SEDAR

Southeast Data, Assessment, and Review

SEDAR 100

Gulf Gray Triggerfish

SECTION II: Data Workshop Report

February 2026

SEDAR
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1 INTRODUCTION

1.1 WORKSHOP TIME AND PLACE

The SEDAR 100 Data Workshop was held August 19-22, 2025, in Tampa, FL. In addition to the in-person workshop, a series for webinars were held before (May and July 2025) and after (September 2025) the meeting. The Data Workshop report was scheduled to be completed in early November 2025 but due to a lapse in funding for NOAA, it was delayed.

1.2 TERMS OF REFERNCE

<u>Objective:</u> Evaluate and revise the SEDAR 43 Gulf gray triggerfish base model, with data through 2024, where possible. Employ assessment best practices and necessary revisions in order to provide a model that describes the population dynamics of the stock and is capable of producing management advice.

1. Explore the appropriateness of an age-based, length-based, and hybrid (age- and length-based) approaches for describing fleet and survey selectivity.
2. Use the Marine Recreational Information Program's Access Point Angler Intercept Survey and Fishing Effort Survey to inform catch and effort for the recreational sector. Consider state-specific catch, effort, and discards from state surveys as applicable (Florida: State Reef Fish Survey; Alabama: Snapper Check; Mississippi: Tails 'n Scales [effort]; Louisiana: LA Creel; Texas: TPWD Creel).
    - Describe any annual differences in the magnitude of landings from the previous assessment greater than 10%, with assistance from the NOAA Office of Science and Technology.
3. Review available life history information, including the ageing methodology. Update growth curves, age and length data, and the natural mortality estimates.
    - Summarize, describe, and tabulate length and age data by year and fleet/survey and area through the terminal year of the assessment where possible.
    - Explore the validity and representativeness of length and age data and ageing methodology across ageing facilities and cooperators.
    - Explore differences in growth parameters if length and/or age sampling methods differ from the previous assessment. Utilize appropriate models and diagnostics to describe sex, population and region-specific growth, as warranted and applicable.
    - Develop age-length keys and Conditional Age at Length as appropriate.

- Evaluate and discuss the sources of uncertainty and error, and data limitations (such as temporal and spatial coverage) for each data source.
- Provide estimates or ranges of uncertainty for length and age data as a whole and by area and source.

4. Provide fishery-independent measures of population abundance developed through the terminal year where possible.
    - Evaluate the G-FISHER composite video index for use in the assessment.
    - Consider any changes to the fishery-independent indices comprising the GFISHER index as provided for the previous assessment and evaluate the representativeness through time of the composition data.
    - Evaluate the compositions available. Recommend modifications needed to inform differences in catchability and selectivity of the surveys.
    - Provide appropriate measures of uncertainty for all fishery-independent abundance indices and effort time series considered.
5. Provide commercial catch statistics for both the Eastern and Western Gulf, including both landings and discards in both pounds and number extended through the terminal year. Provide a corresponding working paper for the data and analyses with the following:
    - Evaluate and discuss the adequacy of available data for accurately characterizing landings and discards by fishery sector or gear in pounds whole weight.
    - Provide length and age distributions for both landings and discards, if feasible.
    - Provide estimates of uncertainty around each set of landings and discard estimates.
6. Utilize the new estimates of shrimp fishery effort and bycatch, as appropriate, based on the peer review of such data from SEDAR 87 and subsequent analyses.
7. Document any change in start year from previous assessments
    - Evaluate the existing composition data and recommend whether the data are sufficient to represent the bycatch by the fleet.
8. Document all new methodologies:
    - Address program objectives, methods, coverage, sampling intensity, and other relevant characteristics.
9. Provide recommendations for future research in areas such as sampling, fishery monitoring, and stock assessment. Include guidance on sampling intensity and appropriate strata and coverage.
10. Prepare a Data Workshop report providing complete documentation of workshop actions and decisions in accordance with project schedule deadlines.

1.3 LIST OF PARTICIPANTS

Assessment Team

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Katie Siegfried .... SEFSC/NMFS
Eliza Syaharani ....

1.4 LIST OF DATA WORKSHOP WORKING PAPERS & REFERNCE DOCUMENTS

Document #	Title	Authors	Date Submitted
Documents Prepared for the Data Workshop			
SEDAR100-DW-01	Headboat Data for Gray Triggerfish in the Gulf of America	Rob Cheshire	6 August 2025 Updated: 12 August 2025
SEDAR100-DW-02	General Recreational Survey Data for Gray Triggerfish in the Gulf of America	Samantha M. Binion-Rock	15 August 2025
SEDAR100-DW-03	Historical (1955-1980) Recreational Landings for Gulf of America Gray Triggerfish (*Balistes capriscus*) estimated using the FHWAR Census Method	Samantha M. Binion-Rock	14 August 2025
SEDAR100-DW-04	Gulf of America Gray Triggerfish (*Balistes capriscus*) length and age compositions from the recreational fishery	Samantha M. Binion-Rock	12 August 2025 Updated: 10 December 2025
SEDAR100-DW-05	Commercial Landings of Gulf of America Gray Triggerfish (*Balistes capriscus*) from 1949 - 2024	Micki Pawluk and Sarina Atkinson	5 August 2025
SEDAR100-DW-06	CPUE Expansion Estimation for Commercial Discards of Gulf of America Gray Triggerfish	Kevin Thompson, Sarina Atkinson, Gary Decossas	6 August 2025
SEDAR100-DW-07	Gulf of America Gray Triggerfish (*Balistes capriscus*) Length and Age Compositions for the Commercial Handline and Longline Fisheries	Micki Pawluk	7 August 2025 Updated: 20 January 2026
SEDAR100-DW-08	Proxy Discard Estimates of Gray Triggerfish (*Balistes capriscus*) from the US Gulf of America Headboat Fishery	Nuttall, MA	14 August 2025
SEDAR100-DW-09	Standardized Catch per Unit Effort for US Gulf of America Gray Triggerfish (*Balistes capriscus*) from the Southeast Region Headboat Survey	Nuttall, MA	15 August 2025
SEDAR100-DW-10	Social Dimensions of Gray Triggerfish (*Balistis capriscus)* in the Gulf and South Atlantic	David Griffith	7 August 2025

SEDAR100-DW-11	A Summary of Gulf Gray Triggerfish Discard Length Data Collected from At-Sea Observers in For-Hire Fishery Surveys in Florida 2005-2024	Ellie Corbett	8 August 2025
SEDAR100-DW-12	A ratio-based method for calibrating estimates of total landings (numbers and pounds of fish), releases (numbers of fish), and total trips from MRIP-FCAL to SRFS for Gulf Gray Triggerfish (*Balistes capriscus*)	Maria McGirl and Chloe Ramsay	11 August 2025
SEDAR100-DW-13	Length and age compositions of Gulf Gray Triggerfish, *Balistes capriscus*, collected in association with fishery-dependent projects	Maria McGirl, Jessica Carroll, and Bridget Cermak	11 August 2025 Updated: 15 August 2025
SEDAR100-DW-14	A Review of Gray Triggerfish (*Balistes capriscus*) Age-length Data in the Gulf of America, 1999-2024	Ashley Pacicco, Steve Garner, Ryan Nichols	14 August 2025
SEDAR100-DW-15	Standardized catch rates of Gray Triggerfish from the United States Gulf of America commercial handline fishery, 1993-2024	Kevin Thompson and Michaela Pawluk	18 August 2025
SEDAR100-DW-16	Gray Triggerfish Abundance Indices from SEAMAP Groundfish Surveys in the Northern Gulf of America	Adam G. Pollack and David S. Hanisko	15 August 2025 Updated: 18 December 2025
SEDAR100-DW-17	Gulf of America gray triggerfish (*Balistes capriscus*) post-release mortality based on long-term conventual tagging	A. Challen Hyman, Chloe Ramsay, and Thomas K. Frazer	19 August 2025 Updated: 2 September 2025
SEDAR100-DW-18	Indices of abundance for Gulf Gray Triggerfish (*Balistes capriscus*) using data from multiple video surveys	Katherine E. Overly, Heather M. Christiansen, Sean F. Keenan, Theodore S. Switzer, Justin Lewis, Matthew D. Campbell	2 September 2025 Updated: 3 September 2025
SEDAR100-DW-19	Gray Triggerfish (*Balistes capriscus*) indices of relative abundance from	David S. Hanisko, Glenn Zapfe, Adam	3 September 2025

	SEAMAP Fall Plankton Surveys, 1986 to 2023	G. Pollack and Denice M. Drass	
SEDAR100-DW-20	Public comments received via the online comment form during the data process		2 September 2025
SEDAR100-DW-21	Fisherman Feedback: Gray Triggerfish Response Summary	Gulf Council Staff	4 November 2025
SEDAR100-DW-22	Estimation of Gray Triggerfish Bycatch from Gulf of America Shrimp Trawls	Cheston T. Peterson, Carly Daiek, Kyle Dettloff, Steve G. Smith, and Sarina Atkinson	12 December 2025

Reference Documents

SEDAR100-RD01	Application of three-dimensional acoustic telemetry to assess the effects of rapid recompression on reef fish discard mortality	Erin Collings Bohaboy, Tristan L. Guttridge, Neil Hammerschlag, Maurits P. M. Van Zinnicq Bergmann, and William F. Patterson III
SEDAR100-RD02	Cooperative Research Program Final Report: Estimating Gulf of Mexico Gray Triggerfish Release Mortality and Its Mitigation with Three-Dimensional Acoustic Telemetry	William F. Patterson III, Derek W. Chamberlin, and Miaya Taylor
SEDAR100-RD03	Bomb ^{14}C validates Gray Triggerfish (*Balistes capriscus*) dorsal spine and otolith ageing protocols	Derek W. Chamberlin, Jennifer C. Potts, Walter D. Rogers, Zachary A. Siders, William F. Patterson III
SEDAR100-RD04	Bayesian estimation of von Bertalanffy growth parameters for gray triggerfish, *Balistes capriscus*, incorporating multiple readers and ageing structures	Derek W. Chamberlin, Zachary A. Siders, Jennifer C. Potts, Walter D. Rogers, Miaya A. Taylora, and William F. Patterson, III
SEDAR100-RD05	Low discard survival of gray triggerfish in the southeastern US hook-and-line fishery	Brendan J. Runde, Paul J. Rudershausen, Beverly Sauls, Chloe S. Mikles, Jeffrey A. Buckel
SEDAR100-RD06	Characterization of the U.S. Gulf of Mexico and South Atlantic Penaeid and Rock Shrimp Fisheries Based on Observer Data	Elizabeth Scott-Denton, Pat F. Cryer, Matt R. Duffy, Judith P. Gocke, Mike R. Harrelson, Donna L. Kinsella, James M. Nance, Jeff R. Pulver, Rebecca C. Smith, and Jo A. Williams

2 LIFE HISTORY

2.1 OVERVIEW

The life history working group (LHWG) met to review and discuss all life history data available for gray triggerfish at the SEDAR100 data workshop. New information on age, length, growth, natural mortality, and meristic conversions from data collected since the previous assessment in 2015 (terminal year 2013) was updated and examined to provide recommendations to the stock assessment panel. Data quality was examined with exploratory analyses to evaluate temporal and spatial representativeness. Specifically, the LHWG examined the data to look for issues within the available data types (e.g., length, age, compositions, etc.) as well as periods of low sample size resulting in poor data quality specific to each fleet in either region (East or West) or combined Gulfwide. The LHWG also assessed the impact of a new spine-ageing methodology, implemented for SEDAR100, on length-at-age and subsequent data products. A summary of the data presented, discussed, and recommendations made by the LHWG is presented in this document. Metadata submitted for SEDAR100 (1999-2024) follow the SEDAR Best Practices Template developed in December 2022.

2.1.1 Work Group members and participants in Life History webinars

Lisa Ailloud - NOAA Fisheries, Charleston, SC

Samantha Binion-Rock - NOAA Fisheries, Beaufort, NC

Bridget Cermak- Florida and Wildlife Conservation Commission, St. Petersburg, Florida

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Ashley Pacicco - CIMAS in support of NOAA Fisheries, Panama City, FL (Group Lead)

William Patterson III - University of Florida, Gainesville, FL

Michaela Pawluk - NOAA Fisheries, Galveston, TX

2.1.2 Topics Reviewed by the Life History Group

1. Morphometrics
2. Length-at-age data
3. Calendar age assignment
4. Growth
5. Reader Precision/Ageing Error
6. Natural Mortality
7. Length Compositions
8. Age Compositions

9. Reproduction
10. Research Recommendations

2.2 MORPHOMETRICS

All morphometric conversion equations were updated for SEDAR100 (Table 2.13.1) due to the quantity of length and weight data collected since they were last estimated for SEDAR43 (2003-2013). Despite the large increase in data quantity, the estimated regression model parameters were very similar for length-length and length-weight conversions compared to previous estimates. Although all length-length conversion equations were updated, fork length (FL, mm), either observed or predicted, was used for final length. If an observed FL was not recorded, an alternative available length measurement was converted to FL based on the approach used in SEDAR43: 1) observed natural total length, 2) observed maximum total length; or 3) observed standard length. If an observed whole weight (WWt, g) was not recorded, it was converted from final FL (observed or converted) following the morphometric equations updated during SEDAR100 (Table 2.13.1; Figure 2.14.1). A conversion equation from gutted weight to whole weight was not provided in SEDAR43 and was not developed for SEDAR100. Only n = 9 records did not have any final length or weight estimate (see SEDAR100-DW-14).

2.2.1 Recommendations for SEDAR 100

The LHWG recommends using the updated meristic equations developed during SEDAR100 given the length of time since they were last updated and the large increase in sample sizes used to develop the parameter estimates.

2.3 LENGTH-AT-AGE DATA

Life history data submitted for SEDAR100 were provided by both federal (NMFS Panama City) and state agencies (Florida Fish and Wildlife Research Institute (FWRI), the Gulf Fisheries Information Network (GulfFIN), and Dauphin Island Sea Lab/University of South Alabama (USA/DISL), Table 2.13.2). Of the n = 20,544 available samples, n = 19,407 had an age estimate; spines deemed unreadable were not included in this total. NMFS Panama City contributed the majority of age estimates (61.54%) followed by GulfFIN (26.24%). The dataset includes historical data submitted from previous assessments (SEDAR 9, 2006; SEDAR 43, 2015), which included years 1999-2013 in addition to new data to be considered for 2014 to 2024. No samples were collected in 2001. Of the samples with a valid age estimate, n=5,812 samples had unique sampling interviews, belonging to fishery-dependent (FD) (79.64%), fishery-independent (FI) (20.32%), or unknown (0.04%) sources (see SEDAR100-DW-14). All available samples had a value for the state landed category, with n = 4,480 samples having a specific catch location (i.e., latitude and longitude). The state with the highest number of samples was FL (57.82%), followed by Alabama (15.38%). Not landed (NL) was recorded for 5.78% of the FI samples collected via scientific survey (sampling program= FWRI-FIM; data provider=FWRI). However, these fish were assumed to come from FL as FWRI only samples from state or federal waters off of FL. The eastern Gulf (state landed = FL, AL, MS, and NL [assumed FL]) had a disproportionately higher number of samples (79.4%) compared to the western Gulf (state landed = LA, TX; 20.6%; Figure 2.14.2). Most spine samples were collected from the recreational (REC) fishery (47.95%) followed by the commercial (COM) fishery (31.69%) and those collected by fishery-independent (FI) surveys (20.32%). Very few samples were collected from unknown sources (0.04%). The majority of samples were collected from fish caught with handline (HL) gear (81.69%) followed by trap (TR; 6.45%) or longline (LL; 4.61%) gear (see SEDAR 100-DW-14). Samples collected at the beginning of the time series (1999-2000, 2002) were caught via neuston nets (NEU) deployed during scientific surveys (data provider = DISL/USA, state landed= MS). No samples were collected in 2001. Production ageing began in 2003 at the NMFS Panama City laboratory resulting in dramatic increases in the number of dorsal spines aged per year (Figure 2.14.3). FWRI-FIM and GulfFIN began ageing gray triggerfish spines in 2006 and 2007, respectively.

Dorsal spines were processed following the standard protocol from SEDAR43 and Allman et al. (2018). Edge types varied depending on the data provider, with some noting wide or narrow opaque zones. Otherwise, data providers recorded the edge type as opaque, translucent, or left the category blank. In SEDAR62, all dorsal spine ages were deemed unreliable and excluded from the assessment due to dorsal spine sections significantly underestimating otolith-based ages, specifically for fish aged 5 years and older (Patterson et. al 2019). For SEDAR100, all historical samples (i.e., collected from 1999-2017) originally aged 5 years and older were re-aged. New age data collected from 2018 to 2024 were read using the new dorsal spine ageing method described in Potts et al. (2023). Results from eye lens bomb radiocarbon (^{14}C) analysis validated that the new spine-ageing method (i.e., including compacted bands along the margin in annuli counts for fish age-5+) used in SEDAR100 was comparable to otolith-based age estimates, which are considered more accurate and without bias (Chamberlin et al. 2024).

Gray triggerfish spine age estimates ranged from 0 to 16 years, with the majority of age estimates between 3 and 6 years old (67.47%). A total of 100 samples were older than age-12 and only 1 fish was estimated at age-16. Samples collected via neuston net were collected from floating sargassum mats and all estimated as either age-0 or age-1 fish (n = 66). Fish collected from the COM sector had a mean age (± SD) of 5.65 (± 2.26) years, while fish sampled from the REC fishery had a mean age of 4.92 (± 1.90) years. Sampled fish caught with HL gear were on average 5.00 (± 2.01) years, while sampled fish caught with LL gear had a mean age of 7.04 (± 2.34) years. Overall, length-at-age was highly variable in all year classes from 2003-2024

(Figure 2.14.3). This variability is due in part to natural variability in length-at-age of gray triggerfish but also due to the difficulty in ageing this species because of deposition issues pertaining to compaction of annuli along the margin and the infrequent occurrence of false or paired annuli called "doublets" that do not correspond to a year's worth of otolith deposition.

2.3.1 Recommendations for SEDAR 100

The LHWG recommends that the spine-based age estimates are accepted for use in SEDAR100 as the new age estimates follow the protocol described in Potts et al. (2023) and validated by Chamberlin et al. (2024). This new approach also was accepted for use in SEDAR82 for spine-based age estimates of South Atlantic gray triggerfish.

2.4 CALENDAR AGE ASSIGNMENT

In SEDAR43, gray triggerfish with a capture month from January to June with no visible translucent zones (i.e., age-0) were advanced to calendar age 1. Fish caught from July to December with a final (fork) length ≥160 mm were also advanced to calendar age 1, and fish <160 mm were not advanced (Allman et al. 2019; see SEDAR100-DW-14). The LHWG explored updating the ageing algorithm used for assigning calendar age to reduce mis assignment of young fish to incorrect year classes. Length-frequency histograms by month and calendar-age assignment indicated a large portion of young fish from age-0 to 2 were likely mis assigned using the previous algorithm. Frequency-histograms suggested that fish originally assigned a calendar age of 1 and collected from January through April should have been advanced to calendar age 2. Fish originally assigned a calendar age of 1 and collected from September through December should have been assigned to the previous age class (calendar age 0; Figure 2.14.4). The LHWG identified and investigated two potential sources of error that potentially required adjustment of calendar age assignments:

1. A settlement mark may have been incorrectly identified as a true annulus
2. Incorrect adjustments based on the previous algorithm

To further explore potential settlement mark misidentification, Panama City Lab personnel re-aged dorsal spines for fish with annuli counts of 0 or 1 that were caught from September through December and were < 250 mm FL (n = 134 total; data provider = NMFS Panama City). Trawl-collected, age-0 gray triggerfish showed settlement marks on dorsal spine sections when fish were between 40 and 160-mm FL (Ingram, 2001; SEDAR 9, 2006). The settlement mark can be extremely similar to the first true translucent zone of a dorsal spine annulus in young fish (age-1 and age-2). Fioramonti (2012, Masters Thesis), estimated that the first annulus was 1.5 mm +/- 0.04 mm, and this estimate was used as a guide during visual reinspection by Panama City Lab personnel, which resulted in n = 56 ages being changed from an age-1 to age-0. In response to the first source of error: Panama City Lab personnel also re-aged samples that appeared as potential outliers in the data for fish with an annuli count of 2 that were caught from April through May with a FL >400 mm (data provider NMFS Panama City), which resulted in n = 29 ages being changed to between 3 and 7 years old. In response to the second source of error, the LHWG discussed whether or not to adjust the ageing algorithm used for SEDAR43. Alternative approaches were discussed, such as using edge type assignments to advance or subtract year classes, which is common practice for many other fishery species. However, because a single annual peak in translucent edge formation was not apparent in the data (Figure 2.14.5), coupled with the fact that edge type was not determined or unreliably determined for many samples aged with the previous ageing protocol, the LHWG deemed edge-type assignments an unreliable solution to adjusting the calendar-age algorithm. Otherwise, annuli count equaled calendar age. Edge type was not used to assign calendar age given the inherent difficulty in assigning edge type, which requires estimating the proportion of total annulus formation. Fractional age was calculated using the established birthdate of July 1, which corresponds to the average peak spawning date of gray triggerfish in the Gulf (Allman et al. 2018; Kelly-Stormer et al. 2017). Each spine was aged independently of fish length and date of capture.

The LHWG also explored the use of ELEFAN with age slicing as an alternative approach to the calendar-age advancement algorithm used in SEDAR43. ELEFAN was used to fit a seasonally-oscillating von Bertalanffy growth function (VBGF) to monthly length-frequency data of fishery independent samples with annuli less than 3. This was done to ensure that the samples were not impacted by regulatory selectivity (i.e., minimum length limits) and focus on the age classes where modal progressions were most obvious. A VBGF model was fit to the data using the function ELEFAN_GA with the R package *TropFishR* using the following settings: 2-cm length bins, moving average = 5, Maxage = 4, Maxiter = 1000, t_anchor (time at length 0) originally estimated then fixed at optimal (0.17, March) for reproducibility. The resulting parameter estimates (Figure 2.14.6) were L_∞=57.06 mm FL, K=0.33yr^{-1}, t_{anchor}= 0.17 years, C = 0.67 (amplitude of growth oscillation where 0 is no seasonal growth and 1 is complete growth cessation during the unfavorable season), and t_s=0.56 (starting point of the growth oscillation as a fraction of the year when the period of slowest growth begins). The group determined that age slicing using ELEFAN was useful for correcting the calendar age of fish with annuli counts of 0 and 1, but not recommended beyond that as modes became less distinct with age. Age slicing (Figure 2.14.7) was applied to the entire dataset of samples with annuli counts of 0 and 1 (both fishery dependent and independent samples) using the growth parameters estimated in the previous step. The slicing was done using the point midway between the lower length bin of calendar age + 1 month and calendar age + 1 year (Figure 2.14.7). Of the 352 samples with annuli count = 0, n = 331 were assigned a calendar age of 0 and n = 21 were assigned a calendar age of 1. Of the 375 samples with annuli count = 1, n=167 were assigned a calendar age of 0, n =

163 a calendar age of 1, n = 25 a calendar age of 2, and n = 20 a calendar age of 3 (Figure 2.14.8).

2.4.1 Recommendations for SEDAR 100

The LHWG recommends that calendar age for samples with annuli counts of 0 or 1 be assigned according to the age slicing algorithm developed using ELEFAN during the data workshop. For all other samples (annuli counts of 2 and up), the annulus count should equal the estimated calendar age.

2.5 GROWTH

Growth (length-at-age) was modeled with von Bertalanffy growth functions (VBGF) estimated in AD Model Builder (Fournier et al., 2012). The length-at-age data used to model growth included all data used in SEDAR43, but with ages for fish 5+ years updated using the new ageing protocol, as well as data from the new data period. Growth models were fit under four different scenarios: 1) sex-specific models; 2) sexes combined; 3) sexes combined but with size-correction for minimum length limits (MLLs) using the updated Diaz method (Diaz et al. 2004); or 4) region-specific models (i.e., East vs West of the MS river outflow) with sexes combined and without size-correction. Although gray triggerfish are known to exhibit sexually dimorphic growth (Kelly-Stormer et al. 2017; Jefferson et al. 2019; Chamberlain et al. 2025), the life-history data submitted for SEDAR100 did not provide sufficient contrast to fit sex-specific growth models (Figure 2.14.9). Likewise, the data did not support modeling growth separately for fish from the eastern or western Gulf (Figure 2.14.10). However, applying the size-correction method to the growth model with sexes combined greatly improved model fit based on visual inspection of residual plots. The parameter estimates for the best-fit VBGF corrected for size-selectivity were L_∞= 468.37 mm FL, K=0.292 yr^{-1}, and t_0=-0.900 years (Figure 2.14.11). Correcting the data for MLLs indicated that selectivity was particularly strong in the COM HL fleet.

2.5.1 Recommendations for SEDAR 100

The LHWG recommended the use of a single set of VBGF parameter estimates (for sexes combined and without regional delineation) to describe gray triggerfish growth in the assessment. The parameter estimates for the best-fit VBGF corrected for size-selectivity were L_∞=468.37 mm FL, K=0.292 yr^{-1}, and t_0=-0.900 years.

2.6 READER PRECISION/AGEING ERROR

The primary age data providers (# of readers; % of total samples aged) for SEDAR100 were NMFS Panama City (two expert readers; 61.54%) and FWRI (one expert reader; 23.12%). Prior to production ageing, each ageing laboratory reviewed and aged the reference set (n=115 spine thin sections with consensus ages) developed for gray triggerfish to ensure comparable reading methodologies and allow for ageing error estimation. The consensus ages for the reference set were established by expert gray triggerfish readers from the South Atlantic (Jennifer Potts and Walt Rogers) using the protocol described in Potts et al. (2023). Given that gray triggerfish are considered a difficult species to age, an individual with an average percent error (APE) of ≤10% for the reference set was considered acceptable to begin production ageing. Bias plots and estimates of precision were calculated using the *FSA* (Fisheries Stock Analysis) package in R (Ogle et al. 2025). Bland-Altman plots with statistical comparisons (paired t-tests, $\propto$=0.05) of each reader's reference set age estimates indicated there was no significant bias observed for any age class from any of the three readers that provided age data for SEDAR100 (Figure 2.14.12).

