SEDAR

Southeast Data, Assessment, and Review

SEDAR 98

Gulf Red Snapper

SECTION III: Assessment Process Report

September 2026

SEDAR
4055 Faber Place Drive, Suite 201
North Charleston, SC 29405

SEDAR 98 Gulf of America Red Snapper Assessment Report

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

September 04, 2026

Table of Contents

1. Introduction

1.1. Workshop Time and Place

The SEDAR 98 Assessment Process for Gulf red snapper conducted via a series of webinars held between June 2025 and June 2026.

1.2. Terms of Reference

The assessment terms of reference approved by the Gulf Fishery Management Council (GFMC) are listed below.

Assessment Terms of Reference

1. Review any changes in data or analyses following the Data Workshop. Summarize data as used in the assessment. Provide justification for any deviations from Data Workshop recommendations.

2. Detail the model building procedure, including modifications from the previously approved stock assessment for red snapper (SEDAR 52), and characterize the effects of new data and methods on model performance.

3. Starting with the SEDAR 74 model, modify as appropriate for the available data: Start year, evaluate selectivity and retention functions for all directed, discard, and bycatch fleets as appropriate.

- Evaluate the effects of any bias correction to fishery independent- or dependent data on reproduction and age and length compositions.

- Investigate fitting recommended length composition data as well as developing age-length keys and converting length frequency to age composition external to the modeling process.

- Investigate the use of (nominal and weighted as recommended by the DW) age compositions for directed fleets either independently or along with the length compositions for the same fleets.

- Explore whether available data supports the estimation of growth parameters within the model.

- Document assumptions made when mirroring between West, Central, and Eastern Gulf parameters. Determine validity of those assumptions using diagnostics.

4. If external surveys were recommended during the Data Workshop, work with the survey PIs to incorporate the surveys in the models as suggested and where possible. Demonstrate any effects to other data fits and evaluate the fit(s) to the survey(s) directly.

- If fits to any external surveys are determined to be unacceptable by the Assessment Panel, discuss and explore other ways in which the data from those external surveys might inform, if even indirectly, other aspects of the assessment.

5. Provide estimates of stock population parameters, including:

    - Fishing mortality, abundance, biomass, selectivity, stock-recruitment relationship, and other parameters as necessary to describe the population.

    - Run appropriate sensitivities of key parameters (e.g., steepness and natural mortality) to demonstrate their effect on stock population parameters.

        A) Explore sensitivities of other biologically relevant estimates of steepness based on species with similar life histories.

6. Characterize uncertainty in the assessment and estimated values.

    - Consider uncertainty in input data, the modeling approach, and the model configuration.

    - Provide appropriate measures of model performance, reliability, and "goodness of fit."

    - Provide measures of uncertainty for estimated parameters.

7. Provide estimates of population benchmarks or management criteria consistent with available data, applicable FMPs, proposed FMPs and Amendments, and other ongoing or proposed management programs.

    - Evaluate existing or proposed management criteria as specified in the management summary.

    - Recommend additional proxy values when necessary.

8. Project future stock conditions (biomass, abundance, and exploitation; including probability density functions) and develop rebuilding schedules if warranted; include estimated generation time. Develop stock projections for the following circumstances, in accordance with the guidance on management needs provided in the management history:

    A. If stock is overfished: F=0, $F_{Current}$, F_{MSY} , $F_{Rebuild}$ (max exploitation that rebuild in greatest allowed time), fixed landings equal to the ABC.

    B. If stock is undergoing overfishing: $F_{Current}$, F_{MSY}, fixed landings equal to the ABC.

    C. If stock is neither overfished nor undergoing overfishing: $F_{Current}$, r F_{MSY}, and r F_{OY} (75% F_{MSY}).

9. Provide recommendations for future research and data collection. Emphasize items that will improve future assessment capabilities and reliability. Consider data, monitoring, and assessment needs.

10. Complete assessment webinars and write an assessment report in accordance with project schedule deadlines.

1.3. List of Participants

Assessment Panel

LaTreese Denson, Co-Lead Analyst .... SEFSC/NMFS
Matt Smith, Co-Lead Analyst .... SEFSC/NMFS
Luiz Barbieri .... GFMC SSC/FWRI
Harry Blanchet .... GFMC SSC/LADWF
David Chagaris .... GFMC SSC/UFL
Steven Saul .... GFMC SSC/ASU
Katie Siegfried .... SEFSC/NMFS

Assessment Process Observers

Jason Adriance .... LDWF
Lisa Ailloud .... SEFSC/NMFS
Sarina Atkinson .... NOAA
Kelsey Banks .... GFMC
Jordan Bajema .... FWC
Hanna Bauer .... TXPWD
Chris Bradshaw .... FWC
James Bruce ....
Bridget Cermak .... FWC
Michaela Cowan .... TXPWD
Judd Curtis .... SAFMC Staff
Brian Daniels ....
Kyle Dettloff .... NOAA
Michael Drexler .... Ocean Conservancy
Alena Figueroa .... FWC
Troy Frady .... Distraction Charters
Francesca Forrestal .... NMFS Miami
Steve Garner .... NOAA
Dakus Geeslin .... TXPWD
Martha Guyas .... ASA
Frank Helies .... NOAA
Rachal Hisler ....
Tiffany Hopper .... TXPWD
Chris Horton .... Congressional Sportsmen
Dylan Hubbard .... Industry
Jeanette Huber .... FWC
Anne Kersting .... NOAA
Alyssa Lopez ....
Daniel Luers .... NOAA
Rich Malinowski .... NOAA
Michelle Masi .... NOAA/SERO
Anthony Mastitski .... MSC

Maria McGirl ....FWC
Ryan Nichols...SEFSC/NMFS
Matt Nuttall...SEFSC/ NMFS
Kate Overly..NOAA
Chloe Ramsay ....FWC
Ashford Rosenberg .... Shareholders Alliance
Skyler Sagarese ....SEFSC/NMFS
Chris Schieble ....LAWLF
Renae Schaak ....MS DMR
Kali Spurgin ....FWC
Molly Stevens ....SEFSC/NMFS
Ted Switzer ....FWC
Nathan Vaughan...NOAA
Ed Walker ....GFMC
Tera Winters...NOAA
Bob Zales, III .... SFA

Staff
Julie Neer .... SEDAR
John Froeschke..GMFMC Staff
Sarah Gardiner .... GFMC Staff
Dominique Lazarre .... NMFS/SERO
Emily Ott... SEDAR
Ryan Rindone...GMFMC Staff

1.4. List of Assessment Process Working Papers and Reference Documents

Document #	Title	Authors	Date Submitted
Documents Prepared for the Assessment Process			
SEDAR98-AP-01	A meta-analysis of immediate and delayed discard mortality of red snapper (*Lutjanus campechanus*) in the Gulf of America (formerly the Gulf of Mexico)	Chloe Ramsay, Matthew D. Campbell, and Beverly Sauls	9 April 2025

2. Data Review and Update

The Gulf of America (GOA) (formerly Gulf of Mexico) Red Snapper required all available and relevant data to be prepared for assessment following the recommended three-area stock structure approved through the Stock ID workshop for the previous stock assessment, SEDAR 74. Data preparation for SEDAR 98 was accomplished through a series of data-focused webinars and a dedicated in person Data Workshop. Per the terms of reference, all selected sources of data were evaluated, prepared following current best practices, and intended to be representative of the spatial and temporal bounds of the assessment. The majority of the data included in the previously approved Red Snapper stock assessment model SEDAR52 were used in SEDAR 98.

Notable new or significantly adjusted sources of data include: Splitting of the Recreational data into Charter and Private boat modes, Conditional age-at-length data, Mean length-at-age data, updated shrimp bycatch estimates, and discard composition data. The complete data utilized in the SEDAR 98 base model are summarized below and illustrated in **Figure 1** along with their corresponding temporal scale. Data details are included in referenced working papers.

1. Life history:
    a. Meristics
    b. Age and growth
    c. Natural mortality
    d. Maturity
    e. Fecundity
2. Landings:
    a. Commercial Handline West: 1950-2023 (metric tons whole weight)
    b. Commercial Handline Central: 1950-2023 (metric tons whole weight)
    c. Commercial Handline East: 1950-2023 (metric tons whole weight)
    d. Commercial Longline West: 1980-2023 (metric tons whole weight)
    e. Commercial Longline Central: 1980-2023 (metric tons whole weight)
    f. Commercial Longline East: 1980-2023 (metric tons whole weight)
    g. Recreational Charter West: 1955-2023 (thousands of fish)
    h. Recreational Charter Central: 1955-2023 (thousands of fish)
    i. Recreational Charter East: 1955-2023 (thousands of fish)
    j. Recreational Headboat West: 1955-2023 (thousands of fish)
    k. Recreational Headboat Central: 1955-2023 (thousands of fish)
    l. Recreational Headboat East: 1955-2023 (thousands of fish)
    m. Recreational Private West: 1955-2023 (thousands of fish)
    n. Recreational Private Central: 1955-2023 (thousands of fish)
    o. Recreational Private East: 1955-2023 (thousands of fish)
3. Discards:
    a. Commercial Handline West: 1996-2023 (metric tons whole weight or metric tons whole weight if relevant)
    b. Commercial Handline Closed Season Discards West: 1996-2006 (metric tons whole weight or metric tons whole weight if relevant)
    c. Commercial Handline Central: 1996-2023 (metric tons whole weight or metric tons whole weight if relevant)
    d. Commercial Handline Closed Season Discards Central: 1996-2006 (metric tons whole weight or metric tons whole weight if relevant)

e. Commercial Handline East: 1996-2023 (metric tons whole weight or metric tons whole weight if relevant)
f. Commercial Handline Closed Season Discards East: 1996-2006 (metric tons whole weight or metric tons whole weight if relevant)
g. Commercial Longline West: 1996-2023 (metric tons whole weight)
h. Commercial Longline Central: 1996-2023 (metric tons whole weight)
i. Commercial Longline East: 1996-2023 (metric tons whole weight)
j. Recreational Charter West: 1982-2023 (thousands of fish)
k. Recreational Charter Central: 1981-2023 (thousands of fish)
l. Recreational Charter East: 1982-2023 (thousands of fish)
m. Recreational Headboat West: 1982-2023 (thousands of fish)
n. Recreational Headboat Closed Season Discards West: 1997-2023 (thousand of fish)
o. Recreational Headboat Central: 1981-2023 (thousands of fish)
p. Recreational Headboat Closed Season Discards Central: 1997-2023 (thousand of fish)
q. Recreational Headboat East: 1982-2023 (thousands of fish)
r. Recreational Headboat Closed Season Discards East: 1997-2023 (thousand of fish)
s. Recreational Private West: 1981-2023 (thousands of fish)
t. Recreational Private Closed Season Discards West: 1998-2023 (thousands of fish)
u. Recreational Private Central: 1981-2023 (thousands of fish)
v. Recreational Private Closed Season Discards Central: 1997-2023 (thousands of fish)
w. Recreational Private East: 1981-2023 (thousands of fish)
x. Recreational Private Closed Season Discards East: 1998-2023 (thousands of fish)
y. Shrimp Trawl West: 1983-2023 (thousands of fish)
z. Shrimp Trawl Central: 1983-2023 (thousands of fish)
aa. Shrimp Trawl East: 1983-2023 (thousands of fish)

4. Length composition of landings:

a. Commercial Handline West: 1984-2023
b. Commercial Handline Central: 1984-2023
c. Commercial Handline East: 1984-2023
d. Commercial Longline West: 1984-2023
e. Commercial Longline Central: NA-NA
f. Commercial Longline East: 1984-2023
g. Recreational Charter West: 1983-2023
h. Recreational Charter Central: 1983-2023
i. Recreational Charter East: 2010-2023
j. Recreational Headboat West: 1982-2023
k. Recreational Headboat Central: 1981-2023

    l. Recreational Headboat East: 2006-2023
    m. Recreational Private West: 1982-2023
    n. Recreational Private Central: 1981-2023
    o. Recreational Private East: 2017-2023

5. Conditional age-at-length composition of landings:

    a. Commercial Handline Central: 1998-2023
    b. Commercial Handline East: 2009-2023
    c. Commercial Handline West: 1998-2023
    d. Commercial Longline Central: 2017-2023
    e. Commercial Longline East: 1998-2023
    f. Commercial Longline West: 1998-2023
    g. Recreational Charter Central: 1991-2023
    h. Recreational Charter East: 2009-2023
    i. Recreational Charter West: 1991-2023
    j. Recreational Headboat Central: 2013-2023
    k. Recreational Headboat East: 2005-2023
    l. Recreational Headboat West: 1986-2023
    m. Recreational Private Central: 2002-2023
    n. Recreational Private East: 2017-2023
    o. Recreational Private West: 1999-2023

6. Mean length-at-age composition of landings:

    a. Commercial Handline Central: 2002-2015
    b. Commercial Handline East: 2005-2019
    c. Commercial Handline West: 1998-2007
    d. Commercial Longline Central: 2016-1993
    e. Commercial Longline East: 2012-2023
    f. Commercial Longline West: 2008-2017
    g. Recreational Charter Central: 2019-2004
    h. Recreational Charter East: 2005-2022
    i. Recreational Charter West: 1998-2014
    j. Recreational Headboat Central: 2018-2010
    k. Recreational Headboat East: 2022-2022
    l. Recreational Headboat West: 2013-2018
    m. Recreational Private Central: 2021-2016
    n. Recreational Private East: 2001-2022
    o. Recreational Private West: 2014-2006

7. Abundance indices:

    a. Fishery-independent:
        i. Bottom Longline Central: 2001-2023
        ii. Bottom Longline East: 2001-2023

  - iii. Bottom Longline West: 2001-2023
  - iv. SEAMAP Fall Trawl Post-2007 Central: 2008-2023
  - v. SEAMAP Fall Trawl Post-2007 East: 2008-2023
  - vi. SEAMAP Fall Trawl Pre-2007 West: 1988-2007
  - vii. SEAMAP Fall Trawl Post-2007 West: 2008-2023
  - viii. G-FISHER Video Survey Central: 1993-2023
  - ix. G-FISHER Video Survey East: 2010-2023
  - x. G-FISHER Video Survey West: 1993-2023
  - xi. SEAMAP Larval Survey Central: 1991-2022
  - xii. SEAMAP Larval Survey West: 1986-2022
  - xiii. SEAMAP Summer Trawl Post-2007 Central: 2009-2023
  - xiv. SEAMAP Summer Trawl Post-2007 East: 2009-2023
  - xv. SEAMAP Summer Trawl Pre-2007 West: 1984-2008
  - xvi. SEAMAP Summer Trawl Post-2007 West: 2009-2023
- b. Fishery-dependent:
  - i. Shrimp Trawl Central: 1950-2023 (effort as a "survey" of *F* to scale annual discards for the Shrimp Trawl Central fleet)
  - ii. Shrimp Trawl East: 1950-2023 (effort as a "survey" of *F* to scale annual discards for the Shrimp Trawl East fleet)
  - iii. Shrimp Trawl West: 1950-2023 (effort as a "survey" of *F* to scale annual discards for the Shrimp Trawl West fleet)
- iv. Commercial Observer Program East: 2007-2023

8. Length composition of surveys:
   - a. SEAMAP Fall Trawl Pre-2007 West: 1988-2007
   - b. SEAMAP Summer Trawl Pre-2007 West: 1987-2007
   - c. Shrimp Trawl Central: 1950-2023
   - d. Shrimp Trawl East: 1950-2023
   - e. Shrimp Trawl West: 1950-2023
9. Age composition of surveys:
   - a. Bottom Longline Central: 2001-2022
   - b. Bottom Longline East: 2003-2023
   - c. Bottom Longline West: 2001-2023
   - d. SEAMAP Fall Trawl Post-2007 Central: 2008-2023
   - e. SEAMAP Fall Trawl Post-2007 East: 2010-2023
   - f. SEAMAP Fall Trawl Post-2007 West: 2008-2023
   - g. G-FISHER Video Survey Central: 2002-2023
   - h. G-FISHER Video Survey East: 2010-2023
   - i. G-FISHER Video Survey West: 1996-2019
   - j. SEAMAP Summer Trawl Post-2007 Central: 2009-2009
   - k. SEAMAP Summer Trawl Post-2007 East: 2009-2009

l. SEAMAP Summer Trawl Post-2007 West: 2009-2009
m. Shrimp Trawl Central: 1950-2023
n. Shrimp Trawl East: 1950-2023
o. Shrimp Trawl West: 1950-2023

2.1. Stock Structure and Management Unit

The management unit for GOA Red Snapper extends from the United States–Mexico border in the West through the Northern GOA waters and West of the Dry Tortugas and the Florida Keys (waters within the GOA Fishery Management Council boundaries). No new literature was identified during SEDAR 98 therefore, the recommendations of the SEDAR 74 Stock ID working group were assumed. SEDAR 74 assumed there were three primary sub-stocks of Red Snapper within this region. Roughly, the West area comprised the waters between the U.S.–Mexico border and the Mississippi River outflow, the Central area included the waters offshore from Mississippi, Alabama, and the panhandle of Florida, while the East area included the Central and southern portions of the West Florida shelf. The areas are illustrated in **Figure 2** with further details available in the SEDAR 74 Stock ID Process Final Report (SEDAR 2021). Currently, the Council manages all Red Snapper sub-stocks (East, Central, and West) as one unit, but the option to utilize the new East, Central, and West management units remains viable.

2.2. Life History Parameters

Life history data used in the assessment included length-length and length-weight relationships, age and growth, natural mortality, maturity, and reproduction data. All life history data incorporated into the proposed population model (Stock Synthesis) were input as fixed parameters, estimated external to the population model. Per the assessment TORs, numerous sensitivity analyses were undertaken to explore a variety of natural mortality and growth formulations including attempting to estimate growth and natural mortality parameters. Details of these analyses can be found in **Section 3.4.8**.

2.2.1. Morphometrics and Conversion Factors

The SEDAR 98 assessment made use of all length-length and length-weight relationships ($W = aFL^b$) that were previously updated during the SEDAR 74 Research Track assessment Data Workshop using combined sex data through 2019. Length-weight relationships incorporated into the assessment model did not vary by area and were fixed at their Data Workshop derived value (See Table 9 in SEDAR (2022)).

2.2.2. Age and Growth

Paired length and age data through 2019 were used to estimate spatially and temporally varying growth curves by the Life History Working Group during the SEDAR74 Data Workshop. Area-specific growth parameters were estimated externally to Stock Synthesis for both sexes combined, and fixed within the model (See Section 2 of SEDAR (2022) for additional details). Due to similarities in the East and Central growth patterns they share growth parameters (**Figure 3**).

Ageing error estimates were not updated for SEDAR 98 therefore the SEDAR 74 matrix remains (further details provided in SEDAR74-DW-34).

2.2.3. Natural Mortality

As in SEDAR 74 an age-specific vector of natural mortality (***M***) was used. Natural mortality rate was estimated using the method of Then et al. (2015) with the Lutjanid-specific parameter subset and a maximum validated age of 57 years. The resulting estimate (***M*** = 0.1040) was used to scale the Lorenzen age-specific natural mortality function (Lorenzen 2000). Following previous Red Snapper assessment recommendations, the natural mortality for age-0 and age-1 were fixed at 2.0 and 1.2 y^{-1}, respectively (see section 2.5 of SEDAR (2022) for additional details). Natural mortality vectors were assumed to be spatially and temporally constant and fixed in the model (**Table 1** and **Figure 3**).

2.2.4. Maturity and Fecundity

Maturity parameters developed during SEDAR 74 were not updated during SEDAR 98 as no new data were provided. Age-based maturity curves were selected for use in the population model. The maturity curves were spatially-specific, time-invariant age at 50% maturity and slope estimates that were input as fixed parameters with the Central and East assessment areas both using the East GOA estimates (**Table 2**). Sex ratio at birth was assumed to be 50% female and 50% male.

SEDAR 98 continues to use the SEDAR 74 Life History Working Group recommendation, using weight (Spawning Stock Biomass) as a proxy for fecundity, given the high level of uncertainty around the previously used, Total Egg Production fecundity estimates.

2.2.5. Discard Mortality

Discard mortality rates have not been updated for SEDAR 98. Area and fleet-specific discard mortality rates were provided for SEDAR 74 in SEDAR 74-AP-02 and are used in SEDAR 98 (SEDAR 2023, Table 2 and Table 4).

Commercial discard mortality rates were estimated as the midpoint between the percent of Red Snapper reported discard dead and the percent of Red Snapper reported discarded dead plus those discarded with indications of barotrauma. Sample size limitations prevented the estimation of separate open and closed season discard mortality rates for the commercial fleets.

Recreational discard mortality rates were estimated using the previously approved meta-analysis approach of Campbell et al. (2014) with updated data sets that accounted for depth of capture, assessment area of capture, season of release, and presence of venting/descending equipment. Detailed methodological description of area and fleet-specific recreational discard mortality rates were provided in SEDAR 74-AP-02 (SEDAR 2023). If there was ample sample size, separate open and closed season discard mortality rates were estimated.

2.3. Fishery-Dependent Data

2.3.1. Commercial Landings

Commercial landings and their corresponding estimates of uncertainty are discussed in the SEDAR 98 GOA Red Snapper Data Workshop report but presented in the working paper, SEDAR98-DW-02 (Atkinson, S., & Pawluk, M. (2025)). The primary commercial gears used for GOA Red Snapper are the Handline (vertical lines, bandit rigs, rod and reel, etc.) and Longline. Handline landings estimates were provided back to 1872; however, the historic estimates (prior to 1950) were not directly included in the final model because they were highly uncertain due to poor historic record keeping and uncertainty around assigning them into the new three-area model structure. For each assessment area, a Handline fleet (1950-2023) and a Longline fleet (1980-2023) were included in the model (**Figure 4**). Commercial landings were reported in pounds and converted to metric tons for input to the assessment model. The model was unable to converge when the Data Workshop recommended CVs were used for all years of the commercial data. Exploratory runs indicated that sufficient model stability was achieved if landings prior to 1990 were input with minimal error (CV 0.05). All other years (1990-2023) made use of the Data Workshop recommended CVs (see SEDAR98-DW-02 for recommended CVs).

Commercial fishing occurred prior to the 1950 model start year, and as such the population for all assessment areas could not be assumed to be at or near unfished conditions at the start of the model. The landings prior to 1950 were highly uncertain and not recommended for use by the Data Workshop, which is consistent with the recommendations from SEDAR 74. Therefore, area and fleet specific initial fishing mortality estimates (*F*) were required for all fleets thought to be operating prior to 1950. For the commercial fleets this was limited to the Handline fleets for each area as no Longline landings were recorded prior to 1980. Initial equilibrium catches were calculated for the Handline fleet as the average landings over the first twenty years of historic landings (1930-1949). CVs of 0.05 were used to force the model to fit the initial catch values and the resulting estimates of *F* were applied prior to the model start year to adjust the area-specific initial population structures.

2.3.2. Recreational Landings

Recreational landings data (1955-2023) used in the assessment are discussed in SEDAR (2025) and presented in SEDAR 98-DW-05. For the data period (1981-2023), recreational landings were computed using fully calibrated estimates from the MRIP using FES, the Southeast Region Headboat Survey (SRHS), Louisiana Creel, and the Texas Parks and Wildlife Department (TPWD) data. Recreational landings were reported for the following fishing modes: Charter Boat, Headboat, and Private fleets. For the assessment, each recreational mode was modeled separately for each assessment area. Recreational landings were reported in numbers of fish and input into the assessment model as 1000s of fish (**Figure 5**).

Historical estimates (1955-1980) for recreational landings were not updated from SEDAR 74. Historical estimates were completed using the National Survey of Fishing, Hunting, & Wildlife-Associated Recreation (FHWAR) method (For a recent document detailing the methodology, see SEDAR72-WP-05).

Uncertainty estimates were provided for the recreational fleet landings for 1981-2023 (SEDAR98-WP-05). Attempts to directly use the Data Workshop supplied estimates of CV resulted in model instability. Consequently, landings had CVs fixed at 0.15 which was the value applied to all years of recreational landings in the most recently completed Red Snapper assessment used for management.

The assessment model starts in 1950, when the stock was already in a fished state, necessitating the estimation of initial conditions via initial equilibrium catches, which are used to calculate initial fishing mortality rates. Initial equilibrium catches were set equal to the reported landings in 1955. Furthermore, the years 1950-1954, for which no landings were reported, also had catch values set equal to the fleet and area-specific 1955 landings. These additional years of landings were required to allow Stock Synthesis (SS) to estimate an initial catch without assuming zero landings in the years between the model start year and the first data year. Initial equilibrium catch was set for all stock assessment areas for recreational headboat.

2.3.3. Commercial Discards

Commercial discards used in SEDAR 98 are discussed in SEDAR (2025) and presented in the working paper SEDAR98-DW-03 (Atkinson et al. 2024), and they use the same methodology as SEDAR 74. The commercial discards for GOA Red Snapper SEDAR 74 were estimated using two methodologies to accommodate differing levels of data quality and availability. Discards occurring between 1995 and 2006 were estimated separately for periods when the fishery was open and closed using methods developed during SEDAR 32 (McCarthy 2015, 2013). Discards occurring after 2006 are estimated using an improved methodology which made use of CPUE from the Commercial Reef Fish Observer Program and total fishing effort from the Commercial Reef Fish Logbook Program to estimate total catch (SEDAR74-DW-19). All discards occurring after 2006 were assumed to be taken during an "open season", because the commercial fleets were allocated individual fishing quota which effectively extended the season year-round. For both methodologies, discard estimates were reported in numbers and were input into the assessment as 1,000s of fish (trends shown in **Figure 6** and proportions by fleet shown in **Figure 7**) with corresponding log-scale standard errors fixed at values provided (Atkinson et al. 2024).

2.3.4. Recreational Discards

Recreational discard estimates used in the assessment were provided for all fleets during 1981-2023 and are presented in SEDAR98-DW-05, Tables 4 & 5 (Nuttall 2024). When the data allowed, recreational discards were divided into those occurring when the fishing season was open and those occurring when the fishing season was closed (open and closed season, respectively). Open and closed season discards were tabulated for all recreational fleets. Methodology for seasonal division of discards is discussed in SEDAR (2025).

Recreational discards were reported as numbers of fish and input into the assessment as 1000s of fish (**Figure 8**) with Data Workshop supplied annual estimates of standard error (Nuttall 2024).

2.3.5. Commercial Length Composition

Commercial Handline and Longline length compositions of landed (retained) fish are discussed in the SEDAR 98-DW-06 (Pawluk, M., and S. M. Binion-Rock, 2024) and SEDAR 98-DW-07 (Binion-Rock, S. M. 2024) working paper. Length samples for commercial fleets were collected via access point interviews and weighted by sub-area to correct for opportunistic sampling biases. Data inclusion required a minimum of 30 length samples and 10 unique trips per stratum. Initially, the East Gulf of America (GOA) area fell short of this threshold for many years. To resolve this, working group members regrouped areas into different subgroups, which significantly improved sample sizes and reduced the number of excluded years for the Commercial Handline (COM HL) fleet from 21 down to 6. West and Central groupings met thresholds without modification. When comparing nominal length-only samples to age-at-length samples, the COM HL fleet showed strong agreement in the West and Central areas, and in the East from 2011 to 2023. Conversely, the Commercial Longline (COM LL) fleet was poorly estimated across many data years, suffering from frequent sample mismatches in the Central (nearly all years), East (prior to 1999), and West (irregularly) (See Pawluk, M., and S. M. Binion-Rock, 2024 for detailed weighting methods). The annual weighted length compositions were combined into 2- cm fork length interval bins (6 - 120). The input sample sizes were the number of trips sampled for that year/fleet. Year/fleet combinations with less than 10 trips sampled were removed from the assessment model.

A mean length-at-age vector for each year and commercial fleet was included in the model for comparison between the expected length-at-age by the assessment model and the observed length-at-age.

2.3.6. Recreational Length Composition

Recreational Charter Boat, Southeast Regional Headboat Survey (SRHS), and Private sector length compositions of landed fish are detailed in the SEDAR98-DW-07 (Binion-Rock, S. M. 2025) working paper. Length samples for recreational fleets were collected via access point angler interviews (including MRFSS/MRIP, TPWD, GulfFIN, and TIP) and subjected to weighting procedures to account for biased, fishery-dependent distributions. Data from the Florida Fish and Wildlife Commission (FWC) Fish and Wildlife Research Institute (FWRI) At-Sea Observer Program (2006–2023) were initially evaluated (Lazarre, 2022) and subsequently recommended for use to characterize the length compositions from recreational discards in the East and Central area Charter Boat and Headboat fleets.

The annual weighted length compositions were combined into 2-cm fork length interval bins (6 - 120) (See SEDAR98-DW-07 for detailed weighting methods). The input sample sizes were the number of trips sampled for that year and fleet. Year and fleet combinations with fewer than 10 sampled trips were removed from the assessment model.

A mean length-at-age vector for each year and recreational fleet was included in the model for comparison between the expected length-at-age by the assessment model and the observed length-at-age.

2.3.7. Commercial Age Composition

Age samples provided by the PC Lab were initially filtered to remove non-random (e.g., selectively picking large fish) and potential duplicate records. For age composition analyses, any strata containing fewer than 10 age samples and 10 trips, were excluded. Analysts initially applied the Chih (2009) reweighting factor to nominal age compositions to reduce bias from non-random sampling. However, visual inspections revealed this reweighting had little effect on the estimated proportions-at-age. Because the weighting procedure caused a significant reduction in the number of usable fleet/area strata that met sample-size thresholds, the working group recommended using nominal age compositions or conditional age-at-length rather than the weighted age compositions. Notably, the Life History Working Group (LHWG) observed a persistent lack of contrast (i.e., completely smoothed cohorts) in the age compositions for the West Commercial Handline (COM HL) fleet. This anomaly was not caused by subsampling issues and was not present in the West Commercial Longline (COM LL) fleet, which tracked cohorts normally. In the end, year-specific conditional age-at-length (CAAL) was used for commercial fleets (detailed in SEDAR98-DW-06). CAAL is recommended over separate age and length compositions because it directly informs length-at-age variability and prevents the model from double-counting the same fish for both age and length data.

2.3.8. Recreational Age Composition

Similar to the commercial sector, recreational age samples were filtered for non-random and duplicate records, and strata with fewer than 10 samples and 10 trips were removed. While reweighting nominal age compositions using the Chih (2009) factor was explored, it was ultimately not recommended. Using weighted age compositions would drastically reduce the number of recreational fleet and area strata that met the minimum sample-size thresholds. Instead, the recommendation is to use either CAAL data or nominal age compositions when available, alongside weighted length compositions, to characterize recreational landings. Year-specific CAAL was also ultimately used for the recreational fleets in each area (detailed in SEDAR98-DW-07). Because otolith samples are almost always collected concurrently with length measurements, treating age data as an independent dataset from length data can introduce bias. Utilizing CAAL circumvents this double-counting issue and provides a highly informative data source for the assessment model to approximate age-based processes.

2.3.9 Commercial Catch Per Unit of Effort Indices of Abundance

The only Commercial Index recommended for use in SEDAR 98 by the Index working groups was the Post- Individual Fishing Quota (IFQ) Commercial Reef Fish Observer data (SEDAR 2025) (**Table 3**). Annual CVs provided by the working group were used in the model and were adjusted internally (**Table 4**).

Length composition data were provided for the Commercial Reef Fish Observer data and were input as nominal composition with sample sizes equal to number of fish.

2.3.10. Recreational Catch Per Unit of Effort Indices of Abundance

Indices based on recreational data were explored and deemed unsuitable during the SEDAR 74 process thus they are excluded from further models. Therefore no standardized CPUE indices based on the recreational fleet data were used in the assessment.

2.3.11. Shrimp Trawl Bycatch

Gulf of America Red Snapper Shrimp Trawl bycatch from commercial shrimp trawls was estimated using an improved methodology (SEDAR98-RD-01) that incorporated trawl configuration and diurnal period, alongside strata-specific time series of shrimp landings and effort. Observer data indicates that Red Snapper bycatch is heavily concentrated in the West Gulf (10 times higher than other assessment areas) and consists almost entirely (99.2%) of sublegal-length fish (<30.5 cm fork length). The estimation methods varied by time period: 2007–2023: Bycatch was directly estimated using the refined methodology and the full time series of observer data. 1984–2006 (Hindcasting): Bycatch was hindcasted using observer data from 2007–2013 combined with the improved 1984–2006 effort and landings time series. This method assumed a stable relationship between shrimp and Red Snapper catch rates and produced much more reliable, less volatile estimates than the SEAMAP trawl proxy method used in previous assessments (e.g., SEDAR 52). Pre-1984: To estimate bycatch prior to the collection of detailed net and diurnal data, the working group recommended using the average annual bycatch estimates by Gulf area from the 1984–1990 period. Because of the large uncertainty in the annual estimates of Shrimp Trawl bycatch, the bycatch discards were input as area-specific super period (i.e. median value from 1984-2023 which was then scaled annually by area-specific time series of Shrimp Trawl effort (available for 1984-2023; **Figure 9**).

The SEDAR 98 assessment also utilizes a re-estimated time series for Gulf penaeid shrimp trawling effort. Effort was heavily stratified by variables known to significantly impact catch rates, including quadrimester, area, depth, trawl configuration (2-net vs. 4-net), and time of day (day vs. night). Because crucial variables like time of day and net configuration were only recorded starting in 1984, the effort methodology was broken down into three distinct time periods: 1960–1983 (Historical): Effort was derived from previously estimated offshore data and apportioned to the assessment subareas based on historical landings of shrimp (75% West, 14% Central, 11% East). A calibration factor of 0.92 was applied to capture only active trawling effort and maintain consistency with later years. 1984–2006: Effort was estimated using port agent interview data. Comparisons with modern electronic data revealed that captains historically overestimated their active trawling time; therefore, the 0.92 calibration factor was applied to align these estimates with modern logbook data. 2007–2023: Effort was calculated using Electronic Logbook (ELB) positional data. However, due to known program transitions and data loss (e.g., unreturned data chips, loss of 3G networks), effort for specific years (2013, 2014, and 2020–2023) was adjusted using observer data to correct for underestimations. Shrimp effort data were generated by the NMFS Galveston Lab using their SNpooled model (Linton, 2012; Nance 2004). The log SE for the mean discard numbers was set to 0.1. The Shrimp Trawl effort time series was scaled to a mean of 1 for input in the assessment model with an assumed constant CV of 0.2 (**Table 5**).

2.4. Fishery-Independent Surveys

2.4.1. SEAMAP Fall Plankton Survey

The primary objective of the SEAMAP Fall Plankton Survey (Larval Survey) is to collect and analyze ichthyoplankton samples in the Gulf of America to produce a long-term database on the early life stages of fish in the region. These data were used to produce area-specific indices of abundance that were incorporated into the assessment model as indices of spawning stock biomass (SEDAR 98-DW-19). Central and West area indices were recommended for inclusion in the model with the East index being excluded again due to low sample sizes. Indices were updated through 2022 and began in 1991 for the Central area and 1986 for the West (**Tables 6-7** & **Figures 10-11**).

2.4.2. SEAMAP Trawl Survey

The primary objective of the SEAMAP Trawl Survey is to collect data on the abundance and distribution of demersal organisms in the northern GOA. Two indices of abundance were produced for each assessment area utilizing data from the Summer (2009-2023) and Fall portions of the survey (2008-2023). Furthermore, in the West assessment area, where longer term sampling has occurred, additional indices were produced using Summer Trawl Survey data from 1984-2008 and Fall Trawl Survey data from 1988-2007. West indices of abundance were input into the model as a separate "Early" and "Late" index due to a substantial survey design change that took place during 2008. See SEDAR98-DW-26 for a full description of the methods used to develop these indices.

Indices were updated through 2023 and began in 2009(**Tables 6-7** & **Figures 10-11**).

Age composition converted from length composition was used for the 2008-2023 SEAMAP Fall Trawl Surveys with sample size specified as number of fish. Development of the age-length keys is discussed in the working paper SEDAR74-DW-18 and was used again for SEDAR 98. Age-length keys were not available far enough back in time to convert the West area 1988-2007 Fall Trawl Survey composition into age, so 5 cm binned length composition data were used with sample sizes input as the number of stations. Differences in composition approaches between the SEAMAP Summer and Fall Trawl Surveys stemmed from a need to limit requests on data providers during model development.

2.4.3. G-FISHER Video Survey

An index of relative abundance was produced for the West assessment area using data collected by the NMFS SEAMAP Reef Fish Video Survey (SRFV), which is now formally part of the Gulf-Fishery Independent Survey of Habitat and Ecosystem Resources (G-FISHER). The SRFV West spans 1993-2023 with data gaps occurring in 1998-2001 and 2003 (**Table 7 & Figure 10**). The assessment model used the provided CVs, which were converted to log-scale SEs for input and eventually adjusted internally (**Table 9**). For the Central and East assessment areas, G-FISHER combined video indices were produced using stationary video surveys for reef fish in the northern Gulf of America. The G-FISHER index (detailed in SEDAR98-DW-16) incorporates the longest running time series from the NMFS SEAMAP Reef Fish Video Survey (carried out by the NMFS Mississippi Laboratory) along with the NMFS Panama City lab survey. Additionally, updated indices of abundance were developed separately for artificial and natural reefs on the West Florida Shelf using data from the Florida Fish and Wildlife Research Institute (FWRI) video survey (SEDAR98-DW-21 and SEDAR98-DW-22). The East G-FISHER Video Survey spans 2010-2023 and the Central G-FISHER Video Survey covers 1993-2023 with data gaps in 1998-2001 and 2003 (**Tables 3, and 6**) & **Figures 11-12**). The assessment model used the provided CVs, which were converted to log-scale SEs for input and eventually adjusted internally (**Tables 4,8, and 9**). Age composition converted from length data through the ALK's were used to estimate selectivity for each area. Sample sizes for the composition data were set equal to the number of area-specific annual sampling sites.

2.4.4. NOAA NMFS Southeast Fisheries Science Center Bottom Longline Survey

The primary objective of NOAA NMFS Southeast Fisheries Science Center Bottom Longline Survey is to collect data on the abundance and distribution of fishes in the northern GOA. The survey has been conducted annually since 1995 and was used to provide area-specific indices of abundance for SEDAR 98 (SEDAR98-DW-17). For index construction, data was limited to 2001-2023 due to gear and survey design changes that occurred prior to 2001. Sample size limitations also resulted in the elimination of 2005 and 2008 for the West area, 2007 and 2008 for the Central area, and 2002, 2008 and 2015 for the East (**Tables 3, 6, and 7** & **Figures 10-12**). Annual CVs were used in the model and eventually adjusted internally (**Tables 4, 8, and 9**).

Age composition converted from length composition through ALK's was used for all areas and for all years for which samples were collected, sample sizes were specified as the number of individuals measured.

2.5. Environmental Considerations & Contributions from Stakeholders

During the SEDAR 74 Research Track Assessment various environmental considerations were discussed. One consideration was to use the Connectivity Modeling System (CMS) to generate an index of recruitment to be used in the assessment (SEDAR 2024). The index would represent a scalar on the total larval supply expected each year, prior to any density-dependent processes that act on the larvae upon settlement. Stakeholders consistently note Increased depredation following Red snapper release due to the recovery of GOA shark and marine mammal populations. These and others detailed in SEDAR (2022) warrant further investigation; however, the lack of actionable time series of environmental covariates and testable hypotheses prevented the inclusion of these environmental factors in SEDAR 74.

3. Stock Assessment Model Configuration and Methods

3.1. Stock Synthesis Model Configuration

The assessment model used was Stock Synthesis (SS), version 3.30.20. Descriptions of SS algorithms and options are available in the SS User's Manual (Methot et al. 2020), the NOAA Fisheries Toolbox website (*http://nft.nefsc.noaa.gov/*), and Methot and Wetzel (2013). Stock Synthesis (SS) is a widely used integrated statistical catch-at-age model (SCAA) that has been tested for stock assessments in the United States (US), particularly on the West Coast and Southeast, and also throughout the world (see Dichmont et al. 2016 for review). SCAA models consist of three closely linked modules: the population dynamics module, an observation module, and a likelihood function. Input biological parameters (e.g., **Section 2.2**) are used to propagate abundance and biomass forward from initial conditions (population dynamics model) and SS develops predicted data sets based on estimates of fishing mortality, selectivity, and catchability (the observation model). The observed and predicted 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 SS 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 GOA Red Snapper SS model constructed for SEDAR 98 differs in a number of ways when compared to the previous model configuration used for the management of GOA Red Snapper. The current fully configured SS model included three distinct spatial areas (West, Central, and East) each with observations of catch and discards for five directed fishery fleets (Commercial Handline, Commercial Longline, Recreational Private, Charter Boat, and Headboat) and one bycatch fleet (Shrimp Trawl). For the Commercial Handline and the Recreational Private and Headboat fleets, discards were separated into Open and Closed Season components to enable the Closed Season discards to be modeled independently of the Open Season fishing dynamics. The model included 17 total indices of abundance spread across the three areas. The West spatial area incorporated the fishery-independent G-FISHER Video Survey, Bottom Longline Survey, SEAMAP Fall Plankton Survey (Larval Survey), and the Summer and Fall SEAMAP Trawl Surveys each split into two indices (Early and Late). The Central spatial area utilized the fishery-independent G-FISHER Video Survey, Bottom Longline Survey, Larval Survey, and the Late variant of the Summer and Fall SEAMAP Trawl Surveys. The East spatial area included one fishery-dependent index of abundance (Commercial Reef Fish Observer), as well as the fishery-independent G-FISHER Video Survey, Bottom Longline Survey, and the late variant of the Summer and Fall SEAMAP Trawl Surveys. Model estimated parameters include fishing mortality by fleet and spatial area for each year, selectivity and retention for each directed fleet, selectivity for the indices of abundance, initial recruitment, stock-recruit deviations, recruitment base apportionment, recruitment apportionment deviations, index catchabilities, and Dirichlet-multinomial parameters.

The SS modeling framework provides estimates for key derived quantities including: time series of recruitment (units: 1000s of age-0 recruits), abundance (units: 1000s of fish), biomass (units: metric tons), SSB (units: metric tons), and harvest rate (units for Red Snapper: total biomass killed age 1+ / 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. The ss3diags software (Carvalho et al. 2021) was also used to perform additional diagnostics.

3.1.1. Initial Conditions

The Gulf of America (GOA) Red Snapper assessment has a start year of 1950 and a terminal year of 2023. Removals of Red Snapper were known to occur in the GOA prior to 1950, primarily by the Commercial Handline fleets and to a lesser extent the recreational fisheries. Therefore, initial depletion was estimated using estimates of initial catch for fleets with significant landings at the beginning of the time series (i.e., Commercial Handline, Combined Recreational and Shrimp Trawl bycatch for all areas). Initial catch values for the Combined recreational fleets were set equal to the sum of all recreational landings in an area (in numbers of fish) in 1955, which was the first available data year. The recreational fleets were combined to reduce the number of initial F parameters that needed to be estimated and because early selectivity curves across the recreational fleets were similar. Headboat fleet selectivity was used to model the initial catch, though any other recreational fleet could have been selected. This resulted in initial fishing mortality rates of the recreational fleets being based on landings of 673,030 for West; 364,100 for Central; 71,860 for East. Commercial initial catch values were set equal to the average catch from 1930 to 1949. This resulted in initial fishing mortality rates for the Commercial Handline fleets being based on landings of 249.1 metric tons for the West Commercial Handline, 614.8 metric tons for the Central Commercial Handline, and 458.1 metric tons for the East Commercial Handline. For all directed fleets with initial catch, CVs of 0.05 were used to force the model to fit the initial catch values. Initial F parameters were freely estimated and the resulting estimates of *F* were applied by SS to achieve a plausible non-virgin initial population structure.

Shrimp trawl bycatch initial F's were modeled using current best practices in the Gulf branch of the SEFSC. This entailed initiating an initial F parameter for each area using a value of 0.001 and a CV of 0.5. Because the shrimp F's are so highly correlated with recruitment, priors were used to help stabilize the area-specific estimates. Priors were lognormal with mean equal to the natural log of model derived estimate of area-specific shrimp bycatch F in 1950 and standard errors equal to a CV of 30%.

3.1.2. Temporal Structure

The Red Snapper population was modeled from age-0 through age-20+ fish, with the last age representing an accumulating plus group. The inclusion of a seasonal component to the removals was not considered for the assessment thus the model time step was set equal to one year with fishery activity assumed to be continuous and homogeneously distributed throughout the year. Temporal structure in fleet behavior (i.e., selection and retention) were created using time blocking of parameter estimates (i.e., different values for retention parameters for one time period versus another). Larval settlement was specified to occur mid-June corresponding with a period of elevated spawning during the protracted Red Snapper spawning season. Indices of abundance, length and age composition were assumed to be collected on July 1st for all fleets and surveys.

3.1.3. Spatial Structure

A three area model was implemented where recruits were assumed to be generated from a single stock recruitment relationship and then divided among the three assessment areas. Recruits were split into the three areas using the base recruitment apportionment parameters for all years until 1985 after which annual apportionment deviations were estimated and used to modify the base apportionment parameters. To improve model stability, priors were used to inform the estimation of the base apportionment parameters. The priors were calculated using the nominal catch per unit effort (CPUE) data from the SEAMAP Fall Plankton Survey (see Table 3 In SEDAR74-DW-31). Area-specific priors were calculated as the log of the average 2009-2019 CPUE divided by the average CPUE for the same time period from the reference area. Using the West area as the reference area, this resulted in priors of 0, -0.620 and -2.085 for the West, Central and East areas, respectively. Priors were input as normal with a standard deviation (SD) of 0.5. The standard error of the apportionment deviations was fixed at 0.5 to moderate the model estimated variability in interannual recruitment deviations. Once settled, recruits followed area-specific life history and mortality parameters with no adult movement across areas assumed.

3.1.4. Life History

A fixed length-weight relationship was used to convert body length (cm Fork Length, FL) to body weight (kg whole weight; See Table 9 in SEDAR (2022), **Figure 3**). Length-weight relationships were not estimated by spatial area so common parameters were applied to all three areas. Stock Synthesis (SS) moves fish across age classes and length bins on January 1^{st} of each modeled year starting from birth (i.e., settlement month) at real age-0. The true birth data for Red Snapper in the GOA does not occur on January 1^{st}, with peak spawning occurring typically during June and July. Unlike previous SS versions, SS version 3.30.20 allows settlement timing to be specified in the model allowing for growth calculations and age-specific natural mortality parameters to operate on real age post-settlement rather than strict calendar age, ensuring mortality and growth act over the correct biological time frame.

Growth was modeled with a three parameter von Bertalanffy equation: (1) L_{Amin} (cm FL), the mean size at age-1 for Red Snapper; (2) L_{Amax} (cm FL), the mean size at maximum age for Red Snapper; and (3) K (year^{-1}), the growth coefficient. In SS, 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 (fixed at 6 cm FL). Fish then grow linearly until they reach a real age equal to the input value of A_{min} (growth age for L_{Amin}) and have a size equal to L_{Amin}. As they age further, they grow according to the von Bertalanffy growth equation (**Figure 3**). L_{Amax} was specified as equivalent to L_{inf}. 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-1) and A_{max} (age-20). For intermediate ages, a linear interpolation of the CV on mean size-at-age is used.

Spatial area-specific von Bertalanffy growth model parameters L_{Amin}, L_{Amax} and K were estimated externally to SS using updated length and age compositions **Table 10**. Variance parameters for the West area CV_{Amin} (0.252) and CV_{Amax} (0.063), Central area CV_{Amin} (0.318) and CV_{Amax} (0.057), and East area CV_{Amin} (0.394) and CV_{Amax} (0.041), were fixed at the values recommended at the SEDAR 74 (see Table 4 in SEDAR 2022) Data Workshop.

The age-specific vector of M (**Section 2.2.3**) was assumed to be constant across the three spatial areas and was fixed within the SS model (**Table 1**). The age-specific vector of M was scaled using a Gulf wide growth equation estimated during the SEDAR 74 Data Workshop and not updated for SEDAR 98.

Maturity was modeled as an age-logistic relationship with no truncation on first mature age (i.e. fish could theoretically mature at age 0). Maturity was assumed to be area-specific and constant across time (**Table 2**). A fecundity relationship was not used in the model to define the relationship between weight and egg production. However, SS required input parameters for the fecundity equation, which was configured using a weight based relationship ($eggs = aWt^b$) that was parameterized with both the alpha and beta parameters fixed to 1 to ensure that derived population biomass metrics were in units of spawning stock biomass.

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 spawner-recruit levels) requires three parameters: (1) steepness (h)

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) 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 spawner-recruit curve and defines the offset between the arithmetic mean spawner-recruit curve and the expected geometric mean from which the deviations are calculated). The steepness parameter, *h* and *sigmaR* were fixed at 1, and 0.6, respectively, in the SEDAR 98 Base Model. Virgin recruitment (lnR_0) was freely estimated. Steepness was fixed as a computational convenience assuming no stock-recruitment relationship, but rather average recruitment from a mean. *SigmaR* was fixed at a recommended value for model stability.

Annual deviations from the stock-recruit function were estimated in SS for the entire time-series, 1950 – 2023. Deviations were estimated in three sections, early deviations (1950 – 1984), main deviations (1985 – 2022), and late deviations (2023). The early deviations were estimated as a vector of unconstrained deviations (i.e., deviations do not sum to zero) assuming a lognormal error structure, with the level of variability set by *sigmaR*. The main deviations were estimated as a vector of deviations constrained to sum to zero, and the late deviation was estimated as a simple unconstrained deviation that had an additional likelihood penalty applied to force it toward 0. A lognormal bias adjustment factor was applied to recruitment estimates as recommended by Methot et al. (2020), but only to the data-rich years in the assessment. This was done so that SS will apply the full bias-correction only to those recruitment deviations that have enough data to inform the model about the full range of recruitment variability (Methot et al. 2020). For the SEDAR 98 Base Model, main period (i.e. data rich) recruitment deviations spanned 1985-2022. Full bias adjustment was used from 1997 to 2023 when length or age composition data were available. Bias adjustment was phased in linearly, from no bias adjustment prior to 1929 to full bias adjustment in 1997. Bias adjustment was phased out in 2023, decreasing from full bias adjustment to no bias adjustment in that year, because the age composition data contains less information on recruitment in more recent years. The years selected for full bias adjustment were estimated following the methods of Methot and Taylor (2011).

3.1.6. Fleet Structure and Surveys

For each of the three spatial areas (W, C, and E), five fishing fleets were modeled and had associated length and conditional age-at-length compositions. The SS fleet codes for these were: Commercial Handline (HL_W, HL_C, HL_E), Commercial Longline (LL_W, etc.), Recreational Charter Boat (CBT_W, etc.), Recreational Headboat (HBT_W, etc.), Recreational Private (PRIV_W, etc.). Discards were incorporated as total discards in 1000s of fish for all fleets in all areas. Prior to the onset of the Commercial Individual Fishing Quota (IFQ) Program in 2007, discards in the Commercial fleets were separated into those occurring in Open and Closed fishing seasons. With the IFQ program in place, commercial discards were assumed to occur continuously throughout the year in conjunction with an assumed year long fishing season. Recreational discards were also separated into Open and Closed Season discards to account for the differing discard practices of anglers when harvest was or was not an option. Commercial Longline and Recreational Charterboat discards were initially separated into their Open and Closed components. However, the magnitude of the closed season discards for these fleets were extremely small which created convergence problems for the model as it attempted to estimate long time-series of near zero fishing mortality rates. Consequently, those fleets' Closed Season discards were combined with the Open Season discards and modeled together.

Discards from the Shrimp Trawl fishery in the GOA were included in all three areas by fitting to median Shrimp Trawl bycatch levels and indices of Shrimp Trawl fishing effort. Shrimp Trawl bycatch was assumed to be 100% dead discards with no landings. For Shrimp discards the 'super-year' approach was utilized to avoid fitting to the noisy and uncertain yearly estimates of Shrimp bycatch. The premise of a super-year is that, instead of fitting each observation directly, a measure of central tendency for the entire time series is fit. In the case of Shrimp bycatch, the median has typically been utilized (i.e., the observed median is fit to the predicted median). The model still predicts annual bycatch values using annual *F*s estimated from area-specific time series of Shrimp Trawl effort, but does not directly fit the annual Shrimp Trawl bycatch observations owing to the high uncertainty associated with them. The super-year covers years 1983-2023 (i.e., the median values correspond to observed and predicted bycatch values for these years).

One fishery-dependent CPUE index was included in the SEDAR 98 base model: Commercial Reef Fish Observer Program index (COMMOBS_E). The fishery-dependent CPUE series was treated as an index of biomass where the observed standardized CPUE time series was assumed to reflect annual variation in population trajectories. The fishery-dependent index was input as a survey into SS (see **Section 2.3.9**).

The inclusion of fishery-independent surveys differed among the assessment areas with spatial, temporal and sample size limitations dictating availability. In the West assessment area, seven fishery-independent surveys were included in the SEDAR 98 base model: the SEAMAP Fall Plankton Survey, the split Early (pre 2007) and Late (post 2006) Summer SEAMAP Trawl Surveys, temporally split Early (pre 2007) and Late (post 2006) Fall SEAMAP Trawl Surveys, the Bottom Longline Survey and the G-FISHER Video Survey (formerly the SEAMAP Video Survey). The Central assessment area had five fishery-independent surveys in the SEDAR 98 base model: the SEAMAP Fall Plankton Survey, Late Summer and Late Fall SEAMAP Trawl Surveys, the G-FISHER Video Survey (formerly the Combined Video Survey), and the Bottom Longline Survey. The East assessment area had four fishery-independent surveys included in the SEDAR 98 base model: the Late Summer and Late Fall SEAMAP Trawl Surveys, the G-FISHER Video Survey, and the Bottom Longline Survey.

The fishery-independent surveys, and Shrimp Trawl effort time-series were incorporated consistently across areas when available. For the Central and West areas, the Larval Survey was set up as a special survey of spawning stock biomass. The SEAMAP Trawl Surveys (early and late), Bottom Longline Surveys and the G-FISHER Surveys were incorporated as indices of relative abundance and had composition data available which was fit directly based on estimated area-specific selectivity functions.

3.1.7. Selectivity

Selectivity represents the probability of capture by age or length for a given fleet 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 (SS) allows users to specify length-based selectivity, age-based selectivity, or both. The final selectivity curve governing each fleet/survey reflects the multiplicative effect of both age- and length- based processes when both data types are present.

Selectivity patterns were not assumed to be constant over time for each fleet and survey. The commercial and recreational fisheries have experienced numerous management changes to both minimum size and bag/trip limits since the mid-1980s. Attempting to capture all changes can lead to model overparameterization therefore only specific changes in patterns are modeled. For the commercial fleets, the switch to an individual fishing quota system in 2007 was hypothesized to be a major event likely to result in angler selectivity changes. To accommodate this in the model, a time block was included for 2007-2023. Similarly, changes to recreational selectivity were thought to coincide with enforcement of a five fish bag limit in 1993 and the further reduction to a two fish bag limit in 2007. Assuming that fishers were shifting fishing locations and changing gear (i.e., hook size) to optimize their bag limit as it was reduced, thus impacting selectivity. Selectivity time blocks for a given sector were applied consistently across all assessment areas because relevant management events were enacted GOA wide for all components of a given sector at the same time (e.g., commercial changes affected both the Handline and Longline fleets simultaneously in all areas). There have been many changes to recreational and commercial minimum size limits throughout the GOA Red Snapper management history. These changes were assumed to influence the discard patterns more so than selectivity. As such, these changes were accounted for in the assessment model using time-varying retention patterns (see **Section 3.1.8.**) and modeling discards explicitly (see **Section 3.1.10.**).

Surveys were assumed to have constant selectivity. In some cases, surveys which likely experienced time-varying selectivity due to significant design or gear changes were handled by either truncating the index time series at the year of the change or by splitting the index into two parts (e.g., "early" and "late" SEAMAP Trawl Surveys in the West area).

3.1.7.1. Length-based Selectivity

Length-based selectivity patterns were specified for each directed fleet. Length-based selectivities were characterized as one of two functional forms: (1) a two-parameter logistic function (SS pattern 1) and (2) a six-parameter double normal function (SS pattern 24). A logistic curve typically implies that fish below a certain size range are not vulnerable, but 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, which were both estimated in this assessment. 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.

In the SEDAR 98 base model, selectivity patterns were defined for each fleet/survey/spatial area combination and forms were consistent across the spatial areas for any given fleet. The selectivities of the Commercial Handline fleets, the East area Commercial Reef Fish Observer index of abundance, the Early SEAMAP Fall and Summer Trawl Survey in the West area, the Recreational Charter Boat fleets, Private fleets and the Headboat fleets were all modeled using double normal functional forms. Length based logistic selectivity was applied to the commercial longline fleets. Lastly, selectivity forms for the Commercial Handline and Private Boat Closed Season discards mirrored the form of their Open Season counterpart (double normal) due to a lack of composition data to inform the Closed Season fleets. Closed season discard composition was available from the Central and East area Headboat fleets. This allowed independent double normal selectivity curves to be estimated for these fleets while the Closed Season Headboat West fleet was mirrored to the Central area due to a lack of composition data in the West.

Double normal selectivity was implemented for all recreational fleets, the Commercial Handline fleets, the Closed season Headboat fleets, and the early summer and fall trawl surveys because dome-shaped selectivity was considered highly likely in these instances due to areas fished (e.g., closer to shore, shallower), targeting behavior and in the case of the surveys, well known size selectivity for the survey gear. For all these fleets, the peak parameter and the ascending and descending limb parameters were estimated for the base values and all time blocks implemented for the commercial and recreational fleets. To reduce correlated parameters, the top parameter was fixed at a small value and not varied temporally and the initial and terminal selectivity parameters were not estimated and setup to allow SS to decay the small and large fish selectivity according to the estimated slope of the ascending width and descending width parameters, respectively. The Commercial Longline East logistic selectivity had both parameters freely estimated for the base and time-block. The Longline West did not include a time block and parameters were able to be estimated for the entire timeseries. The selectivity of the Larval Surveys did not need to be specified as the surveys were set up as relative indices of spawning stock biomass.

3.1.7.2. Age-based Selectivity

Commercial Handline (HL) and Longline (LL) fleets across all areas (West, Central, East) were parameterized with a flat selectivity of 1.0 for ages 1 and older, to prevent the estimation of a non-zero selectivity for age-0 fish. Conversely, the East Commercial Observer (COMMOBS_E) fleet was modeled using a double normal selectivity parameterization.Shrimp bycatch in the West area was fit using 100% selectivity at age-0 and zero selectivity for all other ages. The Central and East shrimp bycatch fleets were configured to directly mirror the West areas selectivity curve.

Age-based selectivity was specified for all surveys.The G-FISHER video surveys in the West, Central, and East areas were fitted using a double normal selectivity parameterization. The Bottom Longline Surveys (BLL) across all three areas were fit assuming age-logistic selectivity parameterizations with no time blocks and all parameters freely estimated. The Late Fall and Late Summer surveys (FALLLATE, SUMLATE) were fitted using an empirical random walk; the West Late Fall survey was parameterized with six parameters, while the Central and East Late Fall surveys, along with all Late Summer surveys, utilized five parameters.The random walk was used to force selectivity to be declining as age increases with age-4 or age-5, in the case of the West late fall trawl survey, having a final selectivity of zero. Restrictions on the parameter space were put in place based on the design of the survey (e.g., targeting predominantly age-0 in the Fall Trawl survey), previous assessment fits to the surveys, and visual inspection of the composition.

3.1.7.3. Mirroring

Compositional sample size limitations for several fleets necessitated mirroring the selectivity of the same fleet in a neighboring spatial area. This need arose most commonly in the East area where all recreational fleets (Charter Boat, Private, and Headboat) were mirrored to their Central area counterparts' length-based selectivity. Likewise, the Central area Commercial Longline fleet lacked sufficient compositional data and had its length-based selectivity mirrored to the Commercial Longline fleet in the West area. In all cases, the area mirrored to was chosen because it had the most similar fleet dynamics to the area lacking compositional data. For the recreational fleets, composition from the East areas was included in the model despite the implementation of mirroring. This composition data would inform the joint shared selectivity especially in the terminal time-block for which most of the East area composition was available. All Closed Season discard fleets had their length-based selectivities mirrored to their corresponding Open Season fleet, with the exception of the Headboat East and Central fleets as previously described. For the Closed Season fleets with mirroring, no composition was included from the mirrored area meaning that the resulting selectivity was identical to the Open Season counterpart. This assumed that angler behavior, as it relates to selectivity, was constant regardless of an angler's ability to land a Red Snapper.

3.1.7.4. Selectivity Priors

All estimated selectivity parameters for age and length selectivity used symmetric Beta priors with SE = 0.5. These priors primarily help move parameters out of the tails of their range in situations where the parameter gradient has approached 0 despite failing to find a global minimum.

3.1.8. Retention

Time-varying retention functions are commonly used in GOA stock assessments to allow for varying discards at size due to the impacts of management regulations. For Red Snapper, time blocks were based on a combination of changes in the federal and state waters minimum size limits, bag limits and the shift to an IFQ quota system for the commercial fleets. The time varying retention blocks were defined as:

1. For commercial fishing fleets:
   a. 1950 - 1984: no minimum size limit regulation in place
   b. 1985 - 1994: 13 inch minimum size limit
   c. 1995 - 2007: 15 inch minimum size limit
   d. 2008 - 2023: 13 inch minimum size limit
2. For recreational fishing fleets (Charter Boat and Private/Headboat):
   a. 1950 - 1984/1986: no minimum size limit regulation in place
   b. 1985/1987 - 1989: 13 inch minimum size limit
   c. 1990 - 1994: 15 inch minimum size limit
   d. 1995 - 1999: 18 inch minimum size limit

e. 2000 - 2023: 16 inch minimum size limit
3. For all recreational fishing fleets:
a. 1950 - 1989: no recreational bag limit
b. 1990 - 1994: 7 fish recreational bag limit
c. 1995 - 1998: 5 fish recreational bag limit
d. 1999 - 2006: 4 fish recreational bag limit
e. 2007 - 2023: 2 fish recreational bag limit

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). The blocks listed above related to the minimum size limits (groups 1 and 2) were linked to the inflection point for the fleets as specified in the group description. The slope parameters for the commercial fleets were blocked using the same blocking group as the commercial inflection points (group 1) while the blocks determined by the recreational bag limit (group 3) were used to vary the slope parameters for all three of the recreational fleets in each area.

High grading, or the discard and release of legal-sized fish, was acknowledged as a possible concern for both the commercial and recreational fleets with the onset of IFQs and 2-fish bag limits, respectively. Consequently, all commercial and recreational fleets had a time-block implemented for asymptote parameters from 2007- 2033 (into the forecast period). These blocked parameters were estimated to allow the model the flexibility to discard legal-sized fish which was supported by both the available discard composition and knowledge of recent angler behavior in response to regulation.

For the commercial fleets, prior to 1995 discards were not tabulated and before 2007 no commercial discard composition data were collected. Consequently, the first commercial retention block had the inflection point parameter fixed at 8 inches TL given the lack of data to inform it otherwise. For subsequent blocks the inflection parameters were estimated for using the minimum size limits of 13- and 15-inches total length initial values for the 1985-1994 and 1995-2007 blocks, respectively. The inflection point for the 2008-2023 block was also estimated, with an initial value established at 13 inches TL, making use of the available commercial discard compositional data from that time-period. In nearly all cases the commercial discard inflection point parameters were freely estimated with a weak symmetric Beta prior (SE = 0.5) imposed to aid with convergence. The exception being the Commercial Handline East fleet inflection points that use lognormal priors with mean equal to the log transformed minimum size limits in cm fork length and SE equal to 1. These priors were needed to help constrain this fleet's early inflection point parameter estimates for which discard composition was non-existent and landed composition data was sparse. Commercial slope parameters were fixed at a value of 1 (imposed knife-edged retention) for the base time block and then estimated with priors for all remaining time-blocks. Priors were set up as LN(0,1) such that each slope parameter had weak prior information indicating knife-edged retention. Use of priors and estimation instead of fixing the slope parameters allowed the model flexibility to fit a small amount of sublegal fish that occurred in the landed composition data for the commercial fleets while maintaining a default knife-edged assumption for retention if the data did not support alternate solutions. Lastly, the asymptote parameter was fixed at 100% retention of legal sized fish for all periods prior to 2007 after which the parameter was estimated to allow for the possibility of high grading in the commercial fishing sector. Estimated asymptote parameters utilized the same symmetric Beta priors as used for the inflection point parameters. Recreational discards have been estimated since 1981; however, discard compositional data has only been collected since 2007 and only in the East and Central assessment areas. Given the lack of early discard or landed composition data, the decision was made to fix the inflection parameters at 8 inches total length for the pre-regulation period (prior to 1985 or 1987 for Charter and Private fleets and Headboat, respectively). Later blocks had inflection parameters estimated, where possible, to allow the model to better fit to sublegal fish that appeared in the landed composition. Practically speaking, this meant that the Charter, Private and Headboat inflection parameters for all non-base time-blocks were estimated with weak (SE=0.5) symmetric Beta priors in the West and Central areas, while East area time-block inflection parameters were fixed at the minimum size except for the last (2000 – 2023) parameter which was estimated with a weak (SE =1) symmetric Beta prior. Slope parameters for the recreational fleets were handled similarly to the inflection points with decisions being based on data availability. All base slope parameters were fixed at 1 enforcing knife-edged retention in the pre-data period. For subsequent time-blocks, the Central and West areas had the slope parameters estimated with weakly informative lognormal priors setup as was done for the commercial fleet slope parameters (see above). As was the case for the recreational inflection parameters, the East area slope parameters were all fixed at 1 for the remaining time-blocks with the exception of the most recent block (2007 – 2023) which was estimated with a weakly informative LN(0,1) prior. Lastly, the asymptote parameters were fixed at 100% retention of legal sized fish for all areas, fleets, and time blocks prior to 2007. After 2007, the asymptote parameters for the recreational fleets were handled on a fleet-by-fleet basis. The Charter fleet's asymptote parameters were initially estimated and then fixed at either the estimated value or at the lower end of the range bound that was set at 1.38, roughly 80% retention. The bound was implemented to constrain the asymptote parameter to a reasonable range after attempts to freely estimate the parameter resulted in unreasonably low estimates of fully selected retention and poor fits to the available discard composition. Headboat fleet asymptotes were estimated and required no additional constraints to achieve reasonable fits. Private fleets had the asymptote parameter in the last time-block fixed at 100% retention due to the absence of any discard composition information from the fleet to inform the shape of the retention curve.

3.1.9. Landings and Associated Length and Age Compositions

Landings by fleet and associated length and age compositions were estimated using fleet-specific continuous fishing mortality rates and length-specific selectivity curves following Baranov's catch equation.

The commercial landings were assumed to be the most representative and reliable data source in the model, especially over the most recent time period. Since 2007 this information was collected in the form of a census as opposed to being collected as part of a survey and a CV of 0.05 was assumed. Prior to 2007, commercial landings were estimated from self reported logbook data which led to fleet and area-specific estimates of annual CVs presented in the Data Workshop Report (SEDAR 2022).). Attempts were made to utilize all recommended CVs but doing so resulted in models which were unable to converge. Consequently, the base model assumed a CV on commercial landings of 0.05 for all fleets and years, and a CV of 0.15 for recreational landings for all fleets and years. A sensitivity was run indicating that sufficient model stability could be achieved if commercial landings CVs and recreational landings CV's were fixed at 0.05 and 0.15, respectively, prior to 1990 and the data workshop recommended CVs were used for all other years. Model stability and convergence was likely achieved in this sensitivity run due to the onset of other sources of data in the more recent years, in particular robust compositional data. All CVs were converted to a log-scale SE (see **Section 3.2.**).

The Dirichlet-multinomial (DM) which differs from the standard multinomial in that it includes an estimable parameter (theta) which scales the input sample size (Thorson et al. 2017; Methot et al. 2020) was used to weight the composition data for SEDAR 98. The DM is self-weighting, which avoids the potential for subjectivity as when the Francis re-weighting procedure is applied (Francis 2011). The DM likelihood also allows for observed zeros in the data, and the effective sample sizes calculated are directly interpretable. The DM likelihood uses the input sample sizes directly, adjusted by an estimated variance inflation factor. The more positive the inflation factor, the more weight the data carry in the likelihood. The DM likelihood is considered an improved practice and recommended for use by the SS model developers, and was first used in a GOA stock assessment during SEDAR70 in 2020 for GOA Greater Amberjack.

Because SS models individual fish growth internally and tracks fish from birth it is possible to fit both age and length composition simultaneously. For SEDAR 98, the age and length composition data for each fleet/survey were assumed to follow a Dirichlet-multinomial error structure where sample size represented either trips, survey stations, individual fish or number of sets, adjusted by an estimated variance inflation factor. Data sources varied in the units of sample sizes provided, leading to a mix of units used in the model. Future models aim to use a common unit of sample sizes. See **Sections 2.3.5-2.3.8** and **Sections 2.4.2-2.4.5** for more detail on input sample sizes for each fleet/survey. The final effective sample sizes for each year are provided on the figures illustrating the fits to the observed age and length composition data (given by N adj in each panel; **Figures 13-41**).

3.1.10. Discards

Discard data for each fleet were directly fit in the SS model using size-based retention functions, and a log-normal error structure was assumed. Annual estimated CVs were provided in the data workshop report (SEDAR 2025) and converted to log-scale SE for input into SS. The model estimates total discards based on the selectivity and retention functions, then calculates dead discards based on the spatially-specific but time invariant discard mortality rates which ranged from 16.9% to 41.2% for the recreational fleets and 19.2% to 40.7% for the commercial fleets (**Sections 2.3.3-2.3.4**).

3.1.11. Indices

The indices are assumed to have a lognormal error structure. The CVs provided by the index standardization were converted to a log-scale SE, required for input to SS for lognormal error structures and eventually adjusted internally during the model fitting process with an extra standard deviation (**Section 3.2.**). The internal scaling of indices using estimated extra standard deviation parameters is a way to objectively weight indices against each other and all other sources of information. This can be useful since the indices typically use different techniques for standardization making the output SEs not directly comparable, nor adequately reflective of the relative confidence in the various indices. Previously the best practice was to scale each index to a common mean allowing them to be equally weighted within the assessment, while maintaining relative annual variation (Francis et al. 2003). Using the SS provided estimation of additional error is preferred since it allows the model to use all sources of data to determine the correct weighting of the indices.

3.2. Goodness of Fit and Assumed Error Structure

A maximum penalized 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 negative log-likelihood component was specified, the value of which was determined by the difference in observed and predicted values along with the assumed variance of the error distribution. The total negative log-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 weights (i.e., the variance associated with each data set) can impact model results, particularly if the various data sets indicate differing population trends.

SS allows, through a lambda parameter, for additional weight to be assigned to components of the overall likelihood to either increase or decrease the likelihood penalty associated with misfitting the specified data source. For SEDAR 98, lambdas were imposed on the mean length-at-age data to use the data for comparisons rather than model fit.

Where lognormal error structures were used, annual CVs associated with each of the data sources were converted to log-scale SEs using the approximation: $log_e(SE) = sqrt(log_e(1 + CV^2))$ provided in Methot et al. (2020).

Estimated parameters with no other prior implemented were given weak symmetric-beta penalty functions to keep parameter estimates from hitting their bounds (Methot et al. 2020). 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 all, 2282 parameters were included in the analysis for the SEDAR 98 base model, of which 1964 were active parameters. These parameters include: year-specific (1950-2023) fishing mortality for each fleet, the stock-recruit deviations for the data-poor time period (1950-1984) the stock-recruit deviations for the data-rich time period (1985-2022), one stock-recruit relationship parameter ($ln(R_0)$), recruitment apportionment to two of the three areas (**Table 11**), size and age selectivity parameters for each relevant fleet or survey, logistic retention parameters for each fleet, catchability parameters for each index, and 11 parameters informing the Dirichlet-multinomial length and age composition weightings. Parameters were estimated in five phases. The first phase initiated initial and annual fishing mortality (*F*) parameters and stock recruitment parameters (see **Table 11**). The second phase activated the base recruitment apportionment, survey catchability (*q*) parameters, and Dirichlet-multinomial parameters. Base and time varying selectivity parameters were initiated in phases two and three. Time varying retention parameters became active in phase four and phase five added parameters for the early recruitment deviations and the annual recruitment apportionment deviations.

3.4. Diagnostics for Model Structure

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, discards). Any temporal trends in model residuals (or trends with age or length for composition data) can be indicative of model mis-specification 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 among 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). However, a large number of extremely correlated parameters warrant reconsideration of modeling assumptions and parametrization. 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 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. Typically, profiling is carried out for a few key parameters, particularly those defining the stockrecruit relationship. Profiles were carried out for the three growth parameters, $\ln(R0)$, σ R , steepness, and initial fishing mortality parameters.

3.4.4. Jitter Analysis

Jitter analysis 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 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 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 an undesirable retrospective pattern (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 composition 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. Jack-knife Analyses

An additional type of data exclusion analysis is the jack-knife approach where individual data sets are removed and the model is rerun with the remaining data. When a survey was removed any associated estimated parameters (e.g., selectivity parameters) were no longer estimated. The goal of this analysis was to determine if any single data set was having undue influence on the model and causing tension with other data in terms of estimating parameters. A full index jack-knife was done for the survey data where each survey was removed (including associated age composition data) and the model rerun.

3.4.7. Additional Diagnostics

Additional diagnostics using the R package 'SS3Diags' are presented following the recommendations of Carvalho et al. (2021). 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).

The 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).

3.4.8. Base Model Sensitivity Runs

Sensitivity runs were conducted with the SEDAR 98 base 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 structure and design 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 provides important information for developing or evaluating the base case model and structure. The focus of the sensitivity runs was on population trajectories, improvements in fit and important parameter estimates (e.g., recruitment).

G-FISHER Index and Composition - Four alternative combinations of data and selectivity forms were evaluated to explore possible data contradictions:

1. The double-normal selectivity curves fit to age composition data in the base model were replaced with logistic selectivity curves for each area
2. Using length composition with double normal selectivity for each area.
3. Using length composition with logistic selectivity for each area.
4. Downweighting or effectively removing the West index and age composition with age based double normal selectivity used in the East and Central areas.

Landings Coefficient of Variation (CV) - Two models were evaluated exploring the impact of landings uncertainty.

1. Using Data Workshop provided CVs for the entire data series (1950 - 2023).
2. Using Data Workshop provided CVs post 1990 with the 1950-1989 commercial and recreational landing CVs fixed at 0.05 and 0.15, respectively..

Age-0 and -1 Natural Mortality (*M*) Treatment- Three models were used to evaluate the impact of the externally inflated age-0 and age-1 natural mortality-at-age rates, compared to the internally scaled mortality-at-age rates:

1. Allow Stock Synthesis to estimate a reference *M* with no prior for each area (East, Central, and West) and internally scale the mortality-at-age vector.
2. Allow Stock Synthesis to estimate a reference *M* with an informative lognormal prior and internally scale the mortality-at-age vector using area-specific growth curves. Priors were lognormal with mean equal to the natural log of 0.1040 and SE = 0.25
3. Fix the reference *M* at 0.1040 provided during the SEDAR 74 workshop and internally scale the mortality-at-age vector.

Estimating Growth with Age-0 and -1 Natural Mortality (*M*) Treatments - Four alternative setups for growth parameters were evaluated under two natural mortality scaling conditions (i.e.,internal and external):

Mortality

1. Externally calculated fixed vector of natural mortality-at-age with inflated age-0 and age-1 mortality at age.
2. Reference *M* fixed and internally scaled natural mortality-at-age based on area-specific growth curves.

Growth

1. L_{inf} , L_{min}, and *K* are estimated in the East/Central and West with no priors (Est. 3VB no Prior).
2. L_{inf} , L_{min}, and *K* are estimated in the East/Central and West with normal priors (Est. 3VB Prior). Means were set at values calculated using the data workshop growth curve and standard deviations set at 0.5, 1.0 and 0.05 respectively.
3. L_{inf} and *K* are estimated using normal priors and standard deviations of 1.0 and 0.05 respectively (Est K and Linf Prior).
4. Fixed L_{inf} , L_{min}, and *K* with the CVs for young and old growth being estimated (Est. CV's Prior).

Fishing Effort Survey (FES) - On average the 2024-2025 benchmarking studies suggest a global 22% decrease in trips for private boat fishing mode. Four alternative data structures used to evaluate possible status changes as a result of reductions in private landings and discards with the updated FES design:

1. Use the restricted CVs of 0.05-0.15, and reduce each area's landings and discards to roughly match the potential Gulf wide 22% decrease in trips and their impact on each Stock ID area (25% East, 18% Central and 9% West).
2. Increase uncertainty in the data by using workshop provided CVs alongside 22% reduction in private landings and discards.
3. Use the restricted CVs and reduce each area's landings and discards to roughly 40% Gulf wide (45% East, 33% Central and 16% West).
4. Increase uncertainty in combination with a roughly 40% decrease in private landings and discards Gulf wide.

Great Red Snapper Count (GRSC) Estimate and Selectivity - Model sensitivity to the inclusion of length composition data and fleet selectivity from the GRSC study (Stunz et al. 2021) were evaluated:

Selectivity

1. Every area estimating dome shaped selectivity
2. Every area estimating logistic selectivity
3. The East estimates logistic selectivity and the other two areas have dome shaped selectivity.

Catchability

1. Estimate catchability.
2. Fix catchability at 1.

Hamel and Cope Based Estimate of Natural Mortality - Test model sensitivity to age-specific natural mortality vectors derived from an estimate of natural mortality produced using the methods of Hamel and Cope (2022) rather than Then et al. (2015).

1. Use a fixed Lorenzen based vector of natural mortality at age derived using the Hamel and Cope (2022) based estimate of natural mortality (0.0947).
2. Use a fixed Lorenzen based vector of natural mortality at age derived using the Hamel and Cope (2022) based estimate of natural mortality (0.0947) and modify the age 0 and age 1 natural mortality estimates to 2.0 and 1.2, respectively
3. Use SS's internal natural mortality function to generate age-specific natural mortality estimates based on the Hamel and Cope estimate of natural mortality and an age range of 2 to 57. Should be similar to model 1; however, area-specific variations in growth should be accounted for in this model.

4. Stock Assessment Model - Results

4.1. Estimated Parameters

SEDAR 98 contained 2282 parameters with 1964 estimated. The majority of the parameters (~63%) being annual fleet-specific fishing mortality rates. Most parameter estimates and variances were reasonably well estimated (i.e., CV < 1). Of the active parameters, 163 had CVs exceeding 1. High CV's were observed for several annual recruitment deviation parameters, and for a number of apportionment deviation parameters across both estimated regions. High CV's were also observed for most of the Summer and Fall Trawl Survey selectivity parameters as well as a few ascending and descending limb parameters of the double normal selectivity functions.

4.2. Fishing Mortality

The exploitation rates (total biomass killed age 1+ / total biomass age 1+) for the entire stock are provided in **Table 12**. Since 1950, the exploitation rate for the stock has averaged around 0.092, and ranged between 0.01 in 1950 to 0.222 in 1993. The exploitation rate was estimated to have increased over time from very low levels (<0.05) in the early parts of the time-series to highs near 0.2 in 1990s. Exploitation rate is estimated to have remained elevated through the remainder of the 1990s and early 2000s until 2005 when exploitation rate began to decline. These declines correspond with the onset of targeted management actions designed to rebuild an overfished stock. Beginning in 2006 the exploitation rates declined rapidly achieving a new equilibrium around 0.07, with interannual variations, throughout the remainder of the time series. The terminal year (2023) exploitation rate for the entire stock was 0.07, which is below the time series average of 0.092 but slightly above the average over the last decade (0.066).

Tables 13-19 and **Figures 42-43** show estimates of exploitation rates by area, fleet and year for the open season landed and discarded fish. The results show that in the West area (**Tables 13-16** and **Figure 42**), exploitation for the stock was, initially, primarily derived from the Commercial Handline fleet. However, beginning in the 1970s, exploitation from the Recreational Private fleet steadily increased until it roughly equaled the Commercial Handline fisheries around 1980. Since then, the Commercial Handline and Private Recreational fleets have remained the dominant West area fleets and continue to be responsible for the majority of the exploitation in this area. Regardless of fleet, exploitation rates in the West appear to be relatively stable over the last decade. Initially, exploitation in the Central area was dominated by the Commercial Handline and Recreational Charter fleets. Beginning around 1985, the recreational fleets, in particular the Private Recreational fleet, became responsible for the majority of the exploitation in the Central area. Exploitation for the central commercial fleets appears to have been relatively stable over the last decade; however, model estimates of exploitation for the Recreational Private and Charter Boat fleets appear to have been increasing over the last decade with no indication that they are nearing a new equilibrium state (**Tables 14-17** and **Figure 42**). The Commercial Handline fleet has consistently been one of the larger contributors to total exploitation in the East area (**Figure 42**). The historic contribution of the recreational fleets is difficult to summarize in the east due to high levels of uncertainty associated with the recreational landings data in this area. However, the uptick in exploitation rate estimated for the Recreational Private fleet in the East is supported by more robust sampling and indicates that the sector has increased in relative importance over the last decade.

Figure 43 depicts the estimated exploitation rates by year for the West areas closed season discard and bycatch only fleets. In terms of biomass, exploitation rates for the closed season discard and shrimp bycatch fleets in the West area are estimated to have been low relative to the exploitation rates of the open season fleets. Shrimp Bycatch and Closed Season Discard exploitation rates have generally declined in the West over the last decade nearing time-series lows with the possible exception of the Recreational Private fleet discards which are potentially beginning to increase in the last several years. In the Central area, Closed Season discard mortality and Shrimp Bycatch mortality were estimated to have been very low for all fleets with the exception of the Recreational Private Closed Season Discard fleet **Figure 43**. The Recreational Private Closed Season Discard fleet was estimated as the second largest source of mortality for the Central area for the last two plus decades. The onset of state management of the recreational Private fishery has generally resulted in increased fishing seasons and consequently shorter closed seasons. No obvious trend or notable decline in the estimates of closed season exploitation rate have been observed corresponding with the onset of state management; however, this is a relatively recent change (2018) so additional years of data may be needed before any conclusions can be drawn. **Figure 43** depicts the East area Closed Season Discard and Shrimp Bycatch exploitation rates, which are generally low when compared to the Open Season fleets. However, exploitation due to the Commercial Handline Closed Season Discards was estimated to be quite large (roughly half of the Open Season exploitation rate) prior to the onset of the IFQ and the end of closed seasons for the commercial sector. Exploitation rates associated with the Recreational Private Closed Season Discards were initially highly variable due to low catch and uncertain discard estimation early in the time-series. More reliably, estimated discard data from the last decade and a half indicate that exploitation for this fleet are low relative to the Open Season fleet and potentially declining in line with the onset of state management and the expansion of open season fishing opportunities.

4.3. Selectivity

4.3.1. Length-Based Selectivity

Estimated terminal year fleet and area-specific length selectivity curves for the directed fishery and Closed Season Discard fleets are shown in **Figure 44**. Fleets that utilized double normal selectivity parameterizations were all estimated to be strongly domed, with the exception of the Private Recreational fleet which was estimated to have some selectivity for the smallest size classes in the model. The Commercial Handline and Recreational Private Closed Season Discard-only fleets mirror the selectivity of their equivalent Open Season fleets (i.e., Commercial Handline Closed Season Discards West mirrored the selectivity for Commercial Handline West). The availability of discard composition for the Private Headboat fleet in the East and Central areas allowed for the estimation of independent selectivity for these fleets. The Headboat West Closed Season Discard fleet selectivity was mirrored to the Central fleet. Estimated Closed Season Discard selectivities were similar to the Open Season Headboat fleets but varied slightly (**Figure 44**). Closed Season West/Central Headboat selectivity peaked at a smaller size relative to their Open Season counterparts, but had similar overall selectivity particularly in regards to sublegal and large size classes. The East Closed Season fleet was quite similar to its Open Season equivalent in all aspects indicating that this selectivity could likely be mirrored to the Open Season selectivity to reduce parameterization of the model without compromising fit to the data.

Time-varying aspects of the selectivity for each fleet and area are shown in **Figures 45-64**. In all cases, peak selectivity either remained relatively stable through time or increased to larger sizes through time. Selectivity shifts to larger size classes were most pronounced in the west area fleets, with all fleets regardless of commercial or recreational sector affiliation experiencing pronounced shifts to larger sizes in association with the terminal time block beginning in 2007. The early (pre-2007) time-block estimated selectivity for the Commercial Handline East fleet differs noticeably from the recent time-block for the fleet and from selectivity estimates for the early time-block from the other handline fleets. Low sample sizes for the composition data during this time period may have contributed to this divergence. Exploratory runs with no block on this fleet did not produce noticeably different estimates of key derived management quantities and resulted in poorer fits to length composition from both time-block periods. Consequently, the time-block was left in place for this fleet despite the somewhat unrealistic estimated selectivity form observed in the early time-block.

Estimated terminal year fleet- and area-specific length selectivity curves for the West area Early Fall and Summer Trawl surveys are shown in **Figure 65**. Selectivity for both surveys was estimated using double normal parameterization. For the Fall, selectivity peaked near 10 cm Fork Length (FL) and then declined rapidly toward 0 selectivity by around 35 cm FL. The Early Summer Trawl survey selectivity peaked around 15 cm FL and then subsequently declined rapidly toward 0 selectivity by roughly 25 cm FL. Residual patterns observed in the fits to the length composition for the Fall Trawl survey indicate that, despite peak selectivity occurring at very small sizes, the model was still underestimating the frequency of the smallest size classes in the model. Alternate selectivity treatments for the trawl surveys, and the Fall Trawl survey in particular, may warrant exploration.

4.3.2. Age-Based Selectivity

Selectivity fits for the surveys modeled using age-composition are shown in **Figure 66**. The Central and West area fits were similar for the Bottom Longline survey with both estimating 50% selectivity around ages 6-7 and maximum selectivity around ages 8-9. The Bottom Longline East survey was estimated to select for slightly younger fish with 50% selectivity around age-5 and maximum selectivity achieved around age-7. Differences in gear selectivity by area for this survey would primarily be attributable to differential age-class availability given uniform gear and survey design across areas. Estimated selectivity for the post-2007 Fall Trawl survey was similar across areas, with maximum selectivity estimated at age-0 and then declining rapidly until age-5 after which selectivity was held constant and was estimated to be around 0% for all areas (**Figure 66**). Summer Trawl selectivities peaked at age-0 for the West and age-1 for the Central and East areas. Selectivity then declined toward 0% selectivity for fish age-5 and older. Estimating selectivity for both trawl surveys, especially the Summer Trawl survey, was particularly challenging. Given the difficulty in selectivity estimation, constructing future trawl data as strict indices of age-0 and -1 for the Fall and Summer Trawl surveys respectively, may be beneficial for Red Snapper assessments.

The video surveys were estimated to reach peak selectivity at age-2 in the East area, age-3 in the Central area and age-4 in the West area. Selectivity curves were steeply domed in the Central and West areas which differed from the curve for the East area which estimated maximum selectivity for ages 2-7. The difference in the shape of the East video selectivity was due in part to the low sample size of available age-composition data used to inform the selectivity parameters. The increasing pattern in peak age selectivity from west to east for the video survey may be due in part to regional variations in population age structure, but is likely also due, in part, to differences in sampling design used in the various areas. For example, West sampling was restricted to deeper waters near the continent shelf break where older fish are expected to be more prevalent due to ontogenetic movement patterns known to Red Snapper. Peak age of selectivity was estimated to be age-5 for the East area Commercial Observer Index of abundance. This index had previously been mirrored to the East Commercial Handline fishing fleet; however, the availability of composition data made it possible to independently estimate a selectivity curve for this survey as part of SEDAR 98. Peak age for the survey corresponds well with the mean age of a landed Red Snapper from the commercial fleet which ranged from age-4 to 5.5 years old during the time-period of the survey.

4.4. Retention

Length-based, time-varying retention functions by time block were estimated for each directed fleet and are shown in **Figures 67-80**. In general, the inflection point and width retention parameters appeared well estimated regardless of fleet and area. Estimation success for the asymptotic retention parameter (e.g., retention of fully selected legal size fish) varied by fleet. The model estimated that a number of fleets were discarding a substantial amount (>20%) of legal sized fish from 2007-2023 (see **Figures 81-102** for terminal year length-based retention for all fleets). For the commercial sector, the Handline East fleet (**Figure 83**) and all three areas of Longline fleets (**Figures 84-85**) had asymptotic retention below 80% with the Commercial Longline fleets in the East and Central area estimated to discard approximately 50% of legal sized catch. High-grading and/or regulatory discards were also estimated to occur in the 2007-

2019 time block for the Central and East areas Recreational Charter Boat and Recreational Headboat-for-hire fleets. In both the Central and East areas, Charter boats were estimated as discarding around 20-30% (**Figures 87 and 88**) of legal-sized fish while Recreational Headboats were estimated to discard roughly 40% (**Figures 53-91**). Of the Recreational Private fleets, the East area fleet was estimated to discard approximately 30% of legal sized catch while the Central and West area fleets retained nearly all caught fish.

4.5. Recruitment

As noted in the description of the SS model configuration, two of the three S/R parameters were fixed: steepness (1) and *sigmaR* (0.6). Steepness was fixed as a computational convenience and *sigmaR* was fixed at a recommended value for model stability. The corresponding Beverton-Holt stock recruit curve is shown in **Figure 103**. Estimated annual recruitment of age-0 fish (1000s) from 1985-2022 including recruitment deviations and variance are shown in **Tables 20-22** and **Figures 104-105**. Virgin recruitment in log-space (Ln(R_0)) was estimated at 11.653, which equates to 115.02 million age-0 Red Snapper. The estimated (and applied) recruitment bias adjustment ramp is shown in **Figure 106**.

During the main recruitment period (1985-2022, see **Section 3.1.5**), estimated recruitment averaged 119.41 million Red Snapper and was lowest in 2008 at 7.48 million Red Snapper and highest in 2007 at 310.71 million Red Snapper (**Figure 107**). Recruitment deviations were characterized by a generally upward trend from the 1980s to present with reasonable interannual variations. There was a noticeable drop in recruitment in 2008 (an 98% drop from the previous year). The drop coincides with low, but not abnormally so, index values across all areas for the 2008 Fall Trawl survey which predominantly indexes age-0 Red Snapper and the 2009 Summer Trawl survey, which predominantly indexes age-1 Red Snapper (**Figures 10-12**).

Estimated base recruitment apportionment placed 67%, 26% and 7% of recruits into the West, Central and East areas, respectively (**Figure 107**). These percentages were applied from 1950 until 1984 after which annual deviations were estimated and applied resulting in variable recruitment across the areas. Allowing the apportionment to vary resulted in the model estimating an increasing trend in the relative proportion of recruits going to the Central area, a decreasing trend in the relative proportion of recruits going to the West area, and an initial drop in recruits for the East followed by a gradually increasing trend over time. By the end of the time series, the average apportionment from 2021-2023 was 45%, 51%, 4% for the West, Central and East areas, respectively.

CVs for recruitment deviations during the main recruitment period averaged 0.107 between 1985 and 2022, and ranged from 0.053 in 2007 to 0.315 in 2008 (**Figure 105**). For the last year of the assessment (2023), recruitment deviations were largely informed by the age-0 index, as age-0 and age-1 fish had not yet fully recruited to the fisheries. Estimated recruitment for the terminal year was slightly below average for the recent time-period but not dissimilar from the immediately preceding years. Terminal year recruitments estimated value and associated CV was 86.064 million Red Snapper (CV=0.204).

4.6. Biomass and Abundance Trajectories

The estimated annual total biomass (metric tons), exploitable biomass (age-1+, metric tons), SSB (metric tons), SSB ratio (SSB/virgin SSB) and exploitable abundance (1,000s of fish) from 1950 to 2023 are provided in **Tables 20-22**. Total biomass was consistently greater in the West area than in either the Central or East areas and averaged 80,546 metric tons, and ranged from 20,234 metric tons in 1990 to 184,071 metric tons in 1950 (**Figure 108**). West area exploitable biomass and numbers, which comprised Red Snapper age-1 or older, averaged 80,208 metric tons and 39,248,969 Red Snapper, respectively. Exploitable biomass in the west was lowest in 1990 at 19,822 metric tons and peaked in 1950 at 183,783 metric tons, whereas exploitable numbers in the west ranged from 12,049,900 Red Snapper in 1989 to 98,098,700 Red Snapper in 2013 (**Table 20**). West area SSB averaged 75,944 metric tons, and ranged from 17,748 metric tons in 1990 to 177,309 metric tons in 1950 (**Figure 108**).

Total biomass in the Central area averaged 32,549 metric tons, and ranged from 6,647 metric tons in 1990 to 78,428 in 1950, (**Figure 108**). Central area exploitable biomass and numbers, which comprised Red Snapper age-1 or older, averaged 32,367 metric tons and 21,704,520 Red Snapper, respectively. Exploitable biomass in the Central area was lowest in 1990 at 6,458 metric tons and peaked in 1950 at 78,325 metric tons, whereas exploitable numbers in the Central ranged from 4,922,800 Red Snapper in 1988 to 75,721,200 Red Snapper in 2008 (**Table 21**). Central area SSB averaged 30,835 metric tons, and ranged from 5,698 metric tons in 1990 to 76,743 metric tons in 1951 (**Figure 108**).

Total biomass in the East area averaged 5,181 metric tons, and ranged from 81 metric tons in 1993 to 18,259 in 1951, (**Figure 108**). East area exploitable biomass and numbers, which comprised Red Snapper age-1 or older, averaged 5,162 metric tons and 2,601,664 Red Snapper, respectively. Exploitable biomass in the East area was lowest in 1993 at 78 metric tons and peaked in 1951 at 18,234 metric tons, whereas exploitable numbers in the East ranged from 97,368 Red Snapper in 1992 to 10,737,100 Red Snapper in 2015 (**Table 22**). East area SSB averaged 4,975 metric tons, and ranged from 66 metric tons in 1993 to 17,866 metric tons in 1951 (**Figure 108**).

In all three areas total biomass and SSB show a steady decline from 1950 to the late 1980s, followed by a plateauing off in the 1990s to early 2000s. Starting in the mid 2000s, biomass began to rapidly recover across all three areas with the onset of management actions aimed at rebuilding the stock. Biomass in the west then continued to increase in a near linear fashion from 2005 (**Figure 108**) to around 2018, after which the rate of increase slows rapidly with biomass estimated to have remained essentially stable in the terminal year. Biomass recovery in the Central area was estimated to have occurred at a somewhat faster rate than in the West up until 2012. From 2012 to around 2018 biomass growth continued in the Central area but at a much slower rate. Beginning in 2019, the model estimates rapid declines in biomass for the Central area (**Figure 108**). The East area experienced sustained biomass growth beginning in roughly 2005 until 2019 when biomass stopped increasing and eventually began to decline in 2022. Estimated declines in biomass for the West and East area are primarily observed in the later years of the assessment which carry additional uncertainty due to limited availability of composition data to inform model parameters. Additional years of data will help to identify whether these declines represent regional trends in biomass or simply annual deviations in an equilibrium population. Estimated declines in the Central area present a different problem as they have been estimated to have been occurring for a longer period of time with an obvious trend. Rates of removals in this area of the Gulf have likely exceeded sustainable rates for a number of years and regionally focused management actions should be considered as part of the management discussion.

Initial depletion in 1950 (SSB/SSB_0) was estimated to be 0.70 in the West and Central areas while the East areas were estimated 0.57 (**Tables 20-22** and **Figure 109**). SSB ratios (SSB/SSB0) in all areas were estimated to have declined rapidly from 1950 until around 1990 when biomass levels stabilized at time-series lows for all areas. As stated previously, biomass has increased across all areas over the last 30 years leading the terminal 2023 SSB ratios to be estimated as 0.56, 0.36, and 0.19 for the West, Central and East areas, respectively. GOA wide trends in SSB ratio follow a similar pattern to the area-specific trends with the highest estimated ratio occurring in 1950, bottoming out in 1990 at 0.06 and then increasing rapidly beginning in 2008. The terminal SSB ratio for the GOA was estimated as 0.47 in 2023.

4.7. Model Fit and Residual Analysis

4.7.1. Landings

Landings for all areas and all fleets were fit almost exactly given the relatively small Standard Errors (SEs) imposed by the analytical team to aid in model fitting (**Figures 110-112**). Models using the Data Workshop provided SEs for catch data were explored through sensitivity analyses but were not recommended for use in the base model base their large standard errors increased model instability (**Tables 23-37**). In the East, estimates of landings for 1983 in the Recreational Charter and Private fleets notably exceeded the observed value in that year. Models imposing additional weight on the fit to landings for these fleets should be considered; however, it's unlikely that the misfit of these fleets in a single data year from 1983 would substantially impact estimates of reference points or terminal year management quantities.

4.7.2. Discards

The time series of commercial discards began in 1996 for all fleets and all areas. Observed and expected values are shown in **Tables 38-46** and **Figures 113-115**. Discards from the Commercial Handline fleets historically made up a significant part of the total catch for the West areas, but have been greatly reduced since the onset of the IFQ program in 2007 (**Figures 113-114**). Commercial Longline discards in all areas are low throughout the time series and contribute little to the total catch of Red Snapper in the GOA (**Figure 77**). Fits to all Commercial Open and Closed Season discard fleets in all areas are generally good with reasonable deviations. However, in a few cases systematic biases were observed between observed and expected discards. Open Season Commercial discards in the East show some model fit issues particularly in the later part of the time series. Model fits were reasonably good for the East area Commercial Open and Closed Season discards until 2014 and 2018 for the Handline and Longline fleets, respectively. Thereafter, expected discards exceed observed discards for all remaining years. A similar bias was also observed in the Commercial Longline West fleet (**Figure 113**). While the presence of bias in model fits is potentially indicative of some model misspecification, the very low magnitude of the misfit and the highly uncertain nature of the discard data resulted in the analytical team deciding to take no further steps to attempt to force better fits to these data. Despite the few noted misfit issues, Commercial discards are in general well estimated given the high levels of uncertainty associated with the data and lack of robust composition samples throughout most areas and years.

Observed and expected Recreational Open Season discards beginning in 1981 or 1982 depending on fleet and area are shown in **Tables 47- 58** and **Figures 113-115**. Despite the presence of a few large residuals, the model was generally able to fit recreational discard observations well throughout the time series. A notable bias to the fit was present in the fit to the recreational headboat central fleet from 2000 to 2008. The bias in this period is somewhat surprising as the model has retention time-blocks in place around these years. It's possible that additional flexibility in the retention inflection parameter may have been warranted as that parameters block runs from 2000 to 2023. However, given the fact that the bias was limited to one area and the magnitude of the misfit was relatively small, no additional blocking adjustments were recommended. The remainder of the open and closed season recreational discard fleets were considered to be fit well with no apparent systematic bias or excessive variability.

4.7.3. Indices

Observed indices of relative abundance and their expected fits are provided in **59-75** and **Figure 10-12**. In the West, fits to the observed indices of the exploitable age range of the population (age-1+) were acceptable with RMSE ranging from 0.312 to 0.597, for the Bottom Longline and G-FISHER survey, respectively (**Figure 10**). Fits to the West area Trawl surveys, which predominantly index age-0 (Fall, **Tables 59 and 60**) and age-1 fish Red Snapper (Summer, **Table 63 and 64**) were also acceptable and had RMSEs ranging from 0.343 to 0.634. In general, the expected fits to the West area indices matched the observed increase in biomass beginning around 2010 and captured the strong year classes observed in the age-0 Fall Trawl survey. Fits to the relative indices of abundance in the Central area were acceptable though generally did not fit as well as the West area indices (**Figure 11**). In particular, the fit to the Larval Survey and G-FISHER survey were poor with RMSE values of 0.918 and 0.935, respectively (**Tables 67-68**). The remaining indices fit reasonably well with RMSE ranging from 0.478 to 0.718. Fits to the East area indices of abundance were mixed with the model fitting the G-FISHER and Commercial Observer indices well while somewhat poorly fitting the Bottom Longline, and Trawl surveys. (**Figure 12**). High RMSE values of 1.041 and 0.965 were estimated for the East area Summer Trawl Late and Bottom Longline surveys, respectively. The remaining East area surveys had RMSE estimates of between 0.316 and 0.76.

4.7.4. Shrimp Trawl Effort and Bycatch Data

Observed values and model estimated fits to the Shrimp Trawl effort time series and bycatch data are shown in **Figures 9 and 116**. Generally, fits to the effort and bycatch were good across all areas with low RMSE for the effort series and reasonable fits for the bycatch superperiod.

4.7.5. Length Compositions

Model fits to the retained length composition data are provided in **Figures 13-26**.

Model fits to the survey length composition data are provided in **Figures 27-41**.

Model fits to the discard length composition data are provided in **Figures 117-120**.

The aggregate fits to the length composition data were acceptable across all fleets and surveys (**Figure 121**), with only a few low sample size fleets showing signs of misfitting (e.g., Recreational Charter Boat Discards in the east area). Pearson residuals for length composition fits are provided in **Figure 122** are generally small in magnitude and un-patterned. However, some residual patterns were present in the Handline Central (HL_C retained), Charter Boat Central (CBT_C retained), Headboat Central and West fleets and indicate a possible retention or selectivity mis-specification. The majority of the patterning in the residuals suggests a systematic underestimation of the smallest sized retained fish. Parameters for these fleets were freely estimated and there was no *a priori* evidence to suggest that any specific area or fleet should follow a unique retention pattern. Thus the decision was made to maintain the specified blocks rather than chase potential noise in the data.

4.7.6. Age Compositions

Model fits to the nominal age composition data for many of the surveys are provided in **Figure 123**. Generally, the model fit the age composition well; however, there was a residual pattern observed for the Bottom Longline East Survey (**Figure 124 - 124**). Patterns in the East Bottom Longline fits are likely due to low composition sample sizes resulting in truncated age distributions for most years.

The CAAL data input for the directed fishery fleets was not modeled explicitly through age-specific selectivity functions. Given that growth was also fixed in the model, the resulting model fits to the mean landed age data were better than anticipated (**Figures 125-139**).

Generally, model fits to the mean-age data were within the 95% confidence bounds for all fleets and areas and demonstrated consistent predictive ability across years and in some cases selectivity and retention time blocks (**Figures 140-155**). Notably, the fits to the mean-age data were the worst in the West area, particularly over the last 5 to 10 years. A systematic underestimation of mean-age was observed in the Commercial fleets and an opposite systematic over-estimation of mean-age was observed in the Recreational fleets,especially the Charter and Private fleets. The exact cause of the misfit in the West area is undetermined; however, it may be indicative of an emerging dynamic in the growth of West area Red Snapper or uncaptured changes in the selectivity and retention behavior of the West area fishing fleets.

4.8. Model Diagnostics

4.8.1. Correlation Analysis

Combinations of base model parameters with correlation coefficients in excess of 70% are contained in **Table 76**. Parameter combinations that displayed strong correlation (>95%) are highlighted in **Table 77**. Correlation among many of these parameters was expected, particularly those between adjacent years of recruitment apportionment deviations and combinations of double normal selectivity parameters The strongest correlations occurred between the parameters defining the peak and the width of the ascending and/or descending limb of the double normal selectivity functions for some fleets.

4.8.2. Likelihood Profiles

The total likelihood component from the ln($R0$) likelihood profile indicates that the global solution for the parameter is approximately 11.8 (**Figure 156**), with the base model total likelihood component estimating 11.65.

The total likelihood component from the steepness likelihood profile indicates that the global solution for the parameter is obtained at 1.0 or a value extremely close to 1.0 (**Figure 157**), with the base model parameter fixed at 1.0.

The total likelihood component from the σ_R likelihood profile indicates that the global solution for the parameter is approximately 0.78 (**Figure 158**). The base model has this parameter fixed at 0.6.

Given the large size of the model (i.e., >2,000 estimated parameters), there is a possibility that there is a wide ranging global minimum (i.e., a relatively flat likelihood surface). With the overall flat likelihood surface, individual runs for the likelihood profiles may have landed at various local minimums, resulting in the rough likelihood surface presented for each of the tested recruitment parameters.

4.8.3. Jitter Analysis

One jitter run demonstrated a lower negative log-likelihood (NLL) solution than the base model (**Figure 159**), and 83% of the 100 runs converged. Out of the converged runs 16.9% converged to a NLL within 0.04% of the lowest NLL and 33.7% converged to a NLL within 0.18% of the lowest NLL. The lowest NLL model was used for all diagnostics, sensitivities and projections.

4.8.4. Retrospective Analysis

Results of the retrospective analysis illustrate a strong level of consistency within the model. As years of data are peeled off, the model estimates of spawning potential ratio (SPR) in each successive terminal year do not change by a large margin and show no pathological trend of over or underestimation (**Figure 160**). Recruitment estimates are slightly more variable with some peels demonstrating underestimation (Mohn's rho = -0.297). However, the magnitude of differences compared to the base model with the full data time series is minimal and there is no constant trend that might indicate model issues. Mohn's rho, which measures the severity of retrospective patterns, was equal to -0.089, -0.059, and -0.006 for the SSB, SSB ratio, and F time series respectively, which is within or near the acceptable range (-0.15 to +0.20; see Hurtado-Ferro et al. 2015).

4.8.5. Jack-knife Analysis

The results of the index jack-knife analysis, which ran the model with one fishery-independent index removed, generally showed that models converged with the base model in the recent time period (**Figure 161**). Removing the G-FISHER Video survey was the only run that resulted in a different result in the recent time period. Removing the G-FISHER Video Survey lowered the spawning biomass in the last 10 years.

4.8.6. Additional Diagnostics

Runs test results revealed evidence of non-randomly distributed residuals for the G-FISHER Central and G-FISHER West Video Survey, the NOAA NMFS Bottom Longline East, and the Commercial Observer Eastern indices of abundance (**Figure 162**), Commercial Handline West and East, Longline West and East, Recreational Charter Central, and all Recreational Private length compositions (**Figure 163**) and G-FISHER Central and Bottom Longline Central age compositions (**Table 78**; **Figure 164**). Although they did not reveal evidence of non-randomly distributed residuals - outliers (evident by red points) were identified in the residuals for the Bottom Longline Central and Summer Trawl Late East Survey indices, residuals for mean age for Commercial Observer East and Bottom Longline fleets, and in residuals for length compositions for the Commercial Handline Central, Recreational Headboat West and Central, and the Early Fall Trawl West Survey.

From the hindcast cross validation analysis, superior prediction skill (MASE <1) was evident over the naive baseline forecast for the mean age for G-FISHER East , Bottom Longline East, and Late Fall Trawl East and Central (**Figures 165**). For mean length, superior prediction skill is evident for the Commercial Handline West and Central (**Figure 166**) . Unsurprisingly the model also showed superior predictive skill for most indices except the West G-FISHER Video Survey and the Post 2006 Summer Trawl West (**Figures 167**).

4.8.7. Continuity and Bridging Analyses

The previous operational model used for Gulf Red Snapper management was SEDAR 52, which incorporated data streams beginning in 1872 with a terminal year of 2016 and utilized a two-area spatial configuration ("fleets-as-areas" SS methodology). Completing a direct continuity run for SEDAR 98 is functionally impossible due to major structural and methodological changes in data preparation that have occurred since the SEDAR 52 assessment. Despite the challenges and limitations, a sequential continuity and bridging analysis was conducted to assist reviewers and policymakers in interpreting the impacts of specific modeling decisions on assessment-derived management quantities.

Two-Area Continuity Model Configuration To bridge the operational SEDAR 52 model to the SEDAR 98 assessment model, a baseline continuity model (i.e.,S98_2Area_Continuity_Model, **Table 79** and **Figure 168**) was constructed based on the SEDAR 52 base model parameterization and two-area stock structure, extending the data time series from 2016 through the SEDAR 98 terminal year of 2023. Because SEDAR 98 datasets were prepared for three spatial regions, data from 2017 to 2023 required specific aggregation and scaling procedures to conform to the historical two-area structure:

- **Landings and Fleet Aggregation:** Commercial Handline (HL) and Longline (LL) landings, discards, and nominal age composition data from the SEDAR 98 East and Central areas were summed to reconstruct the SEDAR 52 East region. Commercial data for the west area was used as provided. For the recreational sector, SEDAR 98 Charter Boat (CBT) and Private (PRIV) landings, discards, and compositions were combined into the historical SEDAR 52 Marine Recreational Information Program ("MRIP") fleets for both East and West areas. To reconcile recreational data currencies, MRIP Fishing Effort Survey (FES) landings from 2017–2023 were converted to Coastal Household Telephone

Survey (CHTS) units by applying the average landings ratio (FES/CHTS) calculated over the 2007–2016 period. Because Headboat data do not require currency calibration, SEDAR 98 West Headboat data were used directly, while East and Central Headboat data were summed to represent the SEDAR 52 East Headboat fleet.

- **Indices of Abundance:** All fishery-dependent indices of abundance (Handline, MRIP, and Headboat) were truncated at 2016 or their respective historical terminal years due to the fact that these were no longer produced as part of SEDAR 98 data production. Fishery-independent indices in the West area were extended through 2023 by scaling SEDAR 98 West data to match the SEDAR 52 time series using the average ratio of the index values S98:S52 from 2012–2016. SEDAR 98 East and Central indices could not be naively combined to create an updated "East" index that fit into the SEDAR 52 framework. Therefore, SEDAR 98 Central area indices were substituted as proxies for the SEDAR 52 East indices (including the Larval Survey, Summer Trawl, Fall Trawl, and Bottom Longline surveys), as the SEDAR 52 "East" indices were primarily based on the much more abundant data from the Central area. These proxy series were rescaled to match the magnitude of the SEDAR 52 indices using average 2012–2016 ratios. CVs for the indices were standardized to a common mean of 0.2 with interannual variability, following SEDAR 52 best practices. Due to differences in gear selectivity and spatial coverage between historical SEAMAP Video Surveys and the modern Combined Video surveys (G-FISHER), it was determined that the populations being indexed by the old and new video design were not equivalent. Therefore the video survey indices were truncated at 2016 rather than extended to the new terminal year of 2023.

- **Handling Open and Closed Season Discards:** SEDAR 98 Commercial discards post-2007 are no longer split into Open and Closed seasons, with all discards being attributed to the Open season. Rather than attempting to split these discards in Open and Closed seasons to match SEDAR 52, the 2017 to 2023 SEDAR 98 discards were combined with the pre-2017 Open season SEDAR 52 discards creating a hybrid time-series which was effectively, start year to 2016 Open Season discards, 2017 to 2023 total discards. A retention parameter block was implemented for 2017–2023 on asymptotic and inflection parameters to allow the model to accommodate the shift of Open season retention behavior to combined Open/Closed retention behavior. As with other data sources, the SEDAR 98 West data used in this step was used as provided, and the East and Central data were combined to form the SEDAR 52 East area. Recreational MRIP discards were summed across Open and Closed seasons, converted from FES to CHTS currencies using 2012–2016 discard ratios, and subsequently partitioned into open and closed season components using average 2012–2016 open-to-closed ratios. Headboat discards were extended through 2023 by summing East and Central discards into combined annual series without seasonal splitting.

- **Shrimp Bycatch and Effort:** Shrimp trawl effort for 2017–2023 was estimated by summing annual SEDAR 98 effort across the Central and East regions, rescaling the estimates to match the SEDAR 52 scale using the average S98:S52 effort ratio from 2012–2016, and appending them to the historical time series with CVs fixed at 0.1 . Shrimp bycatch super-periods were extended through 2023 using SEDAR 52 median bycatch values as operational placeholders.

Two-Area Continuity Model Configuration Results: The two-area continuity model demonstrated acceptable agreement between SEDAR 52 and SEDAR 98 data trajectories. Gulfwide abundance appeared to continue its upward trajectory with variable but untrending exploitation rates. While management recommendations cannot be made directly from the continuity model due to the ad-hoc nature of the data scaling, it provides an appropriate baseline and proxy for subsequent bridging analyses (**Table 79 and Figure 168**).

Three-Area Continuity Model Configuration

To examine the effect of transitioning from a two-area to a three-area spatial structure, as established during the SEDAR 74 Research Track Stock ID workshop, the two-area continuity model was reconfigured into a three-area continuity model (i.e.,S98_3Area_Continuity_Model, **Table 79**). This step incorporated both data and structural adjustments:

- Historical data from 1872–2016 were partitioned into three areas, updating historical time series where methodologies had been modified.
- For landings, West area continuity data were retained, while East area continuity landings were split into Central and East components using regional ratios derived from SEDAR 98 data.
- For relative abundance indices, West area continuity indices were used where possible, while updated SEDAR 98 series were applied in the Central and East regions for the G-FISHER video, Bottom Longline, and Fall/Summer Trawl surveys.
- To ensure the newly partitioned East and Central areas behaved functionally as a single historical eastern unit, key parameters—including catchability, selectivity, and retention—were shared across the two regions.

Three-Area Continuity Model Configuration Results: This initial spatial bridging step verified that transitioning from a two-area to a three-area configuration exerted minimal influence on stock-wide estimates of exploitation, relative abundance, and overall stock productivity when accounting for data formatting constraints (**Table 79**).

Sequential Bridging Analyses

Following the establishment of the three-area continuity model, sequential bridging runs were performed to evaluate model performance across systematic structural and data updates. Due to the interconnected nature of integrated assessment data, bridging models were executed sequentially in the following order:

- **Full SEDAR 98 Data Transition:**
    - Three-area continuity data streams were entirely replaced with complete SEDAR 98 datasets through 2023. This included updating catch and discard series, incorporating new shrimp effort and bycatch data, removing discontinued fishery-dependent indices, and introducing the commercial observer index in the East area. CVs for data were updated at this time as well (i.e., S98_3Areas_Update_All_Data, **Table 79**).

- **Start Year Update:**

The model start year was advanced from 1872 to 1950 (as recommended in SEDAR 74) to reduce reliance on highly uncertain historical reconstructed landings. This change had negligible impact on recent derived quantities, including terminal biomass, fishing mortality, and recruitment (i.e.,Update_StartYear_1950, Table 79).

- **Recruitment and Apportionment Dynamics:**
    - A prior was implemented to stabilize baseline recruitment apportionment estimates, and annual apportionment deviations were restricted to data-rich years (1985–2023) with standard deviations fixed at 0.5.
    - Stock Synthesis was configured to utilize steepness in initial equilibrium calculations, accounting for non-virgin conditions in 1950. Using this feature is generally considered best practices; however, in this specific case it should have no impact since steepness is essentially 1 in the model.
    - Fixed σ_R was updated from 0.3 to 0.6 to align with current Gulf best practices.
    - Recruitment deviations were restructured: zero-sum main deviations were restricted to the data-rich period (1985–2022), early deviations (1950–1984) were freely estimated to decouple the early data-poor period from R_0 estimation, and terminal-year recruitment (2023) was estimated freely but constrained close to zero via data weighting.

Recruitment and Apportionment Dynamics Results: While late-period spawning stock biomass estimates were largely unaffected, removing full-time-series zero-sum constraints resulted in increases in estimated biomass and depletion during the first 30 years of the model (i.e.,Update_Recruitment, **Table 79**).

- **CAAL Integration and Data Weighting:**
    - Directed fleet structures were reordered and updated within the control file to conform to SEDAR 98 conventions, removing obsolete fleets (e.g., commercial longline closed-season discards).
    - Conditional age-at-length (CAAL) and mean-length-at-age (MLAA) data were integrated, and nominal age series were removed to eliminate data redundancy.
    - Lambdas of 0 were applied to allow the model to not fit the MLAA data, utilizing them exclusively as independent diagnostics of model performance.
    - Data weighting lambdas were updated to SEDAR 98 base specifications, removing weights that previously forced fits to shrimp bycatch and closed-season discards, and applying a 50% downweight to Commercial Handline West discards due to conflicting trends in raw data.

Refinement of Fishing Mortality Methodologies:

Fishing mortality parameterization transitioned from parameter-based rates to the Hybrid F method, and the maximum allowable F boundary was expanded from 2.0 to 4.0. Initial fishing mortality estimates were incorporated for shrimp trawl sectors.

Refinement of Fishing Mortality Methodologies Results: Updating the way in which fishing mortality was parameterized and constrained in the model had a fairly large impact in model derived trends in biomass, fishing mortality and recruitment. The majority of these impacts are linked to the inclusion of shrimp bycatch mortality in the initial equilibrium calculations which drove the model to estimate increased R0 as well as much greater initial depletion for the stock. Making changes to the Shrimp fleet in this way without simultaneously updating selectivity assumptions likely created data incongruencies that lead to some unusual model results (i.e.,Update_F, **Table 79**).

- **Comprehensive Data Weighting Update:**
    - Dirichlet-Multinomial (D-M) data weights for the composition data with the DM parameters for trawl surveys fixed at high values to upweight composition fits and constrain selectivity curves. This step was found to be necessary during assessment model development due to the models tendency to not fit the trawl composition when left to freely estimate the selectivity form.
    - Additional standard deviation parameters were estimated for abundance indices to balance index weighting against composition data.

Comprehensive Data Weighting Update Results: SEDAR 52 and SEDAR 74 both used low CVs (scaled to a mean of 0.2 with interannual variability) for the index data to force the model to fit these over the composition data. Based on recommendations from the SEDAR 74 review panel and internal Gulf fisheries best practices discussions the scaled CVs were replaced with the index estimated CVs and the stock synthesis feature of allowing the model to estimate additional error for CVs was implemented. In all cases error around the indices was increased effectively increasing model fit to the composition at the expense of the indices. The result of this was a noticeable increase in terminal estimates of biomass and the first estimates of population decline in the last couple years of the model (i.e.,Update_remaining_DW, **Table 79**).

- **Biological Parameter Update:**
    - Biological specifications were updated to include three distinct regional growth patterns, settlement timing was standardized to mid-June (month 6.5), and the age-0 natural mortality (M) estimate was adjusted to match updated settlement timing.
    - Underlying growth, maturity, and morphometric relationships were updated to SEDAR 98 estimates, while the fecundity-at-age vector was temporarily retained to evaluate derived quantities during the bridging process in Total Egg Production (TEP) scale rather than SSB which was preferred during SEDAR 74 and SEDAR 98.
- **Selectivity, Retention, and Blocking Reconfiguration:**

- Time-varying blocking structures were streamlined where supported by the management history (e.g., SEDAR 52 and 74 blocked all management changes even 1cm short lived adjustments to minimum size, SEDAR 98 eliminated some of this complexity.
- Selectivity for all directed fleets and data-rich surveys was transitioned from age-based to length-based parameterizations, maintaining length-based retention across all sectors. This decision follows on from SEDAR 74.
- Estimated parameters were reduced for double normal selectivities by utilizing built in stock synthesis features for the initial and end selectivity, and fixing the highly correlated “top” parameter at small values.

Selectivity, Retention, and Blocking Reconfiguration Results: The updates to selectivity and retention had a large impact on model estimates of spawning stock biomass, productivity, recruitment and exploitation rates. Of greatest interest is the change in model perception of stock recovery over the last 20 years and the terminal year depletion rates that will have a direct effect on determination of stock status. Presently due to the complexity of the fleet structure and sheer number of selectivity and retention changes made since SEDAR 52, the specific mechanism driving the change in derived quantities remains unknown. Additional modeling efforts are being completed in the hopes of identifying the exact cause for the shift prior to final review (i.e.,Update_Selex_Ret, **Table 79**).

- **Revised Discard Mortality Estimates:**
  - Discard mortality rates were updated based on SEDAR 74 recommendations, removing time-varying rates and generally decreasing commercial discard mortality estimates while increasing recreational rates.

Revised Discard Mortality Estimates Results: As seen during SEDAR 74 changes to the discord mortality rate had only a limited impact on derived management quantities in the model (i.e.,Update_Discard_Mortality, Table 79).

For the Final SEDAR 98 Base Model the fecundity-at-age vector was removed, transitioning management reference points and derived stock quantities from TEP-based metrics to Spawning Stock Biomass (SSB). The final SEDAR 98 base model varied little from the updated selectivity and retention bridging model. The switch to SSB over TEP results in a slightly improved perception of terminal spawning stock biomass and increased rate of stock recovery. This dynamic was also seen during the SEDAR 74 modeling exercises where SSB was initially proposed for use in management over TEP (**Table 79 and Figure 168**).

4.8.8. Sensitivity Model Runs

Results for the sensitivity runs summarized in **Section 3.4.3** are discussed below. Models are presented in **Table 80**.

G-FISHER Index and Composition

Using length-composition instead of age-composition does not significantly change the model’s derived quantities. This model is the only sensitivity model that increases estimated productivity, though it does not improve fit or stability (i.e., Gradient increase by ~0.08 compared to the base model,**Table 80**). Changing selectivity from domed to logistic, whether fitting to age-composition or length-composition causes a decrease in derived quantities (i.e., terminal spawning biomass), both reducing estimated productivity of the stock. The model fit declines when attempting logistic selectivity, indicating that the larger/older fish expected by the model are not in the G-FISHER data set. Removing the Western index and composition data expectedly caused the largest reduction in NLL due to the reduced dataset size. The western G-FISHER index indicates an increase in population size over the last 10 years such that when it is removed from the model estimated productivity R_0 decreases slightly, and the spawning biomass toward the end of the time series decrease compared to the base model (**Figure 169**).

Landings CV

The alternative model using the Data Workshop supplied CVs for the entire time series did not successfully converge. Having tight CVs prior to 1990 and using Data Workshop provided estimates of uncertainty post 1990 expectedly decreased model fit and model stability (**Table 80**). The post-1990 model does not experience as much of an increase in spawning biomass as the base model (tight CVs) in the last 10 years, but they both converge to the same point at the end of the time series (**Figure 170**).

Age-0 and -1 Natural Mortality (*M*) Treatment

Results of models where the reference *M* was estimated to produce nonsensical M values (i.e., some areas with very high *M* and other regions with *M* estimated to be close to 0) are not shown in the results. When compared to the base run (i.e., fixed growth with the artificially inflated mortality for age-0 and -1 fish) the internally scaled mortality run ended up in a very different place for the unfished spawning biomass and only slightly different places for the current spawning biomass. This led to the two runs resulting in populations with slightly different depletion rates but both models resulting in a stock status above the management target. To get to these points it seems the model is either using productivity to recreate the high catches and bycatch (i.e., external M run) or the initial spawning biomass (i.e., internal M run). When mortality is scaled internally, the model uses this opportunity to increase the initial spawning biomass of the population whereas the base model with the externally inflated values instead increases the overall magnitude of recruits being put into the population.

Allowing the mortality- at-age to be scaled internally improves the NLL and the model stability (i.e. Fix_ref_M run, **Table 80**).

Estimating Growth with Age-0 and -1 Natural Mortality (*M*) Treatments

Given the results of the previous sensitivity where fixing the reference *M* and internally scaling age -0 and age-1 mortality increased model fit and stability comparisons were made to determine if growth parameters could also be internally estimated given the wealth of data. Allowing SS to estimate various growth parameters regardless of the treatment of age-0 and age-1 mortality, improves model fit by reducing the NLL but unfortunately it also severely decreases model stability (**Table 80**). The only tradeoff between model fit and model stability seems to come when only the CVs are estimated. Allowing SS to estimate any of the growth parameters *K*, L_{inf} and/or L_{min} despite the treatment of *M*, decreases model stability and results in an uncertain and severe decrease in the spawning biomass. In these runs the model is also estimating relatively high overall fishing mortality rates.

MRIP FES

The reduction in private landings magnitude as a result of the update in FES methodology does not significantly impact the current spawning biomass of the population. It does slightly change the model's perception of the unfinished population size, therefore providing a slightly more optimistic view of end year depletion (**Figure 171** and **Table 80**). Changes in CVs around the catch data did not have much of an effect on the model fit (**Table 80**).

GRSC Estimate and Selectivity

The model is more sensitive to the treatment of catchability rather than the choice of selectivity with the newly included composition data (**Figure 172 and Table 80**). Ending depletion is impacted by the composition data, and the selectivity choice only when catchability is fixed, increasing the spawning biomass. Despite the additional composition data the model does not seem to benefit from the inclusion of the GRSC in the model as the NLL and model stability overall appears to increase when it is included. The model stability only increases when the selectivity is domed in each region. A domed shaped selectivity function is not ideal for this survey as it was intended to select fish that were age 2+, indicating a logistic selectivity should fit best.

Hamel and Cope Based Estimate of Natural Mortality

All model variations that used the Hamel and Cope based estimate of natural mortality (***M*** =0.0947) had predictably lower estimates of R_0 and annual recruitment and higher estimates of virgin spawning stock biomass when compared to the candidate base model (***M*** =0.1040); (**Figure 173 and Table 80**). The effect of the change in natural mortality was less pronounced when the age-0 and age-1 values were modified to their externally derived values of 2 and 1.2, respectively. Estimates of stock status in the terminal year of the assessment are unchanged regardless of the choice in ***M***; however, the estimate of terminal year depletion was substantially lower under the assumption of fixed age-specific Hamel and Cope natural mortality versus the proposed base model. The model utilizing Hamel and Cope natural mortality with the age-0 and age-1 values modified to externally derived values would currently meet all best practices for the Gulf fisheries branch of the SEFSC and the Gulf SSC. Other model configurations would also be reasonable to consider as alternate base model configurations.

5. Discussion

5.1 Response to SEDAR 74 Reviewer Concerns

The SEDAR 98 Red Snapper assessment incorporates much of what was developed and implemented during SEDAR 74 while also making specific changes to address reviewer concerns from the previous assessment and updates to best practices and data preparations. Chief among the concerns expressed during the SEDAR 74 review workshop were, 1) the overreliance on length composition in the assessment model, 2) the use of non-zero sum recruitment deviations throughout the entire estimated time-series, 3) the standardization of the CVs for the indices of abundance to a common mean of 0.2 with inter annual variation and 4) the appropriateness of the estimate of absolute abundance from the Great Red Snapper Count (GRSC) for use in integrated stock assessment models.

To address the concerns around composition data, SEDAR 98 incorporated conditional-age-at-length data for all the directed fleets during the years for which robust sampling was obtained, which varied on a fleet to fleet basis. Despite reservations from the SEDAR 74 review panel over the use of length-based selectivity in the model, the SEDAR 98 analytical team and Panel agreed that it remains the best approach to model the fleet and fish interaction in the model in the same way as it occurs on the water. Fishery interactions and decisions, both in gear selectivity and retention, are not explicitly made based on the age of the fish. Length and body size predominately determine whether a fish can interact with a given hook size and whether an angler decides to retain or release the captured fish. Making use of the integrated nature of the stock synthesis modeling platform to directly model fishery and fish interactions in length remains supported as the best course of action in this assessment. That being said, the criticism levied by the review panel during SEDAR 74 that it was misguided to exclude high quality fishery dependent age composition data in favor of only length composition was warranted. To address this, the analytical team introduced the CAAL data for all directed fleets. The fleet specific, age-based selectivities were not directly estimated in order to avoid model overparameterization. However, the information on year class strength contained in the CAAL data was explicitly accounted for as the length-based selectives being estimated had to accommodate and minimize the likelihood components of both pieces of information.

Second, The SEDAR 74 panel expressed concerns over the move toward implementing unconstrained recruitment deviations as the base model approach to estimating recruitment variability. The SEDAR 74 decision to implement the unconstrained recruitment deviations stemmed from the desire to remove a somewhat arbitrary R_0 block that was placed into earlier Red Snapper assessment models. The R_0 block was implemented as a "computational convenience" which is to say that it was needed to alleviate intractable tension in the early data poor years of the model. The Gulf Red Snapper fishery is old, with removals predating monitoring by over 100 years. During that early data poor period it is widely acknowledged that the stock underwent prolonged periods of overfishing eventually experiencing extremely low Gulf wide abundance in the 1980s and 1990s, around the time that catch monitoring began in earnest. What estimates that are available of the early removals are highly uncertain and in many cases are lower than the estimates of removals being experienced in recent years, especially once dead discards are included in the calculations. Consequently, the model is faced with the need to reduce population abundance with catch data that is less than what it is being observed during the period for which all available indices suggest the stock is rapidly recovering. This issue could potentially be handled by truncating the model start year to an even more recent year (e.g., 1981 or `83 when catch and survey data begin). However, doing so would create a one-way-trip situation where biomass only increases during the modeled time-period making the estimation of key population parameters difficult, if not impossible. Given this assessment's estimation of recently declining abundance, at least in some geographical areas, it is possible that sufficient contrast will be available for future assessments to successfully truncate the model, eliminating the need for either the R0 block or the approach employed in SEDAR 98. For SEDAR 98, to address the concerns of the SEDAR 74 reviewers a combined approach was used that made use of zero-sum deviations during the data rich period of the model and used the unconstrained simple deviations for the early data poor years. This seemed the most reasonable compromise since it allowed the model to utilize only the data for which composition and reliable catch data existed to inform the estimation of R0 and allowed the early simple deviations to capture uncertainty in recruitment and potentially other unspecified time-varying dynamics such as changes in stock productivity or potential biases in historic catch estimation, for example. This approach was preferred to trying to explicitly model a time varying dynamic in recruitment due to the fact that no specific methodological reason could be identified as the basis for the modeling. Rather than guessing at a mechanistic reason, employing the simple deviation approach allowed the model maximum flexibility to reconcile the early and highly uncertain time-series data with the later data rich period.

Recruitment deviations during the main zero-sum constrained time-period (1984-2022) still trend through time, generally increasing until the late 2000's before stabilizing and potentially declining over the most recent years. This pattern in recruitment deviations fairly closely matches the trends in model estimates of population abundance over the same time-period indicating that the recruitment deviations may be compensating for a misspecification in the stock-recruitment relationship, specifically in the steepness value. Numerous attempts were made throughout model development to estimate steepness with and without priors and under various recruitment deviations configurations. All of these attempts failed with the model always estimating steepness values at or only marginally less than 1. The multiple stock assessment areas in the red snapper model likely contribute to the inability to estimate steepness. In the model, the steepness parameter is a global parameter (i.e., there is a single SR relationship for all areas); however, it is being informed by regionally specific data that is reflective of differing relative abundance at a given time, fishing intensity, and settlement habitat quality and availability among other factors. Lastly, an extreme negative deviation is estimated in 2008 indicating abnormally low recruitment for that year. This estimate is supported in the data by low index values in the trawl surveys, particularly in the 2009 summer trawl indices that would be indexing primarily 1 year old fish spawned in 2008. Hurricane Ike traveled through the GOA during September of 2008 eventually making landfall in Texas. This corresponds with peak Red Snapper spawning and may have played a role in disrupting settlement; however, GOA hurricanes are not uncommon with many others occurring during the assessment time period without noticeable impacting recruitment.

Previous red snapper models had used CV mean standardization as a method for giving equal weight to indices of abundance. This process was used to allow fishery independent indices of abundance which typically had relatively large CVs due to the limited scope of survey sampling to not be completely overwhelmed by the signal coming from fishery dependent indices of abundance which often had relatively small CVs. Part of the reasoning behind this decision was that it was thought that the CVs associated with the fishery dependent CPUE indices were artificially small and reflected the uncertainty associated with the statistical model used to standardize the data rather than the uncertainty in the estimate of relative abundance. This approach was used in SEDAR 74 to standardize all indices to a common mean CV of 0.2 and was rejected as a best practices approach by the review panel. The analytical team agreed with this recommendation in part because SEDAR 74 also saw the removal of all fishery dependent indices so the need to balance the relative weight of the various indices had been eliminated. Consequently, SEDAR 98 makes use of the provided CVs for all indices of abundance. This step alone generally increases the uncertainty around the indices and therefore effectively gives more weight to the composition data. Furthermore, as part of SEDAR 98 additional uncertainty was estimated for the indices. These parameters could in theory increase or decrease the CVs around the indices, but in all cases the resulting parameter estimates increased the uncertainty for the indices. The model remains somewhat sensitive to decisions around data weighting with some emergent conflicts in signal from the indices and composition data. Any management decisions made from this model should fully consider the implications of data weighting decisions and how they play into uncertainty around stock status determination criteria and yield forecasts.

Lastly, SEDAR 74 attempted to incorporate the index of absolute abundance known as the Great Red Snapper Count. This study produced a single year estimate of absolute abundance for Gulf red snapper that was later split into separate single year estimates of abundance for the three stock areas used in the assessment. Estimates of uncertainty were provided with the abundance estimates but notably, no estimates of survey catchability or compiled composition data were made available to the analytical team during the SEDAR 74 assessment development process. The SEDAR 74 review panel was critical of the inclusion of the estimate in an integrated stock assessment and recommended that it not be included in future assessments unless externally derived estimates of catchability could be provided and composition data could be compiled and used to estimate selectivity. The SEDAR 98 data workshop attempted to address these concerns and was successful in producing length frequency data for selectivity estimation (See section 5.2 for more detail) but was unable to provide estimates of catchability. As a result GRSC data was only included in SEDAR 98 as part of a sensitivity analysis and is not recommended for inclusion in the base model. This conclusion does not in any way detract from the value of the GRSC in general. It can still serve as a valuable piece of external information when discussing stock assessment results and management decisions. However, because the assertion that the survey is a genuine estimate of absolute abundance has largely been rejected under review, the absence of information to inform the catchability parameters severely limits the ability of a single year index to provide meaningful information in an integrated stock assessment framework. The only reasonable path forward is to utilize the assumption used in SEDAR 74 of fixing catchability at 1 (i.e., make the estimate an absolute index of abundance); however, this assumption was rejected in review of the previous assessment and therefore is not a valid approach in the current modeling effort.

5.2. SEDAR 98 Data Caveats

Recreational Statistics

Since the last Gulf Red Snapper assessment was used for management (SEDAR 52), there have been concerns from the fishing community over the Marine Recreational Information Program (MRIP) Fishing Effort Survey (FES) and its potential bias. Initially, the accuracy of the FES based estimates was called into question, particularly for Red Snapper estimates of recreational statistics derived from state run surveys, because they differed substantially from FES estimates. Research was conducted to understand potential biases in the FES survey design, improve the future design and calibrate the data set retroactively.

To address potential sources of bias in recreational fishing data, NOAA Fisheries conducted a six-month pilot study published in August 2023 (NOAA Fisheries 2023). The pilot study changed the survey’s question sequence, asking anglers about their fishing over a 12-month period before asking about the most recent two months. As anticipated, this adjustment resulted in fewer reporting errors and illogical responses. More importantly, it produced effort estimates that were generally 30 to 40 percent lower for shore and private boat modes than the previous design, thus reducing overall landings estimates, prompting a larger, full-year follow-up study in 2024.

The newly improved FES was officially implemented for the private recreational sector in January 2026. The new survey utilizes a revised question sequence and is now administered on a monthly basis rather than every two months. As a result of these enhancements, the finalized new survey is expected to produce significantly more accurate data, with the full study results indicating an average reduction in effort estimates of 22% for recreational private fishing compared to the old design. Previous data is being calibrated to match the scale of the new survey design (NOAA Fisheries 2025).

The fully calibrated historical estimates are scheduled to be published in the summer of 2026 and will still need to be standardized for the individual species once it is released, therefore the current S98 Benchmark assessment model used for initial projections does not use the calibrated FES data. The analytical team has conducted sensitivity analyses (Section 4.8.8) to determine the potential impact of the expected changes to the data as discussed in the pilot study (citation). The sensitivity analysis indicated that the predicted reduction in the recreational private fishery does not significantly change the ending spawning biomass of the stock but it does influence the models perception of the initial spawning biomass. This is likely due to the fact that total removals for all fishing sectors remain high in past years despite a slight reduction in a major component.

Great Red Snapper Count Length Composition Caveats (GRSC)

Length composition data from participating studies were requested during the SEDAR 98 data workshop. During the workshop it was discovered that none of the data had been standardized across the Gulf or prepared for inclusion into the stock assessment, therefore a massive effort was undertaken by the analytical team to investigate, standardize, and incorporate the raw length data into a format compatible with the Red Snapper stock assessment model. The length composition data were standardized and partitioned into three Stock Identification (ID) regions (East, Central, and West) using spatial coordinates. The initial datasets varied drastically by state in format, collection methodology, and available attributes, suffering from severe spatio-temporal and methodological fragmentation. Spanning 2018 to 2020, the collections utilized four distinct gear types (handlines, vertical longlines, bottom longlines, and remotely operated vehicles [ROV]) across seven habitat classifications (artificial reefs, natural reefs, uncharacterized bottom [UCB], pipeline crossings, platforms, no structure, and unknown structures). However, no single gear or sampling effort consistently characterized the Gulf of America Red Snapper population. For example, the East area was sampled exclusively via ROV on natural reefs, while the Central area employed a fragmented mix of gears where only bottom longlines sampled the UCB. The West area was similarly disjointed, relying on vertical longlines in Texas and handlines in Louisiana. Furthermore, several data limitations complicated this process: Florida records lacked depth data and required geographic splitting to allocate the panhandle to the Central area, and several states included non-GRSC data sources and years. Because of these pervasive sampling inconsistencies, length frequencies had to be weighted by habitat type to accurately reflect each habitat’s true contribution to the overall GRSC abundance estimates. A primary caveat of the raw GRSC data is a drastic mismatch between sampling effort and actual population distribution; while uncharacterized bottom (UCB) accounts for the vast majority of estimated abundance in areas like Louisiana and Texas, length samples were disproportionately extracted from artificial reefs (and Texas lacked UCB length samples entirely). To correct this bias and prevent artificial reef samples from skewing the assessment, UCB data were upweighted and artificial reef data were heavily downweighted when combining samples across states and years for the West and Central areas. While this habitat-based weighting successfully shifted the length distributions to better represent the true population structure, the necessary reliance on data pooling including borrowing Alabama's natural reef-to-UCB ratios for Florida, or using Alabama's 2018 data to proxy Mississippi's population - highlights the significant limitations and assumptions required to use the underlying raw data (Denson and Smith, in prep). A publicly available *shiny app* was created to investigate the variability in the provided data. Despite these efforts to extract a signal from the provided data, the inclusion of the length composition did not have a significant impact on the models ability to fit the GRSC abundance data (See section 4.8.7).

G-FISHER West Population Representation

During the process of model building, evaluating the fit of the G-FISHER (Combined Video Survey) West index revealed notable caveats including data processing changes and possible influences of underlying ecological dynamics. Initially, the model struggled with fitting both the increase in the index of abundance trajectory and the larger fish in the length composition. In the process of uncovering this conflict it was revealed that there was an error in the transition in the data build pipeline from SAS to R. This coding error inadvertently pulled incorrect length records. This was a known issue that had previously affected species like Lane Snapper and Gray Triggerfish in the past. Data providers subsequently corrected the extraction code to generate an updated West index and revised annual length compositions. However, even with the corrected data, the G-FISHER length compositions consistently lack the larger, older Red Snapper size classes, pointing to possible sampling bias that may be a conflict between the Red Snapper life history and the video surveys gear selectivity. We hypothesize that the absence of large fish was primarily driven by an ontogenetic shift in Red Snapper habitat preference. As these fish age and grow, they typically migrate away from the high-relief natural and artificial reefs they inhabited as juveniles and young adults, moving toward deeper, low-relief mud or uncharacterized bottom (UCB) habitats. Because the G-FISHER survey relies on stationary video gear deployed predominantly over structured natural reefs, its gear selectivity is possibly biased toward the younger, reef-associated demographic. It may be systematically missing the older adult population residing in the UCB. The analytical team and Panel were able to corroborate this habitat-driven size divergence using length composition data from the GRSC. By explicitly comparing length samples across habitat types, the GRSC data confirmed a distinct shift in the length distribution, providing empirical evidence that fish residing over the UCB are significantly larger than those remaining on natural reefs. This video sampling limitation is likely further exacerbated by the unique regional habitat dynamics of the Western Gulf of America. The West features a wide, extended continental shelf, creating substantial geographic separation between the sampled natural reefs and the deeper UCB environments. Consequently, the larger fish in the West migrate to areas completely inaccessible to the reef-focused camera arrays. In contrast, surveys utilizing bottom longline (BLL) gear effectively target these unstructured mud habitats across the shelf, capturing a significantly wider and older age distribution that better reflects the mature population missed by the video surveys. Sensitivities conducted around this issue reveal a slight shift in derived quantities when the G-FISHER West index is removed from the model (see section 4.8.7). The ending biomass also responds to shifts in the selectivity function from double normal to logistic (i.e., assuming larger fish can be selected if available). The results of the sensitivity analysis indicated some uncertainty in the indices inclusion which should be taken into account as the results of this assessment and the index itself are used for future management.

5.3. Bridging and Continuity Models

SEDAR 98 made changes to nearly every part of the model structure when compared to the most recently accepted assessment model (SEDAR 52). Among the most significant of these was the change in stock structure moving from the two area configuration used in SEDAR 52 to a three area model. This decision, made during SEDAR 74, to move forward with a three-area model was in no way unanimous and concern remained throughout model development and review about the impact changing stock structure could have on model results. Adding to the uncertainty, was the fact that the research track assessment process did not call for continuity and bridging analyses to be completed as the model originating from the research track assessment was intended to be a new model rather than an extension of previous work. As a benchmark assessment, SEDAR 98 required continuity models and bridging analyses to be completed which as detailed in Section 4.8.7 was a difficult task due to the sweeping number of changes made to the model since the last approved assessment. As outlined in Section 4, constructing the two area continuity model was far from straightforward and required many assumptions that limit its utility as a basis for management advice. However, even with those caveats, it still proved a useful exercise as it demonstrated that the shift in stock structure from two areas to three areas had very little impact on Gulf wide model estimates of population quantities. This result was anticipated, since on a Gulf wide basis the data largely remained unchanged and was simply partitioned into different areas. The advantage of the three-area model remains that it allows regions of the GOA with different fishery and population dynamics to be modeled and subsequently monitored independently. The ability to monitor the population at finer scales could allow for more responsive Red Snapper management at the federal and state levels.

Legitimate concerns remain about the three area model chief among them the lack of robust data, particularly older data (i.e., pre 2000), for the East area. The lack of data in this area required a number of modeling compromises be made (e.g., mirroring fleet selectivity between Central and East area fleets) and produced a number of unstable and unconvincing area-specific results (e.g.,East area recruitment apportionment and apportionment deviations as well as East area estimates of SSB). Given the difficulty created by modeling a somewhat data poor area, the question of appropriate stock structure should continue to be revisited in future red snapper assessments. Prior to SEDAR 74 it was unknown whether a three area model could be constructed and if so whether it would converge to a meaningful result. Between SEDAR 74 and 98 that question has been answered; however, it remains to be determined whether the benefits of the three area model are worth the added data and model complexity or if a two or even Gulf wide model would provide tangible management advice while being more parsimonious.

Most pronounced in the bridging analysis were the shifts in depletion, fishing mortality, and productivity that accompanied the suite of selectivity and retention changes as outlined in Section 4.8.7. The selectivity and retention bridging step, in its current form, implements the full suite of changes in a single step. This includes the shift from age-based selectivity functions to length-based selectivity modeling, updates to the time-varying component of selectivity and retention parameters, additional consideration for and estimation of parameters that will allow for regulatory discards during the most recent time period for which recreational fishing regulations are most restrictive, and the general reduction of poorly estimated and highly correlated parameters in the 6 parameter double normal selectivity functions used for the majority of fleets. Previous explorations into changing selectivity from primarily age-based to primarily length-based were completed during SEDAR 74 and did not show a similar response to that seen in the SEDAR 98 bridging. Perhaps importantly, the SEDAR 74 comparisons were completed without the conditional-age-at-length data which is a notable addition to this assessment model. The CAAL data is derived from a randomly selected subset of the fish used to generate the length composition and would not, therefore, be expected to contain contradictory information on population composition. However, several noticeable divergences were observed in the West area composition that were of interest, particularly the pronounced increase in mean age observed across fleets over the last 5-10 years. Throughout SEDAR 98 base model development the model seemed to fluctuate between two possible states of nature to explain the observed change in mean age in the West. One was through recruitment failure over the last 5 to 10 years. This solution allowed the model to systematically increase the mean age of the landed catch under an assumption of constant selectivity through the removal of young fish from the population. This result conflicted with information in the indices of abundance for the area and likely contributed to some of the difficulty experienced fitting West indices, particularly the G-FISHER index as discussed. The other state of nature, and the one most represented by the base model estimates, is one of a rapidly recovering population age structure leading to greater abundance of older fish in the population and in the landed catch under constant selectivity assumptions. A third option, that was not directly explored, was that selectivity in the West had changed over the last decade. The analytical team and Panel concluded that it was unlikely though not impossible that uncoordinated fleets, acting across various fishing sectors, would simultaneously change their fishing or retention behavior in the absence of specific management direction.

6. Projections

6.1. Introduction

The stock is neither overfished nor undergoing overfishing and the steepness is currently not estimable therefore projections were run for one fishing mortality scenario: $F_{MSYproxy}$. The MSY proxy of 26% SPR ($SPR_{26\%}$) was specified during the 2014 SEDAR 31 Update Assessment.

6.2. Projection Methods

The simulated dynamics used for the projections assumed nearly identical parameter values and population dynamics as the SEDAR 98 Benchmark Assessment Model. **Table 81** provides a summary of projection settings. Projections were run assuming relative *F* and selectivity associated with the last three years (2021-2023) would remain the same into the future. Although the model stock recruit relationship is a Beverton-Holt, the steepness is fixed at one and it is not currently estimable. The forecast recruitment values for the benchmark are values from the stock recruitment relationship and the recruitment values for the Overfishing (OFL) and Allowable Biological Catch (ABC) are the average of the last three years.

The terminal year for SEDAR 98 was 2023, we do not have the final catch values for 2026, and the first year of management advice will likely be 2027. The reported landings for the commercial fishery were within 100,000 lbs of each other from 2019-2022, in 2023 the landings increased by almost one million pounds. To reflect this trend the retained catch for the interim years (2024-2025) for the commercial fleet are based on model based estimates from 2023. For the recreational fleets - 2018 and on is provided state by state. These values are then converted into MRIP-CHTS units using specific formulations that also backfill information states where we do not have complete records (i.e., Texas). When examining the reported catch state by state, years prior to 2023 appeared significantly different. Therefore for estimated 2023 recreational values for charter boat, headboat and private are continued into 2024-2025. For all bycatch fleets (i.e., shrimp, commercial and recreational closed season fleets) the forecasted exploitation rate is assumed to be the average exploitation rate from 2020-2023 (**Table 81**).

F26%SPR was determined using a long-term 100-year projection assuming that equilibrium was obtained over the last 10 years (2112-2123). For the OFL projection, the $F_{26\%SPR}$ was applied to the stock starting in 2026. The fleet allocations for Red Snapper are 51% commercial and 49% recreational per Amendment 1 (GMFMC 1989).

The minimum stock size threshold (MSST) was determined by multiplying the reference spawning stock biomass, $SSB_{26\%SPR}$, by 0.5 (per Amendment 44) and was used to determine stock status (**Table 82**). The maximum fishing mortality threshold (MFMT) was equivalent to the harvest rate (F26%SPR; total biomass killed all ages / total biomass age 0+) that achieved $SSB_{26\%SPR}$ and was used to assess whether overfishing was occurring in a given year (**Table 82**). 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 of the fishing mortality over the most recent three years (2021-2023).

6.3. Projection Results

Benchmarks and reference points were calculated in terms of spawning biomass.

6.3.1. Biological Reference Points

The status determination criteria for Red Snapper based on an MSY proxy of 26% were:

MSST = $0.5*SSB_{26\%SPR}$ = 50,994 MFMT = $F_{MSYproxy}$ ($F_{26\%SPR}$) = 0.095

6.3.2. Stock Status 26%SPR

Benchmarks and reference points are shown in **Table 82**. Detailed time series of derived quantities and benchmarks with SSB are presented in **Table 83**. As of 2023 the Gulf of America Red Snapper stock is not undergoing overfishing ($F_{Current}$ >MFMT) and is not overfished (SSB_{2023} > MSST) according to the SEDAR 98 Benchmark Assessment Base Model. The terminal year SSB (2023) is above $SSB_{26\%SPR}$ (**Figure 174***)* at 139% of the biomass level needed to support MSY (**Table 82**). From 2021 to 2023 the estimated stock harvest rate, using the geometric mean, was 0.078, which was equivalent to 82% of $F_{26\%SPR}$.

The Kobe plot (**Figures 175**) indicates that over the time horizon of the assessment (i.e., 1950 - 2023), the stock was overfished from 1975 - 2008 and had experienced overfishing consistently between 1981 and 2007 (**Table 84**).

6.3.3. Overfishing Limit and Acceptable Biological Catch Projections 26%SPR

OFL and ABC projection results assuming predicted recruitment is the average of the last three years are provided in **Tables 85-83** and **Figure 176**.

7. Acknowledgements

The SEDAR98 Benchmark Assessment for Gulf of America Red Snapper would not have been possible without the efforts of the numerous state, NMFS, SEFSC, SERO, and GMFMC staff along with the many academic and research partners involved throughout the Gulf. 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), NOAA SEFSC Gulf Fisheries Branch of the Sustainable Fisheries Division, NOAA SEFSC Panama City Laboratory, University of Florida, NOAA SEFSC Mississippi Laboratories, NOAA Southeast Regional Office (SERO), Harte Research Institute and the whole GRSC team, LGL Ecological Research Associates, Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Alabama Department of Conservation and Natural Resources, Mississippi Department of Marine Resources, Louisiana Department of Wildlife and Fisheries, Texas Parks and Wildlife Department, Cooperative Institute for Marine and Atmospheric Studies, and the Gulf States Marine Fisheries Commission. Special thanks are also extended to the assessment development team as well as all participating members of the Data, Assessment and Review Working Groups for their assistance and guidance throughout the process. Special thanks are extended to Dr. Richard Methot and team for continued discussions and modifications to the Stock Synthesis model. Thanks are extended to Dr. Skyler Sagarese, Dr. Francesca Forrestal, Dr. Lisa Ailloud, and Dr. Nathan Vaughn for their continued technical support during the assessment process..

7. Research Recommendations

Recommendations for considerations of future research are provided below in no particular order of priority.

Recreational Landings and Discards data

Investigate influence of depredation as a contributor to discard mortality and its significance on observed discard data used in the assessment.

Additional Data Needs

Investigate the impact of using state survey derived landing statistics on the assessment model.

Use simulation studies to investigate the effectiveness of composition data sources (i.e., length, age and conditional age-at-length) and quality on the estimation of growth parameters in a red snapper-like species assessment.

Environmental Influences

Investigate non-anthropogenic changes in the Red snapper system that may be contributing to recruitment fluctuations in time and space. Continue to gain insight on recruitment apportionment for model predictions.

Modeling Platform Updates

Investigate risk associated with switching modeling platforms as newer more modular platforms are developed (i.e., FIMS).

8. References

Atkinson, S., K. Thompson, and G. Decossas. 2024. Estimated Commercial Discards of Gulf of Mexico Red Snapper Using Discard Logbook and Observer Data from 1996-2023. SEDAR98-DW-03. SEDAR, North Charleston, SC.

Atkinson, S., & Pawluk, M. (2025). Commercial Landings of Gulf of Mexico Red Snapper (Lutjanus campechanus) from 1964 - 2023. SEDAR98-DW-02. SEDAR, North Charleston, SC. 17 pp.

Binion-Rock, S. M. 2024. Gulf of America Red Snapper (Lutjanus campechanus) length and age compositions from the recreational fishery. SEDAR98-DW-07. SEDAR, North Charleston, SC.

Denson, L.S., and Smith, MW. (In prep) Lessons Learned Incorporating The Red Snapper Count Into the Gulf of Mexico Red Snapper Stock Assessment.

Dichmont, CM, RA Deng, AE Punt, J Brodziak, YJ Chang, JM Cope, JN Ianelli, CM Legault, RD Methot, CE Porch and MH Prager. 2016. A review of stock assessment packages in the United States. Fisheries Research 183:447-460.

Francis RICC. 2011. Data weighting in statistical fisheries stock assessment models. Canadian Journal of Fisheries and Aquatic Sciences. 68:1124-1138.

Francis RICC, RJ Hurst and JA Renwick. 2003 Quantifying annual variation in catchability for commercial and research fishing. Fishery Bulletin 101(2):293-304.

Hamel OS and JM Cope. 2022. Development and considerations for application of a longevity-based prior for the natural mortality rate. Fisheries Research 256:106477.

Hulson P-J, D Hanselman, and T Quinn. 2012. Determining effective sample size in integrated age-structured assessment models. ICES Journal of Marine Science, 69:281-292.

Lazarre, D. (2022). SEDAR74-DW-18: A Summary of Observer Data from the Size Distribution of Red Snapper Discards from Recreational Fishery Surveys in the Eastern Gulf of Mexico. SouthEast Data, Assessment, and Review (SEDAR).

LGL Ecological Research Associates, Inc. 2022. Estimation of Total Red Snapper Abundance in Louisiana and Adjacent Federal Waters. Louisiana Department of Wildlife and Fisheries, Baton Rouge, LA. 112 pp. *https://www.wlf.louisiana.gov/assets/Resources/Publications/Saltwater_Fish/LDWF-Abundance-of-Red-Snapper-Final-Report-Package-25-March-2022.pdf*

Linton, B. 2012. Shrimp fishery bycatch estimates for Gulf of Mexico red snapper, 1972- 2011. SEDAR31-DW30.

Lorenzen K. 2000. Allometry of natural mortality as a basis for assessing optimal release size in fish-stocking programmes. Canadian Journal of Fisheries and Aquatic Sciences 57(12):2374-2381.

McCarthy, K. 2013. Calculated discards of gray triggerfish and blueline tilefish from US South Atlantic commercial fishing vessels. SEDAR32-DW-11. 17 pp.

McCarthy, K. 2015. Discards of Red Snapper Calculated for Commercial Vessels with Federal Fishing Permits in the US South Atlantic. SEDAR41-DW36. 18 pp.

Methot RD and IG Taylor. 2011. Adjusting for bias due to variability of estimated recruitments in fishery assessment models. Canadian Journal of Fisheries and Aquatic Sciences, 68(10):1744-17.

Methot RD and CR Wetzel. 2013. Stock synthesis: a biological and statistical framework for fish stock assessment and fishery management. Fisheries Research 142:86−99.

Methot RD, CR Wetzel, IG Taylor and K Doering. 2020. Stock Synthesis User Manual Version 3.30.16. NOAA Fisheries, Seattle Washington. 225 pp.

Nance, J. 2004. Estimation of effort in the offshore shrimp trawl fishery of the Gulf of Mexico. NOAA Southeast Fisheries Science Center, Galveston Laboratory. SEDAR7-DW24. SEDAR, North Charleston, SC.

NOAA Fisheries Service, Office of Science and Technology. 2023. Evaluating measurement error in the MRIP fishing effort survey. U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

NOAA Fisheries Service. 2025. Revised MRIP FES and benchmarking results. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. *https://www.fisheries.noaa.gov/s3//2026-02/Revised-MRIP-FES-and-Benchmarking-Results_August_2025-508.pdf*

Nuttall, M. A. 2024. General Recreational Survey Data for Red Snapper in the Gulf of Mexico. SEDAR98-DW-05. SEDAR, North Charleston, SC. 119 pp.

Pawluk, M., and S. M. Binion-Rock. 2024. Gulf of America Red Snapper (Lutjanus campechanus) Commercial Landings Preliminary Length and Age Compositions. SEDAR98-DW-06. SEDAR, North Charleston, SC.

Punt, A.E., Smith, D.C., Krusic-Golub, K., and Robertson, S. 2008. Quantifying age-reading error for use in fisheries stock assessments, with application to species in Australia's southern and eastern scalefish and shark fishery. Canadian Journal of Fisheries and Aquatic Sciences 65: 1991-2005.

SEDAR (Southeast Data, Assessment, and Review). 2018. SEDAR 52 – Gulf of Mexico Red Snapper Stock Assessment Report. SEDAR, North Charleston SC. 434 pp. Available online at: *https://sedarweb.org/documents/sedar-52-gulf-of-mexico-red-snapper-final-stock-assessment-report/*.

SEDAR (Southeast Data, Assessment and Review). 2021. Gulf of Mexico Red Snapper Stock ID Process Final Report. SEDAR, North Charleston SC. 87pp. Available online at: *https://sedarweb.org/documents/sedar-74-gulf-of-mexico-red-snapper-stock-id-process-final-report/* .

SEDAR (Southeast Data, Assessment and Review). 2022. Gulf of Mexico Red Snapper; SECTION III: Data Workshop Report. SEDAR, North Charleston SC. 225pp. Available online at: *https://sedarweb.org/documents/sedar-74-gulf-of-mexico-data-workshop-report/* .

SEDAR 74 Discard Mortality Ad-Hoc Working Group. 2023. Final Report of the SEDAR 74 Ad-hoc Discard Mortality Working Group for Gulf of Mexico Red Snapper (Lutjanus campechanus). SEDAR74-AP-02. SEDAR, North Charleston, SC. 10 pp.

SEDAR. 2024. SEDAR 74: Gulf of Mexico Red Snapper Stock Assessment Report. SEDAR, North Charleston, SC. 733 pp.

SEDAR (Southeast Data, Assessment, and Review. 2025. SEDAR 98 Gulf Red Snapper Data Workshop Report. SEDAR, North Charleston, SC.

Stunz, G. W., W. F. Patterson III, S. P. Powers, J. H. Cowan, Jr., J. R. Rooker, R. A. Ahrens, K. Boswell, L. Carleton, M. Catalano, J. M. Drymon, J. Hoenig, R. Leaf, V. Lecours, S. Murawski, D. Portnoy, E. Saillant, L. S. Stokes., and R. J. D. Wells. 2021. Estimating the Absolute Abundance of Age-2+ Red Snapper (Lutjanus campechanus) in the U.S. Gulf of Mexico. Mississippi-Alabama Sea Grant Consortium, NOAA Sea Grant. 408 pages.

Taylor IG, KL Doering, KF Johnson, CR Wetzel and IJ Stewart, 2021. Beyond visualizing catch-at-age models: Lessons learned from the r4ss package about software to support stock assessments, Fisheries Research 239:105924. *https://doi.org/10.1016/j.fishres.2021.105924*

Then AY, JM Hoenig, NG Hall, and DA Hewitt. 2015. Evaluating the predictive performance of empirical estimators of natural mortality rate using information on over 200 fish species. ICES Journal of Marine Science 72(1):82-92.

Thorson, J.T., I.J. Stewart and A.E. Punt. 2012. nwfscAgeingError: a user interface in R for the Punt et al. (2008) method for calculating ageing error and imprecision. Available from: *http://github.com/nmfscassess/nwfscAgeingError*.

Thorson JT, KF Johnson, RD Methot and IG Taylor. 2017. Model-based estimates of effective sample size in stock assessment models using the Dirichlet-multinomial distribution. Fisheries Research 192: 84–93. *doi:10.1016/j.fishres.2016.06.005*.

Tables

Table 1. Age-specific natural mortality (per year) for Gulf of America Red Snapper used in SEDAR 98.

Age	M	Adj. M
0	0.86	2.00
1	0.64	1.20
2	0.21	0.21
3	0.17	0.17
4	0.15	0.15
5	0.14	0.14
6	0.13	0.13
7	0.12	0.12
8	0.12	0.12
9	0.11	0.11
10	0.11	0.11
11	0.11	0.11
12	0.10	0.10
13	0.10	0.10
14	0.10	0.10
15	0.10	0.10
16	0.10	0.10
17	0.10	0.10
18	0.10	0.10
19	0.10	0.10
20	0.10	0.10

Table 2. Maturity parameters for Gulf of America Red Snapper. All parameters were fixed to values provided from the data workshop (base model maturity).

Parameter	East	Central	West
M_{A50}	1.95	1.95	2.47
M $Slope_{A50}$	-1.57	-1.57	-1.18

Table 3. Standardized indices of relative abundance for Eastern Gulf of America Red Snapper used in SEDAR 98.

Year	CPUE Combined Video	CPUE Bottom Longline	CPUE Fall Trawl Late	CPUE Comm Obs.	CPUE Summer Trawl Late
2001		0.099			
2002					
2003		0.341			
2004		0.554			
2005		0.411			
2006		0.203			
2007		1.358		0.325	
2008			0.658	0.390	
2009		0.916	0.335	0.672	0.109
2010	0.482	1.452	0.664	0.683	0.042
2011	0.580	1.452		0.696	1.148
2012	0.443	0.391	0.866	0.574	0.578
2013	0.834	2.322	0.147	0.611	0.164
2014	0.544	0.281	2.830	0.685	0.388
2015	1.295		1.039	0.744	3.413
2016	2.547	1.363	1.253	1.657	2.063
2017	1.813	0.515	0.674	1.221	1.509
2018	1.509	0.416	0.275	1.432	1.216
2019	1.173	0.746	0.656	0.940	0.533
2020	0.744	2.113	0.255	1.531	

Table 3 Continued. Standardized indices of relative abundance for Eastern Gulf of America Red Snapper used in SEDAR 98.

Year	CPUE Combined Video	CPUE Bottom Longline	CPUE Fall Trawl Late	CPUE Comm Obs.	CPUE Summer Trawl Late
2021	0.657	0.627	3.554	1.676	0.859
2022	0.658	2.138	1.325	1.960	1.063
2023	0.722	2.301	0.469	1.202	0.915

Table 4. Log scale standard error (SE) associated with each standardized relative abundance index for Eastern Gulf of America Red Snapper.

Year	SE Combined Video	SE Bottom Longline	SE Fall Trawl Late	SE Comm Obs.	SE Summer Trawl Late
2001		0.924			
2002					
2003		0.717			
2004		0.607			
2005		0.921			
2006		0.919			
2007		0.706		0.145	
2008			0.692	0.139	
2009		0.536	0.494	0.142	0.764
2010	0.322	0.474	0.406	0.099	0.958
2011	0.213	0.354		0.073	0.456
2012	0.220	0.713	0.681	0.053	0.407
2013	0.224	0.918	0.685	0.081	0.762
2014	0.171	0.917	0.335	0.111	0.407
2015	0.293		0.291	0.188	0.317
2016	0.147	0.599	0.404	0.085	0.272
2017	0.160	0.710	0.347	0.273	0.336
2018	0.184	0.720	0.518	0.140	0.316
2019	0.177	0.712	0.382	0.202	0.486
2020	0.147	0.506	0.615	0.138	

Table 4 Continued. Log scale standard error (SE) associated with each standardized relative abundance index for Eastern Gulf of America Red Snapper.

