended point estimate (SEDAR 100) and natural mortality-at-age vectors, (D) maturity-at-length, and (E) fecundity at weight.

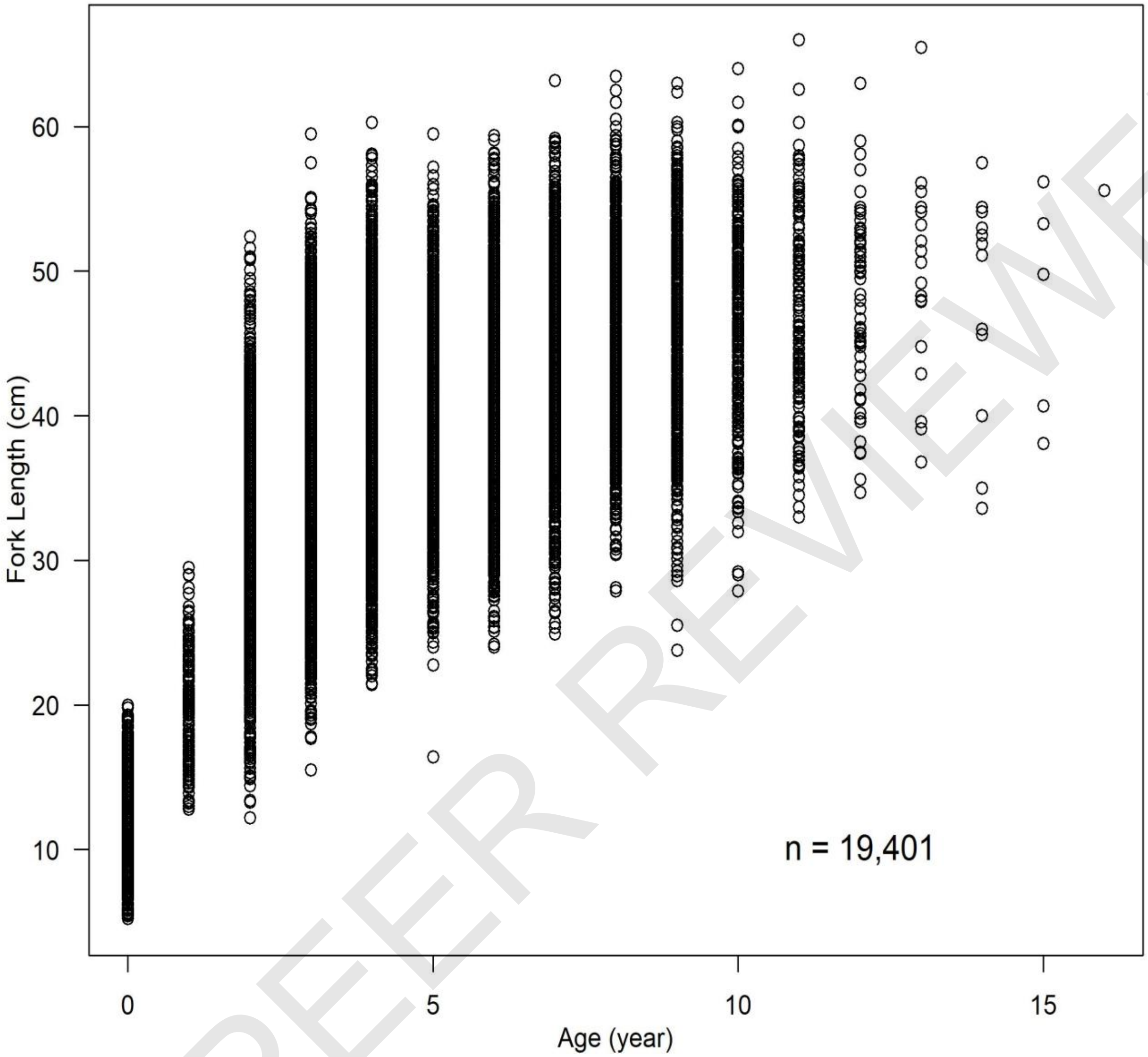


*Figure 3. Scatterplot of age (year) versus Fork Length (cm) for age samples collected from 1999 to 2024. No age samples were collected in 2001. Age samples were updated as described in **Section 2.2.2**, and data prior to this update can be found in **Figure 3 of SEDAR100-DW14**.*

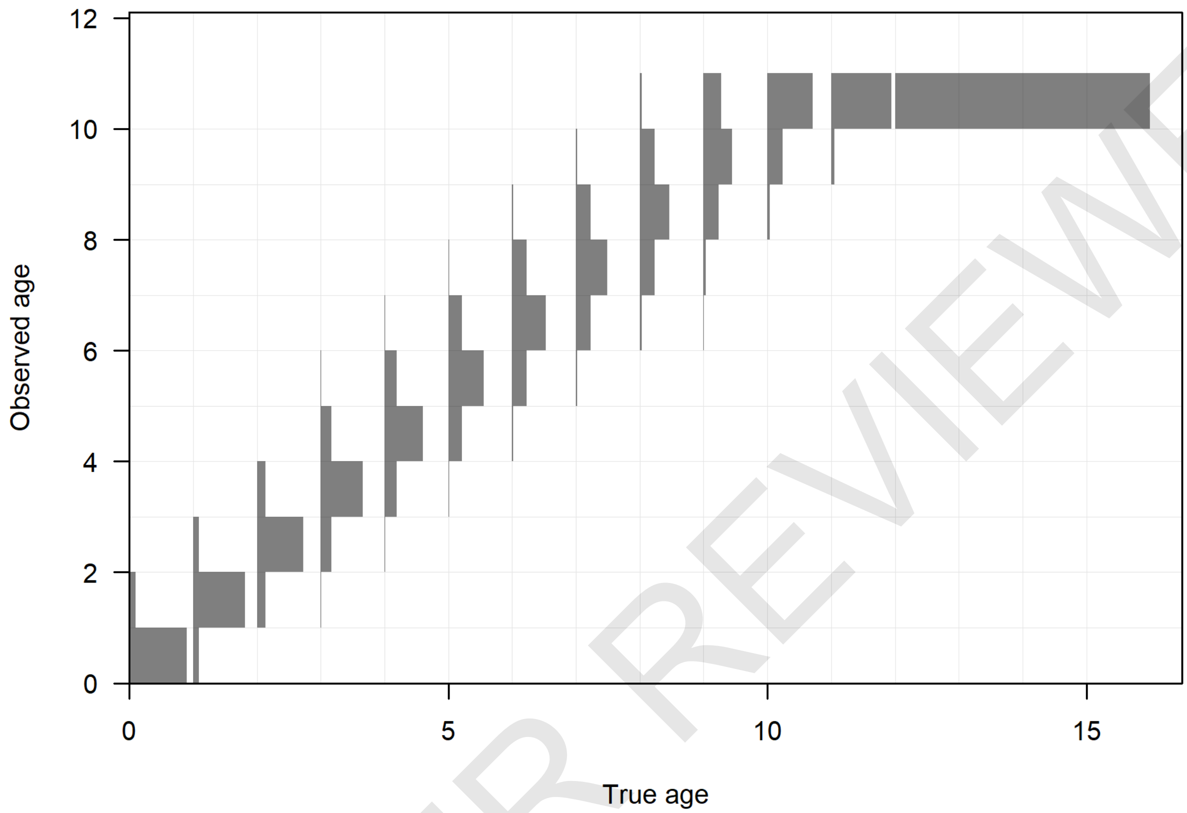


Figure 4. Distribution of observed age at true age for the ageing error matrix developed for the SEDAR 100 Assessment.

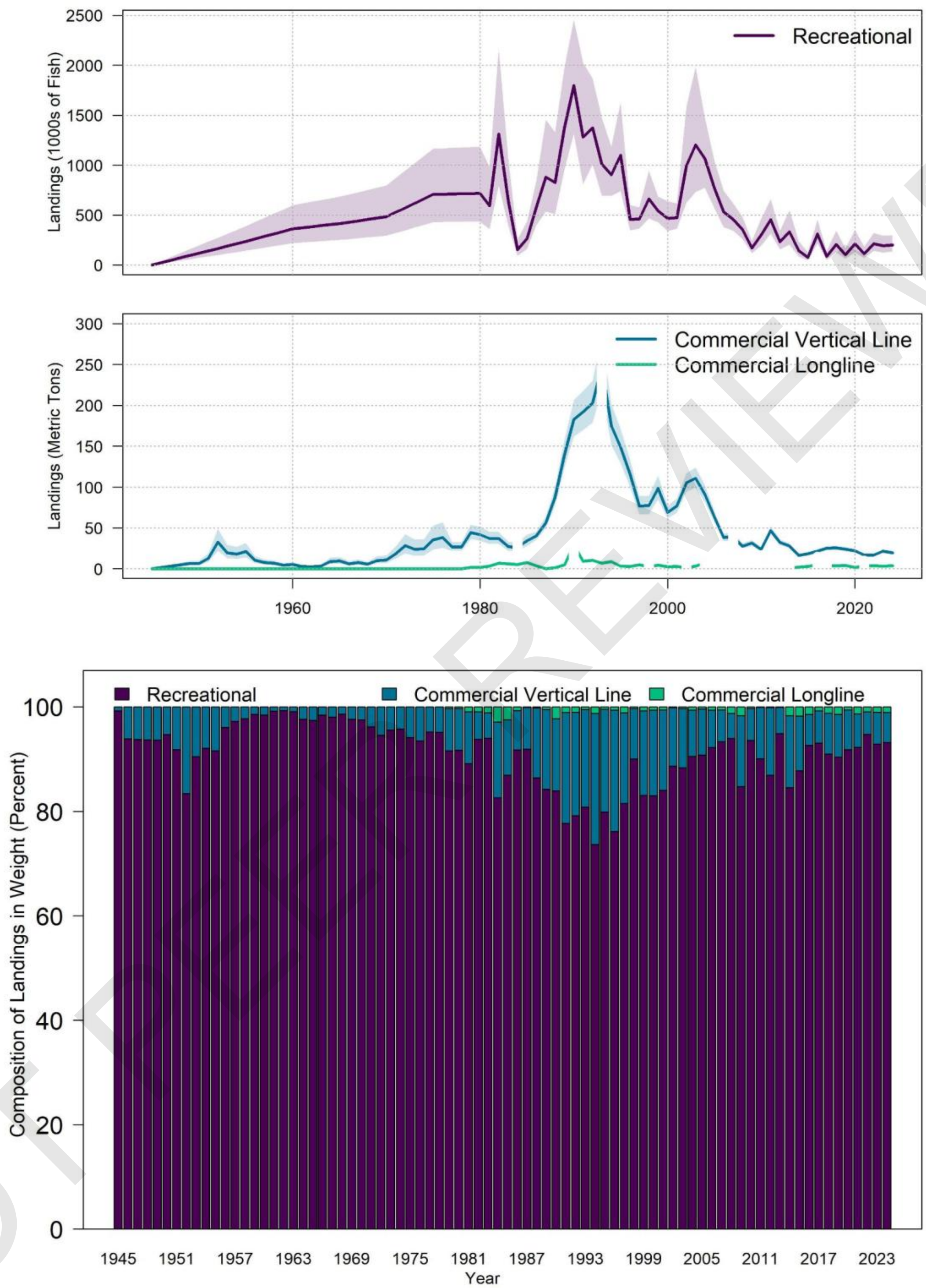


Figure 5. Observed landings by fleet (with associated error estimates) and by percent (by weight based on landings expected by Stock Synthesis). Commercial landings are input into the stock assessment model in units of metric tons. Recreational landings are shown and input in numbers (1,000s of fish). Confidential data have been excluded.

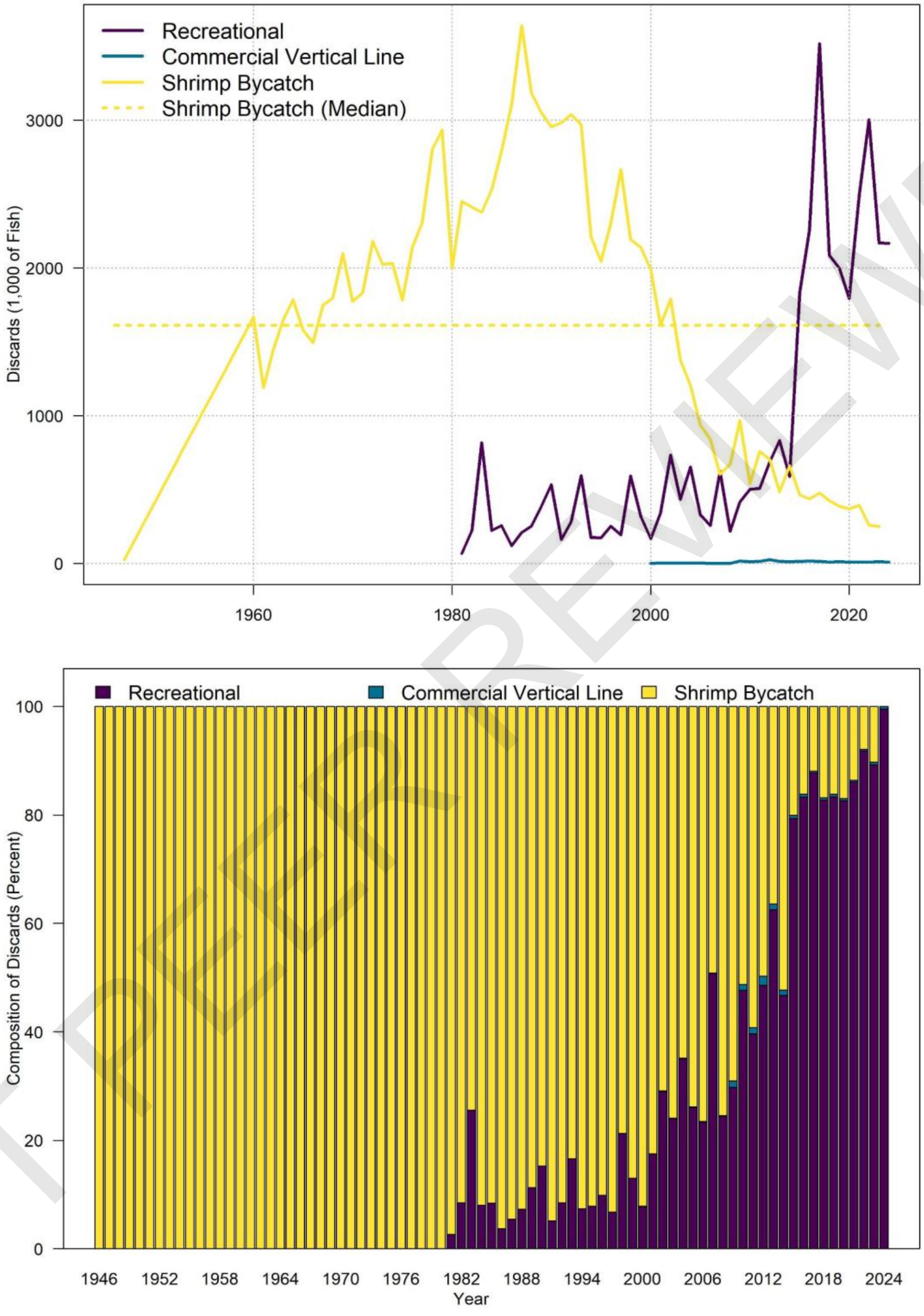


Figure 6. Observed discards by fleet and by percent. Recreational, commercial, and shrimp bycatch discards are all in numbers of fish (1,000s of fish).

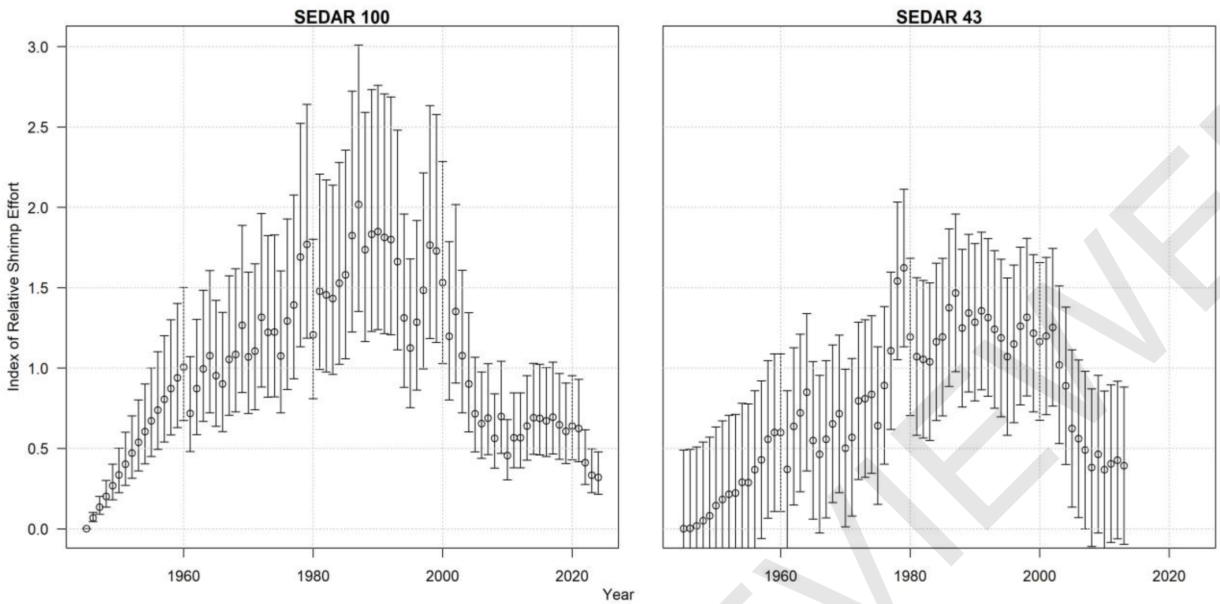


Figure 7. Comparison of the shrimp effort time series used in SEDAR 100 (assumed a lognormal distribution) and SEDAR 43 (assumed a normal distribution). Both time series have been scaled to a mean of 1.

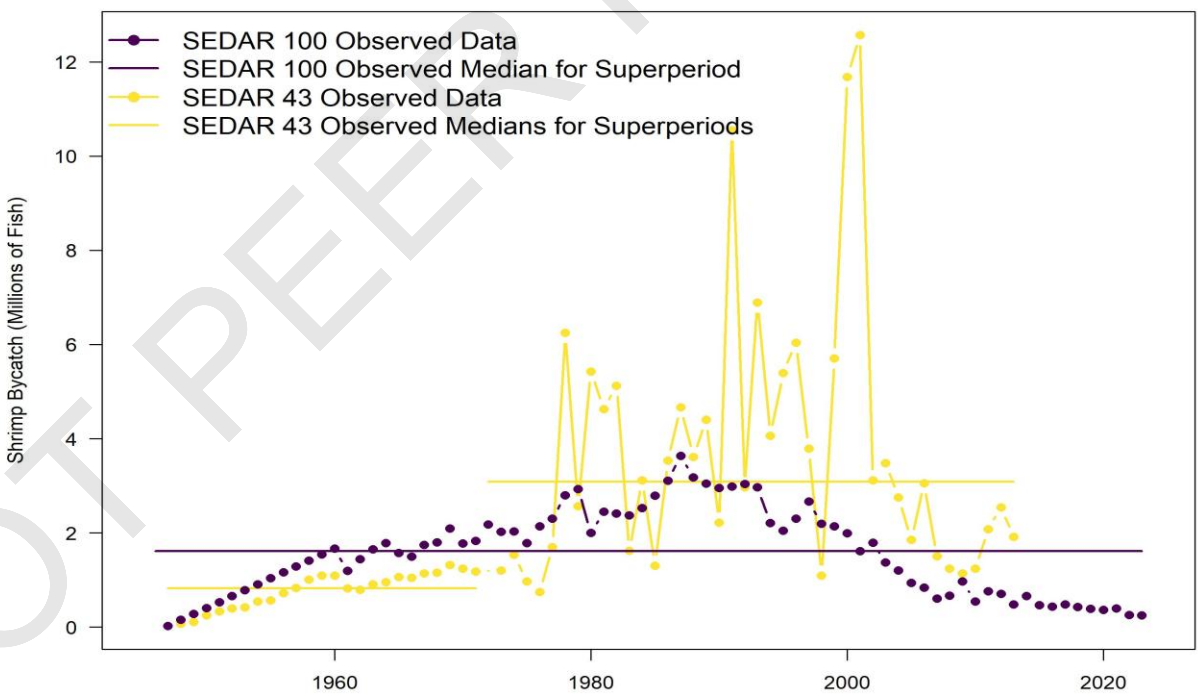


Figure 8. Comparison of the shrimp bycatch (numbers) time series used in SEDAR 100 and SEDAR 43. Median value(s) were input into the assessment model using the super-period approach.

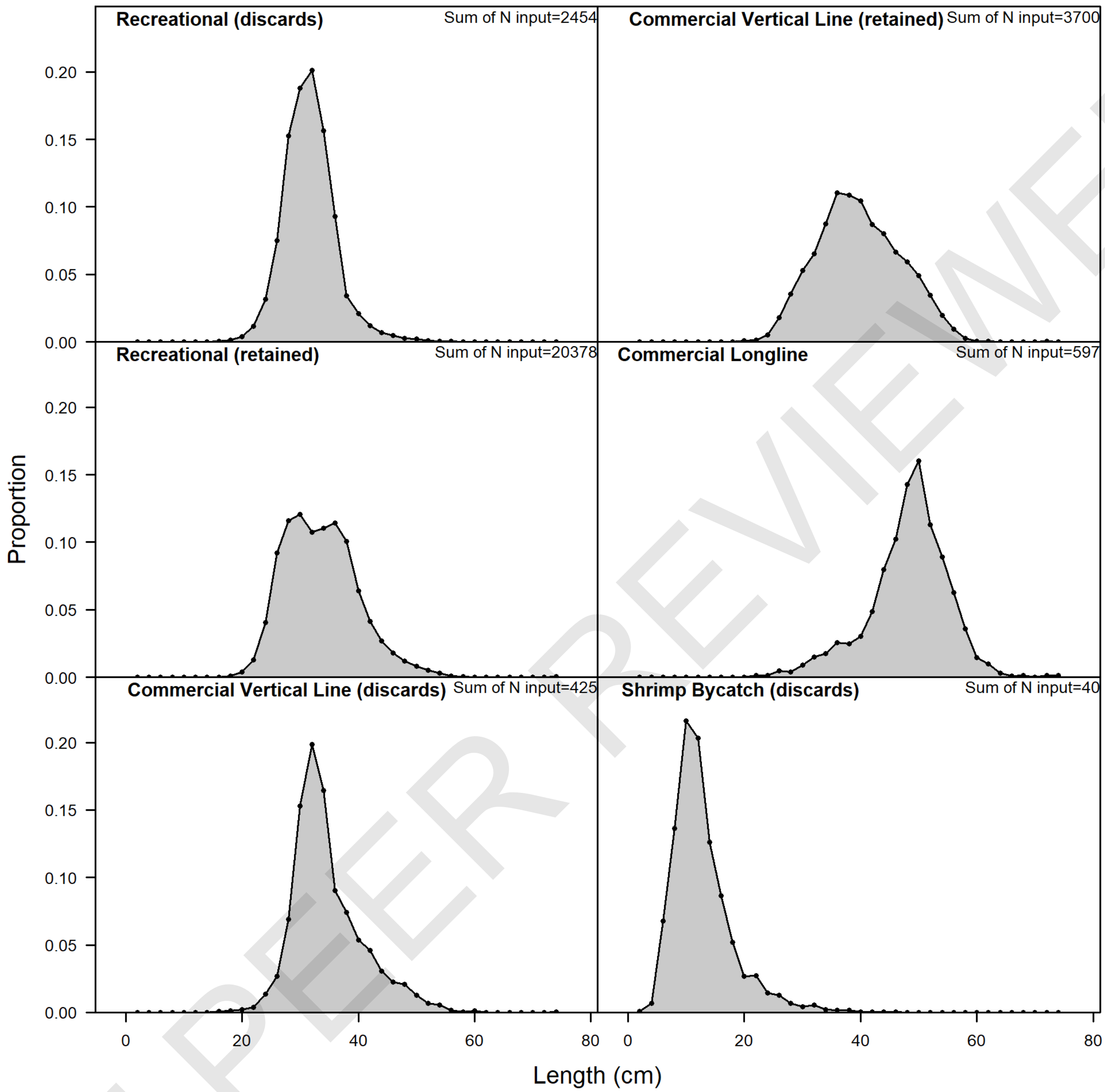


Figure 9. Length compositions aggregated across years for the recreational and commercial fleets and shrimp bycatch. 'N input' is the number of trips for the fleets (N input in terms of trips was not available for shrimp bycatch).

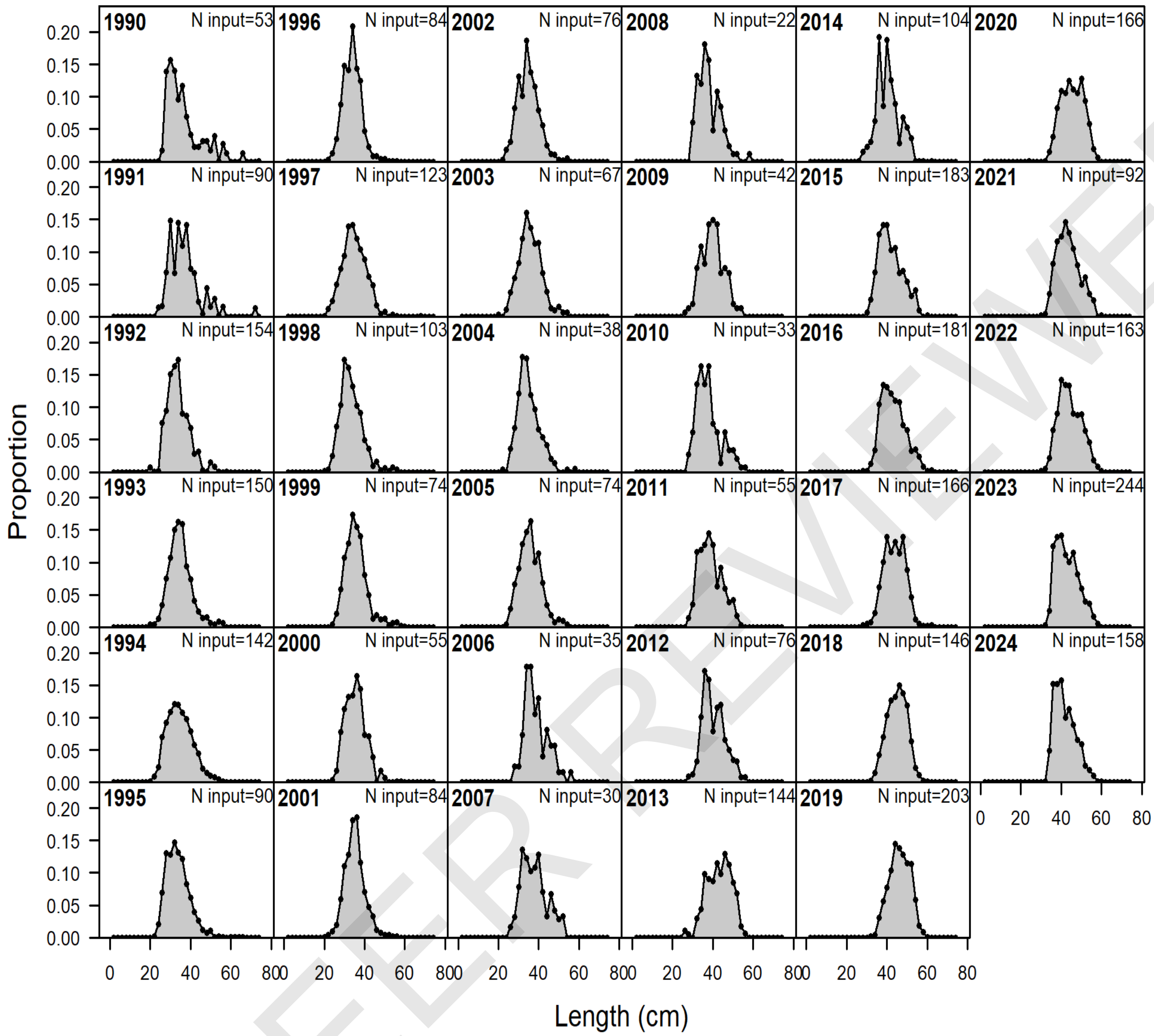


Figure 10. Observed length composition (retained) for the Commercial Vertical Line fleet. 'N input' is the number of trips.

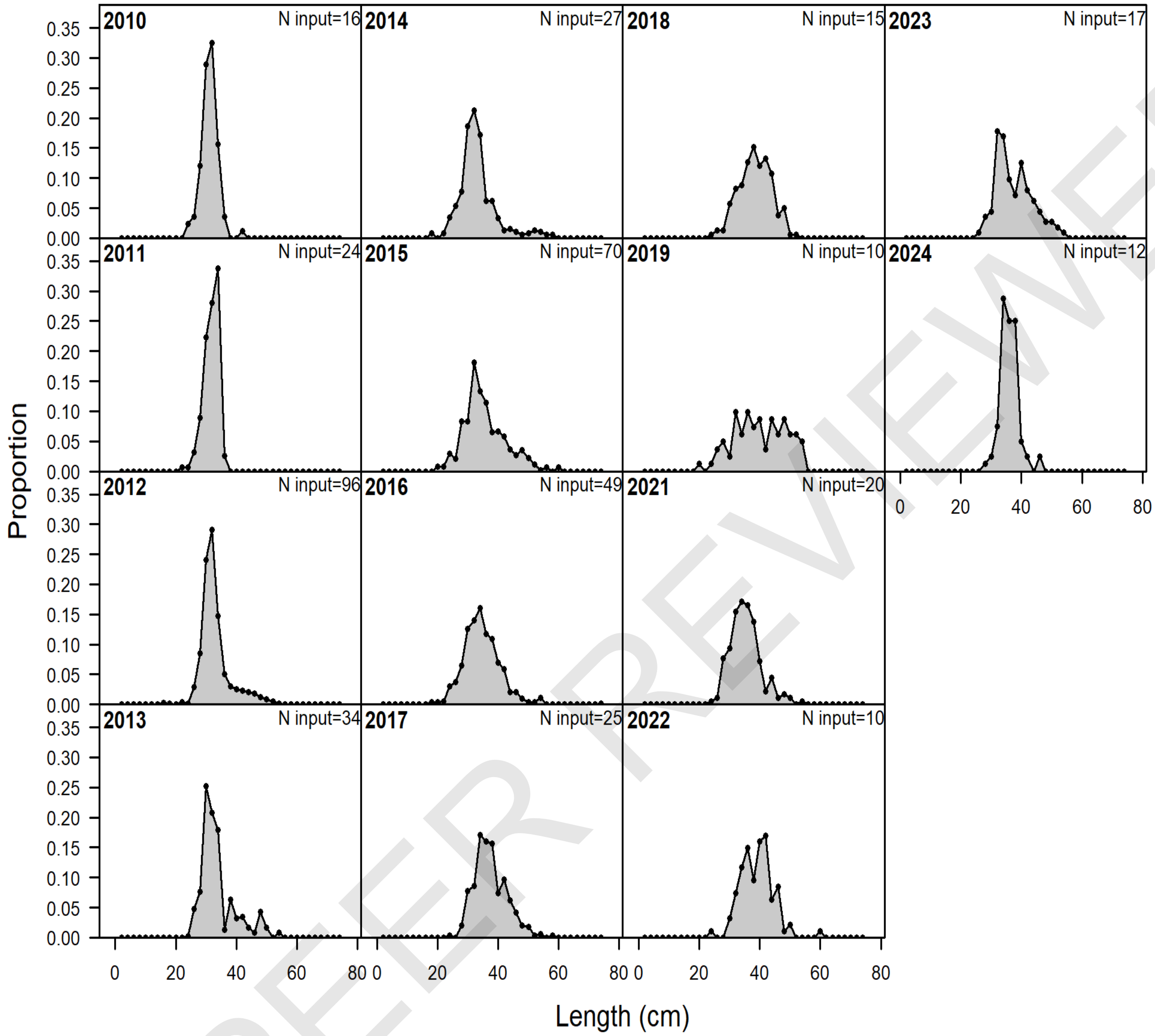


Figure 11. Observed length composition (discarded) for the Commercial Vertical Line fleet. 'N input' is the number of trips.

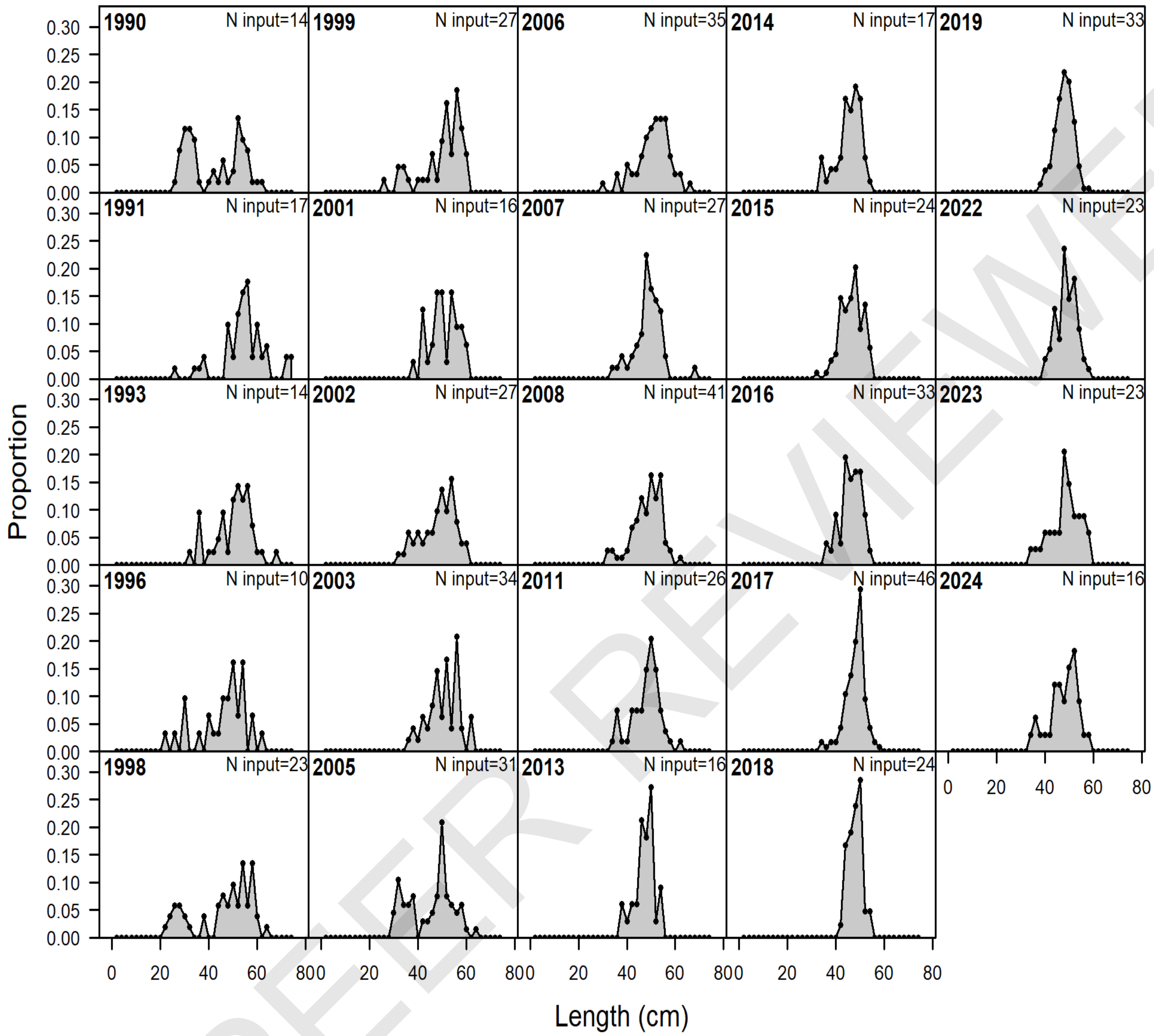


Figure 12. Observed length composition (retained) for the Commercial Longline fleet. 'N input' is the number of trips.

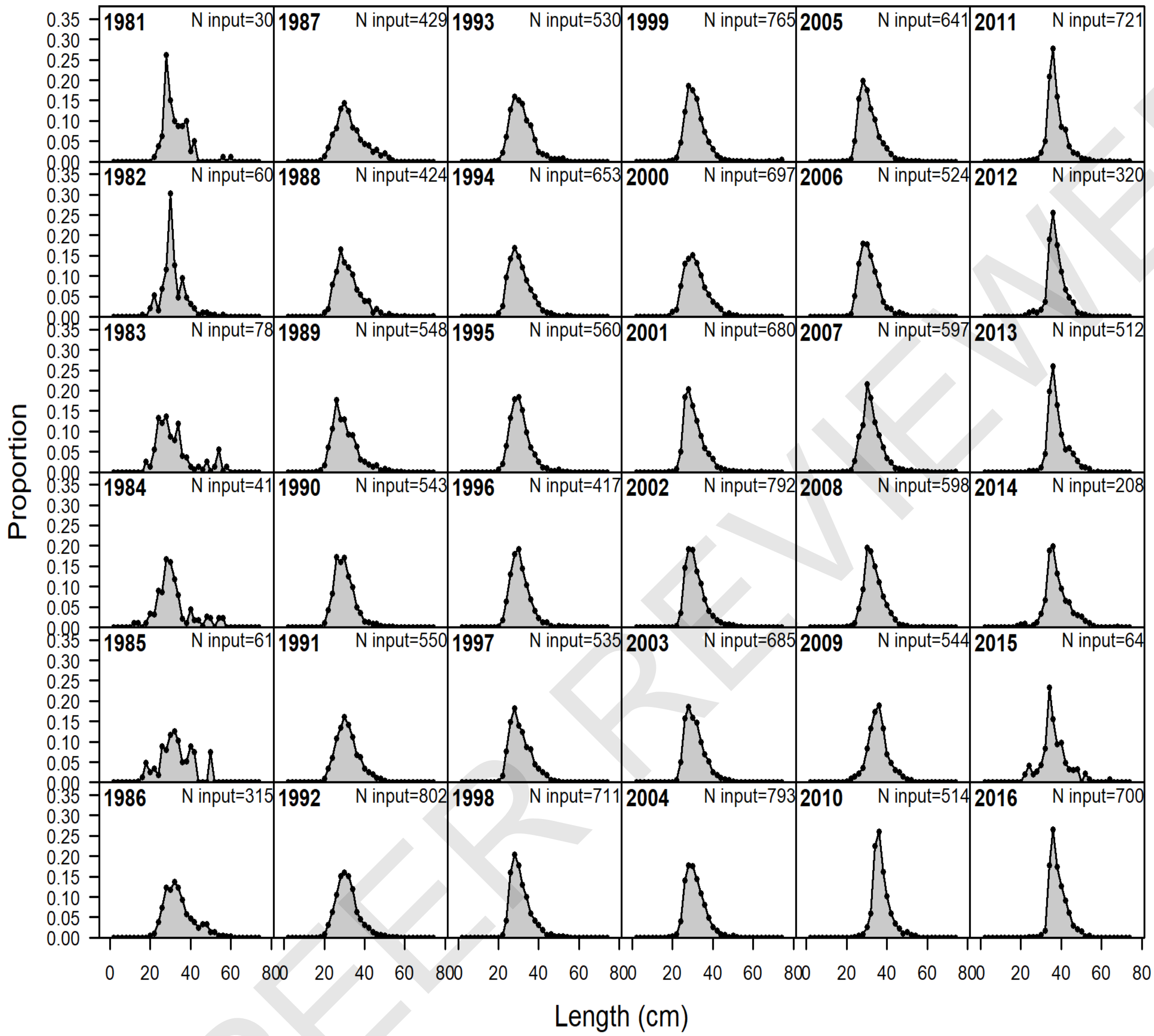


Figure 13. Observed length composition (retained) for the Recreational fleet. 'N input' is the number of trips.

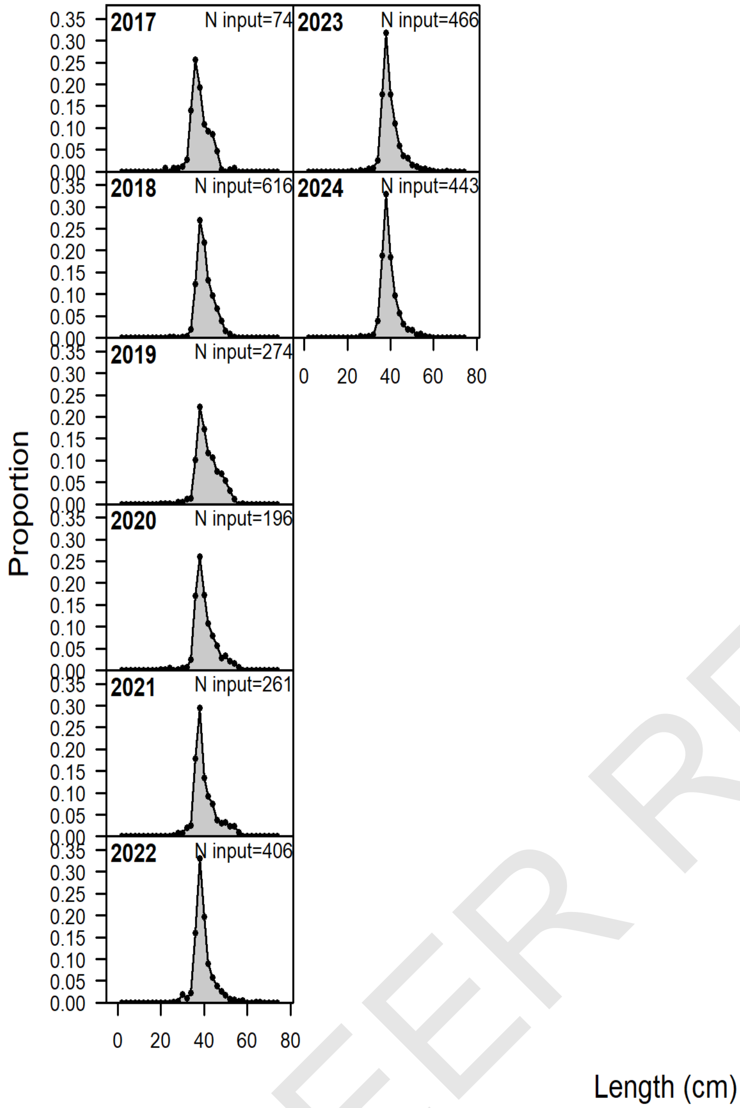


Figure 13 Continued. Observed length composition (retained) for the Recreational fleet. 'N input' is the number of trips.

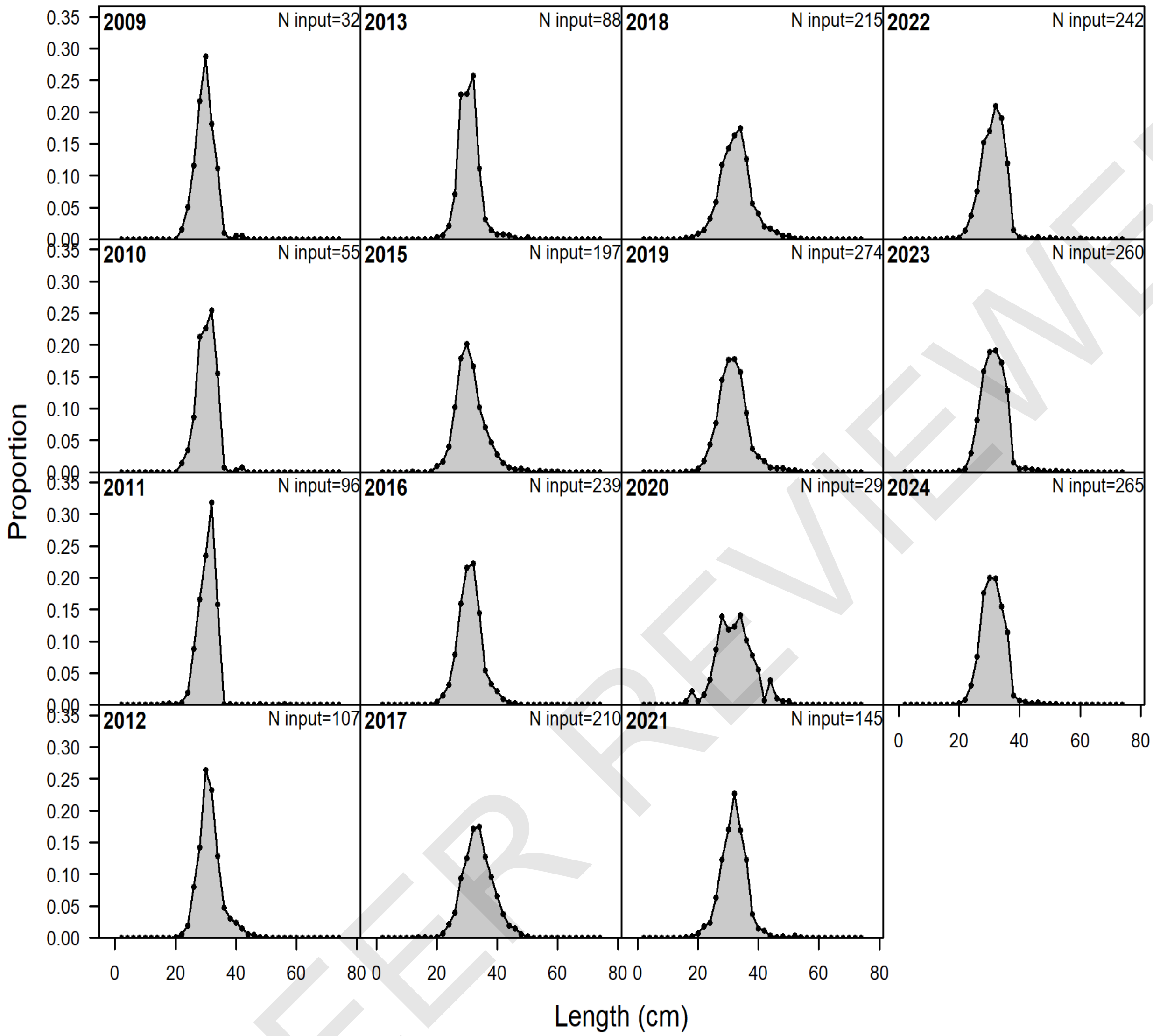


Figure 14. Observed length composition (discarded) for the Recreational fleet. 'N input' is the number of trips.

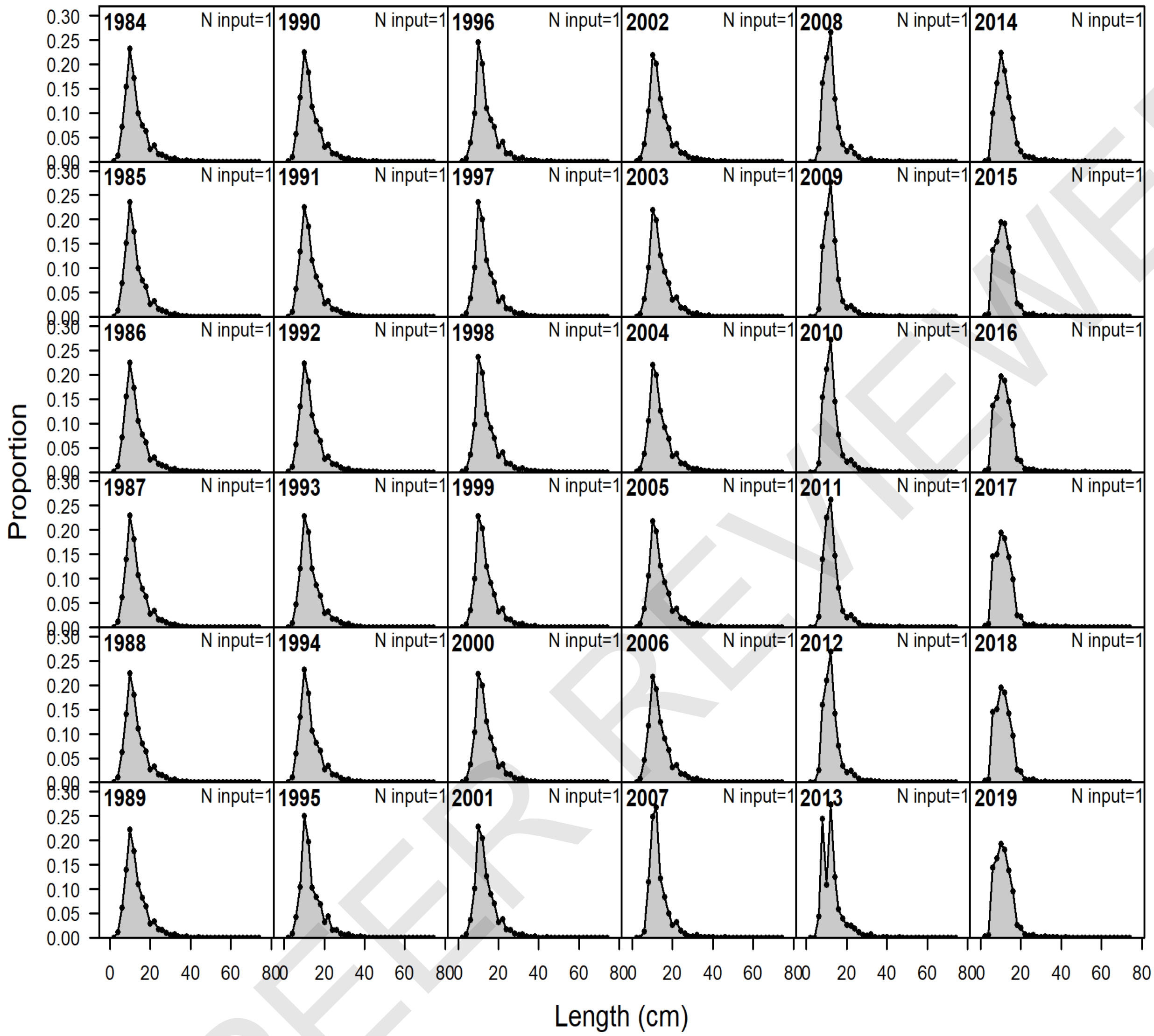


*Figure 15. Proxy length composition (discarded) for the Shrimp Bycatch fleet, which was obtained using SEAMAP length data (see **Section 2.3.8**). 'N input' as the number of trips was not available and therefore a placeholder of 1 was used. This data input was included as a model check and was not fit to within the assessment model (i.e., sample size was not relevant).*

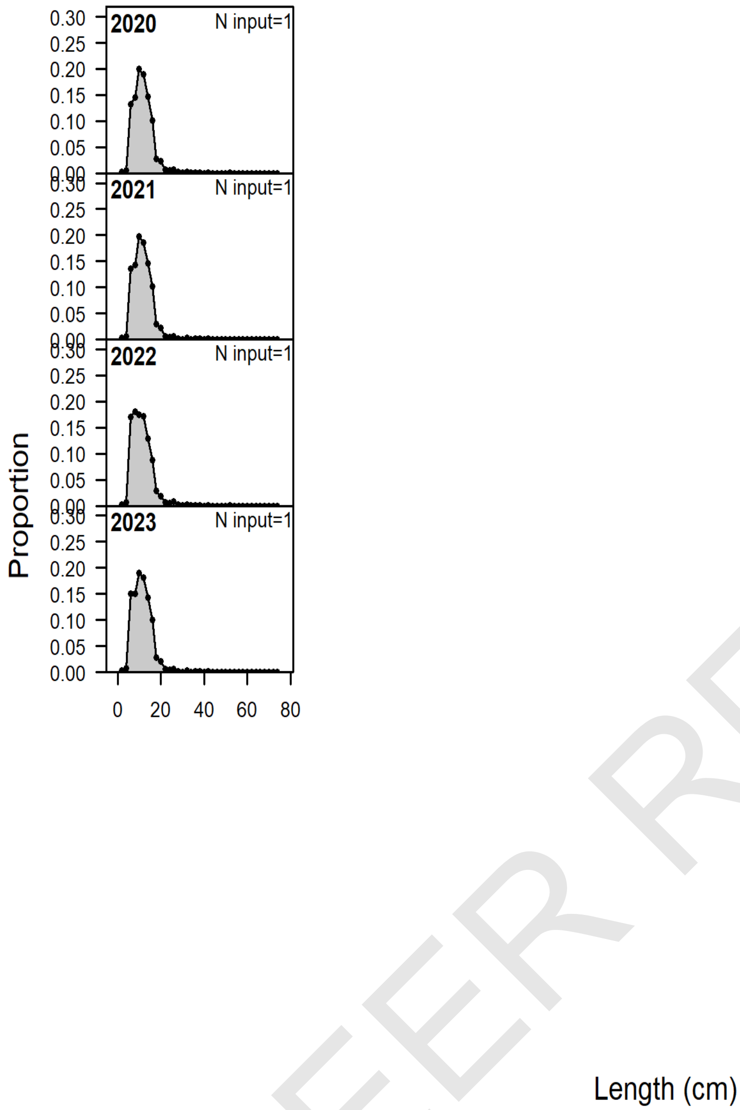


Figure 15 Continued. Proxy length composition (discarded) for the Shrimp Bycatch fleet, which was obtained using SEAMAP length data (see ***Section 2.3.8****). 'N input' as the number of trips was not available and therefore a placeholder of 1 was used. This data input was included as a model check and was not fit to within the assessment model (i.e., sample size was not relevant).*

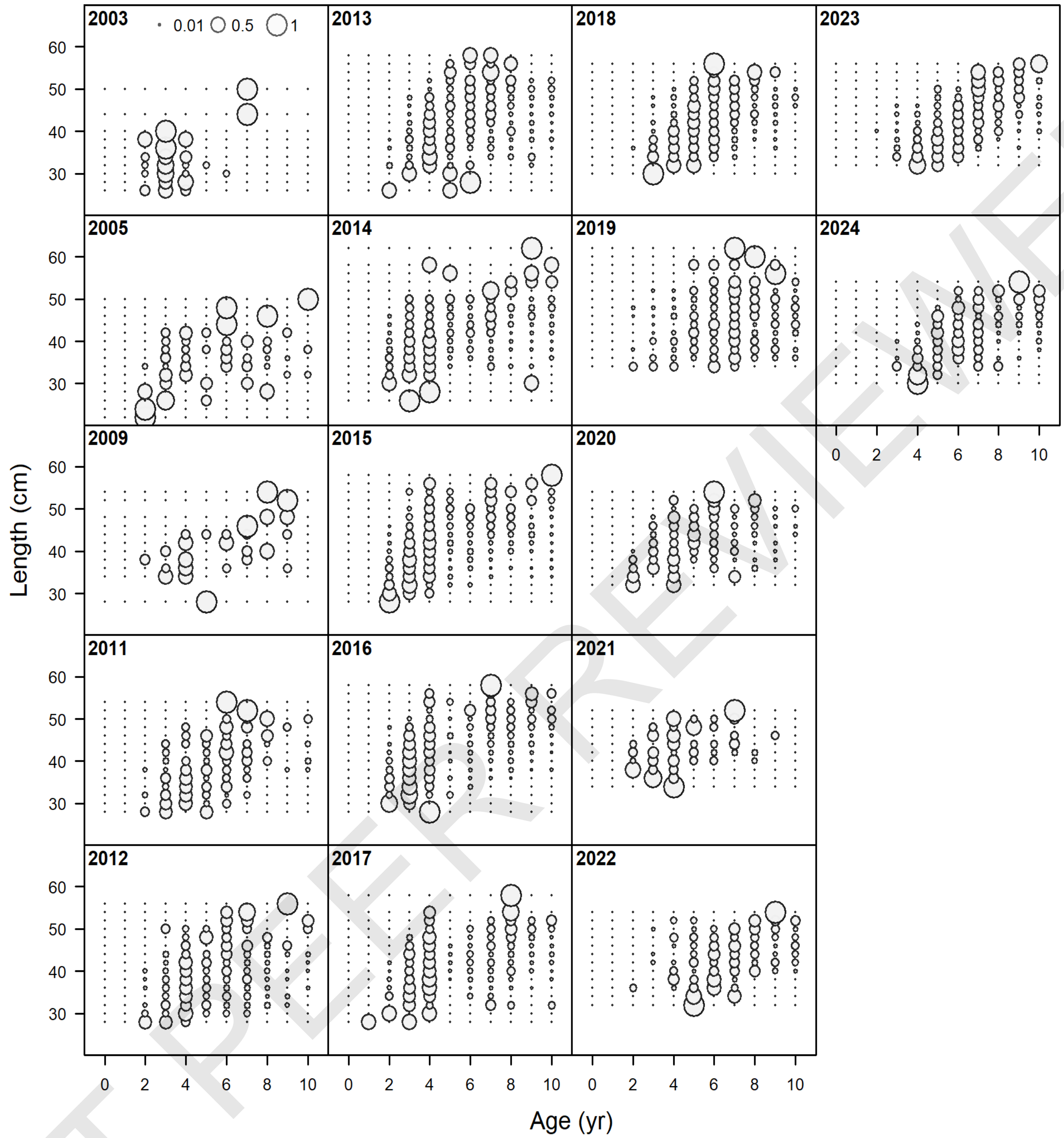


Figure 16. Observed conditional age-at-length composition (retained) for the Commercial Vertical Line fleet.

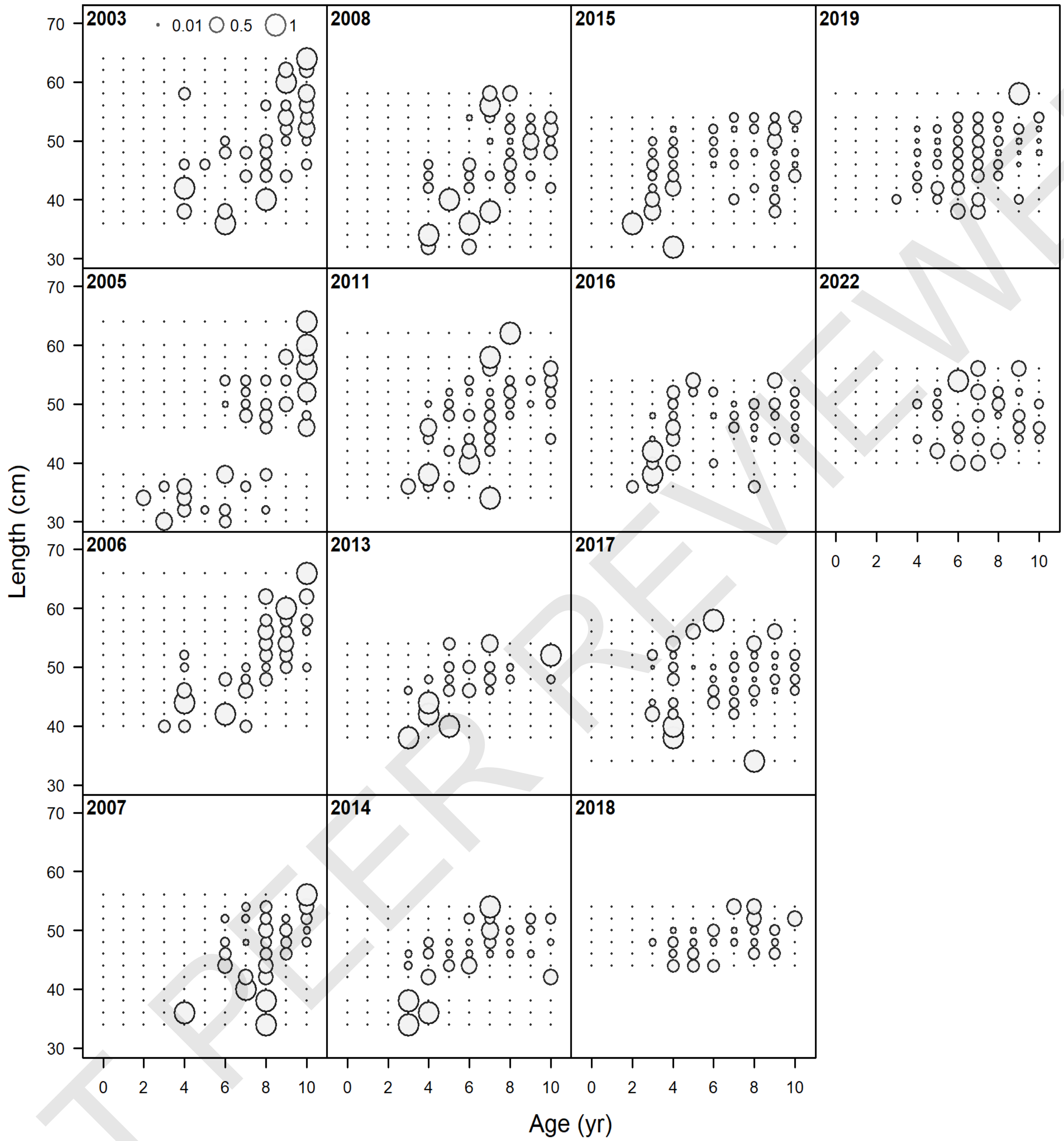


Figure 17. Observed conditional age-at-length composition (retained) for the Commercial Longline fleet.

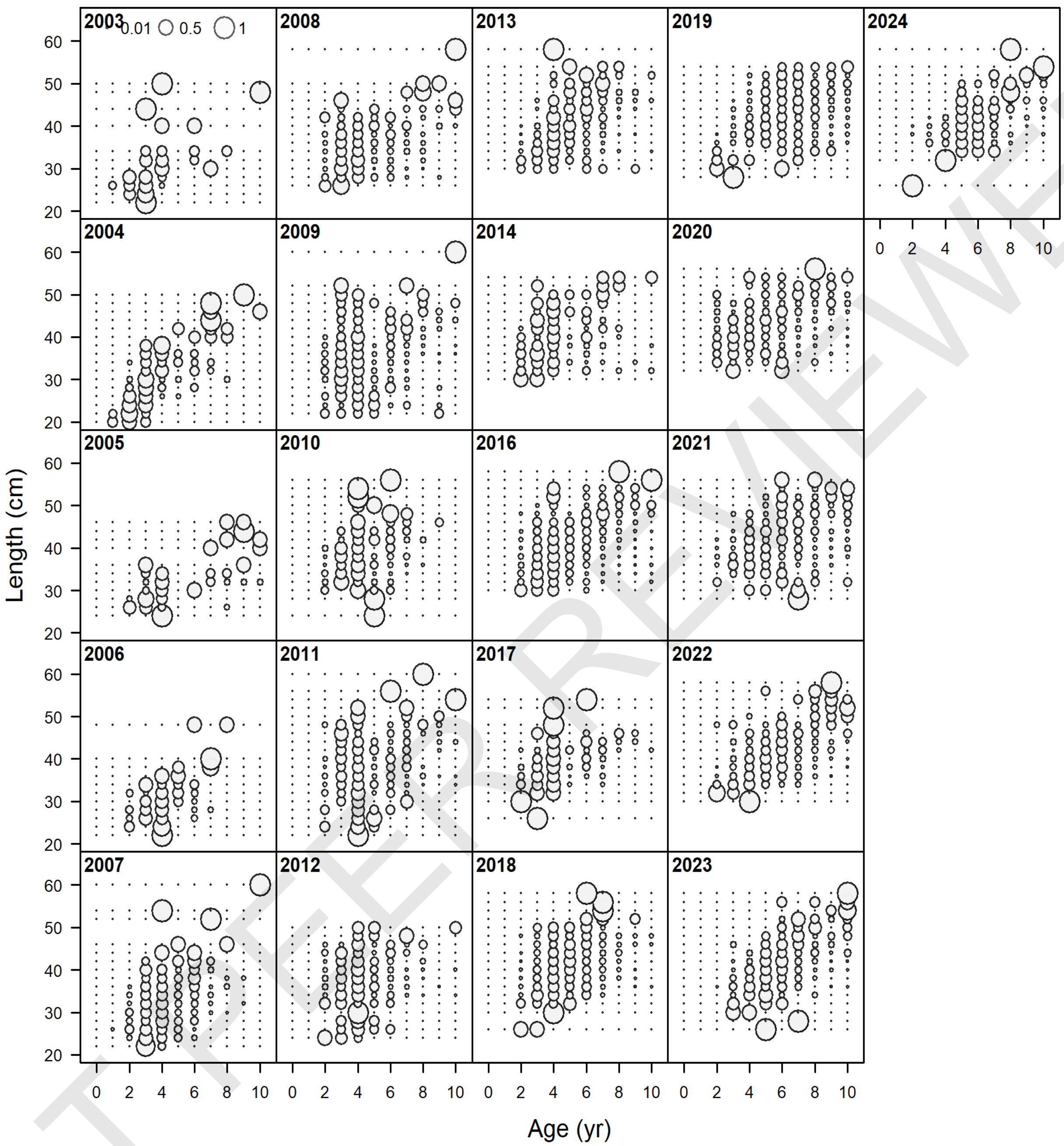


Figure 18. Observed conditional age-at-length composition (retained) for the Recreational fleet.