Ageing error estimates were provided only for the new data period (2018-2024) and were estimated by fitting a single error model to all three sets of age estimates for the gray triggerfish reference set. Candidate models were fit to mode-predicted ages under several different scenarios to estimate bias and precision using the Northwest Fisheries Science Center's *agingerror* package in R (Punt et al. 2008). Bias models included options for no bias or linear bias. Precision model scenarios included parameters that estimated a 1) constant coefficient of variation (CV), 2) curvilinear SD, 3) curvilinear CV, 4) SD that varied as a linear function of age, or 5) CV that varied as a linear function of age. Consensus age estimates for the reference set were assumed to have imprecision but no bias. Precision parameter estimates were mirrored (i.e., each of the three reader-specific data sets were treated as replicates and modeled together) to produce a single SD-at-age matrix, for input into the stock assessment. A single, generalized SD-at-age matrix is estimated for use in the assessment model because each ageing lab provides estimates for multiple fisheries (i.e., recreational, commercial, or fishery independent) which are confounded among data sets input into the assessment model's data structures. Akaike's information criterion (AIC), its form corrected for small sample size (AICc), and Bayesian information criterion (BIC) along with diagnostic plots of expected values, expected confidence intervals (CI's), and SD were used to select the best fit model to describe ageing error and provided to stock assessment analysts. Ageing error models were not estimated separately for each subregion because there is no evidence to suggest a difference in readability among regions. Although bias was slightly apparent it was not significant in Bland-Altman plots from the FSA package. However, the model that best-fit ageing error data was one that estimated linear bias and curvilinear SD in precision-at-age (Table 2.13.3; Figure 2.14.13).

2.6.1 Recommendations for SEDAR 100

The LHWG recommends including the ageing-error matrix with linear bias and curvilinear SD for describing ageing error in the stock assessment model.

2.7 NATURAL MORTALITY

In SEDAR43, target *M* was estimated using the Hoenig (1983) method, assuming a maximum age (t_{max}) of 15 years, and scaled at age using the Lorenzen (1996) method. The LHWG group discussed two alternative estimators to estimated *M* in SEDAR100: Then et al. (2015), and Hamel and Cope (2022). The Then et al. (2015) estimator is essentially the Hoenig (1983) approach revisited using an updated and larger dataset where $M = 4.899 t_{max}^{-0.916}$.

Hamel and Cope (2022) re-evaluated the approach used by Then et al. (2015) and recommended an alternative relationship be used where $M = \frac{5.4}{t_{max}}$. This estimator evaluates Then et al.'s (2015) updated dataset of *M* and maximum age using a more appropriate transformation than was used by Then et al. (2015) (see Hamel and Cope 2022 for more detail on the approach). The LHWG agreed that the Hamel and Cope (2022) estimator was an improvement over the Then et al. (2015) estimator and should be used in SEDAR100.

2.7.1 Recommendations for SEDAR 100

The LHWG recommends continuing to use a maximum age (t_{max}) estimate of 15 years and a minimum/fully selected age of 3 when estimating *M*. The LHWG recommends the Hamel and Cope (2022) equation be used to estimate target *M* (*M*=0.36) and then scale target *M* to age-specific values using the Lorenzen (1996) function (Table 2.13.4 and Figure 2.14.14).

2.8 LENGTH COMPOSITIONS

2.8.1 Commercial

Weighting methodology and final nominal and weighted length compositions for the commercial handline and longline fleets were presented in SEDAR100-DW-07, with preliminary compositions presented in the main paper, and updated final compositions presented in the appendix. The discussion of commercial length compositions at the workshop focused on available sample sizes for a potential 2 area model (East/West) vs. an all-Gulf model, and the potential for splitting longline out as its own fleet vs. proceeding with a single commercial fleet. A minimum sample size of n=30 fish was used to determine suitability of the length compositions. It was also recommended that the samples come from a minimum of n=10 trips to maintain spatial representativeness of samples. However, such a threshold can greatly reduce the amount of data available for use in the assessment, so a 10-trip threshold was used to identify low sample sizes but samples were not excluded if the number fell below that threshold.

When considering a 2-area model, sample sizes for nominal length compositions were sufficient in all years from 1990-2024 for HL samples from the East region, but sample sizes from the HL fleet in the West region were insufficient in some years. For the LL fleet, LL samples from the

East were sufficient to estimate nominal length compositions in roughly half of the years but were insufficient in all years for samples from the West region (for which only a few years had any data). For weighted length compositions, sample sizes for the HL fleet were insufficient for both the East and West regions in several years, while all years had insufficient data to estimate weighted length compositions for the LL fleet in either region. Data suitability for the COM 2-area model is shown in Table 2.13.5.

When considering an all-Gulf model, the HL fleet had sufficient sample sizes for a nominal length composition in all years from 1990-2024, while the LL fleet had sufficient sample sizes to estimate nominal length compositions in approximately half of the years. For weighted length compositions, the HL fleet had sufficient sample sizes in most years, while the LL fleet had insufficient sample sizes in all years. Data suitability for the commercial all-Gulf model is shown in Table 2.13.6.

2.8.2 Recreational

Final nominal and weighted length compositions are presented in Figures A1-A4 of SEDAR100-DW-04. Most of the discussion in the LHWG section focused on evaluating whether the length compositions were suitable for inclusion in the assessment. For the Gulf-wide or East stocks, all years had sufficient sample sizes (nfish ≥30 and ntrip ≥10) to estimate nominal length compositions (Table 2.13.7). For the West stock, there were insufficient sample sizes for most years after 2013. In the mid-1980s to early 2000s, there were sufficient samples to either estimate weighted compositions Gulf-wide, or separately for East and West stocks, however sample sizes were insufficient for the later part of the time series (Table 2.13.7).

2.8.3 Recommendations for SEDAR 100

The LHWG recommended: 1) proceeding with an all-Gulf model due to the limited data available for estimating compositions separately for the East and West in some years; and 2) using weighted length compositions when sufficient data are available and nominal length compositions for years when weighting is not possible. Use of nominal vs. weighted compositions should be compared to evaluate if weighting is having a large impact on compositions.

2.9 AGE COMPOSITION

2.9.1 Commercial

The weighting methodology and final nominal and weighted age compositions are presented in the appendix of SEDAR100-DW-07. For age compositions, the minimum sample size required for suitability was n=10 fish from n=10 trips. However, as with the length compositions, the number of trips was not used as a hard cutoff due to the potential reduction in data availability. Sample sizes for both a 2-area model (East/West) and an all-Gulf model were considered.

When considering the 2-area model, the HL fleet in the East region had sufficient sample sizes for estimating nominal age compositions in all years from 2003-2024, while data for the HL fleet in the West were sufficient in 2009, and 2011-2024. For the LL East fleet, sample sizes were sufficient for nominal compositions from 2004-2024, with the exception of 2020. For the West LL fleet, sample sizes were insufficient in all years to estimate nominal age compositions. For weighted age compositions, there were sufficient sample sizes for the HL East fleet from 2011-2024, while for the HL fleet in the West had only a few years with sufficient sample sizes. For both the LL fleets in East and West, there were insufficient sample sizes in all years to develop weighted age compositions. Data suitability for the COM 2-area model is shown in Table 2.13.5.

When considering the all-Gulf model, the HL fleet had sufficient sample sizes for nominal age compositions in all years from 2003-2024, and the LL fleet had sufficient sample sizes for nominal age compositions in all years from 2003-2024, except for 2020. For weighted age compositions, the HL fleet had sufficient sample sizes in most years, while the LL fleet had insufficient sample sizes in all years. Data suitability for the COM all-Gulf model is shown in Table 2.13.6.

2.9.2 Recreational

Final nominal and weighted age compositions are presented in Figures A5-A11 in SEDAR100-DW-04. Weighted age bubble plots are also provided in the Recreational Fishery Statistics section of this report. Most of the discussion in the LHWG focused on evaluating whether the age compositions were suitable for inclusion in the assessment. Only 6 years have sufficient sample sizes (nfish ≥10 and ntrip ≥10) to estimate nominal age compositions in the West region while the Gulf-wide and East stocks have sufficient sample sizes for all years (Table 2.13.7). Weighted length compositions are used to produce weighted age compositions. Weighted age compositions were only available to be produced for 5 years in the West, 8 years in the East, and 12 years Gulf-wide because of insufficient sample sizes for weighted length compositions and/or insufficient number of age samples (Table 2.13.7). Sample sizes in the West were low for conditional age-at-length (CAAL) and mean length-at-age in the West, but are sufficient in the East and Gulf-wide (Table 2.13.7).

2.9.3 Recommendations for SEDAR 100

The LHWG recommends comparing nominal and weighted age compositions to evaluate whether the weighting procedure is dramatically influencing age compositions. If weighting is not having a large impact, they recommend using nominal age compositions. If weighting is having a large impact, consider only using weighted age compositions for the years they are available. The group also recommends using conditional age-at-length (CAAL) where data are sufficient, but recognizes it may not be informative for many fleets because of insufficient contrast across age classes. They also recommend using mean length-at-age (MLAA) to aid in model diagnostics.

2.10 REPRODUCTION

There have been no significant updates to the available maturity or fecundity information when compared to analysis conducted in SEDAR43 (SEDAR, 2015). While 406 reproduction samples were provided by University of Southern Mississippi/Alabama Department of Conservation Natural Resources, the vast majority were outside the months used in reproductive analyses (June-August) conducted during SEDAR43. In addition, no age estimates or batch fecundity estimates were provided.

2.10.1 Recommendations for SEDAR 100

Following recommendations made during SEDAR 74 for Gulf red snapper, the LHWG suggested that the assessment analyst utilize spawning stock biomass as the measure of reproductive potential within the stock assessment model instead of batch fecundity estimates which were used in SEDAR43. The assessment model treats batch fecundity as known and does not take into account uncertainty. The batch fecundity estimates recommended during SEDAR 43 were based on 73 individuals between 26 and 39 cm FL (~2 – 6 years).

2.11 RESEARCH RECOMMENDATIONS

The LHWG drafted the following recommendations:

- Continue refining ageing algorithms for assigning calendar and fractional ages. This includes further research into the use of edge type, which requires that age readers record narrow versus opaque margin codes to get a better understanding of seasonality of annulus formation.
- Consider evaluating maturity-at-age given the ageing issues identified for ages 0-2
- Continue to examine data for region- and sex-specific differences in growth as data accrue over time.
- Continue to recommend that all age-data providers read the gray triggerfish reference set following the Potts et al. (2023) protocol prior to conducting any production ageing.
- Consider exploring epigenetic ageing as a complementary approach to gain insight into sex-specific growth and to potentially improve confidence in age-class assignments.

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2.13 TABLES

Table 2.13.1. Meristic regressions for gray triggerfish (1999-2024) from the Gulf of America. Data is combined from all data sources, both fishery dependent and independent, and includes data without ages if length and/or weight information was provided. Length Type: Max_TL- Maximum total length, FL- Fork length, Nat_TL – Natural total length, SL- Standard length. Weight Type: GWt- Gutted weight when "Condition Type" = "Gutted-head on", WWt- Whole weight. Units: length (mm) and weight (g). Linear and nonlinear regressions were calculated using R (lm and nls functions, respectively).

Conversion	Equation	Statistic	N	Data Range
Max_TL to FL	FL= Max_TL*0.788 + 23.541	r^2= 0.9591	6,322	Max_ TL: 16-753; FL: 65-617
Nat_TL to FL	FL= Nat_TL*0.792 + 33.477	r^2= 0.9164	3,710	Nat_TL: 50-718; FL: 78-617
SL to FL	FL= SL*1.144 + 13.531	r^2= 0.9850	5,015	SL: 51-590 ; FL: 68-617
Max_TL to WWt	WWt= 2.681*10^{-05} * (Max_TL$^{2.884}$)	RSE = 274.9	5,123	Max_TL: 16-743; WWt: 10-5,300
Nat_TL to WWt	WWt= 4.211*10^{-05} * (Nat_TL$^{2.827}$)	RSE = 275.6	3,654	Nat_TL: 22-718; WWt 0.251-5,840
FL to WWt	WWt= 1.450*10^{-05} * (FL$^{3.070}$)	RSE = 175.4	11,332	FL: 61-617; WWt 6-5,840
SL to WWt	WWt= 8.607*10^{-05} * (SL$^{2.855}$)	RSE = 199.1	4,192	SL: 17-590; WWt: 0.251-5,300
FL to GWt	GWt= 2.938*10^{-05} * (FL$^{2.950}$)	RSE = 193.5	2,196	FL: 275- 625; GWt: 454-4,763

Table 2.13.2. Number of gray triggerfish (final) age samples (n =19,407) collected from the Gulf of America from 1999 to 2024 by data provider. Black line indicates the terminal year for SEDAR 43 (i.e., 2013). No age samples were collected during 2001.

YEAR	FWRI	GulfFIN	AGR	BSD	USA/DISL	
1999	0	0	0	0	2	
2000	0	0	0	0	3	
2002	0	0	0	0	60	
2003	0	0	149	0	0	
2004	0	0	167	0	0	
2005	0	0	269	0	0	
2006	11	0	259	0	0	
2007	28	296	206	0	0	
2008	0	191	424	0	0	
2009	0	173	574	0	0	
2010	81	27	331	0	55	
2011	48	191	227	187	66	
2012	91	126	407	298	17	
2013	42	131	495	495	29	
2014	76	7	232	405	26	
2015	125	6	148	775	57	
2016	164	1354	433	664	599	
2017	126	192	57	594	337	
2018	116	691	254	757	0	
2019	30	287	126	803	0	
2020	4	261	109	290	0	
2021	16	347	82	83	0	
2022	116	344	74	491	0	
2023	15	306	280	440	0	
2024	32	162	0	358	0	
Total (n)	1121	5092	5303	6640	1251	19407
%	5.78	26.24	27.33	34.21	6.45	100.00

Table 2.13.3. Estimates of expected age and standard deviation-at-age fit to consensus age estimates from the gray triggerfish reference set using the NWFSC *ageingerror* package in R.

True_Age	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Expected_age	0.53	1.58	2.64	3.70	4.75	5.81	6.87	7.92	8.98	10.04	11.09	12.15	13.21	14.26
SD	0.394	0.394	0.463	0.529	0.592	0.651	0.707	0.761	0.811	0.859	0.904	0.947	0.988	1.026

Table 2.13.4. Recommended values for age-specific natural mortality (M) for gray triggerfish in the Gulf of America. Target M was calculated using the Cope and Hamel (2022) estimator (M=0.36) then scaled to age-specific values using the Lorenzen (1996) function.

Age	Age-specific M
0	1.374
1	0.775
2	0.589
3	0.500
4	0.450
5	0.419
6	0.398
7	0.384
8	0.375
9	0.368
10	0.363
11	0.359
12	0.356
13	0.354
14	0.353
15	0.352

Table 2.13.5. Final recommendations regarding the suitability of the available length and age data for the Commercial Handline (COM HL) and Commercial Longline (COM LL) fisheries under a 2-area model scenario (East/West). Years in green are considered suitable, red are considered unsuitable, and gray have no available data. Suitability is shown for nominal length compositions, weighted length compositions, nominal age compositions, and weighted age compositions.

Table 2.13.6. Final recommendations regarding the suitability of the available length and age data for the Commercial Handline and Commercial Longline fisheries for an All Gulf model. Years in green are considered suitable, red are considered unsuitable, yellow is considered suitable on if informative in the model, and gray have no available data. Suitability is shown for nominal length compositions, weighted length compositions, nominal age compositions, and weighted age compositions, and conditional age-at-length (CAAL).

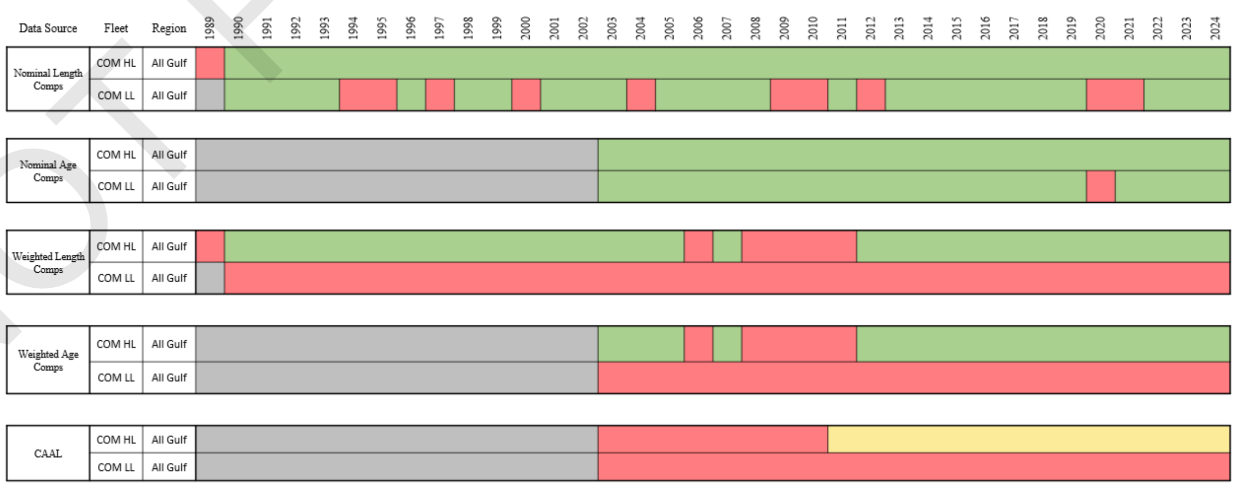
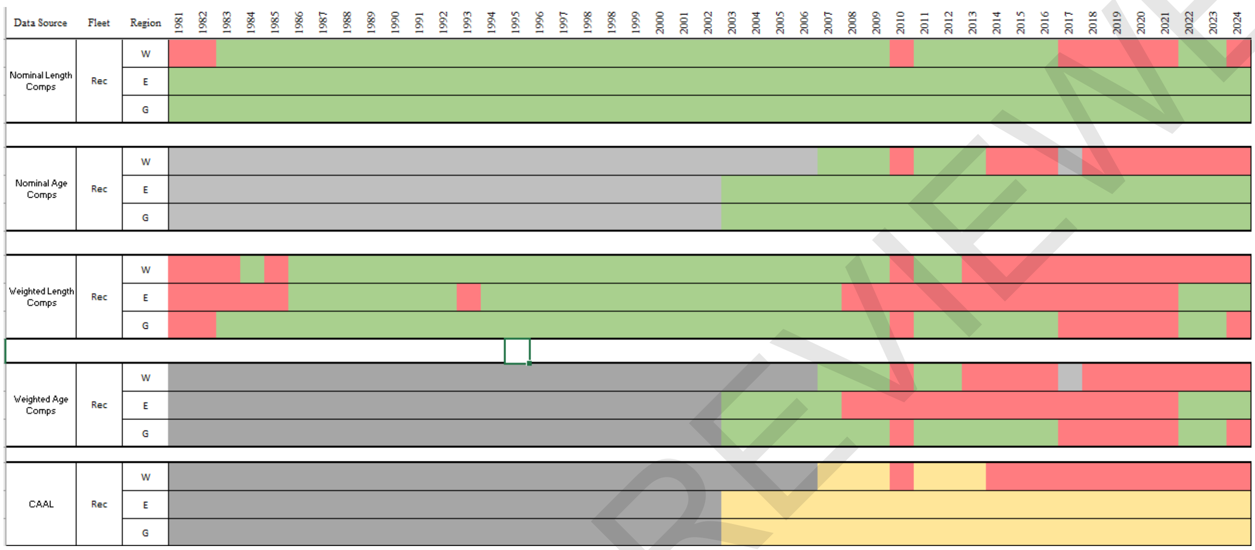
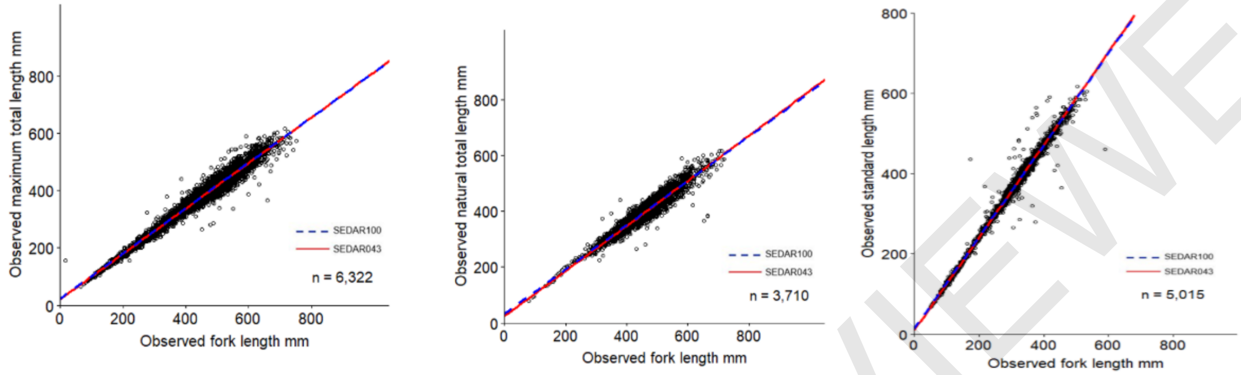


Table 2.13.7. Final recommendations regarding the quality of nominal length and age compositions, weighted length and age compositions, and conditional age-at-length (CAAL) for the recreational fishery for the West (W), East (E), and Gulf-wide (G) stocks. Years in green are deemed sufficient for use in the assessment, yellow are deemed questionable/potentially unreliable for use in assessment, and red are deemed insufficient/unacceptable for use in assessment. Years in gray have no data available.



2.14 FIGURES

LENGTH VS LENGTH



LENGTH VS WEIGHT

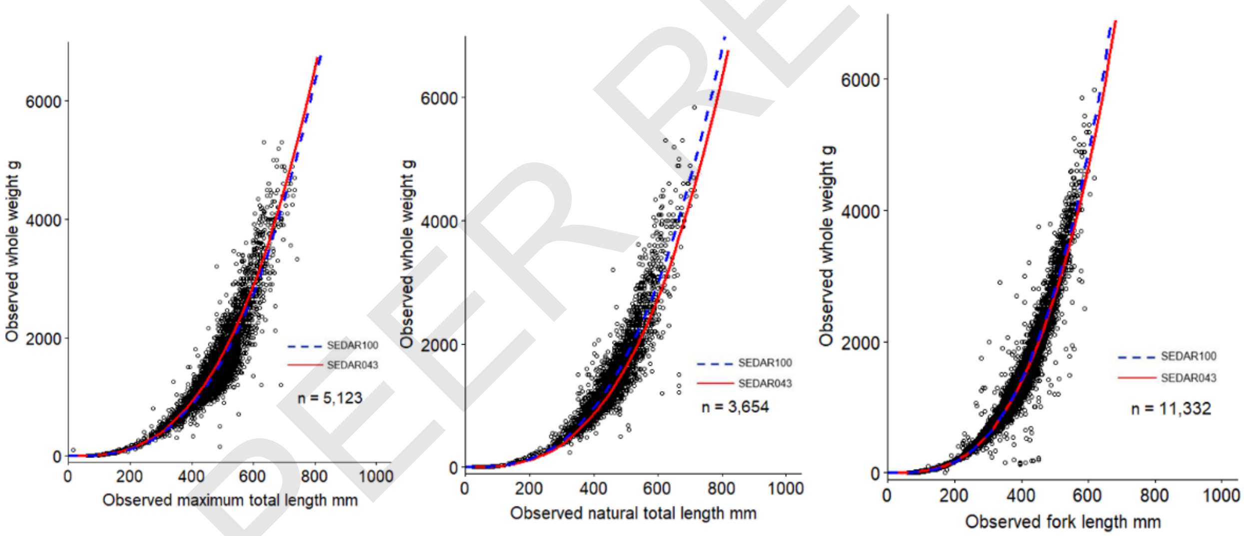


Figure 2.14.1. Scatterplots of observed fork length (FL; mm) versus observed maximum total length (MTL; mm), natural total length (NTL; mm), and standard length (SL; mm), and observed MTL, NTL, and FL versus observed whole weight (g) for SEDAR 43 compared to SEDAR 100 for gray triggerfish data collected from the Gulf of America from 1999-2024.