Year	SE Combined Video	SE Bottom Longline	SE Fall Trawl Late	SE Comm Obs.	SE Summer Trawl Late
2021	0.155	0.708	0.301	0.111	0.397
2022	0.175	0.714	0.346	0.097	0.404
2023	0.165	0.525	0.417	0.100	0.366

Table 5. Standardized index of relative abundance and corresponding standard errors (SE) for Shrimp Trawl bycatch effort time series used in the assessment.

Year	month	CPUE Shrimp Effort west	CPUE Shrimp Effort central	CPUE Shrimp Effort east	SE Shrimp Effort west	SE Shrimp Effort central	SE Shrimp Effort east
1950	7	73946.60	14643.30	14969.90	0.20	0.20	0.20
1951	7	73946.60	14643.30	14969.90	0.20	0.20	0.20
1952	7	73946.60	14643.30	14969.90	0.20	0.20	0.20
1953	7	73946.60	14643.30	14969.90	0.20	0.20	0.20
1954	7	73946.60	14643.30	14969.90	0.20	0.20	0.20
1955	7	73946.60	14643.30	14969.90	0.20	0.20	0.20
1956	7	73946.60	14643.30	14969.90	0.20	0.20	0.20
1957	7	73946.60	14643.30	14969.90	0.20	0.20	0.20
1958	7	73946.60	14643.30	14969.90	0.20	0.20	0.20
1959	7	73946.60	14643.30	14969.90	0.20	0.20	0.20
1960	7	78901.10	16711.50	15620.30	0.20	0.20	0.20
1961	7	55345.40	11815.00	12266.50	0.20	0.20	0.20
1962	7	68218.70	12545.50	15714.40	0.20	0.20	0.20
1963	7	83156.60	13976.30	12869.20	0.20	0.20	0.20
1964	7	84067.60	16871.10	18051.90	0.20	0.20	0.20
1965	7	73990.20	15940.20	15297.10	0.20	0.20	0.20
1966	7	71148.00	14363.80	14198.40	0.20	0.20	0.20
1967	7	91692.00	16480.40	8436.87	0.20	0.20	0.20
1968	7	87435.70	22112.00	10258.50	0.20	0.20	0.20
1969	7	102062.00	26456.90	11341.50	0.20	0.20	0.20

Table 5 Continued. Standardized index of relative abundance and corresponding standard errors (SE) for Shrimp Trawl bycatch effort time series used in the assessment.

Year	month	CPUE Shrimp Effort west	CPUE Shrimp Effort central	CPUE Shrimp Effort east	SE Shrimp Effort west	SE Shrimp Effort central	SE Shrimp Effort east
1970	7	90876.40	16984.50	10386.10	0.20	0.20	0.20
1971	7	95168.30	17786.80	9219.50	0.20	0.20	0.20
1972	7	116644.00	17897.10	10840.30	0.20	0.20	0.20
1973	7	104073.00	14861.60	16177.00	0.20	0.20	0.20
1974	7	101592.00	16589.20	17231.00	0.20	0.20	0.20
1975	7	88352.80	16152.30	14356.80	0.20	0.20	0.20
1976	7	112193.00	18848.80	11825.00	0.20	0.20	0.20
1977	7	120224.00	20345.80	13239.90	0.20	0.20	0.20
1978	7	148165.00	22129.40	16528.10	0.20	0.20	0.20
1979	7	148831.00	26984.10	19787.60	0.20	0.20	0.20
1980	7	106763.00	14502.90	12149.50	0.20	0.20	0.20
1981	7	129325.00	17663.80	16457.50	0.20	0.20	0.20
1982	7	121942.00	27194.00	11690.10	0.20	0.20	0.20
1983	7	111336.00	33061.70	14039.10	0.20	0.20	0.20
1984	7	116137.00	32407.90	20282.80	0.20	0.20	0.20
1985	7	125966.00	29195.80	19432.40	0.20	0.20	0.20
1986	7	147191.00	38284.30	16233.20	0.20	0.20	0.20
1987	7	164966.00	38341.20	19587.60	0.20	0.20	0.20
1988	7	144962.00	31646.80	15343.60	0.20	0.20	0.20
1989	7	147450.00	39078.10	15937.70	0.20	0.20	0.20

Table 5 Continued. Standardized index of relative abundance and corresponding standard errors (SE) for Shrimp Trawl bycatch effort time series used in the assessment.

Year	month	CPUE Shrimp Effort west	CPUE Shrimp Effort central	CPUE Shrimp Effort east	SE Shrimp Effort west	SE Shrimp Effort central	SE Shrimp Effort east
1990	7	140942.00	47914.90	15502.50	0.20	0.20	0.20
1991	7	148214.00	38480.40	13689.80	0.20	0.20	0.20
1992	7	146284.00	35375.50	17319.80	0.20	0.20	0.20
1993	7	143148.00	25625.80	14925.80	0.20	0.20	0.20
1994	7	105250.00	21859.30	17936.80	0.20	0.20	0.20
1995	7	88144.80	14437.80	21824.40	0.20	0.20	0.20
1996	7	96463.10	18477.20	27226.90	0.20	0.20	0.20
1997	7	117574.00	22051.30	24448.50	0.20	0.20	0.20
1998	7	131623.00	34642.30	28869.50	0.20	0.20	0.20
1999	7	138286.00	34900.30	17807.30	0.20	0.20	0.20
2000	7	129580.00	26136.00	13583.30	0.20	0.20	0.20
2001	7	95349.30	20863.60	16134.00	0.20	0.20	0.20
2002	7	112875.00	24518.60	12049.90	0.20	0.20	0.20
2003	7	88406.20	19651.90	11069.30	0.20	0.20	0.20
2004	7	75277.20	14754.90	9524.52	0.20	0.20	0.20
2005	7	60039.30	11726.40	7343.33	0.20	0.20	0.20
2006	7	56197.50	10212.00	5886.93	0.20	0.20	0.20
2007	7	59153.90	9606.99	7314.31	0.20	0.20	0.20
2008	7	50566.00	6224.84	5381.17	0.20	0.20	0.20
2009	7	64080.30	7737.24	5489.18	0.20	0.20	0.20

Table 5 Continued. Standardized index of relative abundance and corresponding standard errors (SE) for Shrimp Trawl bycatch effort time series used in the assessment.

Year	month	CPUE Shrimp Effort west	CPUE Shrimp Effort central	CPUE Shrimp Effort east	SE Shrimp Effort west	SE Shrimp Effort central	SE Shrimp Effort east
2010	7	44400.40	3345.62	2566.29	0.20	0.20	0.20
2011	7	53520.40	5711.64	3408.75	0.20	0.20	0.20
2012	7	53423.10	5341.23	3890.54	0.20	0.20	0.20
2013	7	59274.60	9742.54	1587.21	0.20	0.20	0.20
2014	7	62200.50	8589.98	5496.76	0.20	0.20	0.20
2015	7	61825.40	9468.57	4576.79	0.20	0.20	0.20
2016	7	61443.20	7974.79	4849.78	0.20	0.20	0.20
2017	7	62641.40	8020.28	6159.43	0.20	0.20	0.20
2018	7	55443.30	8929.21	7146.91	0.20	0.20	0.20
2019	7	53063.10	7473.22	6593.17	0.20	0.20	0.20
2020	7	52164.50	10667.70	7805.89	0.20	0.20	0.20
2021	7	54073.70	8365.84	6448.08	0.20	0.20	0.20
2022	7	33293.30	6744.20	5580.17	0.20	0.20	0.20
2023	7	27739.10	5626.90	3534.49	0.20	0.20	0.20

Table 6. Standardized indices of relative abundance for Central Gulf of America Red Snapper used in SEDAR 98.

Year	CPUE Combined Video	CPUE Bottom Longline	CPUE Larval Survey	CPUE Fall Trawl Late	CPUE Summer Trawl Late
1991			0.113		
1992					
1993	0.096				
1994	0.087		0.056		
1995	0.006		0.060		
1996	0.045				
1997	0.220		0.053		
1998					
1999			0.329		
2000			0.821		
2001		0.172	0.250		
2002	0.360	0.116			
2003		0.269	0.444		
2004	1.247	0.110	0.117		
2005	0.735	0.093			
2006	1.408	0.159	0.703		
2007	1.564		0.877		
2008	1.333		0.152	0.605	
2009	1.941	0.365	0.611	2.350	0.467
2010	1.374	1.321	2.073	0.657	1.048

Table 6 Continued. Standardized indices of relative abundance for Central Gulf of America Red Snapper used in SEDAR 98.

Year	CPUE Combined Video	CPUE Bottom Longline	CPUE Larval Survey	CPUE Fall Trawl Late	CPUE Summer Trawl Late
2011	1.346	2.161	0.747	0.637	0.558
2012	0.789	1.168	0.864	1.340	1.099
2013	0.693	0.530	0.967	0.692	1.350
2014	0.691	2.200	1.034	0.974	0.539
2015	0.736	2.479	0.153	1.259	0.879
2016	1.455	2.686	1.326	0.993	1.075
2017	1.471	0.699	3.749	0.495	1.664
2018	1.245	1.225	1.508	1.403	1.453
2019	1.251	1.971	3.699	0.681	0.769
2020	1.471			0.547	
2021	1.888	0.851	2.688	0.647	0.677
2022	1.577	1.275	1.606	0.942	0.943
2023	0.970	0.151		1.778	1.480

Table 7. Standardized indices of relative abundance for Western Gulf of America Red Snapper used in SEDAR 98.

Year	CPUE Bottom Longline	CPUE Larval Survey	CPUE Fall Trawl Late	CPUE Fall Trawl Early	CPUE Summer Trawl Late	CPUE Summer Trawl Early	CPUE Combined Video
1984						0.747	
1985						1.110	
1986		0.175				0.294	
1987		0.330				0.710	
1988				0.428		0.347	
1989		0.472		0.857		0.256	
1990		0.476		0.909		2.262	
1991		0.204		1.027		1.021	
1992		0.203		0.316		0.644	
1993		0.237		0.574		0.704	0.049
1994		0.212		1.625		1.345	0.129
1995		0.678		1.747		1.176	0.191
1996		0.492		0.870		1.309	0.262
1997		0.698		1.290		0.994	0.636
1998				0.595		0.886	
1999		0.255		1.374		0.759	
2000		0.866		0.907		1.391	
2001	0.283	0.534		0.681		0.787	
2002	0.219	0.616		0.650		1.094	0.555
2003	0.248	0.940		1.152		0.614	

Table 7 Continued. Standardized indices of relative abundance for Western Gulf of America Red Snapper used in SEDAR 98.

Year	CPUE Bottom Longline	CPUE Larval Survey	CPUE Fall Trawl Late	CPUE Fall Trawl Early	CPUE Summer Trawl Late	CPUE Summer Trawl Early	CPUE Combined Video
2004	0.303	0.518		1.798		1.331	0.447
2005				1.272		1.502	0.418
2006	0.234	1.009		1.084		1.419	0.181
2007	0.252	0.781		0.845		1.166	0.490
2008			0.473			1.134	0.340
2009	0.465	1.042	1.598		0.364		0.554
2010	0.232	0.414	0.750		0.861		1.045
2011	0.548	1.235	0.873		1.193		0.846
2012	1.059	1.387	1.697		0.818		0.921
2013	1.015	0.804	0.712		1.262		1.155
2014	0.719	1.248	0.977		0.771		1.654
2015	1.815		1.786		1.064		1.405
2016	1.510	2.610	1.190		0.868		1.292
2017	2.295	0.552	0.824		0.836		2.326
2018	1.325	1.228	1.156		1.617		2.859
2019	1.972	2.594	0.898		1.111		1.748
2020			0.462				
2021	1.857	2.700	0.907		0.702		1.917
2022	1.646	5.493	0.980		0.876		1.413
2023	2.004		0.718		1.658		2.170

Table 8. Log scale standard error (SE) associated with each standardized relative abundance index for Central Gulf of America Red Snapper.

Year	SE Combined Video	SE Bottom Longline	SE Larval Survey	SE Fall Trawl Late	SE Summer Trawl Late
1991			0.922		
1992					
1993	0.566				
1994	0.655		0.927		
1995	0.902		0.926		
1996	0.713				
1997	0.355		0.926		
1998					
1999			0.613		
2000			0.539		
2001		0.772	0.607		
2002	0.239	0.774			
2003		0.666	0.537		
2004	0.223	0.968	0.927		
2005	0.157	0.967			
2006	0.229	0.972	0.610		
2007	0.292		0.441		
2008	0.167		0.926	0.330	
2009	0.155	0.670	0.611	0.189	0.266
2010	0.128	0.488	0.372	0.299	0.310

Table 8 Continued. Log scale standard error (SE) associated with each standardized relative abundance index for Central Gulf of America Red Snapper.

Year	SE Combined Video	SE Bottom Longline	SE Larval Survey	SE Fall Trawl Late	SE Summer Trawl Late
2011	0.124	0.337	0.613	0.334	0.405
2012	0.142	0.666	0.469	0.287	0.306
2013	0.149	0.676	0.480	0.386	0.370
2014	0.125	0.451	0.485	0.290	0.375
2015	0.140	0.412	0.928	0.274	0.362
2016	0.082	0.443	0.403	0.399	0.311
2017	0.083	0.597	0.259	0.340	0.245
2018	0.121	0.543	0.376	0.312	0.324
2019	0.087	0.586	0.281	0.321	0.373
2020	0.148			0.353	
2021	0.091	0.775	0.304	0.395	0.470
2022	0.085	0.661	0.401	0.323	0.395
2023	0.088	0.966		0.324	0.334

Table 9. Log scale standard error (SE) associated with each standardized relative abundance index for Western Gulf of America Red Snapper.

Year	SE Bottom Longline	SE Larval Survey	SE Fall Trawl Late	SE Fall Trawl Early	SE Summer Trawl Late	SE Summer Trawl Early	SE Combined Video
1984						0.281	
1985						0.302	
1986		0.552				0.419	
1987		0.553				0.218	
1988				0.149		0.244	
1989		0.541		0.140		0.299	
1990		0.449		0.123		0.159	
1991		0.618		0.117		0.187	
1992		0.429		0.150		0.196	
1993		0.427		0.140		0.192	0.439
1994		0.553		0.121		0.178	0.326
1995		0.308		0.110		0.169	0.320
1996		0.375		0.128		0.169	0.146
1997		0.294		0.125		0.171	0.144
1998				0.143		0.190	
1999		0.400		0.116		0.191	
2000		0.289		0.118		0.153	
2001	0.256	0.423		0.134		0.259	
2002	0.221	0.320		0.133		0.169	0.176
2003	0.281	0.274		0.121		0.208	

Table 9 Continued. Log scale standard error (SE) associated with each standardized relative abundance index for Western Gulf of America Red Snapper.

Year	SE Bottom Longline	SE Larval Survey	SE Fall Trawl Late	SE Fall Trawl Early	SE Summer Trawl Late	SE Summer Trawl Early	SE Combined Video
2004	0.282	0.327		0.109		0.161	0.248
2005				0.102		0.165	0.150
2006	0.344	0.322		0.123		0.146	0.184
2007	0.342	0.272		0.143		0.181	0.138
2008			0.101			0.154	0.163
2009	0.258	0.265	0.092		0.152		0.134
2010	0.441	0.398	0.130		0.148		0.158
2011	0.247	0.307	0.122		0.147		0.160
2012	0.273	0.265	0.123		0.140		0.114
2013	0.249	0.273	0.181		0.165		0.134
2014	0.303	0.294	0.127		0.161		0.142
2015	0.229		0.117		0.149		0.209
2016	0.220	0.245	0.151		0.150		0.120
2017	0.165	0.322	0.146		0.159		0.108
2018	0.223	0.254	0.126		0.139		0.111
2019	0.225	0.218	0.147		0.154		0.097
2020			0.167				
2021	0.229	0.259	0.137		0.196		0.088
2022	0.254	0.216	0.161		0.177		0.087
2023	0.198		0.150		0.165		0.089

Table 10. Growth parameters for Gulf of America Red Snapper. All parameters were fixed at values provided as a result of the Data Workshop (see Data Workshop report, SEDAR 2022).

Parameter	East	Central	West
A_{min}	1.00	1.00	1.00
L_{Amin}	23.80	22.60	23.34
L_{Amax}	85.26	84.09	80.88
K (year^{-1})	0.17	0.15	0.15

Table 11. List of relevant Stock Synthesis recruitment related parameters for Gulf of America Red Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, prior type and densities (value, SE) if applicable, and phases. Parameters designated as 'F' (Fixed) were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
SR_LN(R0)	11.65	(5,20)	0.035	0.003	Sym_Beta(0.5)	1
SR_BH_steep	1					F
SR_sigmaR	0.6					F
SR_regime	0.00e+00					F
SR_autocorr	0.00e+00					F
RecrDist_GP_1_area_1_month_6	-2.3	(-4,4)	0.041	-	Normal(-2.085,0.5)	2
RecrDist_GP_2_area_2_month_6	-0.948	(-4,4)	0.043	-	Normal(-0.62,0.5)	2
RecrDist_GP_3_area_3_month_6	0.00e+00					F
RecrDist_GP_1_area_1_month_6_dev_se	0.5					F
RecrDist_GP_2_area_2_month_6_dev_se	0.5					F

Table 12. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) combined across all fleets for Gulf of America Red Snapper, which was used as the proxy for annual fishing mortality rate.

Year	S98
1950	0.010
1951	0.011
1952	0.012
1953	0.012
1954	0.012
1955	0.013
1956	0.016
1957	0.016
1958	0.023
1959	0.024
1960	0.027
1961	0.030
1962	0.032
1963	0.032
1964	0.034
1965	0.036
1966	0.035
1967	0.041
1968	0.046
1969	0.045
1970	0.050
1971	0.058
1972	0.063
1973	0.073
1974	0.086

Table 12 Continued. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) combined across all fleets for Gulf of America Red Snapper, which was used as the proxy for annual fishing mortality rate.

Year	S98
1975	0.092
1976	0.096
1977	0.094
1978	0.097
1979	0.090
1980	0.086
1981	0.147
1982	0.116
1983	0.198
1984	0.124
1985	0.137
1986	0.140
1987	0.108
1988	0.132
1989	0.124
1990	0.104
1991	0.118
1992	0.154
1993	0.222
1994	0.201
1995	0.187
1996	0.178
1997	0.194
1998	0.177
1999	0.218

Table 12 Continued. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) combined across all fleets for Gulf of America Red Snapper, which was used as the proxy for annual fishing mortality rate.

Year	S98
2000	0.168
2001	0.162
2002	0.216
2003	0.172
2004	0.215
2005	0.158
2006	0.141
2007	0.108
2008	0.069
2009	0.073
2010	0.059
2011	0.073
2012	0.061
2013	0.079
2014	0.052
2015	0.051
2016	0.057
2017	0.081
2018	0.066
2019	0.077
2020	0.061
2021	0.066
2022	0.071
2023	0.070

Table 13. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) by commercial fleets for Western Gulf of America Red Snapper.

Year	Handline	Longline	Handline Closed Season Discards
1950	0.004	0	0
1951	0.004	0	0
1952	0.004	0	0
1953	0.003	0	0
1954	0.004	0	0
1955	0.004	0	0
1956	0.006	0	0
1957	0.006	0	0
1958	0.010	0	0
1959	0.011	0	0
1960	0.012	0	0
1961	0.014	0	0
1962	0.015	0	0
1963	0.011	0	0
1964	0.014	0	0
1965	0.015	0	0
1966	0.014	0	0
1967	0.020	0	0
1968	0.026	0	0
1969	0.023	0	0
1970	0.027	0	0
1971	0.034	0	0
1972	0.033	0	0
1973	0.037	0	0
1974	0.037	0	0

Table 13 Continued. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) by commercial fleets for Western Gulf of America Red Snapper.

Year	Handline	Longline	Handline Closed Season Discards
1975	0.036	0.000	0.000
1976	0.034	0.000	0.000
1977	0.032	0.000	0.000
1978	0.034	0.000	0.000
1979	0.032	0.000	0.000
1980	0.029	0.004	0.000
1981	0.035	0.007	0.000
1982	0.044	0.008	0.000
1983	0.053	0.009	0.000
1984	0.047	0.013	0.000
1985	0.039	0.013	0.000
1986	0.039	0.017	0.000
1987	0.034	0.016	0.000
1988	0.051	0.015	0.000
1989	0.044	0.011	0.000
1990	0.038	0.008	0.000
1991	0.031	0.006	0.000
1992	0.036	0.014	0.000
1993	0.057	0.000	0.000
1994	0.052	0.000	0.000
1995	0.053	0.000	0.000
1996	0.073	0.000	0.003
1997	0.076	0.000	0.004
1998	0.070	0.000	0.003
1999	0.070	0.001	0.004

Table 13 Continued. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) by commercial fleets for Western Gulf of America Red Snapper.

Year	Handline	Longline	Handline Closed Season Discards
2000	0.064	0.003	0.003
2001	0.058	0.002	0.003
2002	0.052	0.002	0.003
2003	0.045	0.002	0.003
2004	0.040	0.006	0.002
2005	0.039	0.004	0.002
2006	0.044	0.003	0.001
2007	0.021	0.002	0.000
2008	0.015	0.001	0.000
2009	0.013	0.000	0.000
2010	0.013	0.000	0.000
2011	0.011	0.000	0.000
2012	0.011	0.000	0.000
2013	0.013	0.000	0.000
2014	0.012	0.000	0.000
2015	0.013	0.000	0.000
2016	0.012	0.000	0.000
2017	0.012	0.000	0.000
2018	0.011	0.000	0.000
2019	0.011	0.001	0.000
2020	0.011	0.000	0.000
2021	0.011	0.001	0.000
2022	0.011	0.000	0.000
2023	0.014	0.000	0.000

Table 14. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) by commercial fleets for Central Gulf of America Red Snapper.

Year	Handline	Longline	Handline Closed Season Discards
1950	0.006	0	0
1951	0.007	0	0
1952	0.008	0	0
1953	0.007	0	0
1954	0.007	0	0
1955	0.007	0	0
1956	0.009	0	0
1957	0.009	0	0
1958	0.015	0	0
1959	0.014	0	0
1960	0.017	0	0
1961	0.016	0	0
1962	0.018	0	0
1963	0.020	0	0
1964	0.018	0	0
1965	0.021	0	0
1966	0.018	0	0
1967	0.023	0	0
1968	0.021	0	0
1969	0.021	0	0
1970	0.020	0	0
1971	0.022	0	0
1972	0.025	0	0
1973	0.035	0	0
1974	0.039	0	0

Table 14 Continued. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) by commercial fleets for Central Gulf of America Red Snapper.

Year	Handline	Longline	Handline Closed Season Discards
1975	0.044	0.000	0.000
1976	0.044	0.000	0.000
1977	0.040	0.000	0.000
1978	0.041	0.000	0.000
1979	0.046	0.000	0.000
1980	0.046	0.002	0.000
1981	0.053	0.003	0.000
1982	0.063	0.003	0.000
1983	0.072	0.004	0.000
1984	0.054	0.005	0.000
1985	0.040	0.002	0.000
1986	0.036	0.004	0.000
1987	0.033	0.000	0.000
1988	0.046	0.003	0.000
1989	0.040	0.002	0.000
1990	0.038	0.002	0.000
1991	0.027	0.001	0.000
1992	0.030	0.001	0.000
1993	0.021	0.000	0.000
1994	0.030	0.000	0.000
1995	0.011	0.000	0.000
1996	0.014	0.000	0.005
1997	0.010	0.000	0.003
1998	0.018	0.000	0.003
1999	0.021	0.000	0.003

Table 14 Continued. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) by commercial fleets for Central Gulf of America Red Snapper.

Year	Handline	Longline	Handline Closed Season Discards
2000	0.027	0.000	0.003
2001	0.027	0.000	0.002
2002	0.032	0.000	0.002
2003	0.033	0.000	0.002
2004	0.030	0.000	0.002
2005	0.029	0.000	0.002
2006	0.024	0.000	0.001
2007	0.021	0.000	0.000
2008	0.013	0.000	0.000
2009	0.012	0.000	0.000
2010	0.014	0.000	0.000
2011	0.015	0.000	0.000
2012	0.016	0.000	0.000
2013	0.018	0.000	0.000
2014	0.019	0.000	0.000
2015	0.021	0.000	0.000
2016	0.018	0.000	0.000
2017	0.018	0.000	0.000
2018	0.019	0.001	0.000
2019	0.020	0.000	0.000
2020	0.021	0.000	0.000
2021	0.020	0.001	0.000
2022	0.018	0.001	0.000
2023	0.019	0.001	0.000

Table 15. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) by commercial fleets for Eastern Gulf of America Red Snapper.

Year	Handline	Longline	Handline Closed Season Discards
1950	0.018	0	0
1951	0.021	0	0
1952	0.024	0	0
1953	0.022	0	0
1954	0.021	0	0
1955	0.024	0	0
1956	0.030	0	0
1957	0.028	0	0
1958	0.048	0	0
1959	0.047	0	0
1960	0.056	0	0
1961	0.056	0	0
1962	0.063	0	0
1963	0.073	0	0
1964	0.078	0	0
1965	0.085	0	0
1966	0.085	0	0
1967	0.067	0	0
1968	0.075	0	0
1969	0.072	0	0
1970	0.079	0	0
1971	0.071	0	0
1972	0.080	0	0
1973	0.078	0	0
1974	0.198	0	0

Table 15 Continued. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) by commercial fleets for Eastern Gulf of America Red Snapper.

Year	Handline	Longline	Handline Closed Season Discards
1975	0.219	0.000	0.000
1976	0.270	0.000	0.000
1977	0.220	0.000	0.000
1978	0.225	0.000	0.000
1979	0.239	0.000	0.000
1980	0.169	0.010	0.000
1981	0.135	0.022	0.000
1982	0.148	0.040	0.000
1983	0.104	0.081	0.000
1984	0.188	0.124	0.000
1985	0.225	0.059	0.000
1986	0.081	0.000	0.000
1987	0.106	0.000	0.000
1988	0.114	0.000	0.000
1989	0.097	0.000	0.000
1990	0.178	0.000	0.000
1991	0.119	0.088	0.000
1992	0.189	0.044	0.000
1993	0.226	0.088	0.000
1994	0.125	0.030	0.000
1995	0.051	0.040	0.000
1996	0.029	0.015	0.078
1997	0.030	0.020	0.112
1998	0.037	0.015	0.080
1999	0.124	0.023	0.086

Table 15 Continued. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) by commercial fleets for Eastern Gulf of America Red Snapper.

Year	Handline	Longline	Handline Closed Season Discards
2000	0.085	0.031	0.103
2001	0.080	0.032	0.066
2002	0.060	0.030	0.040
2003	0.065	0.020	0.027
2004	0.051	0.022	0.017
2005	0.051	0.020	0.013
2006	0.063	0.015	0.013
2007	0.029	0.005	0.000
2008	0.019	0.007	0.000
2009	0.026	0.002	0.000
2010	0.038	0.013	0.000
2011	0.040	0.015	0.000
2012	0.040	0.011	0.000
2013	0.046	0.019	0.000
2014	0.054	0.020	0.000
2015	0.056	0.024	0.000
2016	0.036	0.016	0.000
2017	0.038	0.014	0.000
2018	0.037	0.018	0.000
2019	0.046	0.024	0.000
2020	0.044	0.026	0.000
2021	0.049	0.027	0.000
2022	0.058	0.029	0.000
2023	0.056	0.033	0.000

Table 16. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) by recreational fleets for Western Gulf of America Red Snapper.

Year	Charter	Headboat Closed Season Discards	Headboat	Private Closed Season Discards	Private
1950	0.002	0	0.001	0	0.001
1951	0.002	0	0.001	0	0.001
1952	0.003	0	0.001	0	0.001
1953	0.003	0	0.001	0	0.001
1954	0.003	0	0.001	0	0.001
1955	0.003	0	0.001	0	0.001
1956	0.003	0	0.001	0	0.001
1957	0.004	0	0.001	0	0.001
1958	0.004	0	0.001	0	0.001
1959	0.005	0	0.002	0	0.001
1960	0.005	0	0.002	0	0.001
1961	0.005	0	0.002	0	0.001
1962	0.006	0	0.002	0	0.001
1963	0.006	0	0.002	0	0.002
1964	0.007	0	0.002	0	0.002
1965	0.004	0	0.002	0	0.005
1966	0.005	0	0.002	0	0.005
1967	0.005	0	0.002	0	0.005
1968	0.005	0	0.002	0	0.006
1969	0.006	0	0.003	0	0.006
1970	0.006	0	0.003	0	0.007
1971	0.007	0	0.003	0	0.008
1972	0.008	0	0.004	0	0.009
1973	0.010	0	0.005	0	0.011
1974	0.012	0	0.006	0	0.013

Table 16 Continued. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) by recreational fleets for Western Gulf of America Red Snapper.

Year	Charter	Headboat Closed Season Discards	Headboat	Private Closed Season Discards	Private
1975	0.005	0	0.004	0	0.025
1976	0.006	0	0.004	0	0.027
1977	0.006	0	0.005	0	0.028
1978	0.006	0	0.005	0	0.027
1979	0.005	0	0.005	0	0.024
1980	0.005	0	0.005	0	0.024
1981	0.006	0	0.006	0	0.058
1982	0.008	0	0.007	0	0.032
1983	0.012	0	0.006	0	0.067
1984	0.015	0	0.009	0	0.023
1985	0.023	0	0.008	0	0.034
1986	0.003	0	0.008	0	0.048
1987	0.002	0	0.008	0	0.016
1988	0.001	0	0.012	0	0.035
1989	0.003	0	0.012	0	0.026
1990	0.002	0	0.009	0	0.023
1991	0.007	0	0.011	0	0.025
1992	0.007	0	0.017	0	0.029
1993	0.006	0	0.027	0	0.053
1994	0.004	0	0.029	0	0.063
1995	0.006	0	0.021	0	0.088
1996	0.004	0	0.020	0	0.051
1997	0.004	0	0.019	0	0.052
1998	0.007	0	0.013	0	0.056
1999	0.004	0	0.005	0	0.047

Table 16 Continued. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) by recreational fleets for Western Gulf of America Red Snapper.

Year	Charter	Headboat Closed Season Discards	Headboat	Private Closed Season Discards	Private
2000	0.001	0.000	0.007	0.002	0.037
2001	0.001	0.000	0.007	0.000	0.027
2002	0.004	0.000	0.008	0.004	0.023
2003	0.004	0.000	0.009	0.003	0.022
2004	0.006	0.001	0.006	0.013	0.019
2005	0.005	0.001	0.005	0.005	0.028
2006	0.006	0.000	0.006	0.002	0.033
2007	0.006	0.000	0.006	0.000	0.026
2008	0.002	0.000	0.003	0.004	0.019
2009	0.002	0.000	0.004	0.002	0.016
2010	0.000	0.000	0.002	0.001	0.008
2011	0.000	0.000	0.002	0.003	0.012
2012	0.001	0.000	0.002	0.000	0.012
2013	0.001	0.000	0.001	0.000	0.016
2014	0.000	0.000	0.000	0.000	0.014
2015	0.001	0.000	0.001	0.000	0.015
2016	0.001	0.000	0.001	0.000	0.010
2017	0.001	0.000	0.001	0.000	0.013
2018	0.001	0.000	0.001	0.001	0.013
2019	0.001	0.000	0.001	0.001	0.021
2020	0.000	0.000	0.001	0.001	0.013
2021	0.001	0.000	0.005	0.001	0.013
2022	0.001	0.000	0.004	0.000	0.010
2023	0.001	0.000	0.002	0.000	0.019

Table 17. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) by recreational fleets for Central Gulf of America Red Snapper.

Year	Charter	Headboat Closed Season Discards	Headboat	Private Closed Season Discards	Private
1950	0.005	0	0.002	0	0.001
1951	0.005	0	0.002	0	0.002
1952	0.005	0	0.002	0	0.002
1953	0.006	0	0.002	0	0.002
1954	0.006	0	0.002	0	0.002
1955	0.006	0	0.002	0	0.002
1956	0.007	0	0.002	0	0.002
1957	0.008	0	0.002	0	0.002
1958	0.009	0	0.003	0	0.002
1959	0.010	0	0.003	0	0.003
1960	0.011	0	0.003	0	0.003
1961	0.012	0	0.004	0	0.003
1962	0.013	0	0.004	0	0.003
1963	0.014	0	0.004	0	0.004
1964	0.015	0	0.004	0	0.004
1965	0.013	0	0.004	0	0.006
1966	0.014	0	0.004	0	0.007
1967	0.015	0	0.005	0	0.008
1968	0.016	0	0.005	0	0.008
1969	0.017	0	0.005	0	0.009
1970	0.019	0	0.006	0	0.009
1971	0.021	0	0.007	0	0.011
1972	0.024	0	0.008	0	0.013
1973	0.028	0	0.009	0	0.015
1974	0.034	0	0.011	0	0.017

Table 17 Continued. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) by recreational fleets for Central Gulf of America Red Snapper.

Year	Charter	Headboat Closed Season Discards	Headboat	Private Closed Season Discards	Private
1975	0.031	0	0.010	0.000	0.028
1976	0.035	0	0.011	0.000	0.030
1977	0.038	0	0.012	0.000	0.032
1978	0.037	0	0.012	0.000	0.031
1979	0.027	0	0.011	0.000	0.027
1980	0.025	0	0.011	0.000	0.028
1981	0.006	0	0.003	0.000	0.126
1982	0.043	0	0.019	0.000	0.015
1983	0.088	0	0.038	0.000	0.052
1984	0.033	0	0.015	0.000	0.029
1985	0.036	0	0.015	0.000	0.053
1986	0.087	0	0.002	0.000	0.030
1987	0.087	0	0.001	0.000	0.061
1988	0.081	0	0.002	0.000	0.040
1989	0.046	0	0.001	0.000	0.083
1990	0.032	0	0.002	0.000	0.069
1991	0.038	0	0.002	0.000	0.139
1992	0.065	0	0.004	0.000	0.181
1993	0.113	0	0.004	0.000	0.289
1994	0.079	0	0.005	0.000	0.246
1995	0.074	0	0.005	0.000	0.154
1996	0.088	0	0.005	0.000	0.147
1997	0.097	0	0.007	0.001	0.200
1998	0.108	0	0.009	0.010	0.102
1999	0.126	0	0.008	0.011	0.258

Table 17 Continued. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) by recreational fleets for Central Gulf of America Red Snapper.

Year	Charter	Headboat Closed Season Discards	Headboat	Private Closed Season Discards	Private
2000	0.058	0	0.007	0.031	0.167
2001	0.044	0	0.005	0.044	0.190
2002	0.053	0	0.006	0.054	0.331
2003	0.059	0	0.007	0.037	0.236
2004	0.068	0	0.006	0.024	0.402
2005	0.067	0	0.005	0.040	0.218
2006	0.055	0	0.006	0.017	0.183
2007	0.042	0	0.006	0.010	0.141
2008	0.021	0	0.003	0.017	0.073
2009	0.022	0	0.005	0.018	0.078
2010	0.008	0	0.002	0.022	0.072
2011	0.019	0	0.003	0.019	0.078
2012	0.015	0	0.002	0.025	0.061
2013	0.015	0	0.003	0.009	0.132
2014	0.007	0	0.001	0.019	0.058
2015	0.013	0	0.001	0.010	0.050
2016	0.015	0	0.002	0.015	0.078
2017	0.016	0	0.003	0.022	0.145
2018	0.019	0	0.004	0.018	0.098
2019	0.020	0	0.003	0.019	0.116
2020	0.020	0	0.003	0.014	0.093
2021	0.026	0	0.006	0.013	0.092
2022	0.026	0	0.005	0.026	0.123
2023	0.034	0	0.003	0.012	0.092

Table 18. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) by recreational fleets for Eastern Gulf of America Red Snapper.

Year	Charter	Headboat Closed Season Discards	Headboat	Private Closed Season Discards	Private
1950	0.006	0	0.000	0	0.001
1951	0.006	0	0.000	0	0.001
1952	0.006	0	0.000	0	0.002
1953	0.007	0	0.000	0	0.002
1954	0.007	0	0.000	0	0.002
1955	0.007	0	0.000	0	0.002
1956	0.008	0	0.000	0	0.002
1957	0.009	0	0.000	0	0.002
1958	0.010	0	0.000	0	0.002
1959	0.012	0	0.000	0	0.003
1960	0.013	0	0.000	0	0.003
1961	0.015	0	0.000	0	0.003
1962	0.016	0	0.000	0	0.003
1963	0.017	0	0.000	0	0.004
1964	0.019	0	0.001	0	0.004
1965	0.012	0	0.001	0	0.010
1966	0.013	0	0.001	0	0.011
1967	0.015	0	0.001	0	0.012
1968	0.015	0	0.001	0	0.013
1969	0.017	0	0.001	0	0.014
1970	0.018	0	0.001	0	0.016
1971	0.021	0	0.001	0	0.018
1972	0.024	0	0.001	0	0.021
1973	0.027	0	0.002	0	0.025
1974	0.032	0	0.002	0	0.029

Table 18 Continued. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) by recreational fleets for Eastern Gulf of America Red Snapper.

Year	Charter	Headboat Closed Season Discards	Headboat	Private Closed Season Discards	Private
1975	0.010	0.000	0.002	0.000	0.057
1976	0.012	0.000	0.003	0.000	0.068
1977	0.014	0.000	0.003	0.000	0.082
1978	0.014	0.000	0.004	0.000	0.089
1979	0.011	0.000	0.003	0.000	0.077
1980	0.010	0.000	0.003	0.000	0.076
1981	0.014	0.000	0.007	0.000	0.280
1982	0.003	0.000	0.002	0.000	0.007
1983	0.027	0.000	0.013	0.000	0.467
1984	0.051	0.000	0.023	0.000	0.028
1985	0.016	0.000	0.007	0.000	0.292
1986	0.186	0.000	0.003	0.000	0.479
1987	0.013	0.000	0.001	0.000	0.304
1988	0.024	0.000	0.003	0.000	0.183
1989	0.051	0.000	0.002	0.000	0.437
1990	0.000	0.000	0.001	0.000	0.382
1991	0.001	0.000	0.002	0.000	0.287
1992	0.046	0.000	0.001	0.000	0.099
1993	0.000	0.000	0.007	0.000	0.006
1994	0.001	0.000	0.003	0.000	0.002
1995	0.000	0.000	0.001	0.000	0.067
1996	0.004	0.000	0.001	0.000	0.612
1997	0.022	0.000	0.000	0.000	0.000
1998	0.072	0.000	0.003	0.099	0.001
1999	0.008	0.002	0.023	0.046	0.160

Table 18 Continued. Estimates of annual exploitation rate (total biomass killed age 1+ / total biomass age 1+) by recreational fleets for Eastern Gulf of America Red Snapper.

Year	Charter	Headboat Closed Season Discards	Headboat	Private Closed Season Discards	Private
2000	0.006	0.000	0.013	0.003	0.044
2001	0.022	0.001	0.008	0.000	0.000
2002	0.006	0.000	0.001	0.000	0.072
2003	0.012	0.000	0.002	0.002	0.019
2004	0.002	0.000	0.005	0.000	0.041
2005	0.007	0.001	0.013	0.018	0.321
2006	0.045	0.000	0.003	0.008	0.073
2007	0.003	0.000	0.001	0.000	0.102
2008	0.007	0.001	0.001	0.005	0.009
2009	0.003	0.001	0.002	0.011	0.023
2010	0.005	0.000	0.001	0.015	0.004
2011	0.000	0.001	0.003	0.202	0.014
2012	0.003	0.000	0.000	0.000	0.015
2013	0.001	0.000	0.001	0.001	0.003
2014	0.004	0.000	0.001	0.000	0.005
2015	0.007	0.000	0.000	0.000	0.002
2016	0.006	0.001	0.002	0.032	0.017
2017	0.011	0.001	0.003	0.009	0.035
2018	0.012	0.001	0.004	0.028	0.044
2019	0.009	0.001	0.004	0.018	0.046
2020	0.012	0.000	0.002	0.014	0.018
2021	0.025	0.000	0.003	0.003	0.039
2022	0.021	0.000	0.005	0.009	0.059
2023	0.037	0.000	0.006	0.005	0.099

Table 19. Estimates of annual exploitation rate (primarily age zero) for Shrimp Trawl bycatch for Gulf of America Red Snapper.

Year	Shrimp Bycatch central	Shrimp Bycatch east	Shrimp Bycatch west
1950	0	0.000	0.000
1951	0	0.000	0.000
1952	0	0.000	0.000
1953	0	0.000	0.000
1954	0	0.000	0.000
1955	0	0.000	0.000
1956	0	0.000	0.000
1957	0	0.000	0.000
1958	0	0.000	0.000
1959	0	0.000	0.000
1960	0	0.000	0.000
1961	0	0.000	0.000
1962	0	0.000	0.000
1963	0	0.000	0.000
1964	0	0.000	0.000
1965	0	0.000	0.000
1966	0	0.000	0.000
1967	0	0.000	0.001
1968	0	0.000	0.001
1969	0	0.000	0.001
1970	0	0.000	0.001
1971	0	0.000	0.001
1972	0	0.000	0.001
1973	0	0.001	0.001
1974	0	0.001	0.001

Table 19 Continued. Estimates of annual exploitation rate in terms of biomass of age-0 fish for Shrimp Trawl bycatch for Gulf of America Red Snapper.

Year	Shrimp Bycatch central	Shrimp Bycatch east	Shrimp Bycatch west
1975	0.000	0.001	0.001
1976	0.000	0.001	0.001
1977	0.000	0.001	0.002
1978	0.000	0.005	0.006
1979	0.001	0.007	0.007
1980	0.000	0.001	0.001
1981	0.000	0.002	0.002
1982	0.000	0.002	0.002
1983	0.000	0.001	0.001
1984	0.000	0.005	0.002
1985	0.000	0.001	0.002
1986	0.000	0.002	0.004
1987	0.000	0.003	0.002
1988	0.000	0.002	0.002
1989	0.001	0.002	0.007
1990	0.002	0.001	0.006
1991	0.001	0.001	0.004
1992	0.001	0.004	0.004
1993	0.000	0.005	0.005
1994	0.000	0.004	0.005
1995	0.001	0.004	0.004
1996	0.001	0.006	0.002
1997	0.001	0.006	0.002
1998	0.001	0.003	0.003
1999	0.001	0.003	0.005

Table 19 Continued. Estimates of annual exploitation rate in terms of biomass of age-0 fish for Shrimp Trawl bycatch for Gulf of America Red Snapper.

Year	Shrimp Bycatch central	Shrimp Bycatch east	Shrimp Bycatch west
2000	0.002	0.006	0.005
2001	0.000	0.003	0.001
2002	0.001	0.004	0.003
2003	0.000	0.003	0.002
2004	0.000	0.002	0.002
2005	0.001	0.003	0.003
2006	0.001	0.002	0.002
2007	0.001	0.003	0.003
2008	0.000	0.000	0.000
2009	0.000	0.001	0.003
2010	0.000	0.000	0.001
2011	0.000	0.000	0.001
2012	0.000	0.000	0.002
2013	0.000	0.000	0.000
2014	0.000	0.002	0.001
2015	0.000	0.000	0.001
2016	0.000	0.000	0.001
2017	0.000	0.000	0.001
2018	0.000	0.000	0.001
2019	0.000	0.000	0.000
2020	0.000	0.000	0.000
2021	0.000	0.000	0.000
2022	0.000	0.000	0.000
2023	0.000	0.000	0.000

Table 20. Expected biomass (metric tons) for all Western Gulf of America Red Snapper and exploited (1+ years) Red Snapper, spawning stock biomass (SSB, metric tons), exploited numbers (1,000s of fish), age-0 recruits (1,000s of fish), and SSB ratio (SSB/SSB_0) where SSB_0 = 392218.6 metric tons for Gulf of America Red Snapper.

Year	Biomass (all)	Biomass (exploited)	SSB	Abundance (exploited)	Recruits	SSB ratio
1950	184,071	183,783	177,309	68,068	46,780	0.70
1951	182,783	182,505	176,553	59,837	45,348	0.70
1952	180,684	180,414	175,278	56,811	44,018	0.70
1953	177,713	177,450	173,024	54,147	42,827	0.69
1954	174,232	173,975	169,968	51,843	41,773	0.68
1955	170,209	169,959	166,187	49,759	40,738	0.66
1956	165,705	165,460	161,846	47,804	39,805	0.64
1957	160,488	160,249	156,782	45,834	38,871	0.62
1958	154,931	154,698	151,363	43,940	37,899	0.60
1959	148,375	148,148	144,979	41,817	36,970	0.58
1960	141,564	141,341	138,320	39,775	36,253	0.55
1961	134,510	134,298	131,419	37,722	34,434	0.52
1962	127,113	126,902	124,155	35,929	34,246	0.49
1963	119,843	119,627	116,987	34,016	35,157	0.47
1964	113,283	113,070	110,481	32,660	34,669	0.44
1965	106,639	106,426	103,913	31,190	34,628	0.41
1966	100,230	100,017	97,560	30,139	34,775	0.39
1967	94,408	94,177	91,726	29,282	37,485	0.36
1968	88,281	88,048	85,630	28,454	37,938	0.34
1969	82,011	81,771	79,397	27,509	38,990	0.32
1970	76,510	76,279	73,889	26,667	37,520	0.29
1971	71,108	70,888	68,535	25,619	35,918	0.27
1972	65,500	65,287	63,071	23,944	34,634	0.25
1973	60,155	59,969	57,922	22,013	30,344	0.23
1974	54,749	54,578	52,766	19,777	27,809	0.21

Table 20 Continued. Expected biomass (metric tons) for all Western Gulf of America Red Snapper and exploited (1+ years) Red Snapper, spawning stock biomass (SSB, metric tons), exploited numbers (1,000s of fish), age-0 recruits (1,000s of fish), and SSB ratio (SSB/SSB_0) where SSB_0 = 392218.6 metric tons for Gulf of America Red Snapper.

Year	Biomass (all)	Biomass (exploited)	SSB	Abundance (exploited)	Recruits	SSB ratio
1975	49,448	49,286	47,716	17,736	26,475	0.19
1976	44,400	44,221	42,854	16,224	29,240	0.17
1977	39,932	39,688	38,407	15,532	39,693	0.15
1978	36,524	35,942	34,517	17,424	94,809	0.14
1979	34,646	34,009	31,560	30,164	103,617	0.12
1980	34,447	34,301	30,343	36,508	23,782	0.12
1981	34,787	34,495	30,491	21,307	47,447	0.12
1982	32,635	32,374	29,422	23,377	42,539	0.12
1983	31,013	30,929	28,340	22,180	13,616	0.11
1984	27,416	27,178	25,498	12,478	38,639	0.10
1985	25,000	24,793	23,215	17,486	33,648	0.09
1986	23,222	22,927	21,222	15,998	48,112	0.08
1987	21,800	21,694	19,708	18,995	17,224	0.08
1988	21,590	21,453	19,455	12,460	22,223	0.08
1989	20,426	19,996	18,476	12,050	70,072	0.07
1990	20,234	19,822	17,748	23,922	66,960	0.07
1991	21,515	21,242	18,069	26,776	44,483	0.07
1992	23,241	22,969	19,380	22,961	44,184	0.08
1993	24,502	24,084	20,775	22,473	67,879	0.08
1994	25,037	24,453	21,167	28,228	94,993	0.08
1995	26,190	25,710	21,503	38,303	78,251	0.09
1996	27,552	27,281	22,238	37,318	44,112	0.09
1997	29,079	28,843	24,001	28,739	38,466	0.10
1998	29,484	29,232	25,358	24,926	40,959	0.10
1999	29,268	28,814	25,721	23,601	73,807	0.10

Table 20 Continued. Expected biomass (metric tons) for all Western Gulf of America Red Snapper and exploited (1+ years) Red Snapper, spawning stock biomass (SSB, metric tons), exploited numbers (1,000s of fish), age-0 recruits (1,000s of fish), and SSB ratio (SSB/SSB_0) where SSB_0 = 392218.6 metric tons for Gulf of America Red Snapper.

Year	Biomass (all)	Biomass (exploited)	SSB	Abundance (exploited)	Recruits	SSB ratio
2000	29,513	29,055	25,731	31,222	74,606	0.10
2001	30,500	30,322	26,271	33,384	29,050	0.10
2002	32,196	31,795	27,809	24,127	65,220	0.11
2003	33,642	33,290	29,439	31,639	57,122	0.12
2004	35,442	35,077	31,081	31,836	59,233	0.12
2005	37,498	36,731	32,487	33,558	124,853	0.13
2006	40,646	40,064	34,334	54,692	94,692	0.14
2007	45,186	44,316	37,164	52,198	141,515	0.15
2008	51,655	51,634	42,608	69,634	3,484	0.17
2009	59,720	58,549	50,476	35,782	190,562	0.20
2010	68,583	68,143	59,310	85,457	71,642	0.24
2011	78,742	78,189	68,791	63,206	89,935	0.27
2012	89,004	87,868	78,528	67,544	184,918	0.31
2013	99,653	99,468	88,839	98,099	30,132	0.35
2014	109,463	108,811	98,723	60,553	106,038	0.39
2015	118,626	118,012	108,882	76,436	99,928	0.43
2016	126,322	125,840	117,284	76,878	78,457	0.47
2017	133,642	133,190	124,873	71,781	73,650	0.50
2018	139,351	138,788	131,006	69,256	91,643	0.52
2019	144,149	143,649	136,069	74,030	81,374	0.54
2020	146,229	146,035	138,492	71,262	31,681	0.55
2021	148,146	147,903	141,296	55,939	39,621	0.56
2022	147,643	147,404	142,174	53,388	39,021	0.56
2023	146,379	146,212	141,955	50,803	27,153	0.56

Table 21. Expected biomass (metric tons) for all Central Gulf of America Red Snapper and exploited (1+ years) Red Snapper, spawning stock biomass (SSB, metric tons), exploited numbers (1,000s of fish), age-0 recruits (1,000s of fish), and SSB ratio (SSB/SSB_0) where SSB_0 = 392218.6 metric tons for Gulf of America Red Snapper.

Year	Biomass (all)	Biomass (exploited)	SSB	Abundance (exploited)	Recruits	SSB ratio
1950	78,428	78,325	76,724	29,249	18,132	0.70
1951	78,253	78,154	76,743	25,373	17,577	0.70
1952	77,646	77,549	76,397	24,014	17,061	0.70
1953	76,558	76,464	75,468	22,821	16,600	0.69
1954	75,143	75,051	74,125	21,787	16,191	0.68
1955	73,445	73,356	72,466	20,869	15,790	0.66
1956	71,426	71,339	70,477	20,003	15,428	0.64
1957	68,997	68,912	68,077	19,137	15,067	0.62
1958	66,413	66,330	65,521	18,318	14,690	0.60
1959	63,208	63,127	62,348	17,386	14,330	0.57
1960	59,950	59,870	59,117	16,514	14,052	0.54
1961	56,465	56,389	55,662	15,644	13,347	0.51
1962	53,054	52,979	52,280	14,740	13,274	0.48
1963	49,627	49,549	48,875	14,010	13,627	0.45
1964	46,191	46,115	45,451	13,460	13,438	0.42
1965	43,015	42,939	42,279	12,866	13,422	0.39
1966	39,956	39,880	39,228	12,346	13,479	0.36
1967	37,220	37,137	36,489	11,954	14,529	0.33
1968	34,490	34,407	33,748	11,858	14,705	0.31
1969	32,090	32,004	31,325	11,631	15,112	0.29
1970	29,904	29,821	29,128	11,504	14,543	0.27
1971	27,968	27,890	27,194	11,194	13,922	0.25
1972	26,061	25,985	25,311	10,706	13,424	0.23
1973	24,104	24,038	23,397	10,158	11,761	0.21
1974	21,882	21,821	21,240	9,106	10,779	0.19

Table 21 Continued. Expected biomass (metric tons) for all Central Gulf of America Red Snapper and exploited (1+ years) Red Snapper, spawning stock biomass (SSB, metric tons), exploited numbers (1,000s of fish), age-0 recruits (1,000s of fish), and SSB ratio (SSB/SSB_0) where SSB_0 = 392218.6 metric tons for Gulf of America Red Snapper.

Year	Biomass (all)	Biomass (exploited)	SSB	Abundance (exploited)	Recruits	SSB ratio
1975	19,534	19,476	18,966	8,112	10,262	0.17
1976	17,138	17,074	16,627	7,239	11,334	0.15
1977	14,907	14,820	14,392	6,986	15,385	0.13
1978	13,228	13,020	12,522	7,998	36,748	0.12
1979	12,371	12,144	11,217	15,183	40,162	0.10
1980	12,501	12,449	11,001	18,456	9,218	0.10
1981	13,032	12,928	11,678	10,342	18,391	0.11
1982	12,242	12,148	11,344	11,000	16,488	0.10
1983	11,875	11,845	11,078	10,331	5,278	0.10
1984	9,931	9,846	9,358	5,590	14,976	0.09
1985	9,321	9,283	8,801	7,898	6,800	0.08
1986	8,677	8,601	8,159	5,450	13,387	0.07
1987	7,960	7,921	7,463	6,981	6,913	0.07
1988	7,179	7,110	6,706	4,923	12,336	0.06
1989	6,677	6,505	6,085	6,252	30,363	0.06
1990	6,647	6,458	5,698	12,163	33,310	0.05
1991	7,440	7,273	6,059	14,972	29,484	0.06
1992	8,319	8,178	6,828	15,138	24,838	0.06
1993	8,621	8,541	7,312	13,826	14,057	0.07
1994	7,422	7,326	6,433	9,458	16,936	0.06
1995	6,793	6,569	5,832	9,369	39,454	0.05
1996	7,397	7,119	5,972	17,090	49,042	0.06
1997	8,509	8,322	6,545	22,422	33,105	0.06
1998	9,594	9,452	7,574	19,208	25,121	0.07
1999	11,191	10,894	9,295	16,738	52,334	0.09

Table 21 Continued. Expected biomass (metric tons) for all Central Gulf of America Red Snapper and exploited (1+ years) Red Snapper, spawning stock biomass (SSB, metric tons), exploited numbers (1,000s of fish), age-0 recruits (1,000s of fish), and SSB ratio (SSB/SSB_0) where SSB_0 = 392218.6 metric tons for Gulf of America Red Snapper.

Year	Biomass (all)	Biomass (exploited)	SSB	Abundance (exploited)	Recruits	SSB ratio
2000	10,953	10,443	8,768	23,774	89,932	0.08
2001	12,641	12,488	9,720	38,496	26,971	0.09
2002	14,483	14,178	11,489	22,715	53,728	0.10
2003	13,586	13,412	11,270	27,387	30,778	0.10
2004	13,624	13,410	11,506	20,627	37,599	0.10
2005	11,509	10,947	9,333	20,181	99,101	0.09
2006	12,939	12,216	9,516	40,957	127,459	0.09
2007	17,219	16,309	11,803	56,970	160,501	0.11
2008	23,700	23,679	17,351	75,721	3,785	0.16
2009	32,036	31,678	26,649	33,637	62,980	0.24
2010	39,078	38,906	35,595	45,793	30,199	0.32
2011	44,644	44,357	41,894	35,195	50,534	0.38
2012	47,553	47,273	44,988	38,666	49,501	0.41
2013	49,451	49,389	46,980	37,999	11,029	0.43
2014	47,544	46,727	44,897	23,659	144,066	0.41
2015	49,715	49,224	45,906	64,489	86,613	0.42
2016	53,236	52,854	48,123	55,688	67,298	0.44
2017	55,494	55,330	50,866	50,676	28,988	0.47
2018	52,868	52,555	49,510	35,165	55,202	0.45
2019	52,122	51,838	49,368	39,507	50,070	0.45
2020	49,448	49,204	46,752	36,673	42,932	0.43
2021	47,835	47,617	45,225	33,492	38,490	0.41
2022	45,588	45,375	43,204	30,668	37,676	0.40
2023	41,325	41,009	39,065	28,224	55,666	0.36

Table 22. Expected biomass (metric tons) for all East Gulf of America Red Snapper and exploited (1+ years) Red Snapper, spawning stock biomass (SSB, metric tons), exploited numbers (1,000s of fish), age-0 recruits (1,000s of fish), and SSB ratio (SSB/SSB_0) where SSB_0 = 392218.6 metric tons for Gulf of America Red Snapper.

Year	Biomass (all)	Biomass (exploited)	SSB	Abundance (exploited)	Recruits	SSB ratio
1950	18,240	18,215	17,798	6,722	4,702	0.57
1951	18,259	18,234	17,866	5,803	4,558	0.57
1952	18,123	18,099	17,798	5,480	4,424	0.57
1953	17,828	17,805	17,546	5,192	4,304	0.56
1954	17,468	17,445	17,204	4,948	4,198	0.55
1955	17,045	17,023	16,792	4,734	4,094	0.54
1956	16,508	16,486	16,262	4,529	4,001	0.52
1957	15,820	15,799	15,582	4,322	3,907	0.50
1958	15,130	15,109	14,898	4,131	3,809	0.48
1959	14,119	14,099	13,895	3,896	3,716	0.44
1960	13,150	13,130	12,933	3,683	3,644	0.41
1961	12,093	12,075	11,884	3,464	3,461	0.38
1962	11,110	11,092	10,908	3,265	3,442	0.35
1963	10,126	10,107	9,929	3,067	3,533	0.32
1964	9,130	9,112	8,936	2,950	3,484	0.29
1965	8,198	8,180	8,006	2,764	3,480	0.26
1966	7,353	7,335	7,165	2,648	3,495	0.23
1967	6,615	6,594	6,425	2,555	3,767	0.20
1968	6,098	6,077	5,900	2,624	3,813	0.19
1969	5,618	5,597	5,411	2,599	3,919	0.17
1970	5,233	5,213	5,022	2,600	3,771	0.16
1971	4,876	4,857	4,666	2,539	3,610	0.15
1972	4,597	4,578	4,392	2,465	3,481	0.14
1973	4,290	4,273	4,095	2,352	3,050	0.13
1974	3,993	3,978	3,816	2,110	2,795	0.12

Table 22 Continued. Expected biomass (metric tons) for all East Gulf of America Red Snapper and exploited (1+ years) Red Snapper, spawning stock biomass (SSB, metric tons), exploited numbers (1,000s of fish), age-0 recruits (1,000s of fish), and SSB ratio (SSB/SSB_0) where SSB_0 = 392218.6 metric tons for Gulf of America Red Snapper.

Year	Biomass (all)	Biomass (exploited)	SSB	Abundance (exploited)	Recruits	SSB ratio
1975	3,204	3,190	3,053	1,797	2,661	0.10
1976	2,501	2,486	2,367	1,568	2,939	0.08
1977	1,833	1,812	1,699	1,495	3,989	0.05
1978	1,509	1,458	1,325	1,752	9,529	0.04
1979	1,410	1,354	1,114	3,449	10,414	0.04
1980	1,520	1,507	1,135	4,174	2,390	0.04
1981	1,797	1,772	1,443	2,318	4,769	0.05
1982	1,589	1,566	1,372	2,342	4,275	0.04
1983	1,793	1,786	1,577	2,391	1,369	0.05
1984	942	921	838	893	3,883	0.03
1985	790	785	681	1,467	1,058	0.02
1986	552	544	463	692	1,443	0.01
1987	282	276	237	550	1,003	0.01
1988	251	247	207	442	753	0.01
1989	250	248	210	384	546	0.01
1990	174	172	150	254	228	0.00
1991	118	117	103	135	174	0.00
1992	88	86	76	97	408	0.00
1993	81	78	66	161	624	0.00
1994	90	88	67	251	431	0.00
1995	122	119	94	230	524	0.00
1996	162	158	133	265	886	0.00
1997	115	112	87	325	655	0.00
1998	154	152	120	315	389	0.00
1999	177	173	146	240	696	0.00

Table 22 Continued. Expected biomass (metric tons) for all East Gulf of America Red Snapper and exploited (1+ years) Red Snapper, spawning stock biomass (SSB, metric tons), exploited numbers (1,000s of fish), age-0 recruits (1,000s of fish), and SSB ratio (SSB/SSB_0) where SSB_0 = 392218.6 metric tons for Gulf of America Red Snapper.

Year	Biomass (all)	Biomass (exploited)	SSB	Abundance (exploited)	Recruits	SSB ratio
2000	171	162	138	308	1,673	0.00
2001	209	204	158	641	846	0.00
2002	278	268	210	498	1,892	0.01
2003	369	359	290	837	1,880	0.01
2004	498	488	401	950	1,873	0.01
2005	670	640	542	1,040	5,670	0.02
2006	711	679	524	2,224	6,076	0.02
2007	1,002	956	706	2,779	8,698	0.02
2008	1,452	1,451	1,099	3,967	206	0.04
2009	2,078	2,048	1,752	1,850	5,748	0.06
2010	2,694	2,683	2,444	3,304	1,915	0.08
2011	3,245	3,219	3,013	2,342	4,945	0.10
2012	3,007	2,994	2,808	2,846	2,526	0.09
2013	3,366	3,363	3,167	2,310	595	0.10
2014	3,801	3,645	3,502	1,641	29,237	0.11
2015	4,398	4,363	3,797	10,737	6,549	0.12
2016	5,219	5,199	4,397	5,956	3,778	0.14
2017	6,090	6,042	5,469	4,755	8,995	0.17
2018	6,850	6,834	6,410	5,985	2,868	0.20
2019	7,159	7,126	6,790	4,042	6,246	0.22
2020	7,183	7,169	6,876	4,595	2,622	0.22
2021	7,260	7,241	6,989	3,418	3,537	0.22
2022	6,938	6,924	6,716	3,310	2,725	0.22
2023	6,249	6,232	6,056	2,756	3,245	0.19

Table 23. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Handline West fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input B SE	Input B	Exp B	Exp N	MW
1950	0.05	1.48	1.48	439	3.4
1951	0.05	1.48	1.48	409	3.6
1952	0.05	1.65	1.66	439	3.8
1953	0.05	1.36	1.36	349	3.9
1954	0.05	1.37	1.37	344	4.0
1955	0.05	1.49	1.49	373	4.0
1956	0.05	2.02	2.02	503	4.0
1957	0.05	2.01	2.02	503	4.0
1958	0.05	3.36	3.37	842	4.0
1959	0.05	3.43	3.44	866	4.0
1960	0.05	3.60	3.61	917	3.9
1961	0.05	4.25	4.27	1,092	3.9
1962	0.05	4.13	4.15	1,080	3.8
1963	0.05	3.00	3.01	797	3.8
1964	0.05	3.52	3.54	956	3.7
1965	0.05	3.57	3.59	989	3.6
1966	0.05	2.99	3.00	851	3.5
1967	0.05	4.16	4.18	1,216	3.4
1968	0.05	5.08	5.12	1,533	3.3
1969	0.05	4.10	4.12	1,282	3.2
1970	0.05	4.57	4.60	1,470	3.1
1971	0.05	5.28	5.32	1,736	3.1
1972	0.05	4.77	4.80	1,584	3.0
1973	0.05	4.79	4.83	1,589	3.0
1974	0.05	4.36	4.39	1,430	3.1

Table 23 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Handline West fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input B SE	Input B	Exp B	Exp N	MW
1975	0.05	3.86	3.88	1,252	3.1
1976	0.05	3.26	3.28	1,074	3.1
1977	0.05	2.82	2.84	979	2.9
1978	0.05	2.64	2.66	1,068	2.5
1979	0.05	2.42	2.43	1,328	1.8
1980	0.05	2.19	2.20	1,247	1.8
1981	0.05	2.63	2.64	1,162	2.3
1982	0.05	3.11	3.11	1,367	2.3
1983	0.05	3.65	3.62	1,543	2.3
1984	0.05	2.87	2.84	996	2.9
1985	0.05	2.07	2.06	607	3.4
1986	0.05	1.91	1.90	574	3.3
1987	0.05	1.56	1.55	512	3.0
1988	0.05	2.36	2.35	707	3.3
1989	0.05	1.89	1.90	548	3.5
1990	0.05	1.58	1.59	558	2.8
1991	0.05	1.41	1.41	520	2.7
1992	0.05	1.76	1.76	613	2.9
1993	0.05	2.92	2.93	972	3.0
1994	0.05	2.70	2.70	922	2.9
1995	0.05	2.75	2.74	786	3.5
1996	0.05	4.07	4.02	1,168	3.4
1997	0.05	4.60	4.56	1,270	3.6
1998	0.05	4.28	4.28	1,130	3.8
1999	0.05	4.23	4.26	1,078	3.9

Table 23 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Handline West fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input B SE	Input B	Exp B	Exp N	MW
2000	0.05	3.86	3.86	1,000	3.9
2001	0.05	3.63	3.63	964	3.8
2002	0.05	3.49	3.49	895	3.9
2003	0.05	3.15	3.14	806	3.9
2004	0.05	2.96	2.95	752	3.9
2005	0.05	3.02	3.02	770	3.9
2006	0.05	3.57	3.56	974	3.7
2007	0.05	2.02	2.05	533	3.8
2008	0.05	1.53	1.66	473	3.5
2009	0.05	1.45	1.62	422	3.8
2010	0.05	1.81	1.91	511	3.7
2011	0.05	1.81	1.94	497	3.9
2012	0.05	2.05	2.21	548	4.0
2013	0.05	2.79	2.89	729	4.0
2014	0.05	3.00	2.91	693	4.2
2015	0.05	3.56	3.41	795	4.3
2016	0.05	3.60	3.44	785	4.4
2017	0.05	3.64	3.49	780	4.5
2018	0.05	3.58	3.41	746	4.6
2019	0.05	3.76	3.57	778	4.6
2020	0.05	3.76	3.49	758	4.6
2021	0.05	3.76	3.52	738	4.8
2022	0.05	3.87	3.66	744	4.9
2023	0.05	4.67	4.44	879	5.1

Table 24. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Handline Central fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input B SE	Input B	Exp B	Exp N	MW
1950	0.05	0.97	0.97	188	5.2
1951	0.05	1.16	1.16	219	5.3
1952	0.05	1.29	1.29	235	5.5
1953	0.05	1.16	1.16	204	5.7
1954	0.05	1.08	1.08	184	5.9
1955	0.05	1.21	1.21	201	6.0
1956	0.05	1.44	1.45	239	6.1
1957	0.05	1.30	1.30	213	6.1
1958	0.05	2.13	2.13	352	6.1
1959	0.05	1.95	1.95	323	6.1
1960	0.05	2.19	2.19	364	6.0
1961	0.05	2.01	2.01	337	6.0
1962	0.05	2.07	2.07	351	5.9
1963	0.05	2.19	2.19	375	5.8
1964	0.05	1.86	1.86	326	5.7
1965	0.05	2.00	2.00	356	5.6
1966	0.05	1.60	1.60	292	5.5
1967	0.05	1.87	1.88	351	5.3
1968	0.05	1.57	1.57	304	5.2
1969	0.05	1.47	1.47	294	5.0
1970	0.05	1.31	1.31	271	4.8
1971	0.05	1.37	1.37	290	4.7
1972	0.05	1.45	1.45	311	4.7
1973	0.05	1.88	1.88	405	4.6
1974	0.05	1.87	1.87	400	4.7

Table 24 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Handline Central fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input B SE	Input B	Exp B	Exp N	MW
1975	0.05	1.89	1.89	398	4.7
1976	0.05	1.67	1.67	350	4.8
1977	0.05	1.30	1.30	279	4.7
1978	0.05	1.19	1.19	286	4.2
1979	0.05	1.23	1.23	395	3.1
1980	0.05	1.25	1.25	451	2.8
1981	0.05	1.51	1.51	483	3.1
1982	0.05	1.69	1.69	493	3.4
1983	0.05	1.88	1.88	521	3.6
1984	0.05	1.18	1.18	301	3.9
1985	0.05	0.82	0.82	211	3.9
1986	0.05	0.67	0.68	169	4.0
1987	0.05	0.57	0.57	148	3.9
1988	0.05	0.72	0.72	187	3.9
1989	0.05	0.57	0.57	154	3.7
1990	0.05	0.54	0.54	181	3.0
1991	0.05	0.43	0.43	157	2.7
1992	0.05	0.54	0.54	195	2.8
1993	0.05	0.40	0.40	137	2.9
1994	0.05	0.49	0.49	156	3.1
1995	0.05	0.16	0.16	42	3.7
1996	0.05	0.22	0.22	63	3.5
1997	0.05	0.17	0.17	54	3.2
1998	0.05	0.36	0.36	111	3.2
1999	0.05	0.49	0.49	142	3.4

Table 24 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Handline Central fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input B SE	Input B	Exp B	Exp N	MW
2000	0.05	0.61	0.61	175	3.5
2001	0.05	0.74	0.74	226	3.3
2002	0.05	0.99	0.98	300	3.3
2003	0.05	0.95	0.95	278	3.4
2004	0.05	0.86	0.87	246	3.5
2005	0.05	0.69	0.70	197	3.6
2006	0.05	0.64	0.64	195	3.3
2007	0.05	0.76	0.71	237	3.0
2008	0.05	0.70	0.66	246	2.7
2009	0.05	0.76	0.82	264	3.1
2010	0.05	1.12	1.18	330	3.6
2011	0.05	1.28	1.44	356	4.1
2012	0.05	1.52	1.68	385	4.4
2013	0.05	1.97	1.95	433	4.5
2014	0.05	1.75	1.93	411	4.7
2015	0.05	2.48	2.21	526	4.2
2016	0.05	2.19	2.04	537	3.8
2017	0.05	2.31	2.20	586	3.7
2018	0.05	2.19	2.13	534	4.0
2019	0.05	2.28	2.19	522	4.2
2020	0.05	2.33	2.18	510	4.3
2021	0.05	2.13	2.01	468	4.3
2022	0.05	1.79	1.73	400	4.3
2023	0.05	1.75	1.72	398	4.3

Table 25. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Handline East fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input B SE	Input B	Exp B	Exp N	MW
1950	0.05	0.72	0.72	72	10.1
1951	0.05	0.86	0.86	85	10.1
1952	0.05	0.96	0.96	92	10.4
1953	0.05	0.86	0.86	80	10.8
1954	0.05	0.80	0.80	72	11.1
1955	0.05	0.90	0.90	79	11.4
1956	0.05	1.08	1.07	92	11.6
1957	0.05	0.97	0.96	82	11.8
1958	0.05	1.59	1.58	133	11.9
1959	0.05	1.46	1.45	121	12.0
1960	0.05	1.63	1.62	136	12.0
1961	0.05	1.50	1.49	125	11.9
1962	0.05	1.54	1.54	130	11.8
1963	0.05	1.63	1.62	138	11.7
1964	0.05	1.57	1.56	136	11.5
1965	0.05	1.54	1.53	135	11.3
1966	0.05	1.38	1.38	125	11.0
1967	0.05	0.98	0.98	92	10.7
1968	0.05	1.01	1.01	97	10.3
1969	0.05	0.90	0.89	90	9.9
1970	0.05	0.92	0.91	96	9.5
1971	0.05	0.77	0.76	84	9.1
1972	0.05	0.81	0.81	92	8.8
1973	0.05	0.73	0.73	84	8.7
1974	0.05	1.75	1.73	200	8.7

Table 25 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Handline East fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input B SE	Input B	Exp B	Exp N	MW
1975	0.05	1.55	1.54	178	8.6
1976	0.05	1.49	1.48	172	8.6
1977	0.05	0.88	0.88	107	8.2
1978	0.05	0.73	0.72	99	7.3
1979	0.05	0.72	0.71	130	5.5
1980	0.05	0.56	0.56	134	4.2
1981	0.05	0.53	0.53	123	4.3
1982	0.05	0.51	0.51	108	4.7
1983	0.05	0.41	0.41	78	5.3
1984	0.05	0.38	0.38	67	5.8
1985	0.05	0.37	0.37	56	6.6
1986	0.05	0.09	0.09	13	6.9
1987	0.05	0.06	0.06	8	7.7
1988	0.05	0.06	0.06	8	6.9
1989	0.05	0.05	0.05	7	6.9
1990	0.05	0.06	0.06	9	7.5
1991	0.05	0.03	0.03	4	7.4
1992	0.05	0.03	0.03	5	7.0
1993	0.05	0.04	0.04	6	6.2
1994	0.05	0.02	0.02	4	5.2
1995	0.05	0.01	0.01	3	4.9
1996	0.05	0.01	0.01	2	5.1
1997	0.05	0.01	0.01	1	5.0
1998	0.05	0.01	0.01	2	4.9
1999	0.05	0.05	0.04	9	5.1

Table 25 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Handline East fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input B SE	Input B	Exp B	Exp N	MW
2000	0.05	0.03	0.03	5	5.3
2001	0.05	0.04	0.03	7	5.2
2002	0.05	0.03	0.03	7	4.9
2003	0.05	0.05	0.05	10	5.0
2004	0.05	0.05	0.05	10	5.1
2005	0.05	0.07	0.07	13	5.3
2006	0.05	0.09	0.09	17	5.2
2007	0.05	0.05	0.05	11	5.0
2008	0.05	0.05	0.06	12	4.5
2009	0.05	0.10	0.11	23	4.8
2010	0.05	0.20	0.21	38	5.4
2011	0.05	0.24	0.26	43	6.0
2012	0.05	0.22	0.25	38	6.6
2013	0.05	0.29	0.31	46	6.8
2014	0.05	0.39	0.40	57	7.1
2015	0.05	0.53	0.49	72	6.9
2016	0.05	0.38	0.37	65	5.7
2017	0.05	0.47	0.46	84	5.5
2018	0.05	0.53	0.51	86	6.0
2019	0.05	0.71	0.67	103	6.5
2020	0.05	0.68	0.64	92	7.0
2021	0.05	0.76	0.72	97	7.4
2022	0.05	0.89	0.82	106	7.8
2023	0.05	0.76	0.71	88	8.1

Table 26. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Longline West fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input B SE	Input B	Exp B	Exp N	MW
1980	0.05	0.31	0.31	23	13.7
1981	0.05	0.50	0.50	37	13.4
1982	0.05	0.55	0.55	43	13.0
1983	0.05	0.60	0.60	47	13.0
1984	0.05	0.76	0.76	56	13.4
1985	0.05	0.70	0.70	52	13.3
1986	0.05	0.85	0.85	64	13.3
1987	0.05	0.74	0.74	58	12.8
1988	0.05	0.69	0.69	55	12.6
1989	0.05	0.48	0.48	38	12.6
1990	0.05	0.36	0.36	31	11.9
1991	0.05	0.30	0.30	27	11.1
1992	0.05	0.73	0.73	69	10.6
1993	0.05	0.02	0.02	2	10.4
1994	0.05	0.01	0.01	1	10.2
1995	0.05	0.02	0.02	2	10.4
1996	0.05	0.03	0.03	3	10.0
1997	0.05	0.03	0.03	3	9.9
1998	0.05	0.03	0.03	3	10.0
1999	0.05	0.09	0.09	9	10.2
2000	0.05	0.18	0.18	17	10.3
2001	0.05	0.12	0.12	12	10.2
2002	0.05	0.14	0.14	14	10.2
2003	0.05	0.17	0.17	17	10.2
2004	0.05	0.46	0.46	44	10.3

Table 26 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Longline West fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input B SE	Input B	Exp B	Exp N	MW
2005	0.05	0.29	0.29	28	10.3
2006	0.05	0.25	0.25	25	10.1
2007	0.05	0.18	0.18	18	9.9
2008	0.05	0.06	0.05	6	9.7
2009	0.05	0.05	0.05	5	9.8
2010	0.05	0.04	0.04	4	9.6
2011	0.05	0.02	0.02	2	9.8
2012	0.05	0.01	0.01	1	10.0
2013	0.05	0.05	0.05	5	10.0
2014	0.05	0.05	0.05	5	10.4
2015	0.05	0.05	0.05	4	10.6
2016	0.05	0.07	0.07	6	10.8
2017	0.05	0.06	0.06	5	11.1
2018	0.05	0.06	0.06	6	11.4
2019	0.05	0.15	0.14	12	11.7
2020	0.05	0.08	0.07	6	12.0
2021	0.05	0.18	0.17	14	12.3
2022	0.05	0.11	0.10	8	12.5
2023	0.05	0.12	0.11	8	12.9

Table 27. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Longline Central fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input B SE	Input B	Exp B	Exp N	MW
1988	0.05	0.05	0.05	4	13.4
1989	0.05	0.02	0.02	2	13.3
1990	0.05	0.03	0.03	3	12.2
1991	0.05	0.01	0.01	1	10.8
1992	0.05	0.01	0.01	1	9.8
1993	0.05	0.00	0.00	0	9.5
1994	0.05	0.00	0.00	0	9.6
1995	0.05	0.00	0.00	0	10.0
1996	0.05	0.00	0.00	0	9.6
1997	0.05	0.00	0.00	0	8.8
1998	0.05	0.00	0.00	0	8.0
1999	0.05	0.00	0.00	0	7.9
2000	0.05	0.00	0.00	0	8.0
2001	0.05	0.00	0.00	0	7.7
2002	0.05	0.01	0.01	1	7.4
2003	0.05	0.00	0.00	0	7.4
2004	0.05	0.00	0.00	0	7.6
2005	0.05	0.00	0.00	0	7.8
2006	0.05	0.00	0.00	0	7.6
2007	0.05	0.01	0.01	2	7.0
2008	0.05	0.02	0.01	2	6.2
2009	0.05	0.01	0.01	1	6.7
2010	0.05	0.01	0.01	1	7.3
2011	0.05	0.00	0.00	1	8.2
2012	0.05	0.00	0.00	0	8.9

Table 27 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Longline Central fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input B SE	Input B	Exp B	Exp N	MW
2013	0.05	0.00	0.00	0	9.6
2014	0.05	0.01	0.01	1	10.3
2015	0.05	0.04	0.04	3	10.6
2016	0.05	0.02	0.02	2	10.7
2017	0.05	0.01	0.01	1	10.7
2018	0.05	0.04	0.04	4	10.8
2019	0.05	0.03	0.03	2	10.9
2020	0.05	0.03	0.03	2	11.2
2021	0.05	0.05	0.04	4	11.4
2022	0.05	0.11	0.09	7	11.7
2023	0.05	0.10	0.08	7	11.9

Table 28. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Longline East fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input B SE	Input B	Exp B	Exp N	MW
1991	0.05	0.02	0.02	2	11.7
1992	0.05	0.01	0.01	1	10.9
1993	0.05	0.01	0.01	1	9.7
1994	0.05	0.00	0.00	1	8.3
1995	0.05	0.01	0.01	1	8.8
1996	0.05	0.00	0.00	0	8.5
1997	0.05	0.00	0.00	0	8.4
1998	0.05	0.00	0.00	0	8.1
1999	0.05	0.01	0.01	1	8.1
2000	0.05	0.01	0.01	1	8.2
2001	0.05	0.01	0.01	1	8.3
2002	0.05	0.01	0.01	1	8.1
2003	0.05	0.01	0.01	1	7.9
2004	0.05	0.01	0.01	2	8.0
2005	0.05	0.02	0.02	2	8.2
2006	0.05	0.01	0.01	2	8.4
2007	0.05	0.00	0.00	1	7.8
2008	0.05	0.01	0.02	3	5.9
2009	0.05	0.01	0.01	1	6.1
2010	0.05	0.06	0.06	9	6.7
2011	0.05	0.07	0.09	12	7.5
2012	0.05	0.05	0.06	7	8.2
2013	0.05	0.10	0.12	13	8.8
2014	0.05	0.11	0.14	15	9.2
2015	0.05	0.20	0.19	20	9.5

Table 28 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Longline East fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input B SE	Input B	Exp B	Exp N	MW
2016	0.05	0.16	0.15	18	8.7
2017	0.05	0.16	0.15	20	7.9
2018	0.05	0.25	0.22	27	8.1
2019	0.05	0.37	0.32	37	8.6
2020	0.05	0.40	0.34	37	9.2
2021	0.05	0.43	0.36	37	9.8
2022	0.05	0.47	0.38	36	10.4
2023	0.05	0.46	0.39	35	11.0

Table 29. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Private West fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
1950	0.15	110	110	0.23	2.1
1951	0.15	110	111	0.26	2.3
1952	0.15	110	111	0.27	2.4
1953	0.15	110	111	0.27	2.5
1954	0.15	110	111	0.28	2.5
1955	0.15	110	111	0.27	2.5
1956	0.15	122	123	0.30	2.4
1957	0.15	134	134	0.32	2.4
1958	0.15	146	146	0.35	2.4
1959	0.15	158	158	0.37	2.3
1960	0.15	170	170	0.39	2.3
1961	0.15	175	175	0.40	2.3
1962	0.15	179	180	0.40	2.2
1963	0.15	184	185	0.40	2.2
1964	0.15	189	190	0.40	2.1
1965	0.15	525	534	1.11	2.1
1966	0.15	542	553	1.11	2.0
1967	0.15	560	571	1.12	2.0
1968	0.15	577	589	1.12	1.9
1969	0.15	595	606	1.12	1.8
1970	0.15	612	624	1.12	1.8
1971	0.15	669	682	1.21	1.8
1972	0.15	725	741	1.30	1.8
1973	0.15	782	801	1.41	1.8
1974	0.15	838	861	1.52	1.8

Table 29 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Private West fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
1975	0.15	1,461	1,539	2.69	1.8
1976	0.15	1,466	1,547	2.62	1.7
1977	0.15	1,471	1,551	2.47	1.6
1978	0.15	1,476	1,544	2.16	1.4
1979	0.15	1,481	1,529	1.75	1.1
1980	0.15	1,486	1,524	1.81	1.2
1981	0.15	3,075	2,792	4.43	1.6
1982	0.15	1,863	1,501	2.30	1.5
1983	0.15	3,554	2,919	4.56	1.6
1984	0.15	790	732	1.40	1.9
1985	0.15	1,273	1,149	1.84	1.6
1986	0.15	1,731	1,521	2.42	1.6
1987	0.15	521	510	0.74	1.5
1988	0.15	806	912	1.64	1.8
1989	0.15	531	626	1.14	1.8
1990	0.15	396	391	0.87	2.2
1991	0.15	471	463	1.01	2.2
1992	0.15	625	560	1.32	2.4
1993	0.15	1,043	993	2.63	2.7
1994	0.15	1,205	1,225	3.13	2.6
1995	0.15	1,528	1,366	4.19	3.1
1996	0.15	1,067	859	2.63	3.1
1997	0.15	1,048	905	2.91	3.2
1998	0.15	1,012	965	3.27	3.4
1999	0.15	657	768	2.70	3.5

Table 29 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Private West fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
2000	0.15	656	565	2.05	3.6
2001	0.15	468	426	1.51	3.5
2002	0.15	428	392	1.44	3.7
2003	0.15	382	388	1.42	3.7
2004	0.15	360	351	1.29	3.7
2005	0.15	558	546	2.01	3.7
2006	0.15	697	687	2.37	3.5
2007	0.15	538	516	2.41	4.7
2008	0.15	418	437	1.98	4.5
2009	0.15	419	404	1.96	4.9
2010	0.15	256	238	1.14	4.8
2011	0.15	380	381	1.90	5.0
2012	0.15	449	439	2.26	5.1
2013	0.15	579	632	3.25	5.1
2014	0.15	587	585	3.15	5.4
2015	0.15	714	701	3.87	5.5
2016	0.15	456	473	2.69	5.7
2017	0.15	564	640	3.74	5.8
2018	0.15	634	648	3.88	6.0
2019	0.15	942	1,082	6.58	6.1
2020	0.15	576	684	4.21	6.1
2021	0.15	551	668	4.23	6.3
2022	0.15	439	505	3.29	6.5
2023	0.15	706	873	5.88	6.7

Table 30. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Private Central fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
1950	0.15	88	88	0.24	2.7
1951	0.15	88	88	0.26	2.9
1952	0.15	88	88	0.27	3.1
1953	0.15	88	88	0.28	3.2
1954	0.15	88	88	0.28	3.2
1955	0.15	88	88	0.28	3.2
1956	0.15	98	98	0.31	3.1
1957	0.15	107	107	0.33	3.1
1958	0.15	117	117	0.35	3.0
1959	0.15	126	126	0.37	2.9
1960	0.15	136	136	0.39	2.9
1961	0.15	140	140	0.39	2.8
1962	0.15	143	144	0.40	2.8
1963	0.15	147	148	0.40	2.7
1964	0.15	151	151	0.39	2.6
1965	0.15	240	241	0.61	2.5
1966	0.15	248	249	0.61	2.5
1967	0.15	256	257	0.61	2.4
1968	0.15	264	265	0.61	2.3
1969	0.15	272	273	0.61	2.2
1970	0.15	280	281	0.61	2.2
1971	0.15	306	307	0.67	2.2
1972	0.15	332	332	0.72	2.2
1973	0.15	358	358	0.78	2.2
1974	0.15	383	384	0.83	2.2

Table 30 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Private Central fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
1975	0.15	555	554	1.19	2.2
1976	0.15	557	555	1.15	2.1
1977	0.15	559	555	1.04	1.9
1978	0.15	560	555	0.90	1.6
1979	0.15	562	558	0.71	1.3
1980	0.15	564	562	0.77	1.4
1981	0.15	1,815	1,892	3.60	1.9
1982	0.15	212	211	0.41	1.9
1983	0.15	752	693	1.36	2.0
1984	0.15	273	273	0.63	2.3
1985	0.15	612	527	1.08	2.1
1986	0.15	262	255	0.57	2.2
1987	0.15	492	541	1.06	2.0
1988	0.15	366	299	0.63	2.1
1989	0.15	588	634	1.18	1.9
1990	0.15	349	349	0.85	2.4
1991	0.15	807	838	1.97	2.3
1992	0.15	1,422	1,198	2.95	2.5
1993	0.15	1,435	1,582	5.12	3.2
1994	0.15	1,002	1,103	3.79	3.4
1995	0.15	647	461	2.03	4.4
1996	0.15	507	473	2.00	4.2
1997	0.15	818	801	3.08	3.8
1998	0.15	563	492	1.86	3.8
1999	0.15	1,301	1,407	5.62	4.0

Table 30 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Private Central fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
2000	0.15	865	758	3.32	4.4
2001	0.15	1,393	1,016	4.26	4.2
2002	0.15	1,872	2,201	8.99	4.1
2003	0.15	1,288	1,442	6.10	4.2
2004	0.15	1,633	2,416	10.55	4.4
2005	0.15	900	1,046	4.63	4.4
2006	0.15	985	937	3.98	4.2
2007	0.15	1,526	966	4.06	4.2
2008	0.15	898	772	3.14	4.1
2009	0.15	1,079	1,179	5.02	4.3
2010	0.15	1,033	1,235	5.85	4.7
2011	0.15	1,243	1,385	7.36	5.3
2012	0.15	1,161	1,052	6.14	5.8
2013	0.15	2,092	2,206	13.78	6.2
2014	0.15	893	887	5.78	6.5
2015	0.15	1,023	761	5.06	6.7
2016	0.15	1,281	1,351	8.43	6.2
2017	0.15	2,568	2,832	16.62	5.9
2018	0.15	1,751	1,845	10.84	5.9
2019	0.15	1,947	2,072	12.72	6.1
2020	0.15	1,482	1,506	9.60	6.4
2021	0.15	1,272	1,422	9.22	6.5
2022	0.15	1,428	1,795	11.77	6.6
2023	0.15	1,222	1,208	7.99	6.6

Table 31. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Private East fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
1950	0.15	20	20	0.05	2.7
1951	0.15	20	20	0.06	2.9
1952	0.15	20	20	0.06	3.1
1953	0.15	20	20	0.06	3.2
1954	0.15	20	20	0.06	3.2
1955	0.15	20	20	0.06	3.1
1956	0.15	22	22	0.07	3.0
1957	0.15	24	24	0.07	3.0
1958	0.15	26	26	0.08	2.9
1959	0.15	28	28	0.08	2.8
1960	0.15	31	30	0.08	2.8
1961	0.15	31	31	0.08	2.7
1962	0.15	32	32	0.08	2.6
1963	0.15	33	33	0.08	2.6
1964	0.15	34	34	0.08	2.5
1965	0.15	72	72	0.17	2.4
1966	0.15	75	74	0.17	2.4
1967	0.15	77	76	0.17	2.3
1968	0.15	80	79	0.17	2.2
1969	0.15	82	81	0.17	2.2
1970	0.15	85	83	0.18	2.1
1971	0.15	92	91	0.20	2.2
1972	0.15	100	99	0.21	2.2
1973	0.15	108	106	0.23	2.2
1974	0.15	116	114	0.25	2.2

Table 31 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Private East fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
1975	0.15	188	184	0.40	2.2
1976	0.15	189	186	0.37	2.0
1977	0.15	189	188	0.33	1.8
1978	0.15	190	188	0.28	1.5
1979	0.15	190	187	0.23	1.2
1980	0.15	191	187	0.25	1.3
1981	0.15	568	559	1.09	2.0
1982	0.15	12	12	0.02	1.9
1983	0.15	581	935	1.84	2.0
1984	0.15	21	27	0.06	2.1
1985	0.15	157	230	0.48	2.1
1986	0.15	181	249	0.56	2.2
1987	0.15	106	91	0.17	1.9
1988	0.15	49	49	0.10	1.9
1989	0.15	142	109	0.23	2.1
1990	0.15	42	38	0.12	3.2
1991	0.15	17	21	0.06	3.1
1992	0.15	4	5	0.02	3.2
1993	0.50	0	0	0.00	3.9
1994	0.50	0	0	0.00	3.5
1995	0.15	3	3	0.01	4.2
1996	0.15	37	41	0.18	4.4
1997	0.50	0	0	0.00	4.4
1998	0.50	0	0	0.00	4.3
1999	0.15	12	12	0.05	4.4

Table 31 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Private East fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
2000	0.15	2	3	0.01	4.9
2001	0.50	0	0	0.00	4.9
2002	0.15	8	7	0.03	4.6
2003	0.15	3	3	0.01	4.6
2004	0.15	7	8	0.04	4.8
2005	0.15	81	79	0.39	4.9
2006	0.15	19	17	0.08	4.9
2007	0.15	41	36	0.17	4.6
2008	0.15	6	5	0.02	4.5
2009	0.15	19	19	0.09	4.7
2010	0.15	3	4	0.02	5.3
2011	0.15	16	16	0.10	5.9
2012	0.15	15	14	0.09	6.4
2013	0.15	4	4	0.02	6.7
2014	0.15	5	6	0.04	6.9
2015	0.15	2	2	0.01	7.0
2016	0.15	27	29	0.17	5.8
2017	0.15	77	79	0.43	5.4
2018	0.15	101	107	0.62	5.8
2019	0.15	106	109	0.69	6.4
2020	0.15	38	39	0.27	6.8
2021	0.15	80	83	0.60	7.3
2022	0.15	116	114	0.86	7.6
2023	0.15	153	166	1.32	7.9

Table 32. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Charter West fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
1950	0.15	309	310	0.90	2.9
1951	0.15	309	310	0.97	3.1
1952	0.15	309	311	1.01	3.3
1953	0.15	309	311	1.04	3.4
1954	0.15	309	311	1.06	3.4
1955	0.15	309	311	1.06	3.4
1956	0.15	342	345	1.17	3.4
1957	0.15	375	379	1.28	3.4
1958	0.15	409	413	1.39	3.4
1959	0.15	442	447	1.49	3.3
1960	0.15	475	482	1.58	3.3
1961	0.15	489	496	1.61	3.2
1962	0.15	502	511	1.62	3.2
1963	0.15	516	525	1.64	3.1
1964	0.15	529	540	1.64	3.0
1965	0.15	337	341	1.02	3.0
1966	0.15	348	353	1.02	2.9
1967	0.15	359	364	1.03	2.8
1968	0.15	370	376	1.03	2.7
1969	0.15	382	387	1.02	2.6
1970	0.15	393	399	1.03	2.6
1971	0.15	429	436	1.10	2.5
1972	0.15	465	473	1.18	2.5
1973	0.15	501	511	1.28	2.5
1974	0.15	538	549	1.39	2.5

Table 32 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Charter West fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
1975	0.15	220	223	0.56	2.5
1976	0.15	221	223	0.55	2.5
1977	0.15	222	224	0.52	2.3
1978	0.15	223	225	0.46	2.0
1979	0.15	223	225	0.35	1.6
1980	0.15	224	225	0.35	1.6
1981	0.15	226	227	0.46	2.0
1982	0.15	275	299	0.60	2.0
1983	0.15	422	404	0.84	2.1
1984	0.15	378	367	0.92	2.5
1985	0.15	613	576	1.23	2.1
1986	0.15	77	71	0.15	2.1
1987	0.15	64	62	0.12	1.9
1988	0.15	15	16	0.04	2.3
1989	0.15	63	65	0.15	2.4
1990	0.15	28	30	0.08	2.6
1991	0.15	115	126	0.32	2.5
1992	0.15	123	131	0.35	2.7
1993	0.15	82	88	0.29	3.3
1994	0.15	57	71	0.23	3.2
1995	0.15	74	69	0.28	4.0
1996	0.15	57	56	0.22	3.9
1997	0.15	68	63	0.25	4.0
1998	0.15	106	96	0.41	4.2
1999	0.15	57	49	0.22	4.5

Table 32 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Charter West fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
2000	0.15	20	16	0.07	4.5
2001	0.15	19	18	0.08	4.4
2002	0.15	54	50	0.22	4.5
2003	0.15	56	52	0.24	4.5
2004	0.15	82	91	0.41	4.6
2005	0.15	74	85	0.39	4.6
2006	0.15	95	96	0.42	4.3
2007	0.15	64	89	0.54	6.1
2008	0.15	25	30	0.17	5.9
2009	0.15	29	32	0.20	6.1
2010	0.15	8	6	0.04	6.1
2011	0.15	10	11	0.07	6.3
2012	0.15	28	29	0.19	6.5
2013	0.15	20	22	0.14	6.5
2014	0.15	11	11	0.07	6.7
2015	0.15	29	27	0.19	6.9
2016	0.15	34	32	0.23	7.1
2017	0.15	37	30	0.22	7.3
2018	0.15	26	22	0.16	7.5
2019	0.15	29	40	0.31	7.6
2020	0.15	18	18	0.14	7.7
2021	0.15	28	35	0.27	7.9
2022	0.15	27	26	0.21	8.1
2023	0.15	43	42	0.35	8.3

Table 33. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Charter Central fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
1950	0.15	177	177	0.82	4.6
1951	0.15	177	177	0.87	4.9
1952	0.15	177	177	0.91	5.1
1953	0.15	177	177	0.94	5.3
1954	0.15	177	177	0.97	5.5
1955	0.15	177	177	0.98	5.6
1956	0.15	196	196	1.10	5.6
1957	0.15	215	215	1.20	5.6
1958	0.15	233	234	1.30	5.6
1959	0.15	252	253	1.40	5.5
1960	0.15	271	272	1.49	5.5
1961	0.15	279	280	1.51	5.4
1962	0.15	287	288	1.54	5.3
1963	0.15	295	296	1.55	5.2
1964	0.15	303	303	1.55	5.1
1965	0.15	253	253	1.26	5.0
1966	0.15	261	262	1.26	4.8
1967	0.15	270	270	1.26	4.7
1968	0.15	278	279	1.25	4.5
1969	0.15	287	287	1.23	4.3
1970	0.15	295	296	1.22	4.1
1971	0.15	322	323	1.30	4.0
1972	0.15	349	350	1.39	4.0
1973	0.15	376	378	1.49	3.9
1974	0.15	404	405	1.61	4.0

Table 33 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Charter Central fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
1975	0.15	333	333	1.34	4.0
1976	0.15	334	334	1.33	4.0
1977	0.15	335	334	1.25	3.7
1978	0.15	336	335	1.05	3.1
1979	0.15	337	336	0.72	2.1
1980	0.15	338	337	0.68	2.0
1981	0.15	68	64	0.17	2.7
1982	0.15	409	408	1.16	2.8
1983	0.15	760	771	2.29	3.0
1984	0.15	211	210	0.72	3.5
1985	0.15	239	223	0.73	3.3
1986	0.15	507	472	1.65	3.5
1987	0.15	457	476	1.51	3.2
1988	0.15	358	383	1.27	3.3
1989	0.15	204	217	0.65	3.0
1990	0.15	144	127	0.44	3.5
1991	0.15	190	188	0.58	3.1
1992	0.15	352	361	1.13	3.1
1993	0.15	836	794	2.05	2.6
1994	0.15	373	454	1.23	2.7
1995	0.15	297	317	1.02	3.2
1996	0.15	423	414	1.27	3.1
1997	0.15	544	560	1.62	2.9
1998	0.15	871	712	2.10	2.9
1999	0.15	632	911	2.87	3.2

Table 33 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Charter Central fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
2000	0.15	376	357	1.22	3.4
2001	0.15	396	327	1.07	3.3
2002	0.15	556	470	1.52	3.2
2003	0.15	526	477	1.61	3.4
2004	0.15	532	544	1.86	3.4
2005	0.15	386	433	1.49	3.4
2006	0.15	388	397	1.31	3.3
2007	0.15	476	333	1.33	4.0
2008	0.15	265	245	0.95	3.9
2009	0.15	205	344	1.41	4.1
2010	0.15	69	140	0.64	4.6
2011	0.15	153	338	1.76	5.2
2012	0.15	150	258	1.48	5.7
2013	0.15	166	251	1.54	6.2
2014	0.15	35	113	0.73	6.4
2015	0.15	205	204	1.33	6.5
2016	0.15	218	266	1.61	6.1
2017	0.15	239	324	1.86	5.7
2018	0.15	229	352	2.03	5.8
2019	0.15	282	354	2.15	6.1
2020	0.15	292	330	2.08	6.3
2021	0.15	224	402	2.57	6.4
2022	0.15	302	377	2.45	6.5
2023	0.15	362	442	2.90	6.6

Table 34. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Charter East fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
1996	0.15	0	0	0.00	3.1
1997	0.15	2	2	0.00	3.0
1998	0.15	8	7	0.02	2.9
1999	0.15	1	1	0.00	3.1
2000	0.15	0	0	0.00	4.7
2001	0.15	2	1	0.01	4.7
2002	0.15	1	1	0.00	4.5
2003	0.15	2	2	0.01	4.5
2004	0.15	0	0	0.00	4.6
2005	0.15	2	2	0.01	4.6
2006	0.15	11	10	0.04	4.7
2007	0.15	1	1	0.00	4.8
2008	0.15	3	3	0.02	4.7
2009	0.15	2	2	0.01	5.0
2010	0.15	4	4	0.02	5.6
2011	0.15	0	0	0.00	6.3
2012	0.15	3	3	0.02	6.8
2013	0.15	0	1	0.00	7.1
2014	0.15	4	4	0.03	7.4
2015	0.15	8	8	0.06	7.2
2016	0.15	8	9	0.06	6.2
2017	0.15	19	21	0.13	5.8
2018	0.15	23	26	0.16	6.3
2019	0.15	18	19	0.13	6.8
2020	0.15	26	23	0.17	7.3

Table 34 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Charter East fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
2021	0.15	45	46	0.36	7.8
2022	0.15	34	35	0.29	8.2
2023	0.15	50	53	0.45	8.6

Table 35. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Headboat West fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
1950	0.15	254	255	0.37	1.5
1951	0.15	254	255	0.40	1.6
1952	0.15	254	255	0.40	1.6
1953	0.15	254	255	0.40	1.6
1954	0.15	254	255	0.40	1.6
1955	0.15	254	255	0.40	1.6
1956	0.15	281	283	0.43	1.5
1957	0.15	308	310	0.47	1.5
1958	0.15	336	338	0.50	1.5
1959	0.15	363	366	0.54	1.5
1960	0.15	390	394	0.57	1.5
1961	0.15	401	406	0.58	1.4
1962	0.15	413	417	0.59	1.4
1963	0.15	424	429	0.60	1.4
1964	0.15	435	440	0.61	1.4
1965	0.15	323	326	0.45	1.4
1966	0.15	333	337	0.46	1.4
1967	0.15	344	348	0.47	1.4
1968	0.15	355	358	0.48	1.3
1969	0.15	365	369	0.48	1.3
1970	0.15	376	380	0.49	1.3
1971	0.15	411	415	0.54	1.3
1972	0.15	446	450	0.58	1.3
1973	0.15	480	486	0.63	1.3
1974	0.15	515	522	0.67	1.3

Table 35 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Headboat West fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
1975	0.15	338	341	0.43	1.3
1976	0.15	339	343	0.42	1.2
1977	0.15	340	344	0.41	1.2
1978	0.15	342	344	0.39	1.1
1979	0.15	343	345	0.37	1.1
1980	0.15	344	346	0.38	1.1
1981	0.15	355	357	0.48	1.3
1982	0.15	359	366	0.48	1.3
1983	0.15	371	324	0.42	1.3
1984	0.15	368	354	0.52	1.5
1985	0.15	388	372	0.46	1.2
1986	0.15	316	312	0.38	1.2
1987	0.15	319	293	0.36	1.2
1988	0.15	423	415	0.59	1.4
1989	0.15	372	373	0.53	1.4
1990	0.15	187	186	0.33	1.8
1991	0.15	265	252	0.45	1.8
1992	0.15	413	389	0.73	1.9
1993	0.15	459	496	1.42	2.9
1994	0.15	498	558	1.55	2.8
1995	0.15	355	346	1.10	3.2
1996	0.15	349	345	1.10	3.2
1997	0.15	347	337	1.12	3.3
1998	0.15	245	231	0.81	3.5
1999	0.15	99	90	0.33	3.6

Table 35 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Headboat West fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
2000	0.15	111	99	0.38	3.9
2001	0.15	116	107	0.41	3.8
2002	0.15	138	126	0.49	3.9
2003	0.15	158	148	0.58	3.9
2004	0.15	110	107	0.42	3.9
2005	0.15	100	98	0.38	3.9
2006	0.15	121	116	0.43	3.7
2007	0.15	110	117	0.61	5.2
2008	0.15	58	62	0.31	5.1
2009	0.15	76	85	0.45	5.3
2010	0.15	52	53	0.28	5.3
2011	0.15	51	77	0.41	5.4
2012	0.15	54	58	0.32	5.5
2013	0.15	44	20	0.11	5.5
2014	0.15	36	14	0.08	5.7
2015	0.15	63	35	0.20	5.8
2016	0.15	61	31	0.18	5.9
2017	0.15	60	50	0.30	6.0
2018	0.15	63	48	0.29	6.1
2019	0.15	67	67	0.41	6.1
2020	0.15	70	53	0.33	6.2
2021	0.15	84	276	1.73	6.3
2022	0.15	84	177	1.13	6.4
2023	0.15	79	107	0.70	6.5

Table 36. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Headboat Central fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
1950	0.15	99	99	0.28	2.8
1951	0.15	99	99	0.29	3.0
1952	0.15	99	99	0.31	3.1
1953	0.15	99	99	0.32	3.2
1954	0.15	99	99	0.32	3.2
1955	0.15	99	99	0.32	3.2
1956	0.15	110	110	0.35	3.1
1957	0.15	121	121	0.37	3.1
1958	0.15	131	131	0.40	3.0
1959	0.15	142	142	0.42	3.0
1960	0.15	153	153	0.44	2.9
1961	0.15	157	157	0.45	2.8
1962	0.15	161	162	0.45	2.8
1963	0.15	166	166	0.45	2.7
1964	0.15	170	170	0.45	2.6
1965	0.15	146	146	0.38	2.6
1966	0.15	151	151	0.38	2.5
1967	0.15	156	156	0.38	2.5
1968	0.15	160	161	0.38	2.4
1969	0.15	165	165	0.38	2.3
1970	0.15	170	170	0.39	2.3
1971	0.15	186	186	0.42	2.3
1972	0.15	202	202	0.46	2.3
1973	0.15	217	217	0.49	2.3
1974	0.15	233	233	0.53	2.3

Table 36 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Headboat Central fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
1975	0.15	200	199	0.45	2.2
1976	0.15	200	200	0.43	2.2
1977	0.15	201	200	0.40	2.0
1978	0.15	202	201	0.35	1.7
1979	0.15	202	202	0.28	1.4
1980	0.15	203	202	0.30	1.5
1981	0.15	43	41	0.08	2.0
1982	0.15	247	248	0.51	2.1
1983	0.15	475	478	1.00	2.1
1984	0.15	132	132	0.32	2.4
1985	0.15	149	145	0.30	2.1
1986	0.15	15	14	0.03	2.3
1987	0.15	9	9	0.02	2.1
1988	0.15	13	13	0.03	2.2
1989	0.15	10	10	0.02	2.0
1990	0.15	15	14	0.03	2.2
1991	0.15	15	15	0.03	2.1
1992	0.15	34	33	0.07	2.2
1993	0.15	37	37	0.08	2.3
1994	0.15	29	33	0.08	2.4
1995	0.15	23	24	0.07	2.8
1996	0.15	28	28	0.07	2.6
1997	0.15	48	48	0.12	2.5
1998	0.15	76	68	0.18	2.6
1999	0.15	65	65	0.18	2.7

Table 36 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Headboat Central fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
2000	0.15	56	42	0.14	3.2
2001	0.15	50	37	0.11	3.1
2002	0.15	75	57	0.17	3.1
2003	0.15	71	57	0.18	3.2
2004	0.15	62	51	0.16	3.2
2005	0.15	42	35	0.11	3.2
2006	0.15	47	41	0.13	3.1
2007	0.15	63	56	0.20	3.6
2008	0.15	61	39	0.14	3.5
2009	0.15	78	85	0.32	3.8
2010	0.15	34	33	0.14	4.2
2011	0.15	66	65	0.30	4.6
2012	0.15	52	50	0.25	5.0
2013	0.15	41	64	0.33	5.2
2014	0.15	41	19	0.10	5.3
2015	0.15	42	28	0.15	5.3
2016	0.15	36	51	0.25	4.8
2017	0.15	50	85	0.39	4.6
2018	0.15	57	97	0.45	4.7
2019	0.15	41	72	0.35	4.9
2020	0.15	32	59	0.30	5.0
2021	0.15	28	130	0.66	5.1
2022	0.15	24	104	0.53	5.1
2023	0.15	34	50	0.26	5.1

Table 37. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Headboat East fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
1950	0.15	2	2	0.01	2.7
1951	0.15	2	2	0.01	3.0
1952	0.15	2	2	0.01	3.1
1953	0.15	2	2	0.01	3.2
1954	0.15	2	2	0.01	3.2
1955	0.15	2	2	0.01	3.1
1956	0.15	3	3	0.01	3.1
1957	0.15	3	3	0.01	3.0
1958	0.15	3	3	0.01	2.9
1959	0.15	3	3	0.01	2.9
1960	0.15	4	4	0.01	2.8
1961	0.15	4	4	0.01	2.7
1962	0.15	4	4	0.01	2.7
1963	0.15	4	4	0.01	2.6
1964	0.15	4	4	0.01	2.5
1965	0.15	4	4	0.01	2.5
1966	0.15	4	4	0.01	2.4
1967	0.15	4	4	0.01	2.4
1968	0.15	5	5	0.01	2.3
1969	0.15	5	5	0.01	2.3
1970	0.15	5	5	0.01	2.2
1971	0.15	5	5	0.01	2.3
1972	0.15	6	6	0.01	2.3
1973	0.15	6	6	0.01	2.3
1974	0.15	7	7	0.01	2.3

Table 37 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Headboat East fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
1975	0.15	7	7	0.02	2.3
1976	0.15	7	7	0.01	2.1
1977	0.15	7	7	0.01	1.9
1978	0.15	7	7	0.01	1.6
1979	0.15	7	7	0.01	1.3
1980	0.15	7	7	0.01	1.5
1981	0.15	14	13	0.03	2.1
1982	0.15	3	3	0.01	2.1
1983	0.15	23	24	0.05	2.1
1984	0.15	19	21	0.05	2.2
1985	0.15	7	7	0.01	1.6
1986	0.15	1	2	0.00	1.9
1987	0.15	0	0	0.00	1.8
1988	0.15	1	1	0.00	1.8
1989	0.15	0	0	0.00	2.0
1990	0.15	0	0	0.00	2.4
1991	0.15	0	0	0.00	2.4
1992	0.15	0	0	0.00	2.5
1993	0.15	1	1	0.00	2.2
1994	0.15	0	0	0.00	2.1
1995	0.15	0	0	0.00	2.8
1996	0.15	0	0	0.00	2.9
1997	0.15	0	0	0.00	2.8
1998	0.15	0	0	0.00	2.8
1999	0.15	3	3	0.01	2.9

Table 37 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Headboat East fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of America Red Snapper. The mean body weight (MW, whole pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers.

Year	Input N SE	Input N	Exp N	Exp B	MW
2000	0.15	1	1	0.00	3.5
2001	0.15	1	1	0.00	3.4
2002	0.15	0	0	0.00	3.2
2003	0.15	0	0	0.00	3.4
2004	0.15	1	1	0.00	3.4
2005	0.15	5	4	0.01	3.4
2006	0.15	1	1	0.00	3.4
2007	0.15	1	1	0.00	3.7
2008	0.15	1	1	0.00	3.7
2009	0.15	3	2	0.01	4.0
2010	0.15	2	1	0.01	4.5
2011	0.15	3	4	0.02	5.0
2012	0.15	2	1	0.00	5.3
2013	0.15	3	1	0.00	5.4
2014	0.15	2	1	0.00	5.5
2015	0.15	3	0	0.00	5.1
2016	0.15	3	4	0.02	4.1
2017	0.15	8	8	0.03	4.2
2018	0.15	9	11	0.05	4.8
2019	0.15	9	13	0.07	5.2
2020	0.15	7	6	0.03	5.5
2021	0.15	10	9	0.05	5.7
2022	0.15	11	12	0.07	5.9
2023	0.15	9	13	0.08	6.1

Table 38. Gulf of America Red Snapper Commercial Handline West discards in numbers. Discards refer to the total number of fish discarded before applying the discard mortality rate. In SEDAR 98, catches were modelled as total catch, by summing the landings with the dead discards.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1996	0.665	756.000	1,738.510	368.570	1,629.545	345.464	0.9
1997	0.665	855.973	1,398.530	296.480	1,341.754	284.440	1.0
1998	0.665	945.513	1,061.900	225.120	1,023.473	216.979	1.0
1999	0.665	868.229	1,014.960	215.170	969.702	205.581	1.0
2000	0.665	853.132	1,280.837	271.537	1,194.441	253.223	0.9
2001	0.665	1,062.240	1,276.921	270.711	1,196.050	253.553	0.9
2002	0.665	916.488	837.891	177.631	810.154	171.762	1.0
2003	0.665	993.762	906.785	192.238	855.326	181.330	0.9
2004	0.665	1,095.110	836.256	177.286	790.841	167.639	0.9
2005	0.665	946.639	867.052	183.815	819.435	173.724	0.9
2006	0.665	1,069.060	1,522.317	322.737	1,409.149	298.748	0.9
2007	0.531	448.309	126.869	26.896	187.441	39.736	1.5
2008	0.194	131.783	48.051	10.187	73.769	15.640	1.5
2009	0.194	113.185	26.192	5.553	53.376	11.316	2.0
2010	0.194	95.304	47.579	10.086	77.999	16.537	1.6
2011	0.194	91.635	36.855	7.813	69.080	14.645	1.9
2012	0.194	104.791	38.632	8.190	75.574	16.006	2.0
2013	0.194	106.482	62.478	13.245	109.768	23.281	1.8
2014	0.167	33.968	42.215	8.950	92.043	19.511	2.2
2015	0.167	36.799	52.359	11.100	110.496	23.435	2.1
2016	0.167	35.595	52.226	11.072	111.135	23.545	2.1
2017	0.167	34.843	49.321	10.456	109.790	23.281	2.2
2018	0.167	30.479	45.897	9.731	105.381	22.355	2.3
2019	0.167	32.642	51.105	10.834	113.207	24.008	2.2
2020	0.167	26.728	49.884	10.575	110.716	23.479	2.2
2021	0.167	23.201	40.463	8.578	102.779	21.782	2.5
2022	0.167	25.212	39.452	8.364	104.697	22.201	2.7
2023	0.167	30.905	47.061	9.977	126.655	26.852	2.7

Table 39. Gulf of America Red Snapper Commercial Handline Central discards in numbers. Discards refer to the total number of fish discarded before applying the discard mortality rate. In SEDAR 98, catches were modelled as total catch, by summing the landings with the dead discards.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1996	0.350	30.901	21.815	4.188	25.936	4.981	1.2
1997	0.350	30.433	19.733	3.789	23.620	4.535	1.2
1998	0.350	33.242	30.904	5.934	37.739	7.247	1.2
1999	0.350	37.317	31.118	5.975	38.334	7.361	1.2
2000	0.350	48.952	50.006	9.602	59.999	11.519	1.2
2001	0.350	55.731	83.110	15.957	98.974	19.002	1.2
2002	0.350	61.423	72.932	14.003	90.235	17.326	1.2
2003	0.350	82.161	69.475	13.339	84.300	16.186	1.2
2004	0.350	77.328	55.593	10.674	68.156	13.084	1.2
2005	0.350	66.227	48.807	9.371	59.214	11.369	1.2
2006	0.350	69.795	75.423	14.481	89.322	17.150	1.2
2007	0.165	80.169	152.256	29.233	213.169	40.929	1.4
2008	0.099	49.324	60.414	11.599	92.634	17.785	1.5
2009	0.099	52.109	40.656	7.806	87.096	16.722	2.1
2010	0.099	58.731	49.316	9.469	119.768	22.994	2.4
2011	0.099	71.985	48.265	9.267	138.920	26.671	2.9
2012	0.099	80.294	56.381	10.825	164.330	31.553	2.9
2013	0.099	65.639	67.303	12.922	192.979	37.053	2.9
2014	0.106	79.706	54.179	10.402	181.868	34.919	3.4
2015	0.106	77.486	117.053	22.474	253.664	48.700	2.2
2016	0.106	83.983	107.900	20.716	231.445	44.441	2.1
2017	0.106	88.230	103.313	19.836	236.362	45.375	2.3
2018	0.106	74.393	78.760	15.122	211.855	40.673	2.7
2019	0.106	73.679	81.978	15.740	220.846	42.404	2.7
2020	0.106	67.725	83.471	16.027	222.422	42.701	2.7
2021	0.106	63.388	76.227	14.635	204.573	39.275	2.7
2022	0.106	58.047	64.734	12.429	175.369	33.671	2.7
2023	0.106	62.856	65.671	12.609	175.569	33.709	2.7

Table 40. Gulf of America Red Snapper Commercial Handline East discards in numbers. Discards refer to the total number of fish discarded before applying the discard mortality rate. In SEDAR 98, catches were modelled as total catch, by summing the landings with the dead discards.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1996	0.508	2.634	0.723	0.179	1.632	0.403	2.3
1997	0.508	1.964	0.646	0.160	1.352	0.334	2.1
1998	0.508	2.219	1.043	0.258	2.265	0.559	2.2
1999	0.508	2.180	3.258	0.805	7.535	1.861	2.3
2000	0.508	2.968	1.897	0.469	4.294	1.061	2.3
2001	0.508	2.622	3.009	0.743	6.128	1.514	2.0
2002	0.508	2.637	3.127	0.772	6.800	1.679	2.2
2003	0.508	2.362	3.982	0.983	8.818	2.178	2.2
2004	0.508	2.296	3.861	0.954	8.602	2.125	2.2
2005	0.508	2.073	4.659	1.151	10.539	2.603	2.3
2006	0.508	2.454	7.844	1.938	15.971	3.945	2.0
2007	0.230	8.037	10.142	2.505	30.106	7.436	3.0
2008	0.104	7.990	6.602	1.631	21.204	5.238	3.2
2009	0.104	12.393	9.453	2.335	38.347	9.472	4.1
2010	0.104	19.080	15.506	3.830	71.367	17.627	4.6
2011	0.104	21.323	16.389	4.048	87.530	21.619	5.3
2012	0.104	20.889	14.953	3.693	83.399	20.598	5.6
2013	0.104	23.839	17.932	4.429	105.626	26.089	5.9
2014	0.148	24.126	20.848	5.150	133.671	33.016	6.4
2015	0.148	25.760	41.140	10.162	179.304	44.289	4.4
2016	0.148	27.834	32.293	7.976	136.545	33.726	4.2
2017	0.148	27.967	34.468	8.514	161.065	39.785	4.7
2018	0.148	24.631	33.684	8.320	173.768	42.922	5.2
2019	0.148	24.702	38.572	9.527	224.516	55.455	5.8
2020	0.148	23.442	34.773	8.589	215.144	53.140	6.2
2021	0.148	25.692	35.853	8.855	238.641	58.945	6.7
2022	0.148	23.479	39.355	9.720	273.574	67.574	7.0
2023	0.148	21.853	32.894	8.125	236.765	58.482	7.2

Table 41. Gulf of America Red Snapper Commercial Longline West discards in numbers. Discards refer to the total number of fish discarded before applying the discard mortality rate. In SEDAR 98, catches were modelled as total catch, by summing the landings with the dead discards.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1996	0.490	0.231	0.222	0.049	0.206	0.045	0.9
1997	0.490	0.130	0.178	0.039	0.172	0.038	1.0
1998	0.490	0.133	0.118	0.026	0.115	0.025	1.0
1999	0.490	0.352	0.351	0.078	0.338	0.075	1.0
2000	0.490	0.268	0.929	0.205	0.855	0.189	0.9
2001	0.490	0.164	0.698	0.154	0.648	0.143	0.9
2002	0.490	0.270	0.540	0.119	0.531	0.117	1.0
2003	0.490	0.427	0.778	0.172	0.731	0.162	0.9
2004	0.490	0.601	2.007	0.444	1.896	0.419	0.9
2005	0.490	0.489	1.273	0.281	1.199	0.265	0.9
2006	0.490	0.456	1.797	0.397	1.629	0.359	0.9
2007	0.432	1.266	8.590	1.898	69.920	15.453	8.1
2008	0.432	1.680	3.903	0.863	30.338	6.705	7.8
2009	0.432	2.298	3.314	0.732	27.579	6.095	8.3
2010	0.432	0.801	2.602	0.575	20.604	4.554	7.9
2011	0.432	0.339	1.201	0.266	9.977	2.205	8.3
2012	0.432	0.531	0.861	0.190	7.332	1.620	8.5
2013	0.432	2.053	3.193	0.706	27.043	5.977	8.5
2014	0.432	1.140	3.191	0.705	28.728	6.349	9.0
2015	0.311	1.522	2.767	0.611	25.462	5.627	9.2
2016	0.311	1.982	3.806	0.841	36.148	7.989	9.5
2017	0.311	1.559	3.337	0.737	32.805	7.250	9.8
2018	0.311	1.400	3.325	0.735	33.743	7.457	10.1
2019	0.311	2.595	7.337	1.622	76.279	16.858	10.4
2020	0.311	0.882	3.615	0.799	38.521	8.513	10.7
2021	0.311	0.746	7.945	1.756	87.703	19.382	11.0
2022	0.311	0.095	4.492	0.993	51.089	11.291	11.4
2023	0.311	0.455	4.729	1.045	55.491	12.263	11.7

Table 42. Gulf of America Red Snapper Commercial Longline Central discards in numbers. Discards refer to the total number of fish discarded before applying the discard mortality rate. In SEDAR 98, catches were modelled as total catch, by summing the landings with the dead discards.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1996	0.833	0.078	0.069	0.069	0.058	0.058	0.8
1997	0.833	0.090	0.027	0.027	0.024	0.024	0.9
1998	0.833	0.064	0.043	0.043	0.039	0.039	0.9
1999	0.833	0.052	0.009	0.009	0.008	0.008	0.9
2000	0.833	0.097	0.019	0.019	0.016	0.016	0.9
2001	0.833	0.090	0.019	0.019	0.016	0.016	0.9
2002	0.833	0.093	0.106	0.106	0.102	0.102	1.0
2003	0.833	0.110	0.065	0.065	0.058	0.058	0.9
2004	0.833	0.086	0.048	0.048	0.044	0.044	0.9
2005	0.833	0.083	0.027	0.027	0.024	0.024	0.9
2006	0.833	0.085	0.033	0.033	0.028	0.028	0.8
2007	0.067	1.565	1.205	1.205	4.786	4.786	4.0
2008	0.067	1.172	1.843	1.843	8.288	8.288	4.5
2009	0.067	0.768	0.738	0.738	4.039	4.039	5.5
2010	0.067	0.682	0.885	0.885	5.424	5.424	6.1
2011	0.067	0.482	0.414	0.414	2.923	2.923	7.1
2012	0.067	0.495	0.174	0.174	1.351	1.351	7.8
2013	0.067	0.704	0.267	0.267	2.245	2.245	8.4
2014	0.067	0.783	0.573	0.573	5.240	5.240	9.1
2015	0.115	1.569	2.154	2.154	19.047	19.047	8.8
2016	0.115	1.383	1.246	1.246	11.066	11.066	8.9
2017	0.115	1.070	0.493	0.493	4.346	4.346	8.8
2018	0.115	1.664	2.389	2.389	21.635	21.635	9.1
2019	0.115	0.682	1.572	1.572	14.507	14.507	9.2
2020	0.115	1.000	1.534	1.534	14.552	14.552	9.5
2021	0.115	1.485	2.295	2.295	22.305	22.305	9.7
2022	0.115	1.798	4.610	4.610	45.804	45.804	9.9
2023	0.115	1.341	4.166	4.166	42.026	42.026	10.1

Table 43. Gulf of America Red Snapper Commercial Longline East discards in numbers. Discards refer to the total number of fish discarded before applying the discard mortality rate. In SEDAR 98, catches were modelled as total catch, by summing the landings with the dead discards.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1996	0.483	4.699	1.262	0.333	6.621	1.748	5.2
1997	0.483	5.489	1.244	0.328	6.498	1.715	5.2
1998	0.483	5.462	1.256	0.332	6.499	1.716	5.2
1999	0.483	6.060	2.200	0.581	11.669	3.081	5.3
2000	0.483	5.175	2.648	0.699	14.594	3.853	5.5
2001	0.483	5.123	3.384	0.893	18.431	4.866	5.4
2002	0.483	4.339	4.505	1.189	23.346	6.163	5.2
2003	0.483	4.715	4.150	1.096	21.594	5.701	5.2
2004	0.483	4.344	5.867	1.549	31.545	8.328	5.4
2005	0.483	3.069	6.596	1.741	36.486	9.632	5.5
2006	0.483	3.930	5.290	1.396	28.770	7.595	5.4
2007	0.067	4.216	4.293	1.133	21.277	5.617	5.0
2008	0.067	4.973	3.457	0.913	15.766	4.162	4.6
2009	0.067	1.676	1.492	0.394	7.385	1.950	5.0
2010	0.067	9.690	9.334	2.464	51.975	13.721	5.6
2011	0.067	14.413	10.886	2.874	68.977	18.210	6.3
2012	0.067	8.675	6.317	1.668	43.973	11.609	7.0
2013	0.067	14.411	11.675	3.082	86.530	22.844	7.4
2014	0.067	17.846	12.521	3.305	97.964	25.862	7.8
2015	0.115	13.897	18.494	4.882	137.840	36.390	7.5
2016	0.115	15.986	18.085	4.774	116.887	30.858	6.5
2017	0.115	16.569	20.099	5.306	123.723	32.663	6.2
2018	0.115	15.129	26.015	6.868	171.568	45.294	6.6
2019	0.115	17.510	32.975	8.706	238.652	63.004	7.2
2020	0.115	15.551	31.767	8.387	248.578	65.625	7.8
2021	0.115	13.892	30.216	7.977	253.851	67.016	8.4
2022	0.115	11.710	29.408	7.764	262.200	69.221	8.9
2023	0.115	13.966	28.149	7.431	265.657	70.133	9.4

Table 44. Gulf of America Red Snapper Commercial Handline Closed Season Discards West discards in numbers. Discards refer to the total number of fish discarded before applying the discard mortality rate. In SEDAR 98, catches were modelled as total catch, by summing the landings with the dead discards.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1996	0.05	405.741	405.651	85.998	788.119	167.081	1.9
1997	0.05	517.006	516.877	109.578	1,142.694	242.250	2.2
1998	0.05	405.162	405.140	85.890	980.207	207.804	2.4
1999	0.05	436.787	436.753	92.592	1,090.401	231.165	2.5
2000	0.05	420.384	420.292	89.102	932.118	197.609	2.2
2001	0.05	401.854	401.740	85.169	865.115	183.404	2.2
2002	0.05	429.826	429.664	91.089	1,066.794	226.161	2.5
2003	0.05	417.277	417.092	88.424	974.103	206.510	2.3
2004	0.05	363.947	363.769	77.119	856.737	181.628	2.4
2005	0.05	361.285	361.165	76.567	846.590	179.477	2.3
2006	0.05	263.230	263.163	55.791	524.270	111.145	2.0

Table 45. Gulf of America Red Snapper Commercial Handline Closed Season Discards Central discards in numbers. Discards refer to the total number of fish discarded before applying the discard mortality rate. In SEDAR 98, catches were modelled as total catch, by summing the landings with the dead discards.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1996	0.05	130.017	130.017	24.963	375.035	72.007	2.9
1997	0.05	109.229	109.220	20.970	291.266	55.923	2.7
1998	0.05	109.699	109.689	21.060	306.050	58.762	2.8
1999	0.05	124.443	124.438	23.892	379.038	72.775	3.0
2000	0.05	102.018	102.019	19.588	303.554	58.282	3.0
2001	0.05	97.940	97.947	18.806	264.290	50.744	2.7
2002	0.05	92.380	92.381	17.737	266.420	51.152	2.9
2003	0.05	106.473	106.483	20.445	318.133	61.081	3.0
2004	0.05	79.439	79.450	15.254	247.145	47.452	3.1
2005	0.05	61.086	61.080	11.727	188.821	36.254	3.1
2006	0.05	70.243	70.240	13.486	189.626	36.408	2.7

Table 46. Gulf of America Red Snapper Commercial Handline Closed Season Discards East discards in numbers. Discards refer to the total number of fish discarded before applying the discard mortality rate. In SEDAR 98, catches were modelled as total catch, by summing the landings with the dead discards.

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1996	0.05	25.672	25.700	6.348	110.186	27.216	4.3
1997	0.05	27.086	27.094	6.692	111.391	27.514	4.1
1998	0.05	26.451	26.433	6.529	107.846	26.638	4.1
1999	0.05	30.840	30.804	7.609	133.512	32.977	4.3
2000	0.05	32.661	32.658	8.066	148.272	36.623	4.5
2001	0.05	28.379	28.398	7.014	120.292	29.712	4.2
2002	0.05	23.318	23.333	5.763	94.491	23.339	4.0
2003	0.05	20.935	20.943	5.173	87.581	21.633	4.2
2004	0.05	16.770	16.774	4.143	72.827	17.988	4.3
2005	0.05	16.335	16.340	4.036	73.738	18.213	4.5
2006	0.05	17.960	17.970	4.439	76.123	18.802	4.2

Table 47. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Charter West fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of America Red Snapper. Dead discards in numbers (discard mortality rate = 0.412), dead discards in biomass, and mean weight (MW, whole pounds 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	MW
1982	0.82	13.30	1.64	0.67	0.54	0.22	0.30
1983	0.64	1.55	2.24	0.92	0.74	0.30	0.30
1986	0.39	2.52	3.86	1.59	1.59	0.66	0.40
1987	0.73	1.80	3.65	1.50	1.50	0.62	0.40
1988	0.74	1.21	0.62	0.26	0.26	0.11	0.40
1989	0.82	4.60	2.81	1.16	1.16	0.48	0.40
1990	0.61	64.07	27.50	11.33	18.68	7.70	0.70
1991	0.32	140.53	102.90	42.40	70.52	29.06	0.70
1992	0.36	111.92	82.59	34.03	57.36	23.63	0.70
1993	0.32	67.21	50.96	21.00	33.24	13.70	0.70
1994	0.31	107.78	50.23	20.70	32.28	13.30	0.60
1995	0.47	89.03	138.69	57.14	119.08	49.06	0.90
1996	0.44	90.82	99.89	41.16	87.65	36.11	0.90
1997	0.32	61.42	80.80	33.29	73.82	30.41	0.90
1998	0.46	48.02	103.31	42.56	95.10	39.18	0.90
1999	0.50	12.88	52.65	21.69	47.35	19.51	0.90
2000	0.34	9.99	25.92	10.68	22.98	9.47	0.90
2001	0.52	15.10	30.15	12.42	26.95	11.10	0.90
2002	0.35	37.72	56.71	23.37	53.58	22.07	0.90
2003	0.28	59.42	73.12	30.12	66.11	27.24	0.90
2004	0.30	178.53	124.70	51.37	113.30	46.68	0.90
2005	0.31	196.89	118.91	48.99	107.91	44.46	0.90
2006	0.26	202.34	195.01	80.34	170.71	70.33	0.90
2007	0.22	125.62	69.64	28.69	167.43	68.98	2.40
2008	0.45	68.20	21.92	9.03	55.26	22.77	2.50
2009	0.48	33.12	16.98	7.00	53.52	22.05	3.20
2010	0.48	0.87	4.26	1.76	11.55	4.76	2.70
2011	0.68	7.38	5.77	2.38	18.68	7.70	3.20
2012	0.41	19.16	15.46	6.37	50.89	20.96	3.30

Table 47 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Charter West fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of America Red Snapper. Dead discards in numbers (discard mortality rate = 0.412), dead discards in biomass, and mean weight (MW, whole pounds 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	MW
2013	0.50	27.71	12.57	5.18	40.08	16.51	3.20
2014	0.33	4.36	4.89	2.02	19.45	8.01	4.00
2015	0.26	11.12	12.64	5.21	49.72	20.49	3.90
2016	0.23	13.05	14.51	5.98	59.59	24.55	4.10
2017	0.18	9.92	12.67	5.22	55.58	22.90	4.40
2018	0.21	6.94	9.12	3.76	41.52	17.10	4.60
2019	0.23	33.96	17.52	7.22	79.06	32.57	4.50
2020	0.20	7.69	7.60	3.13	35.71	14.71	4.70
2021	0.15	15.65	12.91	5.32	68.56	28.25	5.30
2022	0.25	8.51	9.22	3.80	51.24	21.11	5.60
2023	0.14	14.71	14.93	6.15	86.23	35.52	5.80

Table 48. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Charter Central fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of America Red Snapper. Dead discards in numbers (discard mortality rate = 0.169), dead discards in biomass, and mean weight (MW, whole pounds 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	MW
1981	0.64	0.49	1.31	0.22	0.19	0.03	0.10
1982	0.83	7.74	11.18	1.89	1.77	0.30	0.20
1984	0.83	3.78	4.77	0.81	0.58	0.10	0.10
1985	0.83	2.29	17.63	2.98	5.26	0.89	0.30
1986	0.58	7.33	29.57	5.00	7.90	1.34	0.30
1987	0.38	42.60	40.19	6.79	11.91	2.01	0.30
1988	0.74	64.91	26.99	4.56	7.22	1.22	0.30
1989	0.43	35.09	24.46	4.13	5.83	0.98	0.20
1990	0.38	80.69	159.24	26.91	119.70	20.23	0.80
1991	0.28	196.02	200.72	33.92	158.82	26.84	0.80
1992	0.20	317.61	305.34	51.60	249.76	42.21	0.80
1993	0.43	260.03	364.95	61.68	438.98	74.19	1.20
1994	0.24	273.36	182.81	30.89	222.09	37.53	1.20
1995	0.41	401.69	278.81	47.12	355.24	60.04	1.30
1996	0.28	486.47	528.04	89.24	657.16	111.06	1.20
1997	0.25	848.27	743.13	125.59	930.05	157.18	1.30
1998	0.11	676.95	725.89	122.68	926.82	156.64	1.30
1999	0.09	858.45	762.96	128.94	965.09	163.12	1.30
2000	0.08	504.74	510.83	86.33	663.67	112.16	1.30
2001	0.10	571.54	615.46	104.01	792.22	133.88	1.30
2002	0.09	555.12	582.47	98.44	778.71	131.60	1.30
2003	0.09	573.35	594.07	100.40	781.23	132.03	1.30
2004	0.09	613.63	622.61	105.22	826.20	139.63	1.30
2005	0.09	571.95	541.24	91.47	711.15	120.19	1.30
2006	0.11	803.20	787.38	133.07	1,007.84	170.33	1.30
2007	0.11	685.09	793.05	134.03	1,138.46	192.40	1.40
2008	0.11	486.49	504.65	85.29	749.64	126.69	1.50
2009	0.12	475.86	358.28	60.55	707.49	119.56	2.00
2010	0.15	226.65	121.10	20.47	268.78	45.42	2.20

Table 48 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Charter Central fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of America Red Snapper. Dead discards in numbers (discard mortality rate = 0.169), dead discards in biomass, and mean weight (MW, whole pounds 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	MW
2011	0.12	375.94	238.80	40.36	635.65	107.43	2.70
2012	0.12	258.46	190.44	32.19	524.19	88.59	2.80
2013	0.21	402.95	199.47	33.71	550.51	93.03	2.80
2014	0.17	281.55	73.06	12.35	239.70	40.51	3.30
2015	0.15	258.41	264.18	44.65	570.83	96.47	2.20
2016	0.19	416.81	339.10	57.31	726.75	122.82	2.10
2017	0.20	537.94	351.96	59.48	795.70	134.47	2.30
2018	0.15	422.03	290.86	49.16	766.95	129.61	2.60
2019	0.25	497.16	296.64	50.13	789.98	133.51	2.70
2020	0.22	347.53	290.18	49.04	771.01	130.30	2.70
2021	0.16	620.10	353.41	59.73	951.27	160.76	2.70
2022	0.26	574.00	328.09	55.45	896.95	151.59	2.70
2023	0.13	447.02	393.28	66.46	1,067.15	180.36	2.70

Table 49. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Charter East fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of America Red Snapper. Dead discards in numbers (discard mortality rate = 0.268), dead discards in biomass, and mean weight (MW, whole pounds 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	MW
1982	0.83	0.40	0.09	0.02	0.02	0.00	0.20
1984	0.83	3.59	0.91	0.24	0.11	0.03	0.10
1985	0.83	1.01	1.33	0.36	0.46	0.12	0.30
1986	0.43	17.13	6.24	1.67	1.99	0.53	0.30
1987	0.83	1.64	0.49	0.13	0.16	0.04	0.30
1992	0.62	1.02	1.13	0.30	0.75	0.20	0.70
1994	0.83	0.06	0.01	0.00	0.01	0.00	1.00
1997	0.83	0.54	1.95	0.52	2.36	0.63	1.20
1998	0.50	3.08	6.81	1.83	8.43	2.26	1.20
1999	0.69	1.92	0.57	0.15	0.71	0.19	1.30
2000	0.66	0.26	1.22	0.33	1.97	0.53	1.60
2001	0.65	2.76	8.32	2.23	12.45	3.34	1.50
2003	0.77	2.88	6.17	1.65	9.95	2.67	1.60
2004	0.77	0.69	1.61	0.43	2.62	0.70	1.60
2005	0.56	1.57	5.46	1.46	8.98	2.41	1.60
2006	0.50	17.68	56.72	15.20	84.56	22.66	1.50
2007	0.58	2.23	3.32	0.89	5.56	1.49	1.70
2008	0.68	16.11	12.02	3.22	21.04	5.64	1.80
2009	0.59	17.66	4.15	1.11	9.77	2.62	2.40
2010	0.59	4.05	6.83	1.83	16.66	4.46	2.40
2011	0.59	1.95	0.00	0.00	0.01	0.00	2.80
2012	0.76	1.34	4.06	1.09	10.65	2.85	2.60
2013	0.78	11.20	0.74	0.20	2.08	0.56	2.80
2014	0.51	9.08	4.38	1.17	14.80	3.97	3.40
2015	0.60	15.14	27.46	7.36	45.51	12.20	1.70
2016	0.41	42.28	25.71	6.89	52.04	13.95	2.00
2017	0.64	160.00	37.91	10.16	95.78	25.67	2.50
2018	0.36	59.03	37.02	9.92	98.72	26.46	2.70
2019	0.37	25.16	21.39	5.73	65.61	17.58	3.10

Table 50. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Headboat West fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of America Red Snapper. Dead discards in numbers (discard mortality rate = 0.406), dead discards in biomass, and mean weight (MW, whole pounds 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	MW
1982	0.87	7.96	3.88	1.57	1.20	0.49	0.30
1983	0.64	0.65	3.50	1.42	1.08	0.44	0.30
1986	0.68	4.34	3.65	1.48	1.12	0.46	0.30
1987	0.80	3.76	19.66	7.98	7.34	2.98	0.40
1988	0.89	14.36	20.44	8.30	7.72	3.13	0.40
1989	0.90	11.38	20.22	8.21	7.59	3.08	0.40
1990	0.80	176.99	256.63	104.19	169.13	68.67	0.70
1991	0.66	135.40	312.51	126.88	208.39	84.61	0.70
1992	0.66	157.82	389.80	158.26	264.57	107.42	0.70
1993	0.65	158.41	52.85	21.46	56.00	22.74	1.10
1994	0.64	393.43	67.96	27.59	71.64	29.09	1.10
1995	0.73	180.04	223.32	90.67	265.67	107.86	1.20
1996	0.73	233.20	205.87	83.58	245.87	99.82	1.20
1997	0.66	118.56	158.00	64.15	190.11	77.19	1.20
1998	0.69	34.53	94.30	38.29	113.70	46.16	1.20
1999	0.72	6.15	36.38	14.77	44.03	17.88	1.20
2000	0.64	12.07	78.85	32.01	102.85	41.76	1.30
2001	0.71	20.25	90.22	36.63	117.82	47.84	1.30
2002	0.64	21.30	81.70	33.17	108.43	44.02	1.30
2003	0.67	36.93	106.86	43.38	140.29	56.96	1.30
2004	0.63	53.46	77.13	31.32	101.34	41.15	1.30
2005	0.64	58.97	71.89	29.19	94.42	38.34	1.30
2006	0.62	57.32	111.64	45.33	144.85	58.81	1.30
2007	0.70	47.89	20.17	8.19	57.61	23.39	2.90
2008	0.24	12.37	10.82	4.39	30.77	12.49	2.80
2009	0.09	12.83	12.40	5.04	38.38	15.58	3.10
2010	0.06	8.27	8.23	3.34	24.48	9.94	3.00
2011	0.05	11.29	10.83	4.40	33.42	13.57	3.10
2012	0.09	7.87	7.72	3.13	24.29	9.86	3.10

Table 50 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Headboat West fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of America Red Snapper. Dead discards in numbers (discard mortality rate = 0.406), dead discards in biomass, and mean weight (MW, whole pounds 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	MW
2013	0.05	2.62	2.79	1.13	8.54	3.47	3.10
2014	0.05	1.58	1.70	0.69	5.49	2.23	3.20
2015	0.05	4.05	4.26	1.73	13.83	5.62	3.20
2016	0.05	3.38	3.58	1.46	11.72	4.76	3.30
2017	0.07	5.49	5.68	2.31	18.81	7.64	3.30
2018	0.05	5.12	5.26	2.13	17.59	7.14	3.30
2019	0.06	7.33	7.34	2.98	24.41	9.91	3.30
2020	0.05	5.72	5.86	2.38	19.44	7.89	3.30
2021	0.05	32.33	28.63	11.62	97.74	39.68	3.40
2022	0.05	18.74	17.41	7.07	60.62	24.61	3.50
2023	0.05	10.43	10.12	4.11	35.71	14.50	3.50

Table 51. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Headboat Central fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of America Red Snapper. Dead discards in numbers (discard mortality rate = 0.244), dead discards in biomass, and mean weight (MW, whole pounds 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	MW
1981	0.64	0.30	0.65	0.16	0.12	0.03	0.20
1982	0.83	4.84	5.67	1.38	1.09	0.27	0.20
1984	0.83	2.37	2.32	0.57	0.39	0.10	0.20
1985	0.83	1.43	3.83	0.93	0.78	0.19	0.20
1986	0.80	0.13	0.32	0.08	0.06	0.01	0.20
1987	0.71	0.51	0.99	0.24	0.35	0.08	0.30
1988	0.79	1.39	1.15	0.28	0.39	0.10	0.30
1989	0.56	1.06	1.29	0.31	0.41	0.10	0.30
1990	0.55	5.16	12.95	3.16	8.04	1.96	0.60
1991	0.48	9.47	11.23	2.74	7.14	1.74	0.60
1992	0.40	18.20	20.08	4.90	12.93	3.15	0.60
1993	0.57	6.82	6.72	1.64	5.61	1.37	0.80
1994	0.43	12.57	5.06	1.24	4.26	1.04	0.80
1995	0.54	18.55	13.47	3.29	14.35	3.50	1.10
1996	0.47	19.43	23.47	5.73	24.45	5.97	1.00
1997	0.40	40.62	40.68	9.93	42.73	10.43	1.10
1998	0.33	26.32	42.13	10.28	45.19	11.03	1.10
1999	0.34	34.34	32.73	7.99	35.54	8.67	1.10
2000	0.31	23.87	62.19	15.17	77.17	18.83	1.20
2001	0.32	22.93	71.09	17.35	87.01	21.23	1.20
2002	0.33	23.61	68.89	16.81	89.94	21.95	1.30
2003	0.38	24.26	71.44	17.43	90.40	22.06	1.30
2004	0.37	22.59	58.96	14.39	75.87	18.51	1.30
2005	0.38	19.48	44.50	10.86	56.28	13.73	1.30
2006	0.46	30.51	83.29	20.32	100.95	24.63	1.20
2007	0.48	28.56	70.71	17.25	93.39	22.79	1.30
2008	0.09	37.17	41.69	10.17	56.12	13.69	1.30
2009	0.05	46.57	46.16	11.26	70.47	17.20	1.50
2010	0.06	13.92	13.96	3.41	21.62	5.28	1.50

Table 51 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Headboat Central fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of America Red Snapper. Dead discards in numbers (discard mortality rate = 0.244), dead discards in biomass, and mean weight (MW, whole pounds 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	MW
2011	0.05	21.76	21.78	5.31	35.73	8.72	1.60
2012	0.08	17.32	17.48	4.26	28.17	6.87	1.60
2013	0.05	26.55	25.45	6.21	40.28	9.83	1.60
2014	0.05	5.73	6.09	1.49	10.46	2.55	1.70
2015	0.05	19.18	19.92	4.86	27.80	6.78	1.40
2016	0.05	37.75	36.47	8.90	52.51	12.81	1.40
2017	0.05	52.99	50.26	12.26	74.83	18.26	1.50
2018	0.05	43.91	41.54	10.14	65.89	16.08	1.60
2019	0.05	32.61	30.63	7.47	47.71	11.64	1.60
2020	0.05	28.89	27.16	6.63	41.85	10.21	1.50
2021	0.05	70.80	60.47	14.76	93.53	22.82	1.50
2022	0.05	55.69	47.89	11.69	74.34	18.14	1.60
2023	0.05	24.89	23.94	5.84	36.90	9.00	1.50

Table 52. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Headboat East fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of America Red Snapper. Dead discards in numbers (discard mortality rate = 0.279), dead discards in biomass, and mean weight (MW, whole pounds 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	MW
1982	0.83	0.25	0.05	0.01	0.01	0.00	0.20
1984	0.83	2.25	0.39	0.11	0.07	0.02	0.20
1985	0.83	0.63	0.19	0.05	0.04	0.01	0.20
1986	0.71	0.17	0.03	0.01	0.01	0.00	0.20
1987	0.92	0.09	0.14	0.04	0.06	0.02	0.50
1992	0.87	0.01	0.02	0.01	0.01	0.00	0.70
1994	1.03	0.10	0.07	0.02	0.07	0.02	0.90
1997	1.00	0.00	0.05	0.01	0.05	0.01	1.10
1998	0.77	0.04	0.25	0.07	0.29	0.08	1.20
1999	0.77	1.83	1.74	0.48	2.09	0.58	1.20
2000	0.79	0.18	1.83	0.51	2.43	0.68	1.30
2001	0.79	0.39	2.44	0.68	3.08	0.86	1.30
2003	0.78	0.20	0.80	0.22	1.06	0.30	1.30
2004	0.63	0.52	2.25	0.63	3.04	0.85	1.40
2005	0.57	1.06	6.92	1.93	9.44	2.63	1.40
2006	0.78	0.42	2.93	0.82	3.67	1.02	1.30
2007	0.77	0.46	1.01	0.28	1.52	0.42	1.50
2008	0.06	0.68	0.75	0.21	1.15	0.32	1.50
2009	0.06	1.49	1.53	0.43	2.84	0.79	1.90
2010	0.10	0.62	0.71	0.20	1.28	0.36	1.80
2011	0.06	1.96	1.87	0.52	3.59	1.00	1.90
2012	0.05	0.25	0.28	0.08	0.49	0.14	1.80
2013	0.05	0.44	0.48	0.13	0.88	0.24	1.80
2014	0.05	0.29	0.31	0.09	0.64	0.18	2.10
2015	0.05	0.41	0.45	0.13	0.60	0.17	1.30
2016	0.05	4.34	4.22	1.18	6.89	1.92	1.60
2017	0.05	4.80	4.83	1.35	9.08	2.53	1.90
2018	0.05	5.88	5.73	1.60	10.57	2.95	1.80
2019	0.05	5.70	5.47	1.53	10.79	3.01	2.00

Table 52 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Headboat East fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of America Red Snapper. Dead discards in numbers (discard mortality rate = 0.279), dead discards in biomass, and mean weight (MW, whole pounds 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	MW
2020	0.05	2.59	2.64	0.74	4.99	1.39	1.90
2021	0.05	3.88	3.92	1.09	7.77	2.17	2.00
2022	0.05	5.21	5.16	1.44	10.14	2.83	2.00
2023	0.05	5.75	5.59	1.56	10.84	3.02	1.90

Table 53. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Private West fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of America Red Snapper. Dead discards in numbers (discard mortality rate = 0.355), dead discards in biomass, and mean weight (MW, whole pounds 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	MW
1981	0.59	30.29	208.62	74.06	43.17	15.32	0.20
1982	0.67	6.49	139.38	49.48	28.66	10.16	0.20
1985	0.71	438.40	231.80	82.29	57.30	20.34	0.20
1987	0.82	120.04	104.28	37.02	25.98	9.22	0.20
1988	0.51	529.27	128.58	45.65	32.30	11.47	0.30
1989	0.51	371.12	101.27	35.95	24.65	8.75	0.20
1990	0.64	422.26	693.37	246.15	378.48	134.36	0.50
1991	0.82	410.62	730.99	259.50	410.06	145.57	0.60
1992	0.33	450.63	681.95	242.09	397.89	141.25	0.60
1993	0.31	528.83	653.19	231.88	493.15	175.07	0.80
1994	0.50	1,213.19	957.71	339.98	706.89	250.95	0.70
1995	0.46	1,942.65	2,701.43	959.01	2,296.35	815.20	0.90
1996	0.47	413.06	1,512.34	536.88	1,308.15	464.40	0.90
1997	0.48	488.43	1,183.37	420.10	1,058.04	375.60	0.90
1998	0.50	735.05	1,092.55	387.85	983.08	348.99	0.90
1999	0.39	1,983.08	887.15	314.94	785.20	278.75	0.90
2000	0.39	478.64	1,066.17	378.49	963.97	342.20	0.90
2001	0.47	448.86	829.38	294.43	754.89	267.98	0.90
2002	0.66	173.88	533.28	189.31	510.53	181.24	1.00
2003	0.61	1,129.39	642.30	228.02	591.32	209.92	0.90
2004	0.75	710.29	573.92	203.74	530.53	188.34	0.90
2005	0.55	1,029.97	903.76	320.84	834.52	296.26	0.90
2006	0.40	1,846.48	1,582.11	561.64	1,413.07	501.64	0.90
2007	0.36	937.29	1,218.55	432.59	492.80	174.96	0.40
2008	0.48	811.09	576.86	204.78	426.25	151.32	0.70
2009	0.43	512.69	658.06	233.62	208.80	74.12	0.30
2010	0.87	53.84	354.96	126.01	200.46	71.16	0.60
2011	0.55	497.16	436.97	155.12	235.49	83.60	0.50
2012	0.46	603.67	639.14	226.89	251.24	89.20	0.40

Table 53 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Private West fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of America Red Snapper. Dead discards in numbers (discard mortality rate = 0.355), dead discards in biomass, and mean weight (MW, whole pounds 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	MW
2013	0.45	1,660.45	678.88	241.00	456.95	162.22	0.70
2014	0.32	569.94	514.89	182.79	264.84	94.03	0.50
2015	0.32	698.77	668.15	237.19	344.25	122.20	0.50
2016	0.32	504.88	415.48	147.49	229.99	81.64	0.60
2017	0.27	753.86	511.29	181.51	284.68	101.06	0.60
2018	0.27	588.50	545.19	193.54	272.89	96.87	0.50
2019	0.24	1,333.84	948.50	336.72	494.32	175.47	0.50
2020	0.27	769.78	469.53	166.68	310.41	110.21	0.70
2021	0.30	760.00	367.08	130.31	230.36	81.77	0.60
2022	0.31	480.12	273.89	97.23	160.94	57.12	0.60
2023	0.28	902.32	443.38	157.40	273.11	96.96	0.60

Table 54. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Private Central fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of America Red Snapper. Dead discards in numbers (discard mortality rate = 0.297), dead discards in biomass, and mean weight (MW, whole pounds 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	MW
1981	0.65	179.40	106.28	31.57	12.15	3.62	0.10
1982	0.60	13.17	15.09	4.48	1.99	0.59	0.10
1983	0.83	4.47	39.71	11.79	6.54	1.94	0.20
1985	0.83	0.92	72.42	21.51	16.85	5.00	0.20
1986	0.74	13.53	32.74	9.72	6.02	1.79	0.20
1987	0.36	113.80	78.22	23.23	17.93	5.32	0.20
1988	0.45	9.13	41.87	12.44	7.76	2.31	0.20
1989	0.55	323.03	145.12	43.10	22.53	6.69	0.20
1990	0.55	772.21	717.71	213.16	439.07	130.40	0.60
1991	0.28	1,587.53	1,381.70	410.36	894.69	265.72	0.60
1992	0.17	1,315.58	1,565.82	465.05	1,045.92	310.65	0.70
1993	0.23	1,657.18	1,327.03	394.13	1,050.92	312.13	0.80
1994	0.24	940.42	750.91	223.02	607.62	180.47	0.80
1995	0.31	226.08	690.29	205.02	675.02	200.47	1.00
1996	0.26	1,014.85	1,170.80	347.73	1,072.05	318.40	0.90
1997	0.25	2,242.91	2,091.18	621.09	1,954.59	580.52	0.90
1998	0.22	756.89	895.99	266.11	890.42	264.46	1.00
1999	0.22	2,299.24	1,918.32	569.74	1,948.44	578.69	1.00
2000	0.23	1,360.72	1,806.70	536.60	1,789.69	531.53	1.00
2001	0.19	1,983.52	3,374.40	1,002.20	3,262.33	968.91	1.00
2002	0.22	3,745.66	4,083.69	1,212.86	4,514.00	1,340.65	1.10
2003	0.20	2,571.12	2,907.66	863.57	2,991.01	888.33	1.00
2004	0.19	3,469.43	4,158.34	1,235.03	4,441.71	1,319.20	1.10
2005	0.18	2,527.75	2,054.39	610.15	2,112.18	627.33	1.00
2006	0.16	3,233.19	3,334.87	990.46	3,165.22	940.07	0.90
2007	0.16	4,516.82	6,476.61	1,923.57	3,391.92	1,007.40	0.50
2008	0.21	2,291.59	2,884.25	856.62	2,266.28	673.09	0.80
2009	0.17	1,904.93	1,736.79	515.83	1,477.14	438.70	0.90
2010	0.19	1,963.08	1,486.03	441.35	1,204.93	357.88	0.80

Table 54 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Private Central fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of America Red Snapper. Dead discards in numbers (discard mortality rate = 0.297), dead discards in biomass, and mean weight (MW, whole pounds 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	MW
2011	0.17	1,609.64	1,363.78	405.05	988.46	293.57	0.70
2012	0.16	1,141.05	1,204.33	357.69	797.81	236.95	0.70
2013	0.29	3,883.52	2,323.86	690.19	1,853.73	550.56	0.80
2014	0.22	1,440.84	1,397.51	415.06	553.82	164.49	0.40
2015	0.19	1,443.62	2,196.76	652.44	1,248.76	370.88	0.60
2016	0.17	2,884.99	3,175.56	943.14	2,174.84	645.93	0.70
2017	0.17	4,853.39	4,648.27	1,380.54	3,726.78	1,106.85	0.80
2018	0.19	2,735.71	2,283.24	678.13	1,675.42	497.61	0.70
2019	0.17	3,316.10	2,876.99	854.47	1,919.67	570.14	0.70
2020	0.14	2,162.31	2,180.12	647.50	1,477.87	438.92	0.70
2021	0.17	2,224.83	2,014.30	598.25	1,398.74	415.42	0.70
2022	0.15	3,053.69	2,548.97	757.04	1,743.17	517.71	0.70
2023	0.16	2,036.08	2,029.20	602.68	1,215.85	361.10	0.60

Table 55. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Private East fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of America Red Snapper. Dead discards in numbers (discard mortality rate = 0.315), dead discards in biomass, and mean weight (MW, whole pounds 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	MW
1981	0.64	76.36	22.03	6.94	2.47	0.78	0.10
1984	0.70	82.41	2.11	0.66	0.19	0.06	0.10
1985	0.71	41.32	161.04	50.73	79.99	25.20	0.50
1986	0.64	11.69	111.40	35.09	53.19	16.75	0.50
1987	0.64	3.10	72.10	22.71	34.65	10.91	0.50
1988	0.46	35.69	29.40	9.26	14.46	4.55	0.50
1989	0.64	7.02	57.51	18.11	28.21	8.89	0.50
1990	0.83	21.54	96.24	30.32	76.86	24.21	0.80
1991	0.40	78.28	38.09	12.00	32.20	10.14	0.80
1992	0.42	80.07	8.97	2.83	7.13	2.25	0.80
1993	0.45	29.73	0.45	0.14	0.39	0.12	0.90
1994	0.55	38.86	0.21	0.06	0.18	0.06	0.90
1995	0.69	13.97	8.43	2.66	9.47	2.98	1.10
1996	0.46	35.81	90.99	28.66	98.28	30.96	1.10
1997	0.83	25.99	0.04	0.01	0.04	0.01	1.00
1998	0.55	12.66	0.13	0.04	0.14	0.05	1.10
1999	0.44	26.44	20.39	6.42	23.74	7.48	1.20
2000	0.62	66.17	6.96	2.19	7.55	2.38	1.10
2001	0.83	5.73	0.03	0.01	0.03	0.01	1.00
2002	0.83	6.87	22.00	6.93	26.17	8.24	1.20
2003	0.65	2.07	7.75	2.44	8.43	2.66	1.10
2004	0.67	92.59	20.63	6.50	23.21	7.31	1.10
2005	0.46	92.92	188.29	59.31	215.08	67.75	1.10
2006	0.51	30.94	84.56	26.64	83.91	26.43	1.00
2007	0.49	43.27	232.49	73.23	154.78	48.75	0.70
2008	0.57	7.23	20.44	6.44	18.79	5.92	0.90
2009	0.61	40.07	31.04	9.78	32.10	10.11	1.00
2010	0.52	24.03	5.55	1.75	5.13	1.62	0.90
2011	0.82	14.60	19.50	6.14	16.67	5.25	0.90

Table 55 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Private East fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of America Red Snapper. Dead discards in numbers (discard mortality rate = 0.315), dead discards in biomass, and mean weight (MW, whole pounds 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	MW
2012	0.83	14.29	22.63	7.13	18.58	5.85	0.80
2014	0.55	44.08	15.49	4.88	4.72	1.49	0.30
2015	0.58	23.24	12.85	4.05	8.72	2.75	0.70
2016	0.60	192.96	82.00	25.83	85.84	27.04	1.00
2017	0.33	127.30	114.69	36.13	118.41	37.30	1.00
2018	0.38	220.12	134.84	42.48	129.68	40.85	1.00
2019	0.35	150.71	105.42	33.21	100.00	31.50	0.90
2020	0.37	55.89	41.30	13.01	38.02	11.98	0.90
2021	0.51	212.68	72.31	22.78	70.08	22.07	1.00
2022	0.59	196.07	105.71	33.30	96.77	30.48	0.90
2023	0.33	283.18	170.14	53.60	145.90	45.96	0.90

Table 56. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Private Closed Season Discards West fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of America Red Snapper. Dead discards in numbers (discard mortality rate = 0.211), dead discards in biomass, and mean weight (MW, whole pounds 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	MW
1998	0.05	56.61	56.61	11.95	117.03	24.69	2.10
1999	0.05	54.31	54.31	11.46	114.44	24.15	2.10
2000	0.05	247.32	247.28	52.17	457.17	96.46	1.80
2001	0.05	65.75	65.75	13.87	118.69	25.04	1.80
2002	0.05	613.73	613.28	129.40	1,290.77	272.35	2.10
2003	0.05	622.79	622.26	131.30	1,216.25	256.63	2.00
2004	0.05	2,476.64	2,467.06	520.55	4,860.99	1,025.67	2.00
2005	0.05	994.55	993.37	209.60	1,946.56	410.72	2.00
2006	0.05	393.90	393.71	83.07	656.67	138.56	1.70
2007	0.05	132.92	132.91	28.05	222.11	46.87	1.70
2008	0.05	796.53	796.26	168.01	1,889.93	398.78	2.40
2009	0.05	612.73	612.57	129.25	1,250.24	263.80	2.00
2010	0.05	187.96	187.94	39.66	425.70	89.82	2.30
2011	0.05	838.08	837.54	176.72	2,187.86	461.64	2.60
2012	0.05	86.31	86.30	18.21	200.94	42.40	2.30
2013	0.05	175.80	175.77	37.09	496.50	104.76	2.80
2014	0.05	37.28	37.28	7.87	115.70	24.41	3.10
2015	0.05	45.71	45.71	9.64	140.86	29.72	3.10
2016	0.05	23.82	23.82	5.03	78.28	16.52	3.30
2017	0.05	85.89	85.89	18.12	300.08	63.32	3.50
2018	0.05	277.14	277.10	58.47	964.57	203.52	3.50
2019	0.05	321.89	321.83	67.91	1,120.77	236.48	3.50
2020	0.05	449.32	449.17	94.78	1,758.45	371.03	3.90
2021	0.05	247.05	246.99	52.12	1,063.71	224.44	4.30
2022	0.05	97.44	97.43	20.56	432.20	91.19	4.40
2023	0.05	146.68	146.66	30.95	685.59	144.66	4.70

Table 57. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Private Closed Season Discards Central fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of America Red Snapper. Dead discards in numbers (discard mortality rate = 0.297), dead discards in biomass, and mean weight (MW, whole pounds 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	MW
1997	0.05	25.12	25.12	7.46	43.74	12.99	1.70
1998	0.05	355.95	355.86	105.69	704.77	209.32	2.00
1999	0.05	384.75	384.66	114.25	875.10	259.90	2.30
2000	0.05	1,201.63	1,201.12	356.73	2,392.32	710.52	2.00
2001	0.05	2,389.24	2,386.76	708.87	4,087.03	1,213.85	1.70
2002	0.05	2,680.20	2,668.44	792.53	5,734.48	1,703.14	2.10
2003	0.05	1,778.04	1,773.62	526.77	3,706.23	1,100.75	2.10
2004	0.05	1,035.62	1,032.93	306.78	2,355.64	699.62	2.30
2005	0.05	1,500.30	1,490.56	442.70	3,241.72	962.79	2.20
2006	0.05	939.92	938.60	278.76	1,569.60	466.17	1.70
2007	0.05	1,179.15	1,178.43	350.00	1,179.54	350.32	1.00
2008	0.05	2,064.54	2,062.38	612.53	3,049.30	905.64	1.50
2009	0.05	1,931.69	1,928.02	572.62	4,298.35	1,276.61	2.20
2010	0.05	2,462.83	2,455.87	729.39	6,371.40	1,892.31	2.60
2011	0.05	2,119.88	2,113.44	627.69	6,414.72	1,905.17	3.00
2012	0.05	2,830.26	2,817.46	836.79	8,668.08	2,574.42	3.10
2013	0.05	987.87	986.18	292.90	3,403.34	1,010.79	3.50
2014	0.05	2,424.15	2,416.19	717.61	6,700.41	1,990.02	2.80
2015	0.05	1,714.14	1,710.58	508.04	3,650.17	1,084.10	2.10
2016	0.05	2,597.60	2,586.42	768.17	6,056.77	1,798.86	2.30
2017	0.05	3,413.24	3,384.15	1,005.09	9,204.95	2,733.86	2.70
2018	0.05	2,289.74	2,274.22	675.45	6,895.37	2,047.92	3.00
2019	0.05	2,448.59	2,434.38	723.01	7,199.52	2,138.26	3.00
2020	0.05	1,741.20	1,735.49	515.44	5,214.08	1,548.59	3.00
2021	0.05	1,541.02	1,537.28	456.57	4,748.33	1,410.25	3.10
2022	0.05	2,809.91	2,800.44	831.73	8,710.36	2,586.99	3.10
2023	0.05	1,325.79	1,324.88	393.49	3,769.59	1,119.57	2.80

Table 58. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Private Closed Season Discards East fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of America Red Snapper. Dead discards in numbers (discard mortality rate = 0.315), dead discards in biomass, and mean weight (MW, whole pounds 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	MW
1998	0.05	52.95	53.00	16.70	104.88	33.04	2.00
1999	0.05	23.42	23.44	7.38	55.77	17.57	2.40
2000	0.05	1.56	1.56	0.49	3.35	1.05	2.20
2003	0.05	2.92	2.92	0.92	5.76	1.82	2.00
2005	0.05	36.26	36.26	11.42	81.43	25.65	2.20
2006	0.05	24.38	24.38	7.68	40.10	12.63	1.60
2008	0.05	33.25	33.25	10.47	54.89	17.29	1.70
2009	0.05	62.76	62.73	19.76	154.20	48.57	2.50
2010	0.05	105.44	105.31	33.17	280.16	88.25	2.70
2011	0.05	1,485.98	1,451.68	457.28	4,548.88	1,432.90	3.10
2013	0.05	8.52	8.51	2.68	31.35	9.87	3.70
2014	0.05	5.30	5.30	1.67	10.92	3.44	2.10
2015	0.05	0.76	0.76	0.24	1.15	0.36	1.50
2016	0.05	515.20	513.02	161.60	1,170.60	368.74	2.30
2017	0.05	133.43	133.28	41.98	373.87	117.77	2.80
2018	0.05	426.92	424.96	133.86	1,320.91	416.09	3.10
2019	0.05	244.44	243.62	76.74	900.95	283.80	3.70
2020	0.05	184.04	183.49	57.80	696.87	219.51	3.80
2021	0.05	36.26	36.23	11.41	156.74	49.37	4.30
2022	0.05	102.08	101.91	32.10	446.03	140.50	4.40
2023	0.05	48.35	48.33	15.22	210.28	66.24	4.40

Table 59. Observed (Obs) versus predicted (Exp) standardized SEAMAP Fall Trawl Pre-2007 West index and associated lognormal standard error (as estimated by the standardization process) for Gulf of America Red Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were converted to log-scale SEs.