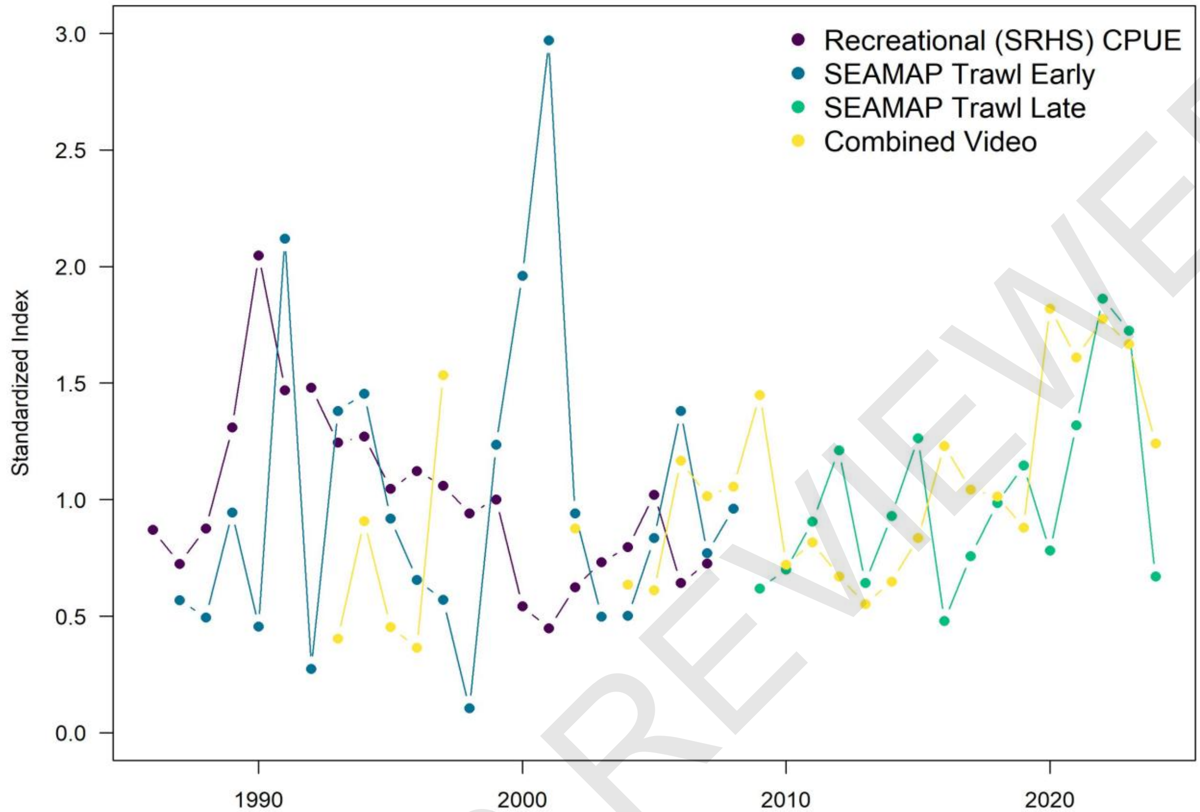


*Figure 19. Standardized indices of relative abundance recommended for use during the SEDAR 100 Assessment. Each index has been rescaled to have a mean of 1. Error bars for each index are shown in **Figures 59-62**.*

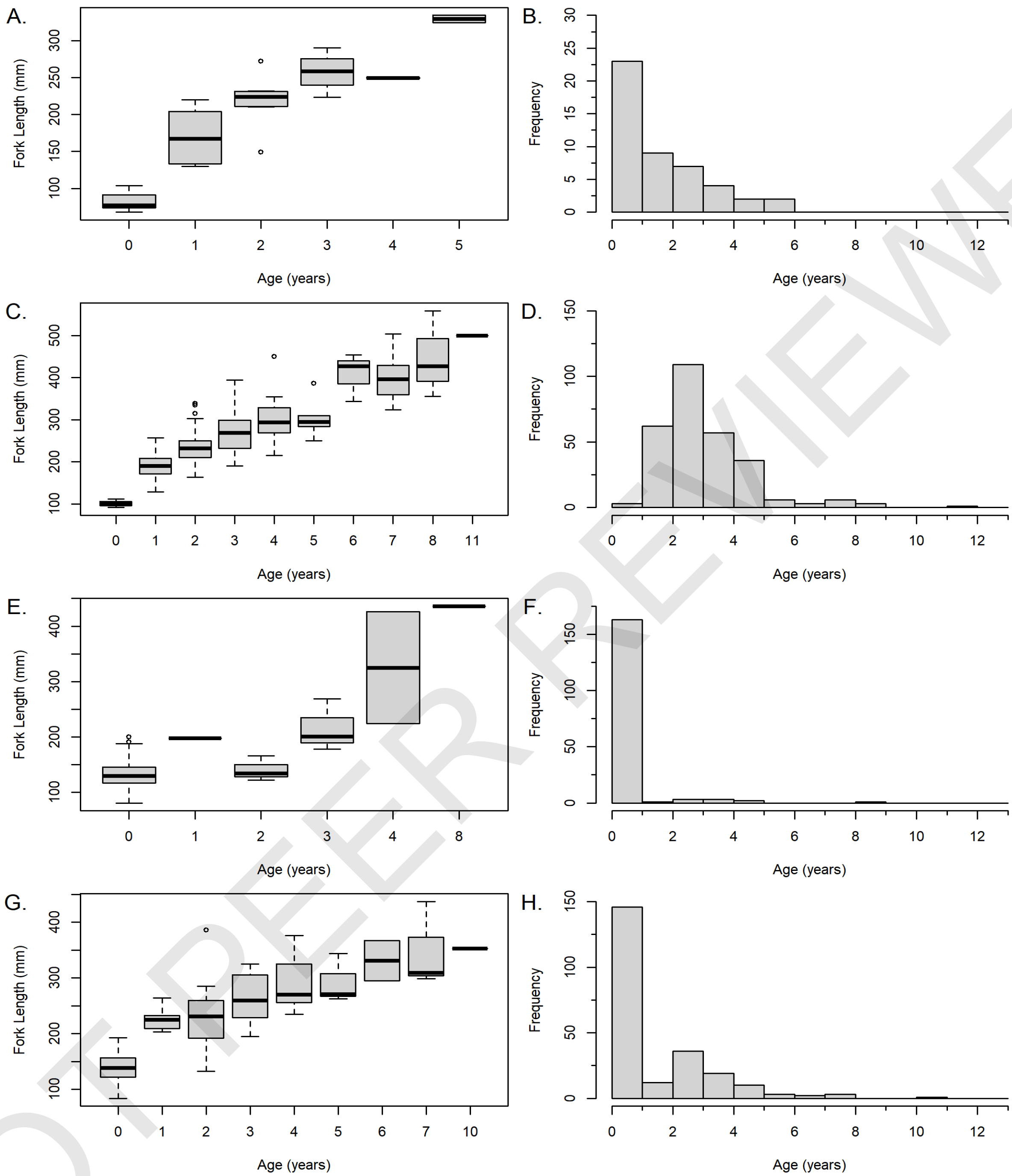


Figure 20. Length at age distribution and age distribution for Gray Triggerfish captured during the SEAMAP Groundfish Trawl Survey (2008-2024) in the: A. and B. Summer - West, C. and D. Summer - East, E. and F. Fall - West, and G. and H. Fall – East. Age samples were updated as described in ***Section 2.2.2****, and plots prior to this update can be found in* ***Figure 5 of SEDAR100-DW16****.*

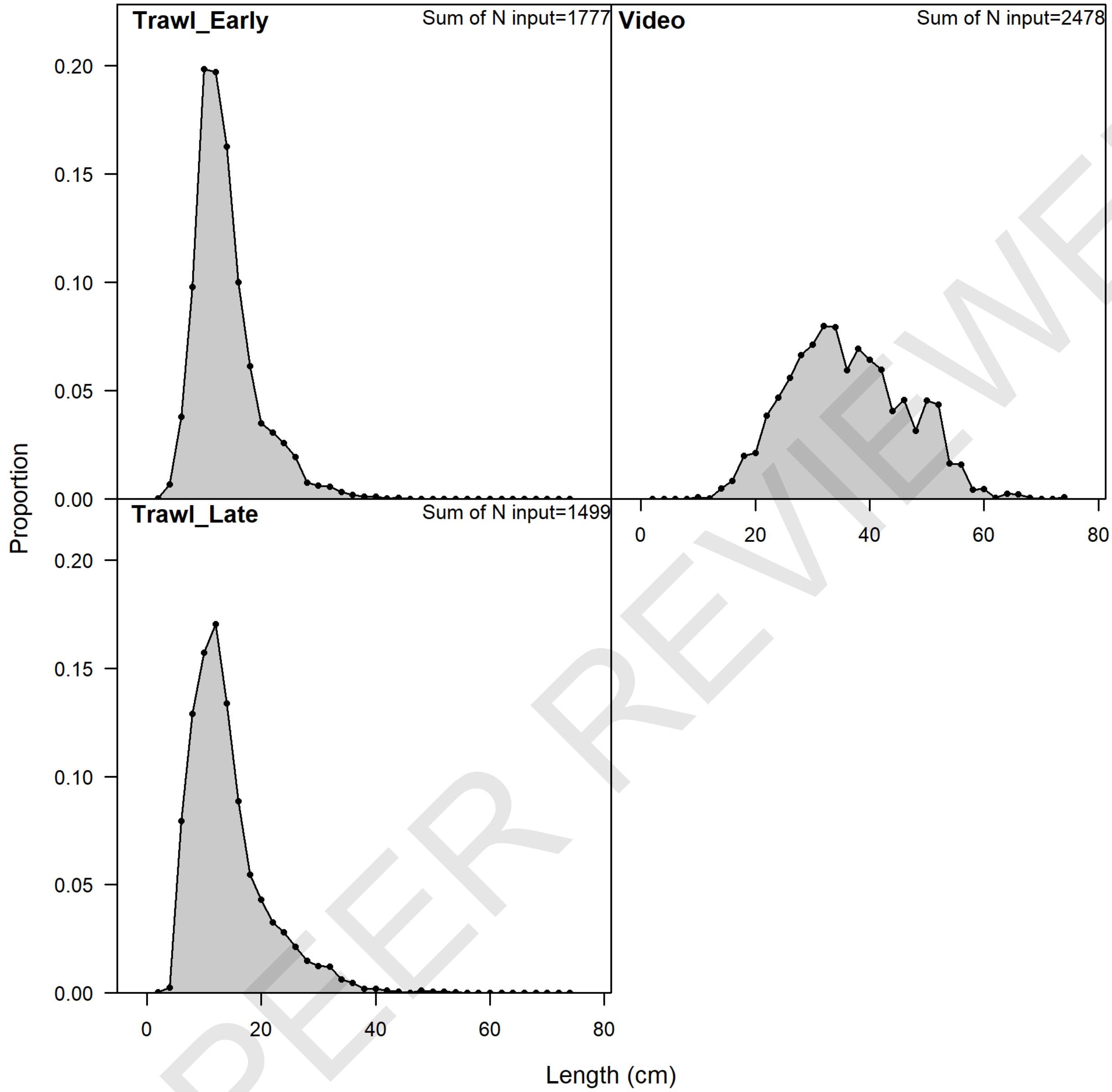


Figure 21. Length compositions aggregated across years for the fishery-independent surveys. 'N input' is the number of stations.

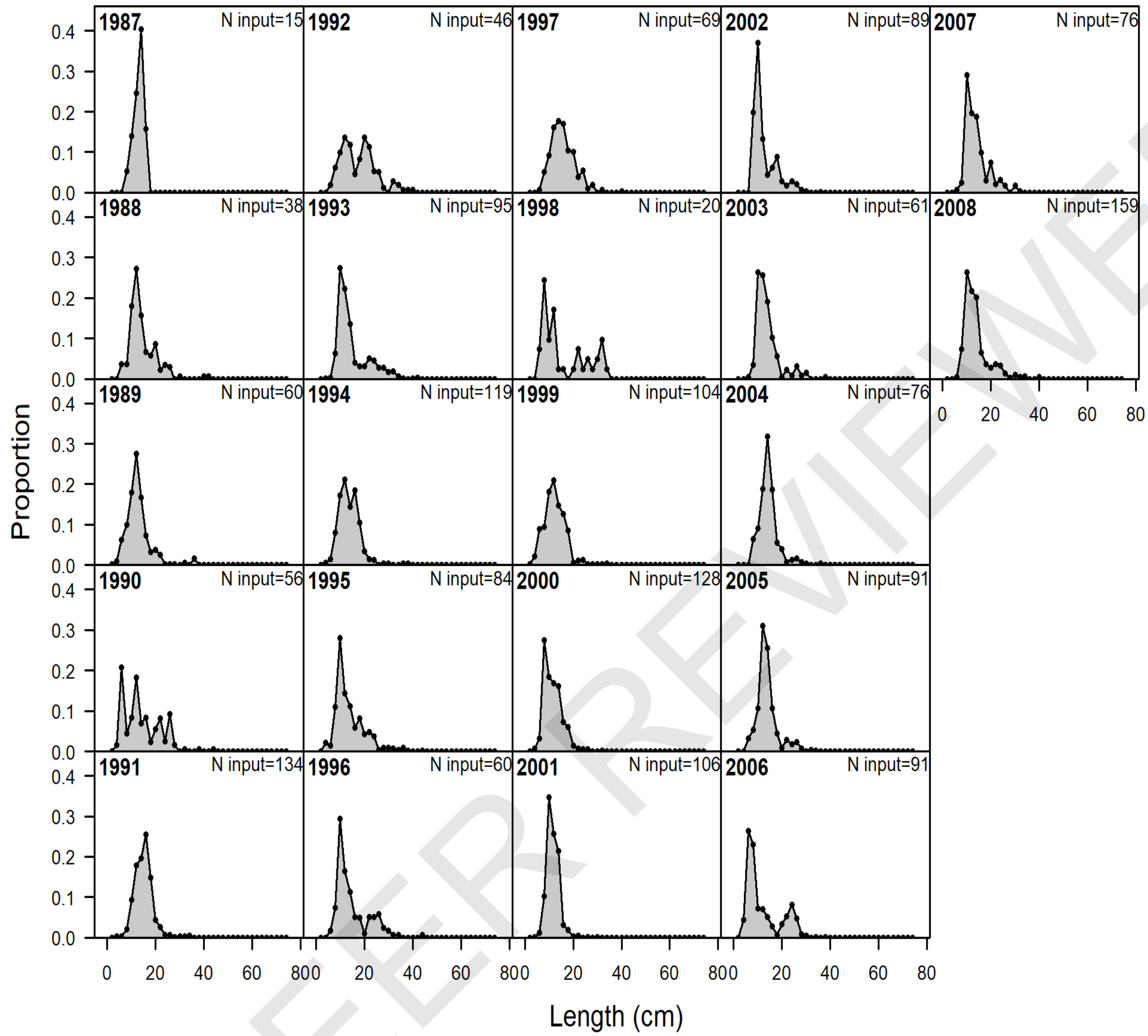


Figure 22. Observed length composition from the SEAMAP Trawl Early Survey. 'N input' is the number of stations.

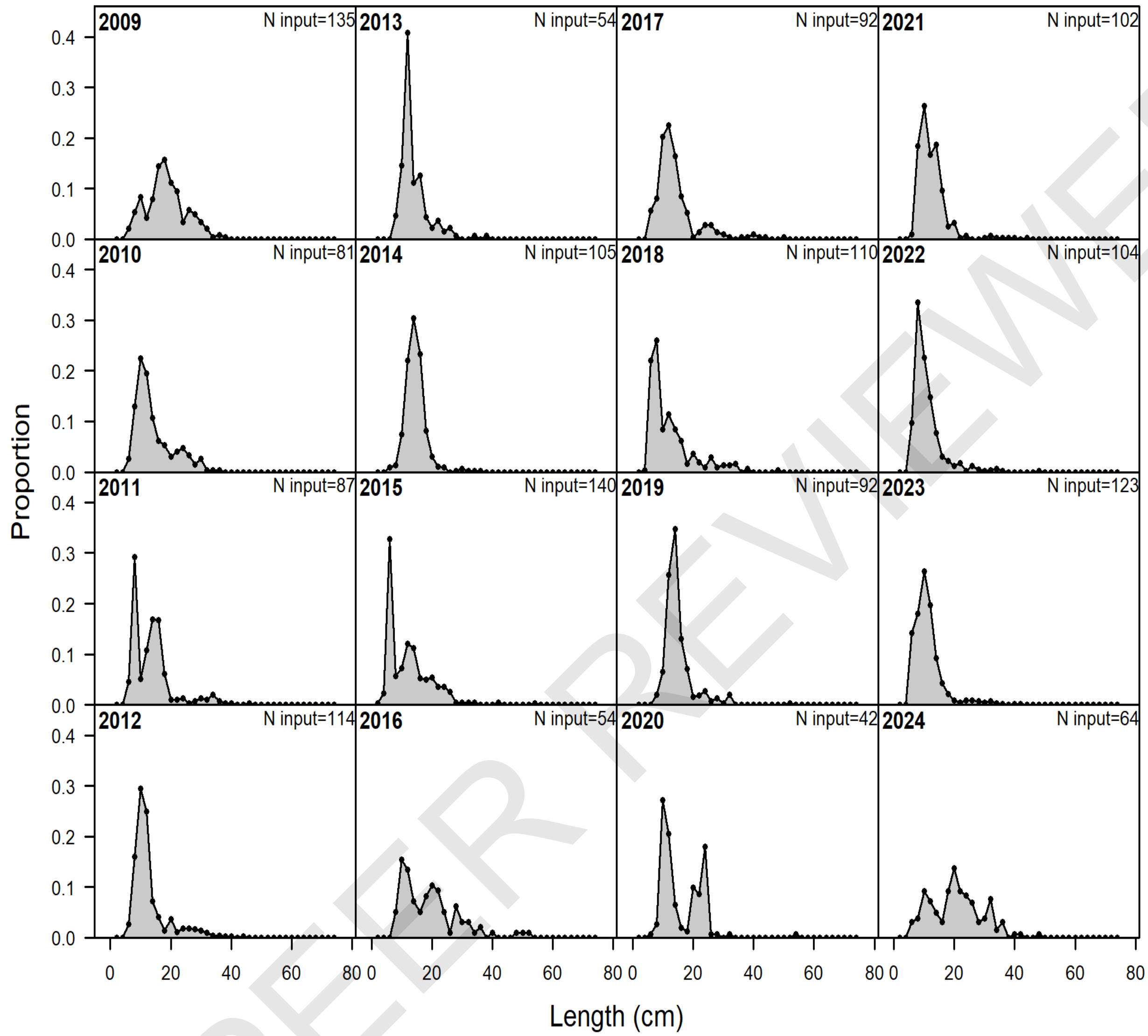


Figure 23. Observed length composition from the SEAMAP Trawl Late Survey. 'N input' is the number of stations.

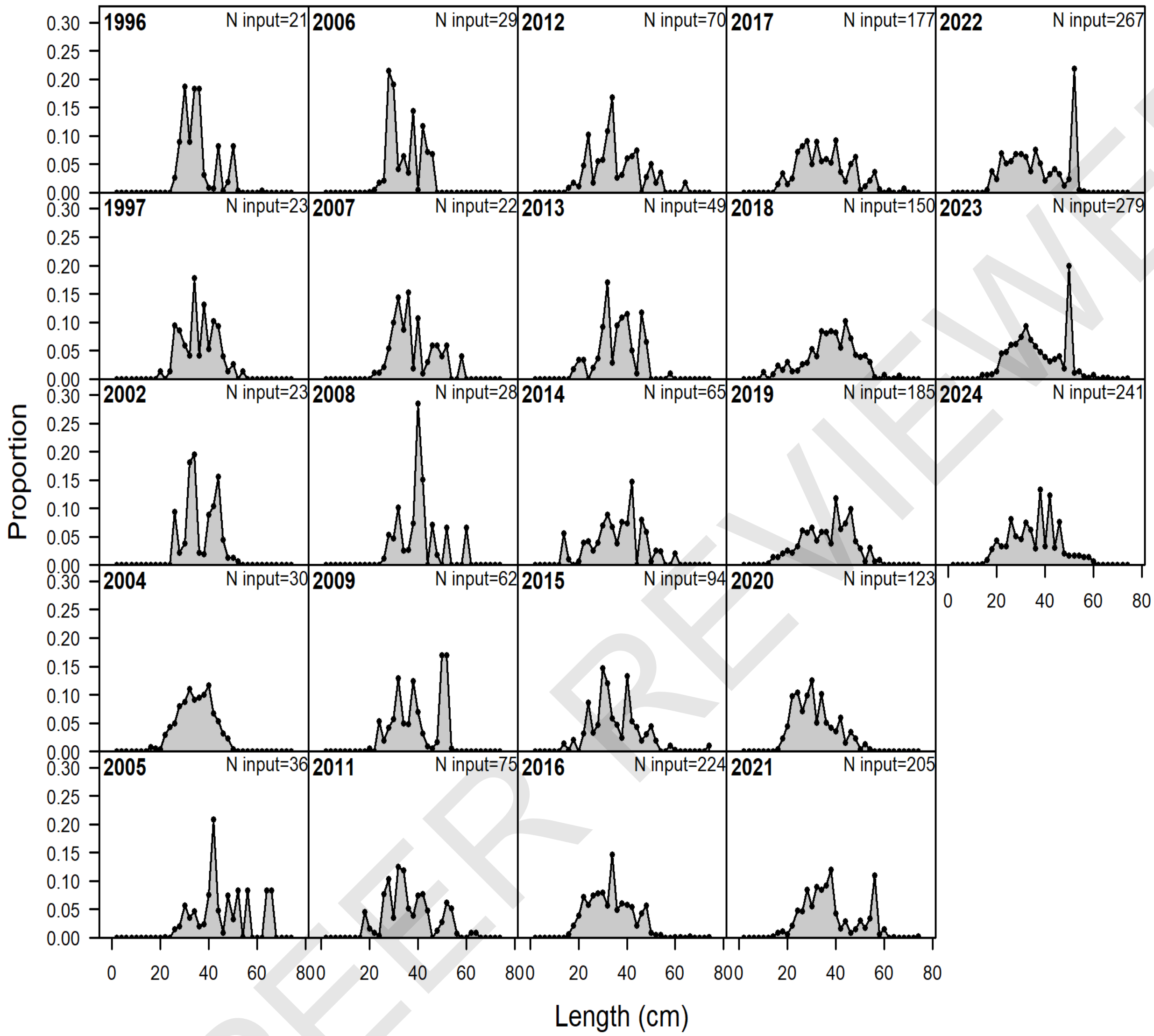


Figure 24. Observed length composition from the Combined Video Survey. 'N input' is the number of stations.

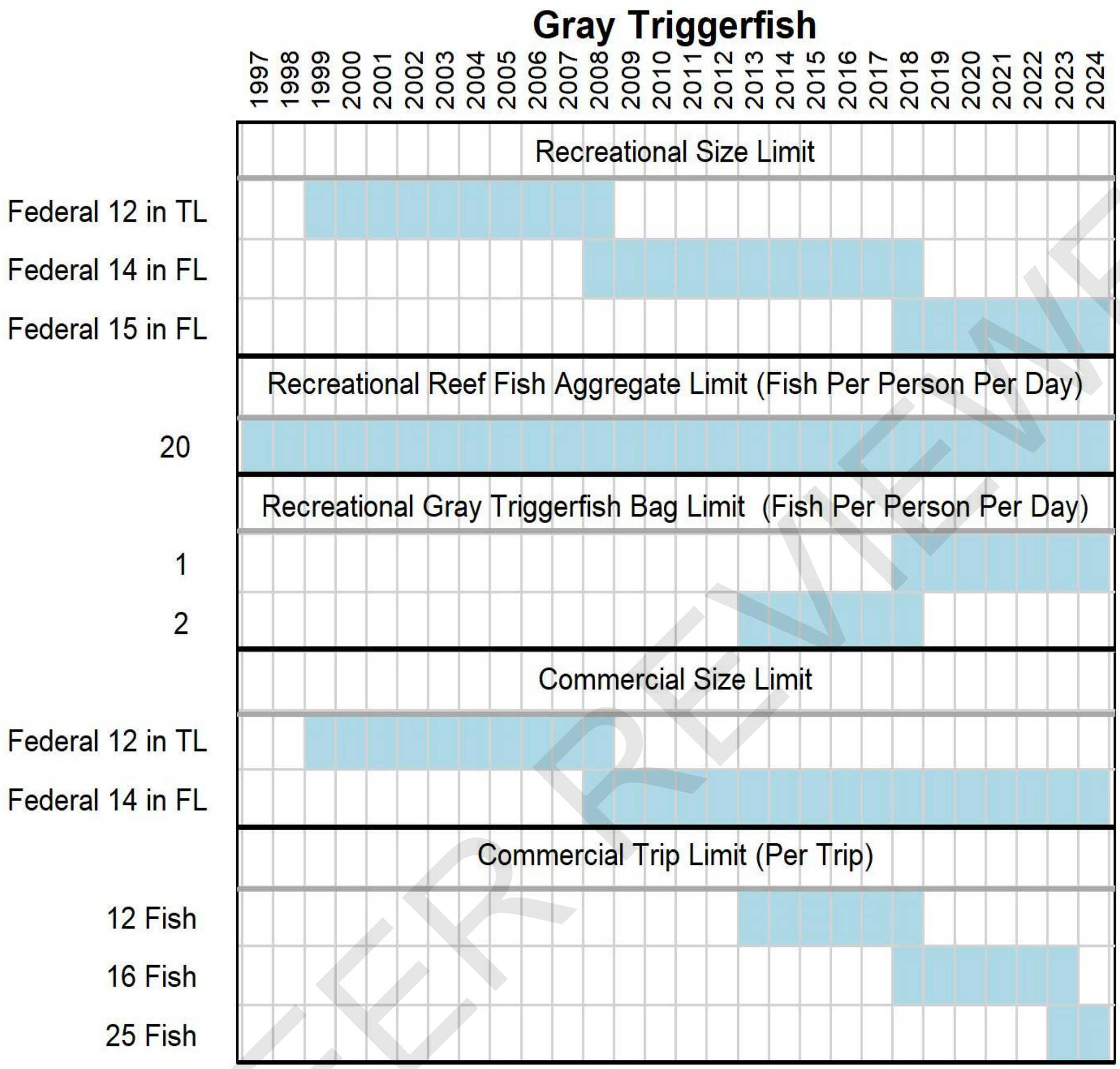


Figure 25. Summary of federal management regulations. Size limits shown are for inches total length (in TL) or fork length (in FL). Not included are time or area closures.

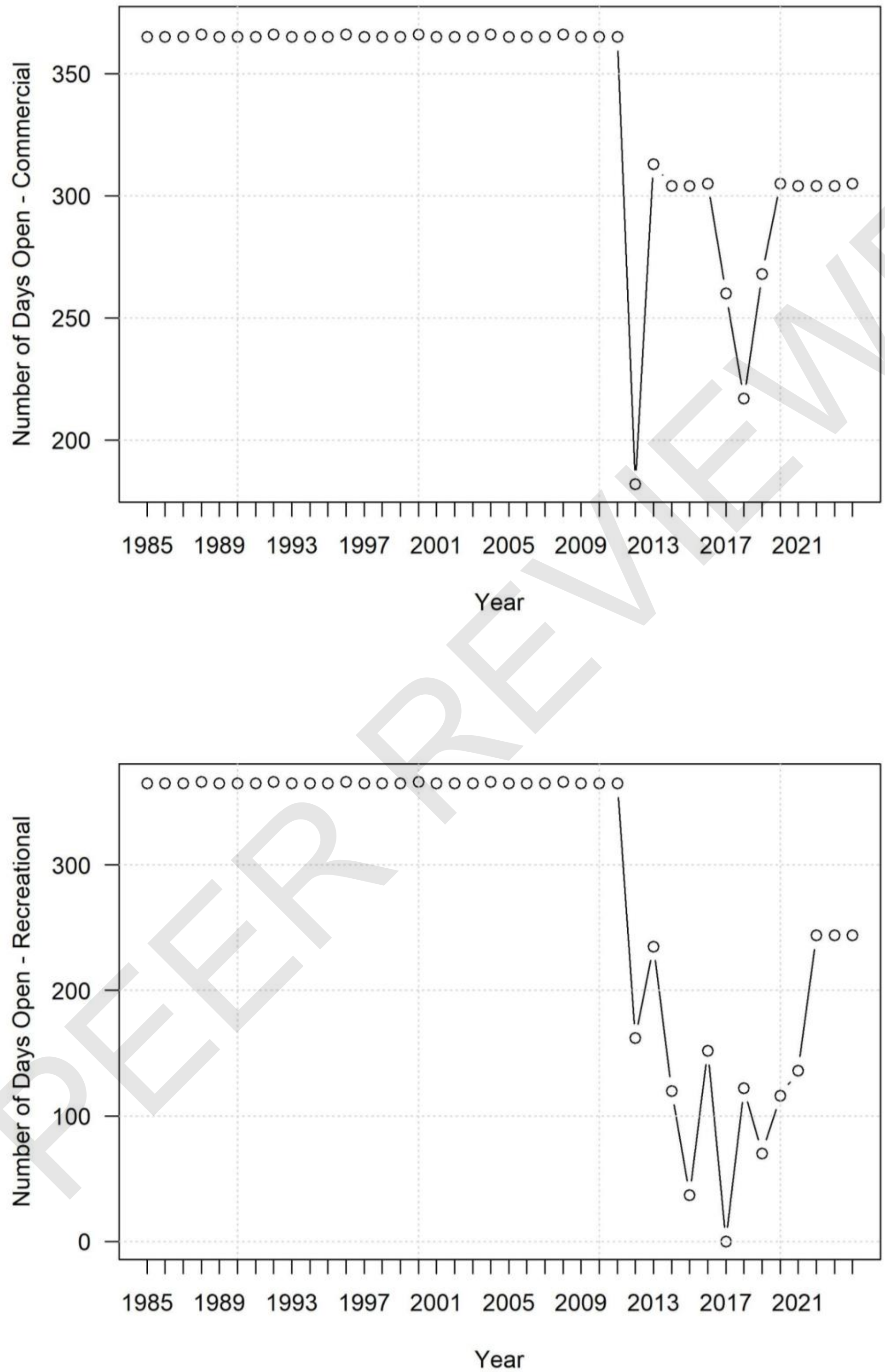


Figure 26. Summary of open season lengths (i.e., number of calendar days open) for the commercial and recreational fleets.

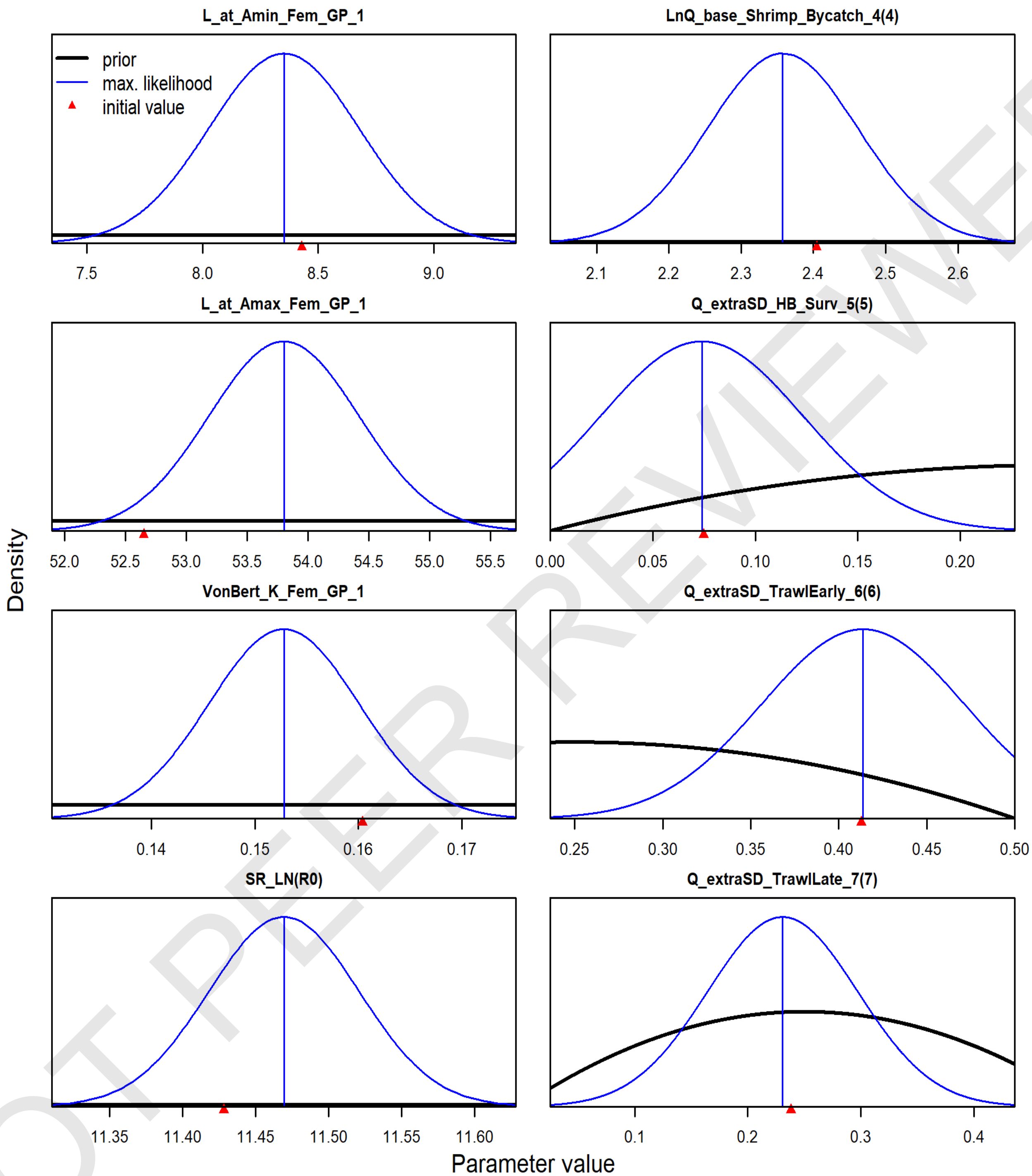


Figure 27. Parameter distribution (blue line) plots along with starting values (red arrow) and priors (black lines). X-axis may not reflect bounds as it is zoomed in on the distribution. Deviation parameters and F parameters are not included. Note: parameter point estimates from a previous model fit were used as the starting values for this final model run.

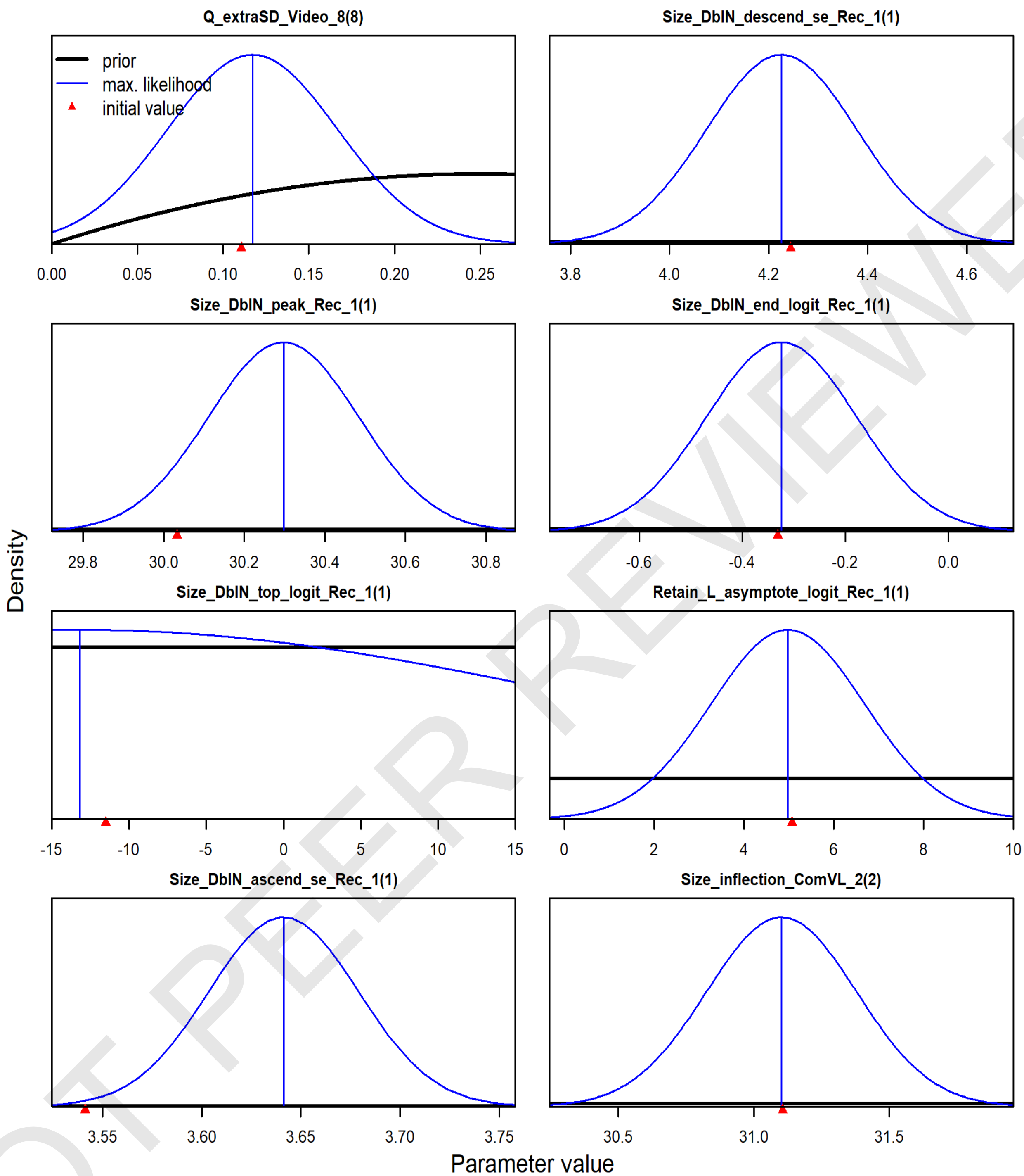


Figure 27 Continued. Parameter distribution (blue line) plots along with starting values (red arrow) and priors (black lines). X-axis may not reflect bounds as it is zoomed in on the distribution. Deviation parameters and F parameters are not included. Note: parameter point estimates from a previous model fit were used as the starting values for this final model run.

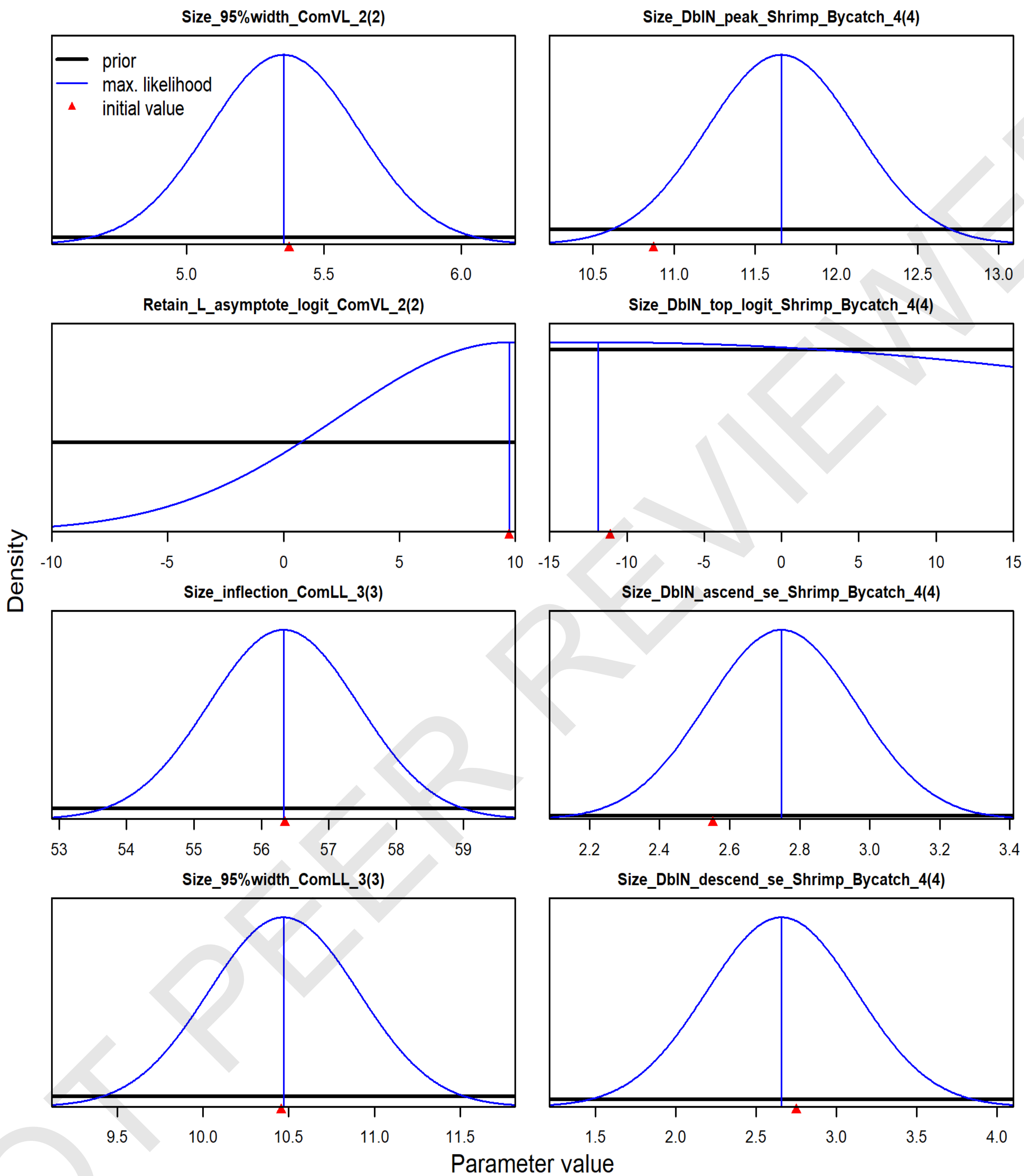


Figure 27 Continued. Parameter distribution (blue line) plots along with starting values (red arrow) and priors (black lines). X-axis may not reflect bounds as it is zoomed in on the distribution. Deviation parameters and F parameters are not included. Note: parameter point estimates from a previous model fit were used as the starting values for this final model run.

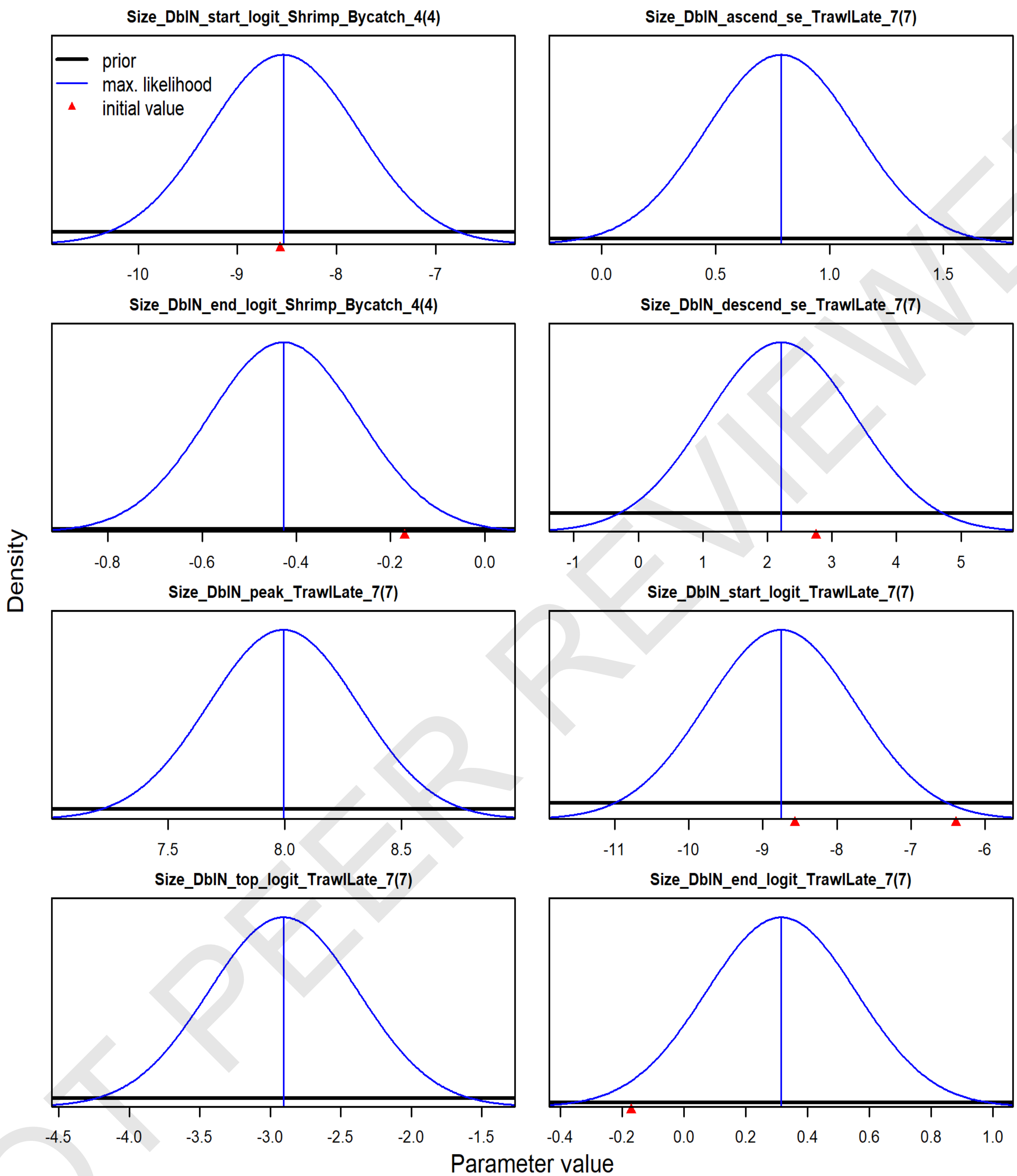


Figure 27 Continued. Parameter distribution (blue line) plots along with starting values (red arrow) and priors (black lines). X-axis may not reflect bounds as it is zoomed in on the distribution. Deviation parameters and F parameters are not included. Note: parameter point estimates from a previous model fit were used as the starting values for this final model run.

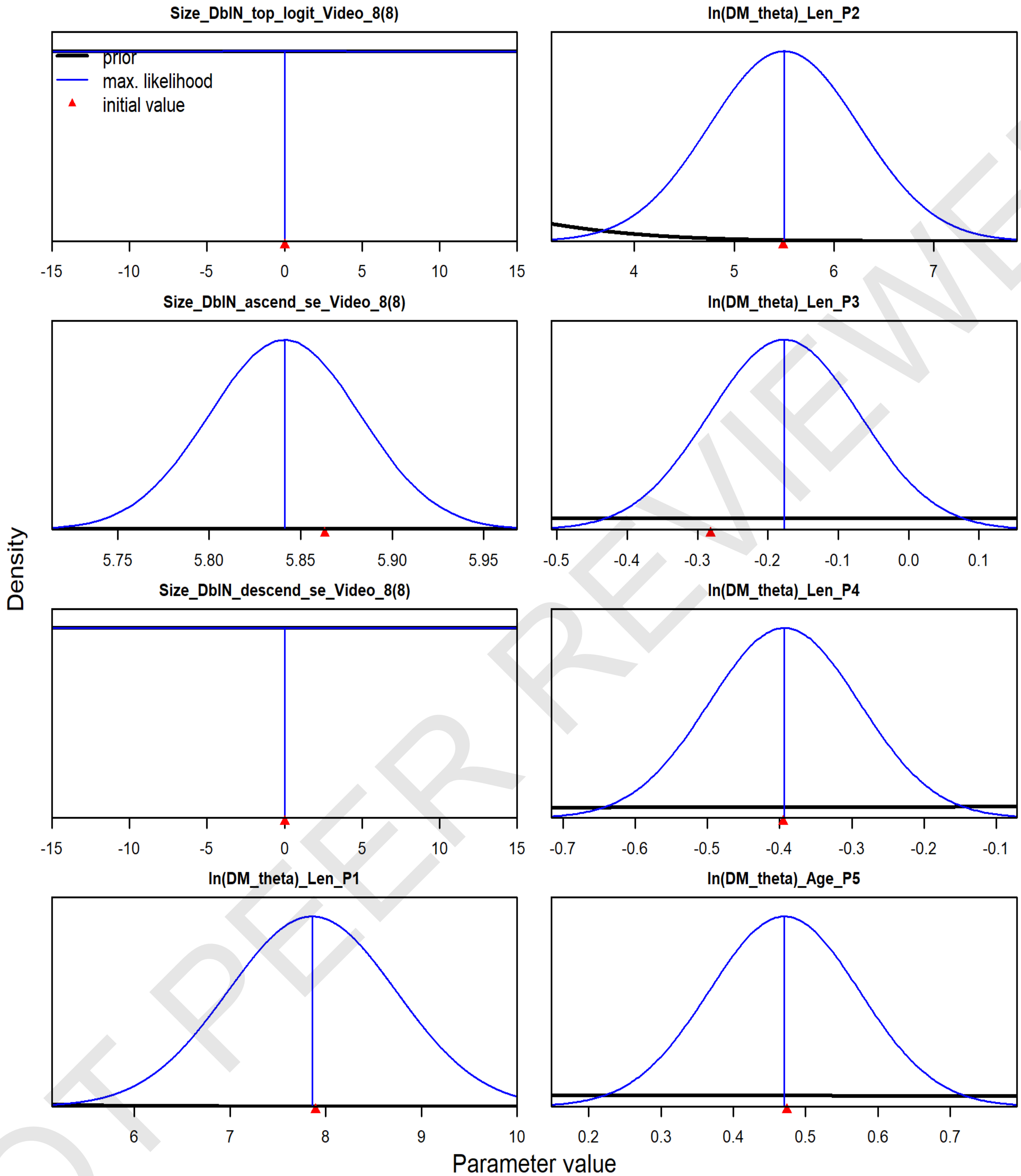


Figure 27 Continued. Parameter distribution (blue line) plots along with starting values (red arrow) and priors (black lines). X-axis may not reflect bounds as it is zoomed in on the distribution. Deviation parameters and F parameters are not included. Note: parameter point estimates from a previous model fit were used as the starting values for this final model run.

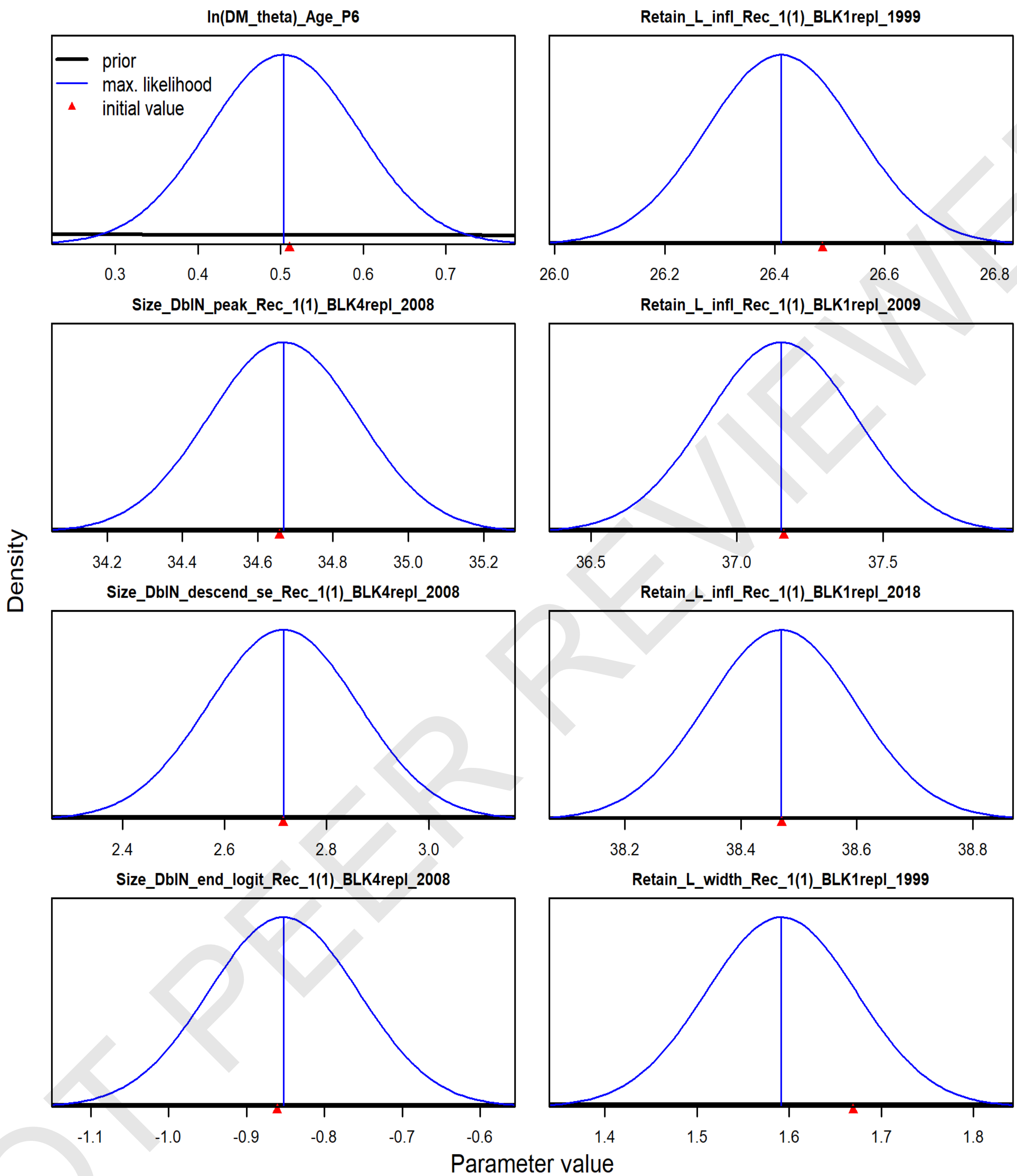


Figure 27 Continued. Parameter distribution (blue line) plots along with starting values (red arrow) and priors (black lines). X-axis may not reflect bounds as it is zoomed in on the distribution. Deviation parameters and F parameters are not included. Note: parameter point estimates from a previous model fit were used as the starting values for this final model run.

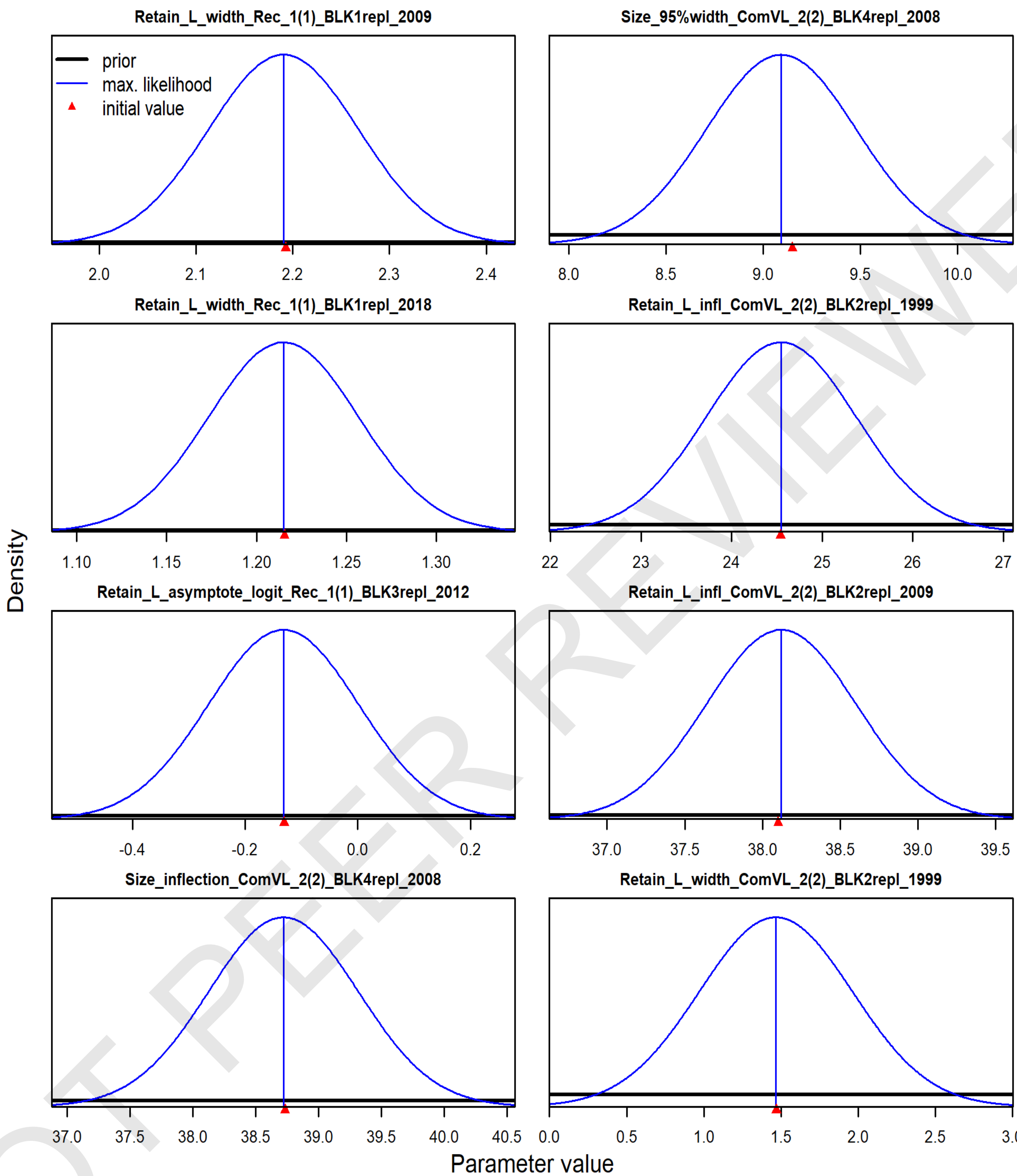


Figure 27 Continued. Parameter distribution (blue line) plots along with starting values (red arrow) and priors (black lines). X-axis may not reflect bounds as it is zoomed in on the distribution. Deviation parameters and F parameters are not included. Note: parameter point estimates from a previous model fit were used as the starting values for this final model run.

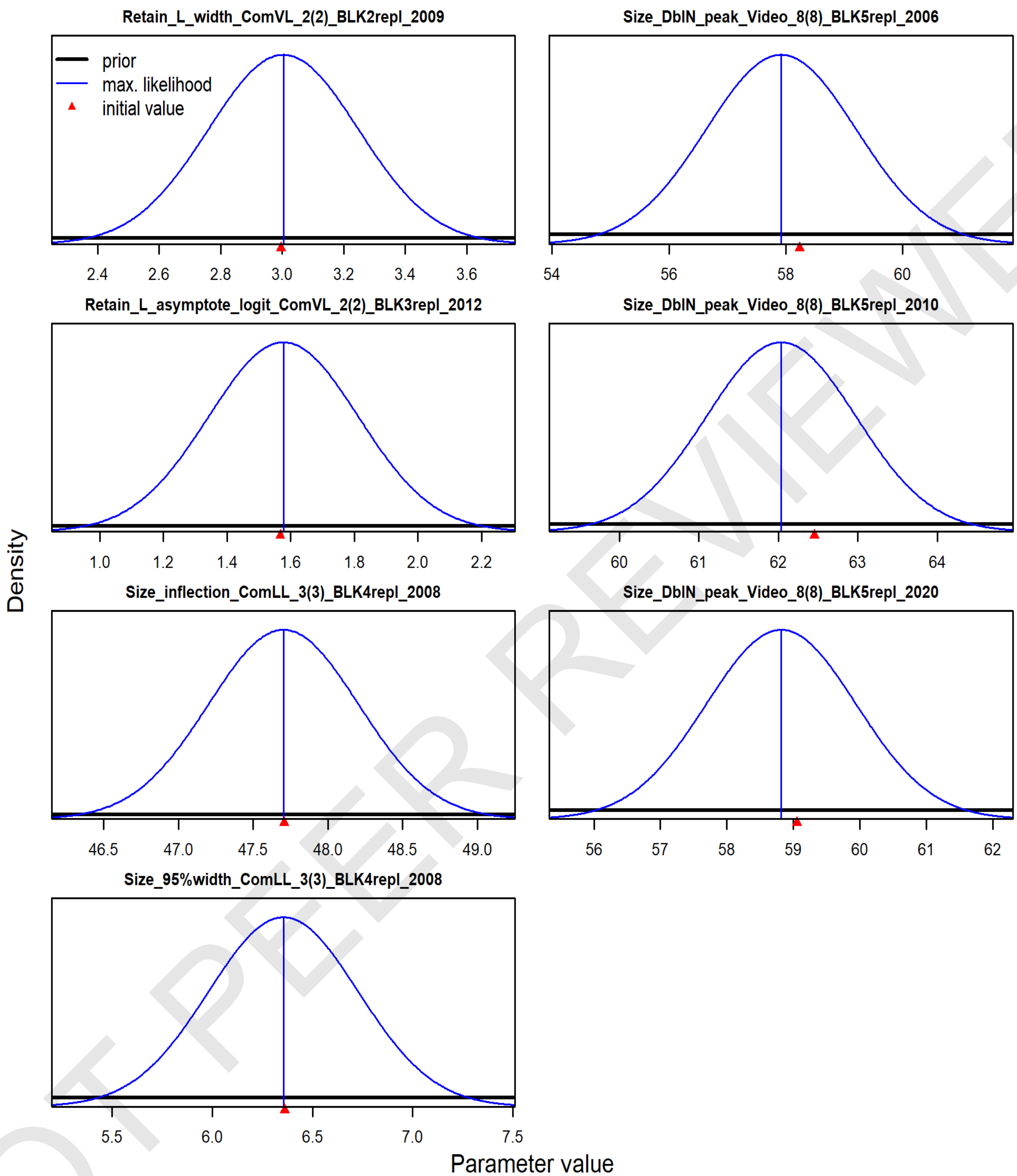
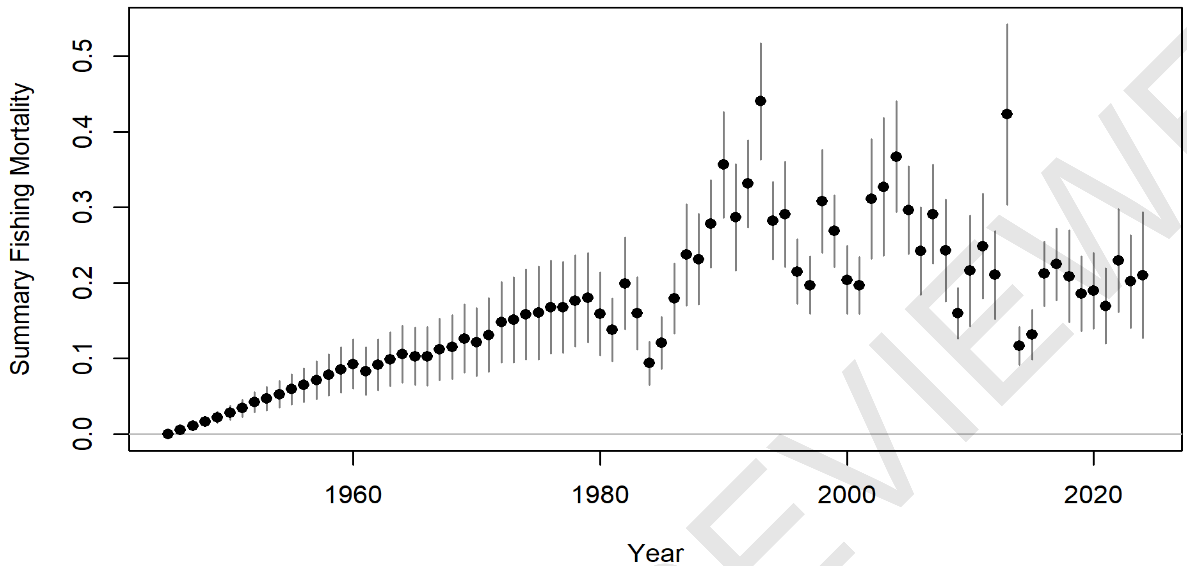


Figure 27 Continued. Parameter distribution (blue line) plots along with starting values (red arrow) and priors (black lines). X-axis may not reflect bounds as it is zoomed in on the distribution. Deviation parameters and F parameters are not included. Note: parameter point estimates from a previous model fit were used as the starting values for this final model run.