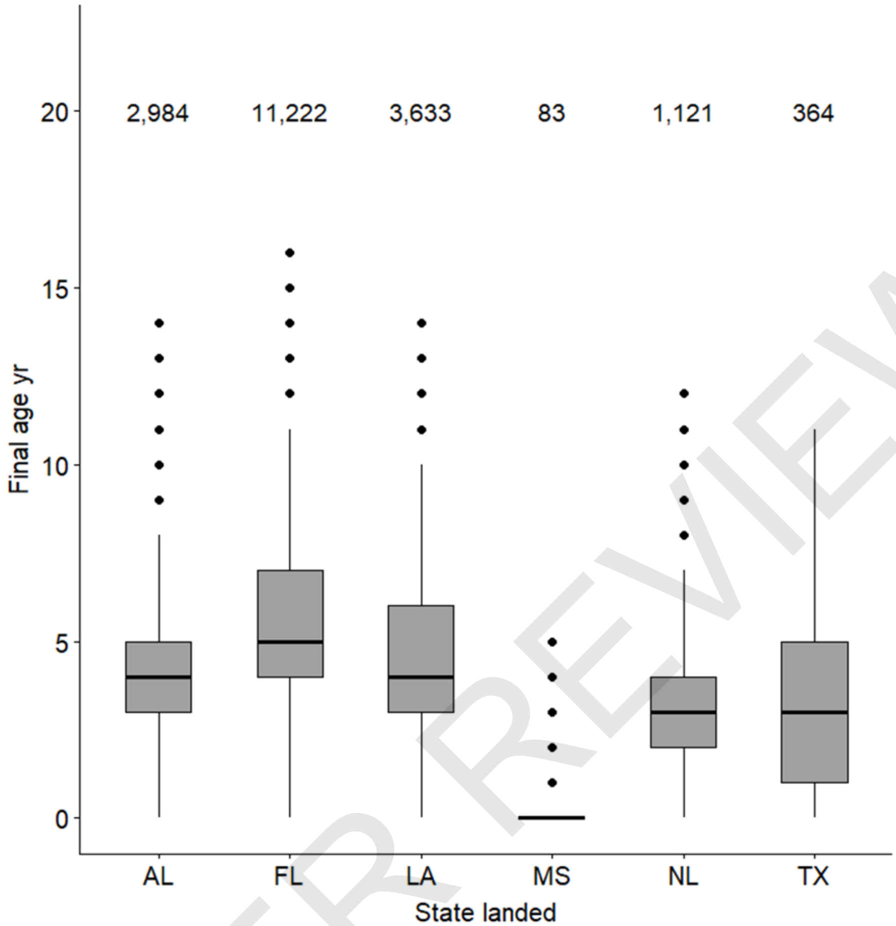


Figure 2.14.2. Boxplot of final age (yr) by state landed (Alabama, AL; Florida, FL; Louisiana, LA; Mississippi, MS; Not Landed, NL; Texas, TX) for gray triggerfish age samples collected from the Gulf of America from 1999 to 2024. No age samples were collected during 2001. Sample numbers are shown along the top of the figure. Boxes indicate the 25th and 75th percentiles, horizontal lines indicate median values, vertical lines indicate the min and max values of the IQR*1.5, and points indicate values outside that range.

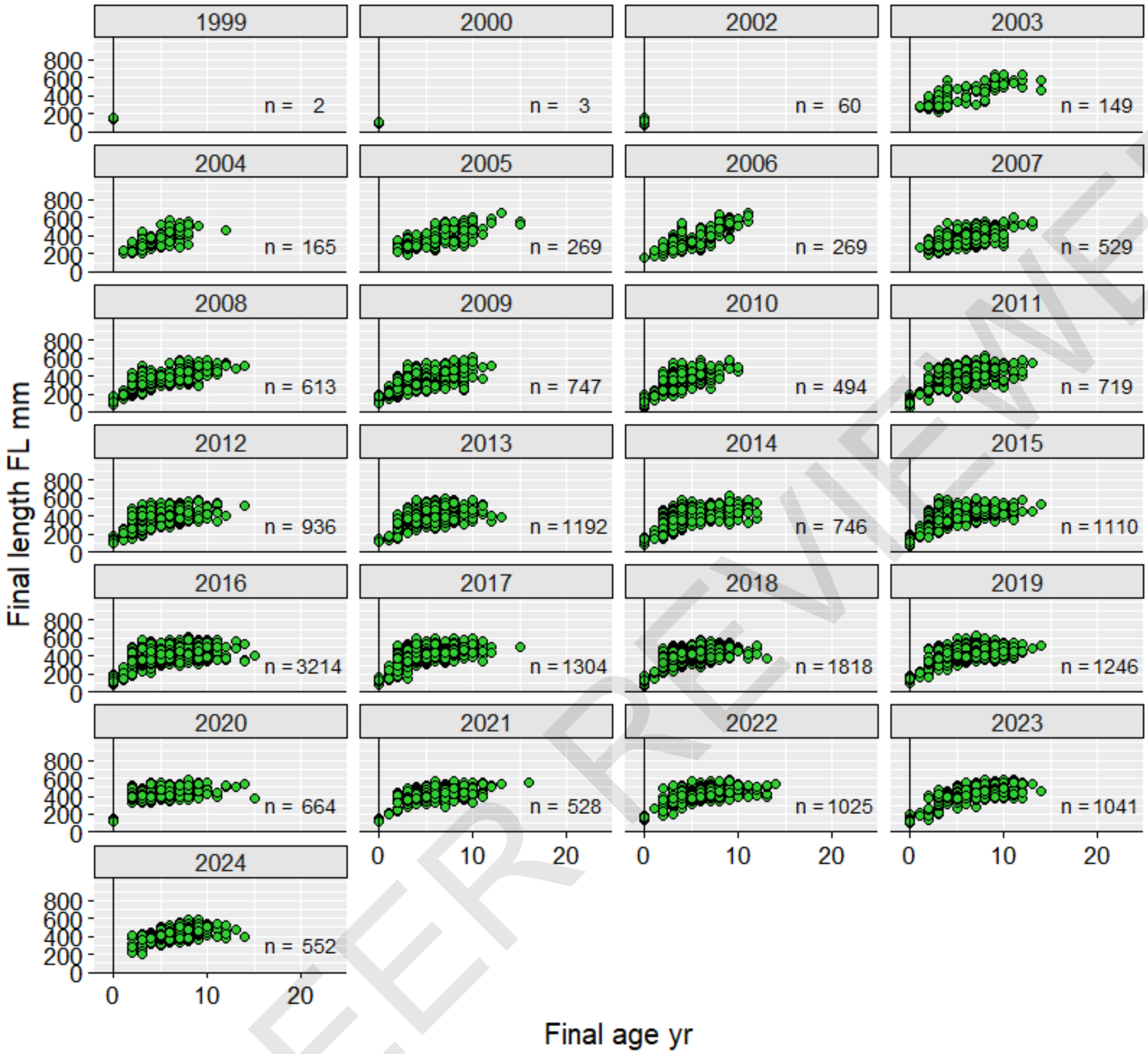


Figure 2.14.3. Scatterplots of final age (yr) at length (FL mm) for gray triggerfish samples collected from the Gulf of America from 1999 to 2024. No age samples were collected from 2001. The number of observations are shown at the bottom right of each panel.

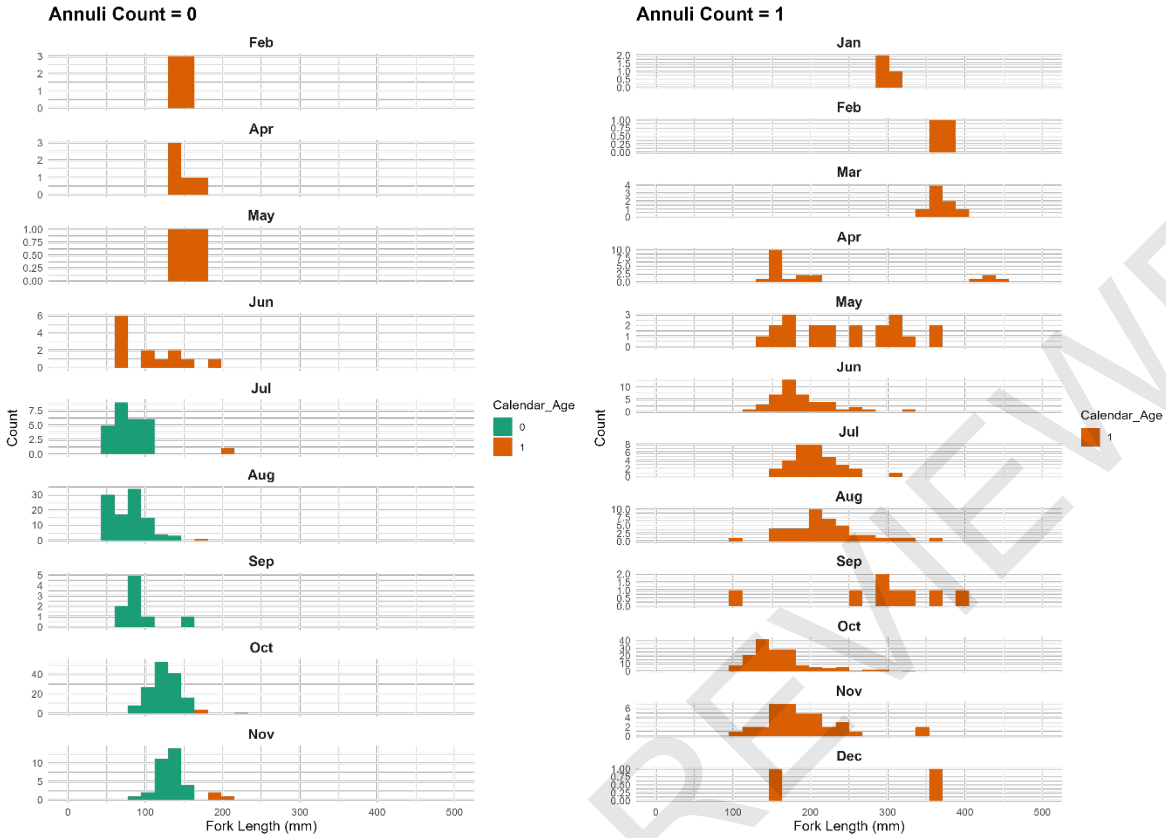


Figure 2.14.4. Monthly histograms of fish size for individuals with an annulus count of zero (left) and one (right). The calendar ages reflect the ages obtained using the SEDAR 43 age adjustment algorithm (fish caught between January and June with no visible translucent zones and fish caught from July to December with FL ≥ 160 mm were advanced by 1 year).

Figure 2.14.5. Edge type assignment by month and annuli count for the samples where month and edge type were recorded (1,987 out of 20,544 samples). The timing of growth band formation remains unclear.

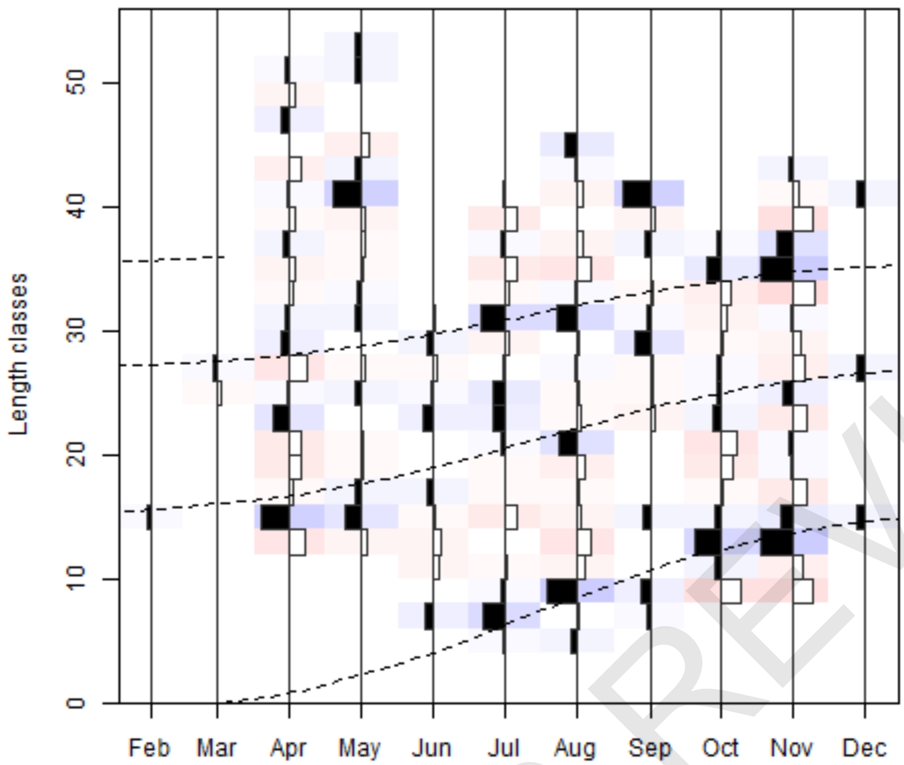


Figure 2.14.6. Monthly length frequency data (histograms) used in fitting the seasonally-oscillating von Bertalanffy growth model (dashed line).

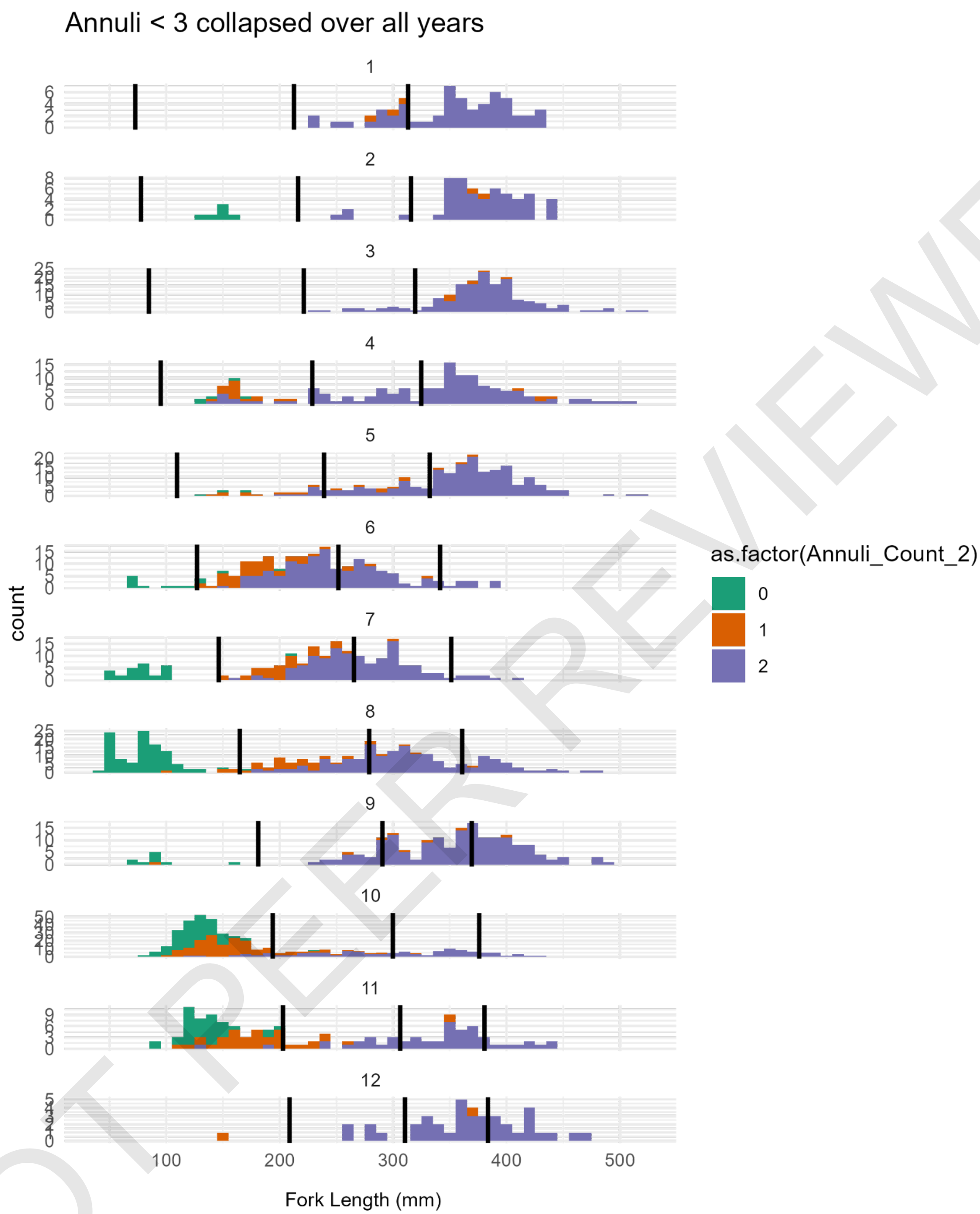


Figure 2.14.7. Location of the age slicing (black vertical lines) against the monthly length frequency data of sample with annuli counts less than 3. Fish with annuli counts of 0 or 1 falling to the left of the first vertical line are assigned a calendar age of 0, fish between the first and second vertical lines a calendar age of 1, etc. Fish with annuli counts of 2 and beyond remained unaltered.

Figure 2.14.8. New calendar age assignments for samples with annuli counts of 0 and 1 using ELEFAN and age slicing.

Population model – sex-specific

Male vs Female - Unweighted VBGF – constant σ

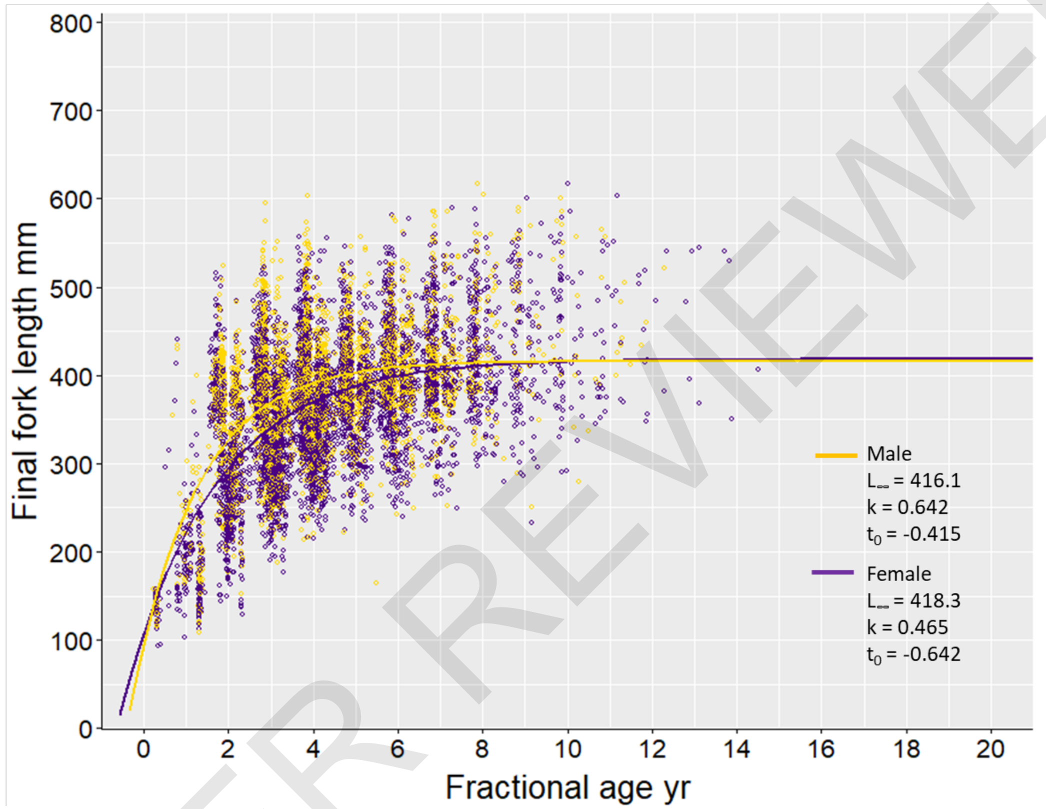


Figure 2.14.9. Von Bertalanffy growth models of gray triggerfish age-at-length (yr, mm) specified by sex. Males are indicated with yellow circles, while females are indicated with purple circles.

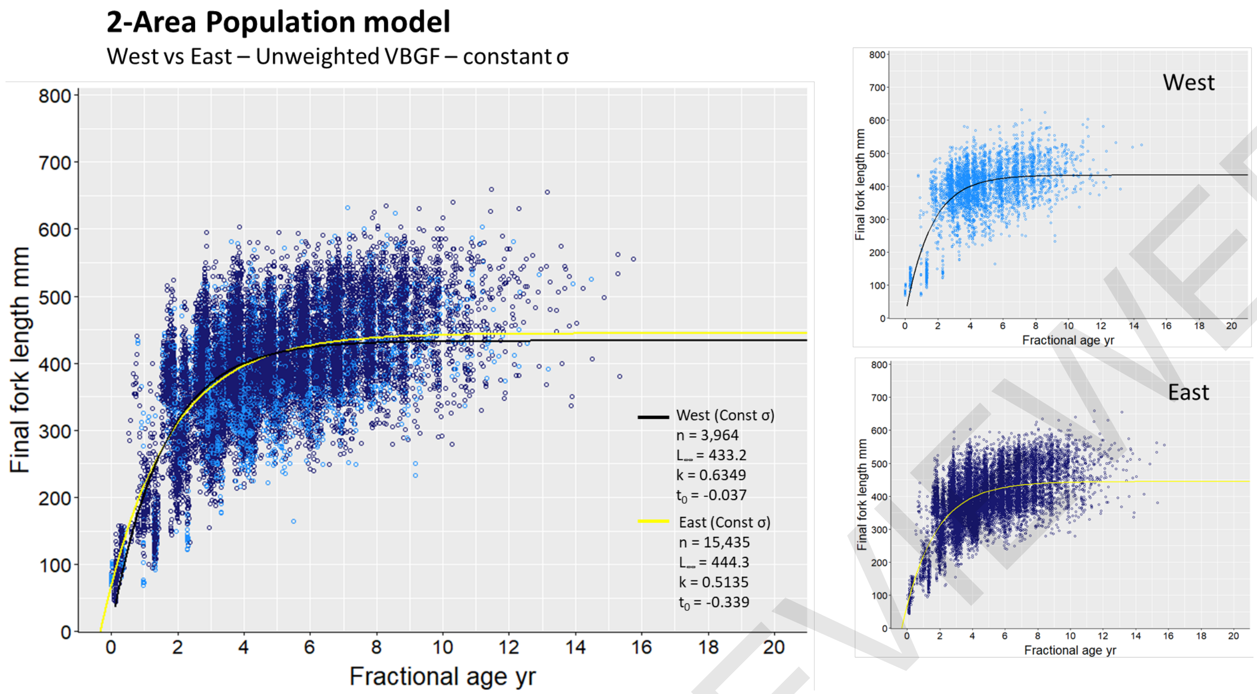


Figure 2.14.10. Von Bertalanffy growth models of gray triggerfish age-at-length (yr, mm) for fish collected from the East vs West Gulf of America (demarcated by the MS river outflow).

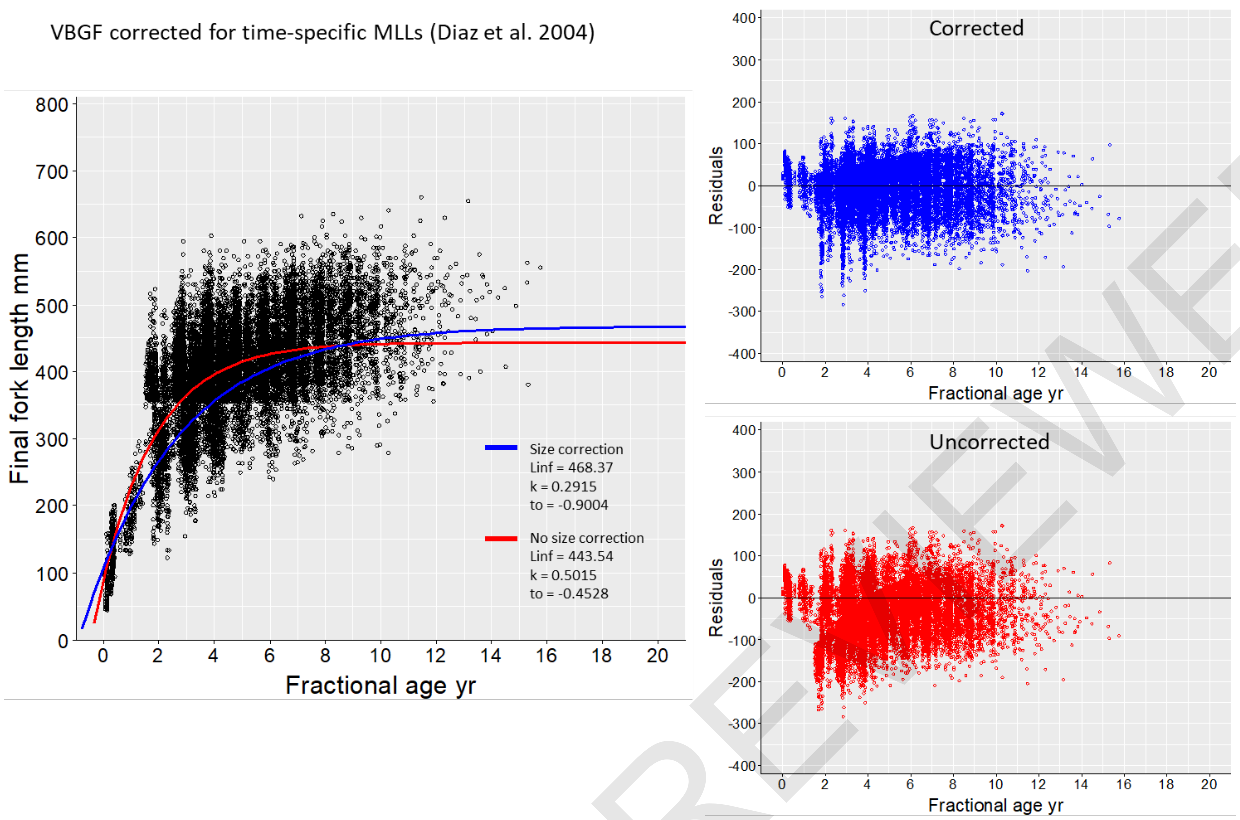


Figure 2.14.11. Von Bertalanffy growth models for gray triggerfish age-at-length (black circles; yr, mm) with lengths uncorrected (red circles, residuals) vs corrected (blue circles, residuals) for truncation due to minimum length limits (i.e., the Diaz method).