Year	Fall Trawl Early (Obs)	Fall Trawl Early (Exp)	Fall Trawl Early (SE)
1988	0.43	0.31	0.40
1989	0.86	0.66	0.39
1990	0.91	0.94	0.38
1991	1.03	0.83	0.37
1992	0.32	0.69	0.40
1993	0.57	0.83	0.39
1994	1.63	1.19	0.37
1995	1.75	1.31	0.36
1996	0.87	1.01	0.38
1997	1.29	0.73	0.38
1998	0.60	0.64	0.40
1999	1.37	0.87	0.37
2000	0.91	1.07	0.37
2001	0.68	0.81	0.39
2002	0.65	0.82	0.39
2003	1.15	0.94	0.37
2004	1.80	0.96	0.36
2005	1.27	1.51	0.35
2006	1.08	1.77	0.38
2007	0.84	2.05	0.40

Table 60. Observed (Obs) versus predicted (Exp) standardized SEAMAP Fall Trawl Post-2007 West index and associated lognormal standard error (as estimated by the standardization process) for Gulf of America Red Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were converted to log-scale SEs.

Year	Fall Trawl Late (Obs)	Fall Trawl Late (Exp)	Fall Trawl Late (SE)
2008	0.47	0.30	0.30
2009	1.60	2.25	0.29
2010	0.75	1.11	0.33
2011	0.87	1.24	0.32
2012	1.70	2.29	0.32
2013	0.71	0.68	0.38
2014	0.98	1.35	0.32
2015	1.79	1.32	0.31
2016	1.19	1.11	0.35
2017	0.82	1.01	0.34
2018	1.16	1.21	0.32
2019	0.90	1.11	0.34
2020	0.46	0.54	0.36
2021	0.91	0.56	0.33
2022	0.98	0.55	0.36
2023	0.72	0.41	0.35

Table 61. Observed (Obs) versus predicted (Exp) standardized SEAMAP Fall Trawl Post-2007 Central index and associated lognormal standard error (as estimated by the standardization process) for Gulf of America Red Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were converted to log-scale SEs.

Year	Fall Trawl Late (Obs)	Fall Trawl Late (Exp)	Fall Trawl Late (SE)
2008	0.61	0.37	0.49
2009	2.35	1.26	0.35
2010	0.66	0.68	0.46
2011	0.64	1.01	0.50
2012	1.34	0.99	0.45
2013	0.69	0.32	0.55
2014	0.97	2.63	0.45
2015	1.26	1.76	0.44
2016	0.99	1.41	0.56
2017	0.49	0.69	0.50
2018	1.40	1.10	0.47
2019	0.68	1.01	0.48
2020	0.55	0.88	0.51
2021	0.65	0.79	0.56
2022	0.94	0.77	0.48
2023	1.78	1.08	0.49

Table 62. Observed (Obs) versus predicted (Exp) standardized SEAMAP Fall Trawl Post-2007 East index and associated lognormal standard error (as estimated by the standardization process) for Gulf of America Red Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were converted to log-scale SEs.

Year	Fall Trawl Late (Obs)	Fall Trawl Late (Exp)	Fall Trawl Late (SE)
2008	0.66	0.36	0.99
2009	0.34	0.84	0.79
2010	0.66	0.48	0.71
2012	0.87	0.52	0.98
2013	0.15	0.22	0.99
2014	2.83	3.77	0.64
2015	1.04	1.77	0.59
2016	1.25	0.91	0.70
2017	0.67	1.45	0.65
2018	0.27	0.74	0.82
2019	0.66	0.98	0.68
2020	0.26	0.60	0.92
2021	3.55	0.61	0.60
2022	1.33	0.51	0.65
2023	0.47	0.55	0.72

Table 63. Observed (Obs) versus predicted (Exp) standardized SEAMAP Summer Trawl Pre-2007 West index and associated lognormal standard error (as estimated by the standardization process) for Gulf of America Red Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were converted to log-scale SEs.

Year	Summer Trawl Early (Obs)	Summer Trawl Early (Exp)	Summer Trawl Early (SE)
1984	0.75	0.33	0.47
1985	1.11	0.54	0.49
1986	0.29	0.54	0.61
1987	0.71	0.63	0.41
1988	0.35	0.33	0.44
1989	0.26	0.46	0.49
1990	2.26	0.99	0.35
1991	1.02	1.01	0.38
1992	0.64	0.77	0.39
1993	0.70	0.77	0.38
1994	1.35	1.11	0.37
1995	1.18	1.48	0.36
1996	1.31	1.31	0.36
1997	0.99	0.86	0.36
1998	0.89	0.70	0.38
1999	0.76	0.77	0.38
2000	1.39	1.14	0.35
2001	0.79	1.10	0.45
2002	1.09	0.75	0.36
2003	0.61	1.04	0.40
2004	1.33	1.05	0.35
2005	1.50	1.30	0.36
2006	1.42	2.09	0.34

Table 64. Observed (Obs) versus predicted (Exp) standardized SEAMAP Summer Trawl Post-2007 West index and associated lognormal standard error (as estimated by the standardization process) for Gulf of America Red Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were converted to log-scale SEs.

Year	Summer Trawl Late (Obs)	Summer Trawl Late (Exp)	Summer Trawl Late (SE)
2009	0.36	1.49	0.54
2010	0.86	1.19	0.53
2011	1.19	1.07	0.53
2012	0.82	1.72	0.52
2013	1.26	0.98	0.55
2014	0.77	1.07	0.54
2015	1.06	1.15	0.53
2016	0.87	1.00	0.53
2017	0.84	0.91	0.54
2018	1.62	1.00	0.52
2019	1.11	0.98	0.54
2021	0.70	0.52	0.58
2022	0.88	0.49	0.56
2023	1.66	0.39	0.55

Table 65. Observed (Obs) versus predicted (Exp) standardized SEAMAP Summer Trawl Post-2007 Central index and associated lognormal standard error (as estimated by the standardization process) for Gulf of America Red Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were converted to log-scale SEs.

Year	Summer Trawl Late (Obs)	Summer Trawl Late (Exp)	Summer Trawl Late (SE)
2009	0.47	0.85	0.41
2010	1.05	1.01	0.45
2011	0.56	0.81	0.55
2012	1.10	0.88	0.45
2013	1.35	0.64	0.51
2014	0.54	1.21	0.52
2015	0.88	1.95	0.50
2016	1.08	1.44	0.45
2017	1.66	1.01	0.39
2018	1.45	0.86	0.47
2019	0.77	0.96	0.52
2021	0.68	0.76	0.61
2022	0.94	0.71	0.54
2023	1.48	0.81	0.48

Table 66. Observed (Obs) versus predicted (Exp) standardized SEAMAP Summer Trawl Post-2007 East index and associated lognormal standard error (as estimated by the standardization process) for Gulf of America Red Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were converted to log-scale SEs.

Year	Summer Trawl Late (Obs)	Summer Trawl Late (Exp)	Summer Trawl Late (SE)
2009	0.11	0.66	0.95
2010	0.04	0.63	1.15
2011	1.15	0.58	0.65
2012	0.58	0.57	0.60
2013	0.16	0.44	0.95
2014	0.39	1.51	0.60
2015	3.41	2.53	0.51
2016	2.06	1.69	0.46
2017	1.51	1.14	0.53
2018	1.22	1.12	0.51
2019	0.53	0.85	0.68
2021	0.86	0.63	0.59
2022	1.06	0.52	0.60
2023	0.91	0.50	0.56

Table 67. Observed (Obs) versus predicted (Exp) standardized SEAMAP Larval Survey West index and associated lognormal standard error (as estimated by the standardization process) for Gulf of America Red Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were converted to log-scale SEs.

Year	Larval Survey (Obs)	Larval Survey (Exp)	Larval Survey (SE)
1986	0.17	0.38	0.73
1987	0.33	0.35	0.73
1989	0.47	0.33	0.72
1990	0.48	0.32	0.63
1991	0.20	0.32	0.80
1992	0.20	0.34	0.61
1993	0.24	0.37	0.61
1994	0.21	0.38	0.73
1995	0.68	0.38	0.49
1996	0.49	0.40	0.56
1997	0.70	0.43	0.48
1999	0.25	0.46	0.58
2000	0.87	0.46	0.47
2001	0.53	0.47	0.61
2002	0.62	0.49	0.50
2003	0.94	0.52	0.46
2004	0.52	0.55	0.51
2006	1.01	0.61	0.50
2007	0.78	0.66	0.45
2009	1.04	0.90	0.45
2010	0.41	1.06	0.58
2011	1.23	1.22	0.49
2012	1.39	1.40	0.45

Table 67 Continued. Observed (Obs) versus predicted (Exp) standardized SEAMAP Larval Survey West index and associated lognormal standard error (as estimated by the standardization process) for Gulf of America Red Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were converted to log-scale SEs.

Year	Larval Survey (Obs)	Larval Survey (Exp)	Larval Survey (SE)
1986	0.17	0.38	0.73
1987	0.33	0.35	0.73
1989	0.47	0.33	0.72
1990	0.48	0.32	0.63
1991	0.20	0.32	0.80
1992	0.20	0.34	0.61
1993	0.24	0.37	0.61
1994	0.21	0.38	0.73
1995	0.68	0.38	0.49
1996	0.49	0.40	0.56
1997	0.70	0.43	0.48
1999	0.25	0.46	0.58
2000	0.87	0.46	0.47
2001	0.53	0.47	0.61
2002	0.62	0.49	0.50
2003	0.94	0.52	0.46
2004	0.52	0.55	0.51
2006	1.01	0.61	0.50
2007	0.78	0.66	0.45
2009	1.04	0.90	0.45
2010	0.41	1.06	0.58
2011	1.23	1.22	0.49
2012	1.39	1.40	0.45

Table 68. Observed (Obs) versus predicted (Exp) standardized SEAMAP Larval Survey Central index and associated lognormal standard error (as estimated by the standardization process) for Gulf of America Red Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were converted to log-scale SEs.

Year	Larval Survey (Obs)	Larval Survey (Exp)	Larval Survey (SE)
1991	0.11	0.22	1.09
1994	0.06	0.24	1.09
1995	0.06	0.21	1.09
1997	0.05	0.24	1.09
1999	0.33	0.34	0.78
2000	0.82	0.32	0.70
2001	0.25	0.36	0.77
2003	0.44	0.41	0.70
2004	0.12	0.42	1.09
2006	0.70	0.35	0.77
2007	0.88	0.43	0.61
2008	0.15	0.63	1.09
2009	0.61	0.97	0.78
2010	2.07	1.30	0.54
2011	0.75	1.53	0.78
2012	0.86	1.64	0.63
2013	0.97	1.72	0.65
2014	1.03	1.64	0.65
2015	0.15	1.68	1.09
2016	1.33	1.76	0.57
2017	3.75	1.86	0.42
2018	1.51	1.81	0.54
2019	3.70	1.80	0.45

Table 68 Continued. Observed (Obs) versus predicted (Exp) standardized SEAMAP Larval Survey Central index and associated lognormal standard error (as estimated by the standardization process) for Gulf of America Red Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were converted to log-scale SEs.

Year	Larval Survey (Obs)	Larval Survey (Exp)	Larval Survey (SE)
1991	0.11	0.22	1.09
1994	0.06	0.24	1.09
1995	0.06	0.21	1.09
1997	0.05	0.24	1.09
1999	0.33	0.34	0.78
2000	0.82	0.32	0.70
2001	0.25	0.36	0.77
2003	0.44	0.41	0.70
2004	0.12	0.42	1.09
2006	0.70	0.35	0.77
2007	0.88	0.43	0.61
2008	0.15	0.63	1.09
2009	0.61	0.97	0.78
2010	2.07	1.30	0.54
2011	0.75	1.53	0.78
2012	0.86	1.64	0.63
2013	0.97	1.72	0.65
2014	1.03	1.64	0.65
2015	0.15	1.68	1.09
2016	1.33	1.76	0.57
2017	3.75	1.86	0.42
2018	1.51	1.81	0.54
2019	3.70	1.80	0.45

Table 69. Observed (Obs) versus predicted (Exp) standardized Bottom Longline West index and associated lognormal standard error (as estimated by the standardization process) for Gulf of America Red Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were converted to log-scale SEs.

Year	Bottom Longline (Obs)	Bottom Longline (Exp)	Bottom Longline (SE)
2001	0.28	0.27	0.28
2002	0.22	0.29	0.25
2003	0.25	0.31	0.31
2004	0.30	0.32	0.31
2006	0.23	0.36	0.37
2007	0.25	0.39	0.37
2009	0.47	0.47	0.28
2010	0.23	0.54	0.47
2011	0.55	0.65	0.27
2012	1.06	0.80	0.30
2013	1.01	0.97	0.27
2014	0.72	1.12	0.33
2015	1.81	1.25	0.25
2016	1.51	1.38	0.24
2017	2.29	1.51	0.19
2018	1.32	1.62	0.25
2019	1.97	1.71	0.25
2021	1.86	1.77	0.25
2022	1.65	1.78	0.28
2023	2.00	1.77	0.22

Table 70. Observed (Obs) versus predicted (Exp) standardized Bottom Longline Central index and associated lognormal standard error (as estimated by the standardization process) for Gulf of America Red Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were converted to log-scale SEs.

Year	Bottom Longline (Obs)	Bottom Longline (Exp)	Bottom Longline (SE)
2001	0.17	0.22	0.80
2002	0.12	0.23	0.80
2003	0.27	0.23	0.69
2004	0.11	0.21	0.99
2005	0.09	0.21	0.99
2006	0.16	0.24	1.00
2009	0.37	0.50	0.70
2010	1.32	0.73	0.51
2011	2.16	1.07	0.36
2012	1.17	1.45	0.69
2013	0.53	1.71	0.70
2014	2.20	1.80	0.48
2015	2.48	1.83	0.44
2016	2.69	1.78	0.47
2017	0.70	1.64	0.62
2018	1.22	1.52	0.57
2019	1.97	1.48	0.61
2021	0.85	1.50	0.80
2022	1.27	1.43	0.69
2023	0.15	1.31	0.99

Table 71. Observed (Obs) versus predicted (Exp) standardized Bottom Longline East index and associated lognormal standard error (as estimated by the standardization process) for Gulf of America Red Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were converted to log-scale SEs.

Year	Bottom Longline (Obs)	Bottom Longline (Exp)	Bottom Longline (SE)
2001	0.10	0.06	1.07
2003	0.34	0.10	0.87
2004	0.55	0.16	0.76
2005	0.41	0.18	1.07
2006	0.20	0.20	1.07
2007	1.36	0.26	0.86
2009	0.92	0.66	0.69
2010	1.45	1.01	0.63
2011	1.45	1.19	0.51
2012	0.39	1.19	0.86
2013	2.32	1.23	1.07
2014	0.28	1.28	1.07
2016	1.36	1.43	0.75
2017	0.51	1.68	0.86
2018	0.42	2.26	0.87
2019	0.75	2.61	0.86
2020	2.11	2.57	0.66
2021	0.63	2.42	0.86
2022	2.14	2.16	0.87
2023	2.30	1.79	0.68

Table 72. Observed (Obs) versus predicted (Exp) standardized G-FISHER Video Survey Central index and associated lognormal standard error (as estimated by the standardization process) for Gulf of America Red Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were converted to log-scale SEs.

Year	Combined Video (Obs)	Combined Video (Exp)	Combined Video (SE)
1993	0.10	0.28	0.86
1994	0.09	0.24	0.95
1995	0.01	0.22	1.20
1996	0.05	0.23	1.01
1997	0.22	0.33	0.65
2002	0.36	0.66	0.53
2004	1.25	0.50	0.52
2005	0.73	0.43	0.45
2006	1.41	0.48	0.52
2007	1.56	0.82	0.59
2008	1.33	1.38	0.46
2009	1.94	1.95	0.45
2010	1.37	1.84	0.42
2011	1.35	1.60	0.42
2012	0.79	1.38	0.44
2013	0.69	1.19	0.44
2014	0.69	1.09	0.42
2015	0.74	0.98	0.43
2016	1.46	1.31	0.38
2017	1.47	1.52	0.38
2018	1.24	1.44	0.42
2019	1.25	1.22	0.38
2020	1.47	1.08	0.44

Table 73. Observed (Obs) versus predicted (Exp) standardized G-FISHER Video Survey West index and associated lognormal standard error (as estimated by the standardization process) for Gulf of America Red Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were converted to log-scale SEs.

Year	Combined Video (Obs)	Combined Video (Exp)	Combined Video (SE)
1993	0.05	0.32	0.76
1994	0.13	0.31	0.65
1995	0.19	0.29	0.64
1996	0.26	0.32	0.47
1997	0.64	0.41	0.47
2002	0.56	0.39	0.50
2004	0.45	0.43	0.57
2005	0.42	0.44	0.47
2006	0.18	0.46	0.51
2007	0.49	0.53	0.46
2008	0.34	0.76	0.48
2009	0.55	0.98	0.46
2010	1.04	1.18	0.48
2011	0.85	1.12	0.48
2012	0.92	1.31	0.44
2013	1.16	1.32	0.46
2014	1.65	1.36	0.46
2015	1.40	1.53	0.53
2016	1.29	1.40	0.44
2017	2.33	1.35	0.43
2018	2.86	1.31	0.43
2019	1.75	1.23	0.42
2021	1.92	1.16	0.41

Table 74. Observed (Obs) versus predicted (Exp) standardized G-FISHER Video Survey East index and associated lognormal standard error (as estimated by the standardization process) for Gulf of America Red Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were converted to log-scale SEs.

Year	Combined Video (Obs)	Combined Video (Exp)	Combined Video (SE)
2010	0.48	0.66	0.44
2011	0.58	0.66	0.33
2012	0.44	0.56	0.33
2013	0.83	0.64	0.34
2014	0.54	0.58	0.28
2015	1.30	0.67	0.41
2016	2.55	1.57	0.26
2017	1.81	1.45	0.27
2018	1.51	1.27	0.30
2019	1.17	1.25	0.29
2020	0.74	1.06	0.26
2021	0.66	1.02	0.27
2022	0.66	0.82	0.29
2023	0.72	0.62	0.28

Table 75. Observed (Obs) versus predicted (Exp) standardized fishery-dependent catch-per-unit-effort (CPUE) indices for Eastern Gulf of America Red Snapper . Values are normalized to the mean. CVs estimated by the standardization process were converted to log-scale SEs.

Yr	HL (Obs)	HL (Exp)	HL (SE)
2007	0.32	0.18	0.35
2008	0.39	0.29	0.34
2009	0.67	0.52	0.35
2010	0.68	0.82	0.30
2011	0.70	0.91	0.28
2012	0.57	0.80	0.26
2013	0.61	0.76	0.29
2014	0.68	0.78	0.32
2015	0.74	0.86	0.39
2016	1.66	0.90	0.29
2017	1.22	1.18	0.48
2018	1.43	1.79	0.34
2019	0.94	2.03	0.41
2020	1.53	1.77	0.34
2021	1.68	1.46	0.32
2022	1.96	1.35	0.30
2023	1.20	1.15	0.30

Table 76. Summary of correlated parameters with correlation coefficients > 0.7 for Gulf of America Red Snapper from the SEDAR 98 base model.

Parameter 1	Parameter 2	Correlation
RecrDist_GP_1_area_1_month_6_DEVrwalk_2009	RecrDist_GP_1_area_1_month_6_DEVrwalk_2008	-0.961
RecrDist_GP_2_area_2_month_6_DEVrwalk_2009	RecrDist_GP_2_area_2_month_6_DEVrwalk_2008	-0.949
Age_DblN_descend_se_COMMOBS_E(27)	Age_DblN_peak_COMMOBS_E(27)	-0.940
Size_DblN_descend_se_PRIV_W(18)_BLK9repl_2007	Size_DblN_peak_PRIV_W(18)_BLK9repl_2007	-0.909
RecrDist_GP_2_area_2_month_6_DEVrwalk_2014	RecrDist_GP_2_area_2_month_6_DEVrwalk_2013	-0.896
Age_DblN_descend_se_COMMOBS_E(27)	Age_DblN_ascend_se_COMMOBS_E(27)	-0.872
Size_DblN_descend_se_CBT_W(13)_BLK9repl_2007	Size_DblN_peak_CBT_W(13)_BLK9repl_2007	-0.864
AgeSel_P7_FALLLATE_W(23)	AgeSel_P6_FALLLATE_W(23)	-0.857
Early_RecrDev_1979	Early_RecrDev_1978	-0.857
RecrDist_GP_1_area_1_month_6_DEVrwalk_2014	RecrDist_GP_1_area_1_month_6_DEVrwalk_2013	-0.856
RecrDist_GP_1_area_1_month_6_DEVrwalk_2011	RecrDist_GP_1_area_1_month_6_DEVrwalk_2010	-0.842
RecrDist_GP_2_area_2_month_6_DEVrwalk_1986	RecrDist_GP_2_area_2_month_6_DEVrwalk_1985	-0.830
Size_DblN_descend_se_HBT_W(15)_BLK9repl_2007	Size_DblN_peak_HBT_W(15)_BLK9repl_2007	-0.829
RecrDist_GP_2_area_2_month_6_DEVrwalk_2011	RecrDist_GP_2_area_2_month_6_DEVrwalk_2010	-0.816
RecrDist_GP_2_area_2_month_6_DEVrwalk_2007	RecrDist_GP_2_area_2_month_6_DEVrwalk_2006	-0.807
RecrDist_GP_1_area_1_month_6_DEVrwalk_2007	RecrDist_GP_1_area_1_month_6_DEVrwalk_2006	-0.805
RecrDist_GP_2_area_2_month_6_DEVrwalk_2002	RecrDist_GP_2_area_2_month_6_DEVrwalk_2001	-0.799
AgeSel_P4_SUMLATE_W(40)	AgeSel_P3_SUMLATE_W(40)	-0.796

Table 76 Continued. Summary of correlated parameters with correlation coefficients > 0.7 for Gulf of America Red Snapper from the SEDAR 98 base model.

Parameter 1	Parameter 2	Correlation
AgeSel_P5_FALLLATE_W(23)	AgeSel_P4_FALLLATE_W(23)	-0.778
Size_DblN_descend_se_PRIV_C(19)_BLK9repl_1993	Size_DblN_peak_PRIV_C(19)_BLK9repl_1993	-0.775
RecrDist_GP_1_area_1_month_6_DEVrwalk_2002	RecrDist_GP_1_area_1_month_6_DEVrwalk_2001	-0.774
Age_DblN_descend_se_GFISHER_E(5)	Age_DblN_top_logit_GFISHER_E(5)	-0.762
Size_DblN_descend_se_PRIV_C(19)_BLK9repl_2007	Size_DblN_peak_PRIV_C(19)_BLK9repl_2007	-0.758
RecrDist_GP_2_area_2_month_6_DEVrwalk_2005	RecrDist_GP_2_area_2_month_6_DEVrwalk_2004	-0.751
Size_DblN_descend_se_HL_E(3)	InitF_seas_1_flt_3HL_E	-0.749
AgeSel_P3_SUMLATE_C(41)	LnQ_base_SUMLATE_C(41)	-0.748
RecrDist_GP_1_area_1_month_6_DEVrwalk_2005	RecrDist_GP_1_area_1_month_6_DEVrwalk_2004	-0.738
Size_DblN_descend_se_HL_W(1)_BLK7repl_2007	Size_DblN_peak_HL_W(1)_BLK7repl_2007	-0.738
AgeSel_P5_SUMLATE_W(40)	AgeSel_P4_SUMLATE_W(40)	-0.735
AgeSel_P6_FALLLATE_E(25)	AgeSel_P5_FALLLATE_E(25)	-0.732
RecrDist_GP_2_area_2_month_6_DEVrwalk_2018	RecrDist_GP_2_area_2_month_6_DEVrwalk_2017	-0.732
Size_DblN_descend_se_PRIV_W(18)_BLK9repl_1993	Size_DblN_peak_PRIV_W(18)_BLK9repl_1993	-0.730
RecrDist_GP_1_area_1_month_6_DEVrwalk_2019	RecrDist_GP_1_area_1_month_6_DEVrwalk_2018	-0.728
AgeSel_P3_FALLLATE_C(24)	AgeSel_P2_FALLLATE_C(24)	-0.727
RecrDist_GP_2_area_2_month_6_DEVrwalk_1999	RecrDist_GP_2_area_2_month_6_DEVrwalk_1998	-0.725
ln(DM_theta)_Len_P7	Size_DblN_descend_se_FALLEARLY_W(26)	-0.706

Table 76 Continued. Summary of correlated parameters with correlation coefficients > 0.7 for Gulf of America Red Snapper from the SEDAR 98 base model.

Parameter 1	Parameter 2	Correlation
RecrDist_GP_1_area_1_month_6_DEVrwalk_1986	RecrDist_GP_1_area_1_month_6_DEVrwalk_1985	-0.701
RecrDist_GP_2_area_2_month_6_DEVrwalk_2004	RecrDist_GP_2_area_2_month_6_DEVrwalk_2003	-0.701
AgeSel_P2_SUMLATE_C(41)	LnQ_base_SUMLATE_C(41)	0.718
Age_95%width_BLL_E(11)	Age_inflection_BLL_E(11)	0.731
Size_DblN_ascend_se_HBT_W(15)	Size_DblN_peak_HBT_W(15)	0.756
Size_DblN_ascend_se_HBT_C(16)_BLK9repl_1993	Size_DblN_peak_HBT_C(16)_BLK9repl_1993	0.764
Size_DblN_ascend_se_HL_E(3)	Size_DblN_peak_HL_E(3)	0.790
Age_95%width_BLL_W(9)	Age_inflection_BLL_W(9)	0.814
Retain_L_asymptote_logit_LL_E(7)_BLK5repl_2007	Retain_L_width_LL_E(7)_BLK1repl_2008	0.818
Size_DblN_ascend_se_HBT_C(16)	Size_DblN_peak_HBT_C(16)	0.849
Size_DblN_ascend_se_PRIV_C(19)	Size_DblN_peak_PRIV_C(19)	0.849
Size_DblN_ascend_se_PRIV_C(19)_BLK9repl_2007	Size_DblN_peak_PRIV_C(19)_BLK9repl_2007	0.851
Size_95%width_LL_W(6)	Size_inflection_LL_W(6)	0.857
Size_DblN_ascend_se_HBT_C(16)_BLK9repl_2007	Size_DblN_peak_HBT_C(16)_BLK9repl_2007	0.862
Size_DblN_ascend_se_CBT_C(12)_BLK9repl_2007	Size_DblN_peak_CBT_C(12)_BLK9repl_2007	0.869
Size_DblN_ascend_se_HBT_Clsd_E(39)	Size_DblN_peak_HBT_Clsd_E(39)	0.870
Size_DblN_ascend_se_HL_C(2)_BLK7repl_2007	Size_DblN_peak_HL_C(2)_BLK7repl_2007	0.882
Age_95%width_BLL_C(10)	Age_inflection_BLL_C(10)	0.885

Table 76 Continued. Summary of correlated parameters with correlation coefficients > 0.7 for Gulf of America Red Snapper from the SEDAR 98 base model.

Parameter 1	Parameter 2	Correlation
Size_DblN_ascend_se_HBT_Clsd_W(37)	Size_DblN_peak_HBT_Clsd_W(37)	0.886
Size_DblN_ascend_se_HBT_W(15)_BLK9repl_2007	Size_DblN_peak_HBT_W(15)_BLK9repl_2007	0.889
Size_DblN_ascend_se_SUMEARLY_W(43)	Size_DblN_peak_SUMEARLY_W(43)	0.891
Size_DblN_ascend_se_CBT_C(12)	Size_DblN_peak_CBT_C(12)	0.905
Size_DblN_ascend_se_CBT_C(12)_BLK9repl_1993	Size_DblN_peak_CBT_C(12)_BLK9repl_1993	0.915
Size_DblN_ascend_se_HL_W(1)_BLK7repl_2007	Size_DblN_peak_HL_W(1)_BLK7repl_2007	0.915
Size_DblN_ascend_se_HL_E(3)_BLK7repl_2007	Size_DblN_peak_HL_E(3)_BLK7repl_2007	0.922
Size_DblN_ascend_se_CBT_W(13)	Size_DblN_peak_CBT_W(13)	0.924
Size_DblN_ascend_se_HL_C(2)	Size_DblN_peak_HL_C(2)	0.924
Age_DblN_ascend_se_GFISHER_W(44)	Age_DblN_peak_GFISHER_W(44)	0.935
Age_DblN_ascend_se_GFISHER_C(4)	Age_DblN_peak_GFISHER_C(4)	0.940
Age_DblN_ascend_se_COMMOBS_E(27)	Age_DblN_peak_COMMOBS_E(27)	0.959
Age_DblN_ascend_se_GFISHER_E(5)	Age_DblN_peak_GFISHER_E(5)	0.960
Size_DblN_ascend_se_PRIV_C(19)_BLK9repl_1993	Size_DblN_peak_PRIV_C(19)_BLK9repl_1993	0.962
Size_DblN_ascend_se_HL_W(1)	Size_DblN_peak_HL_W(1)	0.982
Size_DblN_ascend_se_FALLEARLY_W(26)	Size_DblN_peak_FALLEARLY_W(26)	0.991

Table 77. Summary of correlated parameters with correlation coefficients > 0.95 for Gulf of America Red Snapper from the SEDAR 98 base model.

Parameter 1	Parameter 2	Correlation
RecrDist_GP_1_area_1_month_6_DEVrwalk_2009	RecrDist_GP_1_area_1_month_6_DEVrwalk_2008	-0.961
Age_DblN_ascend_se_COMMOBS_E(27)	Age_DblN_peak_COMMOBS_E(27)	0.959
Age_DblN_ascend_se_GFISHER_E(5)	Age_DblN_peak_GFISHER_E(5)	0.960
Size_DblN_ascend_se_PRIV_C(19)_BLK9repl_1993	Size_DblN_peak_PRIV_C(19)_BLK9repl_1993	0.962
Size_DblN_ascend_se_HL_W(1)	Size_DblN_peak_HL_W(1)	0.982
Size_DblN_ascend_se_FALLEARLY_W(26)	Size_DblN_peak_FALLEARLY_W(26)	0.991

Table 78. Runs tests summary statistics for the Gulf of America Red Snapper SEDAR 98 Base 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.

Data Source	Statistic	Value
CPUE		
GFISHER_C	p-value	0.001
GFISHER_E	p-value	0.145
BLL_W	p-value	0.189
BLL_C	p-value	0.288
BLL_E	p-value	0.003
LARVAL_C	p-value	0.408
LARVAL_W	p-value	0.192
FALLLATE_W	p-value	0.162
FALLLATE_C	p-value	0.162
FALLLATE_E	p-value	0.455
FALLEARLY_W	p-value	0.695
COMMOBS_E	p-value	0.012
Shr_W	p-value	0.002
Shr_C	p-value	0.004
Shr_E	p-value	0.001
SUMLATE_W	p-value	0.133
SUMLATE_C	p-value	0.500
SUMLATE_E	p-value	0.192
SUMEARLY_W	p-value	0.849
GFISHER_W	p-value	0.001
Age		
GFISHER_C	p-value	0.022
GFISHER_E	p-value	0.145

Data Source	Statistic	Value
BLL_W	p-value	0.175
BLL_C	p-value	0.026
BLL_E	p-value	0.355
FALLLATE_W	p-value	0.530
FALLLATE_C	p-value	0.323
FALLLATE_E	p-value	0.968
COMMOBS_E	p-value	0.104
GFISHER_W	p-value	0.454
Length		
HL_W	p-value	0.003
HL_C	p-value	0.313
HL_E	p-value	0.035
LL_W	p-value	0.040
LL_E	p-value	0.000
CBT_C	p-value	0.000
CBT_W	p-value	0.051
CBT_E	p-value	0.872
HBT_W	p-value	0.081
HBT_C	p-value	0.218
HBT_E	p-value	0.500
PRIV_W	p-value	0.000
PRIV_C	p-value	0.009
PRIV_E	p-value	0.024
FALLEARLY_W	p-value	0.805

Table 79. Summary of key model building steps towards the SEDAR 98 Base Model for Gulf of America Red Snapper and associated convergence diagnostics. Note that steps within each model progression are not shown due to the vast number of intermediate runs conducted.

Model Name	NLL	Gradient	Bounded Parms	Ln(R0)
S52_Base	3,295	2e-04	0	12.08
S98_2area_continuity_Model	3,164	8e-04	0	12.01
S98_3area_Continuity_Model	3,994	7e-04	10	12.14
S98_3area_Update_all_data	60,268	2.458e-01	7	12.55
Update_StartYear_1950	57,825	1.64e-02	12	12.27
Update_recruitment	57,824	2.298e-01	6	12.63
Add_CAAL_MLAA	94,478	1.09e-02	7	12.71
Update_F	94,431	6.3e-03	7	13.32
Update_remaining_DW	94,069	2.287e+02	13	13.13
Update_Biology	94,388	2.84e-02	10	12.46
Update_Selex_Ret	90,279	7.01e-02	3	11.62
Update_Discard_Mortality	90,362	5.89e-02	3	11.64

Table 79 Continued. Summary of key model building steps towards the SEDAR 98 Base Model for Gulf of America Red Snapper and associated key estimates and derived quantities (note that steepness and sigmaR were fixed at 0.8 and 0.7, respectively, across all runs). Steps within each model progression are not shown due to the vast number of intermediate runs conducted.

Model Name	Virgin SSB (mt)	Virgin Recr (1000s)	Gulf Depletion Start Yr	Gulf Depletion End Yr	West Depletion Start Yr	West Depletion End Yr
S52_Base	5,114,370,000,000	177,023	0.62	0.20	0.56	0.31
S98_2area_continuity_Model	4,764,620,000,000	164,917	0.70	0.25	0.64	0.32
S98_3area_Continuity_Model	5,397,820,000,000	186,834	0.69	0.22	0.63	0.19
S98_3area_Update_all_data	8,115,150,000,000	280,889	0.50	0.19	0.47	0.24
Update_StartYear_1950	6,137,490,000,000	212,436	0.70	0.28	0.74	0.33
Update_recruitment	8,797,160,000,000	304,495	0.81	0.20	0.83	0.26
Add_CAAL_MLAA	9,524,480,000,000	329,670	0.83	0.23	0.86	0.25
Update_F	17,517,700,000,000	606,340	0.15	0.34	0.10	0.30
Update_remaining_DW	14,591,600,000,000	505,059	0.29	0.28	0.16	0.21
Update_Biology	12,743,800,000,000	257,575	0.48	0.31	0.38	0.36
Update_Selex_Ret	5,531,730,000,000	111,806	0.35	0.47	0.27	0.61

Model Name	Virgin SSB (mt)	Virgin Recr (1000s)	Gulf Depletion Start Yr	Gulf Depletion End Yr	West Depletion Start Yr	West Depletion End Yr
Update_Discard_Mortality	5,594,650,000,000	113,077	0.34	0.46	0.26	0.57

Table 79 Continued. Summary of key model building steps towards the SEDAR 98 Base Model for Gulf of America Red Snapper and associated key estimates and derived quantities (note that steepness and sigmaR were fixed at 0.8 and 0.7, respectively, across all runs). Steps within each model progression are not shown due to the vast number of intermediate runs conducted.

Model Name	Central Depletion Start Yr	Central Depletion End Yr	East Depletion Start Yr	East Depletion End Yr
S52_Base			0.36	0.07
S98_2area_continuity_Model			0.43	0.11
S98_3area_Continuity_Model	0.35	0.36	0.38	0.06
S98_3area_Update_all_data	0.36	0.11	0.27	0.03
Update_StartYear_1950	0.57	0.18	0.64	0.08
Update_recruitment	0.77	0.08	0.75	0.07
Add_CAAL_MLAA	0.72	0.28	0.84	0.04
Update_F	0.20	0.62	0.43	0.04
Update_remaining_DW	0.74	0.61	0.30	0.04
Update_Biology	0.77	0.28	0.42	0.03
Update_Selex_Ret	0.56	0.17	0.30	0.12
Update_Discard_Mortality	0.57	0.24	0.30	0.16

Table 80. Summary of sensitivity runs conducted for the Gulf of America Red Snapper SEDAR 98 Base Model. Gray shading groups similar runs together and NLL = negative log-likelihood.

Description	NLL	Gradient	Estimated Parameters (Bounded)	CV>1	ln(R0)
SEDAR Base Model	90,436.8	0.0168	1964 (0)	0	11.653
Catch_CV					
DW_CVs_Post1990	92,944.2	0.4049	1875 (0)	76	11.655
FES_Update					
DW_CV_22__reduction	90,399.0	0.0109	1875 (0)	78	11.608
DW_CV_40__reduction	90,399.8	0.0850	1875 (0)	86	11.566
Tight_CV_22_reduction	90,399.0	0.0589	1874 (0)	78	11.608
Tight_CV_40_reduction	90,409.9	0.0337	1874 (0)	85	11.568
GFISHER					
LengthComp	91,937.5	0.0902	1883 (0)	74	11.693
LengthComp_Logistic	92,042.2	0.0646	1871 (0)	72	11.640
Logistic	90,614.6	0.0383	1865 (0)	76	11.568
No_West	90,117.3	0.0181	1874 (0)	79	11.627
Growth_M_base					
Est_3VB_NoPrior	83,739.1	0.1868	1883 (0)	77	11.469
Est_3VB_Priors	84,484.6	0.4146	1883 (0)	81	11.449
Est_Growth_CV_Priors	87,275.9	0.0064	1880 (0)	55	12.290
Est_k_Linf_Priors	88,381.8	0.4301	1880 (0)	0	11.311
Growth_M_scaled_internally					
Est_3VB_NoPrior	83,808.9	0.3395	1884 (0)	60	10.130
Est_3VB_Priors	84,632.3	0.0721	1884 (0)	0	10.085
Est_Growth_CV_Priors	87,416.3	0.0365	1880 (0)	54	11.508
Est_K_Linf_Priors	87,978.7	0.6755	1880 (0)	66	10.505
GRSC					

Description	NLL	Gradient	Estimated Parameters (Bounded)	CV>1	ln(R0)
EstQ_allDome	91,061.4	0.0931	1895 (0)	73	11.667
EstQ_allLogistic	91,055.7	0.0675	1892 (0)	73	11.670
EstQ_EastLogistic_RestDome	91,058.1	0.0402	1894 (0)	73	11.668
FixQ_allDome	91,093.2	0.0545	1892 (0)	72	11.729
FixQ_allLogistic	91,079.4	0.0951	1889 (0)	71	11.710
FixQ_EastLogistic_RestDome	91,099.9	0.9989	1891 (0)	73	11.736
Hamel_Cope					
HC_int_scaled	89,693.4	0.0204	1874 (0)	85	10.520
HC_modified	90,358.6	0.0905	1874 (0)	70	11.558
HC_vector	89,667.1	0.0436	1874 (0)	80	10.335
Scale_M					
Fix_ref_M	89,671.2	0.0079	1874 (0)	76	10.268

Table 80 Continued. Summary of sensitivity runs conducted for the Gulf of America Red Snapper SEDAR 98 Base Model. Gray shading groups similar runs together, mt = metric tons, and Recr = recruitment.

Description	Linf	Virgin SSB	Virgin Rec (1,000s)	Depletion Start Yr	Depletion End Yr
SEDAR Base Model	85.26	3.92219e+05	1.15025e+05	0.693	0.477
Catch_CV					
DW_CVs_Post1990	85.26	3.92773e+05	1.15216e+05	0.689	0.445
FES_Update					
DW_CV_22__reduction	85.26	3.74782e+05	1.10011e+05	0.683	0.502
DW_CV_40__reduction	85.26	3.58912e+05	1.05421e+05	0.674	0.529
Tight_CV_22_reduction	85.26	3.74782e+05	1.10011e+05	0.683	0.502
Tight_CV_40_reduction	85.26	3.59823e+05	1.05693e+05	0.674	0.528
GFISHER					
LengthComp	85.26	4.08203e+05	1.19742e+05	0.697	0.467
LengthComp_Logistic	85.26	3.87372e+05	1.13515e+05	0.688	0.417
Logistic	85.26	3.60563e+05	1.05627e+05	0.678	0.392
No_West	85.26	3.82408e+05	1.12136e+05	0.690	0.451
Growth_M_base					
Est_3VB_NoPrior	84.35	3.75482e+05	9.57418e+04	0.662	0.084
Est_3VB_Priors	87.11	3.53134e+05	9.37735e+04	0.651	0.070
Est_Growth_CV_Priors	85.26	8.82803e+05	2.17571e+05	0.852	0.864
Est_k_Linf_Priors	87.02	1.07369e-311	1.07369e-311	0.000	0.000
Growth_M_scaled_internally					
Est_3VB_NoPrior	84.91	5.72450e+05	2.50741e+04	0.688	0.061
Est_3VB_Priors	87.43	5.50542e+05	2.39736e+04	0.672	0.044
Est_Growth_CV_Priors	85.26	2.66176e+06	9.95226e+04	0.842	0.872
Est_K_Linf_Priors	86.49	9.26792e+05	3.65103e+04	0.705	0.386
GRSC					

Description	Linf	Virgin SSB	Virgin Rec (1,000s)	Depletion Start Yr	Depletion End Yr
EstQ_allDome	85.26	3.97772e+05	1.16664e+05	0.694	0.464
EstQ_allLogistic	85.26	3.99021e+05	1.17025e+05	0.694	0.461
EstQ_EastLogistic_RestDome	85.26	3.98327e+05	1.16827e+05	0.694	0.463
FixQ_allDome	85.26	4.22846e+05	1.24102e+05	0.701	0.545
FixQ_allLogistic	85.26	4.14986e+05	1.21773e+05	0.698	0.523
FixQ_EastLogistic_RestDome	85.26	4.25782e+05	1.24965e+05	0.701	0.549
Hamel_Cope					
HC_int_scaled	85.26	5.88540e+05	3.70577e+04	0.651	0.395
HC_modified	85.26	4.22558e+05	1.04578e+05	0.646	0.397
HC_vector	85.26	7.16395e+05	3.07832e+04	0.751	0.305
Scale_M					
Fix_ref_M	85.26	6.65939e+05	2.88097e+04	0.531	0.313

Table 81. Settings used for Gulf of America Red Snapper projections.

Parameter	Value	Comment
Relative F	Average from 2021 - 2023	Average relative fishing mortality (apical F) over terminal three years of model
Selectivity	Average from 2021 - 2023	Fleet specific selectivity estimated in the terminal block of the model
Retention	Average from 2021 - 2023	Fleet specific retention estimated in the terminal block of the model
Recruitment (Benchmark)	79434	Beverton-Holt stock-recruitment relationship with a steepness of 1
Recruitment (OFL/ABC)	115024	Average recruitment over the last 3 years
Interim Landings (2024-2025)	2118.15 mt (Comm. HL West) 792.7 mt (Comm. HL Central) 342.84 mt (Comm. HL East) 52.82 mt (Comm. LL West) 207.45 mt (Comm. LL Central) 47.52 mt (Comm. LL East) 43.05 thousands of fish (CBT West) 361.64 thousands of fish (CBT Central) 49.63 thousands of fish (CBT East) 78.86 thousands of fish (HBT West) 33.72 thousands of fish (HBT Central) 9.39 thousands of fish (HBT East) 706.1 thousands of fish (PRIV West) 1222.02 thousands of fish (PRIV Central) 153.2 thousands of fish (PRIV East)	Final landings estimates provided for 2023; For 2024-2025, used 2023 values
Bycatch F	0 (HL West) 0 (HL Central) 0 (HL East) 0.0069 (PRIV West) 0.0968 (PRIV Central) 0.0968 (PRIV East) 0.0434 (Shrimp West) 0.049 (Shrimp Central) 0.2905 (Shrimp East) 2e-04 (HBT West) 0.0049 (HBT Central)	Average F 2020-2022

Parameter	Value	Comment
	0.0027 (HBT East)	
Allocation Ratio	51:49	Commercial: Recreational

Table 82. Summary of Magnuson-Stevens Reauthorization Act benchmarks and reference points for the SEDAR 98 Gulf of America Red Snapper assessment. Spawning Stock Biomass (SSB) is in metric tons, whereas F is a harvest rate (total biomass killed age 1+ / total biomass age 1+).

Criteria	Definition	Value
Base M	Target M for fully selected ages in the Lorenzen (2000) scaling	0.104
Steepness	Steepness of the Beverton-Holt stock-recruit relationship (fixed)	1
Unfished Recruitment (R0)	Unfished recruitment (1,000s)	115,024
Generation Time	Fecundity-weighted mean age	13.89
Unfished SSB (SSB0)	Unfished spawning stock biomass (metric tons)	392,260
	Mortality Rate Criteria	
FMSYproxy	Equilibrium F that achieves SPR26%	0.095
MFMT	FMSYproxy	0.095
Fcurrent	Geometric mean of the last 3 years of the assessment (F2021-2023), including shrimp bycatch fleet	0.078
Fcurrent/MFMT	Current stock status based on MFMT	0.821
	Biomass Criteria	
SSBMSYproxy	Equilibrium SSB at FSPR 26 %	101,987
MSST	0.5 * SSBSPR26%	50,994
SSBcurrent	SSB in 2023	141,621
SSBcurrent/SSBFMSYproxy	Current stock status based on SSBSPR26% (Equil)	1.39
SSBcurrent/MSST	Current stock status based on MSST	2.78
SSBcurrent/SSBunfished	SSB ratio in 2023	0.36

Table 83. Results of the OFL projections (fishing set at $F_{SPR26\%}$) for Gulf of America Red Snapper assuming recent mean recruitment (*r EndYr-9*-2023). Recruitment (R) is in 1000s of age-0 fish, F is a harvest rate (total biomass killed age 1+ / total biomass age 1+), SSB is in metric tons (males and females combined), and OFL is the overfishing limit in millions of pounds whole weight. Reference points include $F_{SPR26\%}$ = 0.095, $SSB_{FSPR26\%}$ = 101,987 metric tons, and $MSST_{FSPR26\%}$ = 50,994 metric tons which was calculated as (0.5) * $SSB_{FSPR26\%}$. SSBratio was calculated as annual SSB divided by SSB_0 where SSB_0 = 392218.6 metric tons.

Year	R	F	F/FMSY	SSB	SSB/ SSBFMSY	SSB/ MSST	SSB/SSB0	OFL
2026	79,435	0.092	0.97	118,999	1.167	2.334	0.296	25.115
2027	79,435	0.091	0.96	111,560	1.094	2.188	0.278	23.382
2028	79,435	0.090	0.95	104,869	1.028	2.057	0.261	21.932
2029	79,435	0.090	0.95	99,394	0.975	1.949	0.247	20.842
2030	79,435	0.091	0.96	94,503	0.927	1.853	0.235	19.976
2031	79,435	0.092	0.96	90,284	0.885	1.771	0.225	19.314
2032	79,435	0.093	0.98	86,693	0.850	1.700	0.216	18.820
2033	79,435	0.094	0.99	83,344	0.817	1.634	0.207	18.414
2034	79,435	0.096	1.01	80,511	0.789	1.579	0.200	18.122
2035	79,435	0.098	1.03	77,996	0.765	1.530	0.194	17.900
2036	79,435	0.099	1.04	75,750	0.743	1.485	0.188	17.731

Table 84. Time series of fishing mortality and SSB relative to associated biological reference points. SSB is in metric tons (males and females combined), whereas F is a harvest rate (total biomass killed age 1+ / total biomass age 1+). Reference points include $F_{SPR26\%}$ = 0.095, $SSB_{FSPR26\%}$ = 101,987 metric tons, and $MSST_{FSPR26\%}$ = 50,994 metric tons which was calculated as (0.5) * $SSB_{FSPR26\%}$. SSBratio was calculated as annual SSB divided by SSB_0 where SSB_0 = 392218.6 metric tons. Red indicates overfishing and/or overfished states if present.

Year	F	F/ FMSY proxy	SSB	SSB/ SSBFMSY proxy	SSB/ MSST	SSB/SSB0
1950	0.011	0.12	186,227	1.826	3.652	0.463
1951	0.012	0.13	185,822	1.822	3.644	0.462
1952	0.013	0.14	184,755	1.812	3.623	0.460
1953	0.013	0.14	182,532	1.790	3.580	0.454
1954	0.013	0.14	179,468	1.760	3.519	0.446
1955	0.014	0.15	175,689	1.723	3.445	0.437
1956	0.017	0.18	171,221	1.679	3.358	0.426
1957	0.017	0.18	165,851	1.626	3.252	0.413
1958	0.024	0.26	160,111	1.570	3.140	0.398
1959	0.026	0.27	152,999	1.500	3.000	0.381
1960	0.029	0.30	145,664	1.428	2.857	0.362
1961	0.031	0.33	137,891	1.352	2.704	0.343
1962	0.034	0.35	129,976	1.274	2.549	0.323
1963	0.034	0.36	122,092	1.197	2.394	0.304
1964	0.036	0.38	114,603	1.124	2.247	0.285
1965	0.038	0.40	107,310	1.052	2.104	0.267
1966	0.037	0.39	100,241	0.983	1.966	0.249
1967	0.043	0.46	93,794	0.920	1.839	0.233
1968	0.048	0.50	87,284	0.856	1.712	0.217
1969	0.047	0.49	80,990	0.794	1.588	0.201
1970	0.051	0.53	75,381	0.739	1.478	0.188
1971	0.059	0.62	70,077	0.687	1.374	0.174

Year	F	F/ FMSY proxy	SSB	SSB/ SSBFMSY proxy	SSB/ MSST	SSB/SSB0
1972	0.064	0.67	64,775	0.635	1.270	0.161
1973	0.073	0.77	59,633	0.585	1.169	0.148
1974	0.086	0.91	54,273	0.532	1.064	0.135
1975	0.093	0.98	48,566	0.476	0.952	0.121
1976	0.099	1.04	42,978	0.421	0.843	0.107
1977	0.096	1.01	37,766	0.370	0.741	0.094
1978	0.100	1.05	33,409	0.328	0.655	0.083
1979	0.089	0.94	30,160	0.296	0.591	0.075
1980	0.081	0.85	28,894	0.283	0.567	0.072
1981	0.143	1.51	29,182	0.286	0.572	0.073
1982	0.113	1.19	27,829	0.273	0.546	0.069
1983	0.198	2.09	26,829	0.263	0.526	0.067
1984	0.123	1.29	23,288	0.228	0.457	0.058
1985	0.137	1.44	21,404	0.210	0.420	0.053
1986	0.142	1.49	19,567	0.192	0.384	0.049

Table 84 Continued. Time series of fishing mortality and SSB relative to associated biological reference points. SSB is in metric tons (males and females combined), whereas F is a harvest rate (total biomass killed age 1+ / total biomass age 1+). Reference points include $F_{SPR26\%}$ = 0.095, $SSB_{FSPR26\%}$ = 101,987 metric tons, and $MSST_{FSPR26\%}$ = 50,994 metric tons which was calculated as (0.5) * $SSB_{FSPR26\%}$. SSBratio was calculated as annual SSB divided by SSB_0 where SSB_0 = 392218.6 metric tons. Red indicates overfishing and/or overfished states if present.

Year	F	F/ FMSY proxy	SSB	SSB/ SSBFMSY proxy	SSB/ MSST	SSB/SSB0
1987	0.115	1.21	17,916	0.176	0.351	0.045
1988	0.131	1.38	16,939	0.166	0.332	0.042
1989	0.130	1.37	15,686	0.154	0.308	0.039
1990	0.111	1.17	14,739	0.145	0.289	0.037
1991	0.130	1.37	14,954	0.147	0.293	0.037
1992	0.170	1.79	15,990	0.157	0.314	0.040
1993	0.250	2.63	16,837	0.165	0.330	0.042
1994	0.224	2.35	16,110	0.158	0.316	0.040
1995	0.199	2.09	15,679	0.154	0.307	0.039
1996	0.196	2.06	16,244	0.159	0.319	0.040
1997	0.219	2.30	17,858	0.175	0.350	0.044
1998	0.195	2.06	19,813	0.194	0.389	0.049
1999	0.261	2.75	21,758	0.213	0.427	0.054
2000	0.195	2.05	21,286	0.209	0.417	0.053
2001	0.189	1.99	22,291	0.219	0.437	0.055
2002	0.268	2.83	24,499	0.240	0.480	0.061
2003	0.211	2.22	25,073	0.246	0.492	0.062
2004	0.272	2.87	26,187	0.257	0.514	0.065
2005	0.195	2.06	25,189	0.247	0.494	0.063
2006	0.171	1.80	26,672	0.262	0.523	0.066
2007	0.131	1.38	31,140	0.305	0.611	0.077
2008	0.080	0.84	40,807	0.400	0.800	0.102

Year	F	F/ FMSY proxy	SSB	SSB/ SSBFMSY proxy	SSB/ MSST	SSB/SSB0
2009	0.087	0.92	55,963	0.549	1.097	0.139
2010	0.070	0.74	71,588	0.702	1.404	0.178
2011	0.085	0.90	85,072	0.834	1.668	0.212
2012	0.071	0.75	95,216	0.934	1.867	0.237
2013	0.093	0.98	105,285	1.032	2.065	0.262
2014	0.060	0.63	111,295	1.091	2.183	0.277
2015	0.058	0.61	120,445	1.181	2.362	0.300
2016	0.066	0.69	129,642	1.271	2.542	0.323
2017	0.095	1.00	138,943	1.362	2.725	0.346
2018	0.076	0.80	143,025	1.402	2.805	0.356
2019	0.087	0.92	146,973	1.441	2.882	0.366
2020	0.069	0.73	146,426	1.436	2.871	0.364
2021	0.074	0.78	147,271	1.444	2.888	0.366
2022	0.082	0.86	145,993	1.431	2.863	0.363
2023	0.078	0.82	141,621	1.389	2.777	0.352

Table 85. Results of projections at MSST (OY; directed F = `MSSTfrac` * Directed F at $F_{SPR26\%}$ (0.095)) for Gulf of America Red Snapper assuming recent mean recruitment (`r (EndYr-9)-`2023). Recruitment (R) is in 1000s of age-0 fish, F is a harvest rate (total biomass killed age 1+ / total biomass age 1+), SSB is in metric tons (males and females combined), and retained yield in millions of pounds whole weight. Reference points include $F_{SPR26\%}$ = 0.095, $SSB_{FSPR26\%}$ = 101,987 metric tons, and $MSST_{FSPR26\%}$ = 50,994 metric tons which was calculated as (0.5) * $SSB_{FSPR26\%}$. SSBratio was calculated as annual SSB divided by SSB_0 where SSB_0 = 392218.6 metric tons.

Year	R	F	F/FMSY	SSB	SSB/ SSBFMSY	SSB/ MSST	SSB/SSB0	ABC
2026	79,435	0.071	0.75	118,999	1.167	2.334	0.296	19.436
2027	79,435	0.071	0.75	114,270	1.120	2.241	0.284	18.687
2028	79,435	0.071	0.74	109,951	1.078	2.156	0.274	17.973
2029	79,435	0.071	0.74	106,555	1.045	2.090	0.265	17.411
2030	79,435	0.071	0.74	103,486	1.015	2.029	0.257	16.931
2031	79,435	0.071	0.74	100,885	0.989	1.978	0.251	16.550
2032	79,435	0.071	0.74	98,750	0.968	1.937	0.246	16.248
2033	79,435	0.071	0.75	96,720	0.948	1.897	0.241	15.963
2034	79,435	0.071	0.75	95,130	0.933	1.866	0.237	15.735
2035	79,435	0.071	0.75	93,789	0.920	1.839	0.233	15.537
2036	79,435	0.071	0.75	92,673	0.909	1.817	0.231	15.366

Table 99. Shrimp Trawl bycatch time series used in SEDAR 98 input as thousands of fish.

Year	Shrimp Trawl West	Shrimp Trawl Central	Shrimp Trawl East
1983	11664.20	861.42	174.81
1984	11094.80	1172.02	221.14
1985	12380.20	1087.54	234.46
1986	14318.60	1241.66	181.49
1987	16356.40	1387.34	229.63
1988	15074.90	1260.97	182.61
1989	14586.00	1287.58	185.50
1990	14562.60	1441.69	198.25
1991	14347.10	1292.18	157.28
1992	15164.10	1410.09	159.53
1993	15363.60	1133.61	158.78
1994	11276.20	397.46	207.43
1995	9863.33	373.28	257.75
1996	11272.60	579.14	288.30
1997	13251.10	792.87	258.45
1998	22193.40	1618.65	361.23
1999	21650.10	1633.38	242.21
2000	21070.00	1367.94	195.23
2001	15592.40	1539.98	225.59
2002	18822.60	1564.85	147.52
2003	14157.80	1263.12	127.37
2004	12714.20	942.86	119.48
2005	10298.80	587.79	85.80

Table 99 Continued. Shrimp Trawl bycatch time series used in SEDAR 98 input as thousands of fish.

Year	Shrimp Trawl West	Shrimp Trawl Central	Shrimp Trawl East
2006	9114.18	518.09	65.28
2007	10312.60	238.02	147.10
2008	7790.72	442.84	72.78
2009	11080.60	521.57	111.79
2010	6138.58	260.35	53.79
2011	9400.46	233.00	68.89
2012	7629.64	203.43	66.73
2013	4040.86	796.41	41.01
2014	9446.94	1021.71	100.53
2015	9477.17	663.24	178.94
2016	9009.69	519.43	183.61
2017	8669.01	531.61	213.36
2018	8067.89	587.00	267.19
2019	7117.81	491.85	232.38
2020	6617.45	674.81	233.70
2021	7725.85	566.37	223.16
2022	4867.10	386.73	195.03
2023	4648.86	424.47	112.17

Figures

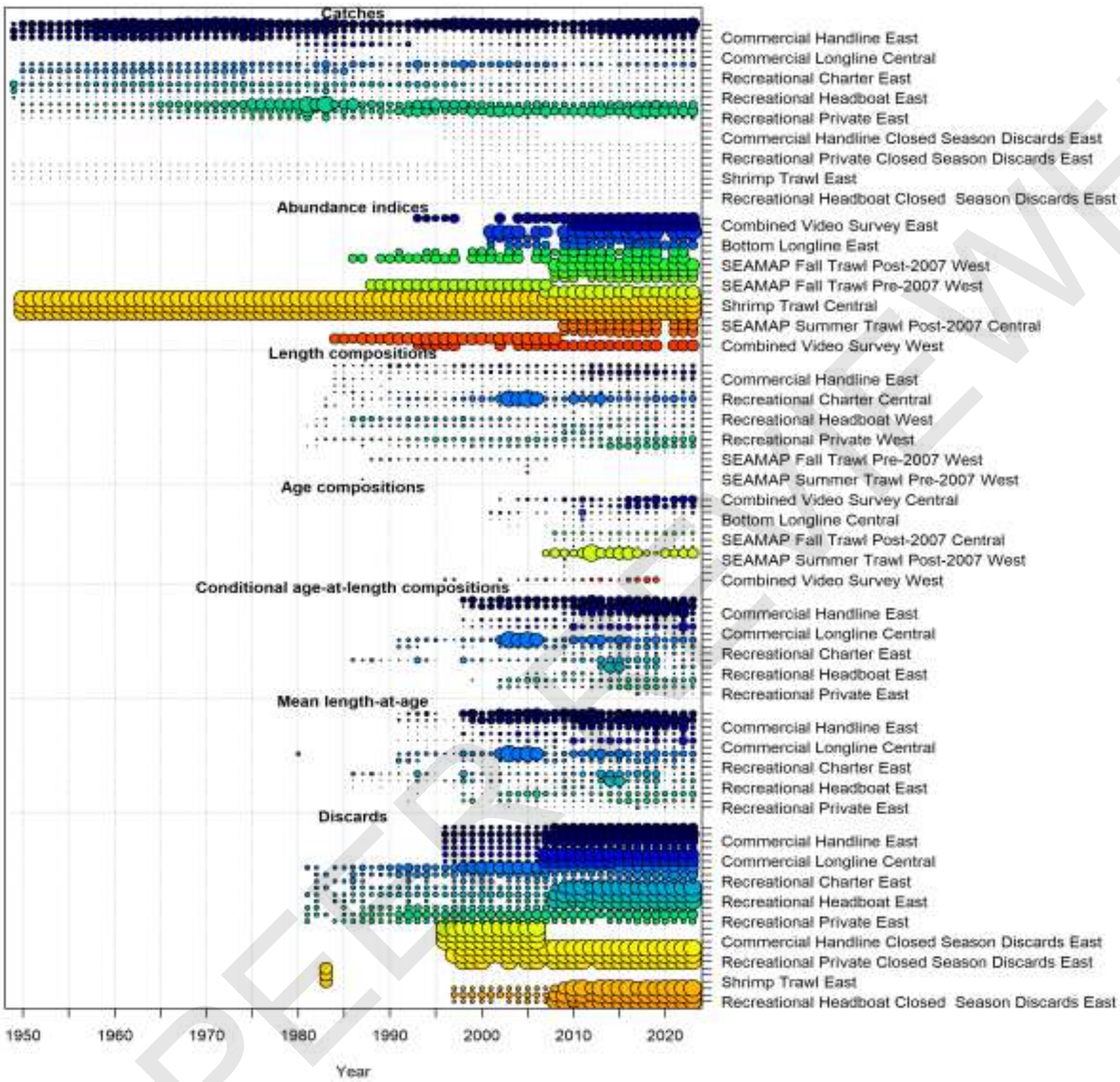


Figure 1. Data sources used in the Gulf of America Red Snapper Stock Synthesis assessment model. Circle area is relative within a data type. Circles are proportional to total catch for catches; to precision for indices, discards, and mean body weight observations; and to total sample size for compositions and mean weight- or length-at-age observations. Note that since the circles are scaled relative to maximum within each type, the scaling between separate data types should not be compared. Due to the number of data sources used in this assessment some labels may be missing. See section 2 (Data Review and Update) for complete list of data sources and time frames.

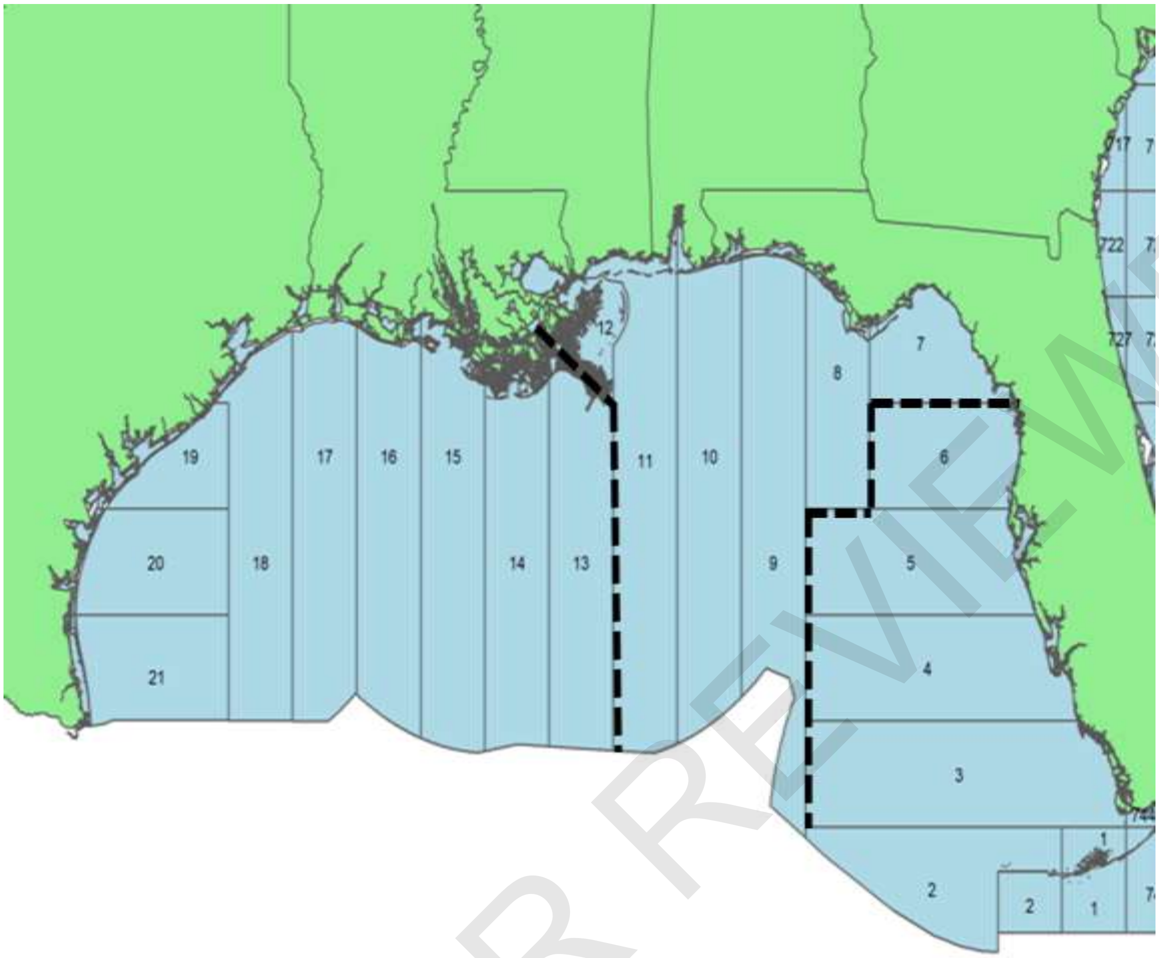


Figure 2. National Marine Fisheries Service (NMFS) fishing area in the Gulf of America, divided into 23 statistical fishing zones. Thick black dashed lines indicate stock boundaries used for SEDAR 98: statistical zone 12/13- Mississippi River outflow, zone 9/10 - De Soto Canyon, zone 7/8 - Cape San Blas, and zone 7/6 - Big Bend.

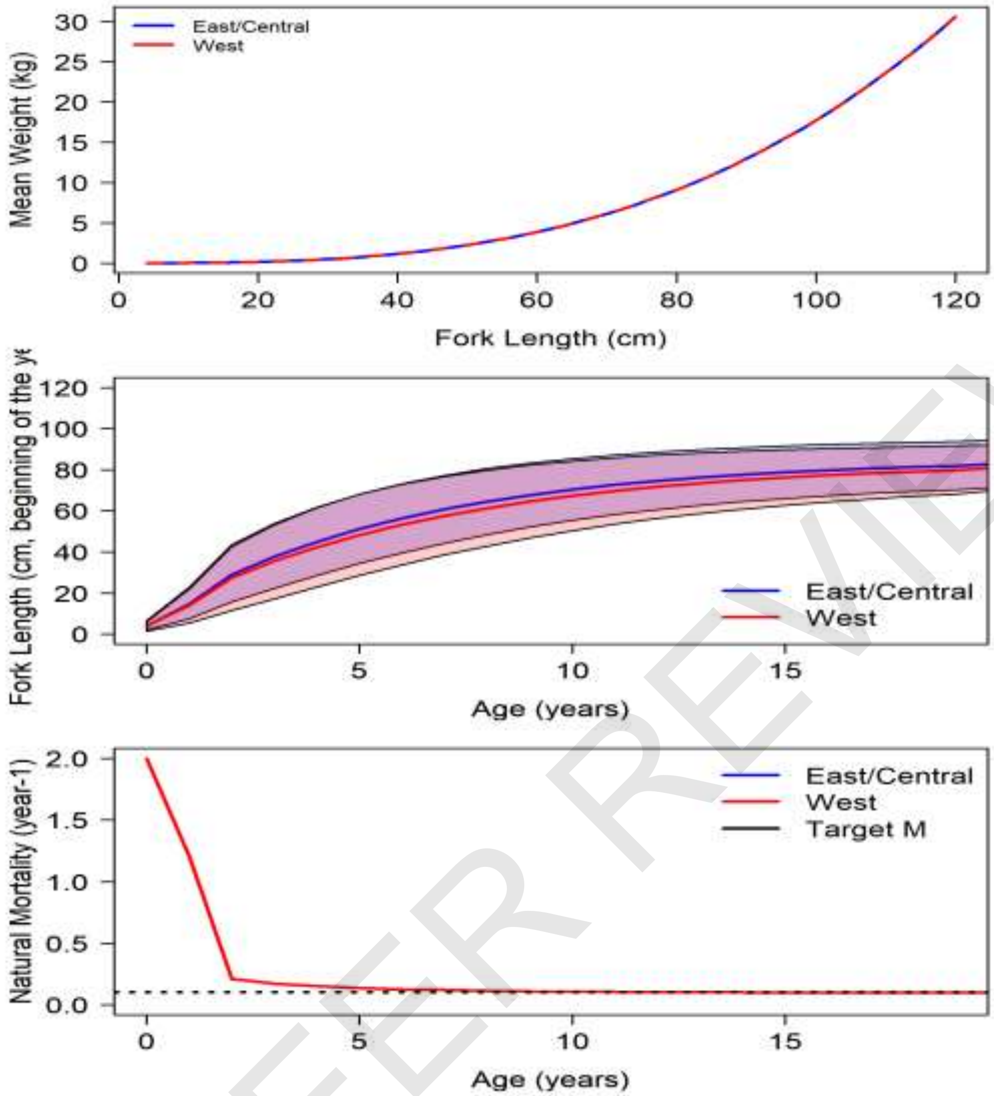
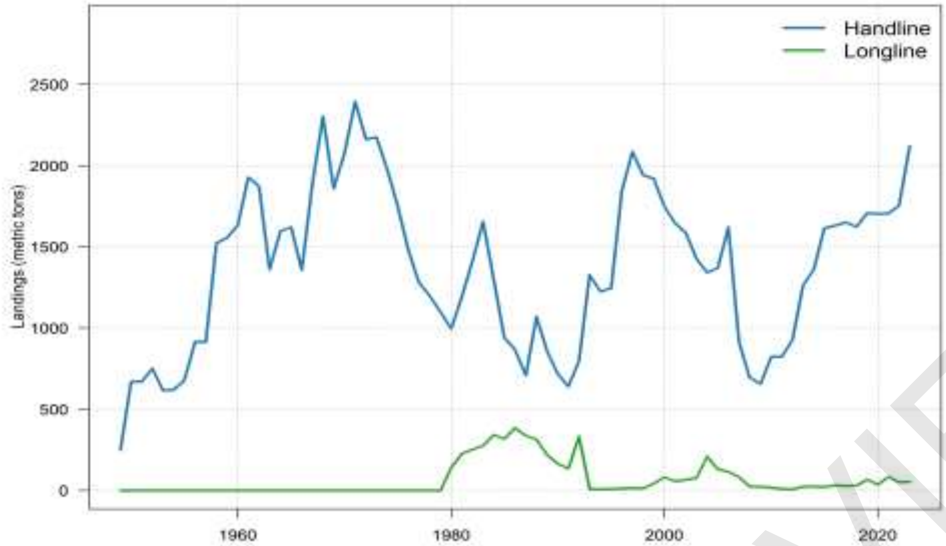


Figure 3. Mean weight-at-length (top panel), growth curves (with 95% confidence intervals; middle panel), and natural mortality (bottom panel) used in the assessment model for Gulf of America Red Snapper.

West



Central

Figure 4. Gulf of America Red Snapper observed commercial landings by fishery and region for SEDAR 98. Commercial landings in weight (mt).

East

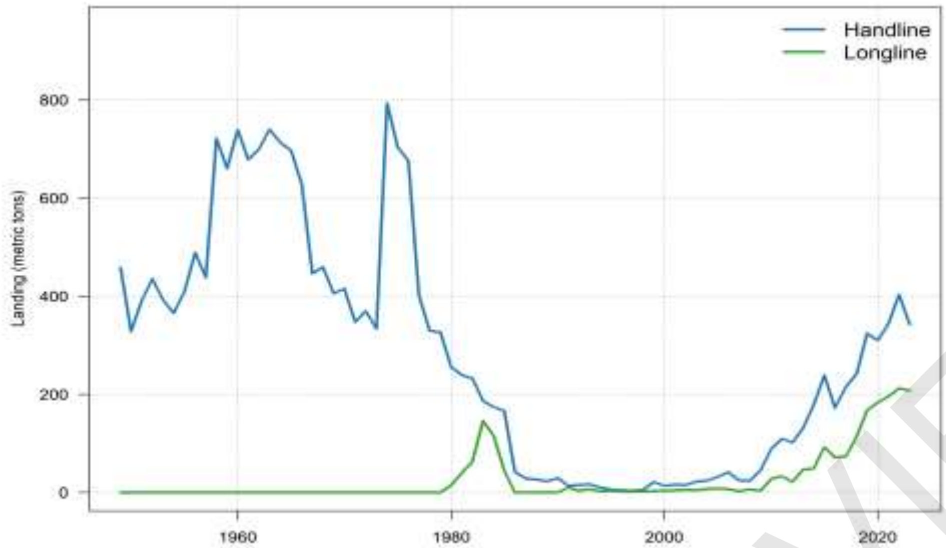
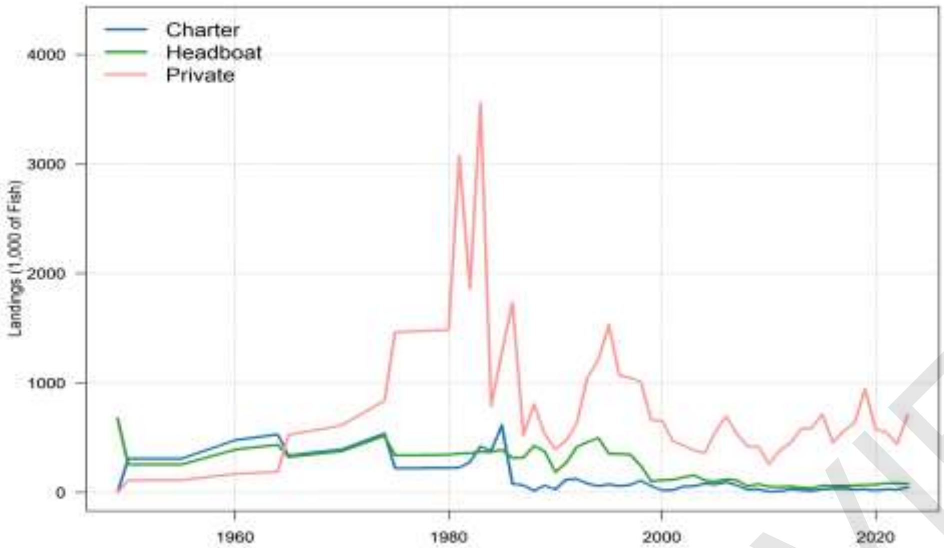


Figure 4 Continued. Gulf of America Red Snapper observed commercial landings by fishery and region for SEDAR 98. Commercial landings in weight (mt).

West



Central

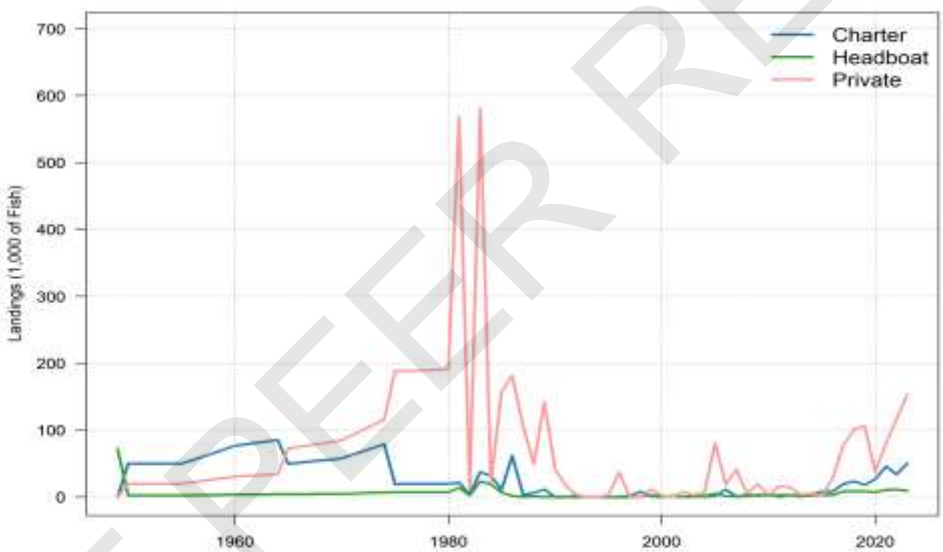


Figure 5. Gulf of America Red Snapper observed recreational landings by fishery for SEDAR 98. Recreational landings are in thousands of fish.

East

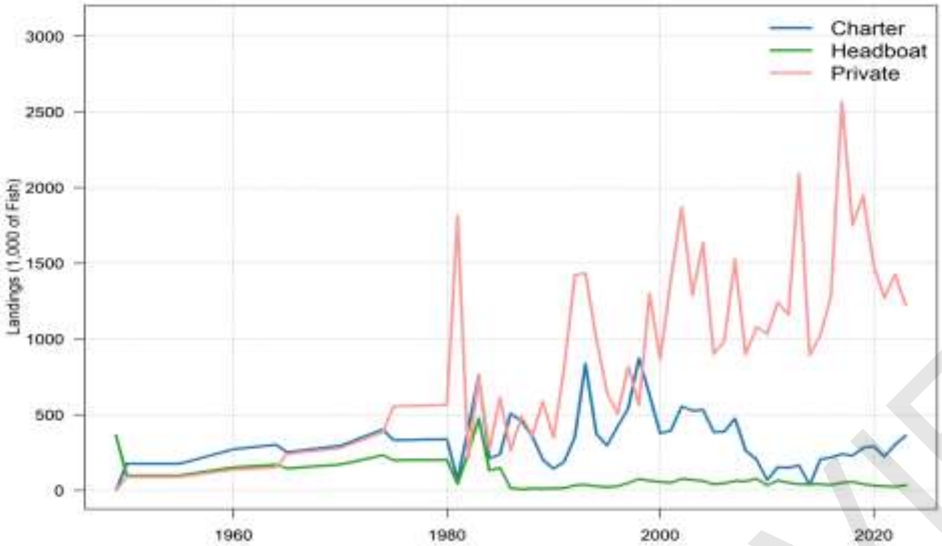
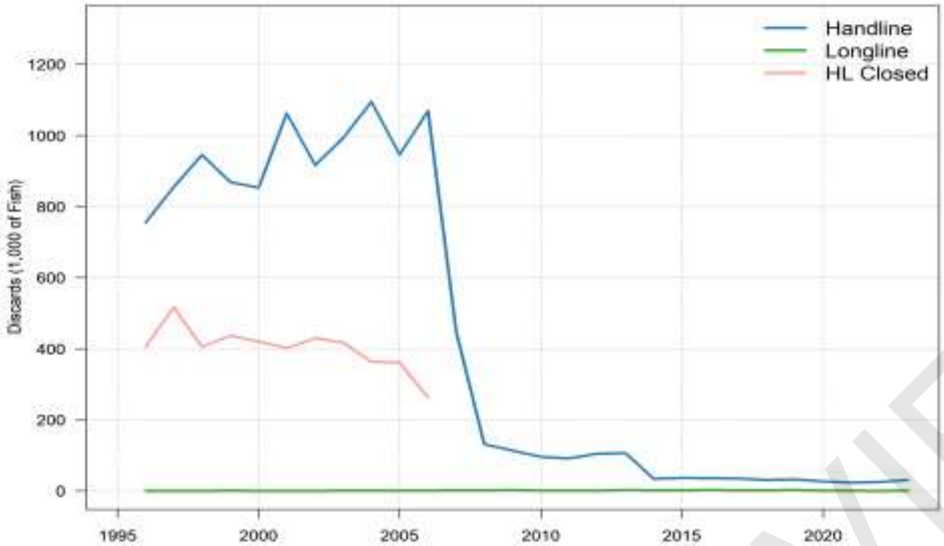


Figure 5 Continued. Gulf of America Red Snapper observed recreational landings by fishery for SEDAR 98. Recreational landings are in thousands of fish.

West



Central

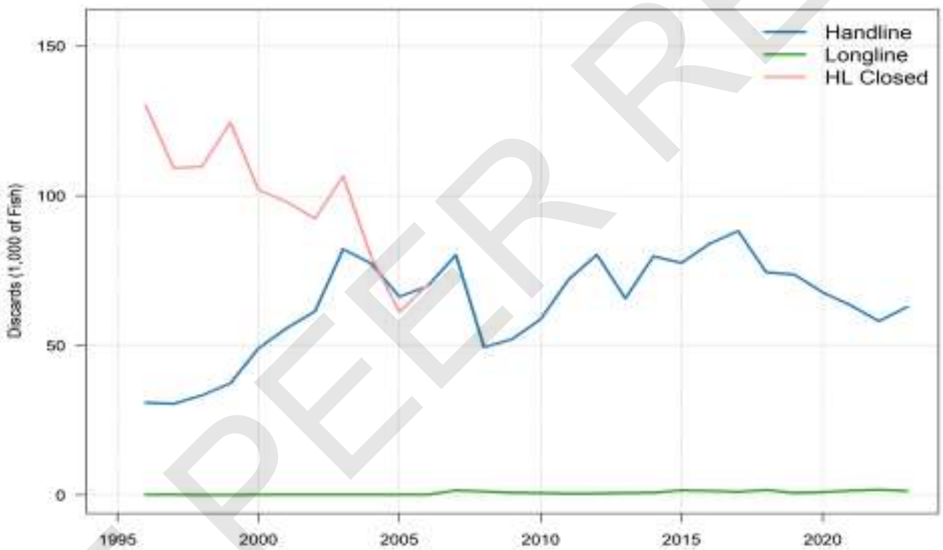
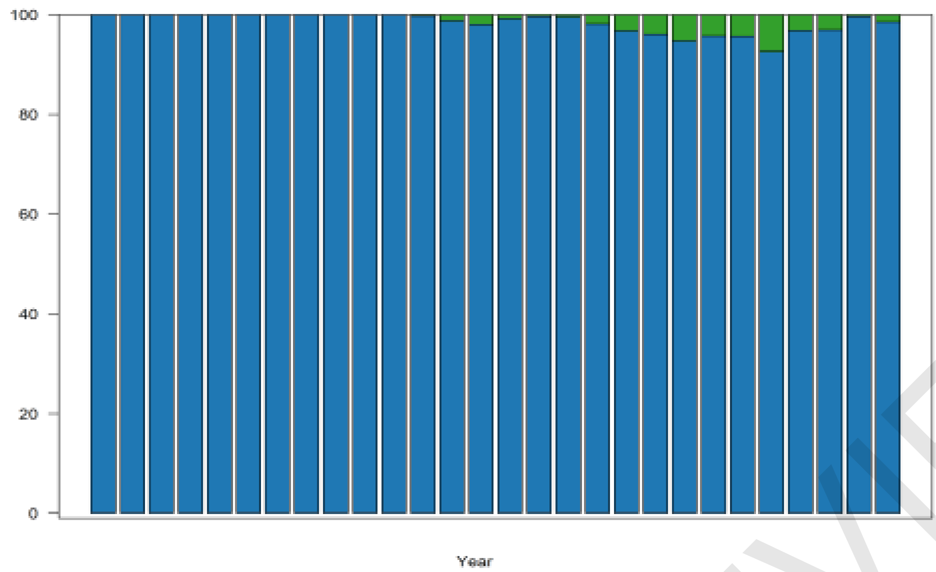


Figure 6. Gulf of America Red Snapper observed commercial discards by fishery and region for SEDAR 98. Commercial discards are in thousands of fish.

East

Figure 6 Continued. Gulf of America Red Snapper observed commercial discards by fishery and region for SEDAR 98. Commercial discards are in thousands of fish.

West



Central

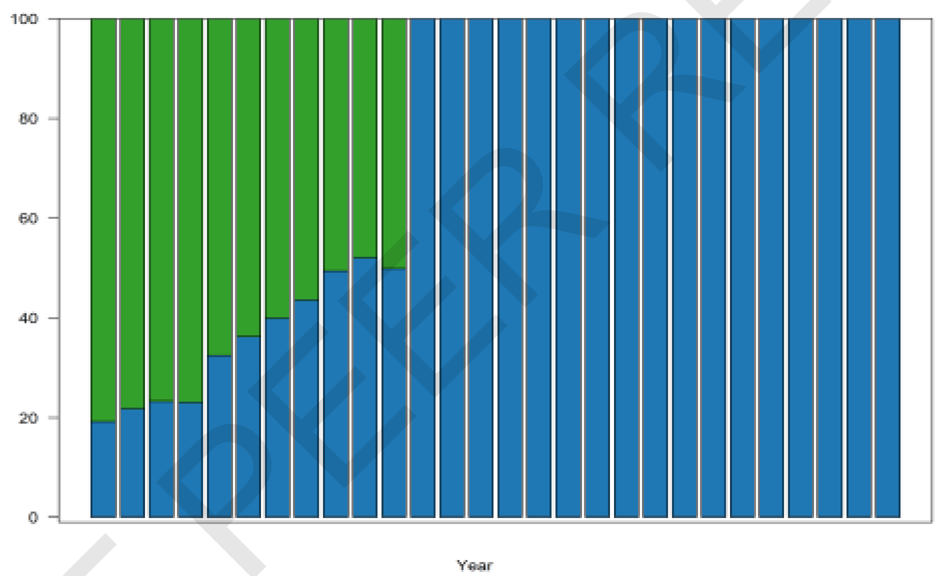


Figure 7. Proportion of Gulf of America Red Snapper observed commercial discards by fishery and region for SEDAR 98. Colors align with those in the previous figure.

East

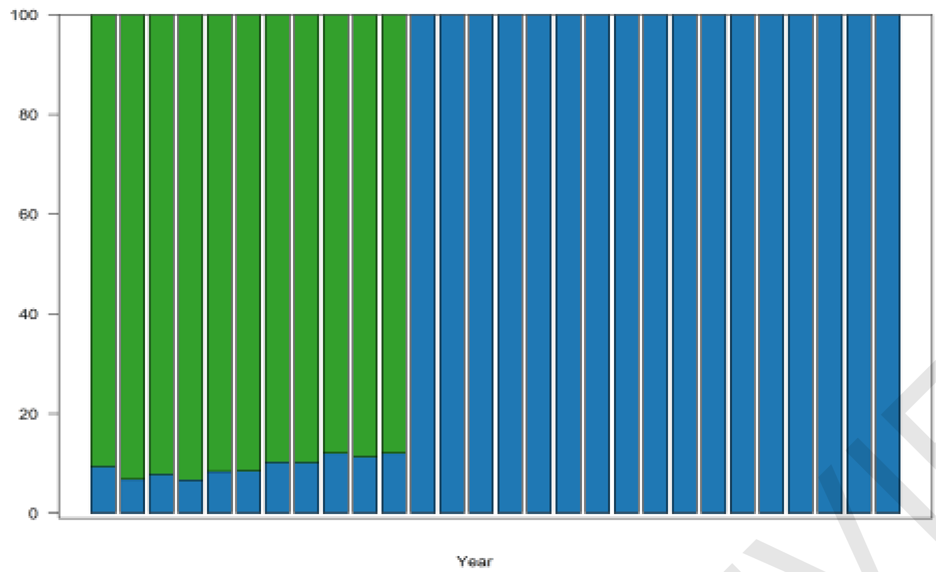
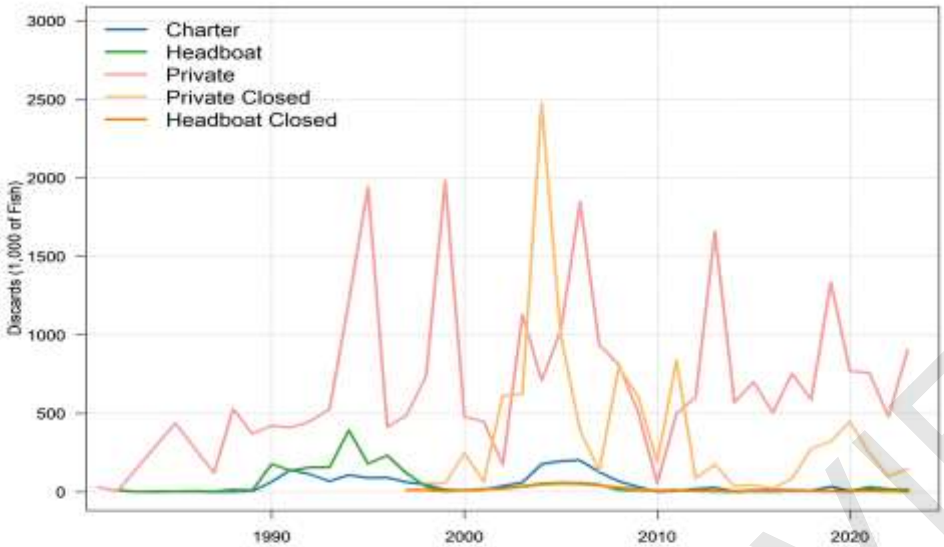


Figure 7 Continued. Proportion of Gulf of America Red Snapper observed commercial discards by fishery and region for SEDAR 98. Colors align with those in the previous figure.

West



Central

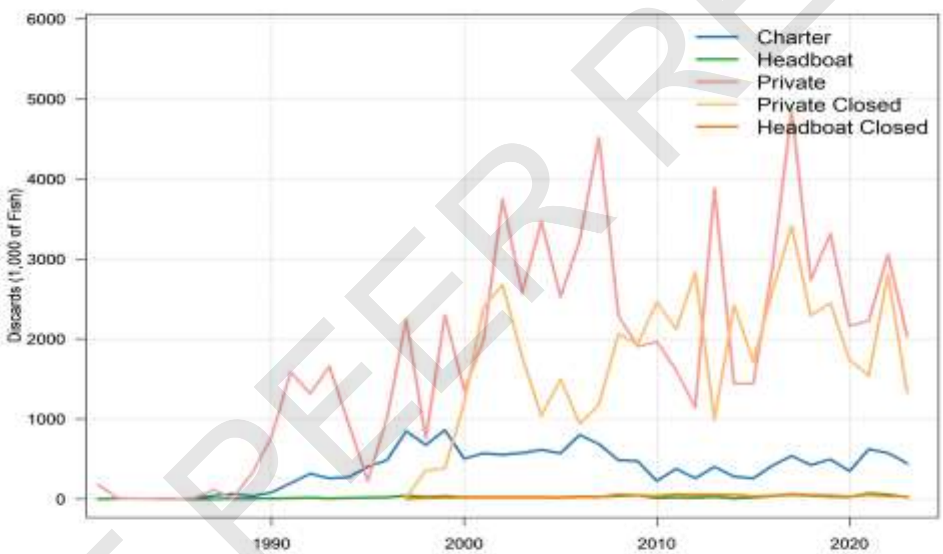


Figure 8. Gulf of America Red Snapper observed recreational discards by fishery for SEDAR 98. Recreational discards are in thousands of fish. East area y-axis is reduced to ensure trends in fleets that were not the Private Closed Season Discards were still visible. Unseen values for Private Closed season discards are 1492.56 in 2011, 669.67 in 2016, 523.3 in 2018 and 334.14 thousand fish in 2019.

East

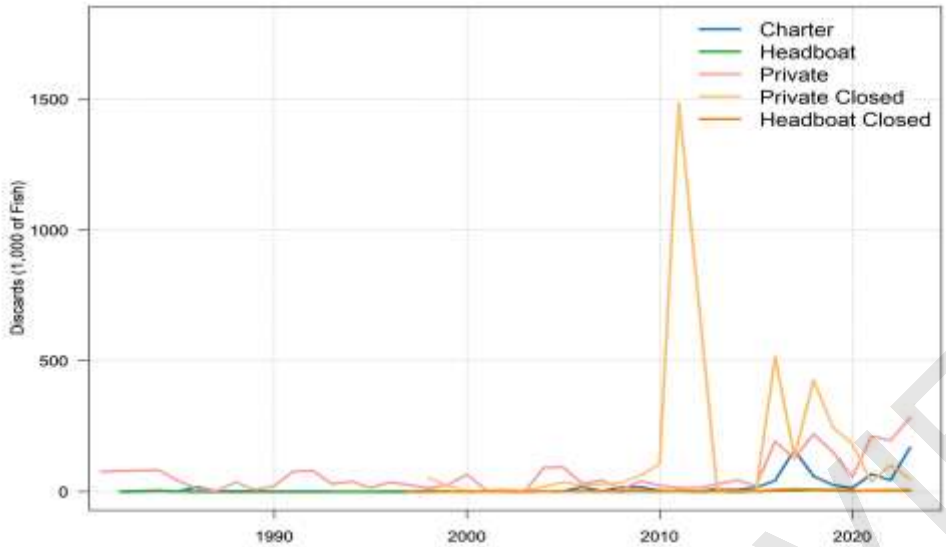


Figure 8 Continued. Gulf of America Red Snapper observed recreational discards by fishery for SEDAR 98. Recreational discards are in thousands of fish. East area y-axis is reduced to ensure trends in fleets that were not the Private Closed Season Discards were still visible. Unseen values for Private Closed season discards are 1492.56 in 2011, 669.67 in 2016, 523.3 in 2018 and 334.14 thousand fish in 2019.

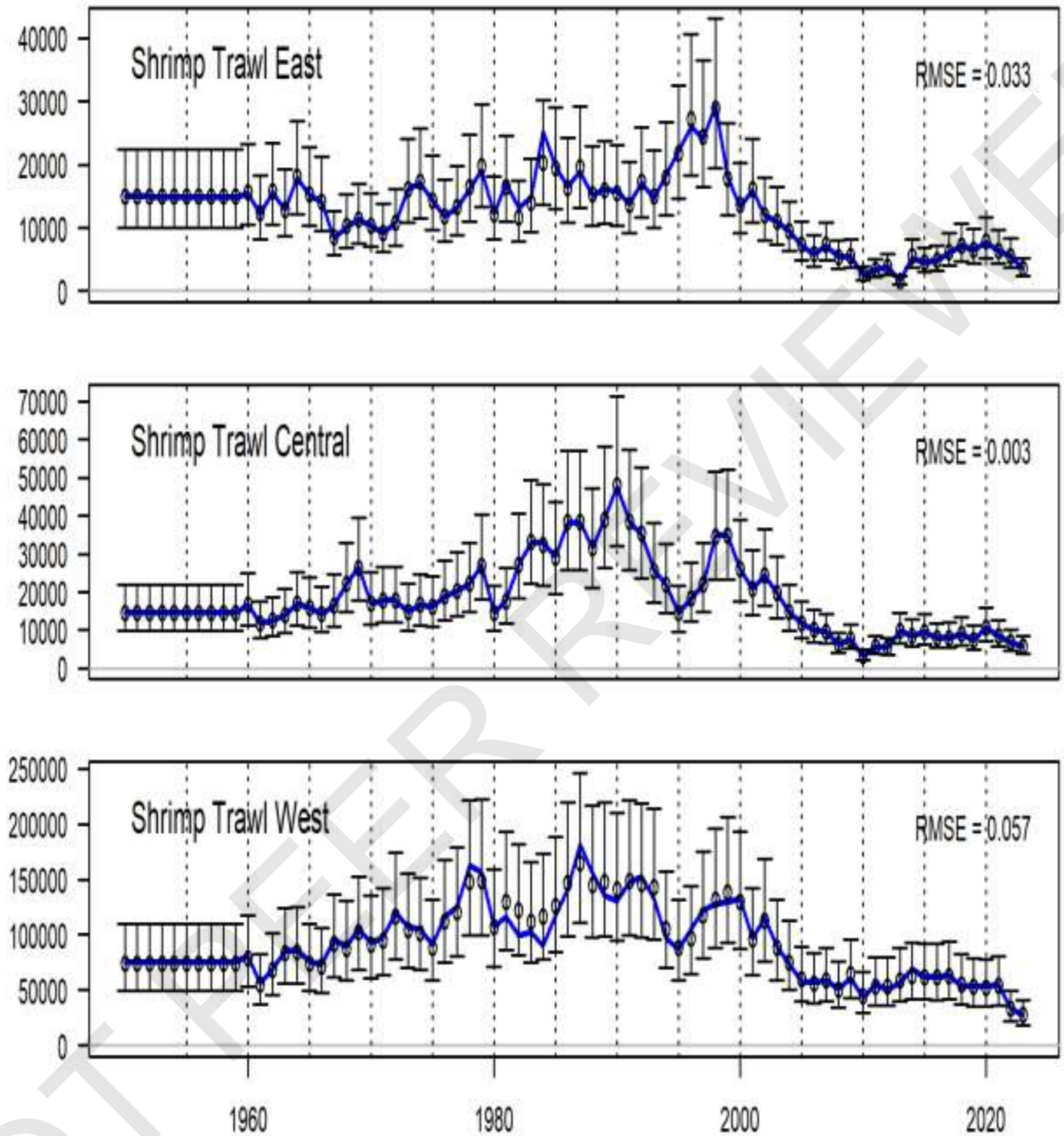


Figure 9. Effort time series for Shrimp Trawl bycatch and associated 95% uncertainty interval around index values based on the model assumption of lognormal error for Gulf of America Red Snapper.

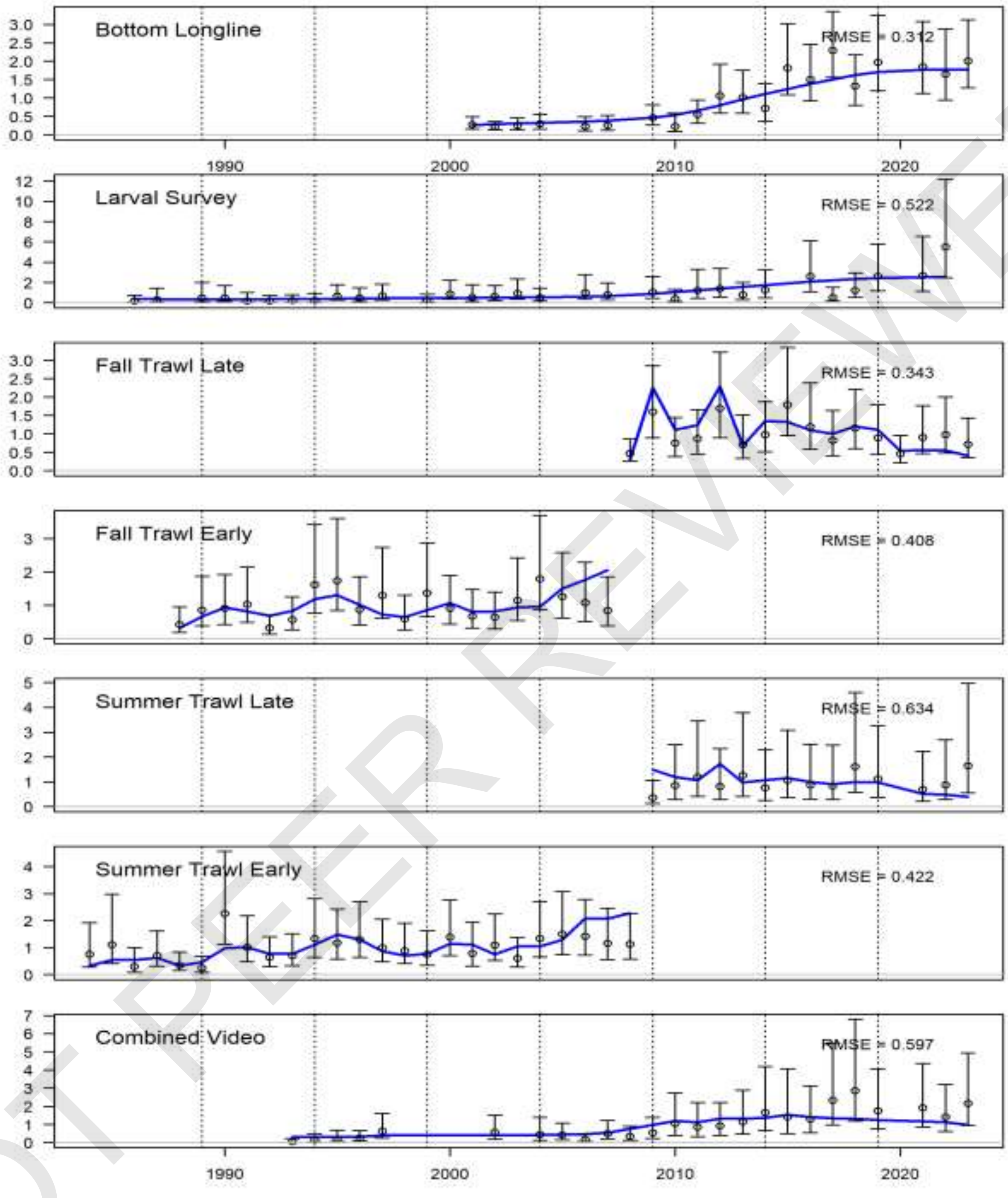


Figure 10. Western Gulf of America Red Snapper observed and expected indices (blue lines) for SEDAR 98 . Dashed vertical lines identify five year intervals. The root mean squared error (RMSE) is also provided.

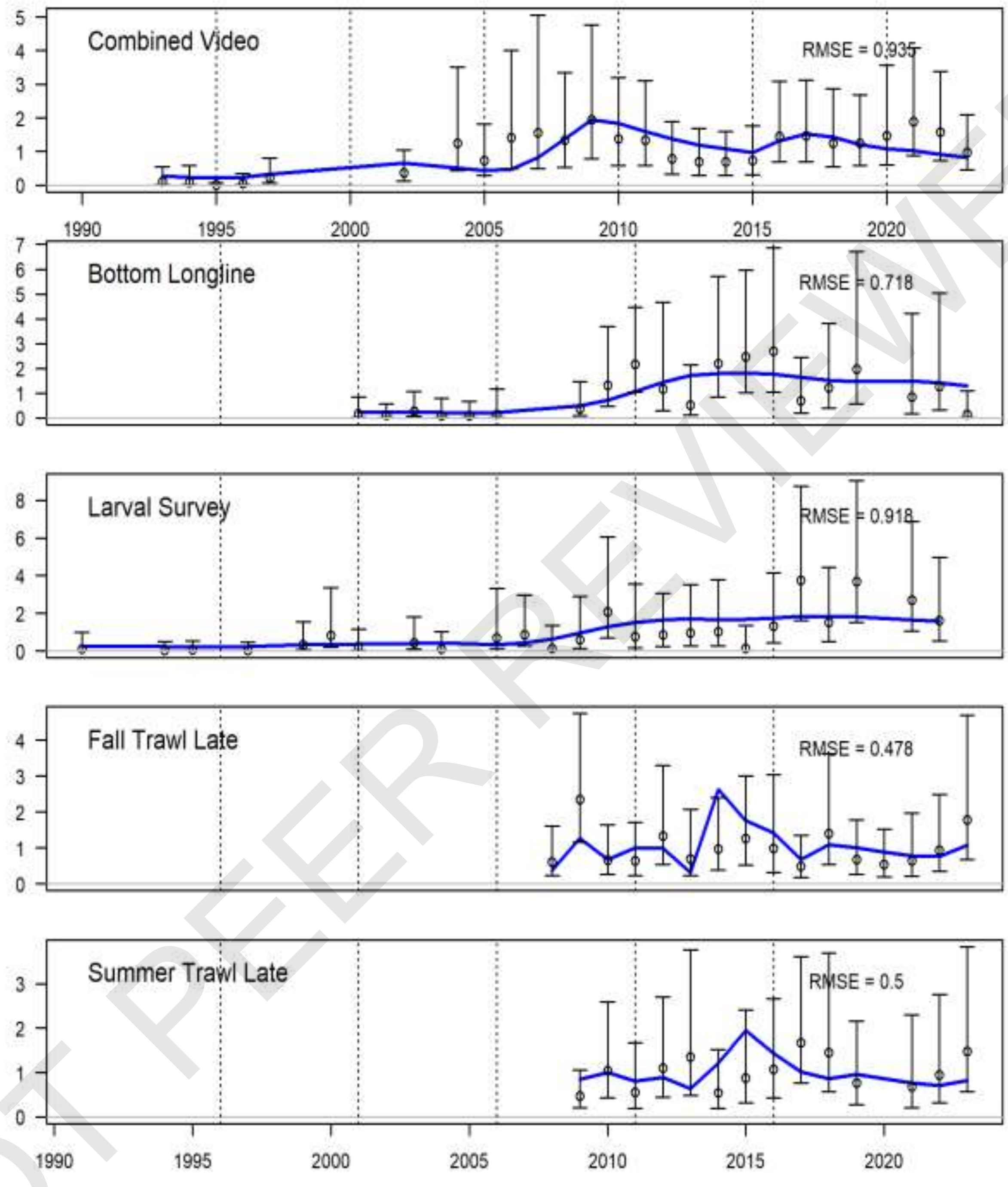


Figure 11. Central Gulf of America Red Snapper observed and expected indices (blue lines) for SEDAR 98. Dashed vertical lines identify five year intervals. The root mean squared error (RMSE) is also provided.

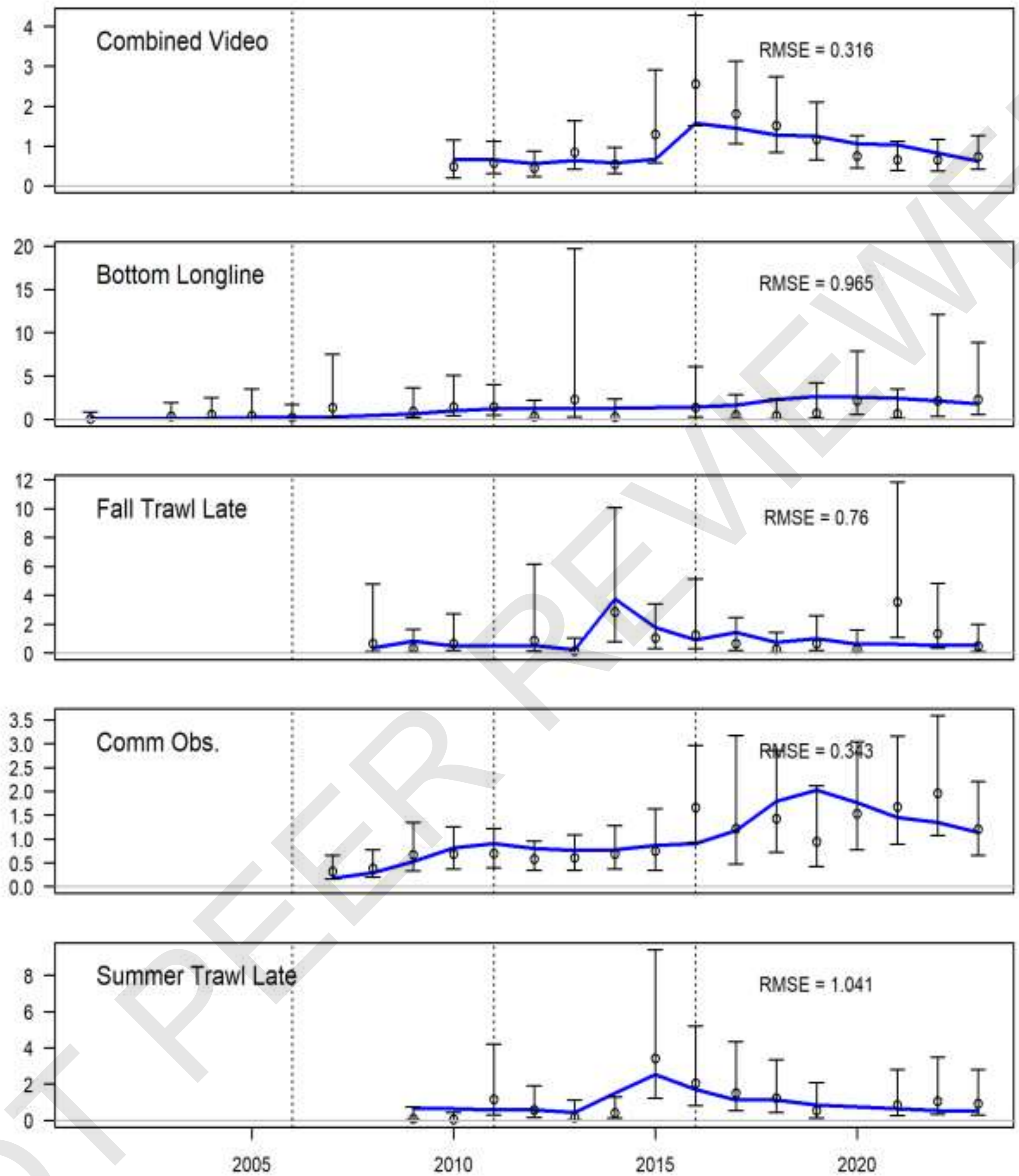


Figure 12. Eastern Gulf of America Red Snapper observed and expected indices (blue lines) for SEDAR 98. Dashed vertical lines identify five year intervals. The root mean squared error (RMSE) is also provided.

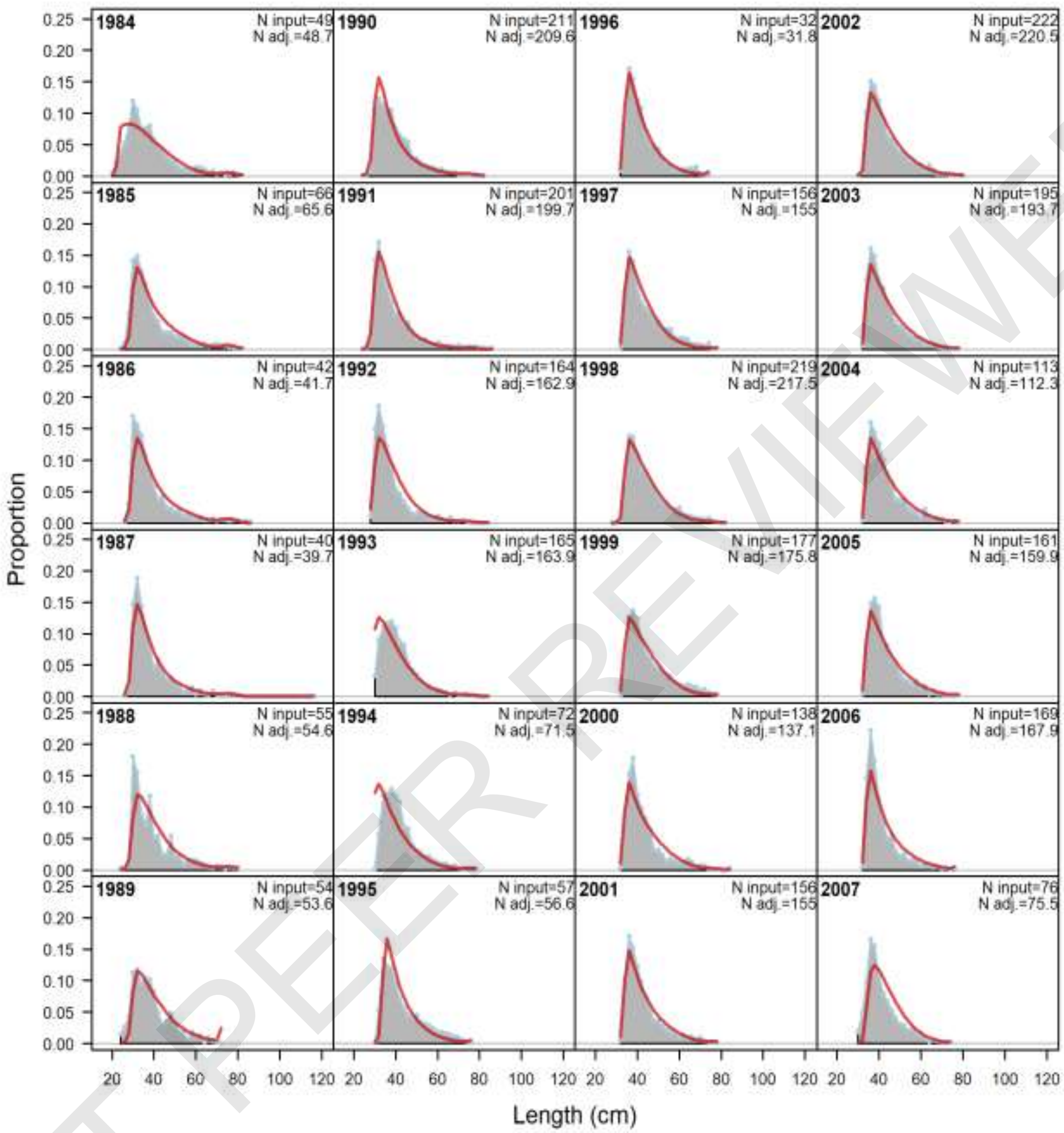


Figure 13. Length comps, retained, Commercial Handline West (plot 1 of 2). 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 148.413 and the sample size multiplier is approximately Θ / (1+Θ) = 0.993.*

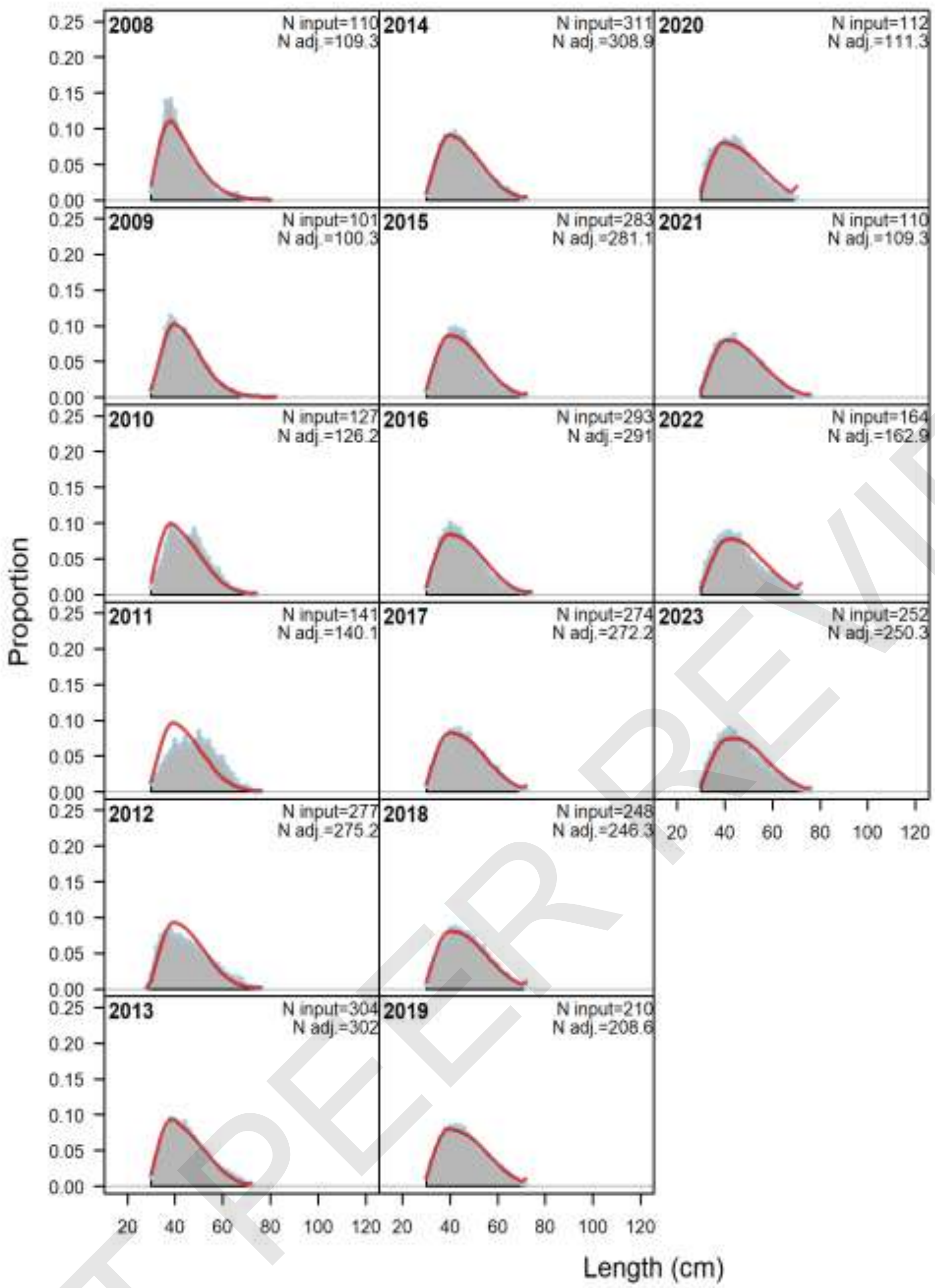


Figure 13 Continued. Length comps, retained, Commercial Handline West (plot 2 of 2). 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 148.413 and the sample size multiplier is approximately Θ / (1+Θ) = 0.993.*

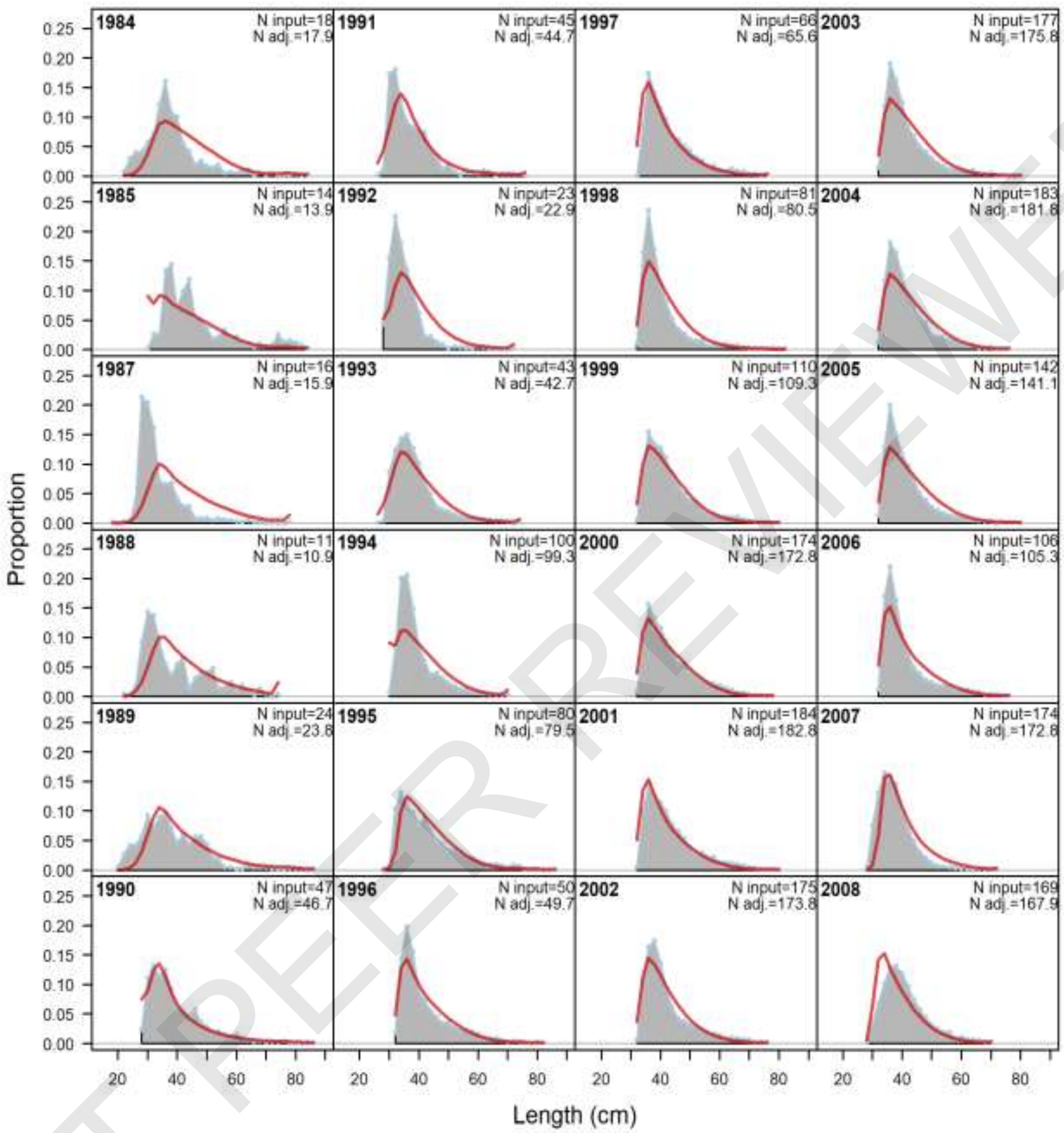


Figure 14. Length comps, retained, Commercial Handline Central (plot 1 of 2). 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = $1 / (1+\Theta) + N \; \Theta / (1+\Theta)$. For this fleet, $\Theta = 148.413$ and the sample size multiplier is approximately $\Theta / (1+\Theta) = 0.993$.*

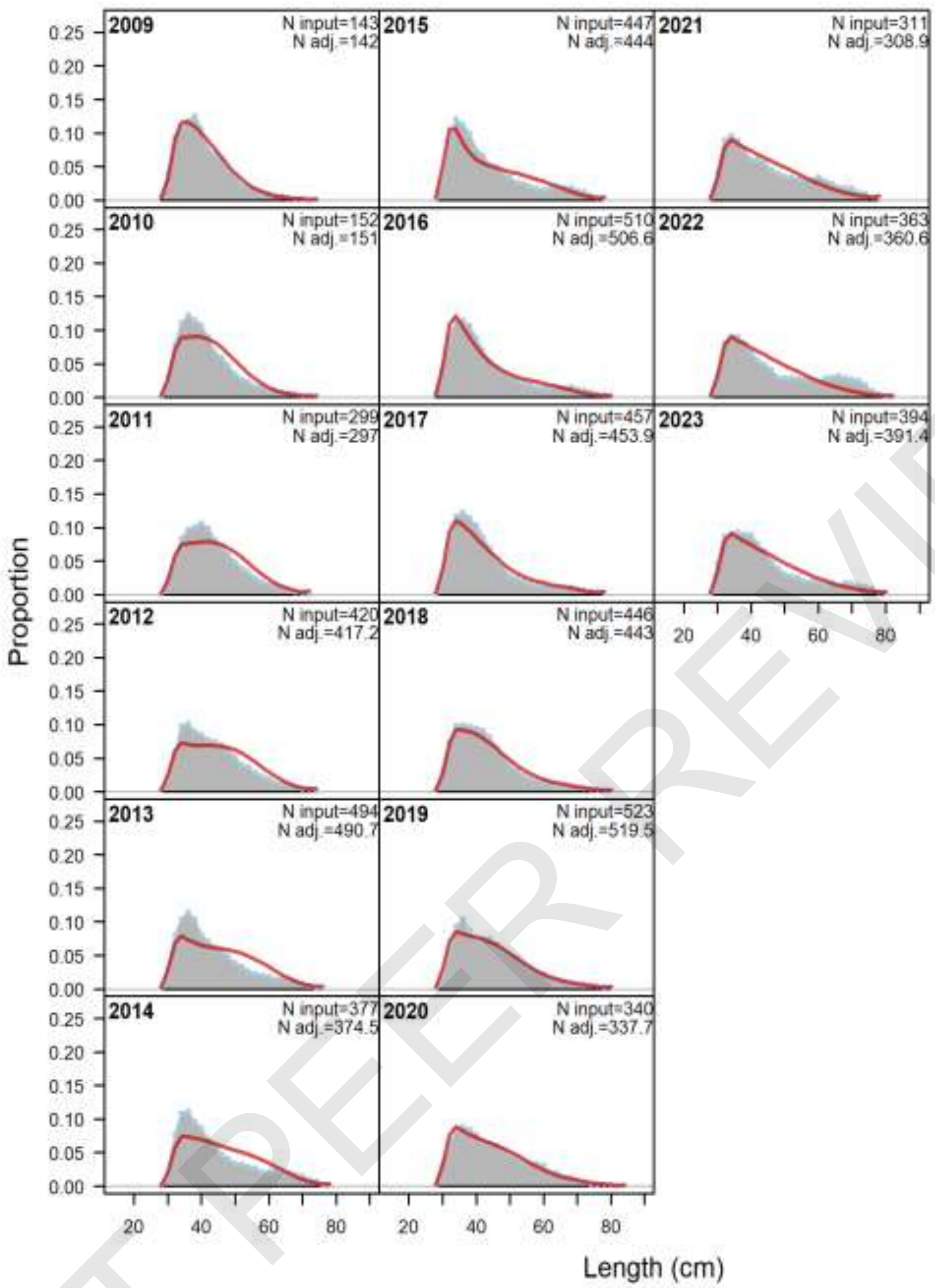


Figure 14 Continued. Length comps, retained, Commercial Handline Central (plot 2 of 2). 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 148.413 and the sample size multiplier is approximately Θ / (1+Θ) = 0.993.*

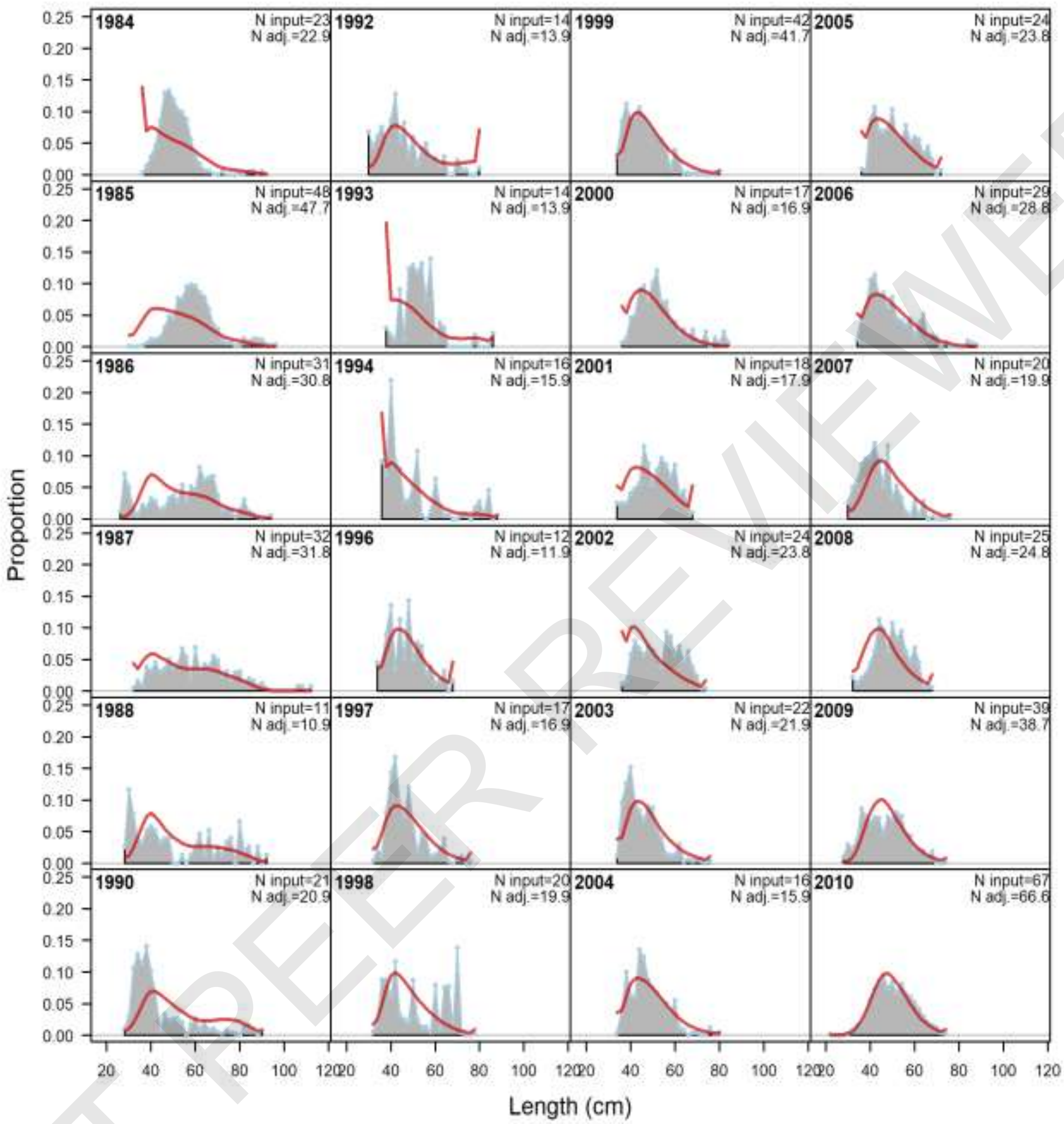


Figure 15. Length comps, retained, Commercial Handline East (plot 1 of 2). 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 148.413 and the sample size multiplier is approximately Θ / (1+Θ) = 0.993.*

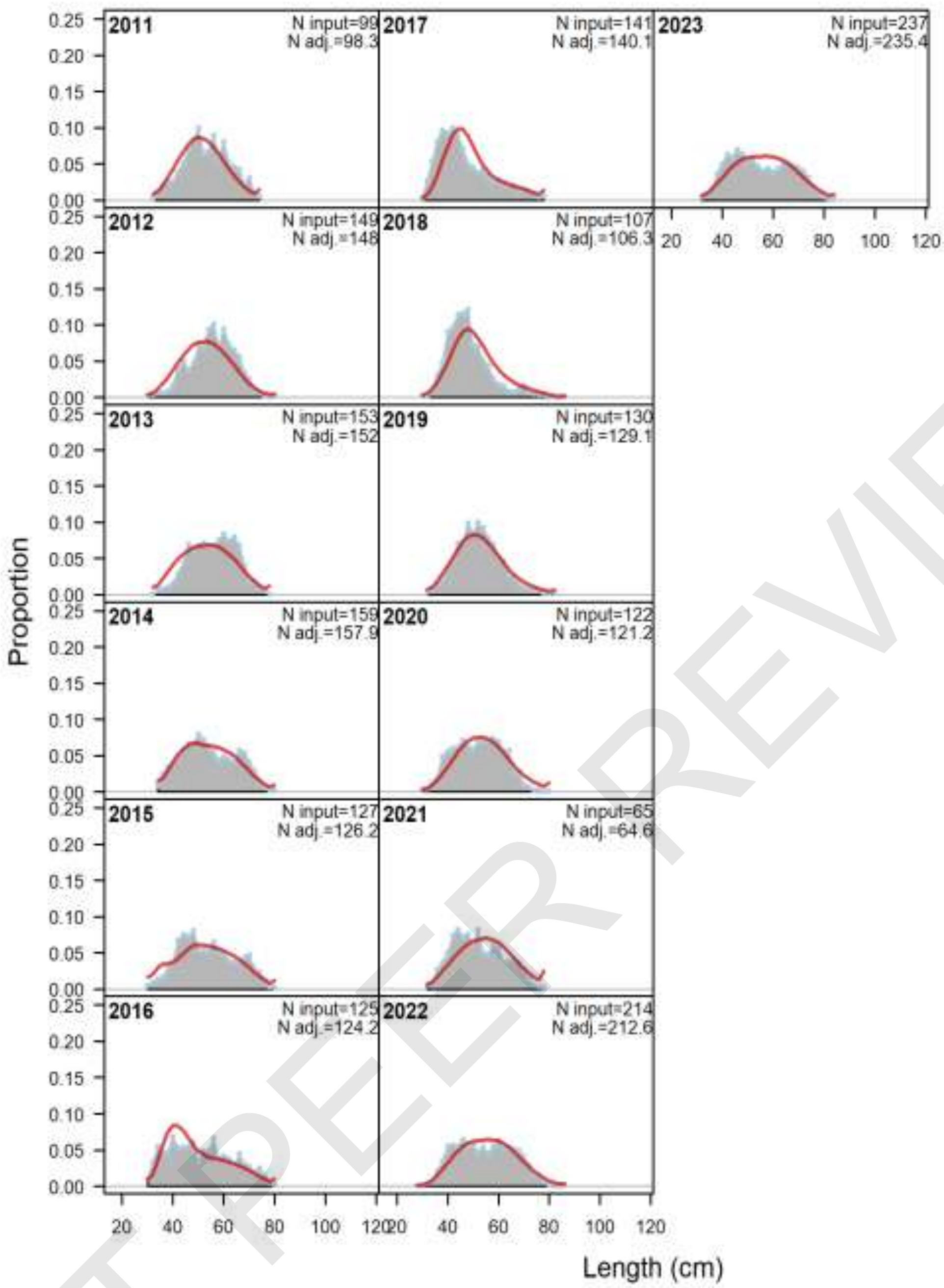


*Figure 15 Continued. Length comps, retained, Commercial Handline East (plot 1 of 2). 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-*Multinomial *Θ parameter based on the formula N adj. = 1 / (1+Θ) + N* Θ / (1+Θ). For this fleet, Θ = 148.413 and the sample size multiplier is approximately Θ / (1+Θ) = 0.993.*

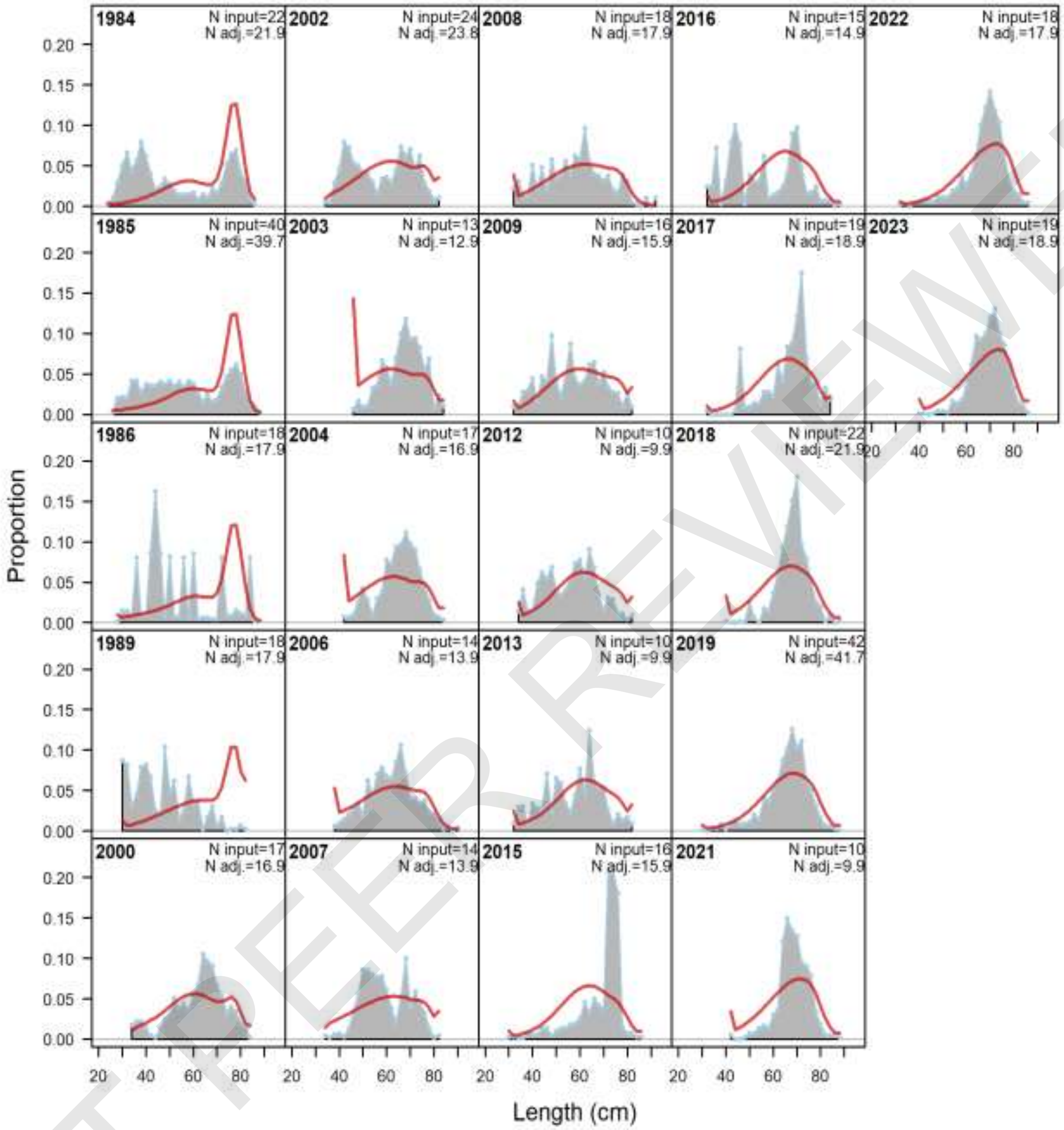


Figure 16. Length comps, retained, Commercial Longline West. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 148.413 and the sample size multiplier is approximately Θ / (1+Θ) = 0.993.*

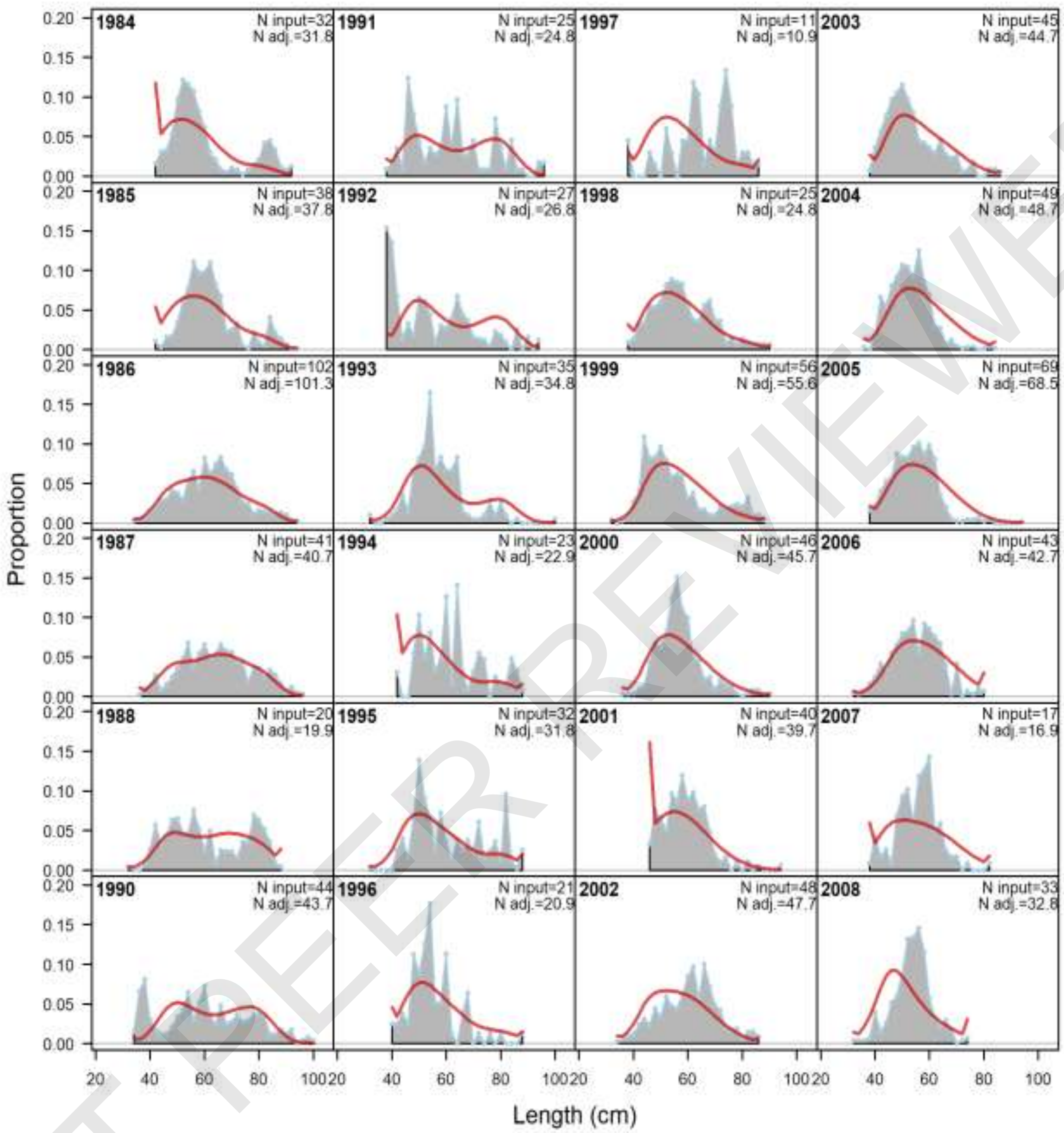


Figure 17. Length comps, retained, Commercial Longline East (plot 1 of 2). 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 148.413 and the sample size multiplier is approximately Θ / (1+Θ) = 0.993.*

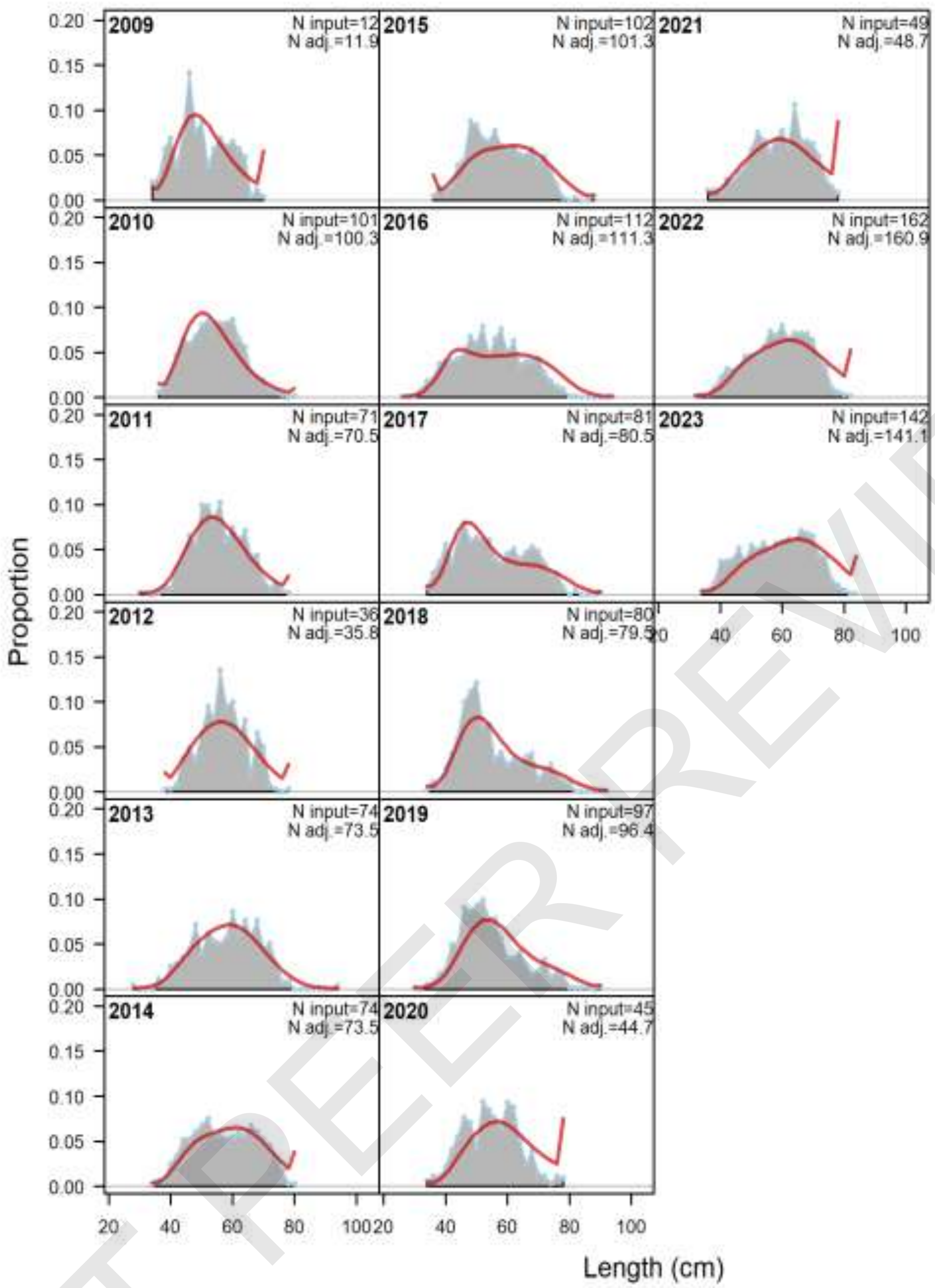


Figure 17 Continued. Length comps, retained, Commercial Longline East (plot 2 of 2). 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 148.413 and the sample size multiplier is approximately Θ / (1+Θ) = 0.993.*

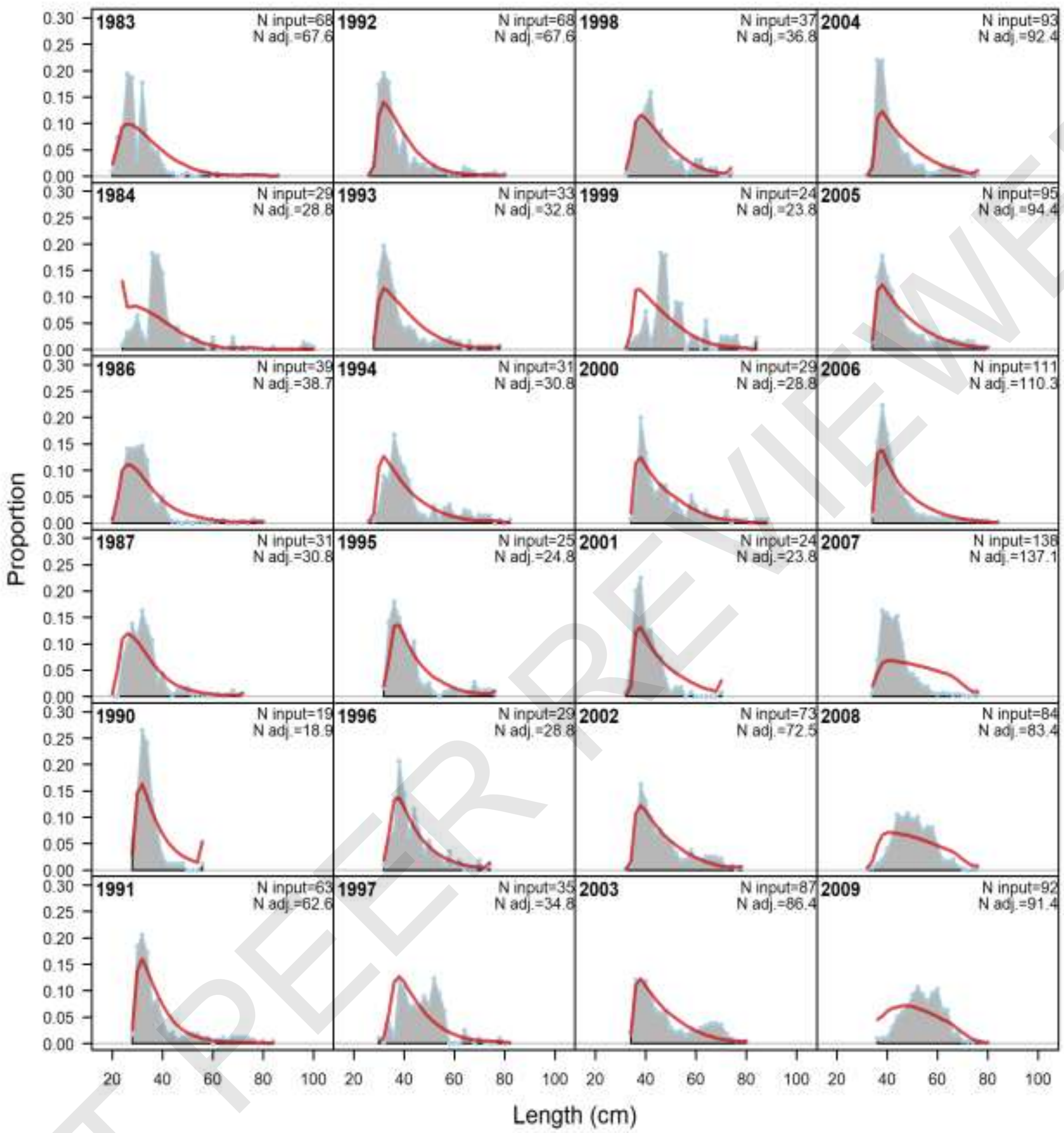


Figure 18. Length comps, retained, Recreational Charter West (plot 1 of 2). 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 148.367 and the sample size multiplier is approximately Θ / (1+Θ) = 0.993.*

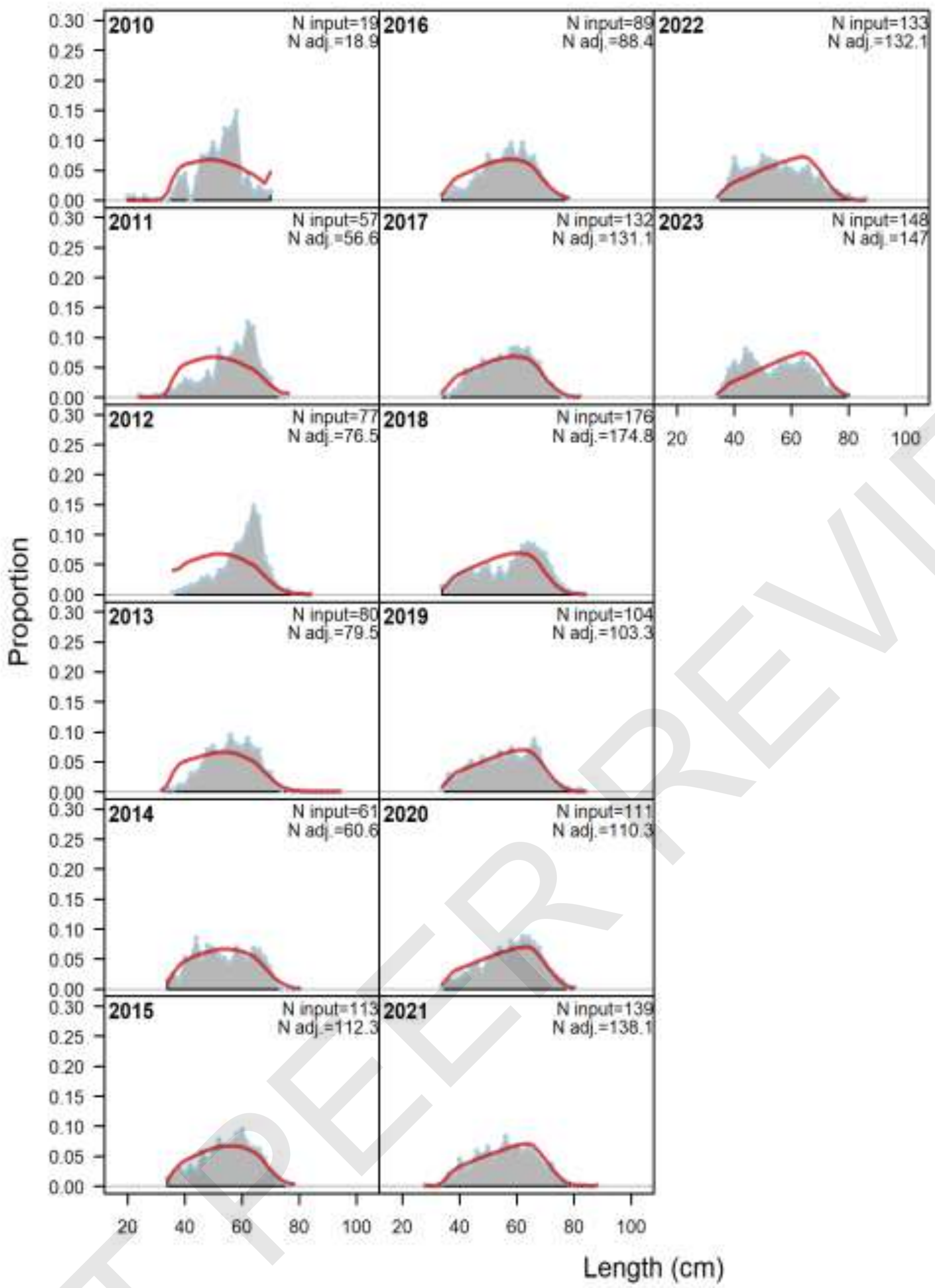


Figure 18 Continued. Length comps, retained, Recreational Charter West (plot 2 of 2). 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 148.367 and the sample size multiplier is approximately Θ / (1+Θ) = 0.993.*

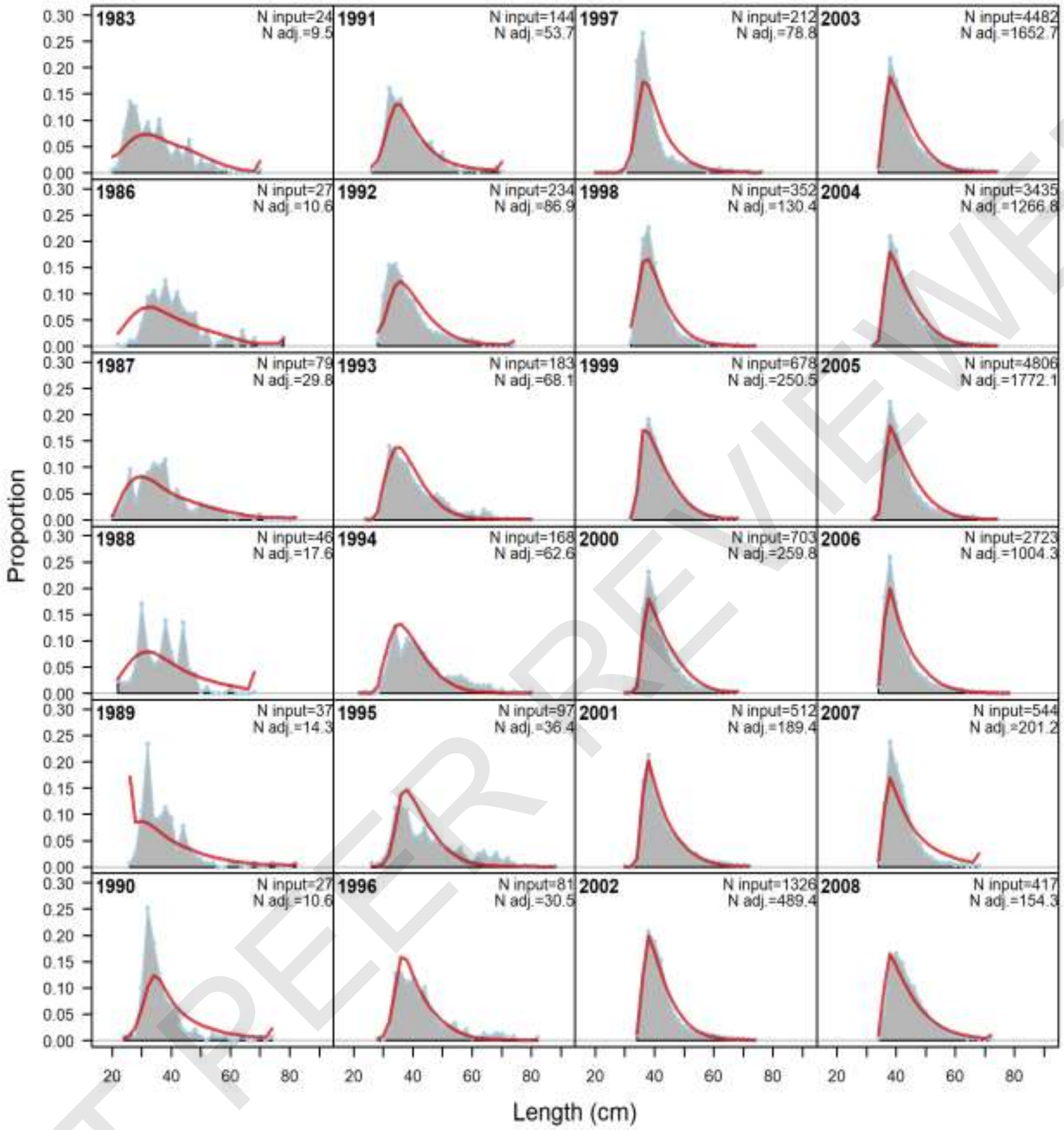


Figure 19. Length comps, retained, Recreational Charter Central (plot 1 of 2). 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 0.584 and the sample size multiplier is approximately Θ / (1+Θ) = 0.369.*

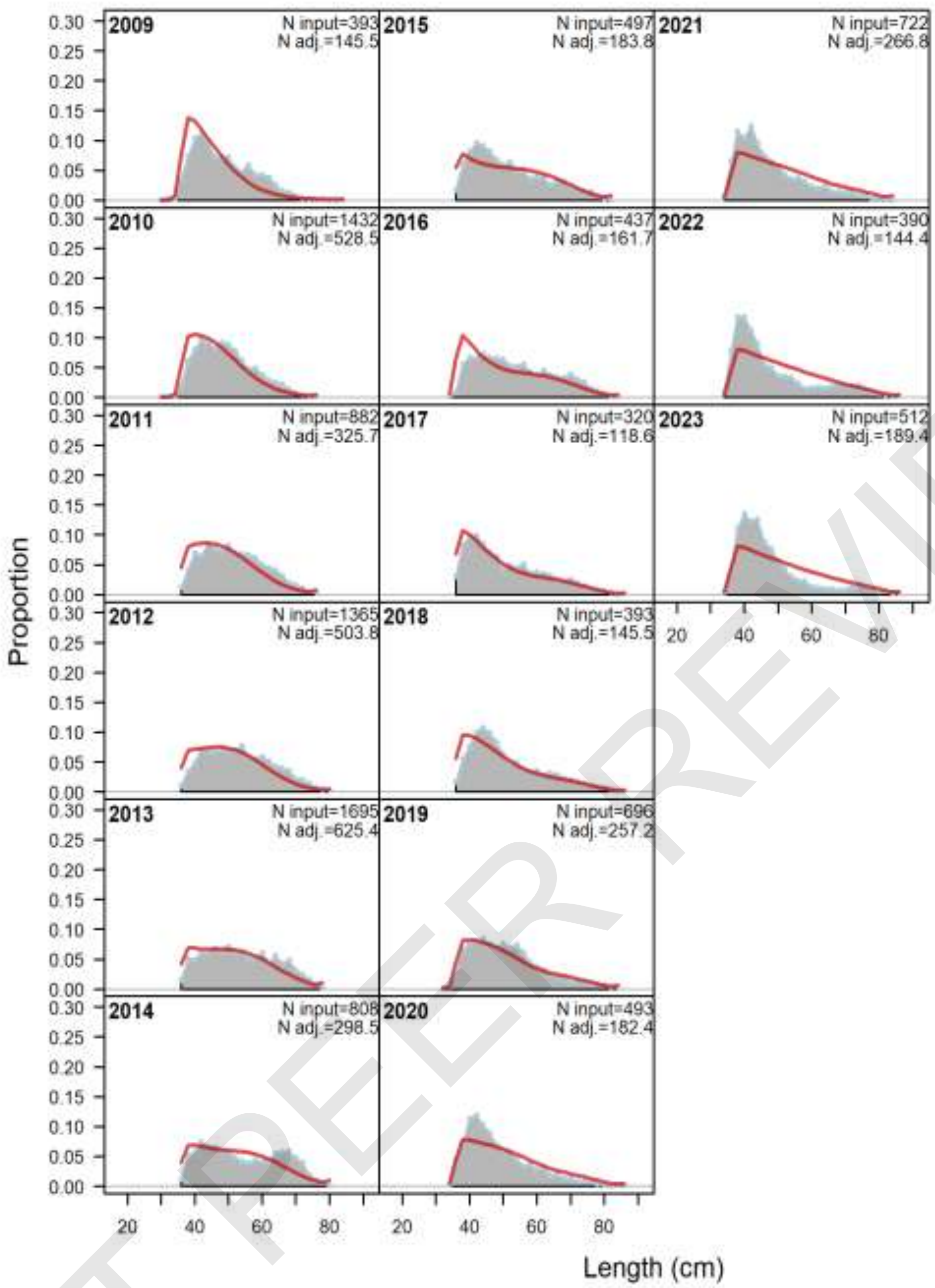


Figure 19 Continued. Length comps, retained, Recreational Charter Central (plot 2 of 2). 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 0.584 and the sample size multiplier is approximately Θ / (1+Θ) = 0.369.*