SEDAR 100



SEDAR 43

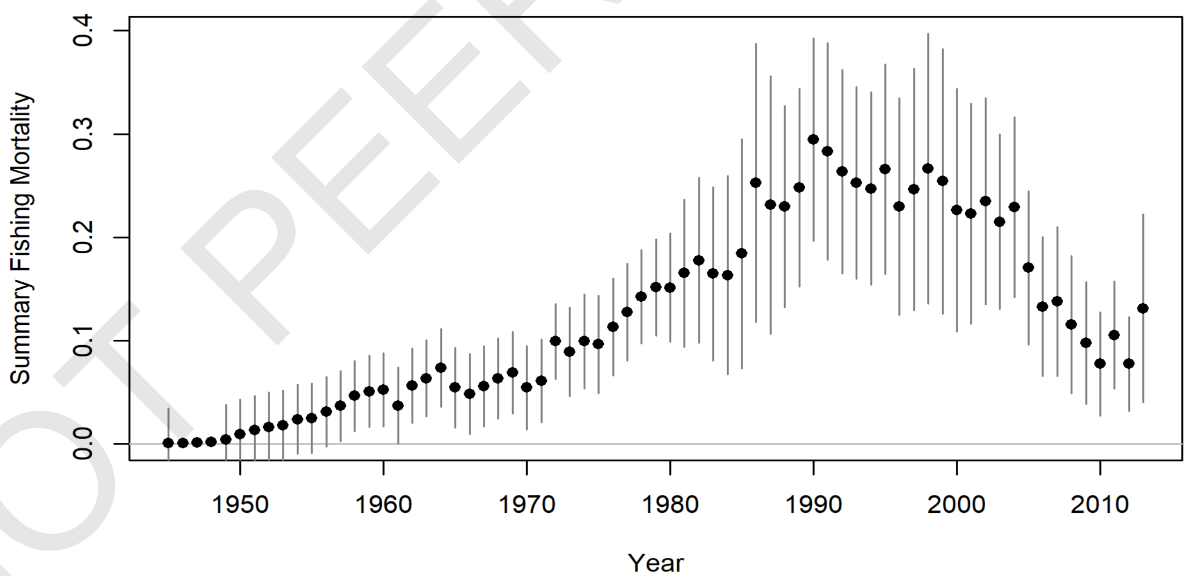
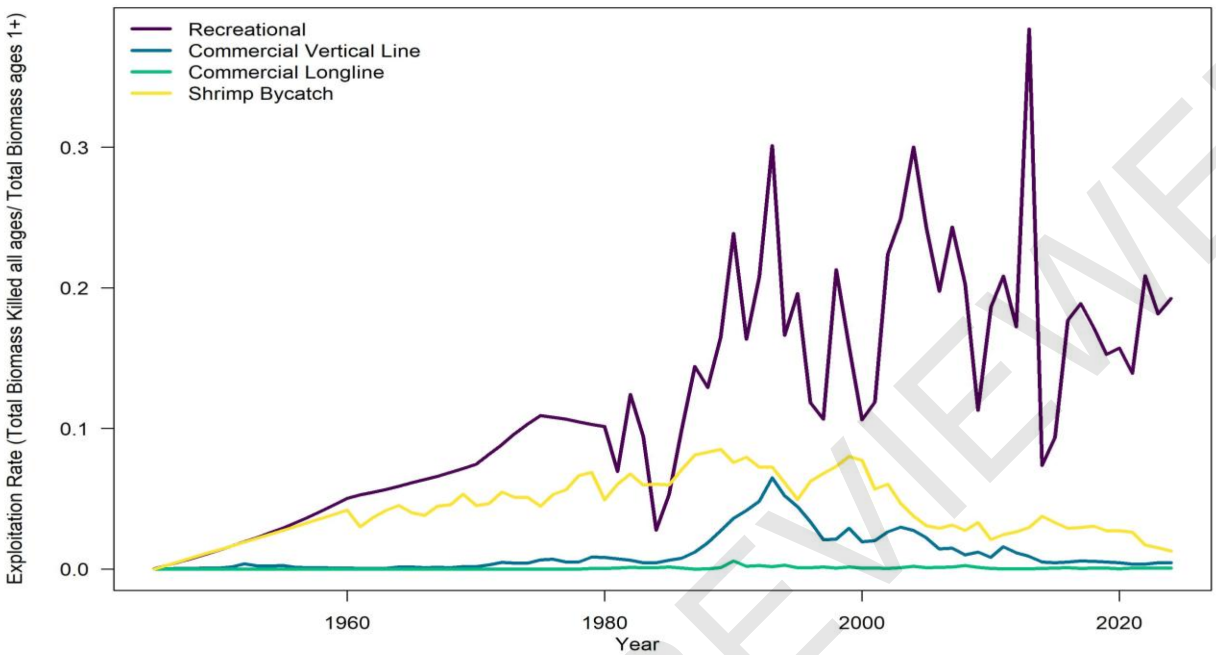


Figure 28. Annual exploitation rate estimates (total biomass killed all ages / total biomass age 1+) for SEDAR 100 and SEDAR 43.

SEDAR 100



SEDAR 43

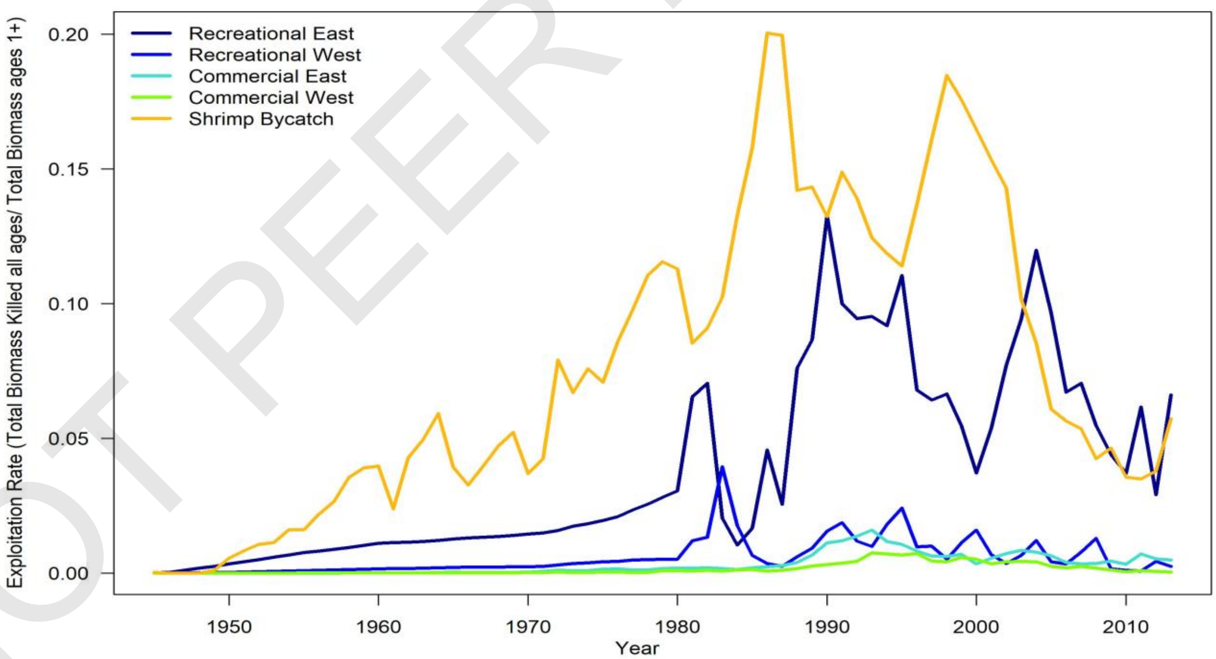


Figure 29. Annual exploitation rate (total biomass killed all ages / total biomass age 1+) by fleet for SEDAR 100 and SEDAR 43.

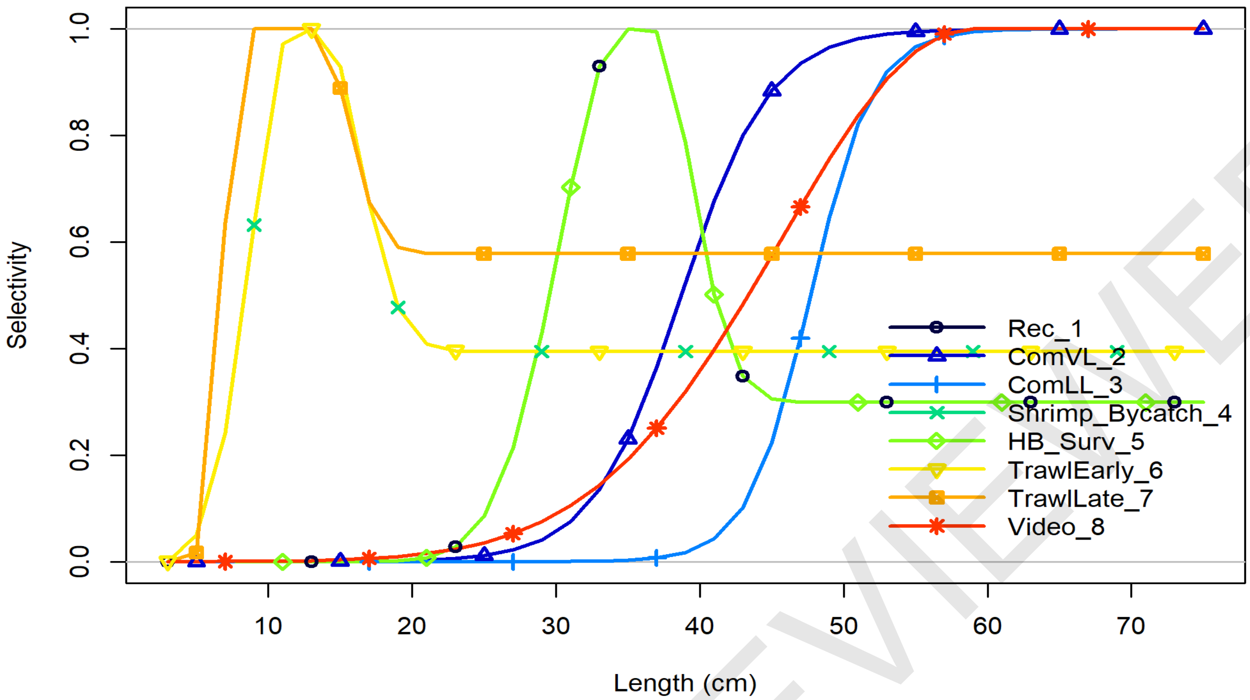


Figure 30. Length-based selectivity for each fleet and survey in the terminal year of the assessment, 2024.

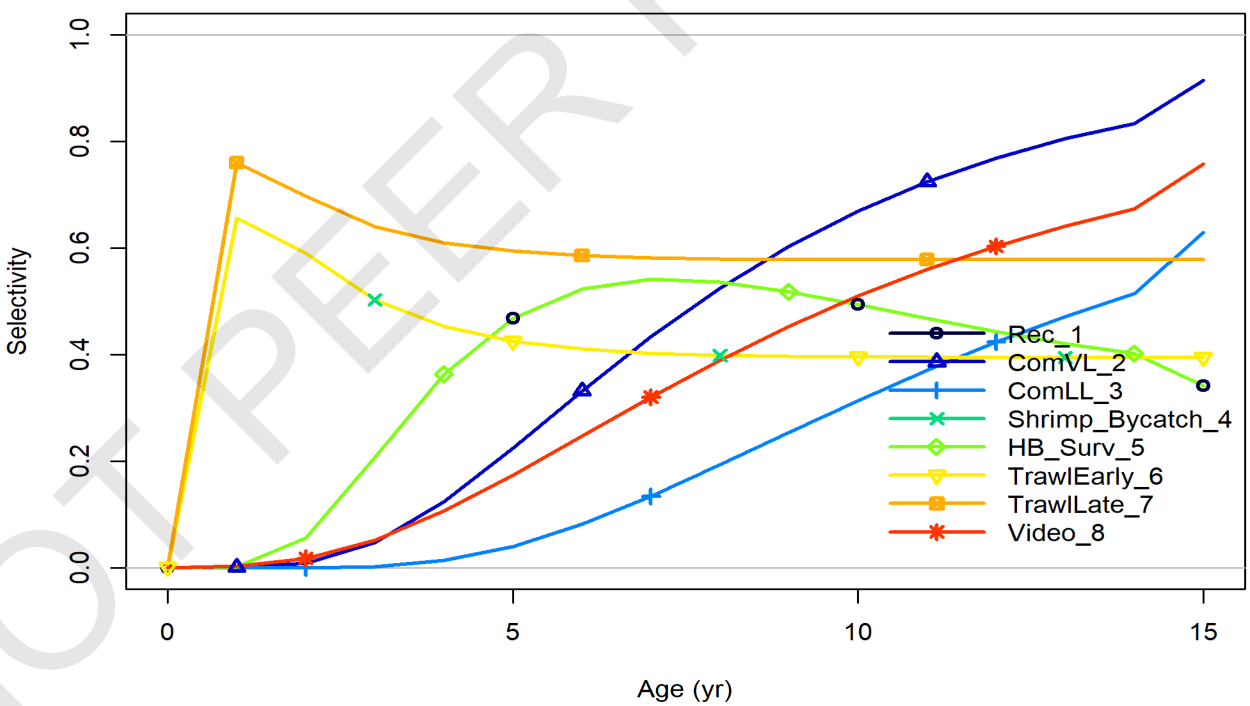


Figure 31. Derived age-based selectivity for each fleet and survey in the terminal year of the assessment, 2024.

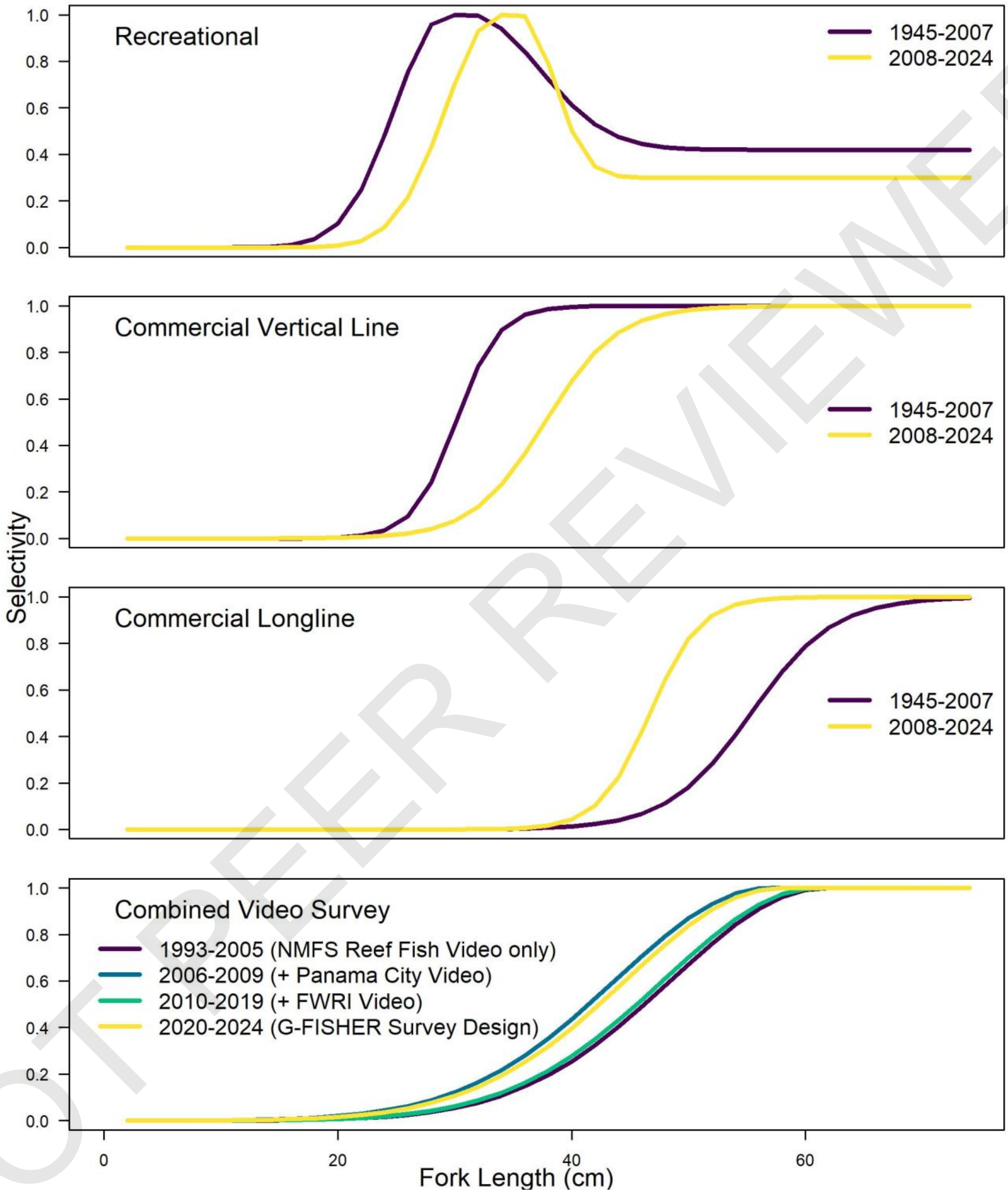


Figure 32. Time-varying selectivity at length for the fishing fleets and the Combined Video Survey.

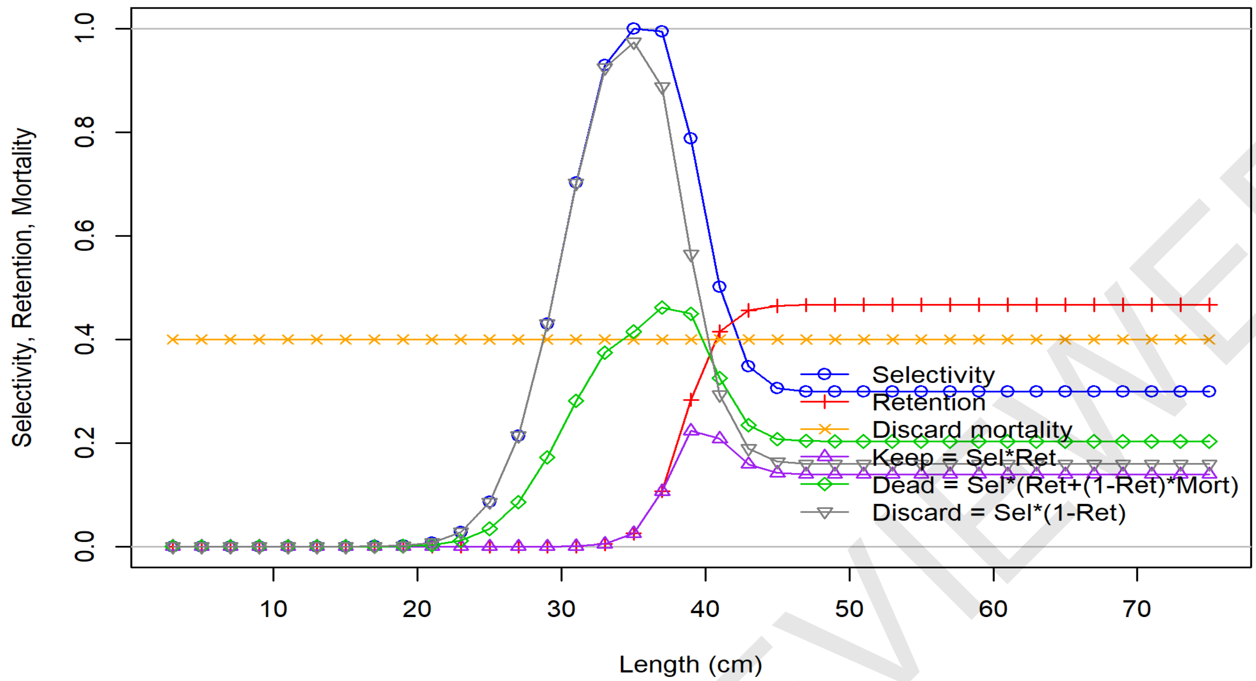


Figure 33. Length-based selectivity, retention, and discard mortality for the Recreational fleet in the terminal year of the assessment, 2024.

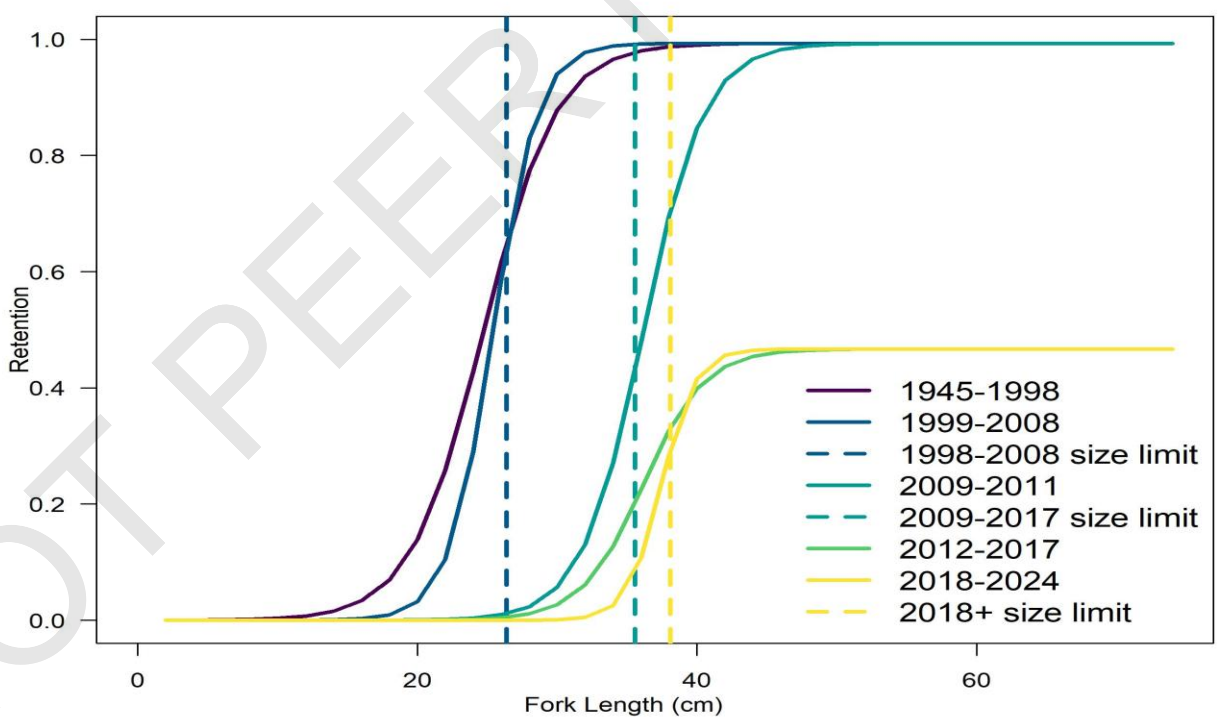


Figure 34. Time-varying retention at length for the Recreational fleet.

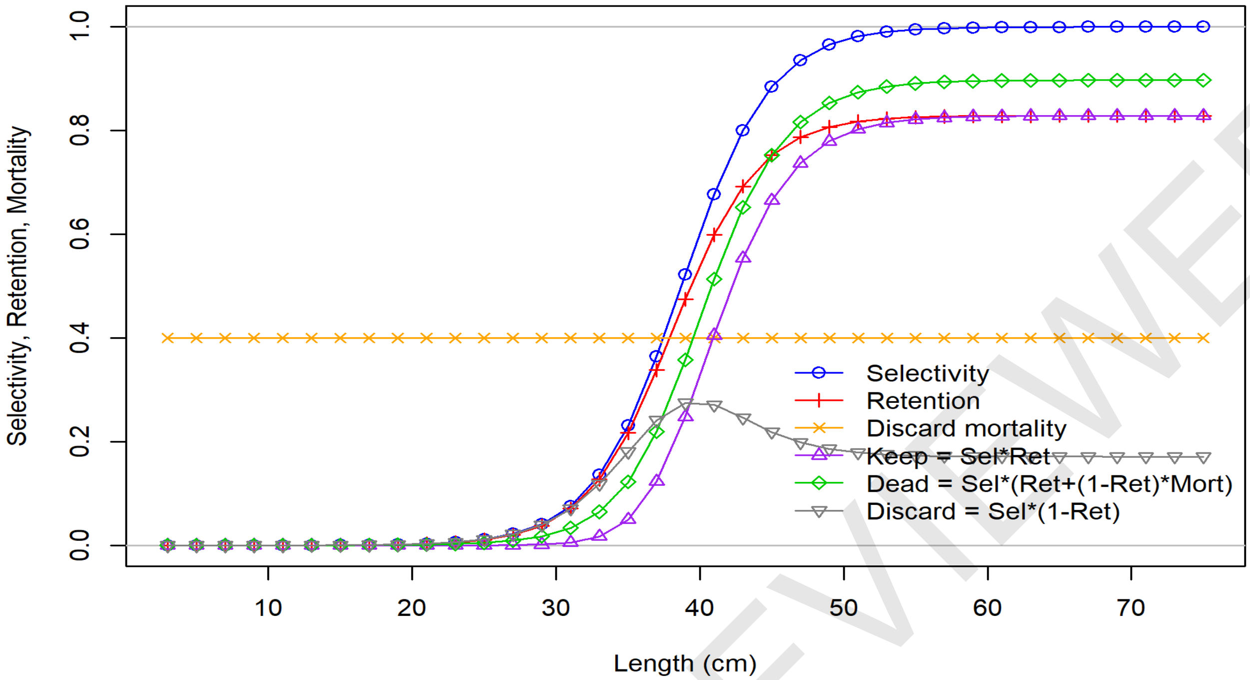


Figure 35. Length-based selectivity, retention, and discard mortality for the Commercial Vertical Line fleet in the terminal year of the assessment, 2024.

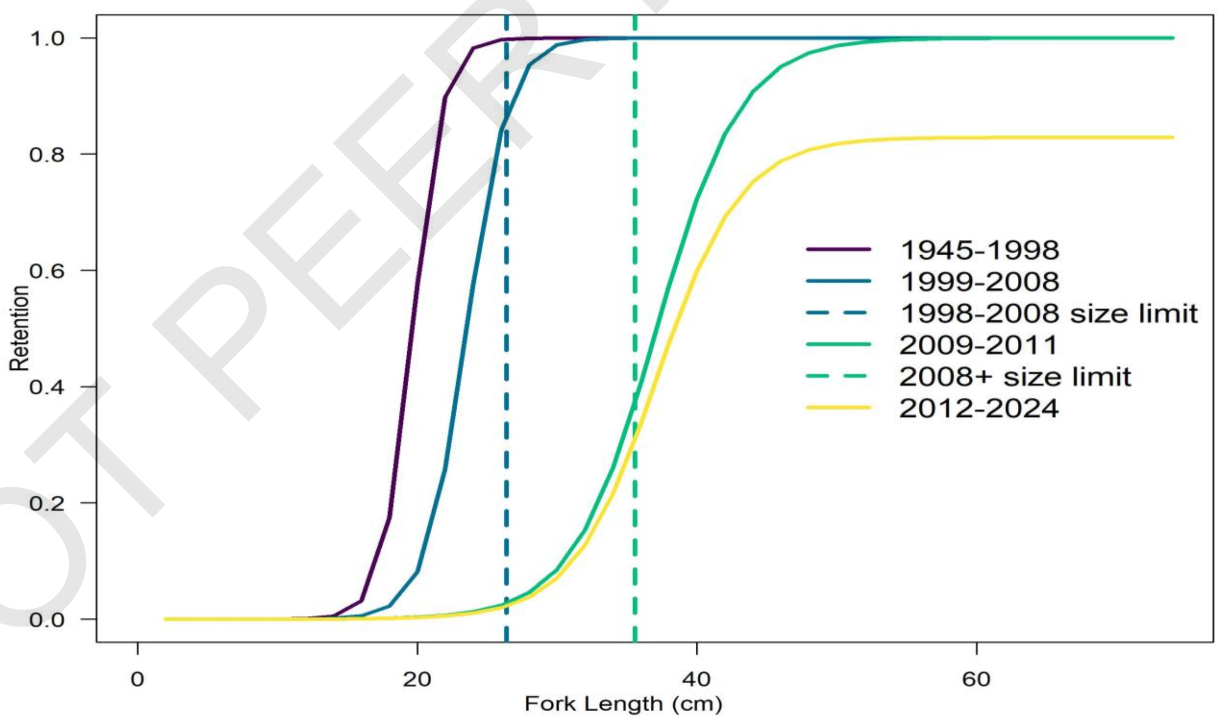


Figure 36. Time-varying retention at length for the Commercial Vertical Line fleet.

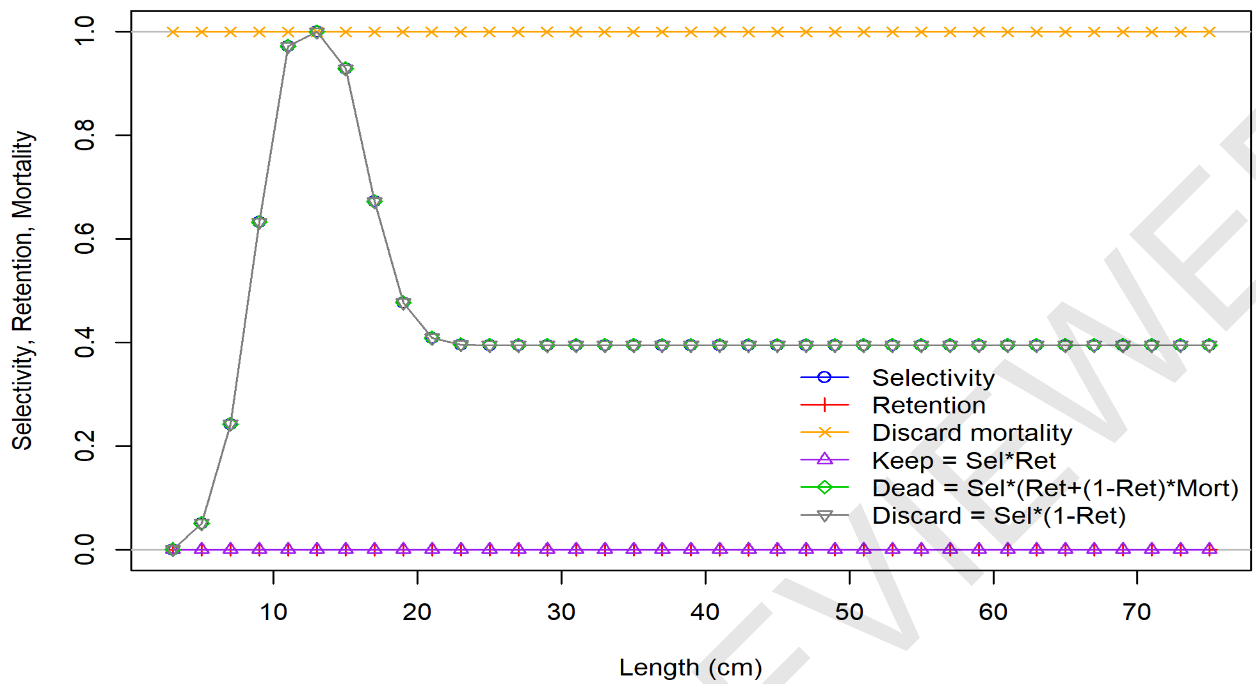
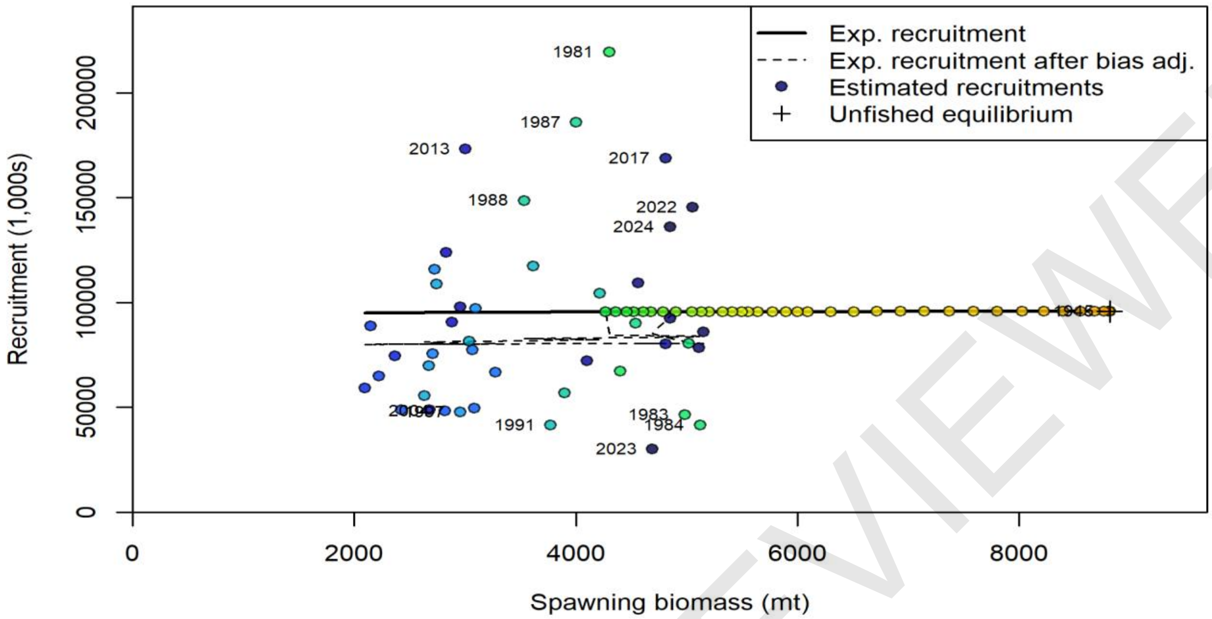


Figure 37. Length-based selectivity, retention, and discard mortality (100%) for the Shrimp Bycatch fleet in the terminal year of the assessment, 2024. Selectivity (blue line) is constant over the entire assessment time period (1945-2024).

SEDAR 100



SEDAR 43

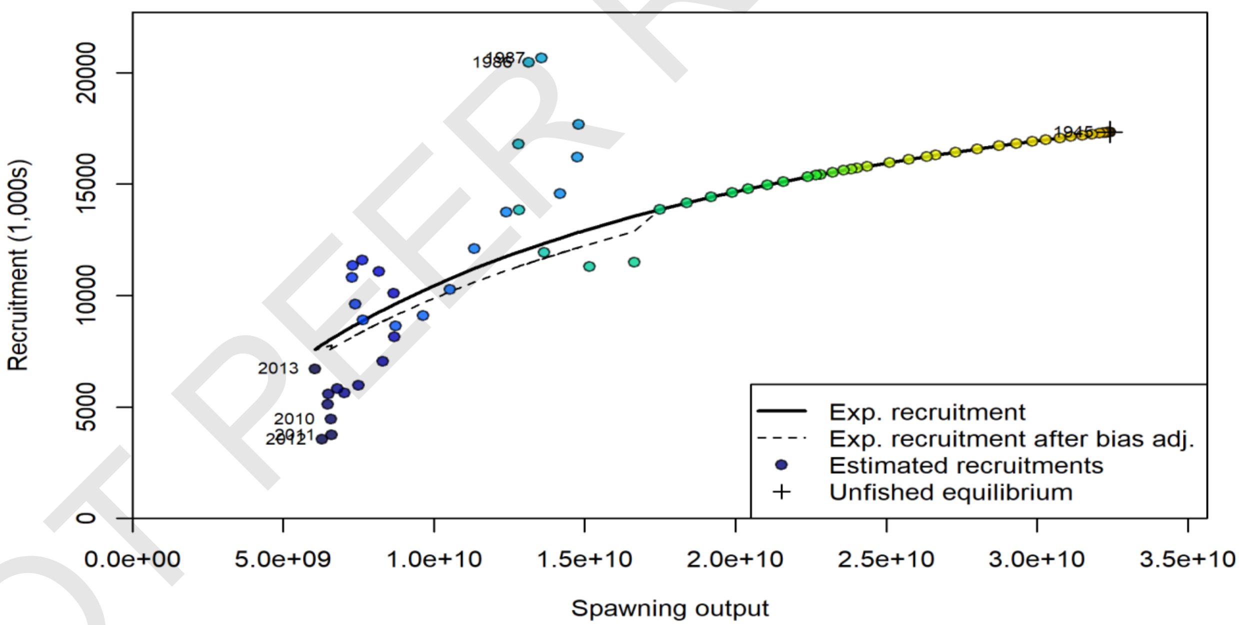
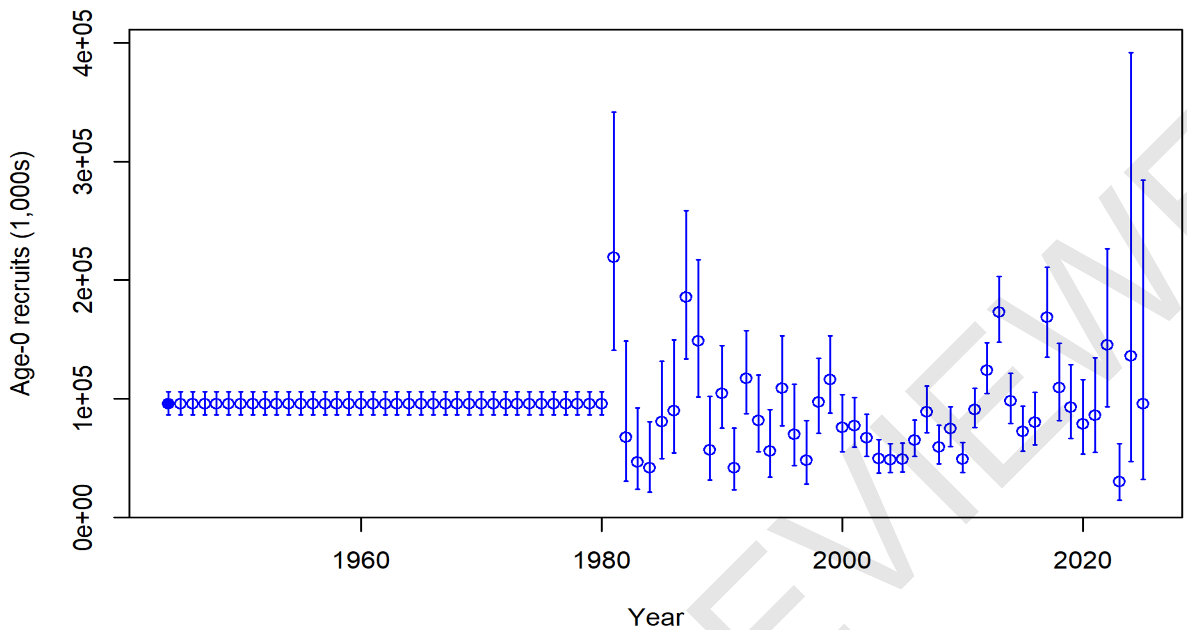


Figure 38. Predicted stock-recruit relationship for SEDAR 100 and SEDAR 43. SEDAR 100 fixed steepness and SigmaR at 0.99 and 0.6, respectively, whereas both were estimated in SEDAR 43. Plotted are predicted annual recruitments from Stock Synthesis (circles), expected recruitment from the stock-recruit relationship (black line), and bias adjusted recruitment from the stock-recruit relationship (dashed line).

SEDAR 100



SEDAR 43

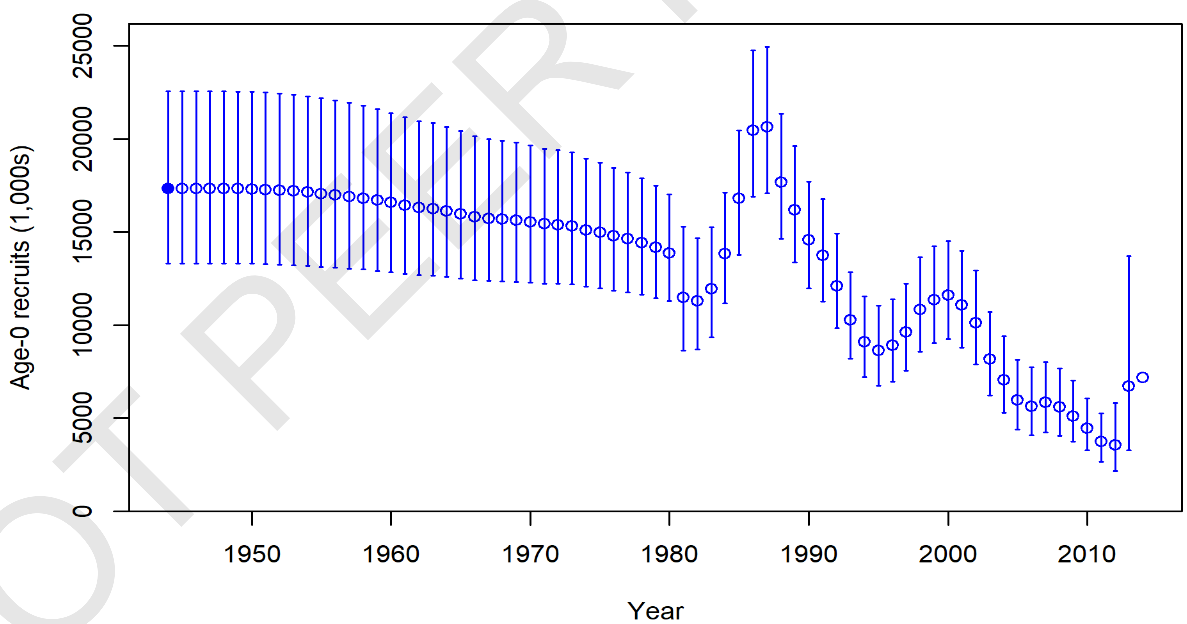
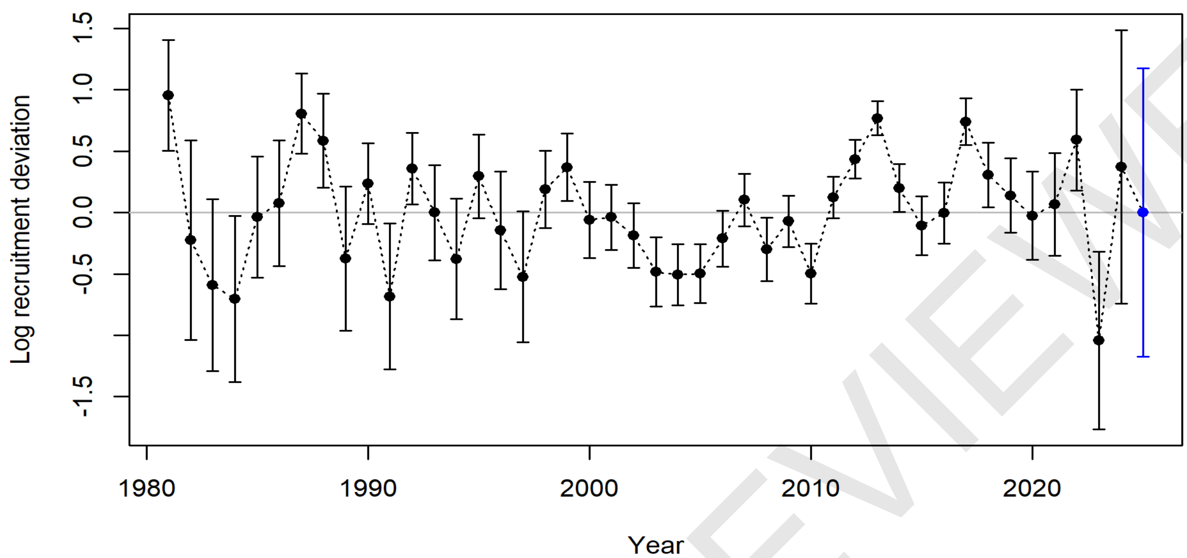


Figure 39. Estimated Age-0 recruitment with 95% confidence intervals for SEDAR 100 and SEDAR 43. SEDAR 100 fixed steepness and SigmaR at 0.99 and 0.6, respectively, whereas both were estimated in SEDAR 43.

SEDAR 100



SEDAR 43

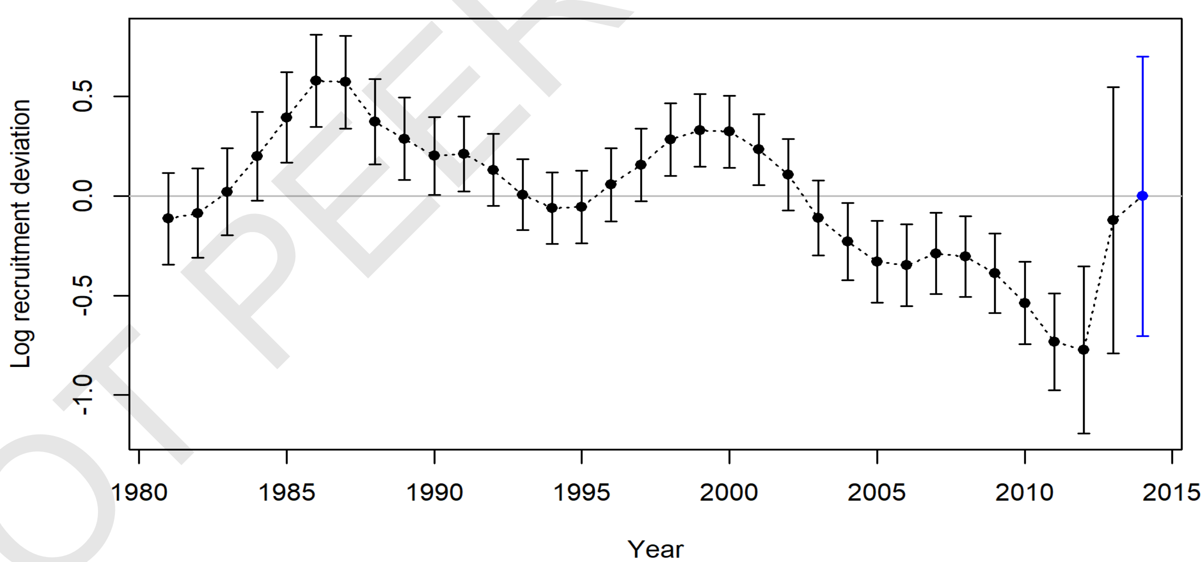
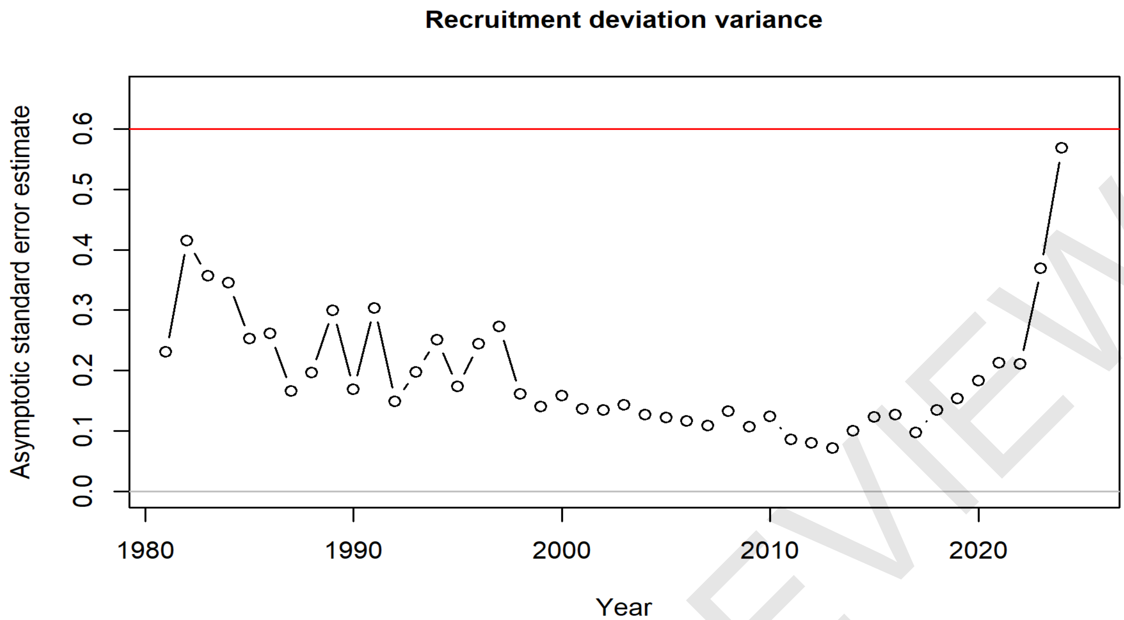


Figure 40. Estimated log recruitment deviations for SEDAR 100 and SEDAR 43. SEDAR 100 fixed steepness and SigmaR at 0.99 and 0.6, respectively, whereas both were estimated in SEDAR 43. Blue dots identify years where recruitment deviations were not estimated.

SEDAR 100



SEDAR 43

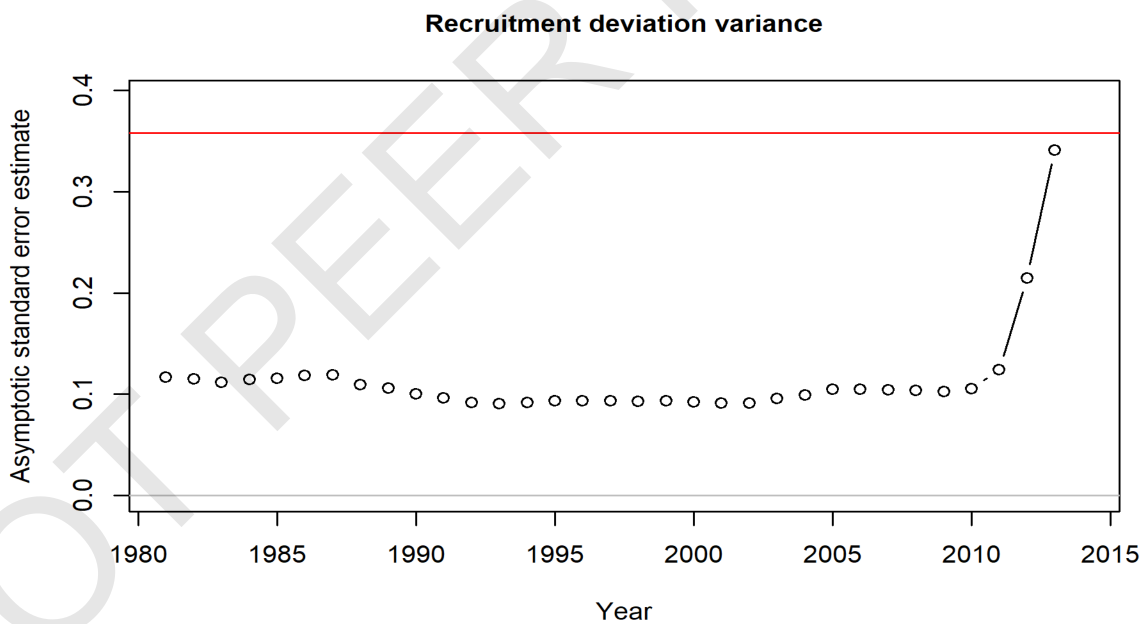


Figure 41. Asymptotic standard errors for recruitment deviations for SEDAR 100 and SEDAR 43. The red line represents the fixed value of 0.6 and estimated value of 0.358 from the SEDAR 100 and SEDAR 43 models, respectively.

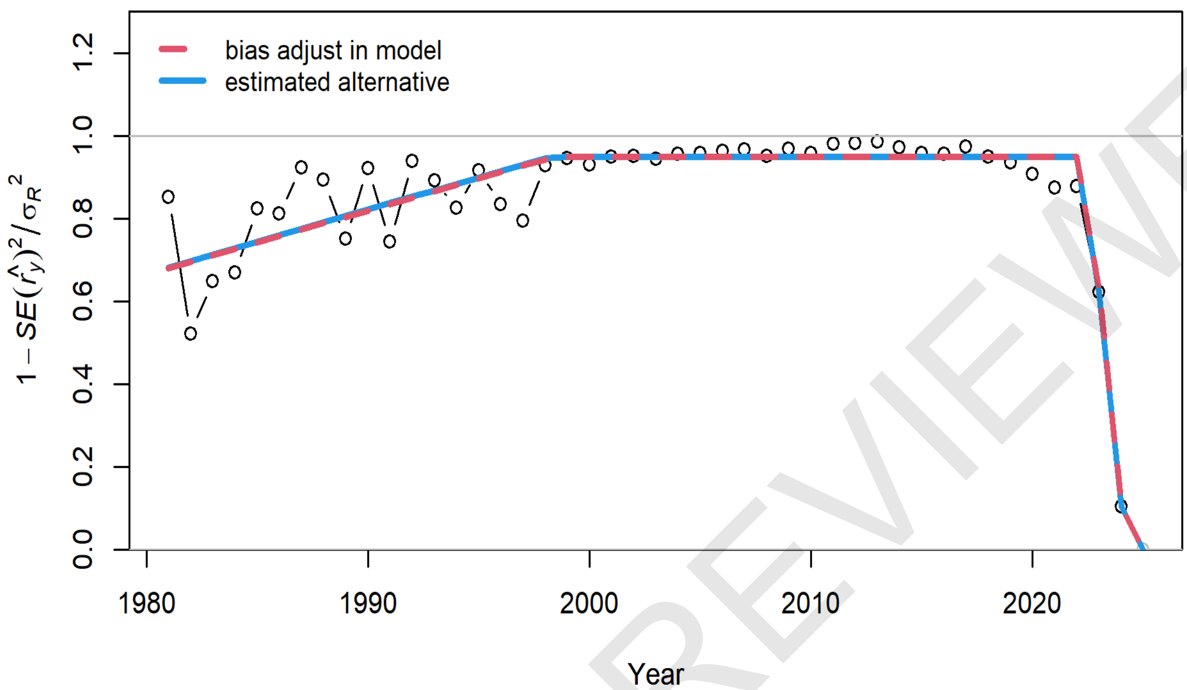


Figure 42. Points are transformed variances. Red line shows current settings for bias adjustment specified for the SEDAR 100 AP Model, which coincides with the least squares estimate of alternative bias adjustment relationship for recruitment deviations (dashed red line). For more information, see Methot and Taylor (2011).

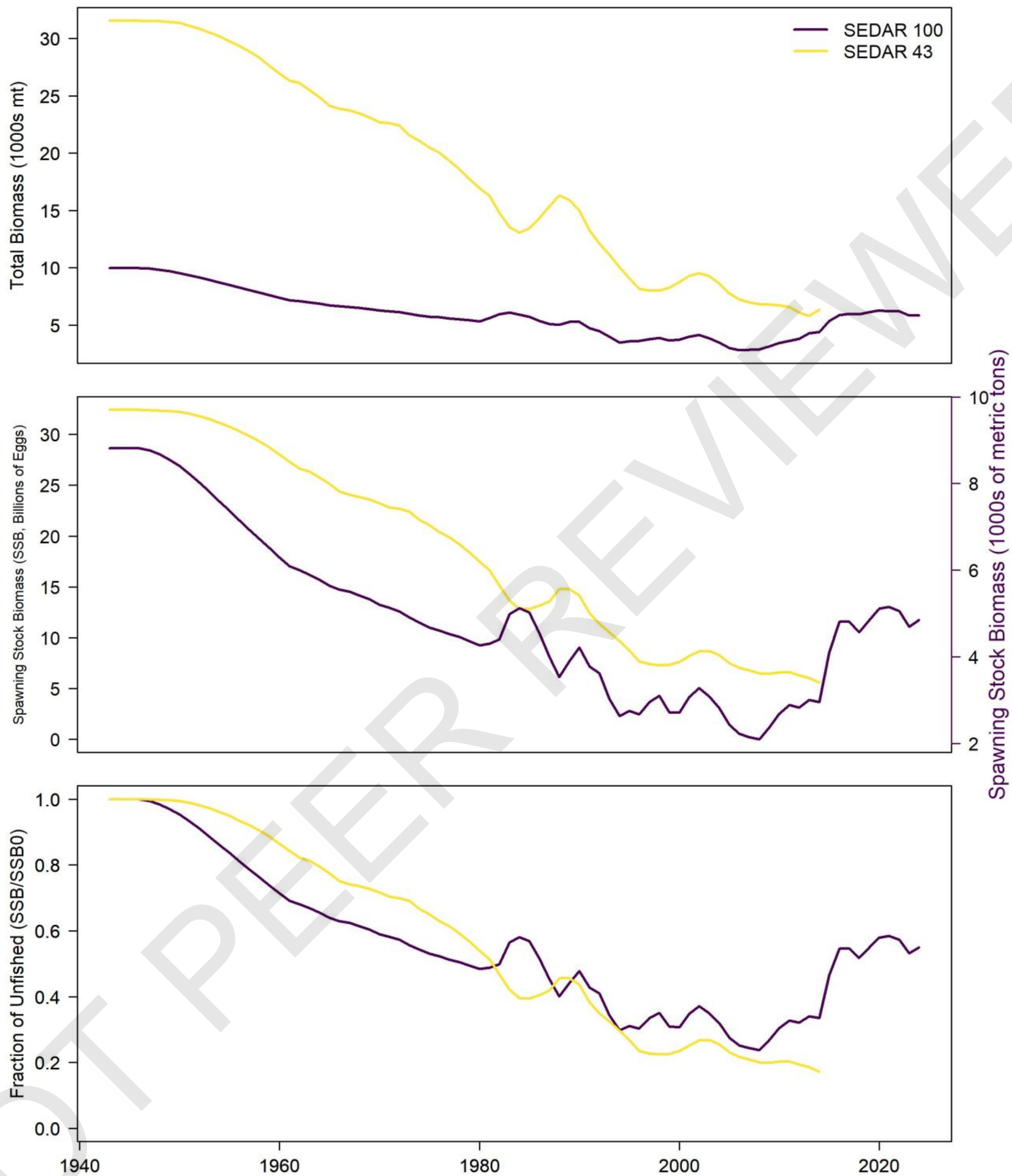
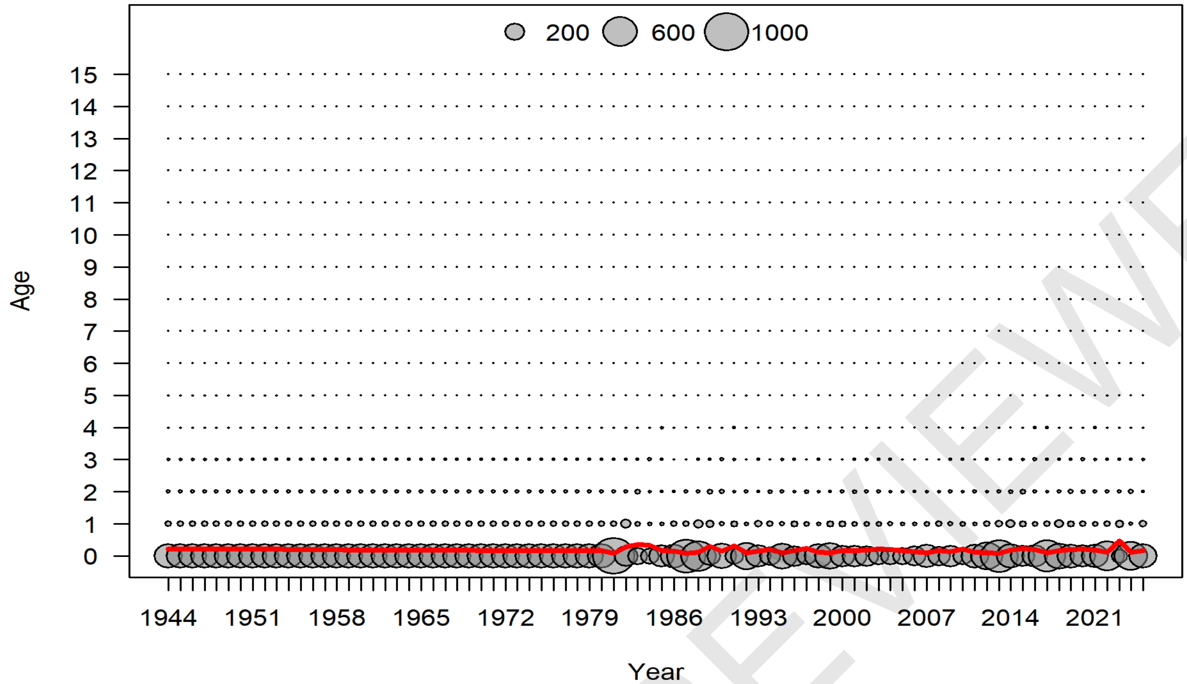


Figure 43. Estimates of annual total biomass (in 1000s of metric tons; top panel), spawning stock biomass (middle panel), and the fraction of virgin or unfished SSB (SSB/SSB$_0$; bottom panel) for SEDAR 100 and SEDAR 43. Note that the units of SSB changed from the number of eggs in SEDAR 43 to metric tons in SEDAR 100.

SEDAR 100



SEDAR 43

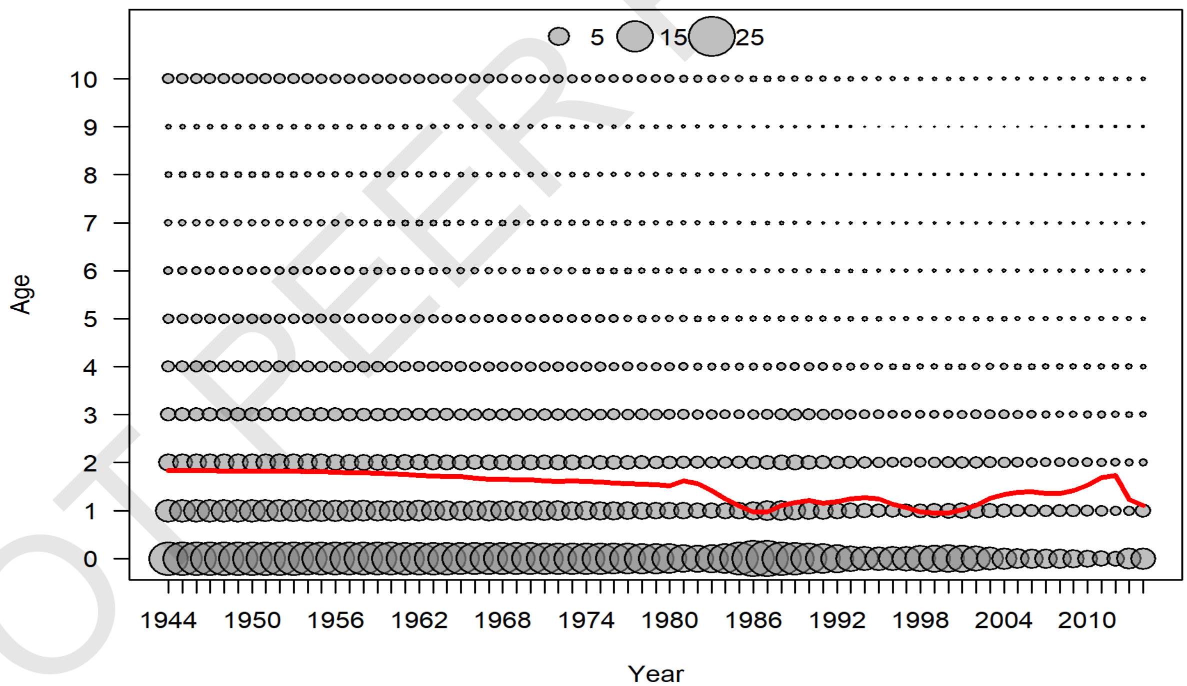


Figure 44. Expected beginning of year numbers-at-age (bubbles) and mean age (red line) for SEDAR 100 and SEDAR 43.