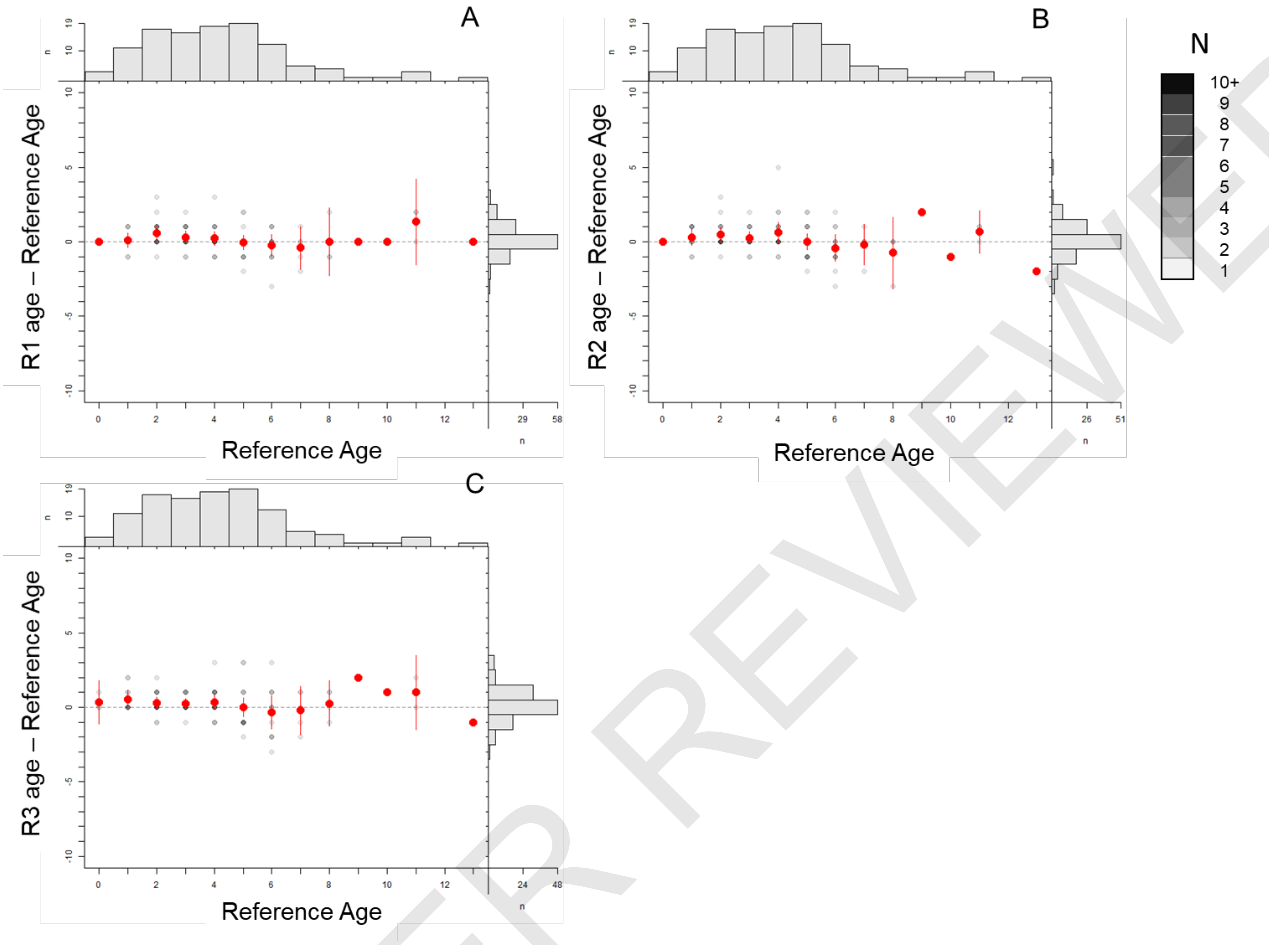


Figure 2.14.12. Bland-Altman plots of reader-specific age estimates vs reference ages for readers from the NMFS Panama City Laboratory (panels A and B) and Florida Fish and Wildlife Research Institute (panel C). Gray-scale circles indicate the number of observations at each point; filled red circles indicate each reader's mean age estimate for each reference age, open red circles indicate means that are significantly different from zero; vertical red lines indicate the standard error of the mean; and gray bars indicate sample sizes for the reference set (top of each plot) and reader-specific age differences (right of each plot).

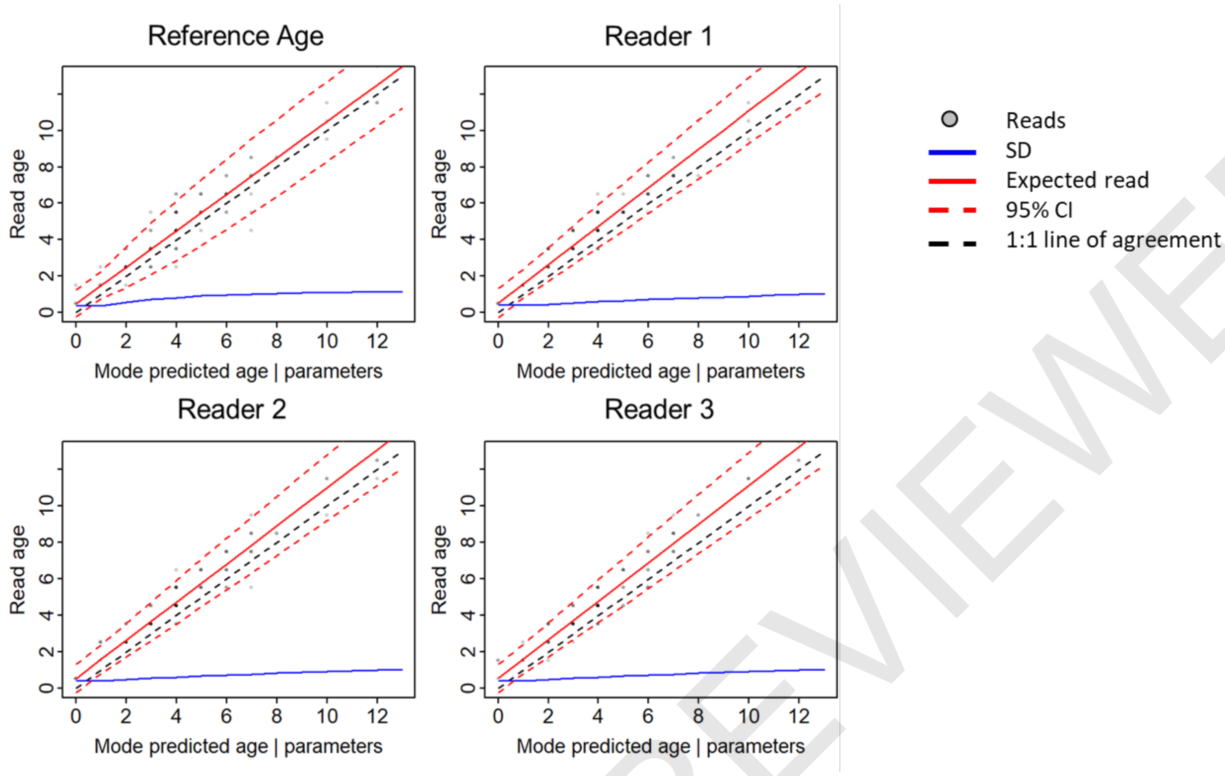


Figure 2.14.13. Output plot indicating ageing error- and bias-at-age estimates from the best-fit model applied to reader-specific age reads of the gray triggerfish reference set. Reader-specific parameters were fixed (i.e., mirrored) to estimate a single set of bias and error parameters for input into the stock assessment.

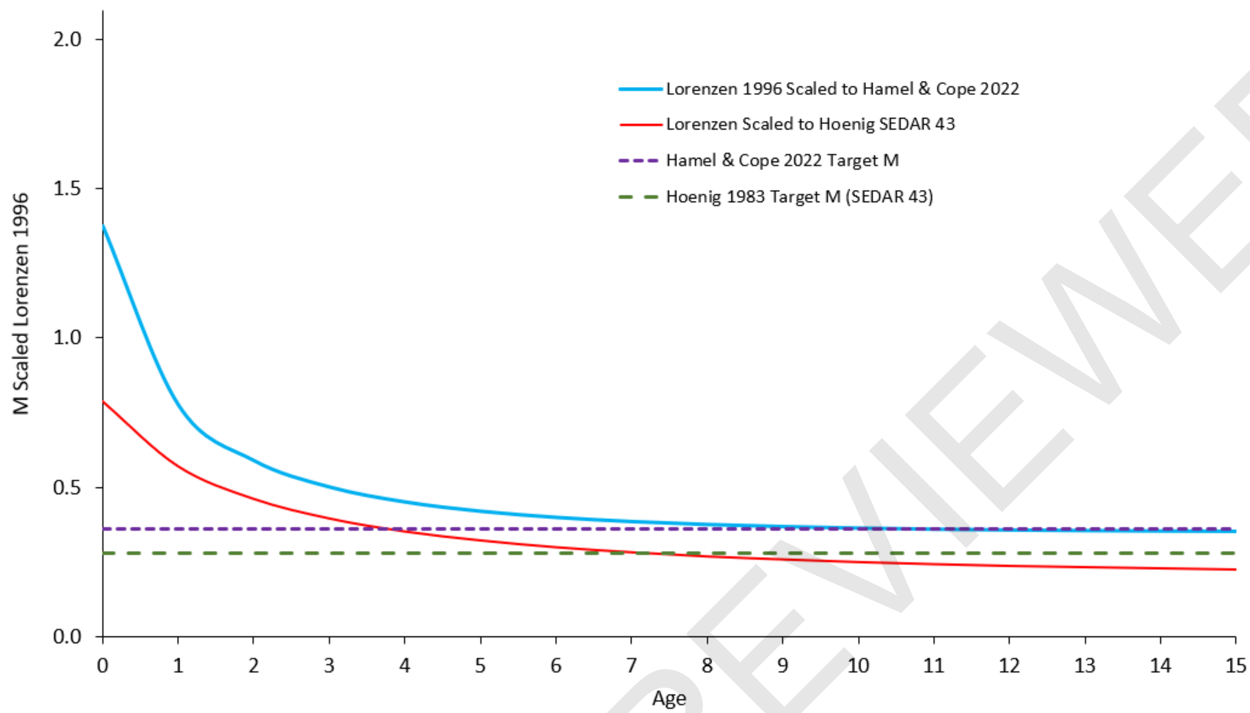


Figure 2.14.14. The recommended age-specific natural mortality (M) vector scaled to the Lorenzen equation (1996) for SEDAR 100 (blue line). The target M based on Hamel & Cope 2022 was 0.36 (dashed purple line). Age-specific M values and Target M used in SEDAR 43 are shown for comparison by the red solid line and the dashed green line, respectively.

3 COMMERCIAL FISHERY STATISTICS

For this data workshop, there was not a Commercial Fisheries Statistics workgroup. The commercial data products discussed at the workshop were shrimp bycatch and shrimp effort (used to derive an index of fleet effort), which were discussed in a combined Indices and Bycatch workgroup, and commercial length and age compositions discussed in the Life History workgroup. For documentation purposes, commercial landings, discards, length and age compositions, and indices are summarized below.

3.1 DATA NOT DISCUSSED AT THE DATA WORKSHOP

Commercial landings and discards were provided for this assessment following decisions adopted during SEDAR 43, SEDAR 62, or through SEDAR best practices. Working papers were provided for these products to thoroughly document the methods and any differences compared to SEDAR 62.

SEDAR100-DW-05: Commercial Landings of Gulf of America Gray Triggerfish (*Balistes capriscus*) from 1949-2024.

SEDAR100-DW-06: CPUE Expansion Estimation for Commercial Discards of Gulf of America Gray Triggerfish.

3.1.1 Commercial Landings

Commercial landings of Gulf Gray Triggerfish were compiled from the Accumulated Landings System (ALS) and state trip ticket programs (STT) following methodology used in SEDAR 43 and SEDAR 62. Landings were provided in whole weight pounds from 1949-2024 by subregion, gear, and year, with subregions being East (Florida - Mississippi) and West (Texas - Louisiana) as shown in Figure 3.10.1. Commercial landings were largely consistent with what was provided in SEDAR 62. Some minor differences were observed between the landings provided in SEDAR 62 and those provided for the current assessment (SEDAR 100), particularly in more recent years, however the landings provided here were consistent with those used for ACL monitoring and therefore considered to be the best available data. Final landings by year, gear, and subregion are summarized in Table 3.9.1, and landings by year and subregion are shown graphically in Figure 3.10.2. Further details regarding the commercial landings are available in the commercial landings working paper, along with recommendations for uncertainty estimates (SEDAR100-DW-05).

3.1.2 Commercial Discards

Commercial discards are estimated for vertical line gear using two different data sources and methods that correspond to differences in management and discard behavior. In 2007, an Individual Fishing Quota (IFQ) was implemented for Red Snapper and this is the same year the SEFSC implemented the Reef Fish Observer Program. For this reason, observer-discard rates were not used to estimate discards prior to IFQ considering this change in management had a significant impact on discard behavior of Red Snapper and other reef fishes caught in the reef fish fishery, such as Gray Triggerfish. Discard estimation from 2007-2024 using observer data followed standard methods presented in SEDAR 62, the previous data/assessment workshop for this species.

Since the SEFSC no longer recommends the use of discard logbook data for estimating discards for SEDAR (Alhale et al. 2024), a hindcast procedure was used to estimate the discards previous to observer coverage using discard rates in the earliest time then applied to logbook-derived effort. The observer method is more reliable because there is a verification step to use observer kept data to re-estimate the landings of Gray Triggerfish. For this assessment, discards were limited to 2000 and after as that was the first year of a size limit in this fishery. Discards were estimated for three overall regions following the TORs of this assessment; East, West, and Gulf-wide (Table 3.9.2). The commercial discard working paper (SEDAR100-DW-06) documents in three sections the observer method with associated discard length compositions, the discard logbook method, a calibration of discard logbook-derived estimates, as well as comparisons to SEDAR 62. Discards were limited to vertical line gears only with longline being excluded due to near 0 observed catches for this species.

3.2 ISSUES DISCUSSED AT THE DATA WORKSHOP IN THE INDICES AND BYCATCH GROUP

Commercial data issues discussed in the Indices and Bycatch workgroup at the data workshop were limited to shrimp bycatch and included:

- Shrimp effort data
- Shrimp bycatch estimation using SEAMAP data
- Overall estimated shrimp bycatch

3.2.1 Review of Working and Reference Documents

The workgroup considered data and analyses presented from the following documents:

SEDAR100-DW-22: Estimation of Gray Triggerfish Bycatch from Gulf of America Shrimp Trawls

3.2.2 Workgroup Participants

Below are the Indices & Bycatch workgroup participants and their affiliations:

Sarina Atkinson	NMFS
Matthew Campbell	NMFS
Heather Christiansen	FWC
Kyle Dettloff	NMFS
David Hanisko	NMFS
Frank Hernandez	NMFS
Matthew Nuttall	NMFS
Katherine Overly	NMFS
Cheston Peterson	University of Miami/CIMAS (Group Co-lead)
Adam Pollack	NMFS (Group Co-lead)
Ted Switzer	FWC
Kevin Thompson	NMFS
Glenn Zapfe	NMFS

3.3 SHRIMP EFFORT & BYCATCH

3.3.1 Shrimp Effort

Gulf penaeid shrimp effort has non-universal coverage of the fleet. Therefore, trawling effort must be estimated from a sample of the fleet and scaled up to total effort using the landings. There are two sources of data for estimating Gulf penaeid offshore trawling effort. Port agent interviews were used from 1984-2006 and electronic logbook (ELB) positional data were used from 2007-2023. Fleet effort for the observer time period (2007-2023) was estimated using shrimp catch and effort data for a subset of vessels equipped with GPS tracklog (ELB) devices (Smith et al. 2025, Dettloff 2024). Fleet catch of non-target species (discarded as bycatch) was estimated in the second expansion using onboard observer catch and effort data for a subset of vessel trips and the estimated fleet effort (Atkinson et al. 2024 and 2025, Smith et al. 2025). GLM analysis of stratification variables confirmed that season, area, and depth were important variables for partitioning mean and variance of penaeid shrimp and non-target species catch rates. An overview of the data of each source as well as the overall methods are summarized in Atkinson et al. 2025 (SEDAR98-DW-23). Shrimp trawl effort estimates are provided in Table 3.9.3.

3.3.2 Shrimp Bycatch

Because Gray Triggerfish are not mandatorily recorded in the Shrimp Observer program, the bycatch estimation methods used for Red Snapper in SEDAR 98 (Smith et al. 2025) could not be applied directly. Instead, bycatch estimation was applied to proxy species for Gray Triggerfish based on a co-occurrence analysis of SEAMAP data, which were filtered to reflect commercial shrimping grounds and habitat as accurately as possible. Bycatch estimates were then calculated using the same methodology applied to Red Snapper in SEDAR 98 and calibrated based on catch-per-unit-effort (CPUE) ratios of Gray Triggerfish and the proxy species in the filtered SEAMAP dataset. Estimation of Gray Triggerfish shrimp trawl bycatch therefore consisted of three phases: **1)** filtering the SEAMAP data to best represent shrimp habitat; **2)** conducting a stratified co-occurrence analysis of Gray Triggerfish and species tracked by the shrimp observer program to determine proxy species using the filtered SEAMAP data; and **3)** estimation of shrimp bycatch of proxy species using the methods in Smith et al. (2025) and calibration to Gray Triggerfish based on CPUE ratios from the filtered SEAMAP data.

SEAMAP data were subset using a series of filters, described in SEDAR100-DW-22, including intersection of known reef habitat, hard bottom indicator species (e.g. octocorals), overlap with known areas of commercial shrimp effort, and presence of penaeid shrimp catch. A blocked co-occurrence analysis (Mackenzie et al. 2006, Smith et al. 2021) using area-season-depth strata was applied to the filtered SEAMAP dataset to identify proxy species from the pool of species tracked by the shrimp observer program. The co-occurrence species interaction factor (SIF) was calculated to evaluate the association between Gray Triggerfish and other species in the SEAMAP catch that are also tracked by the shrimp observer program. The co-occurrence analysis used a stratification, or blocking, scheme to allow for spatio-temporal flexibility in species associations and therefore multiple proxy species if necessary. This stratification scheme followed previous work in the Gulf (Smith et al. 2025) by using an Area-Season-Depth stratification consisting of four areas, three seasons, and two depth zones (≤ 10 fathoms and > 10 fathoms). Lane Snapper (*Lutjanus synagris*) and Red Snapper (*L. campechanus*) were chosen as proxy species.

Bycatch estimation was conducted on proxy species following the methods of Smith et al. (2023; 2025). The general approach to estimating bycatch involves two catch rate expansions: one estimating total fleet effort and one estimating total fleet catch/bycatch. Fleet catch of non-target species (discarded as bycatch) was estimated in the second expansion using onboard observer catch and effort data for a subset of vessel trips and the estimated fleet effort (Atkinson et al. 2024, Smith et al. 2025). GLM analysis of stratification variables confirmed that season, area, and depth were important variables for partitioning mean and variance of penaeid shrimp and non-target species catch rates. A hindcasting procedure was developed for estimating bycatch for the pre-observer years 1984-2006 using observer data for 2007-2013 and the improved time series of shrimp landings and effort for 1984-2006. The key assumption was a stable relationship between strata-specific shrimp and proxy species catch rates. The resulting bycatch estimates for 1984-2006 generally tracked changes in shrimp fleet effort, and were less volatile in terms of magnitude compared to the estimates produced for SEDAR 62, which relied on SEAMAP trawl data as a proxy for commercial shrimp trawls (Zhang 2020, SEDAR62-WP-20). To calibrate bycatch estimates of proxy species to Gray Triggerfish, conversion factors were calculated for each stratum based on catch rates of each species in the filtered SEAMAP dataset.

Estimates of Gray Triggerfish bycatch from commercial shrimp trawls for West and East Gulf regions for 1984-2023 are provided in Table 3.9.4 and Figure 3.10.3. Bycatch of Gray Triggerfish was higher in the West Gulf throughout the time series. The shrimp bycatch working paper (SEDAR100-DW-22) details the filtering process of the SEAMAP data, the co-occurrence analysis used to determine proxy species, and bycatch estimation methods.

Decision 1: The workgroup recommends the bycatch estimates from 1984-2023 following the improved methodology used for Red Snapper in SEDAR 98 with Lane Snapper and Red Snapper as proxy species for Gray Triggerfish in SEDAR 100. From workshop discussions with the analysts, the bycatch team suggested using a time-varying conversion factor for calibrating the estimates of bycatch from proxy species to Gray Triggerfish, which was completed and added to the final calculation.

3.3.3 Shrimp Bycatch Length Composition

Bycatch length compositions were also provided for this assessment. Due to the absence of Gray Triggerfish in the Shrimp Observer data, it was recommended that the filtered SEAMAP data be used as a proxy for discard length compositions. In order to justify this recommendation, Shrimp Observer and filtered SEAMAP Red Snapper length distributions were compared and found to be similar within area-depth-season strata. Therefore, it was assumed that filtered SEAMAP length frequencies for Gray Triggerfish were representative of bycatch length frequencies and calculated based on the estimates of bycatch for both the East/West Gulf regions and Gulf-wide. Length compositions showed that bycatch is focused on sublegal sizes of Gray Triggerfish. The length range was 1.5 to 52.0 cm fork length, with 99.5% of the observations below the minimum legal size of 35.6 cm. Annual length compositions of Gray Triggerfish bycatch were estimated for the entire Gulf region.

3.4 ISSUES DISCUSSED AT THE DATA WORKSHOP IN THE LIFE HISTORY WORKGROUP

Commercial data issues discussed at the data workshop in the life history workgroup include the following topics:

- All Gulf or 2 area model
- Single commercial fleet vs. separate handline and longline fleets
- Adequacy of data for providing nominal and weighted length and age compositions

3.4.1 Review of Working and Reference Documents

The workgroup considered data and analyses presented from the following documents:

SEDAR100-DW-07: Gulf of America Gray Triggerfish (*Balistes capriscus*) Preliminary Length and Age Compositions for the Commercial Handline and Longline Fisheries.

3.4.2 Workgroup Participants

Below are the Life History workgroup participants and their affiliations:

Lisa Ailloud	NMFS
Samantha Binion-Rock	NMFS
Bridget Cermak	FWC
Steven Garner	University of Miami/CIMAS

Ryan Nichols	NMFS
Ashley Pacicco	University of Miami/CIMAS (Group Lead)
William Patterson III	University of Florida, Gainesville, FL
Michaela Pawluk	NMFS

3.5 COMMERCIAL LENGTH AND AGE COMPOSITIONS

Commercial length and age compositions were discussed as part of the life history workgroup. Two main concerns regarding the commercial length and age compositions were 1) whether there was sufficient data to split out longline as its own fleet for modeling, and 2) whether there were sufficient samples for an East/West split in the model. In order to address these concerns, sample sizes for an East/West split, and an All Gulf model were considered for each gear (handline and longline).

Sample sizes were evaluated for adequacy in terms of providing both nominal and weighted compositions. Tables summarizing the data adequacy by year, and gear for an East/West model and an All Gulf model are provided in the Life History report section in Table 2.13.5. Based on the available data, the workgroup recommended that longline be kept a separate fleet from handline as there was a clear difference in size composition between the two gear groups (Figure 3.10.4). Regarding spatial stratification, the workgroup recommended proceeding with an All Gulf model due to extremely limited data in the Western subregion and a lack of evidence for spatial differences in size composition within a given gear group (Figure 3.10.5 - only Handline is shown, as there were limited Longline samples from the Western subregion). Due to limited data for the longline fleet, only nominal age compositions were provided (Figure 3.10.6), while for handline weighted age compositions were provided where possible (Figure 3.10.7). Further details on the construction of the length and age compositions are available in the working paper (SEDAR100-DW-07).

3.6 COMMENTS ON ADEQUACY OF DATA FOR ASSESSMENT ANALYSES

Overall, the Indices and Bycatch workgroup determined the methods for estimating shrimp effort and bycatch from 1984-2023 were appropriate and recommended for use in the assessment model. There was discussion at the workshop of an alternate report detailing shrimp trawl bycatch (Scott-Denton et al. 2012; SEDAR100-RD-06) which included a misleading table which reported Balistidae bycatch to be 0.0%, despite bycatch by weight being non-zero. It was determined this was an error in the presentation of the table in the report, causing some confusion about the validity of these results. The workgroup felt the methods and data were appropriate despite this discussion at the workshop.

The Life History workgroup recommended that the available length and age data were adequate and appropriate for construction of commercial length and age compositions in most years. Two tables are provided in the Life History workgroup report summarizing data adequacy for both nominal and weighted compositions by year and gear (Tables 2.13.5 & 2.13.6). For years when data are insufficient for weighted compositions, nominal compositions are recommended to be used.

3.7 RESEARCH RECOMMENDATIONS

Although the Indices and Bycatch workgroup focused on understanding and evaluating Gray Triggerfish bycatch methods and estimates, the working paper SEDAR100-DW-22 outlines current efforts by SEFSC to improve bycatch estimation in the future. These include:

- Adding Gray Triggerfish to the list of species for which data are currently collected in the Shrimp Observer program.
- Outfitting the commercial shrimp fleet with modern, tamper-proof GPS tracklog devices;
- Applying electronic technologies to enable observers to collect size information on all fish species captured in fish trawls;
- Modifying the allocation of observer sampling effort to better incorporate net configuration and diurnal period;
- The potential for field experiments to improve calibrations of SEAMAP and commercial shrimp trawls.

3.8 LITERATURE CITED

Alhale, S., S. Atkinson, K. Thompson, G. Decossas, K. Dettloff. 2024. Reliability of the Discard Logbook for Use in Commercial Discard Estimates in the South Atlantic. SEDAR92-RD-05. 19 pp.

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Dettloff, K. 2024. Estimation of commercial shrimp effort in the Gulf of Mexico. SEDAR Working Paper SEDAR87-DW-01. SEDAR, North Charleston, SC. 31 pp.