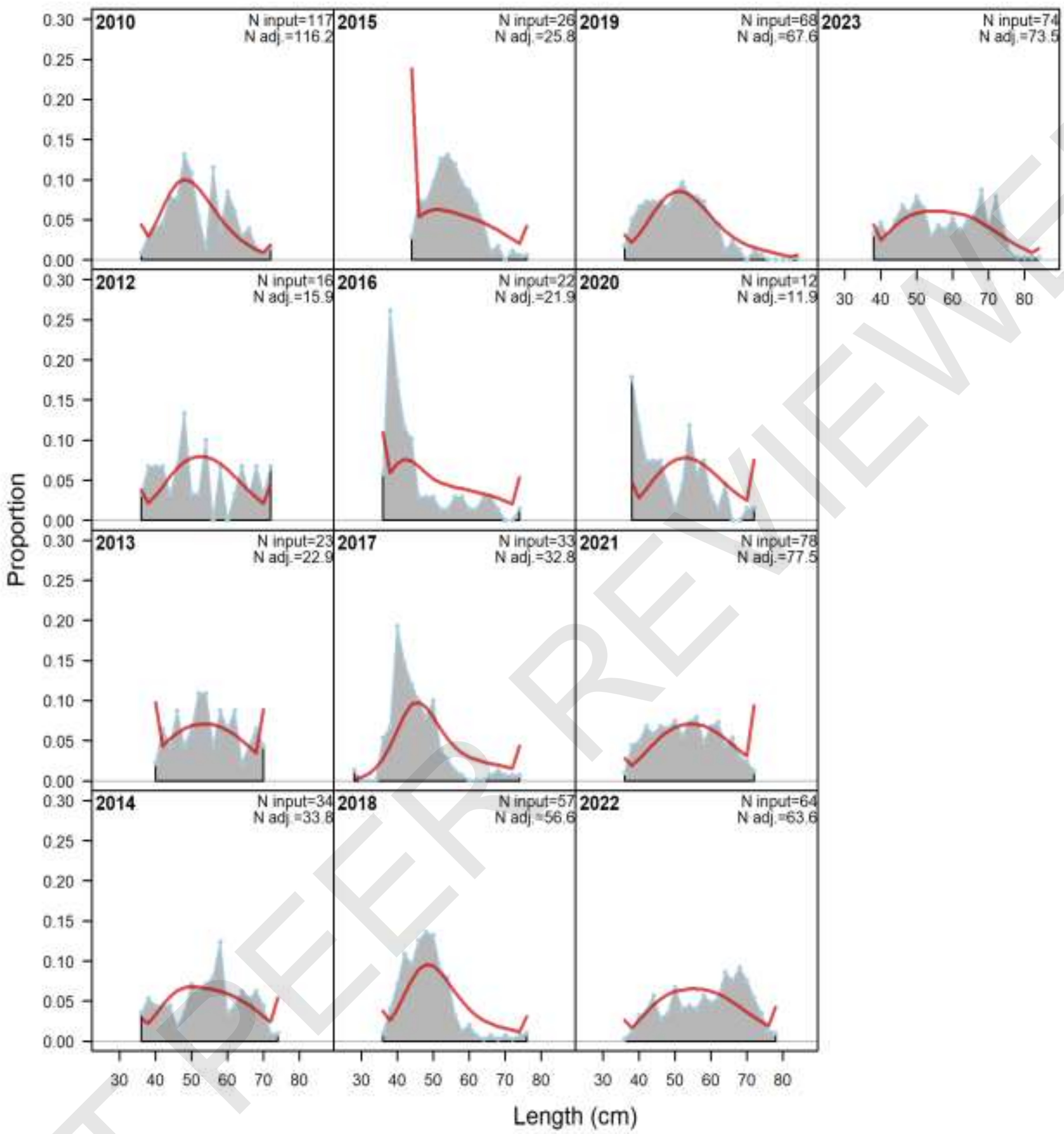


Figure 20. Length comps, retained, Recreational Charter East. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = $1 / (1+\Theta) + N \ \Theta / (1+\Theta)$. For this fleet, $\Theta = 148.367$ and the sample size multiplier is approximately $\Theta / (1+\Theta) = 0.993$.*

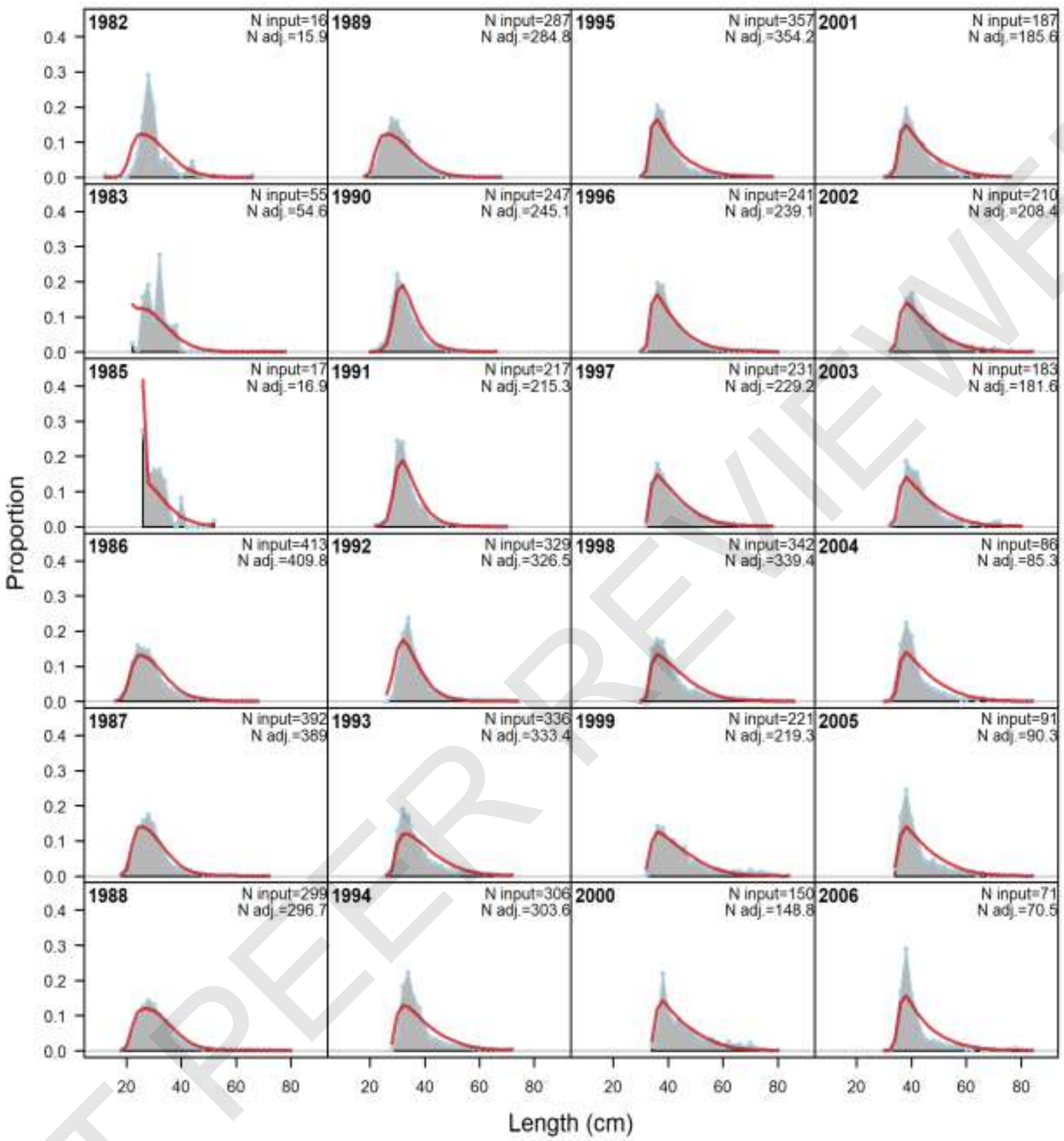


Figure 21. Length comps, retained, Recreational Headboat West (plot 1 of 2). 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 128.406 and the sample size multiplier is approximately Θ / (1+Θ) = 0.992.*

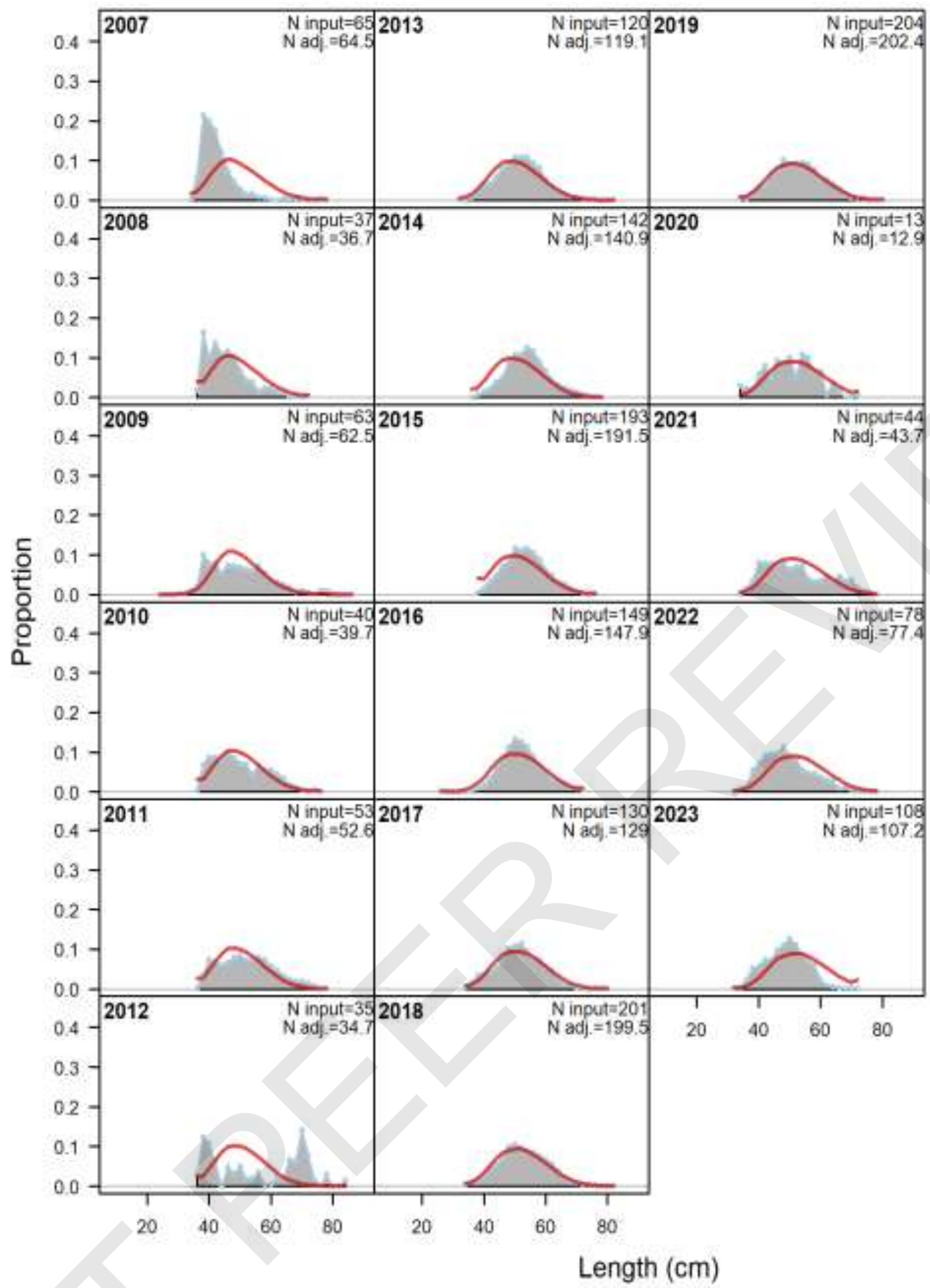


Figure 21 Continued. Length comps, retained, Recreational Headboat West (plot 2 of 2). 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 128.406 and the sample size multiplier is approximately Θ / (1+Θ) = 0.992.*

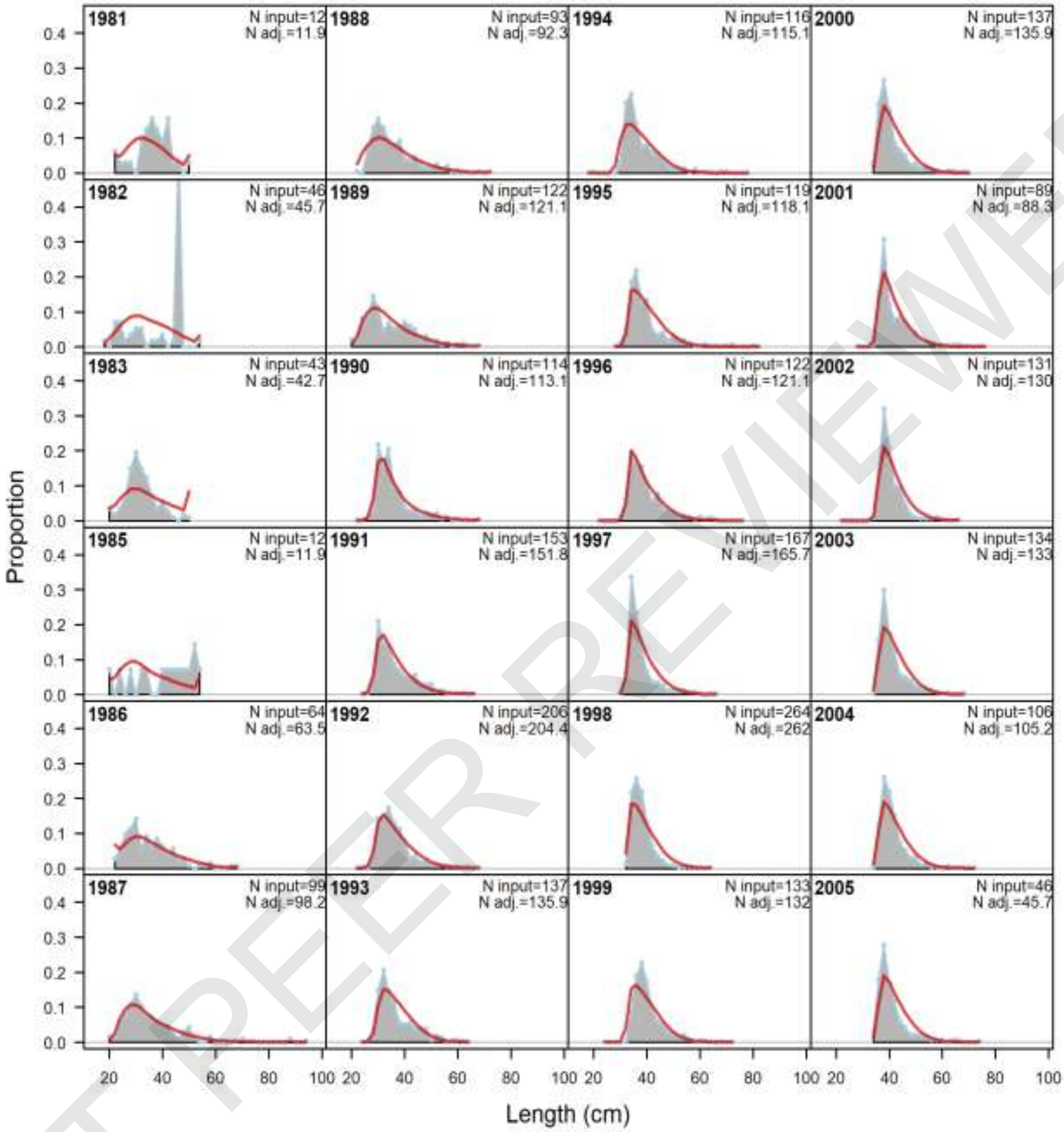


Figure 22. Length comps, retained, Recreational Headboat Central (plot 1 of 2). 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 128.406 and the sample size multiplier is approximately Θ / (1+Θ) = 0.992.*

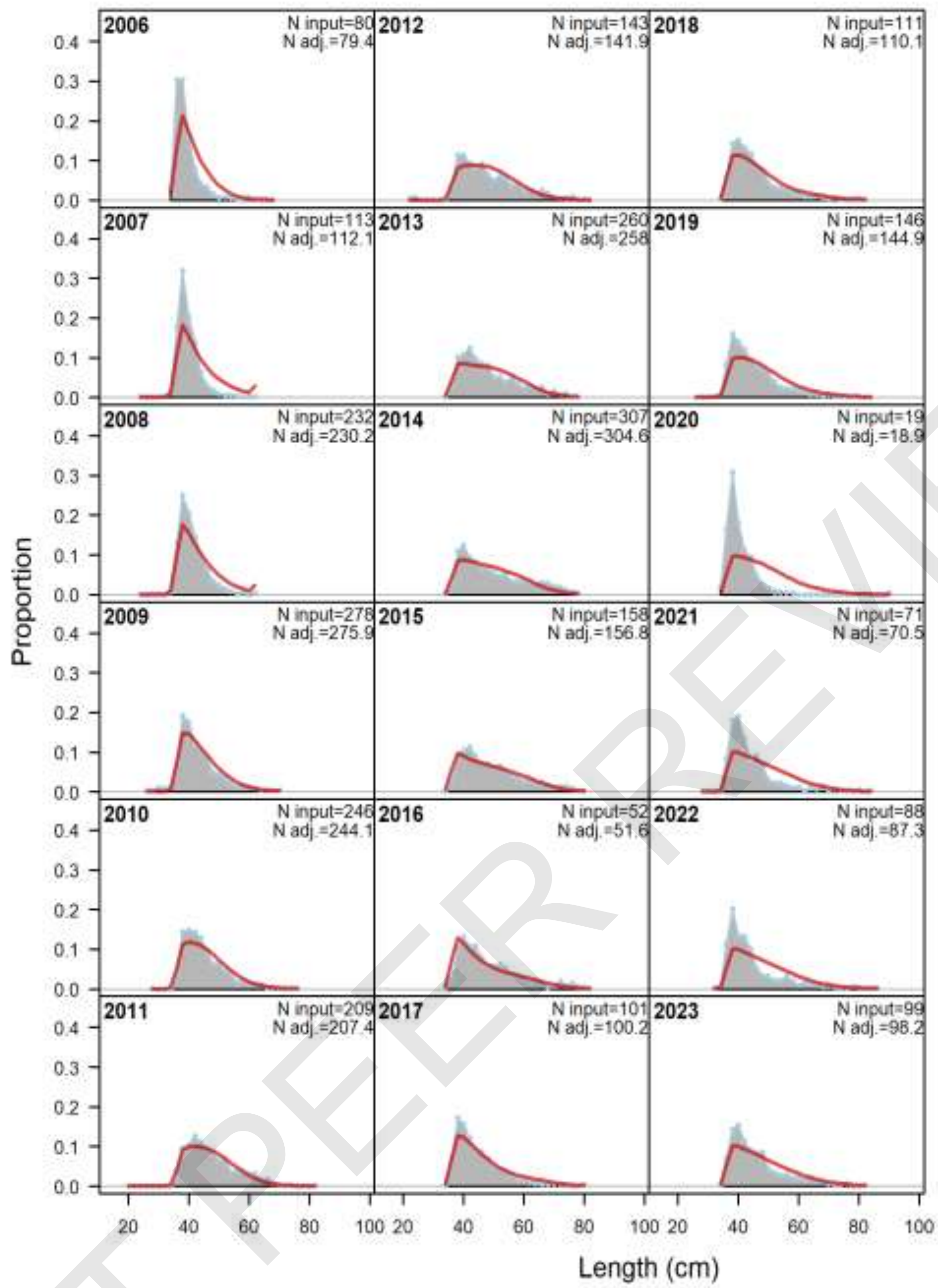


Figure 22 Continued. Length comps, retained, Recreational Headboat Central (plot 2 of 2). 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 128.406 and the sample size multiplier is approximately Θ / (1+Θ) = 0.992.*

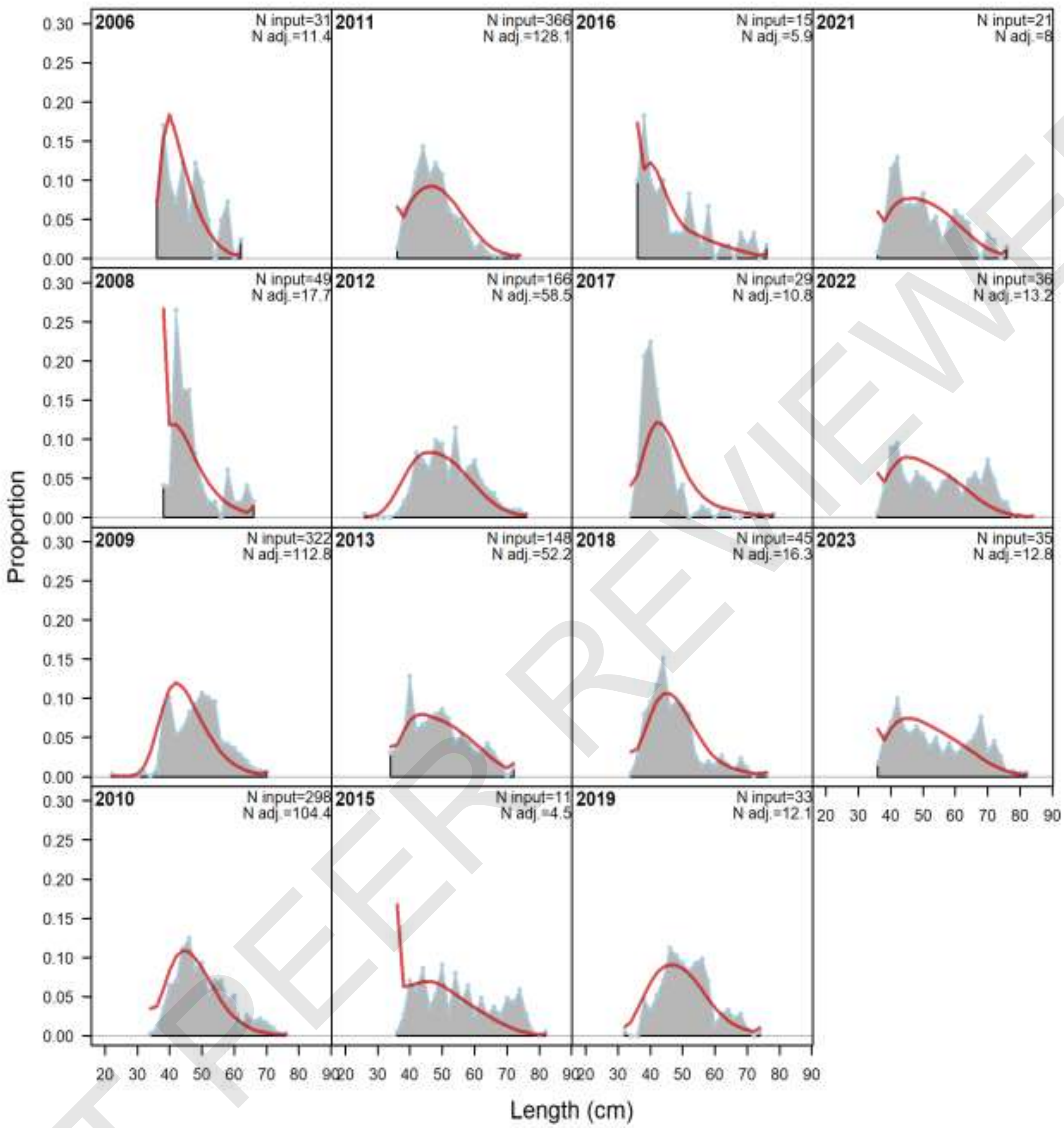


Figure 23. Length comps, retained, Recreational Headboat East. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 0.534 and the sample size multiplier is approximately Θ / (1+Θ) = 0.348.*

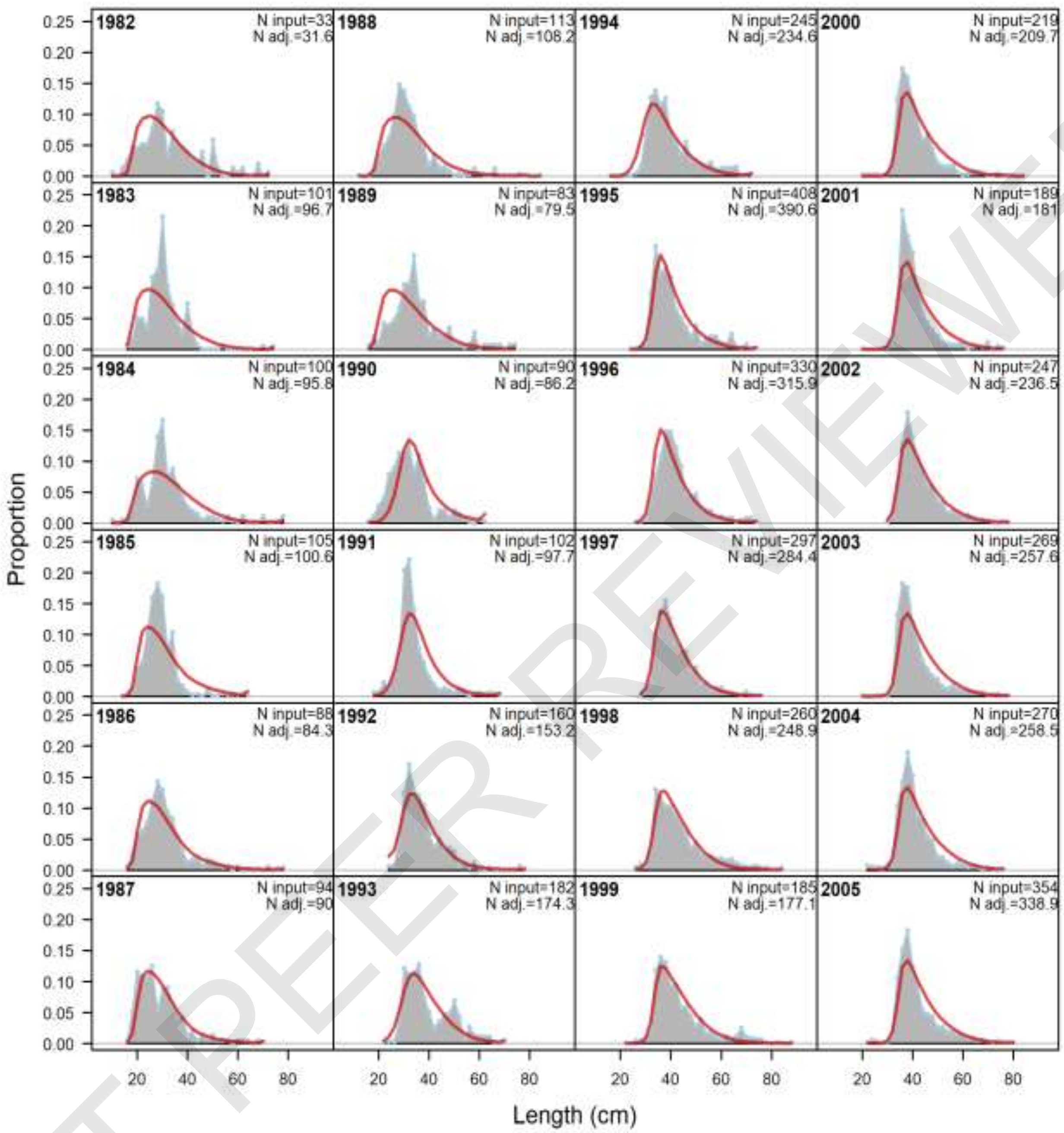


Figure 24. Length comps, retained, Recreational Private West (plot 1 of 2). 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, $\Theta = 22.415$ and the sample size multiplier is approximately $\Theta / (1+\Theta) = 0.957$.*

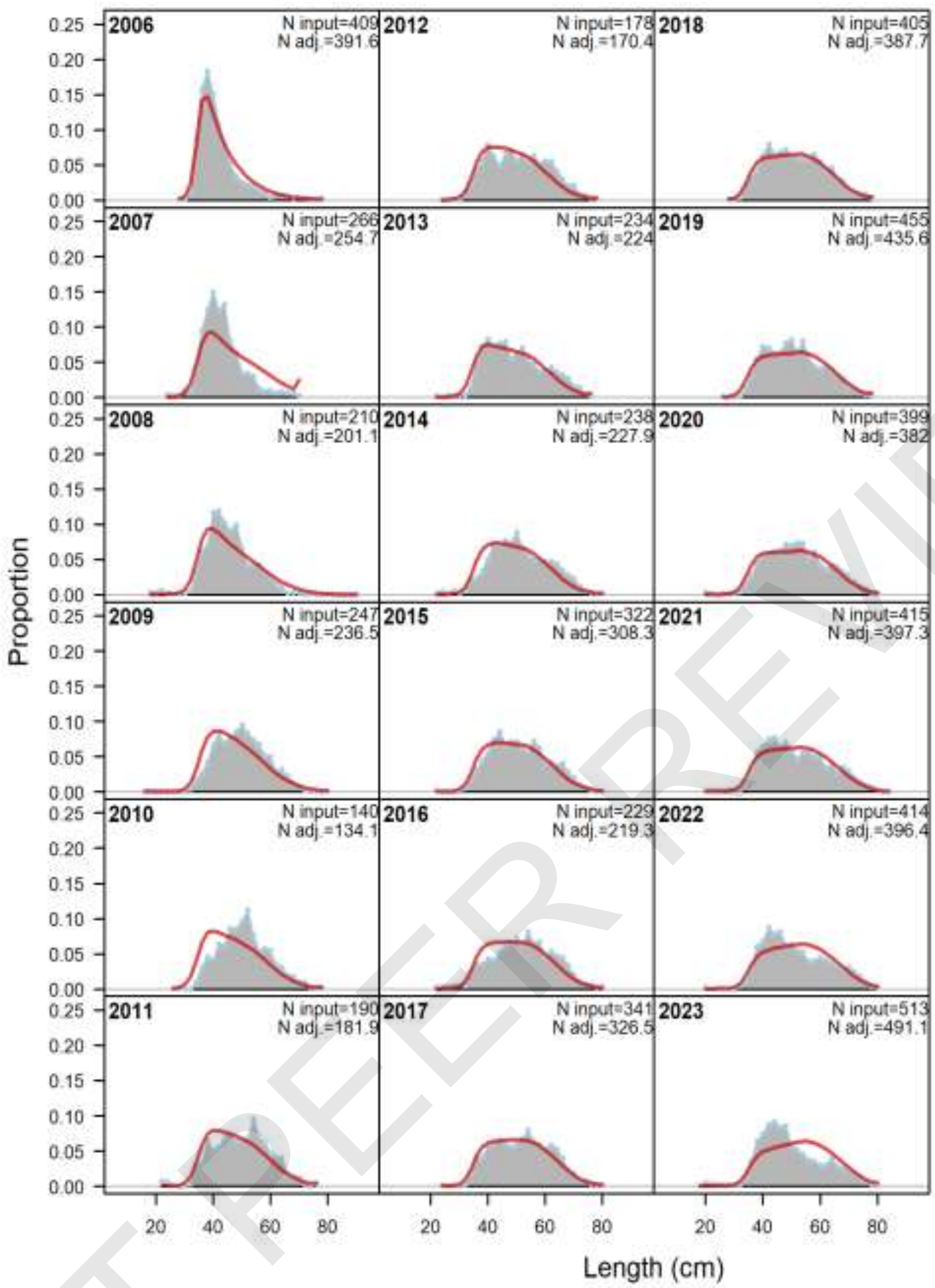


Figure 24 Continued. Length comps, retained, Recreational Private West (plot 2 of 2). 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 22.415 and the sample size multiplier is approximately Θ / (1+Θ) = 0.957.*

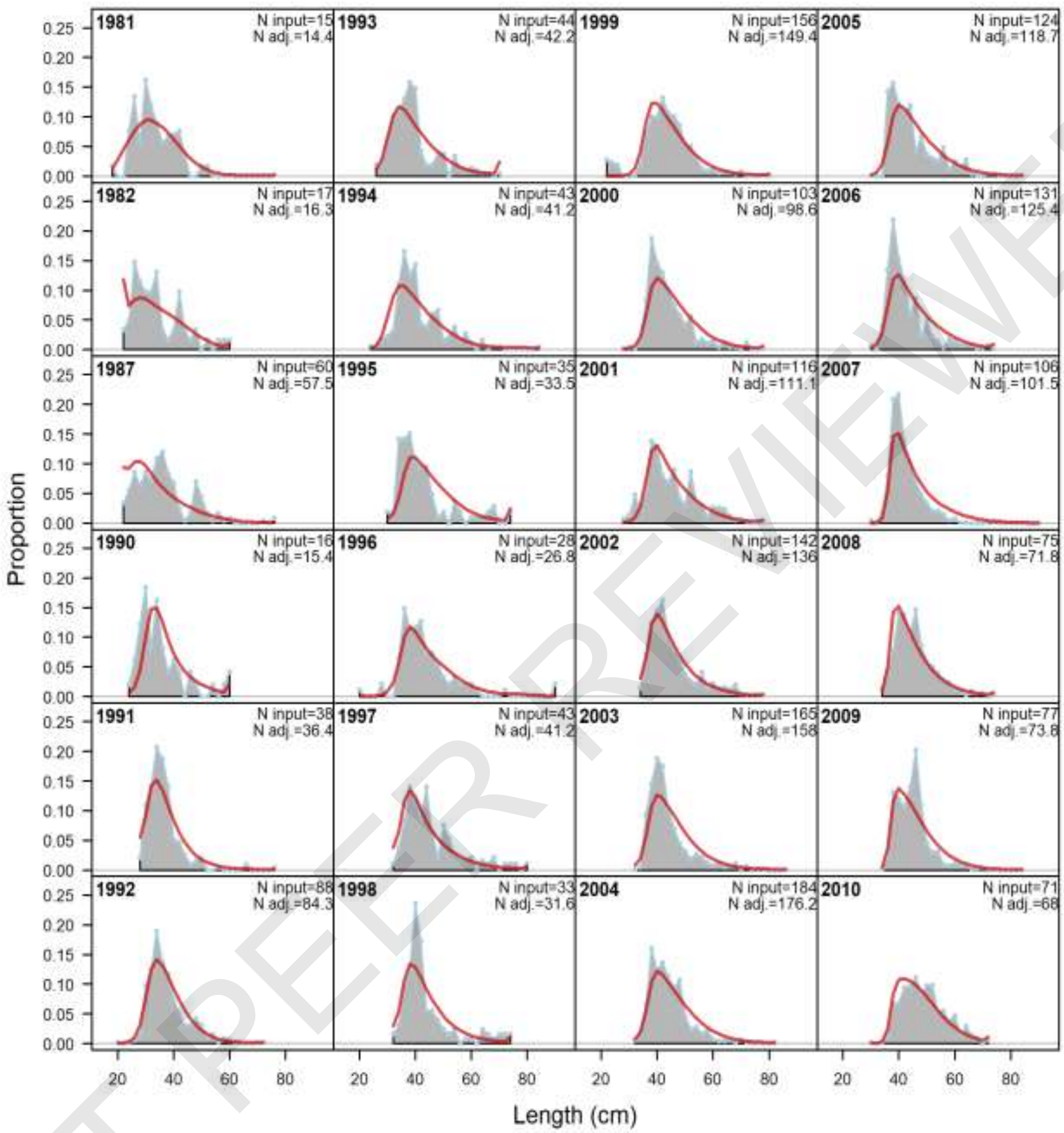


Figure 25. Length comps, retained, Recreational Private Central (plot 1 of 2). 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = $1 / (1+\Theta) + N\ \Theta / (1+\Theta)$. For this fleet, $\Theta = 22.415$ and the sample size multiplier is approximately $\Theta / (1+\Theta) = 0.957$.*

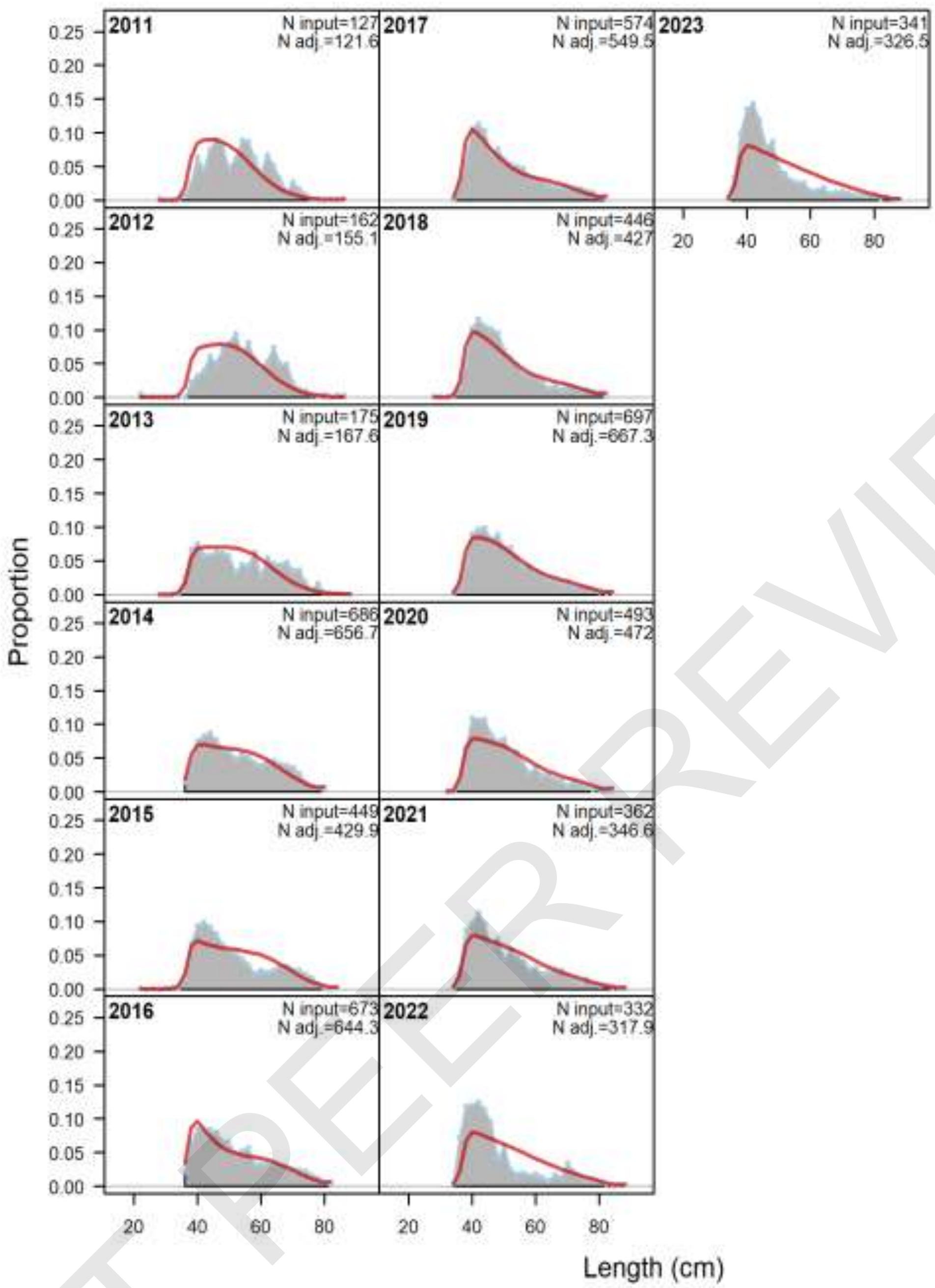


Figure 25 Continued. Length comps, retained, Recreational Private Central (plot 1 of 2). 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 22.415 and the sample size multiplier is approximately Θ / (1+Θ) = 0.957.*

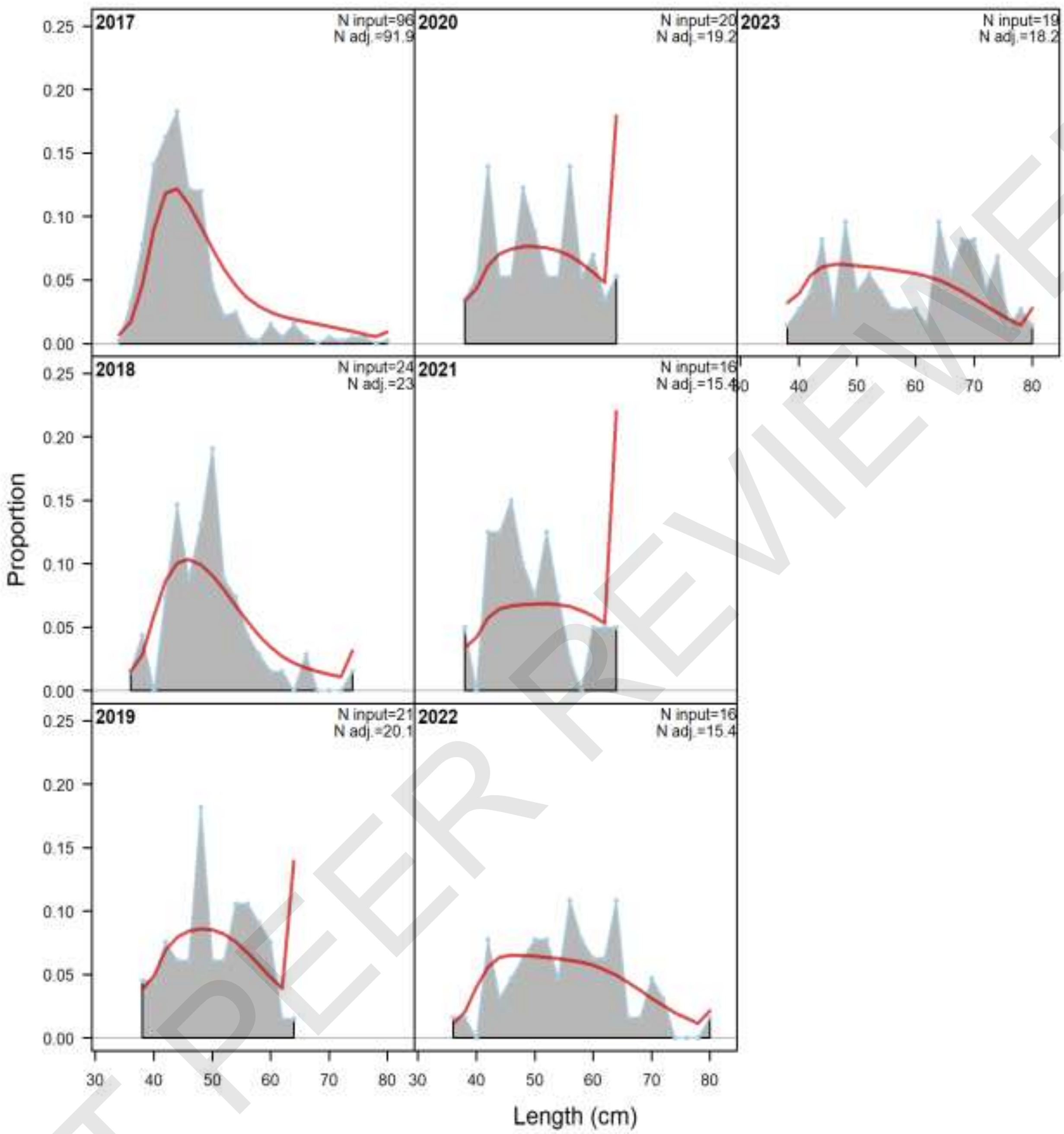


Figure 26. Length comps, retained, Recreational Private East. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 22.415 and the sample size multiplier is approximately Θ / (1+Θ) = 0.957.*

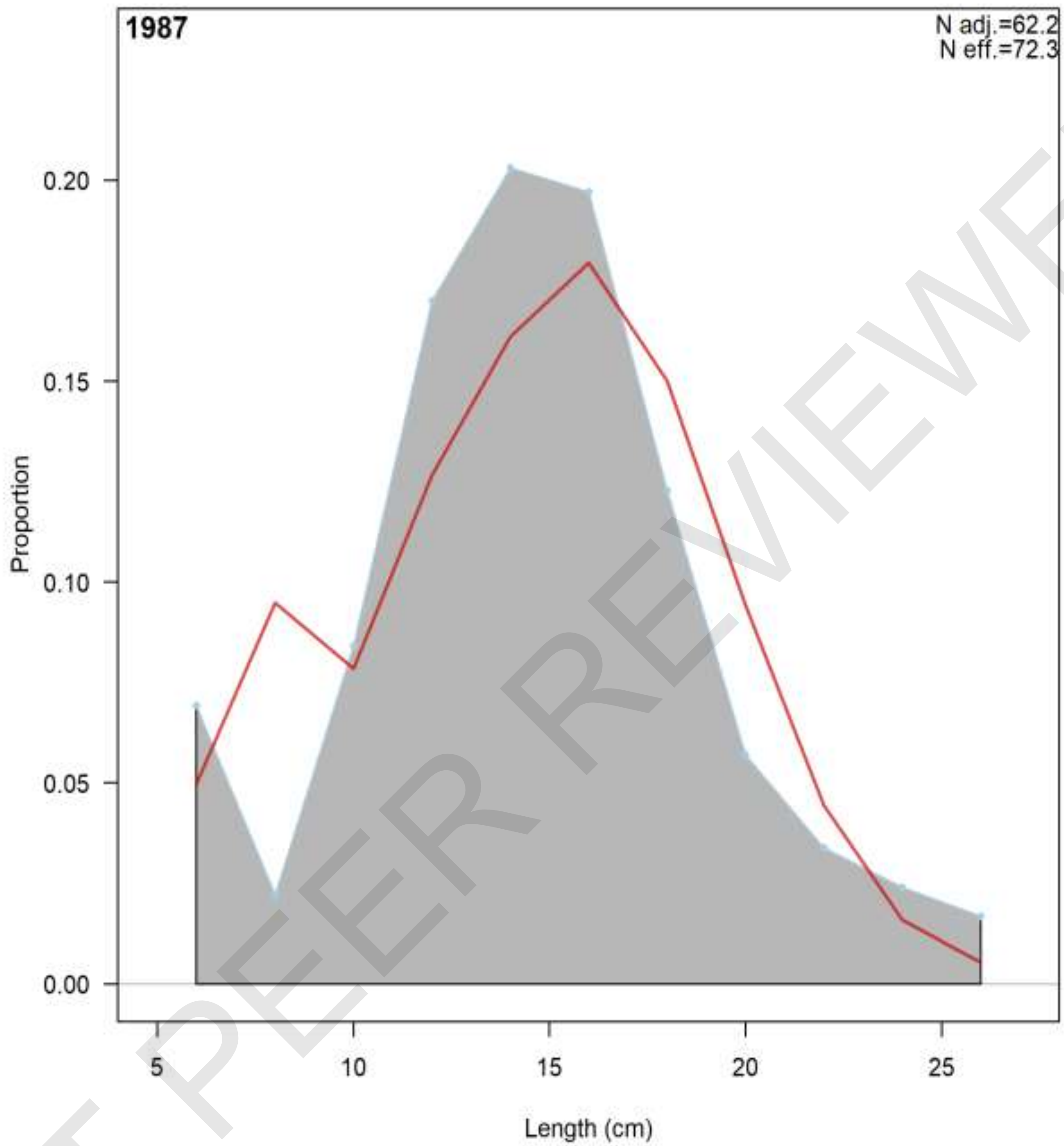


*Figure 27. Length comps, whole catch, SEAMAP Summer Trawl Pre-2007 West.

'N adj.' is the input sample size after data-weighting adjustment. N eff. is the calculated effective sample size used in the McAllister-Ianelli tuning method.*

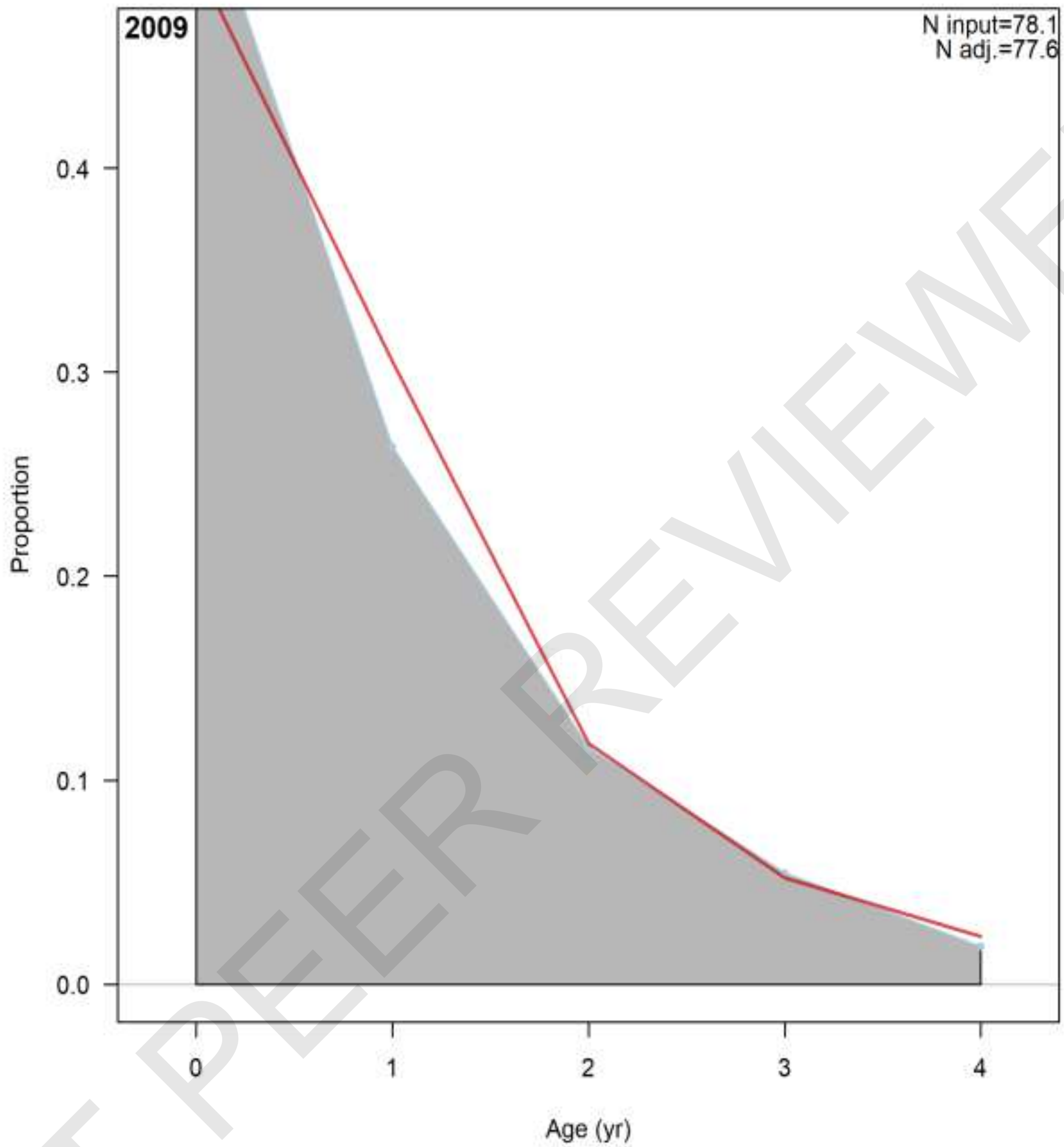


Figure 28. Age comps, whole catch, SEAMAP Summer Trawl Post-2007 West. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 148.413 and the sample size multiplier is approximately Θ / (1+Θ) = 0.993.*

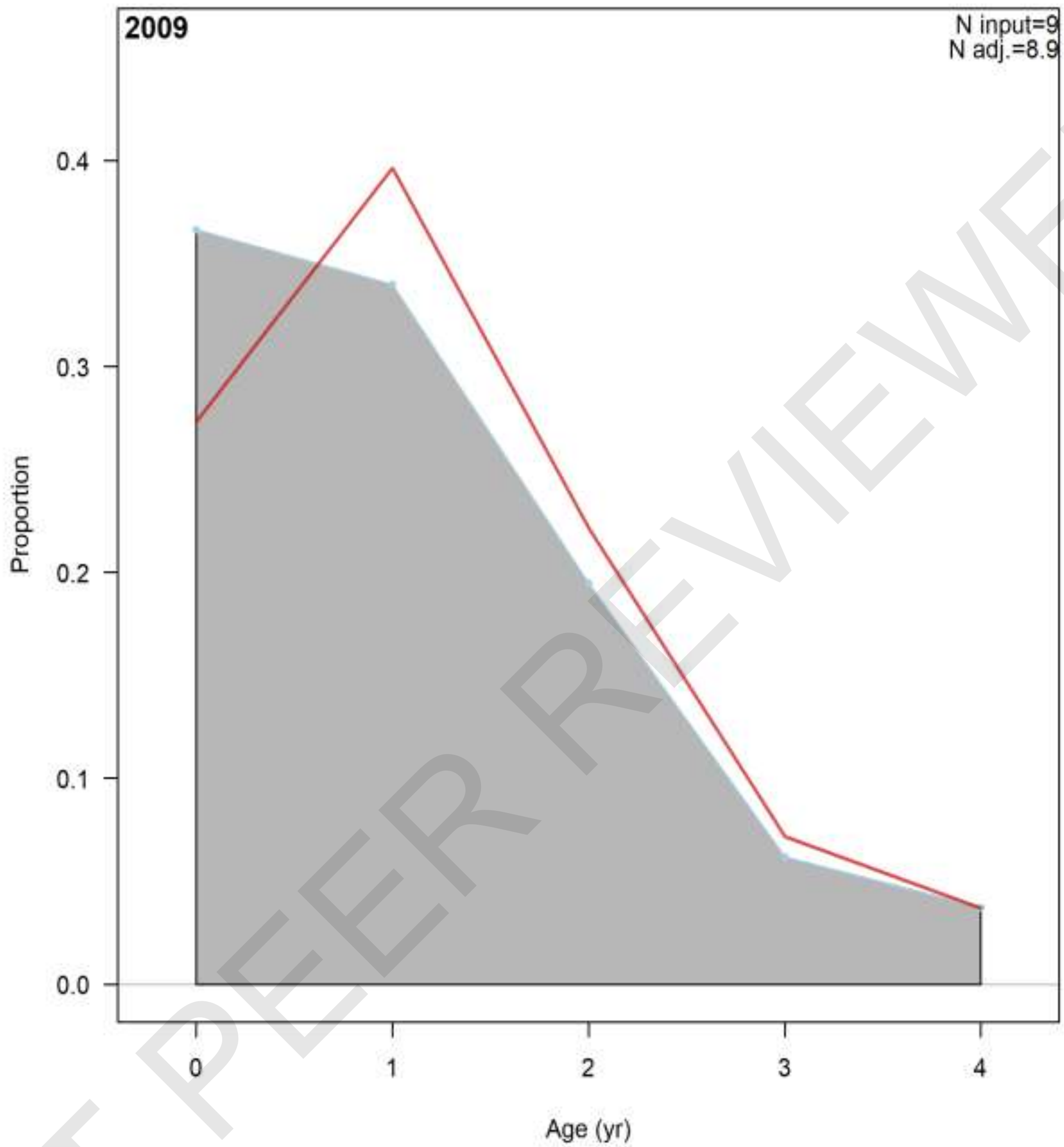


Figure 29. Age comps, whole catch, SEAMAP Summer Trawl Post-2007 Central. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 148.413 and the sample size multiplier is approximately Θ / (1+Θ) = 0.993.*

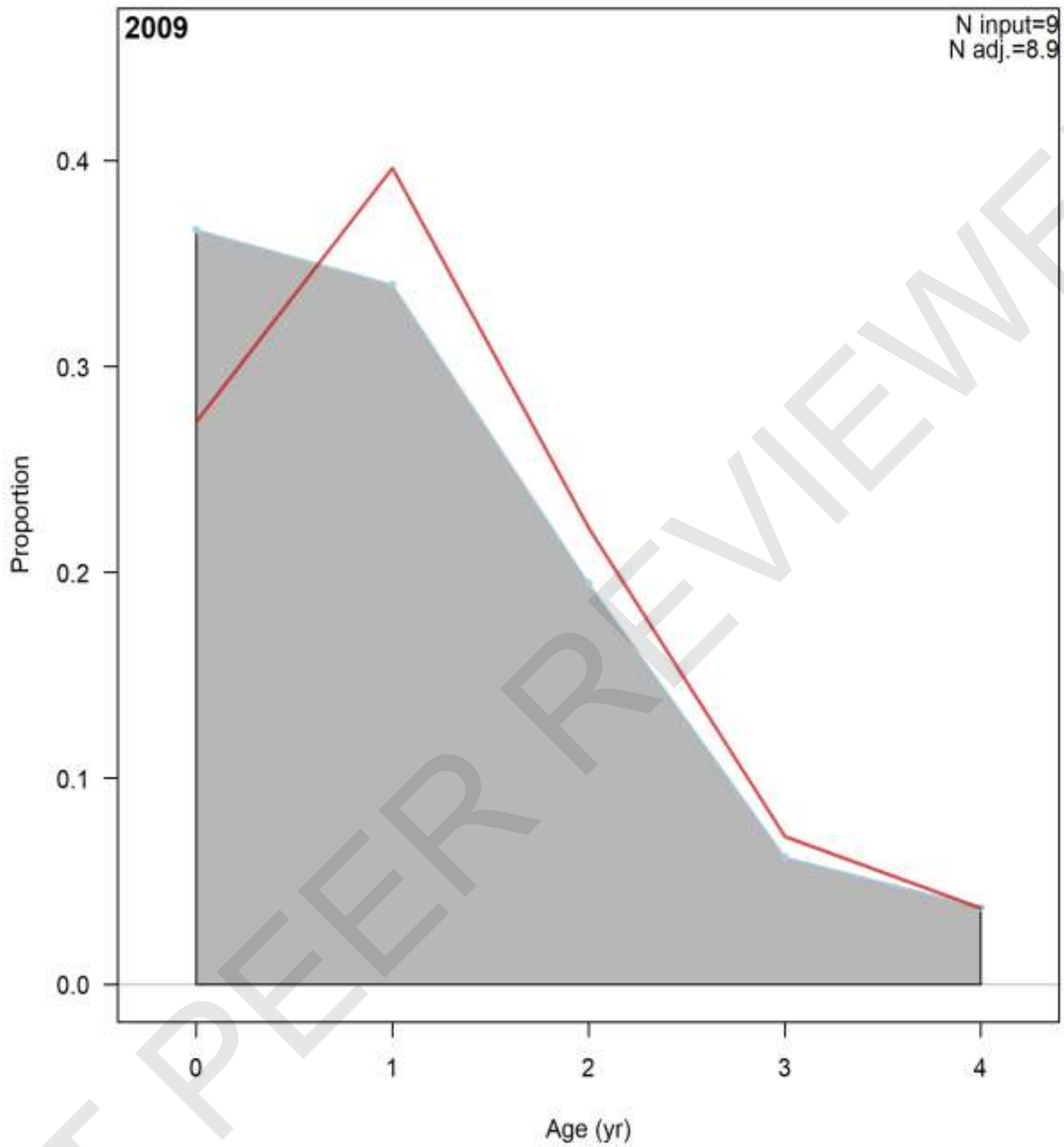


Figure 30. Age comps, whole catch, SEAMAP Summer Trawl Post-2007 East. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 148.413 and the sample size multiplier is approximately Θ / (1+Θ) = 0.993.*

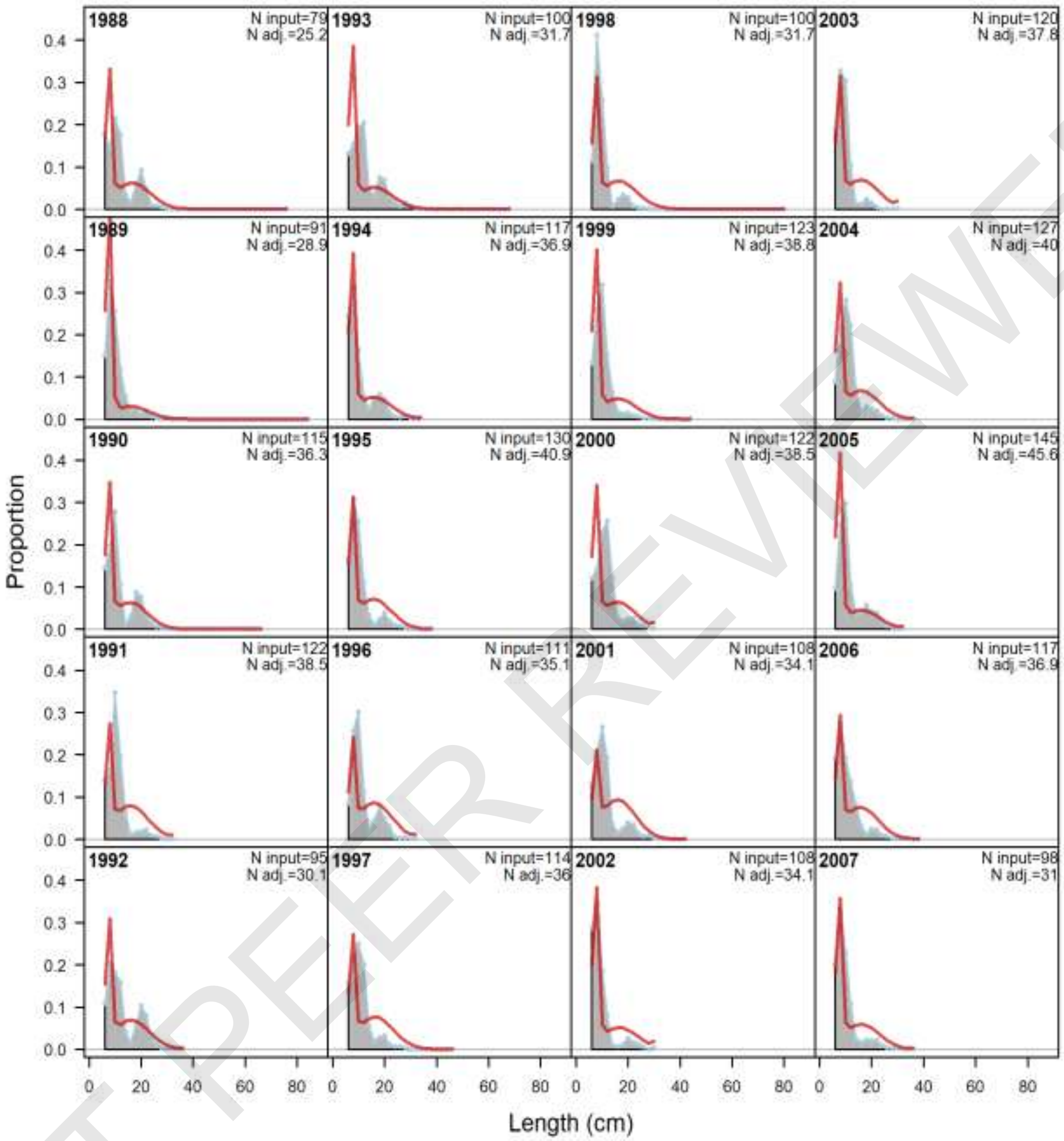


Figure 31. Length comps, whole catch, SEAMAP Fall Trawl Pre-2007 West. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 0.448 and the sample size multiplier is approximately Θ / (1+Θ) = 0.31.*

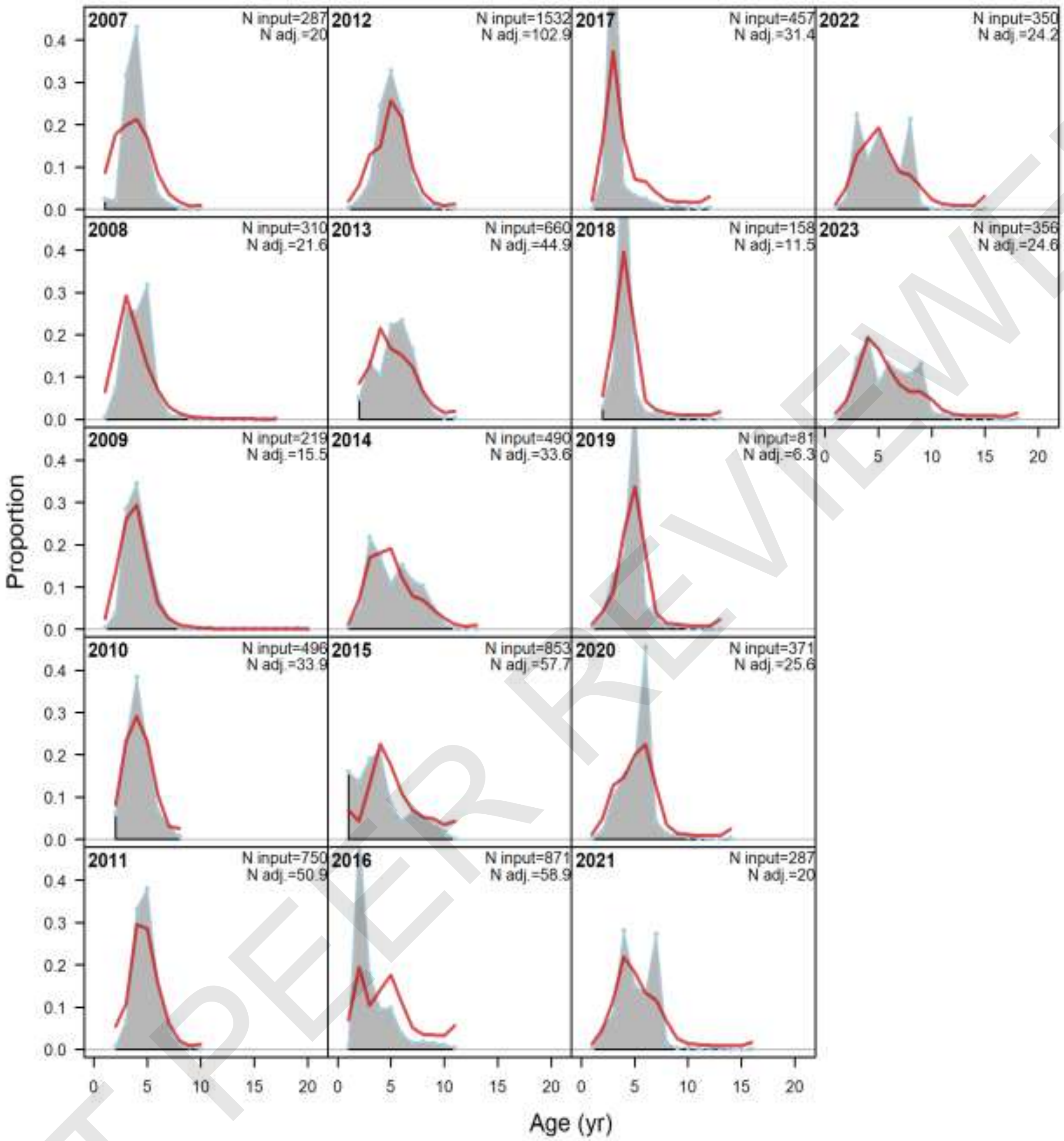


Figure 32. Age comps, whole catch, Commercial Observer Program East. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 0.071 and the sample size multiplier is approximately Θ / (1+Θ) = 0.067.*

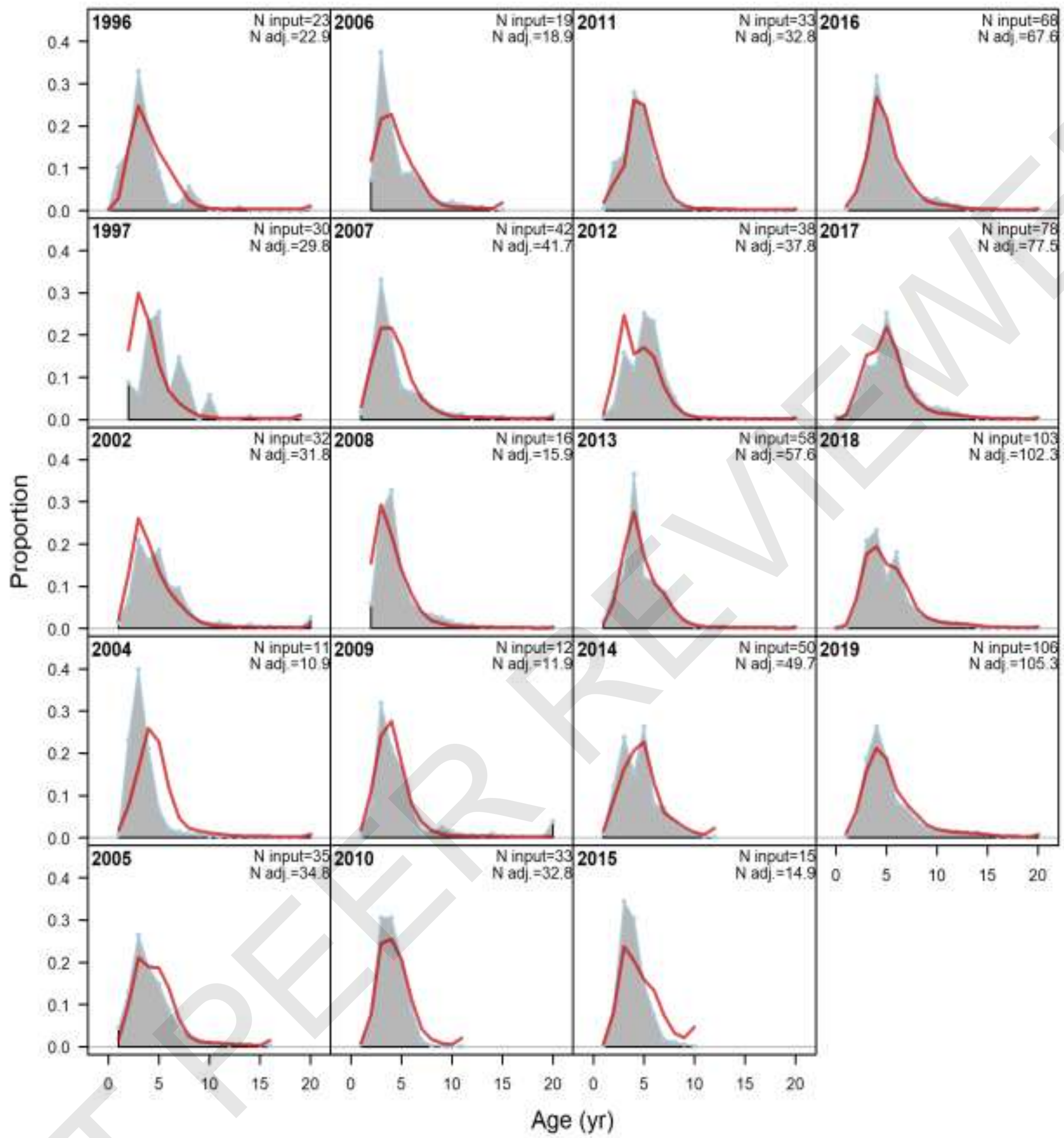


Figure 33. Age comps, whole catch, Combined Video Survey Central. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 148.309 and the sample size multiplier is approximately Θ / (1+Θ) = 0.993.*

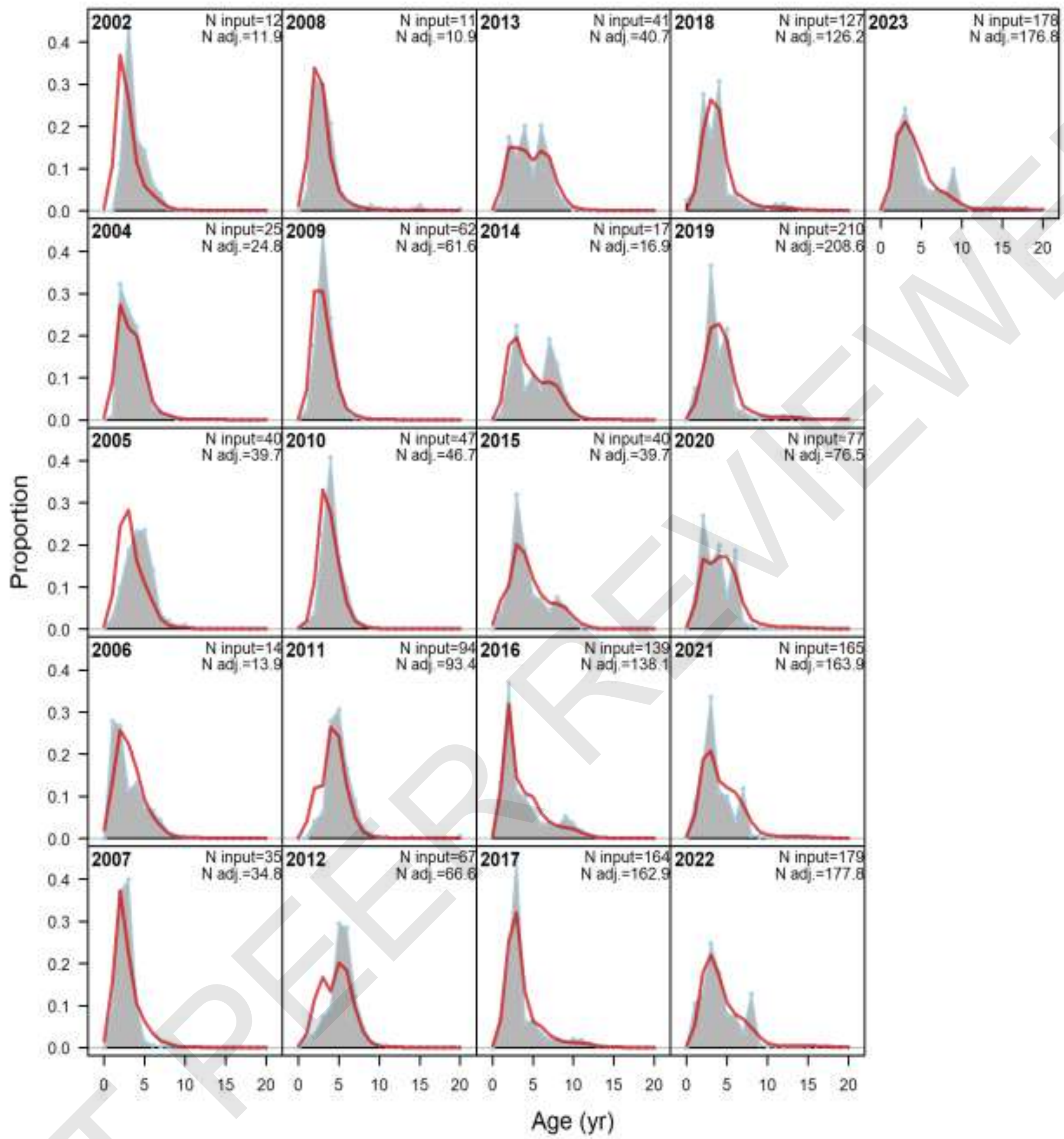


Figure 34. Age comps, whole catch, Combined Video Survey Central. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 148.309 and the sample size multiplier is approximately Θ / (1+Θ) = 0.993.*

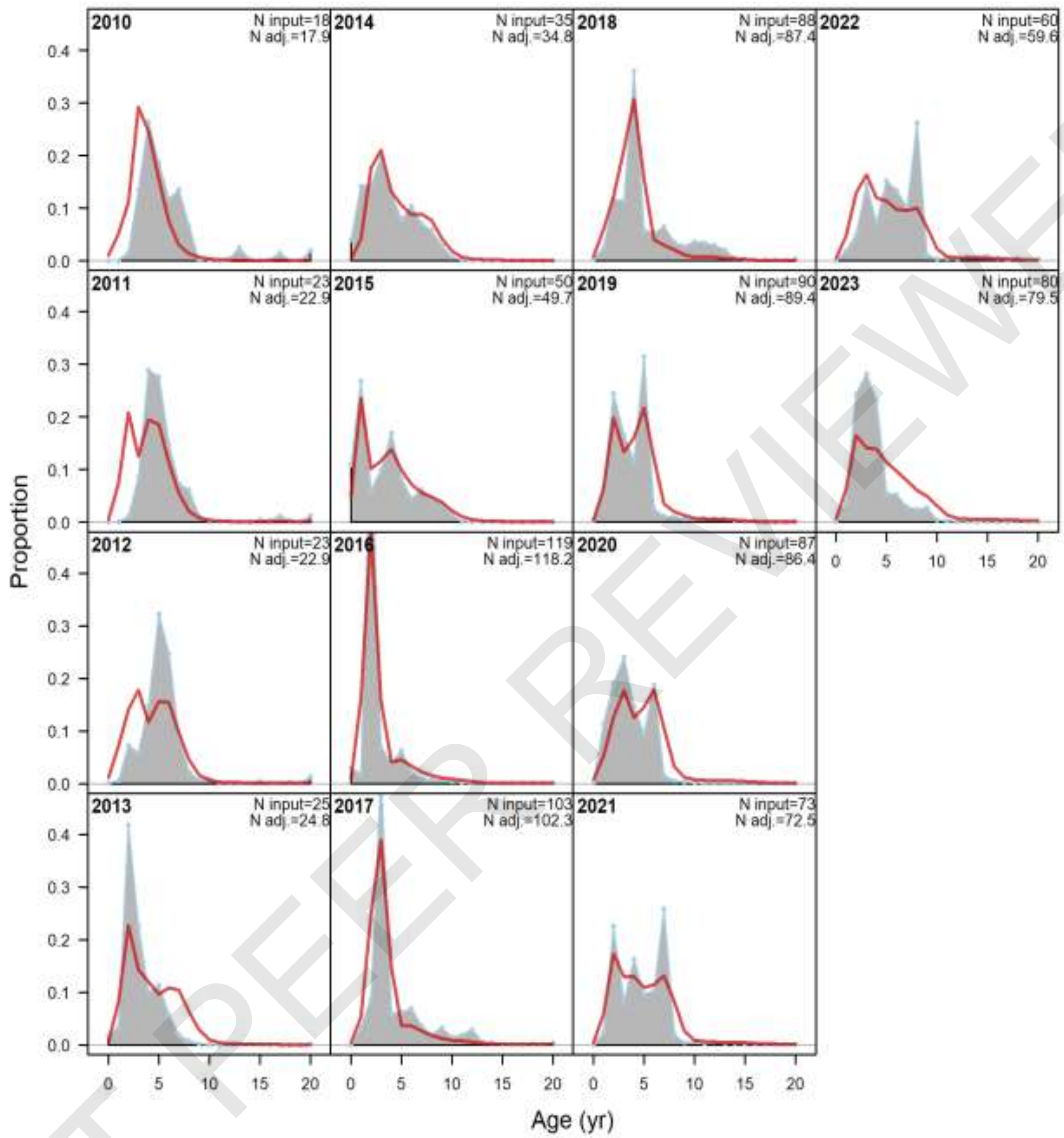


Figure 35. Age comps, whole catch, Combined Video Survey West. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 148.309 and the sample size multiplier is approximately Θ / (1+Θ) = 0.993.*

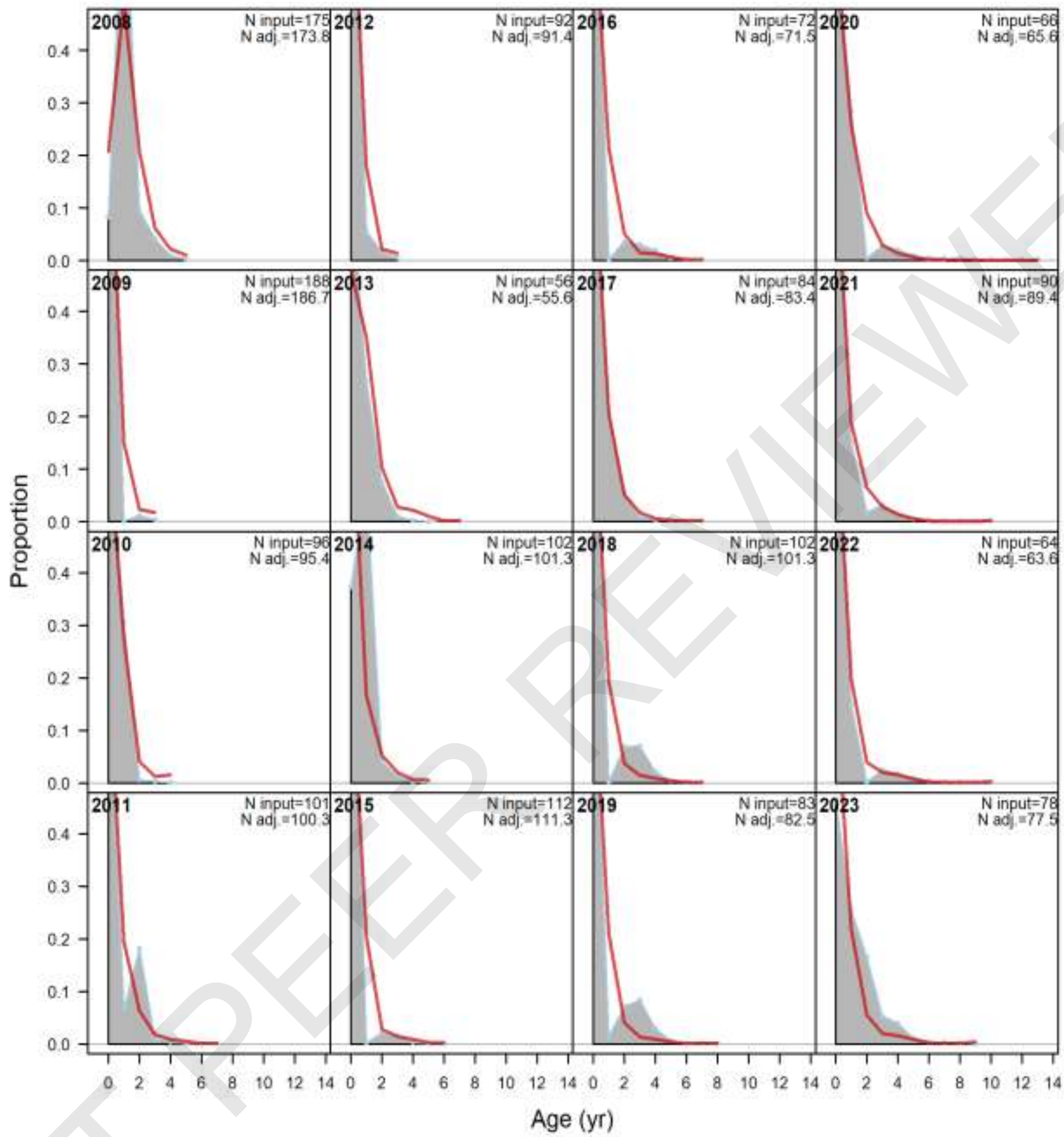


Figure 36. Age comps, whole catch, SEAMAP Fall Trawl Post-2007 West. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 148.413 and the sample size multiplier is approximately Θ / (1+Θ) = 0.993.*

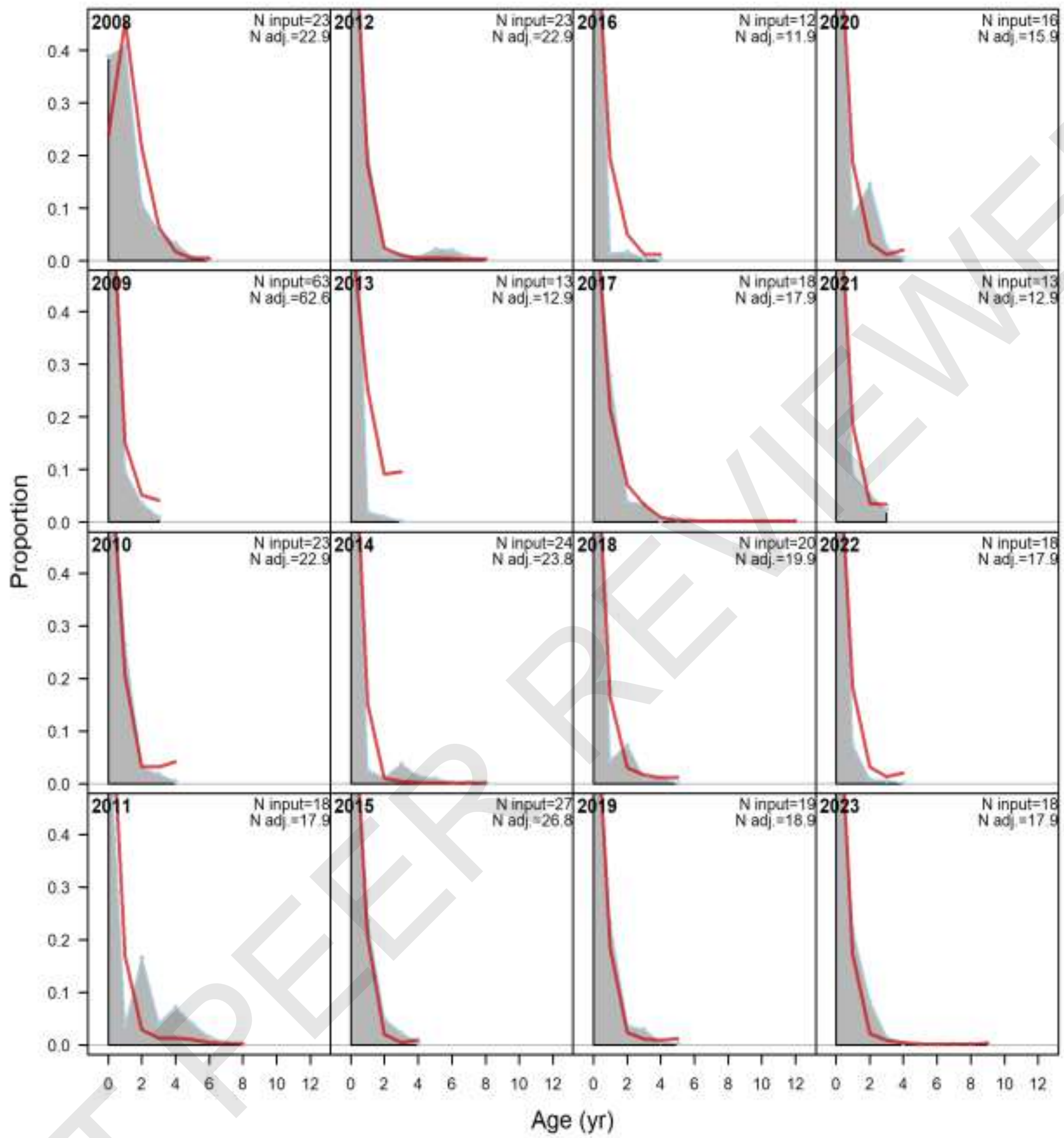


Figure 37. Age comps, whole catch, SEAMAP Fall Trawl Post-2007 Central. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 148.413 and the sample size multiplier is approximately Θ / (1+Θ) = 0.993.*

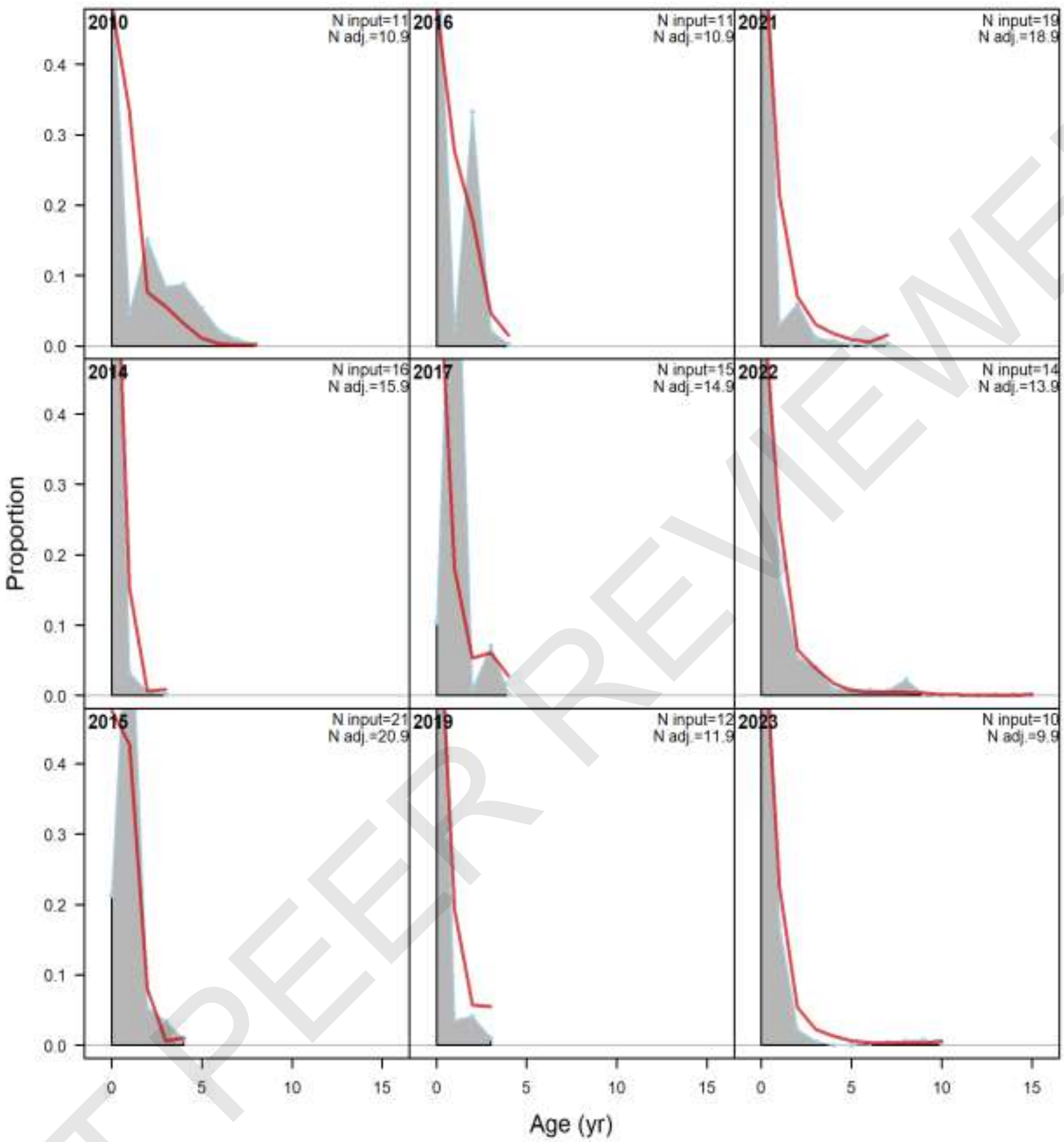


Figure 38. Age comps, whole catch, SEAMAP Fall Trawl Post-2007 East. ‘N input’ is the input sample size. ‘N adj.’ is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 148.413 and the sample size multiplier is approximately Θ / (1+Θ) = 0.993.*

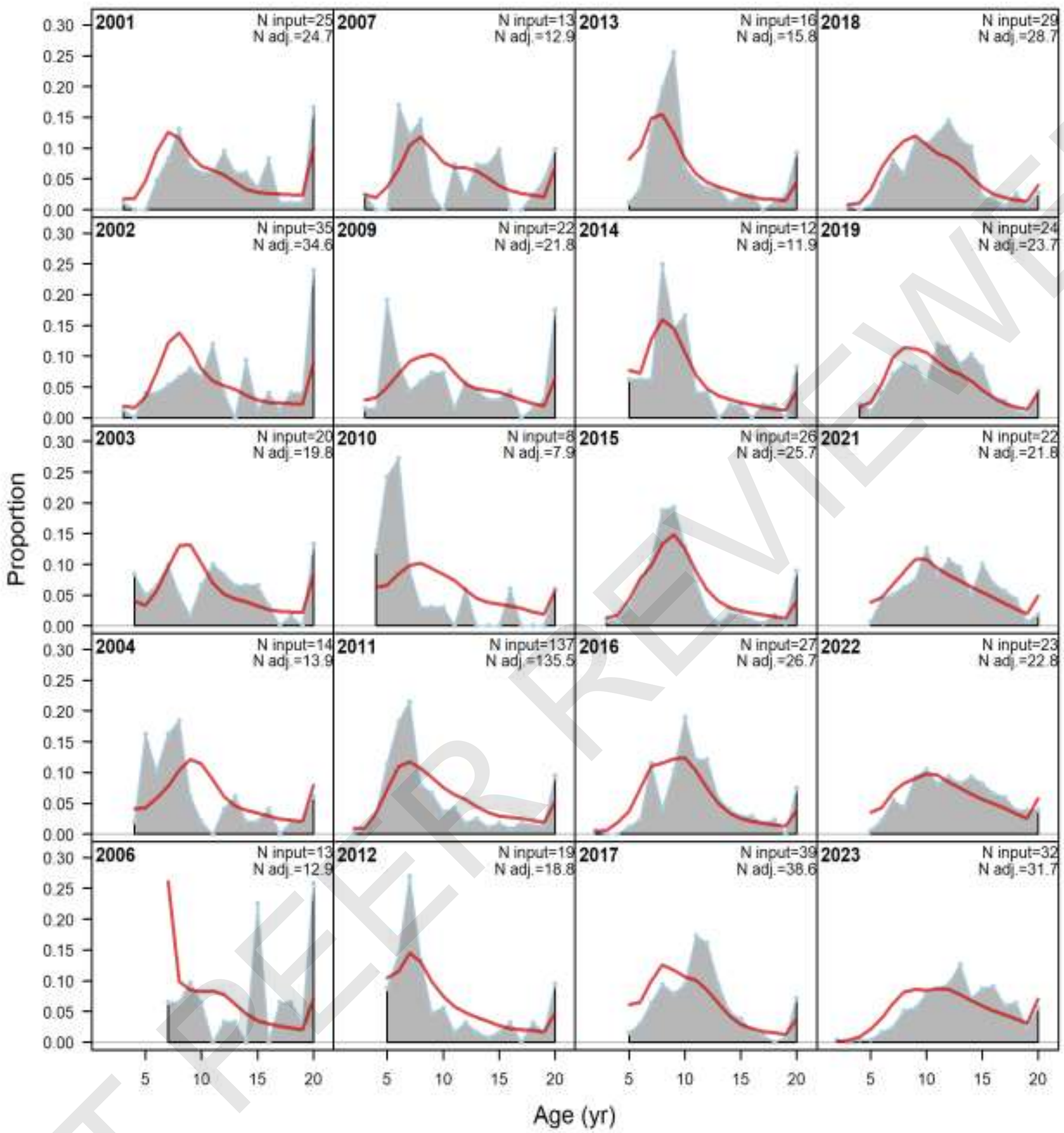


Figure 39. Age comps, whole catch, Bottom Longline West. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 88.536 and the sample size multiplier is approximately Θ / (1+Θ) = 0.989.*

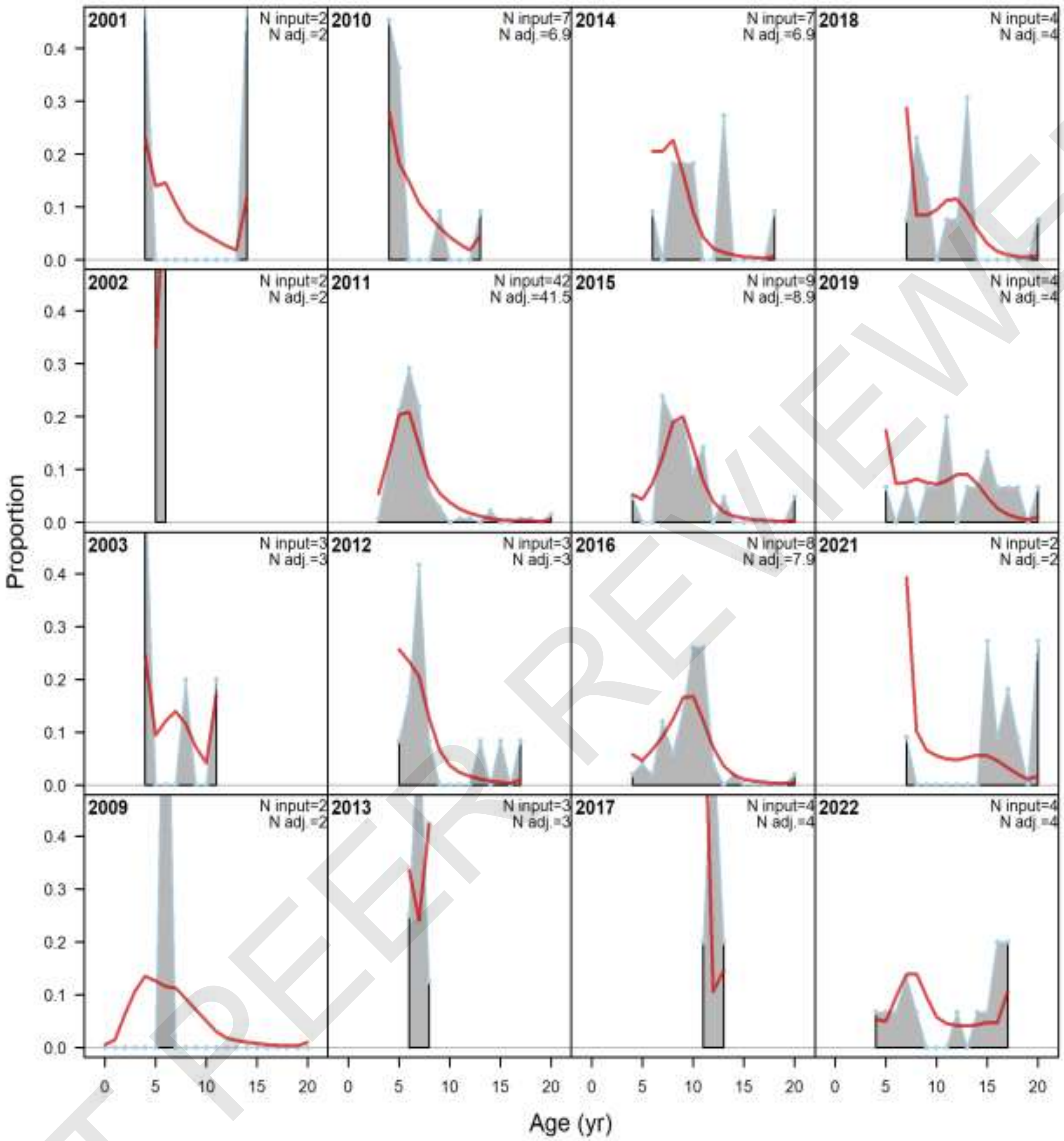


Figure 40. Age comps, whole catch, Bottom Longline Central. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 88.536 and the sample size multiplier is approximately Θ / (1+Θ) = 0.989.*

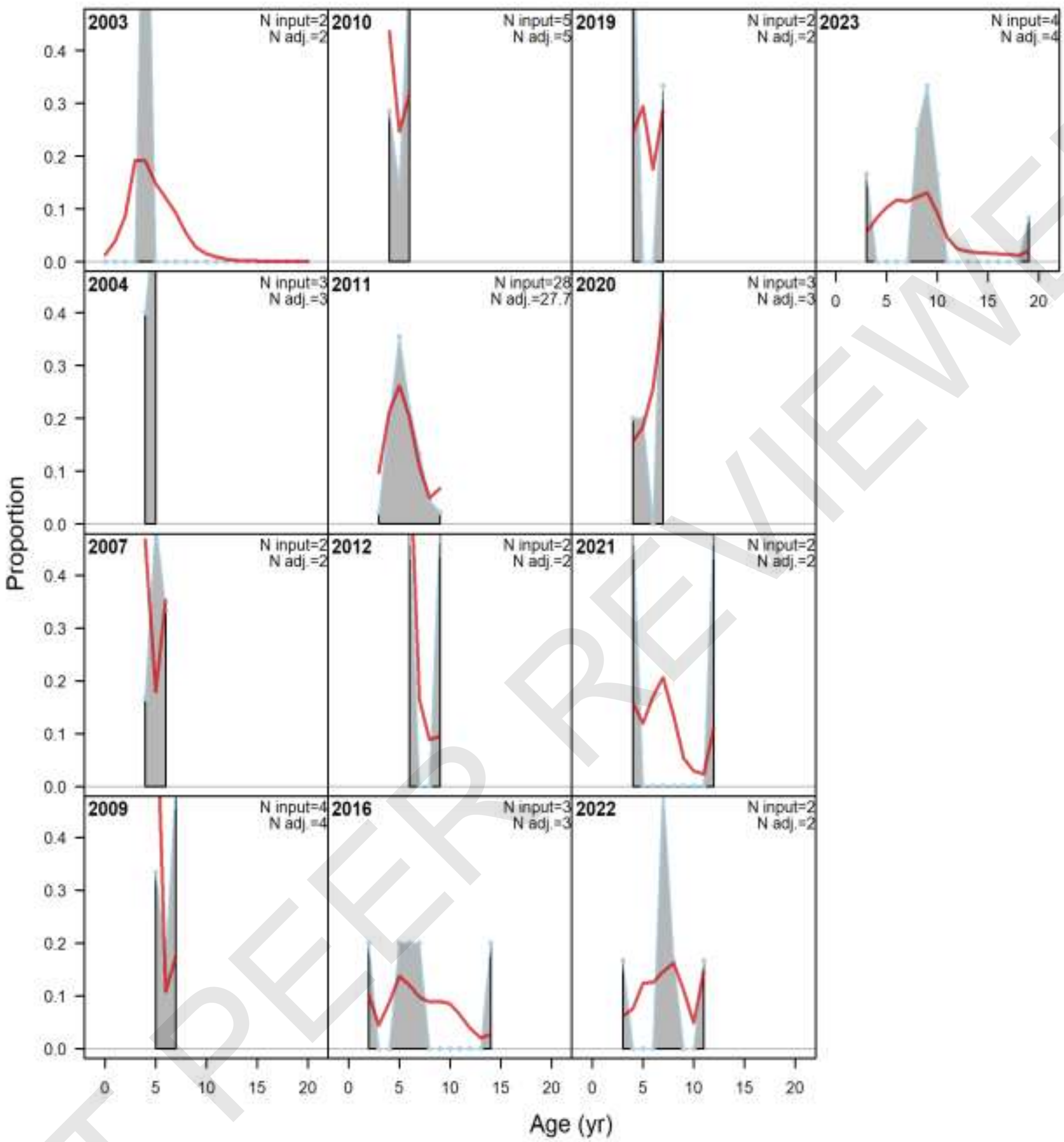
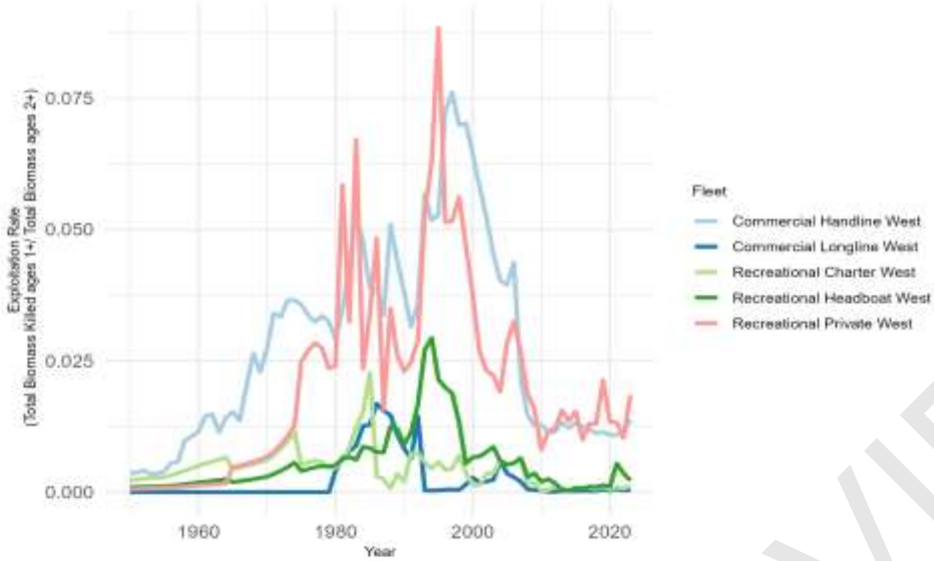


Figure 41. Age comps, whole catch, Bottom Longline East. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 88.536 and the sample size multiplier is approximately Θ / (1+Θ) = 0.989.*

West



Central

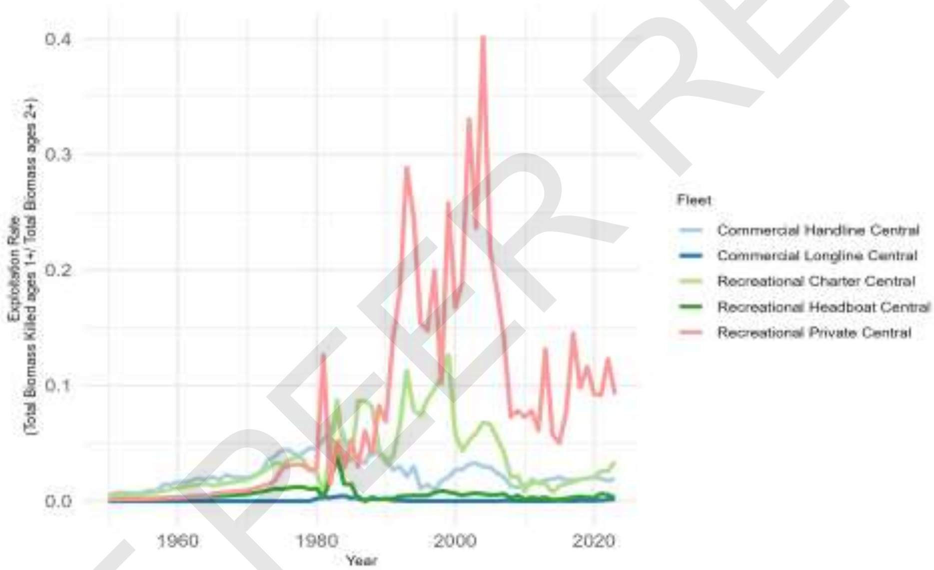


Figure 42. Annual exploitation rate (total biomass killed 1+/ total biomass age 1+) by fleet for Gulf of America Red Snapper.

East

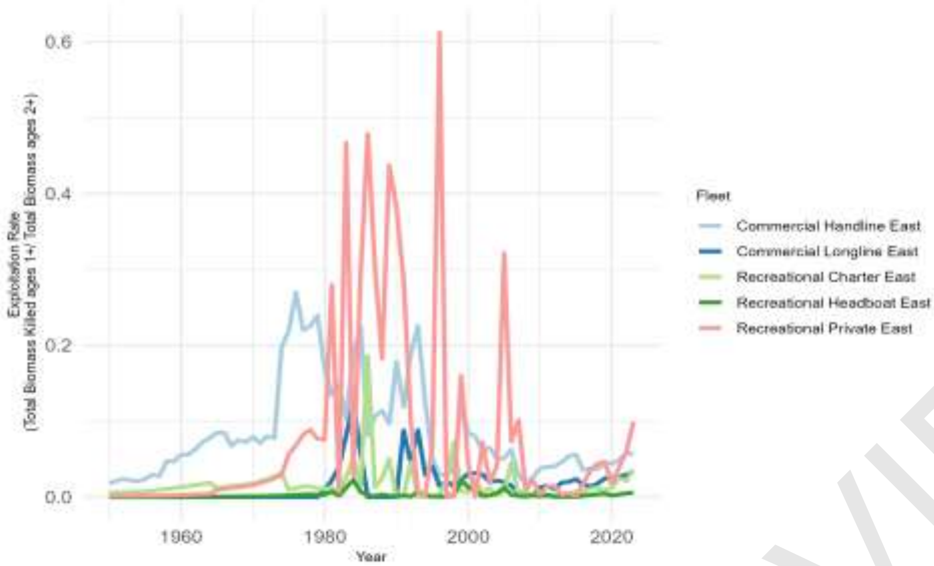
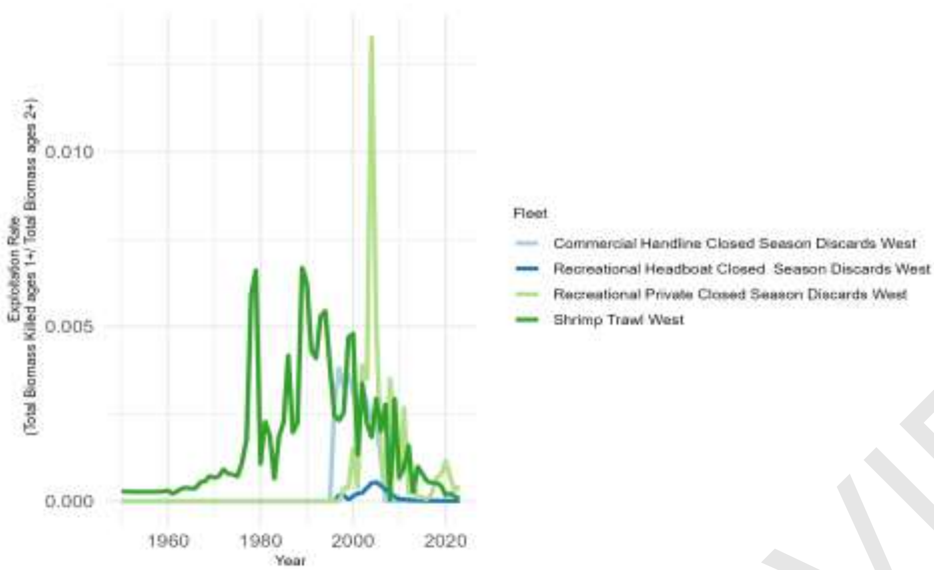


Figure 42 Continued. Annual exploitation rate (total biomass killed 1+/ total biomass age 1+) by fleet for Gulf of America Red Snapper.

West



Central

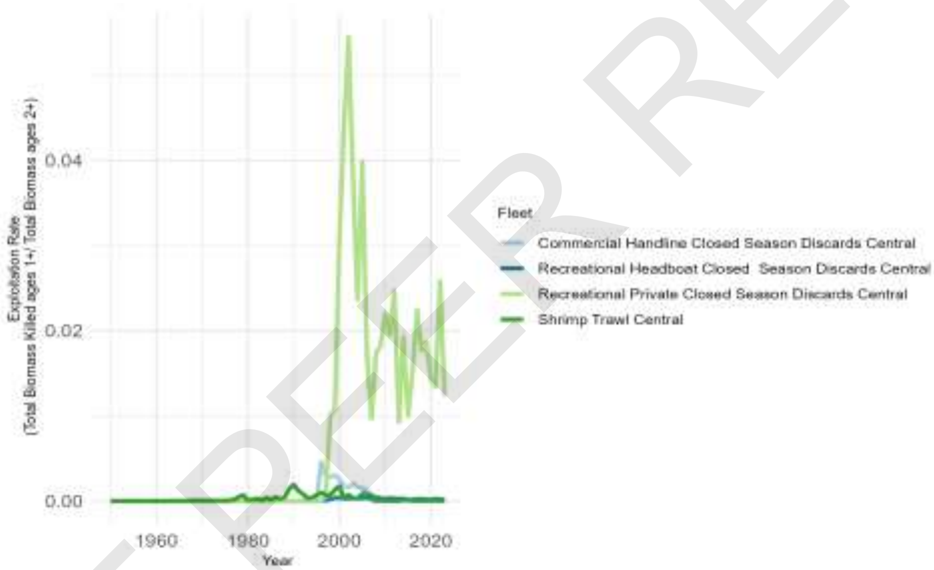


Figure 43. Annual exploitation rate for Gulf of America Red Snapper discard and bycatch (total biomass killed 1+/ total biomass age 1+) fleets.

East

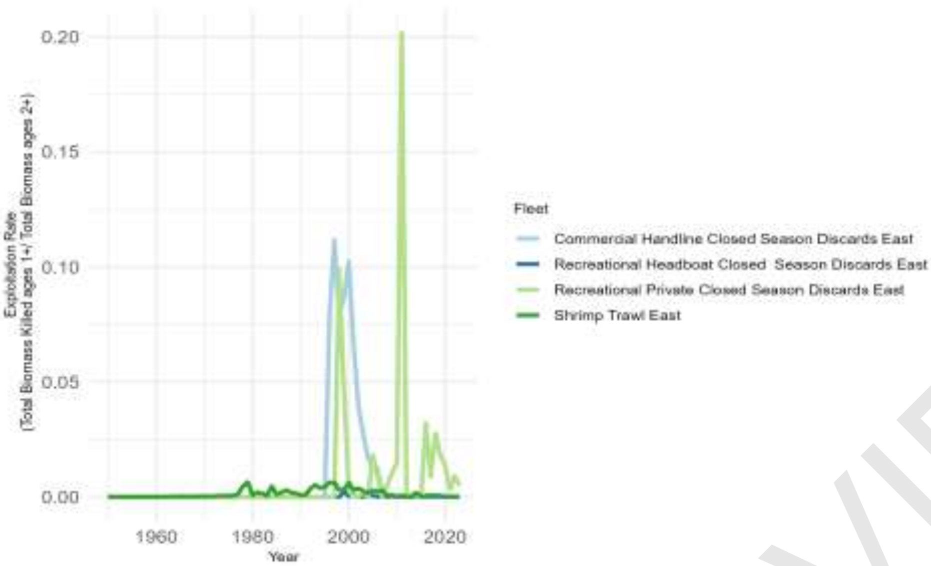


Figure 43 Continued. Annual exploitation rate for Gulf of America Red Snapper discard and bycatch (total biomass killed 1+/ total biomass age 1+) fleets.

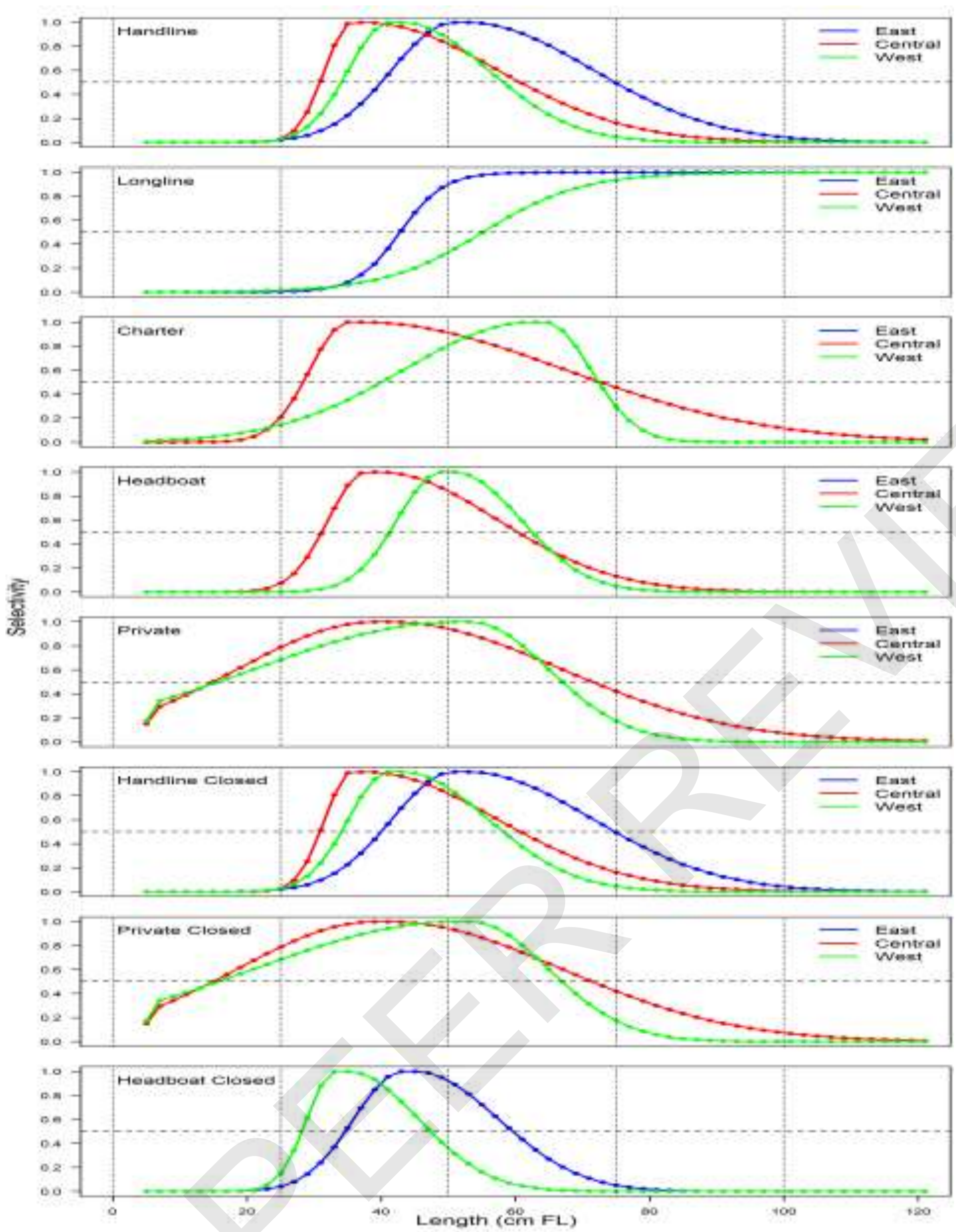


Figure 44. Length-based selectivity for commercial and recreatoinal fleets for Gulf of America Red Snapper in the terminal year of the assessment. Dashed horizontal line indicates 50%, whereas the dashed vertical lines identify lengths in 25 cm FL intervals. Note: The east area selectivity curve mirrors the central area curve in the recreational fleets.

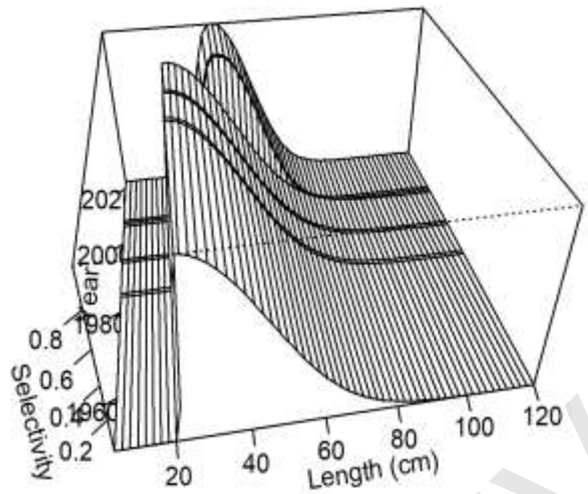


Figure 45. Time varying length-based selectivity for the Commercial Handline West fleet.

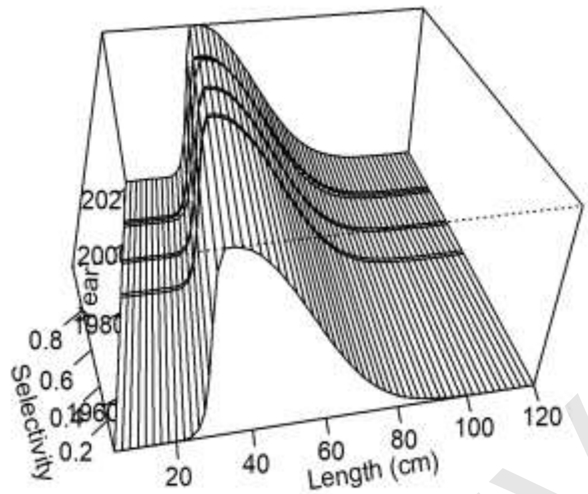


Figure 46. Time varying length-based selectivity for the Commercial Handline Central fleet.

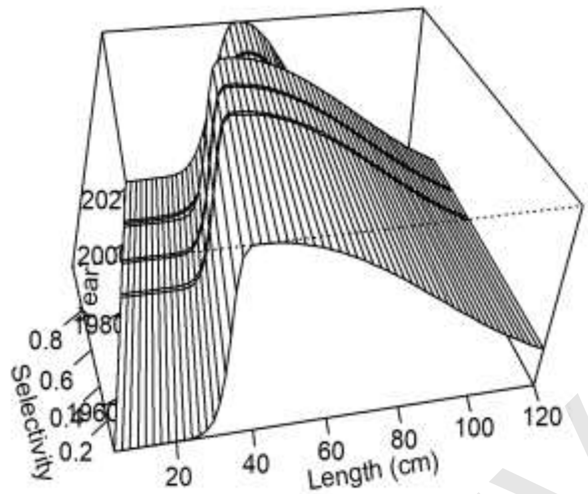


Figure 47. Time varying length-based selectivity for the Commercial Handline East fleet.

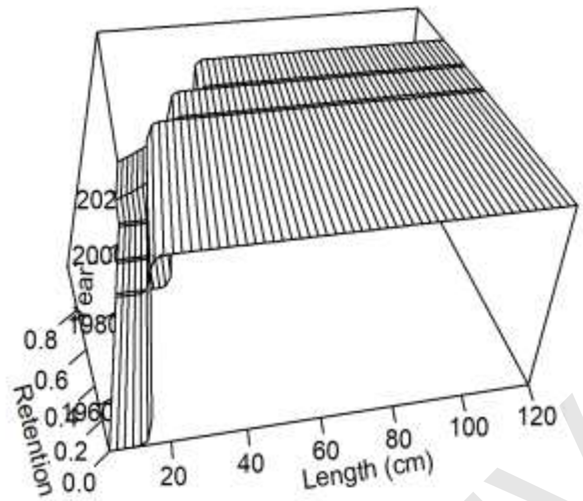


Figure 48. Time varying length-based retention for the Commercial Longline West fleet.

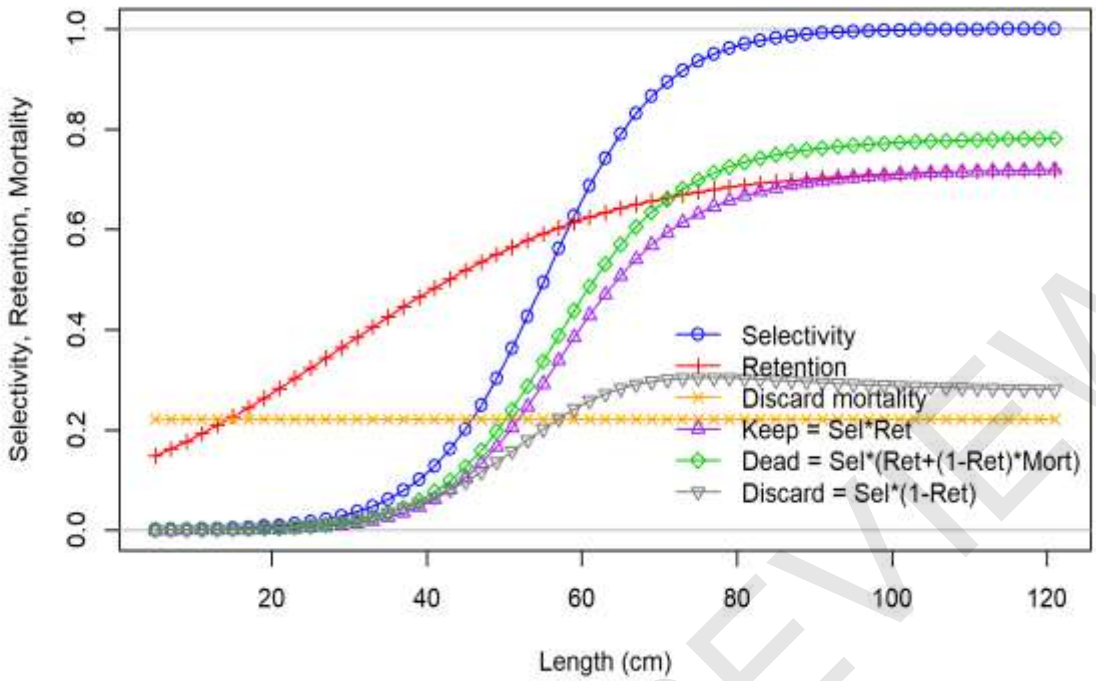


Figure 49. Length-based selectivity and retention for the Commercial Longline West fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

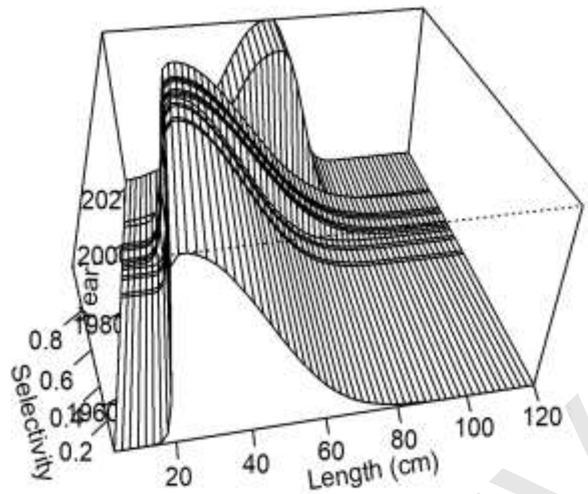


Figure 50. Time varying length-based selectivity for the Recreational Charter West fleet.

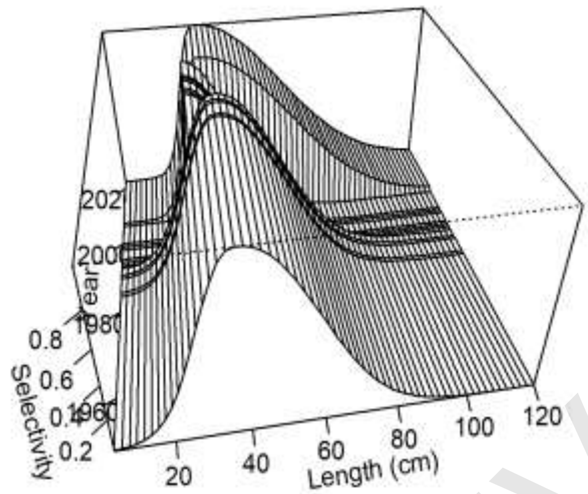


Figure 51. Time varying length-based selectivity for the Recreational Charter Central fleet.

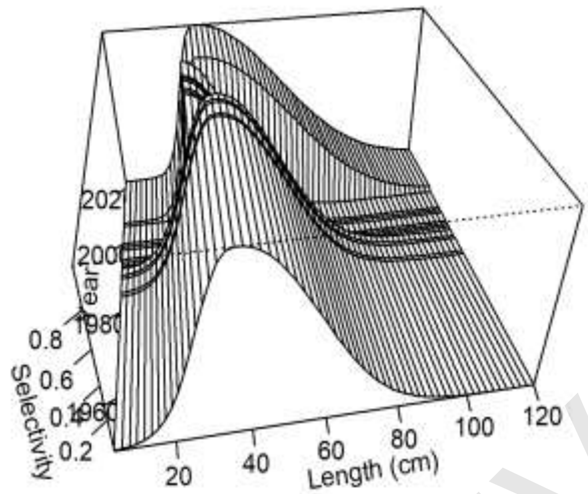


Figure 52. Time varying length-based selectivity for the Recreational Charter East fleet.

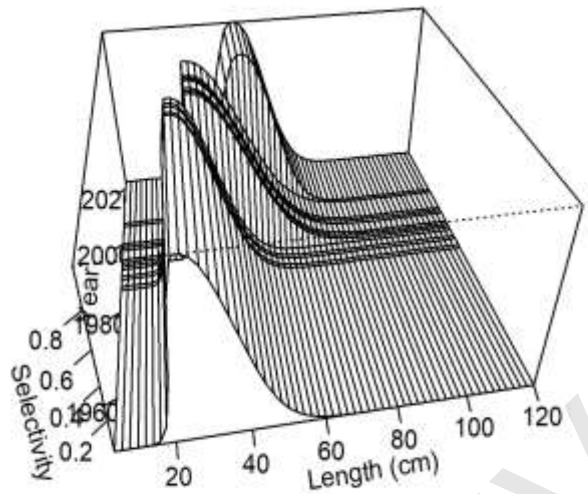


Figure 53. Time varying length-based selectivity for the Recreational Headboat West fleet.

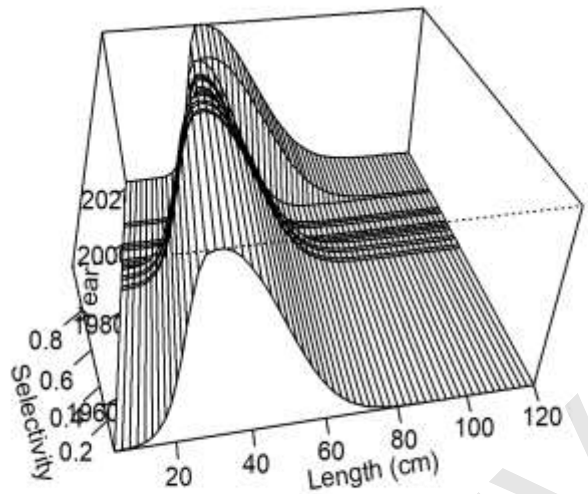


Figure 54. Time varying length-based selectivity for the Recreational Headboat Central fleet.

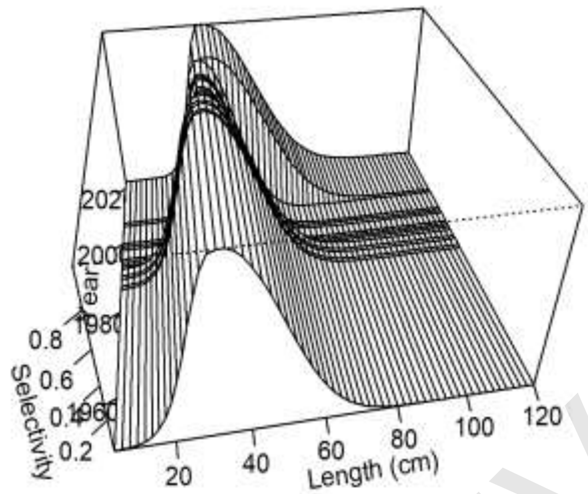


Figure 55. Time varying length-based selectivity for the Recreational Headboat East fleet.

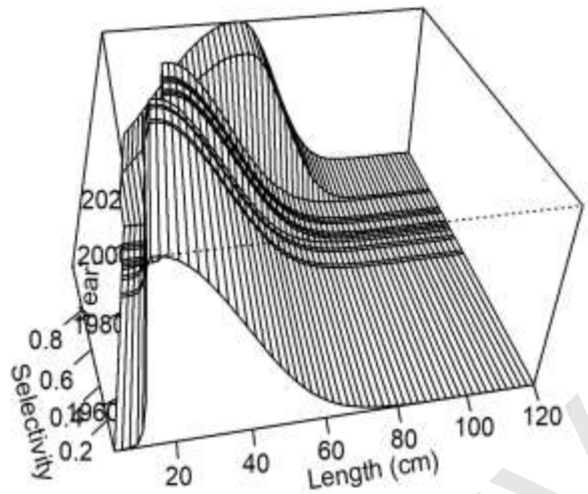


Figure 56. Time varying length-based selectivity for the Recreational Private West fleet.

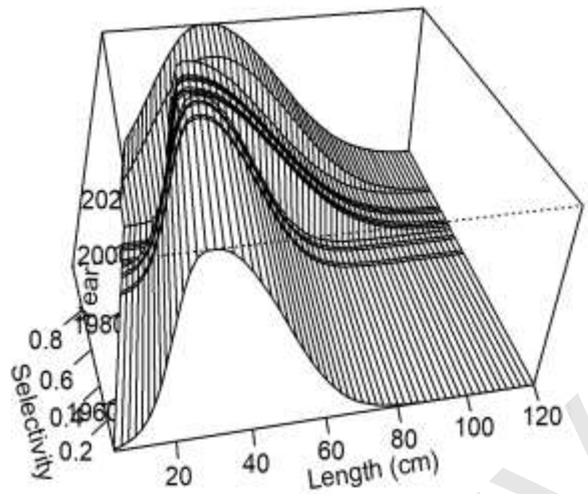


Figure 57. Time varying length-based selectivity for the Recreational Private Central fleet.

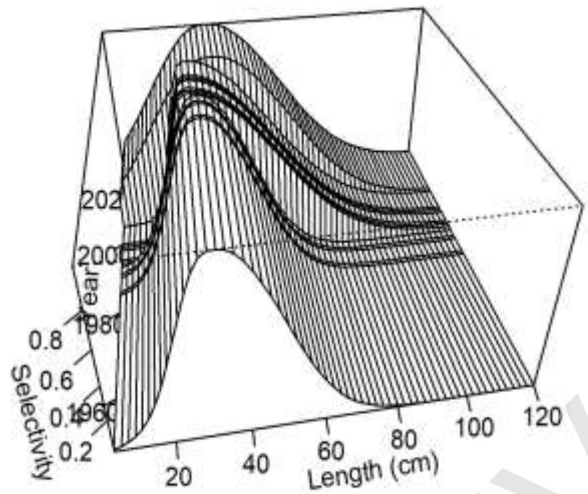


Figure 58. Time varying length-based selectivity for the Recreational Private East fleet.

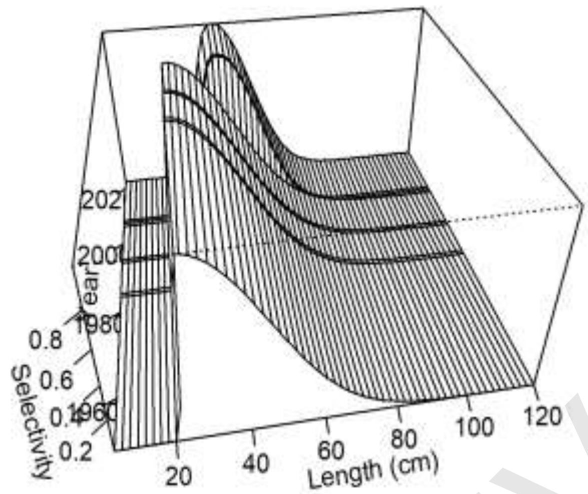


Figure 59. Time varying length-based selectivity for the Commercial Handline Closed Season Discards West fleet.

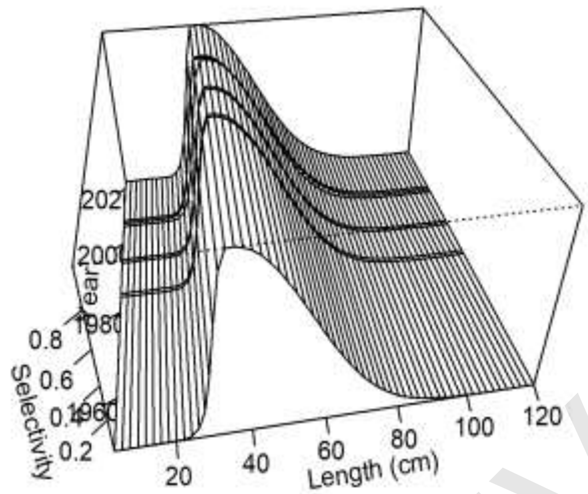


Figure 60. Time varying length-based selectivity for the Commercial Handline Closed Season Discards Central fleet.

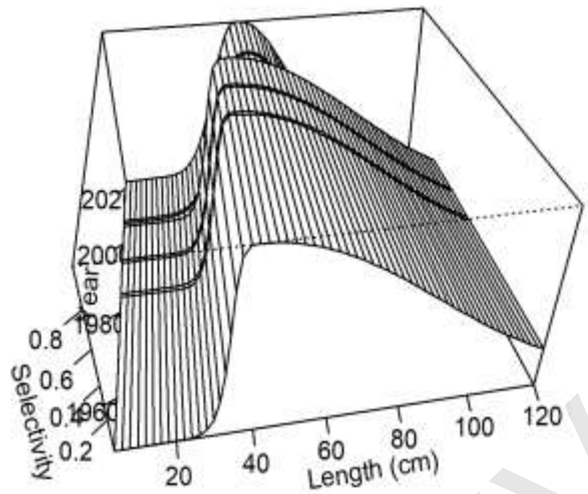


Figure 61. Time varying length-based selectivity for the Commercial Handline Closed Season Discards East fleet.

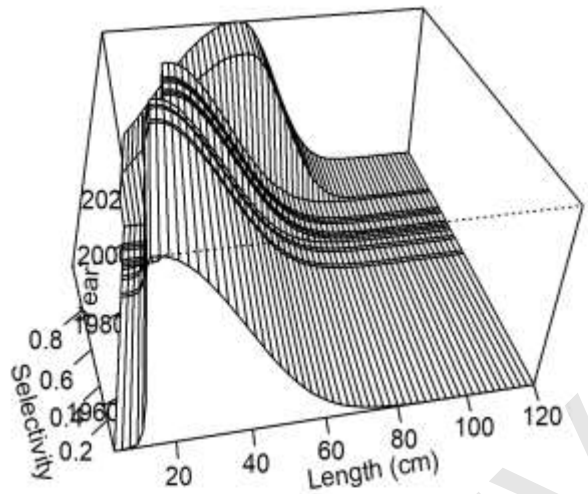


Figure 62. Time varying length-based selectivity for the Recreational Private Closed Season Discards West fleet.

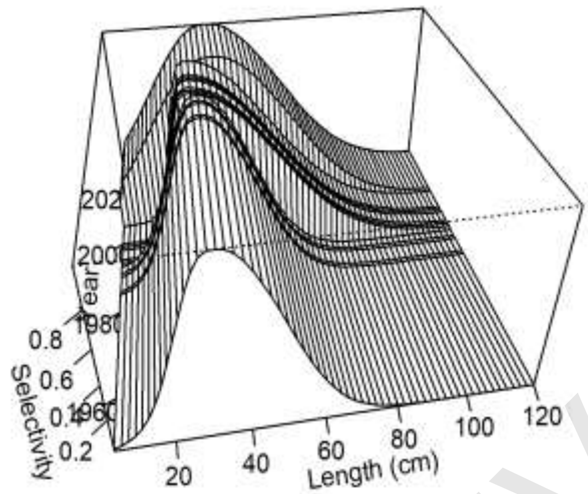


Figure 63. Time varying length-based selectivity for the Recreational Private Closed Season Discards Central fleet.

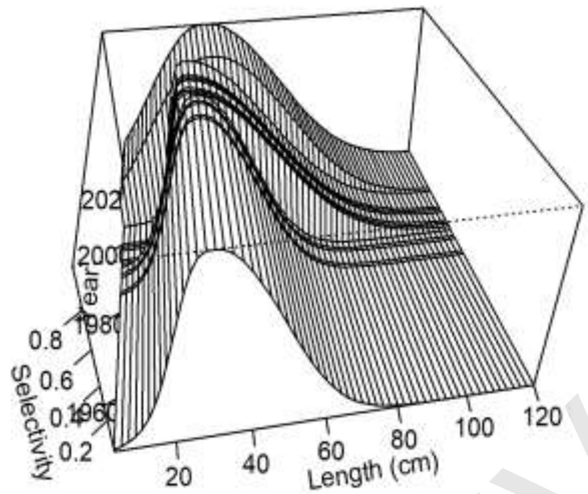


Figure 64. Time varying length-based selectivity for the Recreational Private Closed Season Discards East fleet.

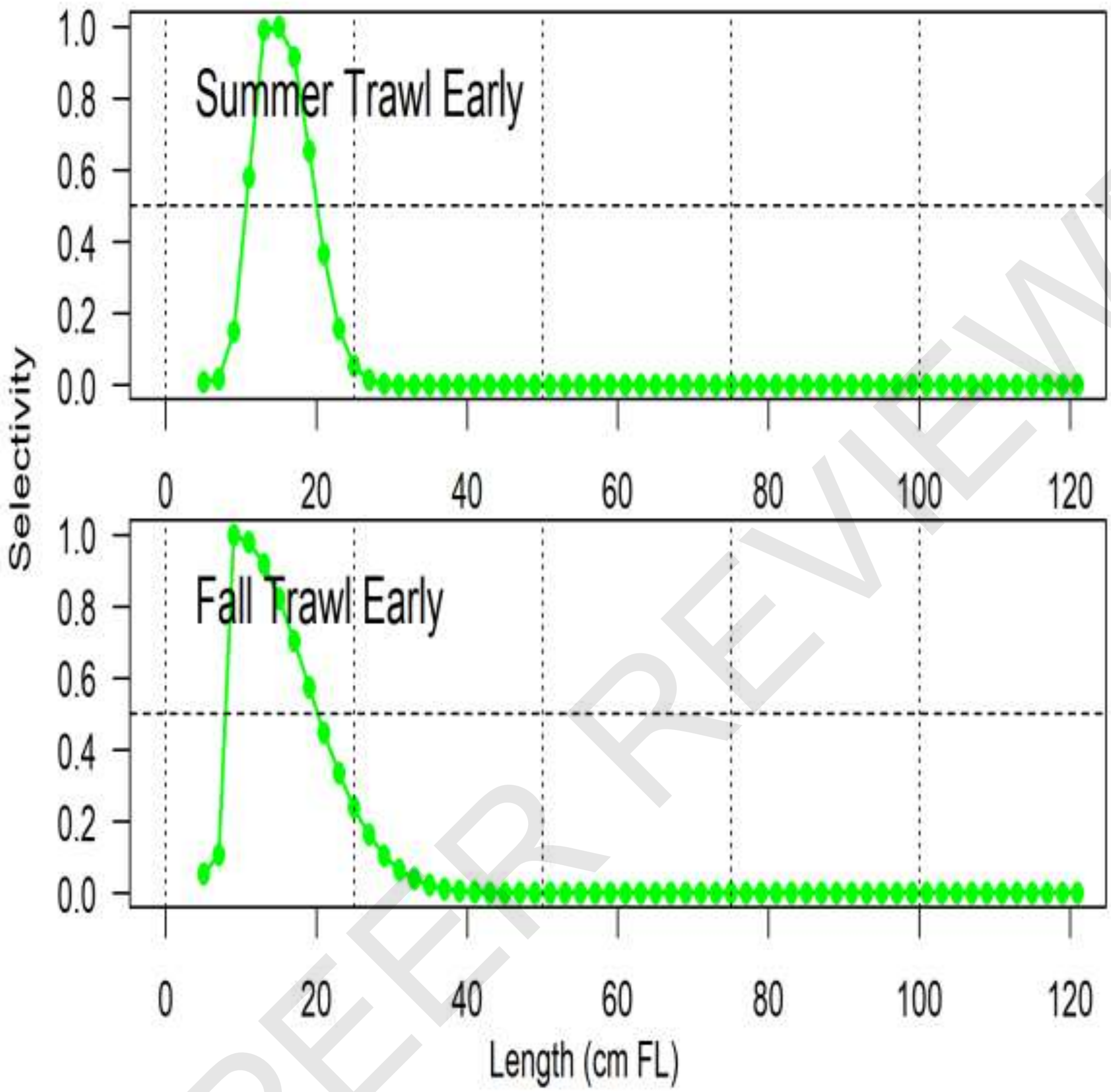


Figure 65. Length-based selectivity for surveys for Gulf of America Red Snapper in the terminal year of the assessment. Dashed horizontal line indicates 50%, whereas the dashed vertical lines identify lengths in 25 cm FL intervals.

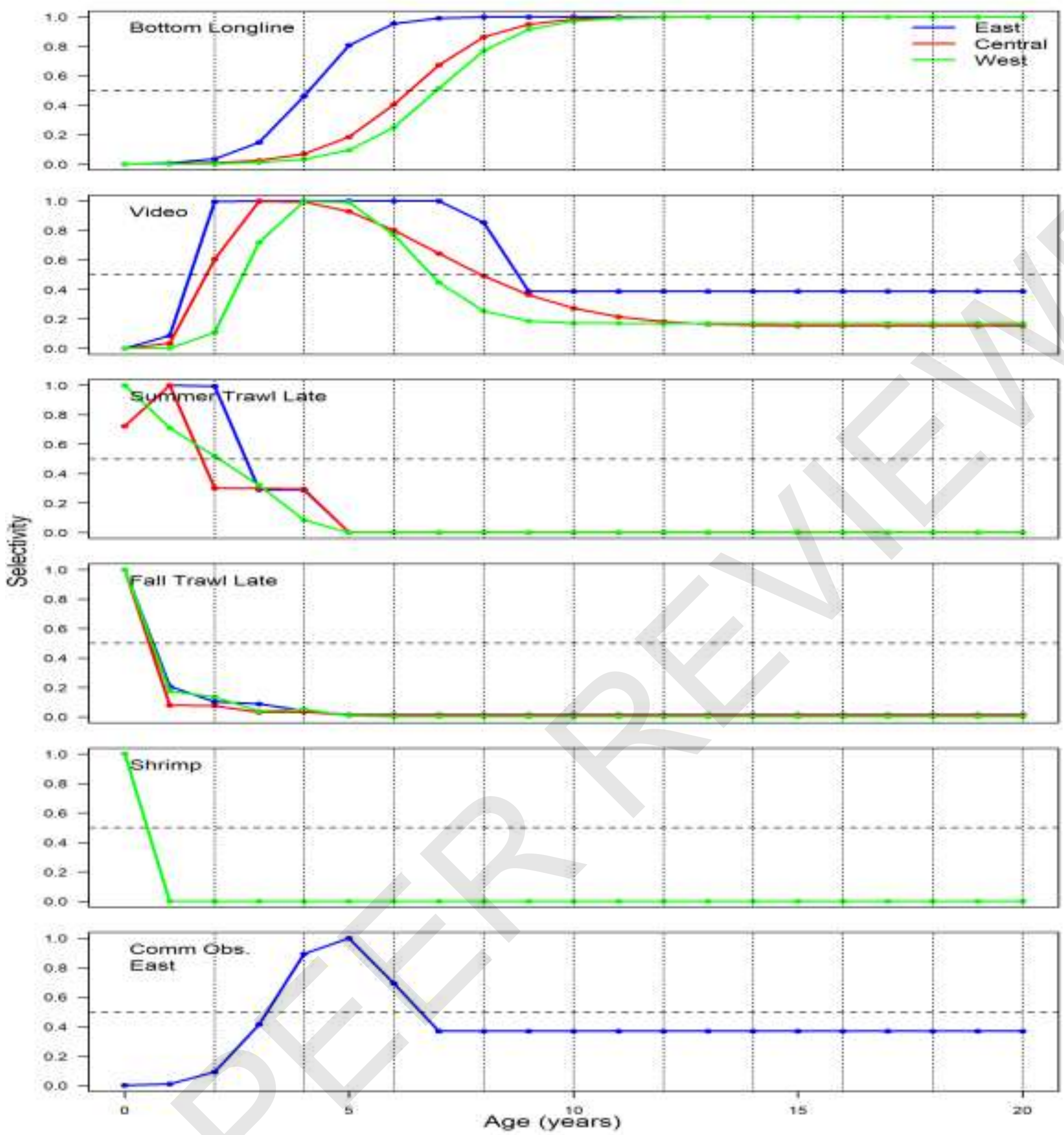


Figure 66. Derived age-based selectivity for specific surveys for Gulf of America Red Snapper in the terminal year of the assessment. Dashed horizontal line indicates 50%, whereas the dashed vertical lines identify ages in 2 year intervals.

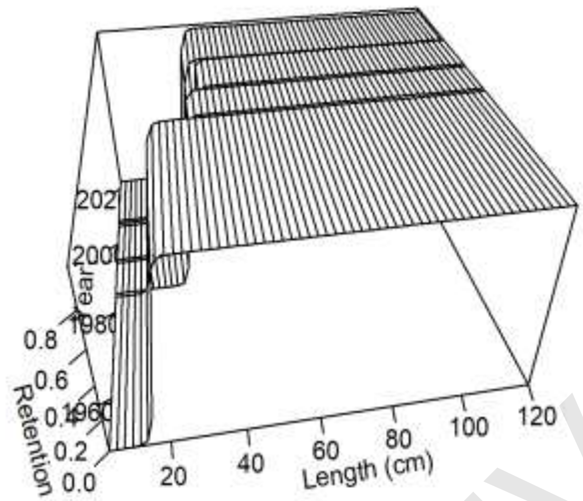


Figure 67. Time varying length-based retention for the Commercial Handline West fleet.

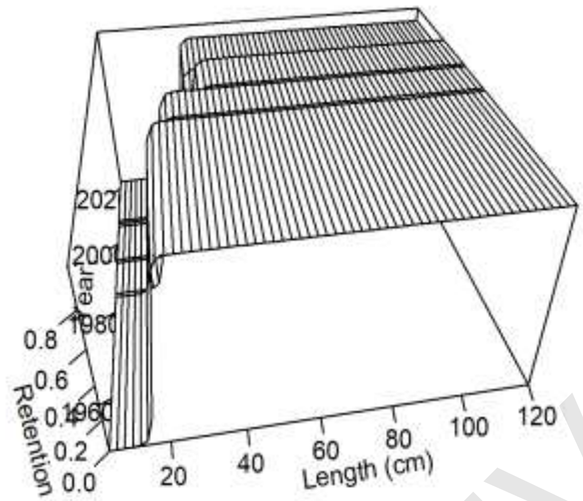


Figure 68. Time varying length-based retention for the Commercial Handline Central fleet.

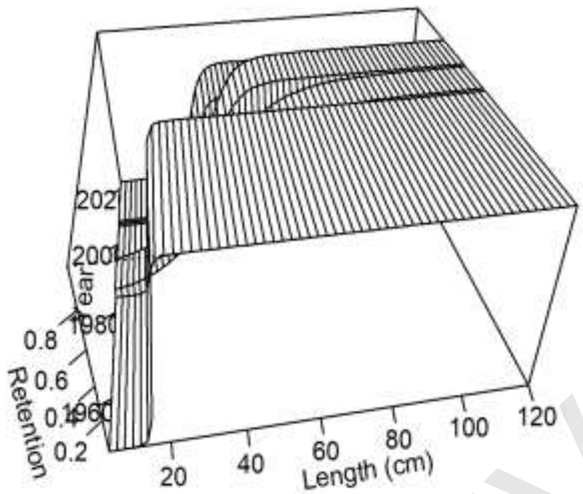


Figure 69. Time varying length-based retention for the Commercial Handline East fleet.

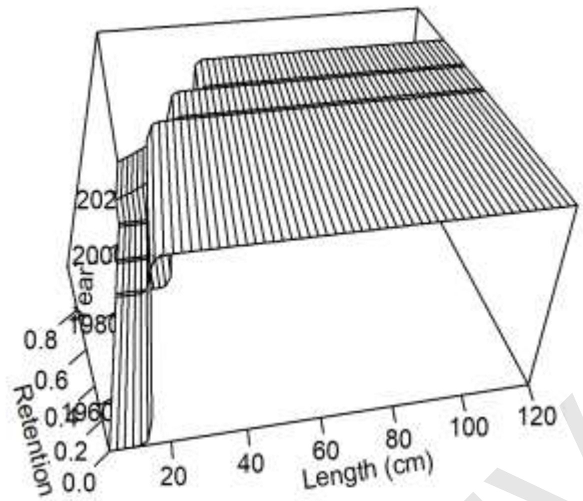


Figure 70. Time varying length-based retention for the Commercial Longline Central fleet.

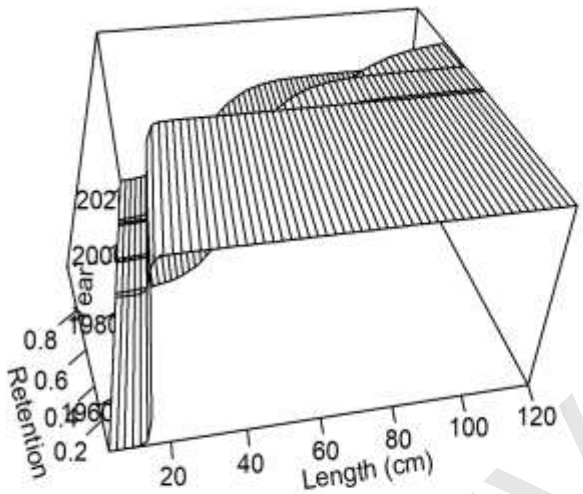


Figure 71. Time varying length-based retention for the Commercial Longline East fleet.

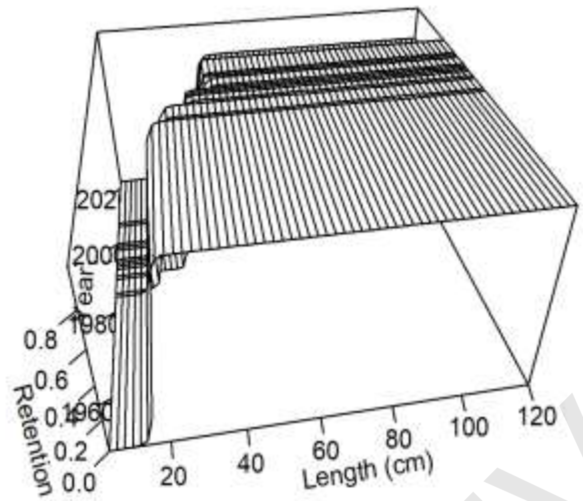


Figure 72. Time varying length-based retention for the Recreational Charter West fleet.

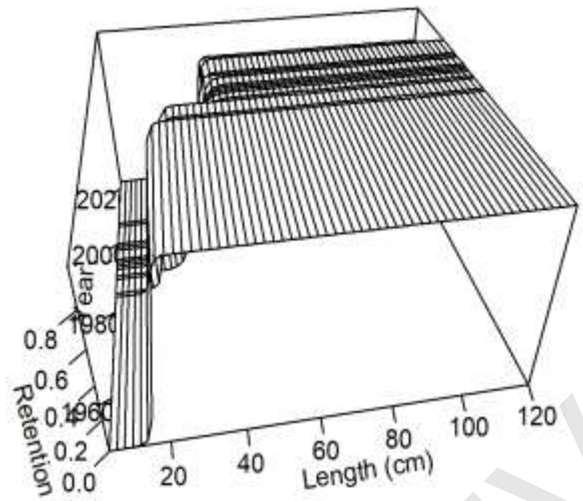


Figure 73. Time varying length-based retention for the Recreational Charter Central fleet.

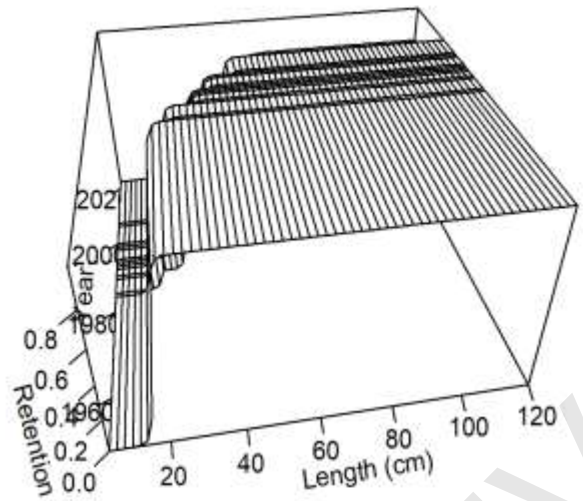


Figure 74. Time varying length-based retention for the Recreational Charter East fleet.

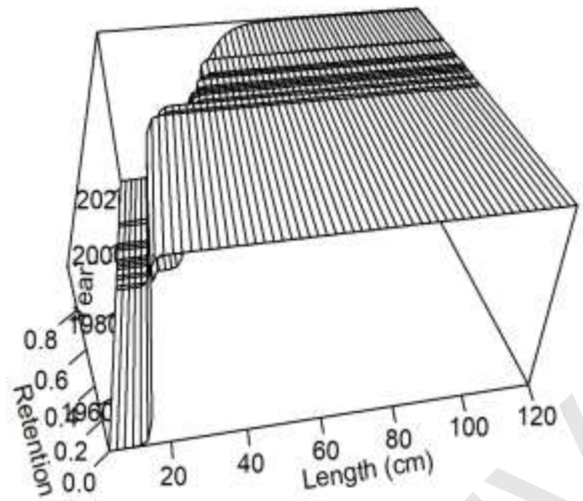


Figure 75. Time varying length-based retention for the Recreational Headboat West fleet.

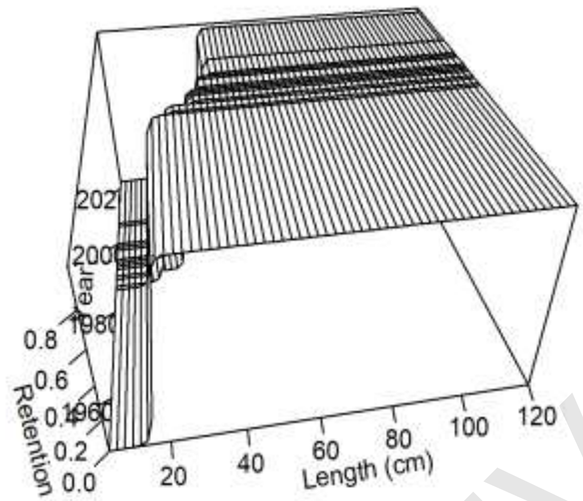


Figure 76. Time varying length-based retention for the Recreational Headboat Central fleet.

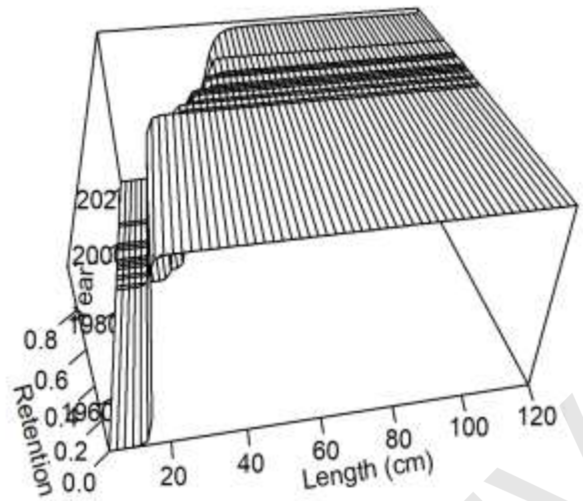


Figure 77. Time varying length-based retention for the Recreational Headboat East fleet.

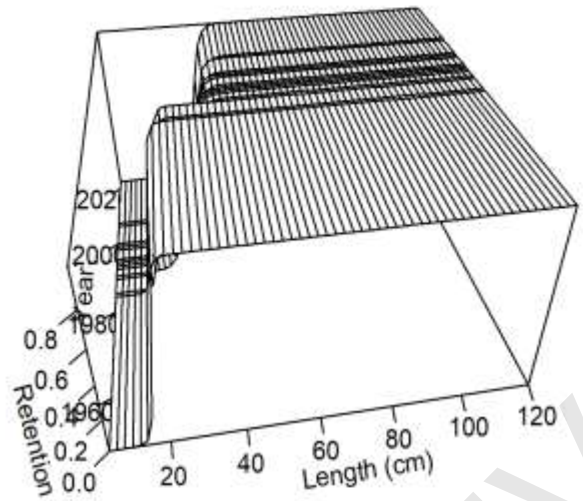


Figure 78. Time varying length-based retention for the Recreational Private West fleet.

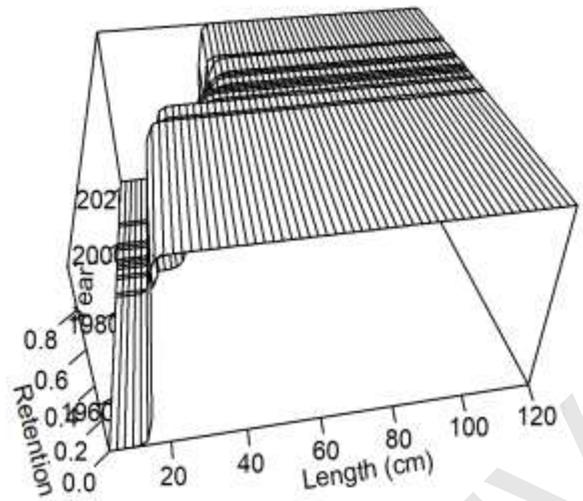


Figure 79. Time varying length-based retention for the Recreational Private Central fleet.

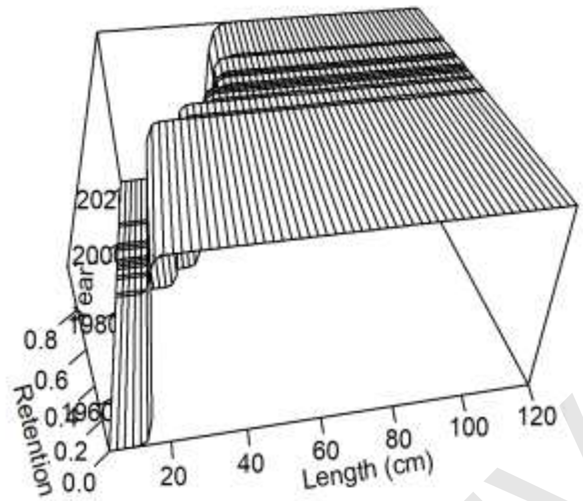


Figure 80. Time varying length-based retention for the Recreational Private East fleet.