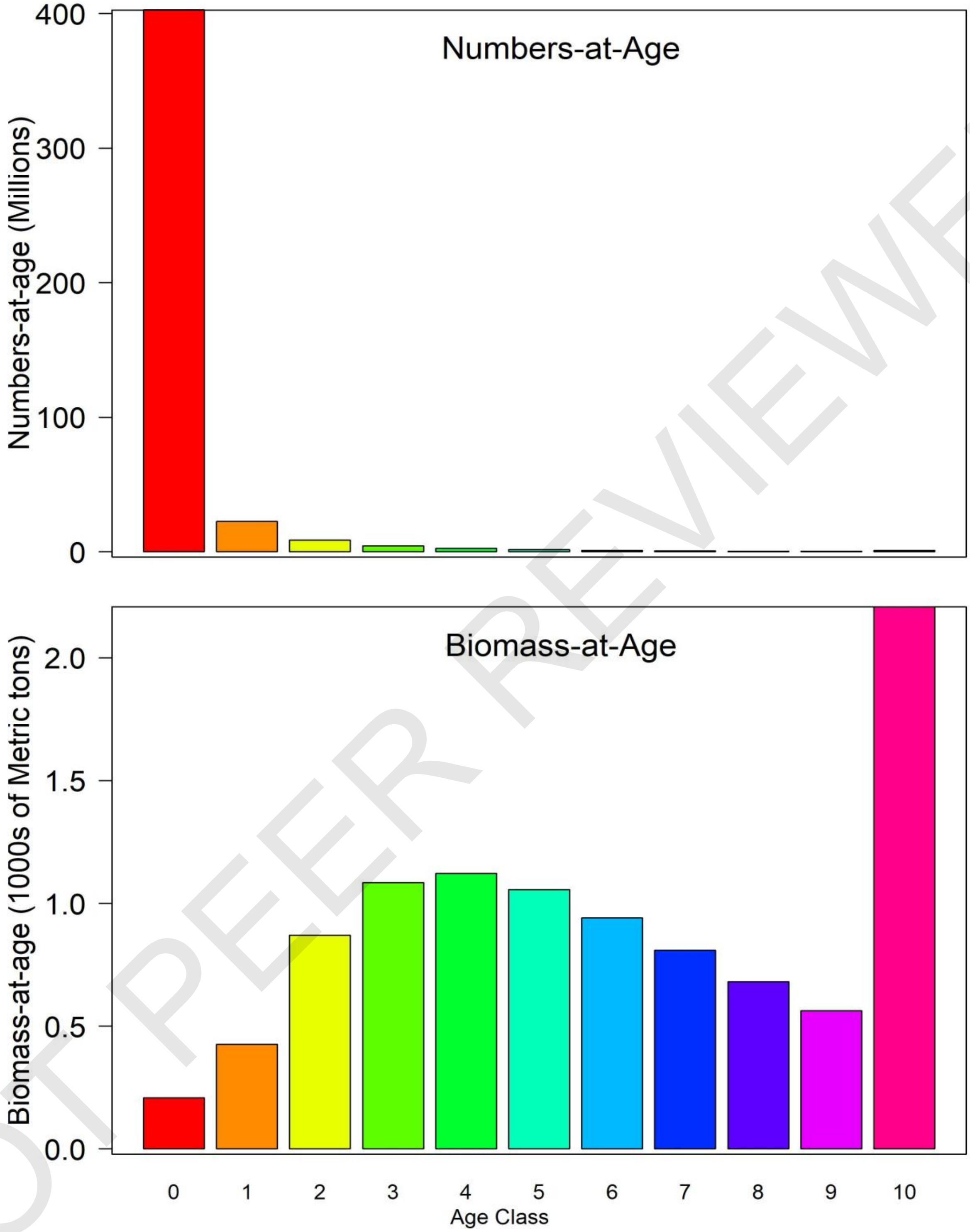


Figure 45. Expected numbers-at-age and biomass-at-age at virgin stock conditions.

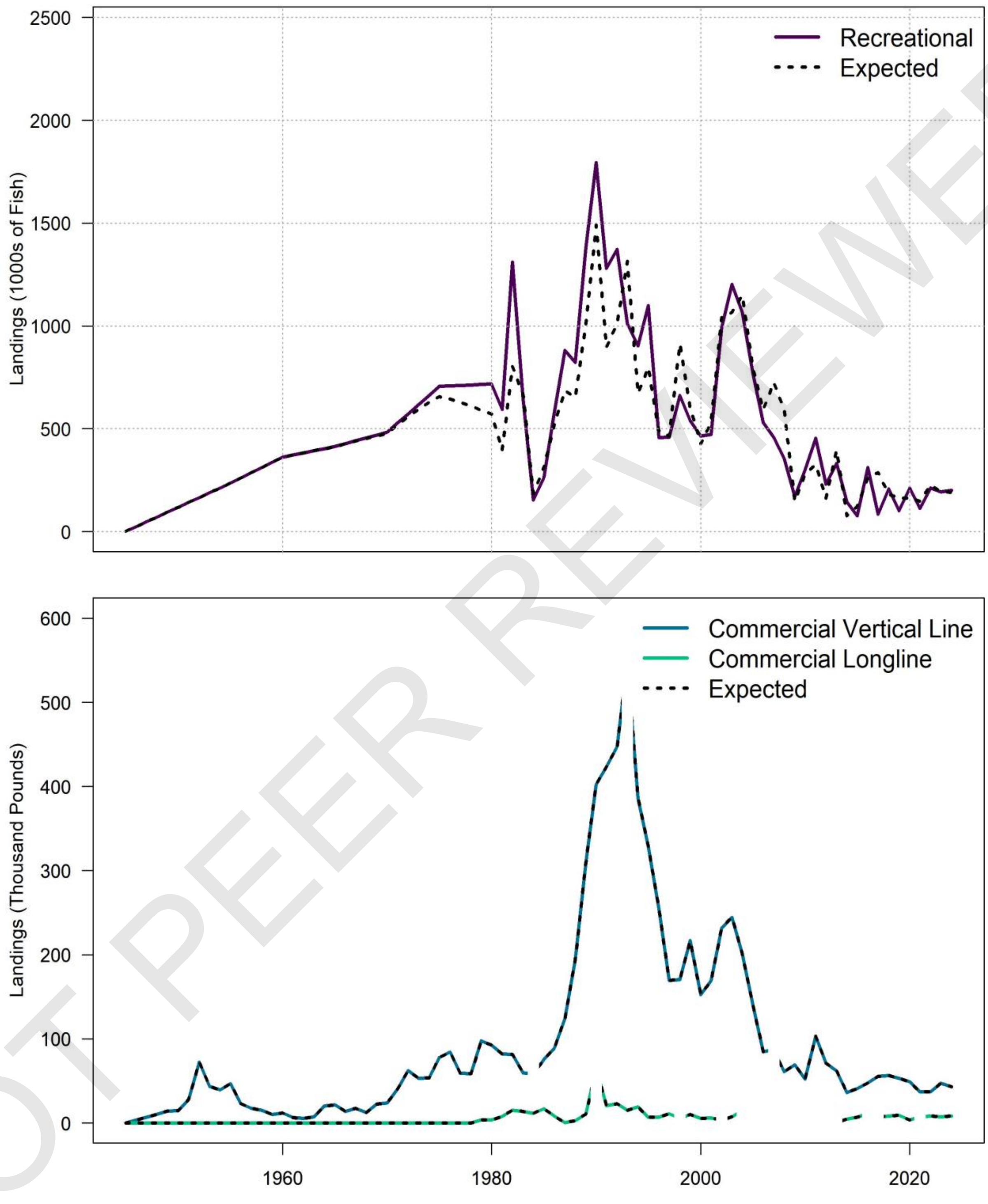
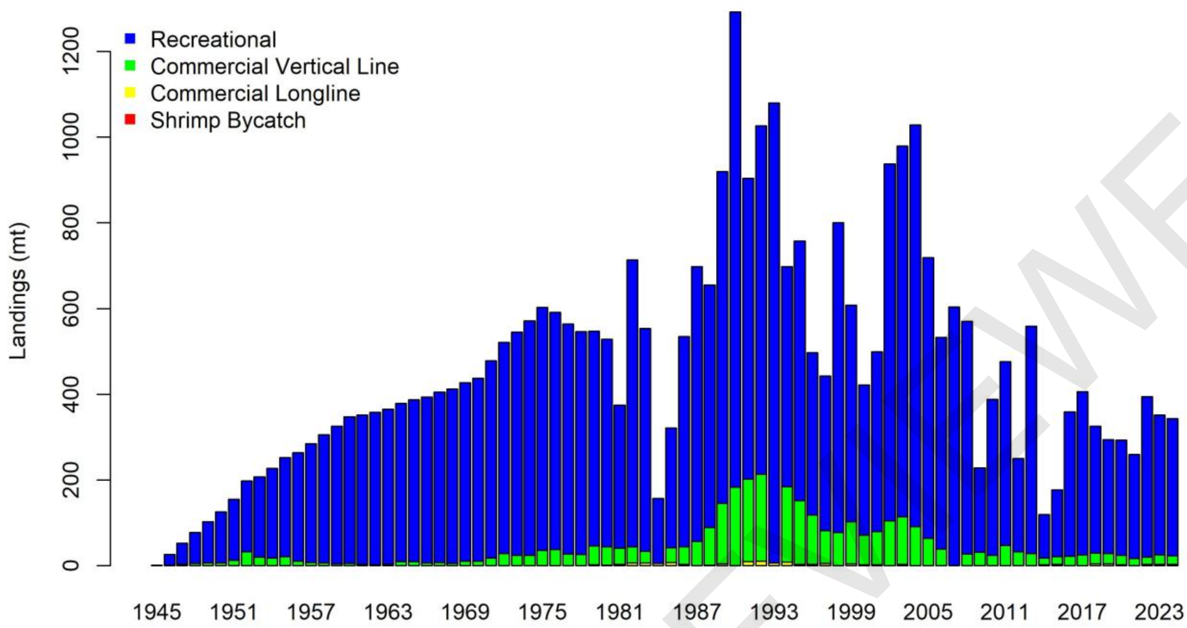


Figure 46. Observed (thick colored lines) and expected (dashed lines) landings by fleet. Commercial landings were input into the stock assessment model as metric tons in whole weight, and are shown in thousands of pounds. Associated log-scale standard errors are provided in ***Tables 21-23****. Confidential data have been excluded.*

SEDAR 100



SEDAR 43

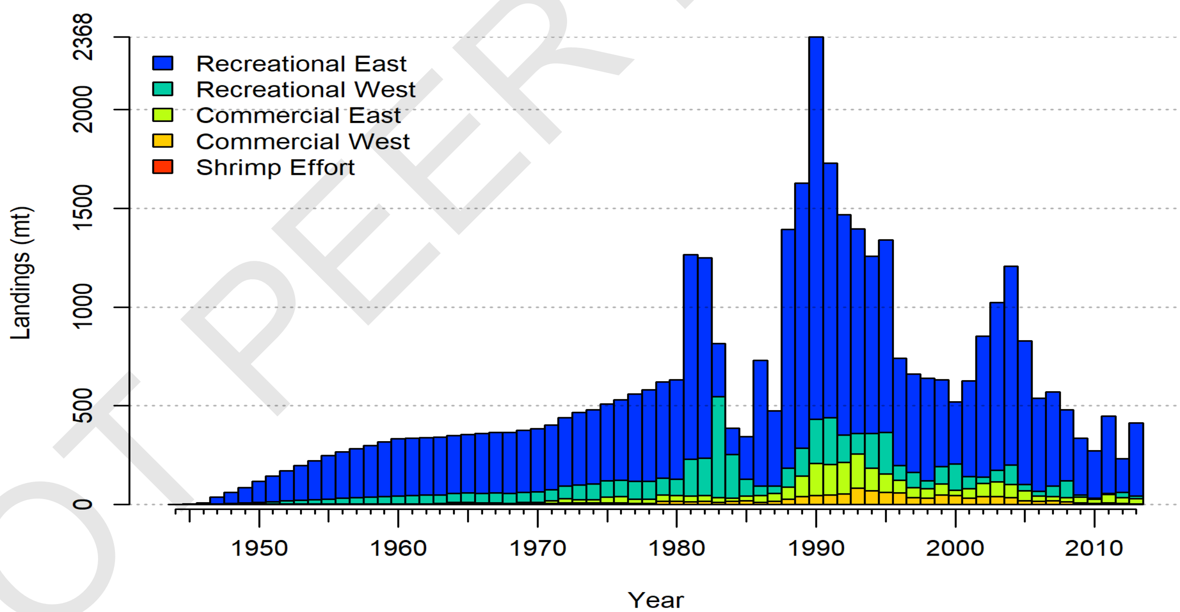


Figure 47. Expected landings (metric tons, mt) by fleet for SEDAR 100 and SEDAR 43. Confidential data for SEDAR 100 have been excluded for the Commercial Vertical Line and Commercial Longline fleets.

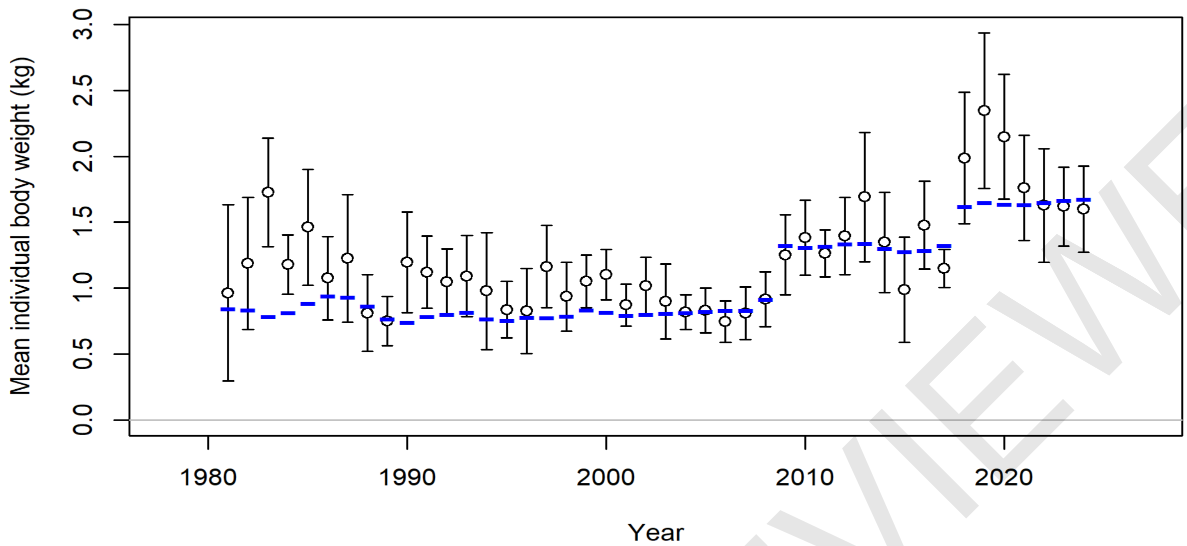
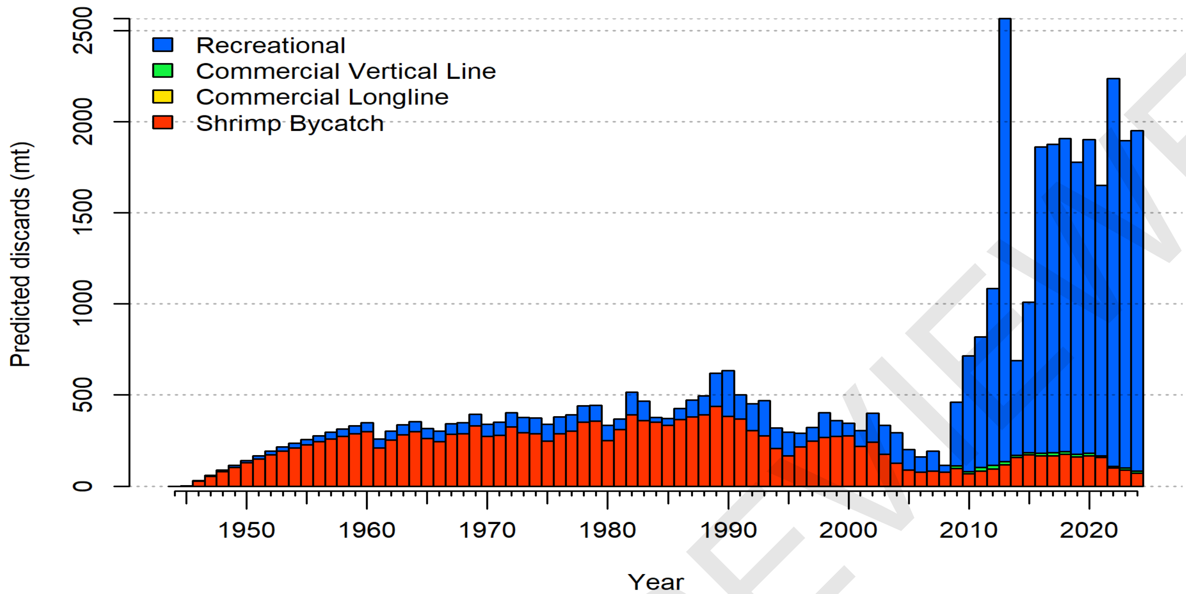


Figure 48. Input (dots with 95% confidence intervals) and expected (blue dashes) mean weight (kg, whole weight) of Gray Triggerfish landed by the Recreational fleet.

SEDAR 100



SEDAR 43

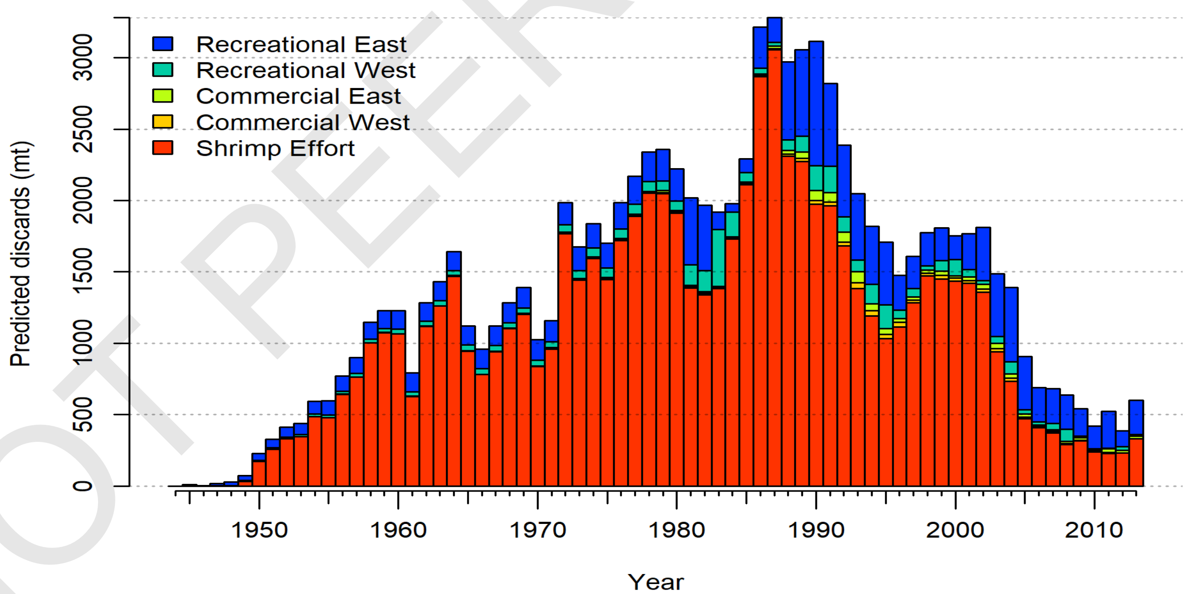
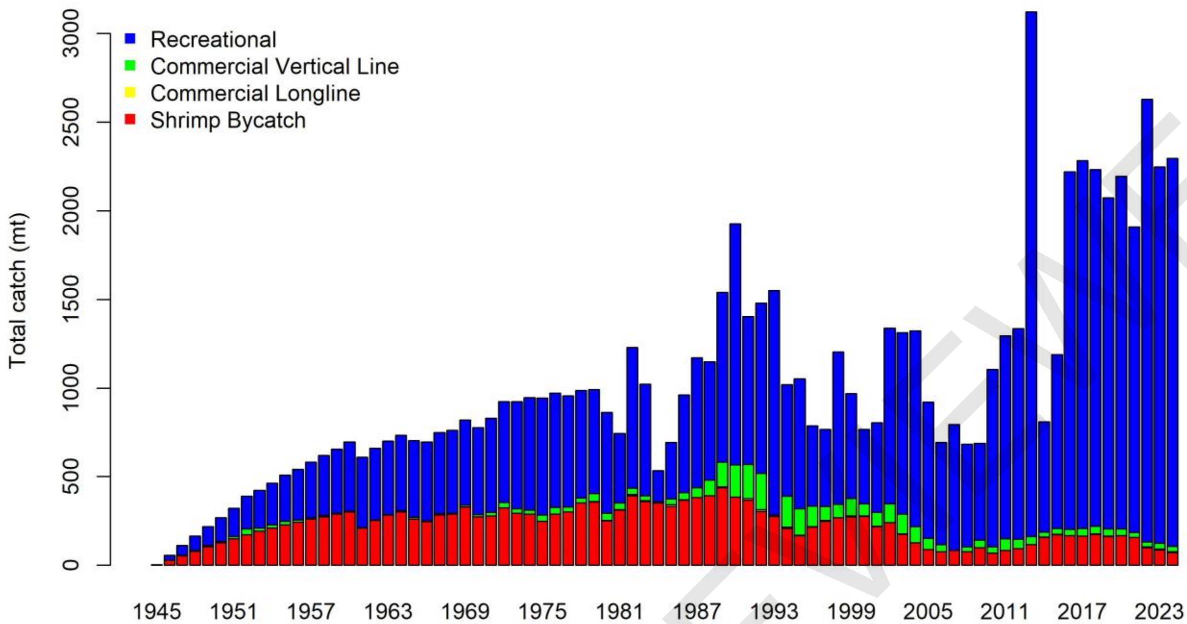


Figure 49. Expected discards (metric tons, mt) by fleet for SEDAR 100 and SEDAR 43.

SEDAR 100



SEDAR 43

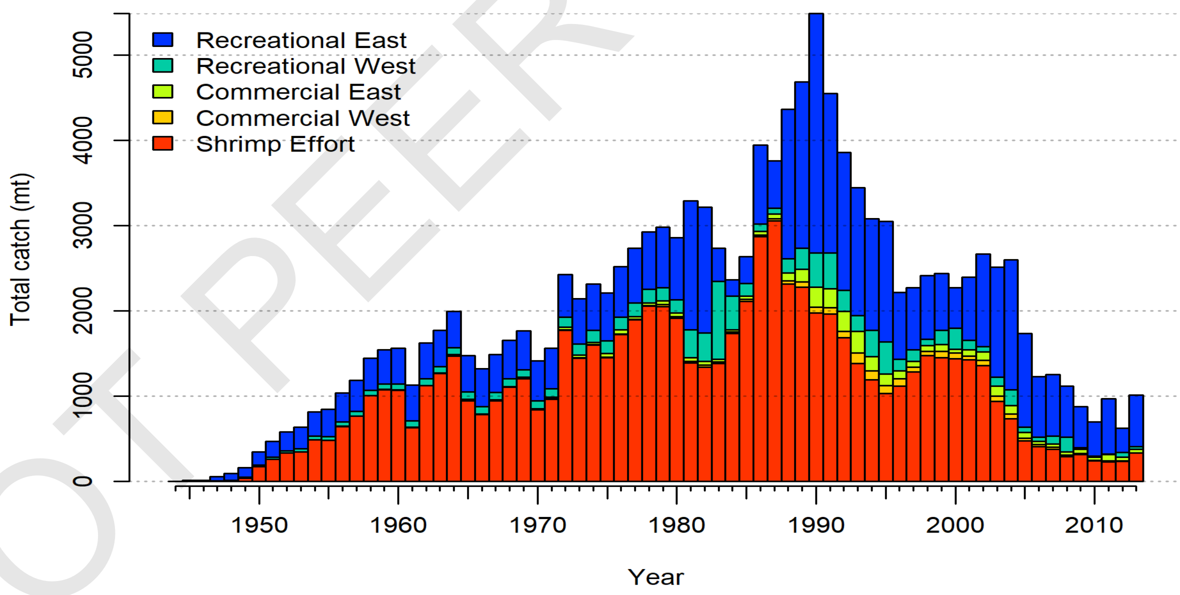
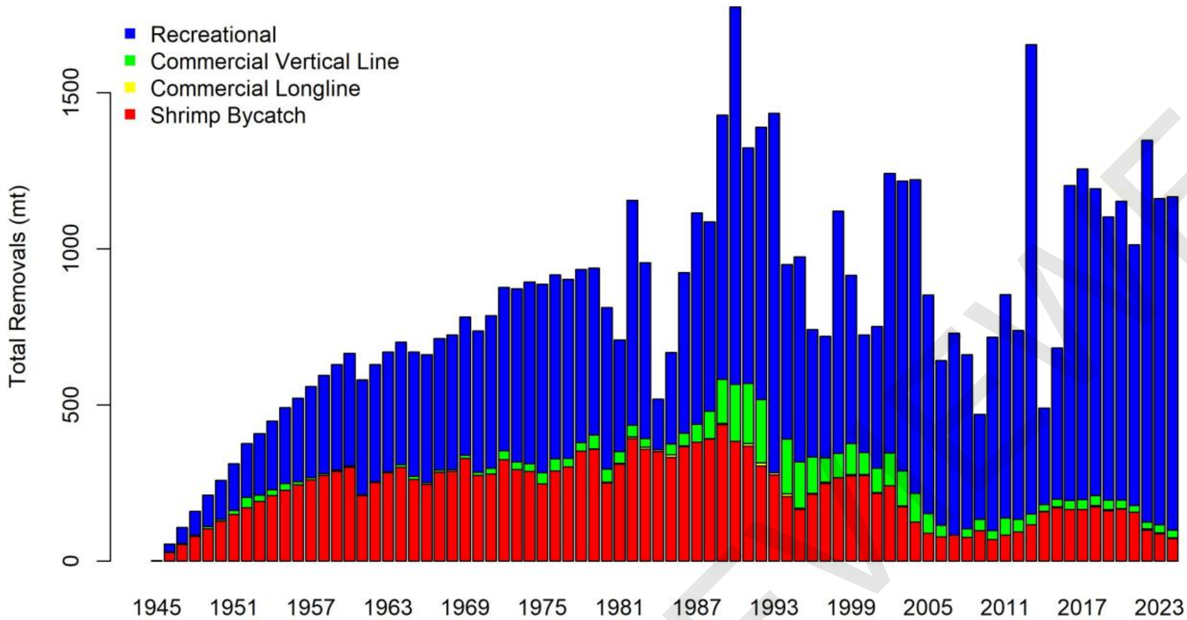


Figure 50. Expected total catch (landings + discards in metric tons, mt) by fleet for SEDAR 100 and SEDAR 43. Confidential data for SEDAR 100 have been excluded for the Commercial Vertical Line and Commercial Longline fleets.

SEDAR 100



SEDAR 43

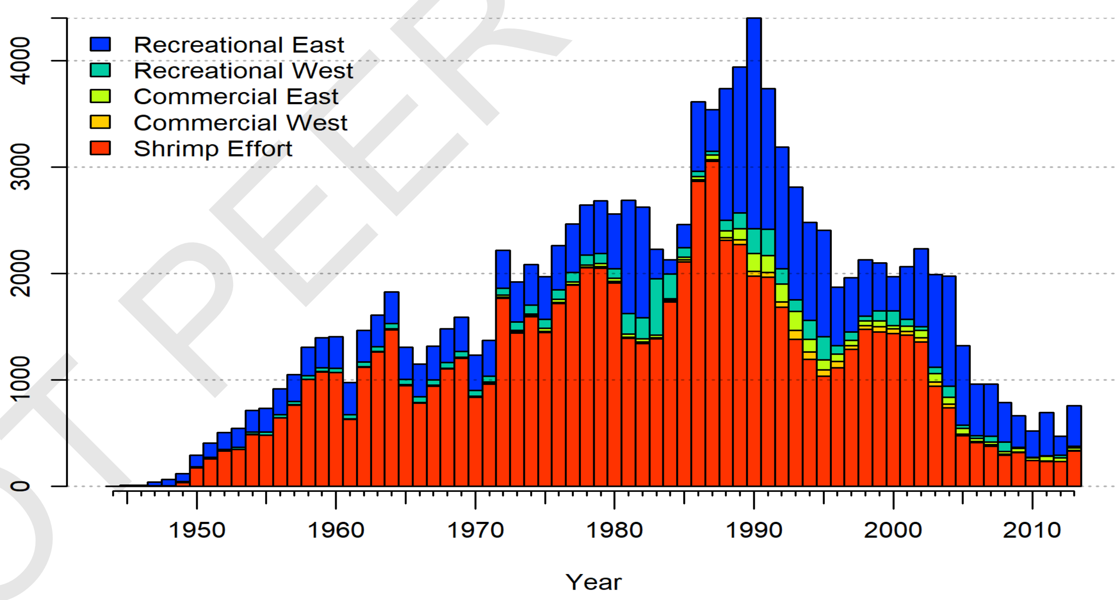
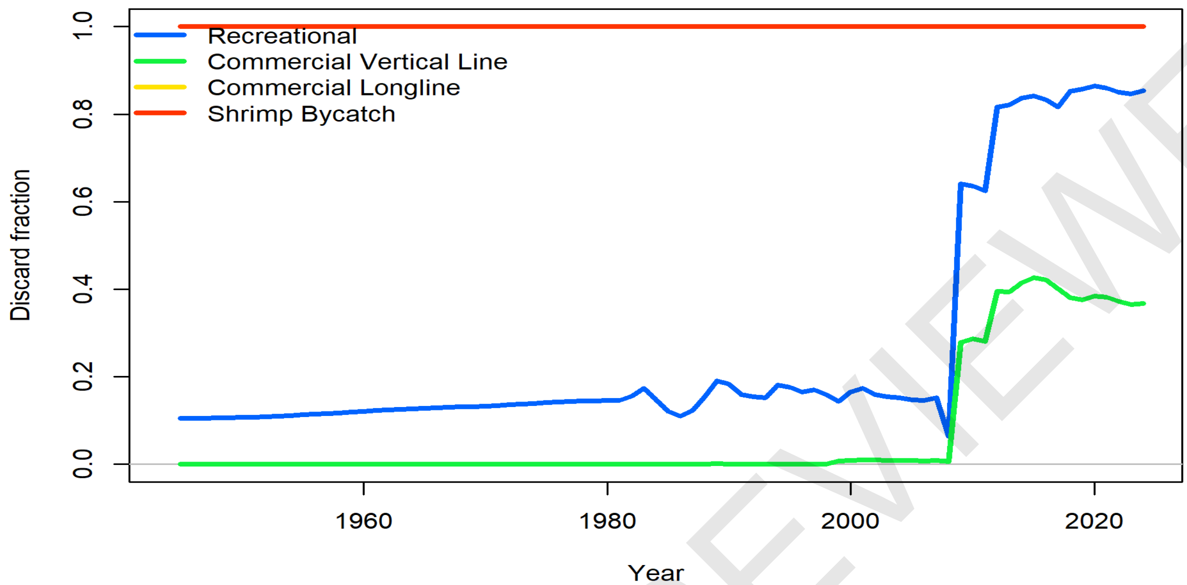


Figure 51. Expected total removals (landings + dead discards in metric tons, mt) by fleet for SEDAR 100 and SEDAR 43. Confidential data for SEDAR 100 have been excluded for the Commercial Vertical Line and Commercial Longline fleets.

SEDAR 100



SEDAR 43

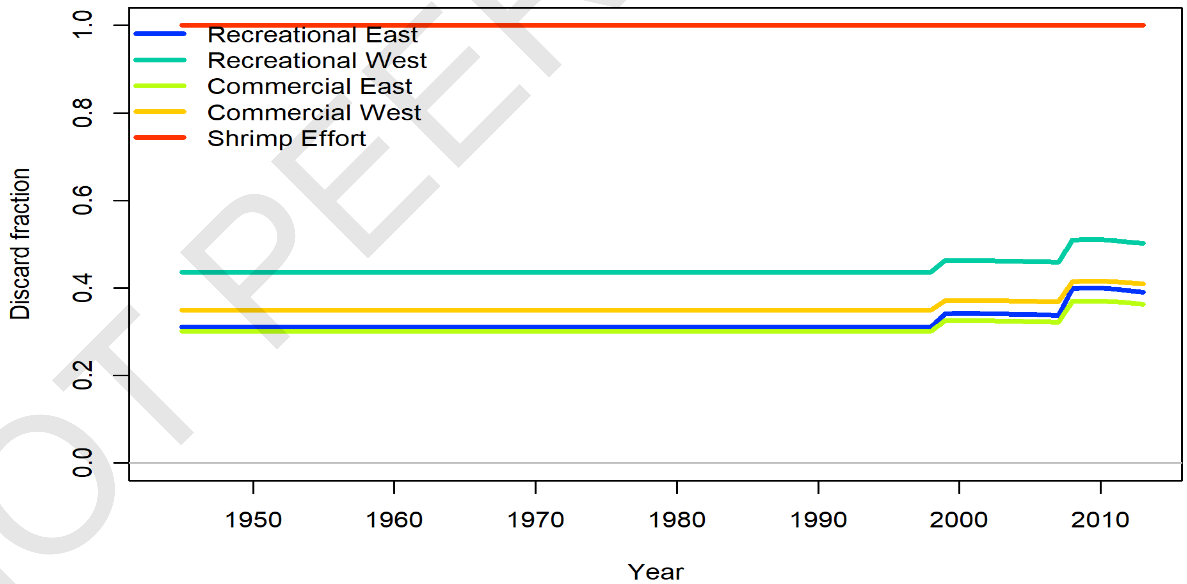


Figure 52. Discard fraction by fleet for SEDAR 100 and SEDAR 43.

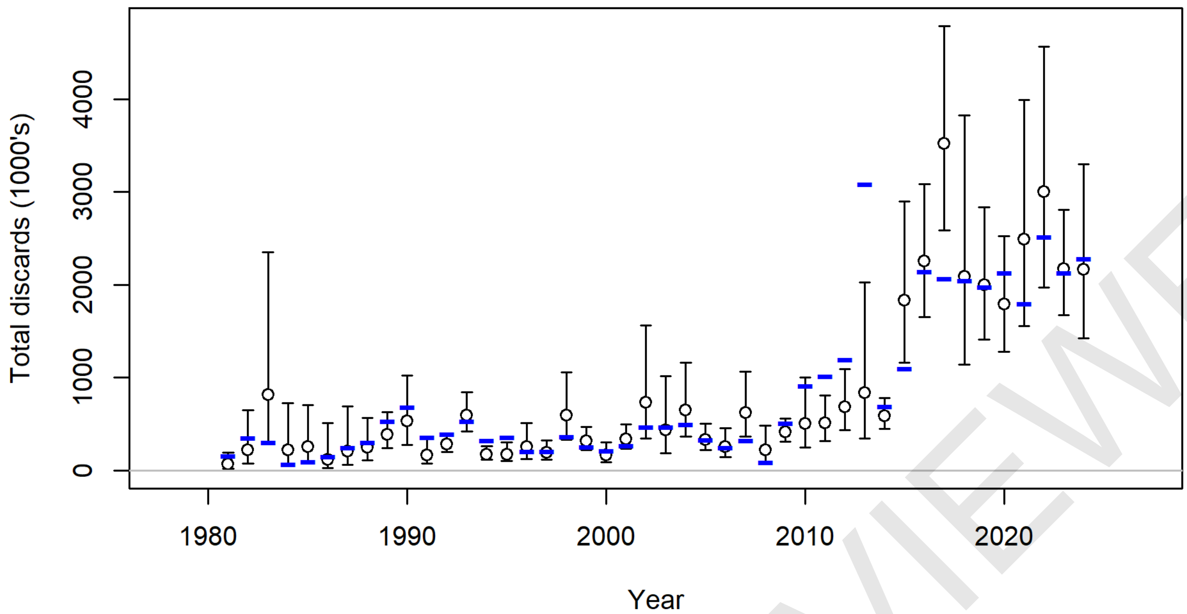


Figure 53. Observed (dots with 95% confidence intervals) and expected (blue lines) discards by the Recreational fleet. Discards are in numbers of fish (1,000s) and reflect released fish (i.e., before discard mortality has been applied).

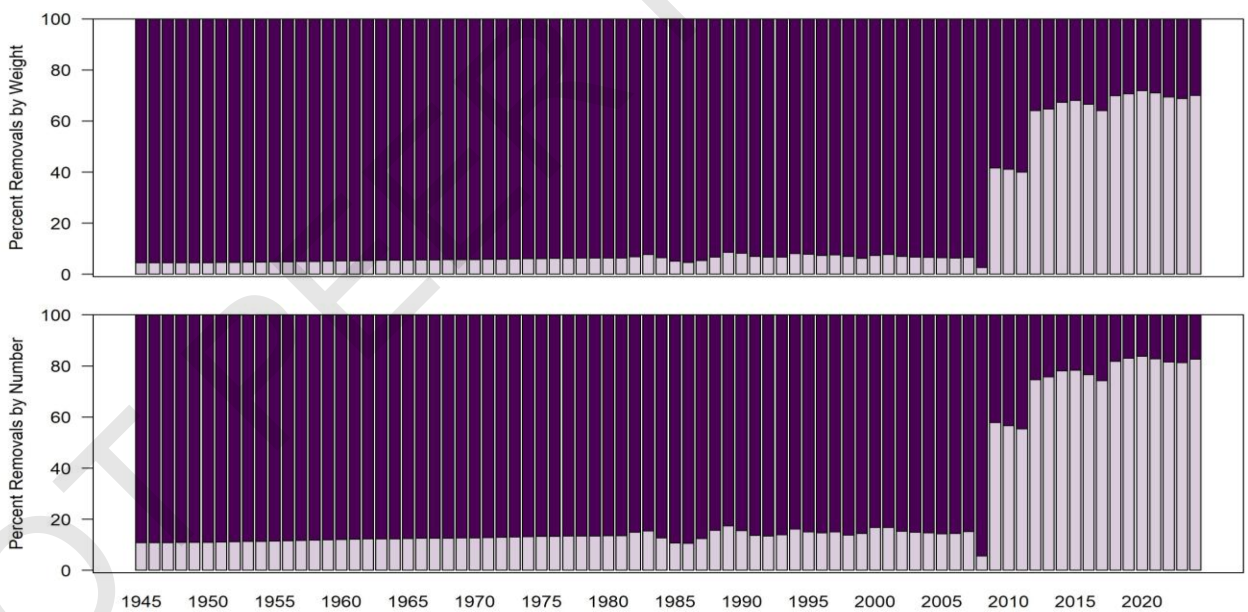


*Figure 54. Comparison of landings (dark bars) and dead discards (light bars) for weights (top panel) and numbers of fish (bottom panel) for the Recreational fleet. Estimates of dead discards in both numbers and weights are provided in **Table 24**.*

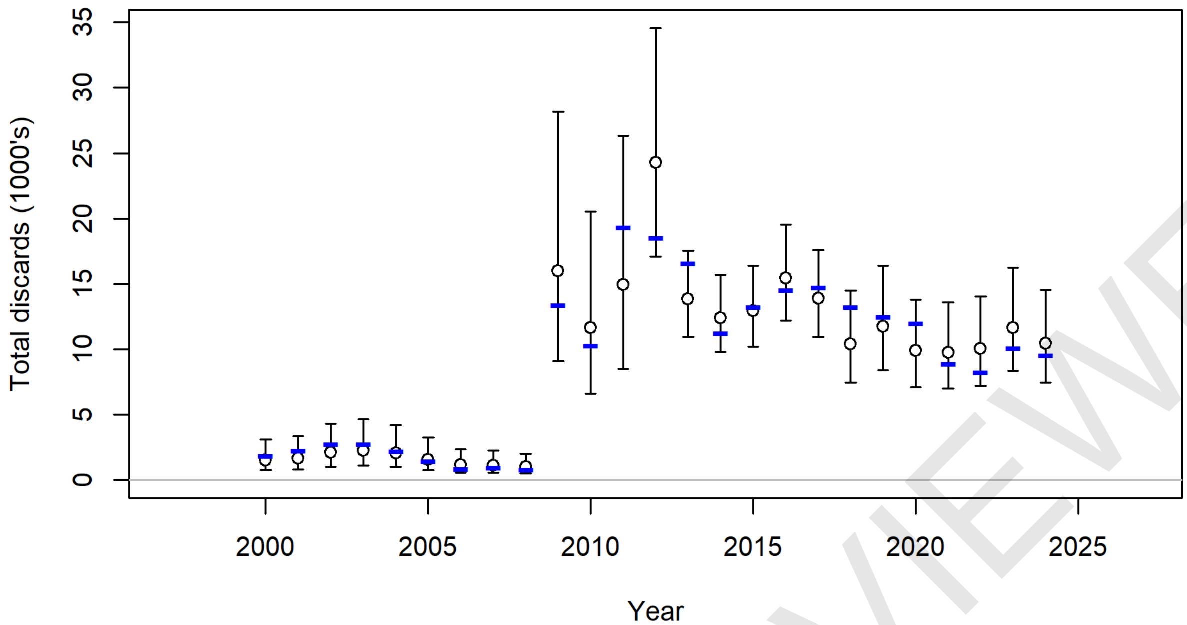


Figure 55. Observed (dots with 95% confidence intervals) and expected (blue lines) discards by the Commercial Vertical Line fleet. Discards are in numbers of fish (1,000s) and reflect released fish (i.e., before discard mortality has been applied).

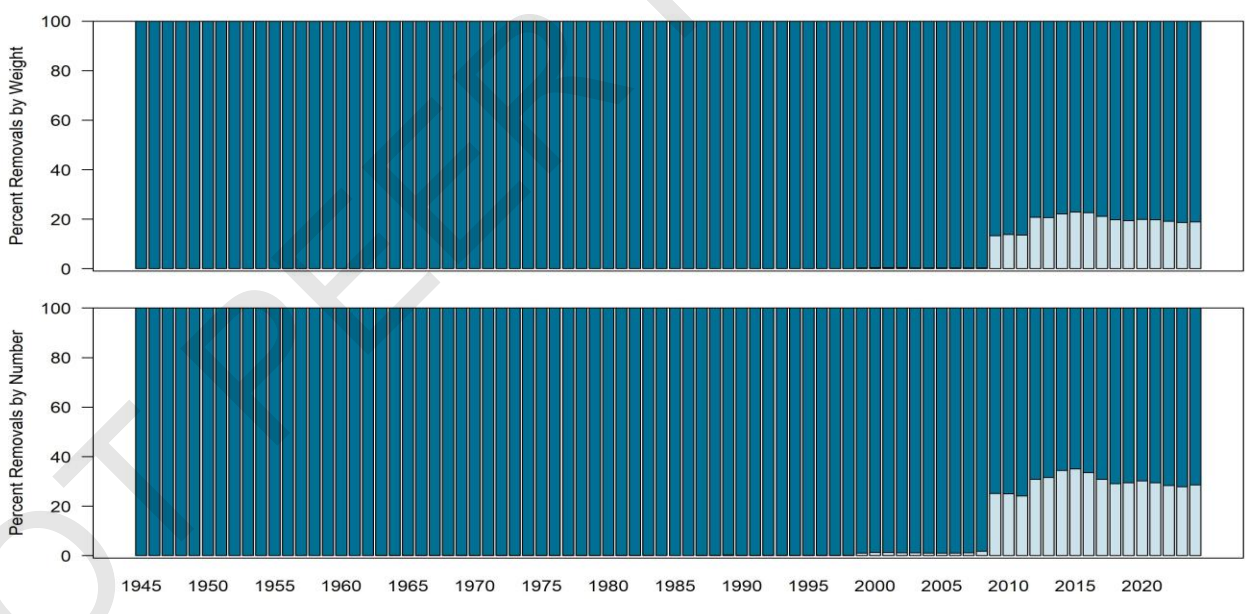


Figure 56. Comparison of landings (dark bars) and dead discards (light bars) for weights (top panel) and numbers of fish (bottom panel) for the Commercial Vertical Line fleet. Estimates of dead discards in both numbers and weights are provided in ***Table 25****.*

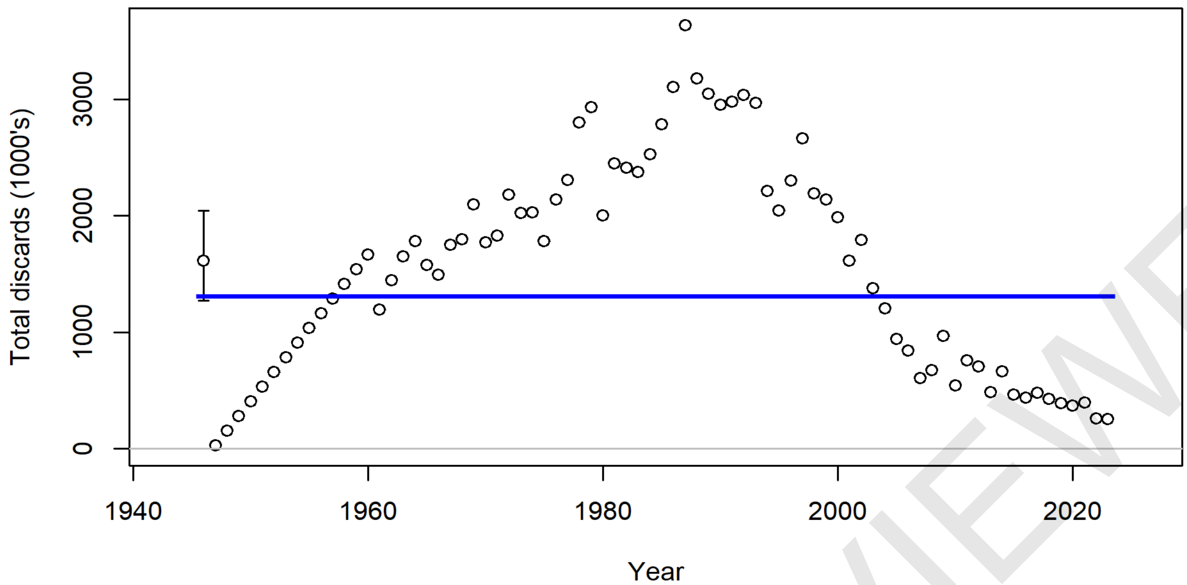


*Figure 57. Observed (dots with 95% confidence intervals) and expected (blue lines) discards by the Shrimp Bycatch fleet. Discards are in numbers of fish (1,000s) and all fish are assumed dead. Estimates of dead discards in both numbers and weights are provided in **Table 26**.*

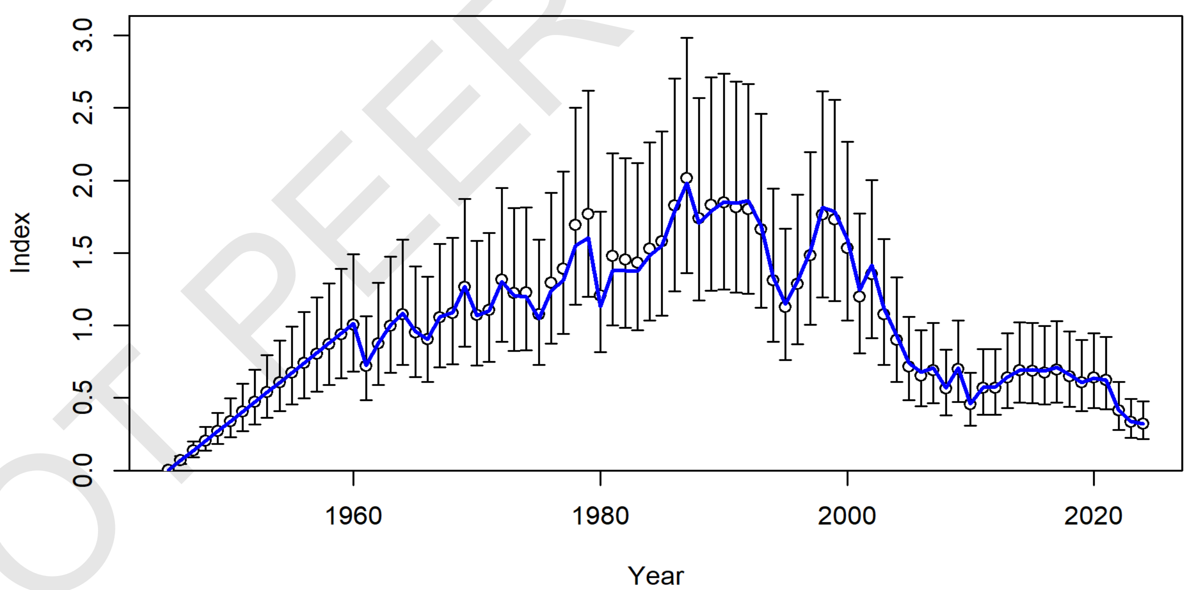


Figure 58. Observed (dots with 95% confidence intervals) and expected (blue lines) indices of fishing effort for the Gulf Shrimp fishery. The stock assessment model assumes lognormal error around the standardized index.

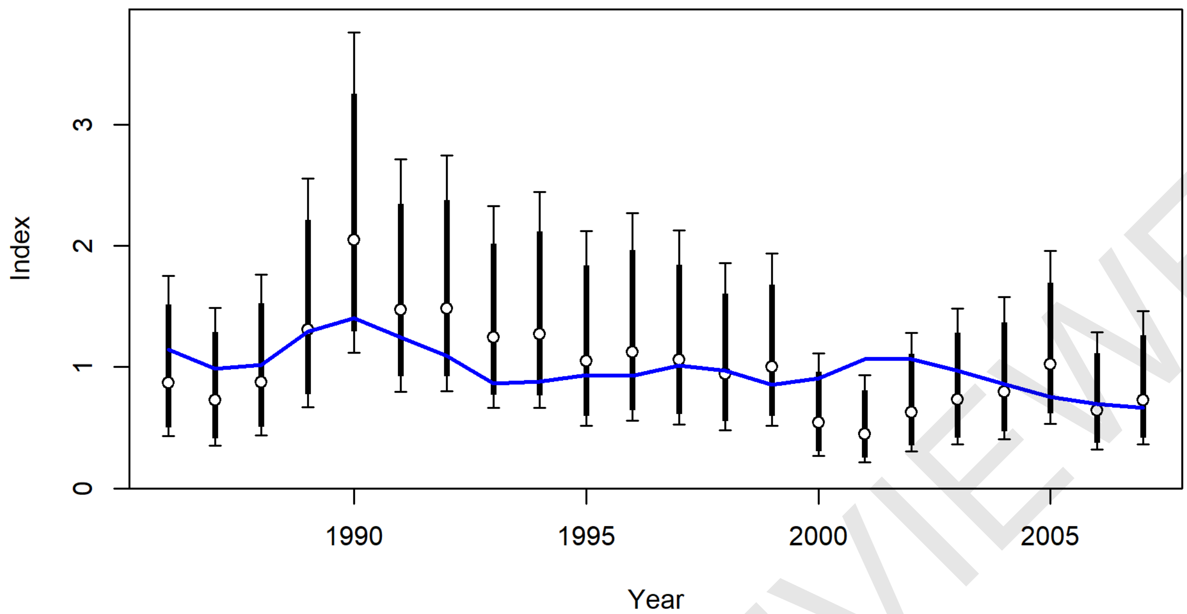


Figure 59. Observed (dots with 95% confidence intervals) and expected (blue lines) indices of relative abundance from the Recreational (SRHS) CPUE. The stock assessment model assumes lognormal error around the standardized index. Thicker lines indicate input uncertainty before addition of the estimated additional uncertainty parameter (0.074).

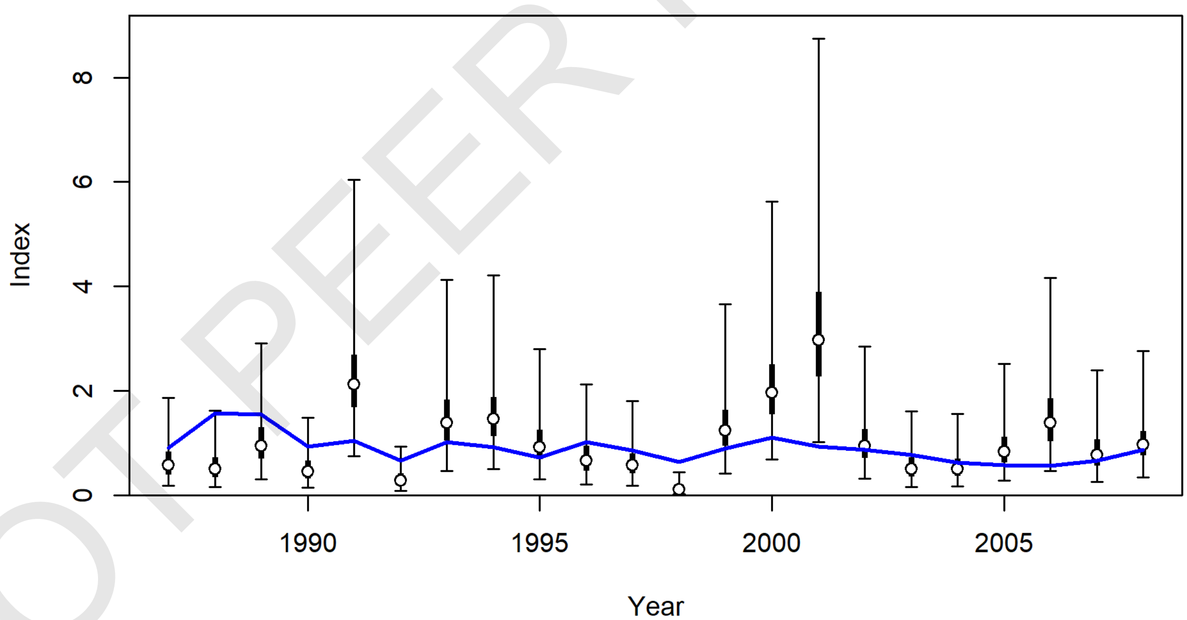


Figure 60. Observed (dots with 95% confidence intervals) and expected (blue lines) indices of relative abundance from the SEAMAP Trawl Early Survey. The stock assessment model assumes lognormal error around the standardized index. Thicker lines indicate input uncertainty before addition of the estimated additional uncertainty parameter (0.414).

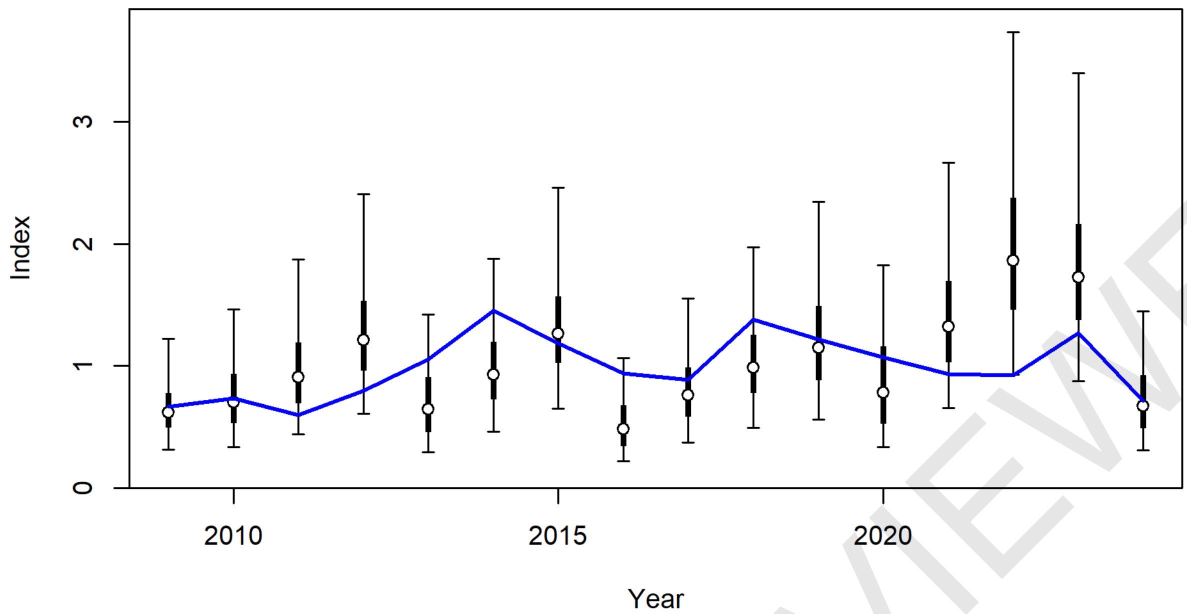


Figure 61. Observed (dots with 95% confidence intervals) and expected (blue lines) indices of relative abundance from the SEAMAP Trawl Late Survey. The stock assessment model assumes lognormal error around the standardized index. Thicker lines indicate input uncertainty before addition of the estimated additional uncertainty parameter (0.231).

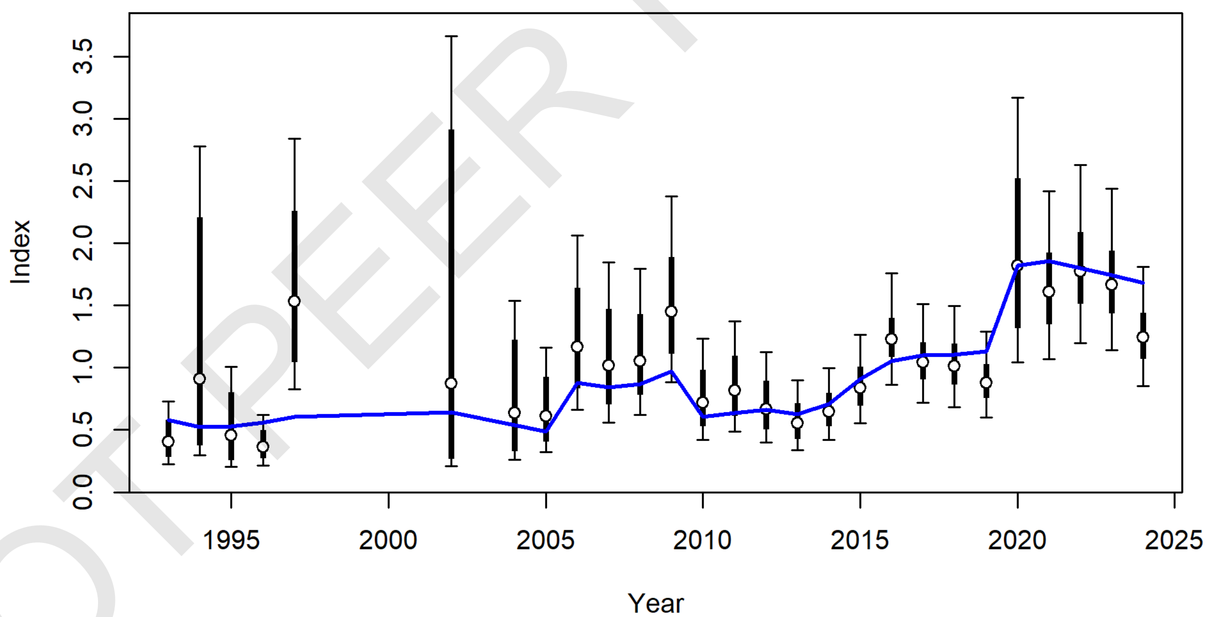


Figure 62. Observed (dots with 95% confidence intervals) and expected (blue lines) indices of relative abundance from the Combined Video Survey. The stock assessment model assumes lognormal error around the standardized index. Thicker lines indicate input uncertainty before addition of the estimated additional uncertainty parameter (0.117).

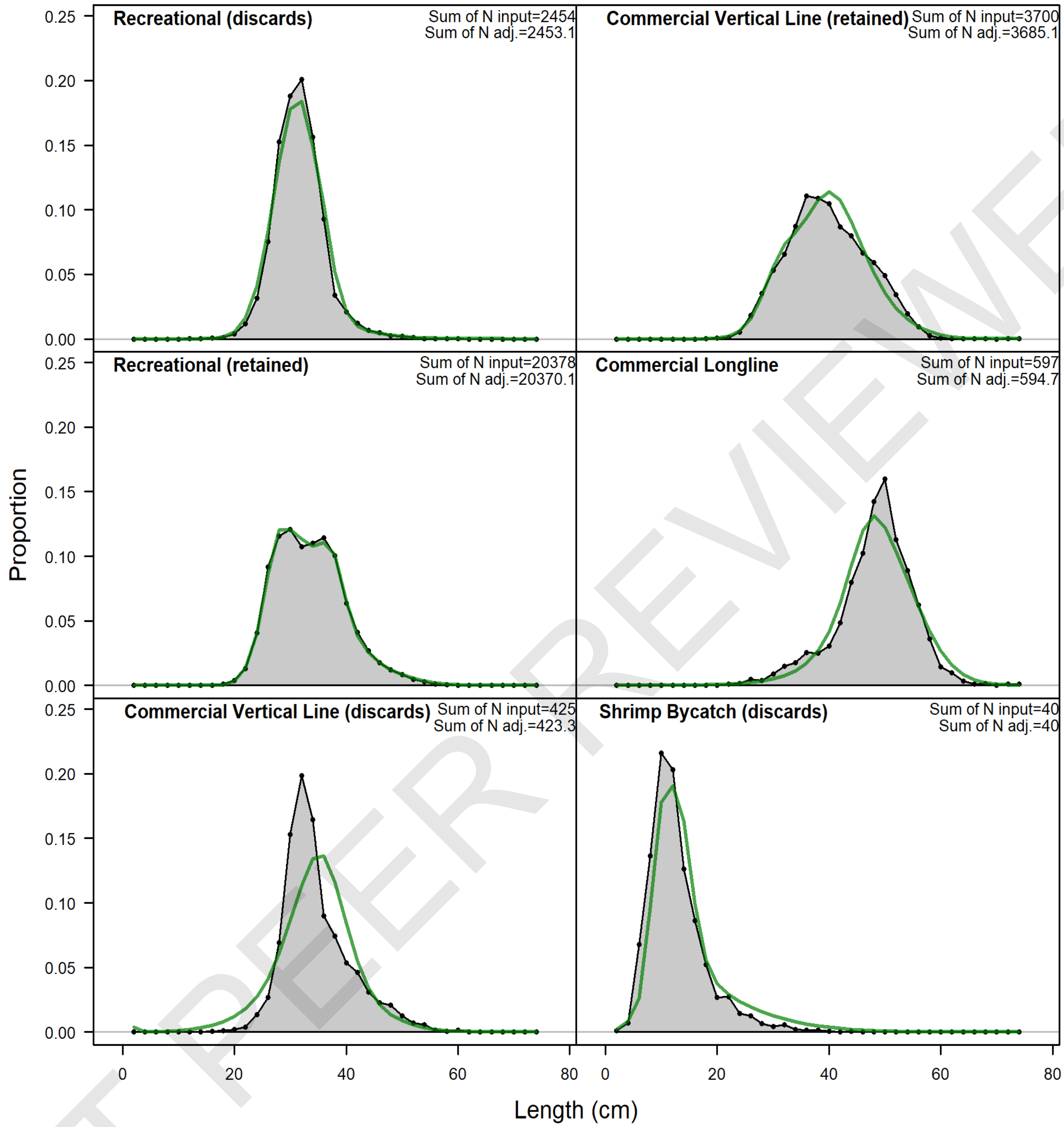


Figure 63. Model fits to the length composition of landed (i.e., retained) or discarded catch aggregated across years for each fleet. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. The input (N input) and adjusted (N adj) sample sizes are provided in the upper right corner of each panel.