Mackenzie, D.I., Nichols, J.D., Royle, J.A. Pollock, K.H., Bailey, L., Hines, J.E. 2006. Occupancy estimation and modeling: inferring patterns and dynamics of species occurrence. Academic Press.

Scott-Denton, E., Cryer, P.F., Duffy, M.R., Gocke, J.P., Harrelson, M.R., Kinsella, D.L., Nance, J.M., Pulver, J.R., Smith, R.C. and Williams, J.A., 2012. Characterization of the US Gulf of Mexico and South Atlantic penaeid and rock shrimp fisheries based on observer data. Marine Fisheries Review, 74: 1-27

Smith, S.G., S. Sagarese, S. Martinez-Rivera, K.J. McCarthy 2021. Estimation of a Commercial Abundance Index for Gulf of Mexico Scamp & Yellowmouth Grouper Using Reef Fish Observer Data. SEDAR68-AW-04. SEDAR, North Charleston, SC. 33 pp.

Smith, S.G., S. Atkinson, C. Peterson, J. Williams, K. Dettloff, A. Lowther. 2023. Improving estimation of bycatch from shrimp trawls in the Gulf of Mexico. SEDAR Reference Document SEDAR98-RD-01. SEDAR, North Charleston, SC. 37 pp.

Smith, S.G., S. Atkinson, C. Peterson, and K. Dettloff. 2025. Estimation of red snapper bycatch from Gulf of America shrimp trawls. SEDAR98-DW-25. SEDAR, North Charleston, SC. 17 pp.

Zhang, X.. 2020. Shrimp Fishery Bycatch Estimates for Gulf of Mexico Grey Triggerfish, 1972-2017. SEDAR62-WP-20. SEDAR, North Charleston, SC. 29 pp.

3.9 TABLES

Table 3.9.1. Annual calculated Gulf of America Gray Triggerfish landings by gear groupings for each Subregion from 1949 to 2024. Confidential strata have been hidden with an asterisk (*).

Year	East			West		
	Handline+	Longline	Trap	Handline+	Longline	Trap
1949	14,300					
1950	14,700					
1951	28,000					
1952	72,400					
1953	43,600					
1954	39,600					
1955	46,600					
1956	22,800					
1957	17,400					
1958	15,200					
1959	10,300					
1960	11,900					
1961	6,500					
1962	5,600					
1963	3,100			4,200		
1964	15,700			4,300		
1965	17,350			4,300		
1966	8,600			5,200		
1967	12,200			5,200		
1968	8,600			3,900		
1969	14,600			7,700		
1970	15,851			8,200		
1971	30,500			9,900		
1972	47,400			15,200		
1973	40,000			13,200		
1974	40,452			13,100		
1975	62,000			16,000		
1976	69,700			14,800		
1977	50,096			9,290		
1978	48,518		108	10,197		
1979	65,670			31,814	3,919	
1980	64,069	1,406		28,707	2,294	
1981	61,465	3,033		20,636	4,726	
1982	55,317	7,642		26,316	7,398	
1983	40,486	9,102		19,350	4,481	

1984	29,058	8,348		29,396	3,335	*
1985	43,333	11,507		32,230	5,556	
1986	73,392			15,461	8,149	
1987	97,167			27,017	642	
1988	149,656			44,089	2,589	
1989	248,800			60,734	10,543	
1990	325,111	*		77,542	12,515	
1991	266,151	7,995	65,578	91,727	12,892	
1992	313,481	9,349	28,008	105,639	13,679	
1993	283,813	14,777	86,267	175,168	516	*
1994	203,379	18,940	29,645	152,829	484	
1995	179,632	6,442	18,924	130,001	523	
1996	108,475	6,447	21,887	124,244	375	
1997	77,995	10,028	15,807	75,791	993	
1998	86,837	5,531	13,301	70,510	*	
1999	100,374	10,055	14,025	102,446	222	
2000	48,291	5,486	9,320	94,881	284	
2001	87,249	5,991	14,593	67,531	52	
2002	128,461	3,019	17,633	85,800	*	
2003	145,116	7,269	14,034	85,336		
2004	115,943	14,230	12,550	72,801	*	
2005	91,920	6,402	6,627	41,711	*	
2006	49,654	7,539	3,675	31,359	*	
2007	42,162	8,250	*	44,767	*	
2008	34,268	15,331		26,941	*	
2009	52,256	8,636		16,994	*	
2010	43,778	2,749		8,586	*	
2011	89,850	979		13,243	*	
2012	63,497	756		7,784	*	
2013	57,368	1,035		4,638	*	
2014	33,536	4,446		2,703		
2015	38,034	6,751		2,711		
2016	44,509	11,450		3,157	*	
2017	53,232	6,985		2,422	*	
2018	54,210	8,417		2,071		
2019	51,676	9,243		1,571		
2020	47,456	3,857		1,467		
2021	36,445	7,569		940	*	
2022	35,966	8,117		1,197		
2023	45,808	7,543		1,508		
2024	41,875	8,264		1,465		

Table 3.9.2. Commercial discard estimates and standard errors (SE) for the vertical line fishery for the East, West and Gulf-wide in numbers (N) and pounds (lbs).

	Discards (N)			Discards (lbs)		
Year	East	West	Gulf-wide	East	West	Gulf-wide
2000	535	1,034	1,502	646	1,623	2,034
2001	725	950	1,632	875	1,491	2,210
2002	1,031	1,024	2,076	1,244	1,606	2,811
2003	1,138	1,166	2,264	1,374	1,830	3,065
2004	953	1,122	2,039	1,150	1,761	2,761
2005	837	808	1,565	1,010	1,268	2,119
2006	548	507	1,149	662	795	1,556
2007	489	1,002	1,078	590	1,572	1,460
2008	494	736	977	596	1,156	1,323
2009	12,838	2,015	15,977	20,896	3,904	26,692
2010	9,015	1,268	11,642	14,697	2,479	19,451
2011	15,566	1,390	14,944	25,555	2,721	24,966
2012	21,516	4,990	24,285	43,011	13,018	50,042
2013	10,641	1,228	13,827	24,778	3,272	33,180
2014	10,329	934	12,367	24,421	2,490	29,674
2015	9,279	1,049	12,920	21,837	2,795	30,735
2016	11,366	1,257	15,411	26,399	3,350	36,692
2017	10,095	861	13,869	23,185	2,295	33,128
2018	10,012	451	10,380	28,778	1,112	29,470
2019	11,542	381	11,735	33,175	977	33,318
2020	9,773	364	9,866	28,090	872	28,010
2021	9,684	349	9,729	27,834	830	27,621
2022	10,034	361	10,059	28,842	853	28,560
2023	11,316	507	11,630	32,524	1,219	33,019
2024	10,009	526	10,412	28,769	1,247	29,560

Table 3.9.2 continued

	SE (N)			SE (lbs)		
Year	East	West	Gulf-wide	East	West	Gulf-wide
2000	150	819	553	187	1,412	896
2001	204	752	601	253	1,298	974
2002	290	810	764	359	1,398	1,238
2003	320	923	834	397	1,592	1,351
2004	268	888	751	332	1,533	1,216
2005	235	639	576	292	1,103	934
2006	154	401	423	191	692	685
2007	137	793	397	170	1,368	643
2008	139	583	360	172	1,006	583
2009	3,888	1,499	4,619	6,213	2,892	7,501
2010	2,730	943	3,366	4,369	1,837	5,466
2011	4,714	1,034	4,320	7,598	2,016	7,016
2012	4,019	1,691	4,377	7,290	4,829	8,094
2013	1,490	311	1,668	3,803	863	3,940
2014	1,446	236	1,492	3,748	657	3,524
2015	1,299	265	1,558	3,352	737	3,650
2016	1,591	318	1,859	4,052	883	4,358
2017	1,413	218	1,673	3,559	605	3,934
2018	1,784	185	1,768	5,383	437	5,316
2019	2,056	156	1,999	6,205	384	6,010
2020	1,741	149	1,680	5,254	343	5,053
2021	1,725	143	1,657	5,206	326	4,983
2022	1,788	148	1,713	5,395	335	5,152
2023	2,016	208	1,981	6,084	479	5,956
2024	1,783	215	1,773	5,381	490	5,333

Table 3.9.3. Gulf of Mexico trawling effort (in days) by region (East/West) and total with associated CV. CVs were only available for 1984 onward.

Year	East	West	Total	CV
1960	32,332	78,901	111,233	
1961	24,082	55,345	79,427	
1962	28,260	68,219	96,479	
1963	26,846	83,157	110,002	
1964	34,923	84,068	118,991	
1965	31,237	73,990	105,228	
1966	28,562	71,148	99,710	
1967	24,917	91,692	116,609	
1968	32,370	87,436	119,806	
1969	37,798	102,062	139,860	
1970	27,371	90,876	118,247	
1971	27,006	95,168	122,175	
1972	28,737	116,644	145,381	
1973	31,039	104,073	135,111	
1974	33,820	101,592	135,412	
1975	30,509	88,353	118,862	
1976	30,674	112,193	142,867	
1977	33,586	120,224	153,810	
1978	38,657	148,165	186,822	
1979	46,772	148,831	195,603	

1980	26,652	106,763	133,416	
1981	34,121	129,325	163,446	
1982	38,884	121,942	160,826	
1983	47,101	111,336	158,437	
1984	52,691	116,137	168,827	1.4
1985	48,628	125,966	174,594	1.4
1986	54,518	147,191	201,708	1.5
1987	57,929	164,966	222,895	1.4
1988	46,990	144,962	191,953	1.5
1989	55,016	147,450	202,466	1.9
1990	63,417	140,942	204,359	2.3
1991	52,170	148,214	200,384	2.3
1992	52,695	146,284	198,979	2.6
1993	40,552	143,148	183,700	3.3
1994	39,796	105,250	145,046	4.4
1995	36,262	88,145	124,407	2.3
1996	45,704	96,463	142,167	2.3
1997	46,500	117,574	164,074	2.1
1998	63,512	131,623	195,135	2
1999	52,708	138,286	190,994	2.1
2000	39,719	129,580	169,299	1.9
2001	36,998	95,349	132,347	3.3
2002	36,568	112,875	149,444	2.6

2003	30,721	88,406	119,127	2.3
2004	24,279	75,277	99,557	2.3
2005	19,070	60,039	79,109	2.3
2006	16,099	56,197	72,296	2.7
2007	16,921	59,154	76,075	6.9
2008	11,606	50,566	62,172	2.6
2009	13,226	64,080	77,307	2
2010	5,912	44,400	50,312	2.4
2011	9,120	53,520	62,641	1.7
2012	9,232	53,423	62,655	2
2013	11,330	59,275	70,604	7.1
2014	14,087	62,201	76,287	1.3
2015	14,045	61,825	75,871	1.2
2016	12,825	61,443	74,268	1.1
2017	14,180	62,641	76,821	1.1
2018	16,076	55,443	71,519	1
2019	14,066	53,063	67,130	1
2020	18,474	52,164	70,638	1.3
2021	14,814	54,074	68,888	2
2022	12,324	33,293	45,618	2.5
2023	9,161	27,739	36,900	3.2
2024	8,449	27,013	35,462	3.8

Table 3.9.4. Time-series (1984-2023) of annual Gray Triggerfish bycatch estimates and associated standard error (SE) for the West/East subregions and Gulf-wide.

	East		West		Gulf	
Year	Bycatch	SE	Bycatch	SE	Bycatch	SE
1984	348,883	51,039	2,181,785	300,991	602,379	148,033
1985	390,068	54,298	2,397,973	329,808	670,997	178,256
1986	300,785	43,757	2,804,911	391,953	966,090	119,242
1987	430,966	65,524	3,206,838	459,509	540,201	50,701
1988	306,332	55,086	2,875,992	414,721	758,124	77,499
1989	298,776	51,267	2,751,088	385,031	704,027	94,371
1990	327,404	46,174	2,627,805	364,406	484,904	68,151
1991	267,675	42,356	2,714,367	392,295	660,309	55,952
1992	260,878	65,109	2,776,928	395,517	463,600	52,897
1993	275,399	41,411	2,694,047	391,001	437,446	51,893
1994	301,546	46,205	1,909,226	257,363	477,767	53,190
1995	456,167	77,144	1,589,749	223,185	424,302	40,706
1996	472,803	83,880	1,827,673	256,193	387,097	32,528
1997	445,693	93,359	2,218,890	321,520	368,221	31,366
1998	355,665	60,117	1,836,106	257,270	392,766	37,086
1999	249,506	38,249	1,891,162	278,825	257,934	19,562
2000	197,805	27,370	1,791,133	258,747	250,215	26,764
2001	201,124	28,334	1,411,184	219,230	2,530,668	307,430
2002	151,989	23,847	1,637,802	243,661	2,788,041	314,337
2003	139,340	26,969	1,237,157	186,654	3,105,696	349,112
2004	116,536	20,076	1,087,187	160,080	3,637,803	426,309
2005	83,861	14,885	854,585	121,871	3,182,324	427,100
2006	62,639	10,647	779,094	109,951	3,049,864	394,229
2007	140,290	39,430	462,089	114,883	2,955,209	317,663
2008	119,350	37,832	551,647	70,224	2,982,042	348,475
2009	102,596	16,604	863,494	110,293	3,037,806	579,787
2010	54,197	6,727	486,003	66,845	2,969,446	334,731
2011	69,321	9,912	688,803	82,488	2,210,772	274,235

2012	79,113	14,384	624,914	77,892	2,045,915	291,909
2013	35,973	7,615	448,932	67,211	2,300,476	349,643
2014	54,108	5,911	606,201	75,176	2,664,584	454,956
2015	34,799	2,926	428,801	172,639	2,191,771	296,618
2016	29,894	2,481	407,552	177,957	2,140,668	245,028
2017	33,993	2,629	443,774	218,757	1,988,938	202,757
2018	41,274	3,345	383,028	164,065	1,612,308	177,561
2019	36,419	2,818	350,678	126,095	1,789,791	202,955
2020	41,930	3,165	326,291	131,559	1,376,498	193,858
2021	36,414	2,996	356,352	142,460	1,203,723	150,714
2022	25,060	1,813	232,874	79,936	938,446	119,082
2023	22,525	1,907	227,690	102,109	841,732	101,584

3.10 FIGURES

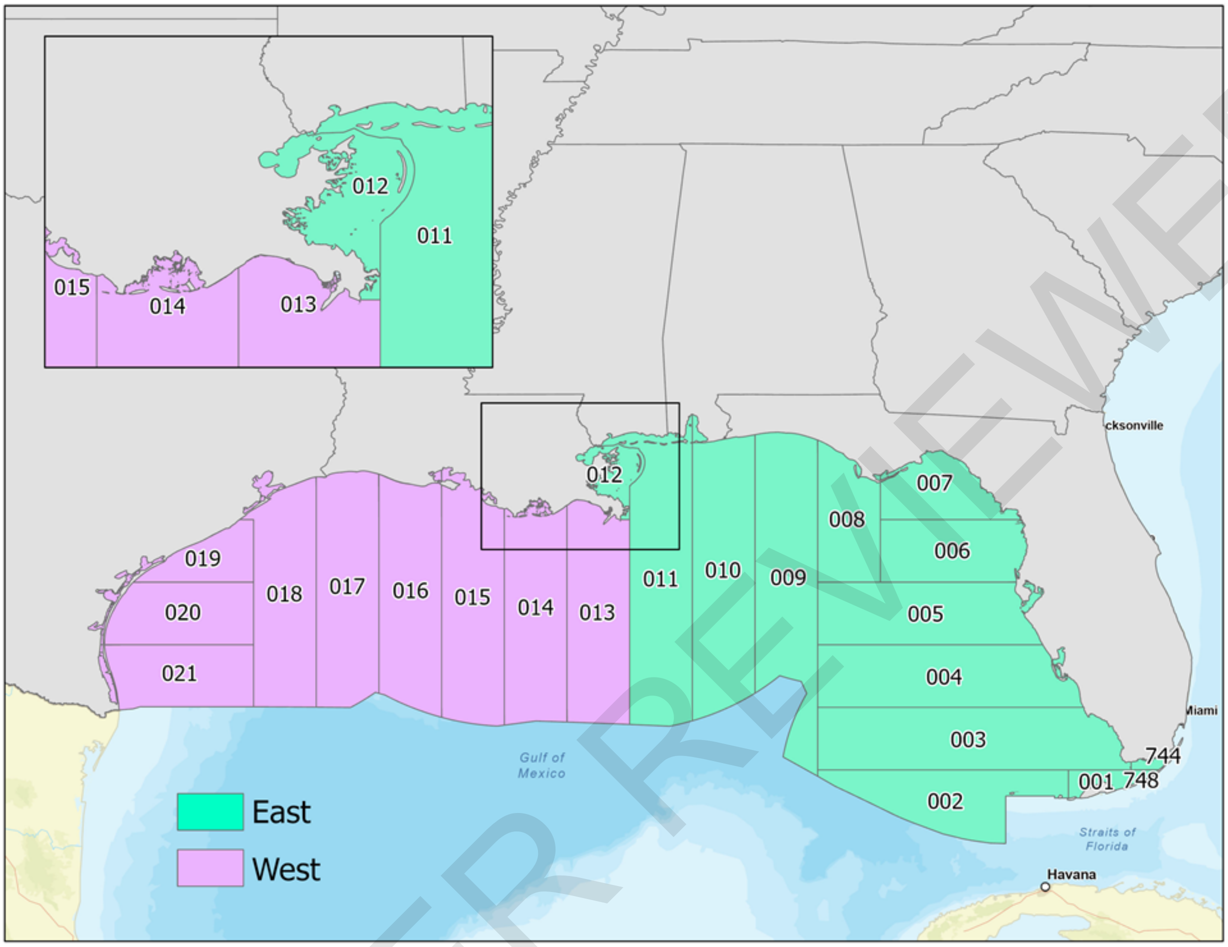


Figure 3.10.1. Gulf of America commercial fishing areas with subregions highlighted.

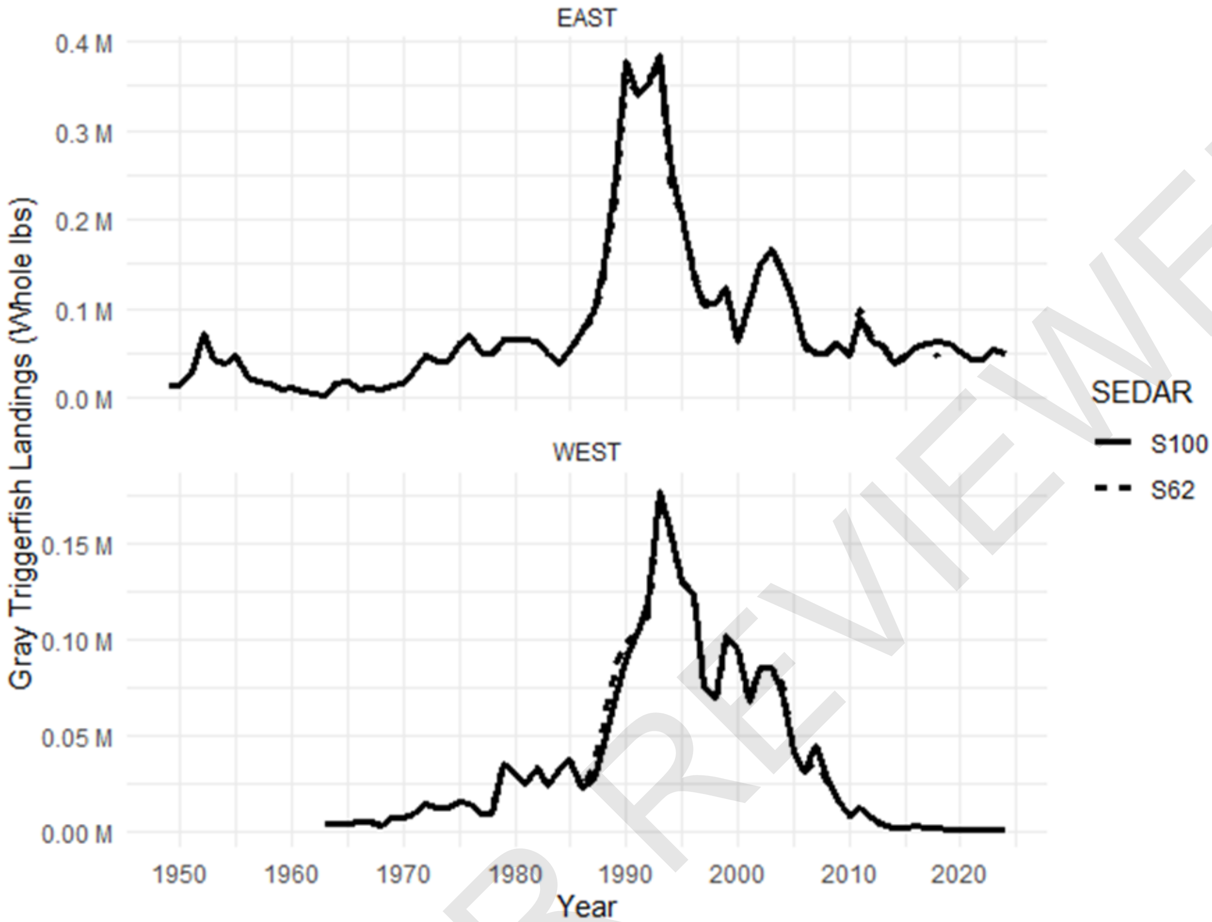


Figure 3.10.2. Annual calculated Gray Triggerfish commercial landings (in whole weight pounds) by subregion for the current SEDAR 100 compared to the previous assessment SEDAR 62 from 1949 - 2024. Confidential landings have been excluded.

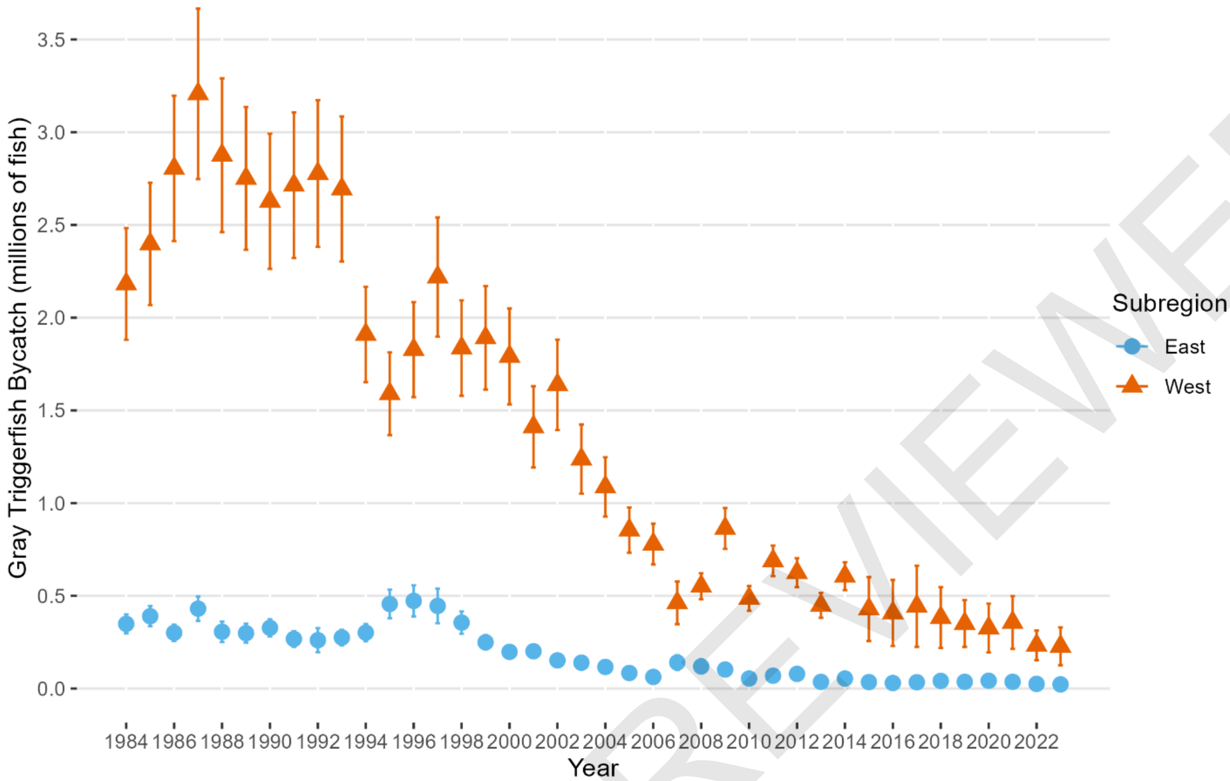


Figure 3.10.3. Gray Triggerfish bycatch time-series (1984-2023) and associated standard errors for West and East Gulf subregions.