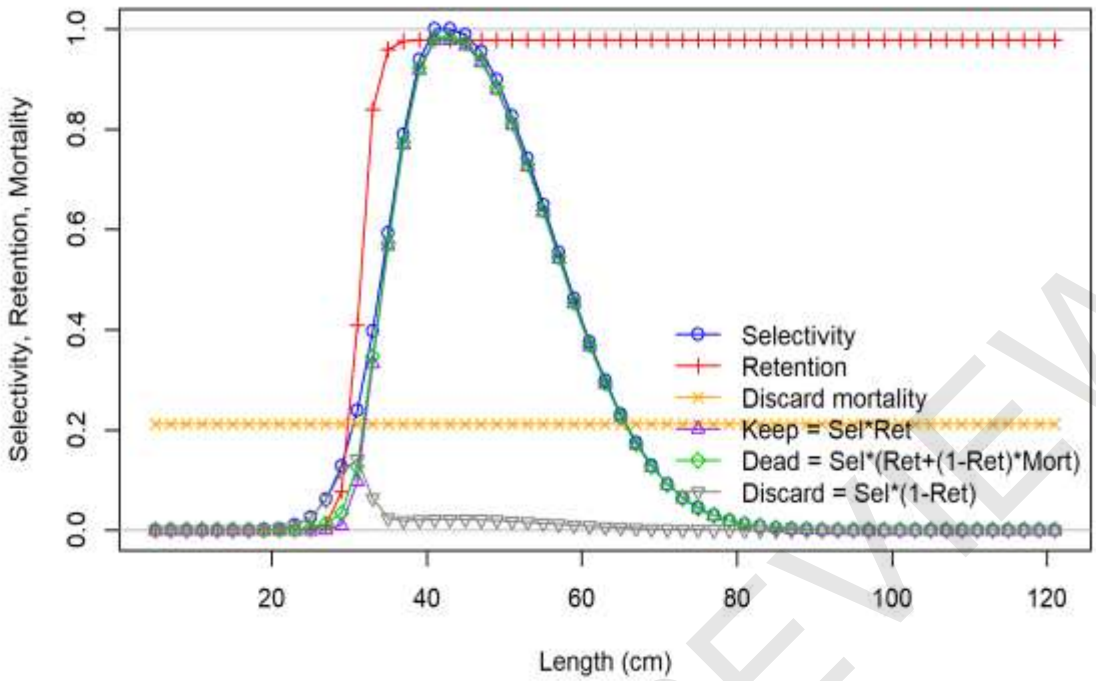


Figure 81. Length-based selectivity and retention for the Commercial Handline West fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

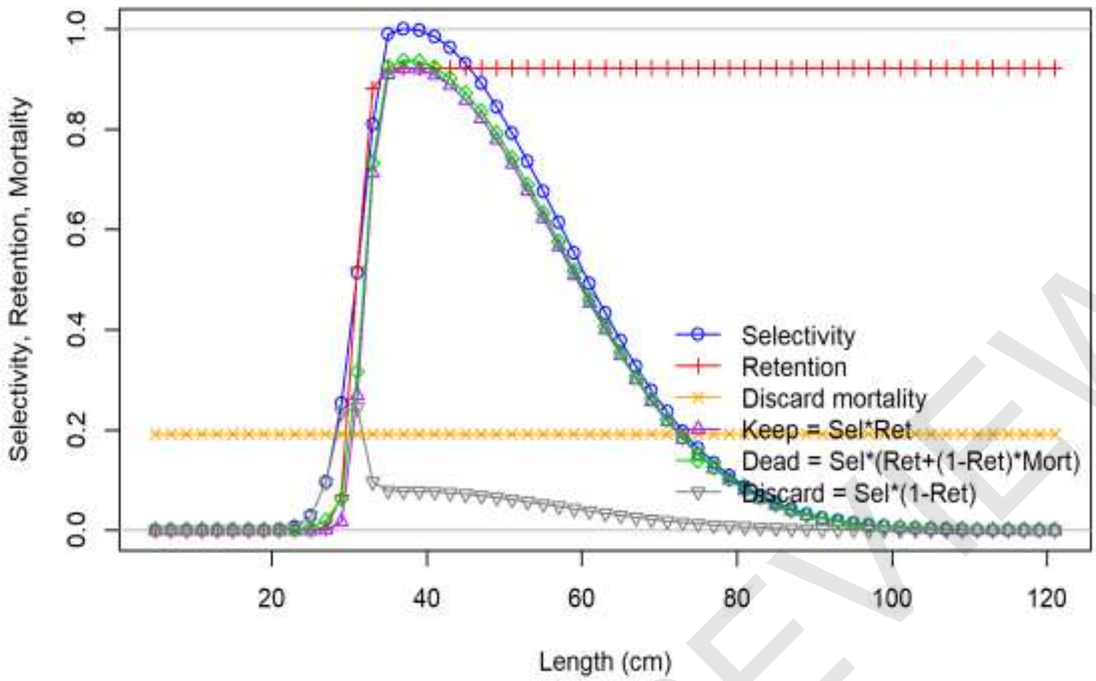


Figure 82. Length-based selectivity and retention for the Commercial Handline Central fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

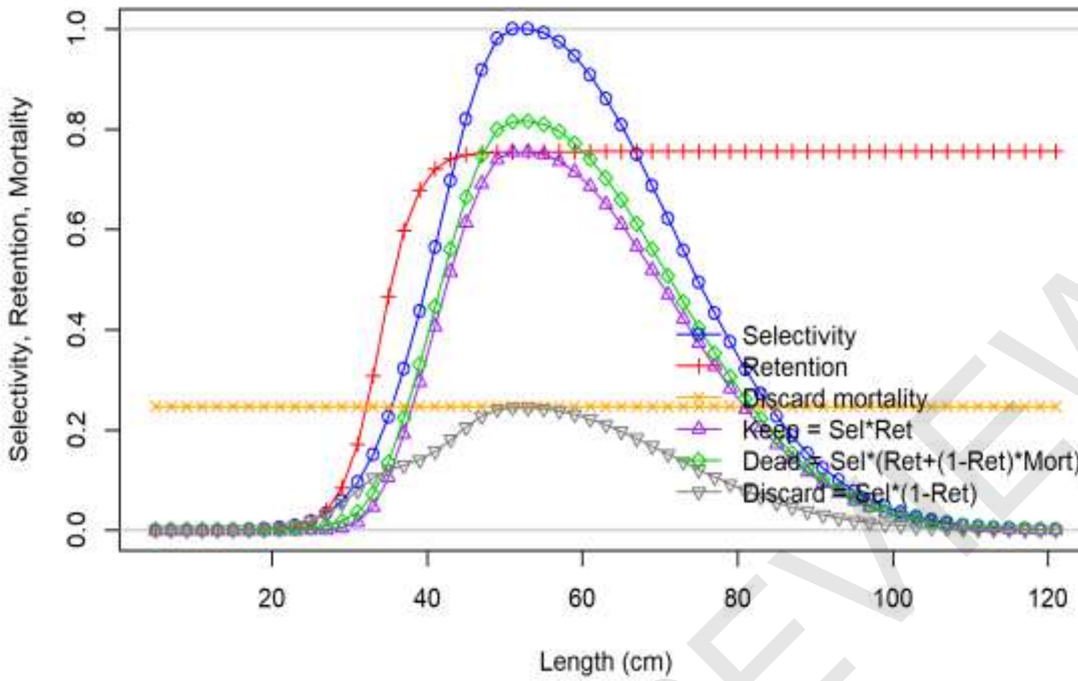


Figure 83. Length-based selectivity and retention for the Commercial Handline East fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

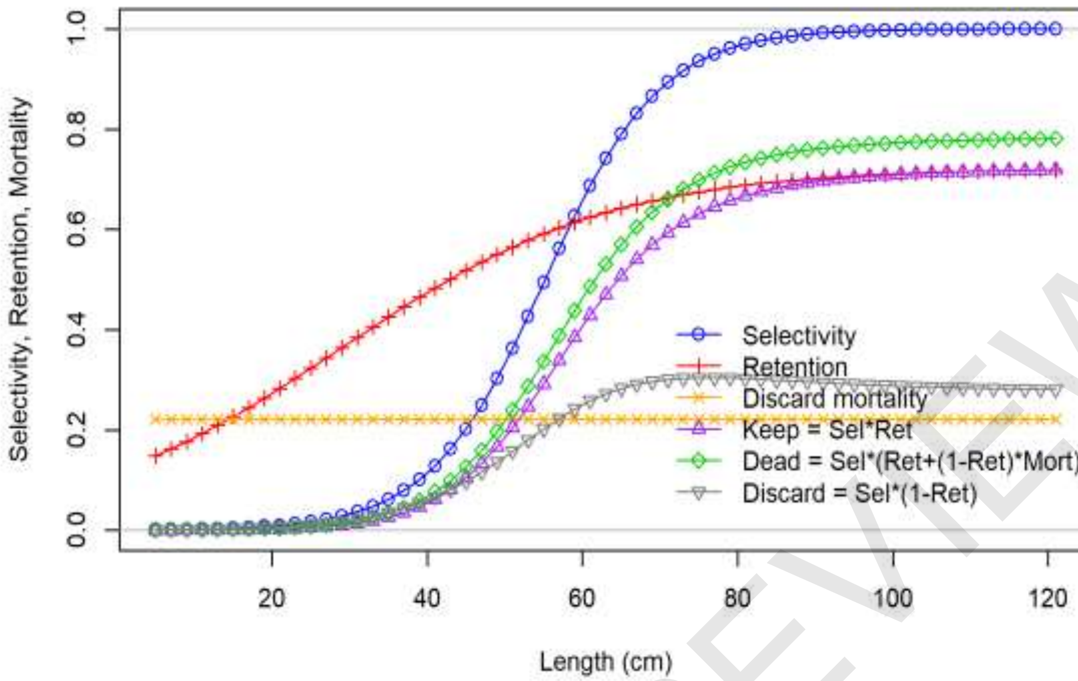


Figure 84. Length-based selectivity and retention for the Commercial Longline Central fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

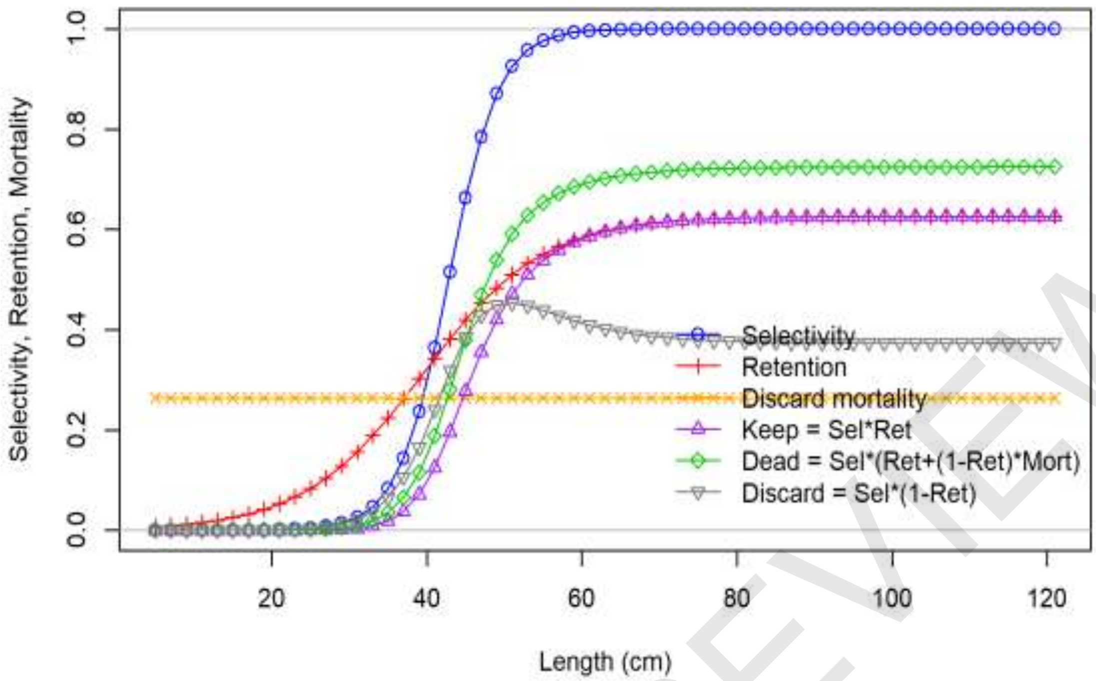


Figure 85. Length-based selectivity and retention for the Commercial Longline East fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

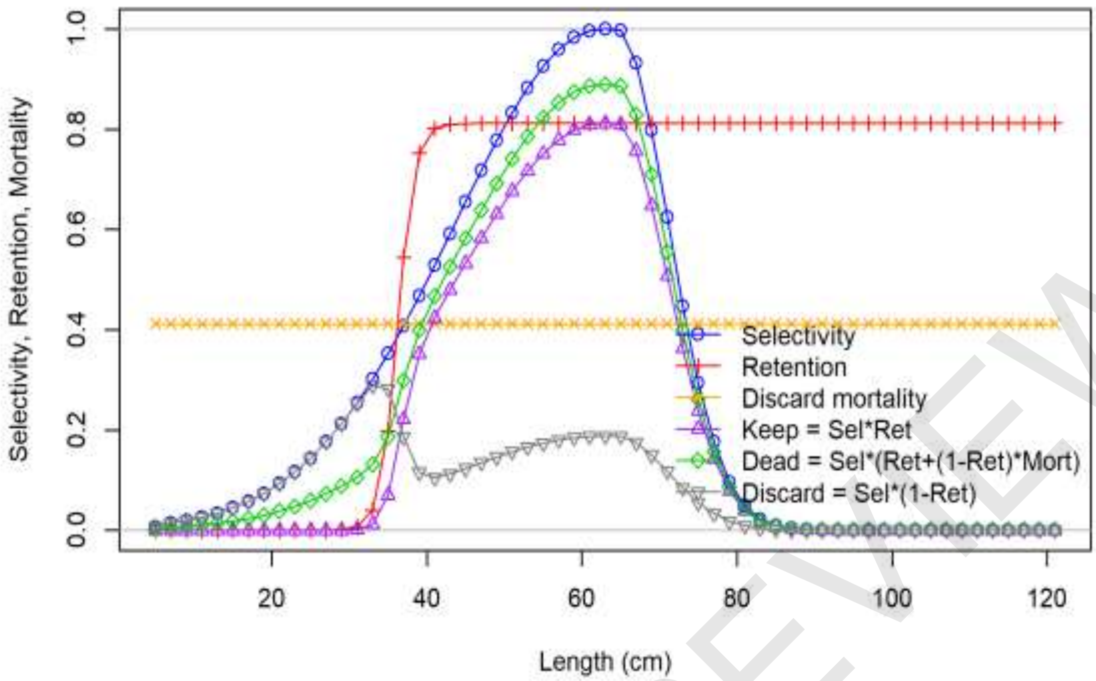


Figure 86. Length-based selectivity and retention for the Recreational Charter West fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

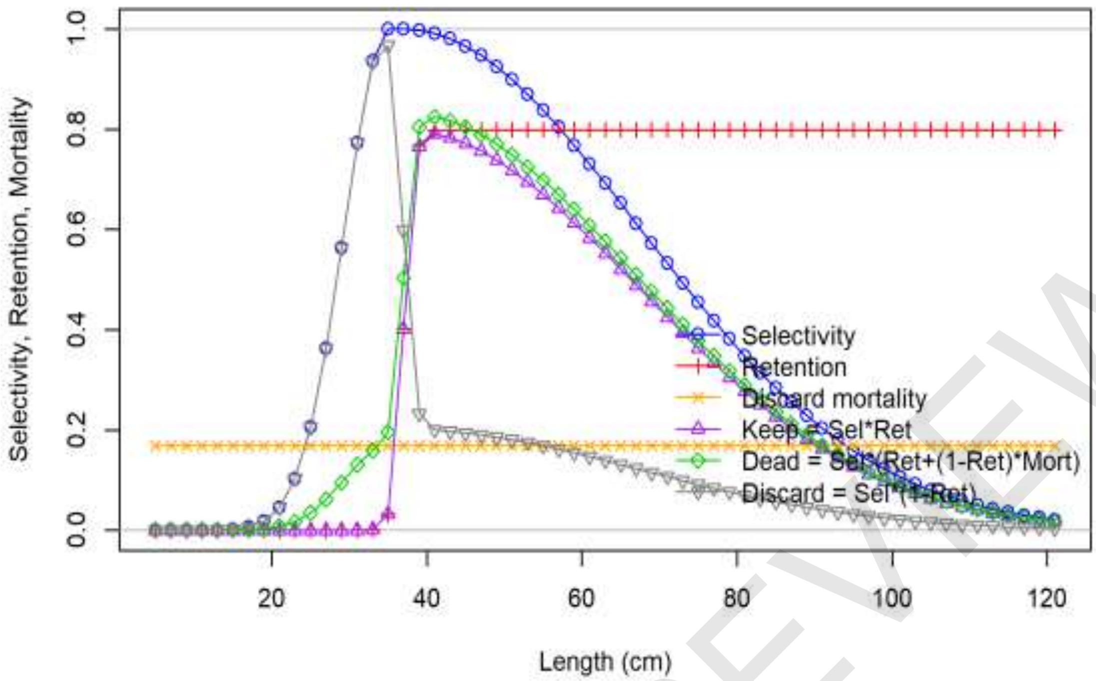


Figure 87. Length-based selectivity and retention for the Recreational Charter Central fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

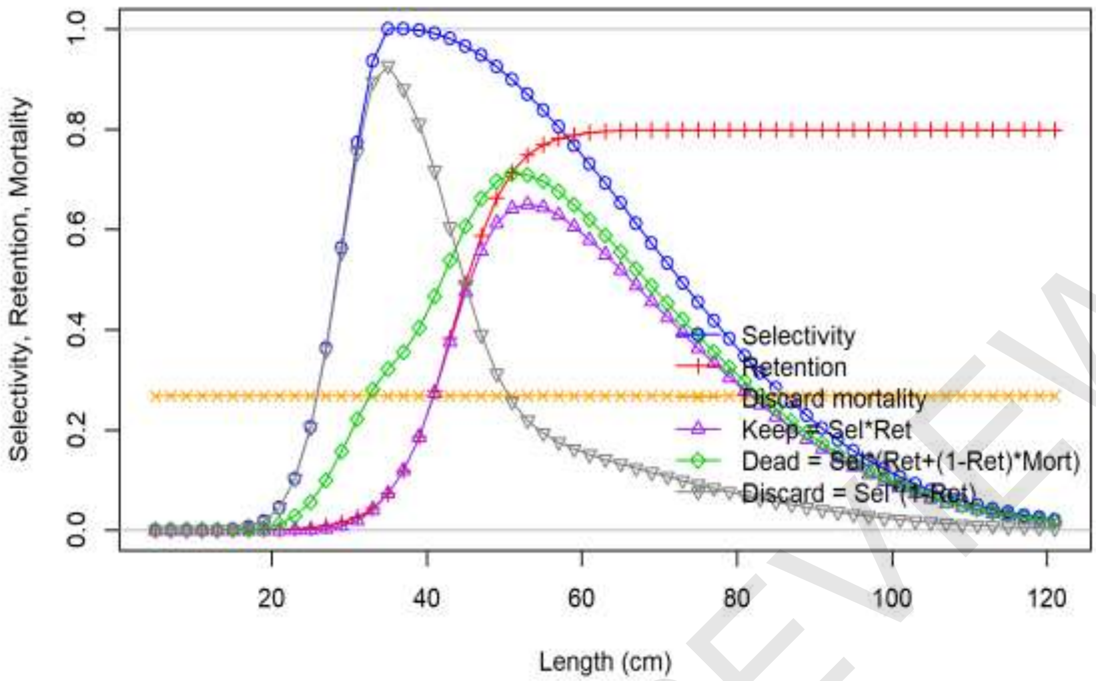


Figure 88. Length-based selectivity and retention for the Recreational Charter East fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

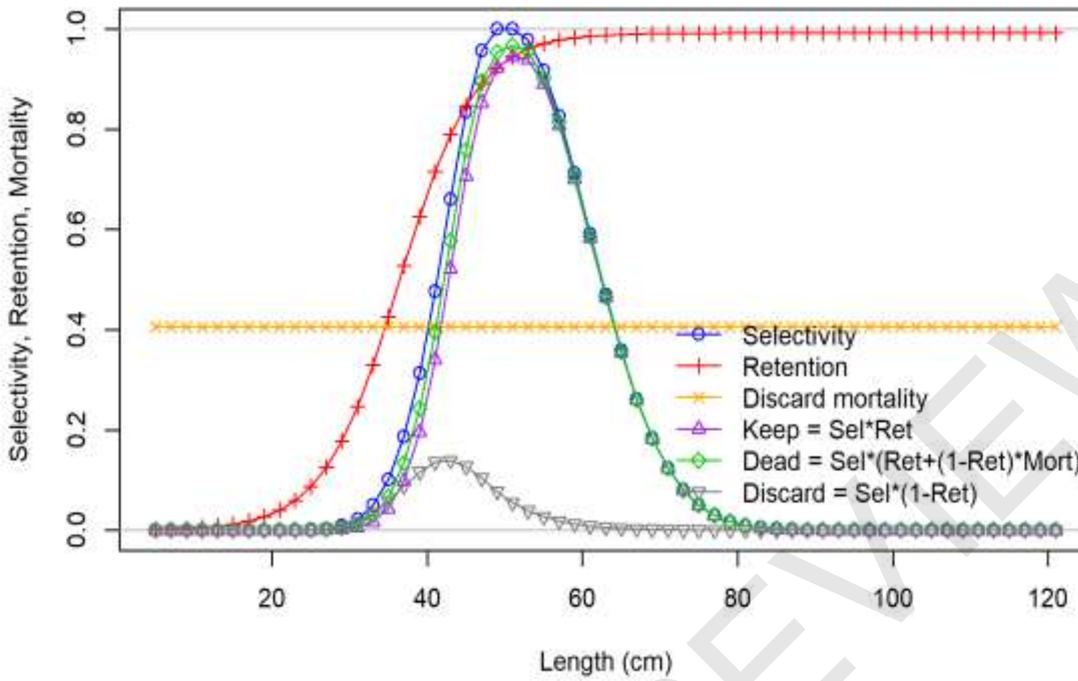


Figure 89. Length-based selectivity and retention for the Recreational Headboat West fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

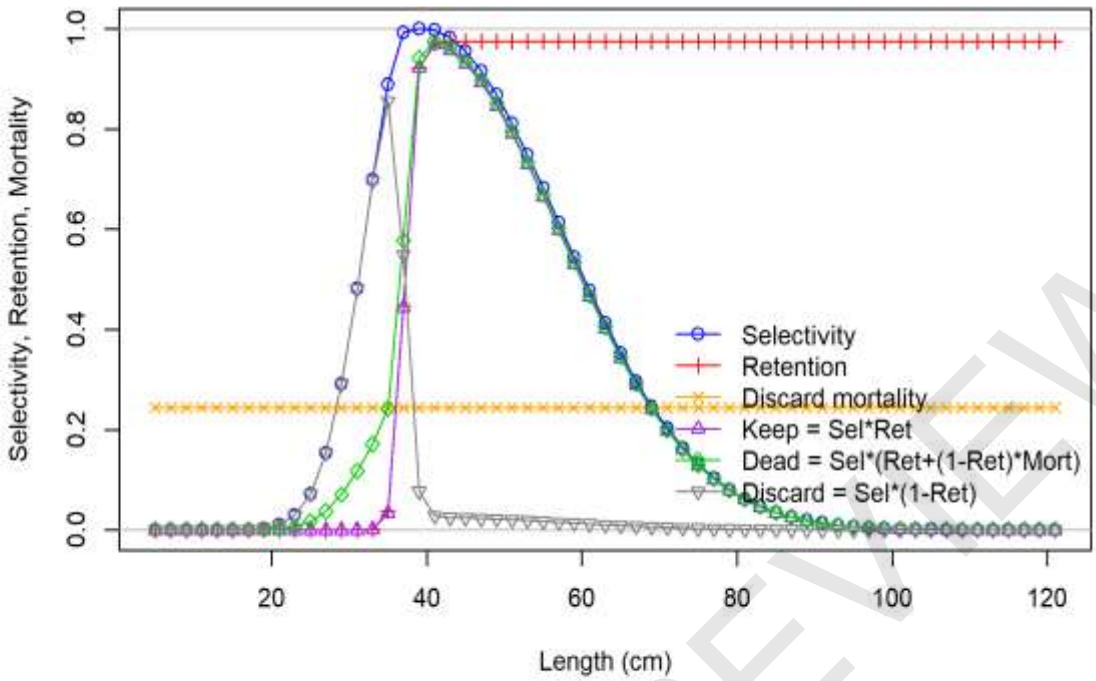


Figure 90. Length-based selectivity and retention for the Recreational Headboat Central fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

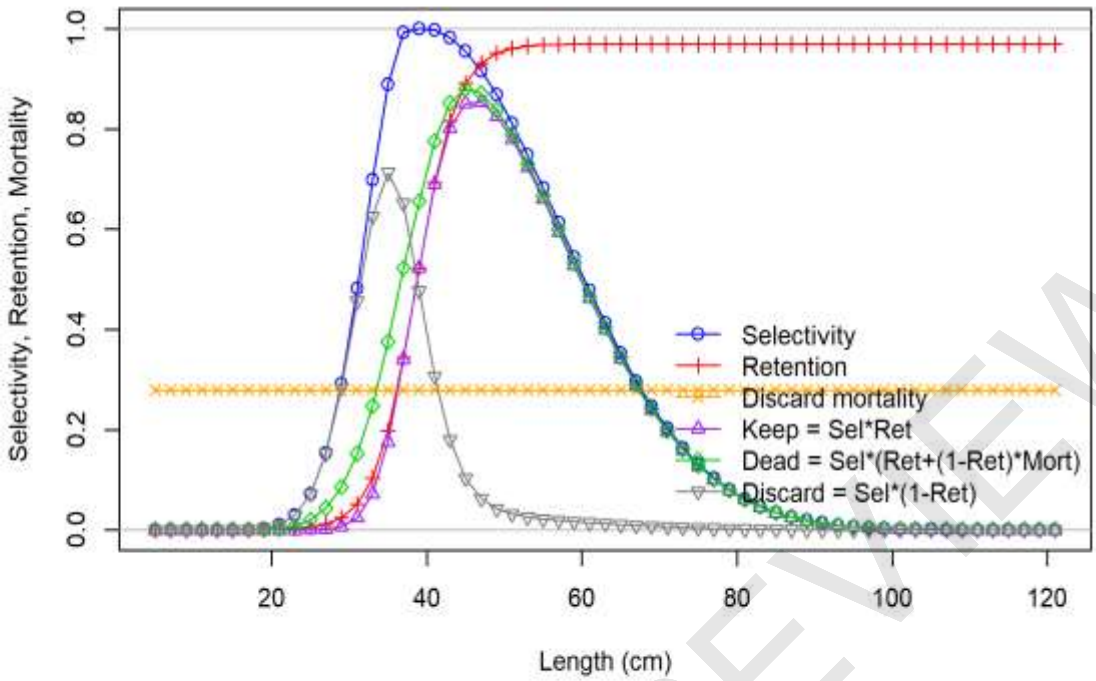


Figure 91. Length-based selectivity and retention for the Recreational Headboat East fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

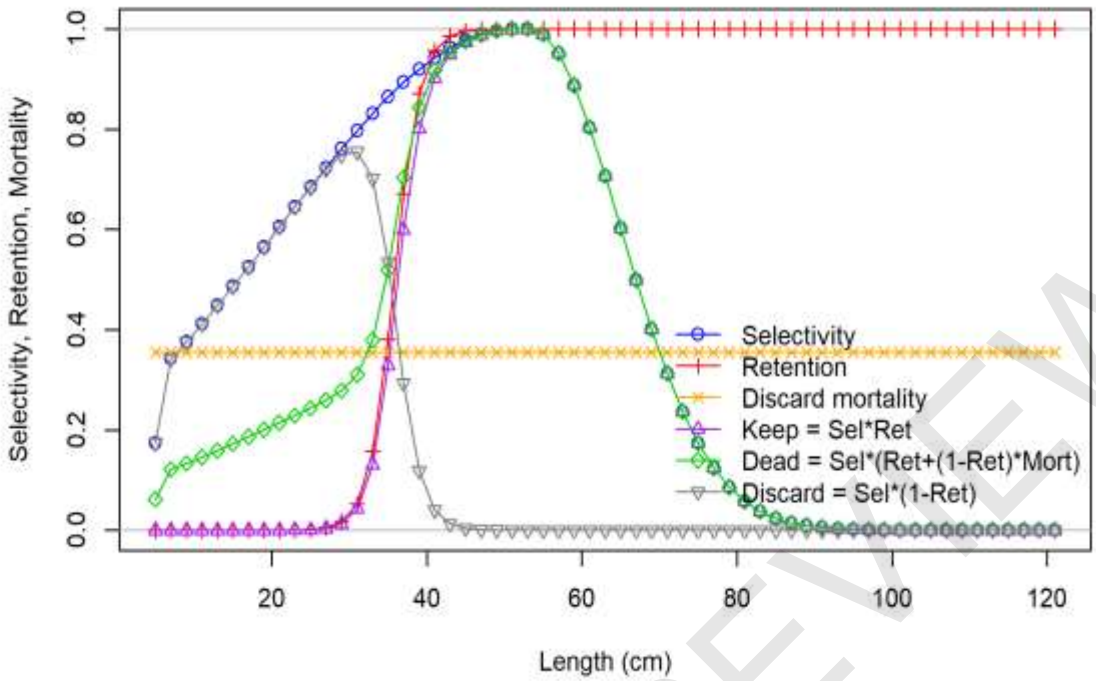


Figure 92. Length-based selectivity and retention for the Recreational Private West fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

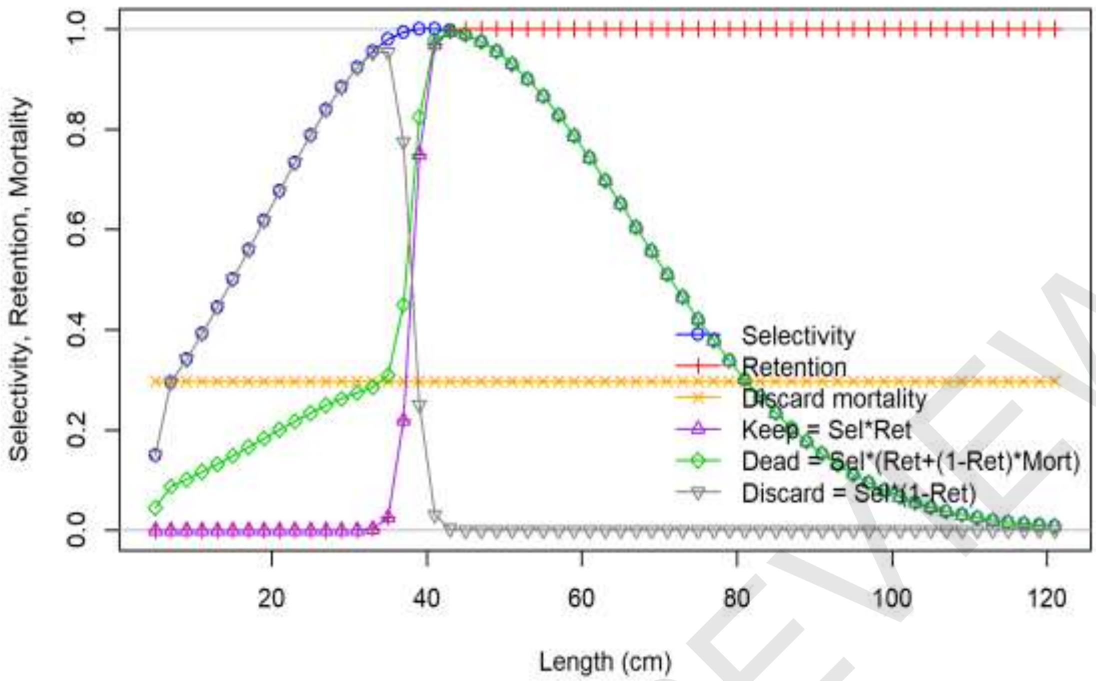


Figure 93. Length-based selectivity and retention for the Recreational Private Central fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

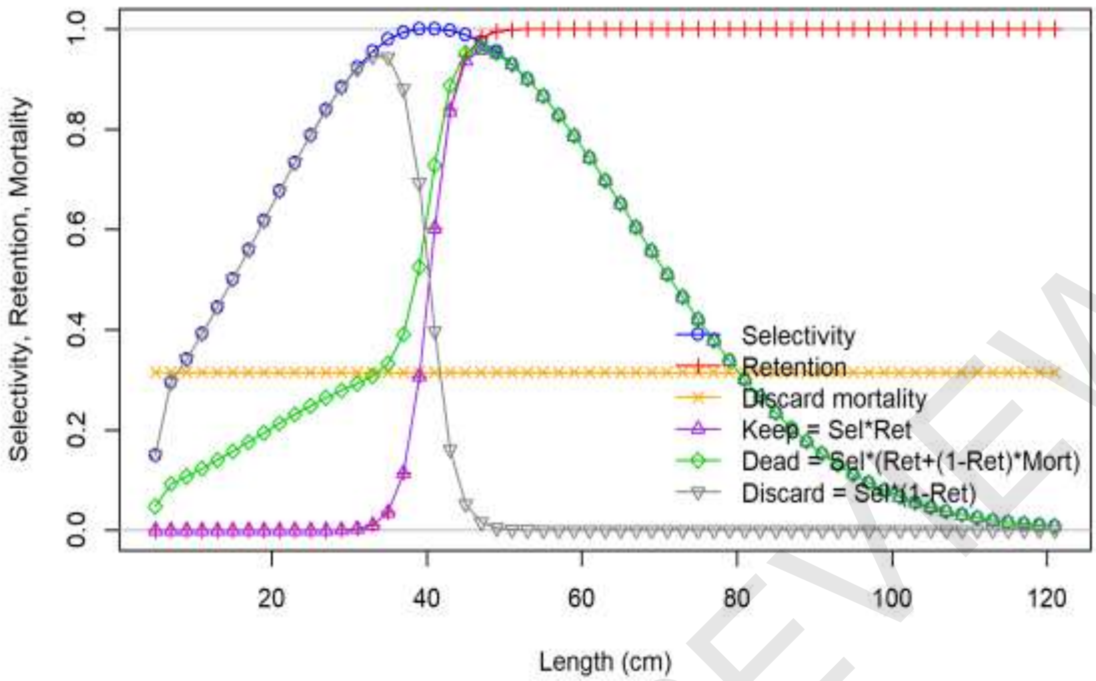


Figure 94. Length-based selectivity and retention for the Recreational Private East fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

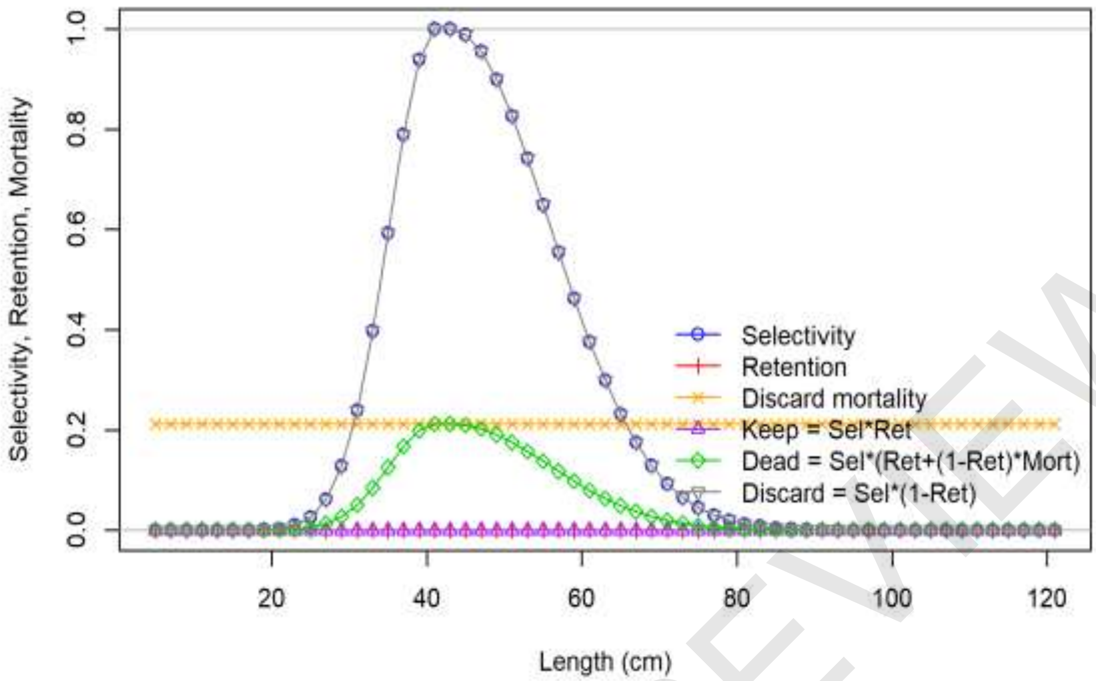


Figure 95. Length-based selectivity and retention for the Commercial Handline Closed Season Discards West fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

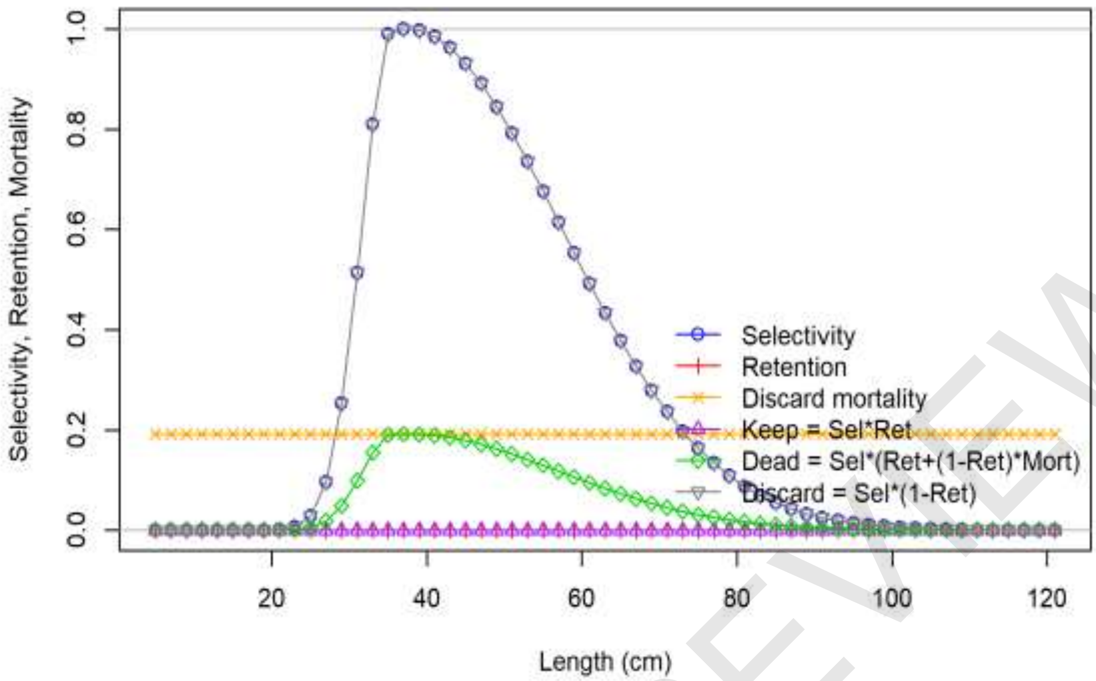


Figure 96. Length-based selectivity and retention for the Commercial Handline Closed Season Discards Central fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

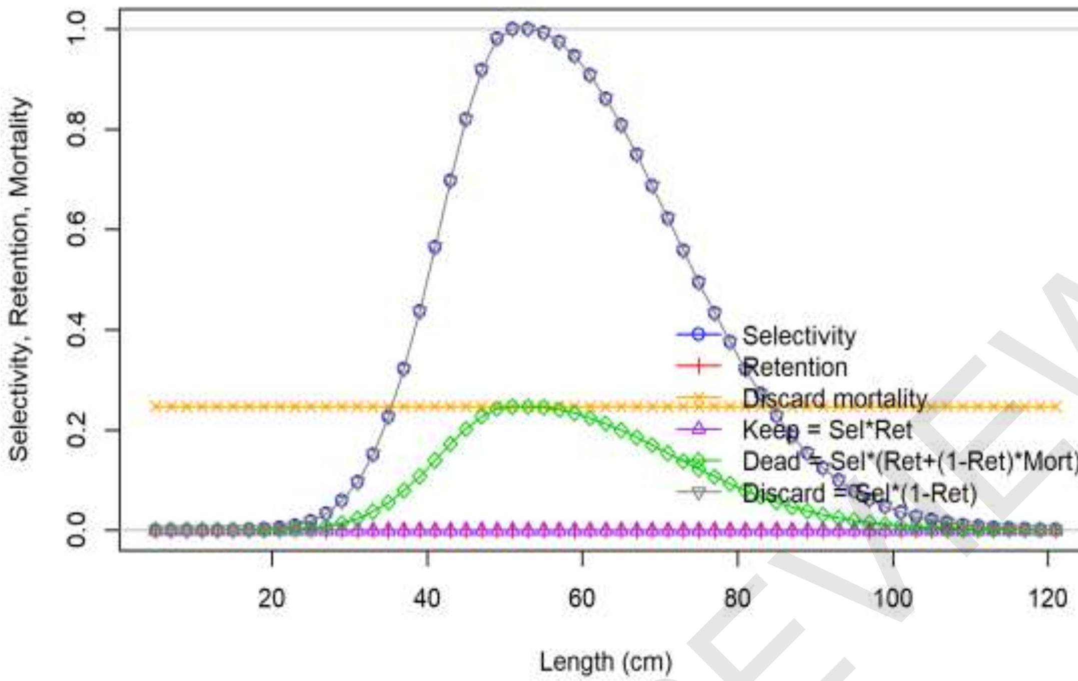


Figure 97. Length-based selectivity and retention for the Commercial Handline Closed Season Discards East fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

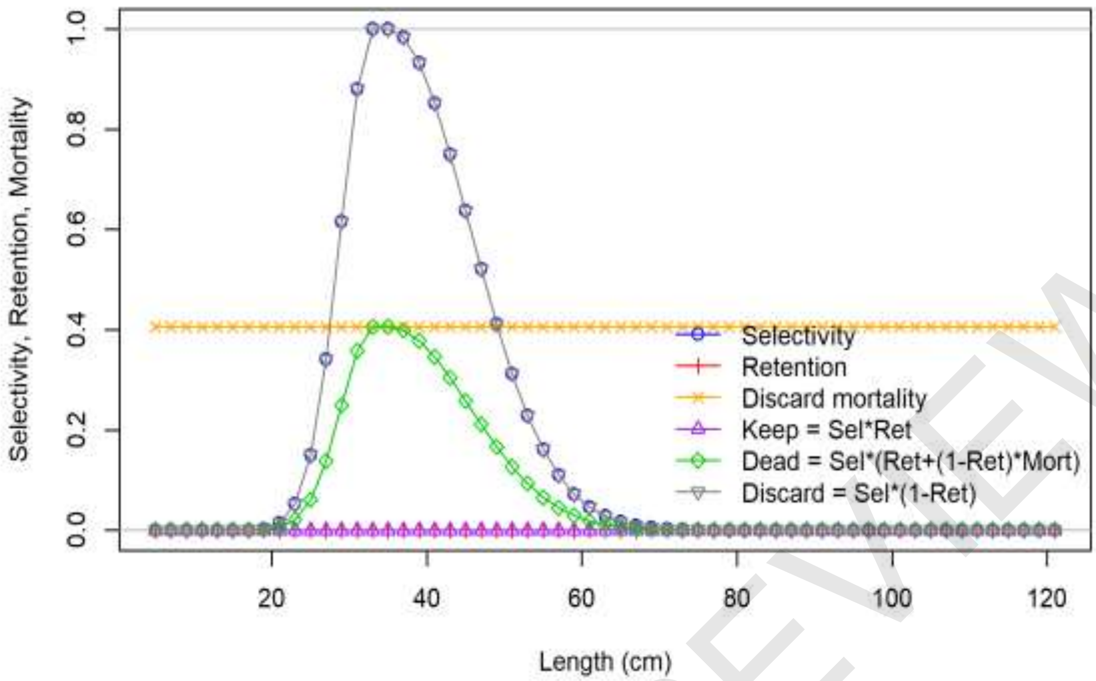


Figure 98. Ending year selectivity for Recreational Headboat Closed Season Discards West

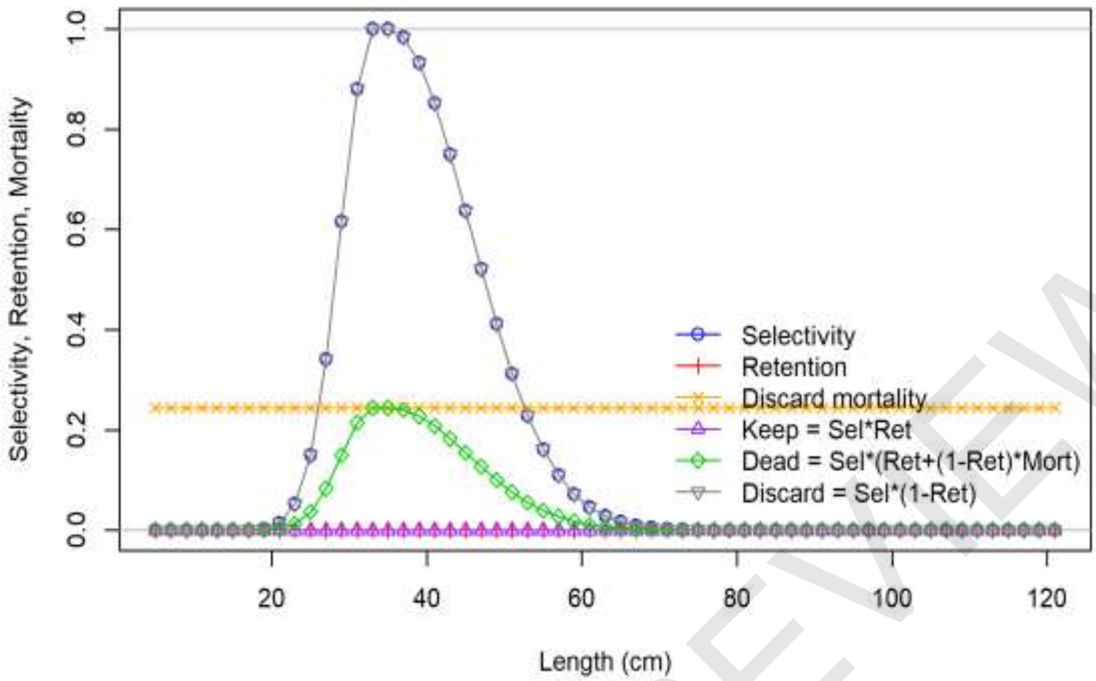


Figure 99. Ending year selectivity for Recreational Headboat Closed Season Discards East

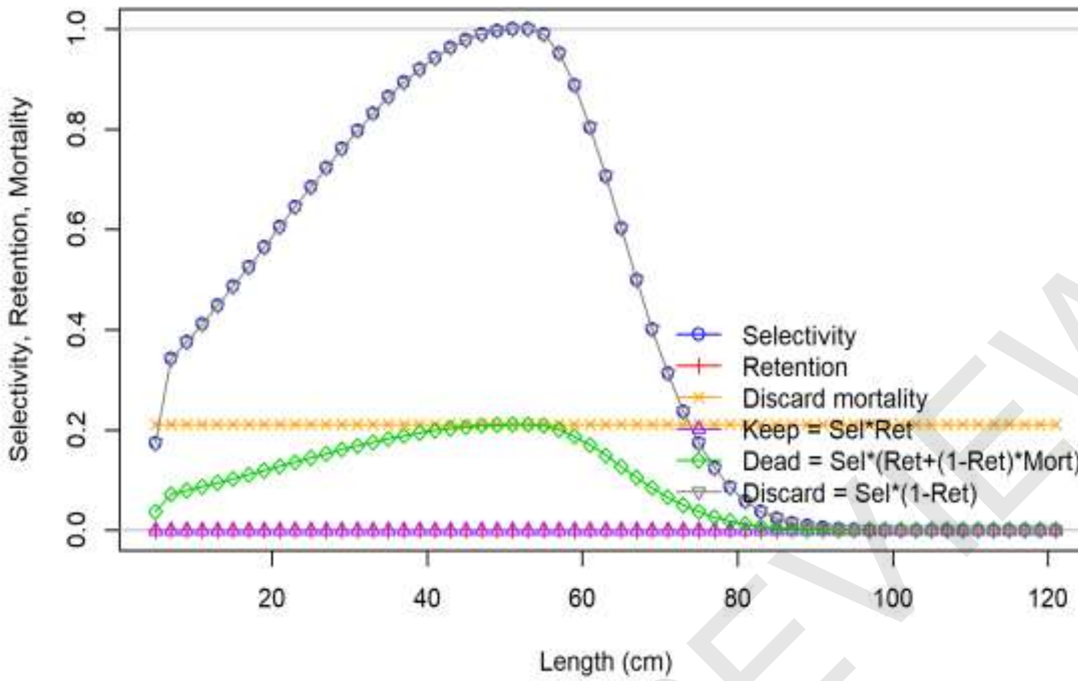


Figure 100. Length-based selectivity and retention for the Recreational Private Closed Season Discards West fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

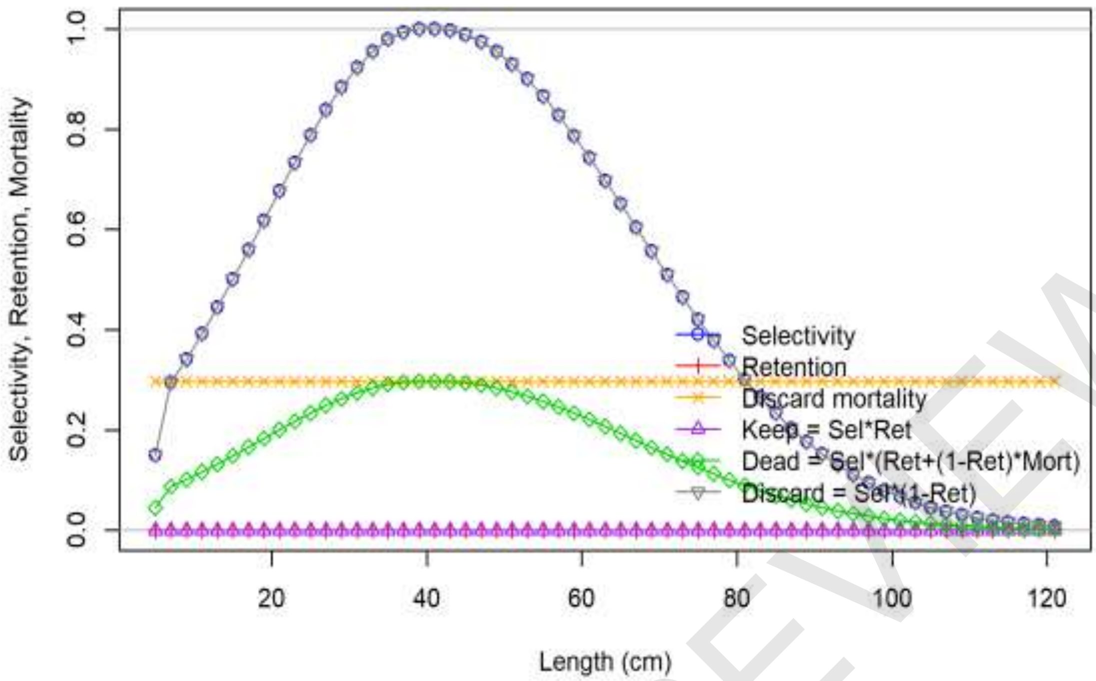


Figure 101. Length-based selectivity and retention for the Recreational Private Closed Season Discards Central fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

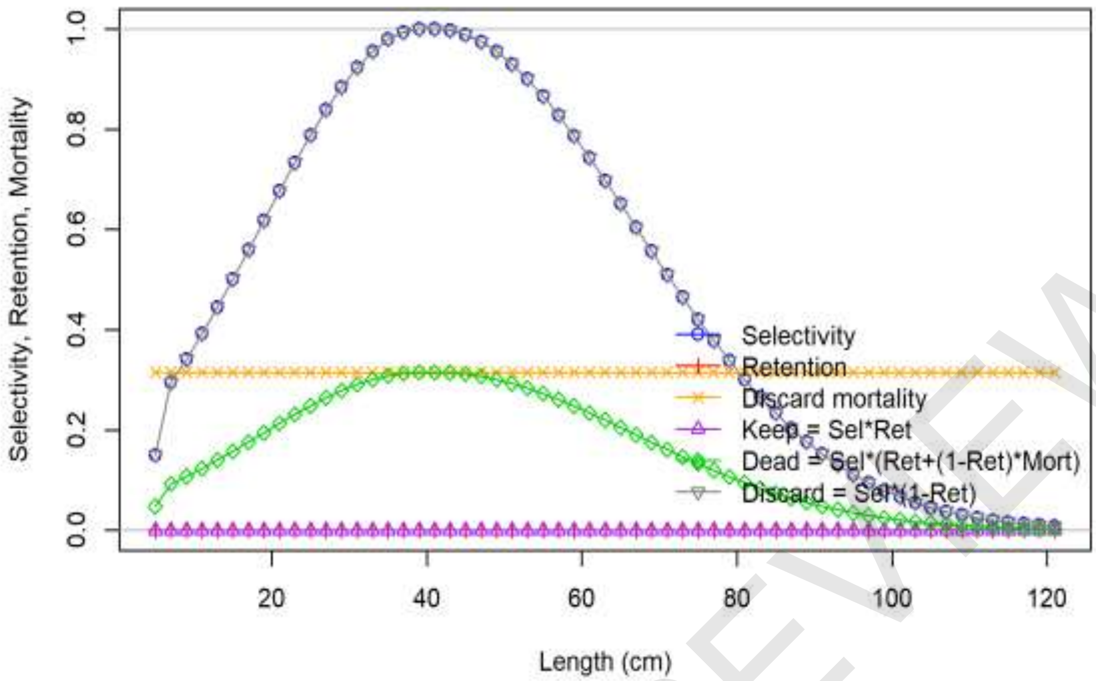


Figure 102. Length-based selectivity and retention for the Recreational Private Closed Season Discards East fleet in the terminal year of the assessment. Selectivity (blue line) and retention (red line) vary, while discard mortality (orange line) is constant.

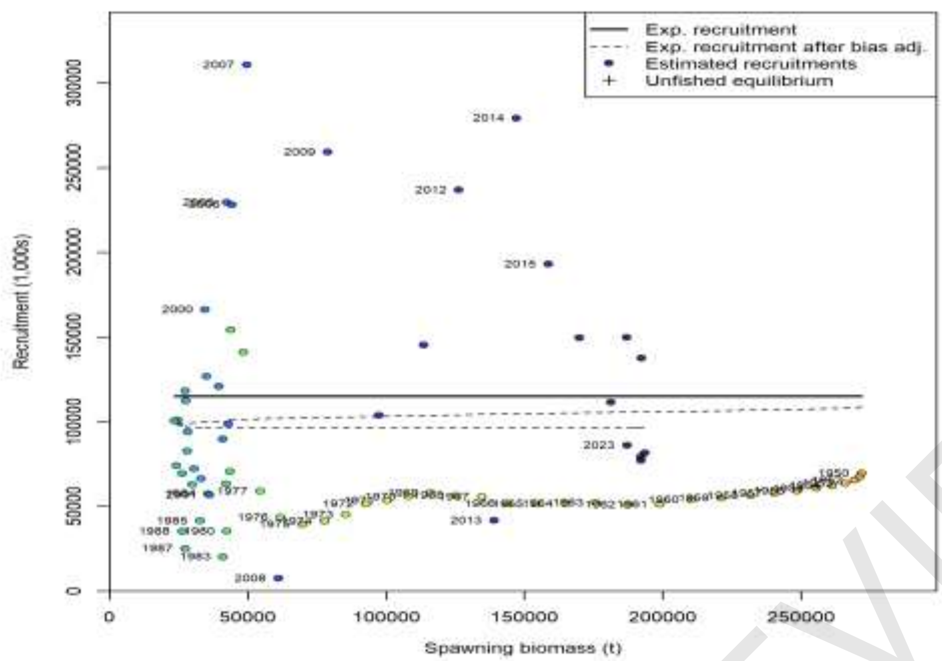


Figure 103. Stock-recruitment relationship for Gulf of America Red Snapper with fixed steepness and SigmaR at 1 and 0.6, respectively. Plotted are predicted annual recruitments from Stock Synthesis (circles), expected recruitment from the stock-recruit relationship (black line), and bias adjusted recruitment from the stock-recruit relationship (dashed line).

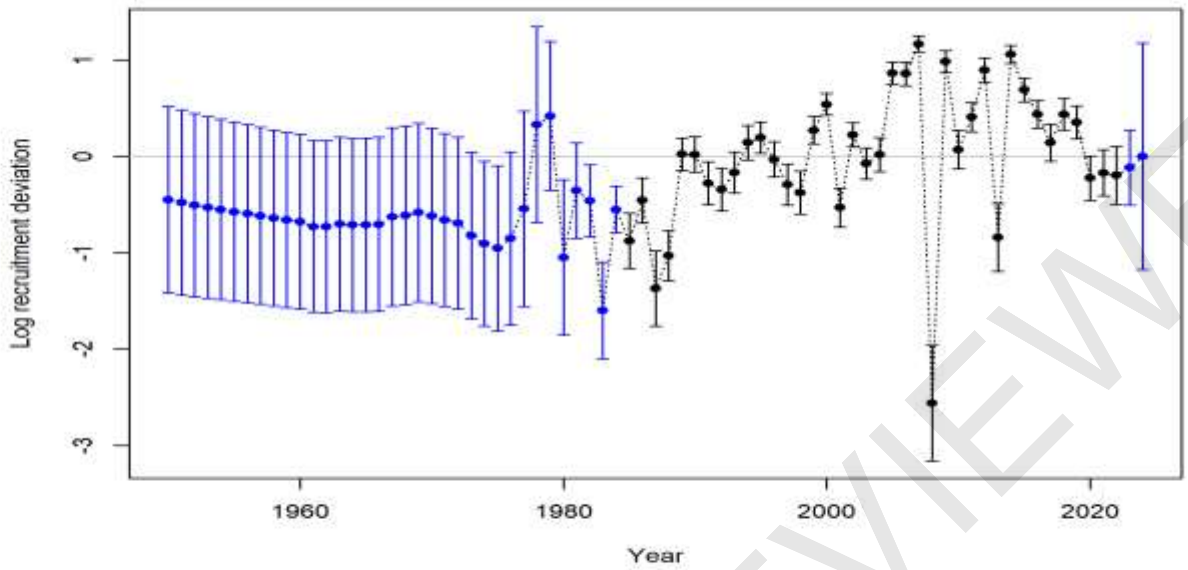


Figure 104. Estimated log recruitment deviations for Gulf of America Red Snapper (steepness and SigmaR were fixed at 1 and 0.6, respectively). The black symbols represent the main recruitment deviation period where deviations are estimated and are not forced to sum to zero.

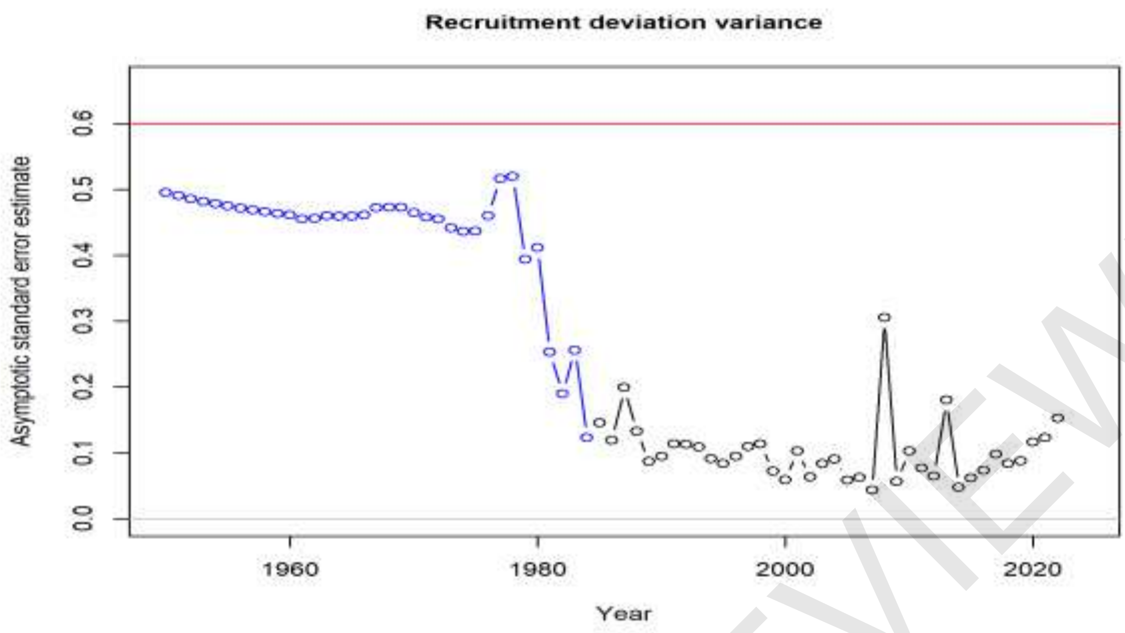


Figure 105. Asymptotic standard errors for recruitment deviations for Gulf of America Red Snapper. The red line represents the fixed value of SigmaR of 0.6 used in the SEDAR 98 model.

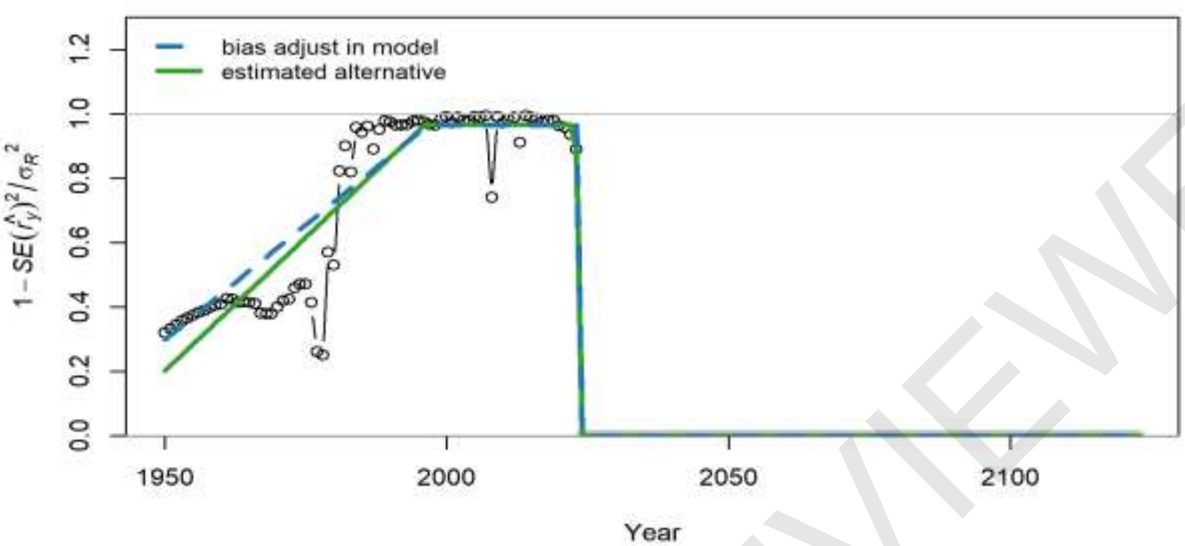
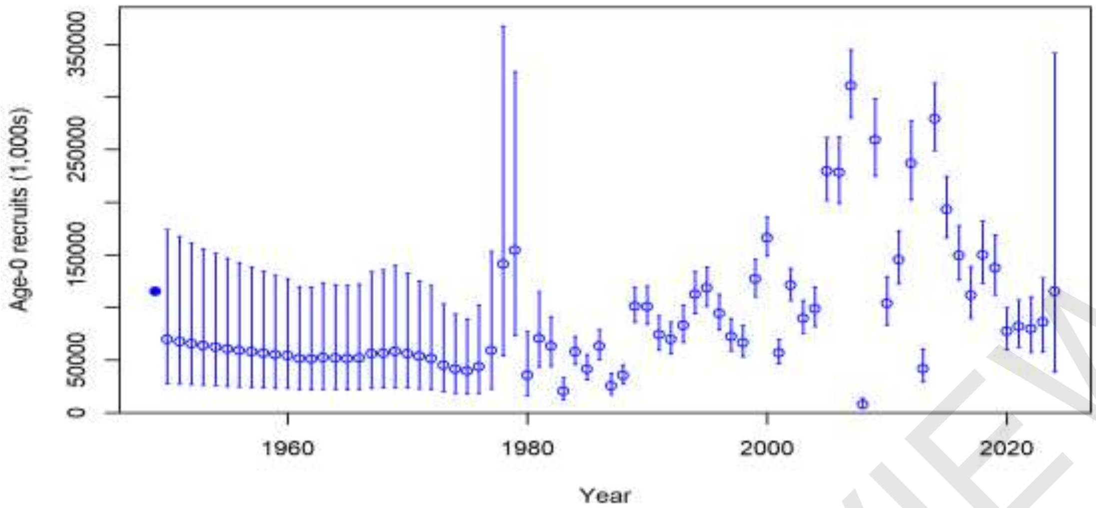


Figure 106. Points are transformed variances. The blue line shows current settings for bias adjustment specified for the Base Run, which coincides with the least squares estimate of alternative bias adjustment relationship for recruitment deviations (green line). For more information, see Methot and Taylor 2011.



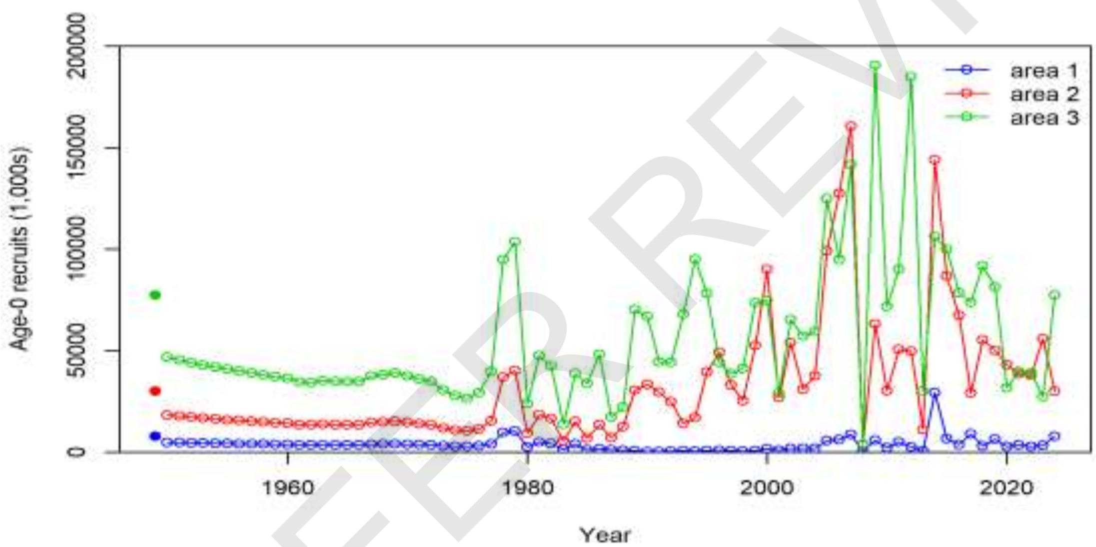


Figure 107. Estimated Age-0 recruitment with 95% confidence intervals for Gulf of America Red Snapper (steepness and SigmaR were fixed at 1 and 0.6, respectively). Bottom figure represents estimated age-0 recruitment by area with area 1 (blue) indicating trends in the East, area 2 (red) indicating trends in the Central area, and area 3 (green) indicating trends in the West area.

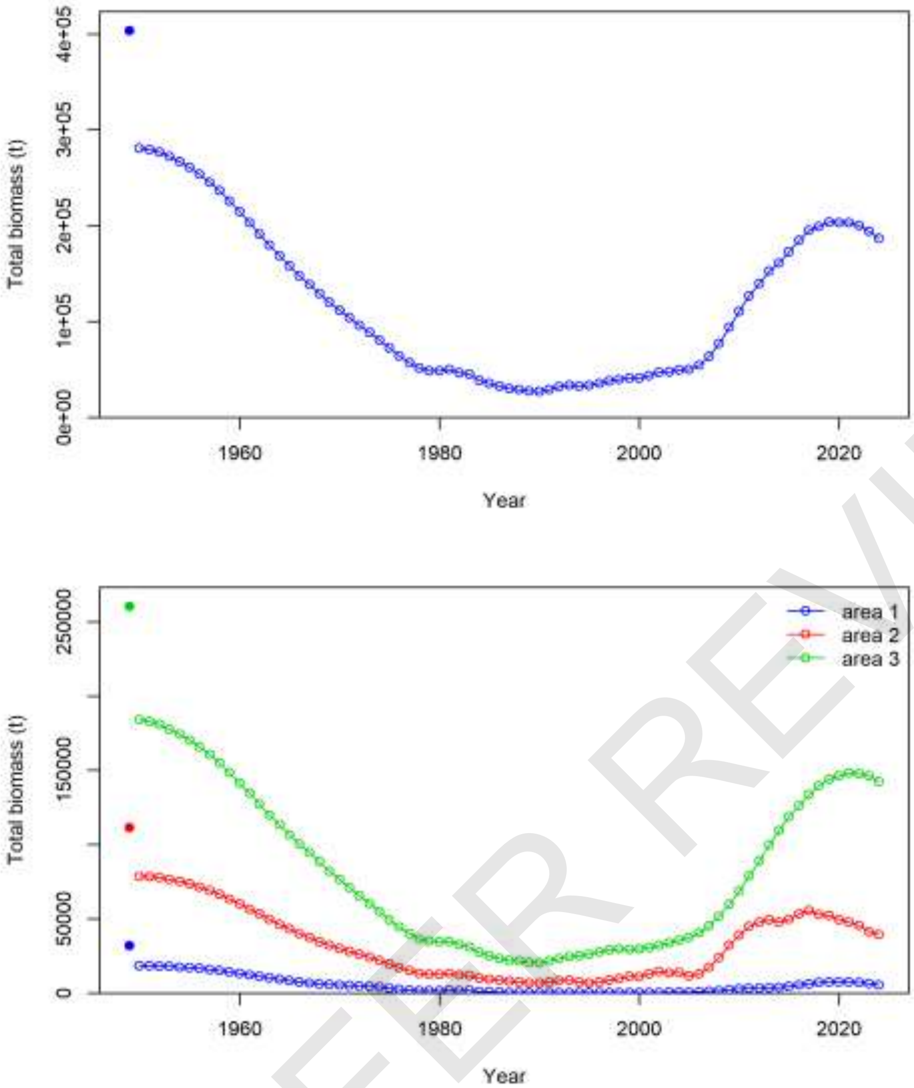


Figure 108. Estimate of total biomass (in metric tons) for Gulf of America Red Snapper and by area with the blue, red and green lines representing the east, central and west areas, respectively.

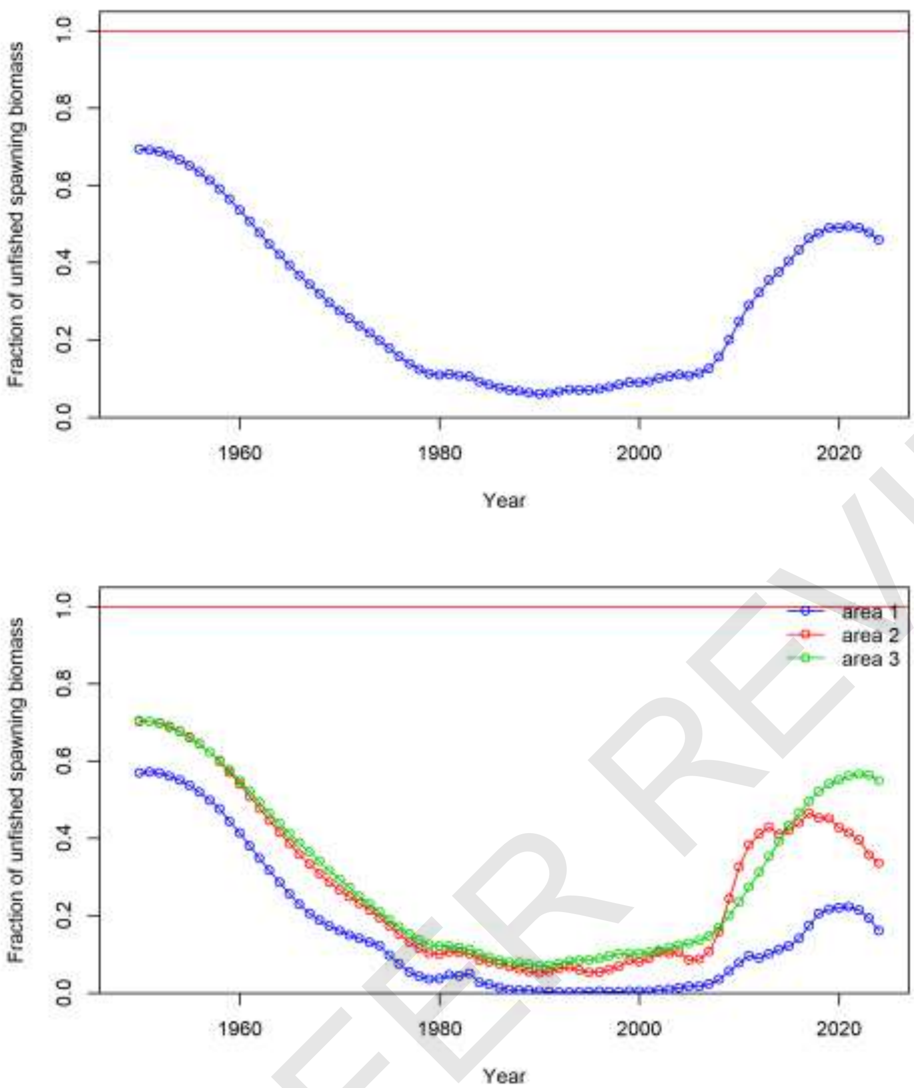


Figure 109. Estimates of fraction of unfished SSB (SSB/SSB0) for Gulf of America Red Snapper and by area with the blue, red and green lines representing the east, central and west area respectively.

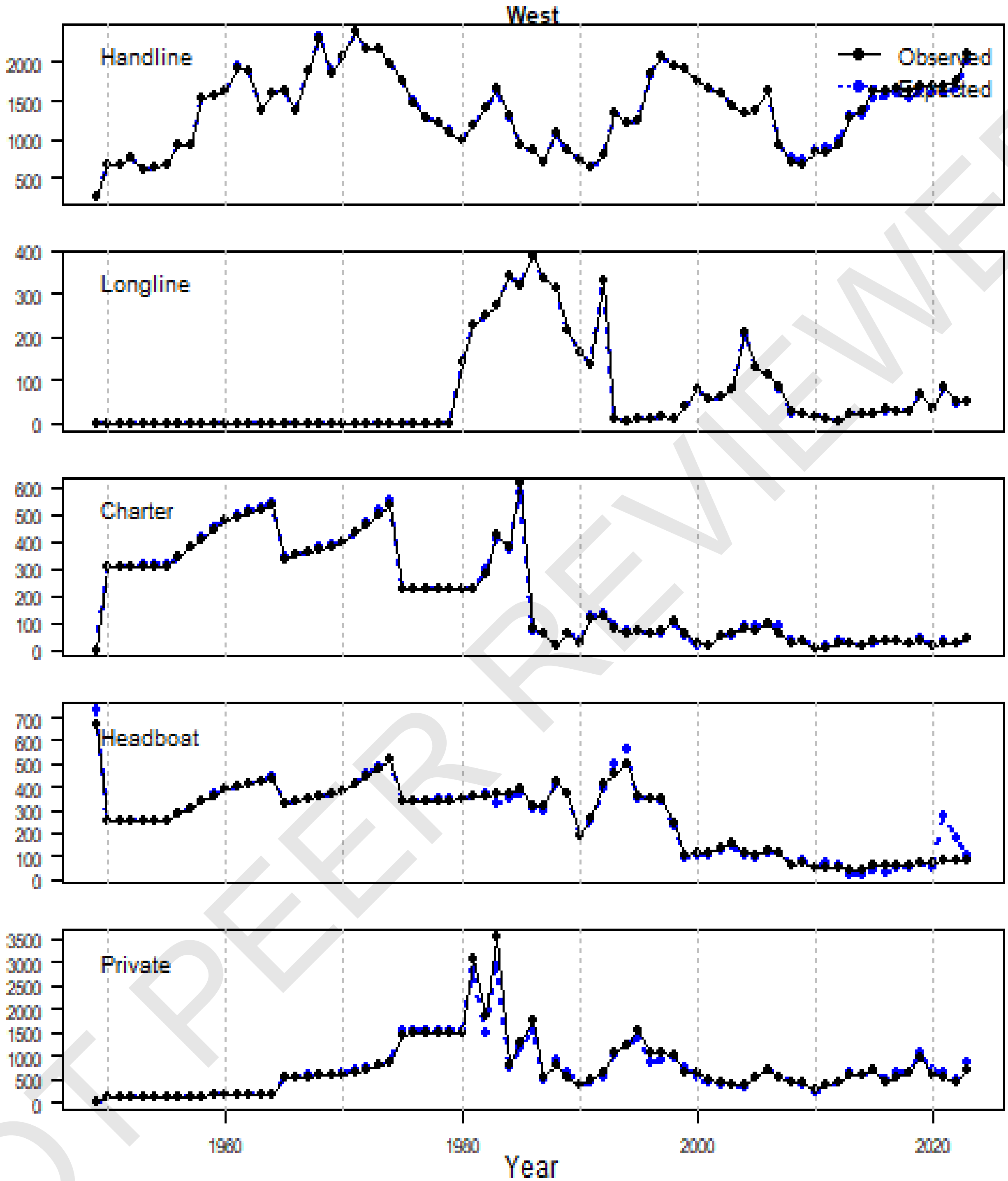


Figure 110. Western Gulf of America Red Snapper observed and expected landings by fleet for SEDAR 98 . Commercial and recreational landings are in metric tons and thousands of fish, respectively. Dashed vertical lines identify ten year intervals.

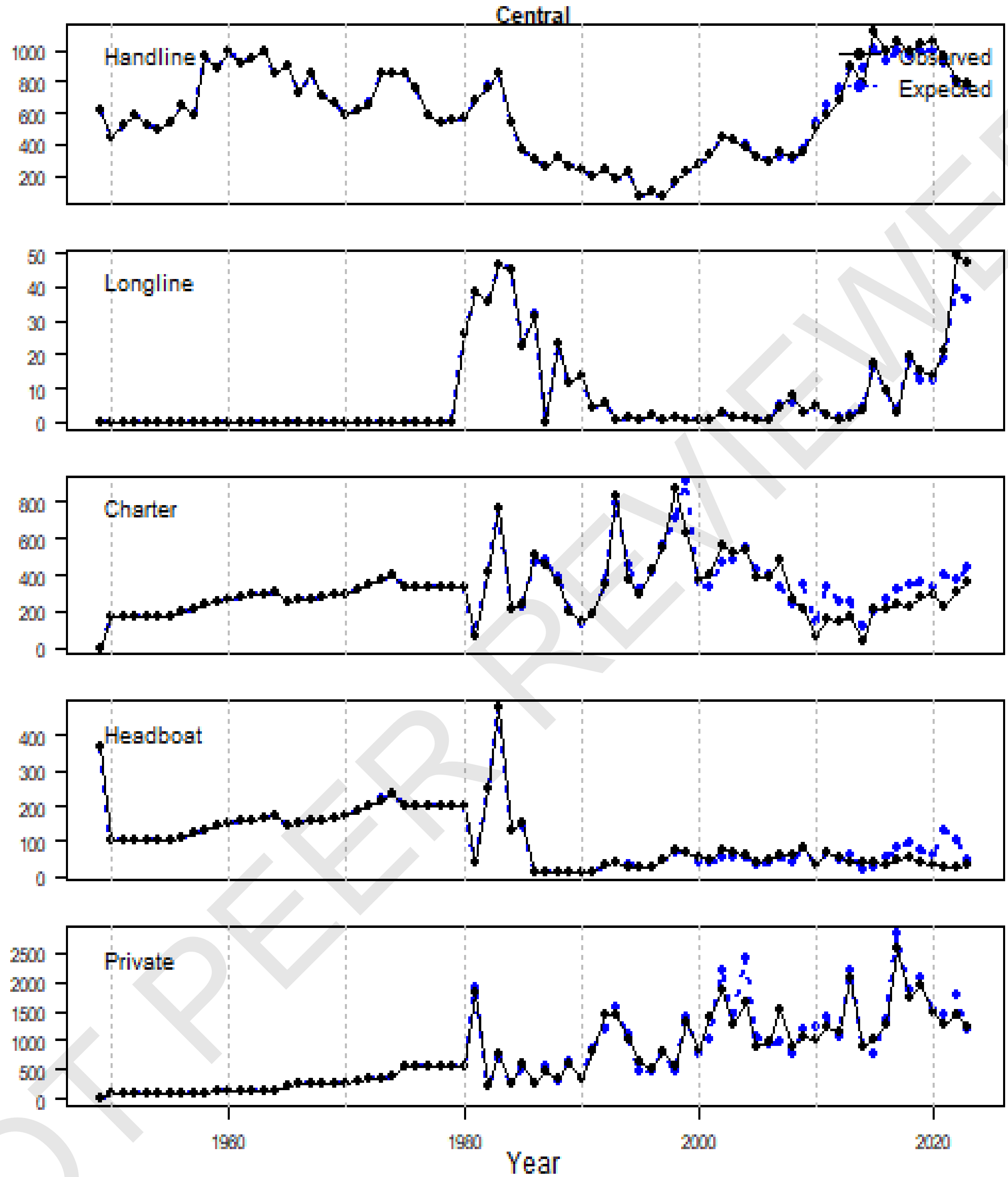


Figure 111. Central Gulf of America Red Snapper observed and expected landings by fleet for SEDAR 98 . Commercial and recreational landings are in metric tons and thousands of fish, respectively. Dashed vertical lines identify ten year intervals.

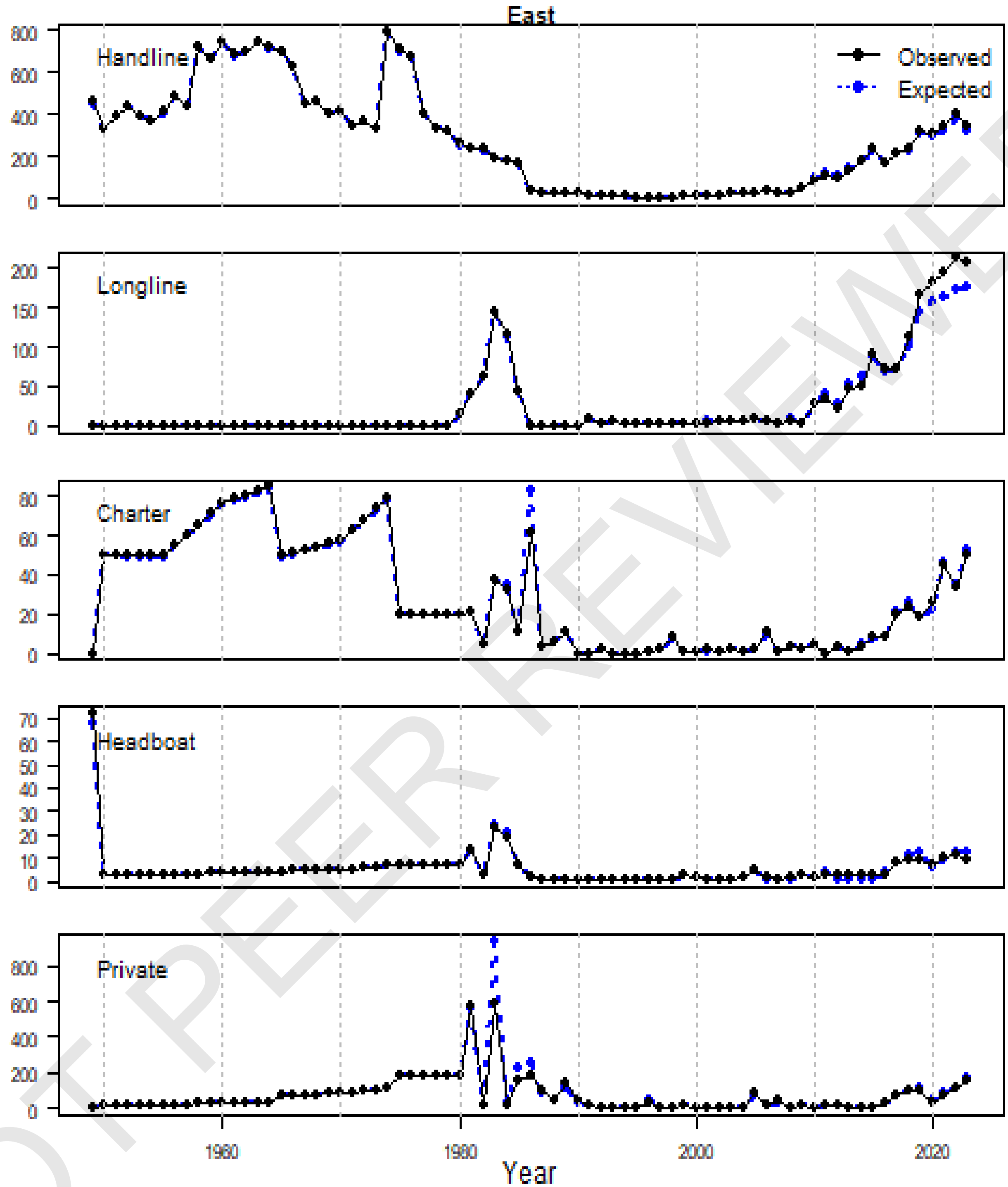


Figure 112. Eastern Gulf of America Red Snapper observed and expected landings by fleet for SEDAR 98 . Commercial and recreational landings are in metric tons and thousands of fish, respectively. Dashed vertical lines identify ten year intervals.

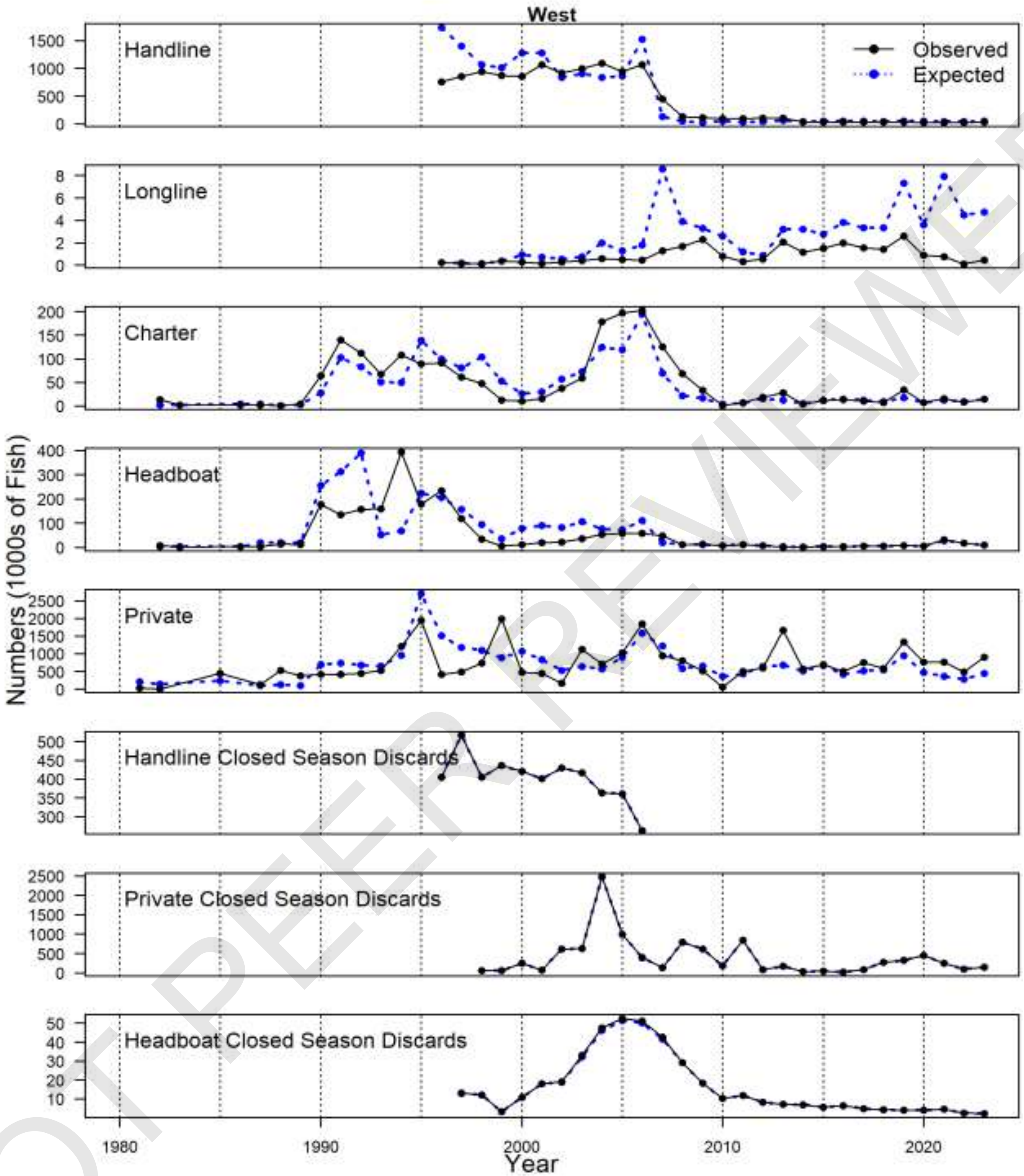


Figure 113. Western Gulf of America Red Snapper observed and expected discards by fleet for SEDAR 98 (left panels). Commercial and recreational discards are in thousands of fish, respectively. Dashed vertical lines identify five year intervals.

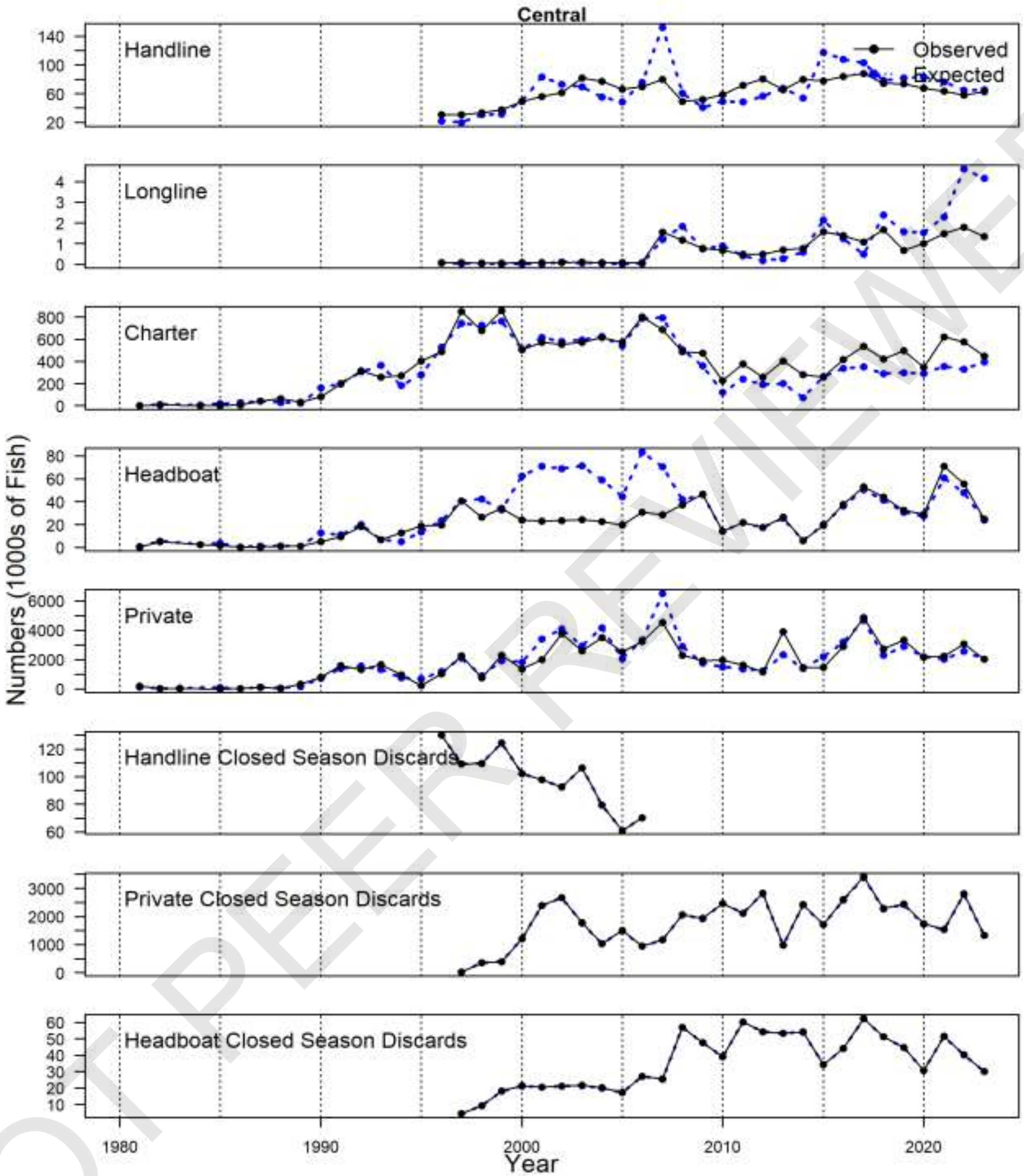


Figure 114. Central Gulf of America Red Snapper observed and expected discards by fleet for SEDAR 98 (left panels). Commercial and recreational discards are in thousands of fish, respectively. Dashed vertical lines identify five year intervals.

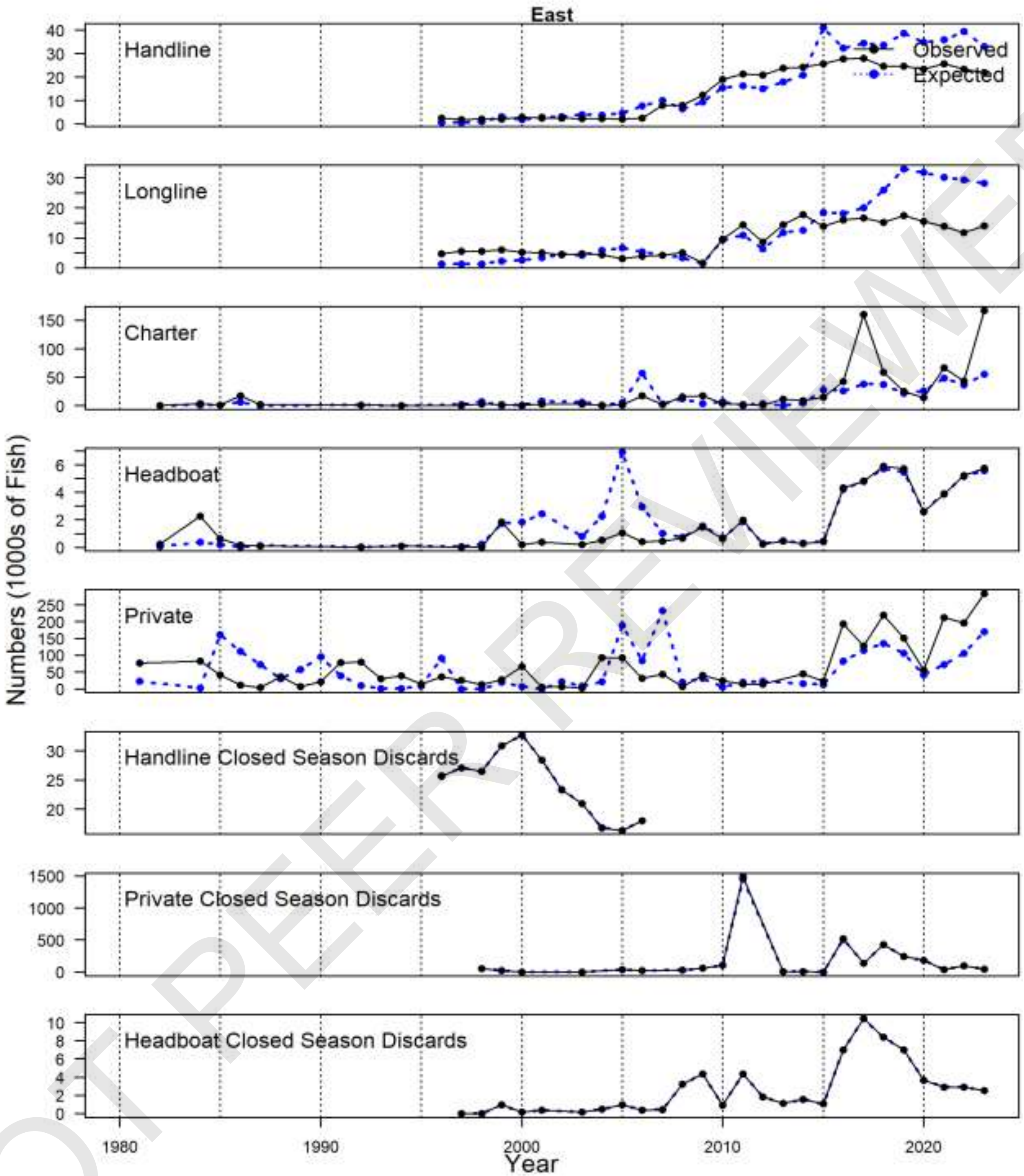


Figure 115. Eastern Gulf of America Red Snapper observed and expected discards by fleet for SEDAR 98 (left panels). Commercial and recreational discards are in of fish, respectively. Dashed vertical lines identify five year intervals.

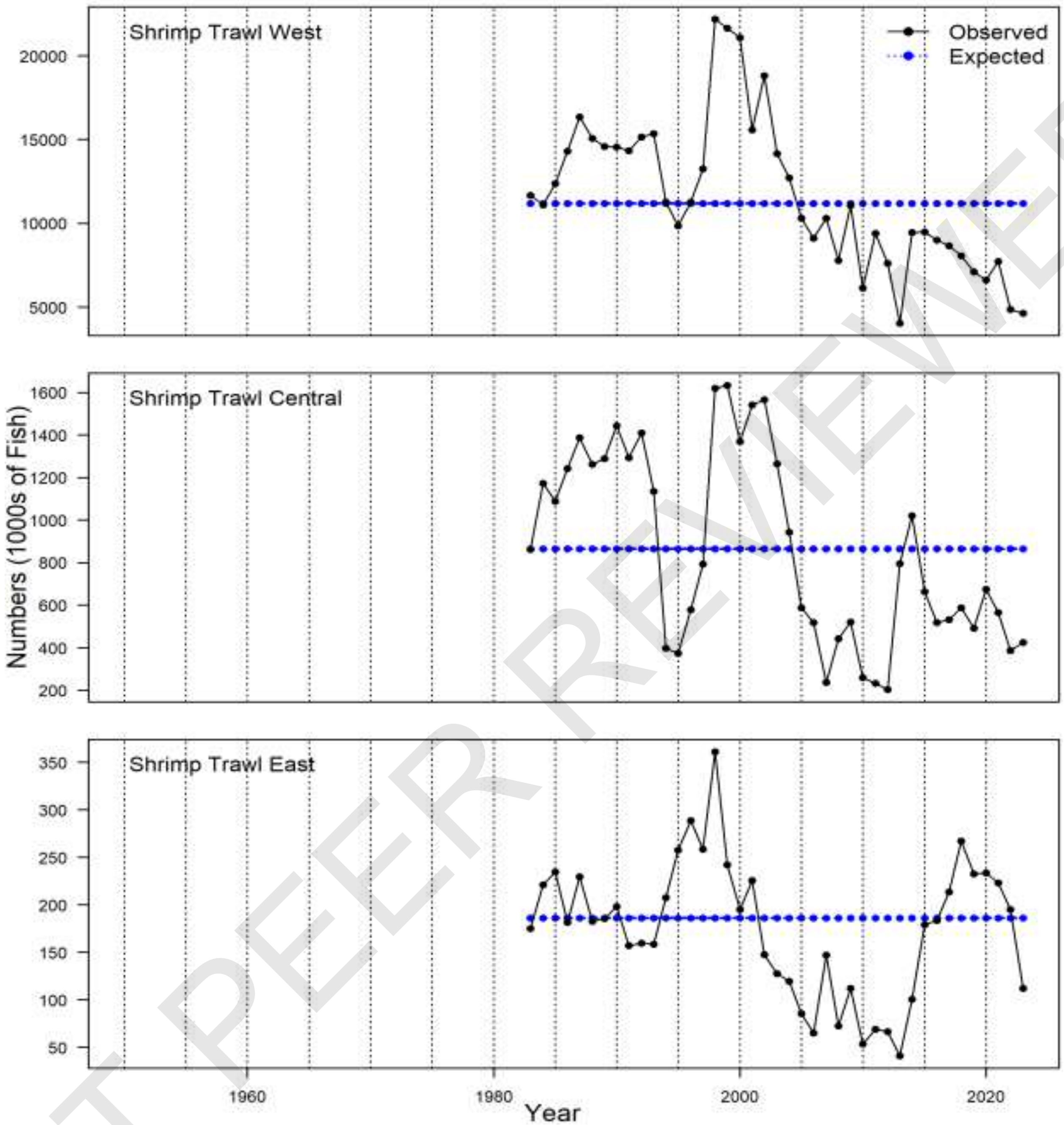


Figure 116. Shrimp Trawl bycatch for Gulf of America Red Snapper observed and expected indices (blue lines) for SEDAR 98. Dashed vertical lines identify five year intervals.

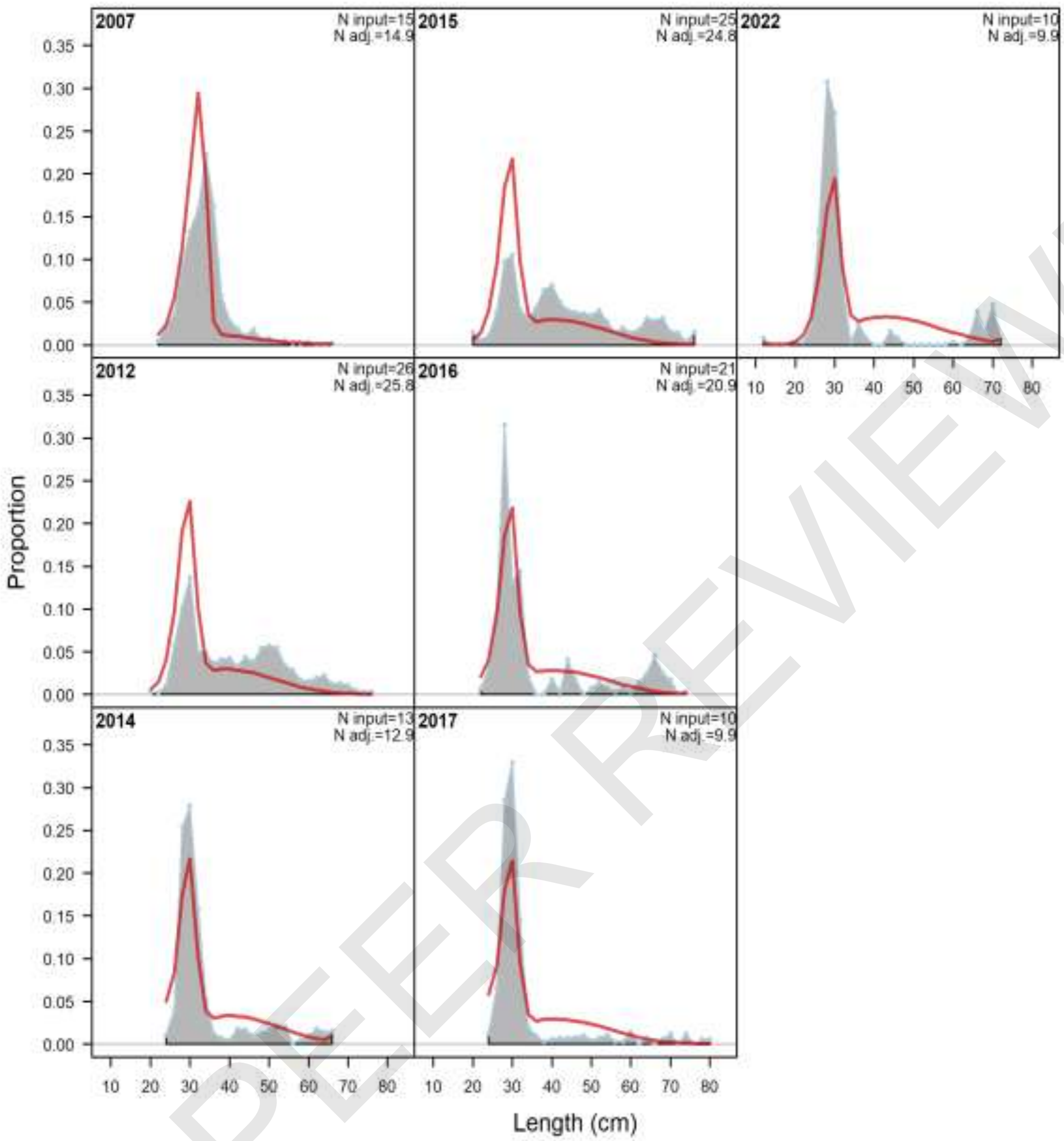


Figure 117. Length compositions, discard, Commercial Handline West. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 92.844 and the sample size multiplier is approximately Θ / (1+Θ) = 0.989.*

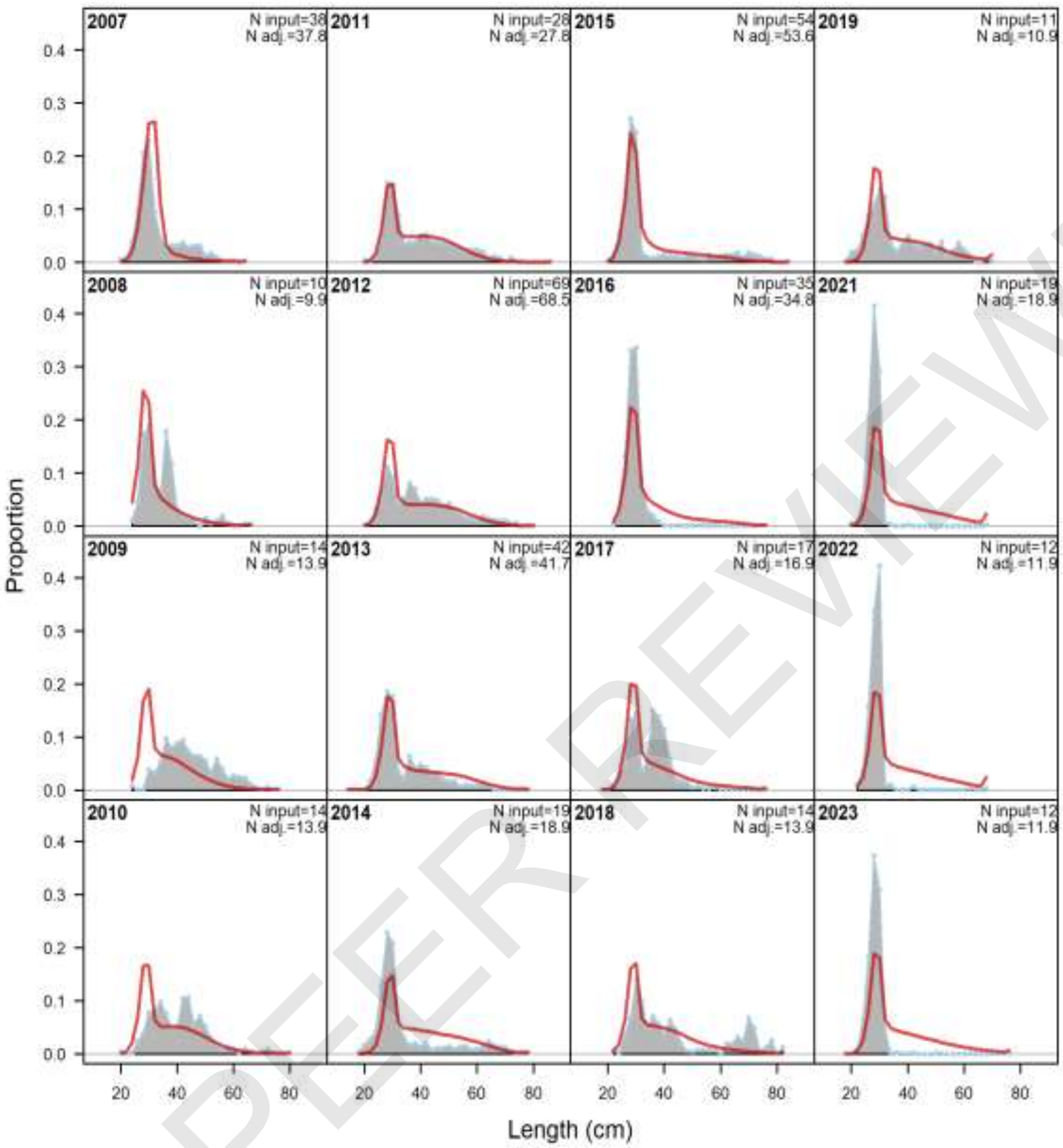


Figure 118. Length compositions, discard, Commercial Handline Central. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 70.442 and the sample size multiplier is approximately Θ / (1+Θ) = 0.986.*

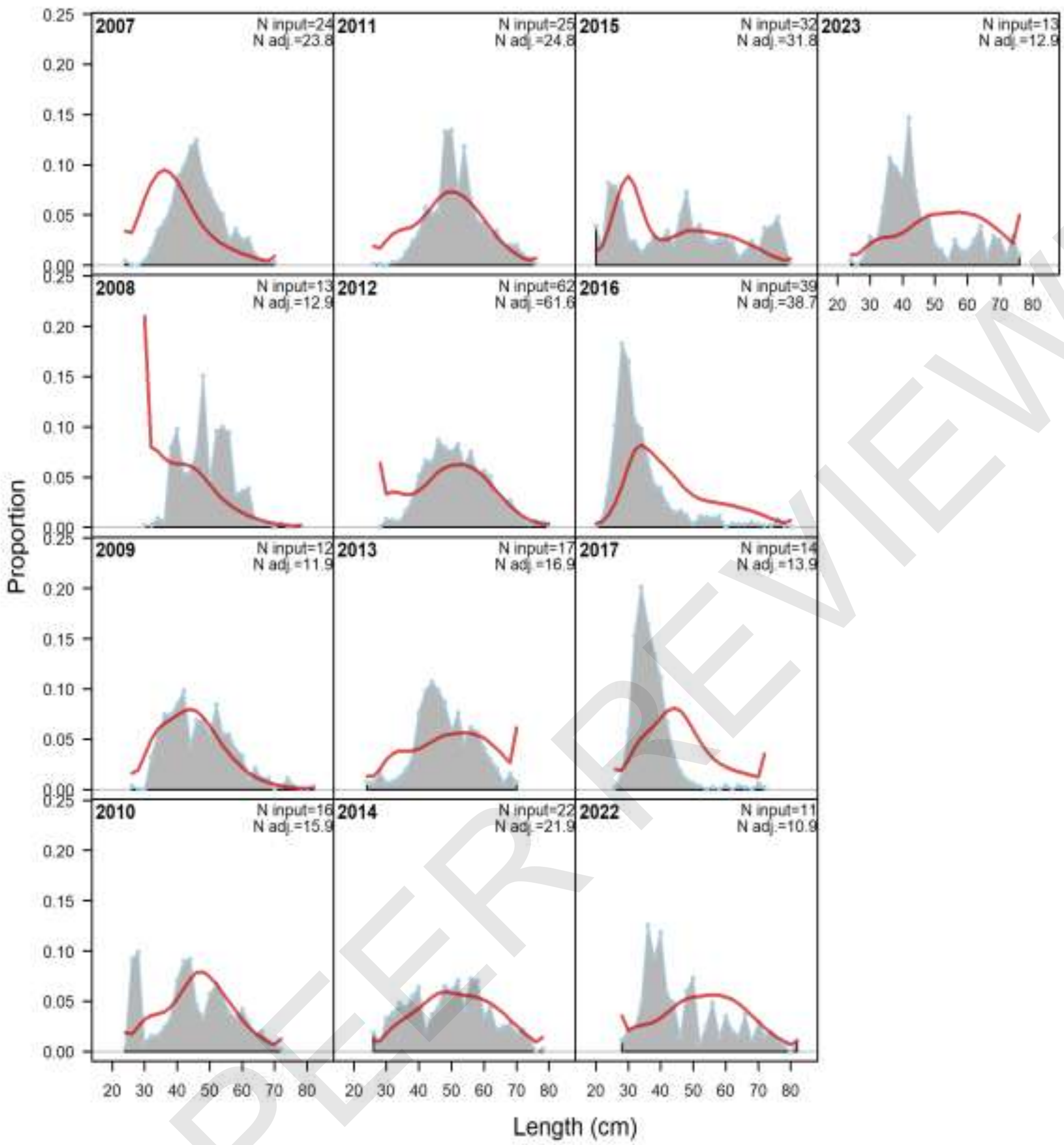


Figure 119. Length compositions, discard, Commercial Handline East. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 56.942 and the sample size multiplier is approximately Θ / (1+Θ) = 0.983.*

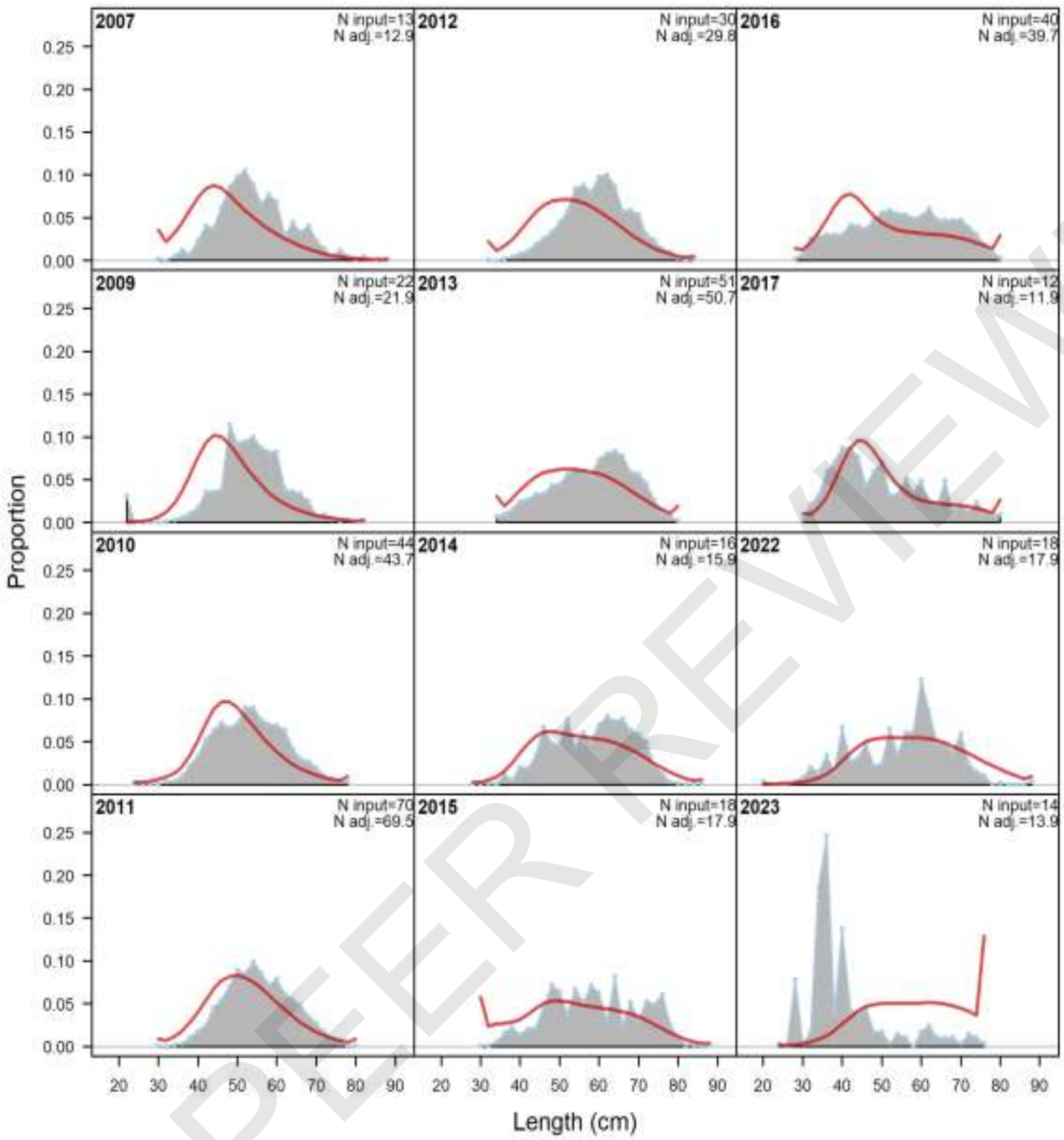


Figure 120. Length compositions, discard, Commercial Longline East. 'N input' is the input sample size. 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial Θ parameter based on the formula N adj. = 1 / (1+Θ) + N Θ / (1+Θ). For this fleet, Θ = 40.876 and the sample size multiplier is approximately Θ / (1+Θ) = 0.976.*

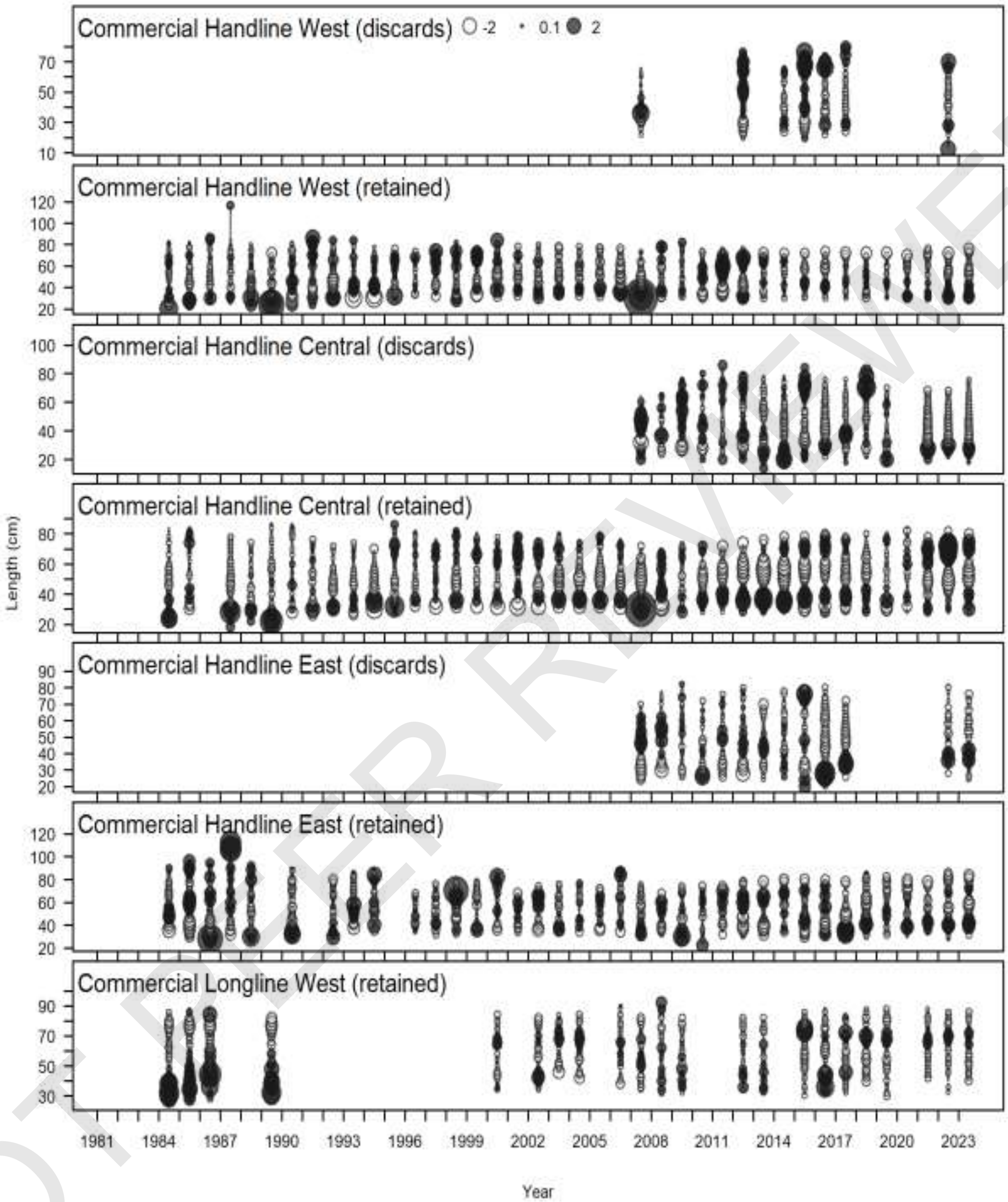


Figure 122. Pearson residuals for discard and retained length composition data by year compared across fleets and surveys for Gulf of America Red Snapper for SEDAR 98. Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected).

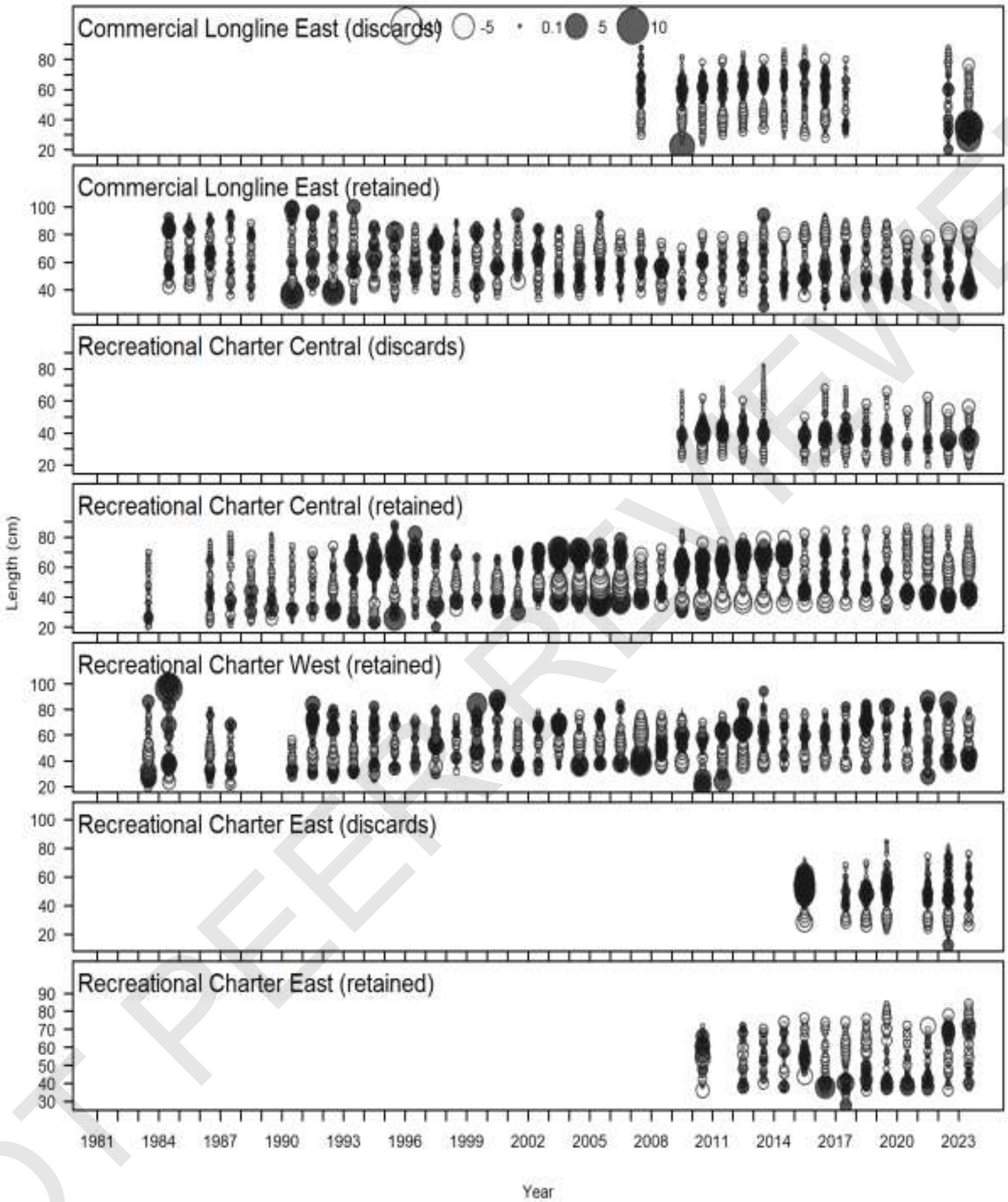


Figure 122 Continued. Pearson residuals for discard and retained length composition data by year compared across fleets and surveys for Gulf of America Red Snapper for SEDAR 98. Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected).

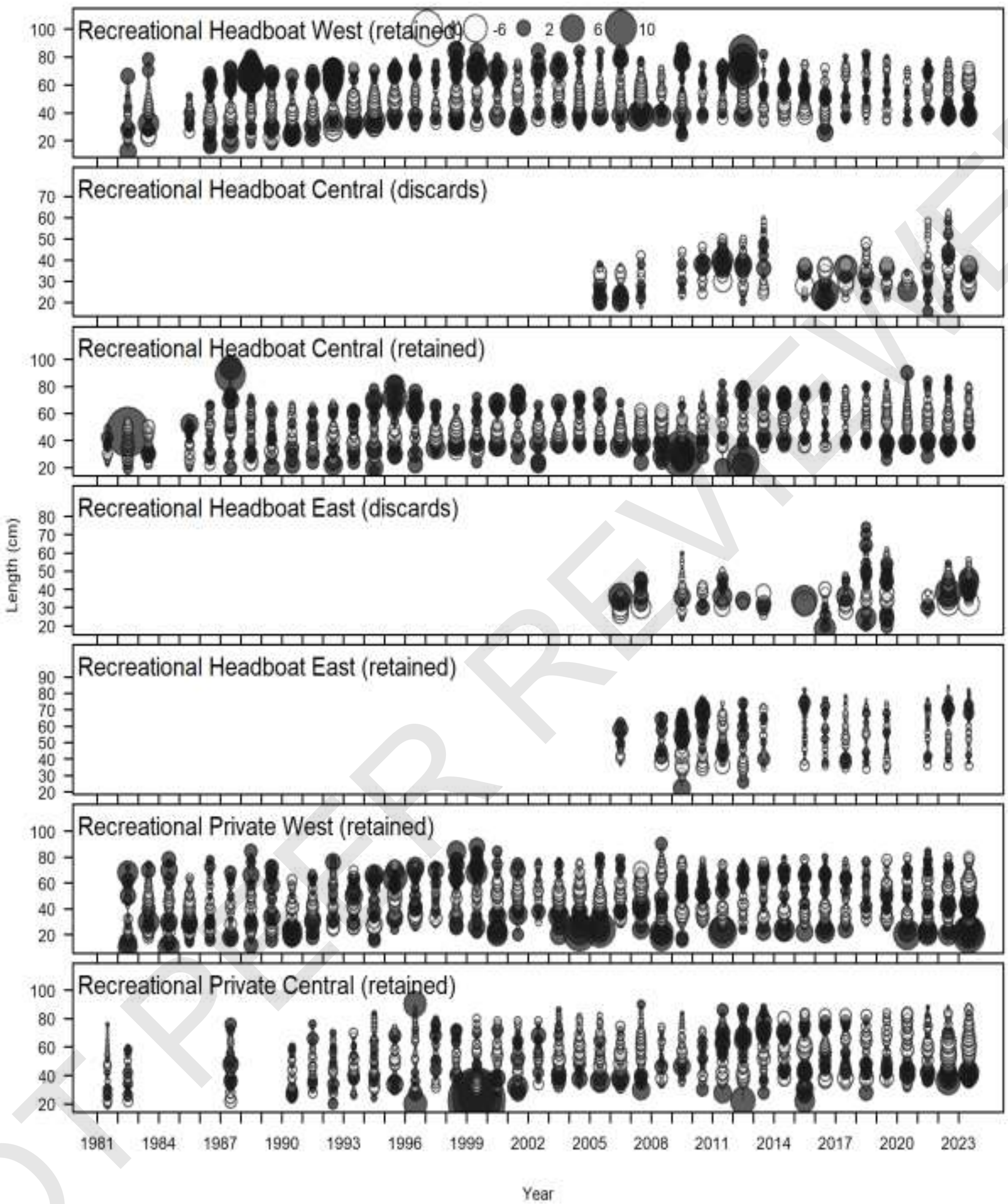


Figure 122 Continued. Pearson residuals for discard and retained length composition data by year compared across fleets and surveys for Gulf of America Red Snapper for SEDAR 98. Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected).

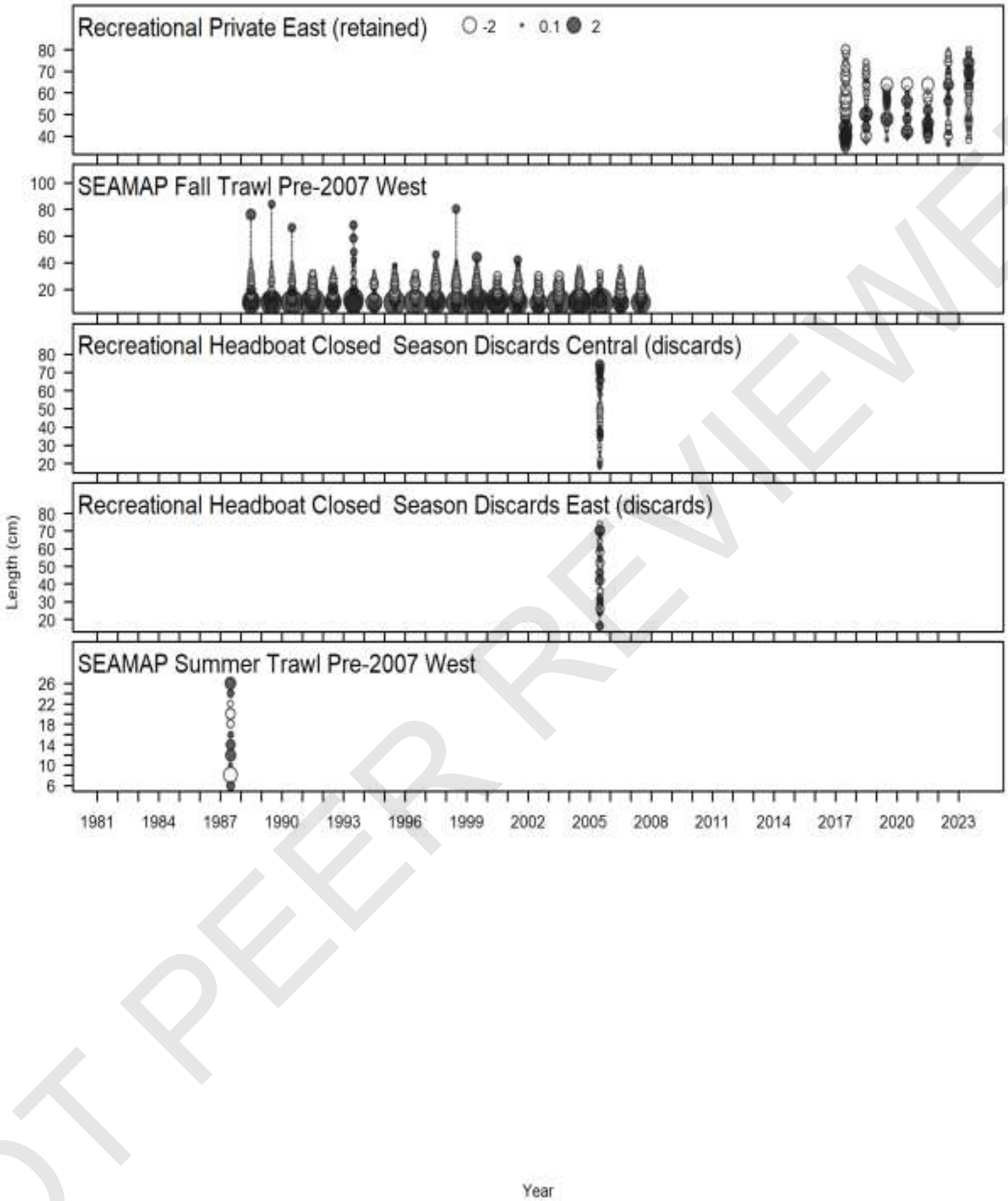


Figure 122 Continued. Pearson residuals for discard and retained length composition data by year compared across fleets and surveys for Gulf of America Red Snapper for SEDAR 98. Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected).

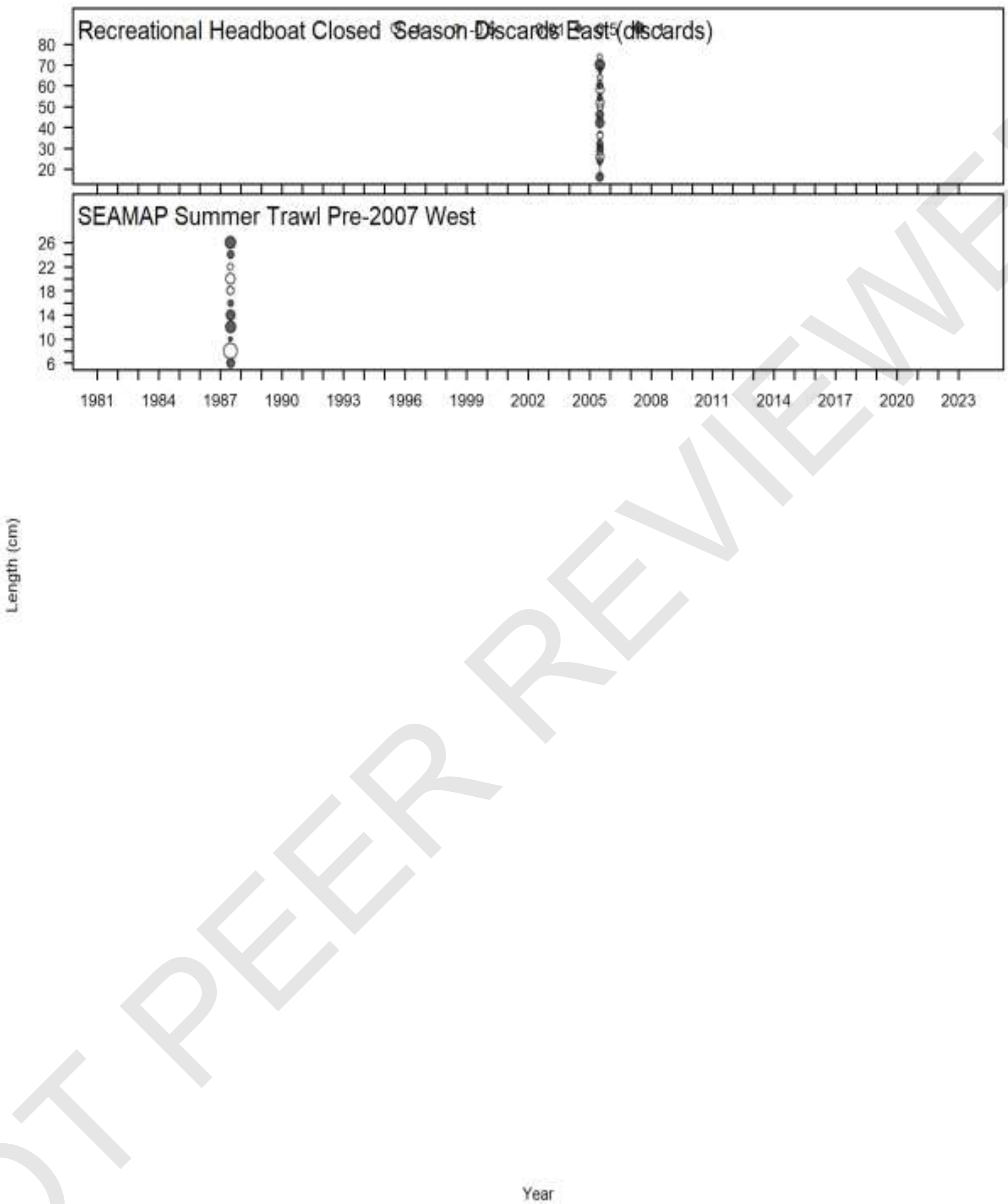


Figure 122 Continued. Pearson residuals for discard and retained length composition data by year compared across fleets and surveys for Gulf of America Red Snapper for SEDAR 98. Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected).

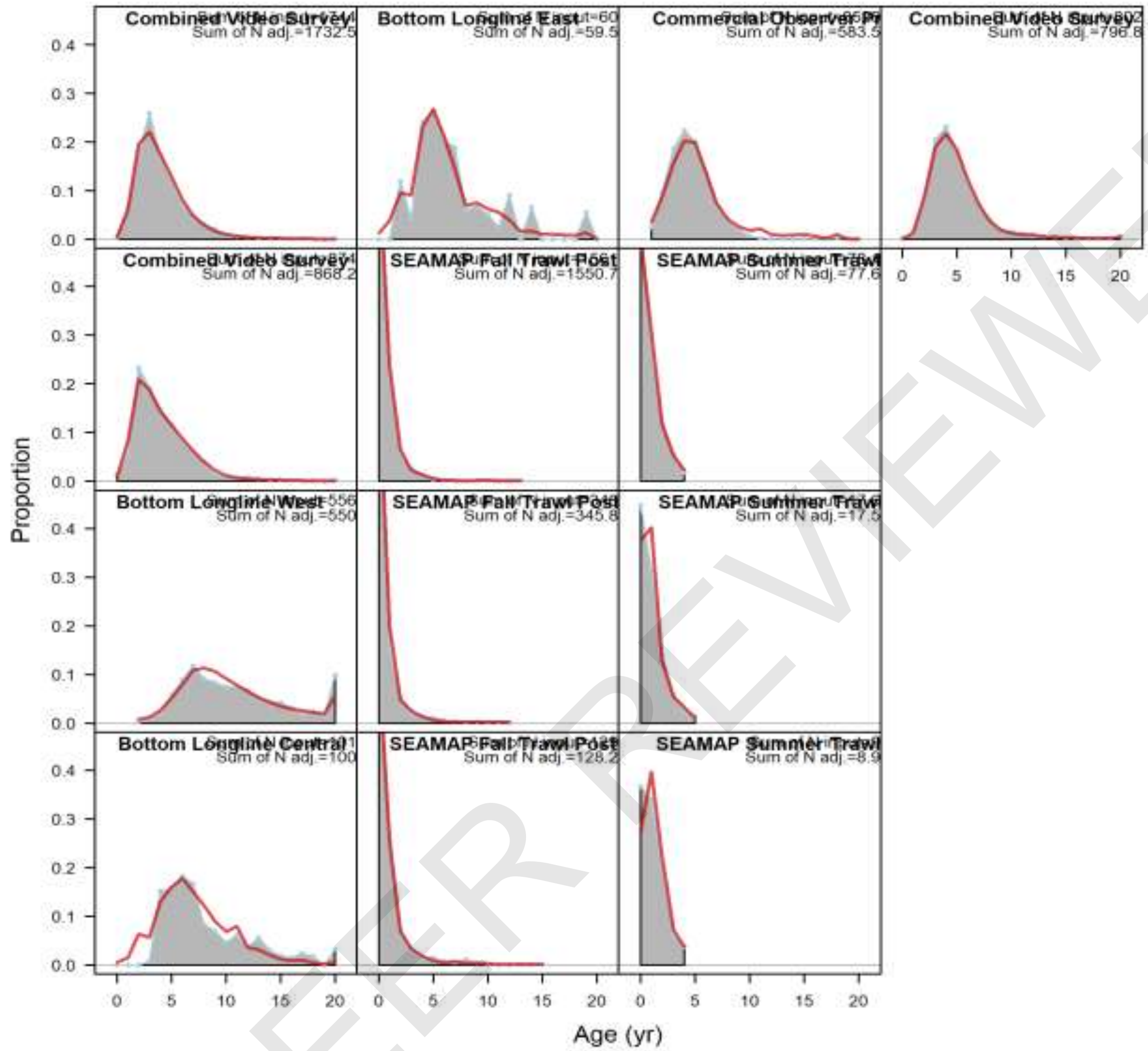


Figure 123. Age compositions, aggregated across time by fleet. Labels 'retained' and 'discard' indicate discarded or retained sampled for each fleet. Panels without this designation represent the whole catch.

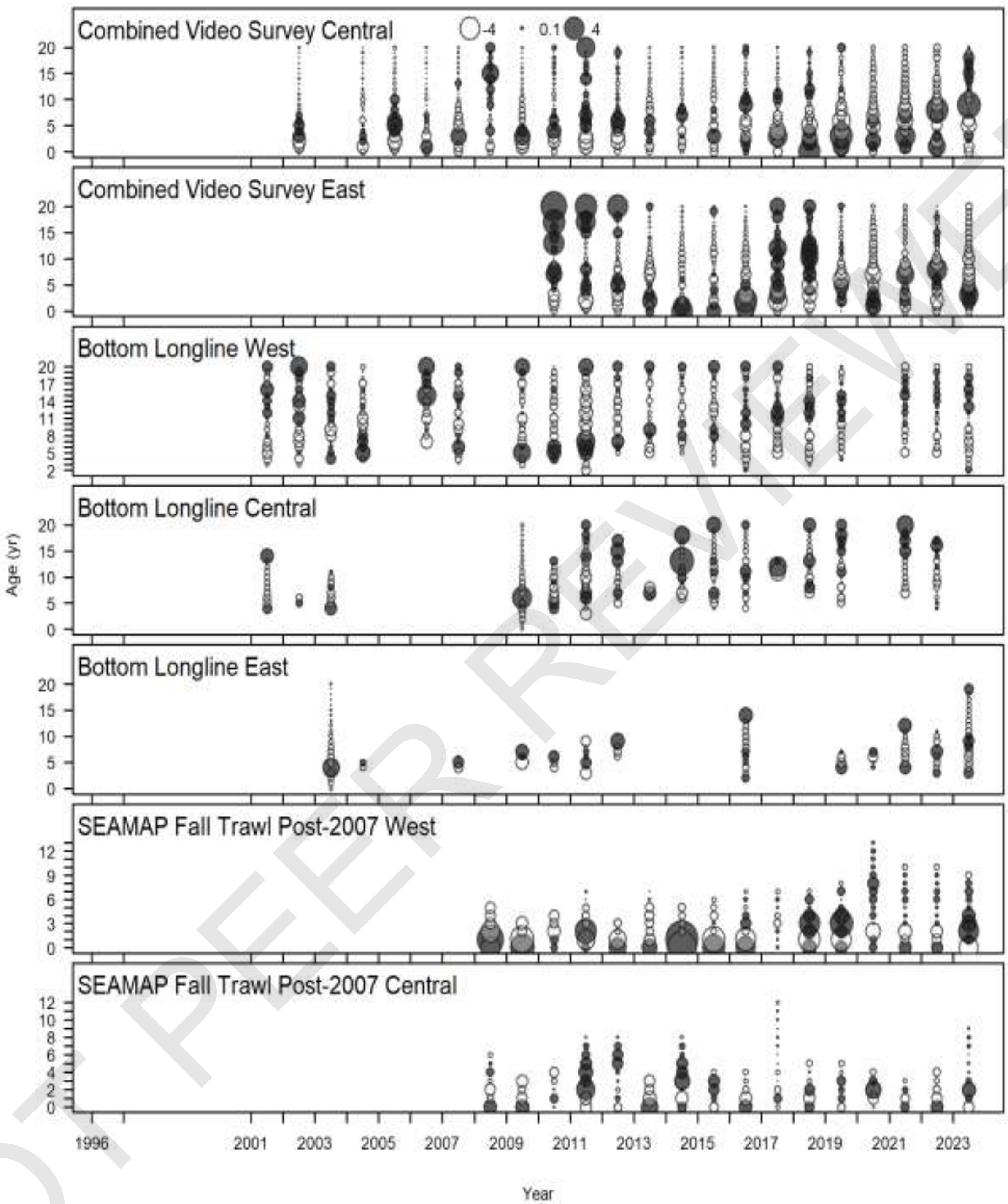


Figure 124. Pearson residuals for discard and retained length composition data by year compared across fleets and surveys for Gulf of America Red Snapper for SEDAR 98. Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected).

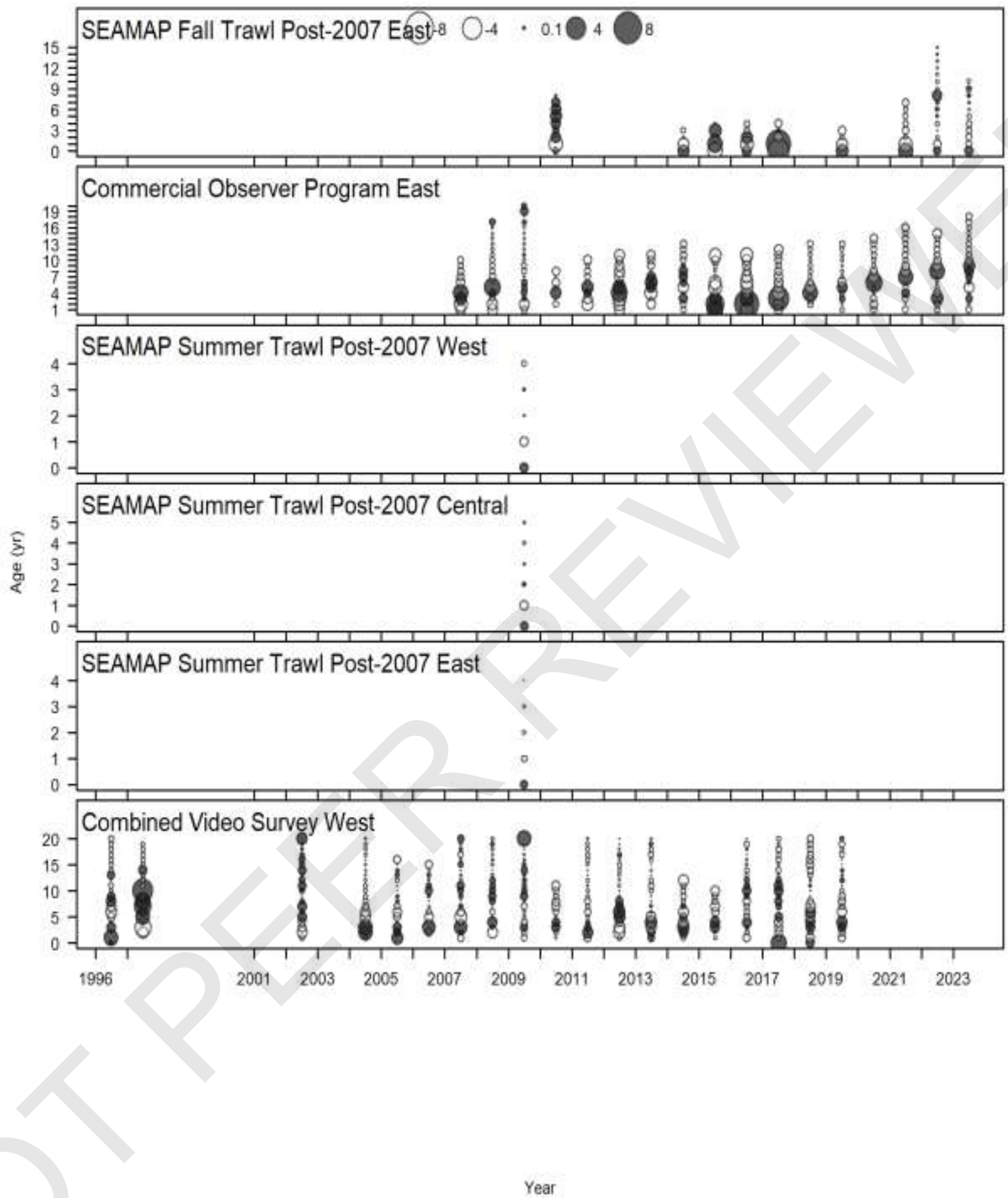


Figure 124 Continued. Pearson residuals for discard and retained length composition data by year compared across fleets and surveys for Gulf of America Red Snapper for SEDAR 98. Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected).

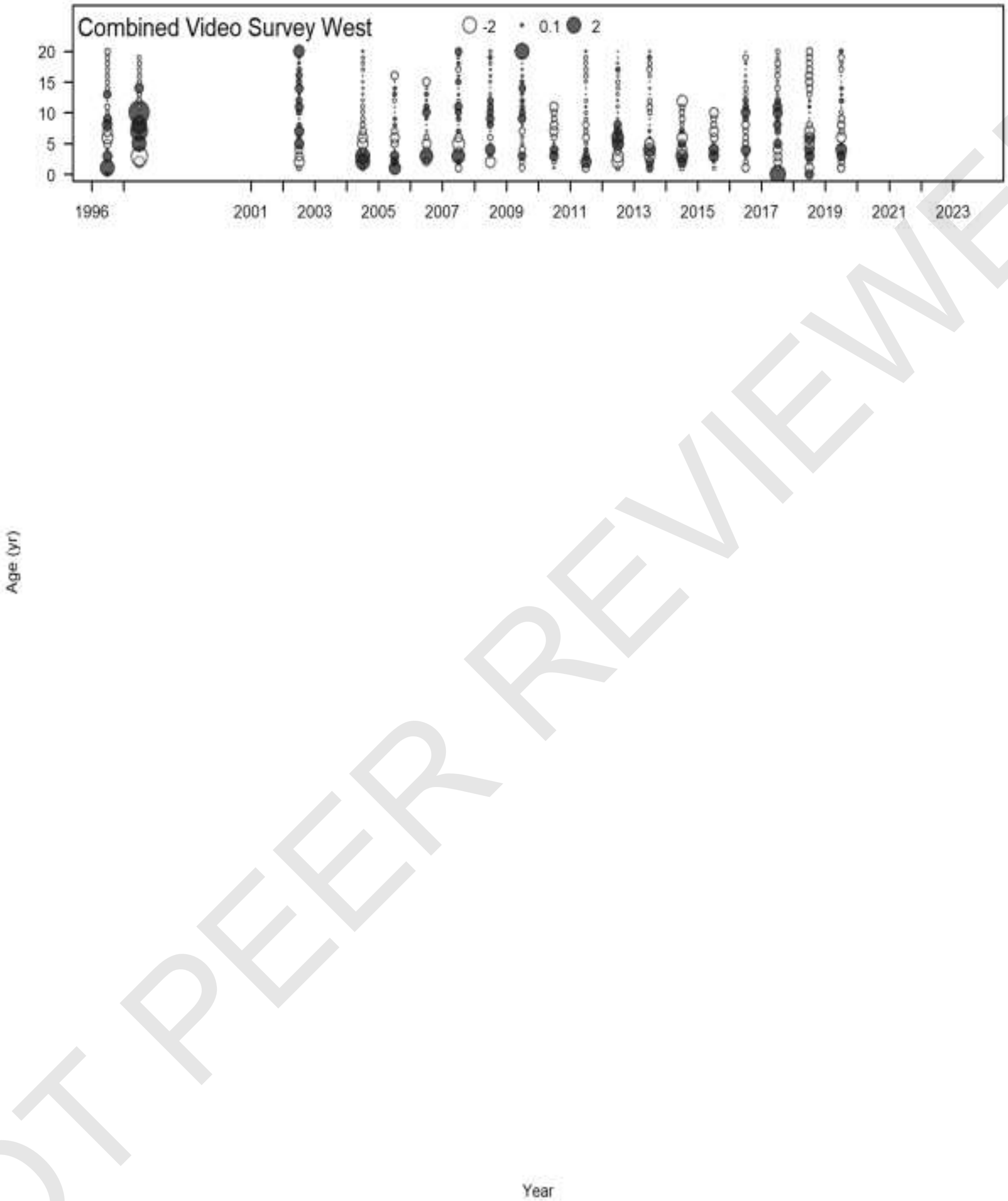


Figure 124 Continued. Pearson residuals for discard and retained length composition data by year compared across fleets and surveys for Gulf of America Red Snapper for SEDAR 98. Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected).

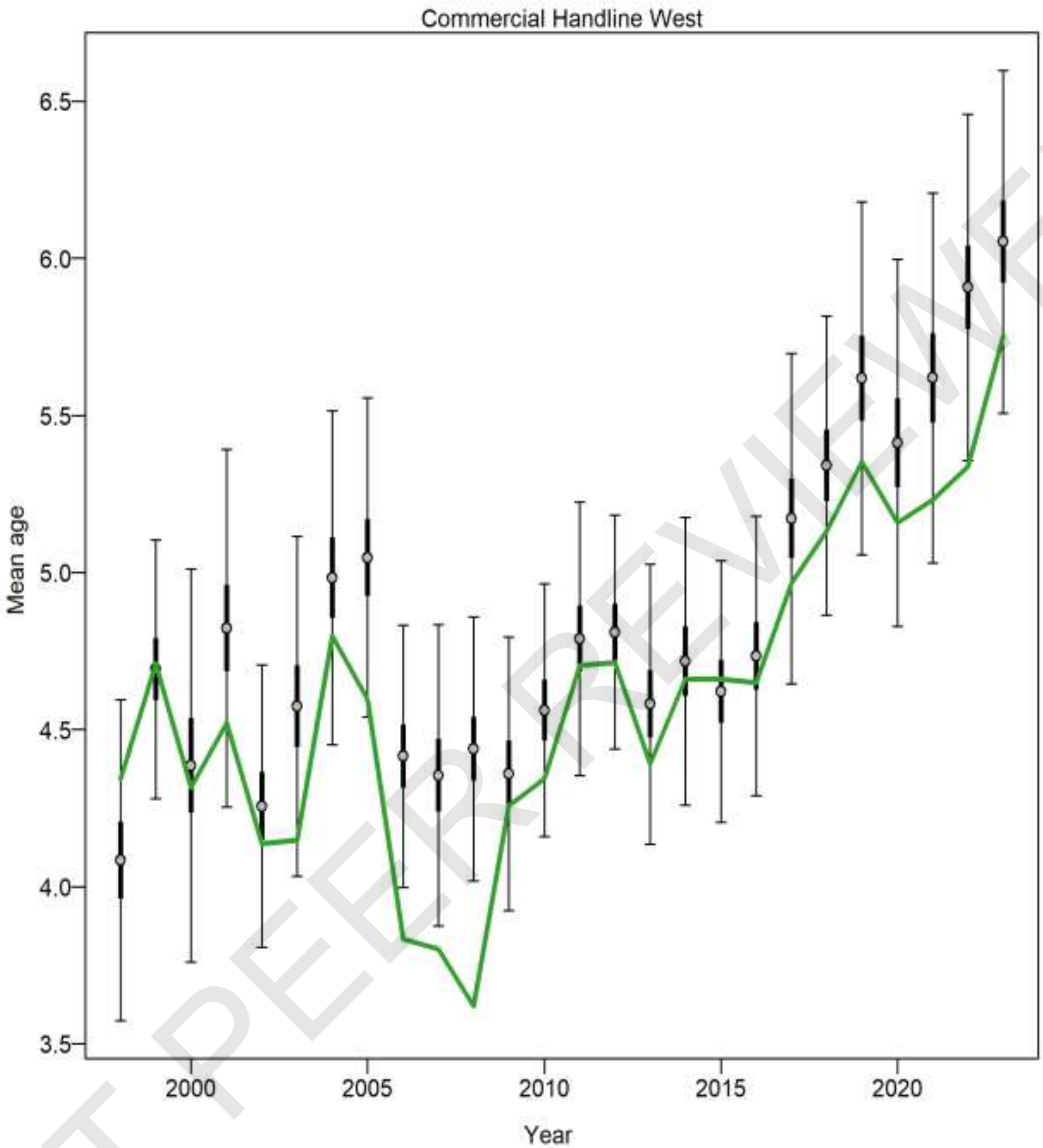


Figure 125. Mean age from conditional data (aggregated across length bins) for Commercial Handline West with 95% confidence intervals based on current samples sizes.

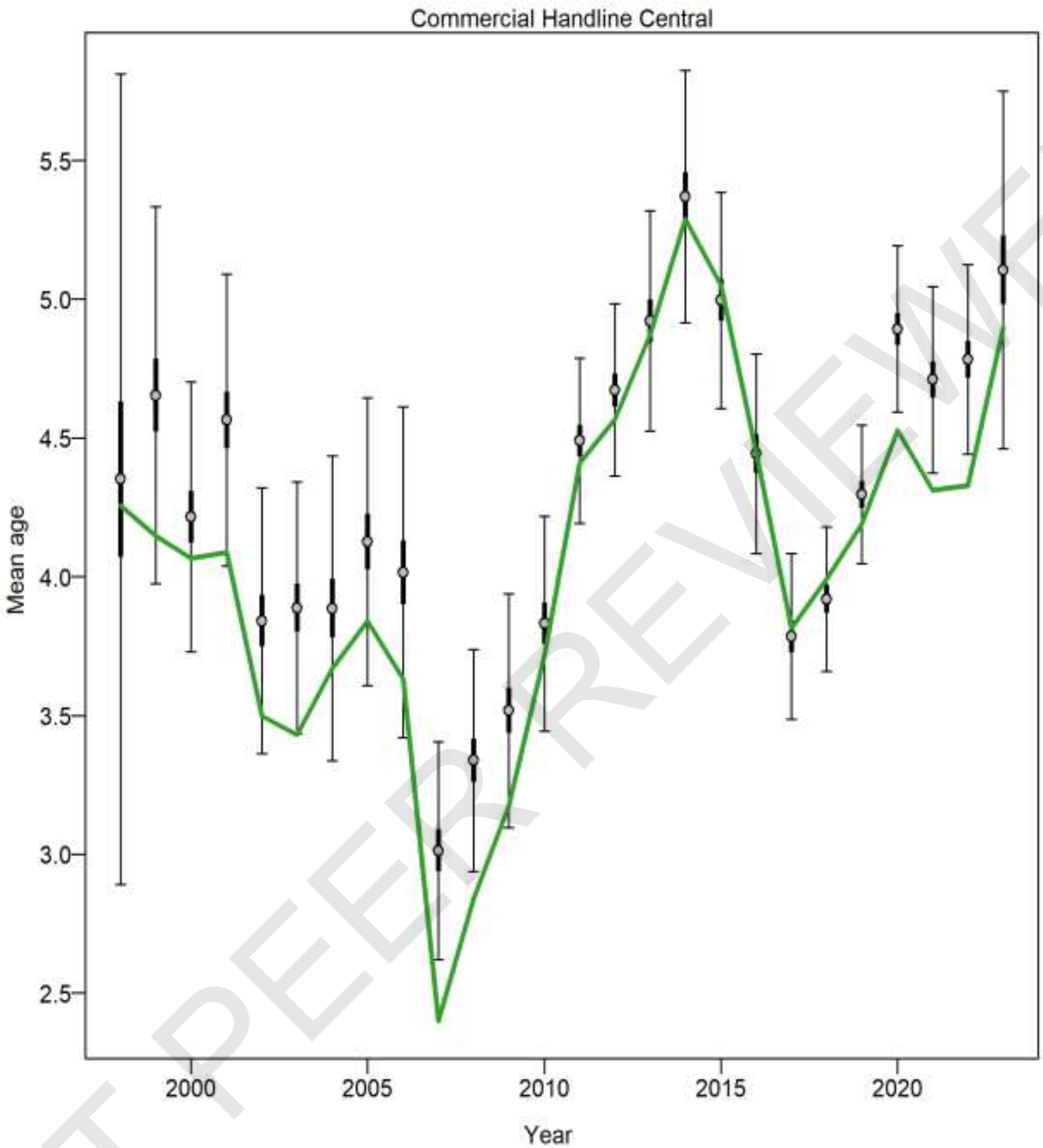


Figure 126. Mean age from conditional data (aggregated across length bins) for Commercial Handline Central with 95% confidence intervals based on current samples sizes. Francis data weighting method TA1.8: thinner intervals (with capped ends) show result of further adjusting sample sizes based on suggested multiplier (with 95% interval) for conditional age-at-length data from Commercial Handline Central: 0.037 (0.0266-0.0644)

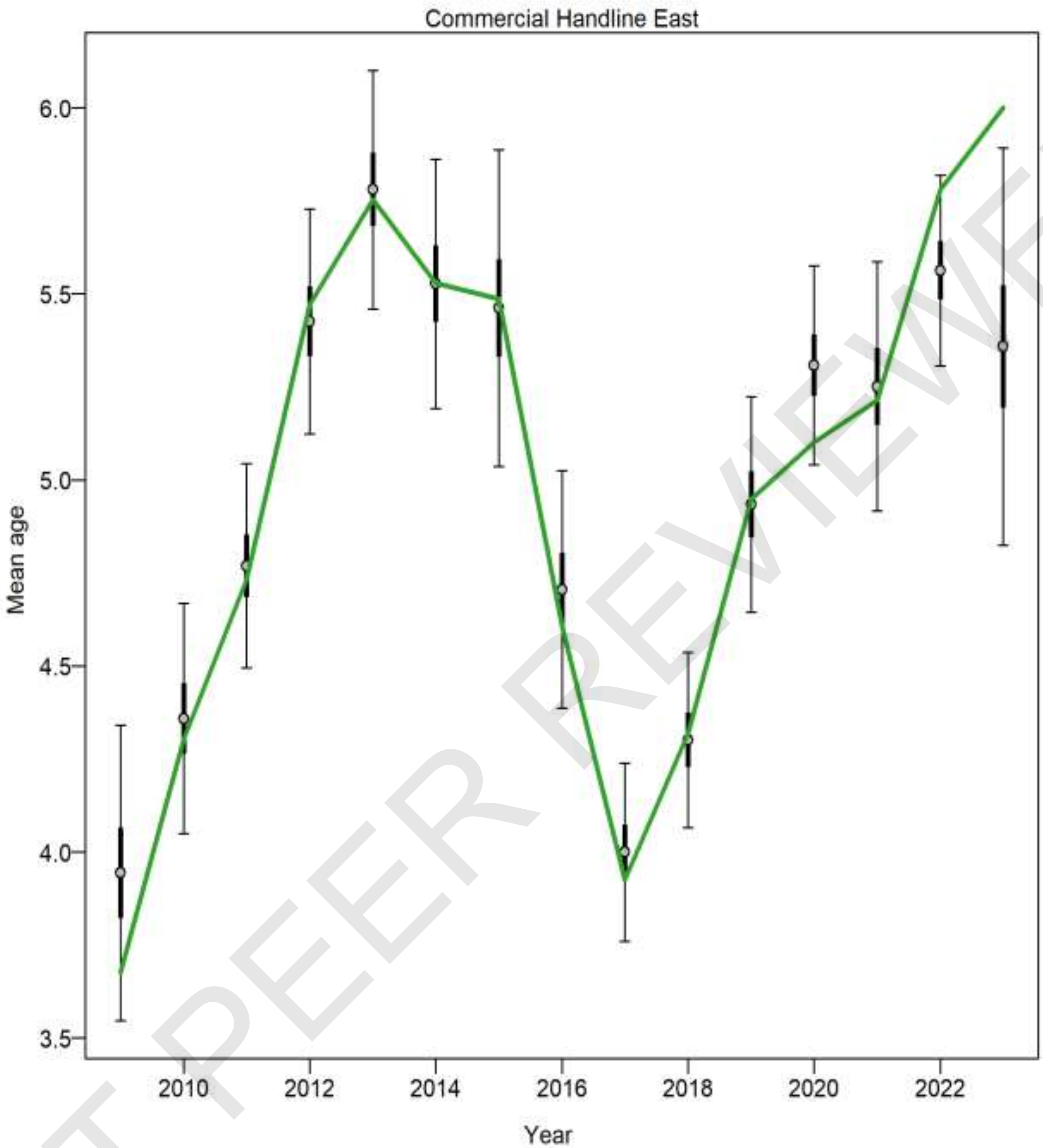


Figure 127. Mean age from conditional data (aggregated across length bins) for Commercial Handline East with 95% confidence intervals based on current samples sizes. Francis data weighting method TA1.8: thinner intervals (with capped ends) show result of further adjusting sample sizes based on suggested multiplier (with 95% interval) for conditional age-at-length data from Commercial Handline East: 0.095 (0.053-0.4875)

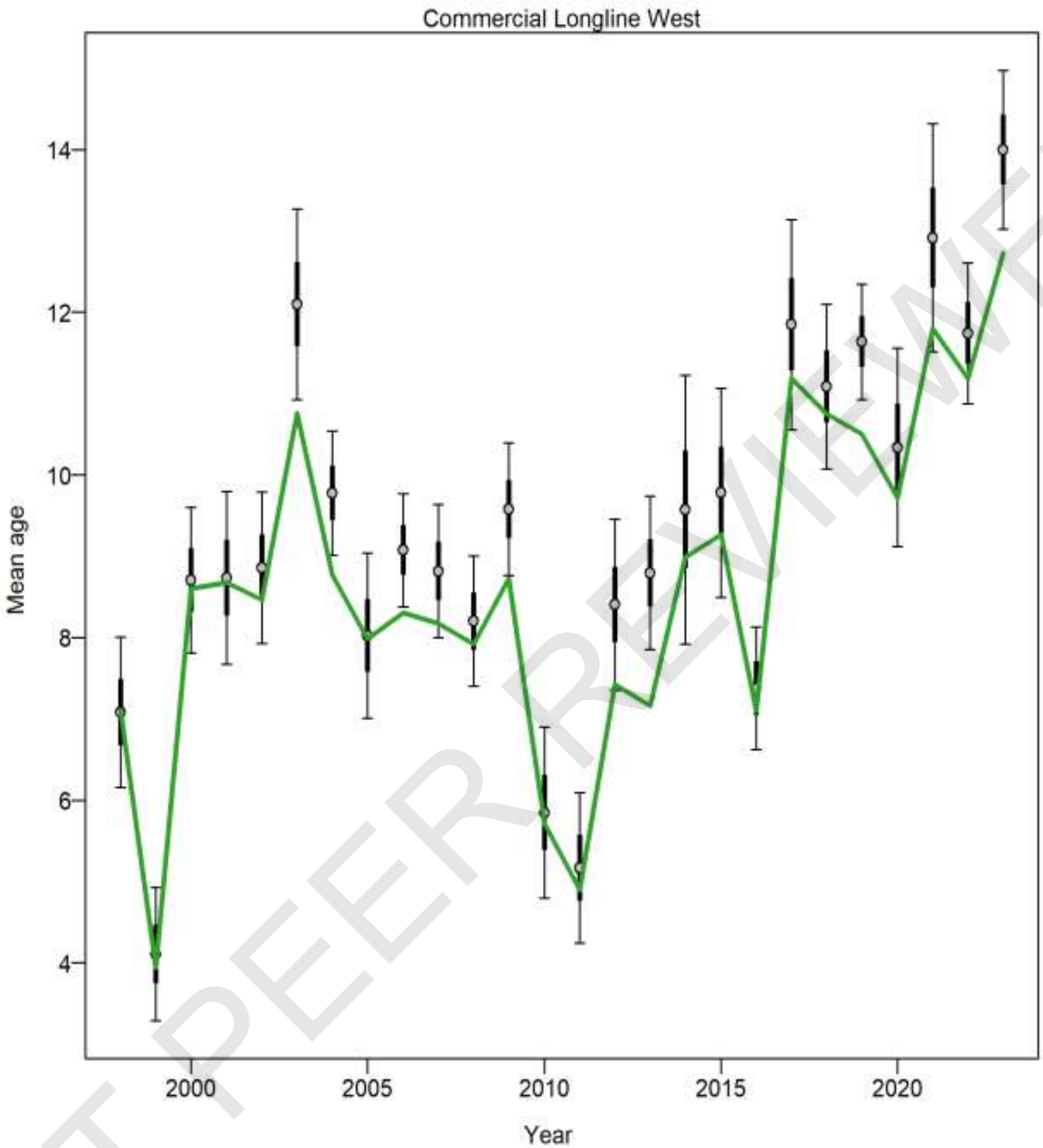


Figure 128. Mean age from conditional data (aggregated across length bins) for Commercial Longline West with 95% confidence intervals based on current samples sizes.Francis data weighting method TA1.8: thinner intervals (with capped ends) show result of further adjusting sample sizes based on suggested multiplier (with 95% interval) for conditional age-at-length data from Commercial Longline West:0.1931 (0.1356-0.3585) For more info, see Francis (2011) and Punt (2017).