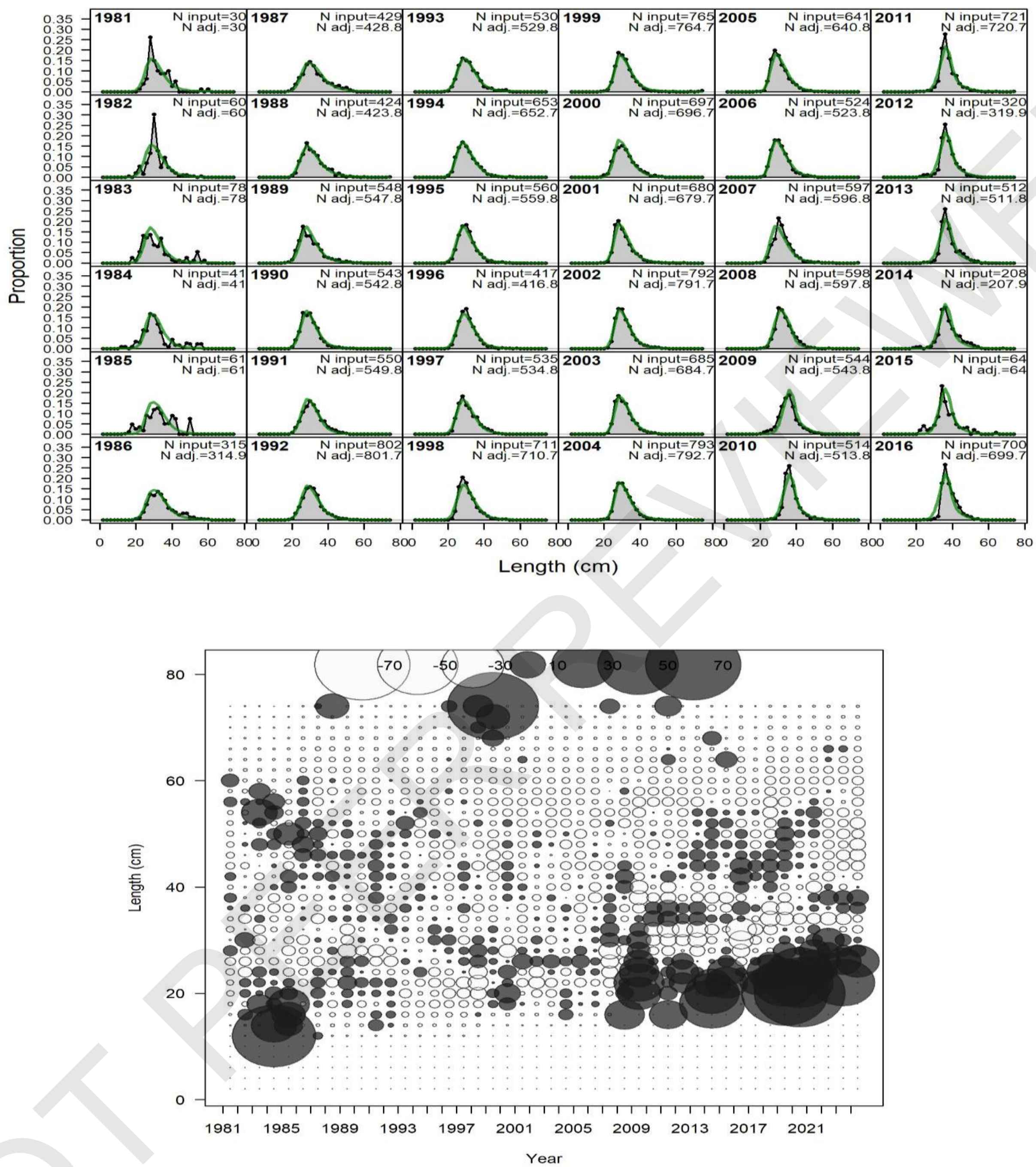
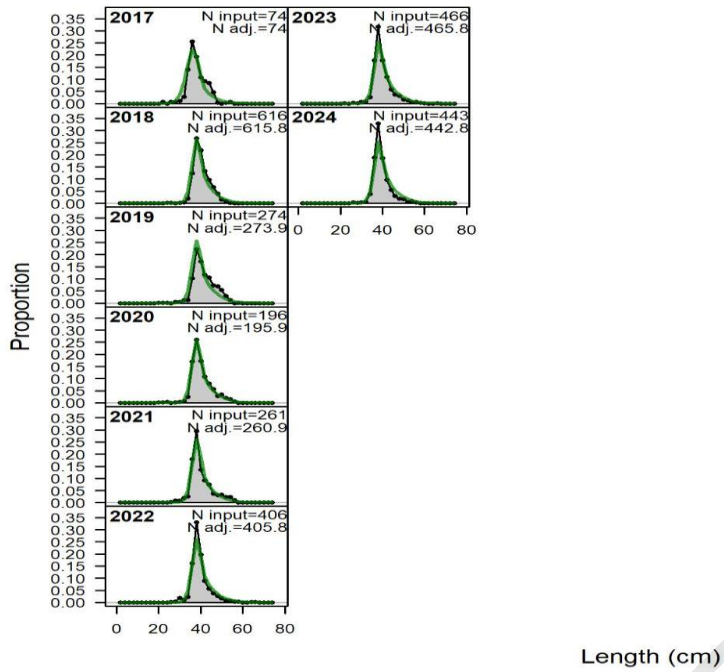


Figure 64. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gray Triggerfish landed by the Recreational fleet. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).



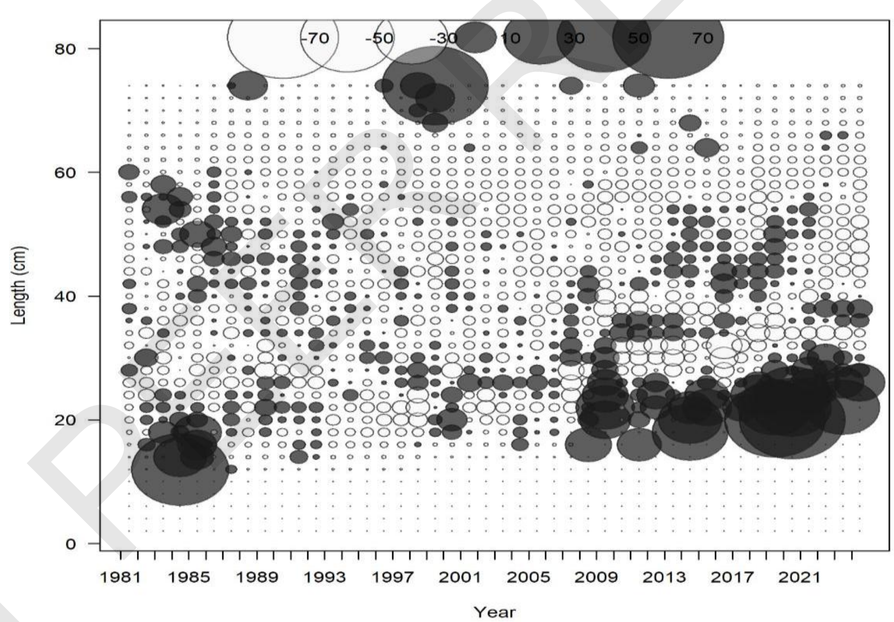


Figure 64 Continued. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gray Triggerfish landed by the Recreational fleet. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

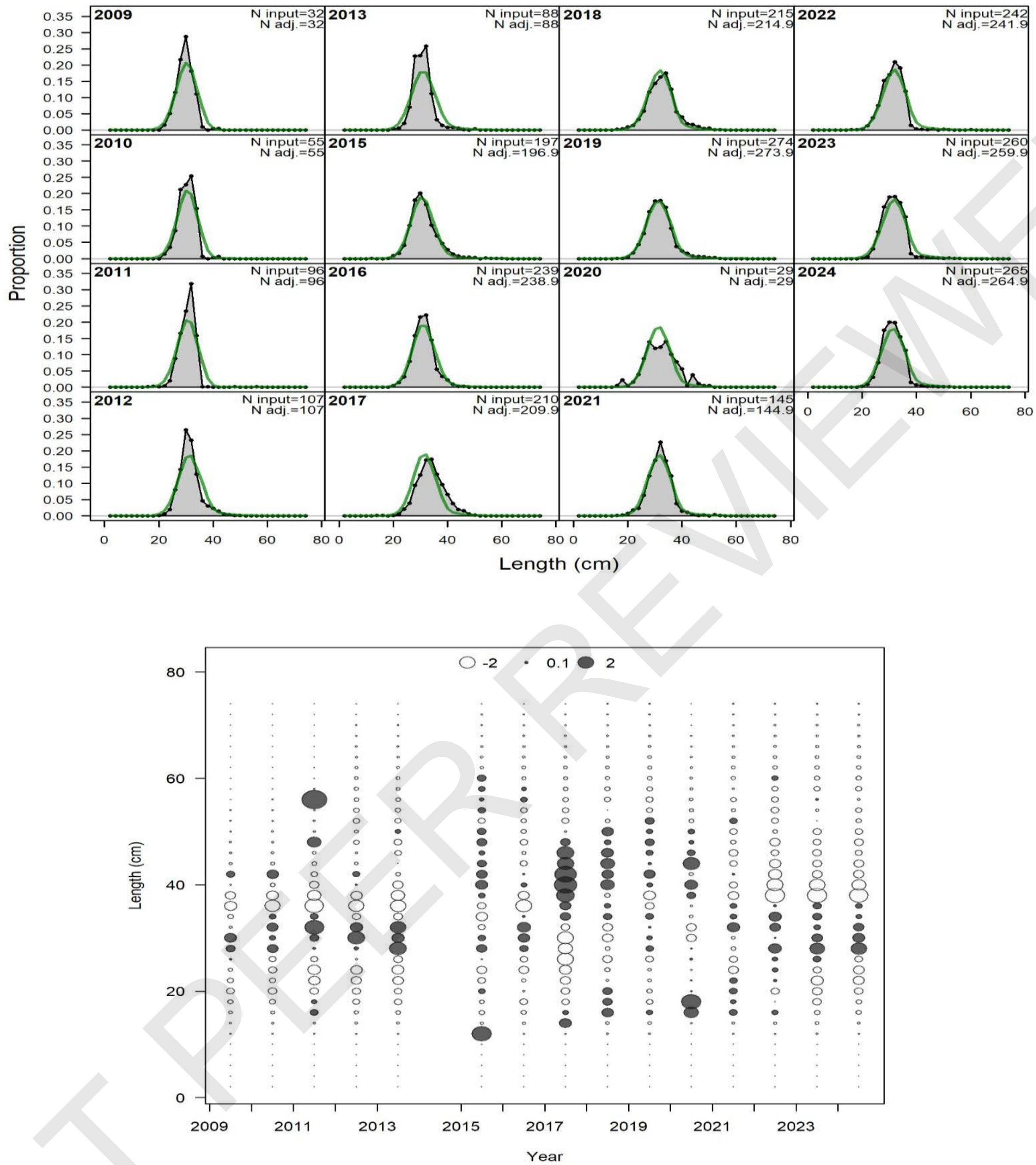


Figure 65. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gray Triggerfish discarded by the Recreational fleet. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

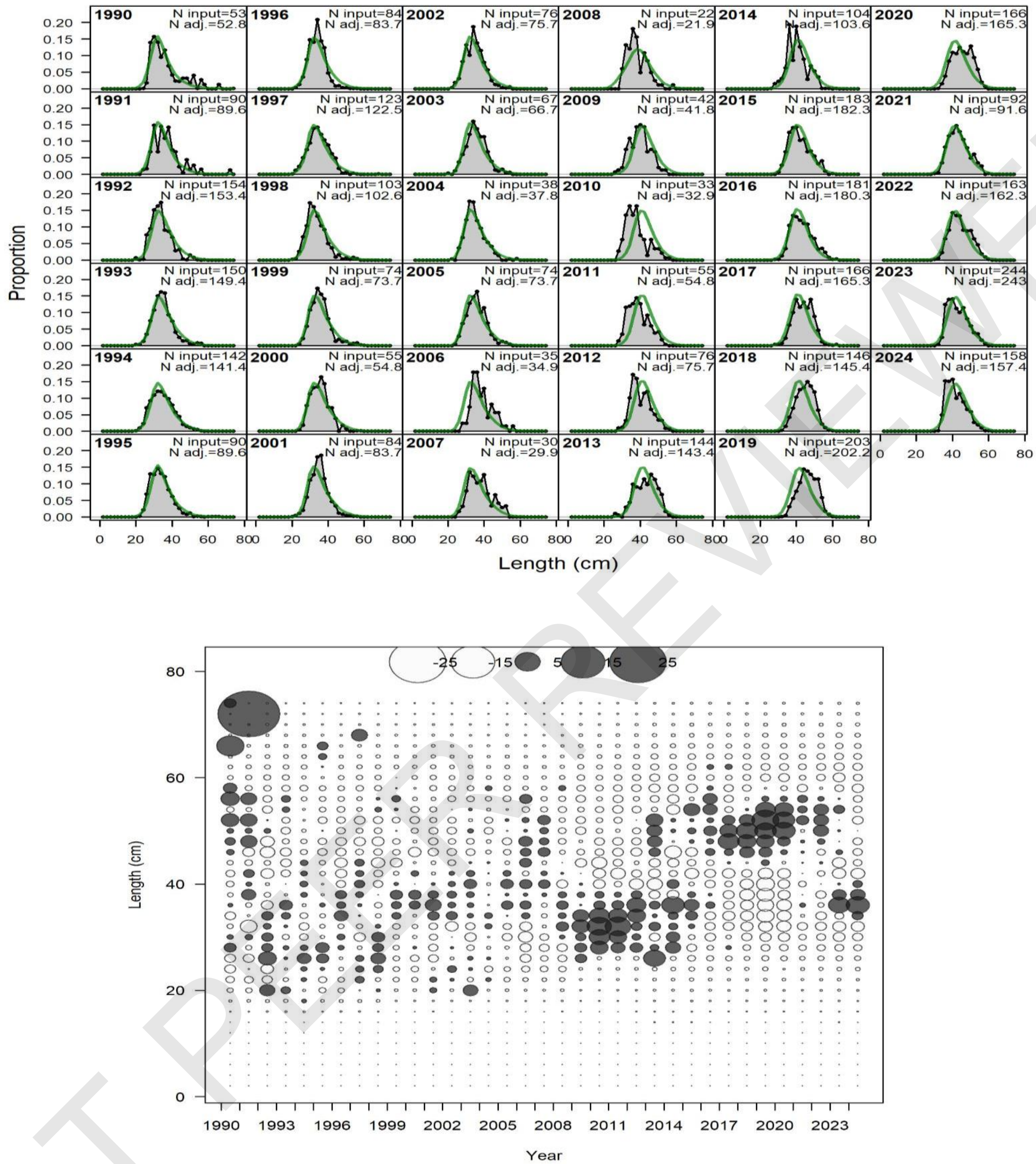


Figure 66. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gray Triggerfish landed by the Commercial Vertical Line fleet. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

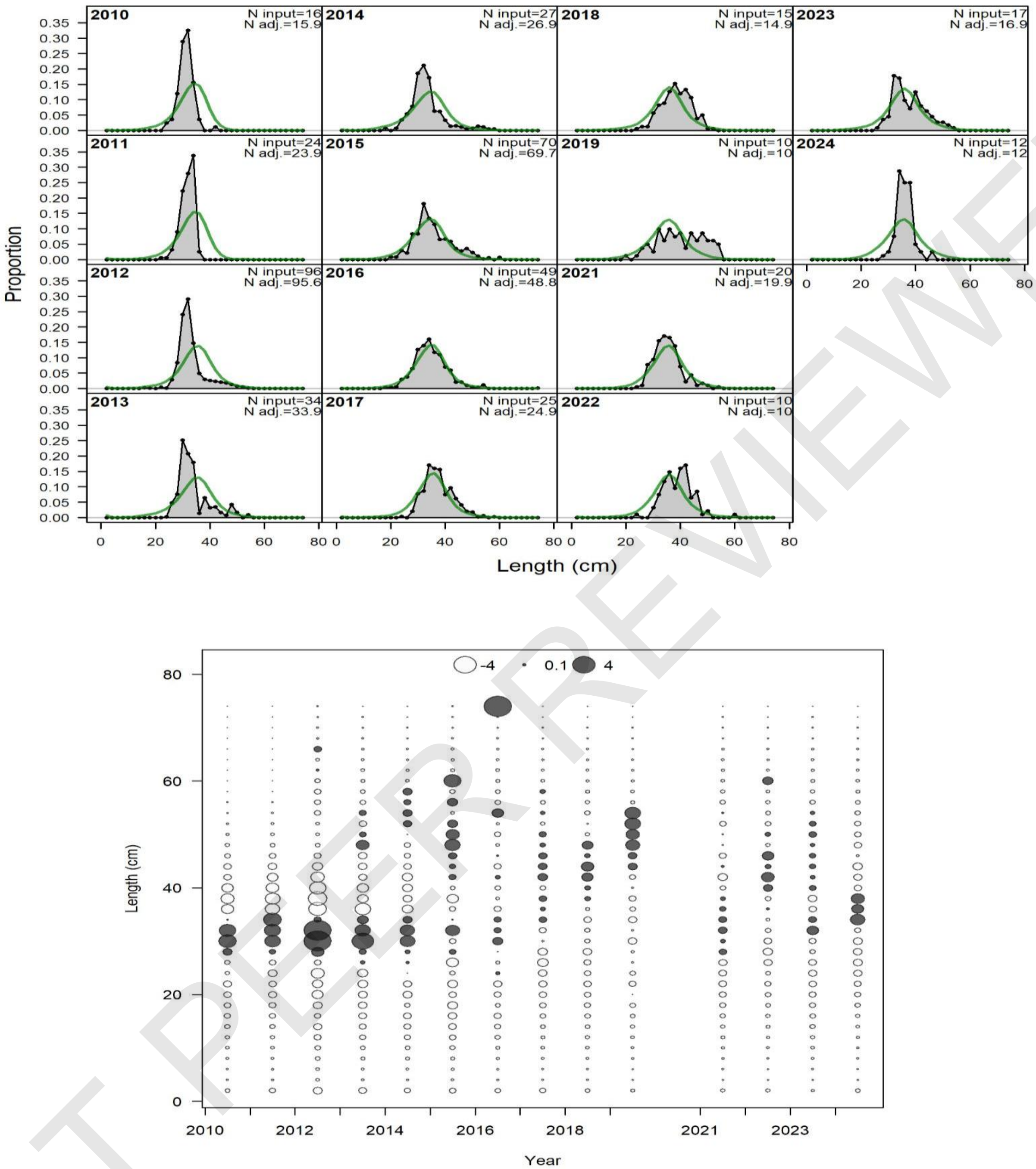


Figure 67. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gray Triggerfish discarded by the Commercial Vertical Line fleet. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

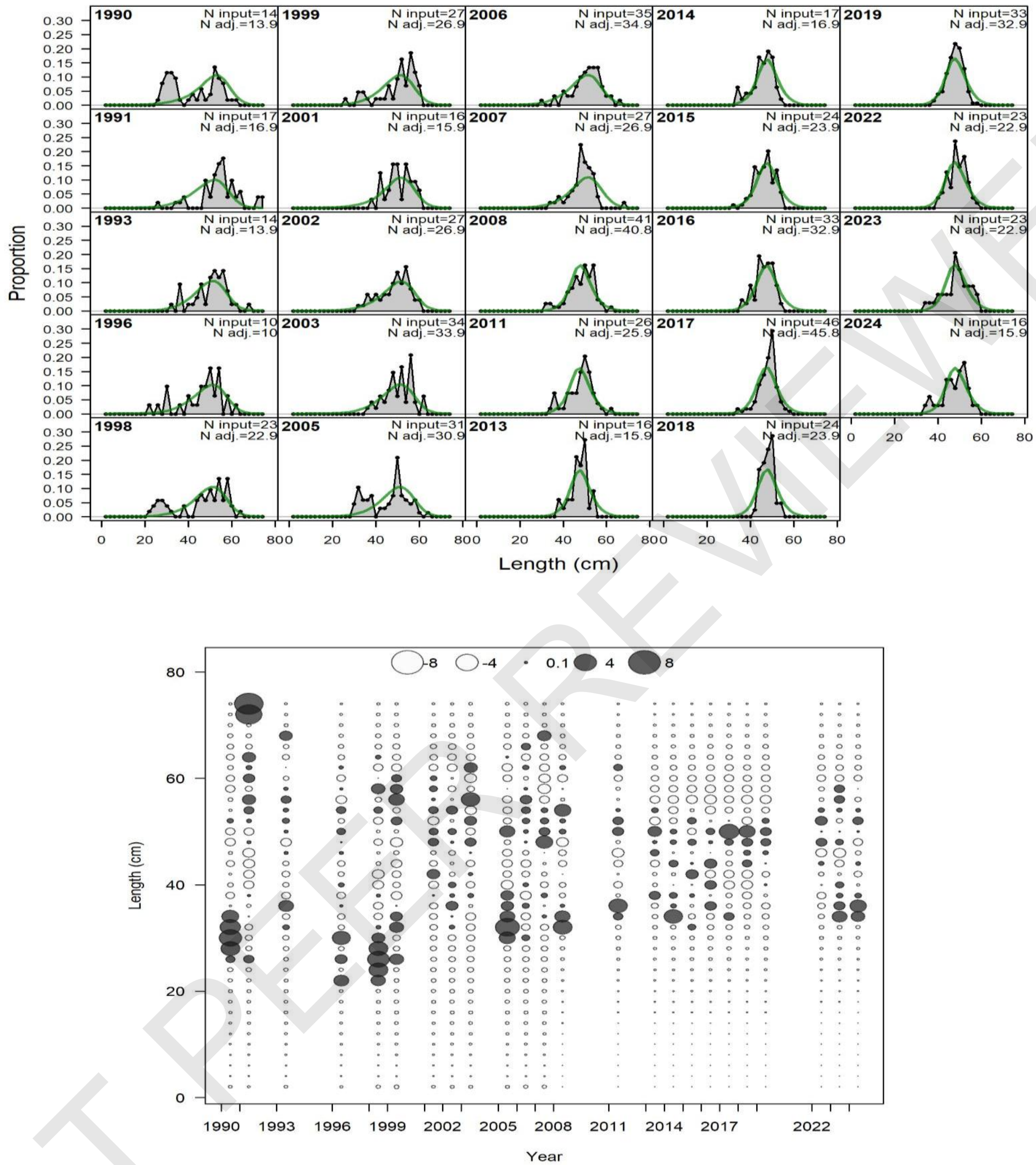


Figure 68. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gray Triggerfish landed by the Commercial Longline fleet. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

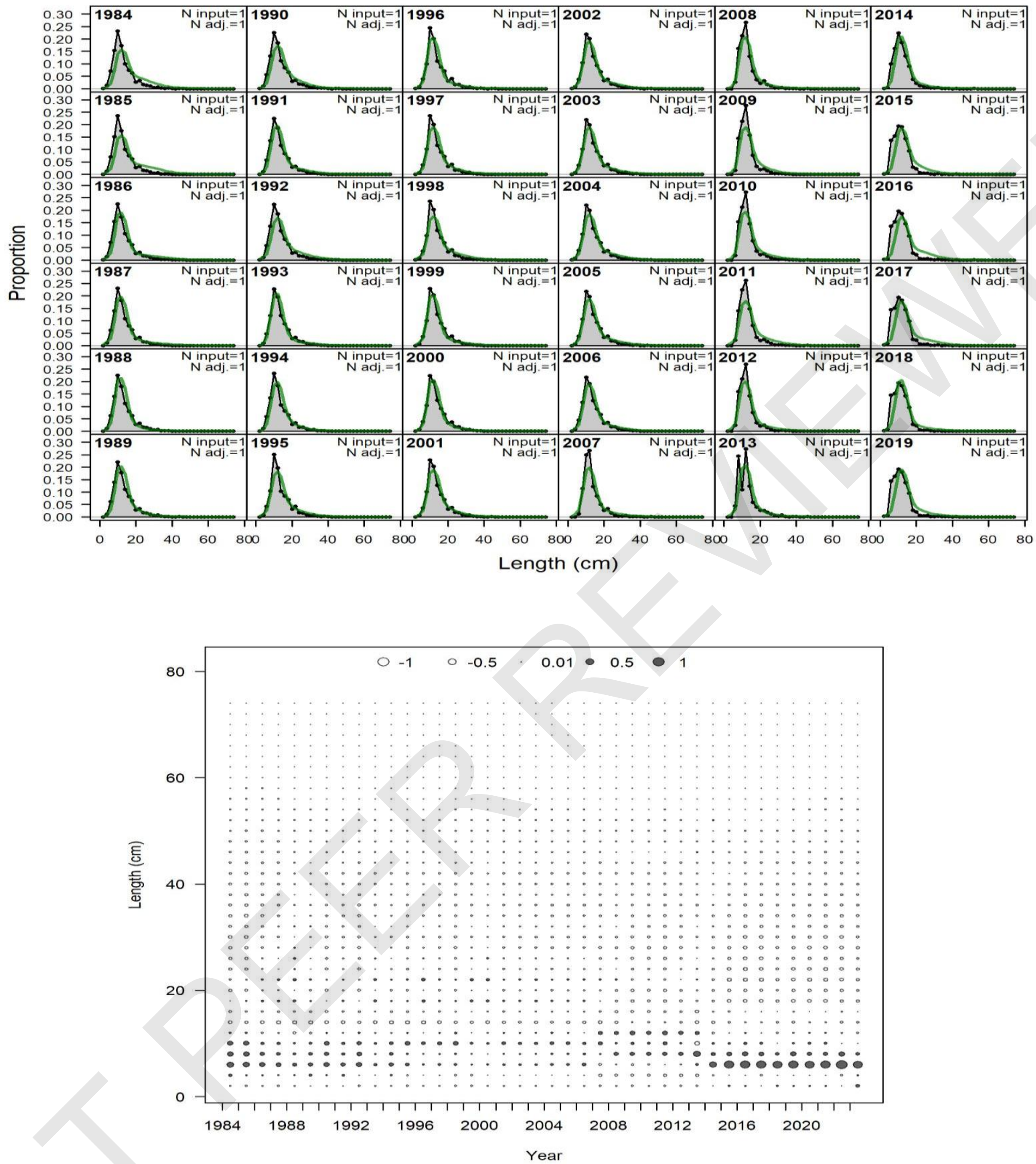


Figure 69. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gray Triggerfish discarded by the Shrimp Bycatch fleet. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) are reported but were not adjusted, as this input was not included in the likelihood. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

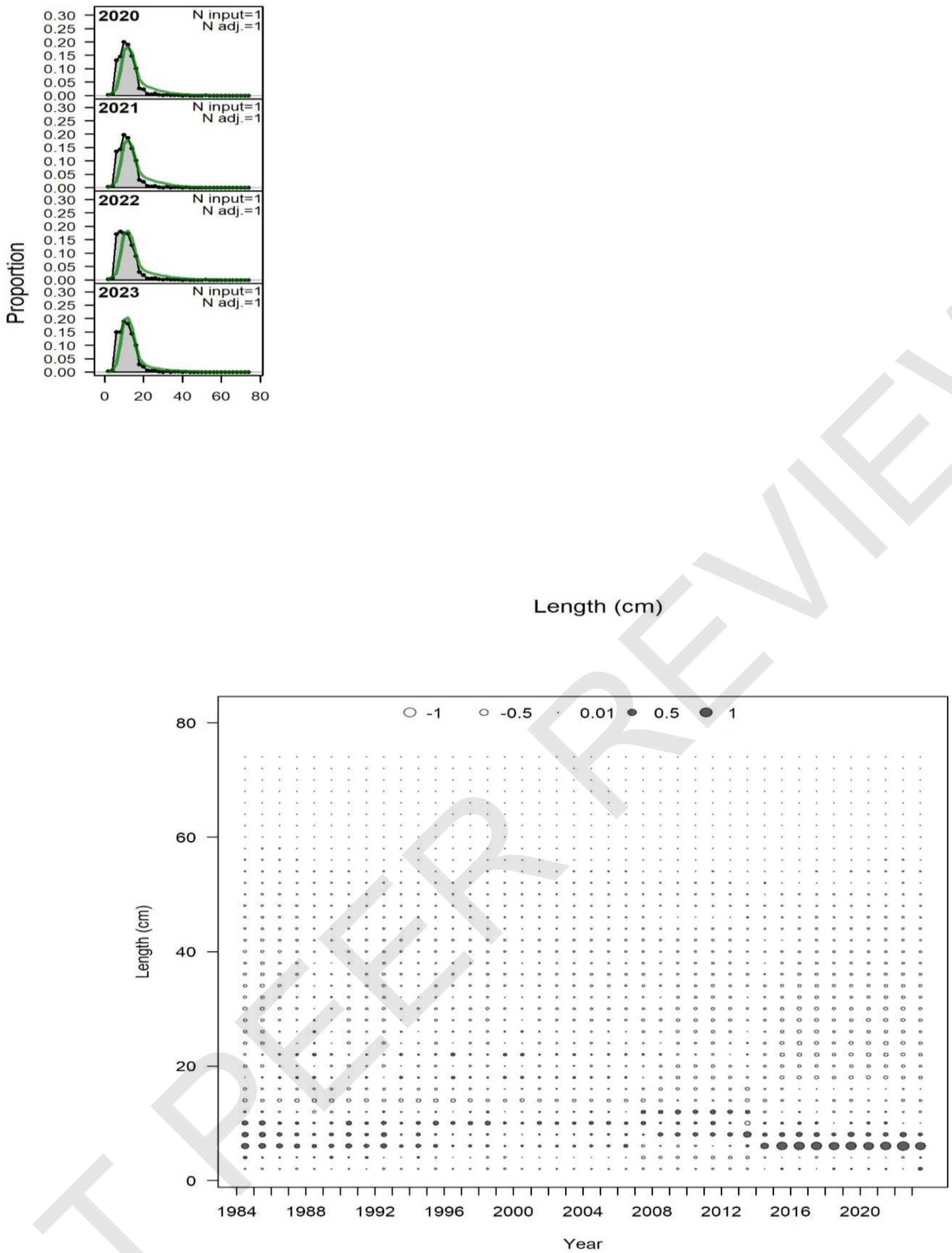


Figure 69 Continued. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gray Triggerfish discarded by the Shrimp Bycatch fleet. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) are reported but were not adjusted, as this input was not included in the likelihood. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

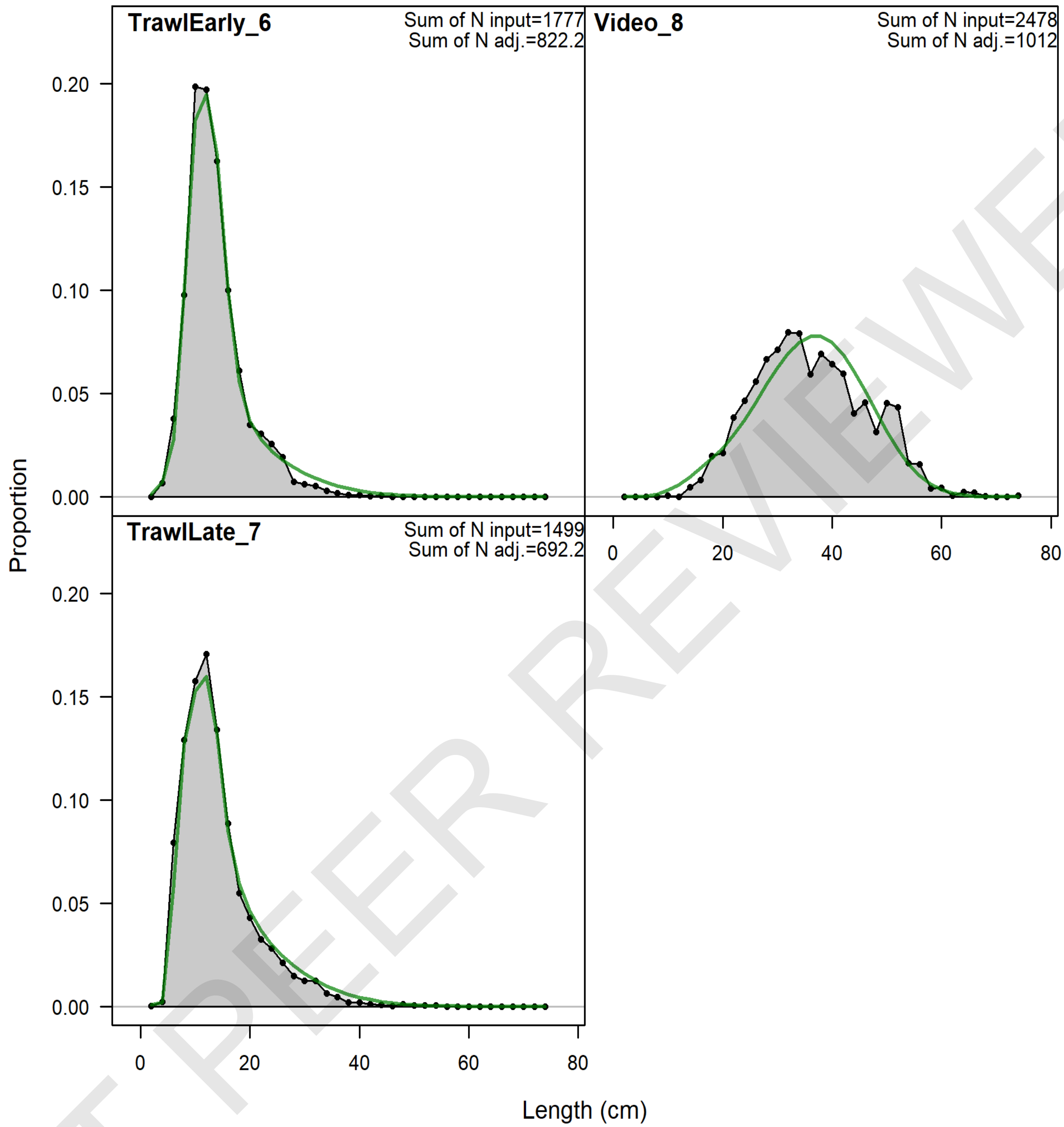


Figure 70. Model fits to the length composition of catch aggregated across years for each survey. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. The input (N input) and adjusted (N adj) sample sizes are provided in the upper right corner of each panel.

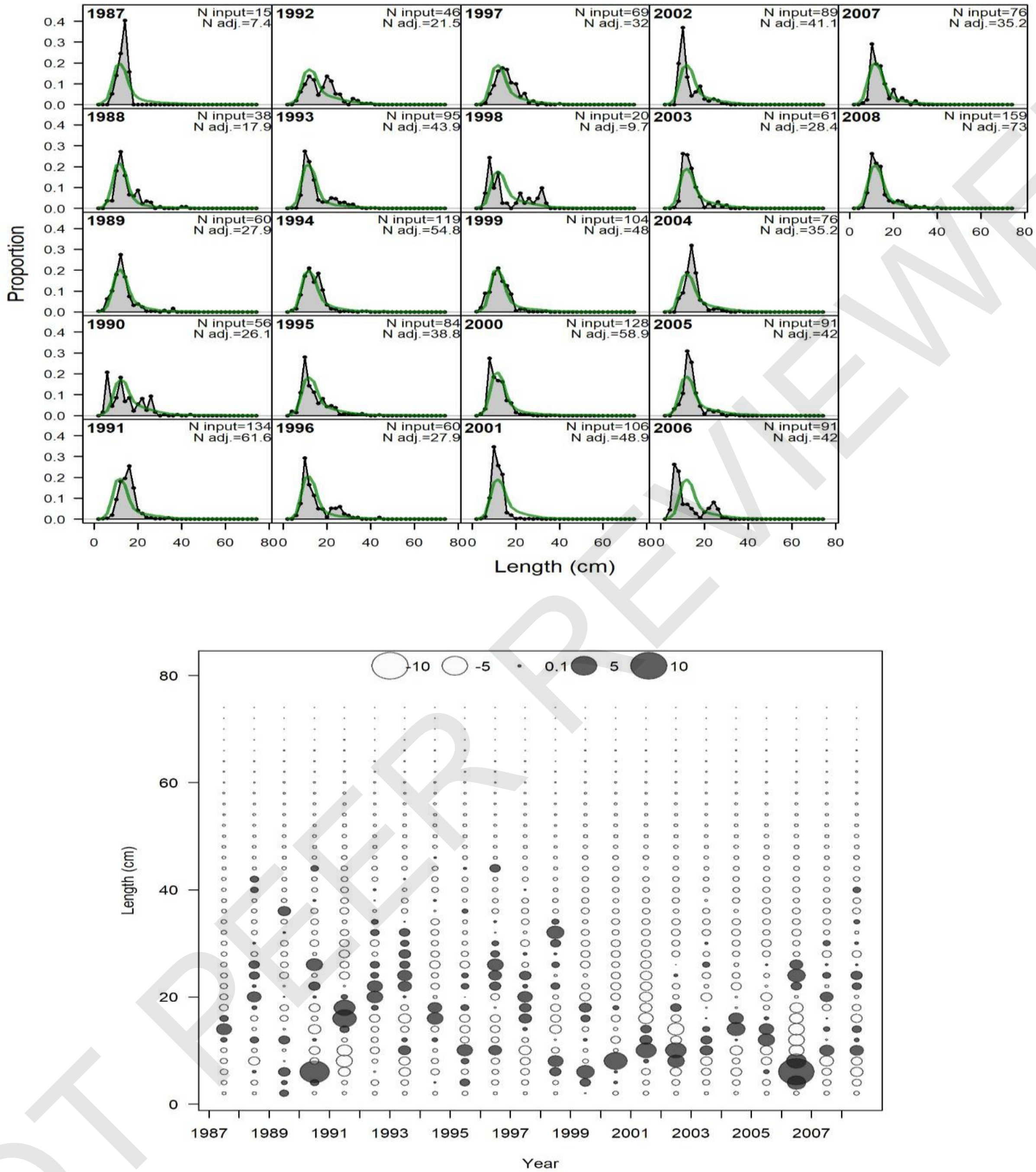


Figure 71. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gray Triggerfish in the SEAMAP Trawl Early Survey. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

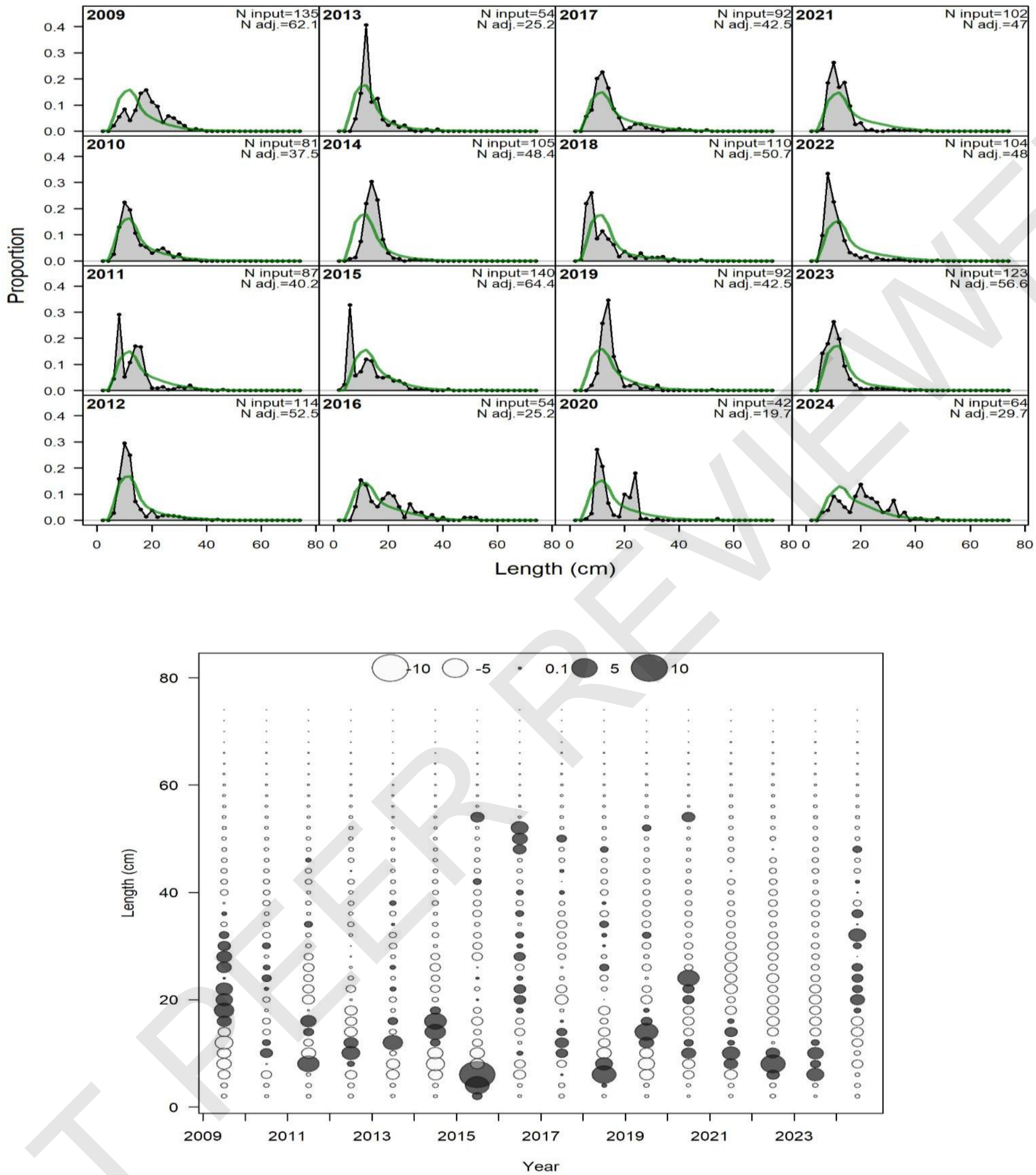


Figure 72. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gray Triggerfish in the SEAMAP Trawl Late Survey. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

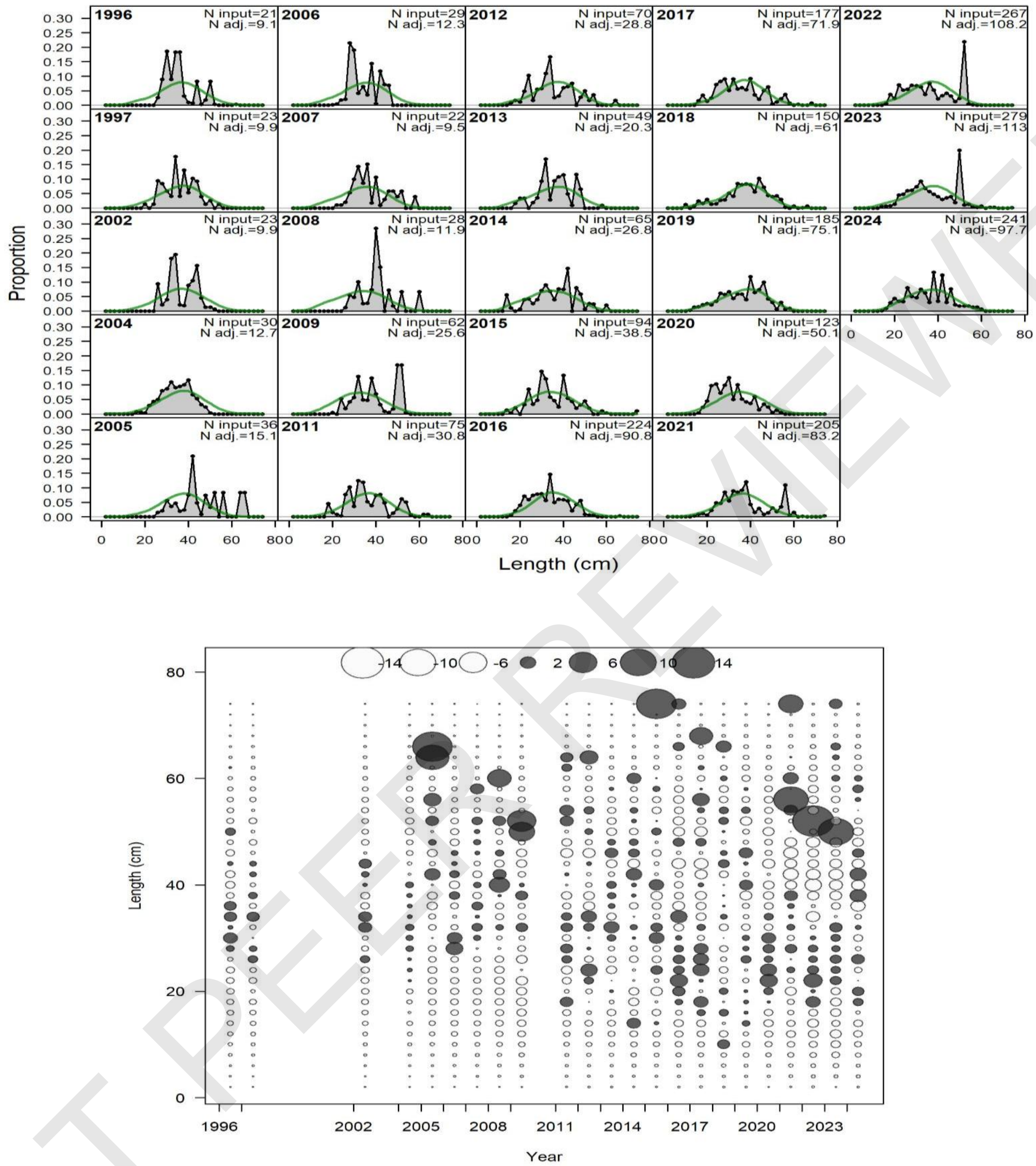


Figure 73. Observed and expected length compositions (top) and Pearson residuals (bottom) for Gray Triggerfish in the Combined Video Survey. Green lines represent expected length compositions, while grey shaded regions represent observed length compositions. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

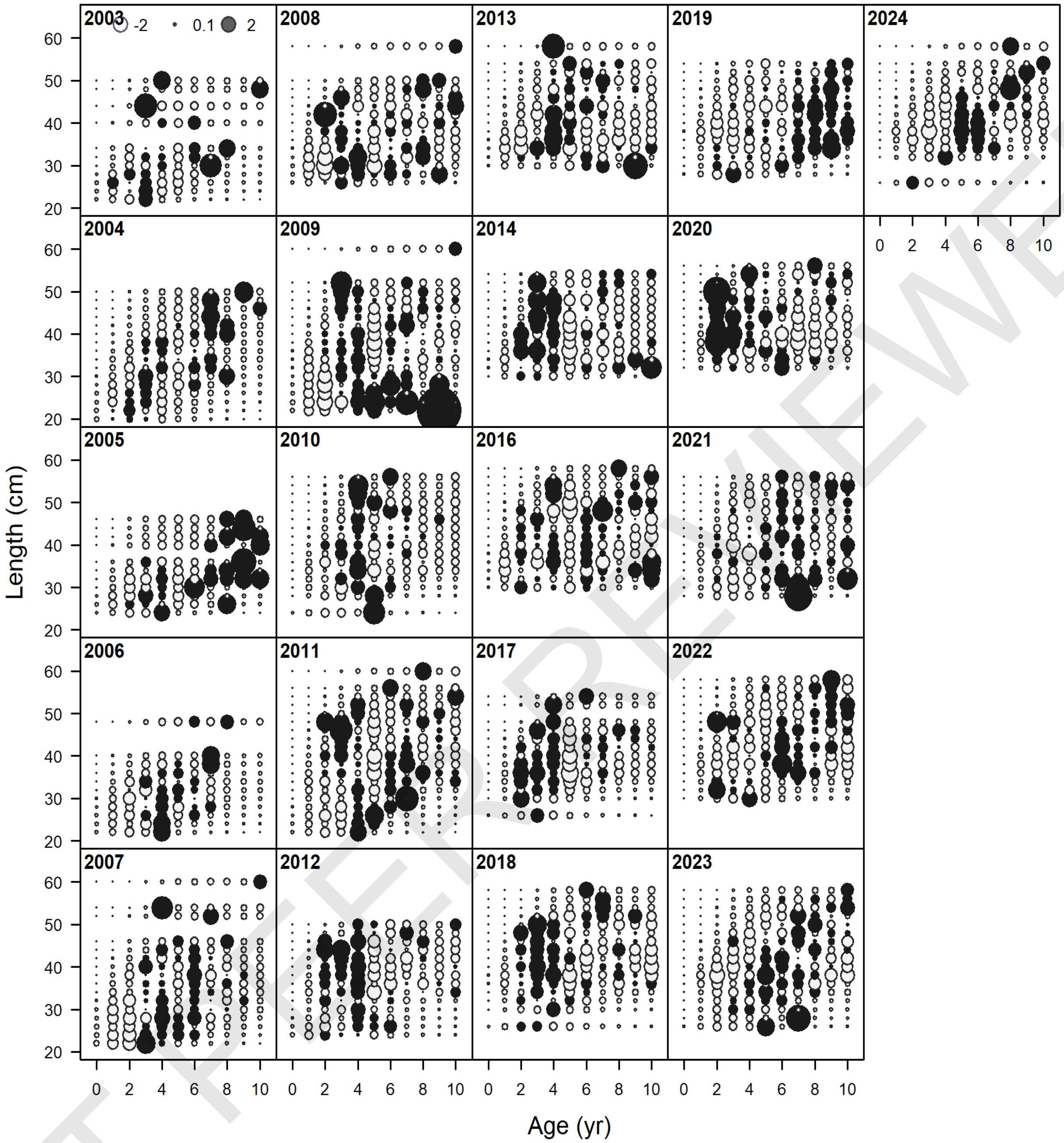


Figure 74. Pearson residuals for the conditional age-at-length compositions for Gray Triggerfish landed by the Recreational fleet. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

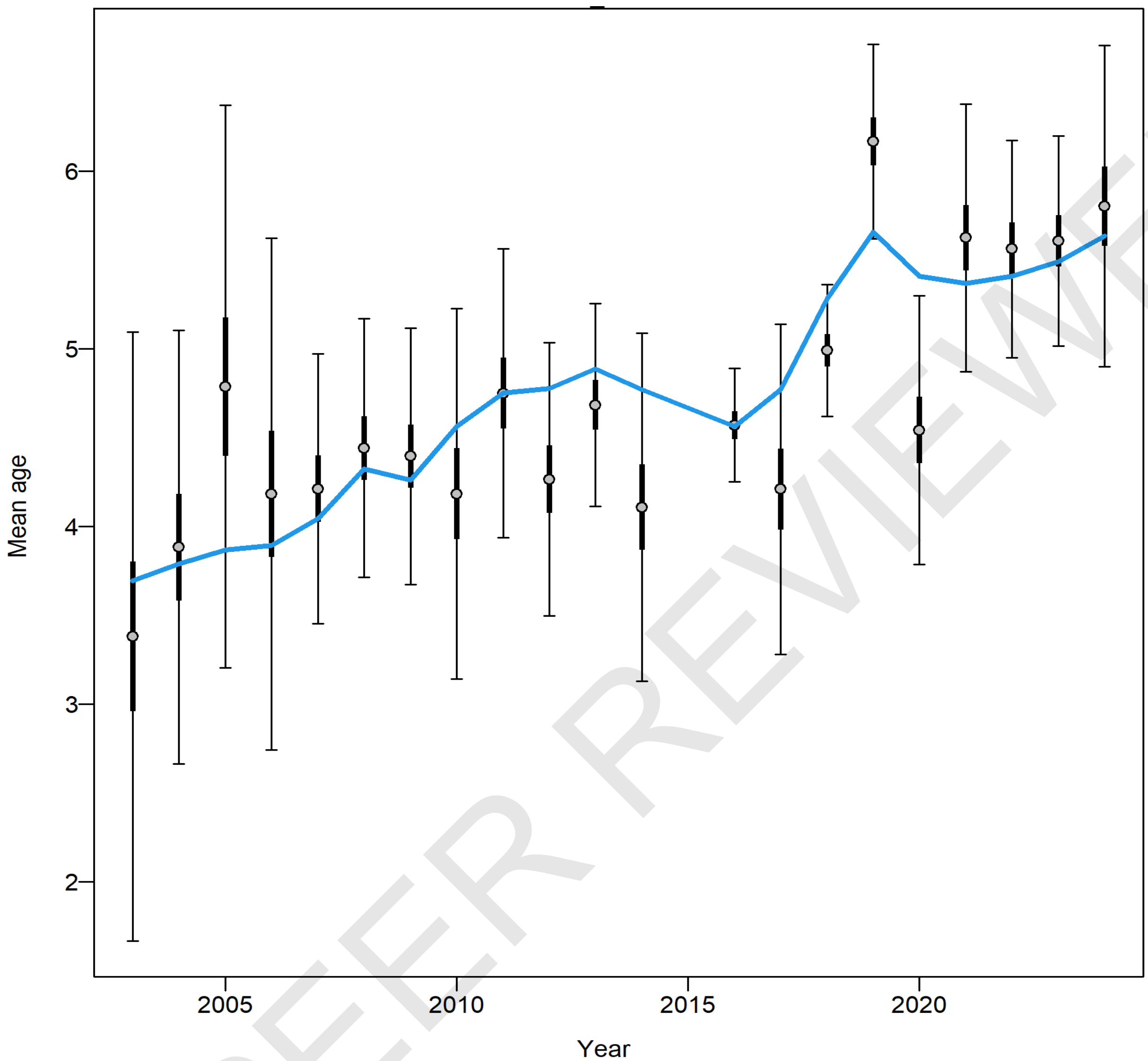


Figure 75. Mean age of Gray Triggerfish landed by the Recreational fleet from conditional data (aggregated across length bins) with 95% confidence intervals (thick bars). Thinner intervals (with capped ends) show the result of further adjusting sample sizes based on the Francis data weighting method, which was not used here.

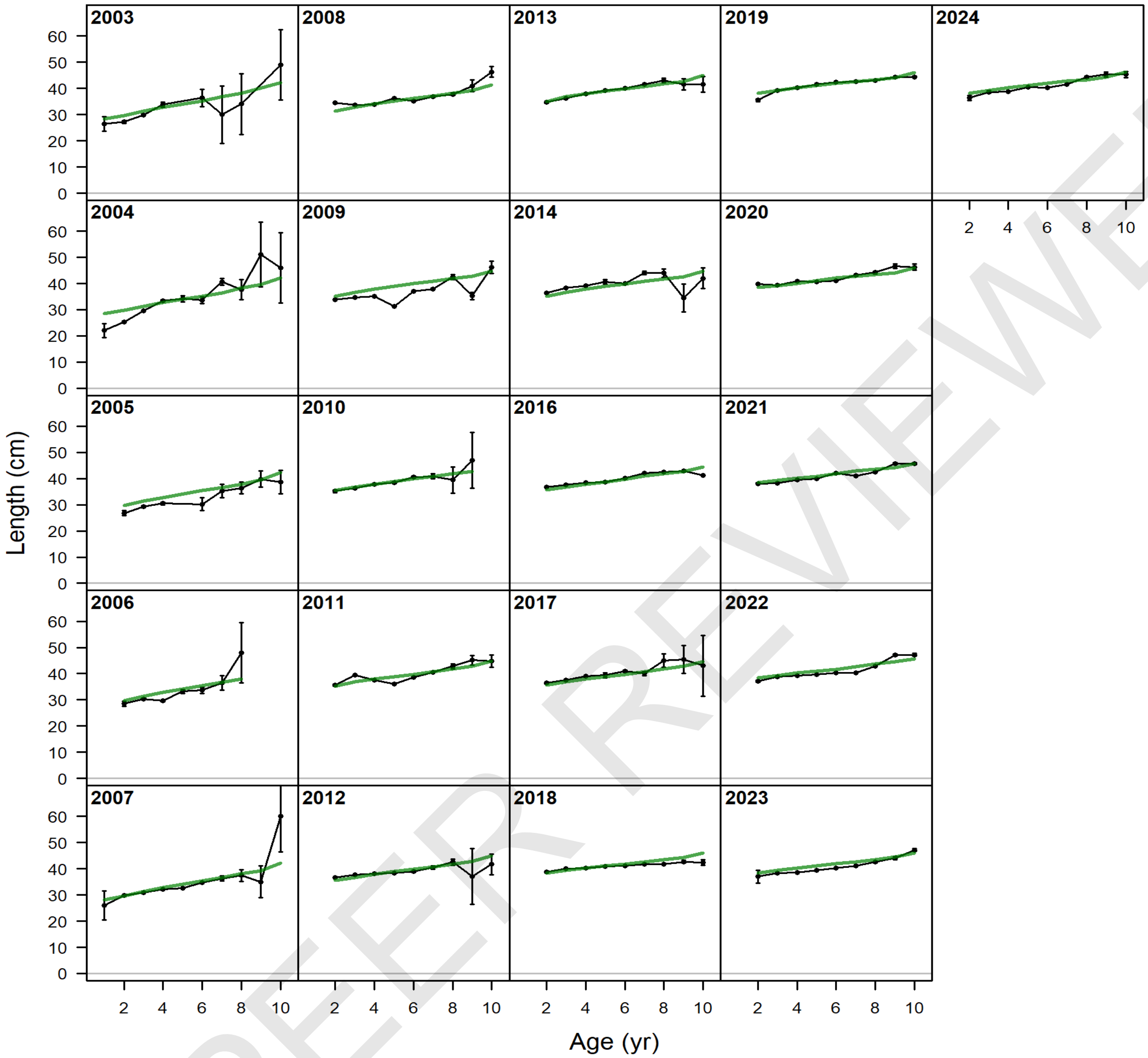


Figure 76. Observed and expected mean length-at-age for Gray Triggerfish landed by the Recreational fleet. Mean length-at-age is provided for comparison of trends and was not included in the likelihood.

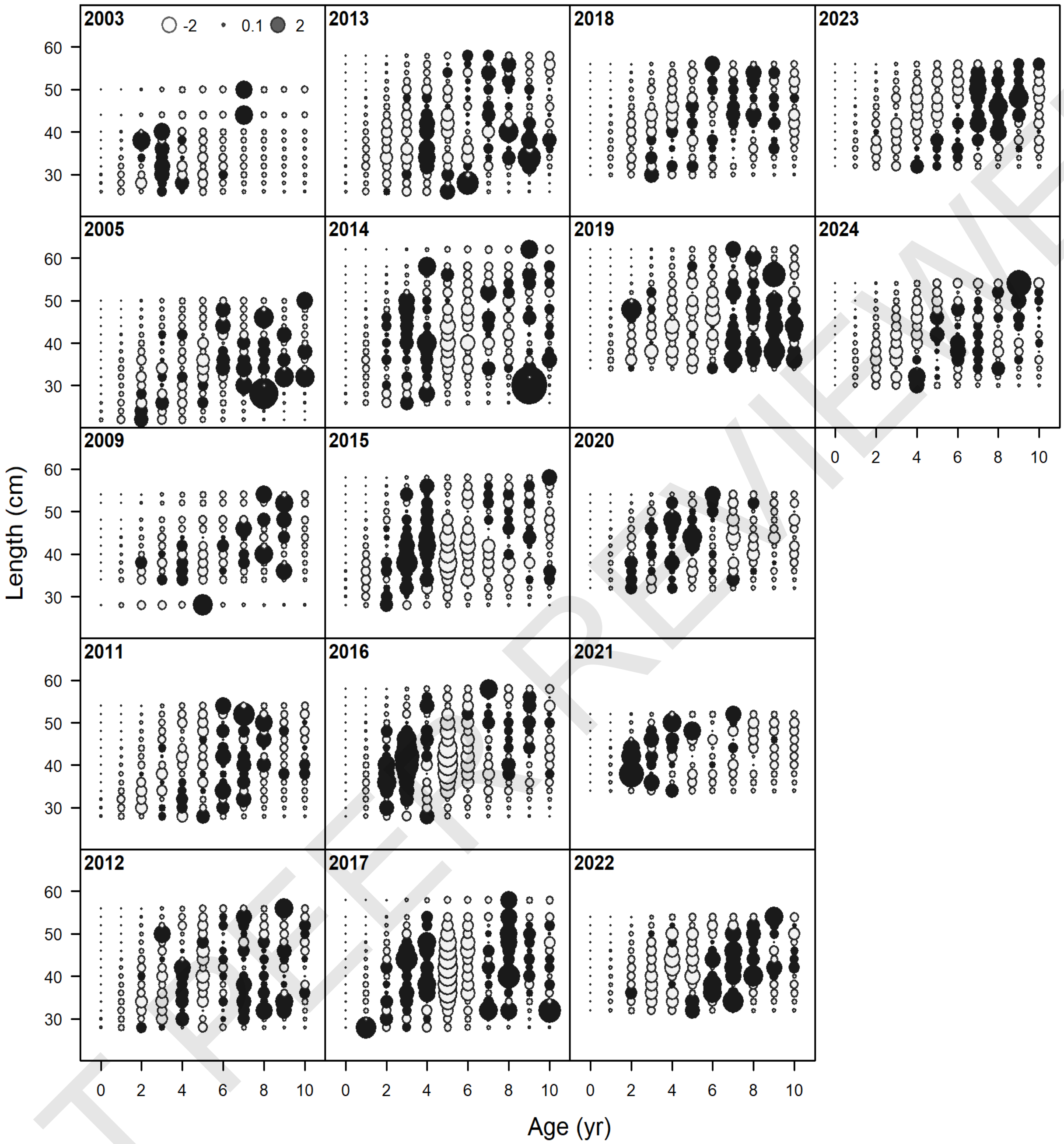


Figure 77. Pearson residuals for the conditional age-at-length compositions for Gray Triggerfish landed by the Commercial Vertical Line fleet. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

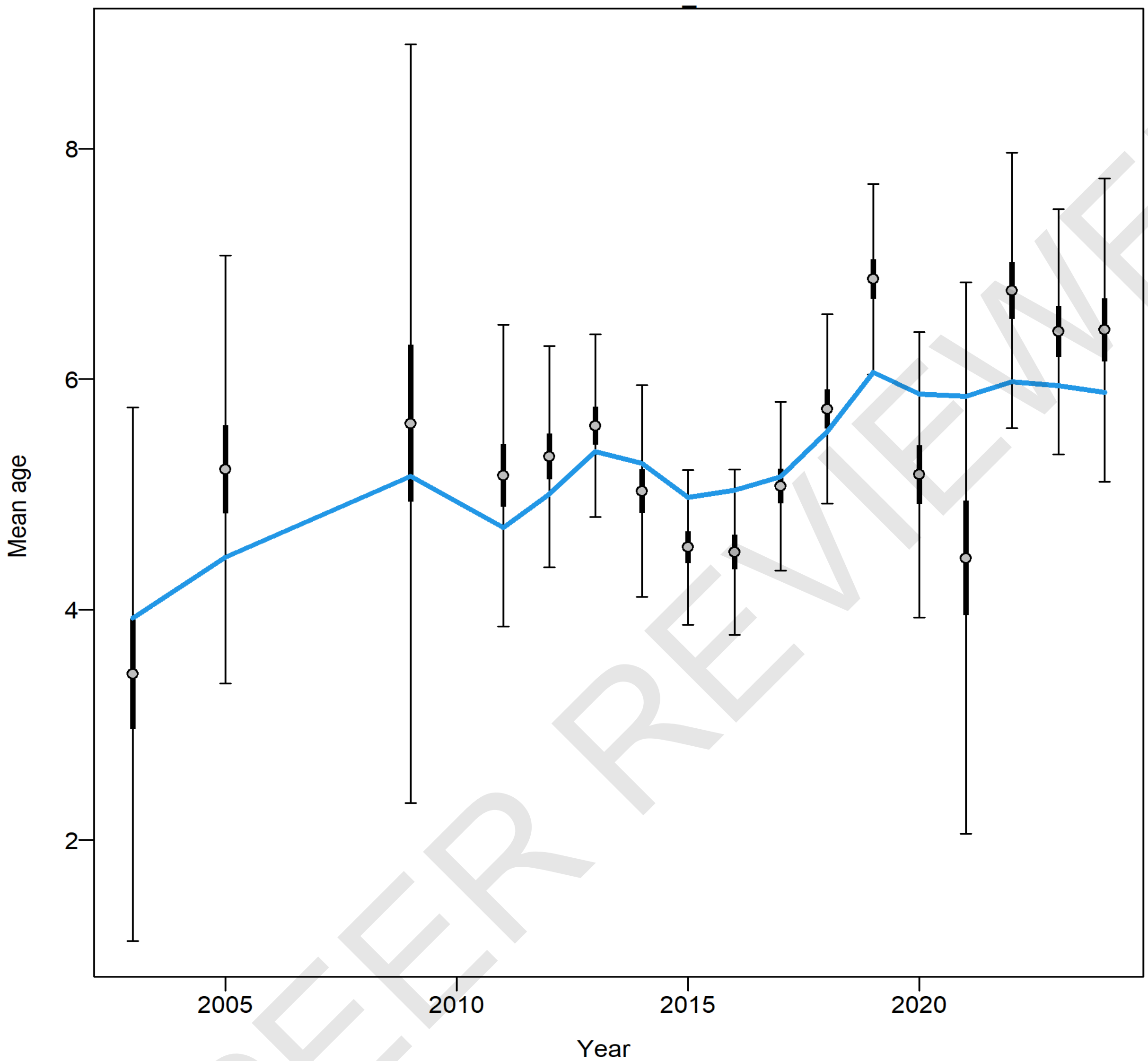


Figure 78. Mean age of Gray Triggerfish landed by the Commercial Vertical Line fleet from conditional data (aggregated across length bins) with 95% confidence intervals (thick bars). Thinner intervals (with capped ends) show the result of further adjusting sample sizes based on the Francis data weighting method, which was not used here.