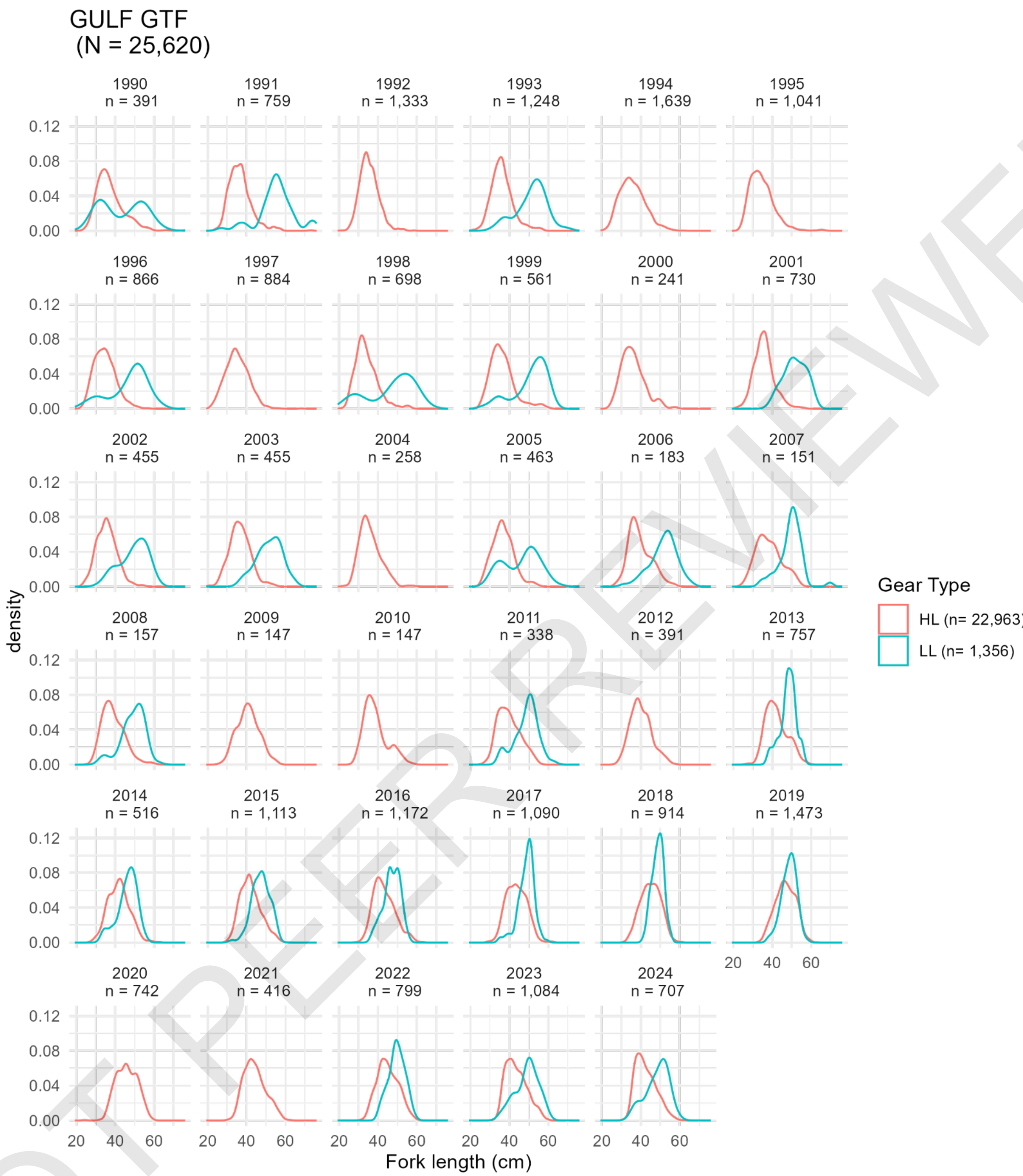


Figure 3.10.4. Annual nominal gulf-wide length compositions for the Gulf Gray Triggerfish commercial handline and longline fisheries.

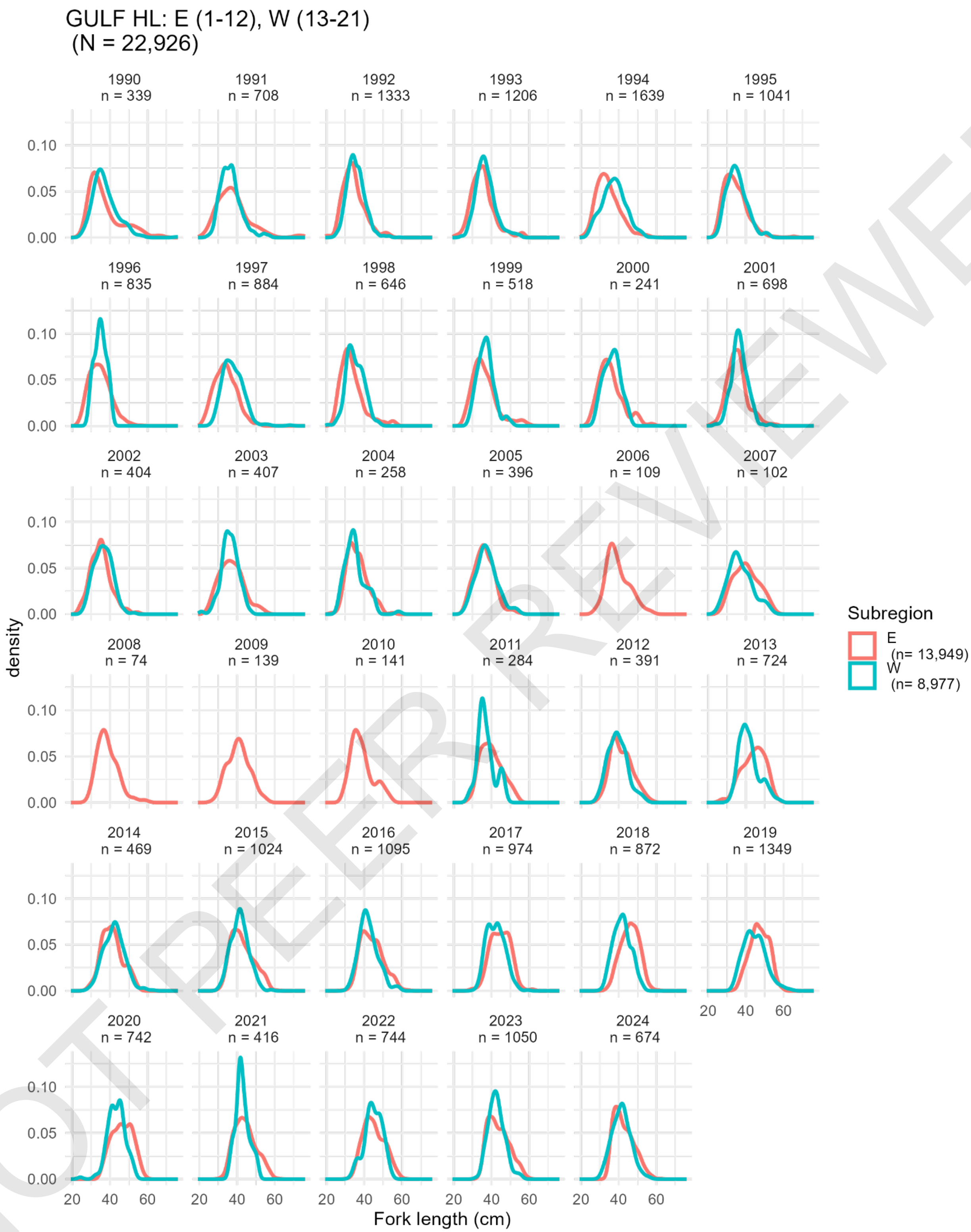


Figure 3.10.5. Annual nominal length compositions for the East and West subregions of the Gulf Gray Triggerfish commercial handline fishery.

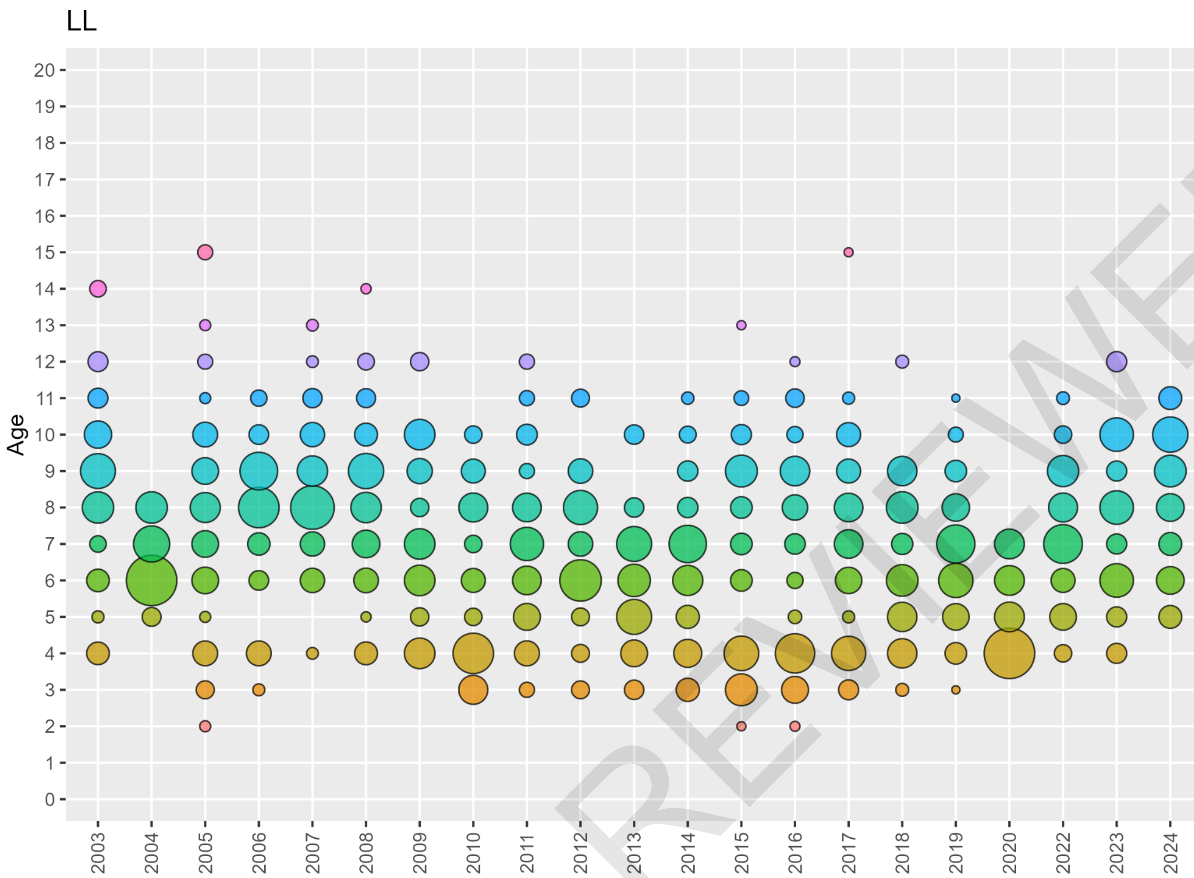


Figure 3.10.6. Final annual nominal age compositions for the Gulf Gray Triggerfish commercial longline fishery. The size of the dots represents the relative proportion at age. Refer to Table 2.13.6 for which years do not meet sample size criteria for inclusion.

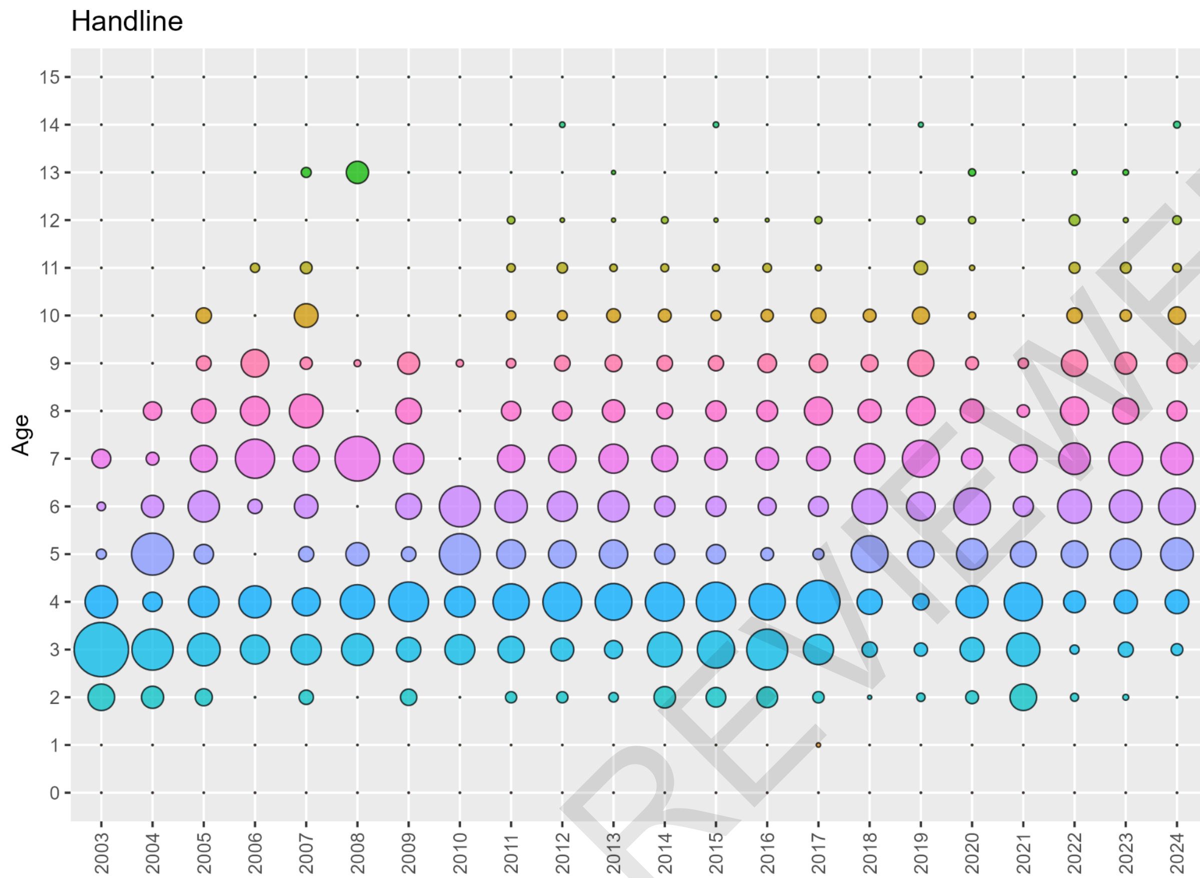


Figure 3.10.7. Final annual weighted age compositions for the Gulf Gray Triggerfish commercial handline fishery. The size of the dots represents the relative proportion at age. Refer to Table 2.13.6 for which years do not meet sample size criteria for inclusion.

4 RECREATIONAL FISHERY STATISTICS

4.1 OVERVIEW

4.1.1 Group Membership

Lead

Matthew Nuttall - National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center (SEFSC) Sustainable Fisheries Division (SFD)

Members

Abby Carrigan - Florida Fish and Wildlife Conservation Commission (FWCC)
Alicia Paul - FL Charter Fisherman
Challen Hyman - FWCC
David Griffith - Gulf Scientific and Statistical Committee (SSC)
Ellie Corbett - FWCC
Erin Driscoll - FWCC
*Gaitlyn Malone - NMFS SEFSC SFD
Genine McClair – FWCC

Juan Cortes - FWCC
Maria McGirl - FWCC
Mark Tryon - FL Commercial Fisherman
Matthew Nuttall - NMFS SEFSC SFD
Michael Larkin - NMFS SERO
Mike Rowell - AL Charter Fisherman
Olivia Wilms - FWCC
*Rob Cheshire - NMFS SEFSC Fisheries Statistics Division (FSD)
Samantha Binion-Rock - NMFS SEFSC SFD
Sascha Cushner - NMFS SEFSC SFD
Sean Wilms - FWCC
Vivian Matter - NMFS SEFSC SFD

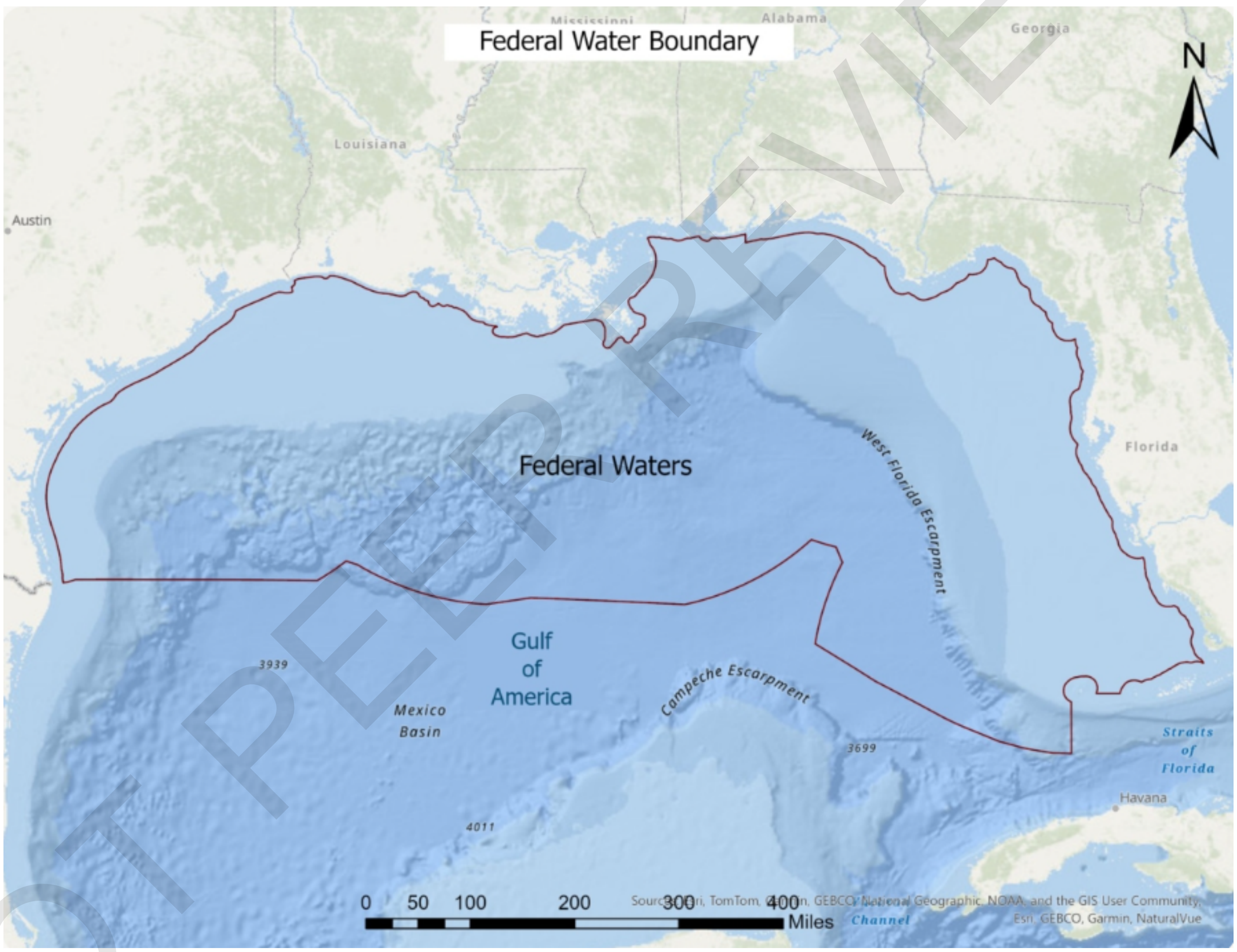
** indicates virtual participation*

4.1.2 Tasks

1. Review fully calibrated MRIP Fishing Effort Survey (FES)/Access Point Angler Intercept Survey (APAIS)/For-Hire Survey (FHS) landings and discard estimates.
2. Allocate MRIP catch estimates from Monroe County to the Gulf of America or South Atlantic.
3. Evaluate MRIP catch estimates by mode of fishing and determine how to incorporate all appropriate modes into the Gray Triggerfish stock assessment.
4. Review calibrations between federal (e.g., MRIP-FES) and state survey estimates.
5. Determine whether MRIP or SRFS estimates should be used to inform Florida Private mode landings and discards.
6. Evaluate usefulness of historical data sources such as the Fishing, Hunting, and Wildlife-Associated Recreation Survey (FHWAR) to generate estimates of landings prior to 1981.

7. Provide input on an appropriate “start year” for the SEDAR 100 Assessment Model.
8. Provide estimates of uncertainty around each set of landings and discard estimates.
9. Review whether SRHS discard estimates (2004+) are reliable for use and determine if there are other sources of data prior to 2004 that could be used as a proxy to estimate headboat discards.
10. Evaluate if the recreational fleet structure should be updated.
11. Provide nominal and weighted length and age distributions for landings, if feasible.
12. Provide nominal and weighted length distributions for discards, if feasible.
13. Evaluate adequacy of available data.
14. Provide research recommendations to improve recreational data.

4.1.3 Gulf of Mexico Fishery Management Council Scamp Group Management Boundaries



4.2 REVIEW OF WORKING PAPERS

Headboat Data for Gray Triggerfish in the US Gulf of America (SEDAR 100-DW-01)

This document provides an overview of the Southeast Region Headboat Survey, the catch estimates of Gray Triggerfish in numbers and weight, the uncertainty associated with these catch estimates, a description of the number of fish measured by the survey, a summary of average lengths and weights, total effort by headboats in the Gulf of America, and the number of vessels by strata to determine confidentiality. The public version is limited to non-confidential records, but the lead assessment analyst was provided with a confidential version of the working paper to include more detailed information and maps of Gray Triggerfish catch.

General Recreational Survey Data for Gray Triggerfish in the Gulf of America (SEDAR 100-DW-02)

General recreational survey data for Gray Triggerfish from the Marine Recreational Information Program (MRIP), Texas Parks and Wildlife Department (TPWD), and Louisiana Creel Survey (LA Creel) are summarized from 1981 to 2024 for Gulf of America states from Texas to western Florida, excluding the Florida Keys. Estimates from the Charter, Private, Headboat (1981-1985 from Texas to the Florida Keys) fishing modes are presented. These fully calibrated MRIP estimates take into account the change in the Fishing Effort Survey, the redesigned Access Point Angler Intercept Survey, and the For Hire Survey. Tables and figures presented include calibration comparisons, landing and discard estimates, associated CVs, sample sizes, fish sizes, and effort estimates.

Historical Recreational Landings for Gulf of America Gray Triggerfish (Balistes capriscus) estimated using the FHWAR Census Method (SEDAR 100-DW-03)

The National Survey of Fishing, Hunting, and Wildlife-Associated Recreation Survey (FHWAR) is one of the oldest and most comprehensive recreational surveys in the US and was conducted every 5 years between 1955-1985. The FHWAR census method utilizes information from these surveys including U.S. angler population estimates and angling effort estimates from 1955–1985 for the Gulf of America. To obtain historical Gray Triggerfish landings prior to 1981, FHWAR effort estimates in saltwater angler trips (1955-1980) are multiplied by average catch rates from early years (1981-1989) of the MRIP and SRHS data. Interpolation is used to complete the time series.

Gulf of America Gray Triggerfish (Balistes capriscus) length and age compositions from the recreational fishery (SEDAR 100-DW-04)

This working paper describes the data and methodologies used to estimate nominal length and age compositions, conditional age-at-length (CAAL), and mean length-at-age (MLAA) for a combined recreational fleet (i.e., Headboat, Charter, and Private combined) included in the SEDAR 100 Gulf of America Gray Triggerfish Assessment. Changes from SEDAR 62 are also described in this document. Weighting methodologies were discussed during the Data Workshop and an updated working paper was submitted that documents the final nominal and weighted length and age compositions, CAAL, and MLAA for the combined recreational fleet.

Proxy Discard Estimates of Gray Triggerfish (Balistes capriscus) from the US Gulf of America Headboat Fishery (SEDAR 100-DW-08)

Discard data from the Southeast Region Headboat Survey (SRHS) were not routinely collected until 2004, and there are concerns with underreporting during the first few years of data collection (2004-2007). These data are self-reported and not currently validated within the SRHS program. This paper describes the method used and decisions applied in the SRHS (proxy) discards provided in SEDAR 100 for years lacking discard estimates (e.g., 1981-2003) or years with unreliable discard estimates (e.g., 2004-2007) and provides relevant summaries of these proxy discards.

A Summary of Gulf of America Gray Triggerfish Discard Length Data Collected from At-Sea Observers in For-Hire Fishery Surveys in Florida (SEDAR 100-DW-11)

Detailed information on the size and release condition of discarded fish is not collected in traditional dockside surveys of recreational fisheries. At-sea observer surveys provide valuable information on the size and condition of discarded fish, and have been conducted on for-hire vessels in Florida since 2005. At-sea observer surveys have not been consistently funded on both coasts of Florida, which has led to short breaks in the time series in some regions. The majority of these observer trips were conducted on headboat vessels, with charter vessels being surveyed intermittently starting in 2009. This report provides a summary of available information on the size composition, release condition, and disposition of Gray Triggerfish collected by trained observers since 2005 during at-sea surveys on for-hire vessels along the Gulf Coast of Florida.

A ratio-based method for calibrating estimates of total landings (numbers and pounds of fish), releases (numbers of fish), and total trips from MRIP-FCAL to SRFS for Gulf Gray Triggerfish (Balistes capriscus) (SEDAR 100-DW-12)

The Fishery Dependent Monitoring subsection (FDM) of the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute (FWRI) generates private recreational landings, release, and effort estimates for a suite of reef fish in Florida using the State Reef Fish Survey (SRFS). SRFS estimates for Florida Gray Triggerfish (*Balistes capriscus*) from 2016-2024 are provided in this report. Additionally, historical (1981-2015) MRIP-FCAL estimates for Florida have been calibrated into SRFS currency using a peer-reviewed, ratio-based method that has been applied in previous SEDAR stock assessments (e.g. 72, 79, 88, 90, 96), which are also provided.

Length and age compositions of Gulf Gray Triggerfish, Balistes capriscus, collected in association with fishery-dependent projects along Florida's Gulf Coast (SEDAR 100-DW-13)

The Fishery Dependent Monitoring subsection (FDM) of the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute (FWRI) monitors commercial and recreational fishing in marine environments along the Florida coast in association with several fishery-dependent research and monitoring projects. FDM administers three federal surveys: The Marine Recreational Information Program (MRIP) and the Southeast Region Headboat Survey (SRHS) for the recreational sector, and the Trip Interview Program (TIP) for the commercial sector. Additionally, FDM conducts several unique surveys of recreational anglers that allow for the collection of supplemental biological data. Each fishery-dependent research or monitoring project that contributed age and length data to the Life History Group is detailed in this report.