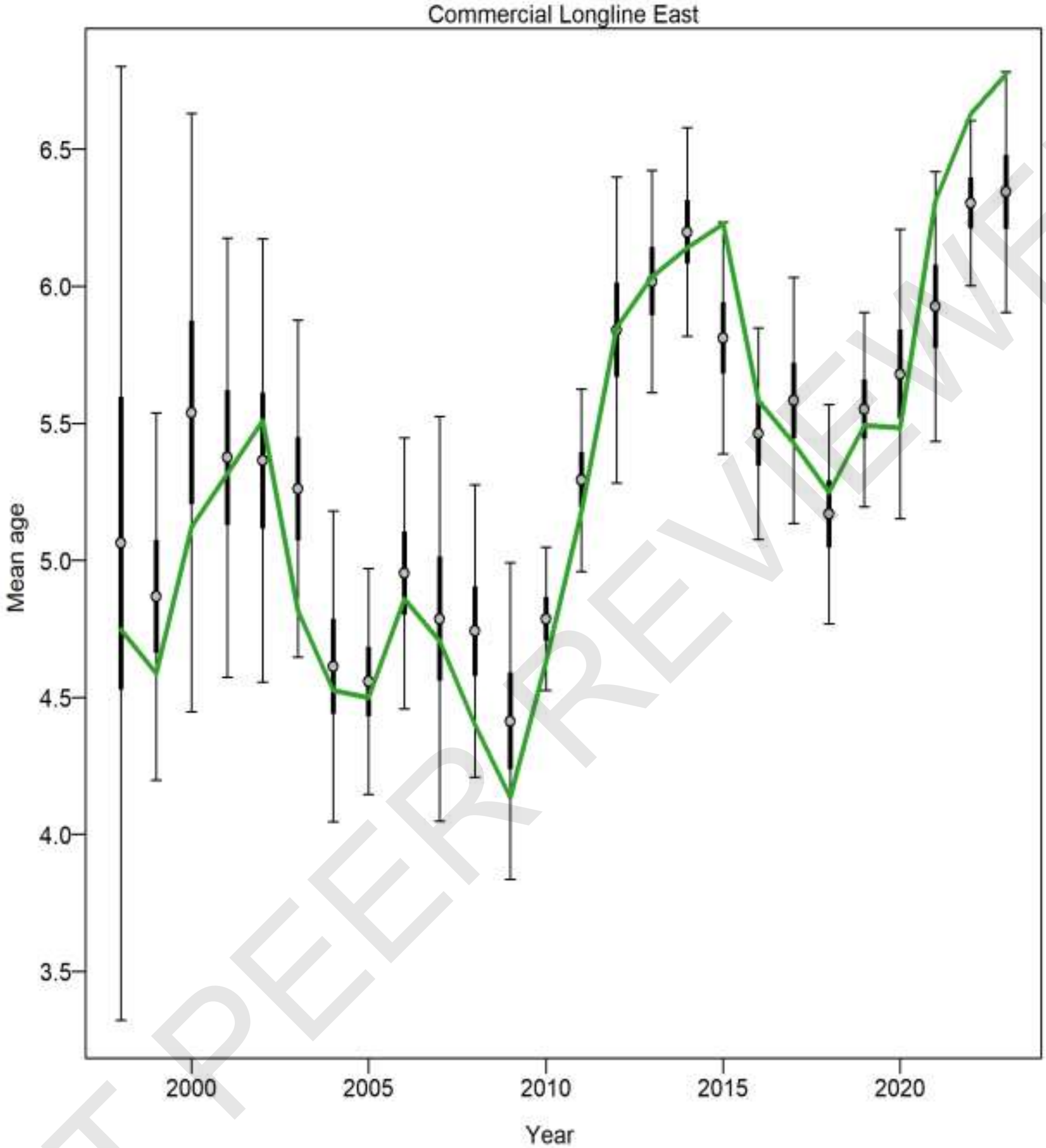


Figure 129. Mean age from conditional data (aggregated across length bins) for Commercial Longline East with 95% confidence intervals based on current samples sizes.Francis data weighting method TA1.8: thinner intervals (with capped ends) show result of further adjusting sample sizes based on suggested multiplier (with 95% interval) for conditional age-at-length data from Commercial Longline East:0.0941 (0.0633-0.2157) For more info, see Francis (2011) and Punt (2017).

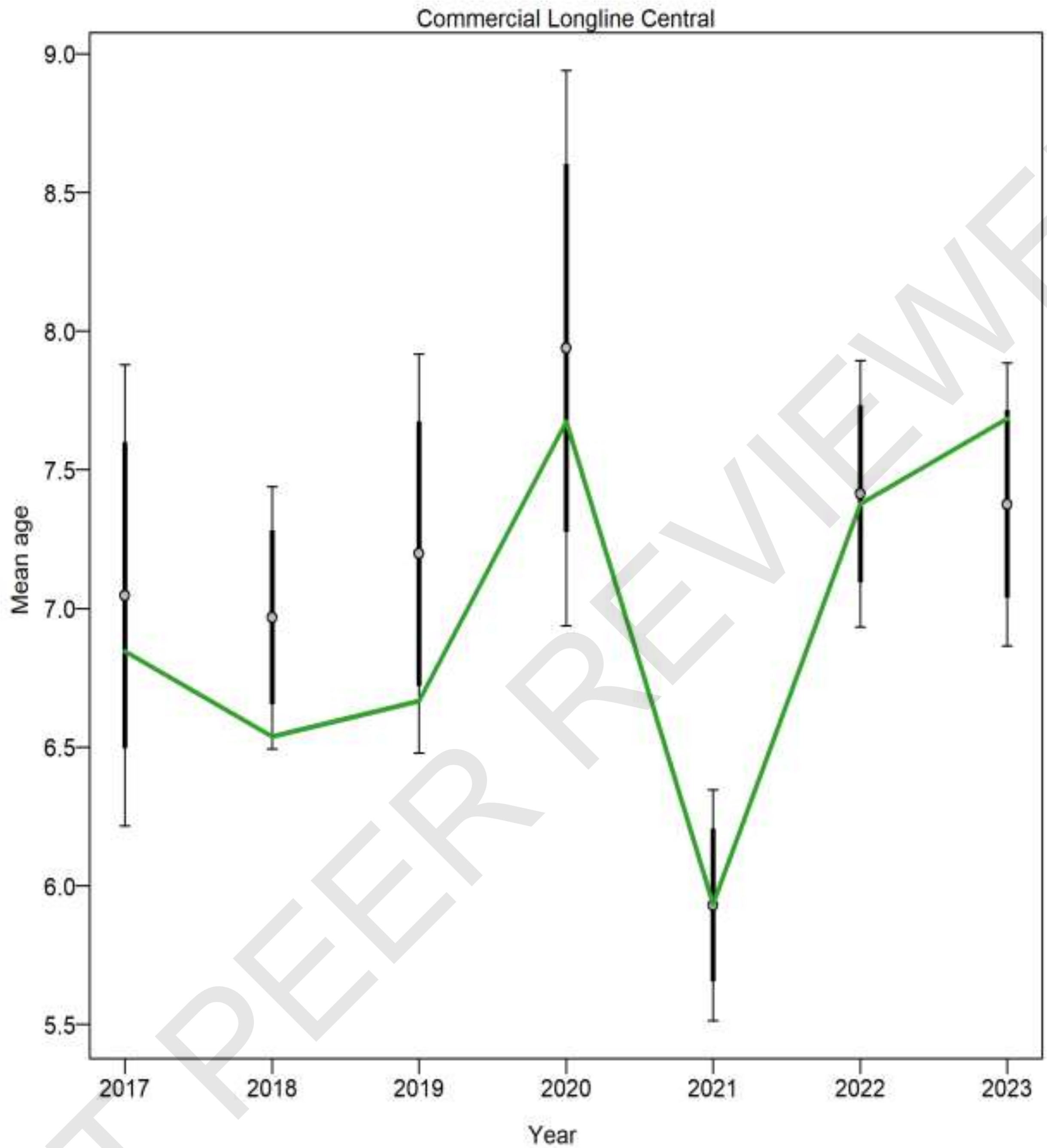


Figure 130. Mean age from conditional data (aggregated across length bins) for Commercial Longline Central with 95% confidence intervals based on current samples sizes.Francis data weighting method TA1.8: thinner intervals (with capped ends) show result of further adjusting sample sizes based on suggested multiplier (with 95% interval) for conditional age-at-length data from Commercial Longline Central:0.4401 (0.2507-1.9835) For more info, see Francis (2011) and Punt (2017).

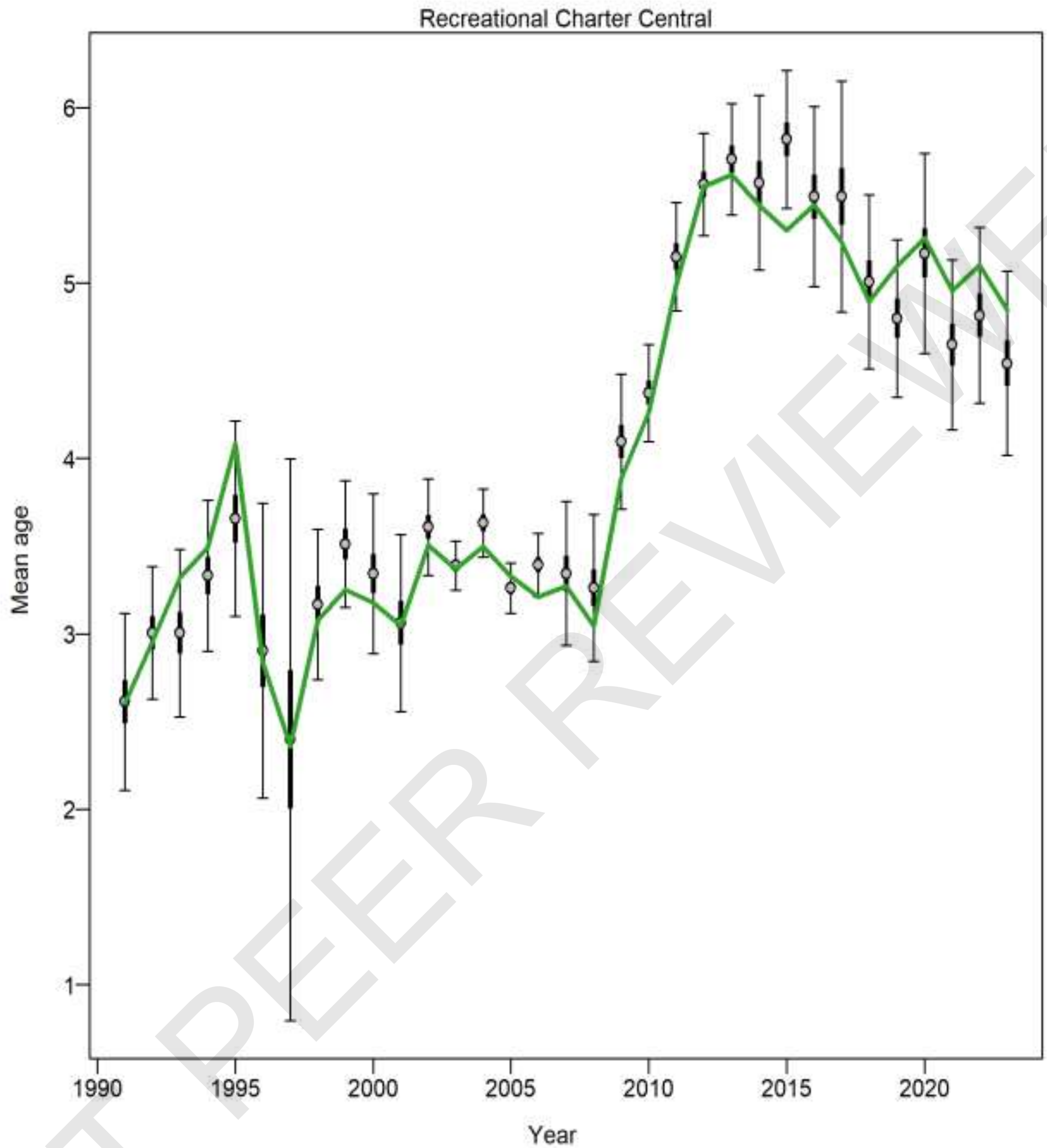


Figure 131. Mean age from conditional data (aggregated across length bins) for Recreational Charter Central with 95% confidence intervals based on current samples sizes.Francis data weighting method TA1.8: thinner intervals (with capped ends) show result of further adjusting sample sizes based on suggested multiplier (with 95% interval) for conditional age-at-length data from Recreational Charter Central:0.0606 (0.041-0.1085) For more info, see Francis (2011) and Punt (2017).

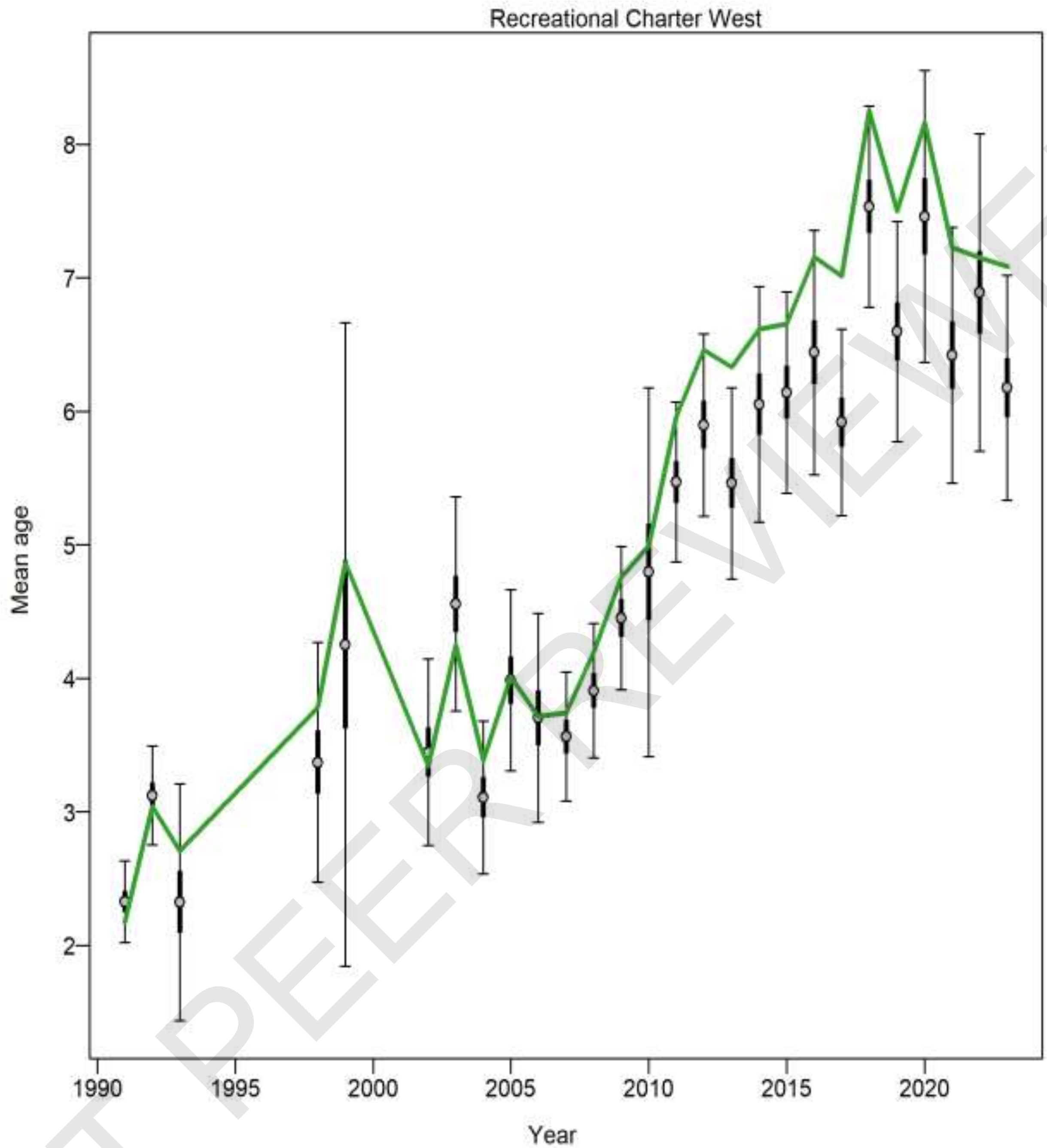


Figure 132. Mean age from conditional data (aggregated across length bins) for Recreational Charter West with 95% confidence intervals based on current samples sizes.Francis data weighting method TA1.8: thinner intervals (with capped ends) show result of further adjusting sample sizes based on suggested multiplier (with 95% interval) for conditional age-at-length data from Recreational Charter West:0.0688 (0.0468-0.1289) For more info, see Francis (2011) and Punt (2017).

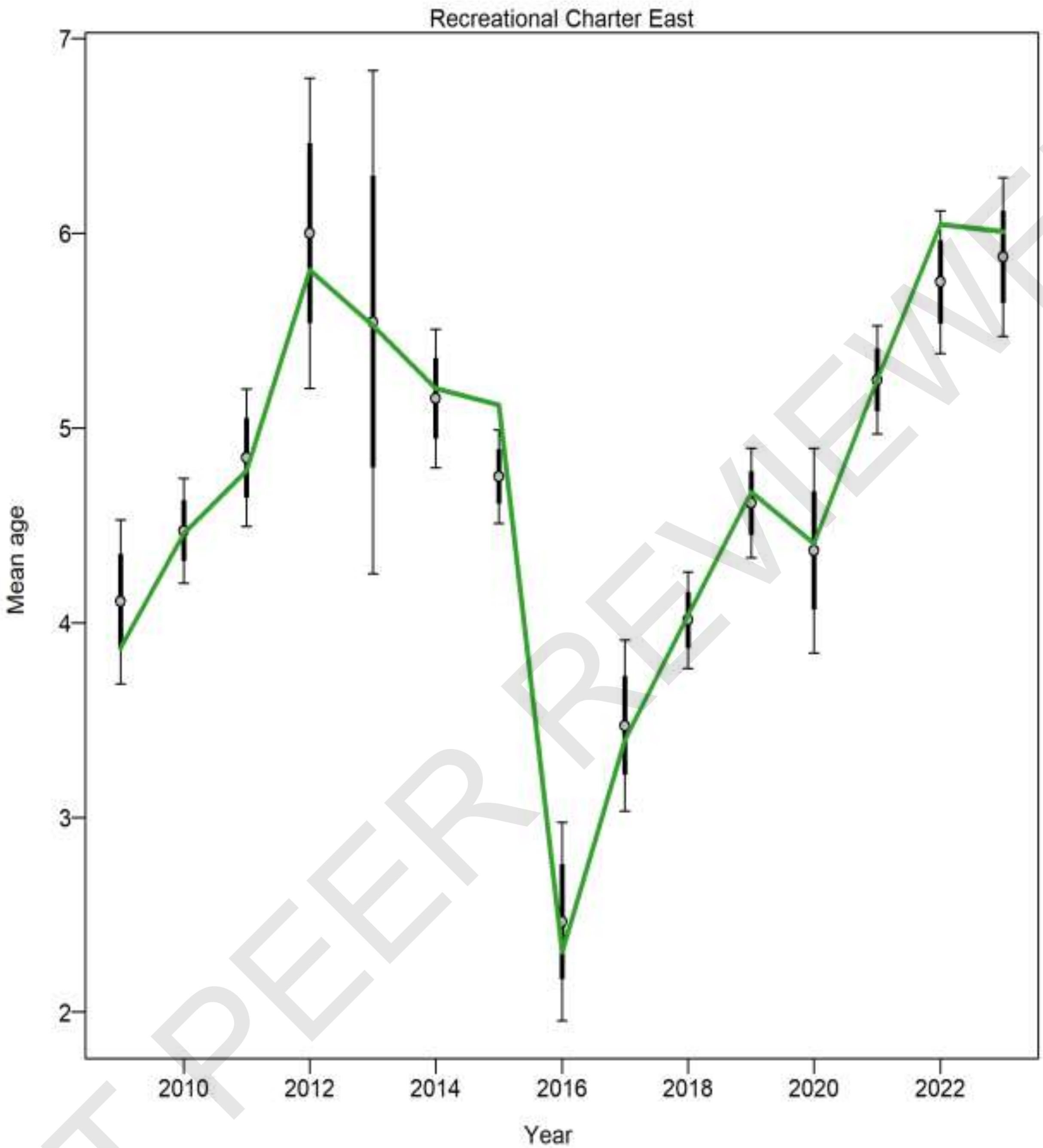


Figure 133. Mean age from conditional data (aggregated across length bins) for Recreational Charter East with 95% confidence intervals based on current samples sizes.Francis data weighting method TA1.8: thinner intervals (with capped ends) show result of further adjusting sample sizes based on suggested multiplier (with 95% interval) for conditional age-at-length data from Recreational Charter East:0.337 (0.1651-2.229) For more info, see Francis (2011) and Punt (2017).

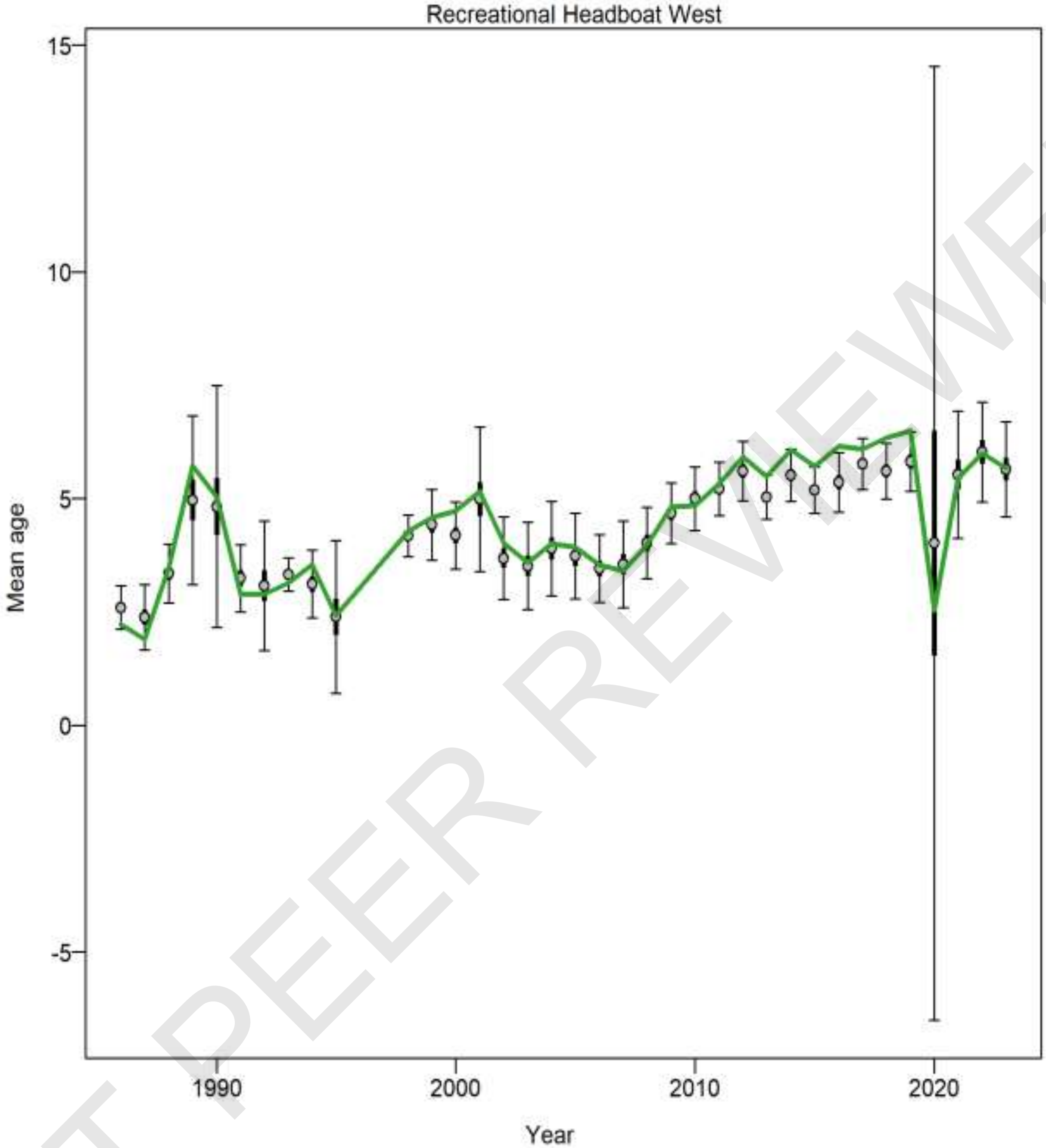


Figure 134. Mean age from conditional data (aggregated across length bins) for Recreational Headboat West with 95% confidence intervals based on current samples sizes.Francis data weighting method TA1.8: thinner intervals (with capped ends) show result of further adjusting sample sizes based on suggested multiplier (with 95% interval) for conditional age-at-length data from Recreational Headboat West:0.056 (0.0397-0.0952) For more info, see Francis (2011) and Punt (2017).

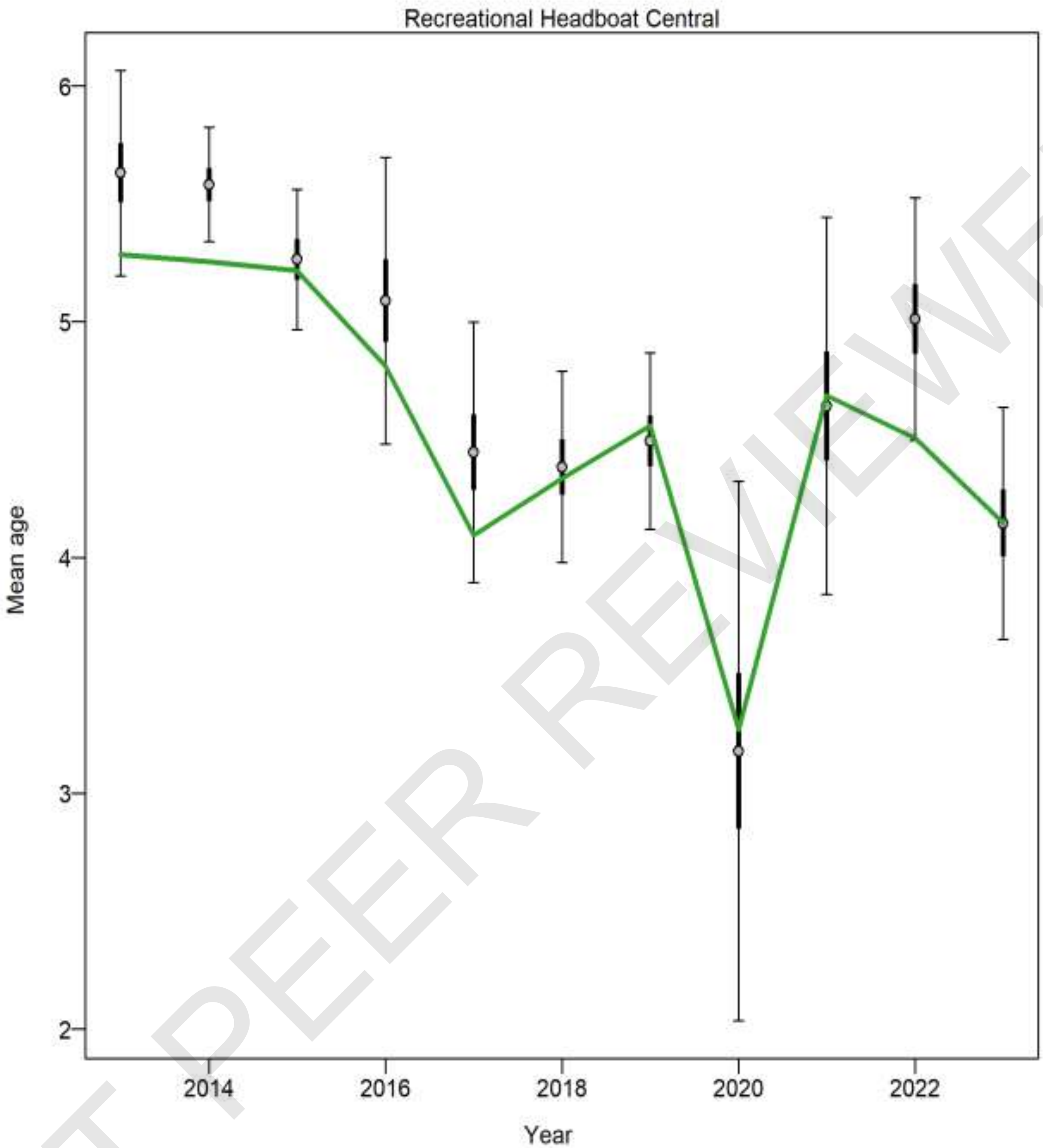


Figure 135. Mean age from conditional data (aggregated across length bins) for Recreational Headboat Central with 95% confidence intervals based on current samples sizes.Francis data weighting method TA1.8: thinner intervals (with capped ends) show result of further adjusting sample sizes based on suggested multiplier (with 95% interval) for conditional age-at-length data from Recreational Headboat Central:0.0838 (0.0538-0.2707) For more info, see Francis (2011) and Punt (2017).

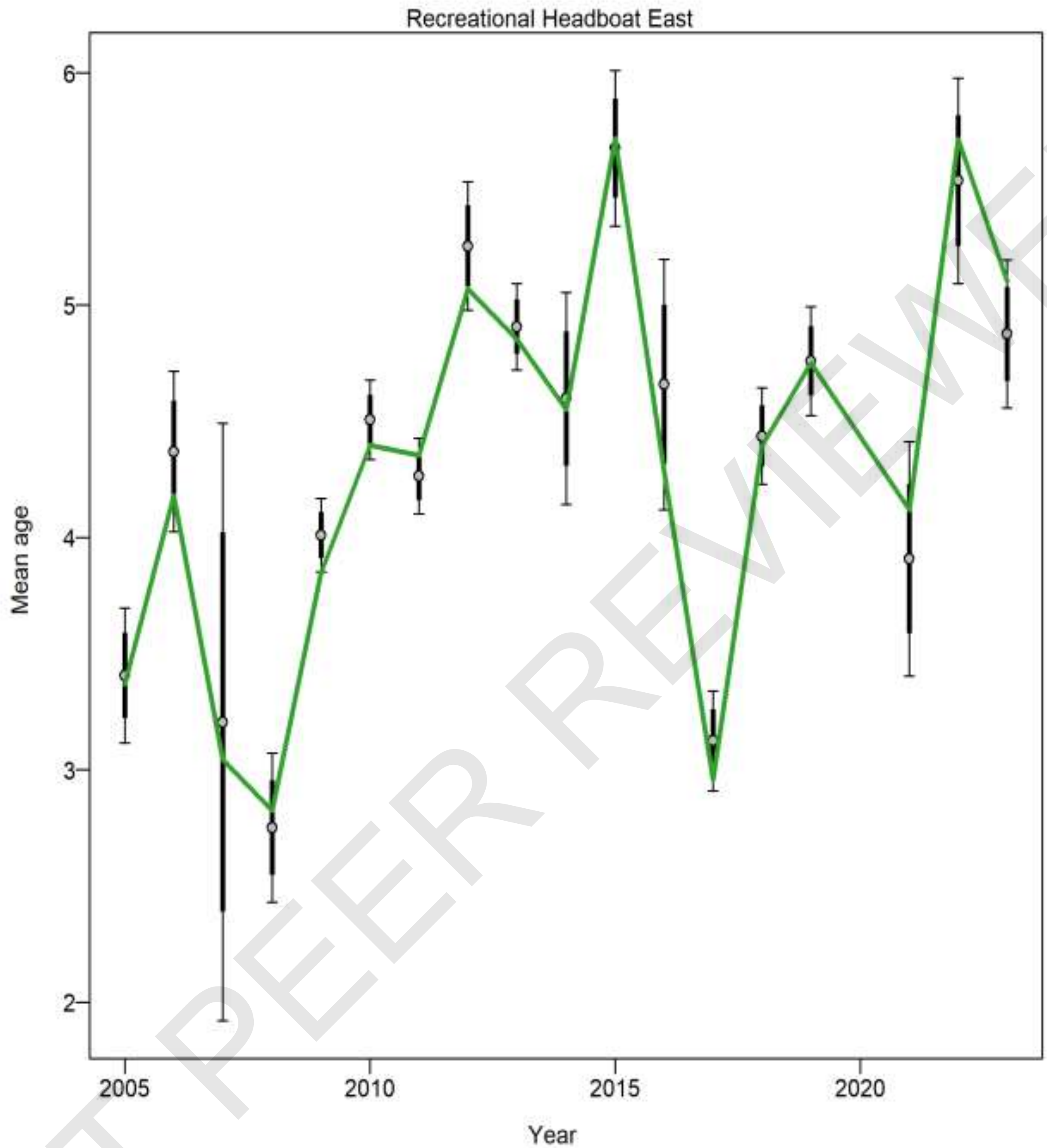


Figure 136. Mean age from conditional data (aggregated across length bins) for Recreational Headboat East with 95% confidence intervals based on current samples sizes.Francis data weighting method TA1.8: thinner intervals (with capped ends) show result of further adjusting sample sizes based on suggested multiplier (with 95% interval) for conditional age-at-length data from Recreational Headboat East:0.4031 (0.2885-0.8221) For more info, see Francis (2011) and Punt (2017).

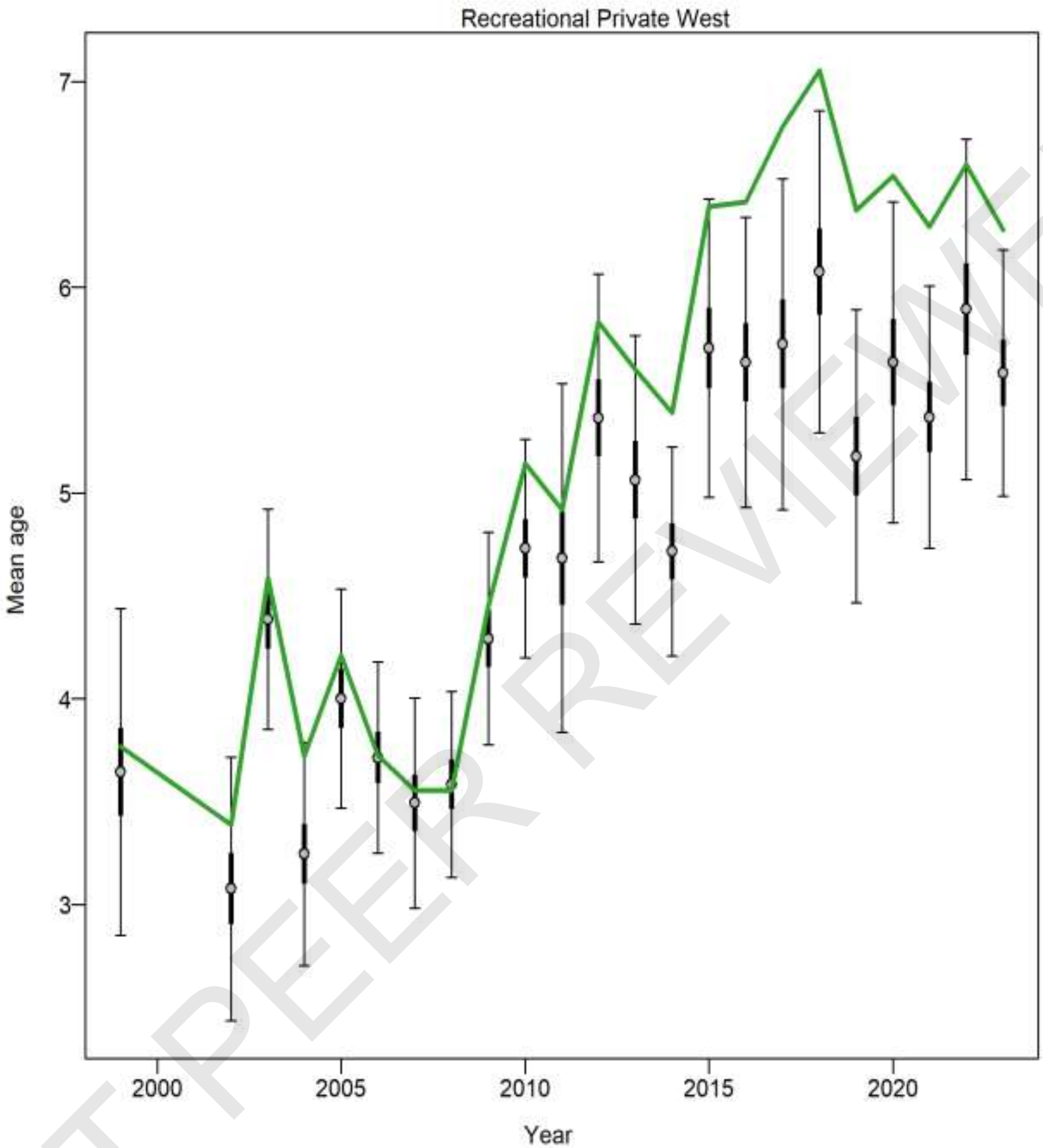


Figure 137. Mean age from conditional data (aggregated across length bins) for Recreational Private West with 95% confidence intervals based on current samples sizes.Francis data weighting method TA1.8: thinner intervals (with capped ends) show result of further adjusting sample sizes based on suggested multiplier (with 95% interval) for conditional age-at-length data from Recreational Private West:0.0722 (0.0527-0.1203) For more info, see Francis (2011) and Punt (2017).

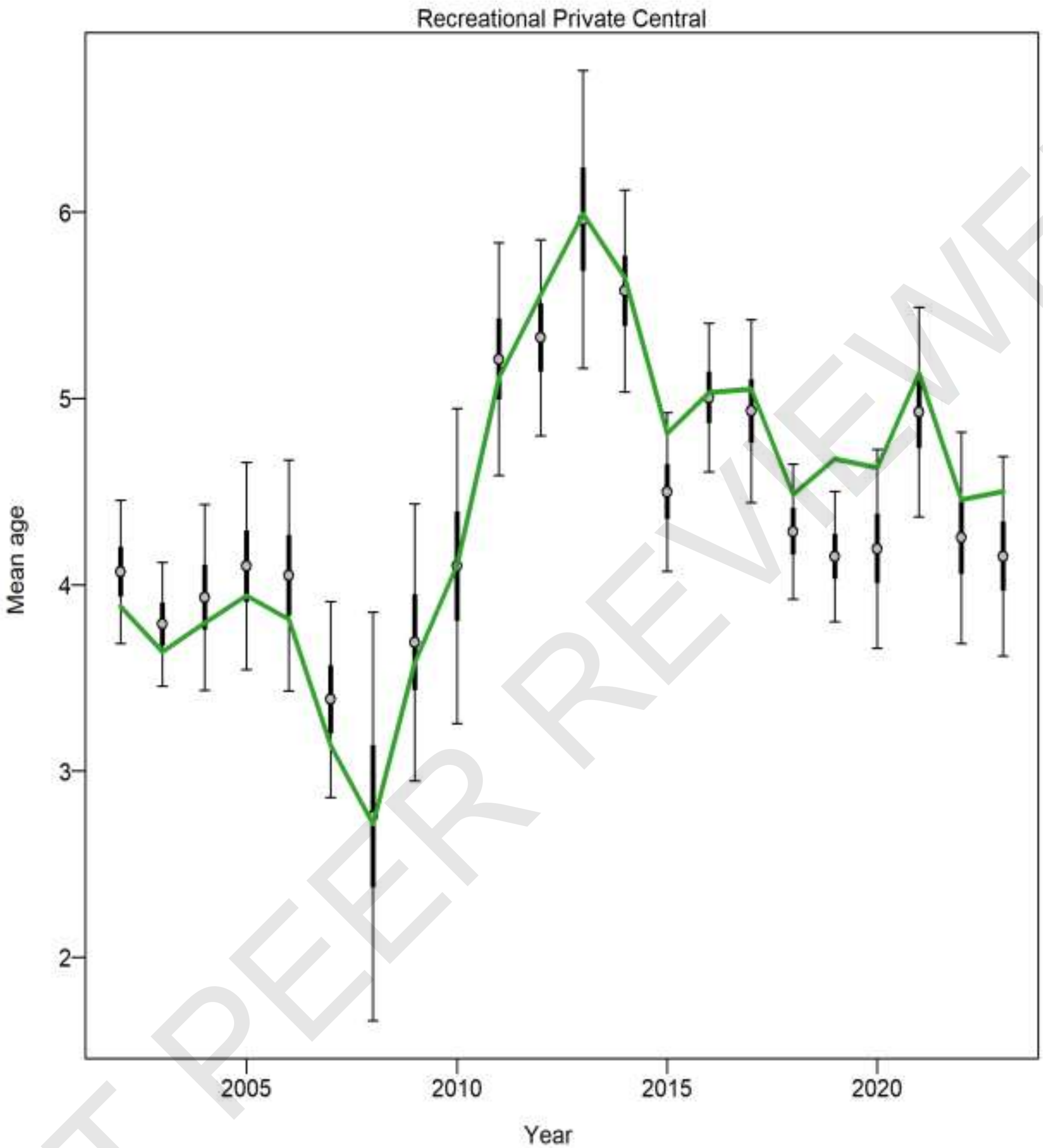


Figure 138. Mean age from conditional data (aggregated across length bins) for Recreational Private Central with 95% confidence intervals based on current samples sizes.Francis data weighting method TA1.8: thinner intervals (with capped ends) show result of further adjusting sample sizes based on suggested multiplier (with 95% interval) for conditional age-at-length data from Recreational Private Central:0.1207 (0.0733-0.2741) For more info, see Francis (2011) and Punt (2017).

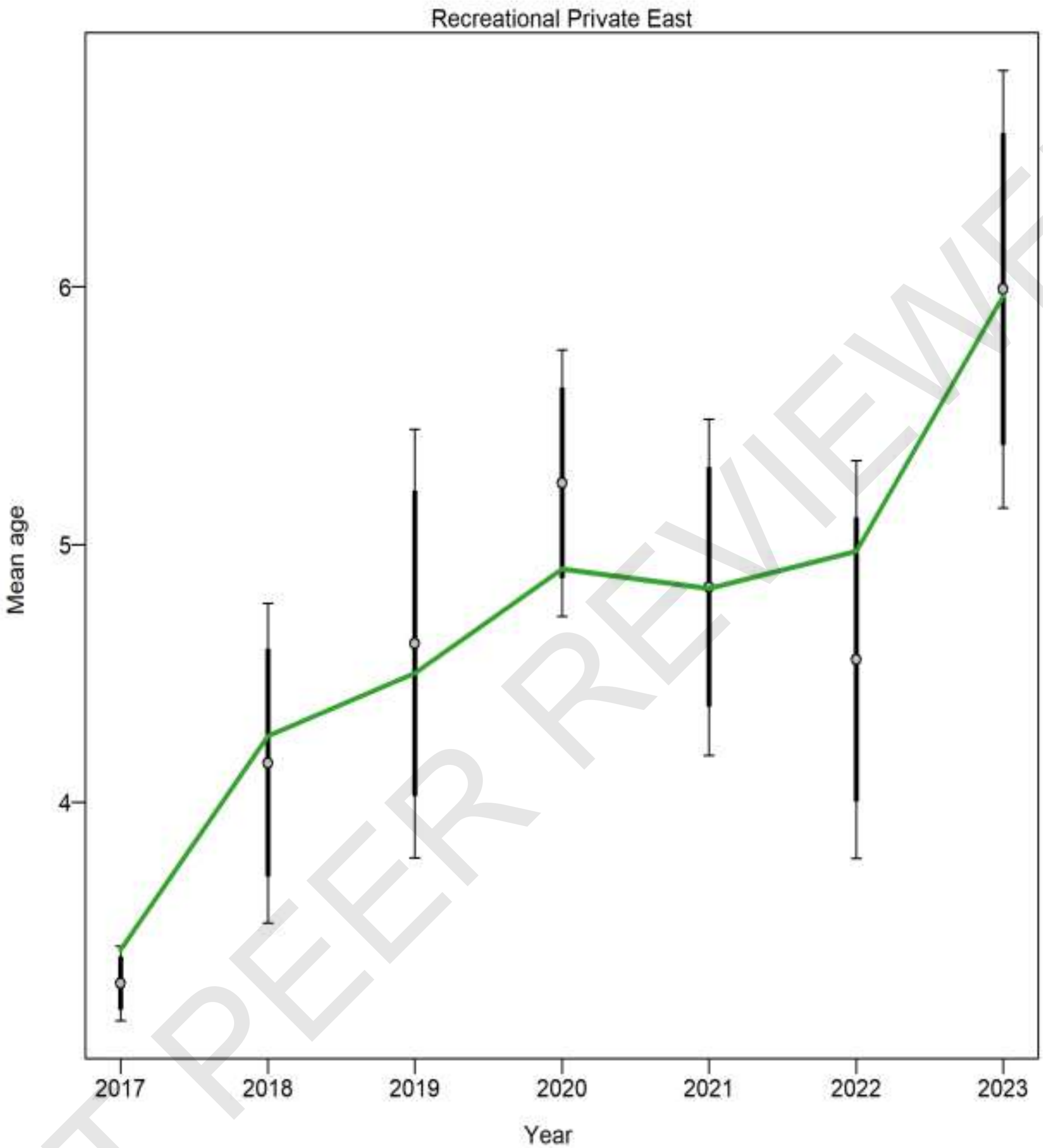


Figure 139. Mean age from conditional data (aggregated across length bins) for Recreational Private East with 95% confidence intervals based on current samples sizes.Francis data weighting method TA1.8: thinner intervals (with capped ends) show result of further adjusting sample sizes based on suggested multiplier (with 95% interval) for conditional age-at-length data from Recreational Private East:0.5091 (0.2872-2.8215) For more info, see Francis (2011) and Punt (2017).

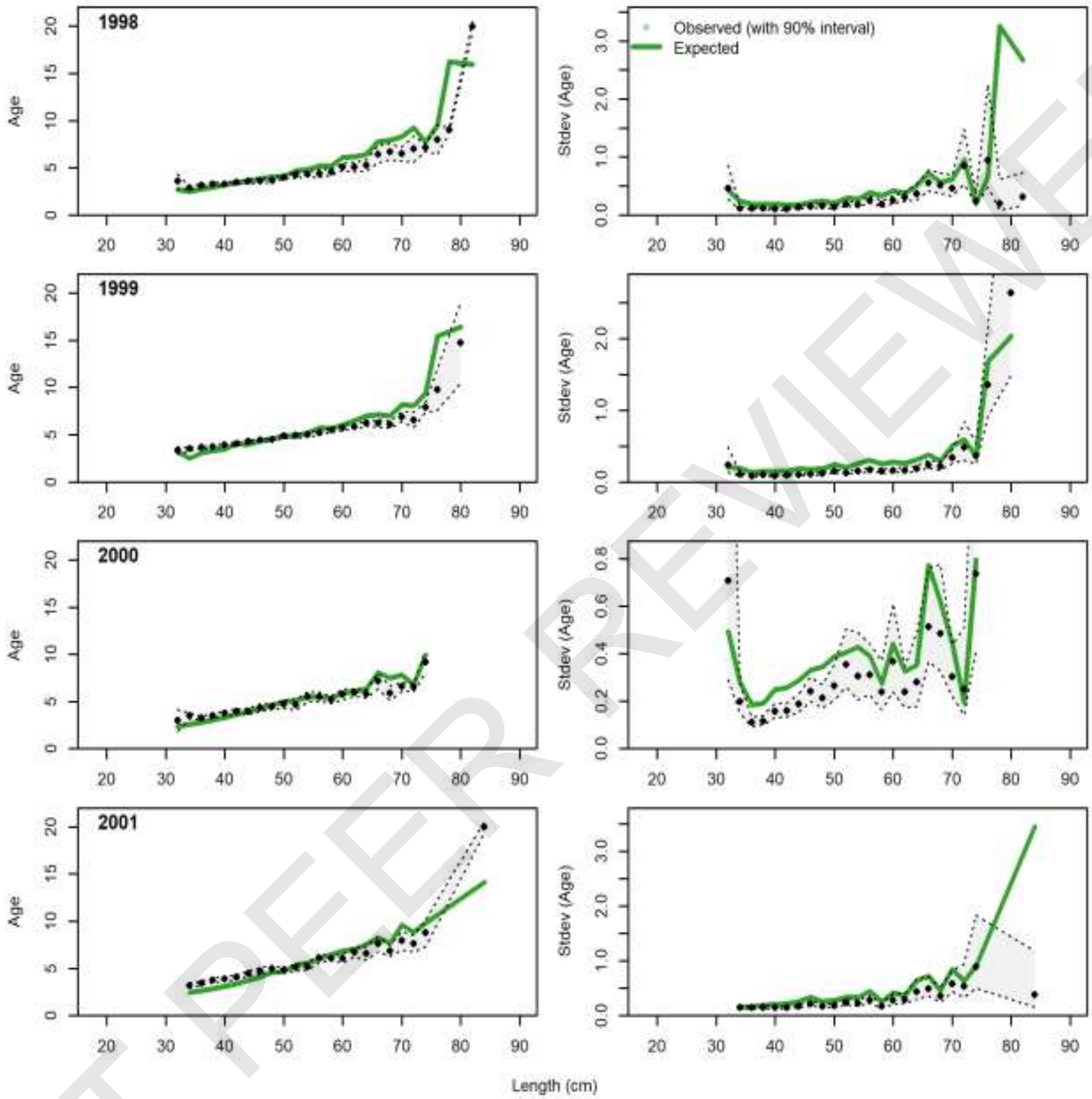


Figure 140. Conditional AAL plot, retained, Commercial Handline West (plot 1 of 7) These plots show mean age and std. dev. in conditional A@L.Left plots are mean A@L by size-class (obs. and exp.) with 90% CIs based on adding 1.64 SE of mean to the data.Right plots in each pair are SE of mean A@L (obs. and exp.) with 90% CIs based on the chi-square distribution.

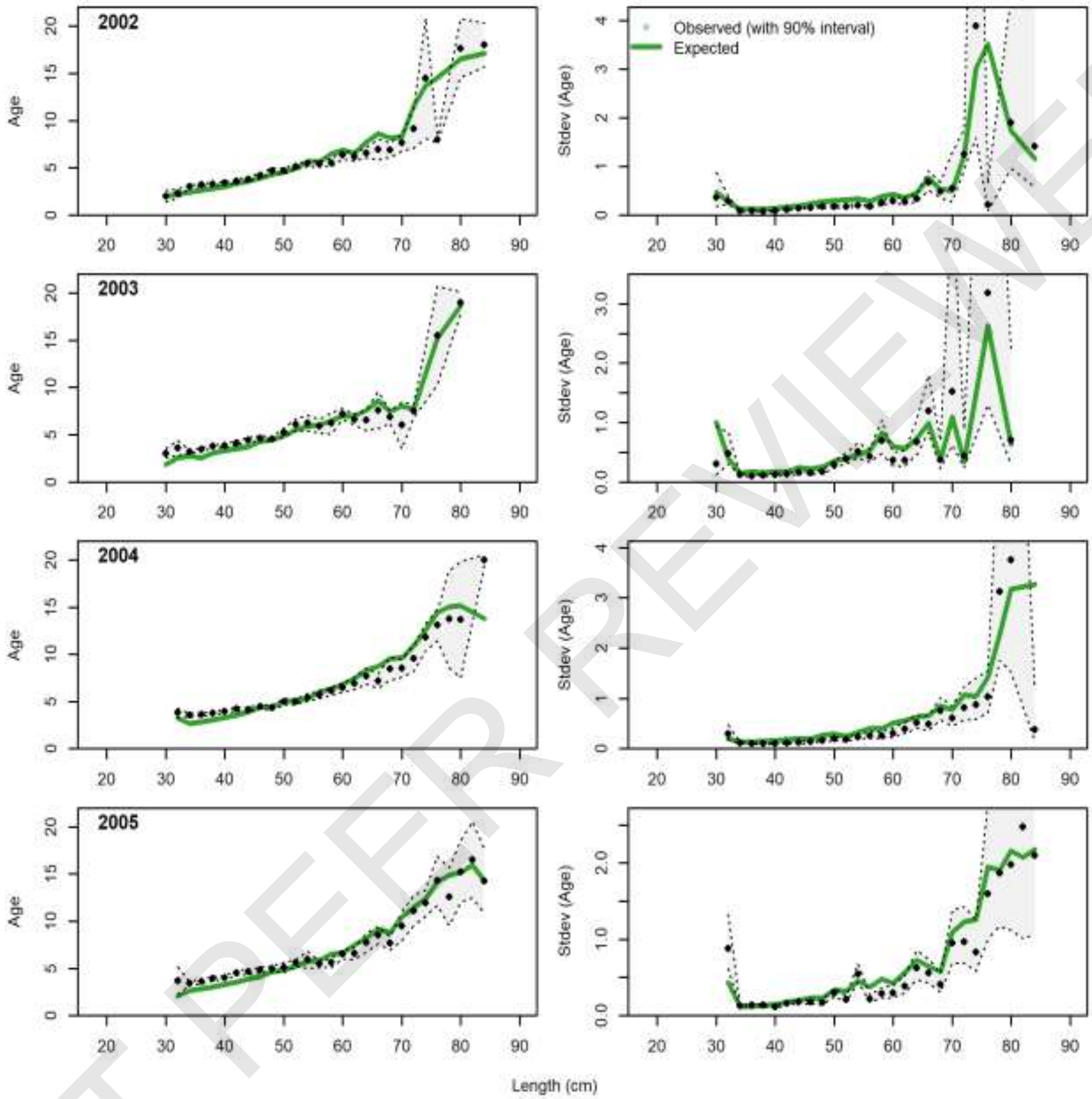


Figure 140 Continued. Conditional AAL plot, retained, Commercial Handline West (plot 2 of 7)

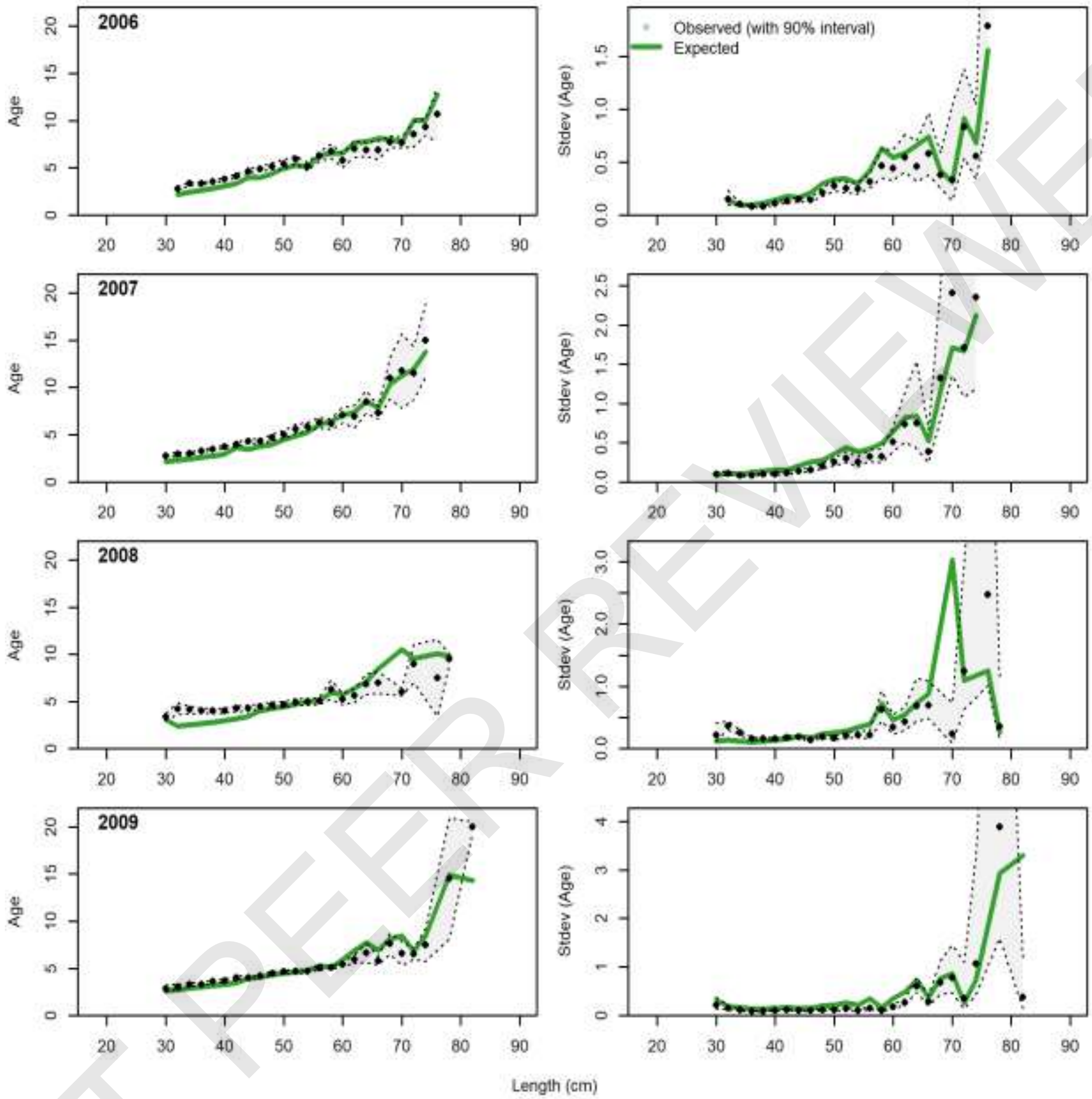


Figure 140 Continued. Conditional AAL plot, retained, Commercial Handline West (plot 3 of 7)

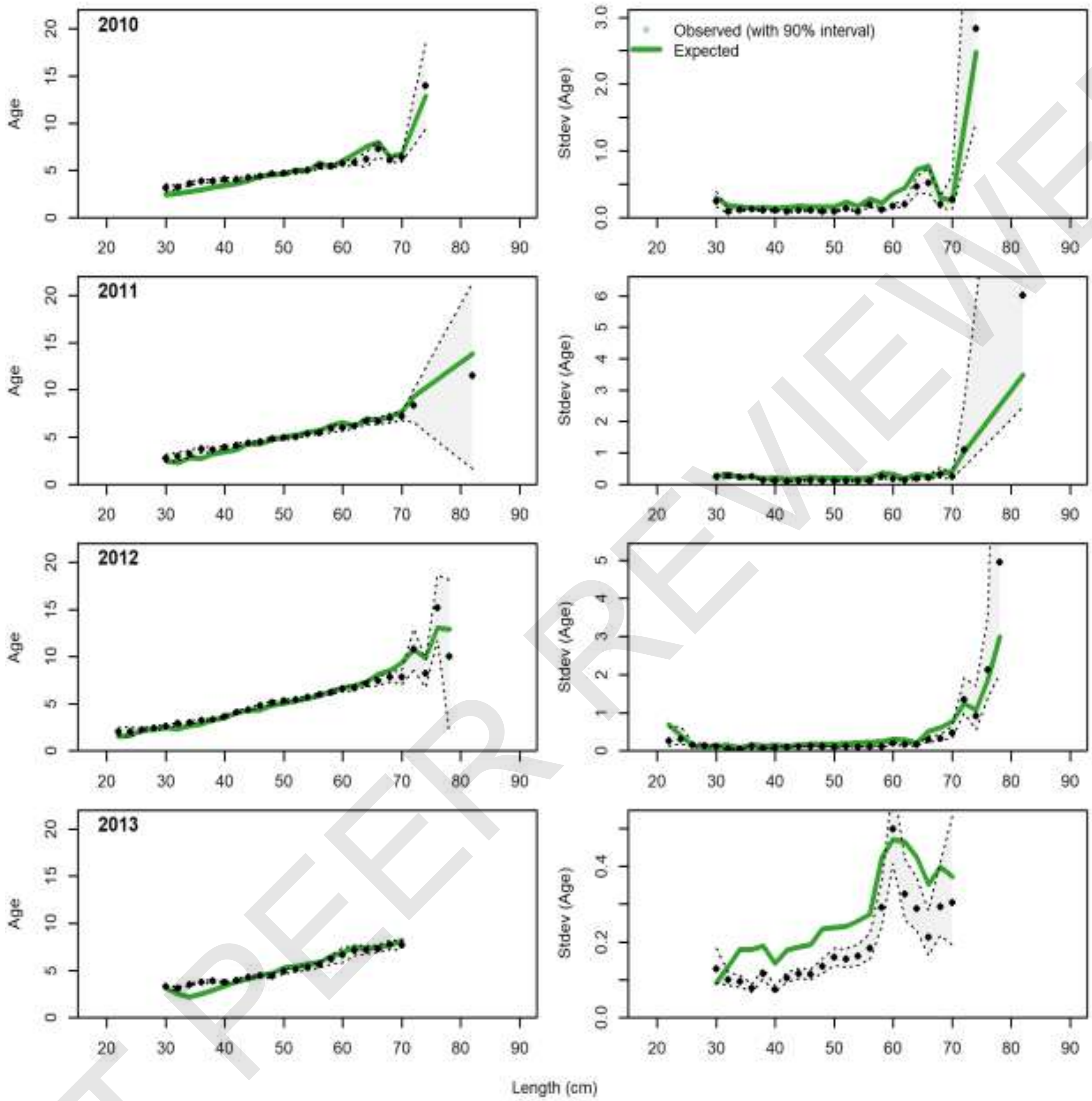


Figure 140 Continued. Conditional AAL plot, retained, Commercial Handline West (plot 4 of 7)

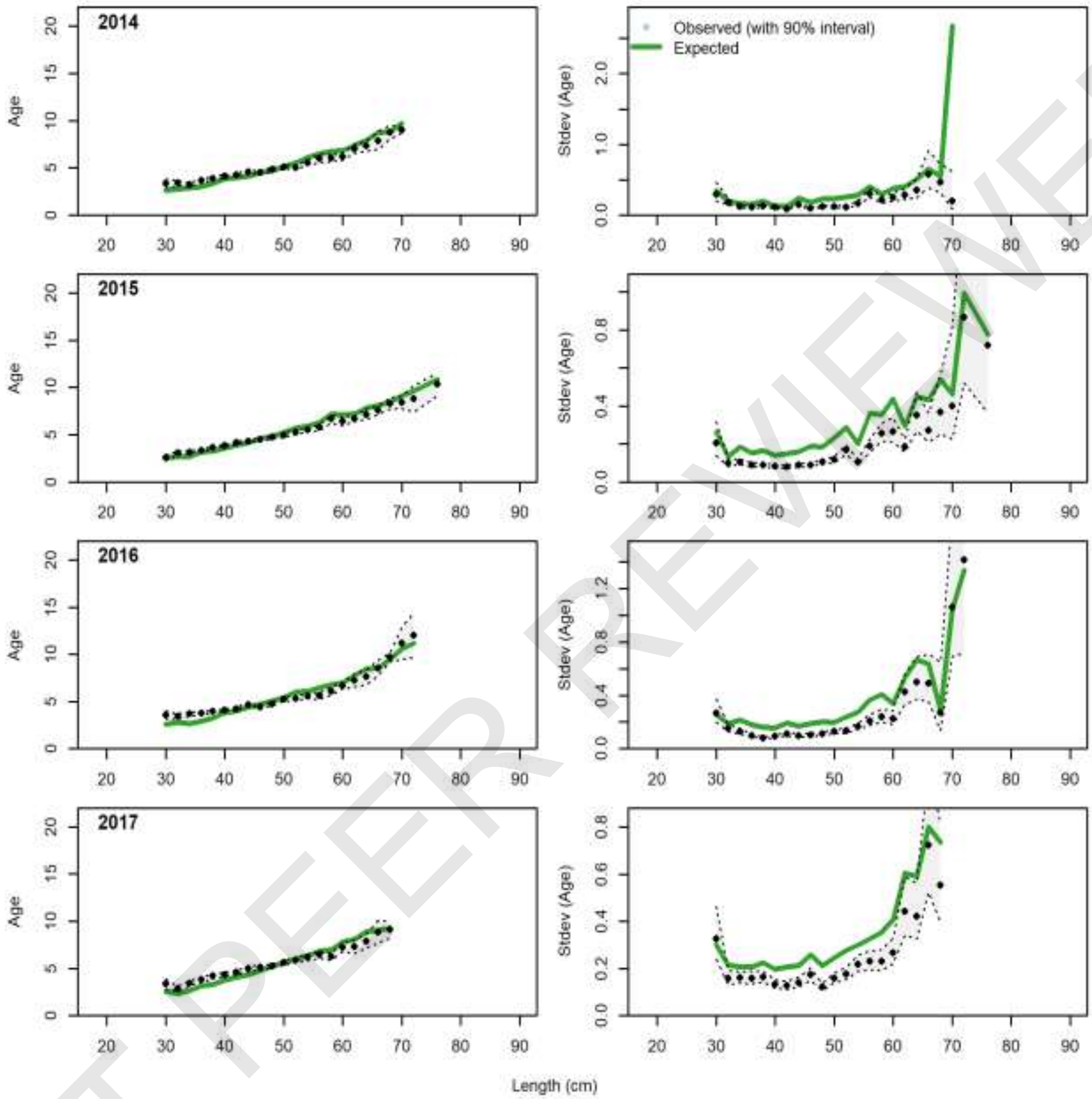


Figure 140 Continued. Conditional AAL plot, retained, Commercial Handline West (plot 5 of 7)

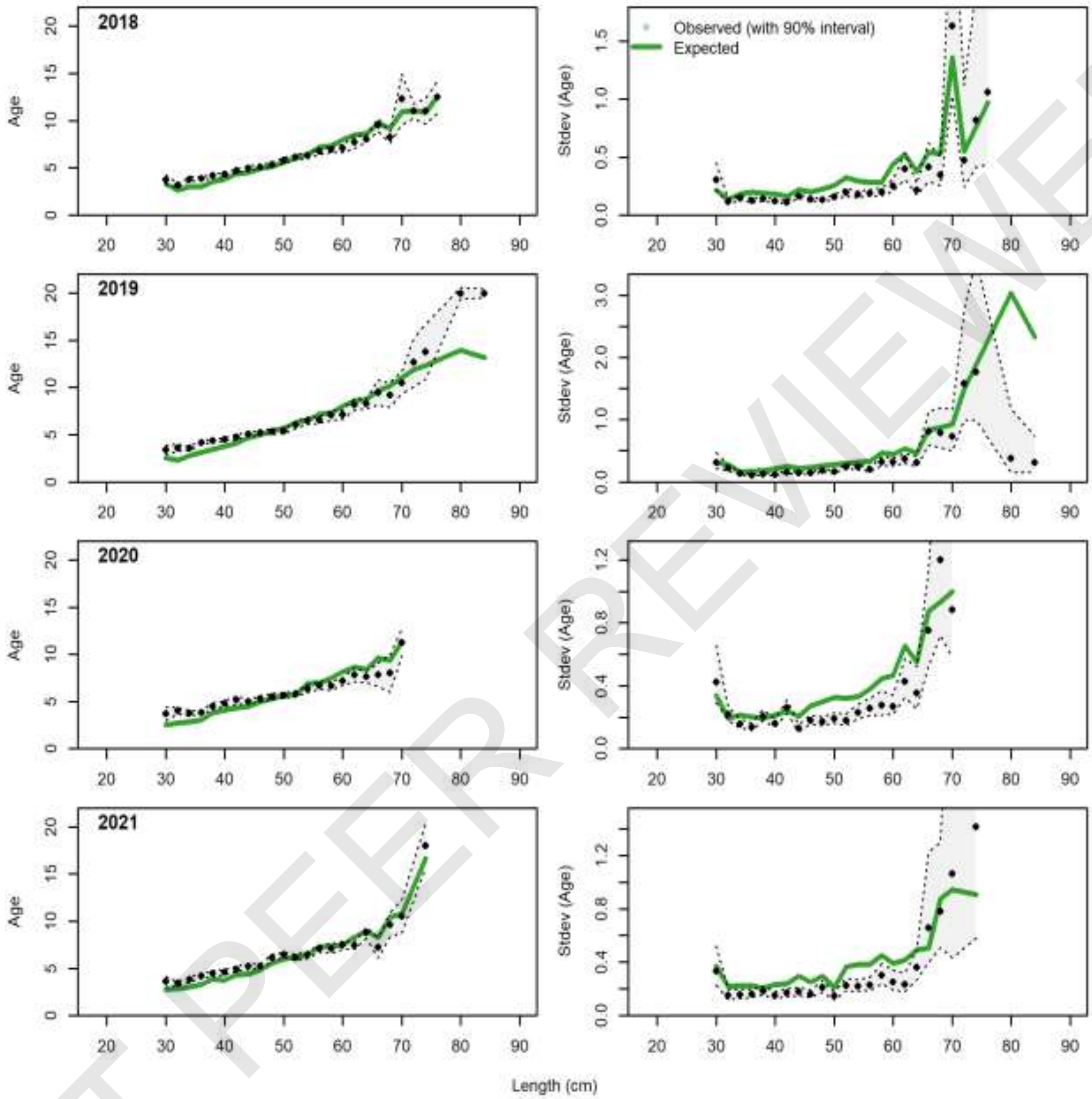


Figure 140 Continued. Conditional AAL plot, retained, Commercial Handline West (plot 6 of 7)

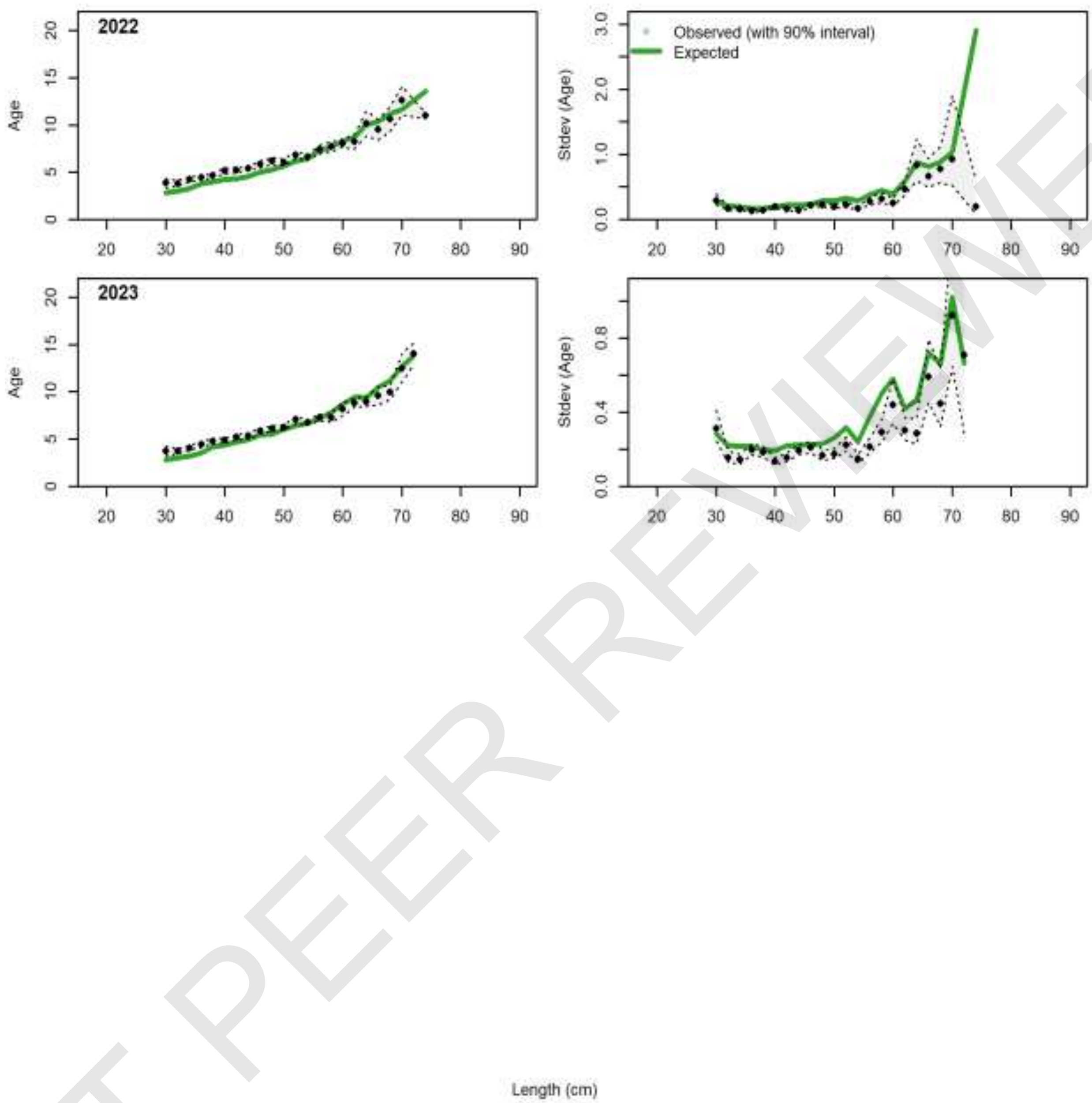


Figure 140 Continued. Conditional AAL plot, retained, Commercial Handline West (plot 7 of 7)

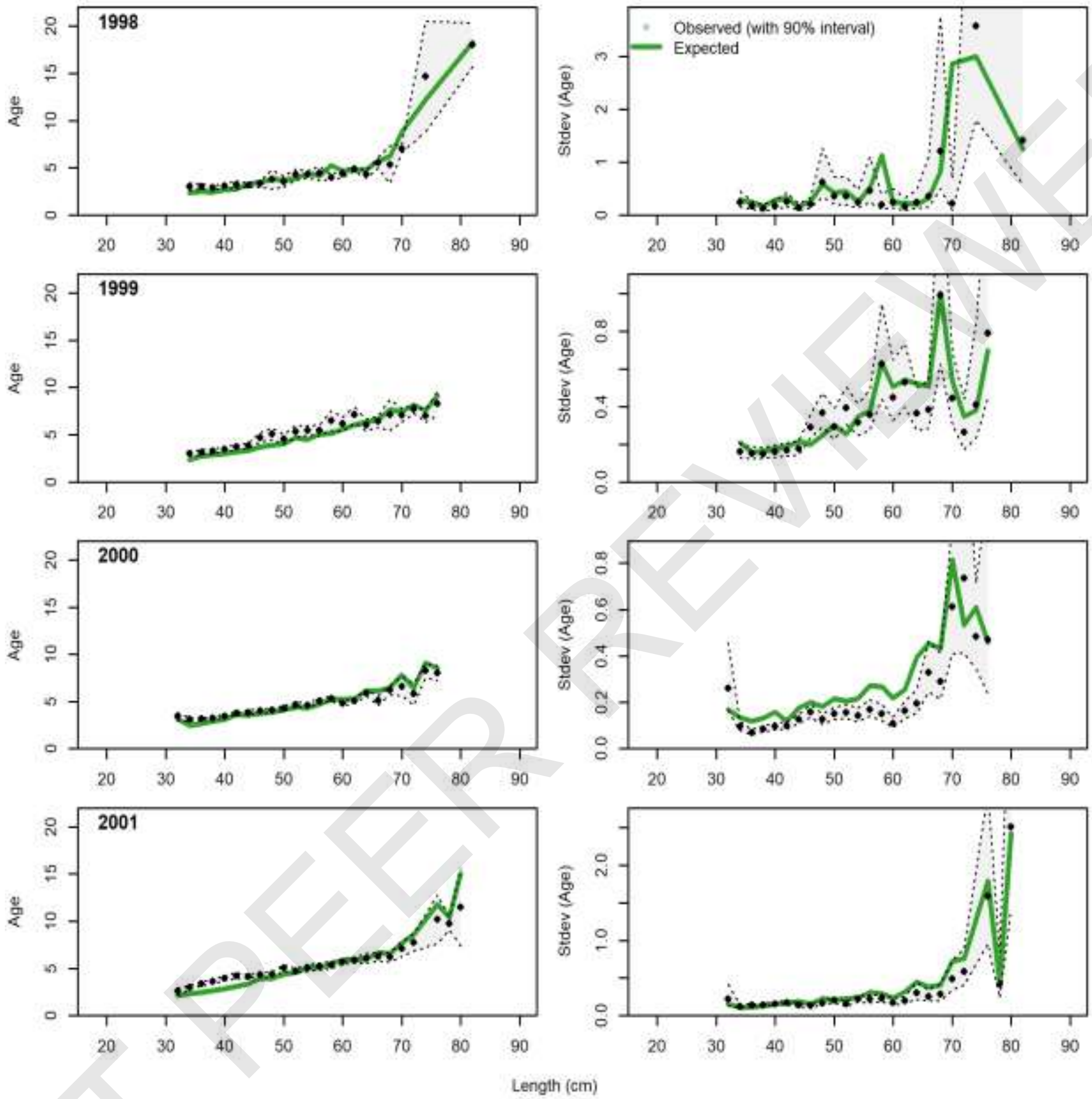


Figure 141. Conditional AAL plot, retained, Commercial Handline Central (plot 1 of 7) These plots show mean age and std. dev. in conditional A@L.Left plots are mean A@L by size-class (obs. and exp.) with 90% CIs based on adding 1.64 SE of mean to the data.Right plots in each pair are SE of mean A@L (obs. and exp.) with 90% CIs based on the chi-square distribution.

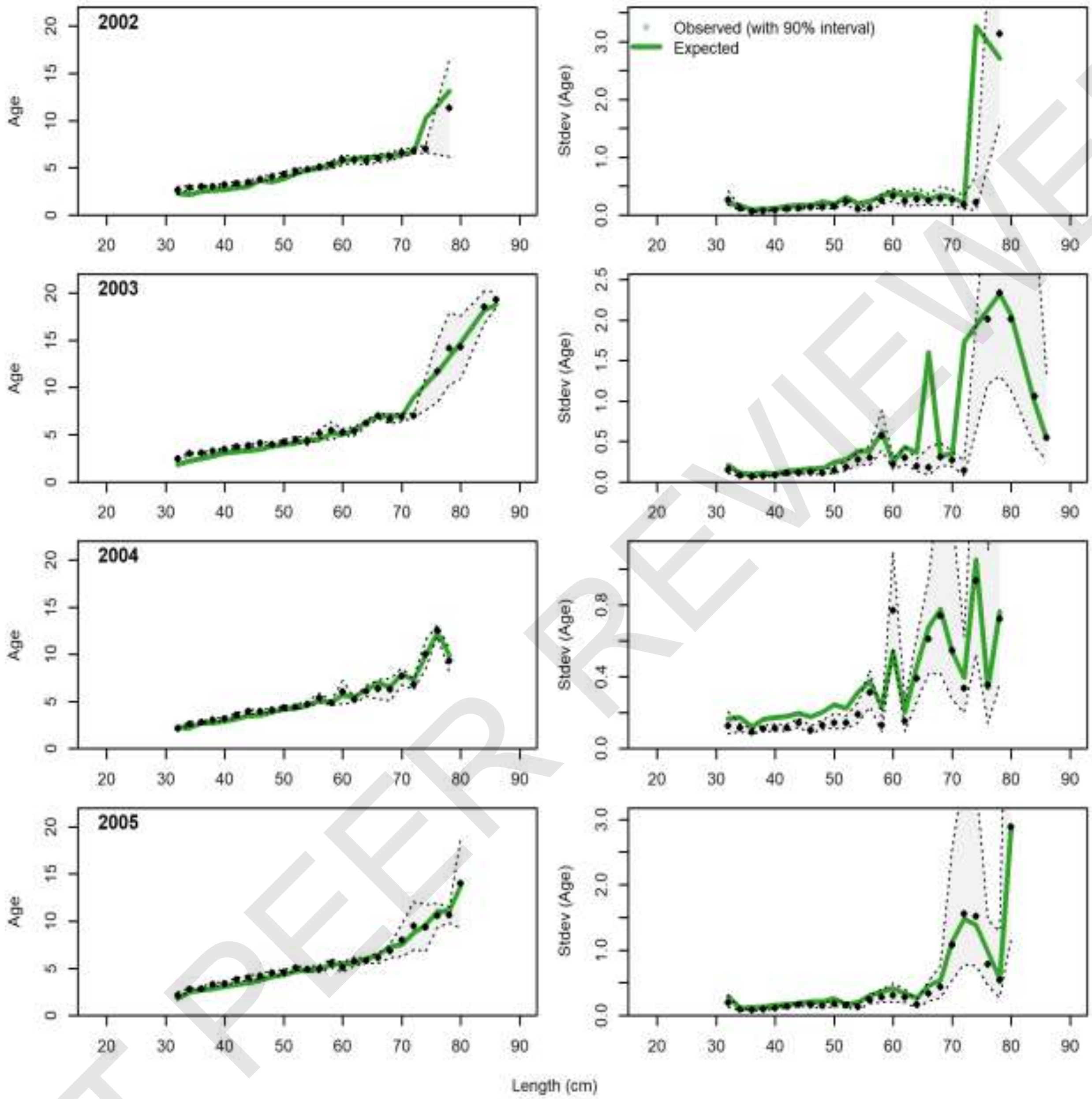


Figure 141 Continued. Conditional AAL plot, retained, Commercial Handline Central (plot 2 of 7)

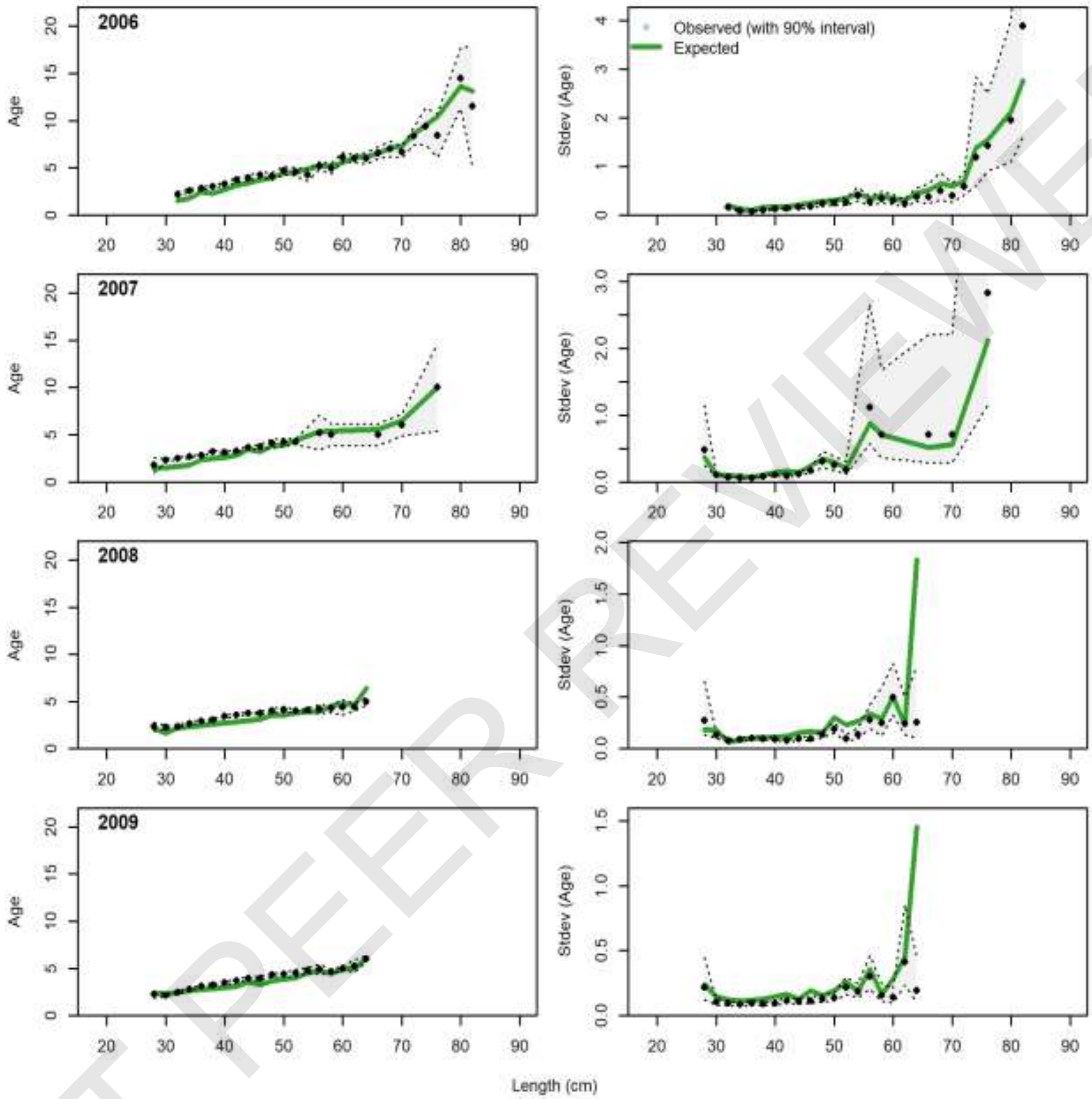


Figure 141 Continued. Conditional AAL plot, retained, Commercial Handline Central (plot 3 of 7)

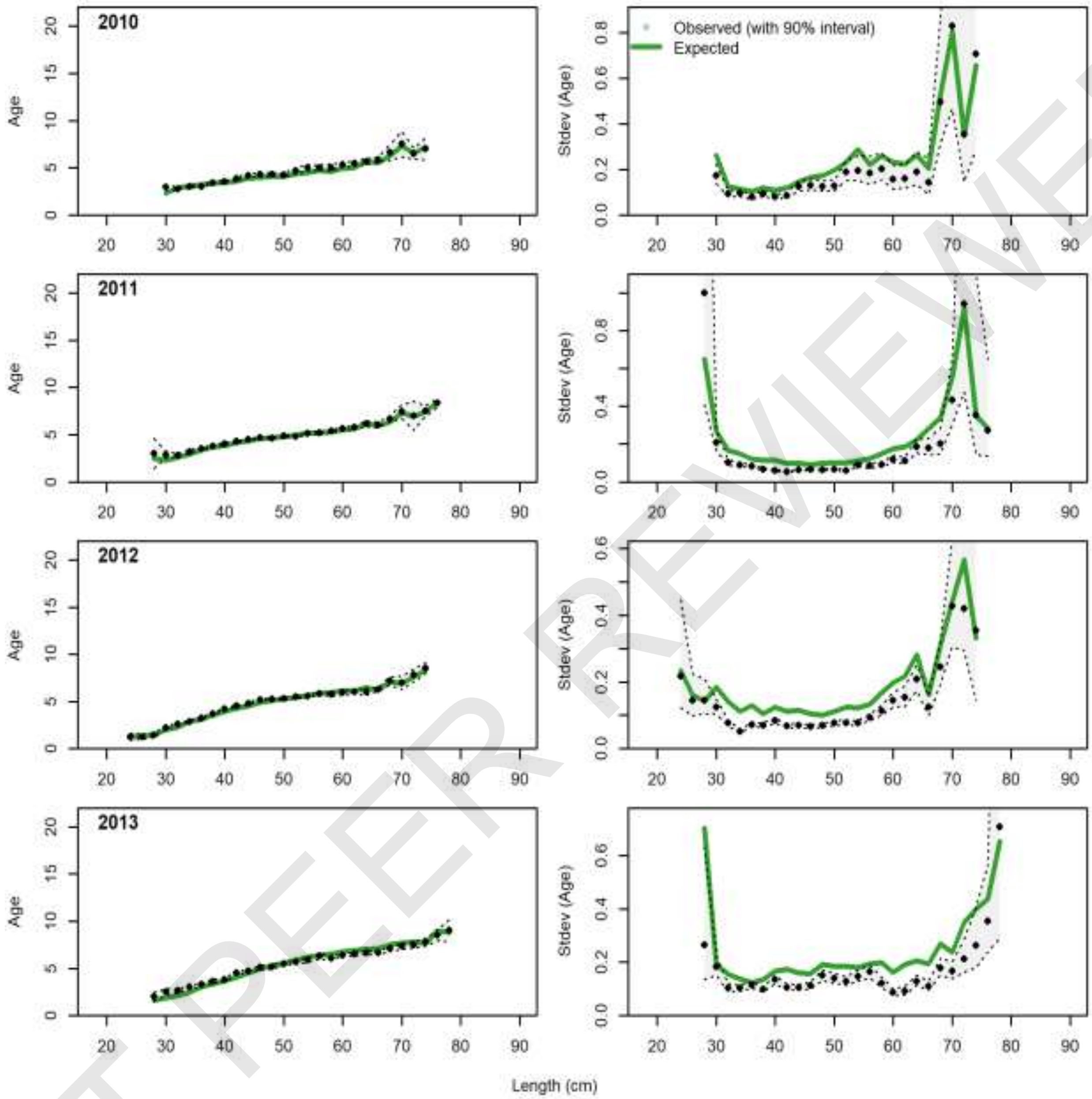


Figure 141 Continued. Conditional AAL plot, retained, Commercial Handline Central (plot 4 of 7)

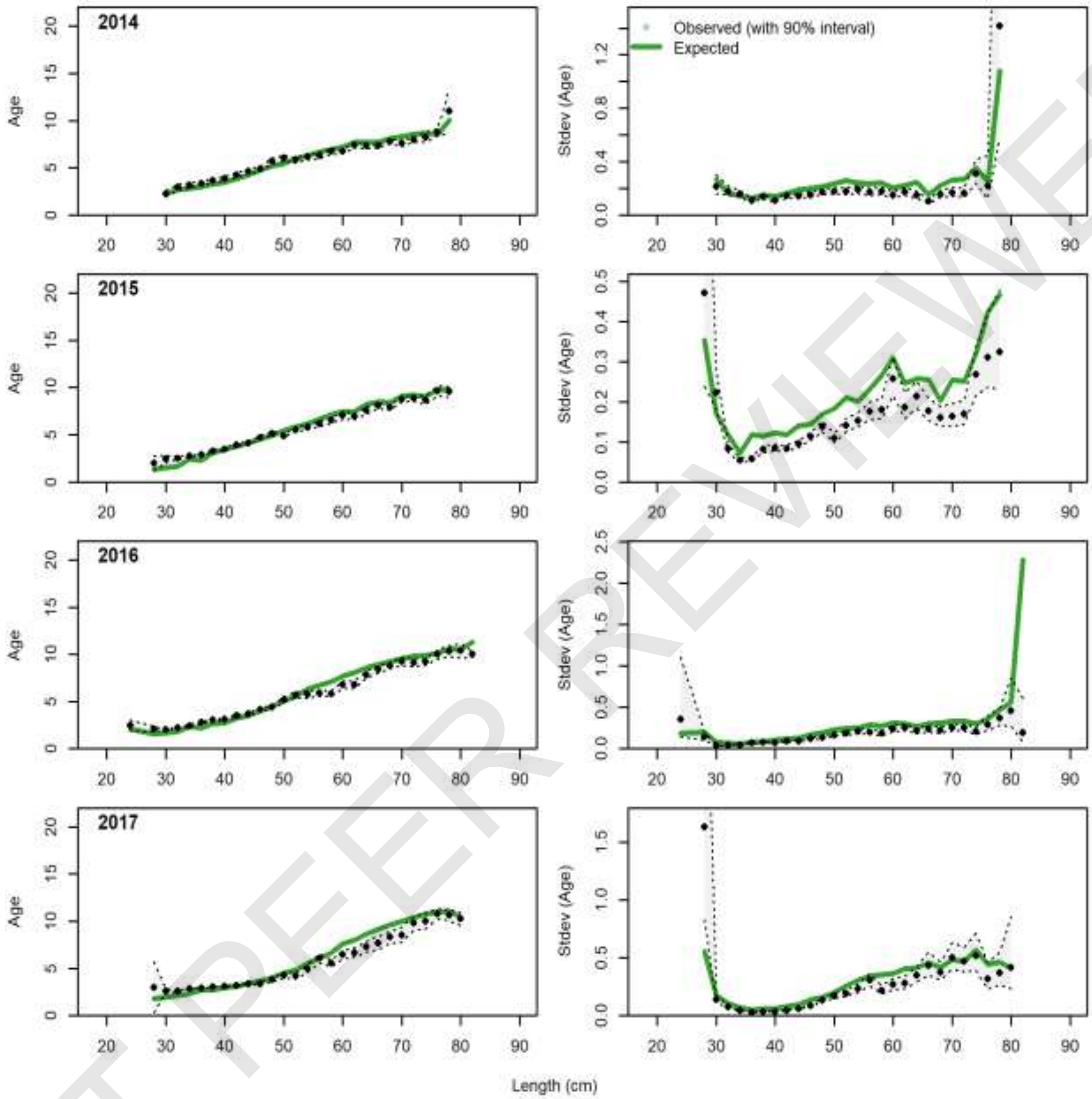


Figure 141 Continued. Conditional AAL plot, retained, Commercial Handline Central (plot 5 of 7)

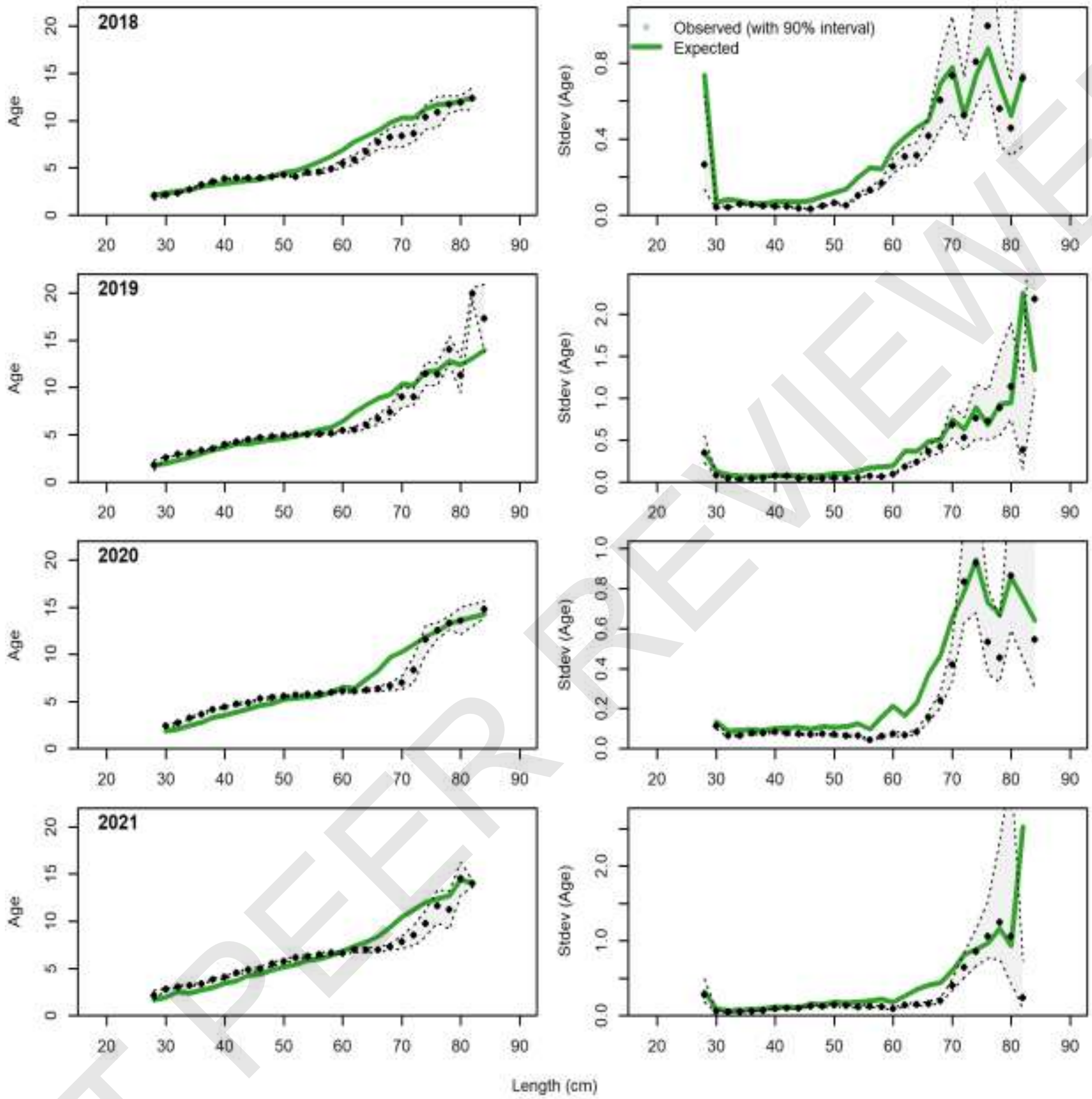


Figure 141 Continued. Conditional AAL plot, retained, Commercial Handline Central (plot 6 of 7)

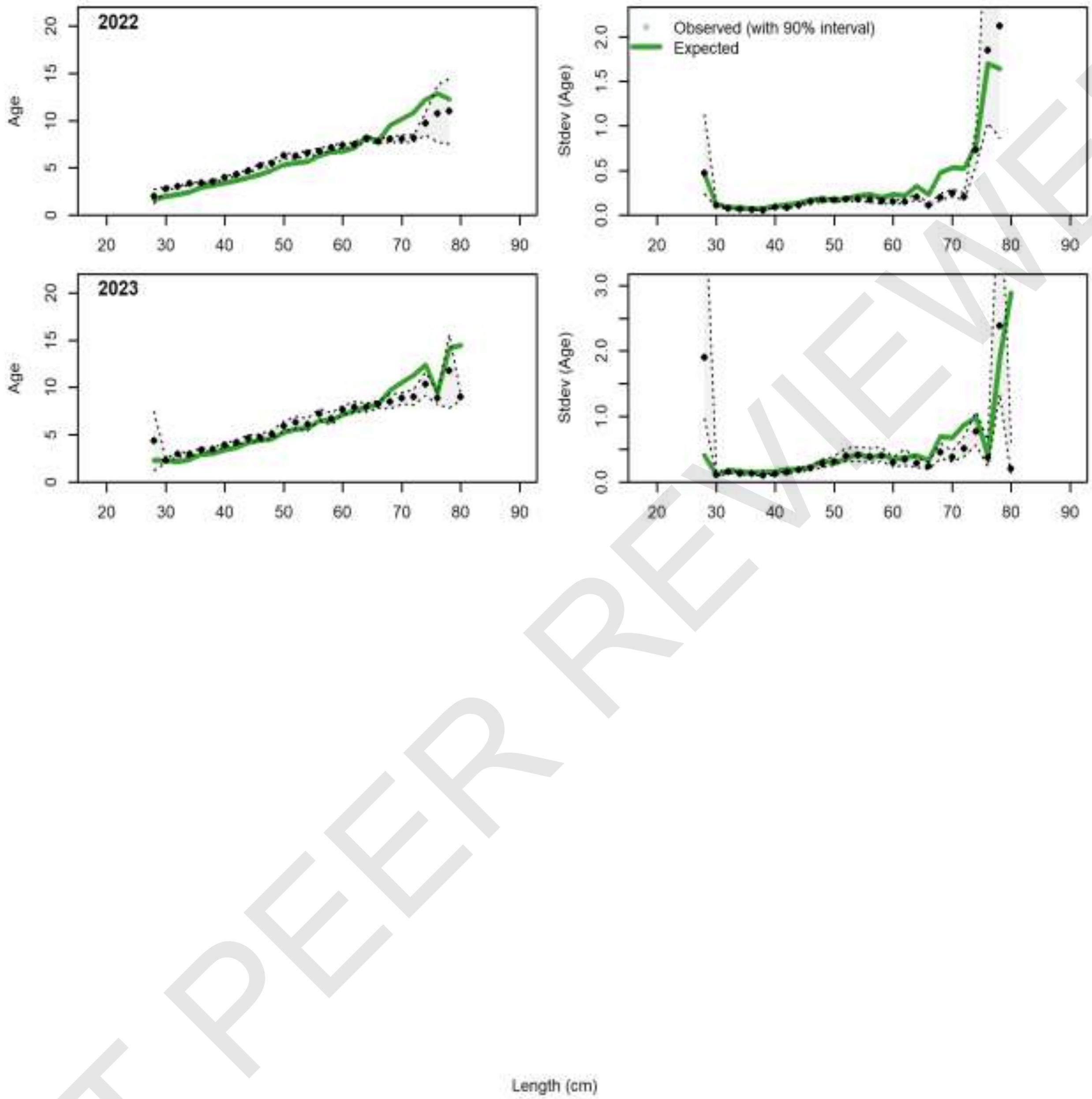


Figure 141 Continued. Conditional AAL plot, retained, Commercial Handline Central (plot 7 of 7)

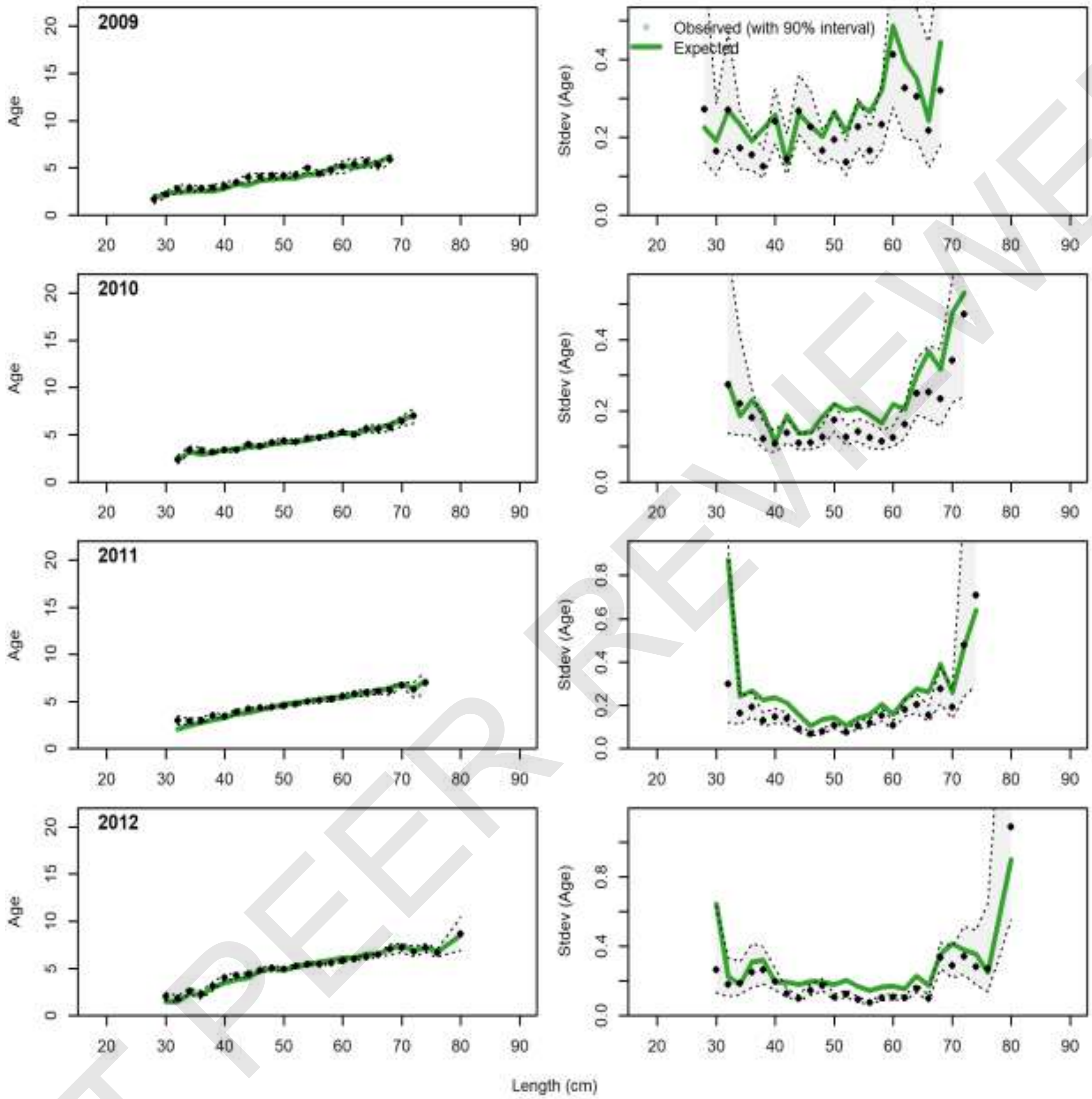


Figure 142. Conditional AAL plot, retained, Commercial Handline East (plot 1 of 4) These plots show mean age and std. dev. in conditional A@L.Left plots are mean A@L by size-class (obs. and exp.) with 90% CIs based on adding 1.64 SE of mean to the data.Right plots in each pair are SE of mean A@L (obs. and exp.) with 90% CIs based on the chi-square distribution.

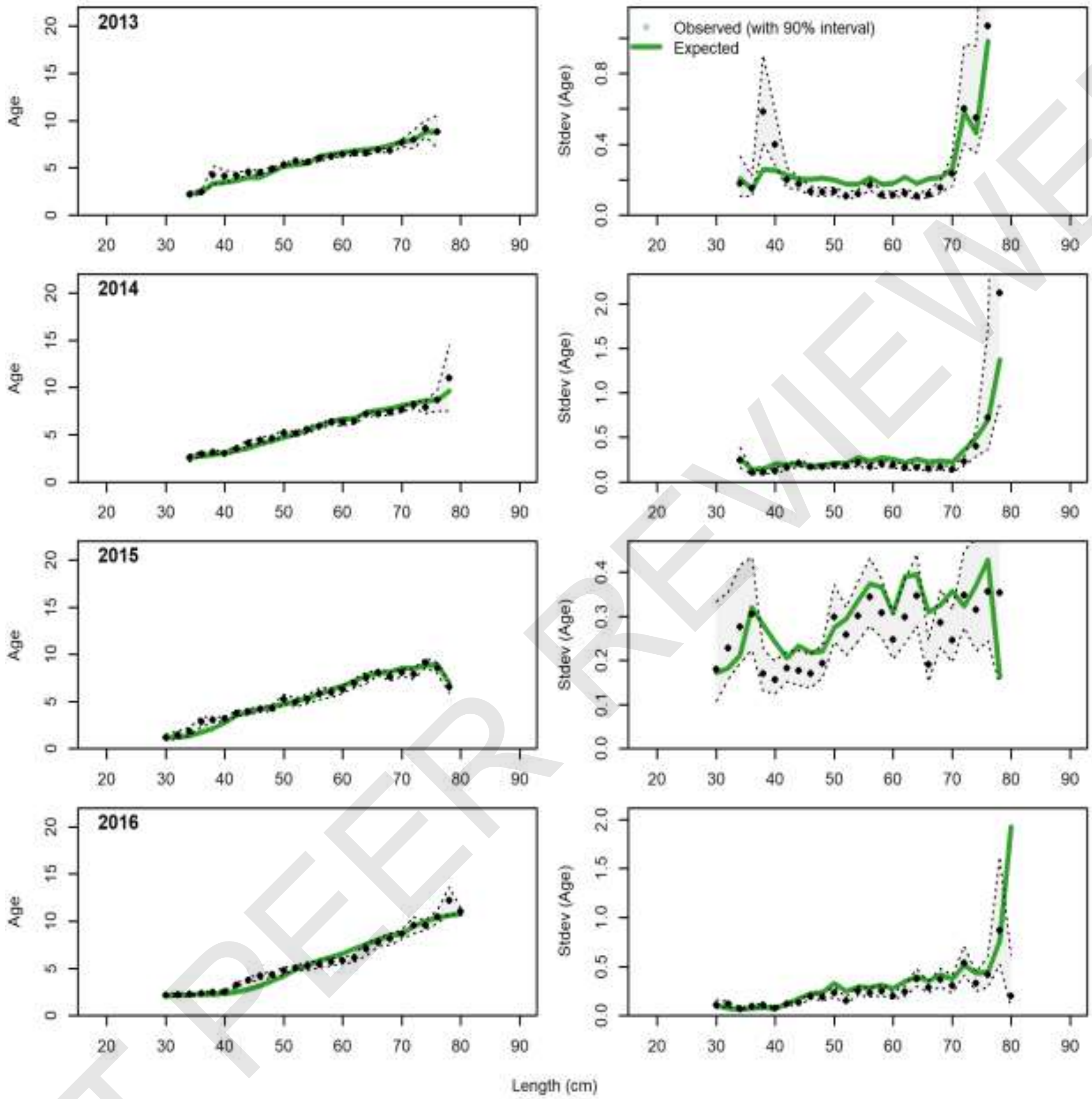


Figure 142 Continued. Conditional AAL plot, retained, Commercial Handline East (plot 2 of 4)

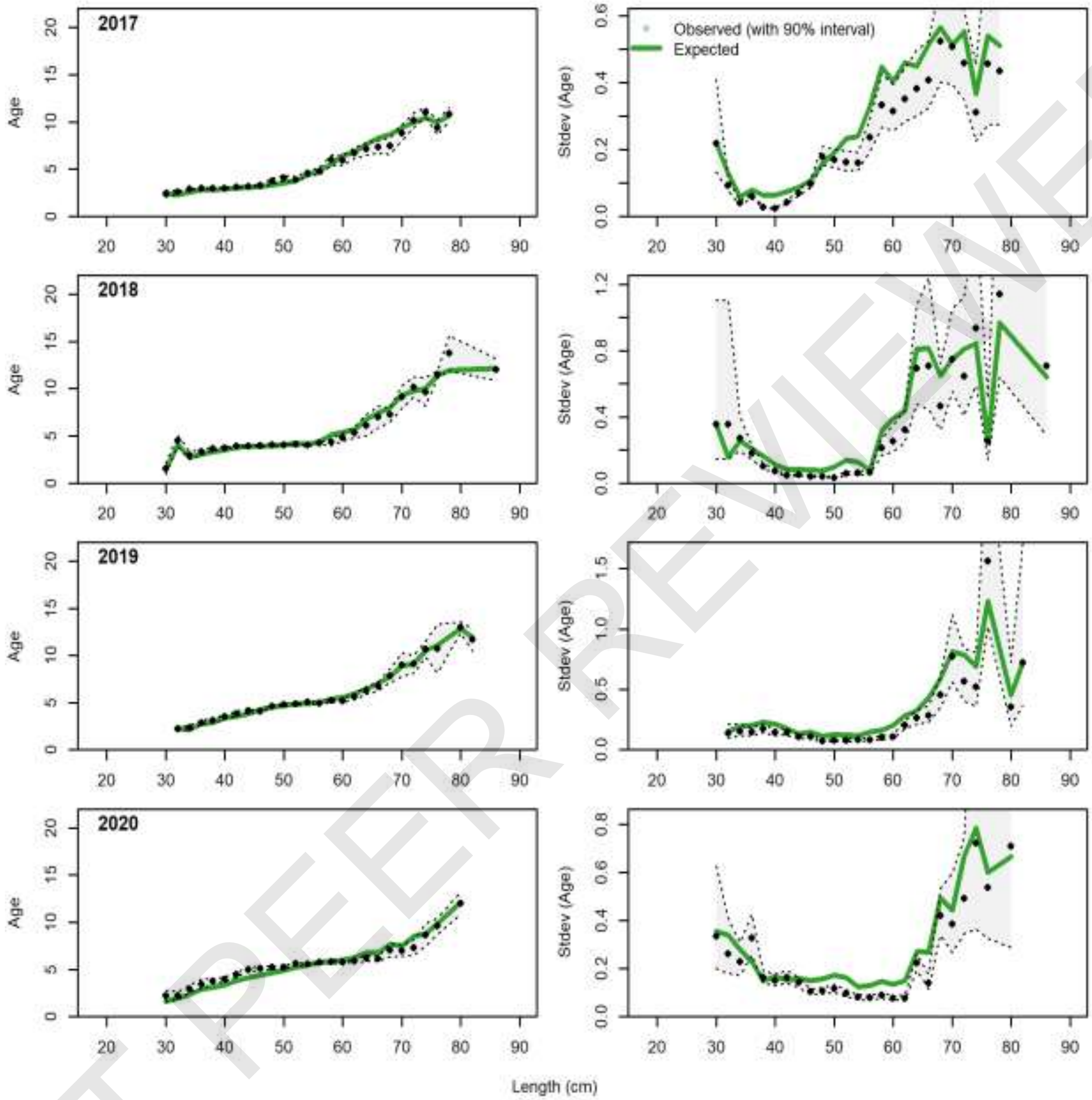


Figure 142 Continued. Conditional AAL plot, retained, Commercial Handline East (plot 3 of 4)

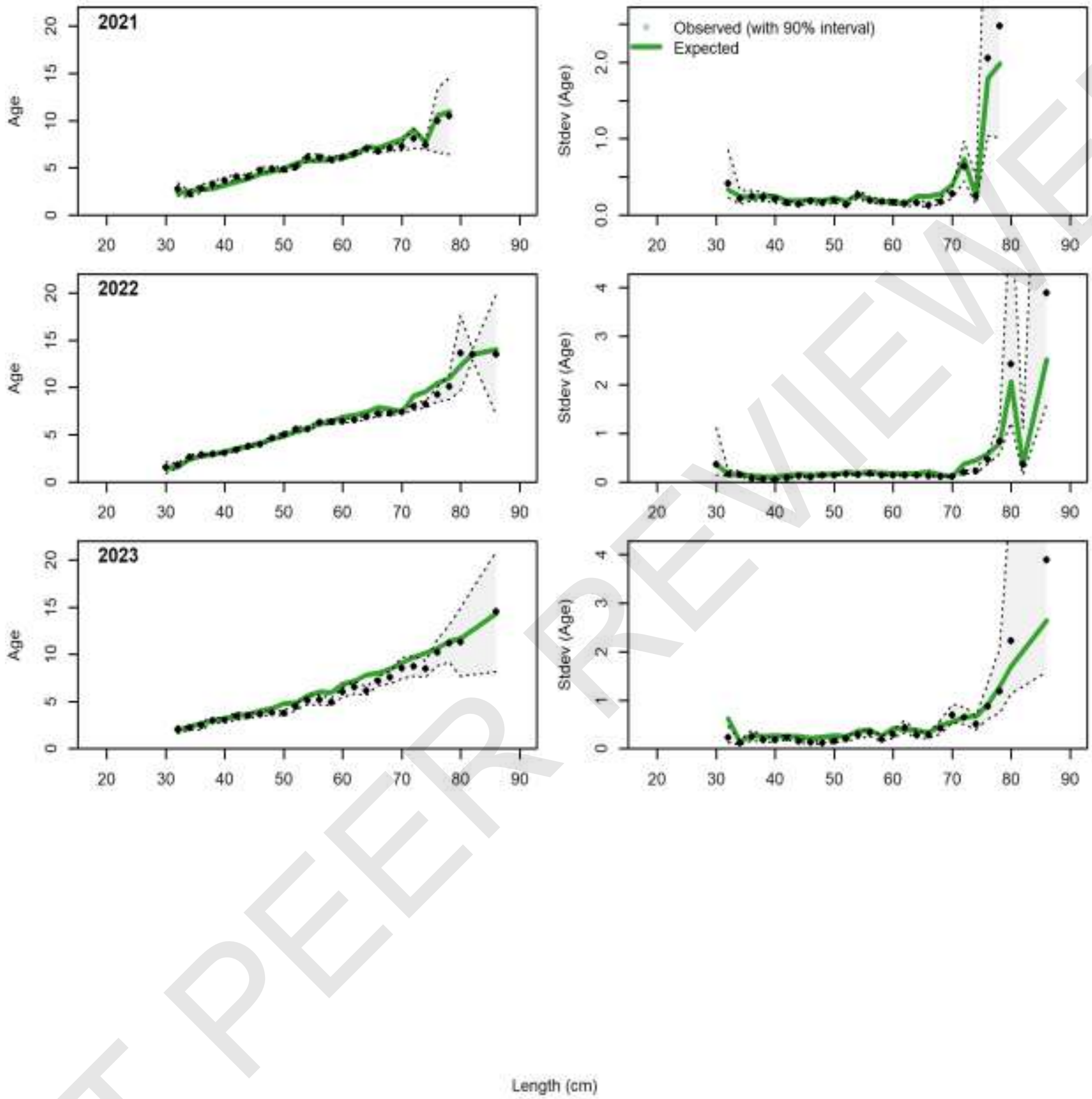


Figure 142 Continued. Conditional AAL plot, retained, Commercial Handline East (plot 4 of 4)

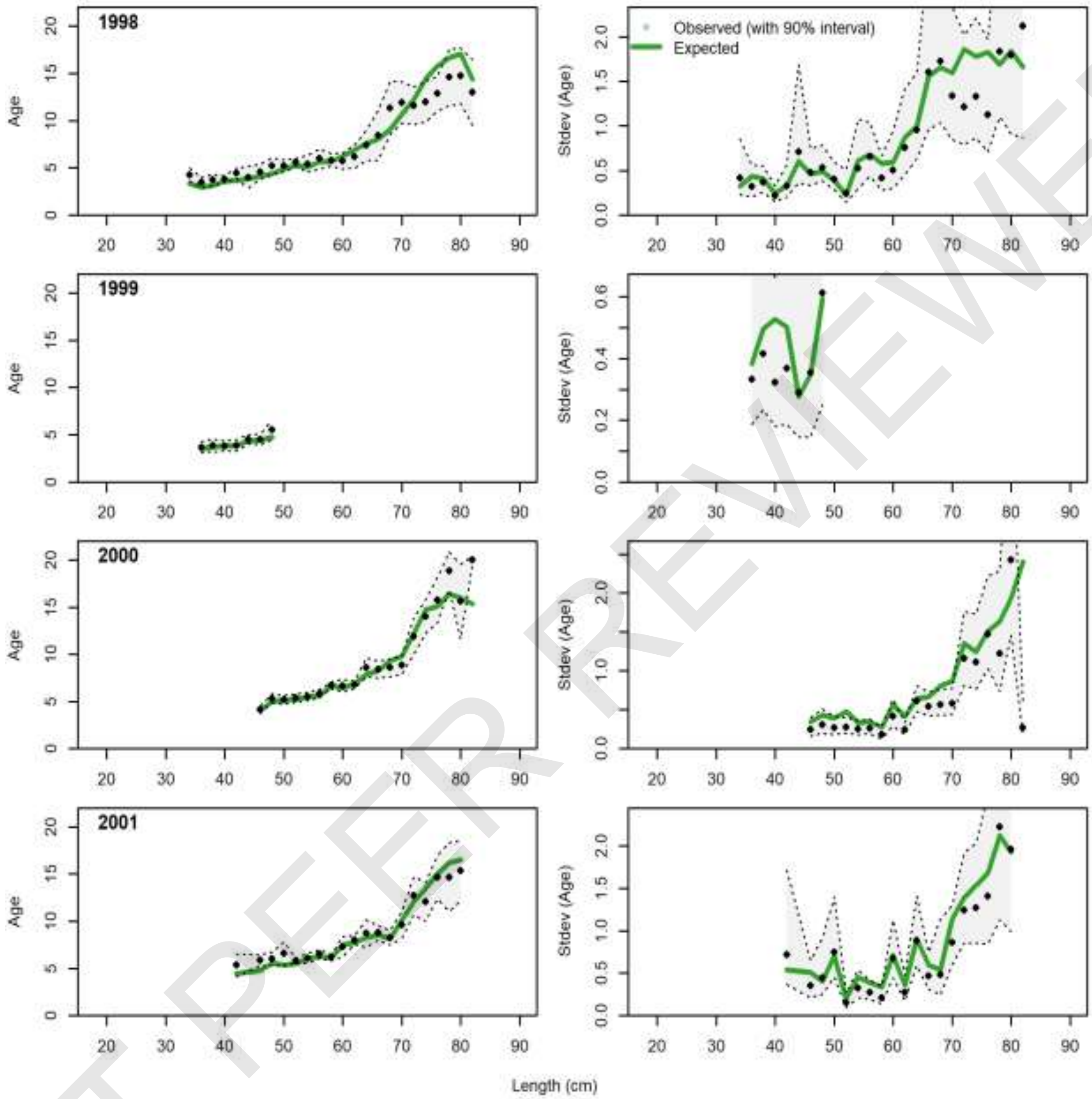


Figure 143. Conditional AAL plot, retained, Commercial Longline West (plot 1 of 7) These plots show mean age and std. dev. in conditional A@L.Left plots are mean A@L by size-class (obs. and exp.) with 90% CIs based on adding 1.64 SE of mean to the data.Right plots in each pair are SE of mean A@L (obs. and exp.) with 90% CIs based on the chi-square distribution.

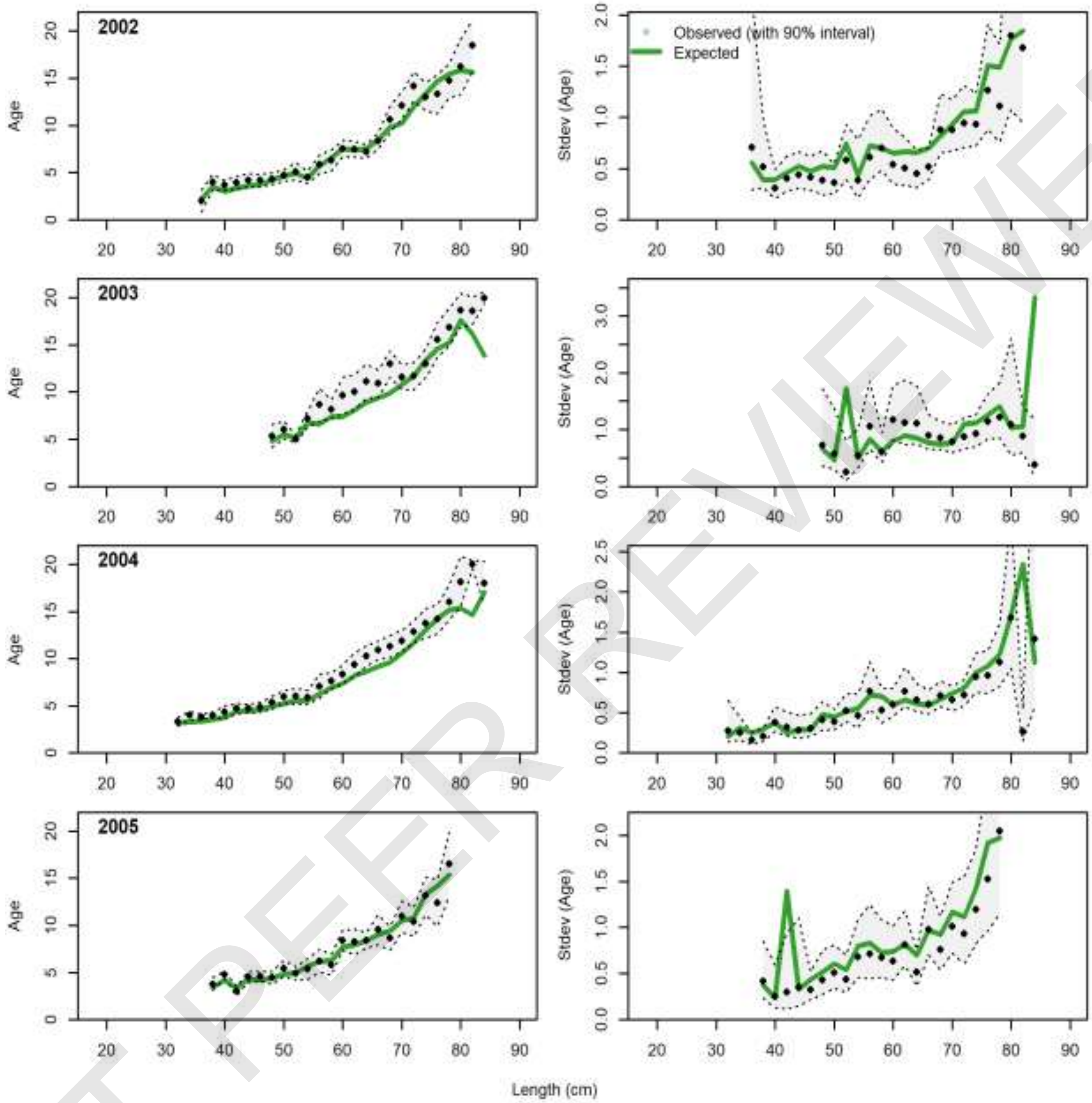


Figure 143 Continued. Conditional AAL plot, retained, Commercial Longline West (plot 2 of 7)

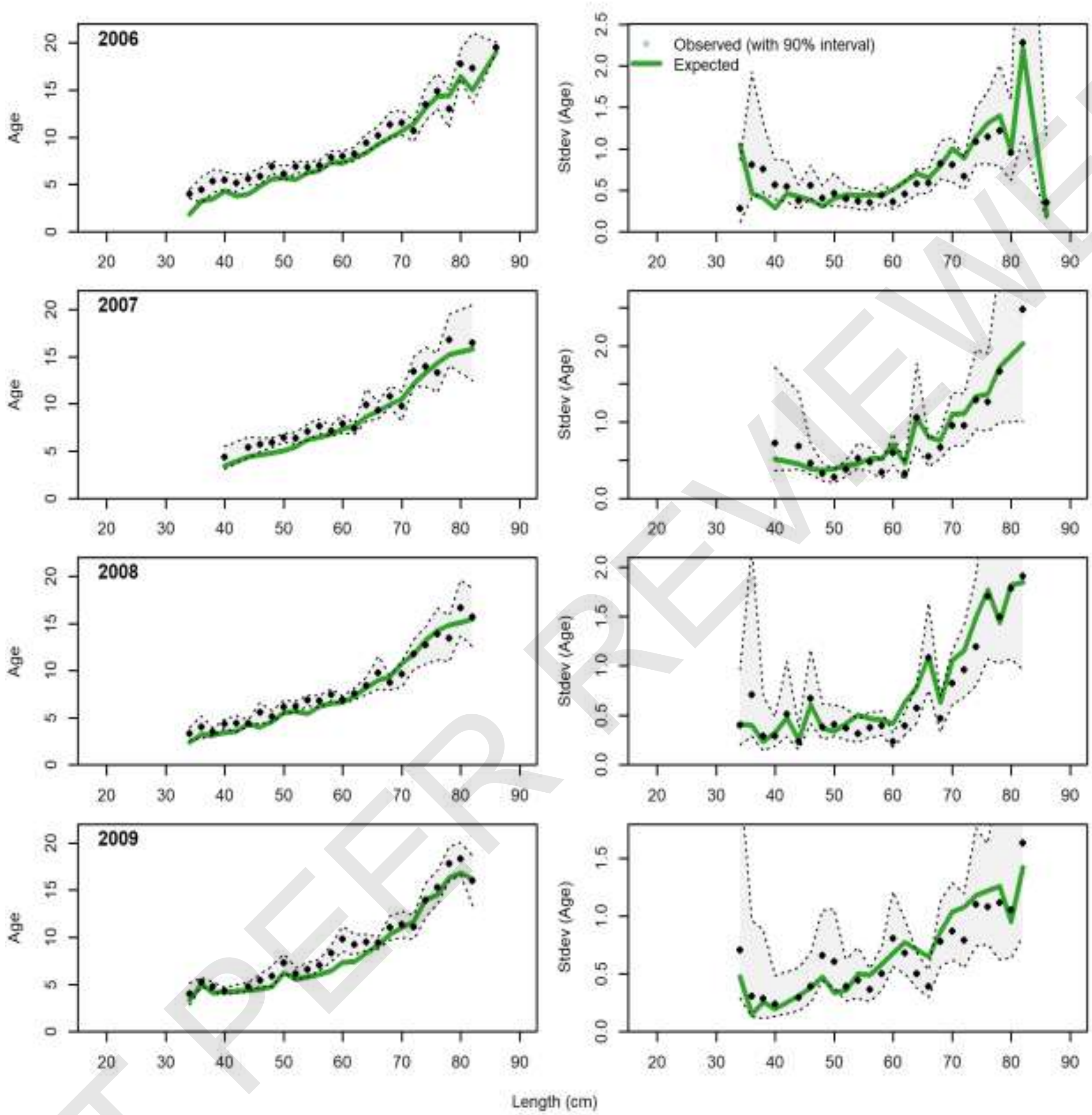


Figure 143 Continued. Conditional AAL plot, retained, Commercial Longline West (plot 3 of 7)

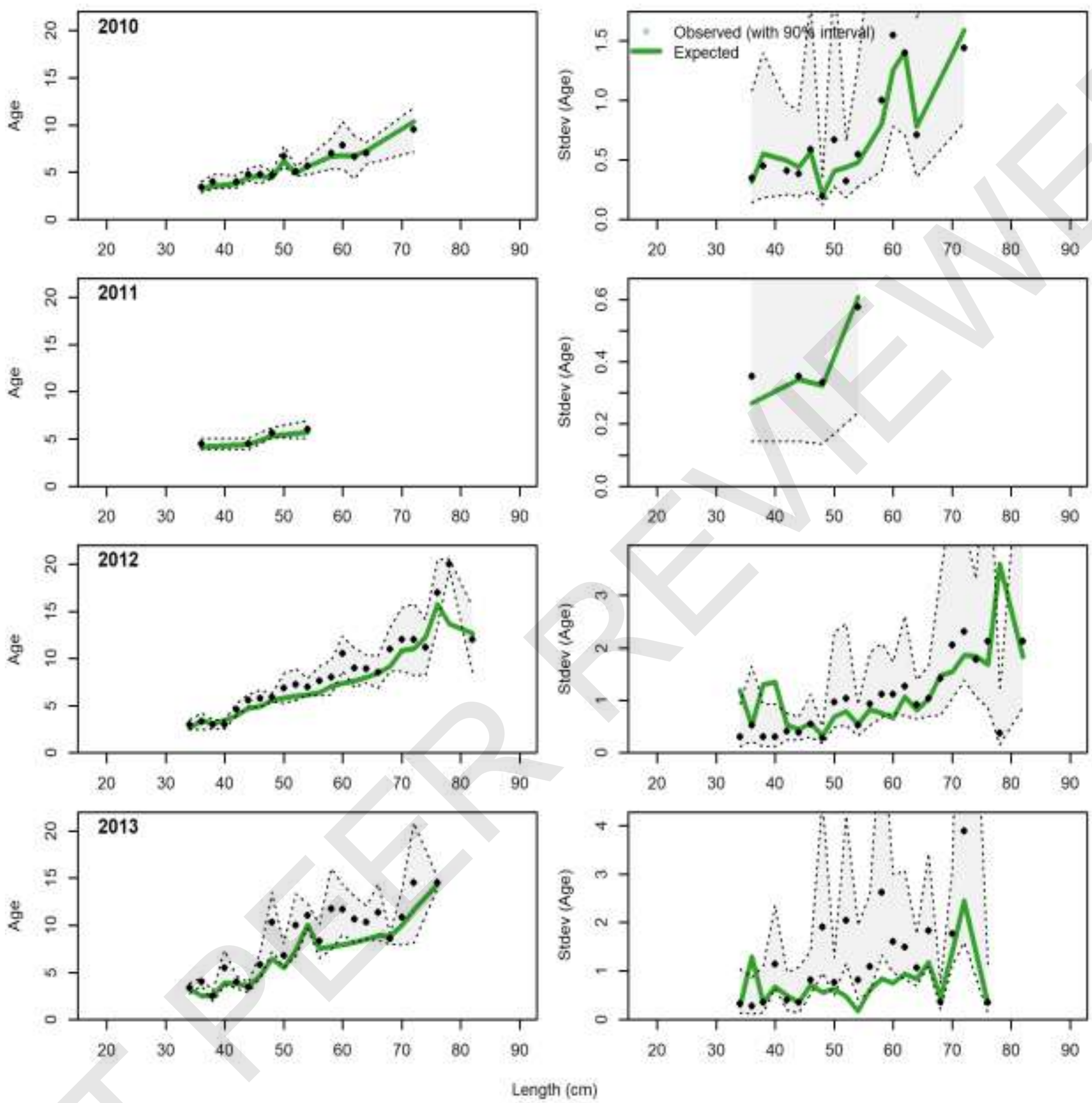


Figure 143 Continued. Conditional AAL plot, retained, Commercial Longline West (plot 4 of 7)

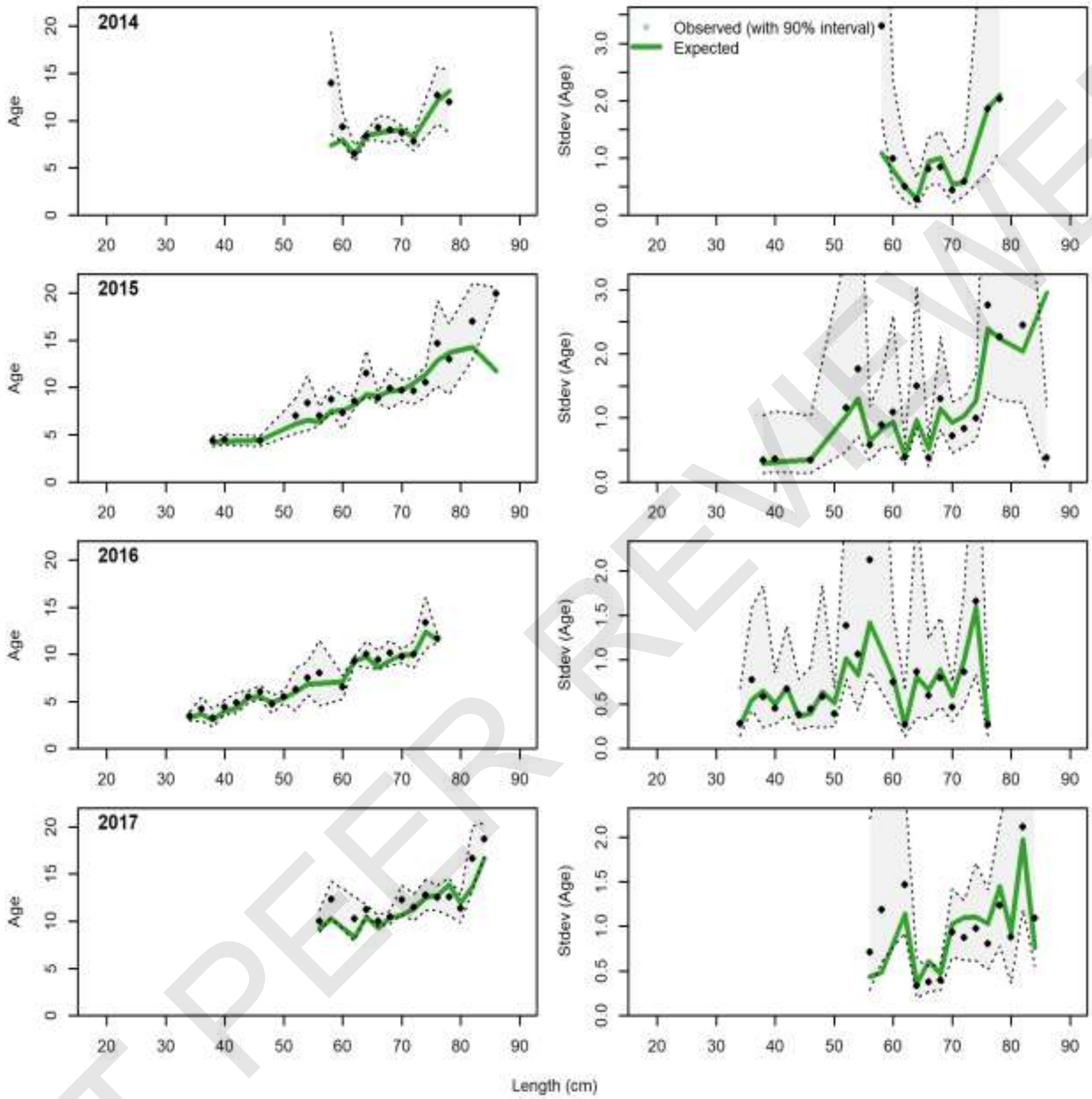


Figure 143 Continued. Conditional AAL plot, retained, Commercial Longline West (plot 5 of 7)

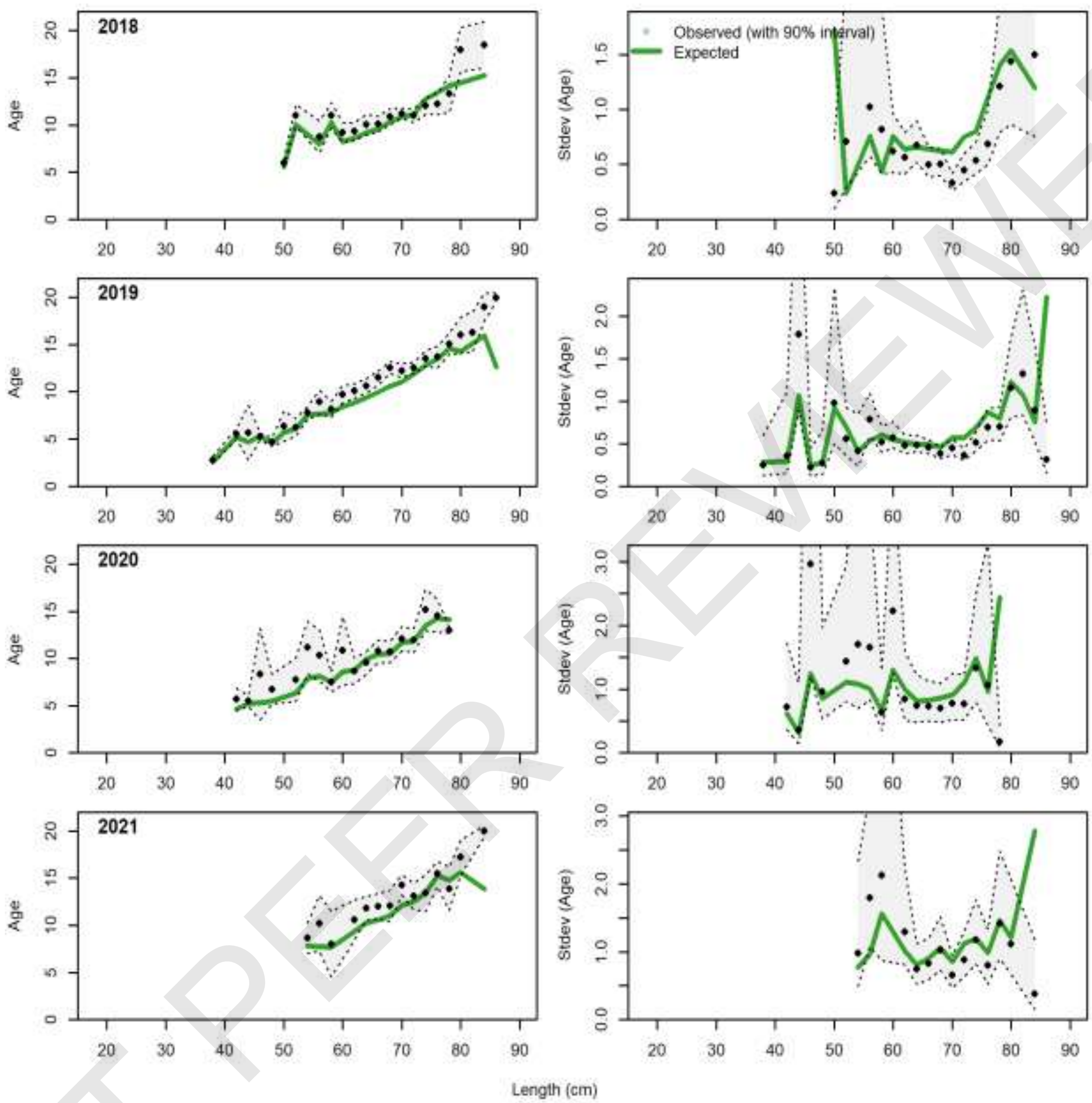


Figure 143 Continued. Conditional AAL plot, retained, Commercial Longline West (plot 6 of 7)

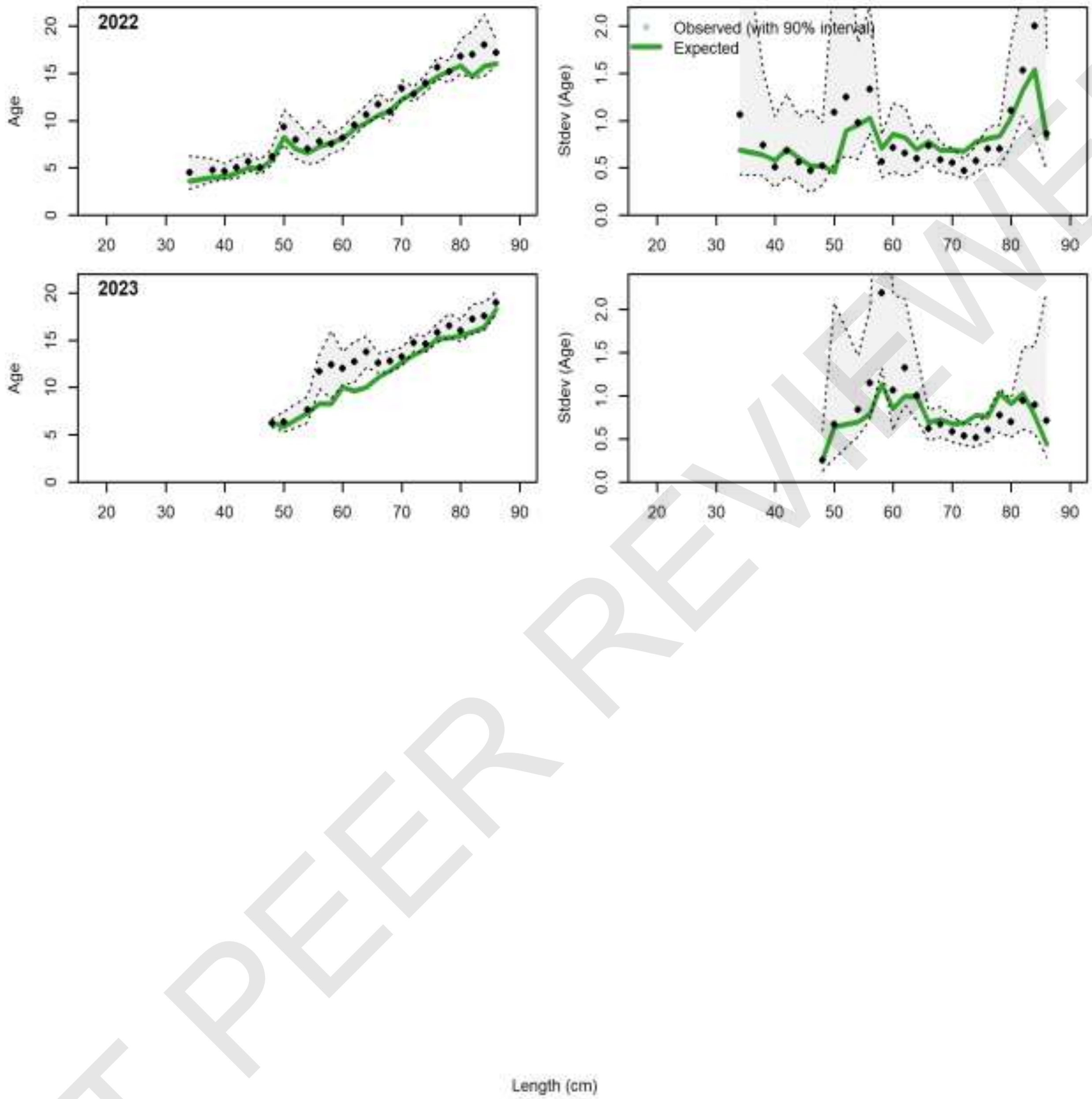


Figure 143 Continued. Conditional AAL plot, retained, Commercial Longline West (plot 7 of 7)

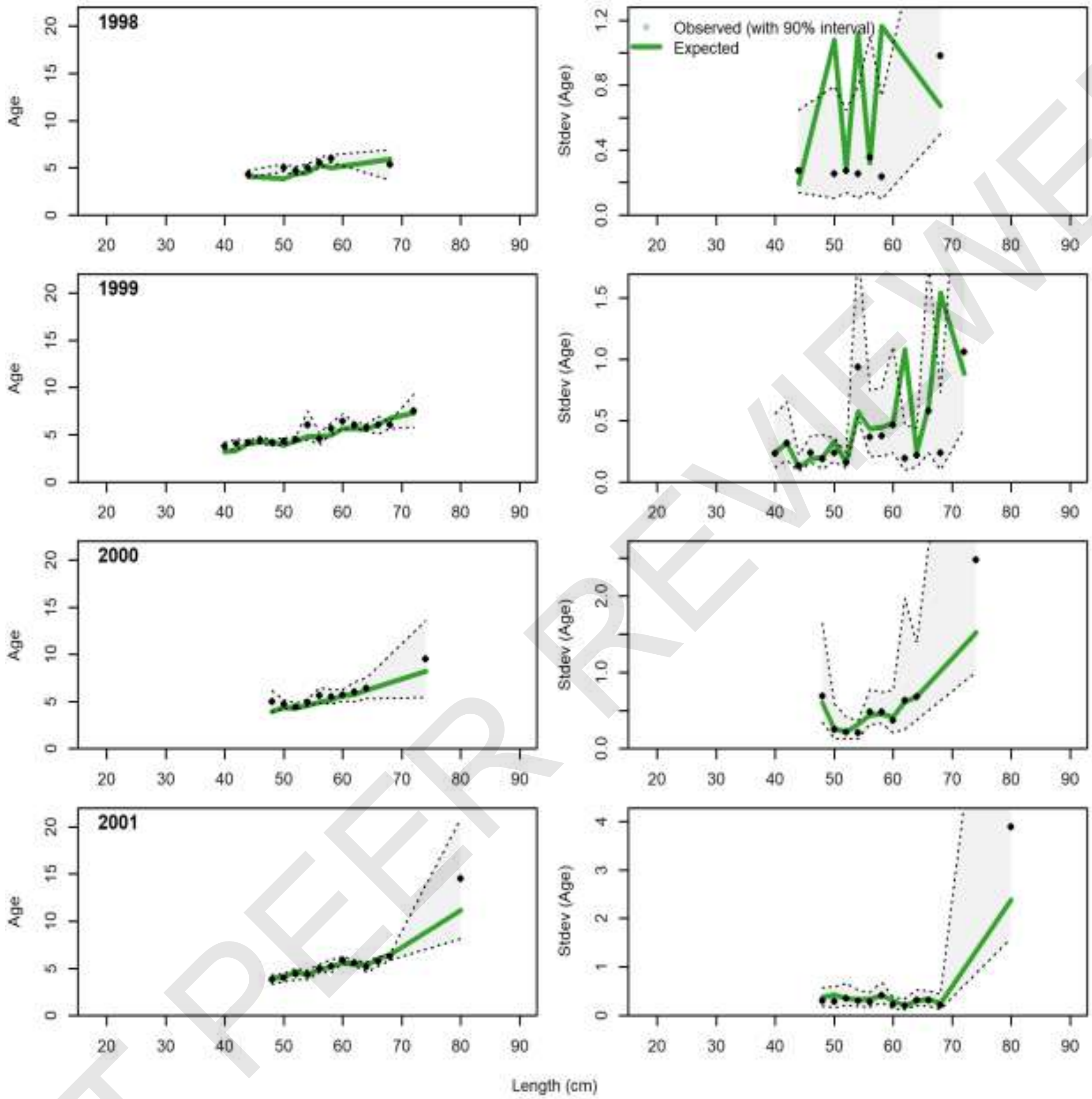


Figure 144. Conditional AAL plot, retained, Commercial Longline East (plot 1 of 7) These plots show mean age and std. dev. in conditional A@L.Left plots are mean A@L by size-class (obs. and exp.) with 90% CIs based on adding 1.64 SE of mean to the data.Right plots in each pair are SE of mean A@L (obs. and exp.) with 90% CIs based on the chi-square distribution.