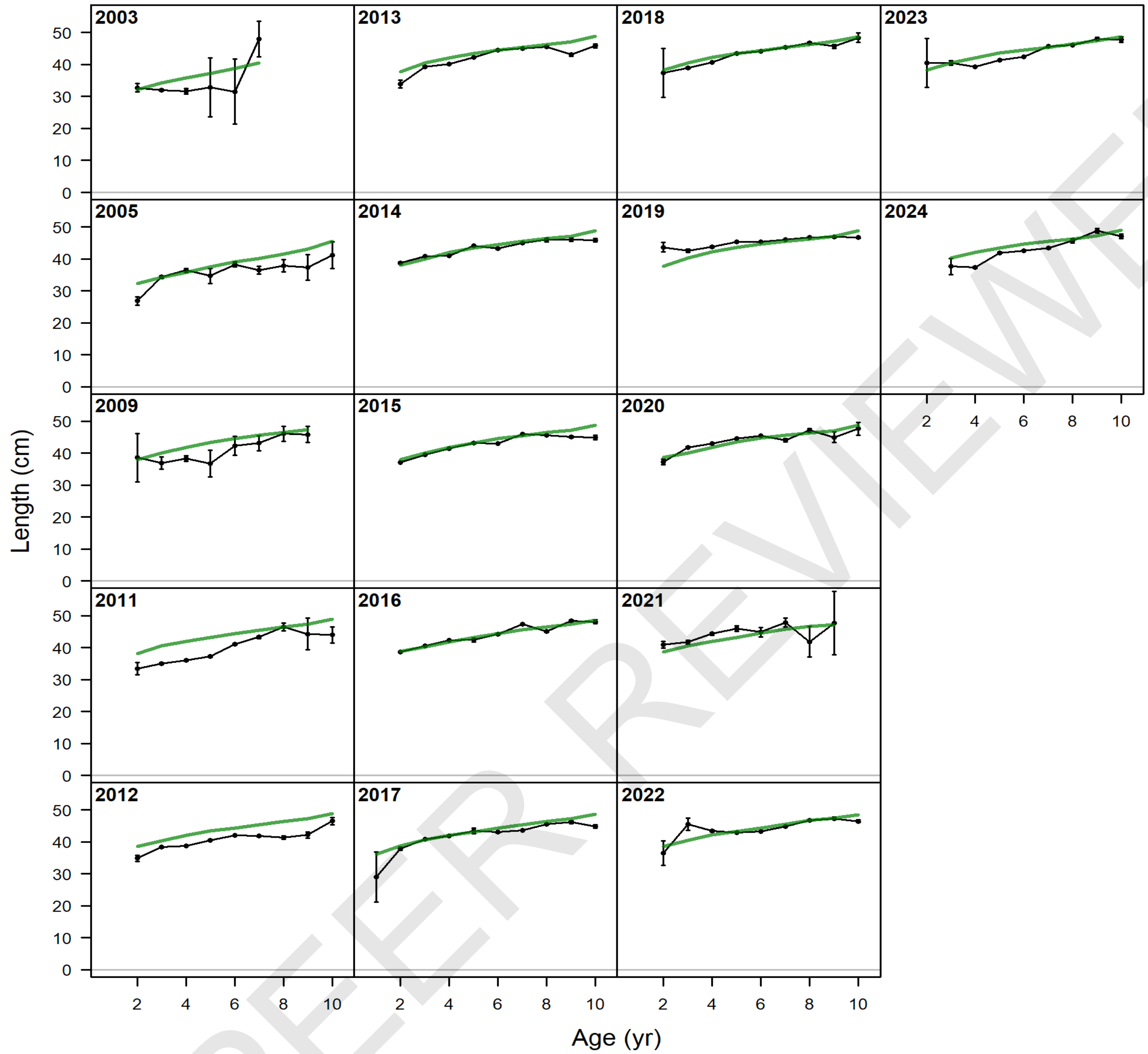


Figure 79. Observed and expected mean length-at-age for Gray Triggerfish landed by the Commercial Vertical Line fleet. Mean length-at-age is provided for comparison of trends and was not included in the likelihood.

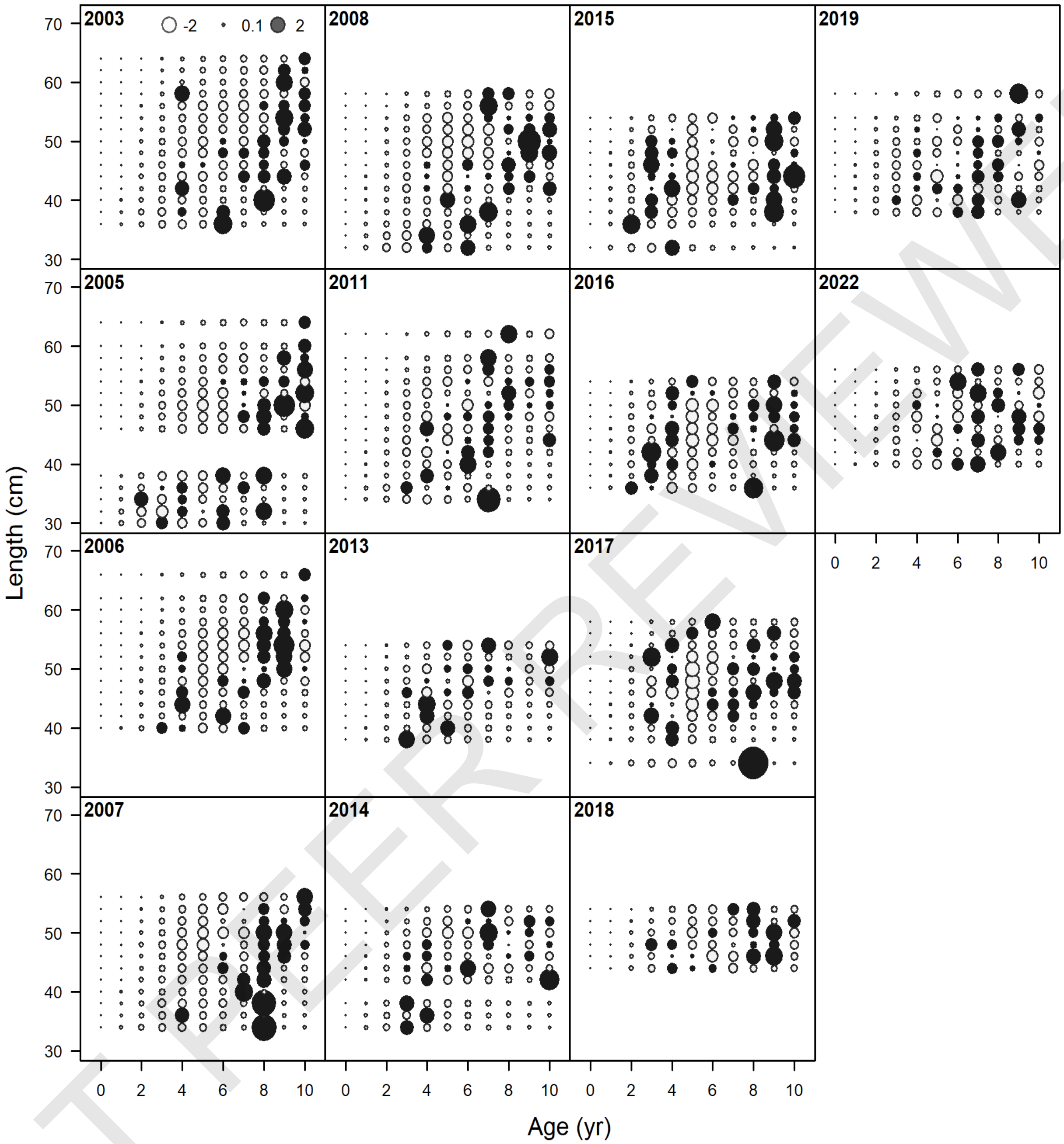


Figure 80. Pearson residuals for the conditional age-at-length compositions for Gray Triggerfish landed by the Commercial Longline fleet. Closed bubbles are positive residuals (Obs > Exp) and open bubbles are negative residuals (Obs < Exp).

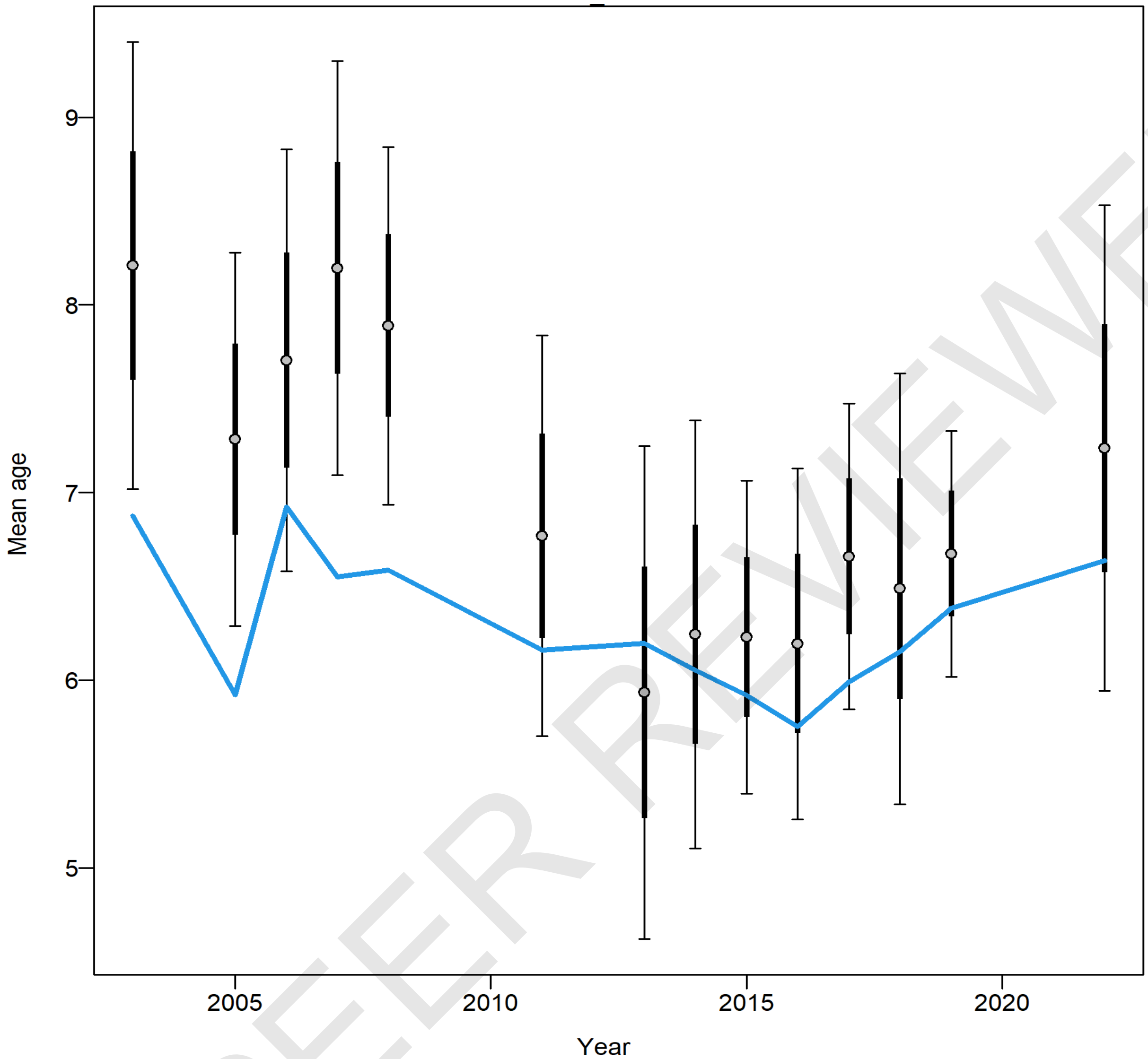


Figure 81. Mean age of Gray Triggerfish landed by the Commercial Longline fleet from conditional data (aggregated across length bins) with 95% confidence intervals (thick bars). Thinner intervals (with capped ends) show the result of further adjusting sample sizes based on the Francis data weighting method, which was not used here.

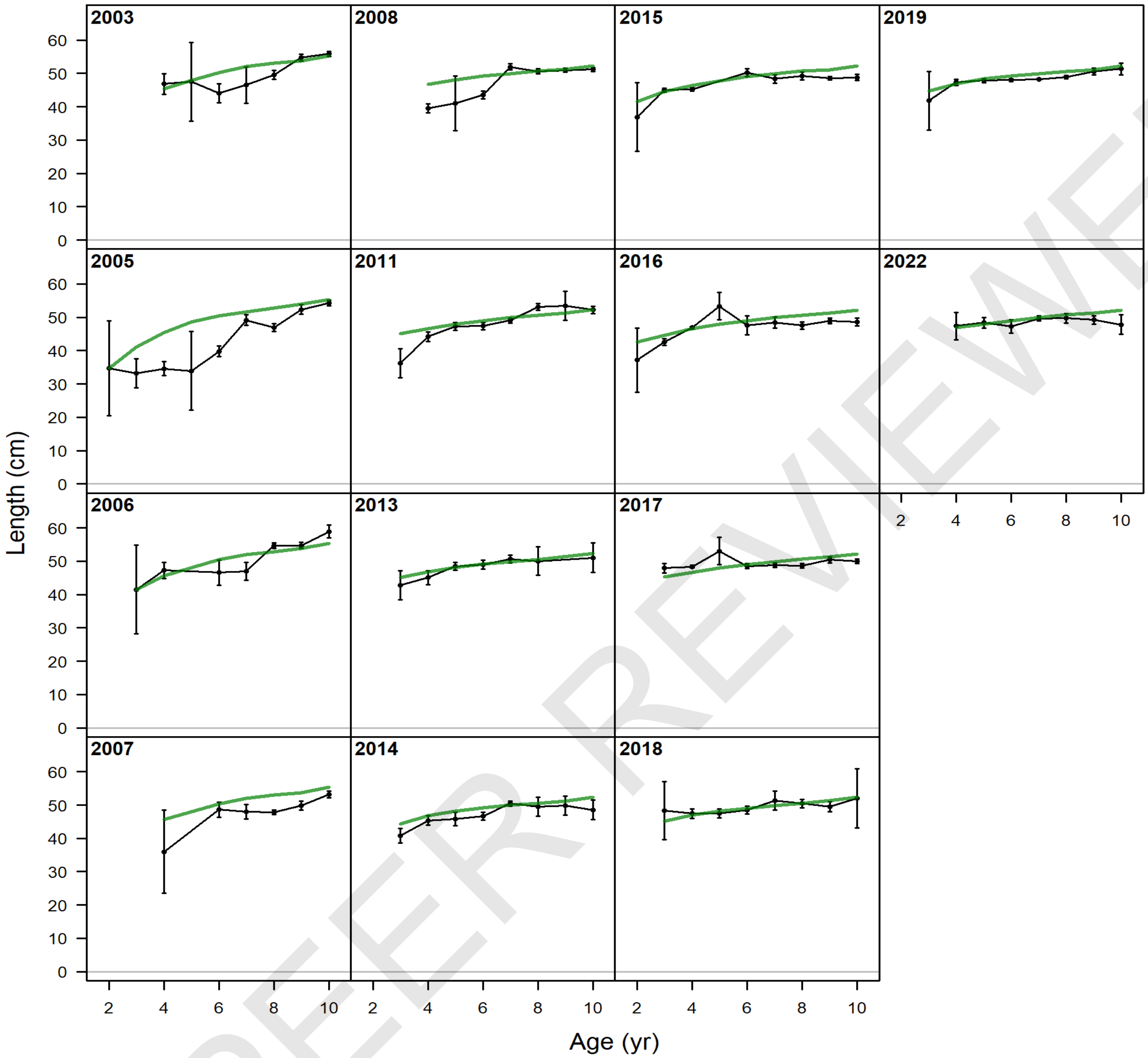


Figure 82. Observed and expected mean length-at-age for Gray Triggerfish landed by the Commercial Longline fleet. Mean length-at-age is provided for comparison of trends and was not included in the likelihood.

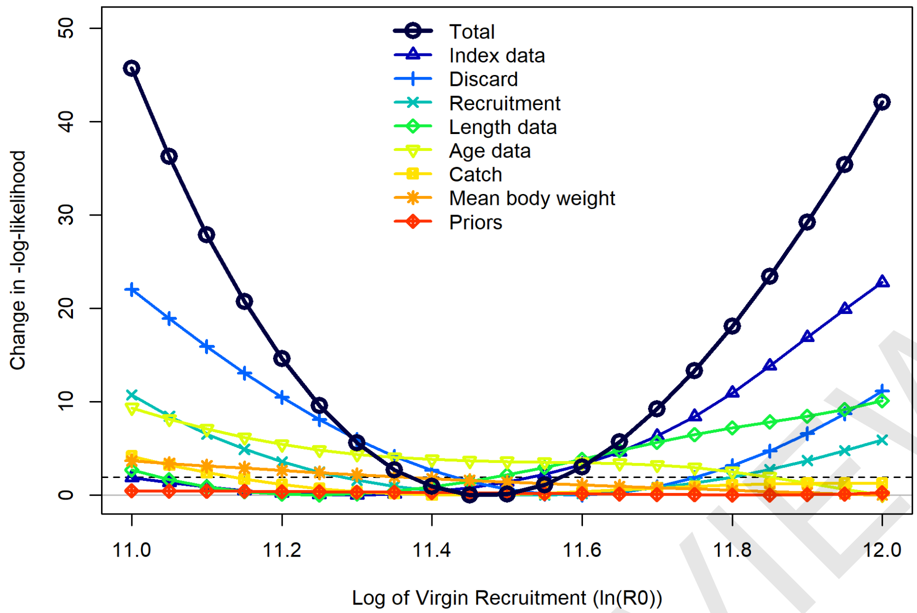


Figure 83. The likelihood profile for the natural log of the virgin recruitment parameter (ln(R_0)) of the Beverton – Holt stock-recruit function. Each line represents the change in negative log-likelihood value for each of the data sources fit in the model across the range of fixed values tested. The MLE (CV) for the SEDAR 100 AP Model was 11.469 (0.004). The dashed horizontal line at ~1.92 indicates the 95% confidence interval.

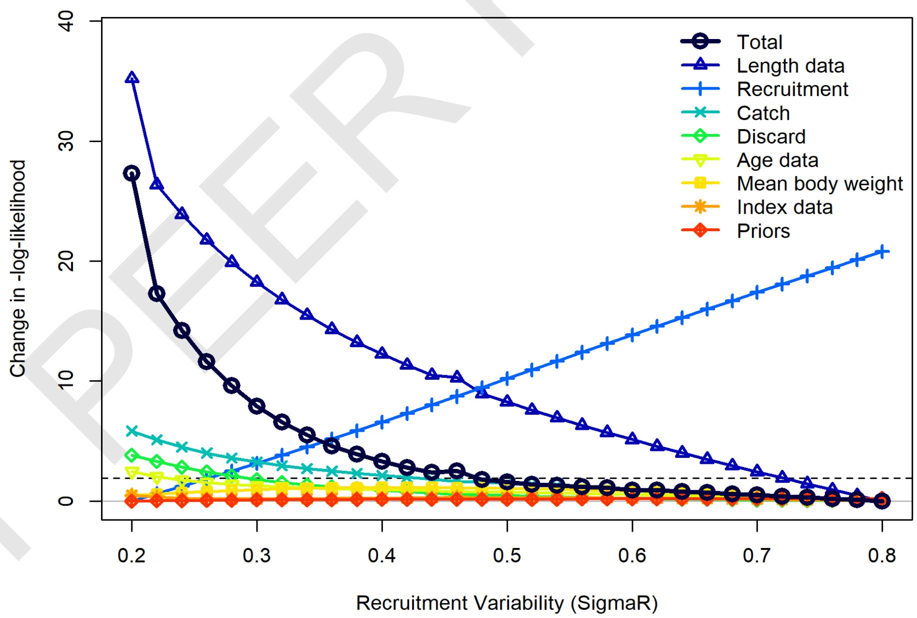


Figure 84. The likelihood profile for the recruitment variability (SigmaR) parameter of the Beverton – Holt stock-recruit function. Each line represents the change in negative log-likelihood value for each of the data sources fit in the model across the range of fixed values tested. SigmaR was fixed at 0.6 in the SEDAR 100 AP Model. The dashed horizontal line at ~1.92 indicates the 95% confidence interval.

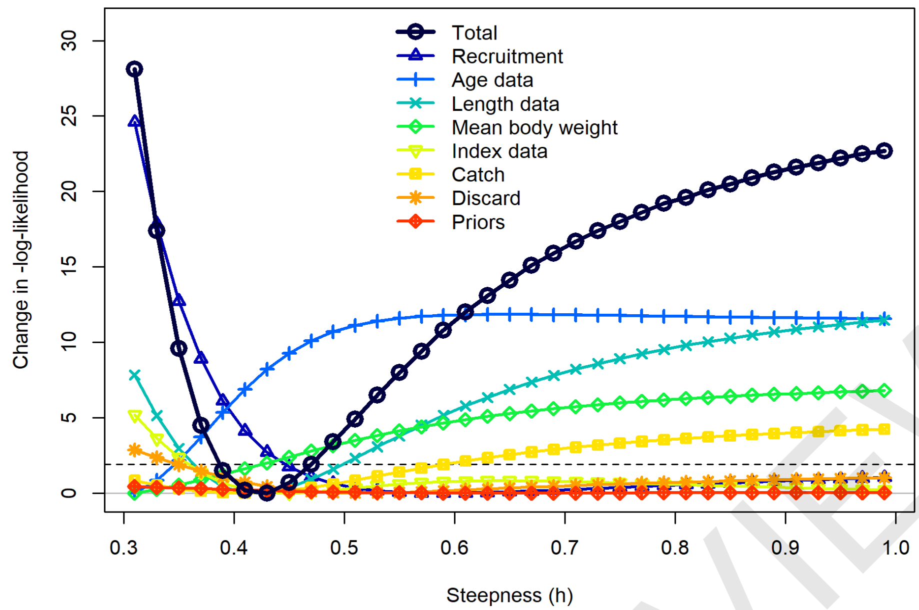


Figure 85. The likelihood profile for the steepness parameter of the Beverton – Holt stock-recruit function. Each line represents the change in negative log-likelihood value for each of the data sources fit in the model across the range of fixed values tested. Steepness was fixed at 0.99 in the SEDAR 100 AP Model. The dashed horizontal line at ~1.92 indicates the 95% confidence interval.

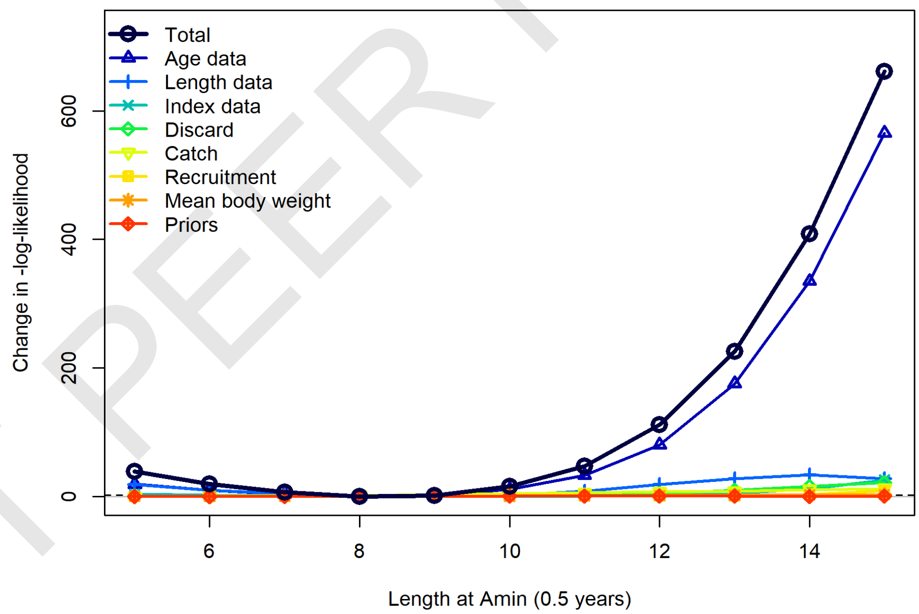


Figure 86. The likelihood profile for the length at the minimum age (0.5 year) parameter (L_{Amin}). Each line represents the change in negative log-likelihood value for each of the data sources fit in the model across the range of fixed values tested in the profile diagnostic run. The MLE (CV) for the SEDAR 100 AP Model was 8.353 (0.039). The dashed horizontal line at ~1.92 indicates the 95% confidence interval.

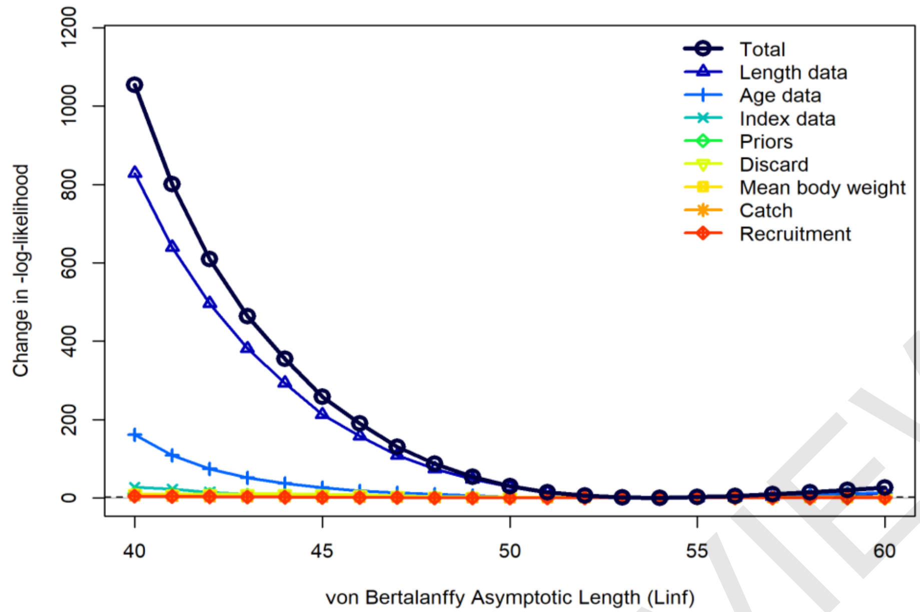


Figure 87. The likelihood profile for the von Bertalanffy asymptotic length parameter (L_{Amax} [i.e., L∞]). Each line represents the change in negative log-likelihood value for each of the data sources fit in the model across the range of fixed values tested in the profile diagnostic run. The MLE (CV) for the SEDAR 100 AP Model was 53.804 (0.011). The dashed horizontal line at ~1.92 indicates the 95% confidence interval.

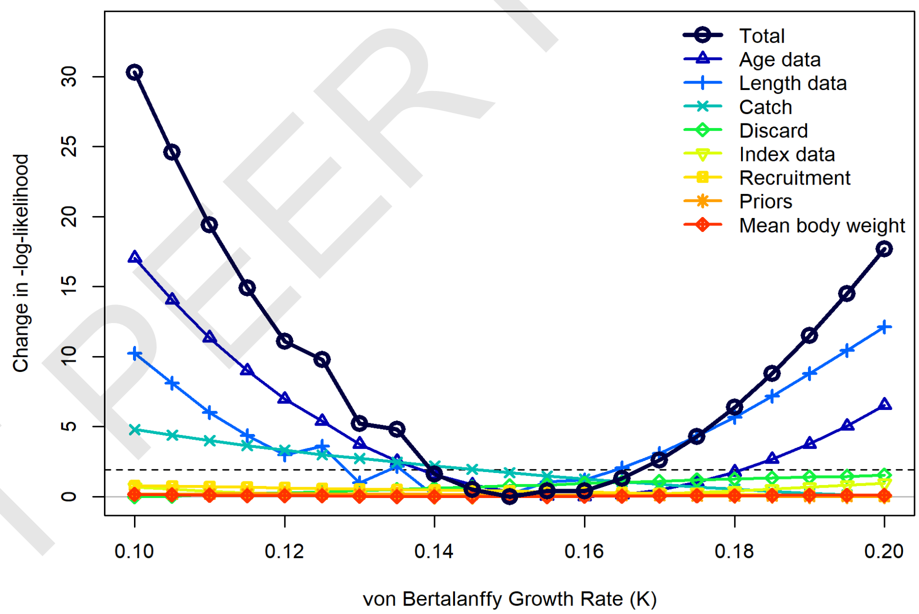


Figure 88. The likelihood profile for the von Bertalanffy growth rate parameter (K). Each line represents the change in negative log-likelihood value for each of the data sources fit in the model across the range of fixed values tested in the profile diagnostic run. The MLE (CV) for the SEDAR 100 AP Model was 0.153 (0.048). The dashed horizontal line at ~1.92 indicates the 95% confidence interval.

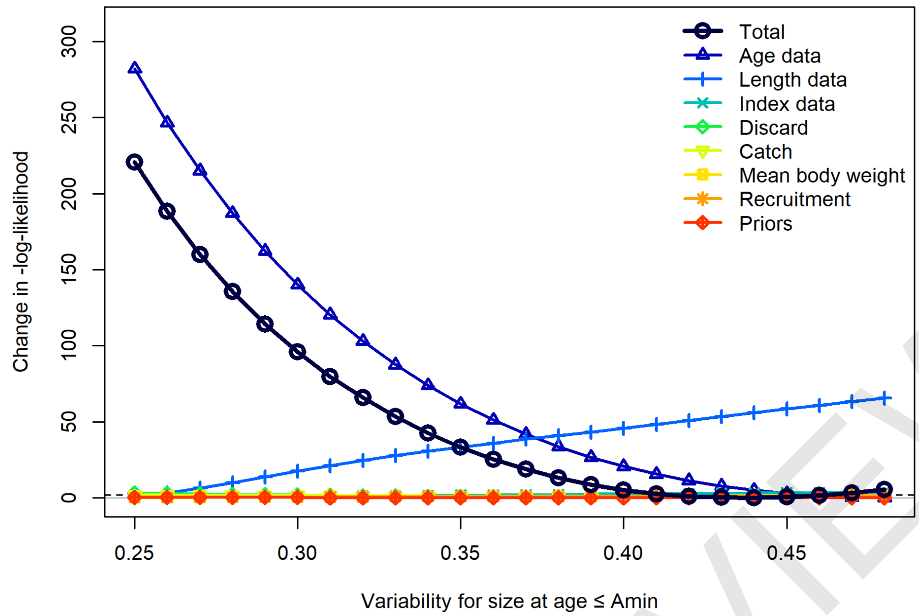


Figure 89. The likelihood profile for the variability for size-at-age ≤ Amin (CV_{Amin}). Each line represents the change in negative log-likelihood value for each of the data sources fit in the model across the range of fixed values tested in the profile diagnostic run. The CV_{Amin} parameter was fixed at 0.437 for the SEDAR 100 AP Model after estimating it in an intermediate run. The dashed horizontal line at ~1.92 indicates the 95% confidence interval.

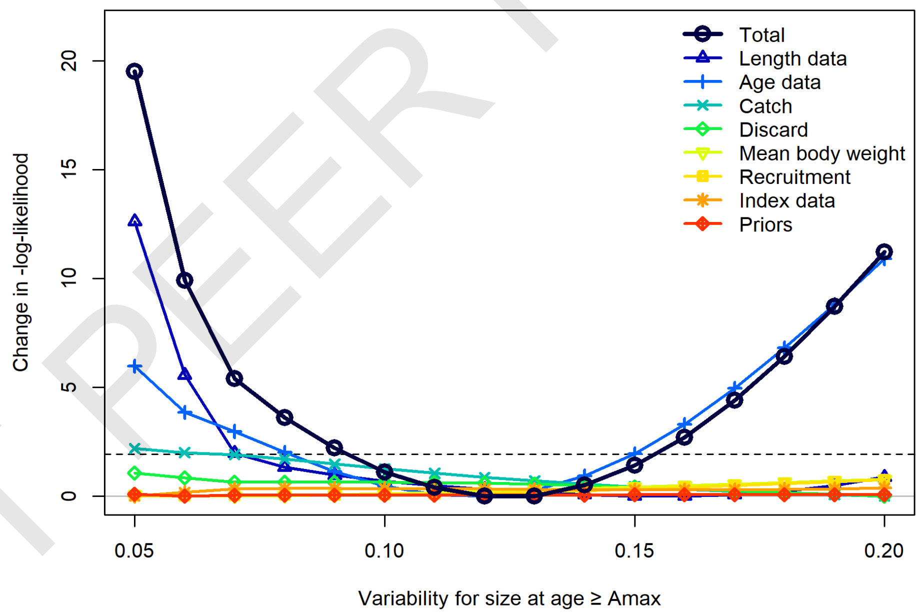


Figure 90. The likelihood profile for the variability for size-at-age ≥ Amax (CV_{Amax}). Each line represents the change in negative log-likelihood value for each of the data sources fit in the model across the range of fixed values tested in the profile diagnostic run. The CV_{Amax} parameter was fixed at 0.124 for the SEDAR 100 AP Model after estimating it in an intermediate run. The dashed horizontal line at ~1.92 indicates the 95% confidence interval.

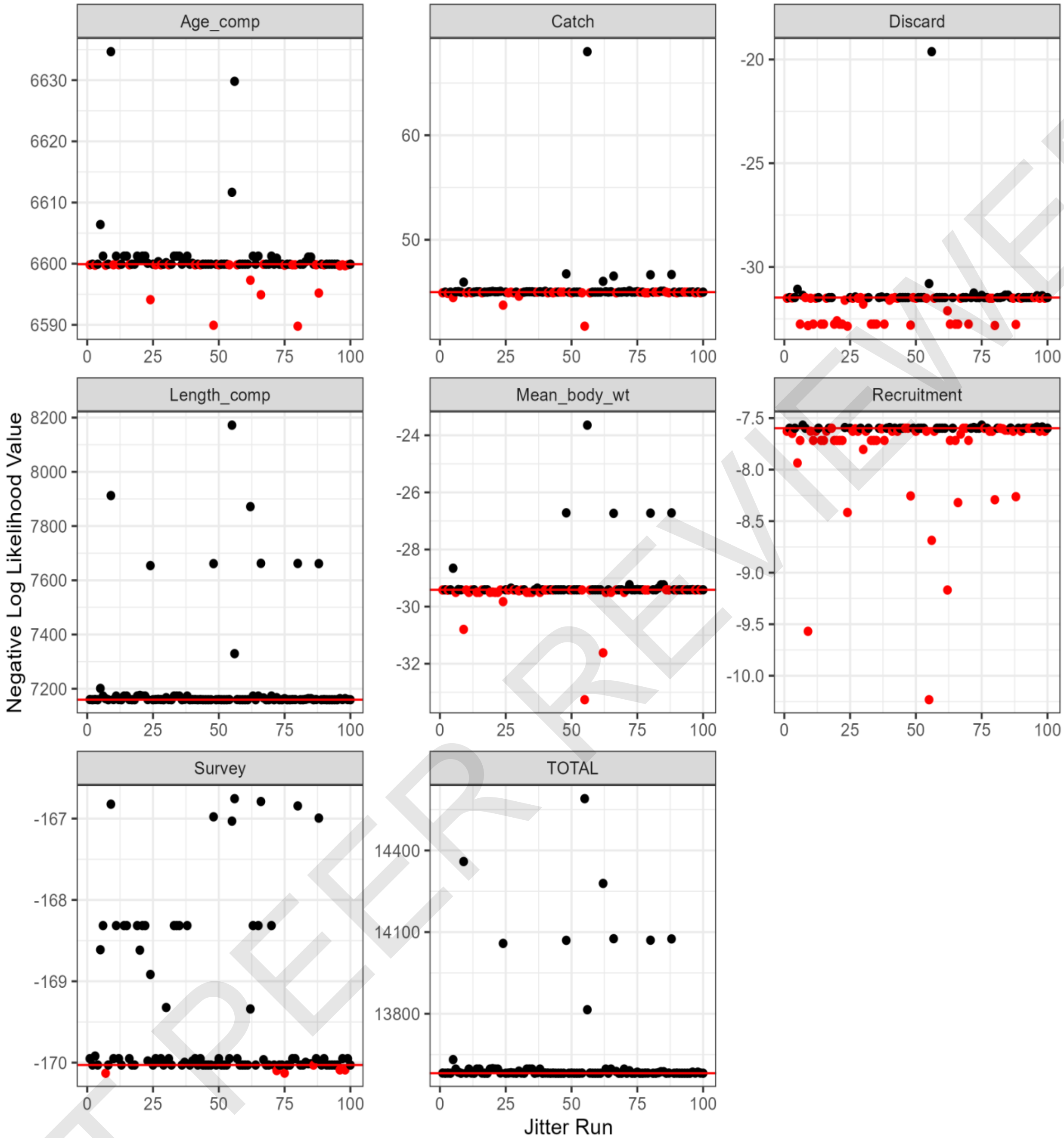


Figure 91. Results of the jitter analysis for various likelihood components for the SEDAR 100 AP Model. Each panel gives the results of 100 model runs where the starting parameter values for each run were randomly changed ('jittered') by 10% from the SEDAR 100 AP Model best fit values. Note that the y-axes differ between panels. Negative log-likelihood components shown from top left through bottom right include: conditional age-at-length (Age_comp), catch, discards, length composition (length_comp), mean weight of landings (Mean_body_wt), recruitment, survey, and total.

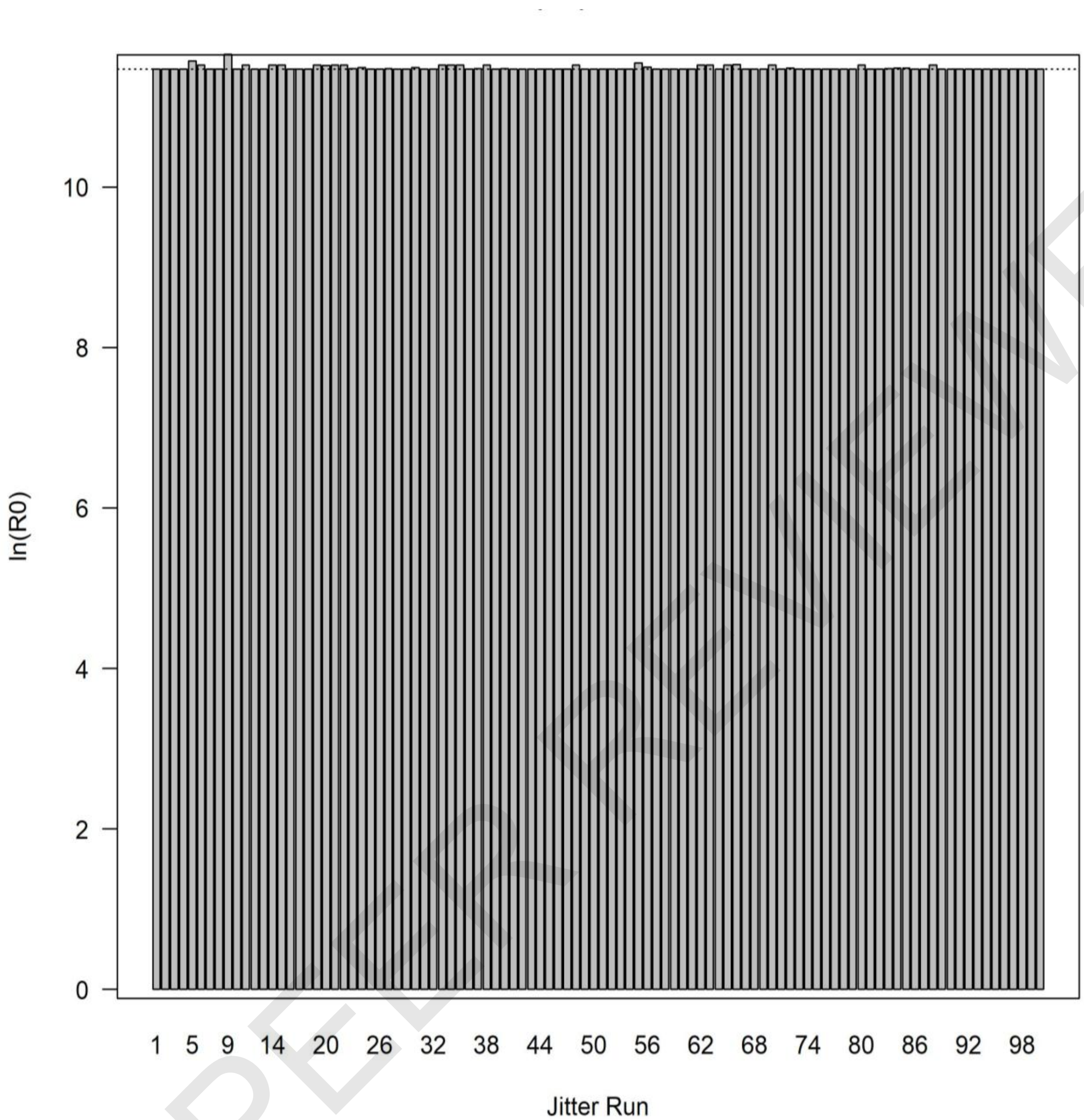


Figure 92. Results of the jitter analysis for the natural log of the virgin recruitment parameter ($ln(R_0)$) for the SEDAR 100 AP Model from 100 model runs where the starting parameter values for each run were randomly changed ('jittered') by 10% from the SEDAR 100 AP Model best fit value (dashed horizontal line).

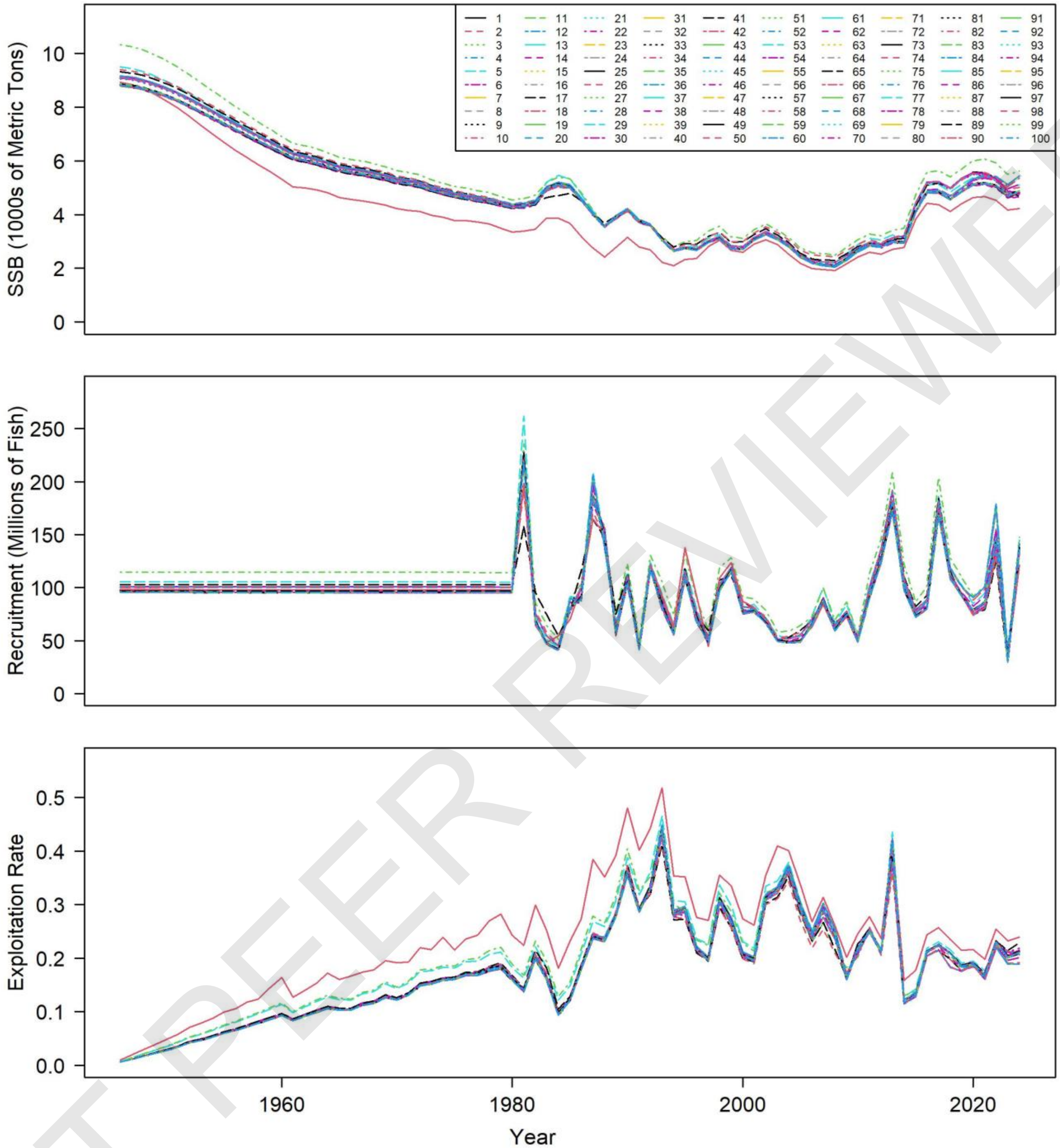


Figure 93. Estimated trajectories in spawning stock biomass (SSB in 1,000s of metric tons; top panel), recruitment (millions of age-0; middle panel), and exploitation rate (total biomass killed all ages / total biomass age 1+; bottom panel) for the SEDAR 100 AP Model.

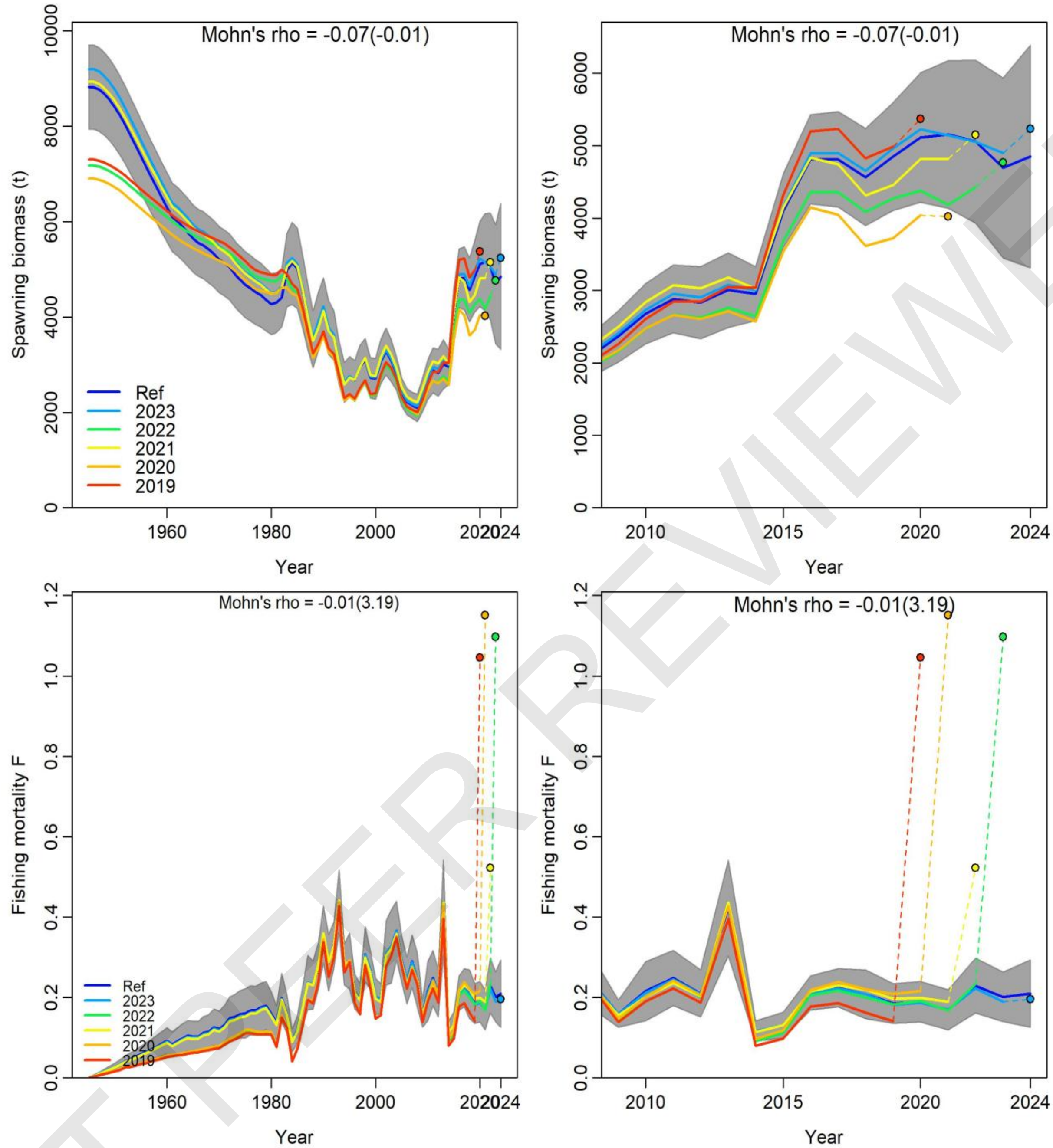


Figure 94. Retrospective analysis of spawning stock biomass (SSB, top panels) and fishing mortality (F, bottom panels) estimates by re-fitting each reference model (Ref) after removing five years of observations, one year at a time sequentially. The retrospective results are shown for the entire time series and for the most recent years only. Mohn's Rho statistic and the corresponding 'hindcast rho' values (in brackets) are printed at the top of each panel. One-year-ahead projections denoted by color-coded dashed lines with terminal points shown for each model. Grey shaded areas are the 95% confidence intervals from the reference model. See Carvalho et al. (2021) for additional details.

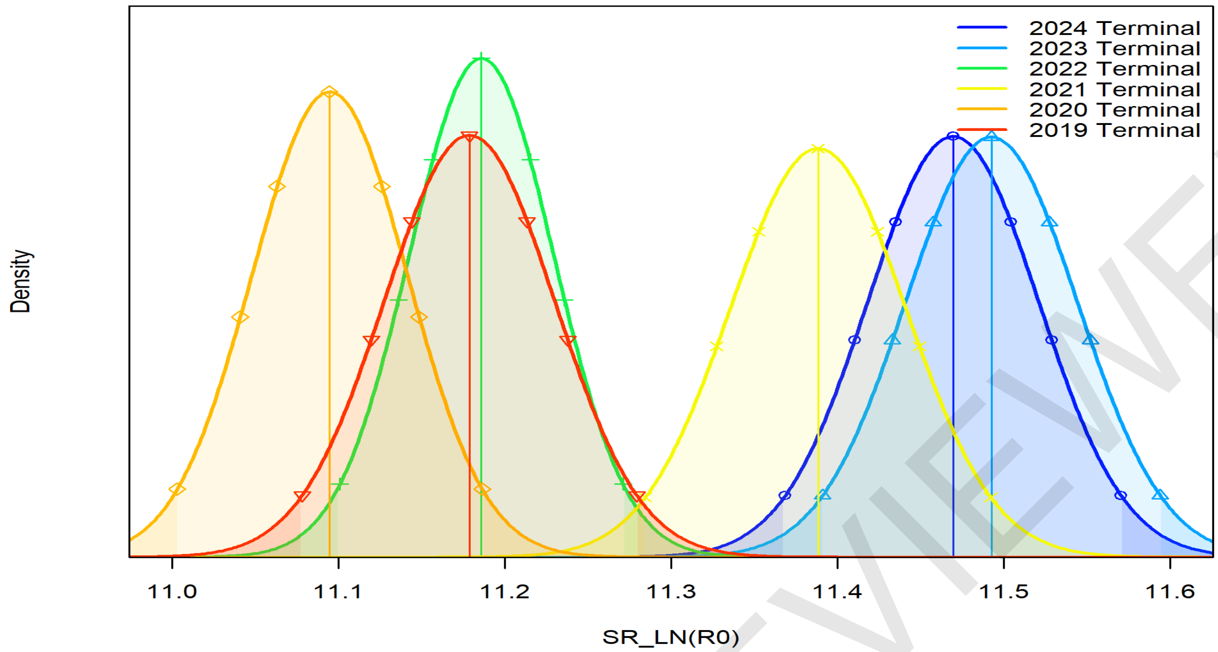


Figure 95. Results of a five year retrospective analysis for the natural log of the virgin recruitment parameter ($ln(R_0)$) for the SEDAR 100 AP Model.

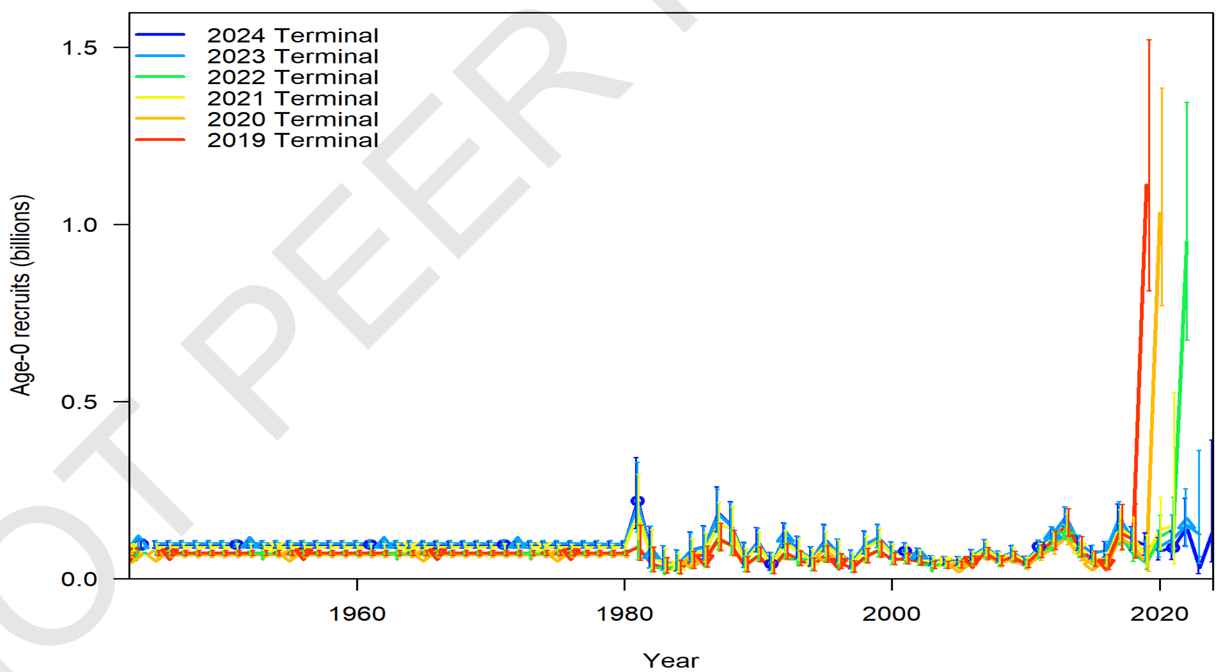


Figure 96. Results of a five year retrospective analysis for recruitment (billions of fish) for the SEDAR 100 AP Model.

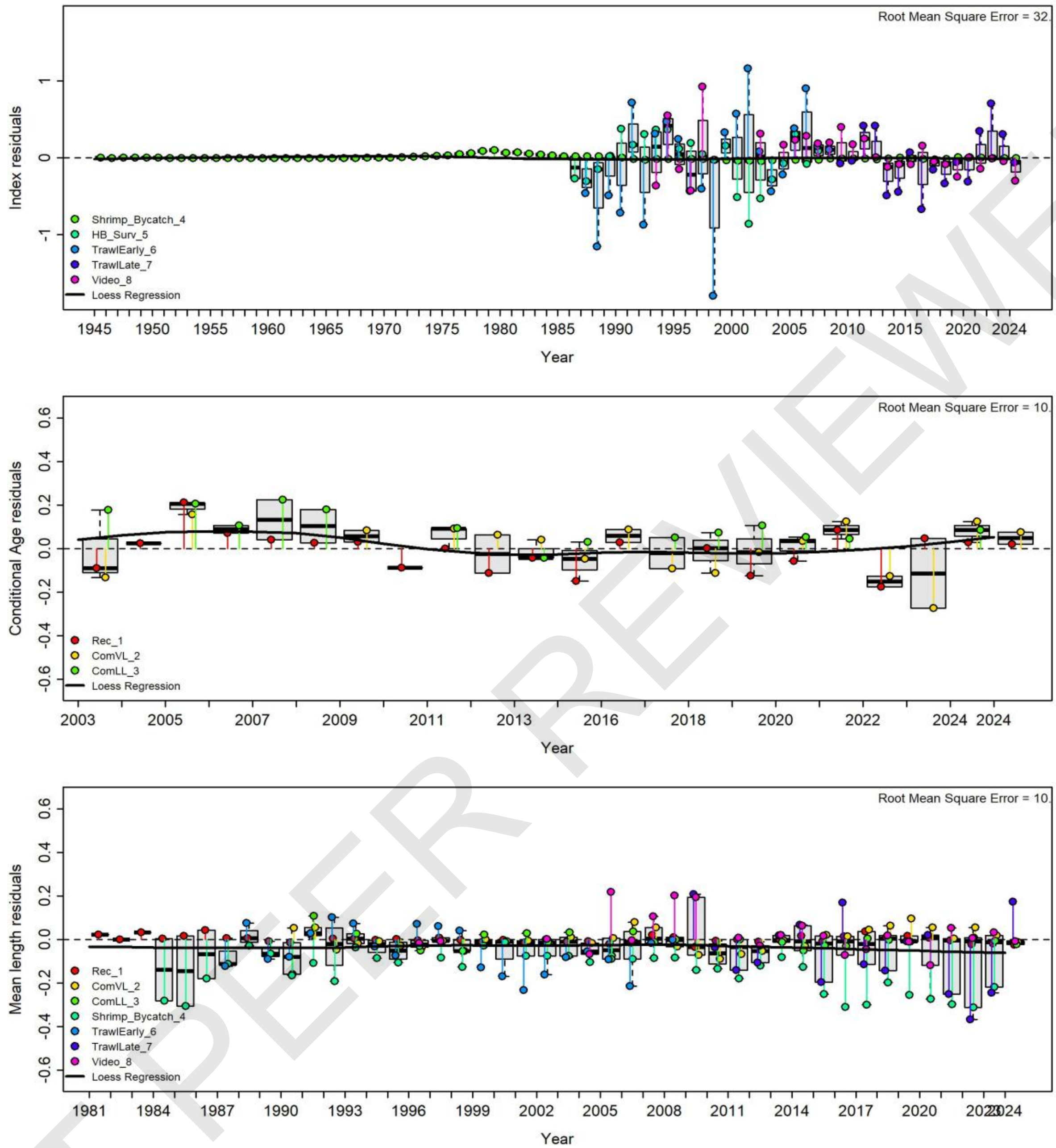


Figure 97. Joint residual plots for indices of abundance fits (top panel), fits to conditional at-age-length (middle panel), and fits to annual mean length estimates (bottom panel). Vertical lines with points show the residuals (in colors by index), and solid black line reflects the loess smoother through all the residuals. Boxplots indicate the median and quantiles in cases where residuals from the multiple indices are available for any given year. Root-mean squared errors (RMSE) are included in the upper right-hand corner of each plot. See Carvalho et al. (2021) for additional details.

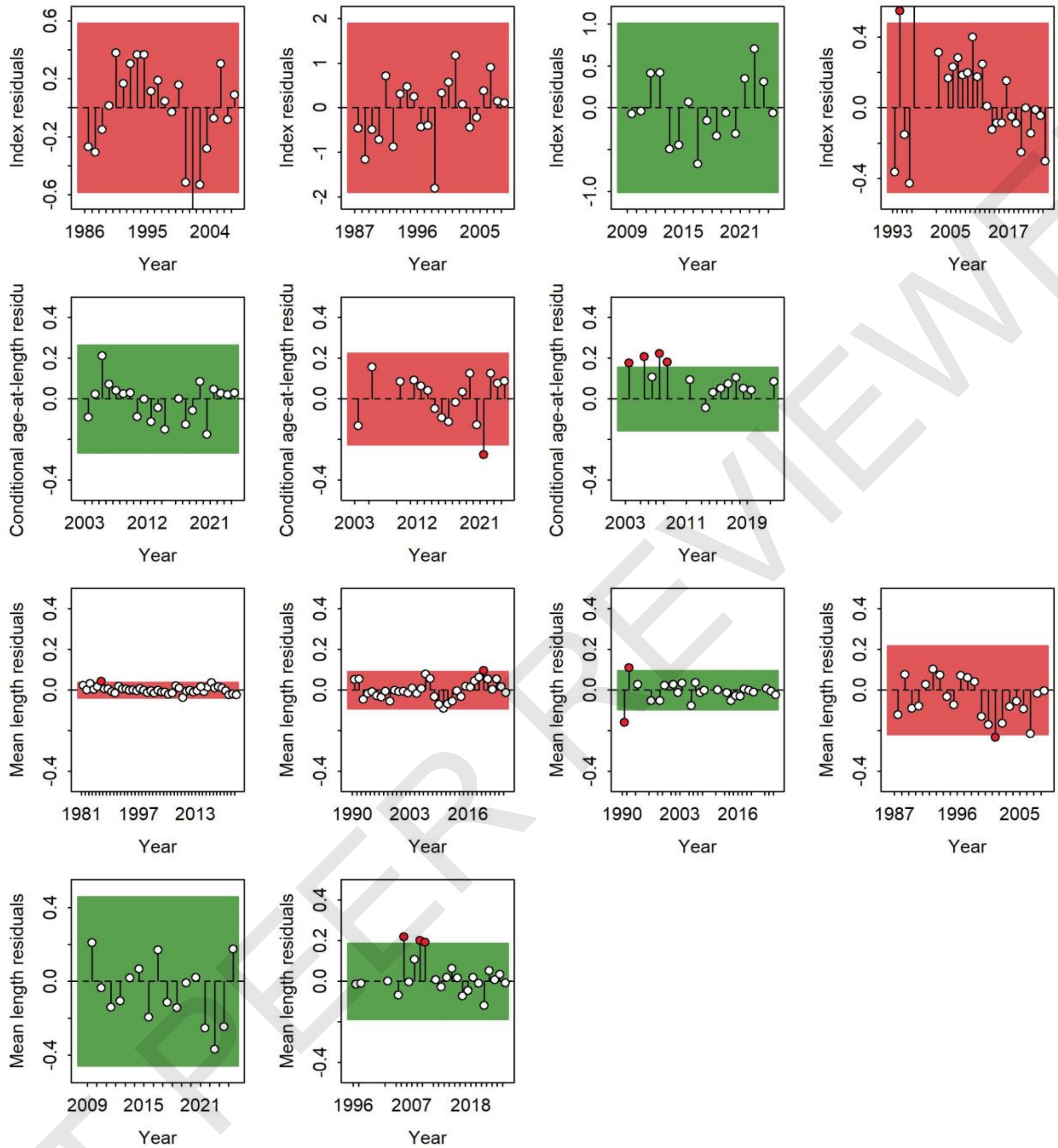


Figure 98. Runs tests results for indices of abundance, conditional age-at-length, and mean length. Green shading indicates no evidence ($p >= 0.05$) and red shading evidence ($p < 0.05$) to reject the hypothesis of a randomly distributed time series of residuals, respectively. The shaded (green/red) area spans three residual standard deviations to either side from zero, and the red points outside of the shading violate the 'three-sigma limit' for that series. See Carvalho et al. (2021) for additional details.

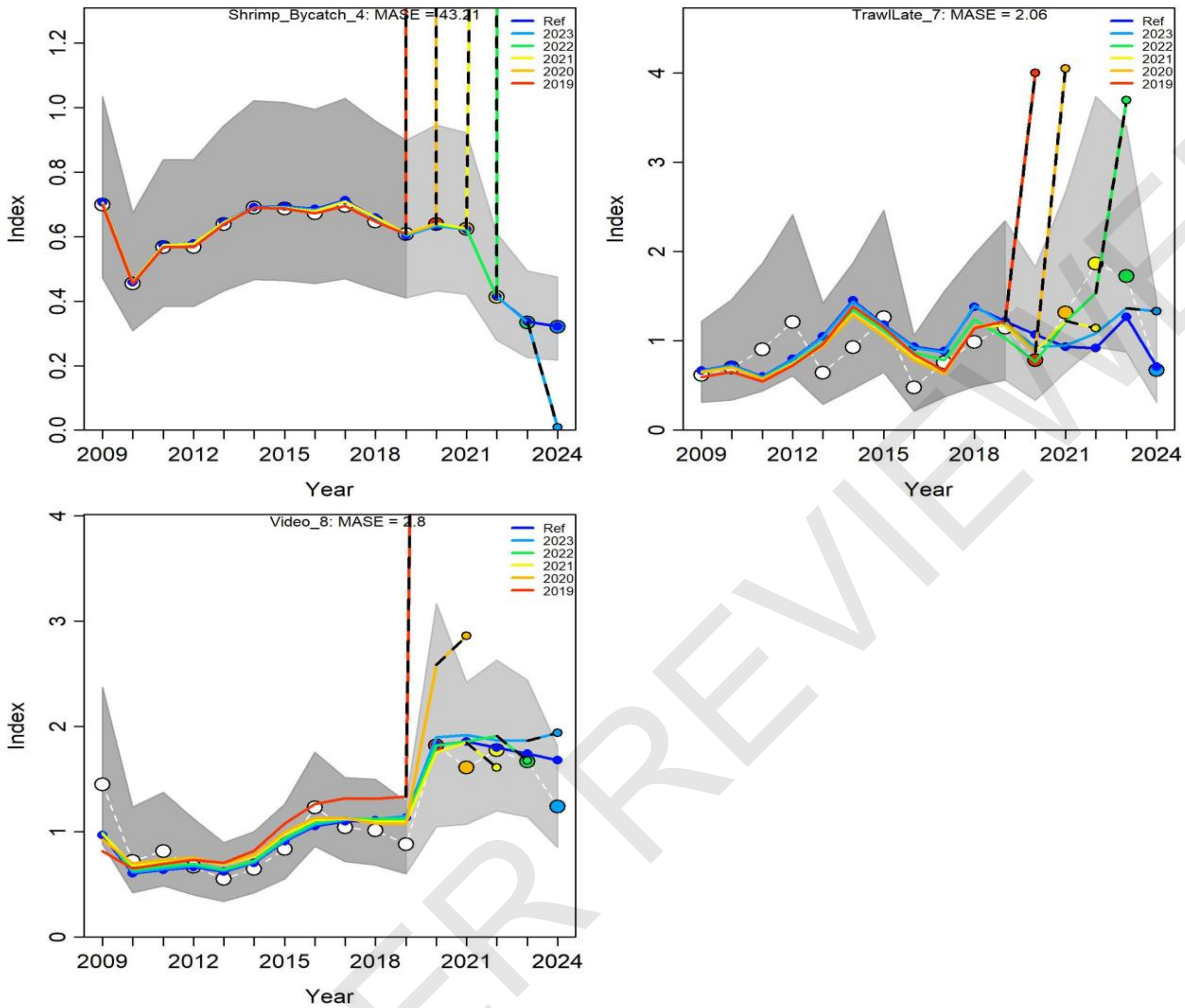


Figure 99. Hindcasting cross-validation (HCxval) results for indices of abundance fits. Shown are observed (large points connected with dashed line), fitted (solid lines) and one-year ahead forecast values (small terminal points). HCxval was performed using one reference model (Ref) and five hindcast model runs (solid lines) relative to the expected index. The observations used for cross validation are highlighted as color-coded solid circles with associated 95% confidence intervals (light-grey shading). The model reference year refers to the endpoints of each one-year-ahead forecast and the corresponding observation (i. e., year of peel + 1). The mean absolute scaled error (MASE) score associated with each index time series is denoted in each panel. See Carvalho et al. (2021) for additional details.