4.3 RECREATIONAL DATA SOURCES

4.3.1 Marine Recreational Information Program (MRIP)

Introduction

The Marine Recreational Information Program (MRIP), formerly the Marine Recreational Fisheries Statistics Survey (MRFSS), conducted by NOAA Fisheries (NMFS) provides estimates of catch per unit effort, total effort, landings, and discards for six two-month periods (waves) each year. In all states where MRIP samples, MRIP provides estimates for three main recreational fishing modes: shore-based fishing (Shore), private and rental boat fishing (Priv), and for-hire charter and guide fishing (Cbt). MRIP covers all Gulf of America states from western Florida to Mississippi. Louisiana was covered by the survey until 2014 and Texas is not covered to avoid overlap with the TPWD survey (discussed below in 4.3.3). When the survey first began in Wave 2 (Mar/Apr) of 1981, headboats were included in the for-hire mode, but this component has been excluded after 1985 to avoid overlap with the Southeast Region Headboat Survey (SRHS), conducted by the NMFS Beaufort laboratory.

Recreational catch, effort, and participation were estimated through a suite of independent but complementary surveys that are described in SEDAR 68-DW-13. Over the years, effort data have been collected from three different surveys: (1) the Coastal Household Telephone Survey (CHTS) which used random digit dialing of coastal households to obtain information about recreational fishing trips, (2) the weekly For-Hire Survey which interviews charterboat operators (captains or owners) to obtain trip information and replaced the CHTS for the charter mode (in 2000 for the Gulf of America and East Florida and 2004 for the Atlantic coast north of Georgia), and (3) the Fishing Effort Survey which is a mail based survey whose sample frame consists of anglers from the National Saltwater Angler Registry and replaced the CHTS for the private and shore modes in 2018. Catch data are collected through dockside angler interviews in the Access Point Angler Intercept Survey (APAIS), which samples recreational fishing trips after they have been completed. In 2013, MRIP implemented a new APAIS procedure to remove sources of potential bias from the sampling process. Catch rates from dockside intercept surveys are combined with estimates of effort to estimate total landings and discards by wave, mode, and area fished (e.g. inland, state, and federal waters).

Catch estimates from the early years of the survey are highly variable with high proportional standard errors (PSE's), and sample sizes in the dockside intercept portion have been increased over time to improve precision of catch estimates. Several quality assurance and quality control improvements were implemented for the intercept surveys in 1990. Prior to 1990, the contractor did not have regional representatives hired to supervise the samplers in any given area. All samplers were hired as independent sub-contractors and communicated directly with the contractor's home office staff. It is more likely that the samplers who worked in the 80's would have varied more in their interpretation of sampling protocols and their ability to identify at least some of the more difficult-to-recognize species. There were a number of other changes made to enhance consistency in sampling protocols and improve error-checking in the Statement of Work for the 1990-1992 contracts. Improvements have continued over the years, but the biggest changes happened during that time (personal communication, NMFS). Catch rate data have improved through increased sample quotas and additional sampling (requested and funded by the states) to the intercept portion of the survey.

Task 1: In order to maintain a consistent time series, charter estimates were calibrated on the Gulf coast prior to 2000 (SEDAR 64-RD-12), and MRIP estimates for private and shore prior to 2018 were calibrated to FES (Papacostas and Foster 2021). CHTS and calibrated FHS charter catch estimates for Gulf of America Gray Triggerfish from 1981 to 1999 are shown in Figure 1 of SEDAR 100-DW-02. Calibrated APAIS and FES estimates for Gulf of America Gray Triggerfish from 1981 to 2024 are shown in Figure 2 of SEDAR 100-DW-02.

Monroe County

MRIP catch from Monroe County is allocated to the official estimates for West Florida. However, they can be estimated separately using domain estimation. The Monroe County domain includes only intercepted trips returning to that county as identified in the intercept survey data. Estimates are then calculated within this domain using standard design-based estimation which incorporates the MRIP design stratification, clustering, and sample weights (SEDAR 68-DW-13). Although Monroe county estimates can be separated from the rest of western Florida using this process, they do not distinguish catch from the Atlantic Ocean and that from the Gulf of America (SEDAR-PW-07).

Task 2: For SEDAR 100, MRIP estimates from Monroe County were allocated to the Atlantic because Gray Triggerfish is a species associated with hard-bottoms and Monroe County catches are most likely from the Atlantic side of the Florida Keys. This recommendation differs from that applied in SEDAR 9 for Gulf Gray Triggerfish, which included the Florida Keys (SEDAR 9), but is in agreement with Gulf of America (SEDAR 43 and 62) and South Atlantic (SEDAR 32, 41, and 82) Gray Triggerfish assessments thereafter.

Adjustment to Fishing Modes

Task 3a: Between 1981 and 1985, MRIP charter and headboat modes were combined into a single mode for estimation purposes. Since the NMFS Southeast Region Headboat Survey (SRHS) began in the Gulf in 1986, the MRIP combined charter/headboat mode must be split in order to provide estimates of headboat landings in these early years. The MRIP charter/headboat mode (1981-1985) was split by using a ratio of SRHS headboat angler trip estimates to MRIP charterboat angler trip estimates for 1986-1990. In accordance with SEDAR Best Practices, the mean ratio was calculated by state (or state equivalent to match SRHS areas to MRIP states) and then applied to the 1981-1985 estimates to split out the headboat component when needed (SEDAR-PW-07). The MRIP headboat component from this split was used to represent headboat fishing in the Gulf (Louisiana to western Florida) from 1981-1985 and SRHS headboat estimates were used for all years after 1985.

Task 3b: As done in SEDAR 43, shore mode was excluded from MRIP landings and discard estimates. Gray Triggerfish are strongly associated with reefs and hard-bottom and are unlikely to be caught from shore access sites in the Gulf. This is supported by the relatively low contribution of shore catch to general recreational catch. This recommendation is in agreement with decisions made during SEDARs 43 and 62.

Unidentified Triggerfish

Catch estimates of unidentified triggerfish (i.e., leatherjacket family) are present in the MRIP dataset. For SEDAR 100, 100% of unidentified Triggerfish landings and discards were assumed to be Gray Triggerfish. This is consistent with SEDAR 62. For all Triggerfish species (e.g. Gray, Ocean, and Queen), Gray Triggerfish account for almost 100% of all landings and discards, except for a few years in the 1980s (Table 12 in SEDAR 100-DW-02). This is consistent with observations made by commercial and charter fishermen work group members, who reported rarely (~1-2 total occasions spanning many years) catching other Triggerfish species.

Uncertainty

Coefficient of variation (CV) estimates for Marine Recreational Information Program (MRIP) survey catch totals are provided for stock assessments by the Southeast Fisheries Science Center (SEFSC). Variances of total catch-in-number estimates are computed directly from the raw survey data to obtain CVs appropriate for custom aggregations by year, wave, sub-region, state, and mode using standard survey methods (SEDAR 68-DW-10).

4.3.2 Louisiana Creel Survey (LA Creel)

The Louisiana Department of Wildlife and Fisheries (LDWF) began conducting the Louisiana Creel (LA Creel) survey program on January 1, 2014 to monitor marine recreational fishery catch and effort. The program is designed to sample guided (e.g., charter) and unguided (i.e., combined private/shore) fishing modes and is comprised of three separate surveys: an intercept survey, a private telephone/email survey, and a for-hire telephone/email survey. The dockside/shoreside survey is used to collect data needed to estimate the mean numbers of fish landed by species for each of five different inshore basins and one offshore area. The private telephone/email survey samples from a list of people who possess either a LA fishing license or a LA offshore fishing permit and provided a valid telephone number. The for-hire telephone/email survey samples from a list of Louisiana's registered for-hire captains who provided a valid telephone number. Both telephone/email surveys are conducted weekly. Dockside/shoreside discard information has been collected since 2016 but only for a subset of finfish species which includes Gray Triggerfish.

Calibration to MRIP-FES units

Task 4a: The MRIP and LA Creel surveys were conducted simultaneously in 2015 for benchmarking purposes. A ratio estimator is used to calibrate private mode LA Creel landings and discards in numbers of fish to MRIP FES units. Because the charter fishing frame used by the LA Creel and MRIP surveys are functionally equivalent, charter fishing estimates of the two surveys are assumed equivalent and are not adjusted (SEDAR 98-DW-18). The ratio of the 2015 private mode landings estimates from the LA Creel and MRIP FES surveys (ratio = 3.55) is used to calibrate LA Creel private estimates (2014-2024) to MRIP FES units as the product of the 2015 MRIP/LA Creel landings ratio and the annual LA Creel estimates. Discard and effort estimates between surveys are calibrated using the same ratio as applied to landings. Note that the LA Creel calibration ratios applied to date in SEDAR 100 are considered preliminary and may be revised in the future after MRIP-FES estimates are updated with the new survey design (Gulf Transition Plan 2025).

Uncertainty

Coefficients of variation for annual LA Creel landings and discards estimates are provided by the LDWF. Variances are calculated from the survey data for each week of year, area, and fishing mode and are summed to estimate annual CV's of landings and discards. These variances, in LA Creel units, are then scaled into MRIP-FES units using a Taylor Series expansion that assumes the MRIP and LA Creel point estimates are independent (i.e., correlation = 0). This is the same approach used to calibrate the TPWD time series into MRIP-FES units, as discussed in section 4.3.3 below.

4.3.3 Texas Parks and Wildlife Department's (TPWD) Marine Sport-Harvest Monitoring Program

The TPWD Coastwide Creel Survey samples fishing trips made by sport-boat anglers fishing in Texas marine waters. Sampling occurs at recreational boat access sites along the Texas coast. Data collected from dockside interviews includes information regarding trip satisfaction, angler county of origin, species sought and landed, geographical area of fish landed, length composition, bait utilized, as well as trip length for sampled boat-trips. Texas Parks and Wildlife began dockside survey methods for recreational anglers in 1974, but only generate recreational catch and effort estimates beginning in May 1983, when methods became largely standardized (SEDAR 70-WP-03). The Coastwide Creel Survey is designed to estimate landings and effort by parsing out seasons based on fishing pressure, for high-use (May 15-November 20) and low-use seasons (November 21-May 14). From there, TPWD disaggregates seasons into waves for all estimates, using the fraction of the total catch for each species from each two-month wave, to make the TPWD time series compatible with the MRIP time series. TPWD surveys private and charterboat fishing trips. While TPWD samples all trips (private, charterboat, ocean, bay/pass), most of the sampled trips are associated with private boats fishing in bay/pass areas, as these trips represent most of the fishing effort in Texas waters. Charterboat trips in ocean waters are the least encountered by the survey. Additional information on the TPWD survey can be found in SEDAR 70-WP-03.

Calibration to MRIP-FES units

Task 4b: The MRIP-FES was implemented in Texas in 2016 (SEDAR 74-RD-110) to compare MRIP-FES effort estimates with the associated effort estimates from the TPWD survey. A ratio estimator was calculated from these two sets of estimates and reviewed during the data workshop for SEDAR 74. This calibration is described in SEDAR 74-DW-10 and may be applied to landings, discards, and effort estimates to calibrate private TPWD estimates into MRIP-FES units. The MRIP-FHS has never been conducted in Texas and so an appropriate TPWD:MRIP calibration for the Texas charter mode is not available.

The Recreational Working Group (RecWG) was tasked with providing a continuous and consistent time series of recreational catch statistics by area for the combined recreational fleet. In accordance with the Terms of Reference, state survey catch estimates were calibrated to a common data unit to be comparable across time and Gulf states. While concerns were raised regarding the current calibration approach in adjusting TPWD private estimates into MRIP FES units (SEDAR 74-DW-10), the SEDAR 100 RecWG recommended application of this approach in the absence of a better alternative. This decision is in agreement with that from a joint TPWD/SEFSC collaboration that explored potential calibrations between TPWD and MRIP during SEDAR 98, and supported use of the SEDAR 74-DW-10 approach until additional benchmarking becomes feasible (Gulf Transition Plan 2025).

Catch and Uncertainty Estimates

TPWD provides catch estimates by matching high- and low-use seasons (the months included in each) to MRIP waves. Data are summarized by daily angler hours, trips, number of anglers, total catch, length measurement, mean length, and mean weight. These summaries are joined with seasonal and yearly relative pressure to calculate TPWD and NOAA pound estimates. Estimates for trips, anglers, angler hours, total catch, and mean weight incorporate relative pressure from boat ramps. Further breakdown includes estimates by Gulf area, day type, and wave. Overall totals are provided, along with standard errors for effort (angler hours), landings (fish count), and catch per unit effort (fish per angler hour) which are applied as measures of uncertainty. These variances, in TPWD units, are then scaled into MRIP-FES units using a Taylor Series expansion that assumes the MRIP and TPWD point estimates are independent (i.e., correlation = 0). This approach is described in SEDAR 74-DW-10.

4.3.4 Southeast Region Headboat Survey (SRHS)

The Southeast Region Headboat Survey estimates landings and effort for headboats in the South Atlantic and Gulf of America. The SRHS incorporates two components for estimating catch and effort. 1) Information about the size of fish landed is collected by port samplers during dockside sampling, where fish are measured to the nearest mm and weighed to the nearest 0.01 kg. These data are used to generate mean weights for all species by area and month. Port samplers also collect otoliths for aging studies during dockside sampling events. 2) Information about total landings, discards (numbers), and effort (trip duration and number of anglers) are collected via the logbook, a form (electronic since 2013) filled out by vessel personnel for individual trips. These logbooks are summarized by vessel and expanded for known missing trips to generate estimated landings by species, area, and time strata.

The SRHS was started in 1972 but only included vessels from North Carolina and South Carolina. In 1975, the survey was expanded to northeast Florida (Nassau-Indian River counties), followed by Georgia in 1976 and southeast Florida (St. Lucie-Monroe counties) in 1978. In 1986, the survey expanded to include west Florida, Alabama, Louisiana, and Texas. There have been a few changes to the spatial strata definitions within the SRHS over the years. Most notably, Mississippi was added to the survey in 2010 and Alabama was split from Northwest Florida in 2013.

Texas Headboat Landings (1981-1985)

Landings estimates for Gulf of America headboats between 1981 and 1985 come from the MRFSS/MRIP survey for all states except Texas. As in previous SEDARs, Texas headboat landings for 1981 to 1985 were estimated as a five-year average (1986-1990) from SRHS Texas headboat landings.

Uncertainty

The SRHS is designed to be a census and so reporting compliance and accuracy are the primary components of the uncertainty in landings and discard estimates over time. Headboat activity is monitored by port agents to validate trips. Three proxy estimates of SRHS uncertainty were provided for consideration in the assessment model: (1) unweighted, (2) weighted by landings-in-number, and (3) weighted by landings-in-weight. Unweighted proxy uncertainty estimates (CV) applied the annual proportions of reported to estimated trips by region as a proxy for CV with an additional buffer of 0.05 to prevent the estimate from reaching a zero value:

$$proxyCV = 1 - \frac{n}{N} + 0.05$$

where n is the number of reported trips and N is the number of estimated trips. Weighted proxy CVs were developed to approximate uncertainty by scaling the unweighted CVs with either landings-in-number or weight within each region:

$$proxyCV_i = 1 - \sum_{j=1}^{n} \left[\frac{n_{i,j}}{N_{i,j}} * \frac{L_{i,j}}{L_i} \right] + 0.05$$

where n is the number of reported trips, N is the number of estimated trips, and L is the landings (in number or weight) for year *i* and subregion/region *j*. The weighted proxy CVs by landings-in-number were recommended for use in characterizing SRHS landings and discard uncertainty in the SEDAR 100 assessment model.

4.3.5 For-Hire At-Sea Observer Coverage

At-sea observer sampling is conducted to provide detailed information on the size and release condition (e.g. live, dead) of discarded fish. In Florida, at-sea sampling by FWC, for the headboat and charter boat modes has occurred since 2005 and 2009, respectively, however there have been breaks in coverage (Table 1 in SEDAR 100-DW-11). From 2005-2007, FWC also included Alabama in their at-sea coverage of headboats. ADNR conducted at-sea observer sampling on headboats from 2017-2019. In 2022, the Return 'Em Right program began in Florida, Alabama, and Mississippi. Return 'Em Right is an ongoing program where at-sea observers sample both headboat and charter trips.

4.3.6 State Reef Fish Survey (SRFS)

In response to the need for more precise estimates of recreational catch for reef fishes, particularly from private boats, the Florida Fish and Wildlife Conservation Commission developed and implemented a new survey that runs side-by-side with the historical Marine Recreational Information Program (MRIP), described in Section 4.3.1. The MRIP is a general survey of all saltwater recreational fishing in both state and federal waters, whereas the State Reef Fish Survey (SRFS) is a supplemental, more specialized survey that directly targets participants in the reef fish fishery to collect information on effort and catch. The SRFS is the result of a decade of development and testing in Florida, in collaboration with independent statistical consultants and NOAA Fisheries scientists. The survey provides year-round, monthly estimates of fishing effort, landings, and discards for a suite of reef fish species commonly targeted by recreational anglers fishing from private boats in Florida. Initially named the Gulf Reef Fish Survey (GRFS), the methodology was implemented in May 2015 and was only conducted on the west coast of Florida, north of Monroe County. In 2018, the survey design and estimation methods were peer-reviewed and subsequently certified by NOAA Fisheries as statistically valid and suitable for use (SRFS Certification Memo and design documentation, available online: https://www.fisheries.noaa.gov/recreational-fishing-data/transitioning-new-recreational-fishingsurvey-designs). The SRFS runs concurrently with the MRIP survey in Florida, which has provided vital statistics on recreational fishing effort and catch in the Gulf of America and Atlantic Ocean off the coast of Florida since 1981. The SRFS and MRIP surveys use independent methods to estimate fishing effort (angler trips). However, catch estimates derived from each method are not completely independent. To estimate catch-per-unit-effort (CPUE), MRIP uses data collected in the Access Point Angler Intercept Survey (APAIS), and SRFS uses a combination of data from the APAIS and supplemental reef fish angler intercepts. Assignments for both intercept surveys are drawn together so that sample weights are compatible (Foster, 2018). SRFS effort is estimated through a mail survey that is used to estimate effort for the suite of reef fish found in Florida, which include Gray Triggerfish. This survey is sent out monthly to 10,000 anglers with the Florida State Reef Fish Angler designation on their Florida saltwater fishing license. This designation is free, but is a required add-on for Florida anglers who intend to or may incidentally catch any of the fish in our reef fish suite. Information on whether anglers targeting or catching this suite of reef fish have the required designation is used as an undercoverage estimate to account for all the anglers who should have been eligible to receive the mail survey, but did not. Combining dockside intercepts for reef fish collected by APAIS with the supplemental SRFS dockside estimates at offshore angling site to estimate CPUE and large sample sizes for the mail survey allows for the generation of precise estimates of landings and releases for reef fish in the suite.

Consideration of SRFS in SEDAR 100

Task 5: The SEDAR 100 RecWG was tasked with evaluating whether MRIP (SEDAR 100-DW-02) or SRFS estimates (SEDAR 100-DW-12) should be used as a source of landings and discards for the private boat mode in Florida. Responsible for providing a continuous and consistent time series of recreational catch statistics, the Group recommended the use of MRIP-FES estimates for the Florida private boat mode. This decision was largely based on the non-negligible catch coming from private fishing outside of Florida, with catches from Florida comprising 69% and 79% of regional private landings and discards respectively.

4.4 RECREATIONAL LANDINGS

4.4.1 MRIP Landings

Weight Estimation

The Southeast Fisheries Science Center used the MRIP, TPWD, and LA Creel sample data to obtain an average weight by strata using the following hierarchy: species, region, year, state, mode, wave, and area (SEDAR 32-DW-02). The minimum number of weights used at each level of substitution is 15 fish, except for the final species level where the minimum is 1 fish (SEDAR 67-WP-06). Average weights are then multiplied by the landings estimates in numbers to obtain estimates of landings in weight. These estimates are provided in pounds whole weight.

Uncertainties for average weight estimates were calculated from approach #2 in SEDAR 74-DW-12. All observations of fish weight are averaged at the trip level, from which the mean and standard error of these trip-level summaries are calculated at the same strata used in SEFSC weight estimation (e.g., syrsmwa), combined to the year/mode level, and converted to coefficients of variation (CV). These uncertainty estimates for SEFSC average weights are then combined with those for landings-in-number, using the variance product law (Goodman 1960), as an uncertainty estimate for landings-in-weight.

Catch Estimates

Final MRIP landings estimates, in numbers of fish, are shown by year and mode in Table 4.12.1, and associated coefficients of variation by year, region and mode in Tables 3.1-3.3 of SEDAR

100-DW-02 and by year and region in Tables 5.1-5.3 of SEDAR 100-DW-02. Estimates are provided for all Gulf of America states from Louisiana to western Florida, excluding the Florida Keys. Final MRIP landings estimates in pounds whole weight are shown by year and mode in Table 4.12.1, and associated coefficients of variation in Tables 6.1-6.3 of SEDAR 100-DW-02.

4.4.2 LA Creel Landings

Starting in 2014, recreational data for Louisiana are only available from the LA Creel survey. LA Creel landings estimates, calibrated to MRIP-FES units for the private mode, for Louisiana Gray Triggerfish (2014-2024) are provided in Table 4.12.2. These landings-in-number estimates are then multiplied by the corresponding SEFSC average weights to estimate landings-in-weight. Uncertainties for average weight and landings-in-weight are calculated using the same approach described above for MRIP (approach #2 in SEDAR 74-DW-12).

4.4.3 TPWD Landings

TPWD average estimates from 1983 to 1985 (by wave and mode) were used to impute missing estimates for Texas charter and private boat fishing from 1981 until the survey started in May 1983. TPWD Gray Triggerfish landings estimates, calibrated to MRIP-FES units for the private mode (SEDAR 74-DW-10), from 1981 to 2024 are provided in Table 4.12.3. These landings-in-number estimates are then multiplied by the corresponding SEFSC average weights to estimate landings-in-weight. Uncertainties for average weight and landings-in-weight are calculated using the same approach described above for MRIP (approach #2 in SEDAR 74-DW-12).

4.4.4 SRHS Headboat Logbook Landings

Final SRHS landings estimates (in number and weight) for the eastern and western Gulf of America are shown in Tables 2 and 3, respectively, in SEDAR 100-DW-01. CVs are provided for landings estimates in number of fish and can be used as a proxy for uncertainty of estimates in weight. This would assume there is no additional uncertainty from the average weights calculated from the SRHS dockside biological sampling.

The paper headboat logbook forms have changed multiple times throughout the history of the SRHS. The primary changes have been which species are explicitly listed on the forms, although there have always been blank lines to write-in species not listed. Gray Triggerfish has been listed on SRHS logbook forms since the beginning of this survey in the Gulf of America. Electronic reporting started in 2013 and all species were available for selection.

4.4.5 Historic Recreational Landings

Introduction

The historical recreational landings time period is defined as pre-1981 for the charter, private, and headboat fishing modes, which represents the start of the Marine Recreational Information Program (MRIP) and availability of landings estimates for Gray Triggerfish. The RecWG was tasked with evaluating historical sources and methods to compile landings estimates for Gray Triggerfish prior to 1981.

FHWAR Census Method

The 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (FHWAR) presents summary tables of U.S. population estimates, along with estimates of hunting and fishing participation and effort from surveys conducted by the US Fish and Wildlife Service every 5 years from 1955 to 1985 (SEDAR 100-DW-03). This information was used to develop a method for estimating recreational landings prior to 1981. The two key FHWAR survey components that were used in this census method were the estimates of U.S. saltwater anglers and U.S. saltwater days. These estimates are used to calculate the historical effort of Gulf of America saltwater anglers. Landings estimates from modern surveys (e.g., MRIP, SRHS) were used to calculate mean catch rates from 1981-1989 for Gray Triggerfish. The Gray Triggerfish fishery was largely unregulated over these years (e.g., no bag limits, no size restrictions), a characteristic shared with the historical fishery prior to 1981. The nine-year time period is meant to offset the relatively high variability in MRIP catch estimates from the early years of the survey, as described in section 4.3.1. For this calculation, MRIP effort for 1981-wave1 and TPWD effort for 1981-May 1983 were imputed using the best practice approaches described in SEDAR-PW-07. This mean CPUE is applied to the historical FHWAR effort estimates for Gulf of America saltwater anglers to provide estimates of recreational Gray Triggerfish landings prior to 1981.

The final stock ID for Gulf Gray Triggerfish will not be decided until the assessment phase. The lead analyst requested historical recreational landings estimates for two different stock structures. The first treats the entire Gulf as a single stock. The second structure splits the Gulf into West (Texas and Louisiana) and East (Mississippi to west Florida). The mean proportion of landings (MRIP and SRHS) for the West and East was calculated from 1981-1989. The Gulf-wide historical recreational landings estimates were delineated into East and West landings by applying the mean West and East proportions.

Task 6: The SEDAR 100 RecWG reviewed the FHWAR method and preliminary estimates. The Group recommended using the historical estimates calculated using the FHWAR method for the Recreational fleet from 1955-1980. Historical Gray Triggerfish landings estimates in numbers of fish are shown in Table 4.12.4 by region.

Uncertainty

The CV calculated using the FHWAR method for total recreational landings is 0.577, which is the CV of the mean CPUE multiplied by historical FHWAR effort estimates (in saltwater days) and assumed to reflect the uncertainty in historical landings estimates (SEDAR 100-DW-03). The historical FHWAR estimates are believed to be highly uncertain given the limited information available to describe historical recreational fisheries.