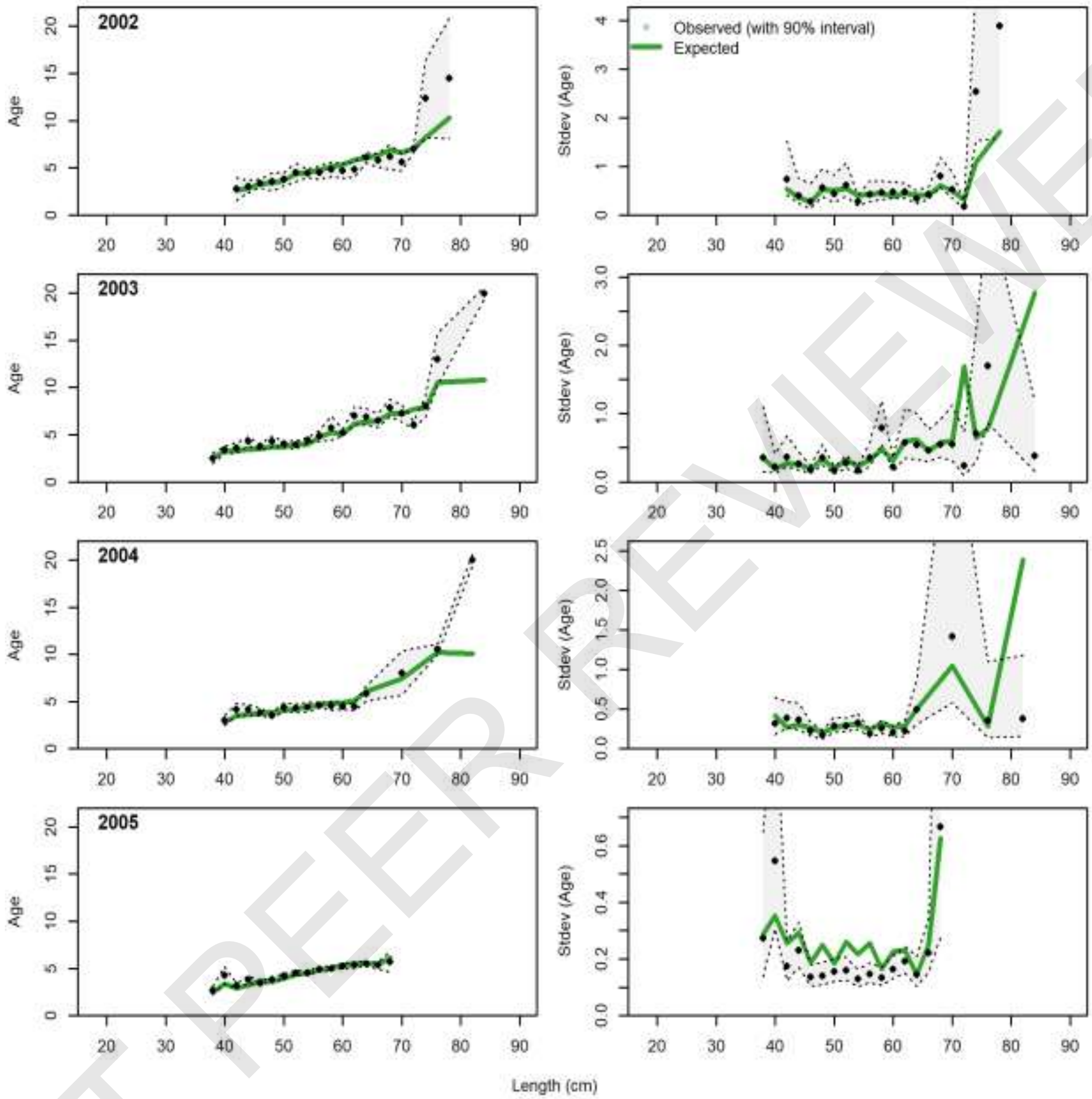


Figure 144 Continued. Conditional AAL plot, retained, Commercial Longline East (plot 2 of 7)

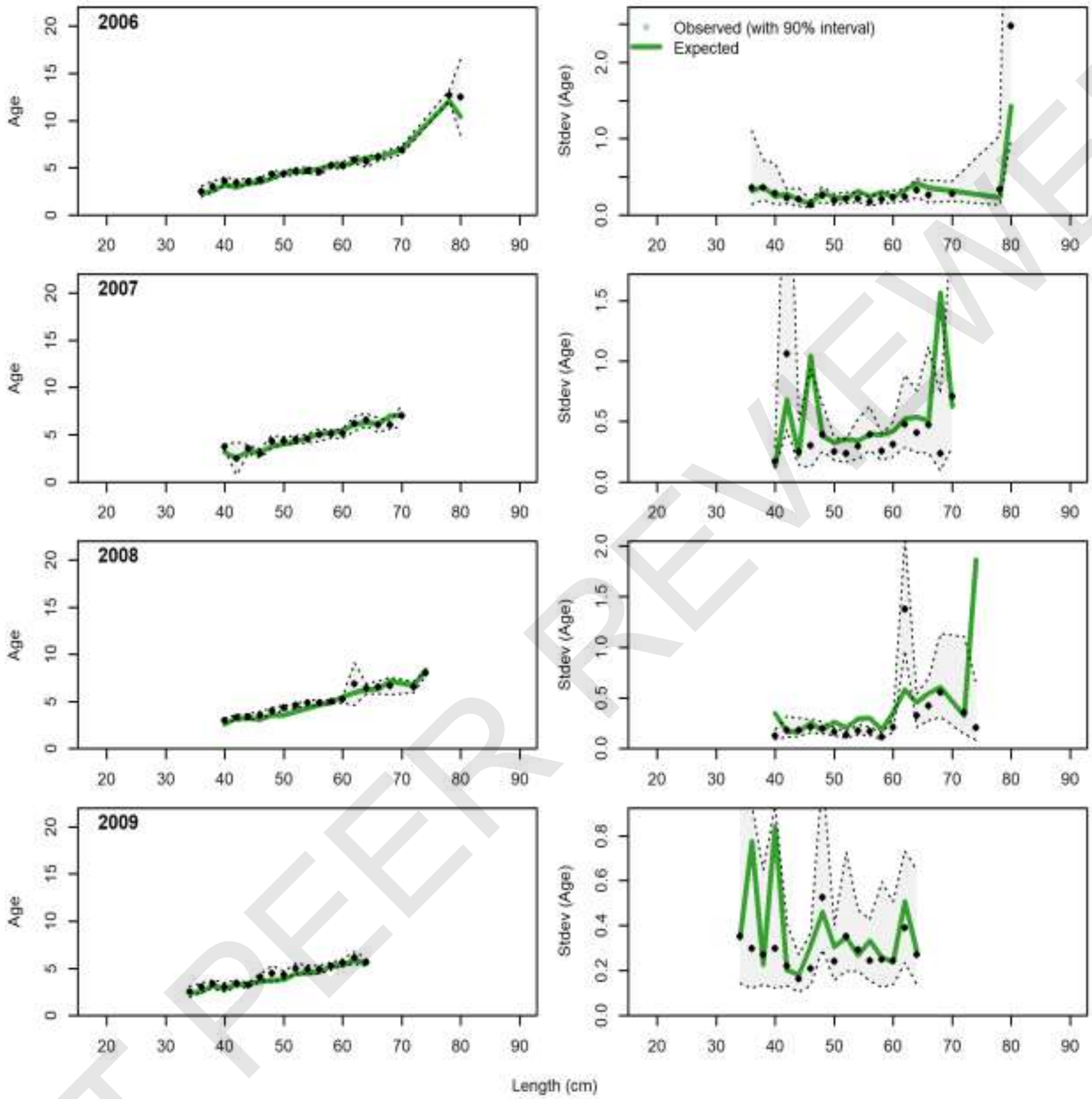


Figure 144 Continued. Conditional AAL plot, retained, Commercial Longline East (plot 3 of 7)

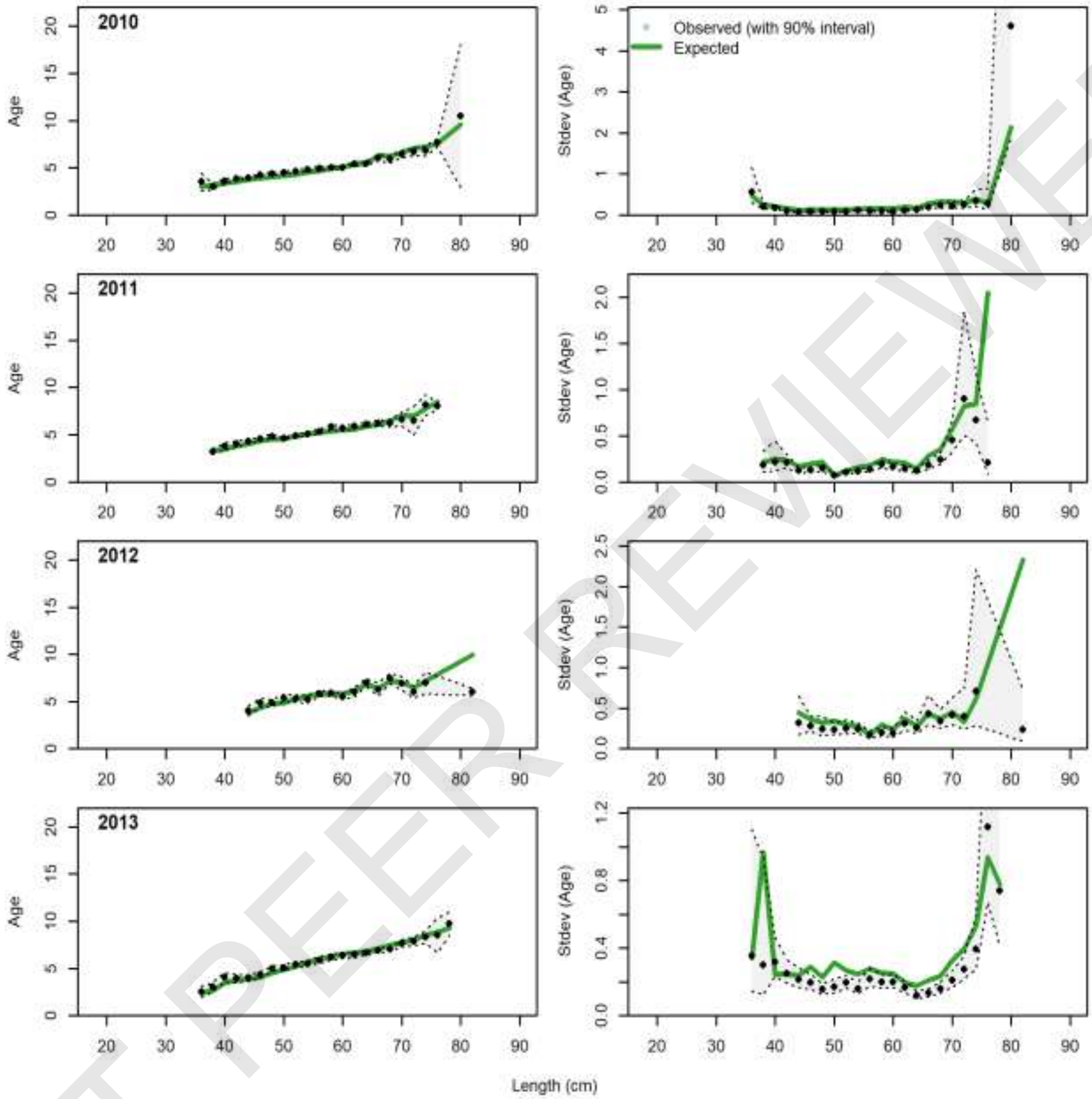


Figure 144 Continued. Conditional AAL plot, retained, Commercial Longline East (plot 4 of 7)

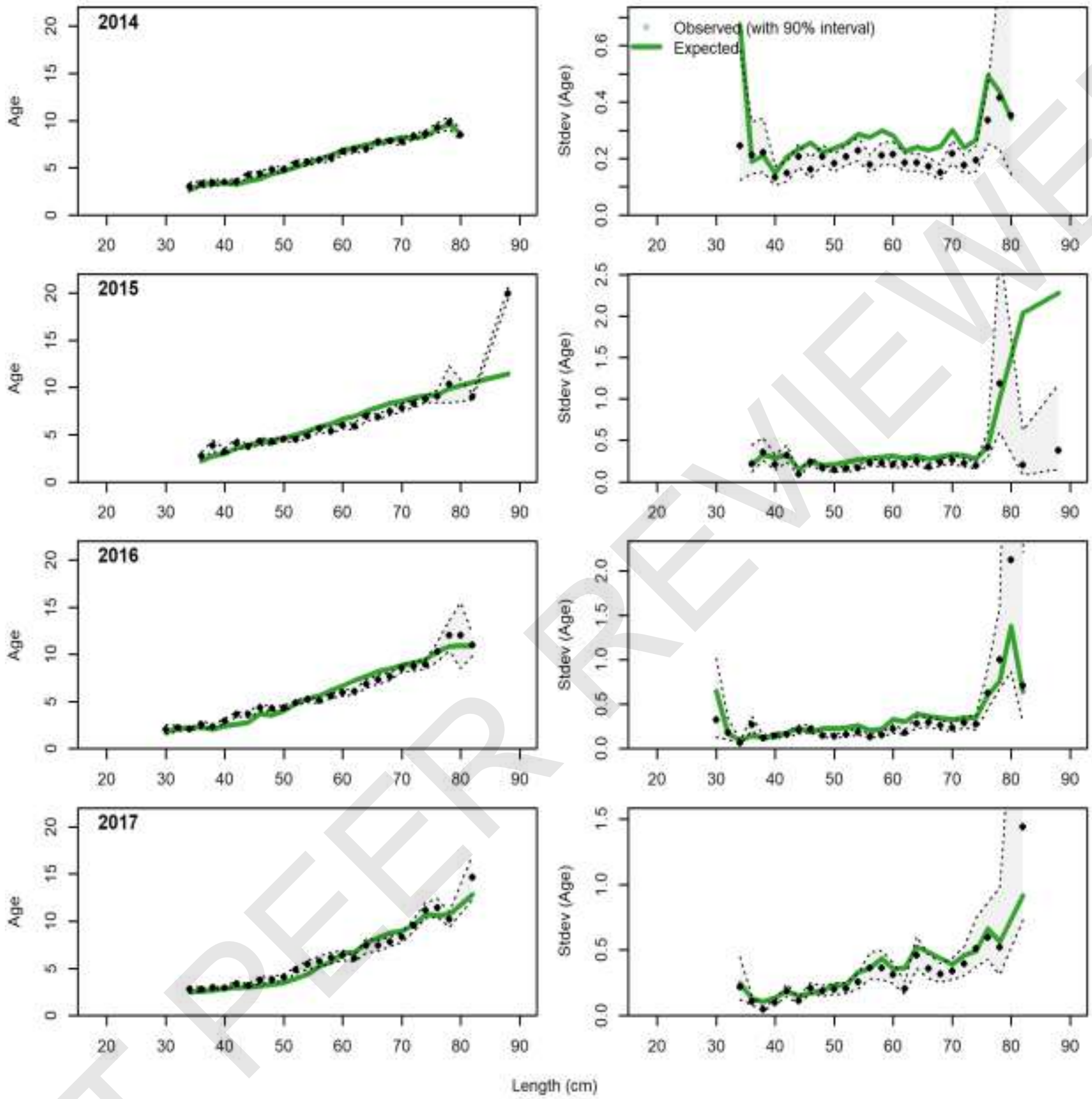


Figure 144 Continued. Conditional AAL plot, retained, Commercial Longline East (plot 5 of 7)

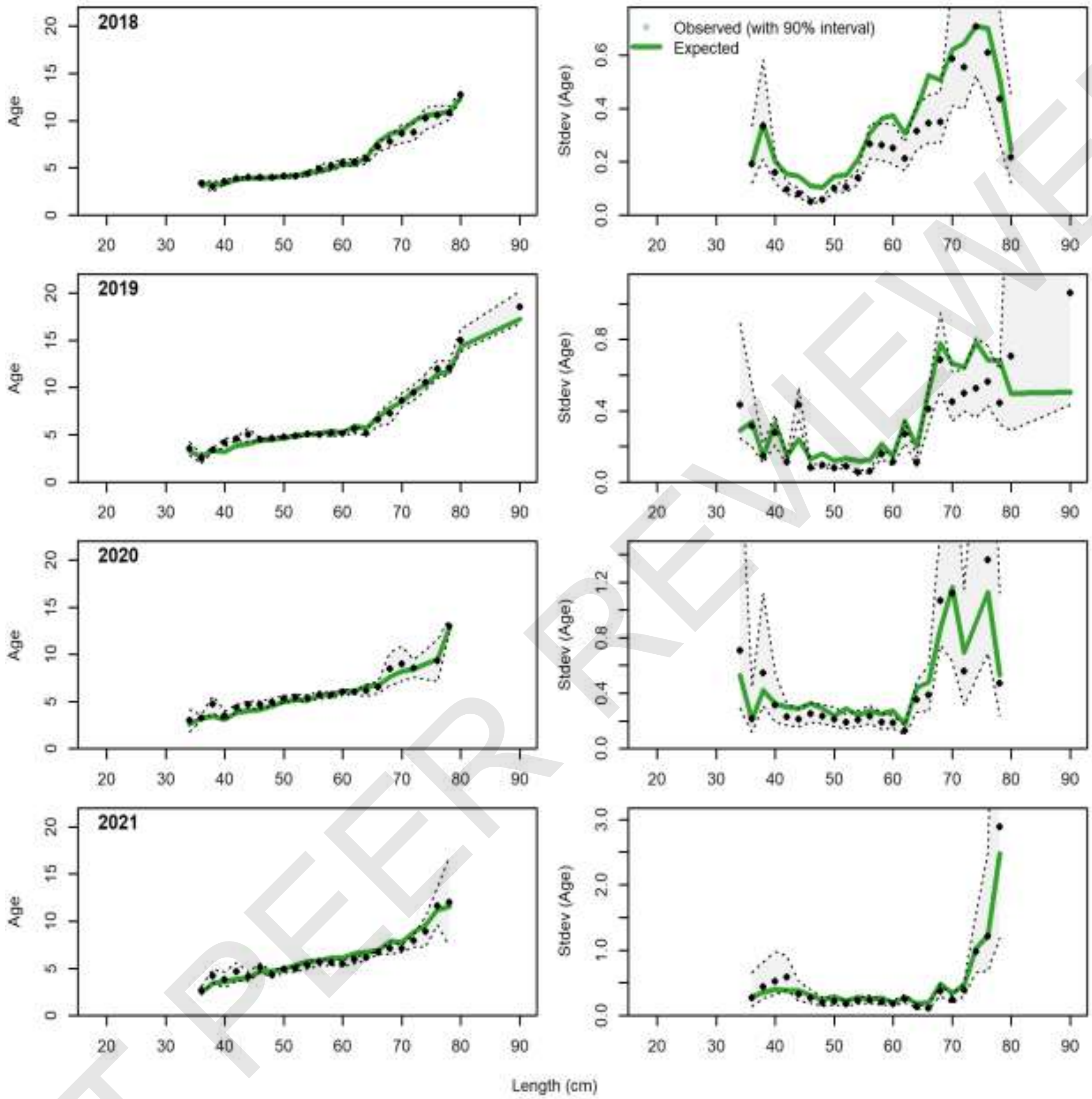


Figure 144 Continued. Conditional AAL plot, retained, Commercial Longline East (plot 6 of 7)

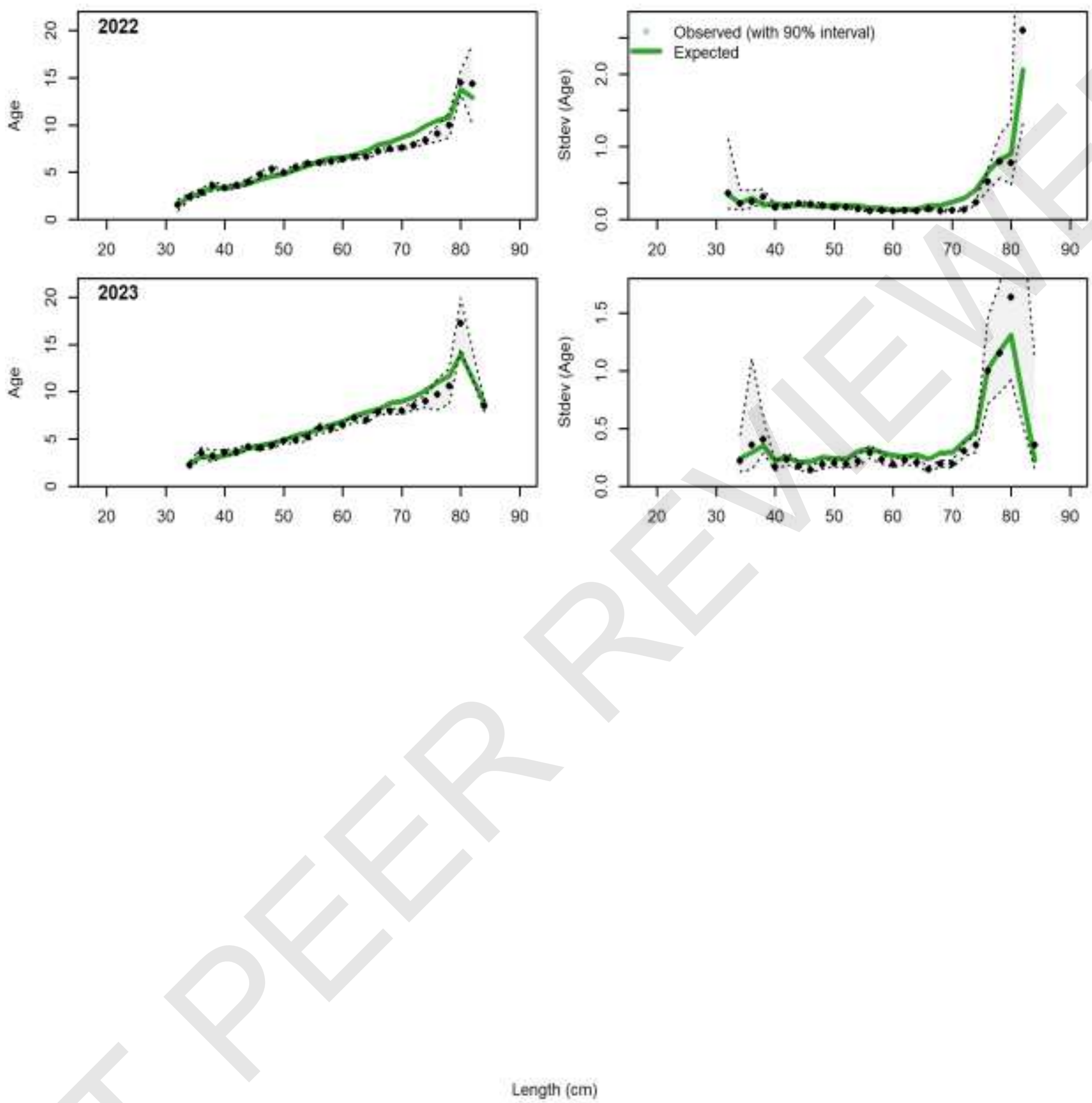


Figure 144 Continued. Conditional AAL plot, retained, Commercial Longline East (plot 7 of 7)

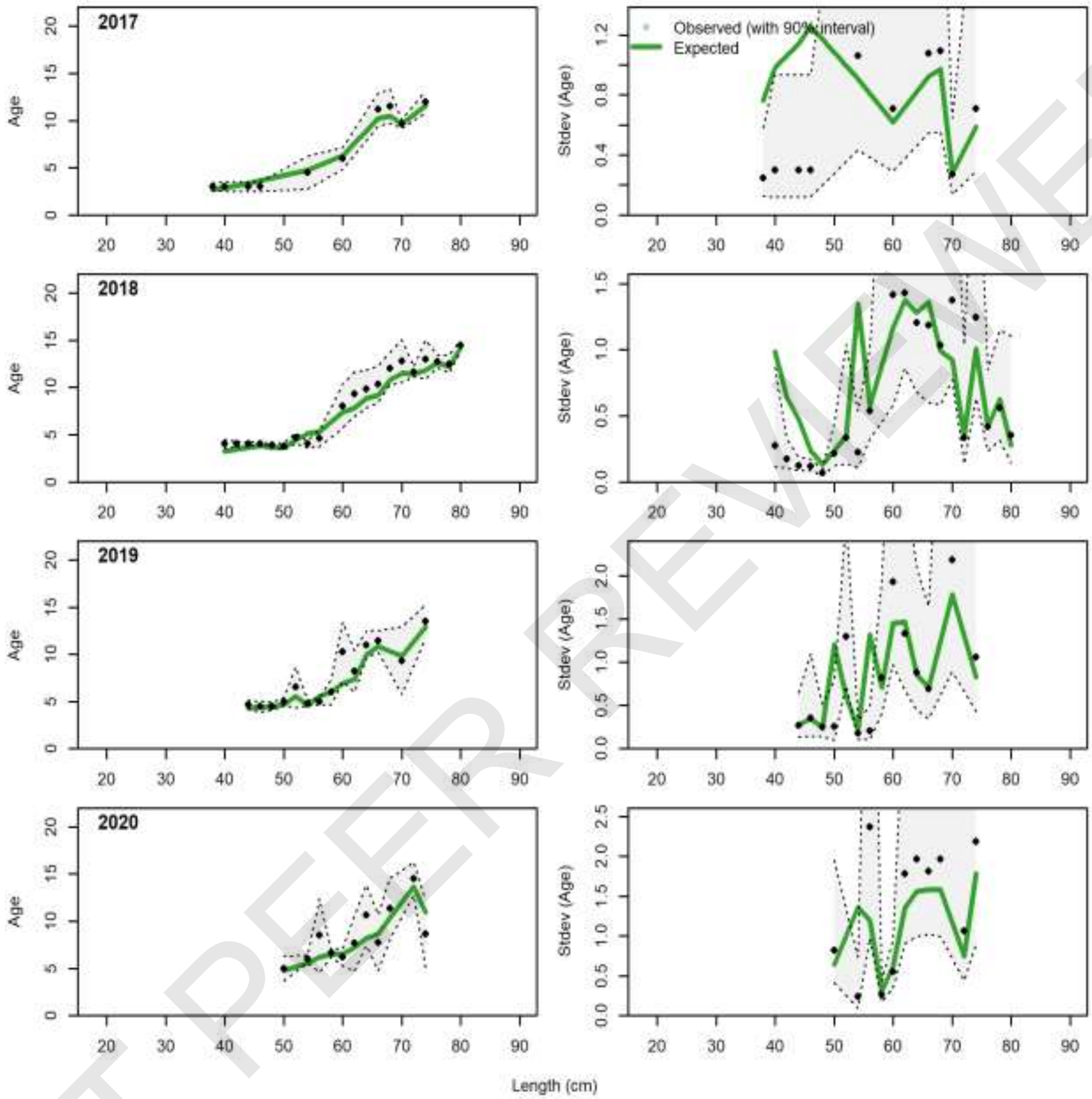


Figure 145. Conditional AAL plot, retained, Commercial Longline Central (plot 1 of 2) These plots show mean age and std. dev. in conditional A@L.Left plots are mean A@L by size-class (obs. and exp.) with 90% CIs based on adding 1.64 SE of mean to the data.Right plots in each pair are SE of mean A@L (obs. and exp.) with 90% CIs based on the chi-square distribution.

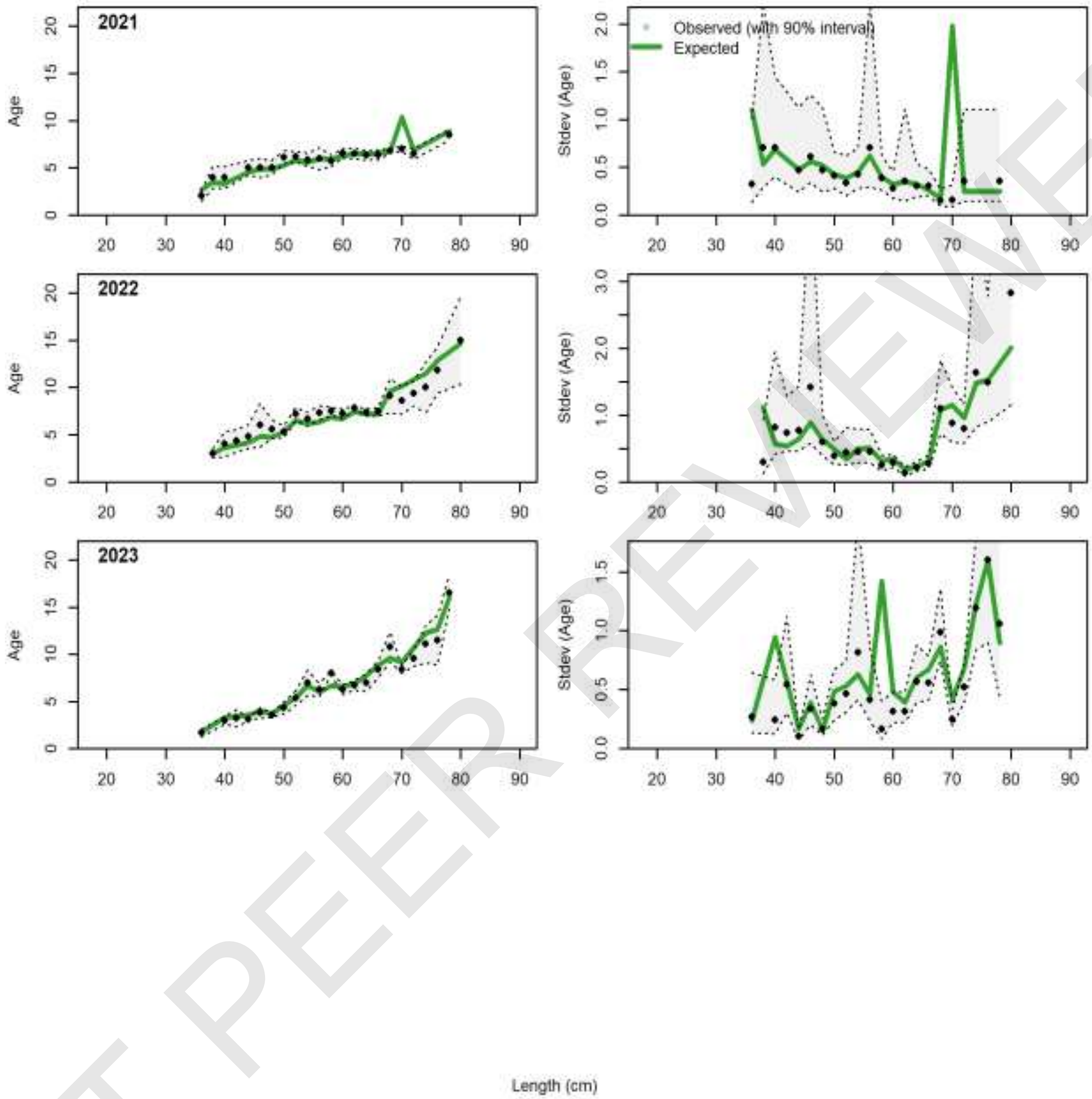


Figure 145 Continued. Conditional AAL plot, retained, Commercial Longline Central (plot 2 of 2)

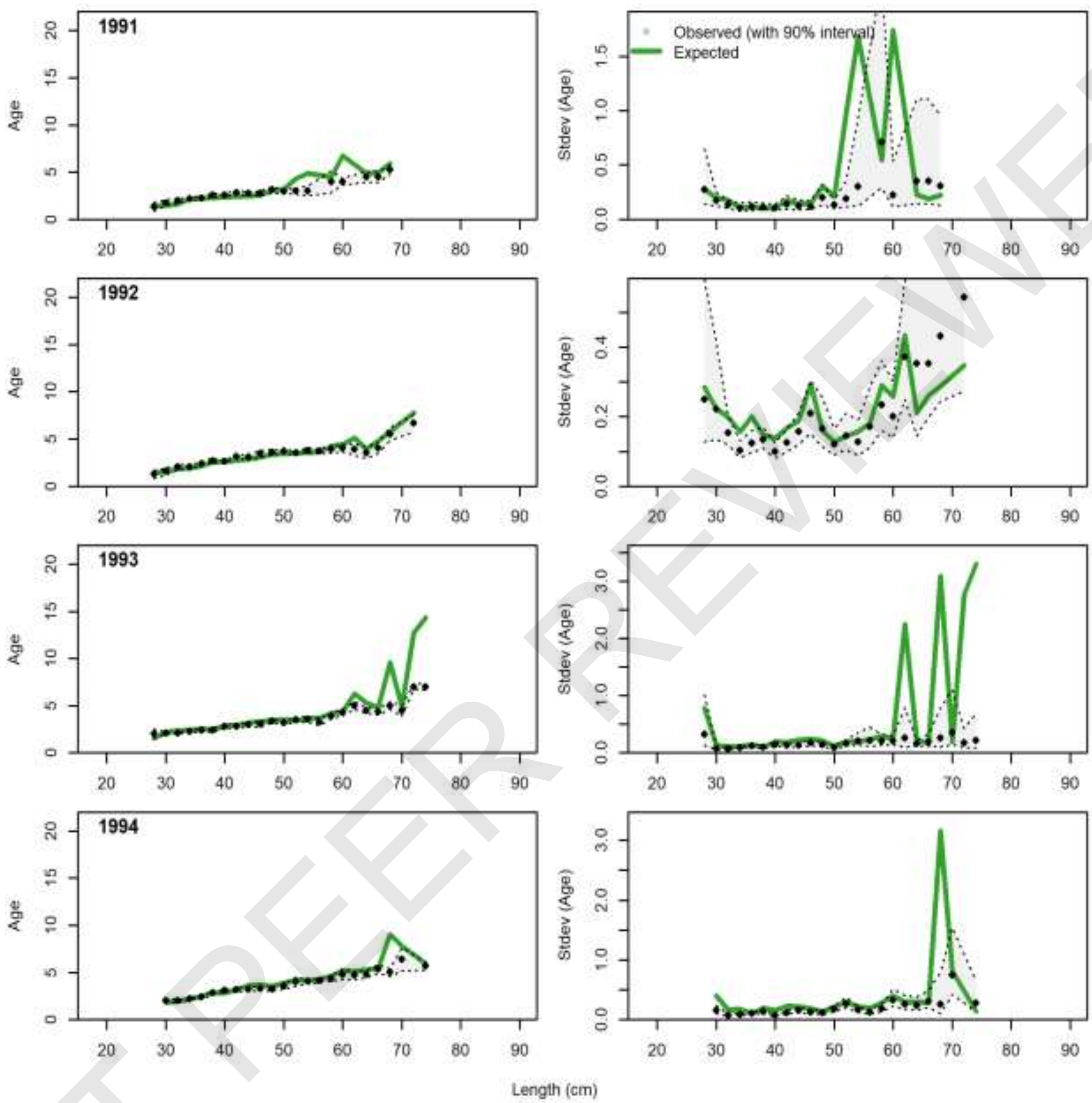


Figure 146. Conditional AAL plot, retained, Recreational Charter Central (plot 1 of 9) These plots show mean age and std. dev. in conditional A@L.Left plots are mean A@L by size-class (obs. and exp.) with 90% CIs based on adding 1.64 SE of mean to the data.Right plots in each pair are SE of mean A@L (obs. and exp.) with 90% CIs based on the chi-square distribution.

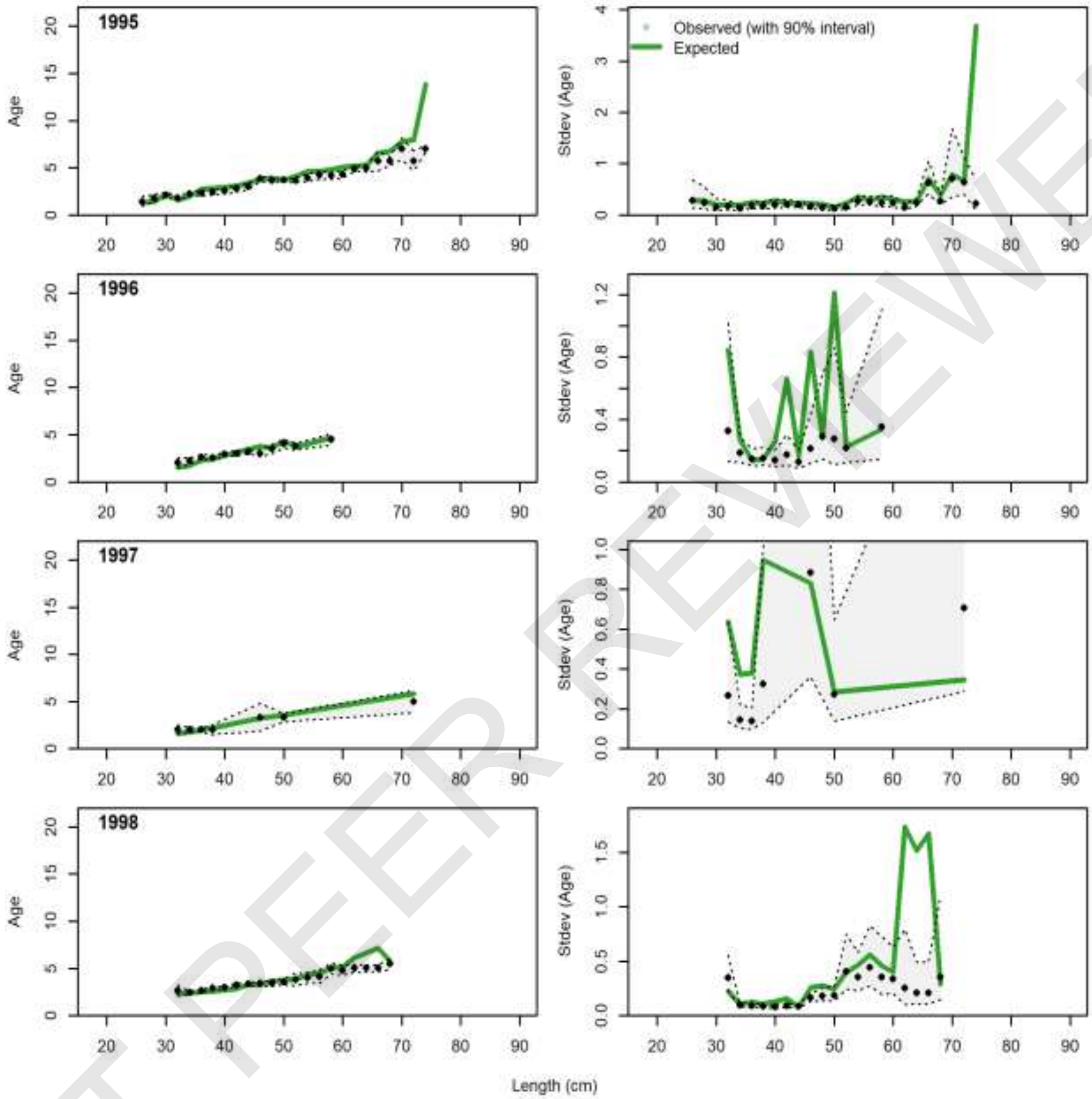


Figure 146 Continued. Conditional AAL plot, retained, Recreational Charter Central (plot 2 of 9)

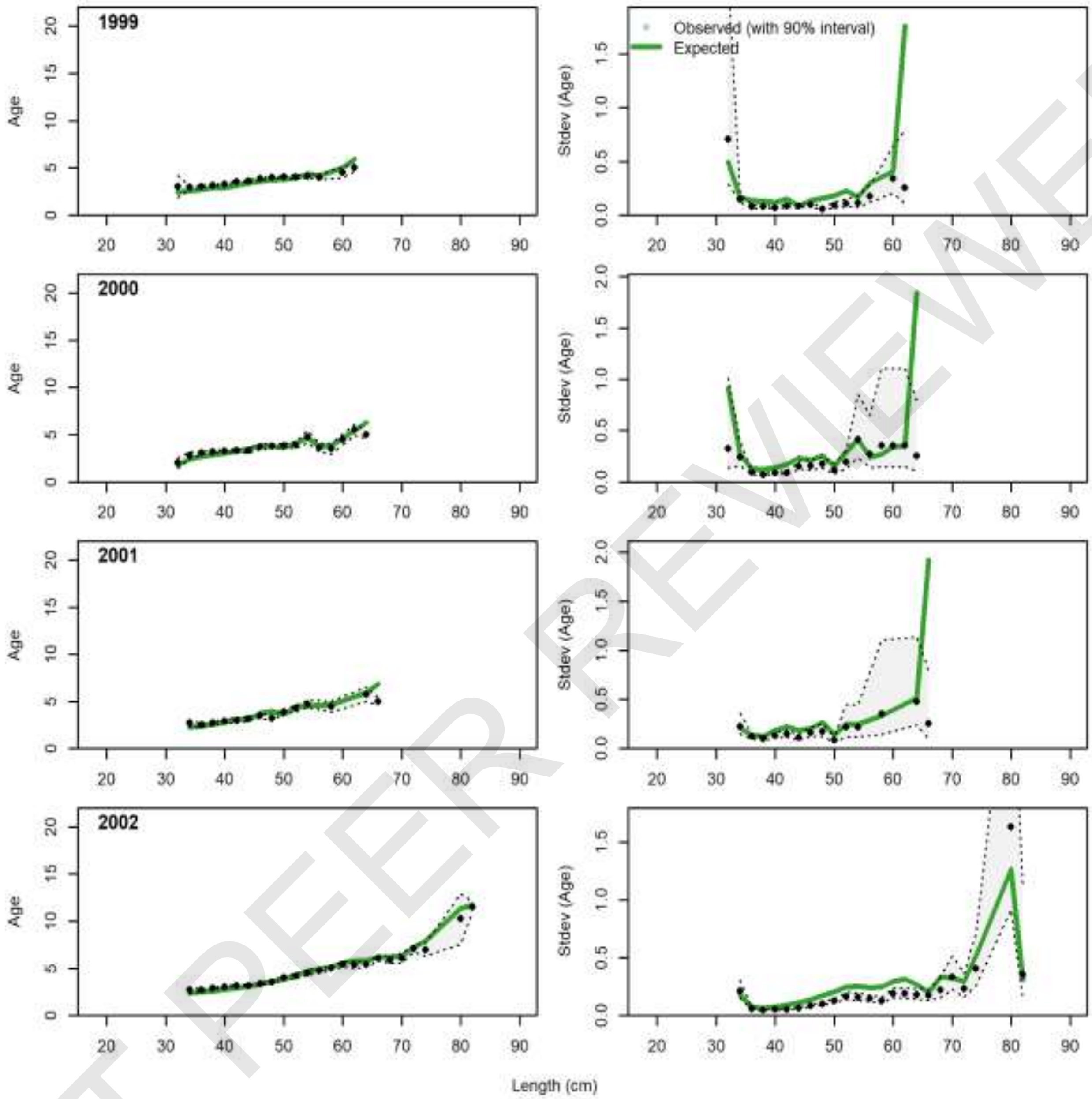


Figure 146 Continued. Conditional AAL plot, retained, Recreational Charter Central (plot 3 of 9)

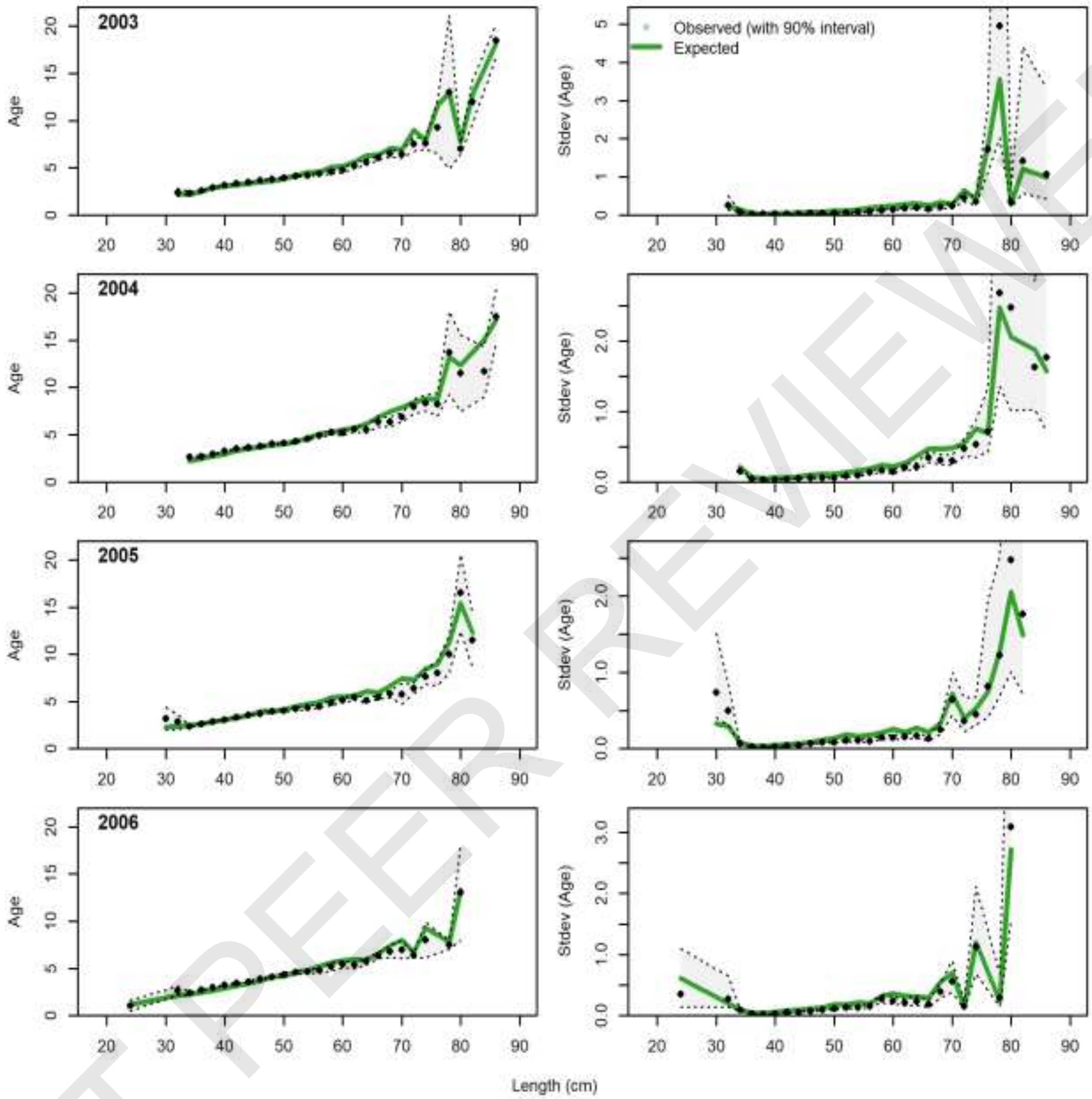


Figure 146 Continued. Conditional AAL plot, retained, Recreational Charter Central (plot 4 of 9)

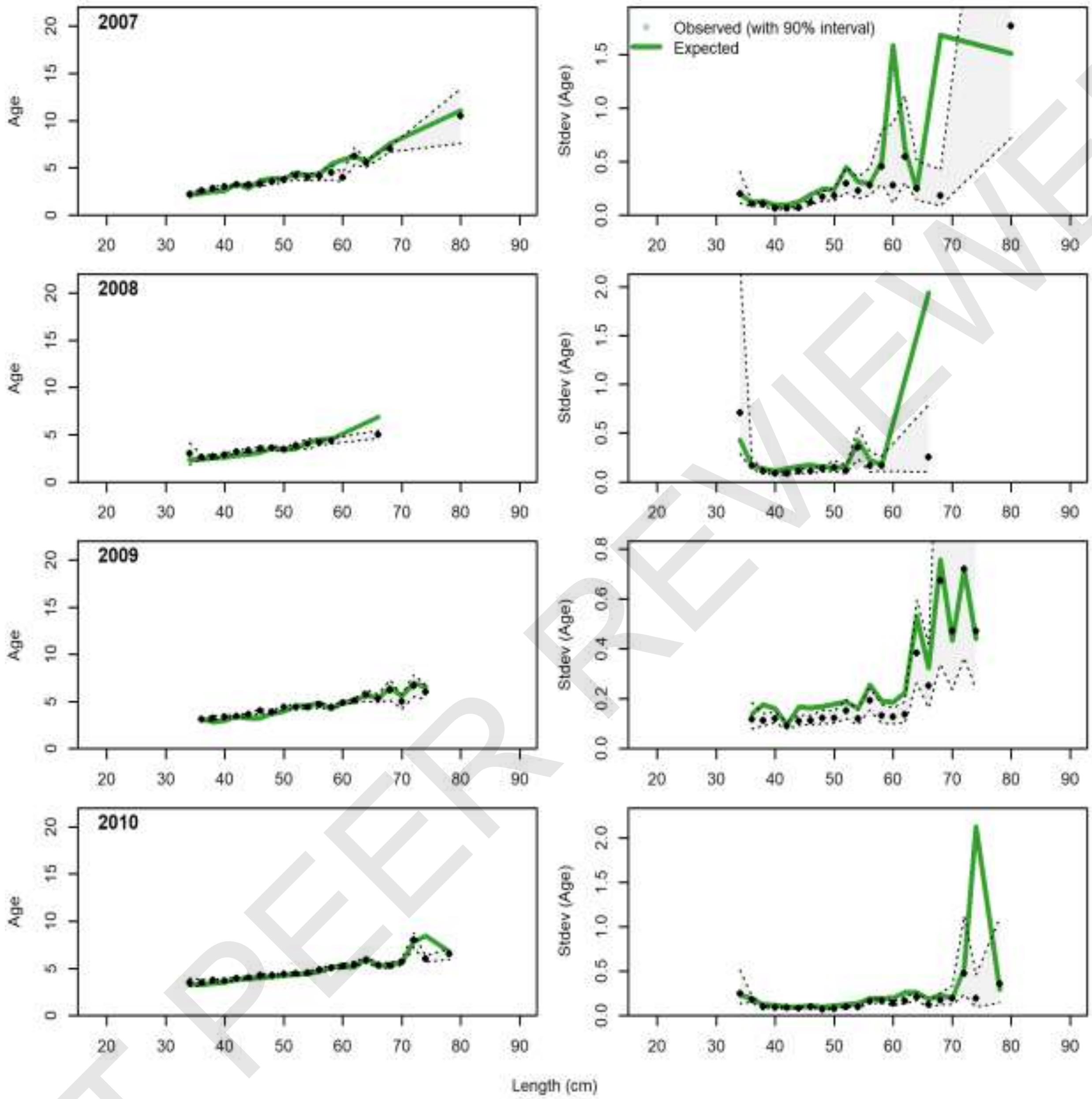


Figure 146 Continued. Conditional AAL plot, retained, Recreational Charter Central (plot 5 of 9)

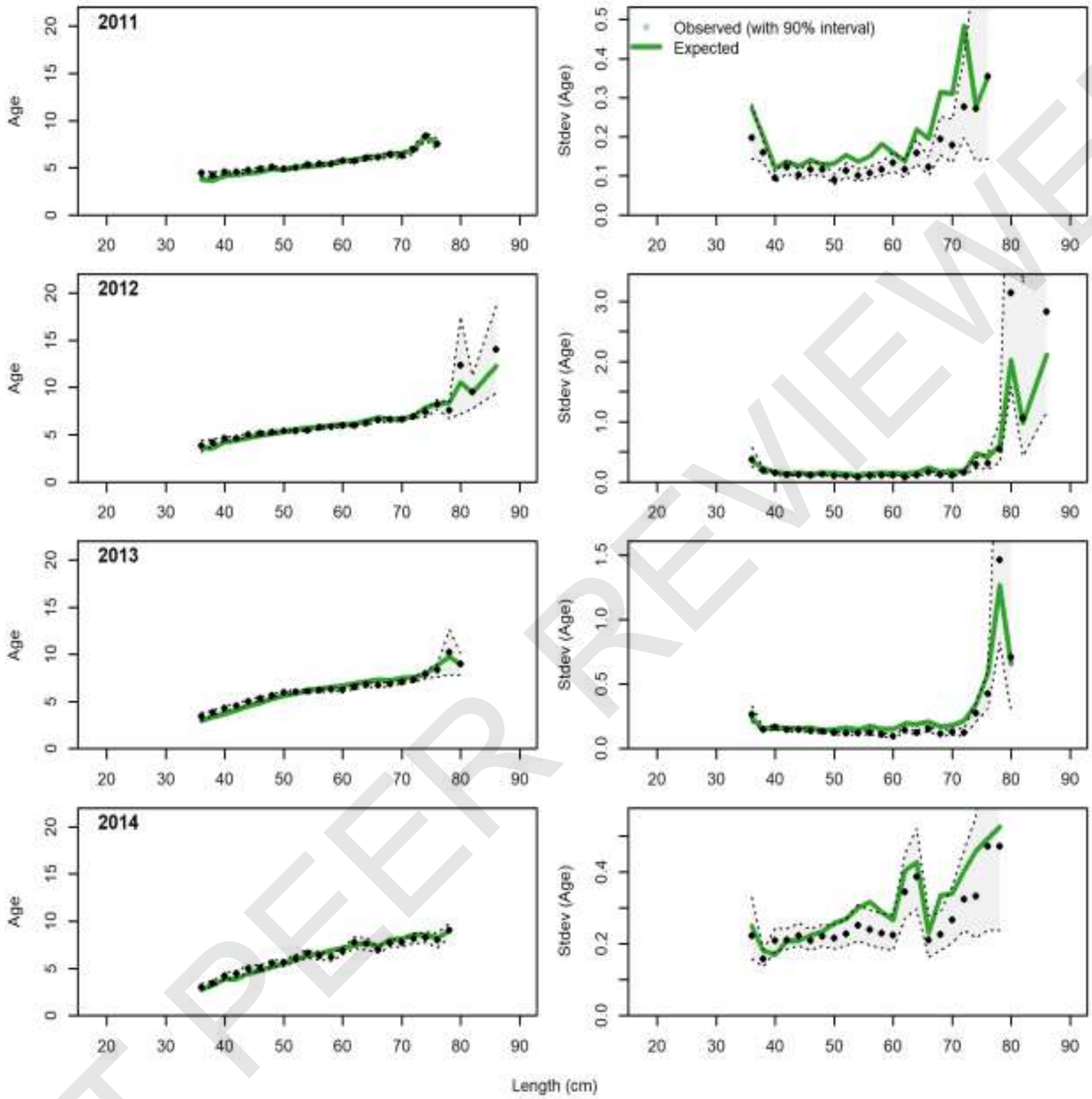


Figure 146 Continued. Conditional AAL plot, retained, Recreational Charter Central (plot 6 of 9)

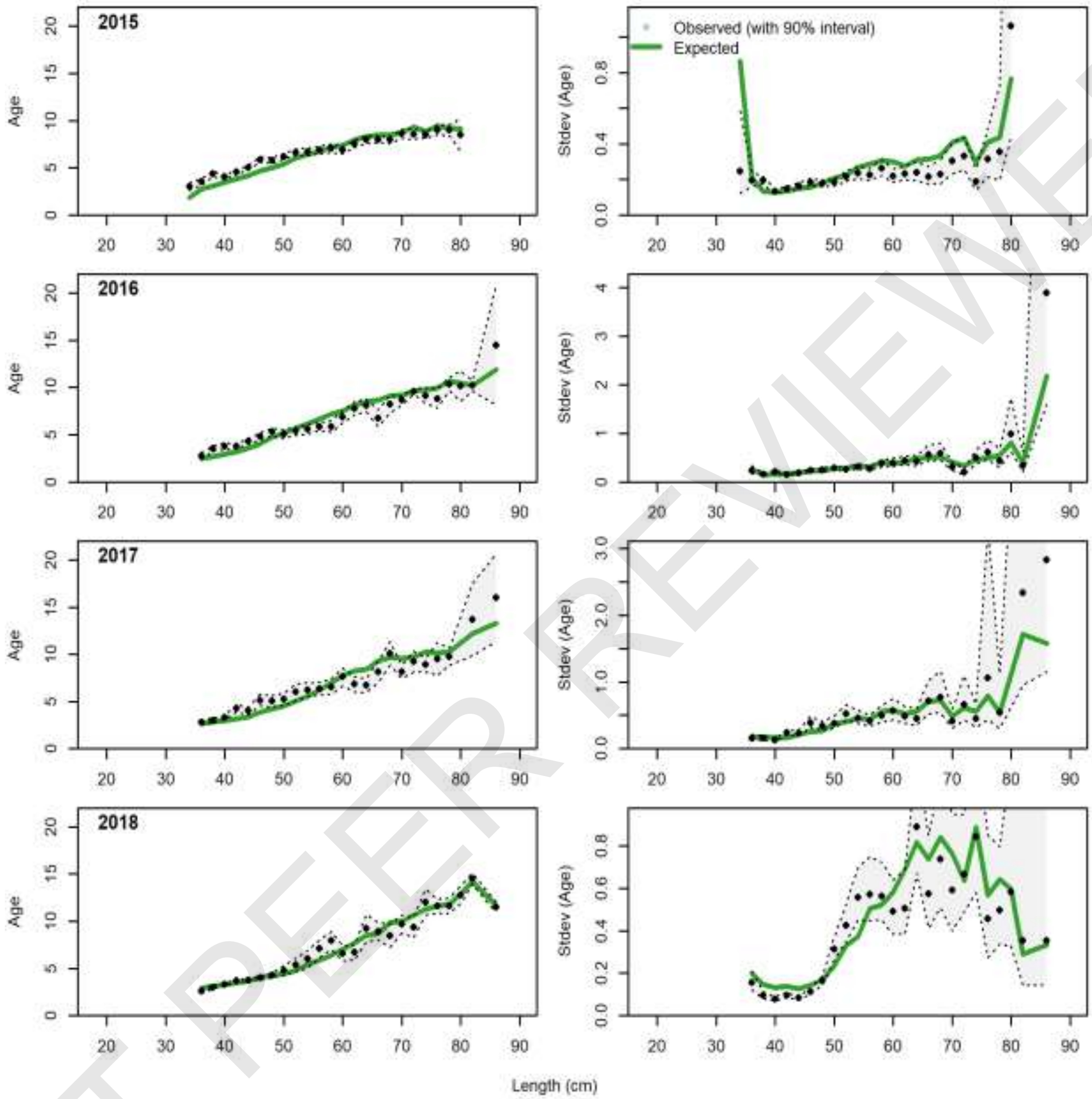


Figure 146 Continued. Conditional AAL plot, retained, Recreational Charter Central (plot 7 of 9)

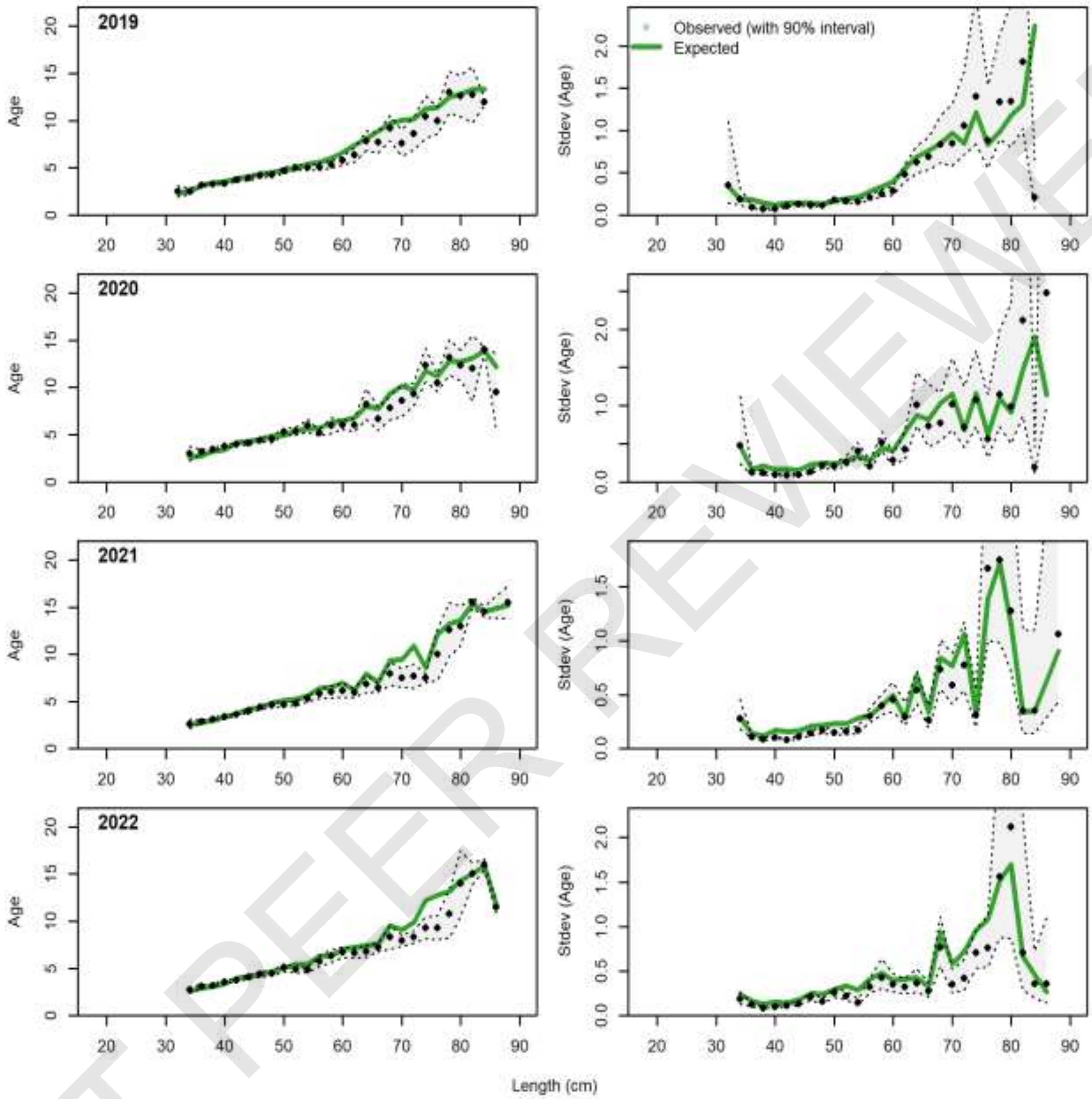


Figure 146 Continued. Conditional AAL plot, retained, Recreational Charter Central (plot 8 of 9)

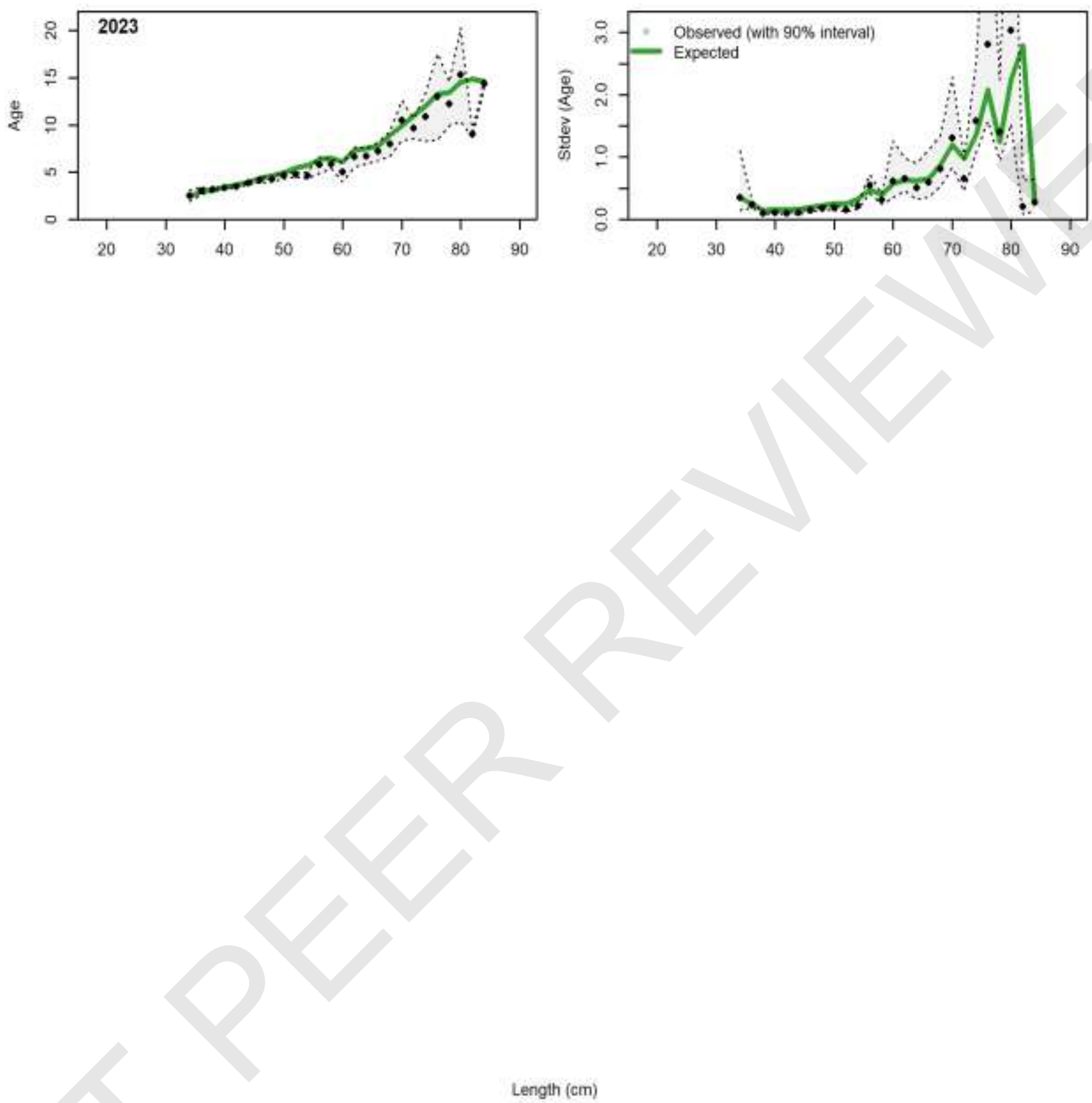


Figure 146 Continued. Conditional AAL plot, retained, Recreational Charter Central (plot 9 of 9)

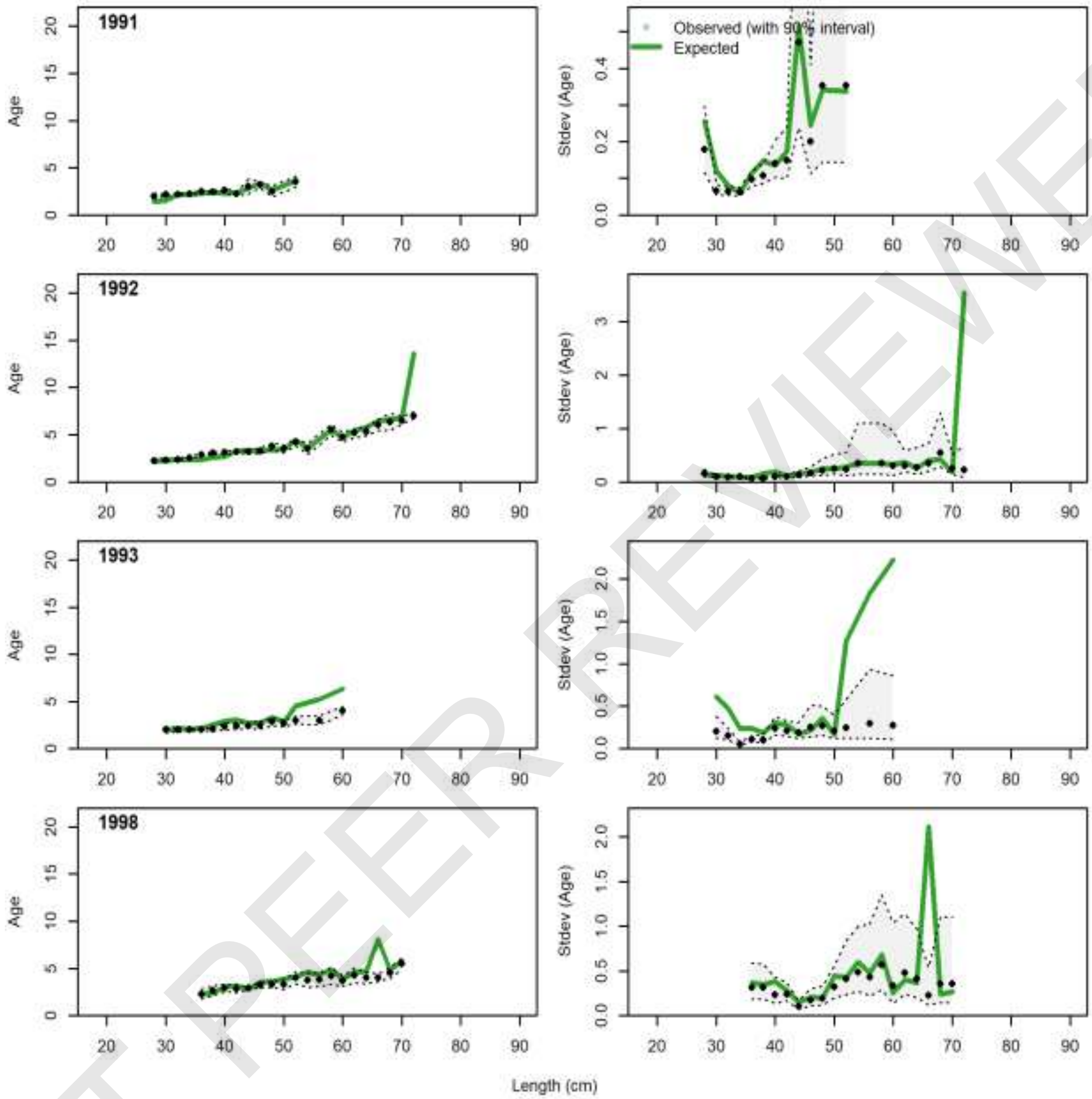


Figure 147. Conditional AAL plot, retained, Recreational Charter West (plot 1 of 7) These plots show mean age and std. dev. in conditional A@L.Left plots are mean A@L by size-class (obs. and exp.) with 90% CIs based on adding 1.64 SE of mean to the data.Right plots in each pair are SE of mean A@L (obs. and exp.) with 90% CIs based on the chi-square distribution.

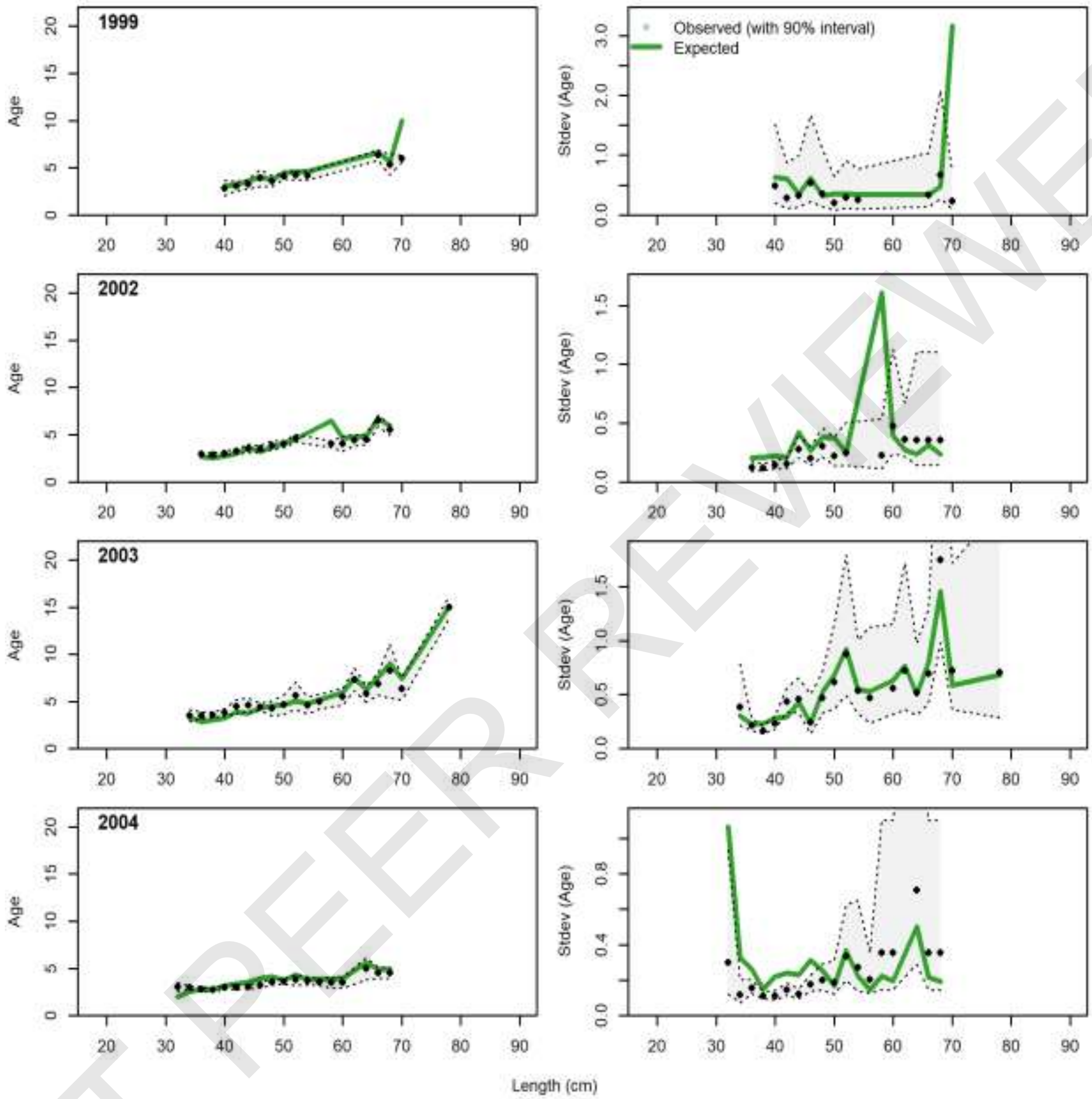


Figure 147 Continued. Conditional AAL plot, retained, Recreational Charter West (plot 2 of 7)

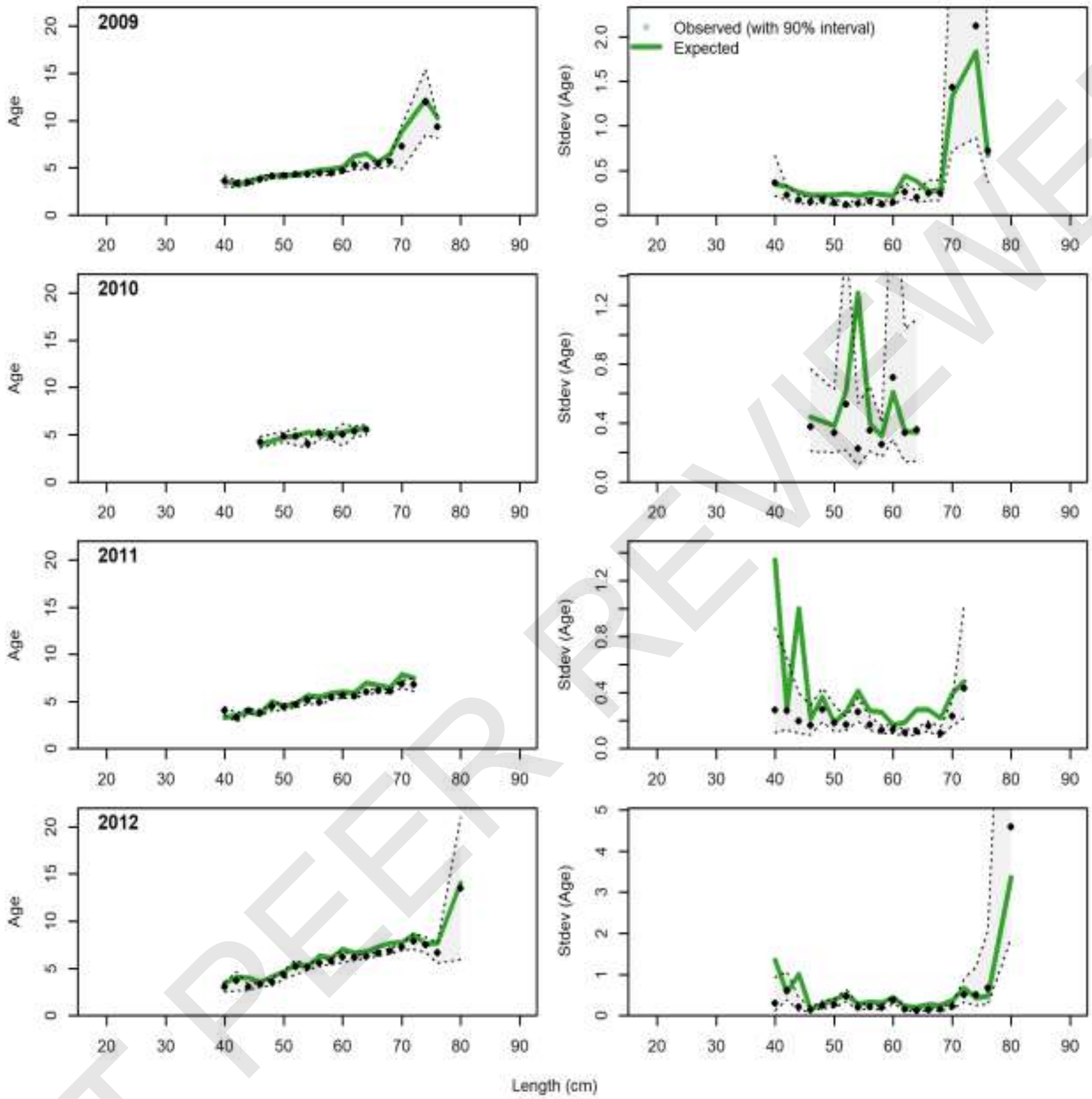


Figure 147 Continued. Conditional AAL plot, retained, Recreational Charter West (plot 4 of 7)

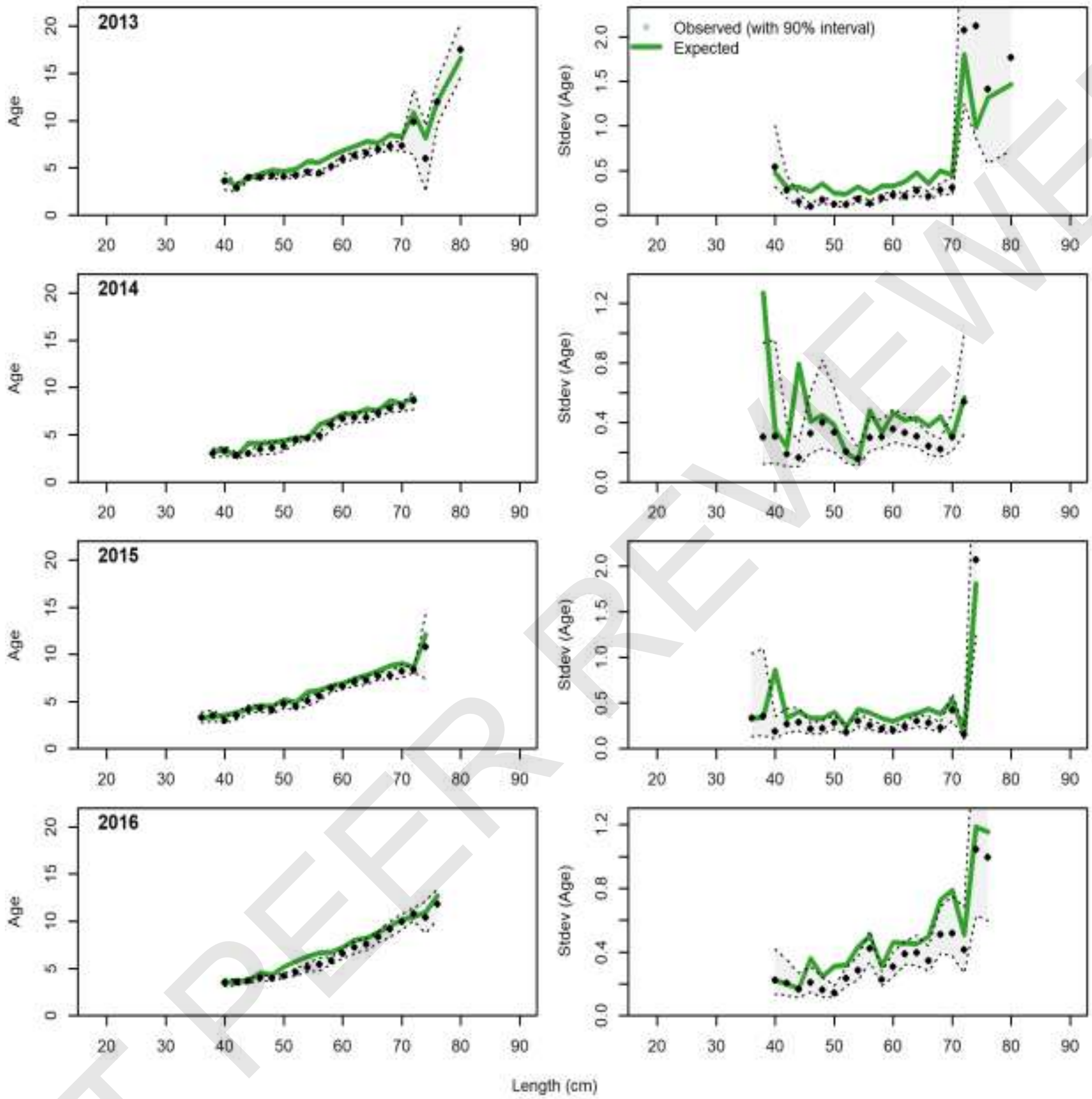


Figure 147 Continued. Conditional AAL plot, retained, Recreational Charter West (plot 5 of 7)

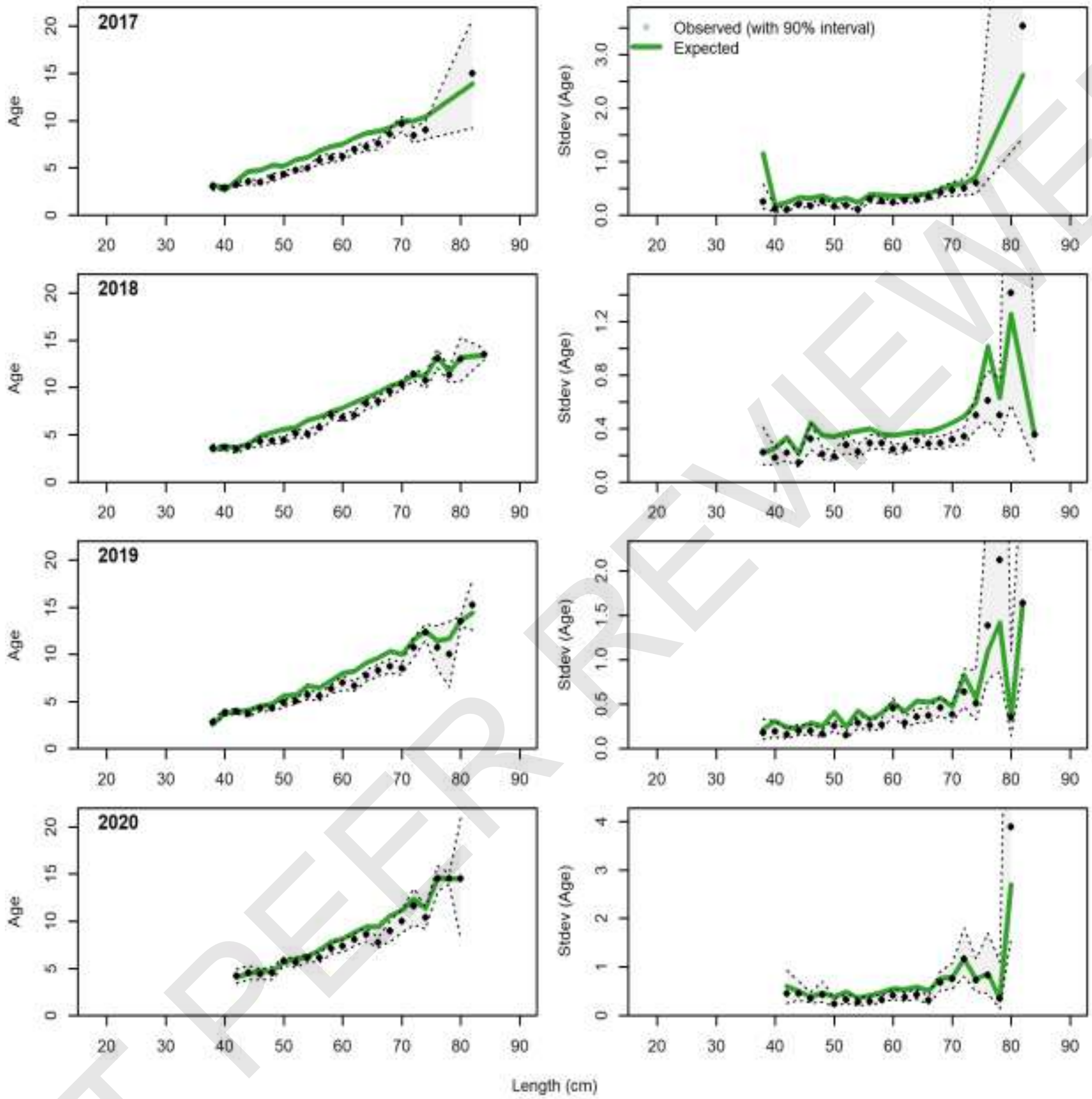


Figure 147 Continued. Conditional AAL plot, retained, Recreational Charter West (plot 6 of 7)

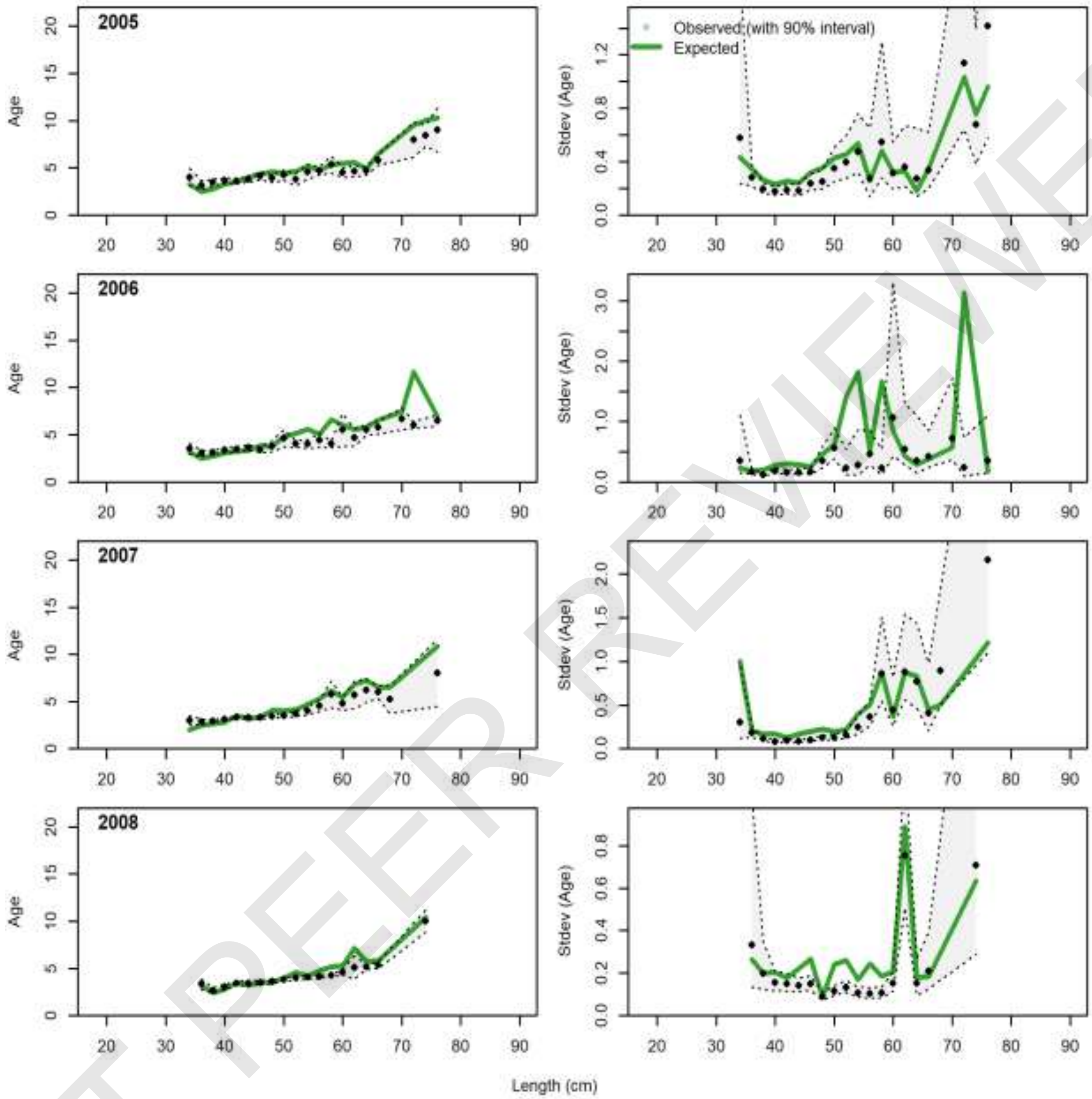


Figure 148. Conditional AAL plot, retained, Recreational Charter West (plot 3 of 7)

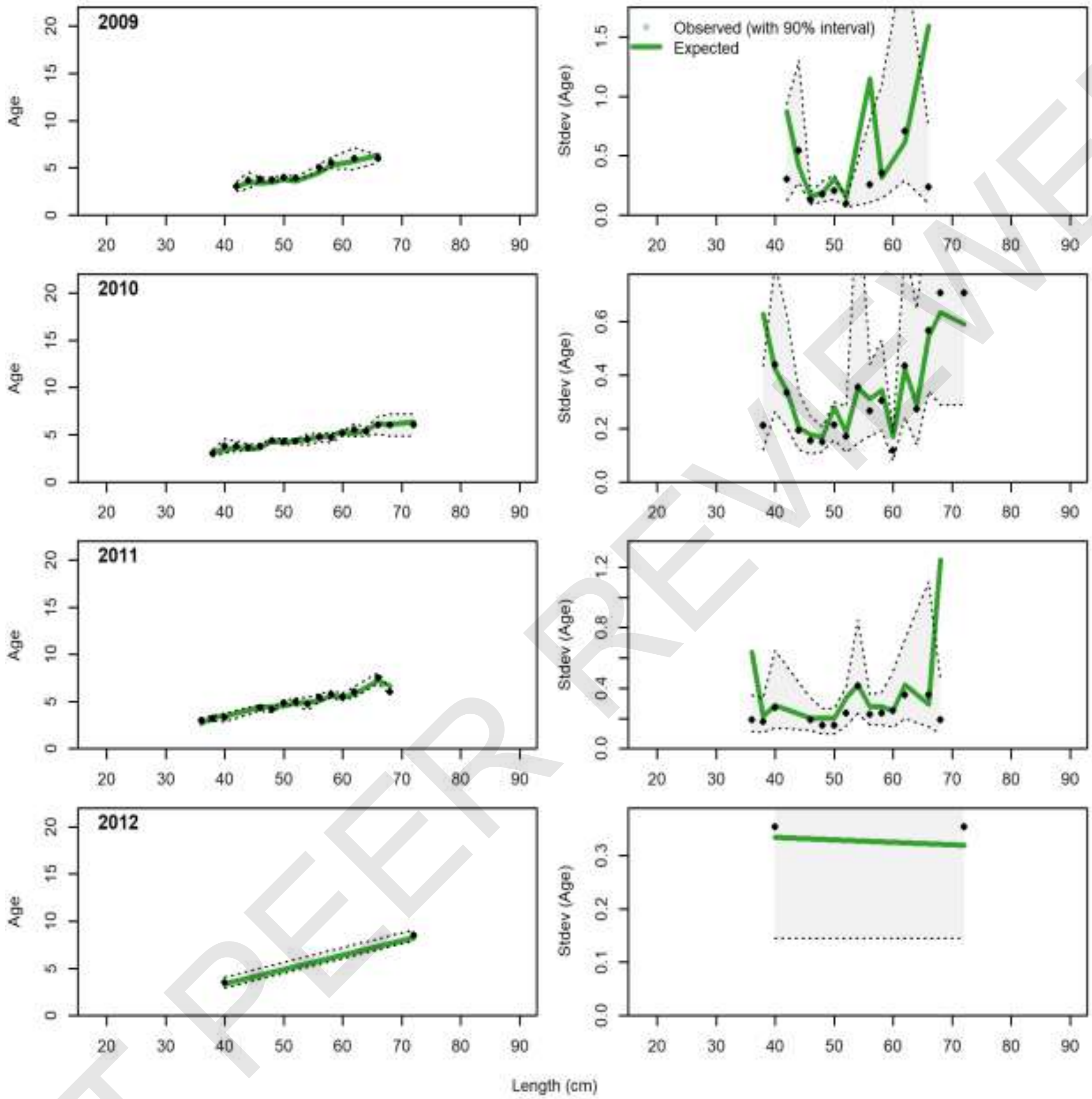


Figure 149. Conditional AAL plot, retained, Recreational Charter East (plot 1 of 4) These plots show mean age and std. dev. in conditional A@L.Left plots are mean A@L by size-class (obs. and exp.) with 90% CIs based on adding 1.64 SE of mean to the data.Right plots in each pair are SE of mean A@L (obs. and exp.) with 90% CIs based on the chi-square distribution.

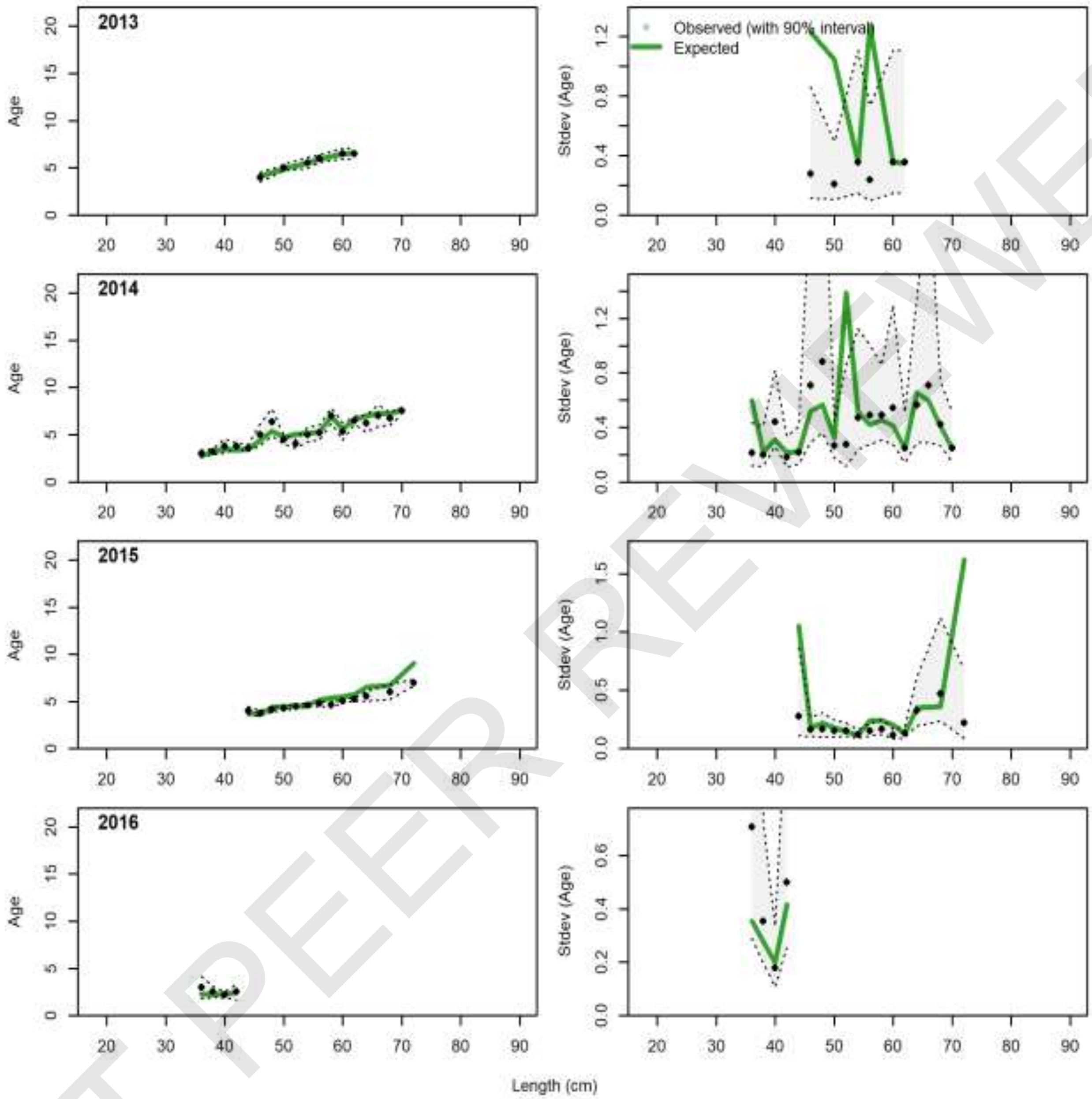


Figure 149 Continued. Conditional AAL plot, retained, Recreational Charter East (plot 2 of 4)

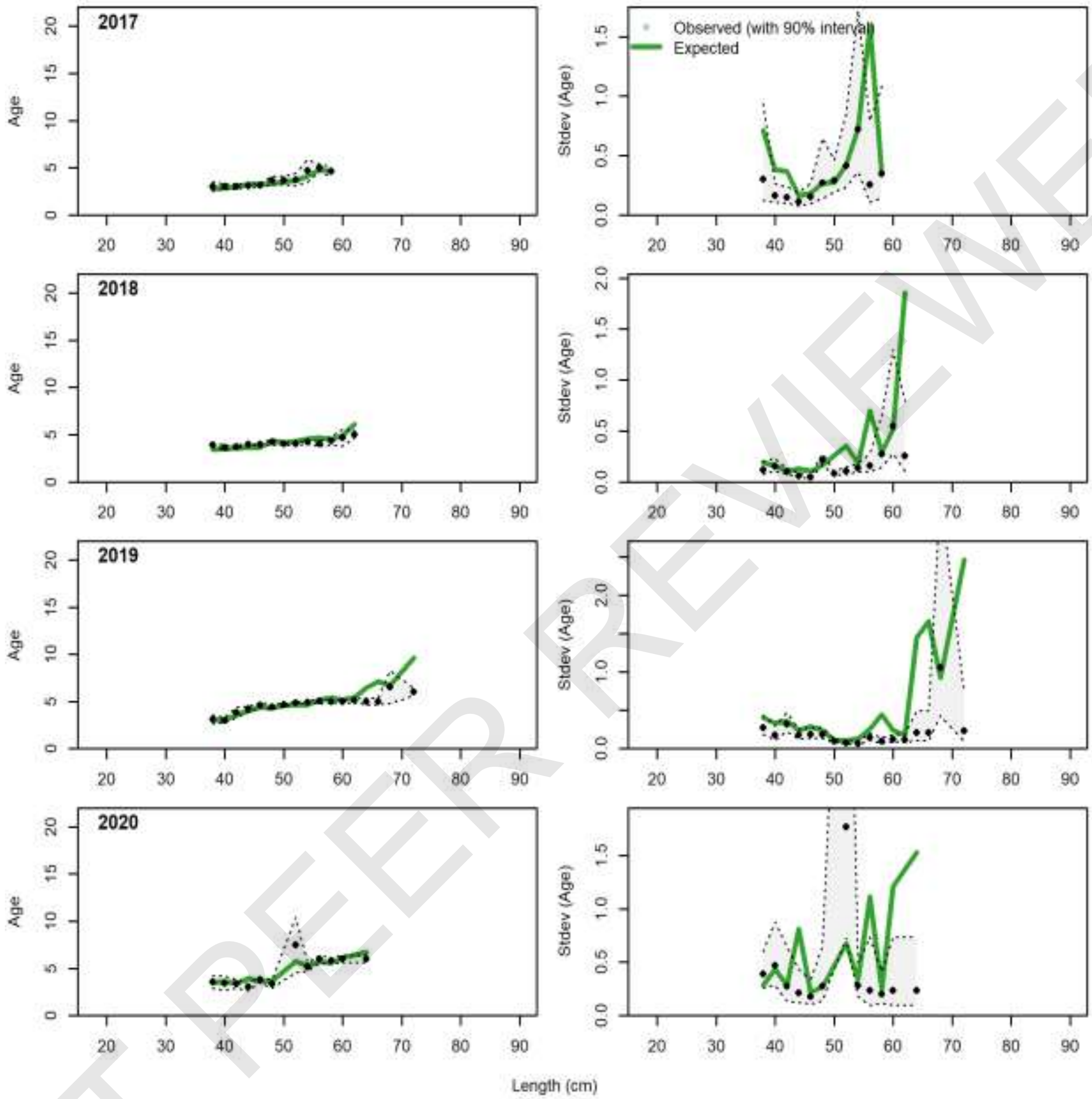


Figure 149 Continued. Conditional AAL plot, retained, Recreational Charter East (plot 3 of 4)

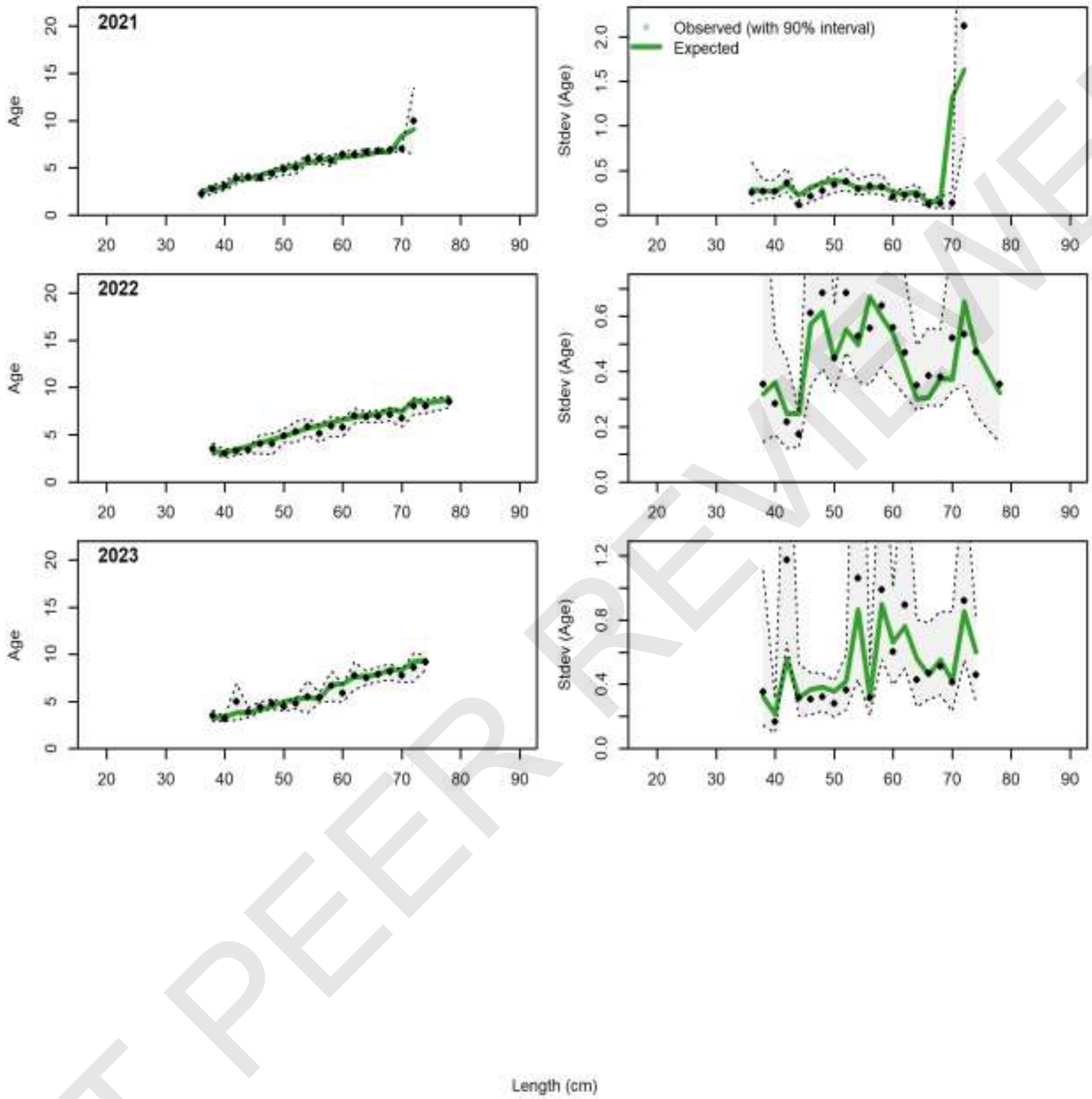


Figure 149 Continued. Conditional AAL plot, retained, Recreational Charter East (plot 4 of 4)

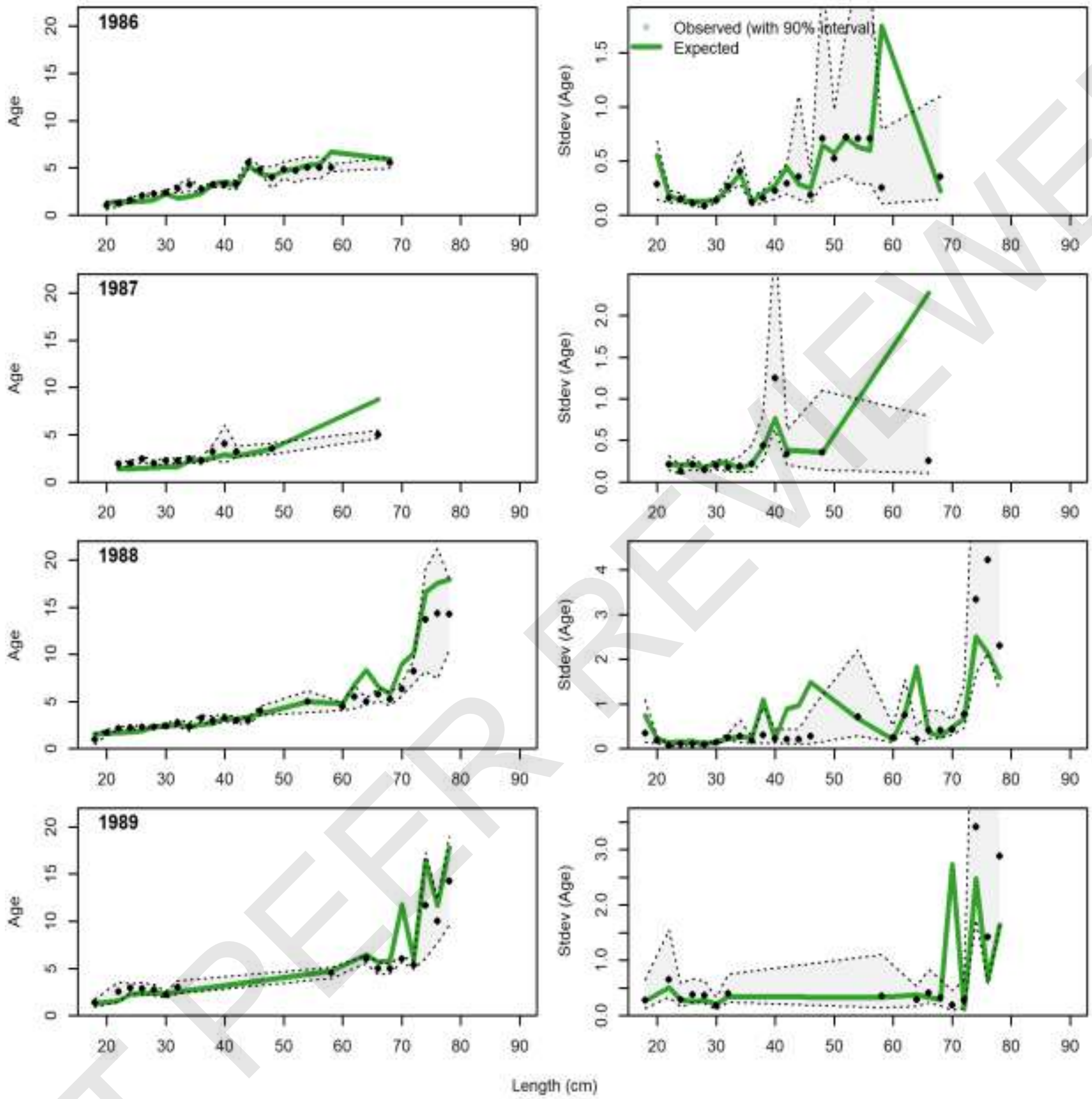


Figure 150. Conditional AAL plot, retained, Recreational Headboat West (plot 1 of 9) These plots show mean age and std. dev. in conditional A@L.Left plots are mean A@L by size-class (obs. and exp.) with 90% CIs based on adding 1.64 SE of mean to the data.Right plots in each pair are SE of mean A@L (obs. and exp.) with 90% CIs based on the chi-square distribution.

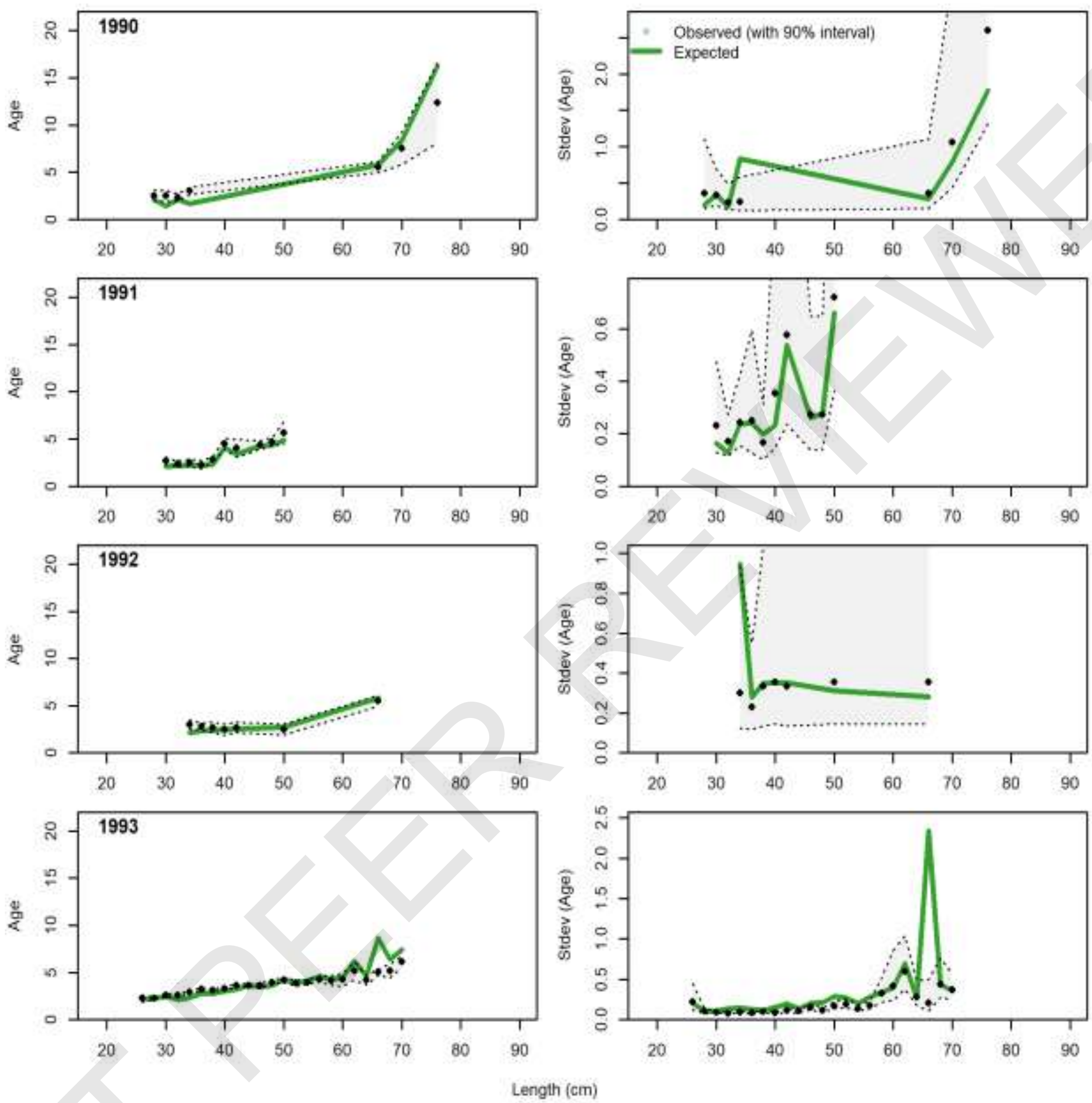


Figure 150 Continued. Conditional AAL plot, retained, Recreational Headboat West (plot 2 of 9)

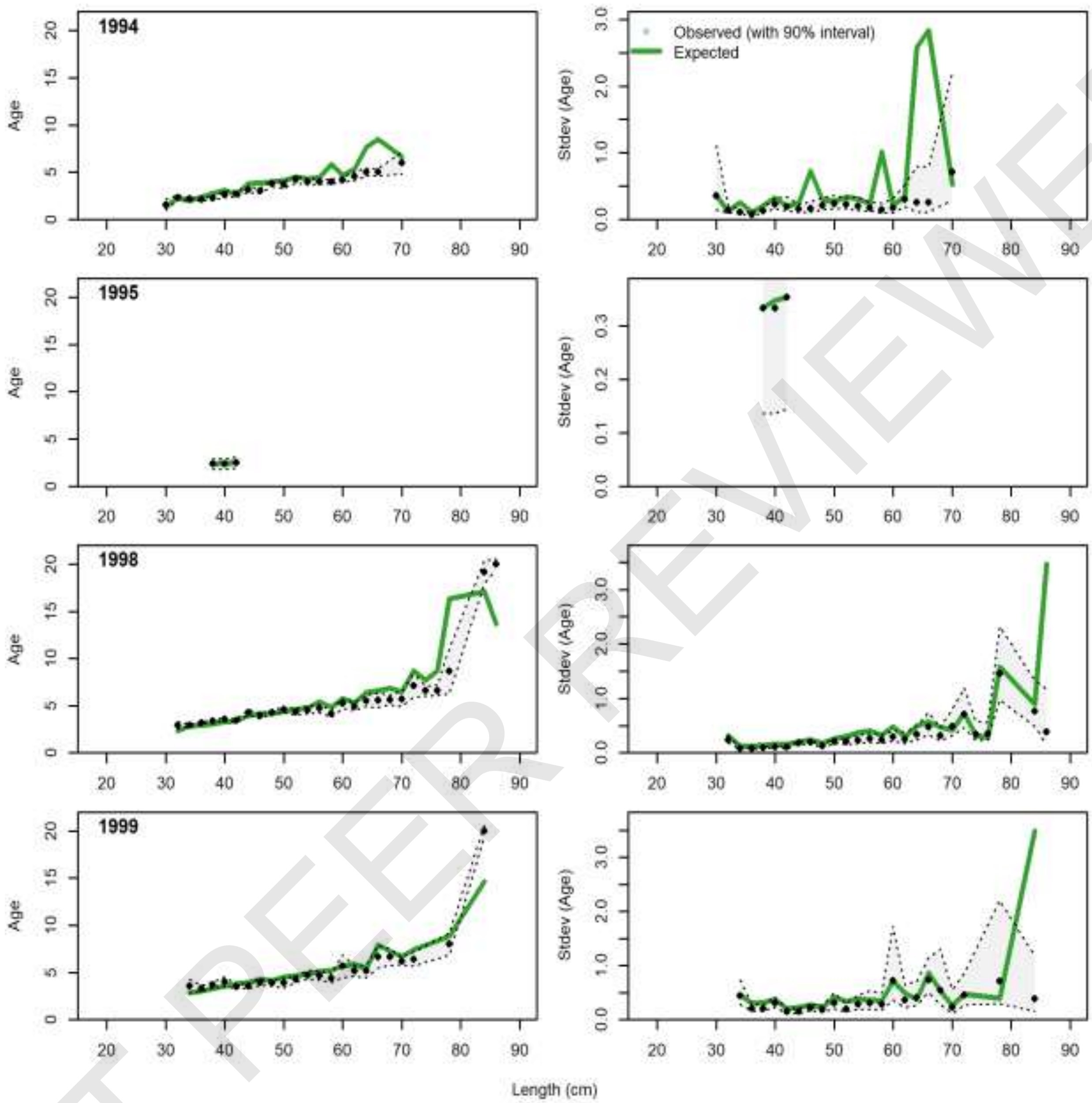


Figure 150 Continued. Conditional AAL plot, retained, Recreational Headboat West (plot 3 of 9)

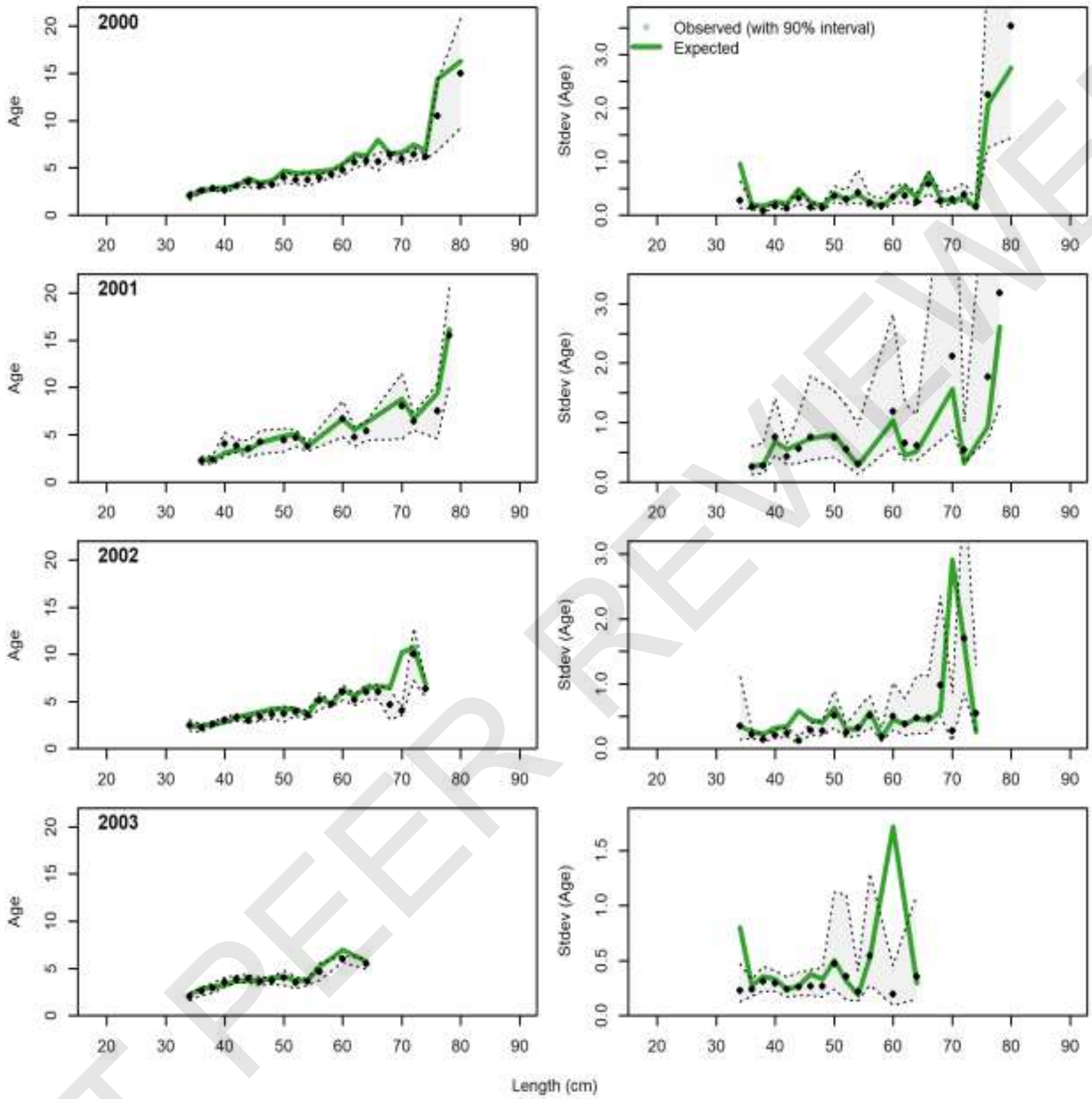


Figure 150 Continued. Conditional AAL plot, retained, Recreational Headboat West (plot 4 of 9)

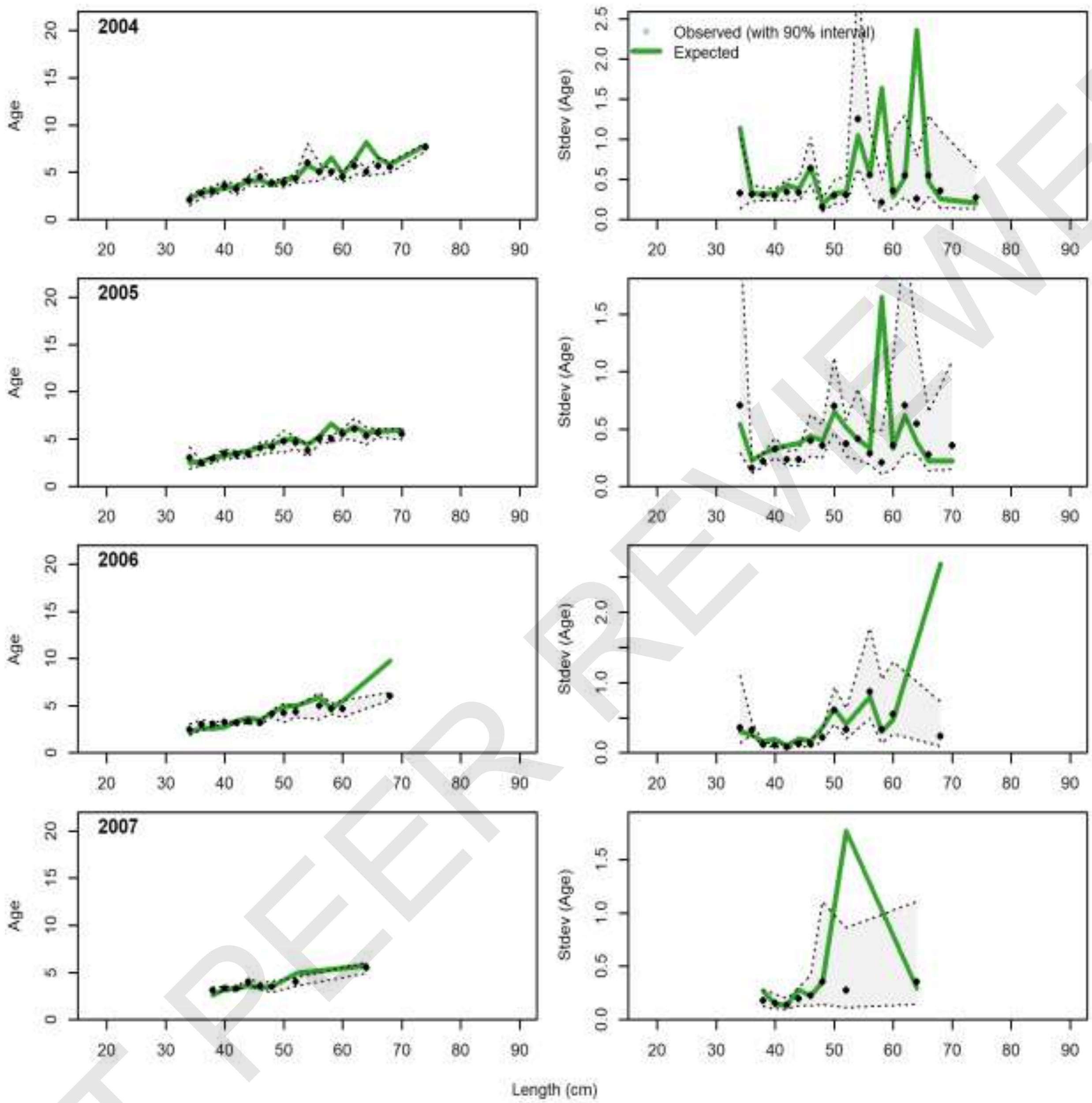


Figure 150 Continued. Conditional AAL plot, retained, Recreational Headboat West (plot 5 of 9)

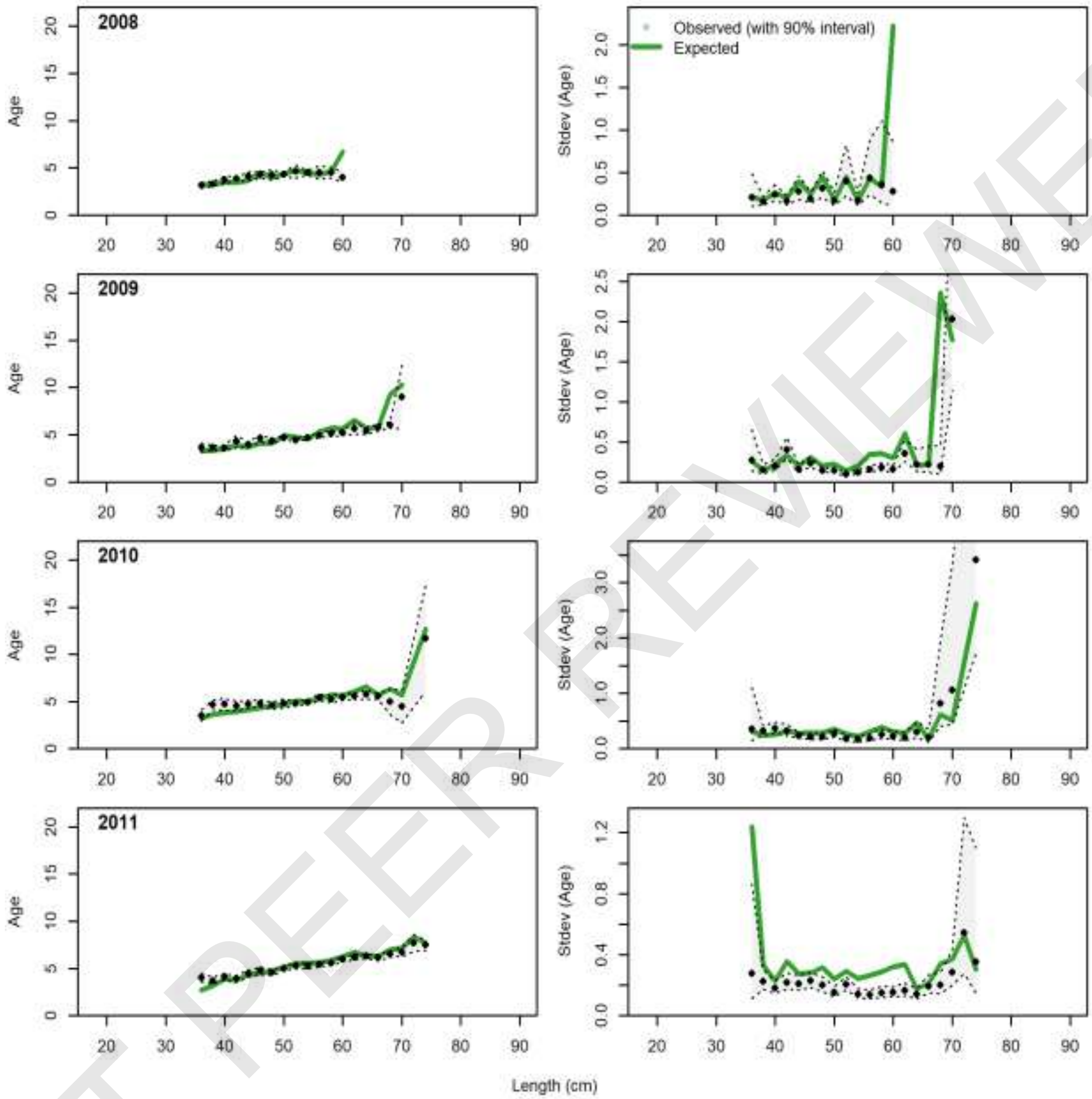


Figure 150 Continued. Conditional AAL plot, retained, Recreational Headboat West (plot 6 of 9)

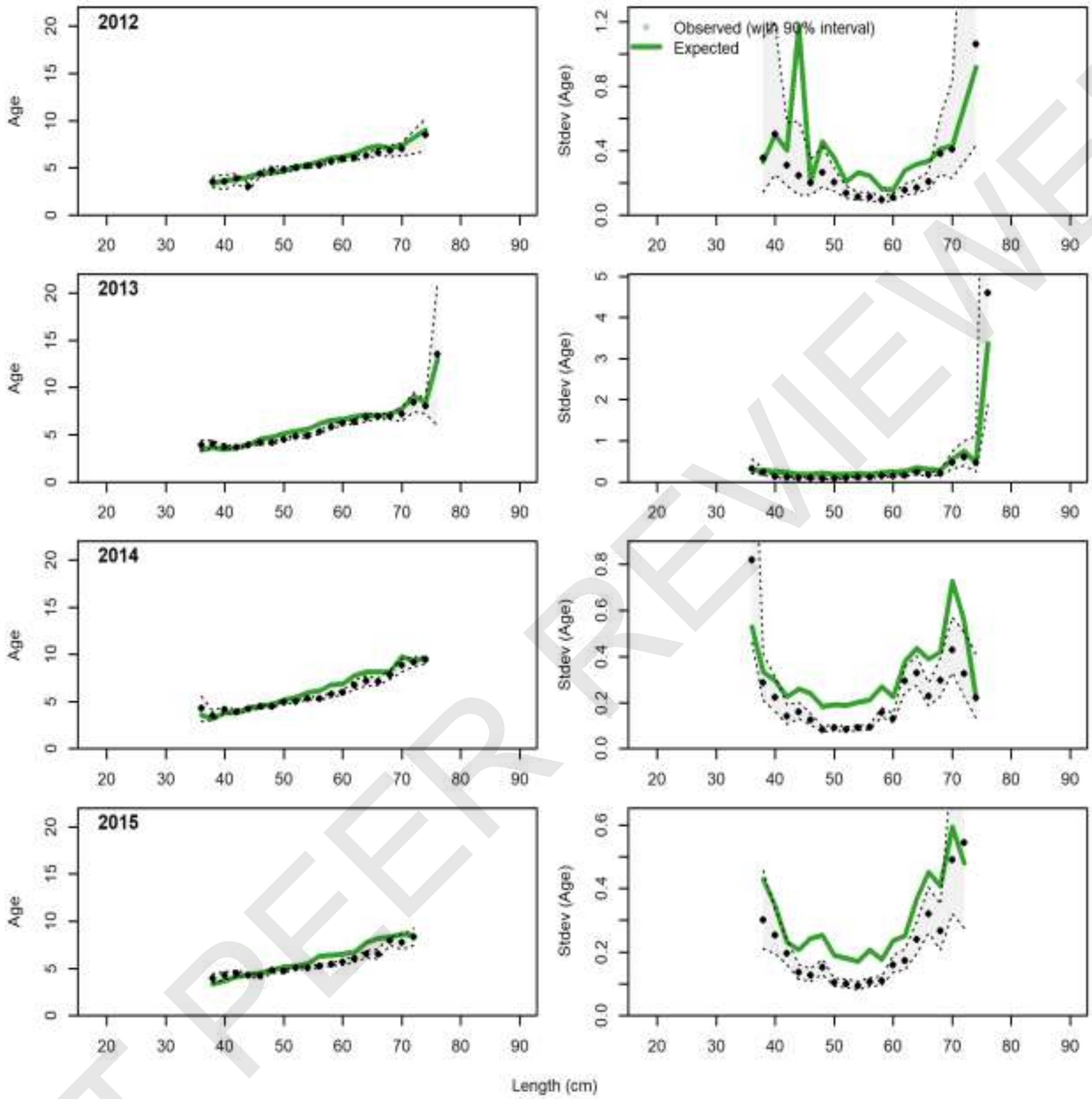


Figure 150 Continued. Conditional AAL plot, retained, Recreational Headboat West (plot 7 of 9)

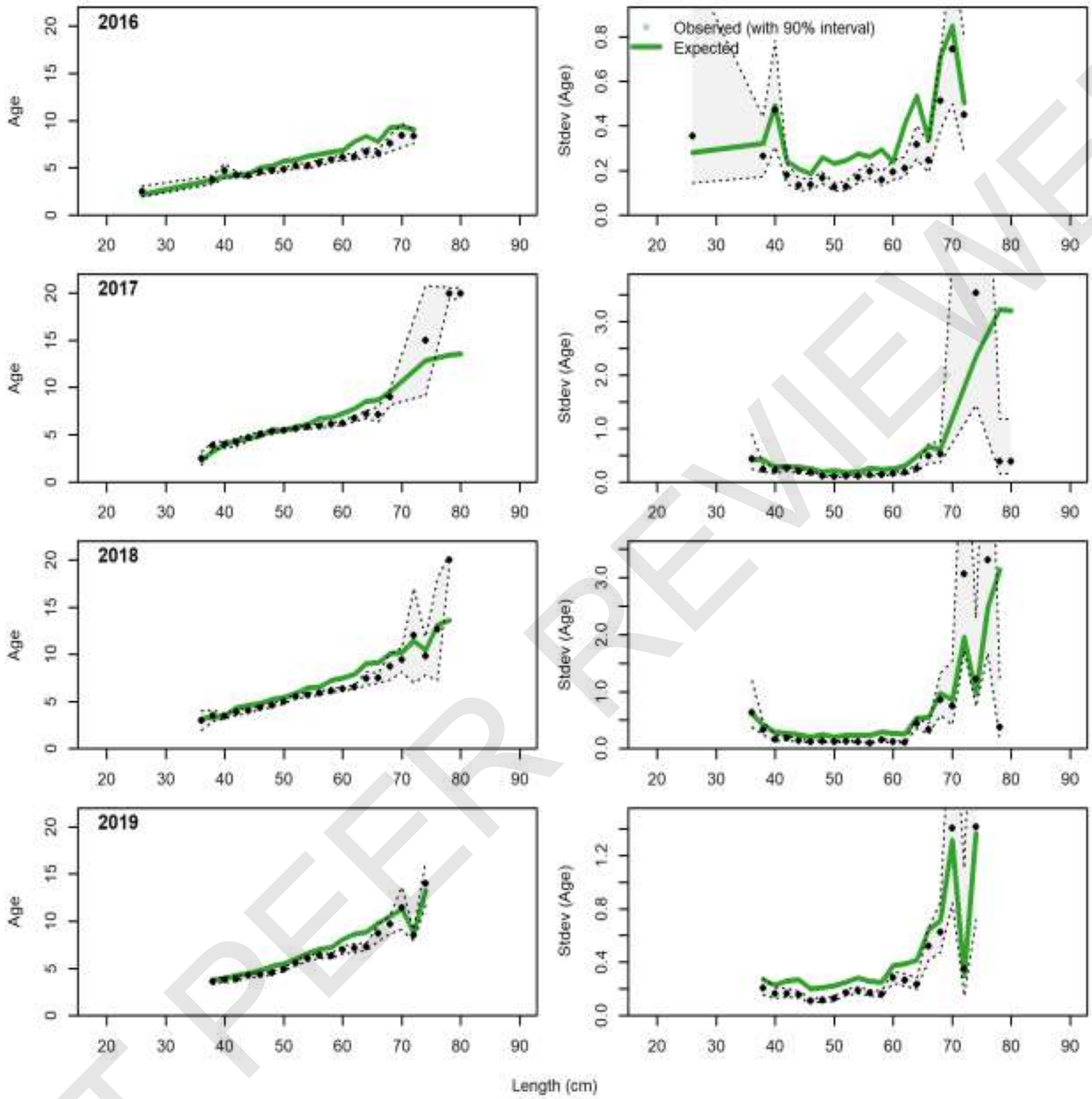


Figure 150 Continued. Conditional AAL plot, retained, Recreational Headboat West (plot 8 of 9)

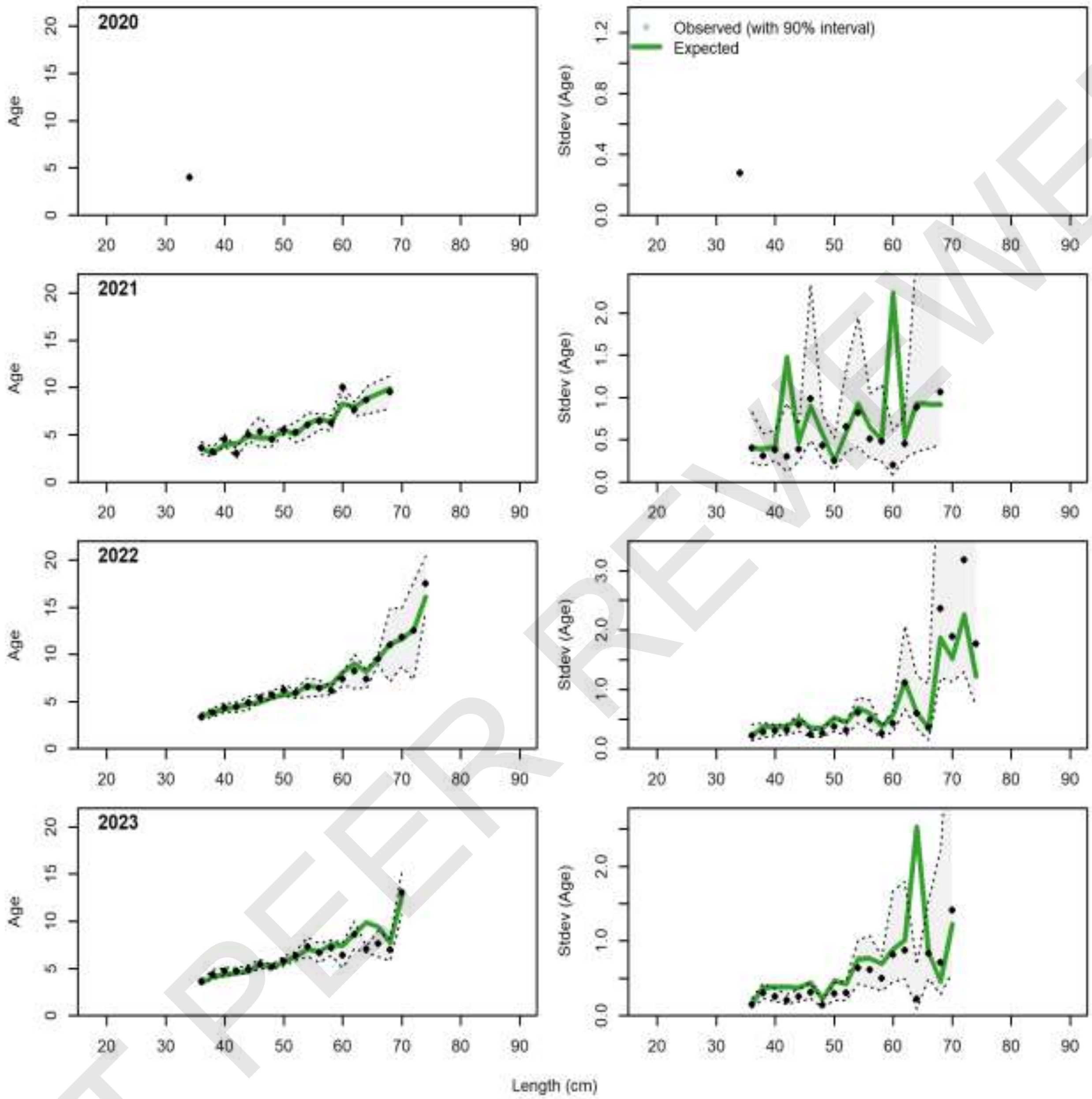


Figure 150 Continued. Conditional AAL plot, retained, Recreational Headboat West (plot 9 of 9)

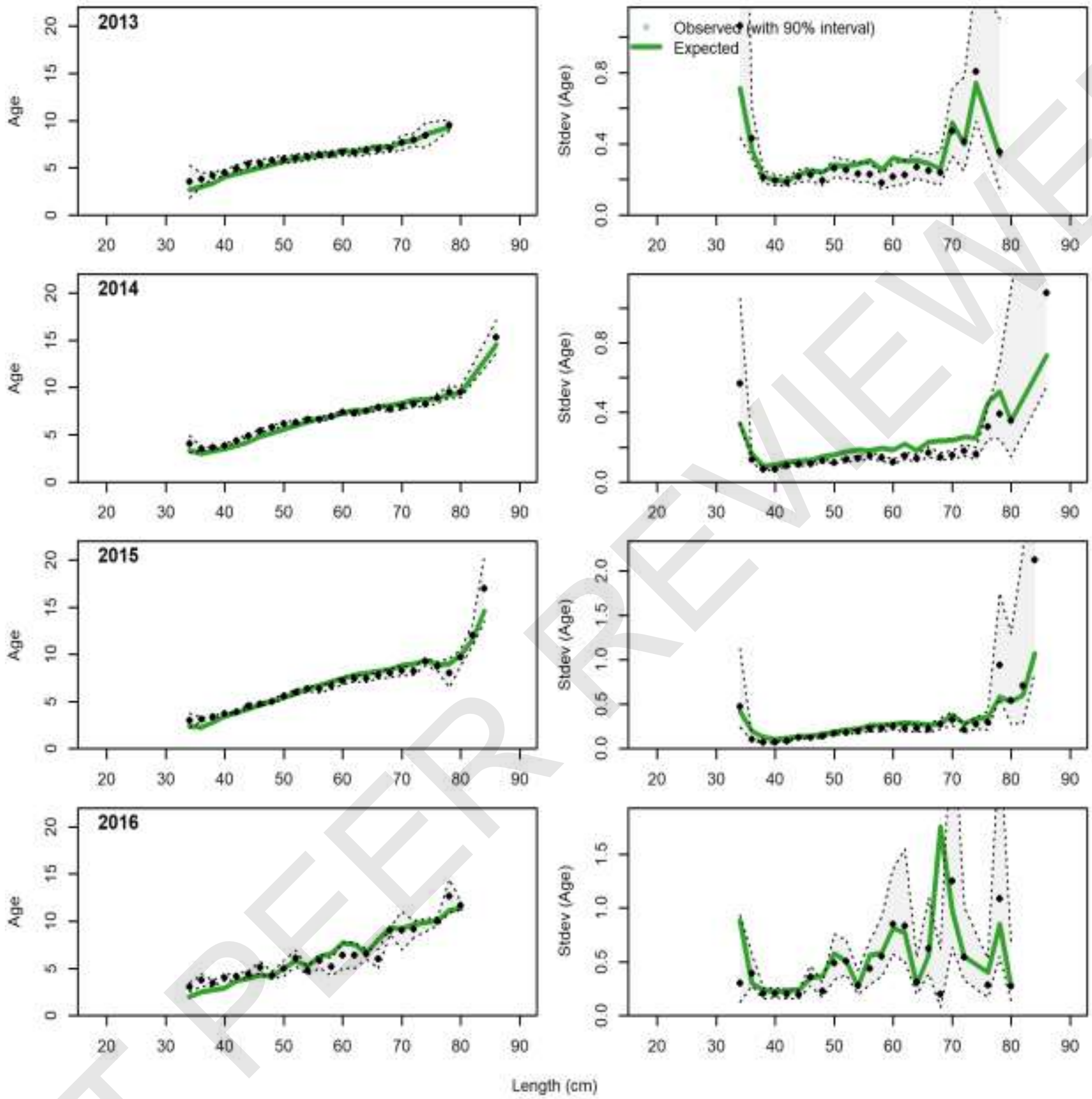


Figure 151. Conditional AAL plot, retained, Recreational Headboat Central (plot 1 of 3) These plots show mean age and std. dev. in conditional A@L.Left plots are mean A@L by size-class (obs. and exp.) with 90% CIs based on adding 1.64 SE of mean to the data.Right plots in each pair are SE of mean A@L (obs. and exp.) with 90% CIs based on the chi-square distribution.

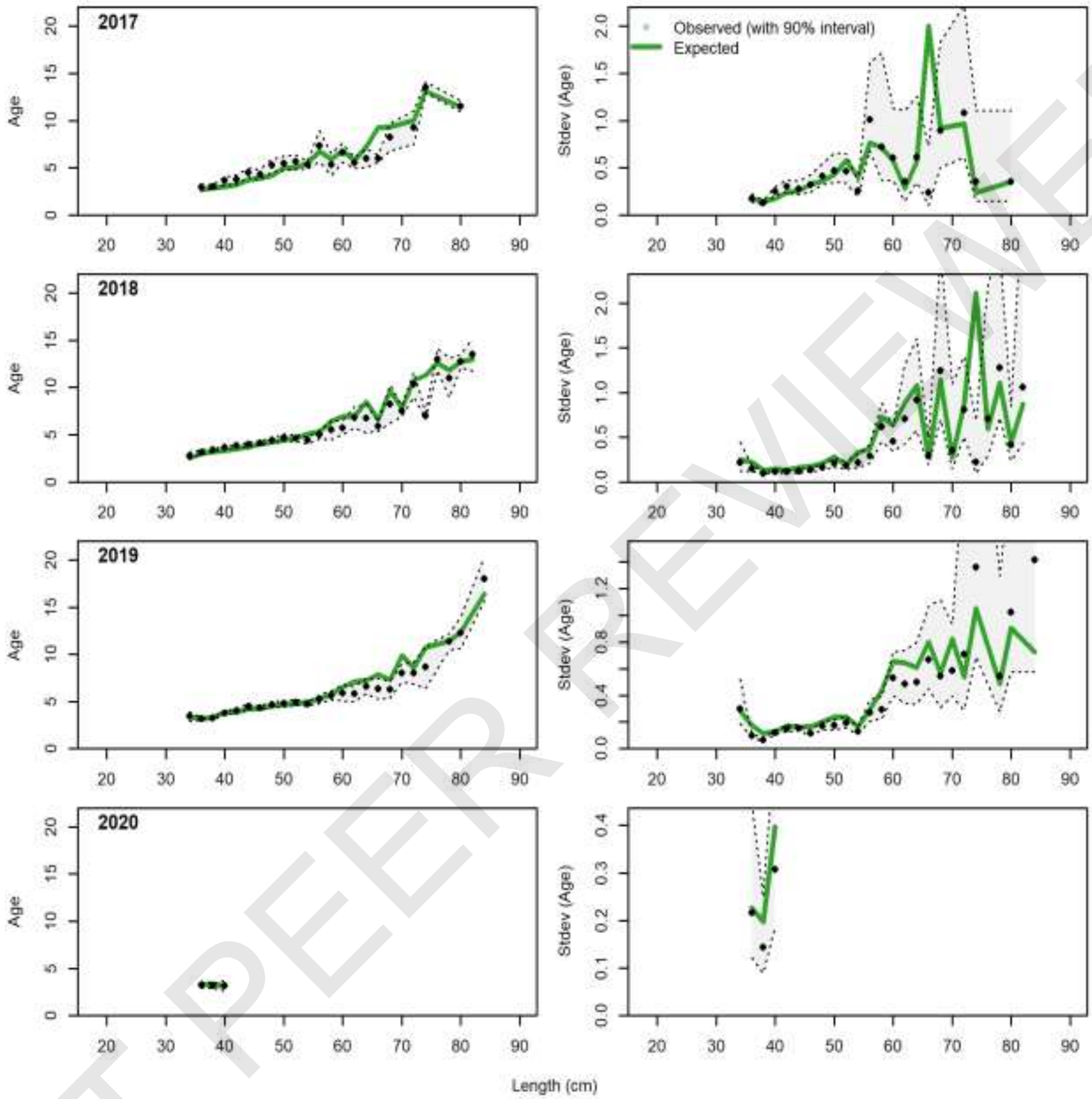


Figure 151 Continued. Conditional AAL plot, retained, Recreational Headboat Central (plot 2 of 3)

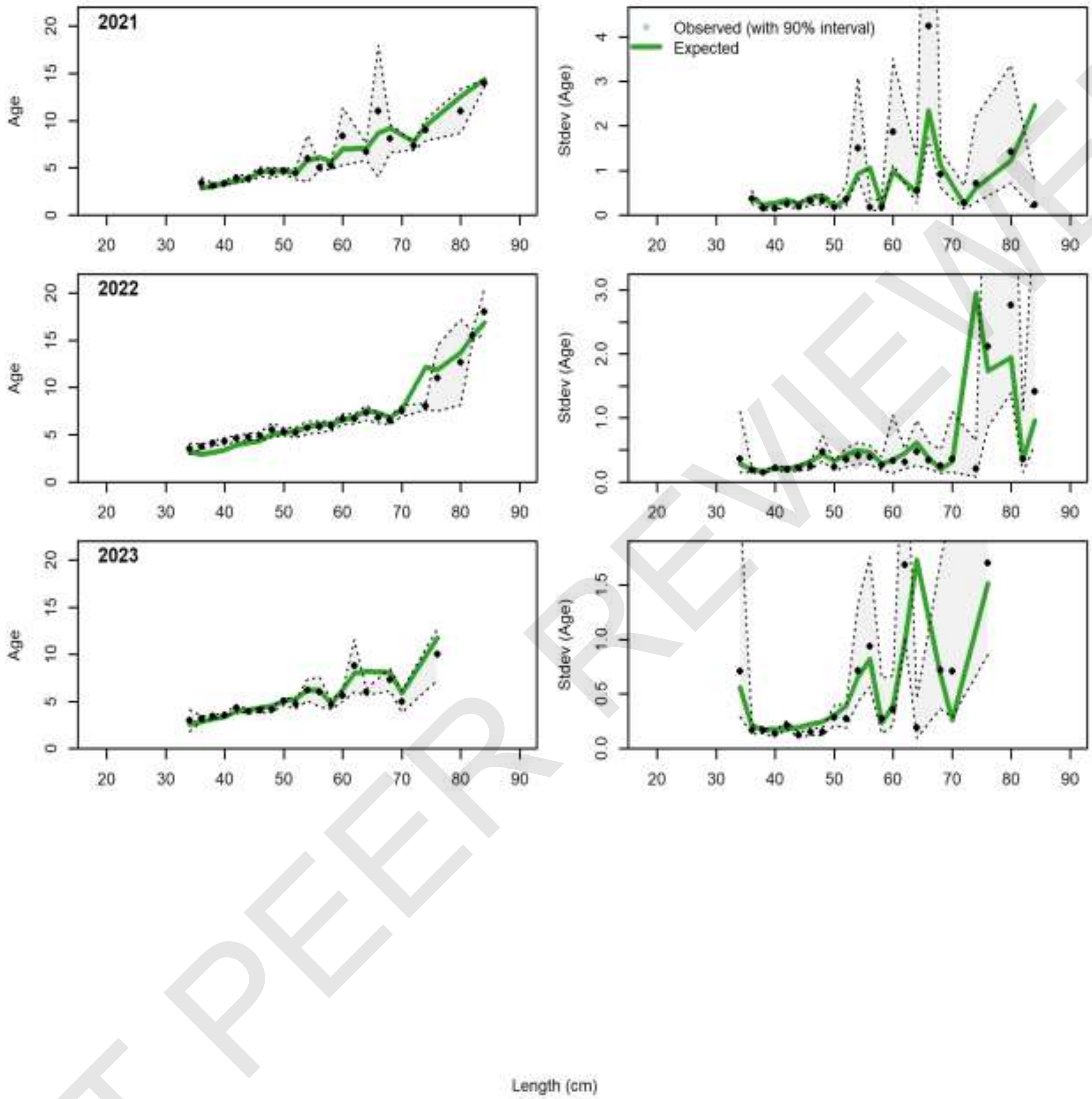


Figure 151 Continued. Conditional AAL plot, retained, Recreational Headboat Central (plot 3 of 3)

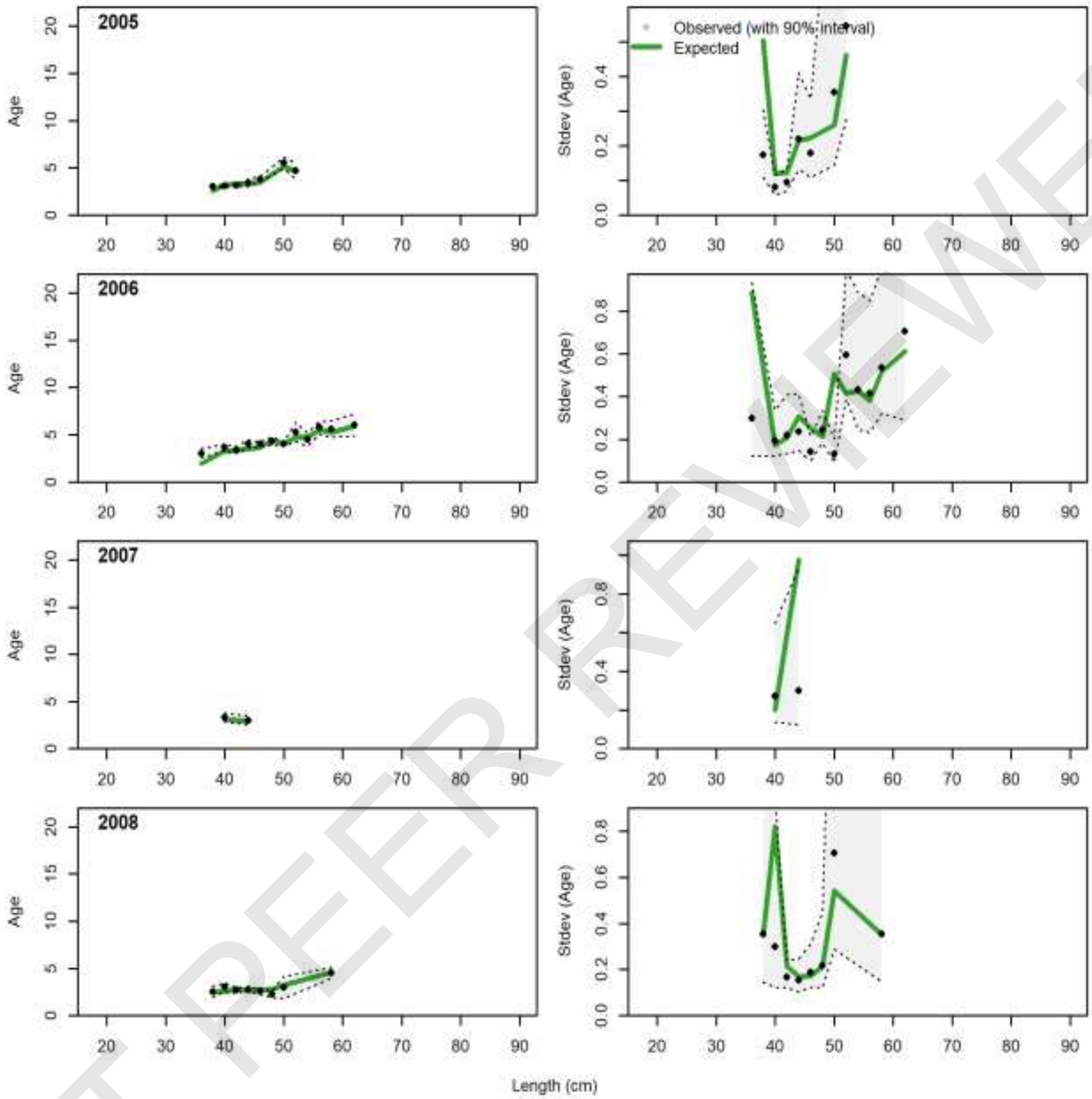


Figure 152. Conditional AAL plot, retained, Recreational Headboat East (plot 1 of 5) These plots show mean age and std. dev. in conditional A@L.Left plots are mean A@L by size-class (obs. and exp.) with 90% CIs based on adding 1.64 SE of mean to the data.Right plots in each pair are SE of mean A@L (obs. and exp.) with 90% CIs based on the chi-square distribution.

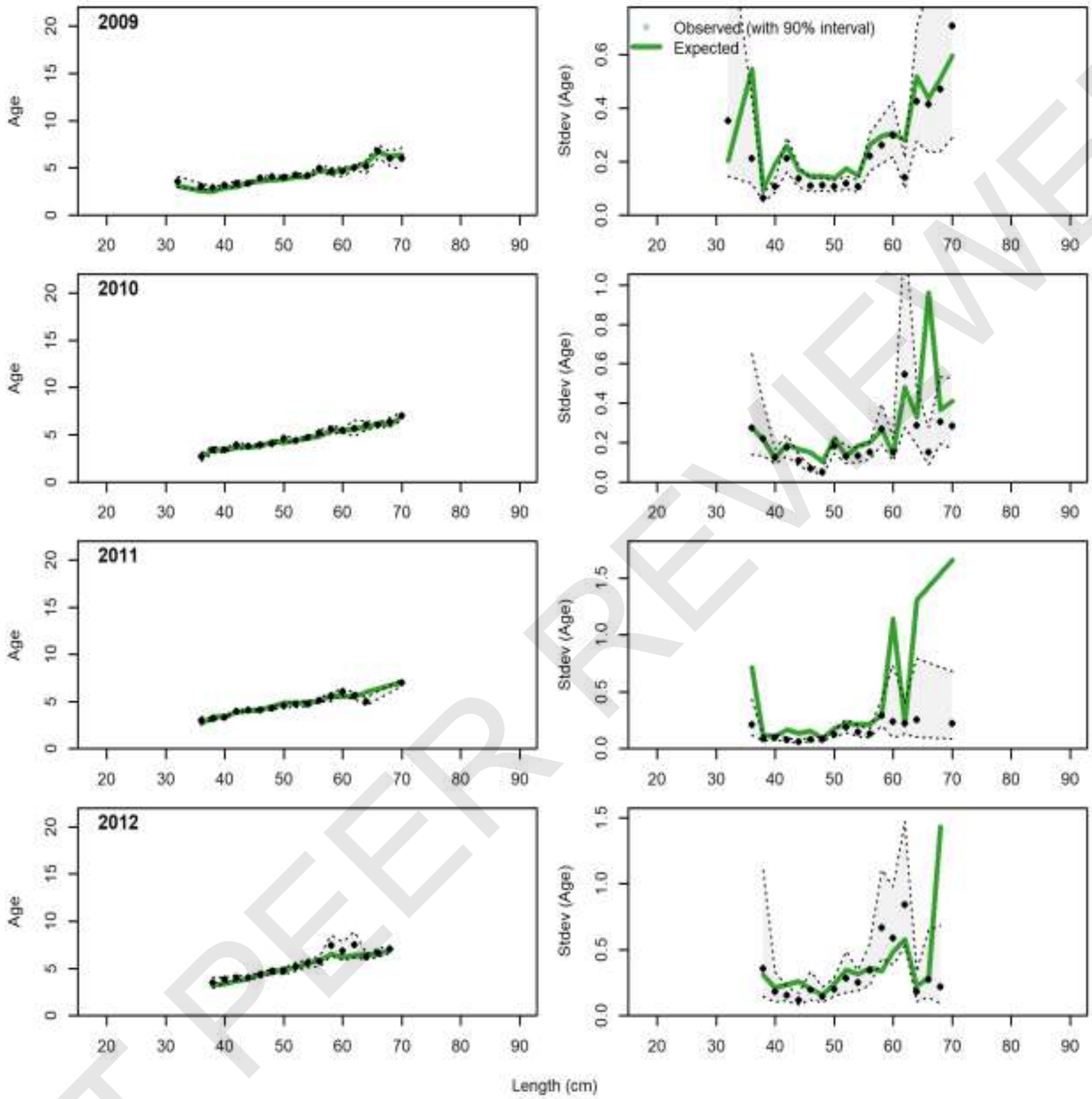


Figure 152 Continued. Conditional AAL plot, retained, Recreational Headboat East (plot 2 of 5)

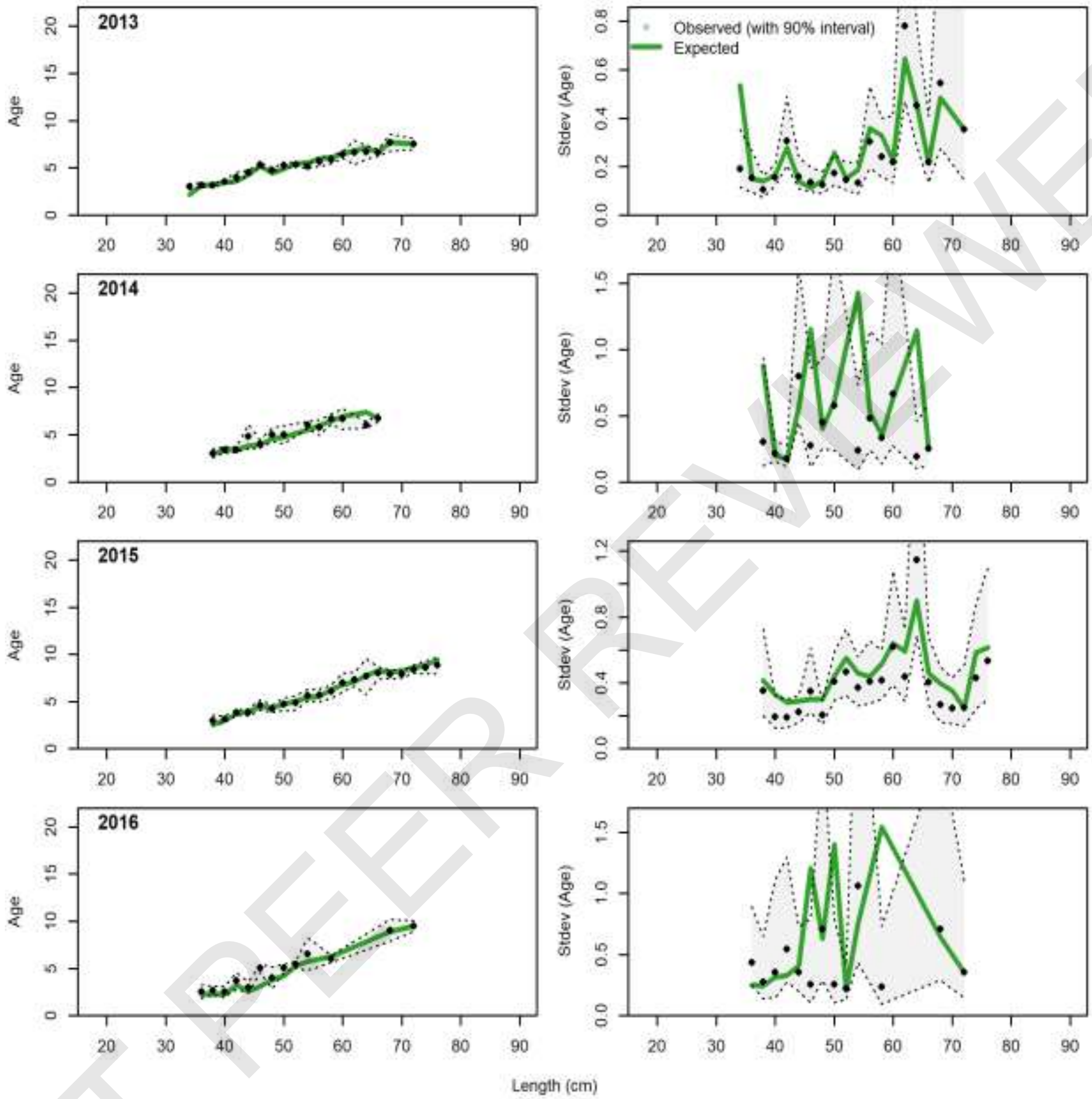


Figure 152 Continued. Conditional AAL plot, retained, Recreational Headboat East (plot 3 of 5)

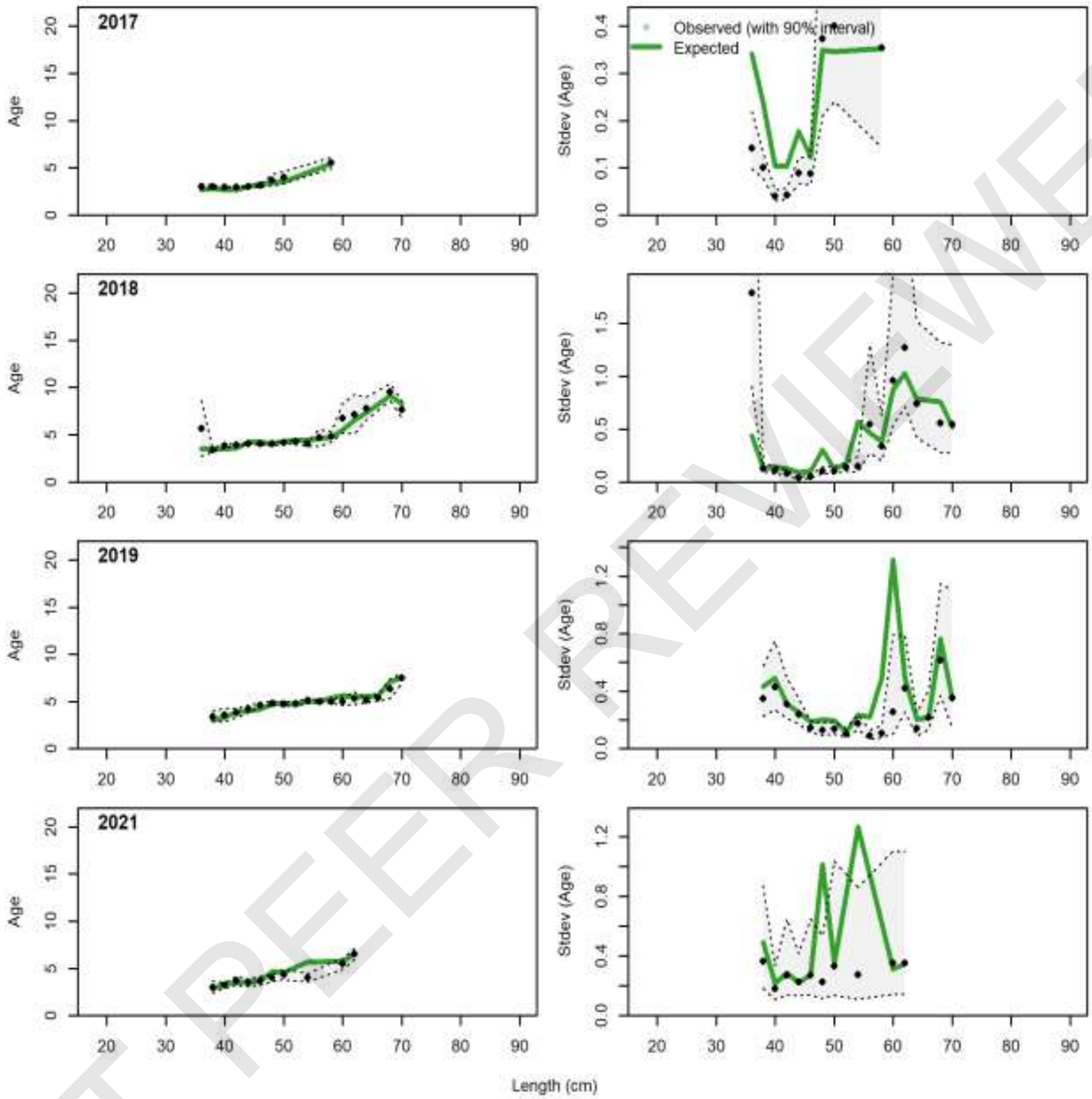


Figure 152 Continued. Conditional AAL plot, retained, Recreational Headboat East (plot 4 of 5)

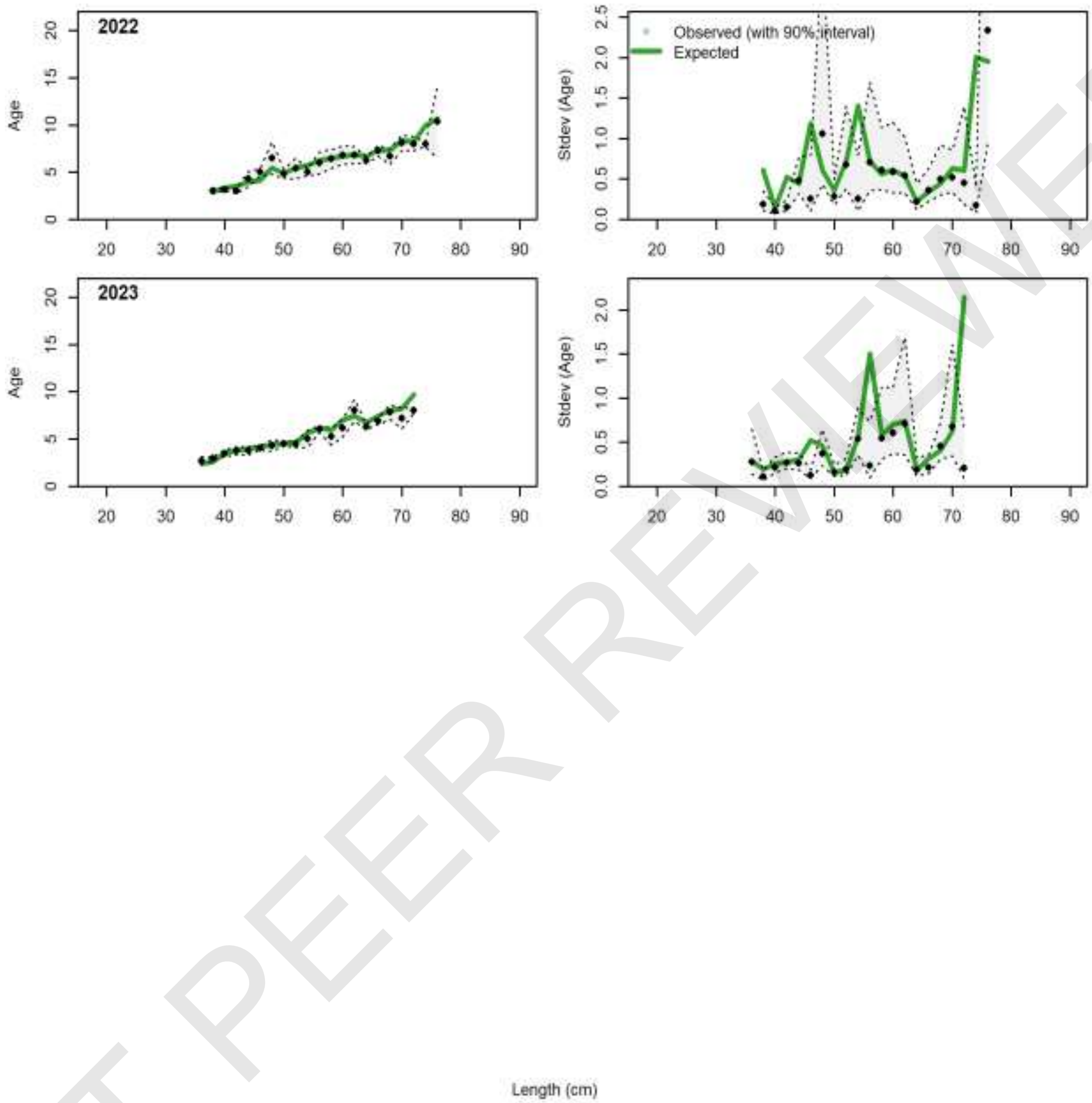


Figure 152 Continued. Conditional AAL plot, retained, Recreational Headboat East (plot 5 of 5)

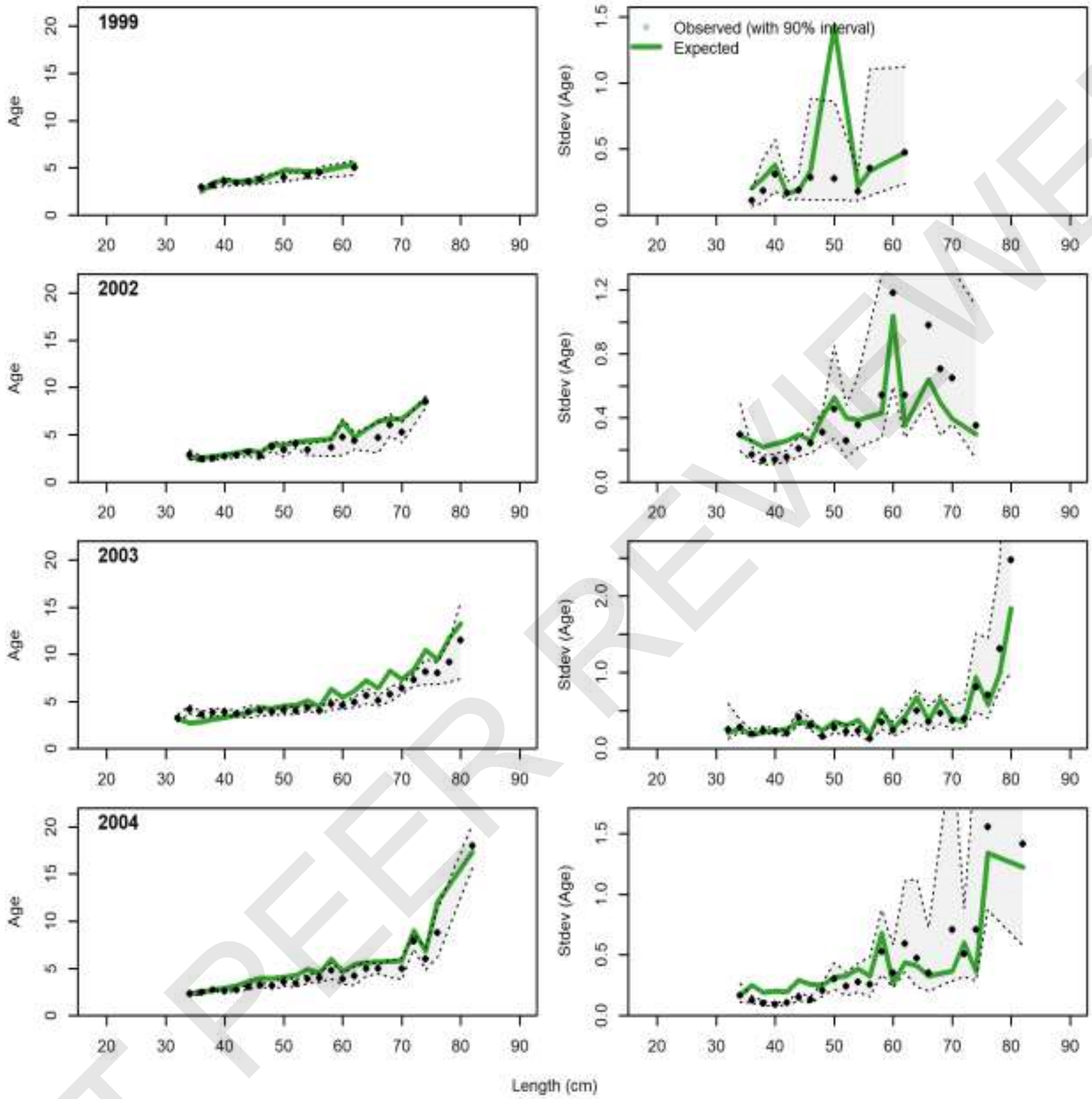


Figure 153. Conditional AAL plot, retained, Recreational Private West (plot 1 of 6) These plots show mean age and std. dev. in conditional A@L.Left plots are mean A@L by size-class (obs. and exp.) with 90% CIs based on adding 1.64 SE of mean to the data.Right plots in each pair are SE of mean A@L (obs. and exp.) with 90% CIs based on the chi-square distribution.