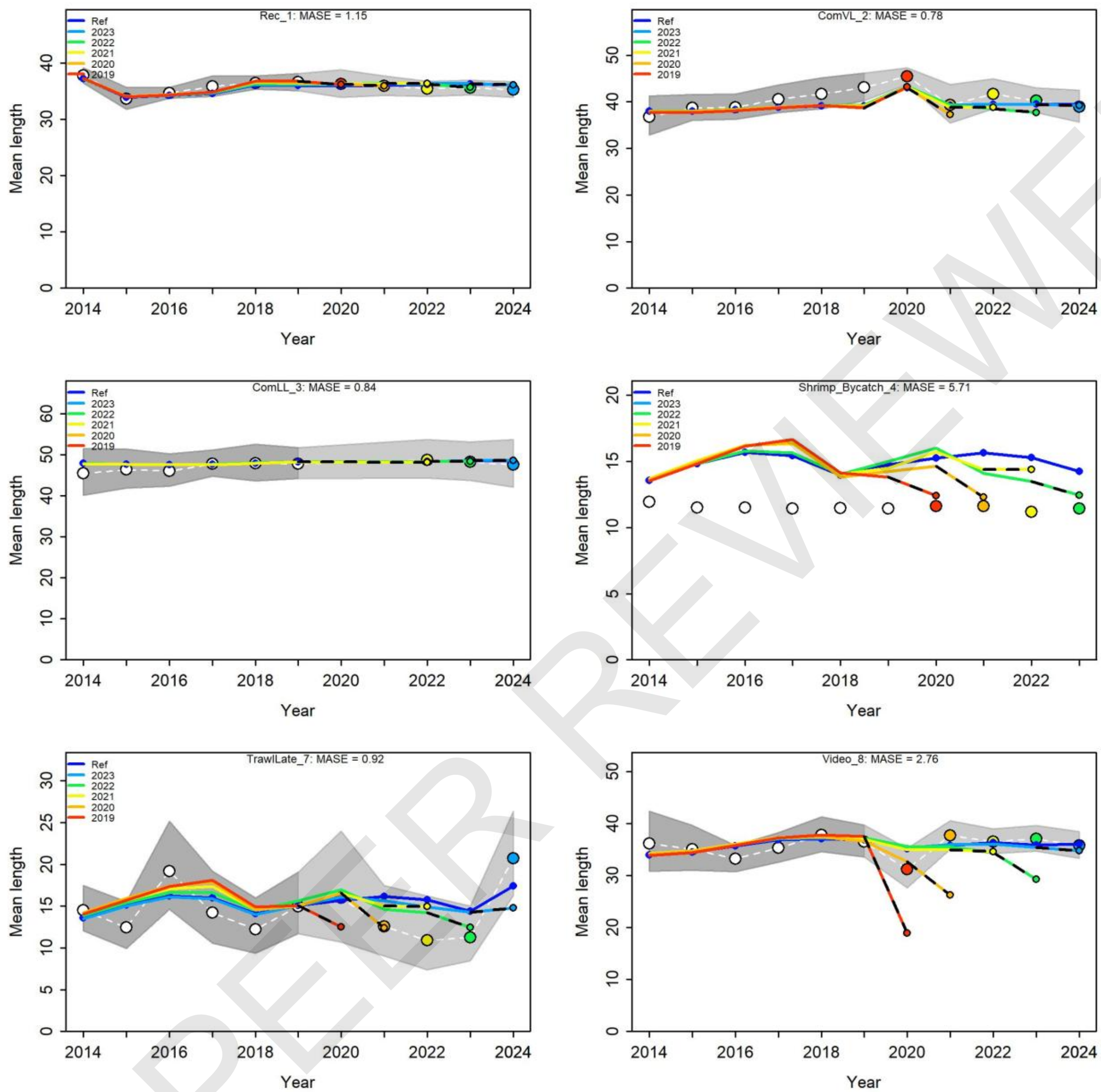


Figure 100. Hindcasting cross-validation (HCxval) results for fits to annual mean length estimates. Shown are observed (large points connected with dashed line), fitted (solid lines) and one-year ahead forecast values (small terminal points). HCxval was performed using one reference model (Ref) and five hindcast model runs (solid lines) relative to the expected mean length. The observations used for cross-validation are highlighted as color-coded solid circles with associated 95% confidence intervals (light-grey shading). The model reference year refers to the endpoints of each one-year-ahead forecast and the corresponding observation (i. e., year of peel + 1). The mean absolute scaled error (MASE) score associated with each size composition time series is denoted in each panel. See Carvalho et al. (2021) for additional details.

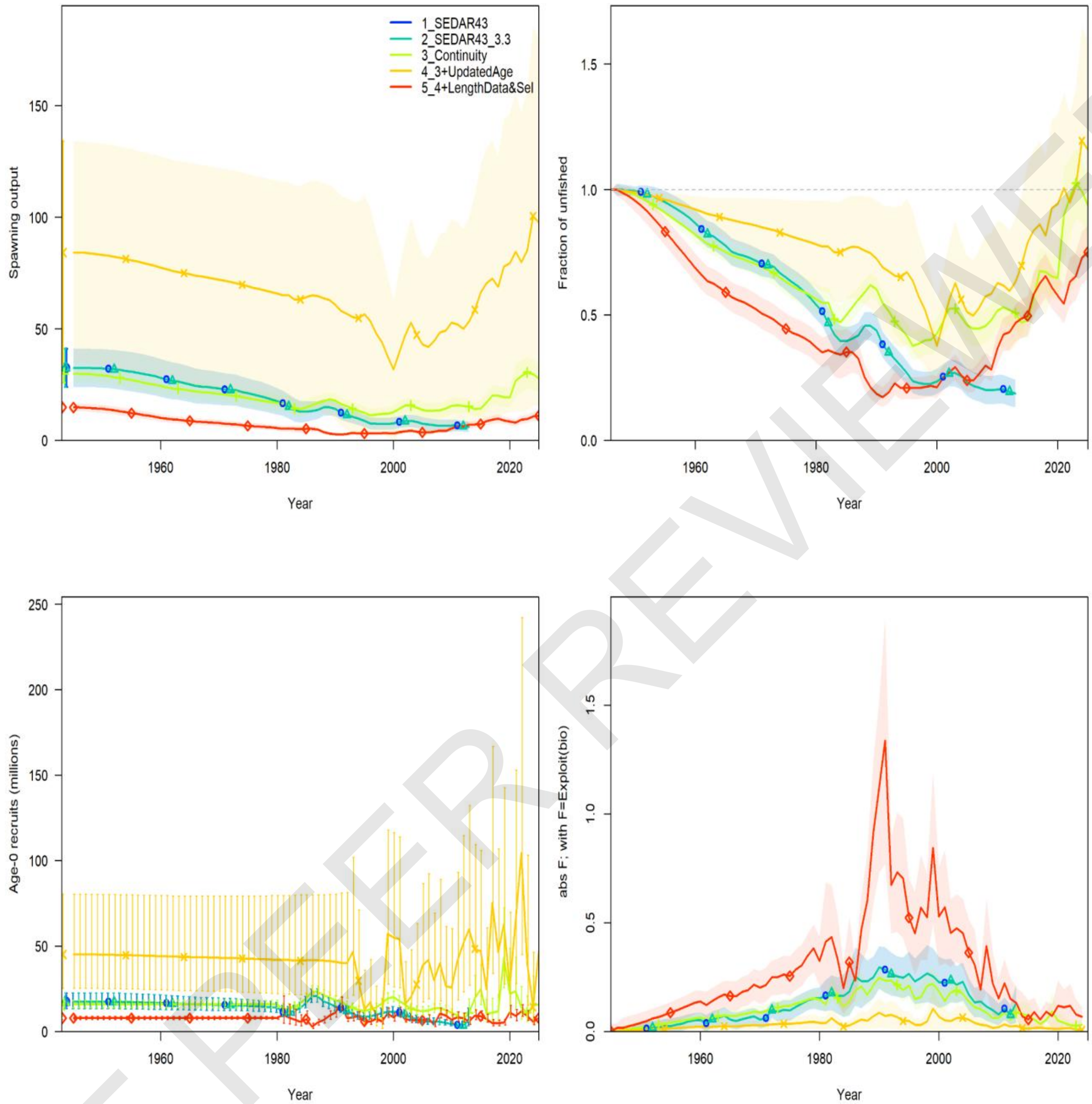


Figure 101. Bridging analysis showing phase 1 changes in estimates of spawning output (eggs; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed all ages / total biomass age 1+; bottom right panel) and associated uncertainty through each major step of model building between the SEDAR 43 Standard Model (Step 1) and the SEDAR 100 AP Model (Step 28).

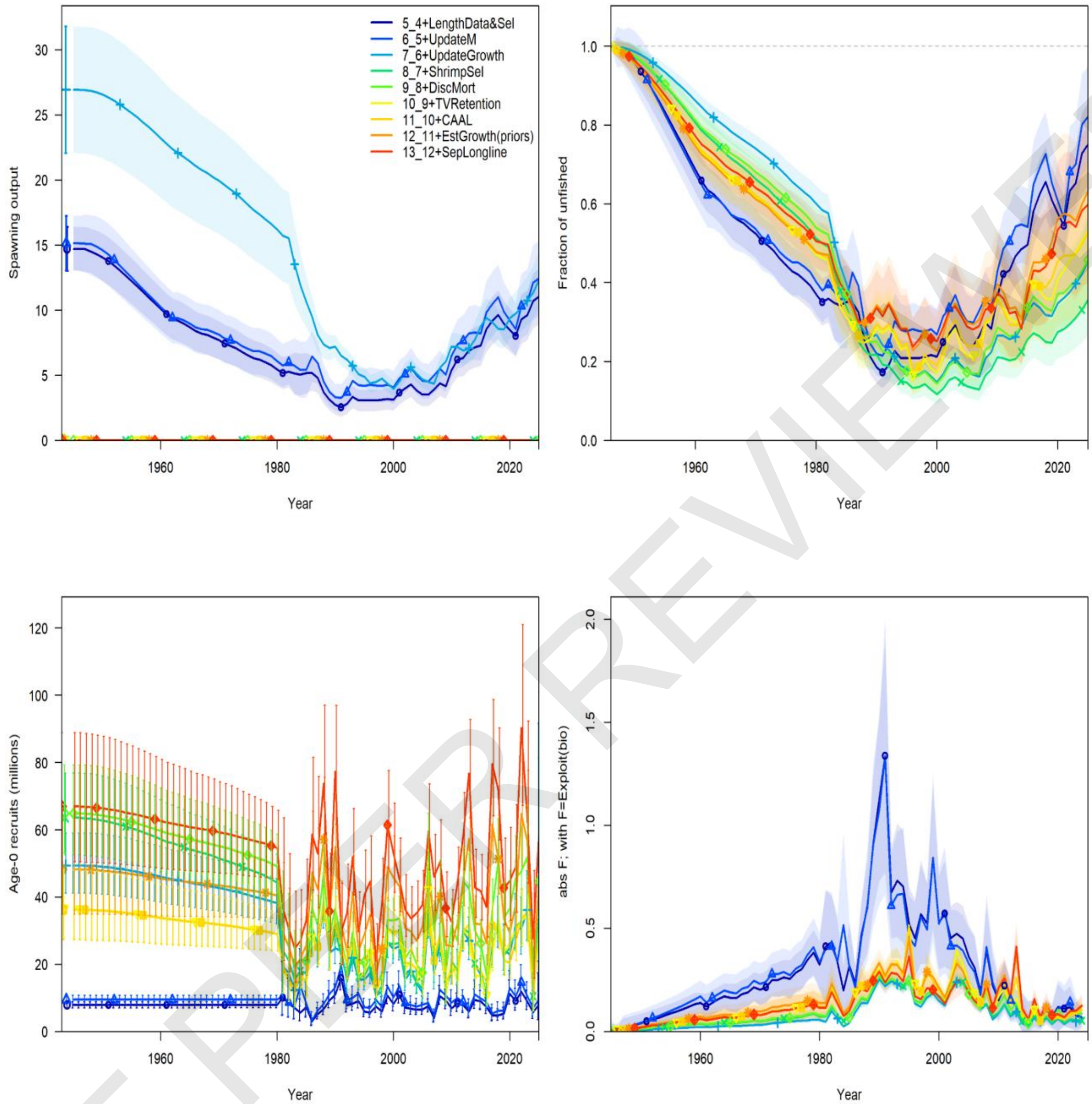


Figure 102. Bridging analysis showing phase 2 changes in estimates of spawning stock biomass (SSB in 1,000s of metric tons except for steps 5-7 which are eggs; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed all ages / total biomass age 1+; bottom right panel) and associated uncertainty through each major step of model building between the SEDAR 43 Standard Model (Step 1) and the SEDAR 100 AP Model (Step 28).

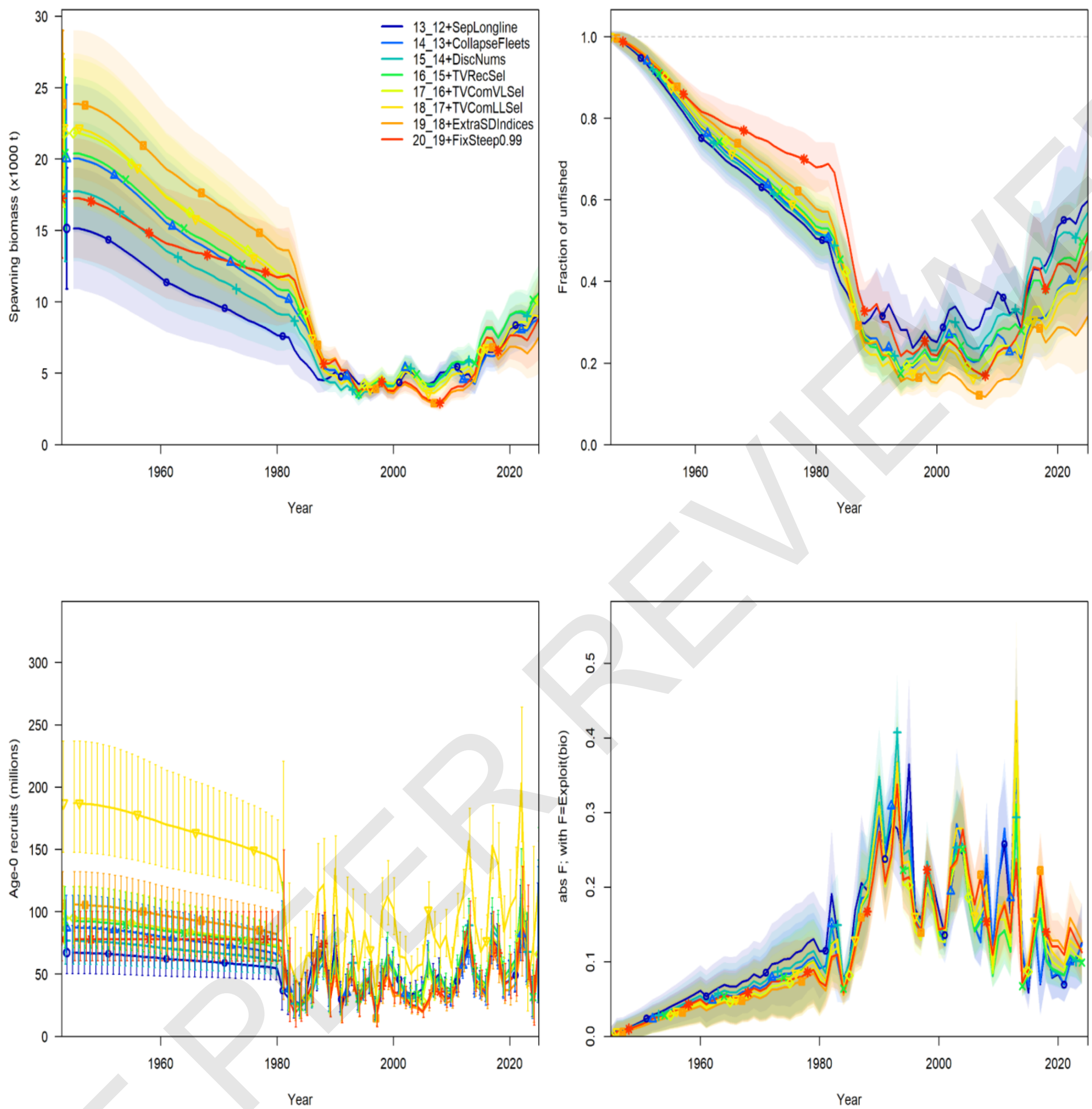


Figure 103. Bridging analysis showing phase 3 changes in estimates of spawning stock biomass (SSB in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed all ages / total biomass age 1+; bottom right panel) and associated uncertainty through each major step of model building between the SEDAR 43 Standard Model (Step 1) and the SEDAR 100 AP Model (Step 28).

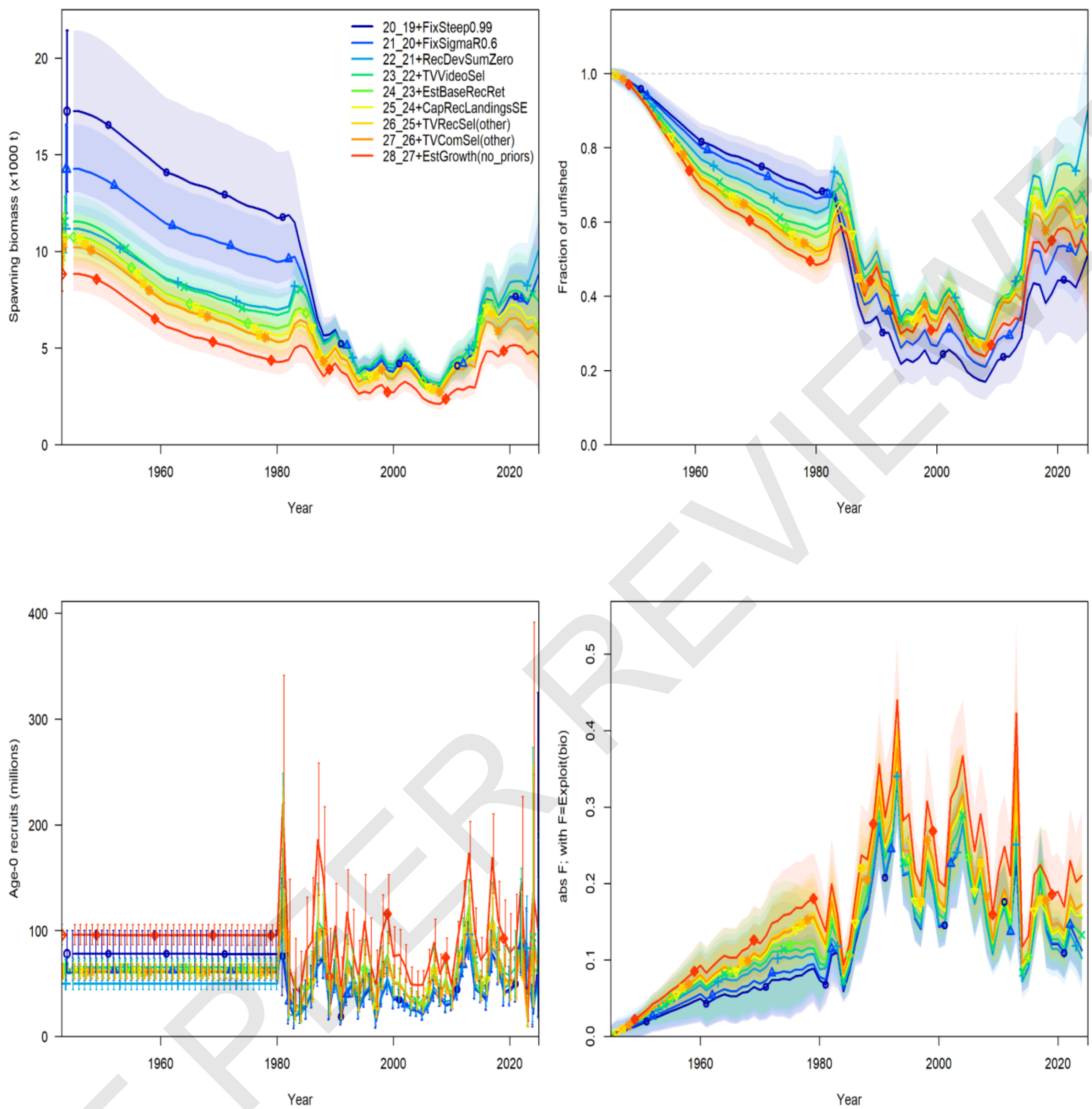


Figure 104. Bridging analysis showing phase 4 changes in estimates of spawning stock biomass (SSB in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed all ages / total biomass age 1+; bottom right panel) and associated uncertainty through each major step of model building between the SEDAR 43 Standard Model (Step 1) and the SEDAR 100 AP Model (Step 28).

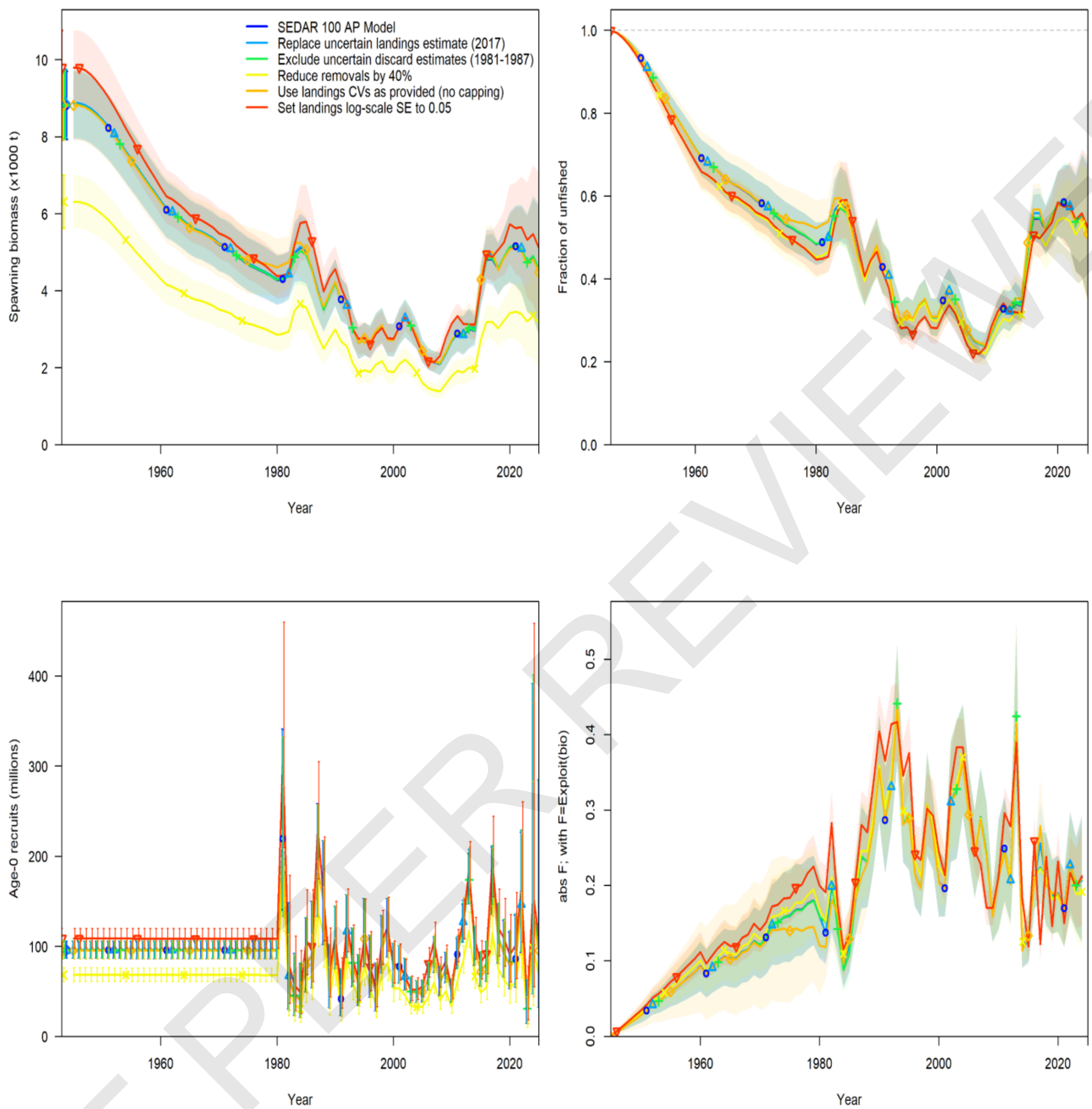


Figure 105. Estimates of spawning stock biomass (SSB in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed all ages / total biomass age 1+; bottom right panel) for the sensitivity runs exploring recreational data and uncertainty for the SEDAR 100 AP Model.

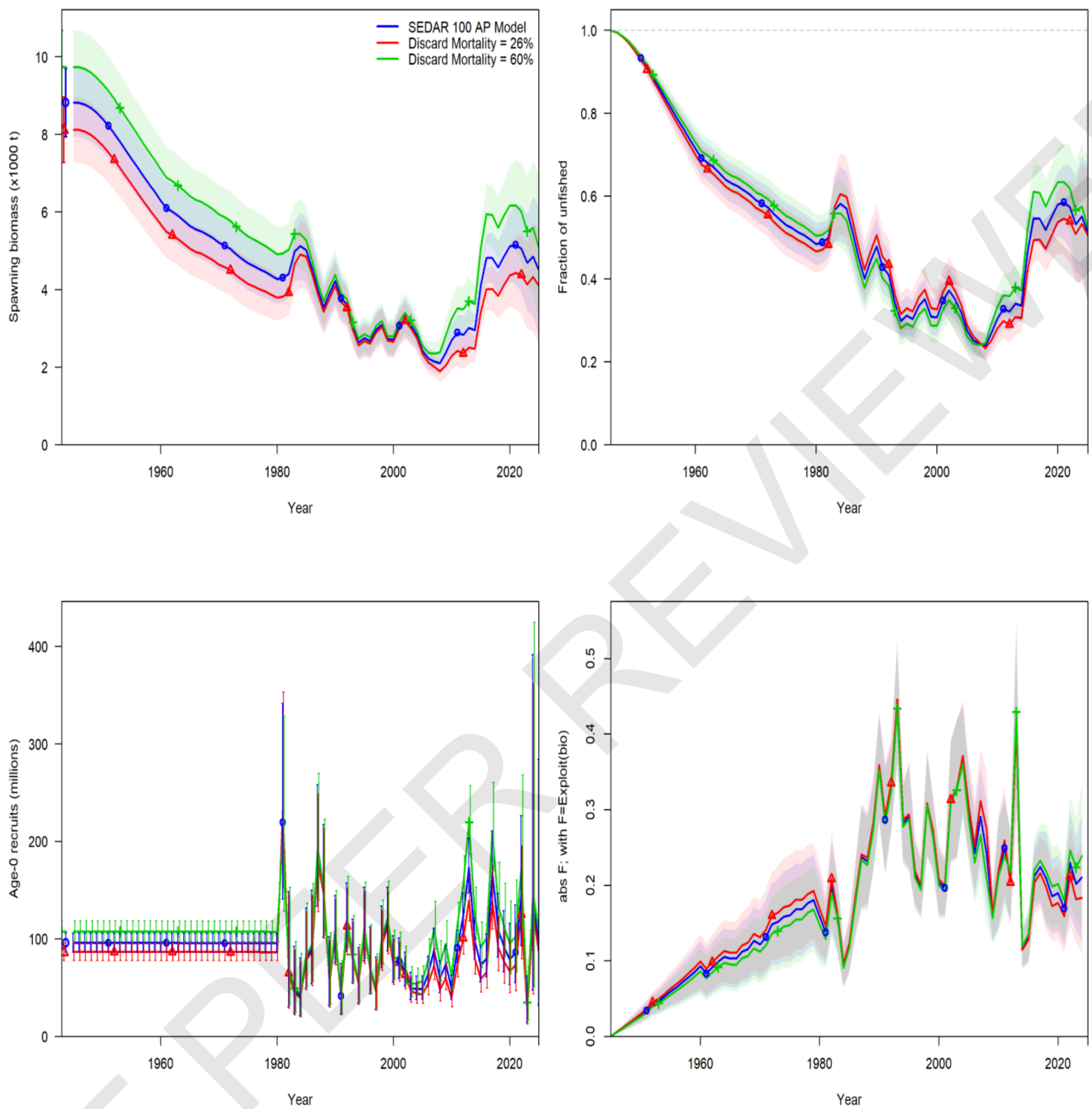


Figure 106. Estimates of spawning stock biomass (SSB in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed all ages / total biomass age 1+; bottom right panel) for the sensitivity runs exploring alternative values for discard mortality for the SEDAR 100 AP Model.

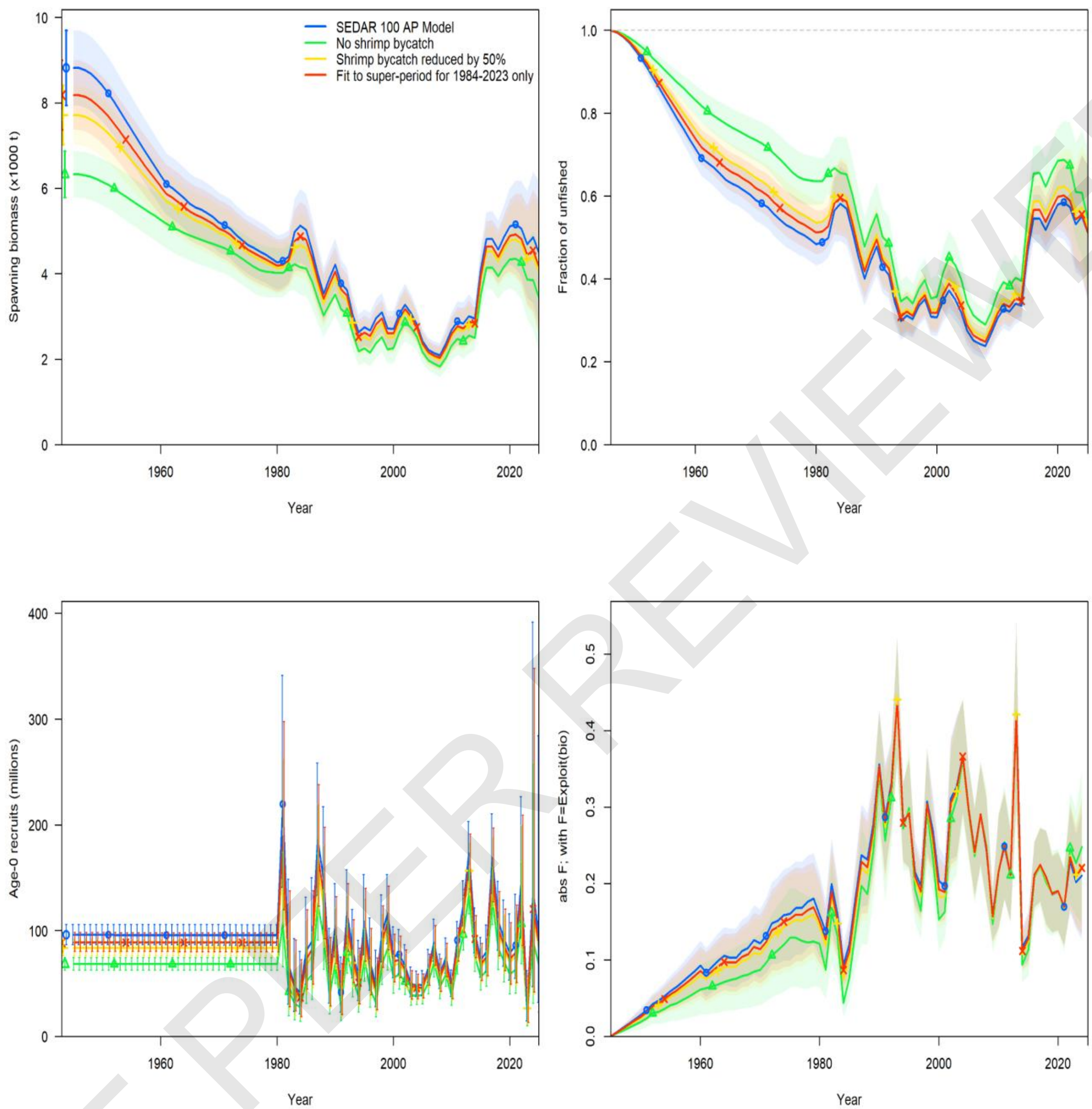


Figure 107. Estimates of spawning stock biomass (SSB in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed all ages / total biomass age 1+; bottom right panel) for the sensitivity runs exploring different treatments of shrimp bycatch data for the SEDAR 100 AP Model.

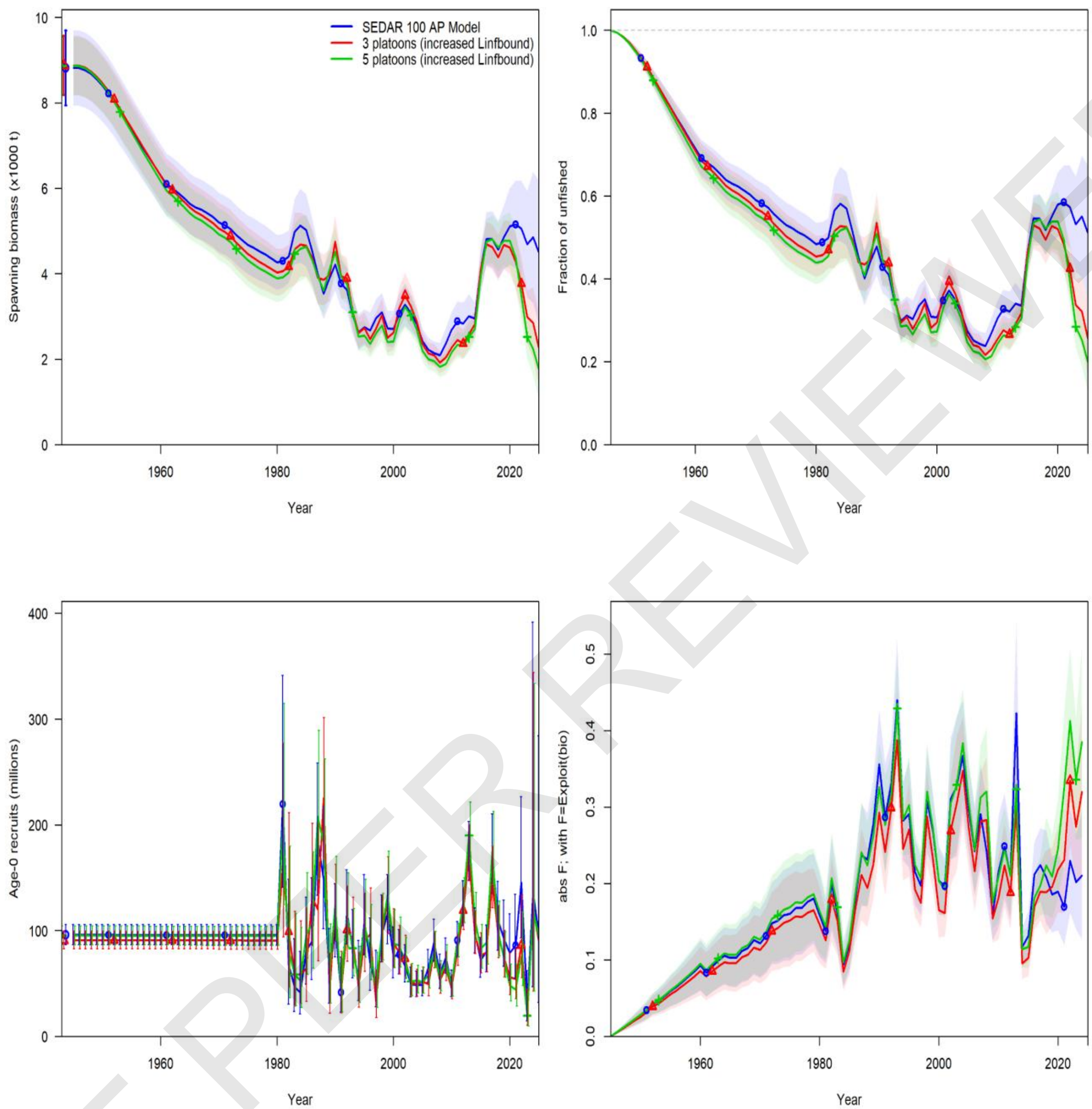


Figure 108. Estimates of spawning stock biomass (SSB in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed all ages / total biomass age 1+; bottom right panel) for the sensitivity runs exploring growth platoons for the SEDAR 100 AP Model.

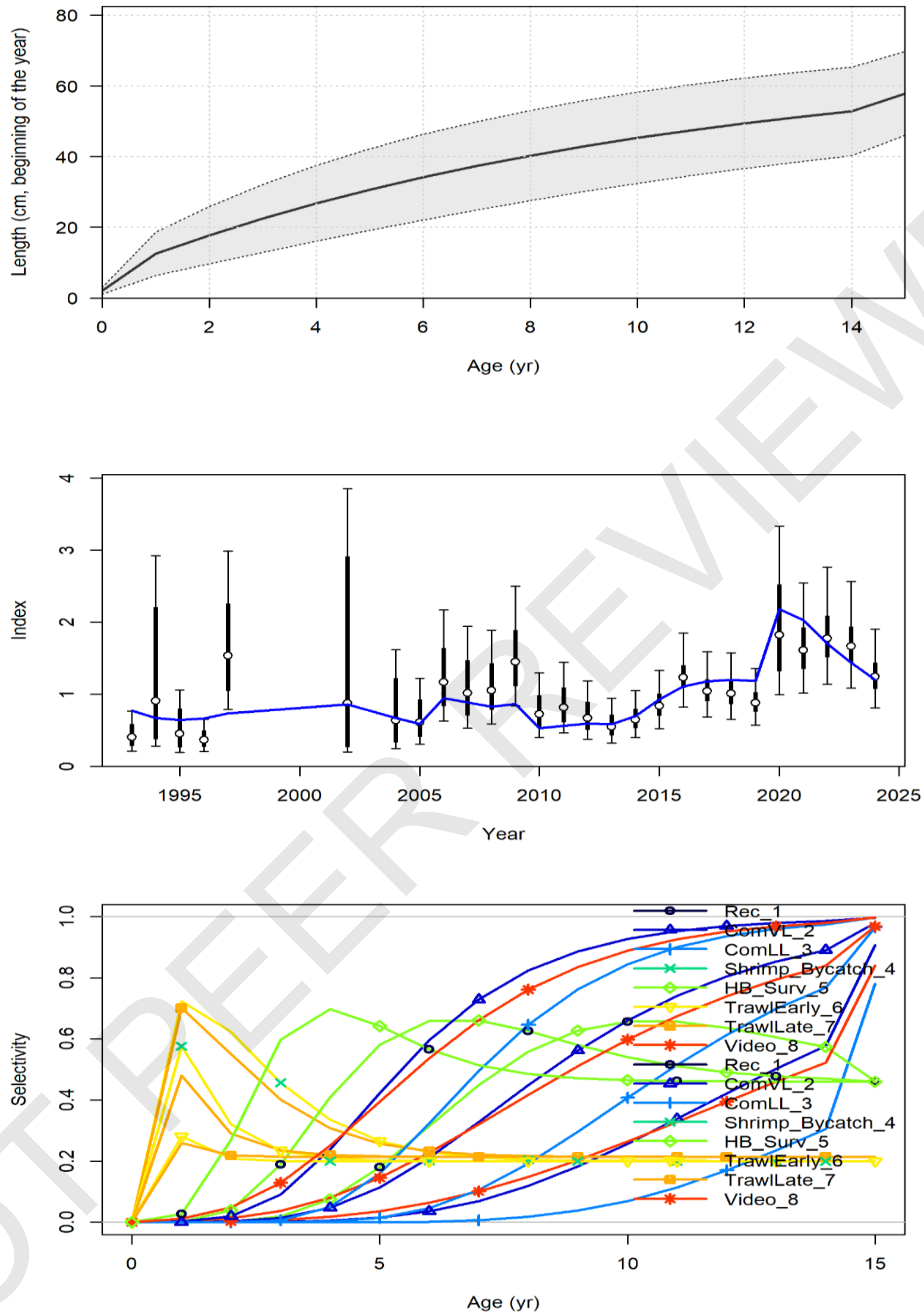


Figure 109. Estimated growth curve with uncertainty (top panel), expected fit to the Combined Video Surveyindex (middle panel), and the derived age-based selectivity patterns for the three platoons for each fishing fleet and survey.

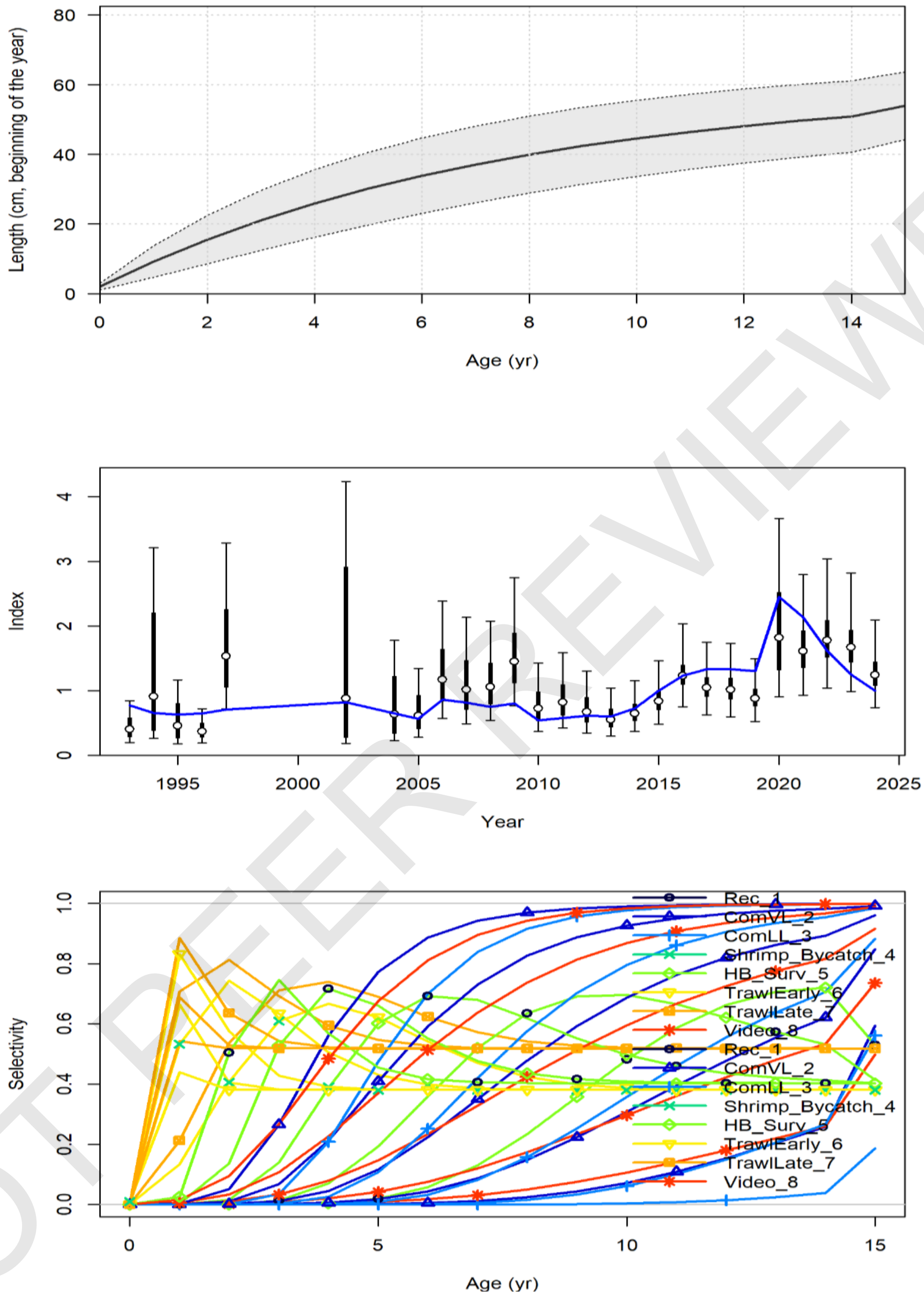


Figure 110. Estimated growth curve with uncertainty (top panel), expected fit to the Combined Video Surveyindex (middle panel), and the derived age-based selectivity patterns for the five platoons for each fishing fleet and survey.

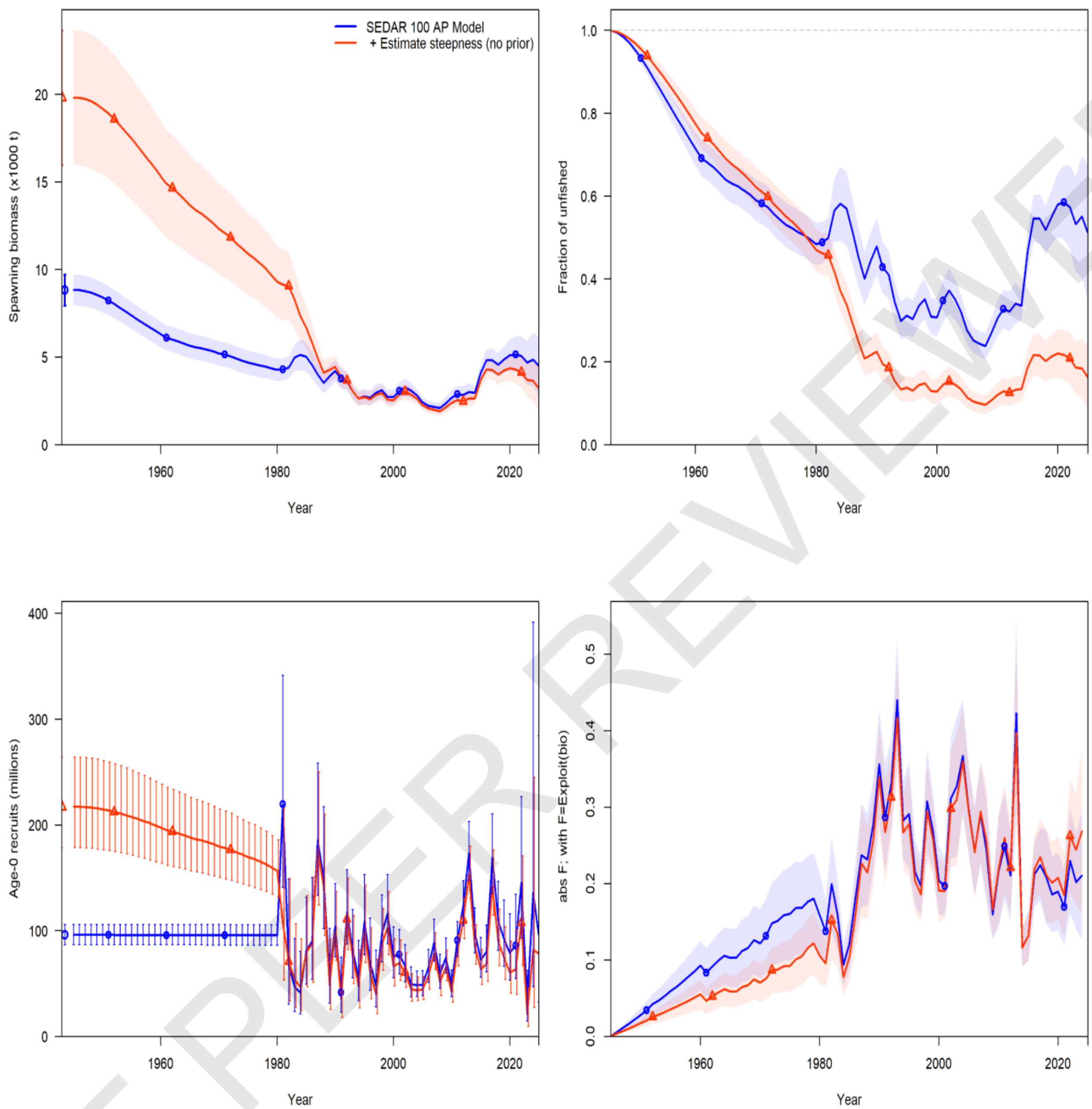


Figure 111. Estimates of spawning stock biomass (SSB in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed all ages / total biomass age 1+; bottom right panel) for the sensitivity run exploring estimation of steepness for the SEDAR 100 AP Model.

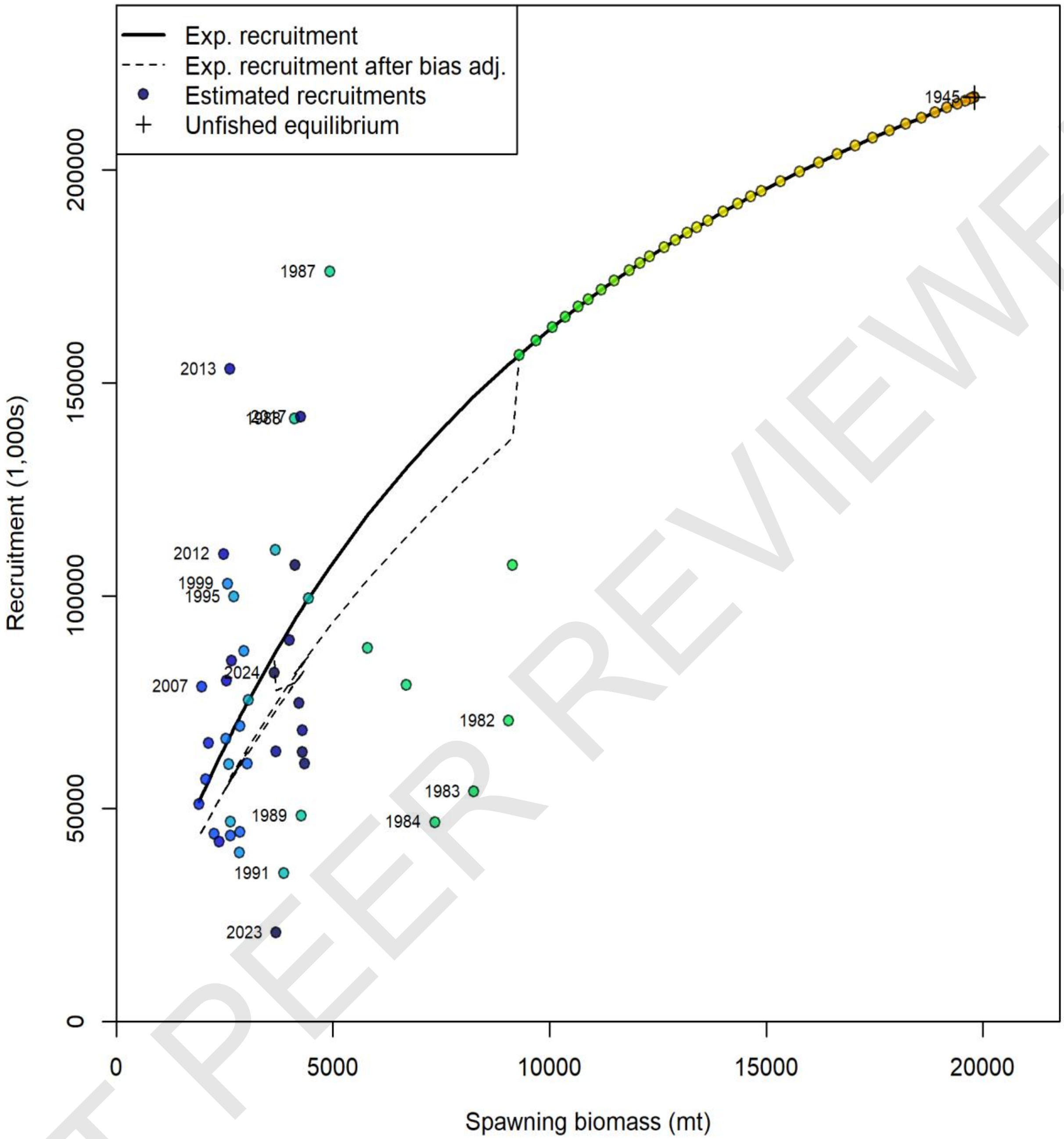


Figure 112. Predicted stock-recruit relationship for the sensitivity run exploring estimation of steepness without a prior. Plotted are predicted annual recruitments from Stock Synthesis (circles), expected recruitment from the stock-recruit relationship (black line), and bias adjusted recruitment from the stock-recruit relationship (dashed line).

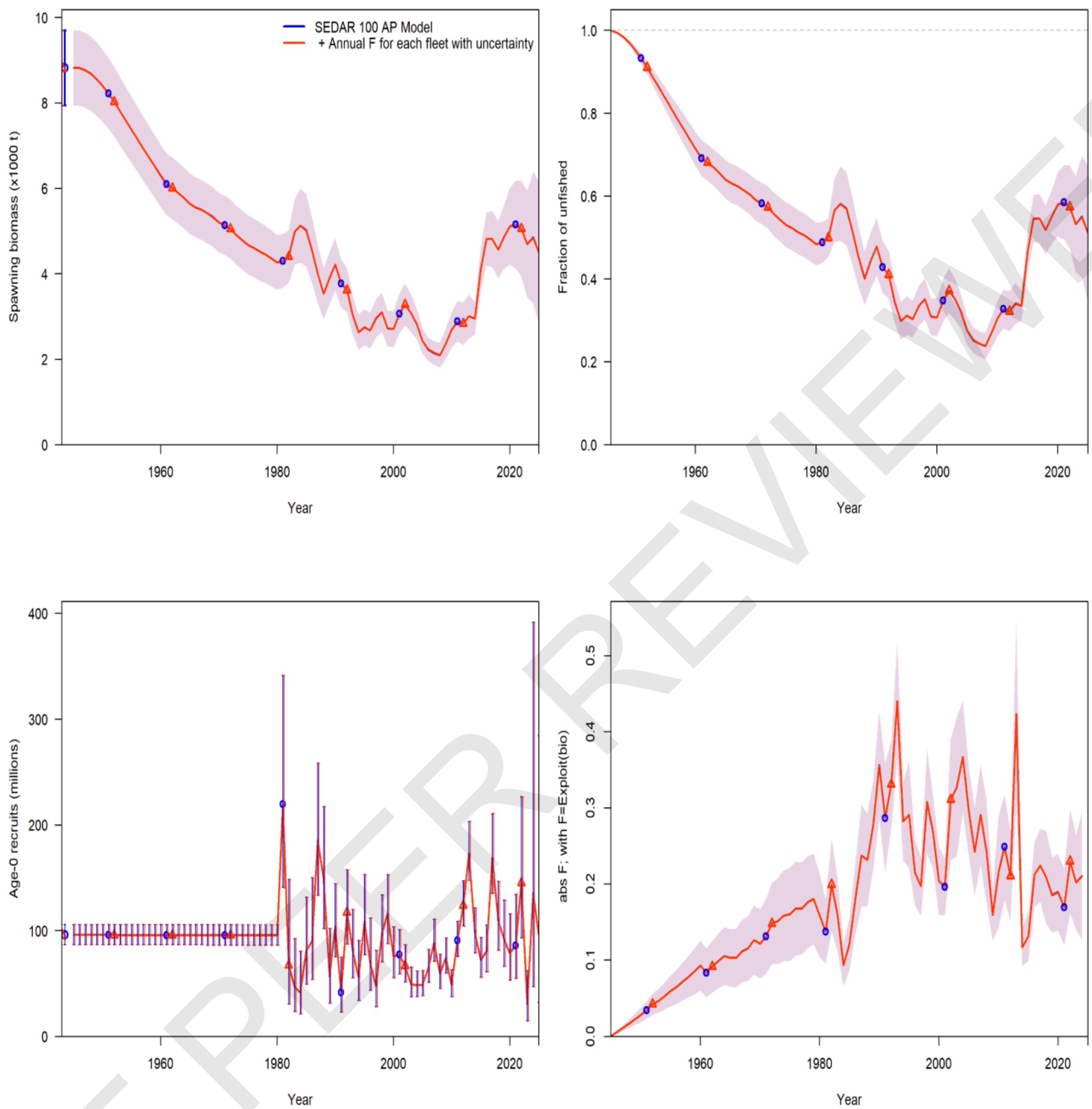


Figure 113. Estimates of spawning stock biomass (SSB in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed all ages / total biomass age 1+; bottom right panel) for the sensitivity run exploring the estimation of annual Fs with landings uncertainty for the SEDAR 100 AP Model.

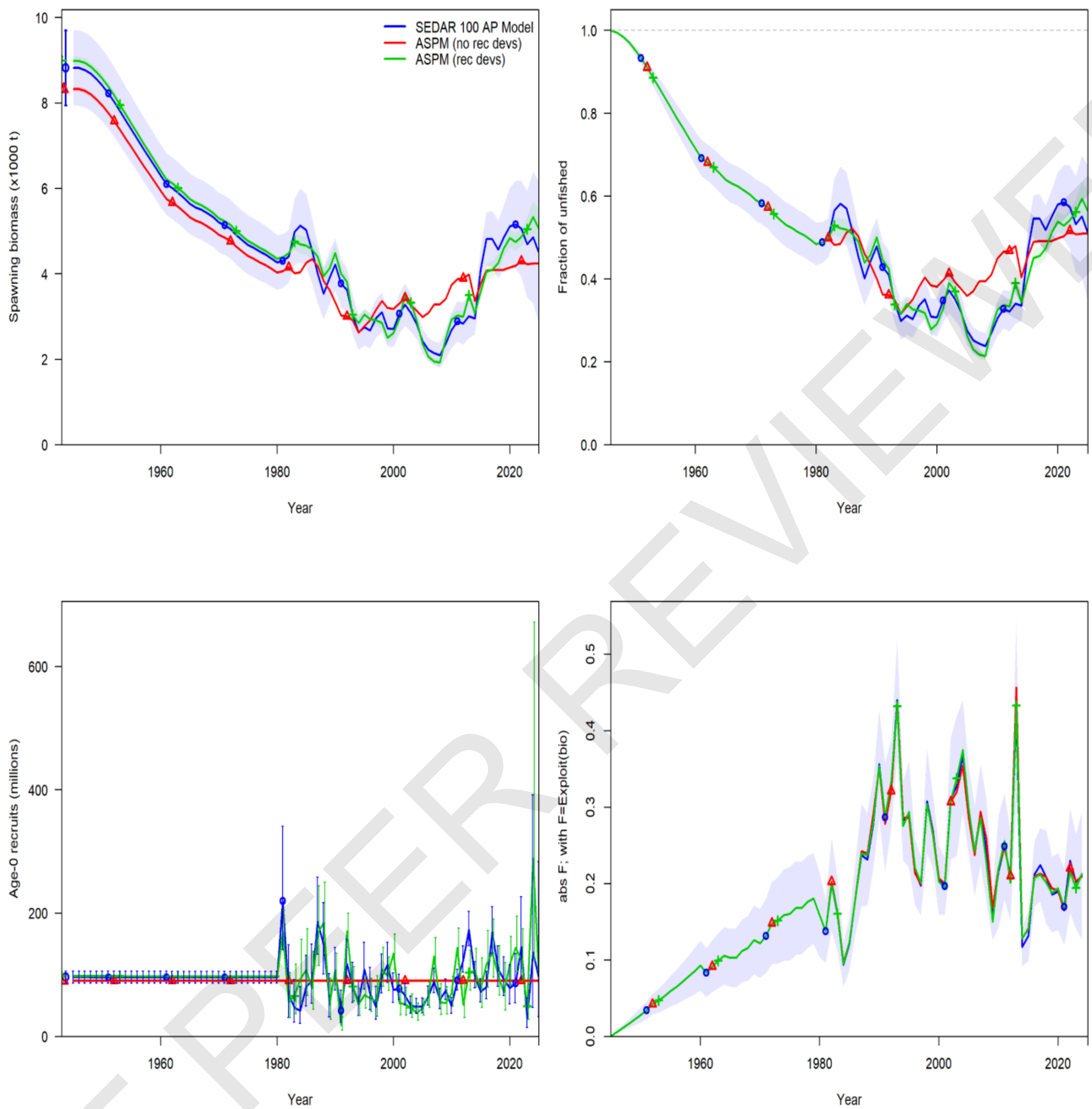


Figure 114. Estimates of spawning stock biomass (SSB in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed all ages / total biomass age 1+; bottom right panel) for the sensitivity runs exploring simpler age-structured production models for the SEDAR 100 AP Model.

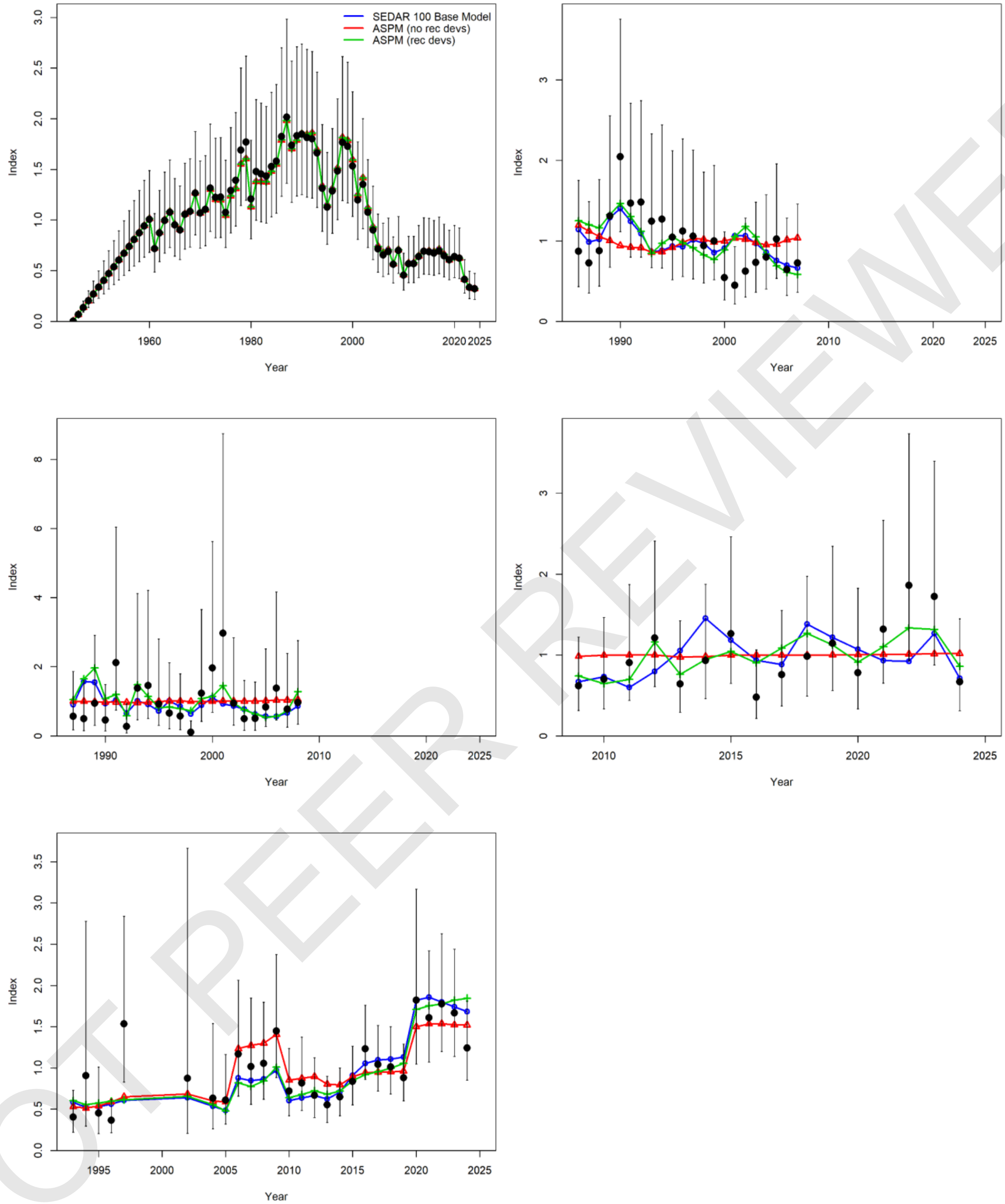


Figure 115. Comparison of fits to the indices of abundance for the sensitivity runs exploring simpler age-structured production models for the SEDAR 100 AP Model.