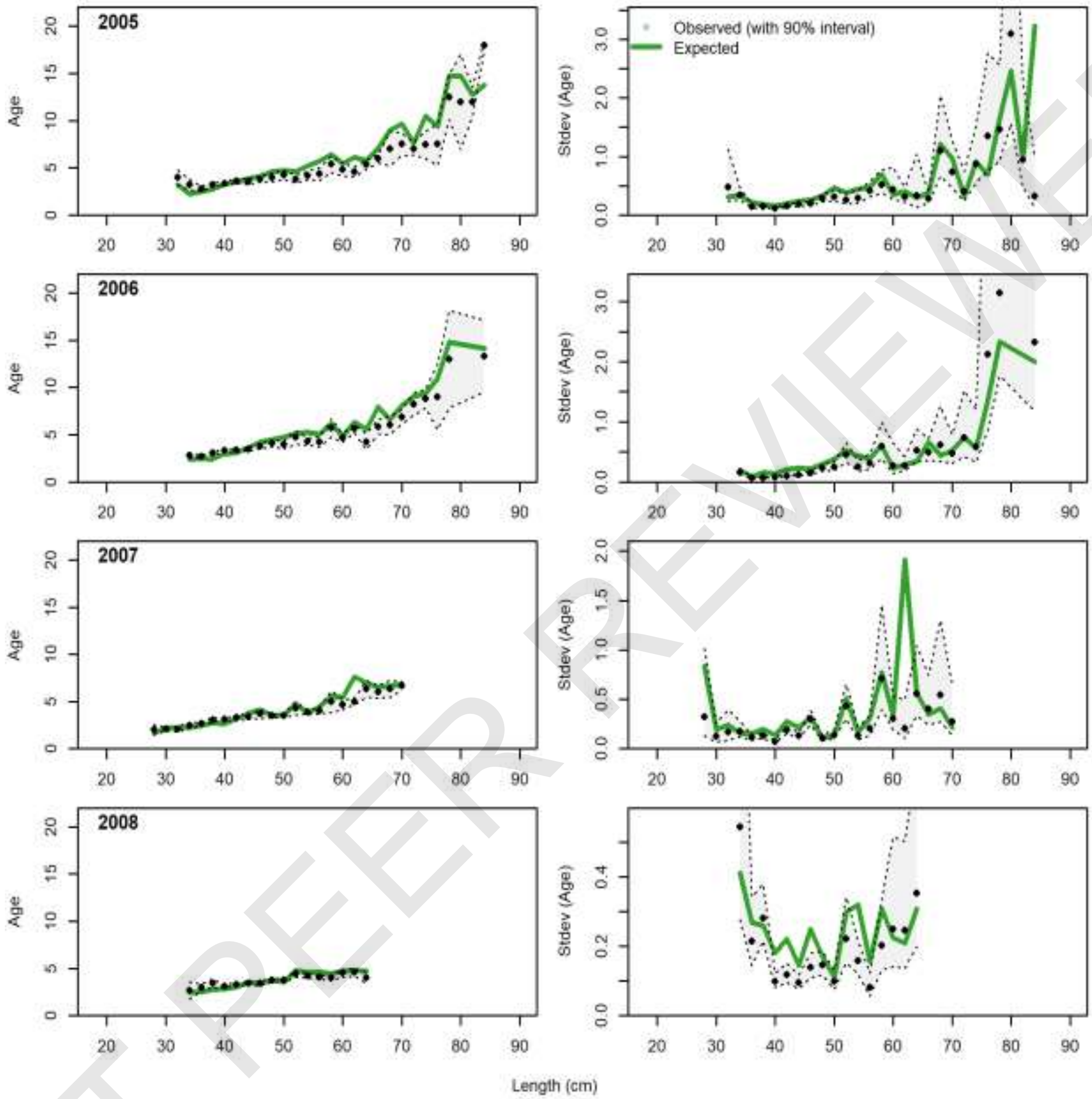


Figure 153 Continued. Conditional AAL plot, retained, Recreational Private West (plot 2 of 6)

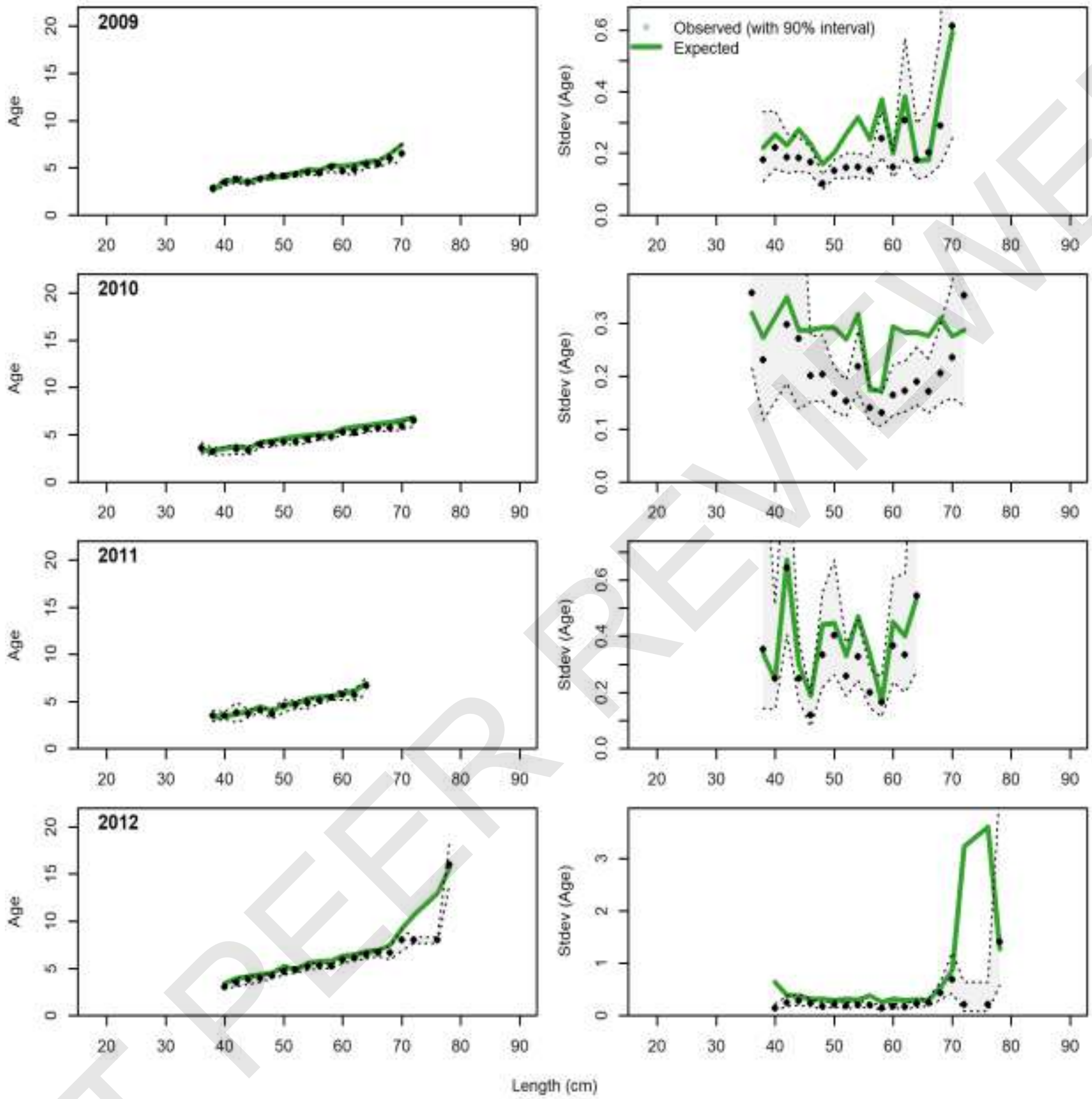


Figure 153 Continued. Conditional AAL plot, retained, Recreational Private West (plot 3 of 6)

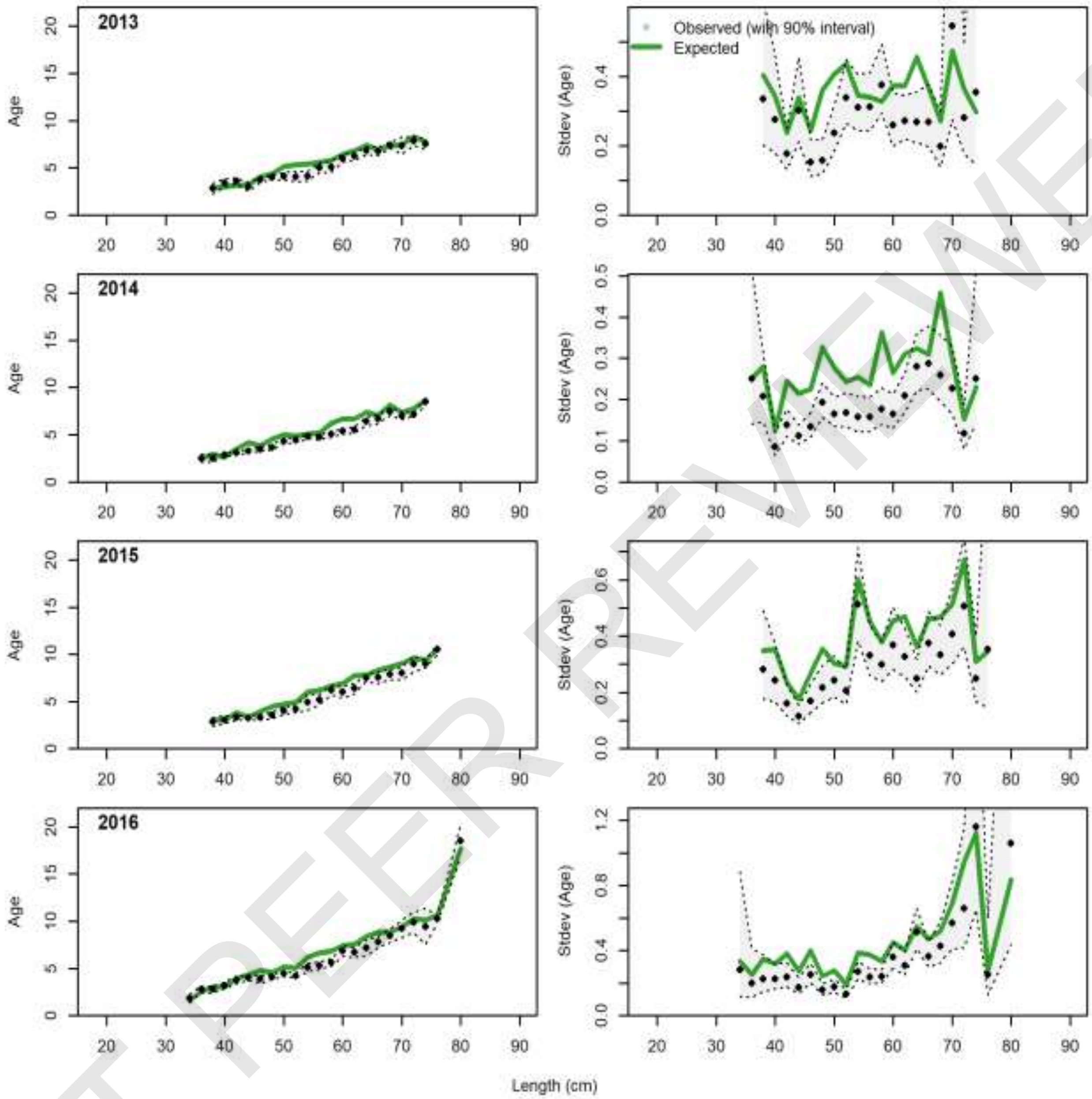


Figure 153 Continued. Conditional AAL plot, retained, Recreational Private West (plot 4 of 6)

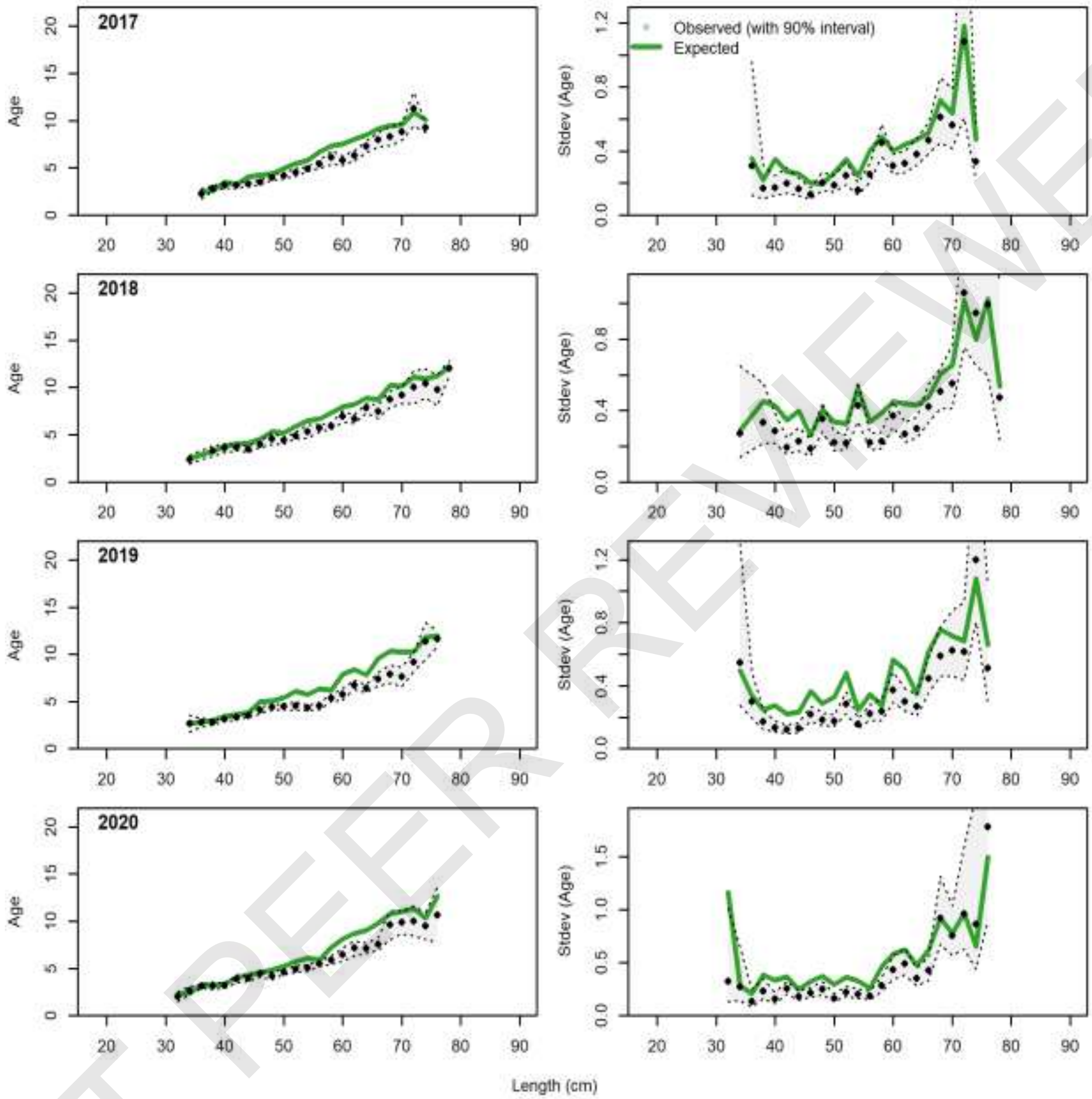


Figure 153 Continued. Conditional AAL plot, retained, Recreational Private West (plot 5 of 6)

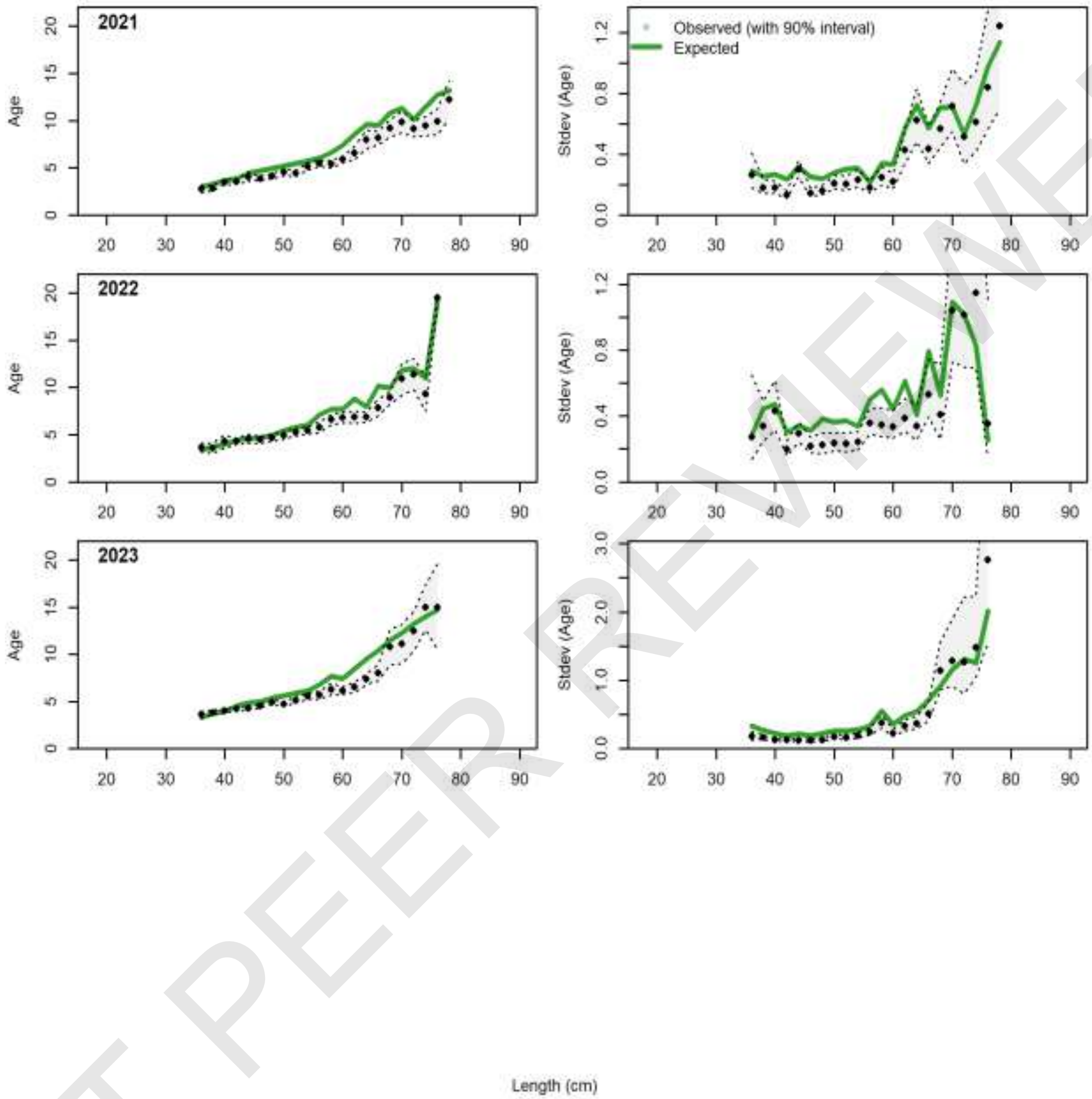


Figure 153 Continued. Conditional AAL plot, retained, Recreational Private West (plot 6 of 6)

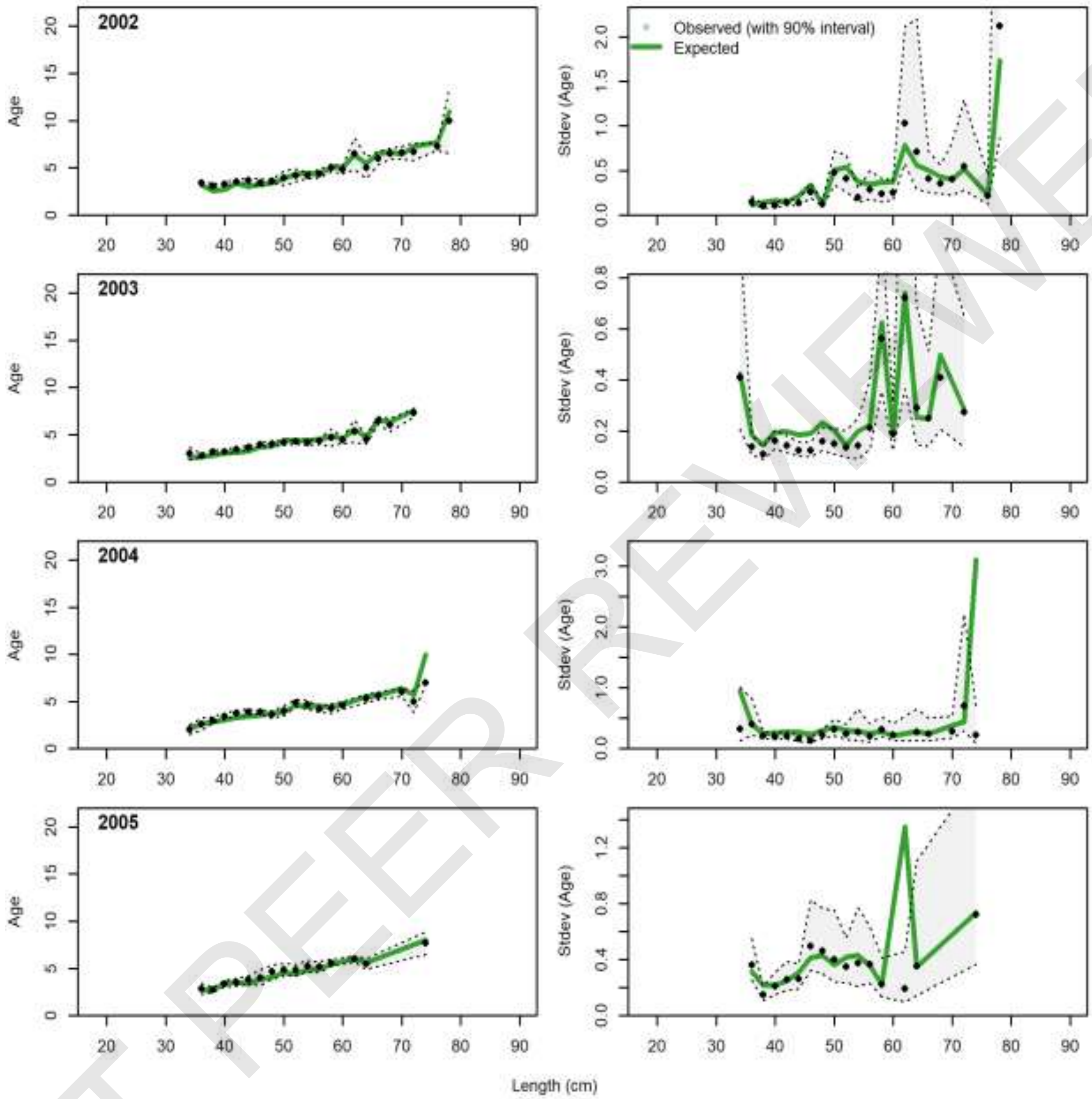


Figure 154. Conditional AAL plot, retained, Recreational Private Central (plot 1 of 6) These plots show mean age and std. dev. in conditional A@L.Left plots are mean A@L by size-class (obs. and exp.) with 90% CIs based on adding 1.64 SE of mean to the data.Right plots in each pair are SE of mean A@L (obs. and exp.) with 90% CIs based on the chi-square distribution.

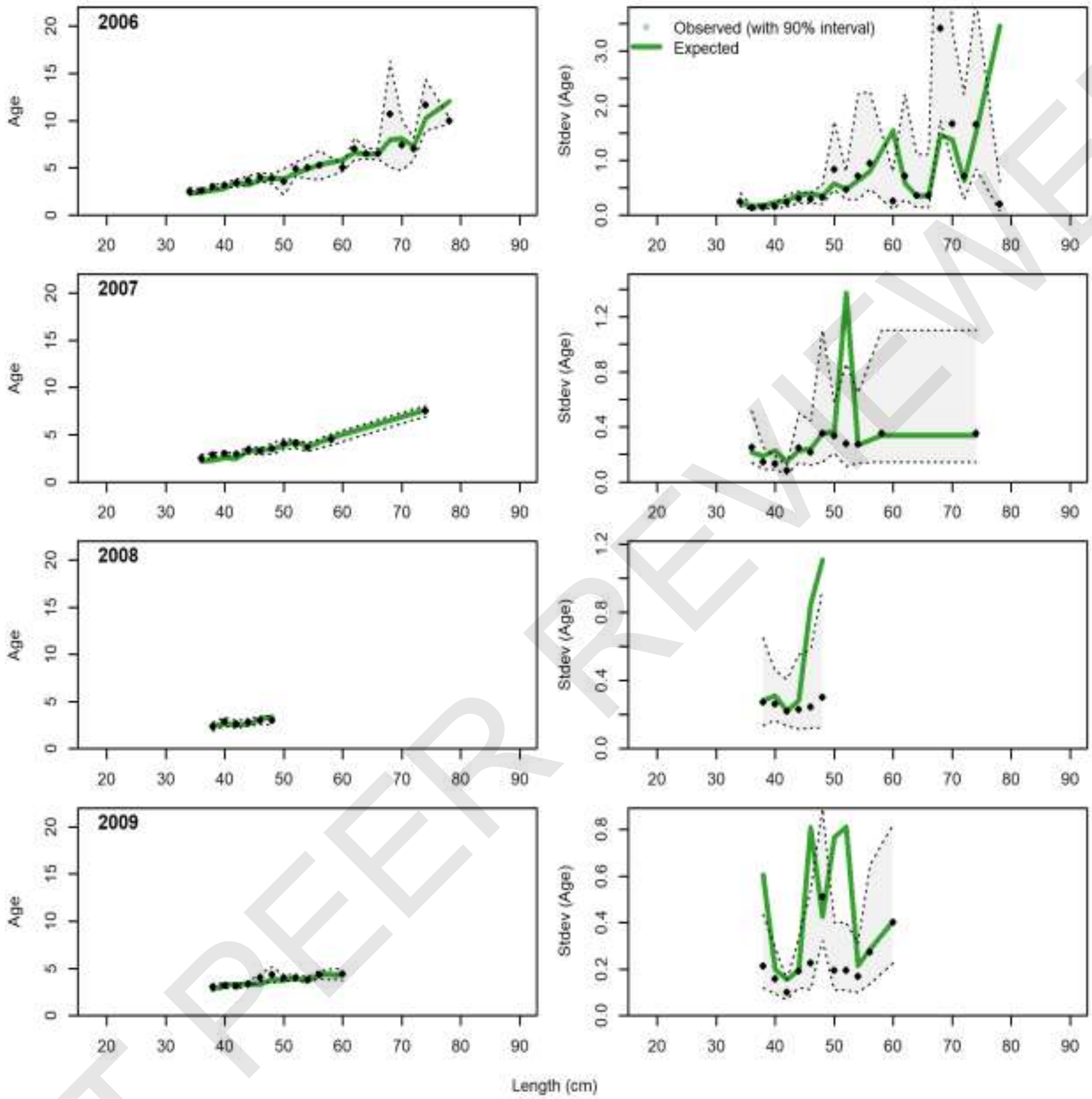


Figure 154 Continued. Conditional AAL plot, retained, Recreational Private Central (plot 2 of 6)

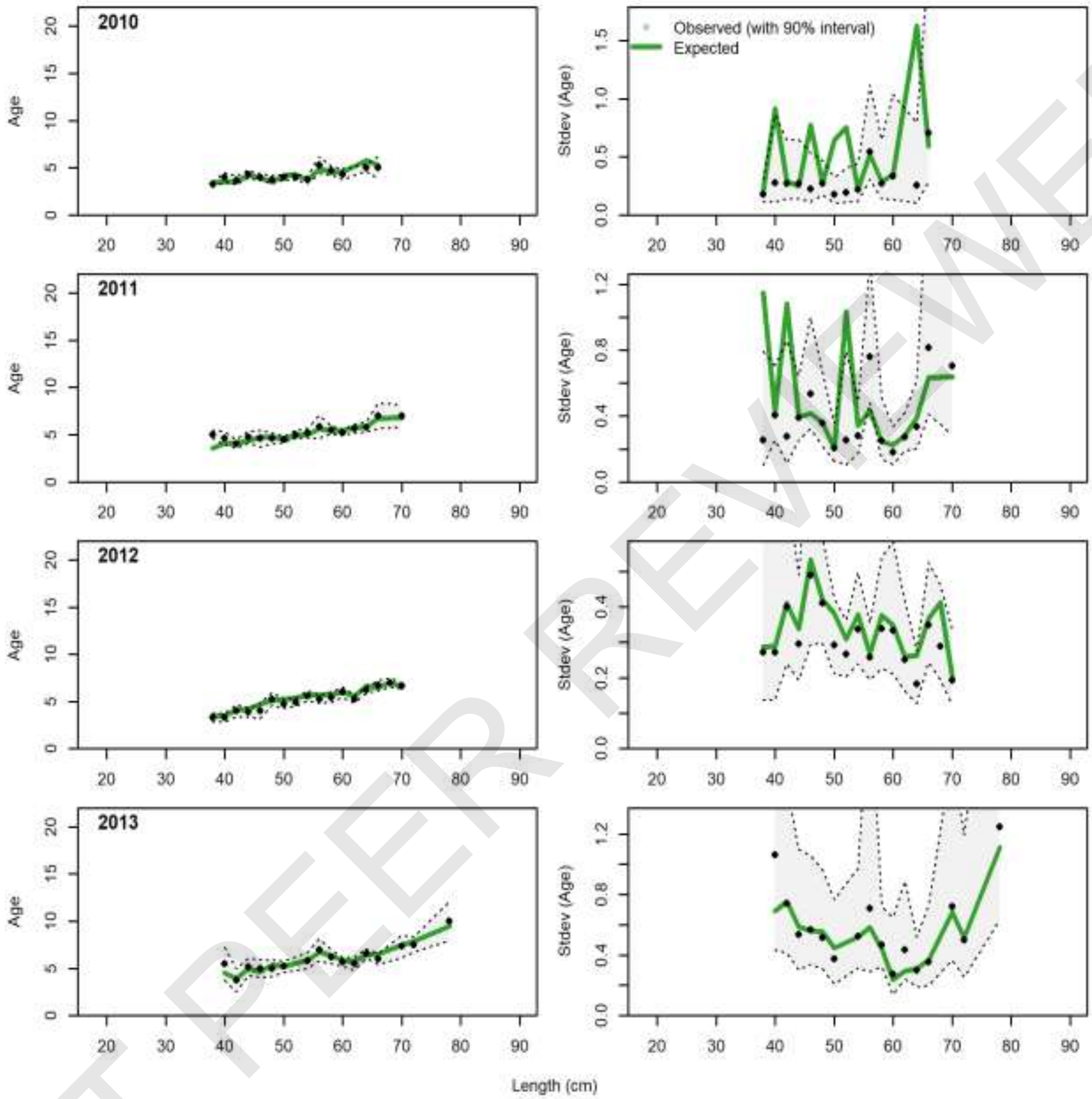


Figure 154 Continued. Conditional AAL plot, retained, Recreational Private Central (plot 3 of 6)

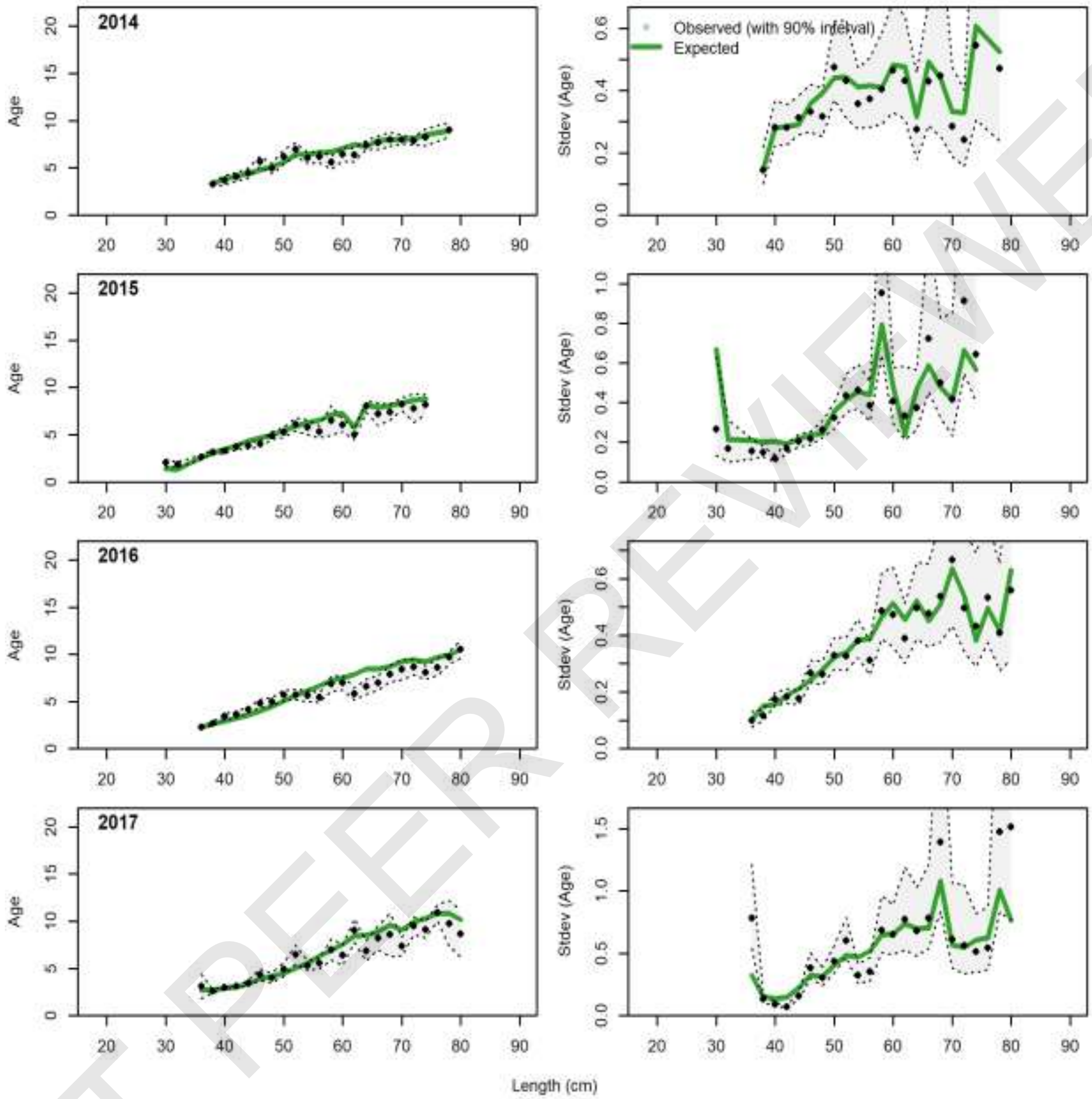


Figure 154 Continued. Conditional AAL plot, retained, Recreational Private Central (plot 4 of 6)

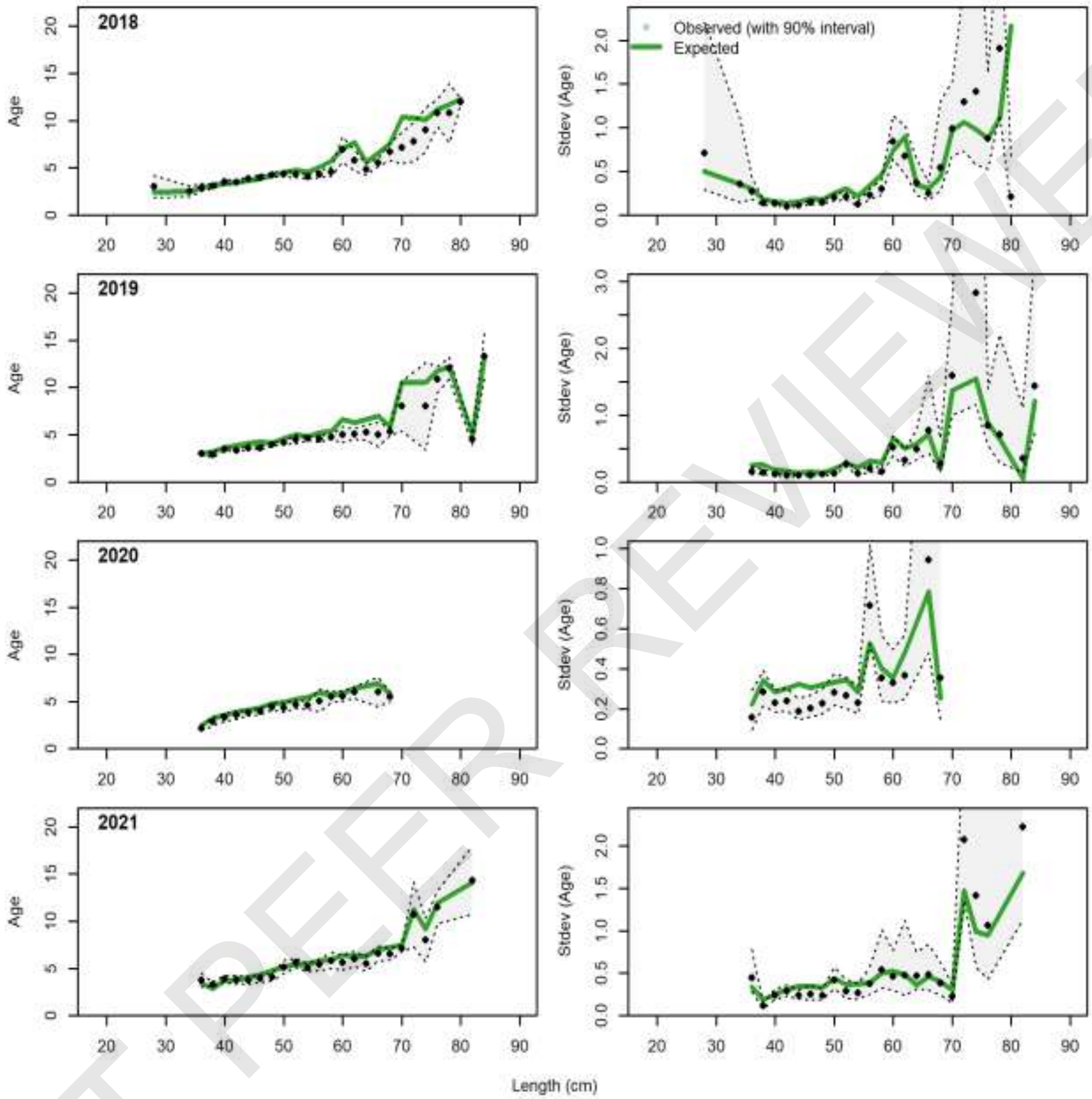


Figure 154 Continued. Conditional AAL plot, retained, Recreational Private Central (plot 5 of 6)

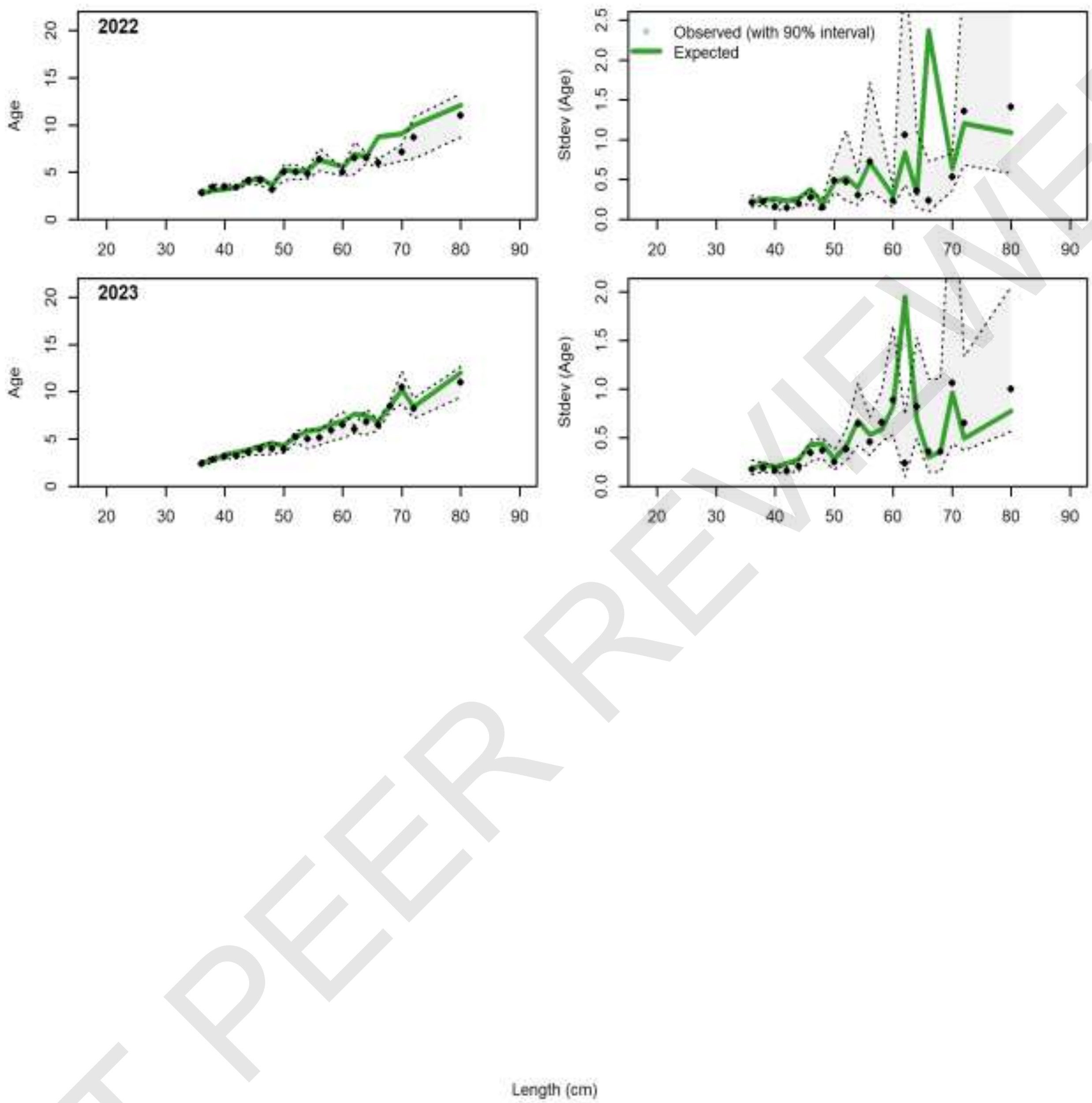


Figure 154 Continued. Conditional AAL plot, retained, Recreational Private Central (plot 6 of 6)

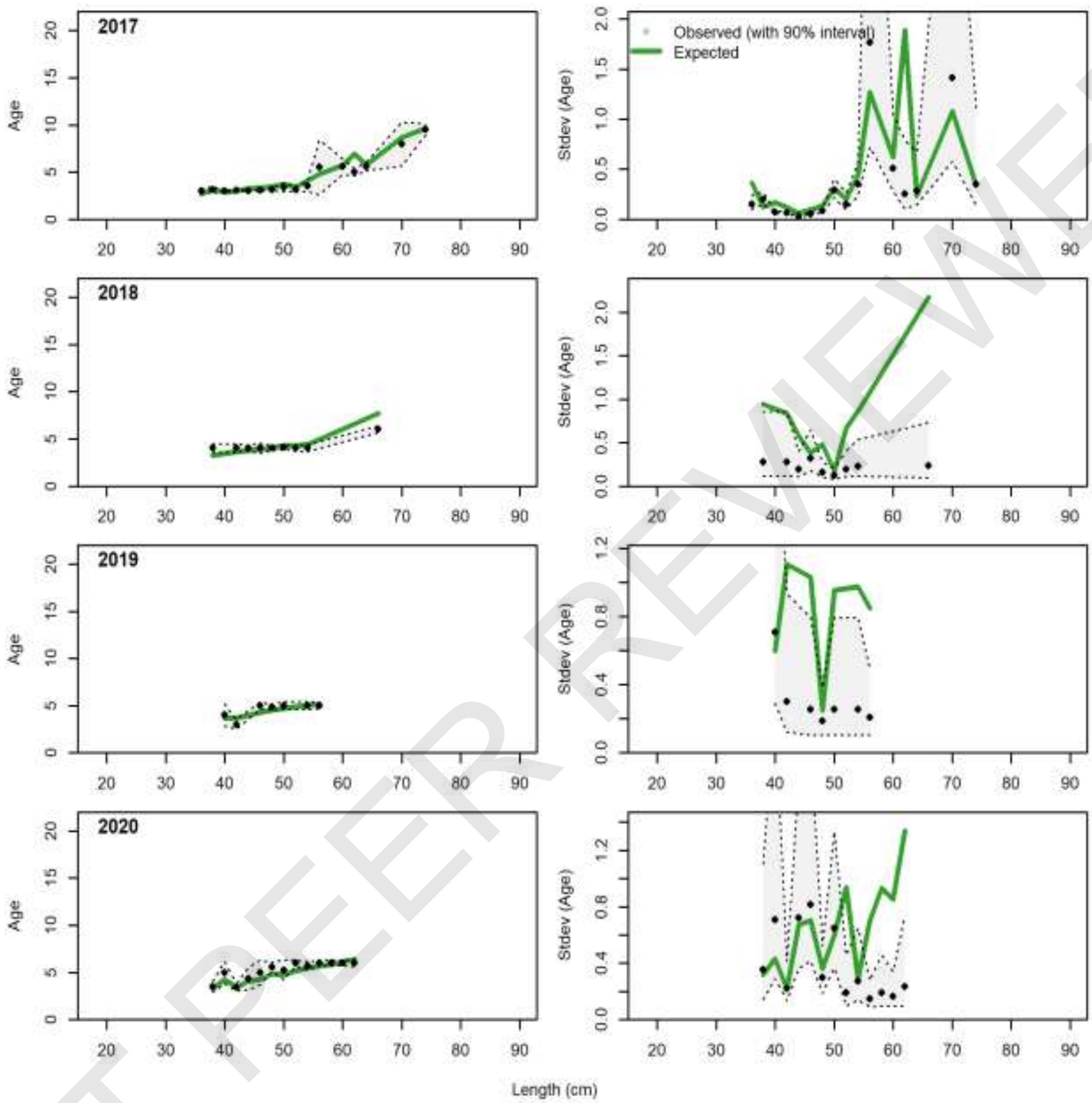


Figure 155. Conditional AAL plot, retained, Recreational Private East (plot 1 of 2) These plots show mean age and std. dev. in conditional A@L.Left plots are mean A@L by size-class (obs. and exp.) with 90% CIs based on adding 1.64 SE of mean to the data.Right plots in each pair are SE of mean A@L (obs. and exp.) with 90% CIs based on the chi-square distribution.

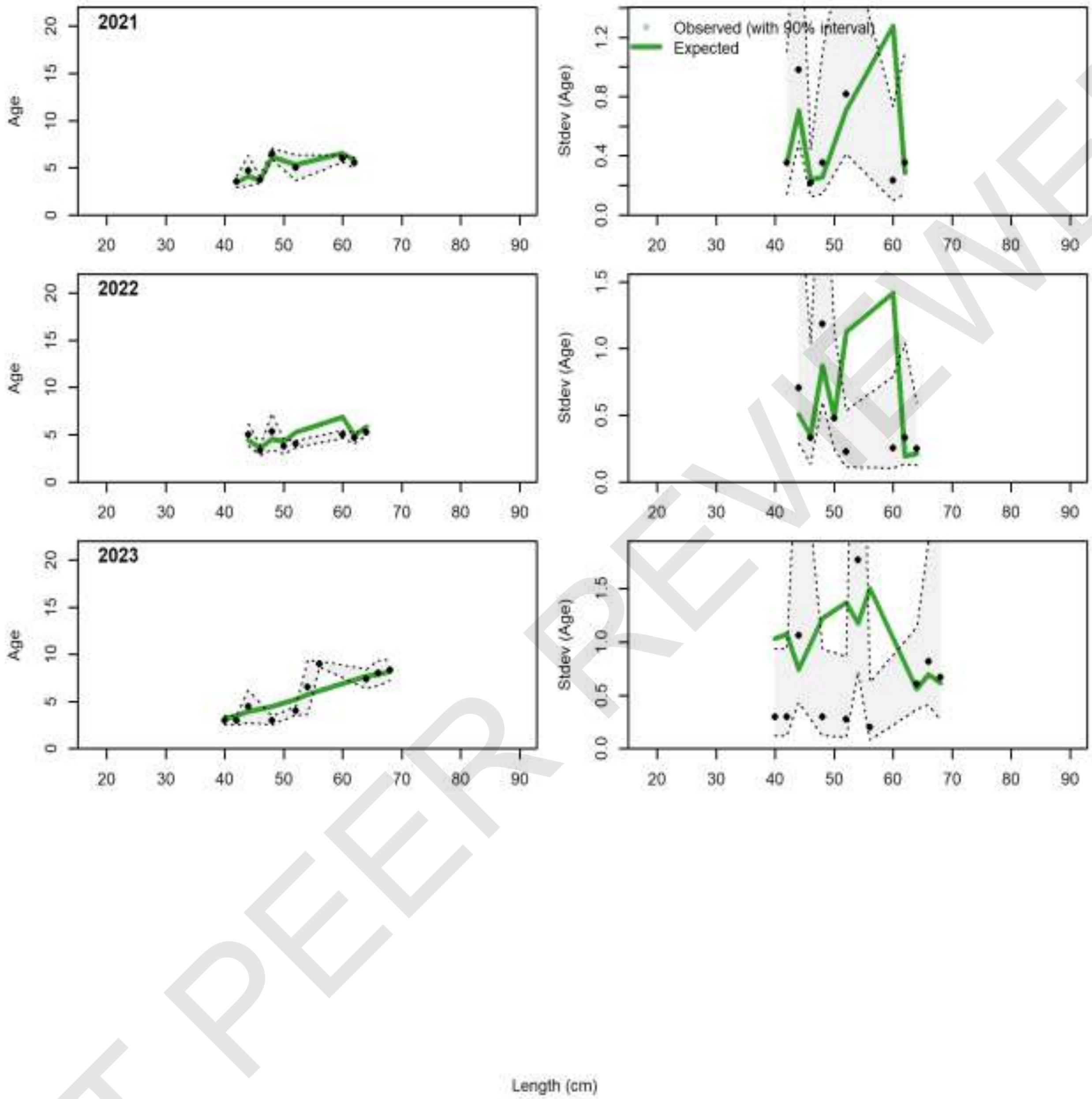


Figure 155 Continued. Conditional AAL plot, retained, Recreational Private East (plot 2 of 2)

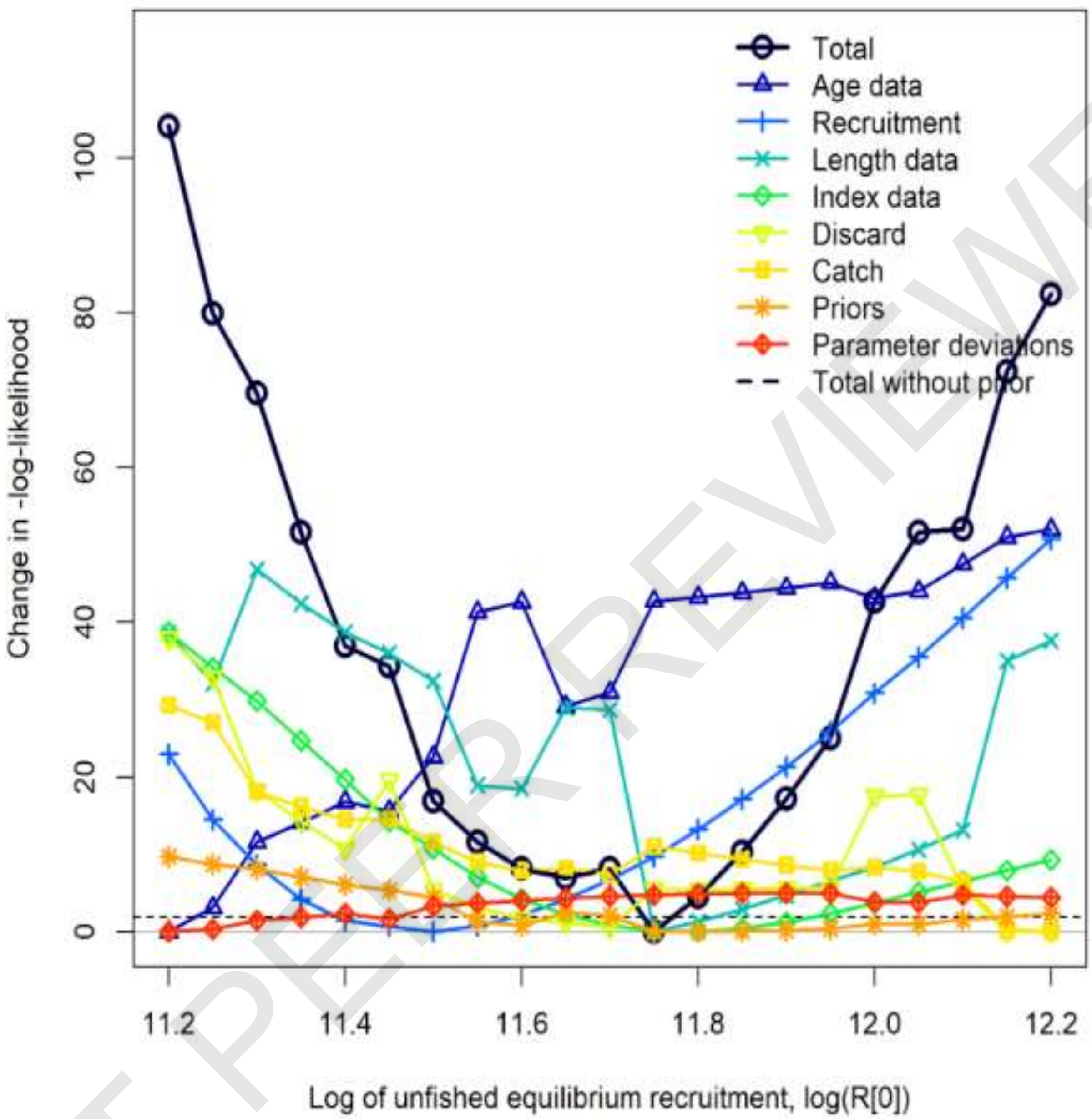


Figure 156. The likelihood profile for the natural log of the virgin recruitment parameter ($ln(R_0)$) of the Beverton – Holt stock-recruit function for Gulf of America Red Snapper. Each line represents the change in negative log-likelihood value for each of the data sources fit in the model across the range of fixed values tested. The MLE (CV) for the SEDAR 98 Base Model was 11.653 (0.003). The dashed horizontal line at ~1.92 indicates the 95% confidence interval.

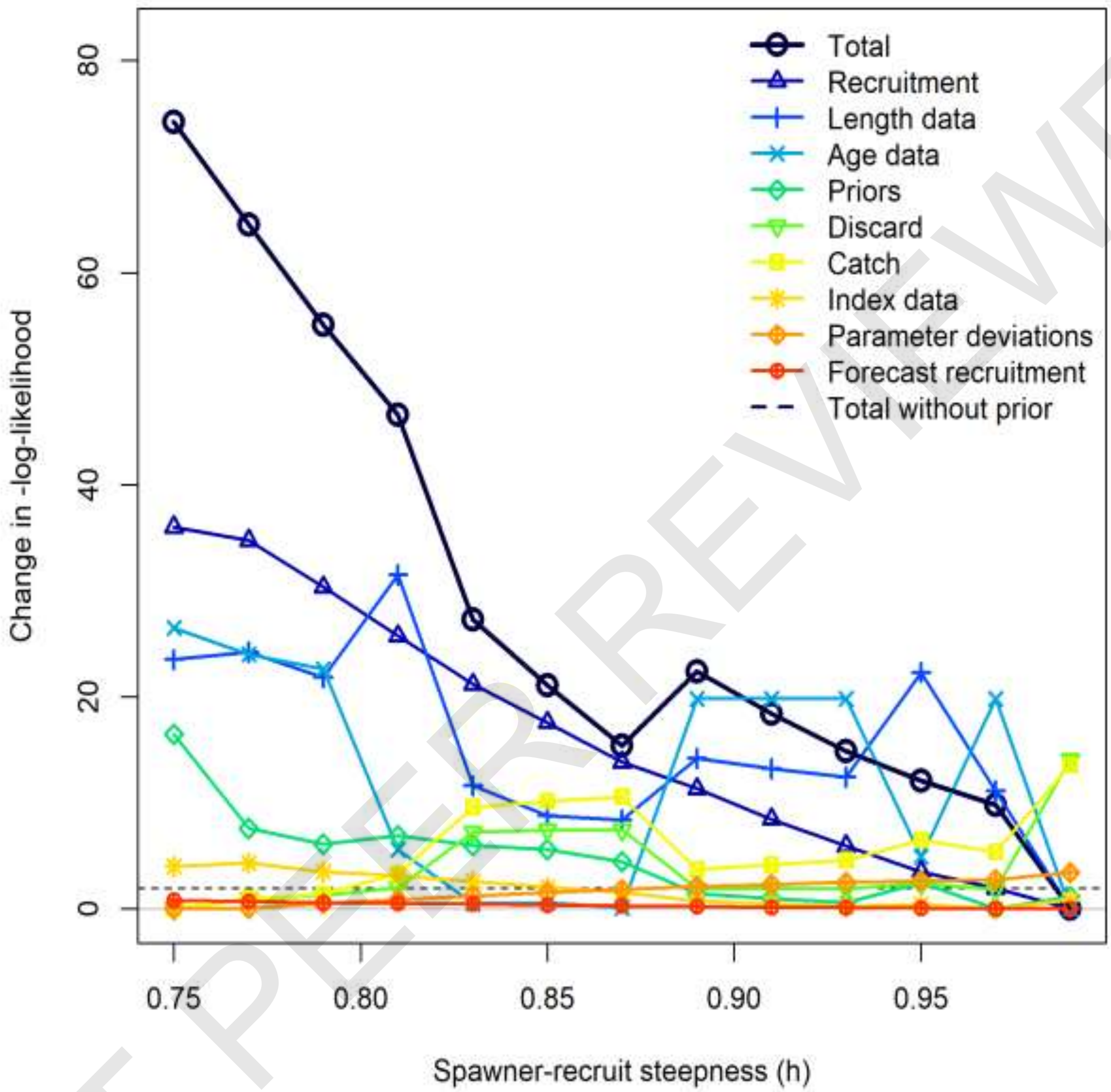


Figure 157. The likelihood profile for the steepness parameter in the Beverton – Holt stock-recruit function for Gulf of America Red Snapper. Each line represents the change in negative log-likelihood value for each of the data sources fit in the model across the range of fixed values tested. The MLE (CV) for the SEDAR 98 Base Model was 11.653 (0.003).

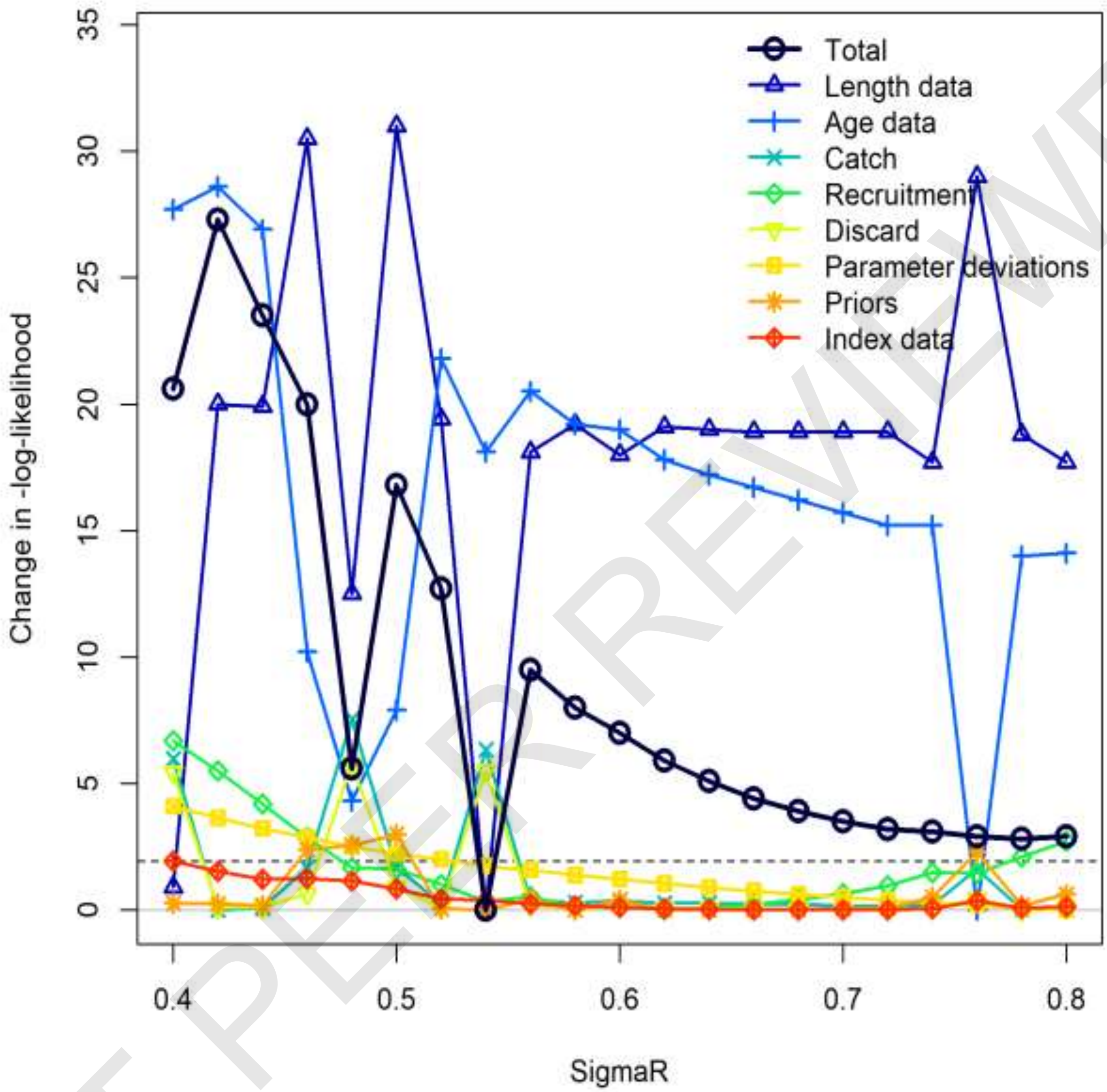


Figure 158. The likelihood profile for the recruitment variability (sigmaR) parameter of the Beverton – Holt stock-recruit function for Gulf of America Red Snapper. Each line represents the change in negative log-likelihood value for each of the data sources fit in the model across the range of fixed values tested. The MLE (CV) for the SEDAR 98 Base Model was 0.6 (NA). The dashed horizontal line at ~1.92 indicates the 95% confidence interval.

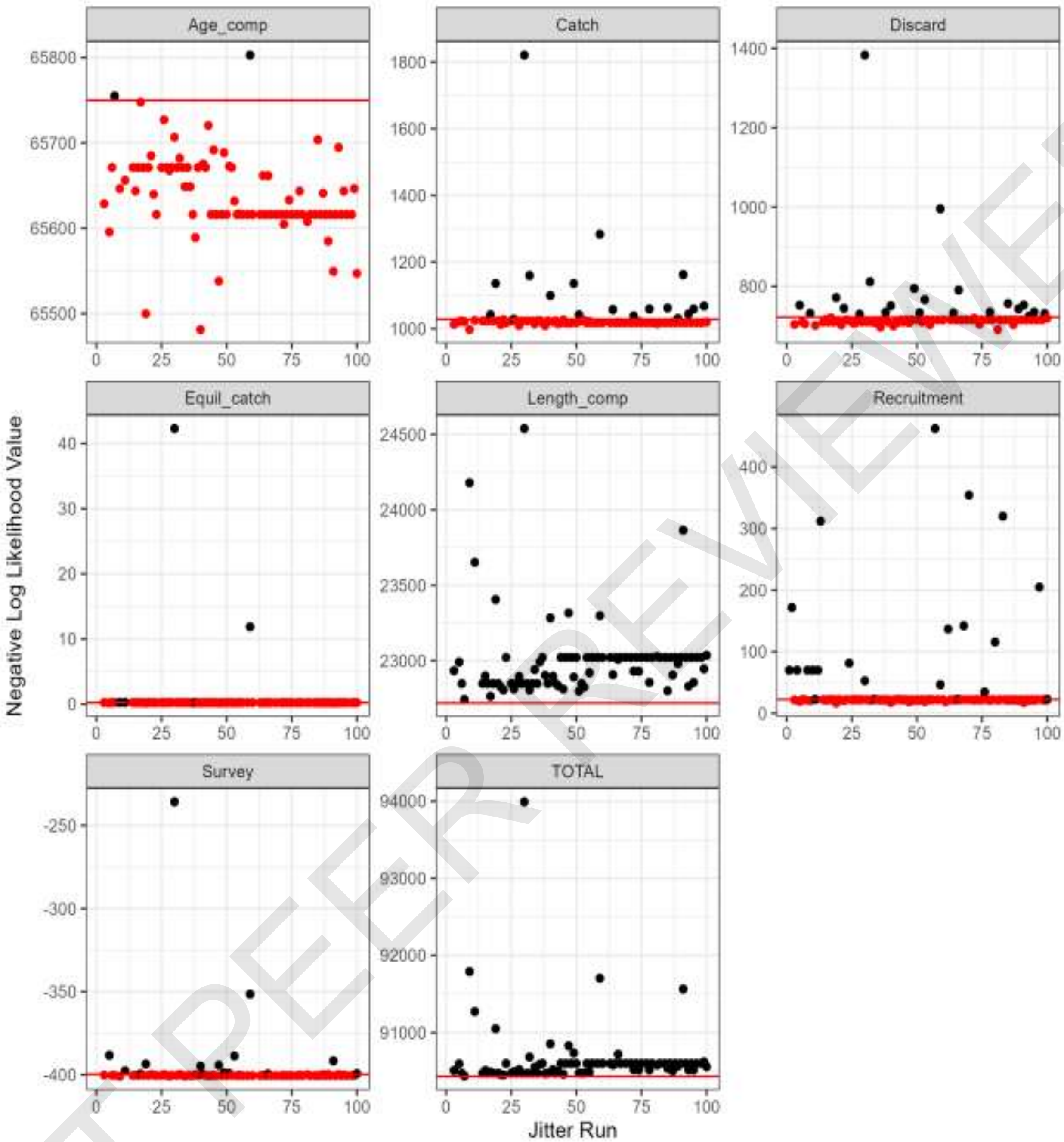


Figure 159. Results of the jitter analysis for various likelihood components for the SEDAR 98 Base Model for Gulf of America Red Snapper. Each panel gives the results of 100 model runs where the starting parameter values for each run were randomly changed ('jittered') by 10% from the SEDAR 98 Base Model best fit values. Note that the y-axes differ between panels. Negative log-likelihood components shown from top left through bottom right include: survey, total, length composition (length_comp), mean weight (Mean_body_wt), parameter priors (Parm_priors), recruitment, age composition (Age_comp), catch, discards, and equilibrium catch (Equil_catch).

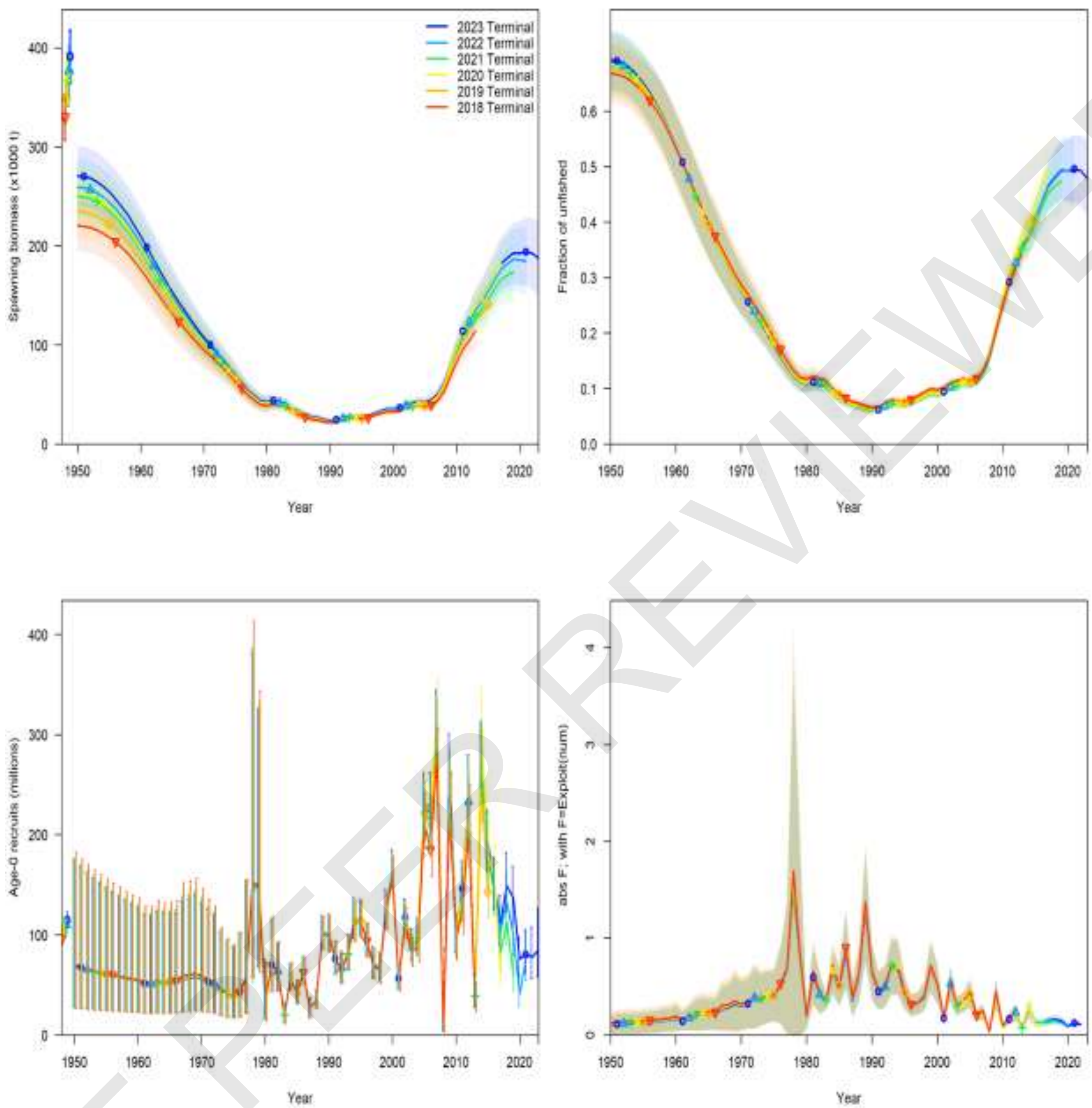


Figure 160. Retrospective analysis of spawning stock biomass (males and females combined, top panels) and fishing mortality (F, bottom panels) estimates for Gulf of America Red Snapper conducted by re-fitting each reference model (Ref) after removing five years of observations, one year at a time sequentially. 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.

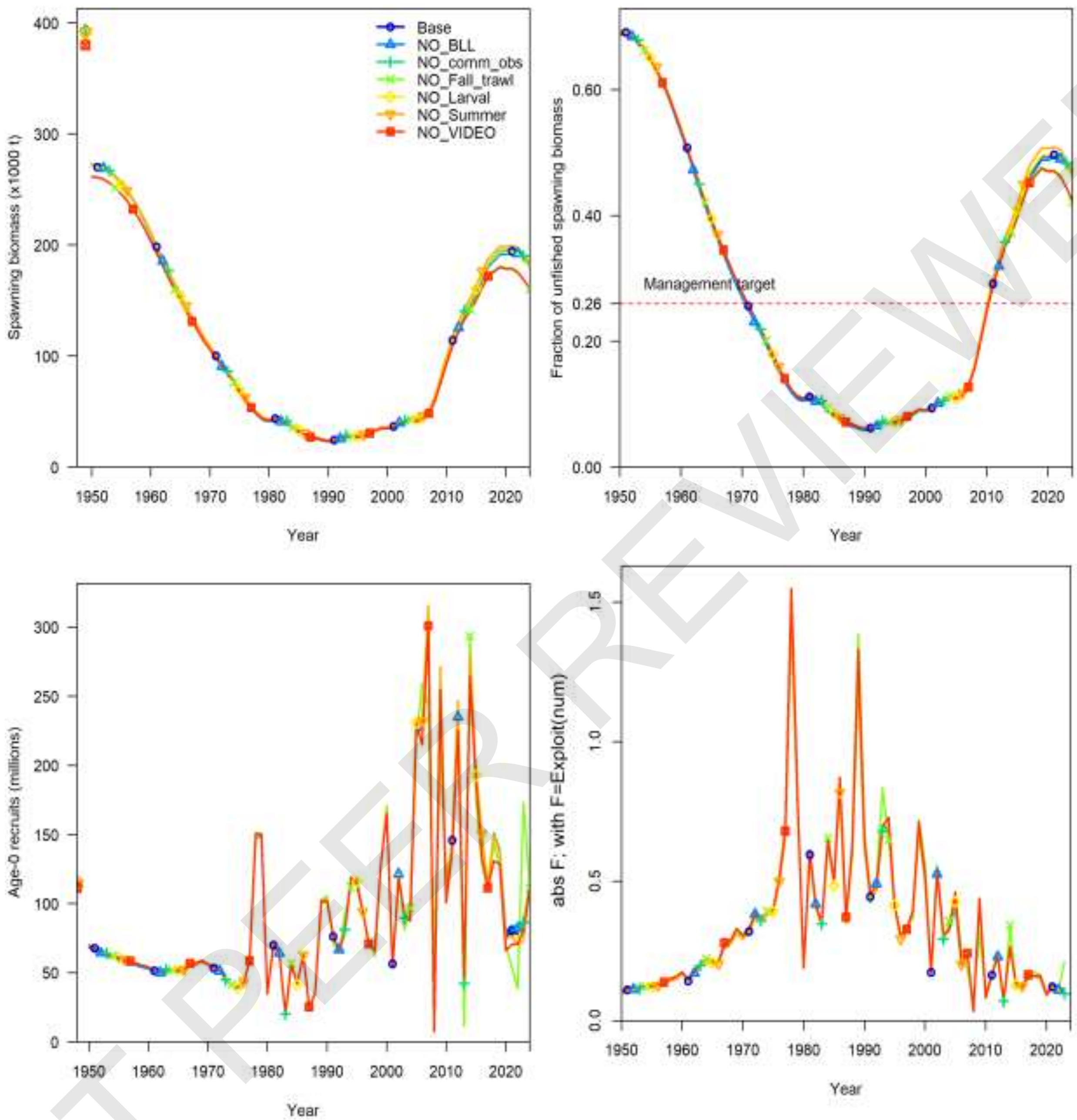


Figure 161. Estimates of spawning stock biomass (males and females combined in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed age 1+ / total biomass age 1+; bottom right panel) for the sensitivity runs removing each index of abundance conducted for the SEDAR 98 Base Model for Gulf of America Red Snapper.

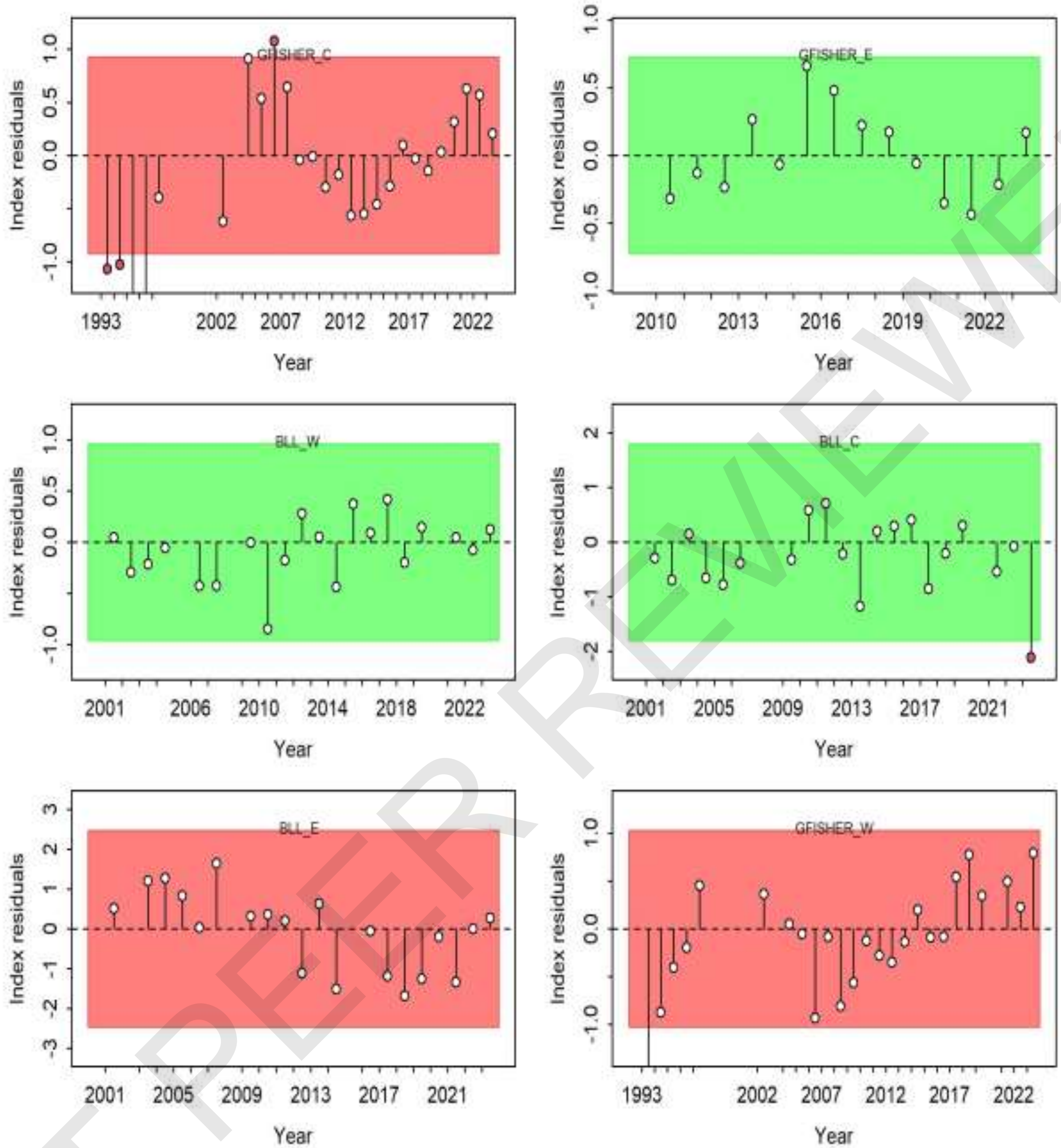


Figure 162. Runs tests results for indices of abundance, mean age, and mean length for Gulf of America Red Snapper. Green shading indicates no evidence ($p >= 0.05$) and red shading evidence ($p < 0.05$) to reject the hypothesis of a randomly distributed time-series of residuals, respectively. The shaded (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.

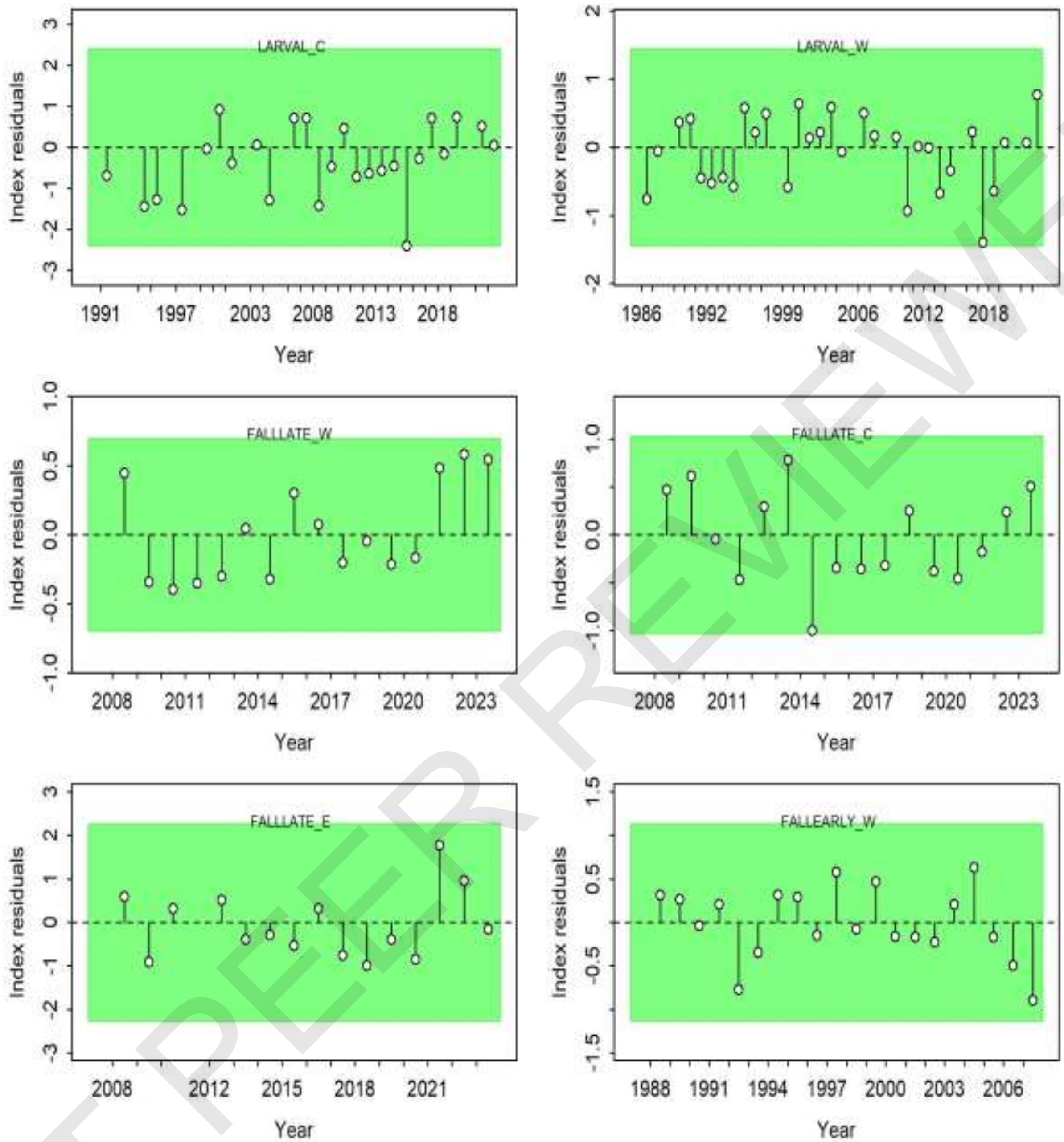


Figure 162 Continued. Runs tests results for indices of abundance, mean age, and mean length for Gulf of America Red Snapper. Green shading indicates no evidence (p >= 0.05) and red shading evidence (p < 0.05) to reject the hypothesis of a randomly distributed time-series of residuals, respectively. 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.

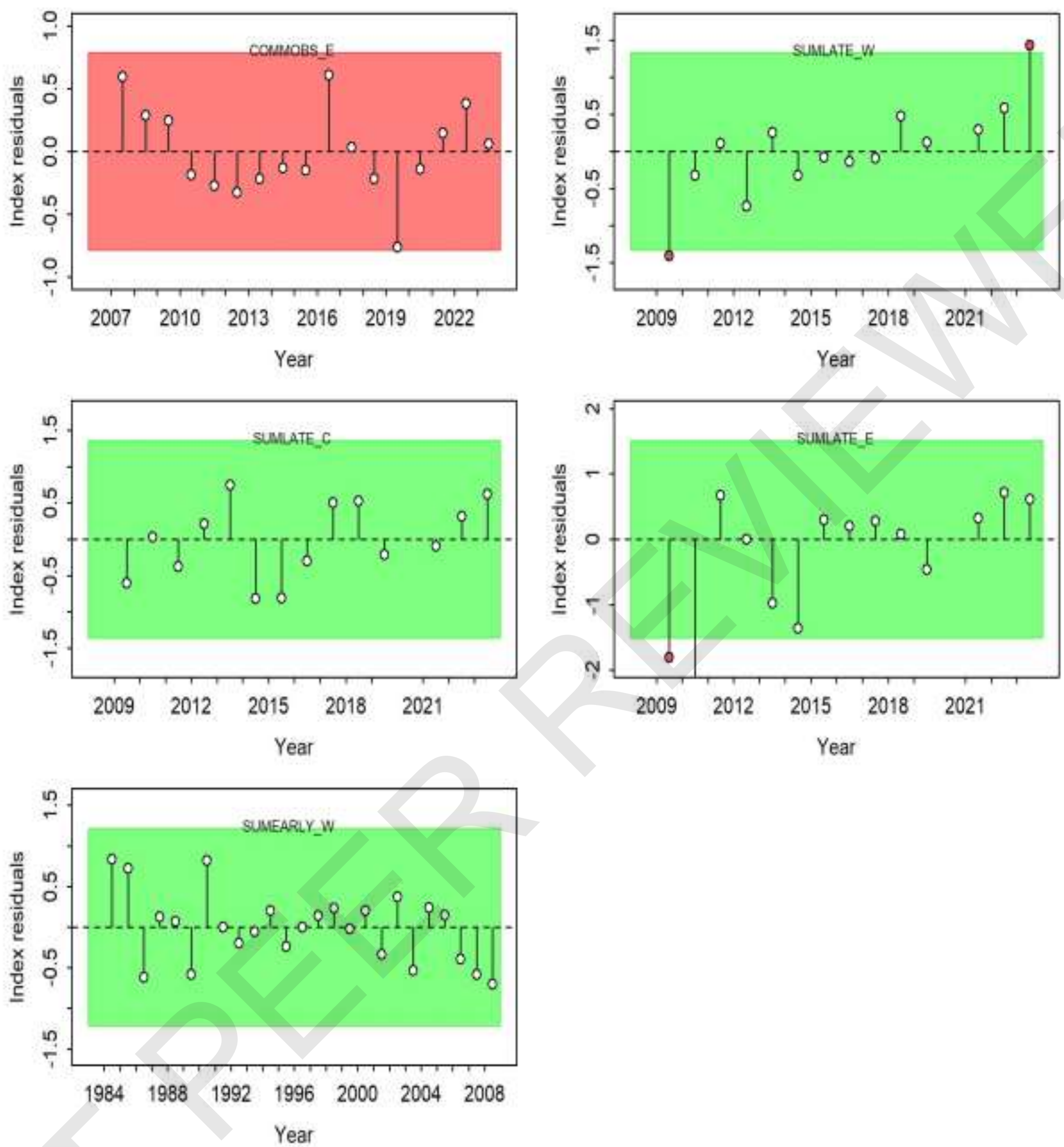


Figure 162 Continued. Runs tests results for indices of abundance, mean age, and mean length for Gulf of America Red Snapper. Green shading indicates no evidence (p >= 0.05) and red shading evidence (p < 0.05) to reject the hypothesis of a randomly distributed time-series of residuals, respectively. 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.

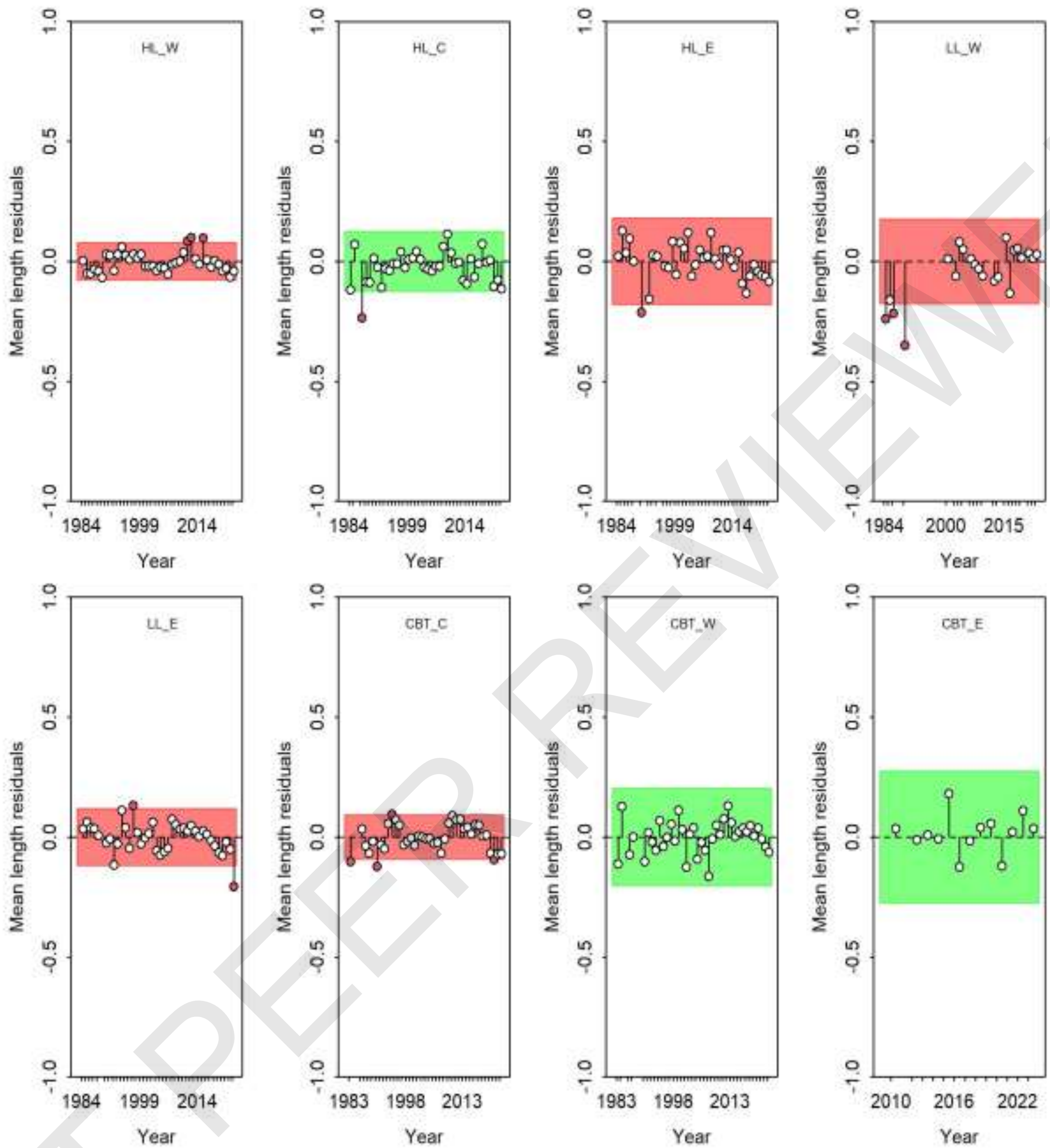


Figure 163. Runs tests results for indices of abundance, mean age, and mean length for Gulf of America Red Snapper. Green shading indicates no evidence (p >= 0.05) and red shading evidence (p < 0.05) to reject the hypothesis of a randomly distributed time-series of residuals, respectively. The shaded (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.

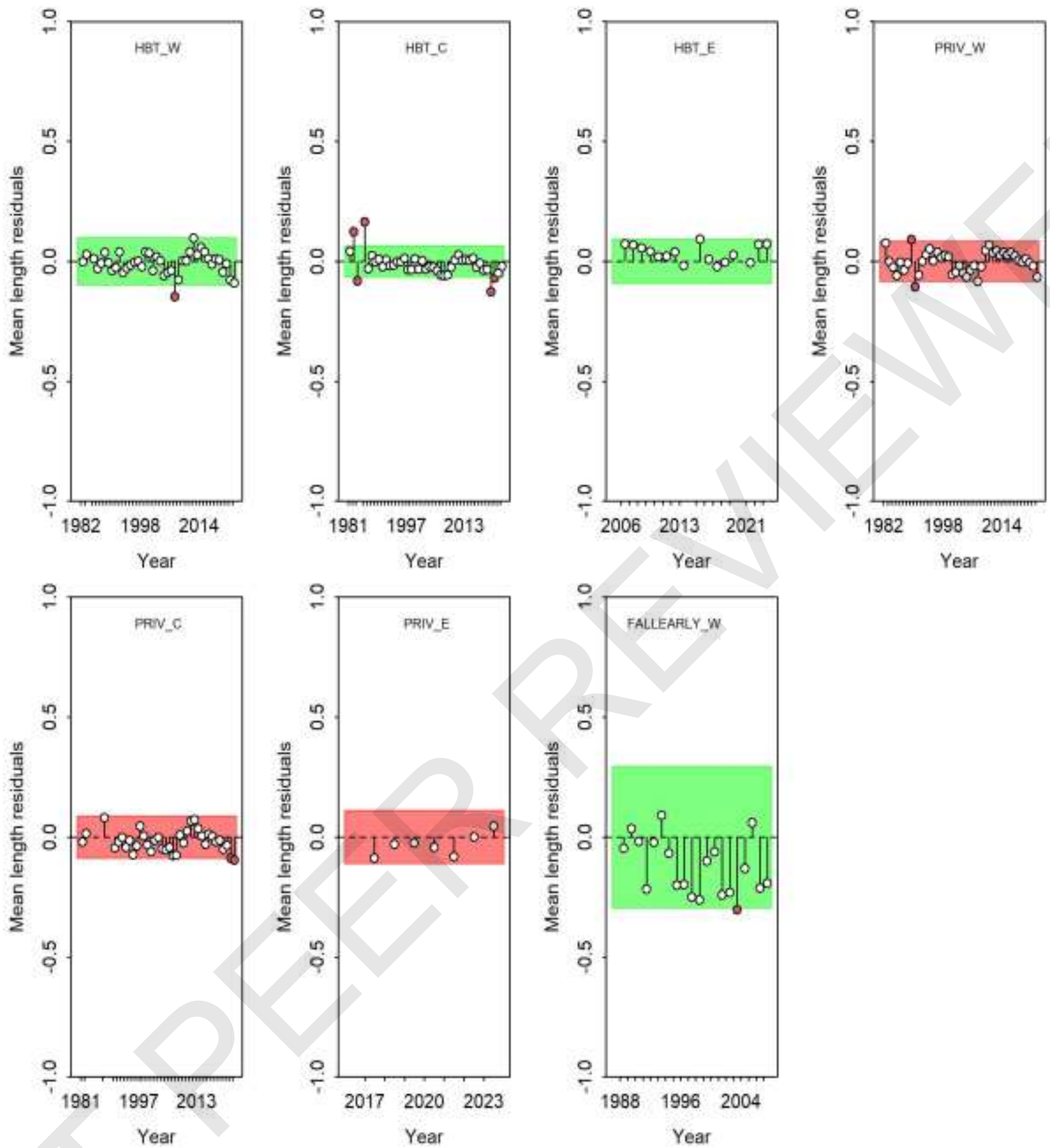


Figure 163 Continued. Runs tests results for indices of abundance, mean age, and mean length for Gulf of America Red Snapper. Green shading indicates no evidence (p >= 0.05) and red shading evidence (p < 0.05) to reject the hypothesis of a randomly distributed time-series of residuals, respectively. 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.

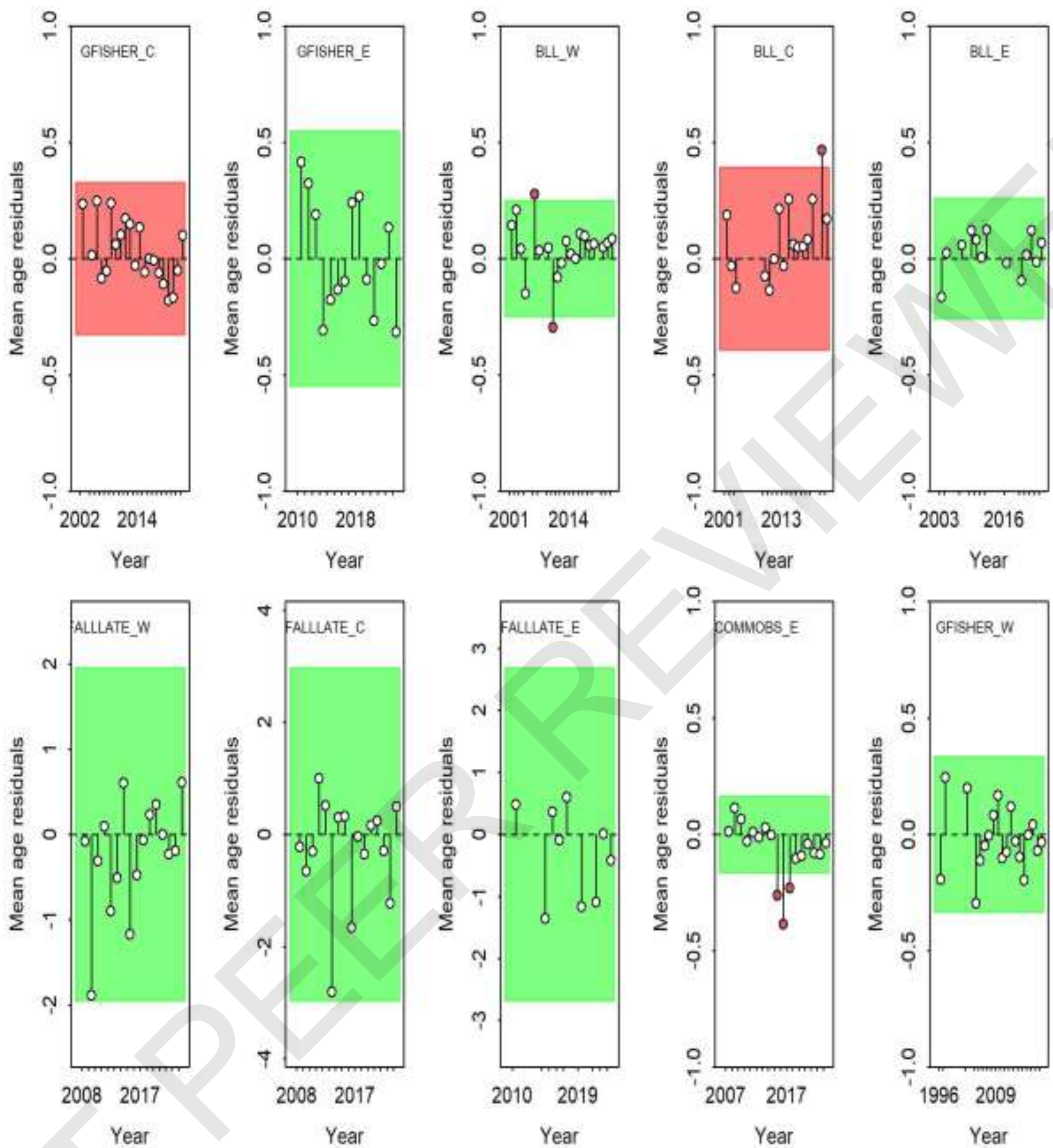


Figure 164. Runs tests results for indices of abundance, mean age, and mean length for Gulf of America Red Snapper. Green shading indicates no evidence ($p >= 0.05$) and red shading evidence ($p < 0.05$) to reject the hypothesis of a randomly distributed time-series of residuals, respectively. The shaded (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.

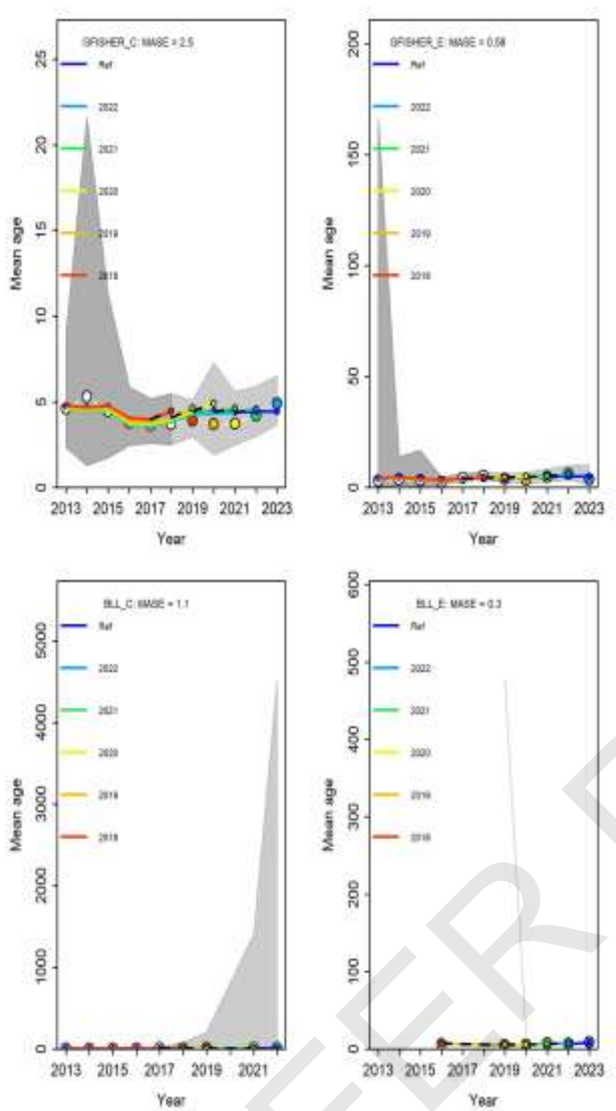


Figure 165. Hindcasting cross-validation (HCxval) results for fits to annual mean age estimates for Gulf of America Red Snapper. Shown are observed (large points connected with dashed line), fitted (solid lines) and one-year ahead forecast values (small terminal points). HCxval was performed using one reference model (Ref) and five hindcast model runs (solid lines) relative to the expected mean age. 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 age composition time series is denoted in each panel. See Carvalho et al. (2021) for additional details.

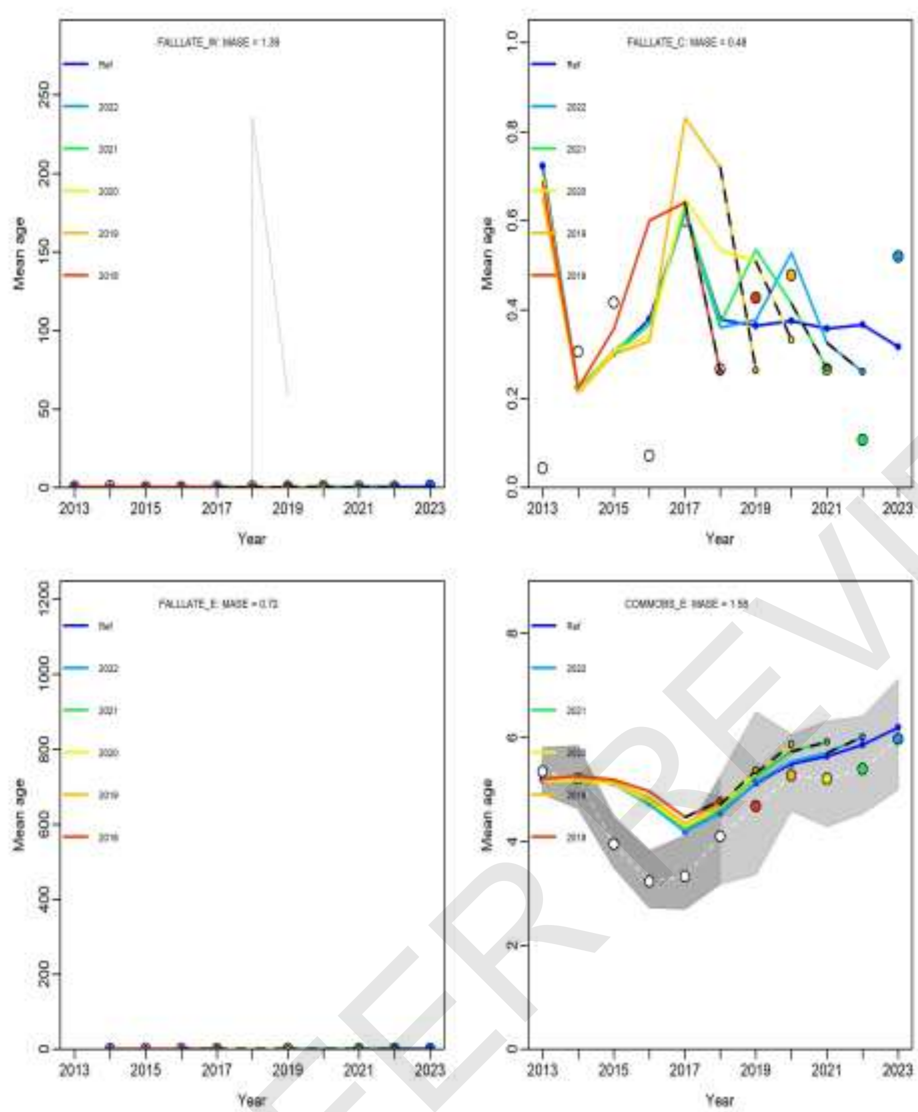


Figure 165 Continued. Hindcasting cross-validation (HCxval) results for fits to annual mean age estimates for Gulf of America Red Snapper. Shown are observed (large points connected with dashed line), fitted (solid lines) and one-year ahead forecast values (small terminal points). HCxval was performed using one reference model (Ref) and five hindcast model runs (solid lines) relative to the expected mean age. 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 age composition time series is denoted in each panel. See Carvalho et al. (2021) for additional details.

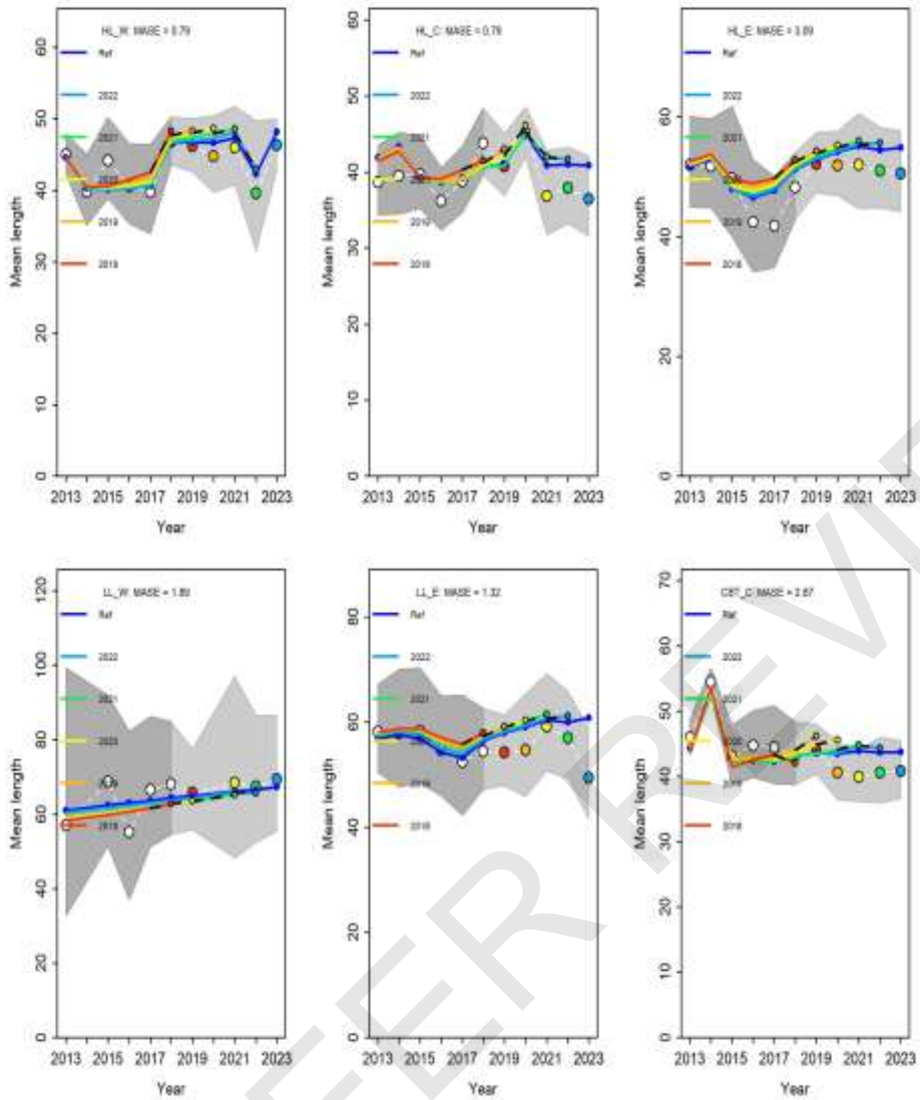


Figure 166. Hindcasting cross-validation (HCxval) results for fits to annual mean age estimates for Gulf of America Red Snapper. Shown are observed (large points connected with dashed line), fitted (solid lines) and one-year ahead forecast values (small terminal points). HCxval was performed using one reference model (Ref) and five hindcast model runs (solid lines) relative to the expected mean age. 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 age composition time series is denoted in each panel. See Carvalho et al. (2021) for additional details.

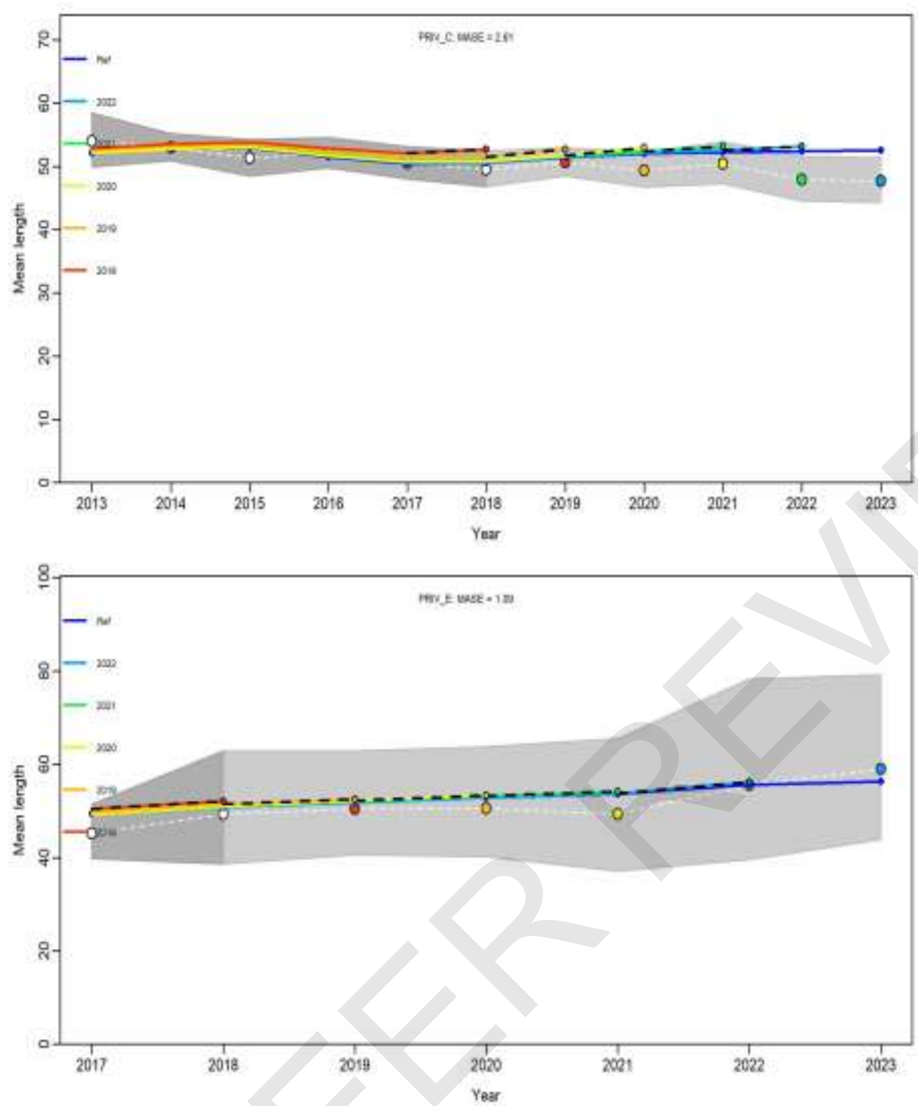


Figure 166 Continued. Hindcasting cross-validation (HCxval) results for fits to annual mean age estimates for Gulf of America Red Snapper. Shown are observed (large points connected with dashed line), fitted (solid lines) and one-year ahead forecast values (small terminal points). HCxval was performed using one reference model (Ref) and five hindcast model runs (solid lines) relative to the expected mean age. 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 age composition time series is denoted in each panel. See Carvalho et al. (2021) for additional details.

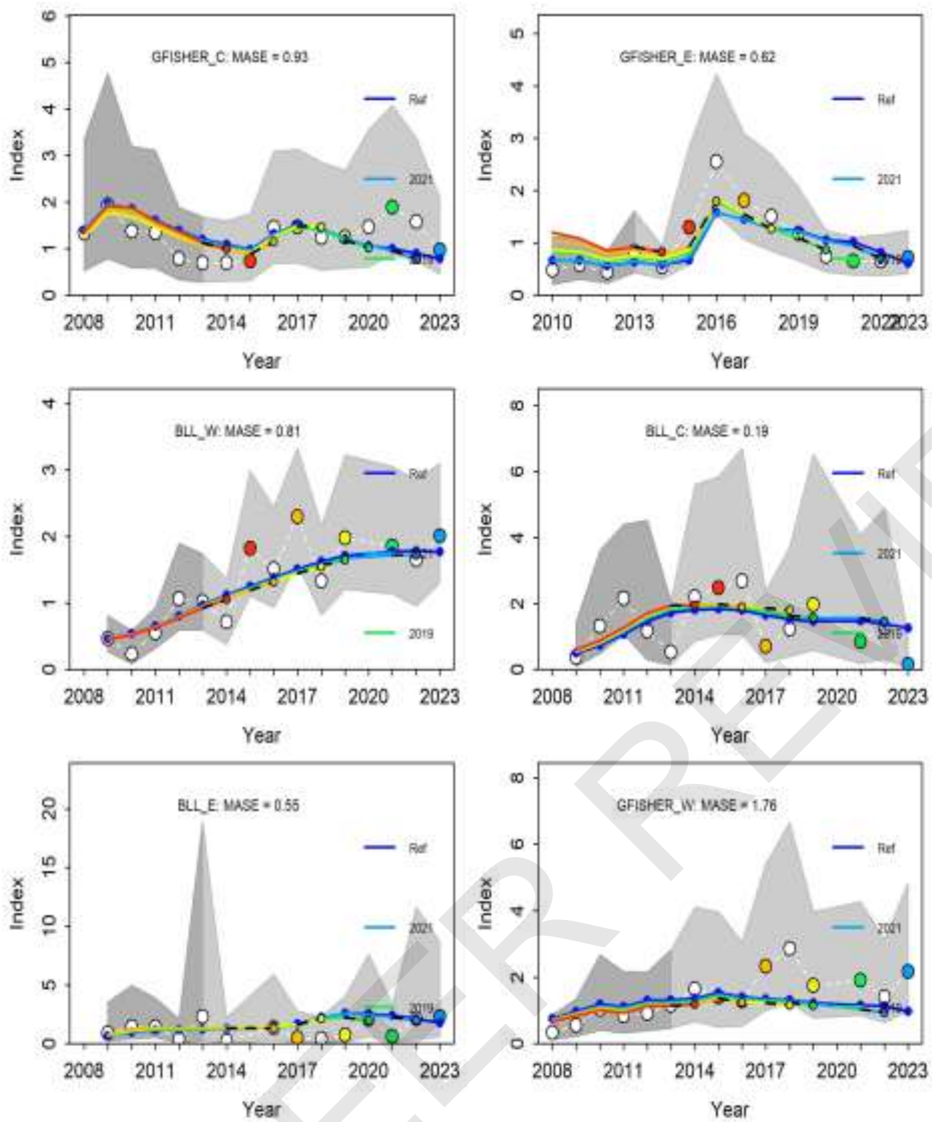


Figure 167. Hindcasting cross-validation (HCxval) results for indices of abundance fits for Gulf of America Red Snapper. Shown are observed (large points connected with dashed line), fitted (solid lines) and one-year ahead forecast values (small terminal points). HCxval was performed using one reference 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.

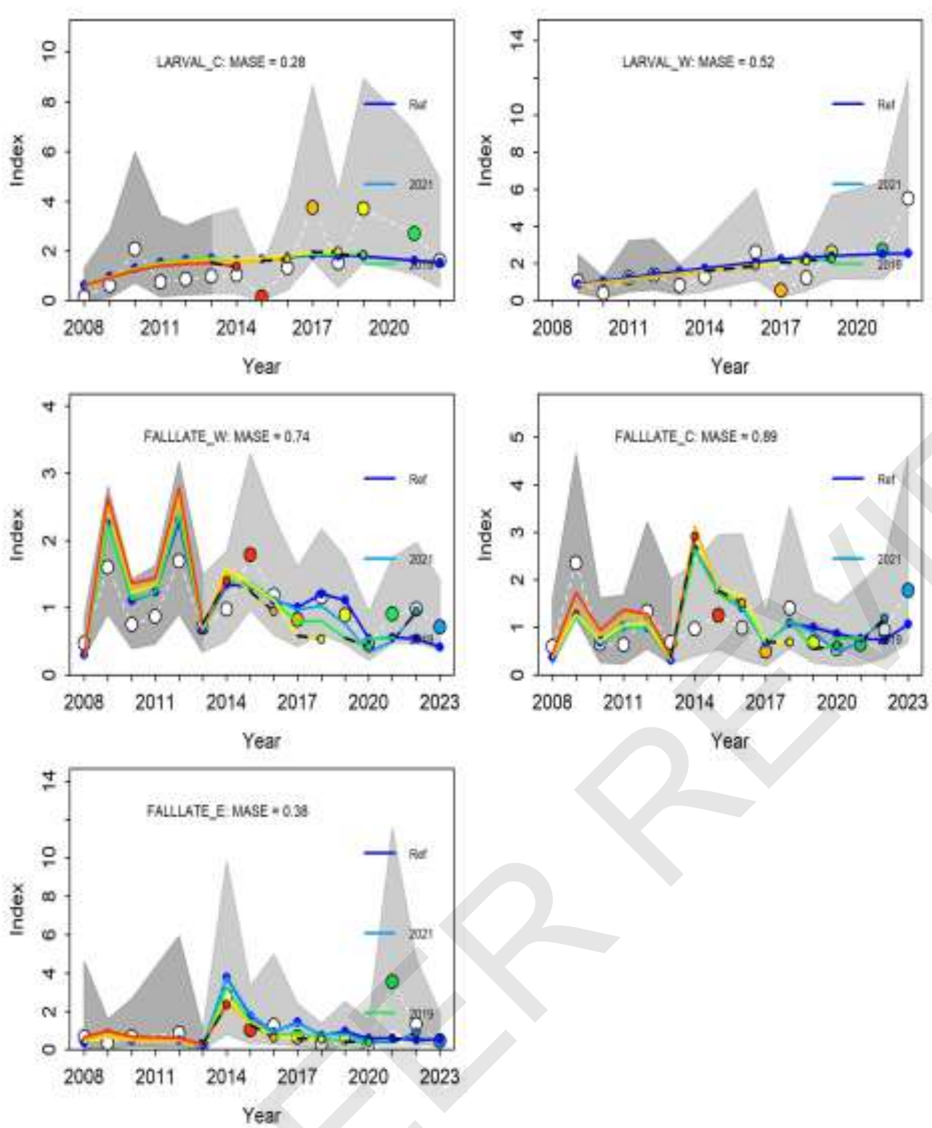


Figure 167 Continued. Hindcasting cross-validation (HCxval) results for indices of abundance fits for Gulf of America Red Snapper. Shown are observed (large points connected with dashed line), fitted (solid lines) and one-year ahead forecast values (small terminal points). HCxval was performed using 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.

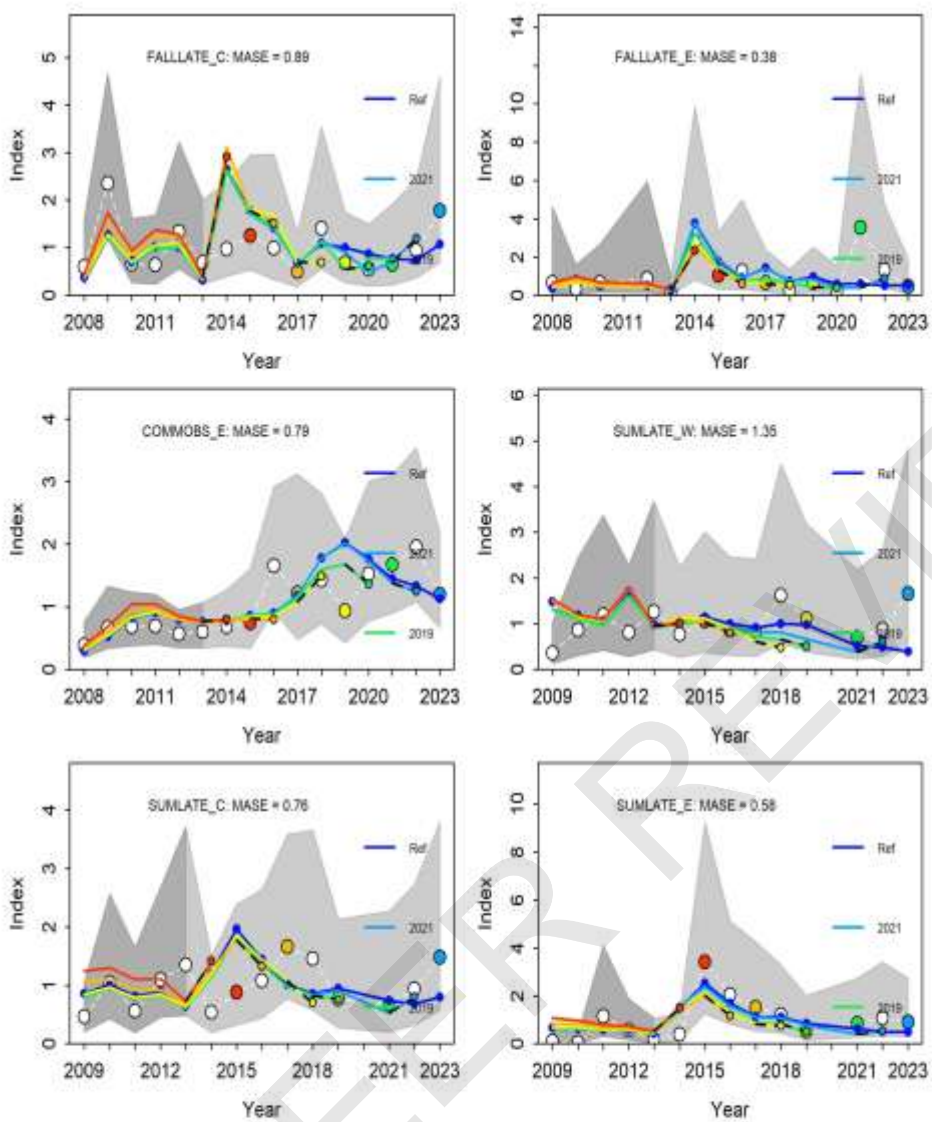


Figure 167 Continued. Hindcasting cross-validation (HCxval) results for indices of abundance fits for Gulf of America Red Snapper. Shown are observed (large points connected with dashed line), fitted (solid lines) and one-year ahead forecast values (small terminal points). HCxval was performed using 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.

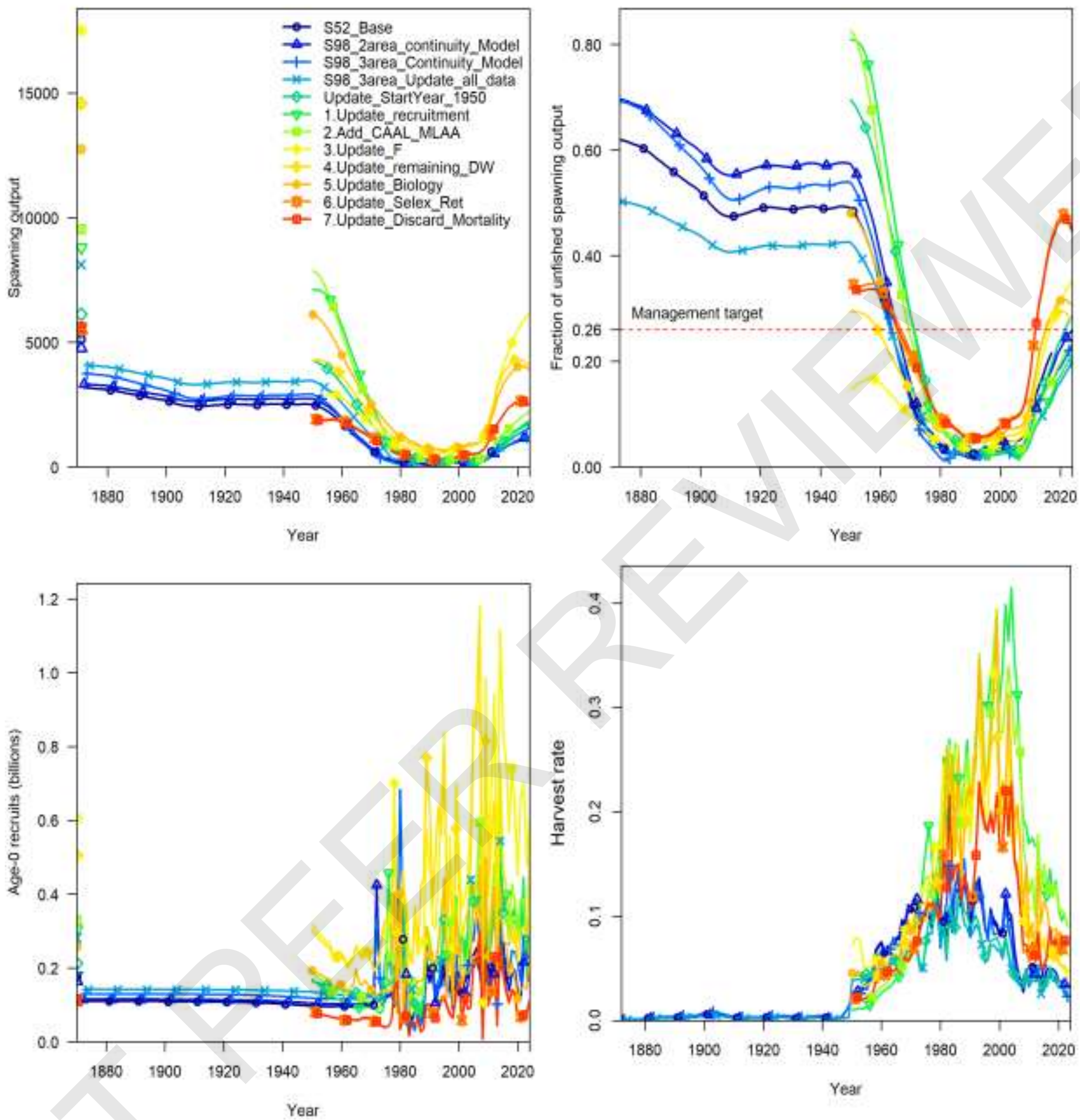


Figure 168. Continuity and bridging analysis model comparison.

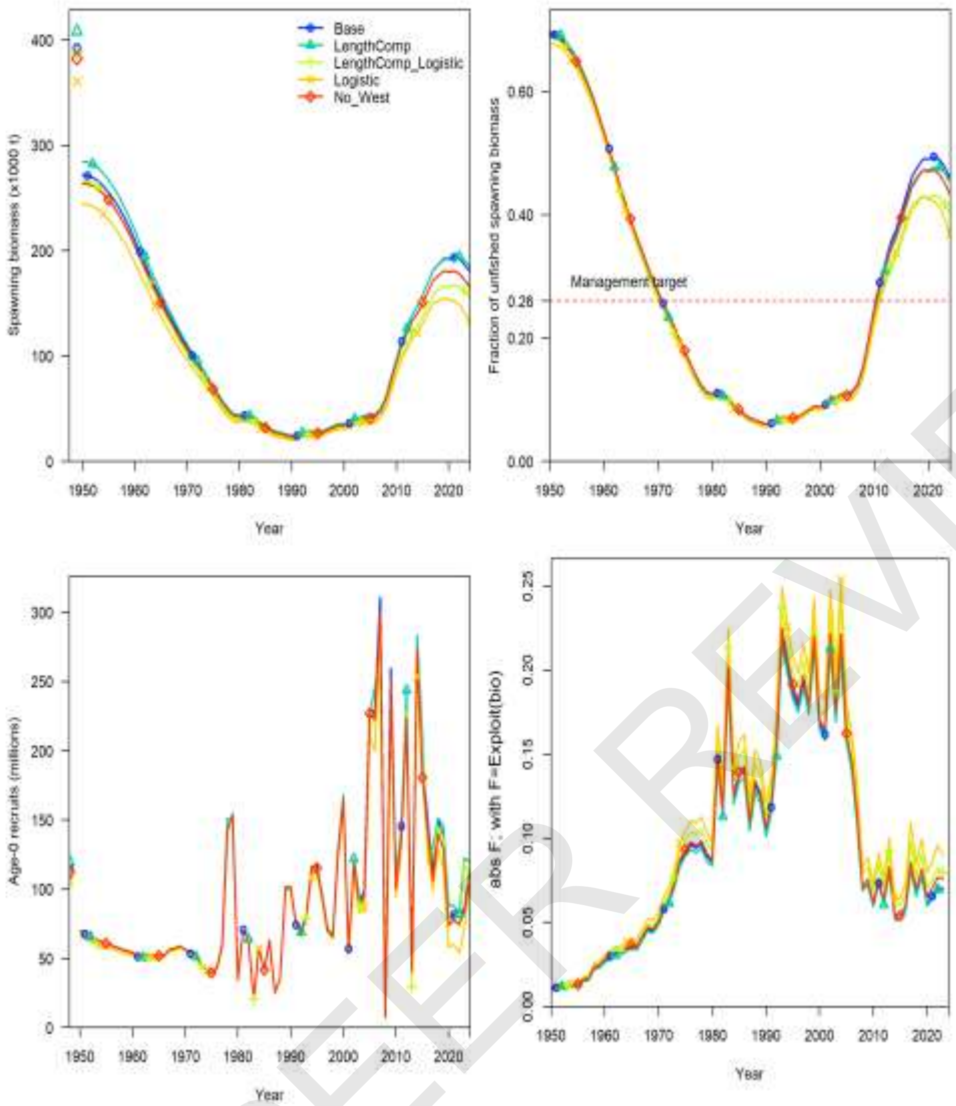


Figure 169. Estimates of spawning stock biomass (males and females combined in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed age 1+ / total biomass age 1+; bottom right panel) for the sensitivity runs evaluating the G-FISHER Video Survey conducted for the SEDAR 98 Base Model for Gulf of America Red Snapper.

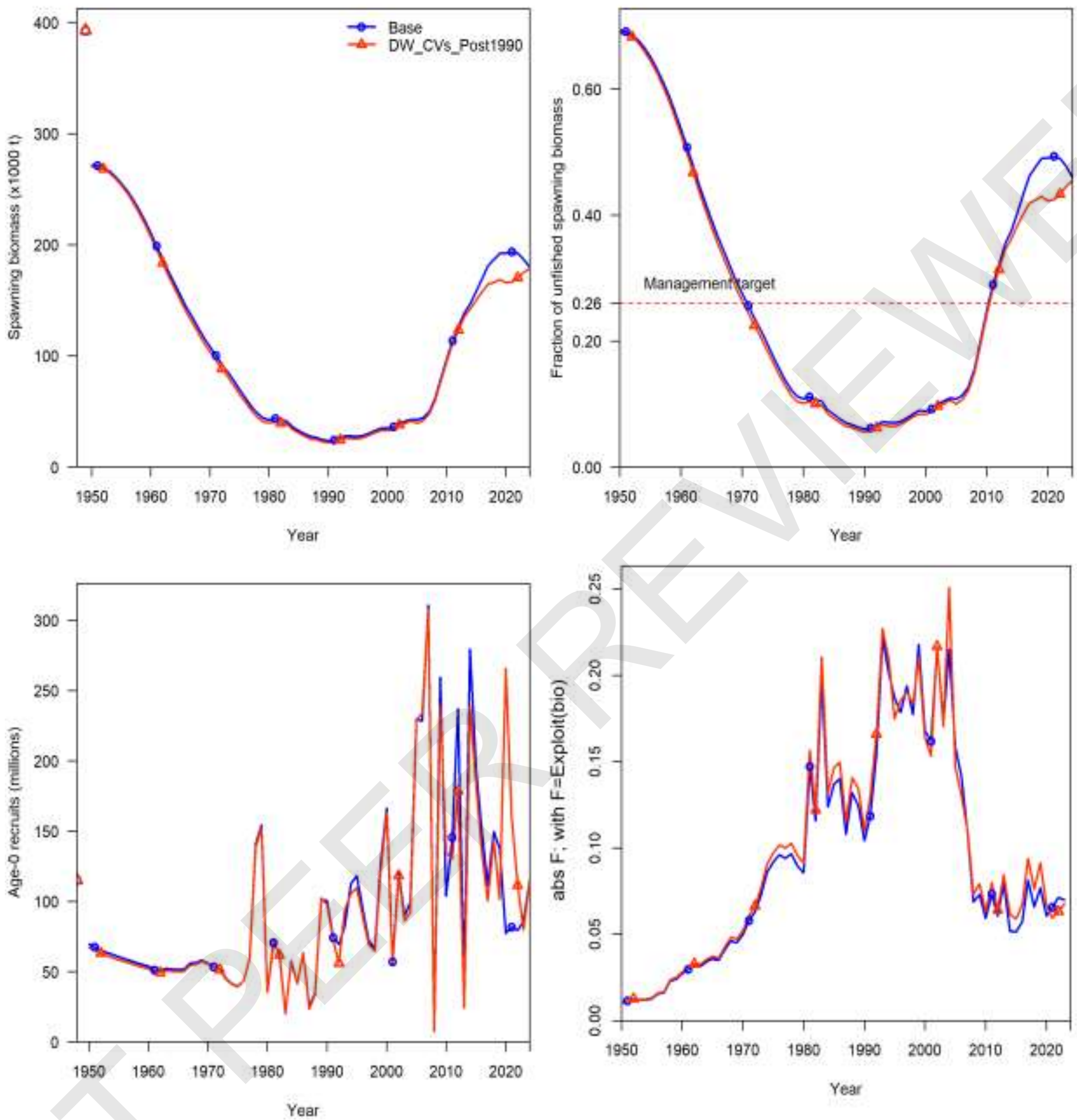


Figure 170. Estimates of spawning stock biomass (males and females combined in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed age 1+ / total biomass age 1+; bottom right panel) for the sensitivity runs evaluating the catch coefficients of cariation conducted for the SEDAR 98 Base Model for Gulf of America Red Snapper.

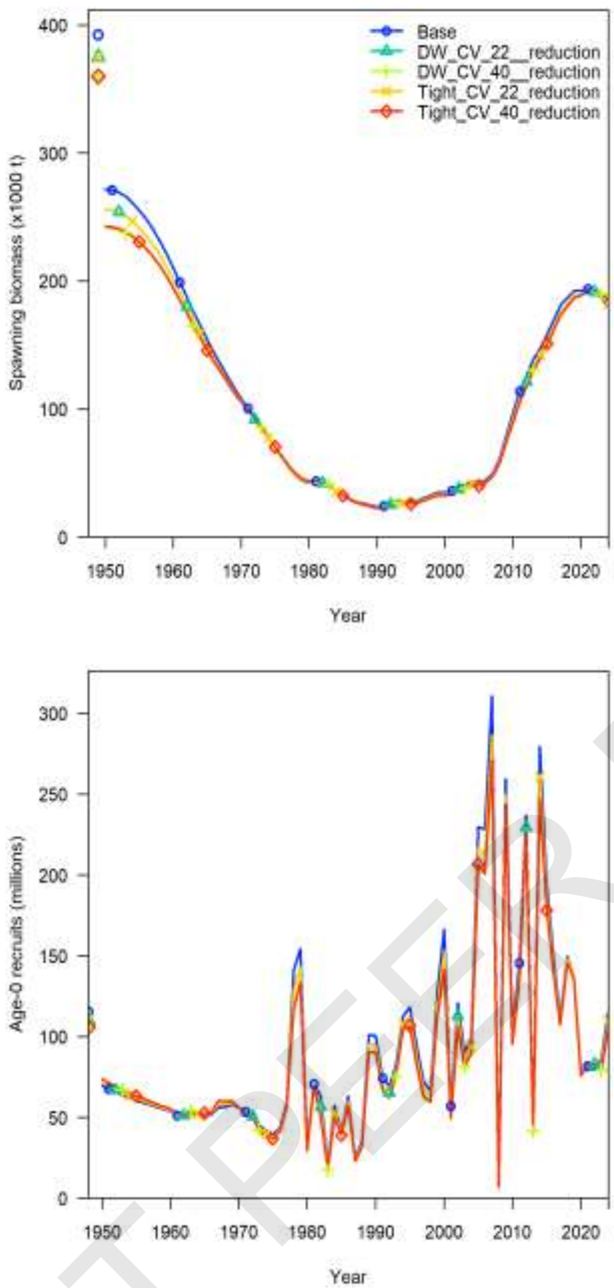


Figure 171. Estimates of spawning stock biomass (males and females combined in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed age 1+ / total biomass age 1+; bottom right panel) for the sensitivity runs evaluating the change in FES landings magnitude conducted for the SEDAR 98 Base Model for Gulf of America Red Snapper.

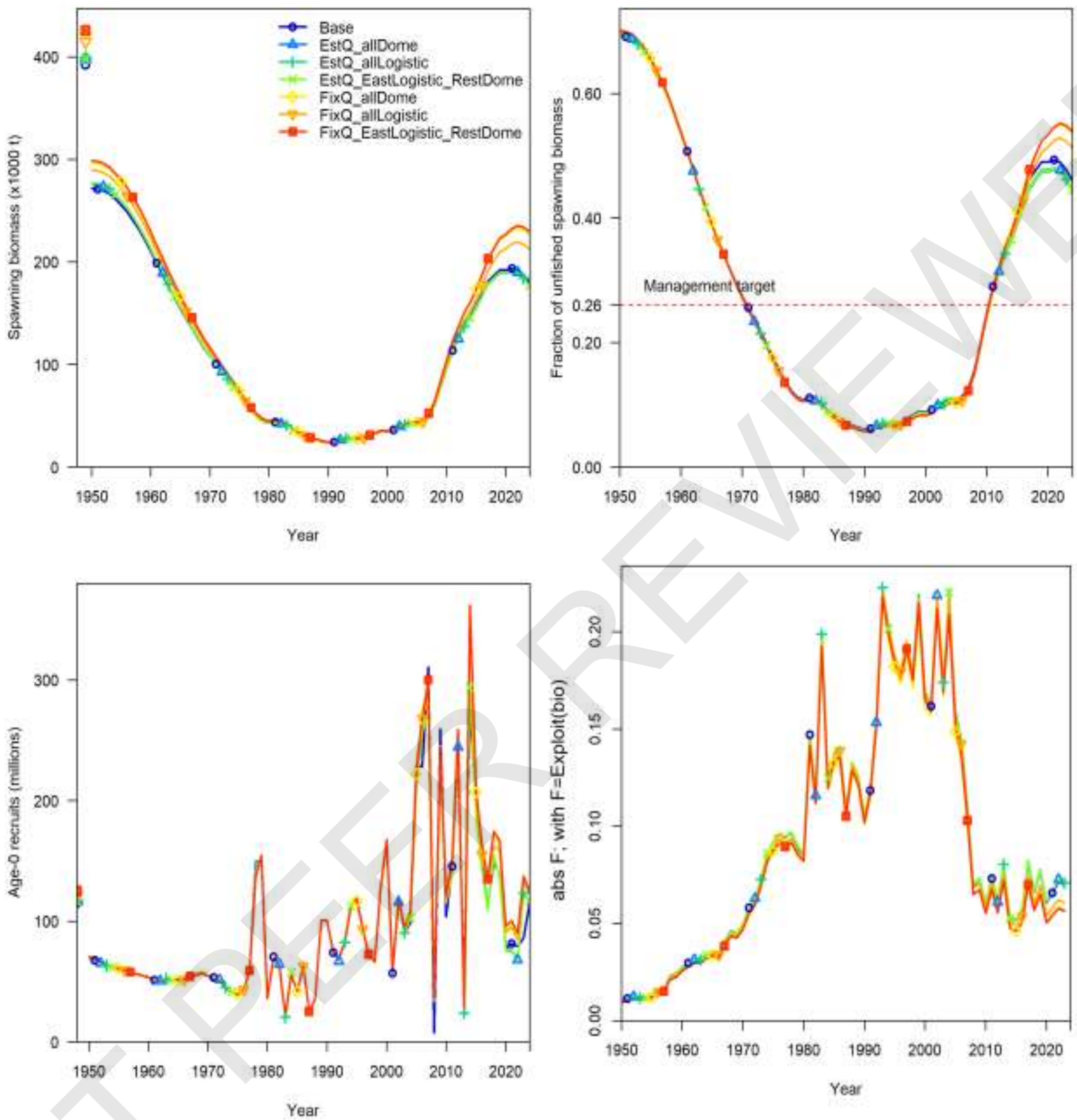


Figure 172. Estimates of spawning stock biomass (males and females combined in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed age 1+ / total biomass age 1+; bottom right panel) for the sensitivity runs evaluating the inclusion of the GRSC and length composition data, conducted for the SEDAR 98 Base Model for Gulf of America Red Snapper.

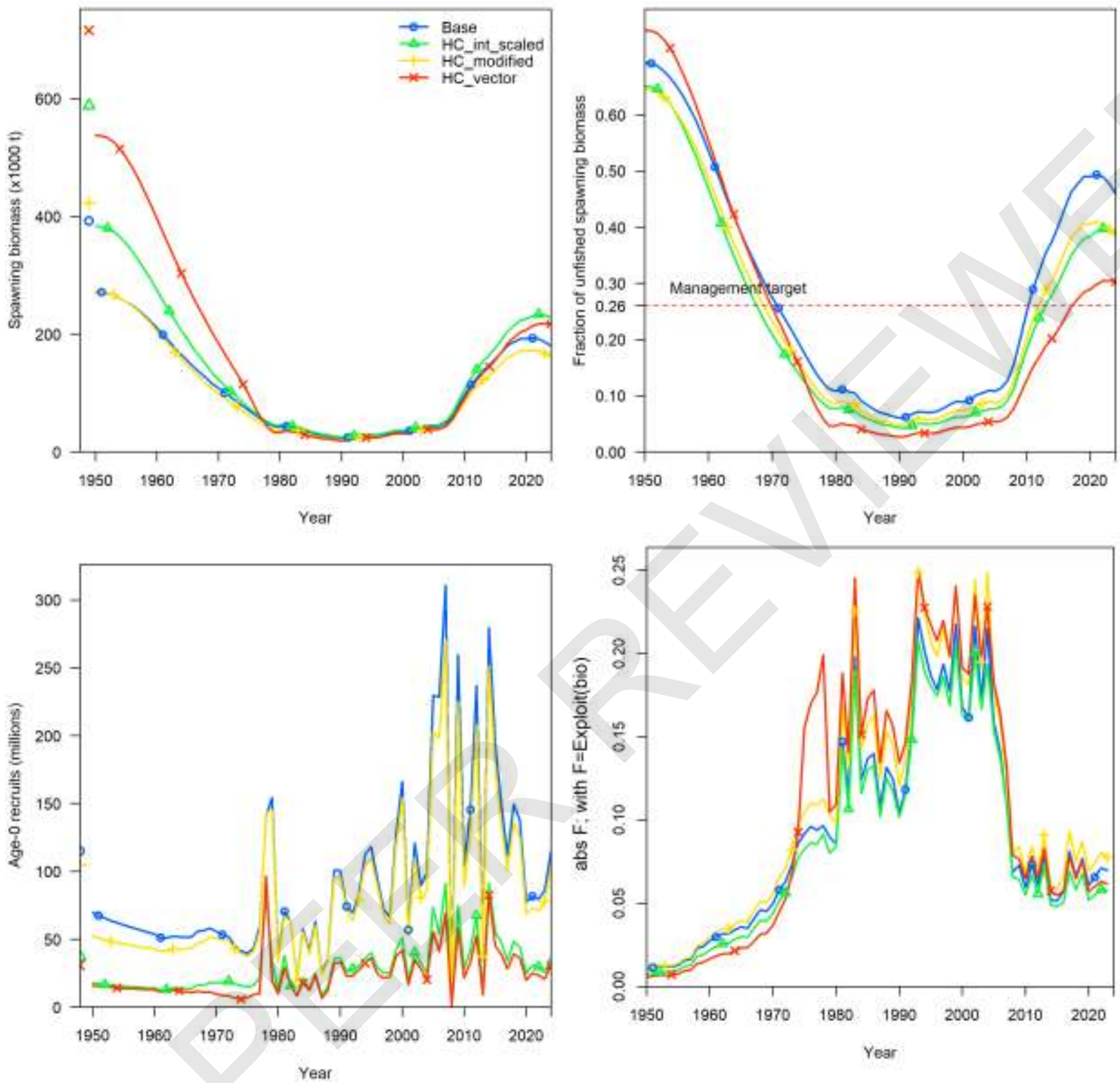


Figure 173. Estimates of spawning stock biomass (males and females combined in 1,000s of metric tons; top left panel), the ratio of SSB to virgin SSB (top right panel), recruitment (millions of fish; bottom left panel), and fishing mortality (total biomass killed age 1+ / total biomass age 1+; bottom right panel) for the sensitivity runs evaluating the use of the Hamel & Cope naural mortality estimate for the SEDAR 98 Base Model for Gulf of America Red Snapper.

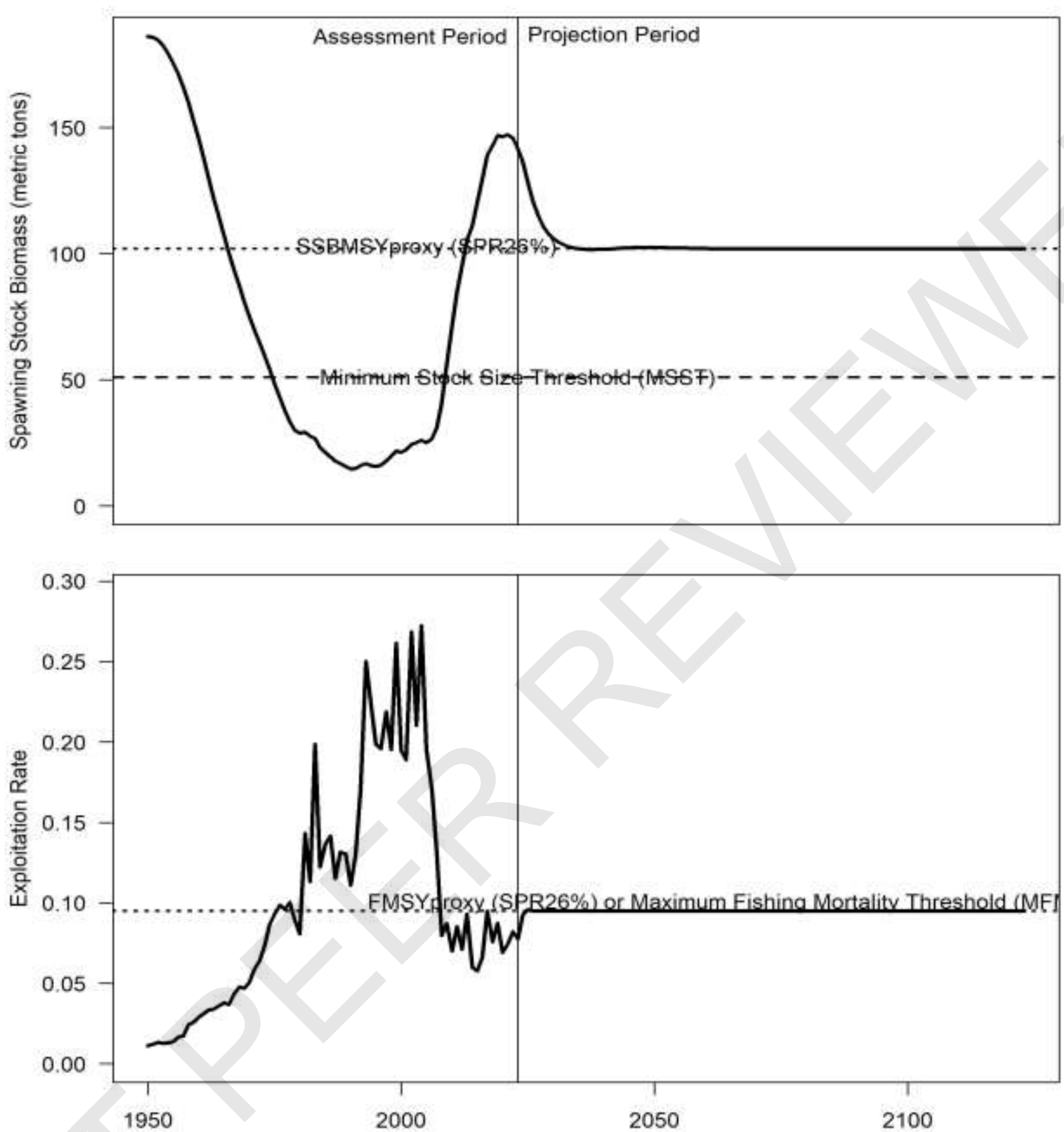


Figure 174. Time series of SSB (males and females combined) and exploitation rate (total biomass killed age 1+ / total biomass age 1+) with respect to status determination criteria for the SEDAR 98 Gulf of America Red Snapper .

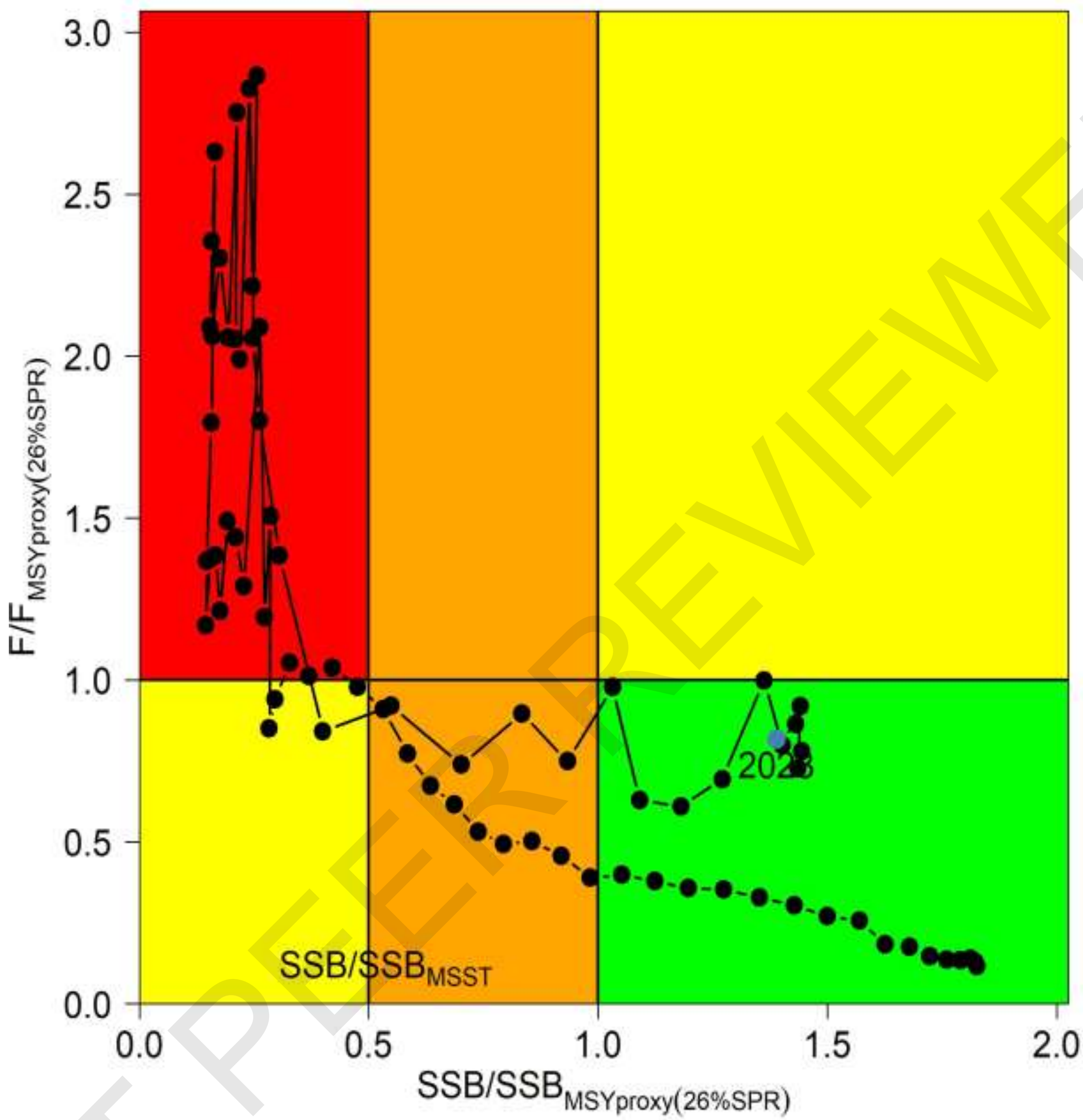


Figure 175. Kobe plot illustrating the trajectory of stock status for Gulf of America Red Snapper. The orange coloring indicates regions where the stock is below the biomass target but above the biomass threshold (MSST = 0.5 x $SSB_{30\%SPR}$). The 2023 terminal year stock status is indicated by the gray dot. See Table 84 for values. SSB defined as males and females combined.

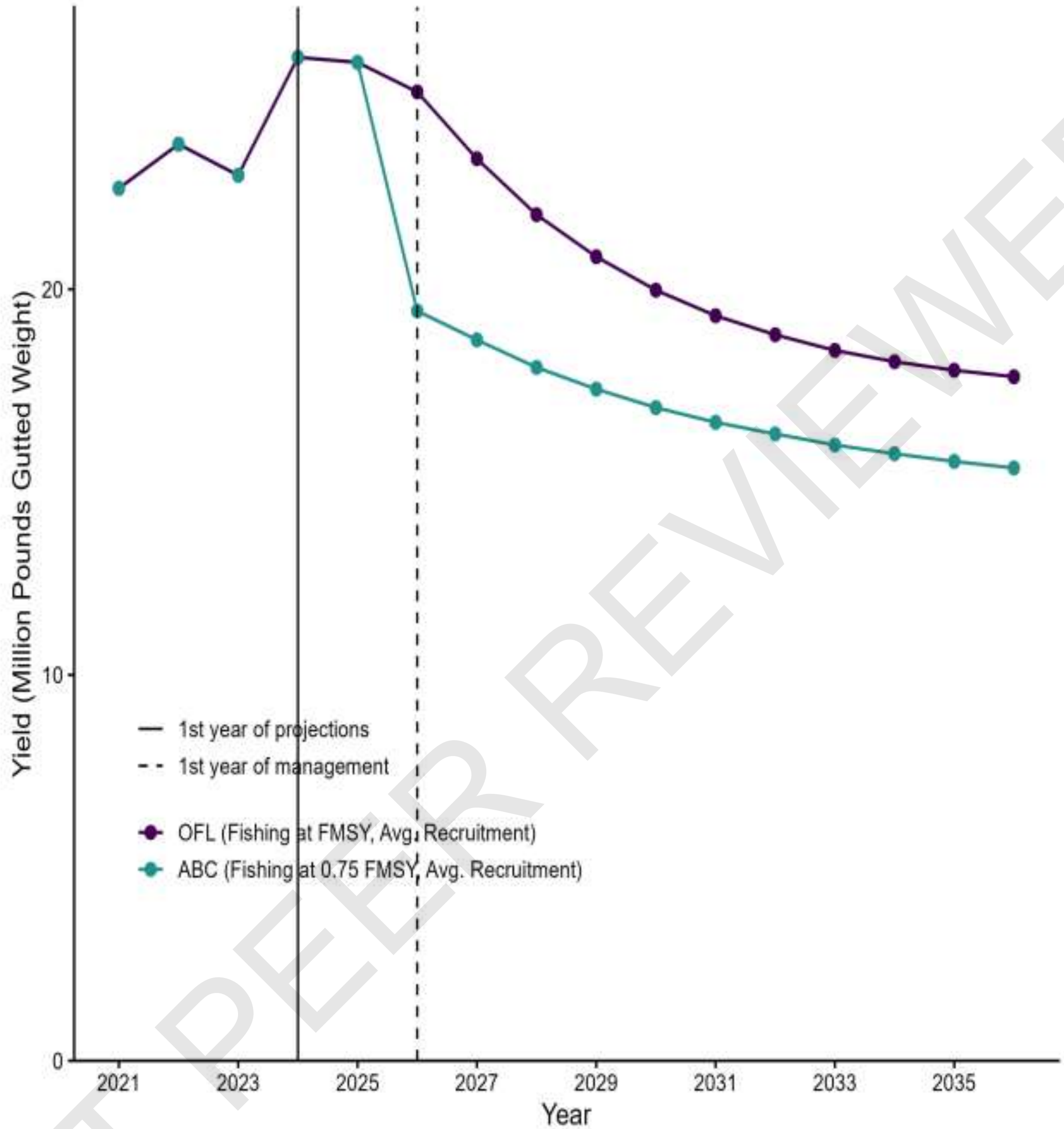


Figure 176. Historic, interim and forecasted yields (2033+) for the OFL and OY projections for Gulf of America Red Snapper with recruitment predicted by the spawner-recruit curve.