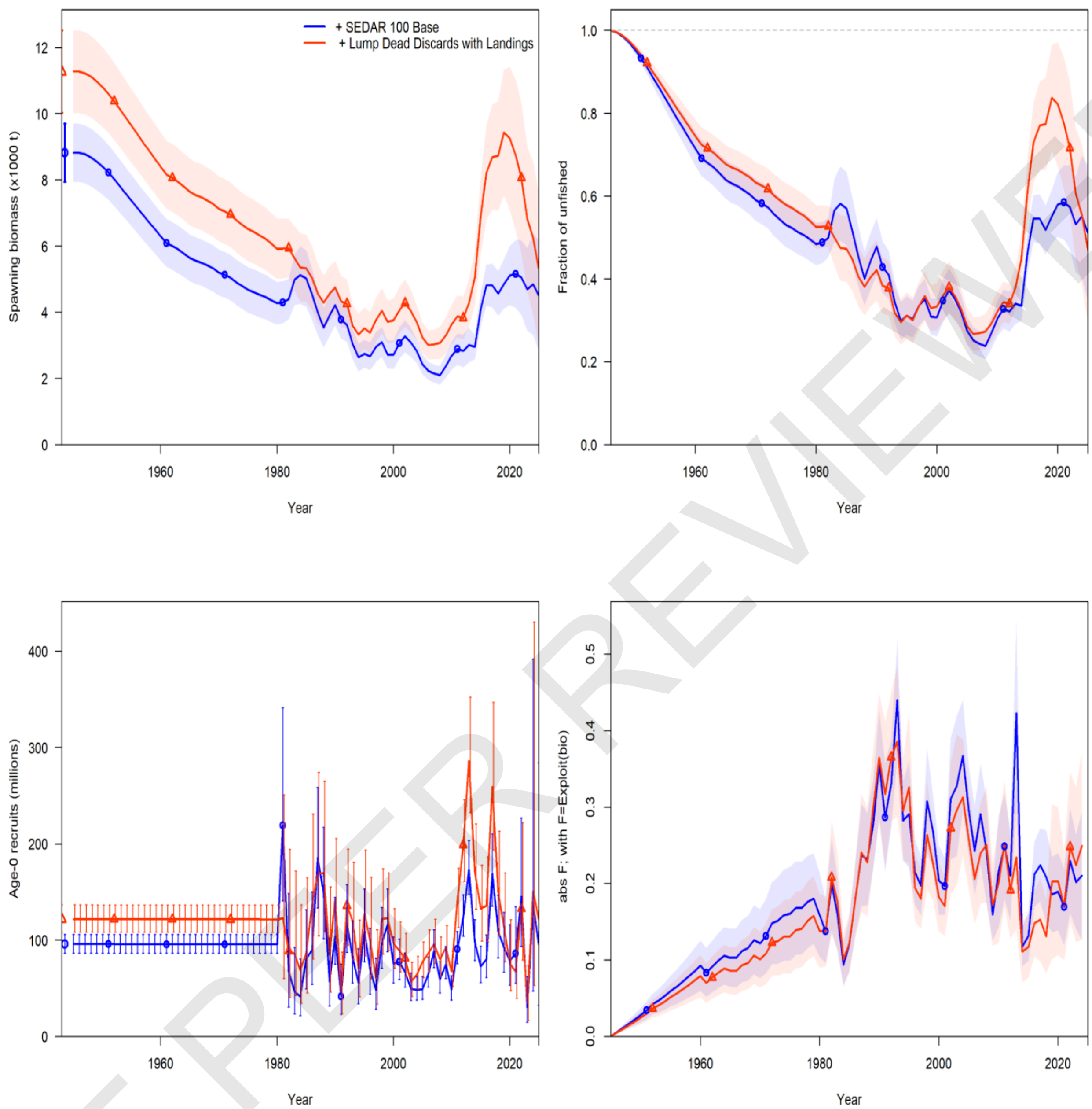


Figure 116. Estimates of spawning stock biomass (SSB in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed all ages / total biomass age 1+; bottom right panel) for the sensitivity run combining dead discards with landings for the SEDAR 100 AP Model.

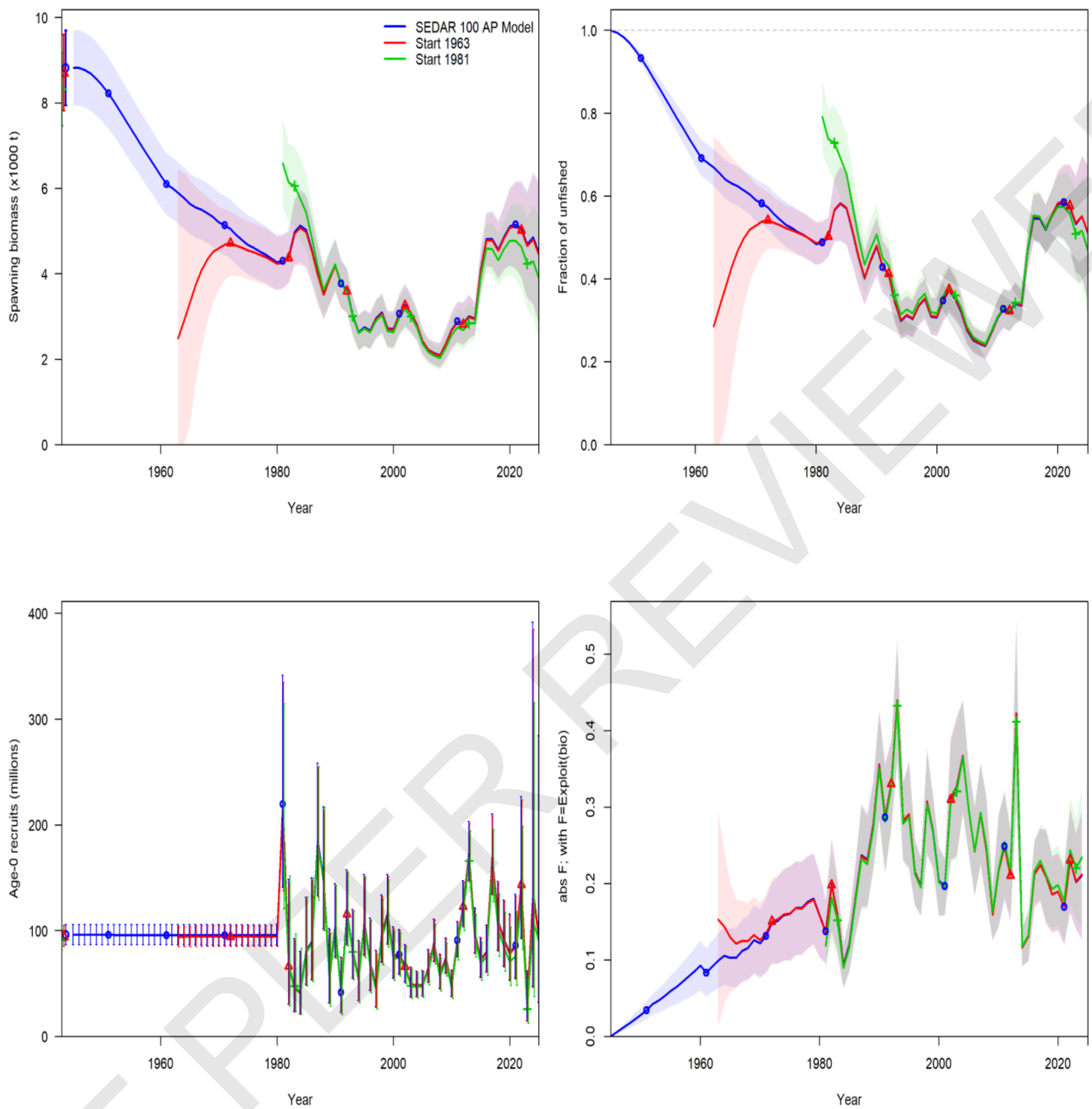


Figure 117. Estimates of spawning stock biomass (SSB in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed all ages / total biomass age 1+; bottom right panel) for the sensitivity runs exploring different start years for the SEDAR 100 AP Model.

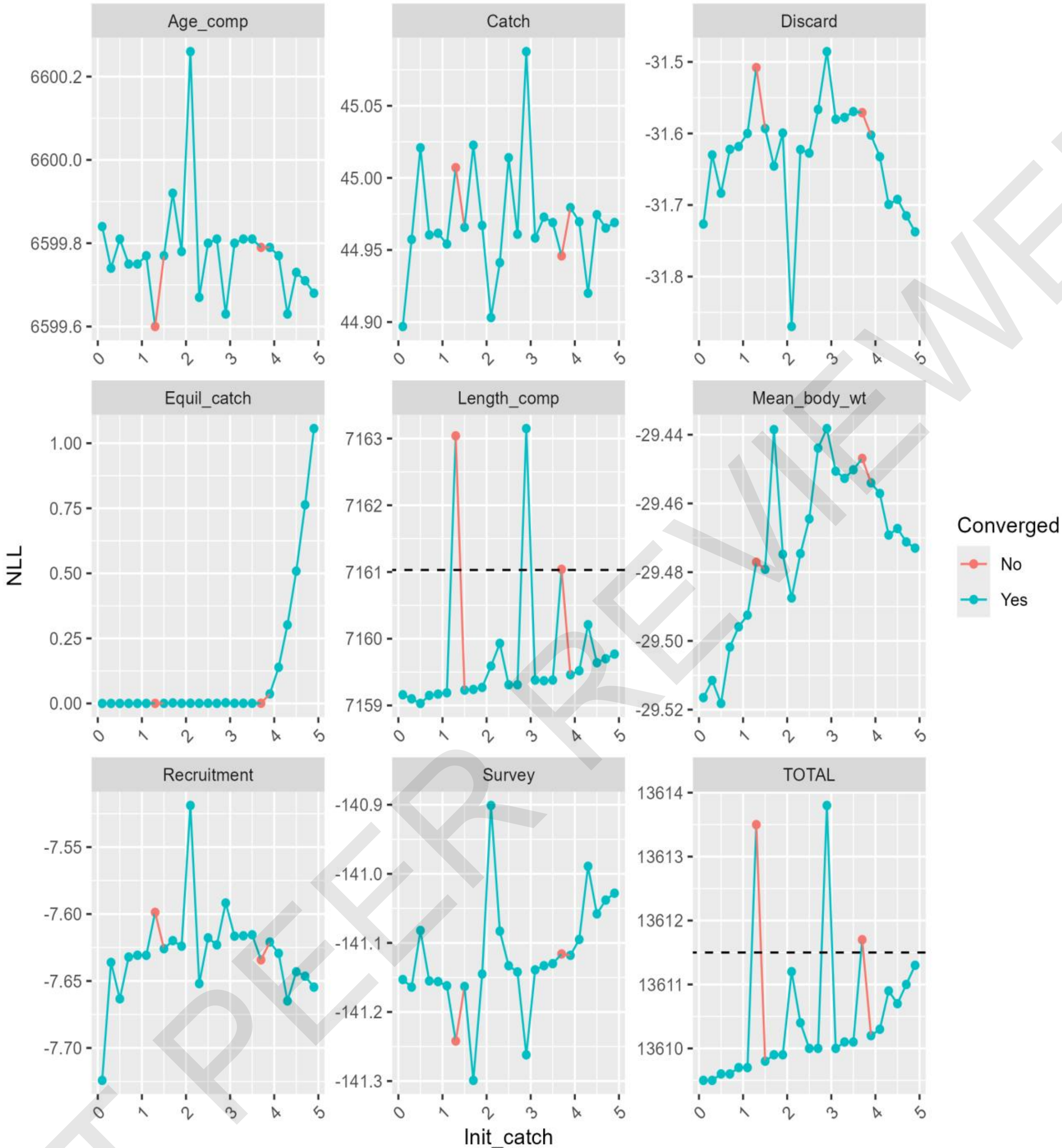


Figure 118. Likelihood profile for the scalar value search for the sensitivity run starting in 1963. Points that fall below the dashed lines are within 2 likelihood units of the minimum. If no dashed line is shown, the y-axis does not range more than 2 likelihood units.

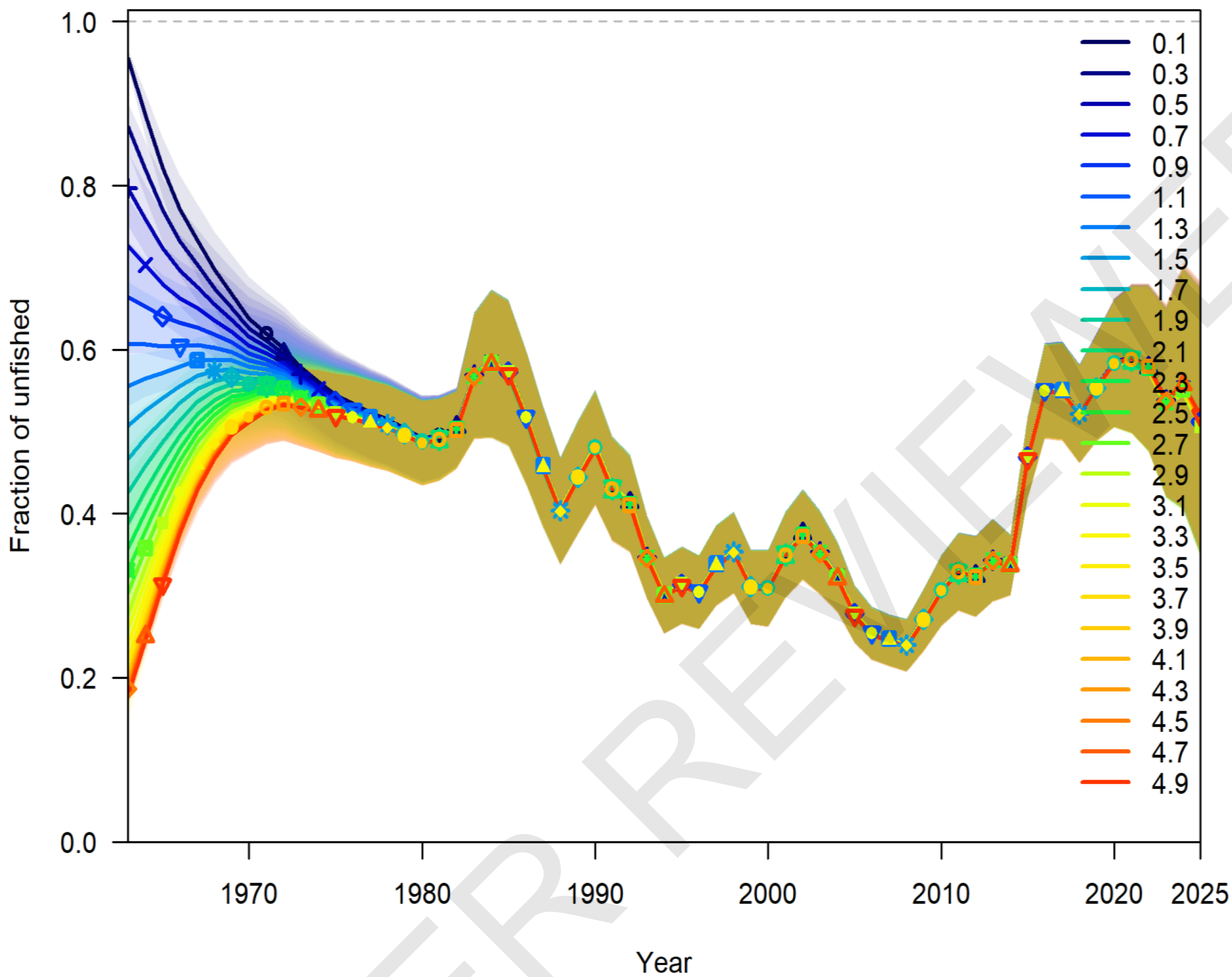


Figure 119. Estimates of the ratio of SSB to virgin SSB for the sensitivity run starting in 1963 and additional runs exploring initial conditions (across scalar values) for the SEDAR 100 AP Model.

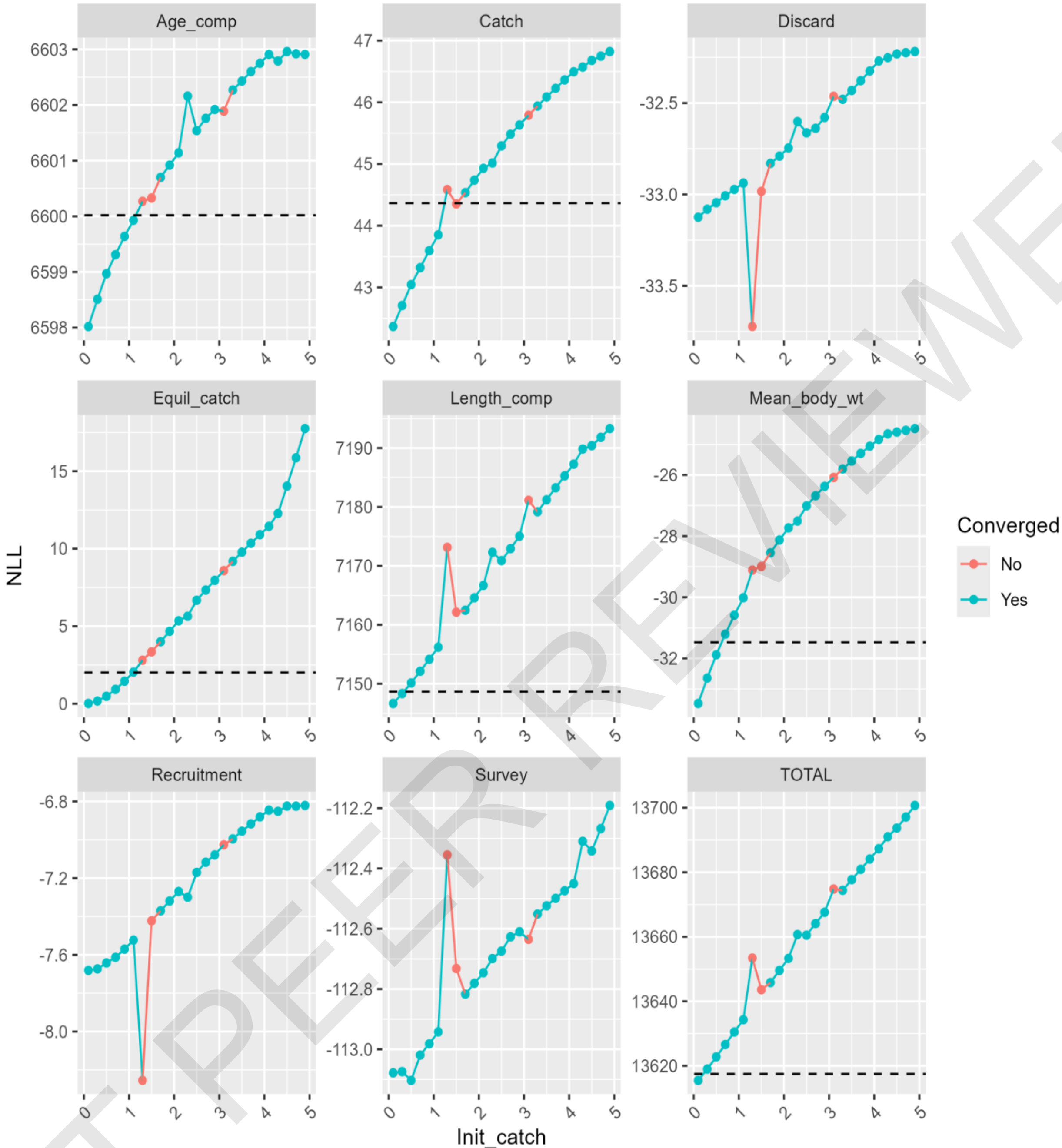


Figure 120. Likelihood profile for the scalar value search for the sensitivity run starting in 1981. Points that fall below the dashed lines are within 2 likelihood units of the minimum. If no dashed line is shown, the y-axis does not range more than 2 likelihood units.

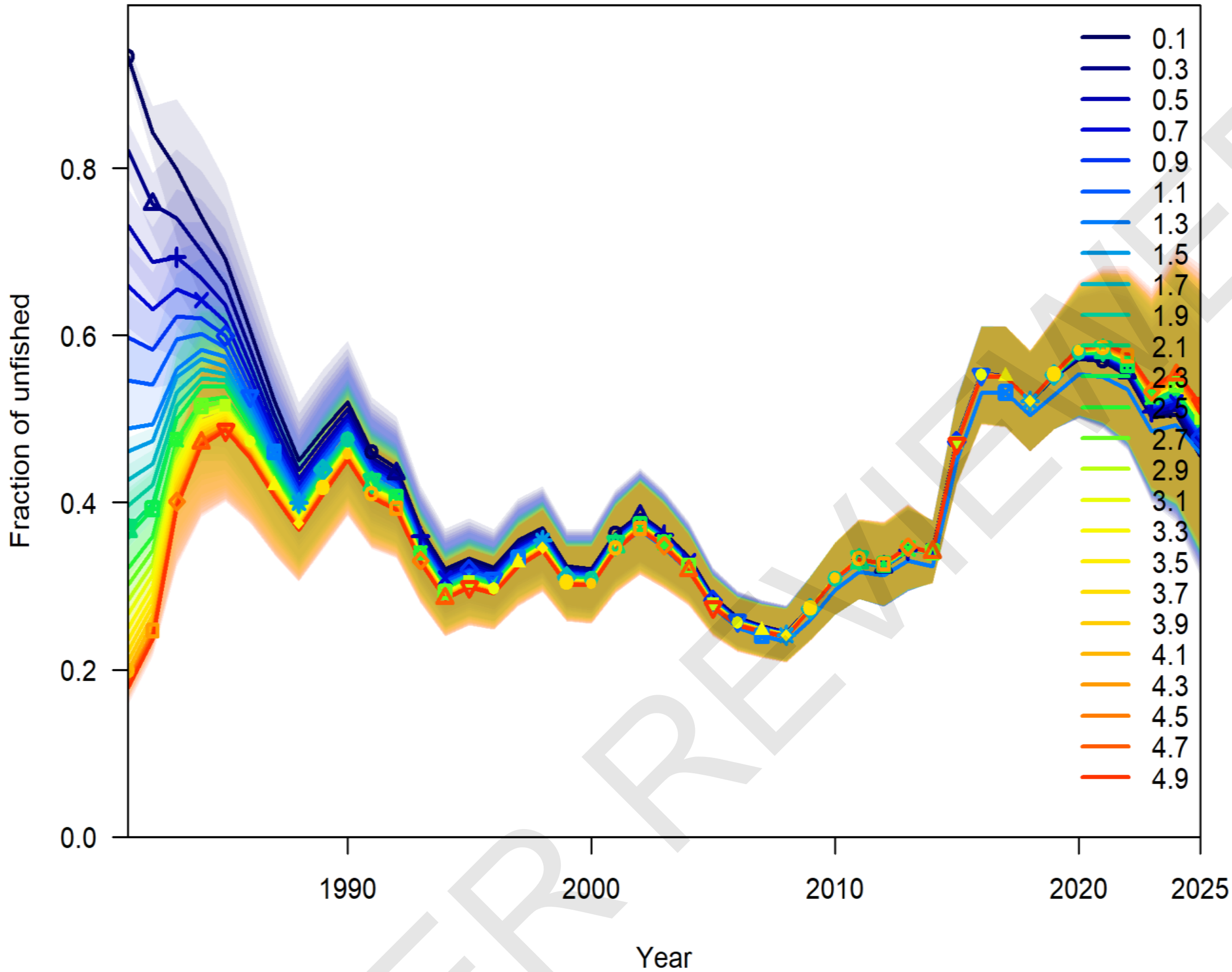


Figure 121. Estimates of the ratio of SSB to virgin SSB for the sensitivity run starting in 1981 and additional runs exploring initial conditions (across scalar values) for the SEDAR 100 AP Model.

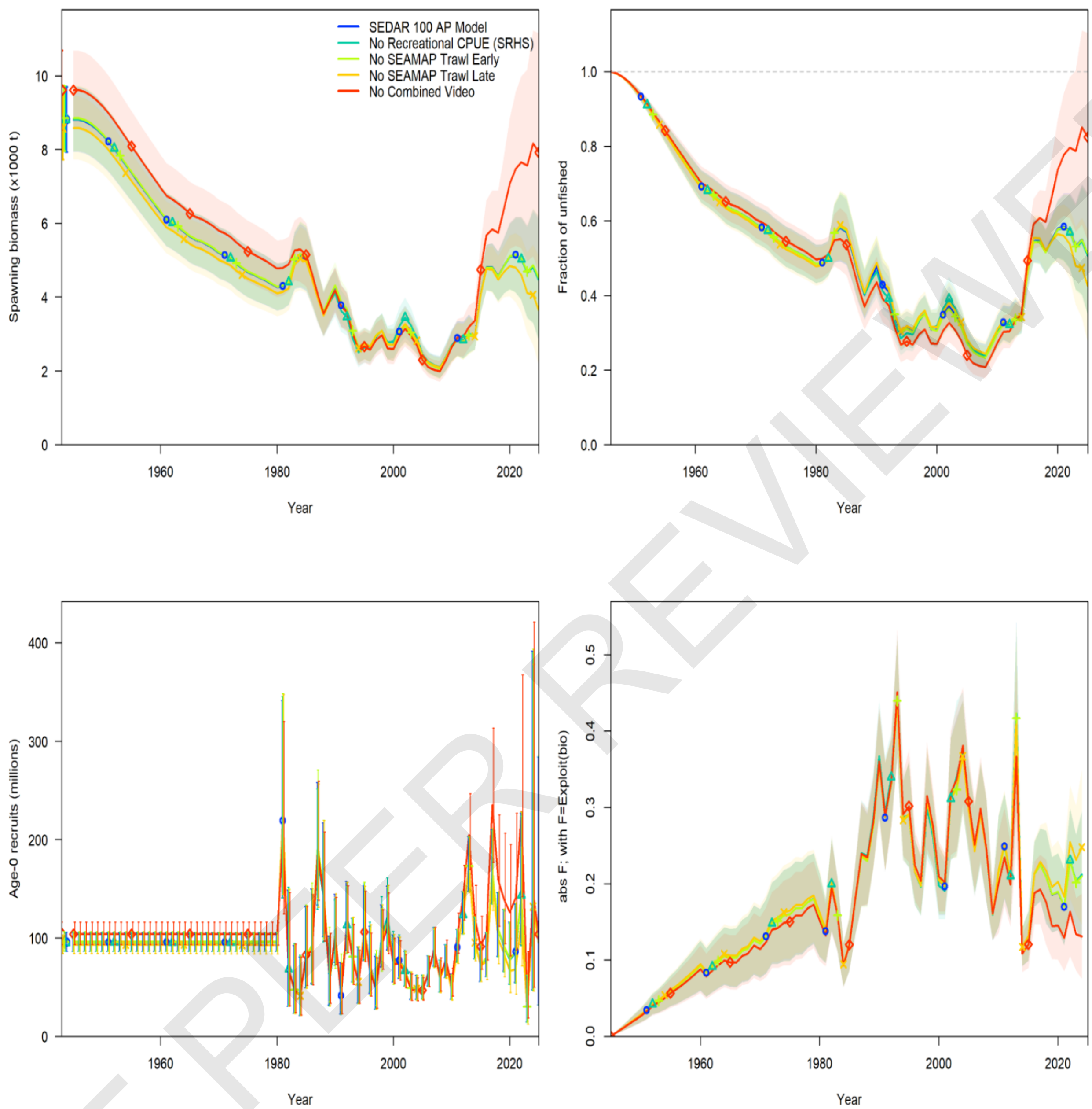


Figure 122. Estimates of spawning stock biomass (SSB in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed all ages / total biomass age 1+; bottom right panel) for the sensitivity runs removing each index of abundance for the SEDAR 100 AP Model.

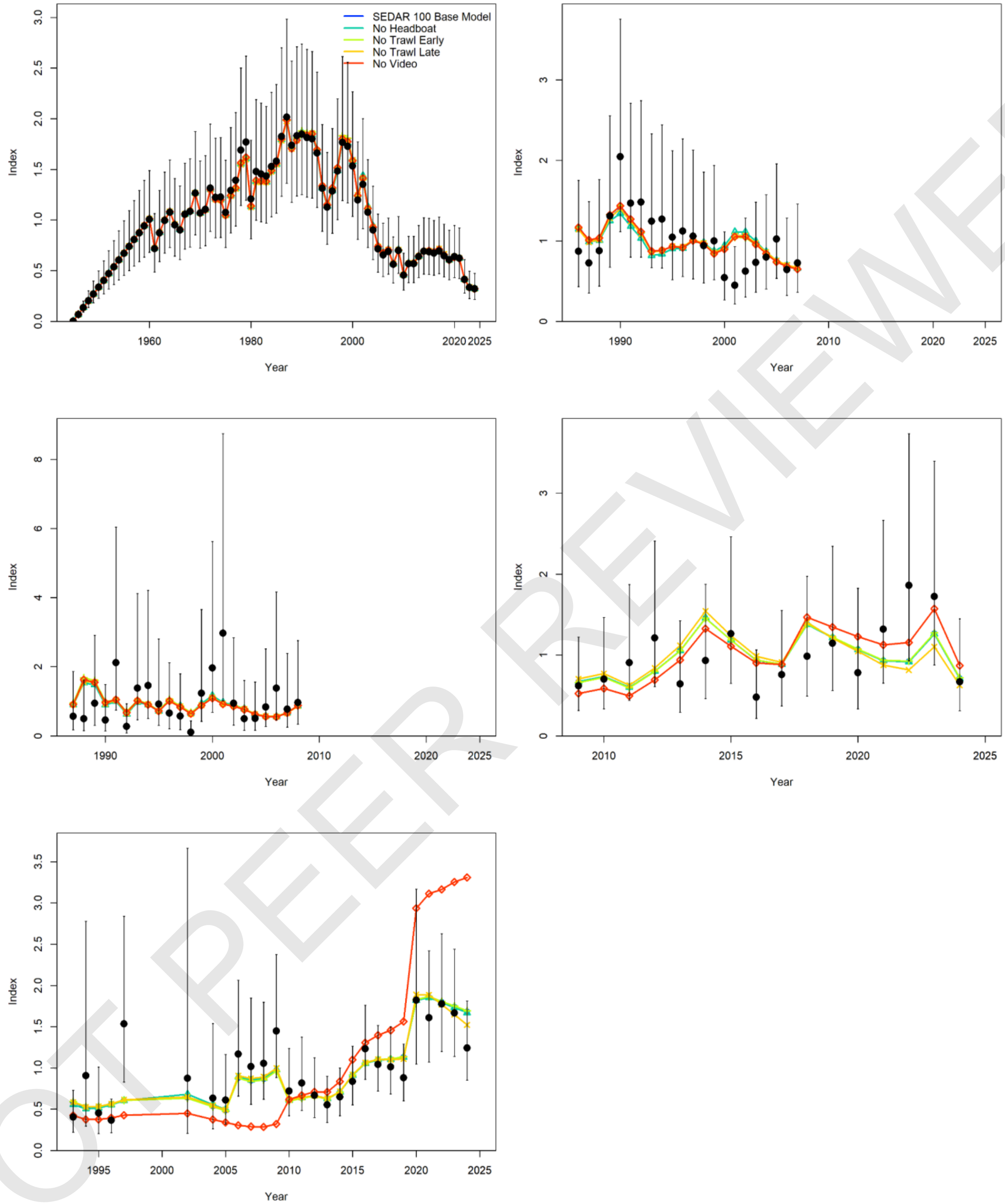


Figure 123. Comparison of fits to the indices of abundance for the sensitivity runs removing each index of abundance for the SEDAR 100 AP Model.

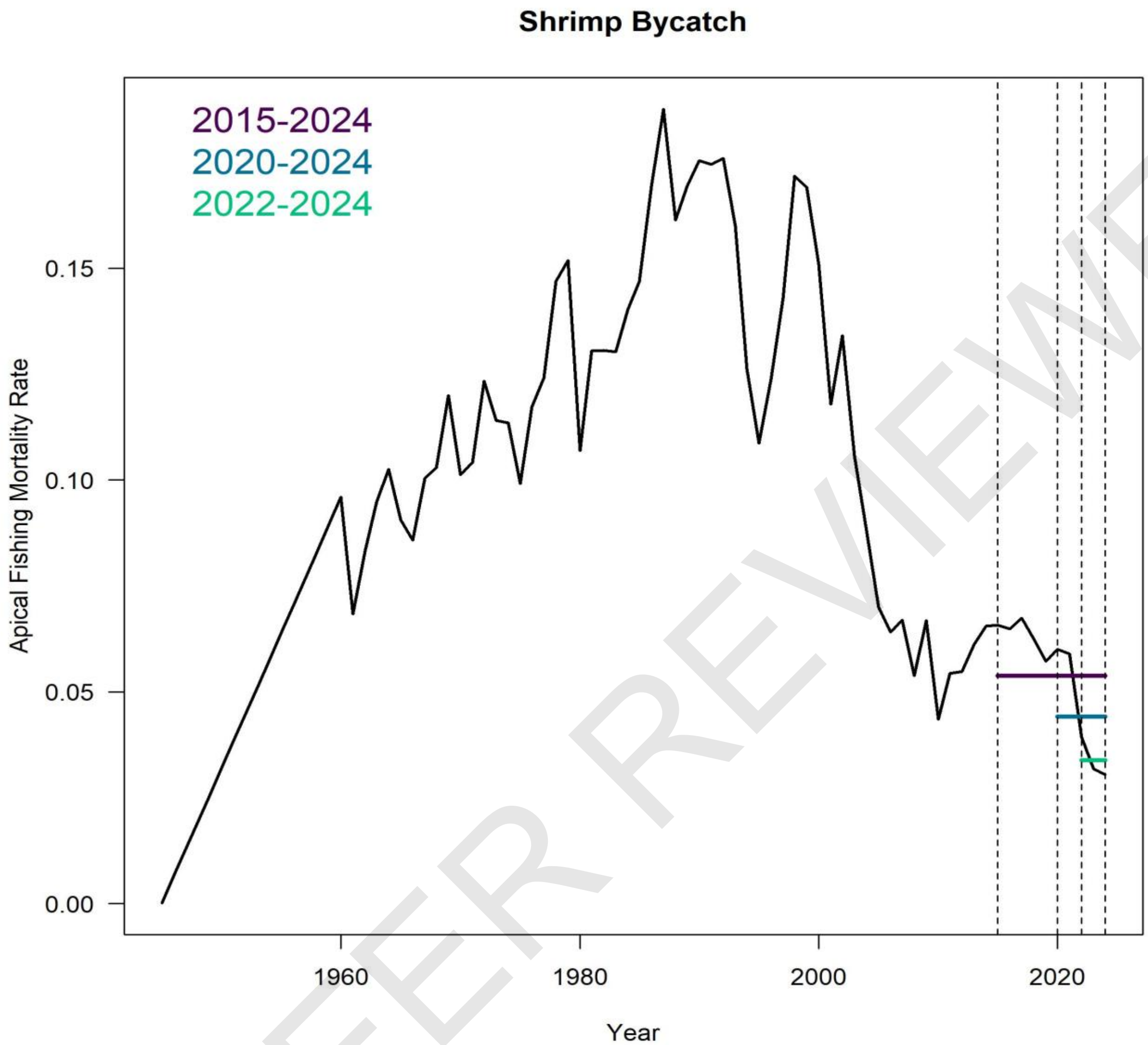


Figure 124. Time series of apical fishing mortality rate for the Shrimp Bycatch fleet. 3, 5 and 10 year averages are shown. The 3-year average was used in projections.

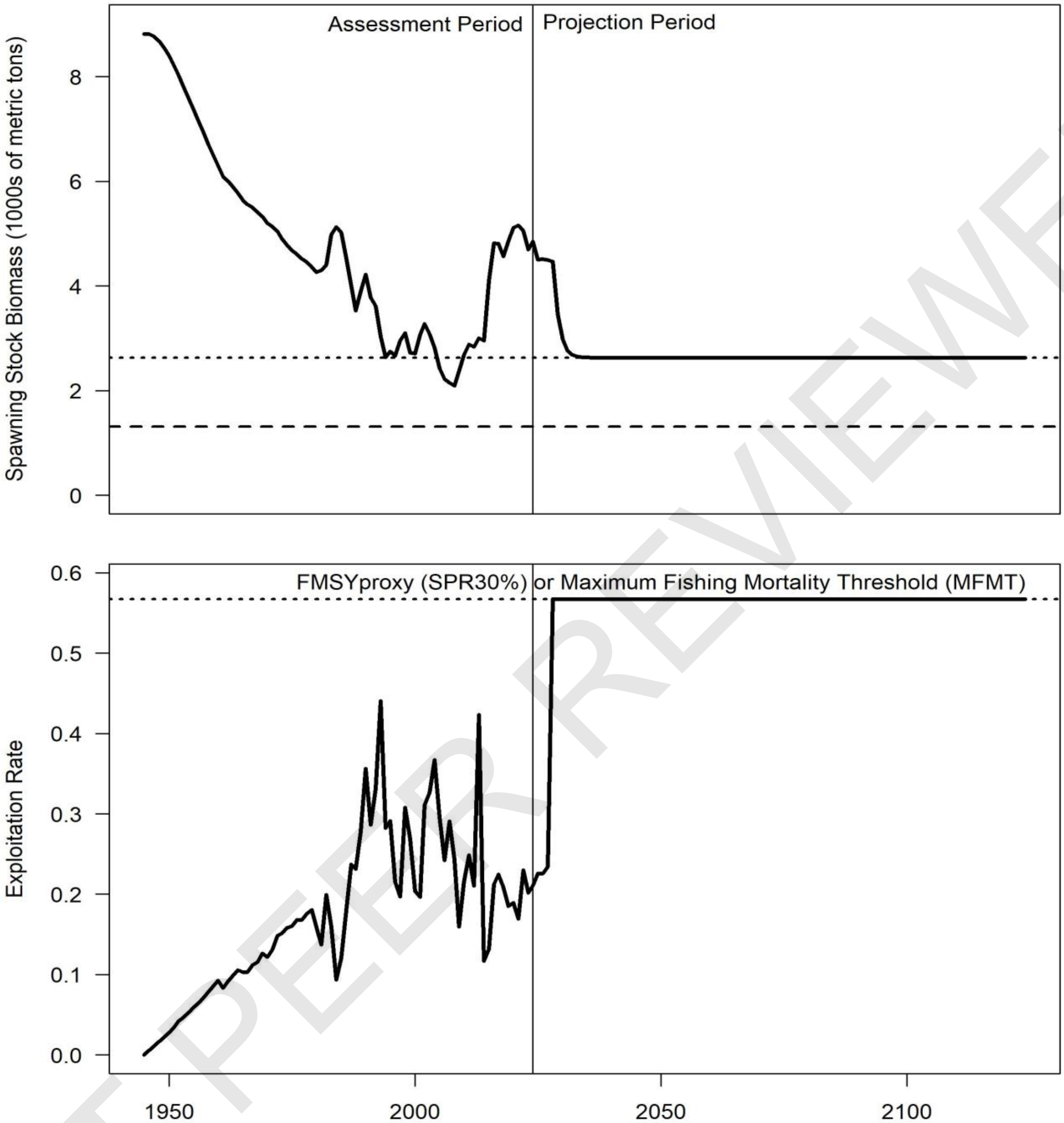


*Figure 125. Time series of SSB (1,000s of SSB) and exploitation rate (total biomass killed all ages / total biomass age 1+) with respect to status determination criteria with mean recruitment (i.e., steepness fixed at 0.99) throughout the projection period. An SPR proxy of 30% was specified in the SEDAR 100 AP Terms of Reference (**Section 1.2**).*

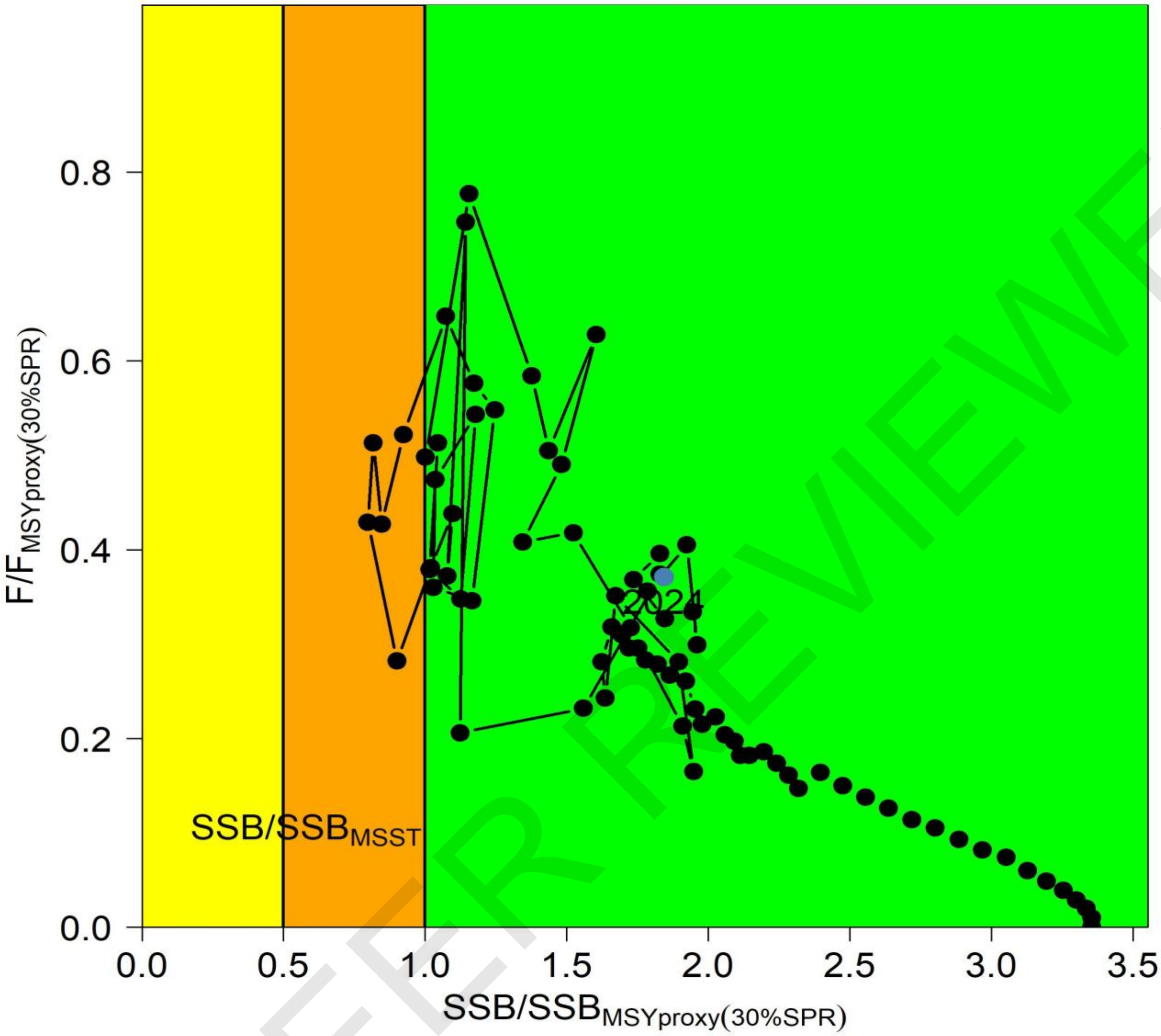


*Figure 126. Kobe plot illustrating the trajectory of stock status with mean recruitment (i.e., steepness fixed at 0.99) throughout the projection period. The orange coloring indicates regions where the stock is below the biomass target but above the biomass threshold (MSST = 0.5 x SSB$_{30\%SPR}$). The 2024 terminal year stock status is indicated by the gray dot. See **Table 42** for values. SSB is in metric tons. An SPR proxy of 30% was specified in the SEDAR 100 AP Terms of Reference (**Section 1.2**).*

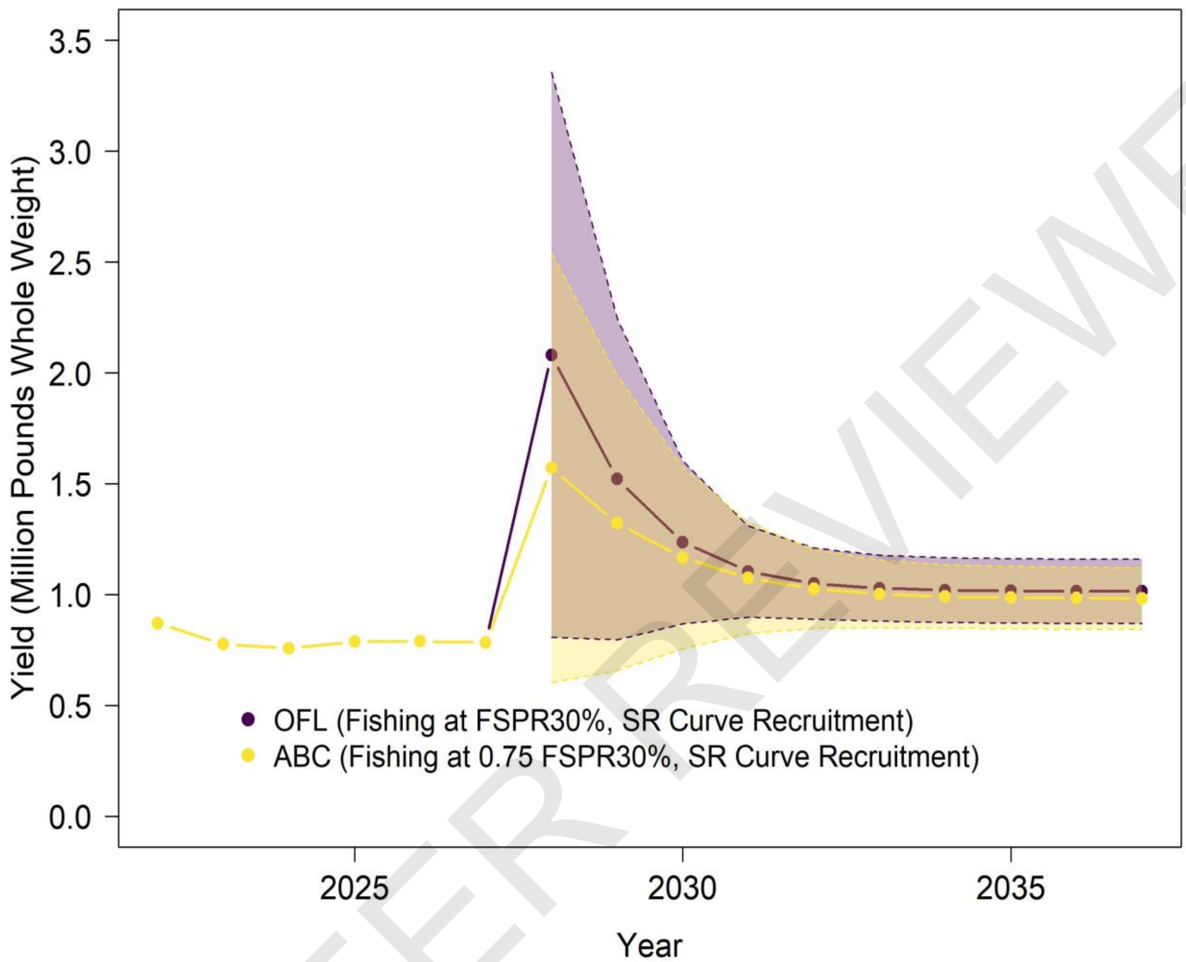


*Figure 127. Historic (2022-2024), interim (2025-2027) and forecasted yields (2028+) for the OFL (fishing set at $F_{30\%SPR}$) and ABC (directed F = 0.75 x Directed F at $F_{30\%SPR}$ (0.567)) projections assuming mean recruitment (i.e., steepness fixed at 0.99) throughout the projection period. An SPR proxy of 30% was specified in the SEDAR 100 AP Terms of Reference (**Section 1.2**).*

12. Appendix

Table A1. Annual fishing mortality parameters estimated by Stock Synthesis. The list includes expected parameter values, lower and upper bounds of the parameters, associated standard deviations (SD) and coefficients of variation (CV), prior type and densities (value, SD) if applicable, and phases.

Label	Value	Range	SD	CV	Prior	Phase
F_fleet_1_YR_1945_s_1	2.63e-04	(0,4)	7.35e-05	0.280		1
F_fleet_1_YR_1946_s_1	0.005	(0,4)	0.001	0.280		1
F_fleet_1_YR_1947_s_1	0.010	(0,4)	0.003	0.280		1
F_fleet_1_YR_1948_s_1	0.015	(0,4)	0.004	0.281		1
F_fleet_1_YR_1949_s_1	0.021	(0,4)	0.006	0.281		1
F_fleet_1_YR_1950_s_1	0.026	(0,4)	0.007	0.281		1
F_fleet_1_YR_1951_s_1	0.032	(0,4)	0.009	0.282		1
F_fleet_1_YR_1952_s_1	0.038	(0,4)	0.011	0.282		1
F_fleet_1_YR_1953_s_1	0.045	(0,4)	0.013	0.282		1
F_fleet_1_YR_1954_s_1	0.051	(0,4)	0.015	0.283		1
F_fleet_1_YR_1955_s_1	0.058	(0,4)	0.017	0.283		1
F_fleet_1_YR_1956_s_1	0.066	(0,4)	0.019	0.284		1
F_fleet_1_YR_1957_s_1	0.074	(0,4)	0.021	0.284		1
F_fleet_1_YR_1958_s_1	0.083	(0,4)	0.024	0.285		1
F_fleet_1_YR_1959_s_1	0.092	(0,4)	0.026	0.286		1
F_fleet_1_YR_1960_s_1	0.101	(0,4)	0.029	0.286		1
F_fleet_1_YR_1961_s_1	0.106	(0,4)	0.030	0.287		1
F_fleet_1_YR_1962_s_1	0.110	(0,4)	0.031	0.287		1
F_fleet_1_YR_1963_s_1	0.114	(0,4)	0.033	0.287		1
F_fleet_1_YR_1964_s_1	0.119	(0,4)	0.034	0.287		1
F_fleet_1_YR_1965_s_1	0.123	(0,4)	0.036	0.288		1
F_fleet_1_YR_1966_s_1	0.128	(0,4)	0.037	0.288		1
F_fleet_1_YR_1967_s_1	0.133	(0,4)	0.038	0.288		1
F_fleet_1_YR_1968_s_1	0.139	(0,4)	0.040	0.288		1
F_fleet_1_YR_1969_s_1	0.145	(0,4)	0.042	0.289		1
F_fleet_1_YR_1970_s_1	0.151	(0,4)	0.044	0.289		1
F_fleet_1_YR_1971_s_1	0.166	(0,4)	0.048	0.289		1
F_fleet_1_YR_1972_s_1	0.181	(0,4)	0.052	0.289		1

Table A1 Continued. Annual fishing mortality parameters estimated by Stock Synthesis. The list includes expected parameter values, lower and upper bounds of the parameters, associated standard deviations (SD) and coefficients of variation (CV), prior type and densities (value, SD) if applicable, and phases.

Label	Value	Range	SD	CV	Prior	Phase
F_fleet_1_YR_1973_s_1	0.198	(0,4)	0.057	0.289		1
F_fleet_1_YR_1974_s_1	0.212	(0,4)	0.061	0.289		1
F_fleet_1_YR_1975_s_1	0.225	(0,4)	0.065	0.287		1
F_fleet_1_YR_1976_s_1	0.223	(0,4)	0.063	0.285		1
F_fleet_1_YR_1977_s_1	0.220	(0,4)	0.062	0.282		1
F_fleet_1_YR_1978_s_1	0.216	(0,4)	0.060	0.278		1
F_fleet_1_YR_1979_s_1	0.213	(0,4)	0.058	0.274		1
F_fleet_1_YR_1980_s_1	0.208	(0,4)	0.056	0.270		1
F_fleet_1_YR_1981_s_1	0.141	(0,4)	0.036	0.253		1
F_fleet_1_YR_1982_s_1	0.283	(0,4)	0.068	0.241		1
F_fleet_1_YR_1983_s_1	0.197	(0,4)	0.047	0.238		1
F_fleet_1_YR_1984_s_1	0.051	(0,4)	0.013	0.257		1
F_fleet_1_YR_1985_s_1	0.097	(0,4)	0.024	0.243		1
F_fleet_1_YR_1986_s_1	0.199	(0,4)	0.041	0.204		1
F_fleet_1_YR_1987_s_1	0.317	(0,4)	0.075	0.237		1
F_fleet_1_YR_1988_s_1	0.315	(0,4)	0.070	0.221		1
F_fleet_1_YR_1989_s_1	0.401	(0,4)	0.067	0.166		1
F_fleet_1_YR_1990_s_1	0.519	(0,4)	0.081	0.156		1
F_fleet_1_YR_1991_s_1	0.338	(0,4)	0.075	0.221		1
F_fleet_1_YR_1992_s_1	0.432	(0,4)	0.060	0.138		1
F_fleet_1_YR_1993_s_1	0.711	(0,4)	0.101	0.143		1
F_fleet_1_YR_1994_s_1	0.379	(0,4)	0.055	0.144		1
F_fleet_1_YR_1995_s_1	0.415	(0,4)	0.079	0.190		1
F_fleet_1_YR_1996_s_1	0.252	(0,4)	0.039	0.156		1
F_fleet_1_YR_1997_s_1	0.223	(0,4)	0.031	0.137		1
F_fleet_1_YR_1998_s_1	0.442	(0,4)	0.075	0.171		1
F_fleet_1_YR_1999_s_1	0.338	(0,4)	0.043	0.127		1
F_fleet_1_YR_2000_s_1	0.238	(0,4)	0.040	0.167		1
F_fleet_1_YR_2001_s_1	0.253	(0,4)	0.034	0.133		1

Table A1 Continued. Annual fishing mortality parameters estimated by Stock Synthesis. The list includes expected parameter values, lower and upper bounds of the parameters, associated standard deviations (SD) and coefficients of variation (CV), prior type and densities (value, SD) if applicable, and phases.

Label	Value	Range	SD	CV	Prior	Phase
F_fleet_1_YR_2002_s_1	0.476	(0,4)	0.093	0.196		1
F_fleet_1_YR_2003_s_1	0.530	(0,4)	0.111	0.209		1
F_fleet_1_YR_2004_s_1	0.642	(0,4)	0.091	0.142		1
F_fleet_1_YR_2005_s_1	0.503	(0,4)	0.067	0.134		1
F_fleet_1_YR_2006_s_1	0.407	(0,4)	0.066	0.161		1
F_fleet_1_YR_2007_s_1	0.532	(0,4)	0.080	0.151		1
F_fleet_1_YR_2008_s_1	0.621	(0,4)	0.115	0.185		1
F_fleet_1_YR_2009_s_1	0.501	(0,4)	0.075	0.150		1
F_fleet_1_YR_2010_s_1	0.787	(0,4)	0.170	0.216		1
F_fleet_1_YR_2011_s_1	0.850	(0,4)	0.155	0.183		1
F_fleet_1_YR_2012_s_1	0.873	(0,4)	0.165	0.189		1
F_fleet_1_YR_2013_s_1	2.388	(0,4)	0.445	0.186		1
F_fleet_1_YR_2014_s_1	0.449	(0,4)	0.065	0.144		1
F_fleet_1_YR_2015_s_1	0.513	(0,4)	0.090	0.175		1
F_fleet_1_YR_2016_s_1	0.865	(0,4)	0.114	0.131		1
F_fleet_1_YR_2017_s_1	0.882	(0,4)	0.122	0.138		1
F_fleet_1_YR_2018_s_1	0.924	(0,4)	0.179	0.194		1
F_fleet_1_YR_2019_s_1	0.855	(0,4)	0.148	0.173		1
F_fleet_1_YR_2020_s_1	0.835	(0,4)	0.144	0.172		1
F_fleet_1_YR_2021_s_1	0.696	(0,4)	0.133	0.191		1
F_fleet_1_YR_2022_s_1	1.055	(0,4)	0.190	0.181		1
F_fleet_1_YR_2023_s_1	0.975	(0,4)	0.177	0.182		1
F_fleet_1_YR_2024_s_1	1.012	(0,4)	0.243	0.240		1
F_fleet_4_YR_1945_s_1	1.05e-04	(0,4)	2.39e-05	0.228		1
F_fleet_4_YR_1946_s_1	0.006	(0,4)	0.001	0.225		1
F_fleet_4_YR_1947_s_1	0.013	(0,4)	0.003	0.225		1
F_fleet_4_YR_1948_s_1	0.019	(0,4)	0.004	0.225		1
F_fleet_4_YR_1949_s_1	0.026	(0,4)	0.006	0.225		1
F_fleet_4_YR_1950_s_1	0.032	(0,4)	0.007	0.225		1

Table A1 Continued. Annual fishing mortality parameters estimated by Stock Synthesis. The list includes expected parameter values, lower and upper bounds of the parameters, associated standard deviations (SD) and coefficients of variation (CV), prior type and densities (value, SD) if applicable, and phases.

Label	Value	Range	SD	CV	Prior	Phase
F_fleet_4_YR_1951_s_1	0.038	(0,4)	0.009	0.225		1
F_fleet_4_YR_1952_s_1	0.045	(0,4)	0.010	0.225		1
F_fleet_4_YR_1953_s_1	0.051	(0,4)	0.011	0.225		1
F_fleet_4_YR_1954_s_1	0.057	(0,4)	0.013	0.225		1
F_fleet_4_YR_1955_s_1	0.064	(0,4)	0.014	0.225		1
F_fleet_4_YR_1956_s_1	0.070	(0,4)	0.016	0.225		1
F_fleet_4_YR_1957_s_1	0.077	(0,4)	0.017	0.225		1
F_fleet_4_YR_1958_s_1	0.083	(0,4)	0.019	0.225		1
F_fleet_4_YR_1959_s_1	0.090	(0,4)	0.020	0.225		1
F_fleet_4_YR_1960_s_1	0.096	(0,4)	0.022	0.224		1
F_fleet_4_YR_1961_s_1	0.068	(0,4)	0.015	0.225		1
F_fleet_4_YR_1962_s_1	0.083	(0,4)	0.019	0.225		1
F_fleet_4_YR_1963_s_1	0.095	(0,4)	0.021	0.224		1
F_fleet_4_YR_1964_s_1	0.103	(0,4)	0.023	0.224		1
F_fleet_4_YR_1965_s_1	0.091	(0,4)	0.020	0.224		1
F_fleet_4_YR_1966_s_1	0.086	(0,4)	0.019	0.224		1
F_fleet_4_YR_1967_s_1	0.100	(0,4)	0.022	0.224		1
F_fleet_4_YR_1968_s_1	0.103	(0,4)	0.023	0.224		1
F_fleet_4_YR_1969_s_1	0.120	(0,4)	0.027	0.224		1
F_fleet_4_YR_1970_s_1	0.101	(0,4)	0.023	0.224		1
F_fleet_4_YR_1971_s_1	0.104	(0,4)	0.023	0.223		1
F_fleet_4_YR_1972_s_1	0.123	(0,4)	0.027	0.222		1
F_fleet_4_YR_1973_s_1	0.114	(0,4)	0.025	0.222		1
F_fleet_4_YR_1974_s_1	0.113	(0,4)	0.025	0.221		1
F_fleet_4_YR_1975_s_1	0.099	(0,4)	0.022	0.220		1
F_fleet_4_YR_1976_s_1	0.117	(0,4)	0.026	0.218		1
F_fleet_4_YR_1977_s_1	0.124	(0,4)	0.027	0.216		1
F_fleet_4_YR_1978_s_1	0.147	(0,4)	0.031	0.213		1
F_fleet_4_YR_1979_s_1	0.152	(0,4)	0.032	0.211		1

Table A1 Continued. Annual fishing mortality parameters estimated by Stock Synthesis. The list includes expected parameter values, lower and upper bounds of the parameters, associated standard deviations (SD) and coefficients of variation (CV), prior type and densities (value, SD) if applicable, and phases.

Label	Value	Range	SD	CV	Prior	Phase
F_fleet_4_YR_1980_s_1	0.107	(0,4)	0.023	0.215		1
F_fleet_4_YR_1981_s_1	0.130	(0,4)	0.028	0.214		1
F_fleet_4_YR_1982_s_1	0.131	(0,4)	0.028	0.214		1
F_fleet_4_YR_1983_s_1	0.130	(0,4)	0.028	0.217		1
F_fleet_4_YR_1984_s_1	0.140	(0,4)	0.031	0.218		1
F_fleet_4_YR_1985_s_1	0.147	(0,4)	0.032	0.220		1
F_fleet_4_YR_1986_s_1	0.169	(0,4)	0.037	0.219		1
F_fleet_4_YR_1987_s_1	0.188	(0,4)	0.041	0.218		1
F_fleet_4_YR_1988_s_1	0.161	(0,4)	0.035	0.216		1
F_fleet_4_YR_1989_s_1	0.169	(0,4)	0.036	0.215		1
F_fleet_4_YR_1990_s_1	0.175	(0,4)	0.039	0.220		1
F_fleet_4_YR_1991_s_1	0.175	(0,4)	0.039	0.222		1
F_fleet_4_YR_1992_s_1	0.176	(0,4)	0.039	0.223		1
F_fleet_4_YR_1993_s_1	0.160	(0,4)	0.036	0.223		1
F_fleet_4_YR_1994_s_1	0.126	(0,4)	0.028	0.224		1
F_fleet_4_YR_1995_s_1	0.109	(0,4)	0.024	0.225		1
F_fleet_4_YR_1996_s_1	0.124	(0,4)	0.028	0.223		1
F_fleet_4_YR_1997_s_1	0.143	(0,4)	0.032	0.222		1
F_fleet_4_YR_1998_s_1	0.172	(0,4)	0.038	0.224		1
F_fleet_4_YR_1999_s_1	0.169	(0,4)	0.038	0.225		1
F_fleet_4_YR_2000_s_1	0.151	(0,4)	0.034	0.226		1
F_fleet_4_YR_2001_s_1	0.118	(0,4)	0.027	0.227		1
F_fleet_4_YR_2002_s_1	0.134	(0,4)	0.031	0.228		1
F_fleet_4_YR_2003_s_1	0.106	(0,4)	0.024	0.227		1
F_fleet_4_YR_2004_s_1	0.088	(0,4)	0.020	0.228		1
F_fleet_4_YR_2005_s_1	0.070	(0,4)	0.016	0.228		1
F_fleet_4_YR_2006_s_1	0.064	(0,4)	0.015	0.229		1
F_fleet_4_YR_2007_s_1	0.067	(0,4)	0.015	0.227		1
F_fleet_4_YR_2008_s_1	0.054	(0,4)	0.012	0.224		1

Table A1 Continued. Annual fishing mortality parameters estimated by Stock Synthesis. The list includes expected parameter values, lower and upper bounds of the parameters, associated standard deviations (SD) and coefficients of variation (CV), prior type and densities (value, SD) if applicable, and phases.

Label	Value	Range	SD	CV	Prior	Phase
F_fleet_4_YR_2009_s_1	0.067	(0,4)	0.015	0.225		1
F_fleet_4_YR_2010_s_1	0.043	(0,4)	0.010	0.226		1
F_fleet_4_YR_2011_s_1	0.054	(0,4)	0.012	0.226		1
F_fleet_4_YR_2012_s_1	0.055	(0,4)	0.012	0.227		1
F_fleet_4_YR_2013_s_1	0.061	(0,4)	0.014	0.225		1
F_fleet_4_YR_2014_s_1	0.065	(0,4)	0.015	0.224		1
F_fleet_4_YR_2015_s_1	0.066	(0,4)	0.015	0.225		1
F_fleet_4_YR_2016_s_1	0.065	(0,4)	0.015	0.226		1
F_fleet_4_YR_2017_s_1	0.067	(0,4)	0.015	0.227		1
F_fleet_4_YR_2018_s_1	0.062	(0,4)	0.014	0.226		1
F_fleet_4_YR_2019_s_1	0.057	(0,4)	0.013	0.223		1
F_fleet_4_YR_2020_s_1	0.060	(0,4)	0.013	0.223		1
F_fleet_4_YR_2021_s_1	0.059	(0,4)	0.013	0.224		1
F_fleet_4_YR_2022_s_1	0.039	(0,4)	0.009	0.225		1
F_fleet_4_YR_2023_s_1	0.032	(0,4)	0.007	0.225		1
F_fleet_4_YR_2024_s_1	0.030	(0,4)	0.007	0.226		1