Potential Start Year for SEDAR 100 Assessment Model

Task 7: As requested by the assessment analyst, the SEDAR 100 RecWG provided input on an appropriate start year for the Gulf Gray Triggerfish assessment model. Acknowledging the relatively high uncertainty in historical FHWAR estimates, the RecWG highlighted the highly variable trends in recreational landings between 1981-1985, which were part of the time series applied to FHWAR effort estimates to back-calculate historical landings back to 1955. There are also no recreational length or age compositions available over the historical time period, so FHWAR estimates are likely to have a relatively large influence on the model's parameterization of virgin conditions. However, the RecWG also agreed the FHWAR time series constitutes the "best available" representation of historical recreational landings. They were provided and used in past SEDAR stock assessments for Gulf Gray Triggerfish (SEDARs 43 and 62), and their inclusion reduces the chances of a potential one-way trip in the recreational time series, which shows a general decline after the early 1990s. Given these concerns, the RecWG proposed two configurations for the SEDAR 100 stock assessment model:

- Historical Model – to include FHWAR, with potential start years of 1955 or 1945, the latter being a continuity with SEDARs 43 and 62
- Modern Model – to exclude FHWAR, with potential start years of 1981 or 1986

The ultimate choice of which start year is most appropriate is recommended to be left to the SEDAR 100 assessment modeling team, who have access to all available data sources and can better determine whether a model built from unfished conditions or a fished state provides a more defensible representation of the Gulf Gray Triggerfish stock.

4.4.6 Total Recreational Landings

Combined landings estimates from all sources by stock ID region are shown in Table 4.12.4, Figure 4.13.1, and mapped in Figure 4.13.2. Comparisons of landings across stock ID regions for individual modes are shown in Figure 4.13.3, including historical recreational landings estimates for all modes combined. Overall, landings estimates for Gray Triggerfish showed a general increase into the early 1990s and subsequent decrease thereafter, and with peaks occurring in the early-1990s and mid-2000s. The majority of the recreational landings in the Gulf of America come from the private mode (about 57.4%). The charter mode contributes about 33.6% and the headboat mode makes up the remaining 9.0% of recreational landings. Geographically, most landings come from the East (about 87.4%).

Uncertainty

Task 8a: To provide an associated measure of uncertainty for total recreational landings estimates, coefficients of variation (CVs) are calculated from the sum total of variance across all recreational data sources (i.e., SRHS logbook landings, MRIP landings data, and calibrated TPWD and LA Creel landings data). Details of this approach are outlined in SEDAR 68-DW-31, and are applied to estimates of both landings-in-number and landings-in-weight.

4.5 RECREATIONAL DISCARDS

4.5.1 MRIP Discards

Fish reported to have been discarded alive are not seen by MRIP interviewers and so neither the identity nor the quantities of discarded fish can be verified. The size and weight of discarded fish are also unknown for all modes of fishing. MRIP discard estimates, in numbers of fish, are shown by year and mode in Table 4.12.1, and associated coefficients of variation are shown by year, region, and mode in Tables 4.1-4.3 of SEDAR 100-DW-02 and by year and region in Tables 5.1-5.3 of SEDAR 100-DW-02. Estimates are provided for all Gulf of America states from Louisiana to western Florida, excluding the Florida Keys.

4.5.2 LA Creel Discards

Gray Triggerfish are a target species of the LA Creel survey and so discard estimates for Louisiana Gray Triggerfish are available starting in 2016. Because MRIP discards in Louisiana from 1981 to 2013 are sparse and negligible relative to the Gulf-wide estimates, Louisiana Gray Triggerfish discards in 2014 and 2015 are also considered negligible and were not imputed. This is consistent with the decision for SEDAR 62. Discard estimates for Louisiana Gray Triggerfish are provided in Table 4.12.2, with LA Creel private mode estimates calibrated to MRIP FES units.

4.5.3 TPWD Discards

Self-reported catch is not monitored by the TPWD survey and so discards of Gray Triggerfish from Texas are not estimated by this survey (SEDAR 70-WP-03). As a proxy for recreational discards from Texas private and charter boat anglers, discard:landings ratios (B2:AB1) are calculated (by year) from Louisiana catch estimates and multiplied by TPWD landings estimates. This is a deviation from the best practice approach of calculating discard:landings ratios that are year *and* mode specific (SEDAR-PW-07). Using the best practice approach, the discard ratios were highly variable and there were two years of imputed Texas discard estimates that were unusually high (Figure 5a in SEDAR 100-DW-02). In an effort to stabilize the applied discard ratios, the RecWG considered applying 1) Louisiana ratios calculated by collapsing mode and 2) mode-specific ratios calculated by collapsing state in a Gulf-wide dataset. The RecWG recommended using the combined mode ratio from LA, which aligns with the combined recreational fleet structure (i.e., charter, headboat, and private combined) applied in previous assessments. The RecWG also expressed concern in calculating discard rates from combined eastern and western data, the latter of which tends to support lower landings. Texas estimates of Gray Triggerfish discards (1981-2024) are provided in Table 4.12.3, including those calibrated to MRIP FES units for the private mode (SEDAR 74-DW-10).

4.5.4 SRHS Headboat Logbook Discards

The SRHS logbook form was modified in 2004 to include a category to collect self-reported discards for each reported trip. This category is described on the form as the number of fish by species released alive and number released dead. Port agents instructed each captain on criteria for determining the condition of discarded fish. A fish is considered "released alive" if it is able to swim away on its own. If the fish floats off or is obviously dead or unable to swim, it is considered "released dead". As of Jan 1, 2013 the SRHS began collecting logbook data electronically. Changes to the trip report were also made at this time, one of which removed the condition category for discards (i.e., released alive vs. released dead) due to difficulties in standardizing these determinations. The form now collects only the total number of fish released, regardless of condition. The SRHS discard data provided for this assessment is in total discards for all years.

As a proxy for SRHS headboat discards of Gulf of America Gray Triggerfish from 1986:2007, the ratio of the mean ratio of SRHS discard:landings (2008-2012) to the mean ratio of MRFSS CH discard:landings (2008-2012) was applied to the yearly MRIP charter boat discard:landings ratio (1986-2007) to estimate the yearly SRHS discard:landings ratio (1986-2007). This ratio was then applied to the SRHS landings (1986-2007) as a proxy for SRHS headboat discards (1986-2007). This method is termed the Super-Ratio approach and is the current SEDAR "Best Practice" method, allowing for changes in both management and year class effects to be incorporated into the proxy discard time series (SEDAR-PW-07). Details of this approach and the associated decision points for SEDAR 100 are described in SEDAR 100-DW-08.

Task 9: The SEDAR 100 RecWG recommended using the Best Practice Super-Ratio proxy method (1986-2007) and the SRHS estimated discards from 2008-2024. Alternative approaches are only considered when the preferred approach fails (SEDAR-PW-07) and given no clear indication of failure, the Super-Ratio approach was chosen for SEDAR 100 (SEDAR 100-DW-08). Final headboat proxy discard estimates are summarized in Table 1 and Figure 2 of SEDAR 100-DW-08.

Uncertainty

Uncertainty proxies for SRHS discards between 2008-2024 by stock ID region and for the entire Gulf of America (Tables 10 and 12 in SEDAR 100-DW-01) are calculated using the same method described for landings. Prior to 2008, uncertainty estimates for SRHS proxy discards are calculated from SRHS estimates of landings, the associated uncertainty for that year, and estimates of the applied discard rate and associated variance. Given proxy discards are calculated as the product of these two terms, the associated variance is approximated using Goodman's Formula for the product of two independent random variables (SEDAR 74-DW-10). Final uncertainty estimates for headboat discards are shown in Figure 2 of SEDAR 100-DW-08.

4.5.5 Total Recreational Discards

Combined discard estimates from all sources by stock ID region are shown in Table 4.12.5, Figure 4.13.4, and mapped in Figure 4.13.5. Comparisons of discards across stock ID regions for individual modes are shown in Figure 4.13.6. Overall, discard estimates for Gray Triggerfish remained low before 2015 and consistently high thereafter, which seemingly coincides with management changes (e.g., short season in 2015, no season in 2017, reduced bag limit in 2018). The majority of the recreational discards in the Gulf of America come from the private mode (about 83.0%). The charter mode contributes about 13.5% and the headboat mode makes up the remaining 3.5% of recreational discards. Geographically, most discards come from the East (about 93.9%).

Uncertainty

Task 8b: Uncertainties for total recreational discards-in-number are calculated using the same approach as that described above for total recreational landings (in Section 4.4.6).

4.6 BIOLOGICAL SAMPLING

4.6.1 Landed Fish

4.6.1.1 MRIP Biological Sampling

The MRIP Access Point Angler Intercept Survey (APAIS) includes the collection of fish lengths from the harvested catch (landed, whole condition). Up to 15 individuals of each landed species per angler interviewed are measured to the nearest mm along a centerline (defined as tip of snout to center of tail along a straight line, not curved over body). For all fish, the centerline is equivalent to fork length. For fish with truncate or rounded tails, centerline length, forked length, and natural total length are considered to be equivalent. Weights are typically collected for the same fish measured, although weights are preferred when time is constrained. Ageing structures and other biological samples are not collected during MRIP assignments because of concerns over the introduction of bias to survey data collection. Information on discarded fish size is not collected during MRIP APAIS sampling.

Summaries of fish size (pounds whole weight) for MRIP-sampled Gray Triggerfish in the Gulf of America by stock ID region and fishing mode (1981-2024) are provided in Tables 7.1-7.3 of SEDAR 100-DW-02. Table 8 in SEDAR 100-DW-02 provides annual summaries for all stock ID regions and fishing modes combined. These summaries include the number of Gray Triggerfish weighed, number of angler trips from which Gray Triggerfish were weighed, and the minimum, average, and maximum weights. The number of Gray Triggerfish sampled for lengths by MRIP are available in Table 1 of SEDAR 100-DW-04.

4.6.1.2 LDWF Biological Sampling

Size, weight, and age structures of recreationally landed Gray Triggerfish have been collected from the LDWF Biological Sampling Program starting in 2014. During the open season for Louisiana Gray Triggerfish, sampling targets for size measurements have been 30 fish per area per mode (charter and private) per week. Sizes are largely measured as maximum total length, with associated weight measurements collected as time permits. Otolith sampling targets are obtained from the federal GulfFIN grants. Summaries of fish size, in pounds whole weight, for LDWF-sampled Gray Triggerfish by mode (2014-2024) are provided in Table 9 of SEDAR 100-DW-02. These summaries include the number of Gray Triggerfish weighed, number of angler trips from which Gray Triggerfish were weighed, and the minimum, average, and maximum weights. The number of Gray Triggerfish sampled for age by LDWF is available in Table 2 of SEDAR 100-DW-04. The number of Gray Triggerfish sampled for lengths by LDWF is available in Table 1 of SEDAR 100-DW-04.

4.6.1.3 TPWD Biological Sampling

Length composition of the catch of Texas sport-boat anglers has been sampled by the TPWD since the high-use season of 1983 (mid-May). Maximum total length is measured by compressing the caudal fin lobes dorsoventrally. Weights of sampled fish are not recorded, but lengths can be converted to weights using length-weight equations (Table 1 in SEDAR 70-WP-

03). The number of Gray Triggerfish sampled for lengths by TPWD is available in Table 1 of SEDAR 100-DW-04.

4.6.1.4 SRHS Biological Sampling

SRHS dockside sampling has been conducted in all Gulf states since 1986, except for Mississippi where sampling started in 2010. Weights are typically collected for the same fish measured during dockside sampling. Biological samples (scales, otoliths, spines, stomachs, and/or gonads) are also collected routinely and processed for aging, diet studies, and maturity studies.

The number of Gray Triggerfish sampled by SRHS for lengths are available in Tables 1 and 2 and the number sampled for age are available in Tables 1 and 3 of SEDAR 100-DW-04. Mean lengths and mean weights by year and stock ID region from biologically sampled Gray Triggerfish in the SRHS are summarized in Tables 20 and 22 of SEDAR 100-DW-01.

4.6.1.5 Length Frequency Distributions of Landings

Length data from the recreational fisheries of the Gulf of America are collected by multiple federal surveys (MRIP 1981-2024, SRHS 1986-2024) and state agencies. Data collected by state agencies (described above and in SEDAR 100-DW-04) are warehoused by the Gulf States Marine Fisheries Commission (GSMFC) in the GulfFIN database (2001-2024).

Length sample sizes from all data sources are shown in Tables 1 and 2 of SEDAR 100-DW-04. Length sample sizes for each potential stock ID (e.g. Gulf, West, East) are provided in Table A1 of SEDAR 100-DW-04.

Task 10a: Nominal length distributions by year and mode are shown in Figure 4.13.7. For most years, the length distributions for Gray Triggerfish sampled from the private, charter, and headboat modes are very similar. There are years where the distributions are different, especially in the early 1980s. These years are typically associated with lower sample sizes and do not appear to be indicative of true differences in length distributions among Gray Triggerfish landed by the different modes. Based on the length distribution of retained Gray Triggerfish, there is not strong evidence to support differences in selectivity among the fishing modes. It is recommended to continue modeling the recreational sector as a combined recreational fleet consisting of the private, charter, and headboat modes, as done in SEDAR 62 and 43.

Task 11a: Nominal (Figures A1-A3 in SEDAR 100-DW-04) and weighted (Figure 4.13.8) length frequencies were generated for recreational landings for each potential stock ID. At the request of the stock assessment analyst, length compositions for SEDAR 100 were generated using 2-cm length bins, with the bin label representing the bin floor. The majority of samples come from the East stock and the Gulf-wide and East length distributions are very similar for all years. Sample sizes in the West are much lower and the length distribution from the West does not always align with the East and Gulf-wide distributions, especially in years where the sample sizes are the lowest in the 2010s. In the 1990s when sample sizes were higher, there was generally high overlap in the length distributions from the three different stock options. It is not clear if the observed differences are a reflection of lower sample sizes or indicative of true differences in the length distribution of fish from the West stock.

4.6.1.6 Aging Data

Age samples were collected from 13 sampling programs (Tables 1 and 3 in SEDAR 100-DW-04). The largest number of samples are provided through FIN-BIOSTAT. FIN-BIOSTAT sampling began in 2003 and is administered by the Gulf States Marine Fisheries Commission (GSMFC) through GulfFIN. All recreational fishing modes are sampled through FIN-BIOSTAT (Bray, personal communication 2024). FIN-BIOSTAT (n=1,664 from TX-AL) is conducted in every Gulf state, however, in FL it is called RECFIN (n=2,608) from 2003-2018 and RepBio (n=593) from 2018-2024 (Bray and Cermak, personal communication 2023). Descriptions of the various sampling programs are available in SEDAR 100-DW-04 and SEDAR 100-DW-13.

The number of Gray Triggerfish sampled for age from the recreational fishery by year and stock ID region are summarized in Table A3 in SEDAR 100-DW-04. Sample sizes are much higher in the East compared to the West. All years in the East have sufficient sample sizes (n_fish and n_trip ≥ 10) for age compositions, while there were only six years in the early 2000s with sufficient samples for the West.

4.6.1.7 Age Compositions

Task 10b: Nominal age compositions by mode are shown in Figure 4.13.9. The age distributions are fairly similar across the three modes, especially for fish between 1-4 years. It is recommended to continue modeling the recreational sector as a combined recreational fleet consisting of the private, charter, and headboat modes, as done in SEDAR 62 and 43.

Comparisons of nominal and weighted age compositions are shown in Figures A5-A7 of SEDAR 100-DW-04. Weighting had a minimal impact on the age compositions and nominal and weighted age distributions are very similar for all stock scenarios.

Task 11b: Weighted age compositions for all potential stock ID regions are shown in Figure 4.13.10. The age distribution of Gray Triggerfish is more truncated in the West compared to the East. The maximum observed age in the West is 11 years while it is 16 years in the East.

4.6.2 Discards

4.6.2.1 For-Hire At-Sea Observer Biological Sampling

Cooperative headboat and charterboat vessels were randomly selected each month throughout the year in each state. Biologists board selected vessels with permission from the captain and observe anglers as they fish. Data collected for catch include the species, number, final disposition, and size of landed and discarded fish, and that describing effort include the length of the trip and area fished (inland, state, and federal waters). Annual sample sizes of discarded live Gray Triggerfish sampled for length are shown in Table 4.12.6.

4.6.2.2 Length Frequency Distributions of Discards

At-sea observers collected length measurements from 20,470 discarded Gray Triggerfish and 2,565 harvested Gray Triggerfish (Table 4.12.7). Harvested Gray Triggerfish are generally larger than discarded Gray Triggerfish (Figure 4.13.11). The range of harvested Gray Triggerfish constricts in 2009 and this corresponds to a change in the minimum size limit from a 12 inch total length to a 14 inch fork length in 2009. Table 4.12.7 provides the annual number of discarded and harvested Gray Triggerfish measured by at-sea observers for length.

For many assessments (e.g. SEDAR 98, SEDAR 90), the headboat mode is modelled as a separate fleet from the charter and private modes. When headboat is a separate fleet, nominal headboat discard length compositions are weighted by sample weights that correct for under- or over-sampling of a trip duration (e.g. half day, full day) relative to its contribution to the total number of trips of that type conducted across all headboats (SEDAR 100-DW-11) to produce weighted discard length compositions. For SEDAR 100, this approach cannot be used because there is a single recreational fleet and there are discard lengths from both headboat and charter modes. The RecWG discussed two potential weighting options for discard length compositions that use the proportion of discarded Gray Triggerfish. The first option weighted the nominal discard length compositions by mode while the second option weighted them spatially using North (Mississippi - Florida panhandle) and South (Florida peninsula) regions. The Group recommended using the spatial weighting because there were more pronounced spatial differences (Figure 4.13.12) in discard length compositions of fish than there were between modes (Figure 4.13.13).

Task 12: Florida-only discard length compositions for headboat and charter modes are shown in Figures 2 and 4, respectively, in SEDAR 100-DW-11. Final nominal and weighted discard length compositions, using the combined MS, AL, and FL data are shown in Figure 4.13.14. Weighting had minimal impacts on the discard length compositions of Gray Triggerfish from the Recreational fleet.

4.7 RECREATIONAL EFFORT

4.7.1 MRIP Effort

MRIP effort estimates are produced via the Fishing Effort Survey (FES) for private/rental boats and shore mode and the For-Hire Survey (FHS) for charterboat mode. MRIP effort is calculated in units of angler trips, which represents a single day of fishing in the specified mode that does not exceed 24 hours, and is included in the year and mode summaries provided by Table 4.12.1. This table includes MRIP effort estimates for all Gulf of America states from Louisiana to western Florida, excluding the Florida Keys.

4.7.2 LA Creel Effort

Louisiana effort estimates (in angler trips) are provided by LA Creel for years 2014-2024. These estimates are included in Table 4.12.2, which summarizes effort by year and mode and includes the calibration of LA Creel private effort estimates into MRIP-FES units.

4.7.3 TPWD Effort

Texas effort estimates (in angler trips) are provided by TPWD for years 1983-2024. TPWD average estimates from 1983 to 1985 (by wave and mode) were used to impute estimates for Texas charter and private boat fishing from 1981 until the survey started in May 1983**.** These estimates are included in Table 4.12.3, which summarizes effort by year and mode and includes the calibration of TPWD private effort estimates into MRIP-FES units (SEDAR 74-DW-10).

4.7.4 SRHS Effort

Effort data from the SRHS is self-reported by headboat captains as the number of anglers on and the duration of a given trip in their logbooks, which is standardized to "angler days" based on the length of the trip (e.g., 40 anglers on a half-day trip would yield 40 * 0.5 = 20 angler days). Angler days are summed by month for individual vessels. Each month, port agents collect these logbook trip reports and check for accuracy and completeness. Although reporting via the logbooks is mandatory, compliance is not 100% and is variable by location. To account for non-reporting, a correction factor is developed based on sampler observations, angler numbers from office books, and any available information. This information is used to provide estimates of total catch by month and area, along with estimates of effort.

SRHS effort estimates (in angler days) for the eastern and western Gulf of America are provided in Table 16 and Figure 7 of SEDAR 100-DW-01. Estimated headboat angler days have remained relatively stable in the Gulf of America in recent years. Reports from industry staff, captains/owners, and port agents indicated fuel prices, the economy, and fishing restrictions most affected the number of trips and number of passengers, reducing overall fishing effort over the entire time series. The impact of COVID in 2020 is also reflected in fishing effort, especially in the East.

To standardize recreational fishing effort across the Gulf of America, SRHS effort estimates are also provided in the coarser units of angler trips to match estimates provided by the MRIP, TPWD, and LA Creel surveys. Monthly estimates of angler trips are calculated as the product of the reported number of anglers and ratios for the estimated number of total trips to the reported number of total trips. SRHS effort estimates (in angler trips) for the eastern and western Gulf of America are provided in Tables 17 and Figure 7 of SEDAR 100-DW-01.

4.7.5 Total Recreational Fishing Effort

Combined effort estimates from all sources in angler trips by stock ID region are shown in Table 4.12.8, Figure 4.13.15, and mapped in Figure 4.13.16. Comparisons of effort for the entire Gulf of America for individual modes are shown in Figure 4.13.17. These effort estimates depict all recreational fishing activity in the Gulf of America and are not specific to Gray Triggerfish. Effort estimates have steadily increased between the early 1980s and mid-2000s and have since remained consistently high. The majority of the recreational effort in the Gulf of America comes from the private mode (96.5%) and, geographically, relatively similar amounts of effort are noted in the West and East (43.7% and 56.3% respectively).

4.8 Comments on the Adequacy of Data for Assessment Analyses

Task 13: Regarding the adequacy of available recreational data for SEDAR 100, the Recreational Working Group discussed the following:

- Calibrations to MRIP-FES units for TPWD (1981-2024) and LA Creel (2014-2024) were presented and recommended for use during the Data Workshop.
- Historical landings have a high uncertainty based on data availability and assumptions made in the methodology. Nonetheless, the RecWG considered these historical estimates as the best scientific information available for the historical period (1955-1980) in SEDAR 100.
- Landings, as adjusted, appear to be adequate for the time period covered (1955-2024).
- Since there are no discard estimates from Texas, a proxy discard rate from Louisiana was used to fill this data gap. Similarly, headboat discards prior to 2008 used a proxy discard rate from the charter mode. Discards are self-reported from all data sources. Discards, as adjusted, appear to be adequate for the time period covered (1981-2024).
- Size data appear to adequately represent the landed catch for all modes.
- Discard size data from the headboat and charterboat modes appear to be adequate for describing the size composition of discarded Gray Triggerfish.

4.9 Itemized List of Tasks for Completion following Workshop

- Final recreational catch estimates were completed after the Data Workshop by applying an updated LA Creel calibration factor (Task 4a) and modified approach in imputing TPWD discards (described in Section 4.5.3).
- Final nominal and weighted length and age compositions, conditional age-at-length, and mean length-at-age were completed after the Data Workshop. All analyses are presented in an updated Appendix added to SEDAR 100-DW-04 (completion of Tasks 10 and 11).

4.10 RESEARCH RECOMMENDATIONS

4.10.1 Evaluation and Progress of Research Recommendations from Last Assessment Research Recommendations

Task 13: Research recommendations for the improvement of recreational datasets from SEDAR 43 were evaluated and progress on each item is outlined below:

1. *Evaluate existing methods for deriving historical discard numbers and discard rates and improve methods as appropriate*
   - No information on historical (1955-1980) discard rates were presented for consideration at the SEDAR 100 Data Workshop, so hindcasting of historical discards remains unfeasible.
   - As is now the best practice (SEDAR-PW-07), proxy estimates of SRHS discards (1986-2007) for SEDAR 100 were calculated using the Super-Ratio approach, which differs from the MRIP-charter approach applied in SEDAR 43.
   - Conversely, the best practice approach (SEDAR-PW-07) to impute TPWD discards (1981-2024) resulted in highly variable discard rates, and so a modified approach was applied in SEDAR 100 to stabilize those ratios.

4.10.2 Research Recommendations for SEDAR 100

Task 14: The Recreational Working Group provided the following recommendations to improve recreational data in the Gulf of America:

1. Continued evaluation of LA Creel Calibration Ratios for Gulf Gray Triggerfish
2. Additional MRIP Study in TX to include additional year(s) of benchmarking with TPWD
3. Collection of additional biological samples, particularly from the West
4. Continued funding of at-sea observer programs for tagging and estimation of associated discard mortalities

5. Tagging studies to estimate discard mortalities from recreational fisheries as well as additional sources of mortality, including shrimp trawl bycatch

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4.12 TABLES

Table 4.12.1. Annual landings (AB1), discard (B2), and effort (EFF) estimates for Gulf of America Gray Triggerfish from the MRIP survey. Estimates are provided in numbers of fish and angler trips by mode.

	Cbt			Hbt			Priv			Total		
Year	AB1	B2	EFF	AB1	B2	EFF	AB1	B2	EFF	AB1	B2	EFF
1981	85,258	9,112	418,390	46,432	4,192	199,301	431,749	53,499	11,566,424	563,438	66,803	12,184,115
1982	736,728	16,476	523,703	442,158	4,448	260,912	100,996	197,783	11,539,636	1,279,883	218,707	12,324,251
1983	87,911	7,739	546,272	48,089	4,504	256,493	472,799	790,110	13,790,884	608,798	802,353	14,593,649
1984	76,749	334	515,534	37,736	29	242,211	11,527	207,186	13,385,940	126,012	207,550	14,143,685
1985	74,547	621	558,783	29,631	389	277,516	130,803	210,968	14,380,401	234,982	211,978	15,216,700
1986	451,982	4,320	539,606				64,011	112,747	13,911,468	515,993	117,067	14,451,074
1987	283,043	3,763	552,897				543,971	205,682	13,690,478	827,014	209,446	14,243,375
1988	233,909	1,923	485,592				486,277	175,147	16,173,554	720,187	177,070	16,659,146
1989	375,257	8,955	553,840				914,189	372,400	15,737,950	1,289,446	381,355	16,291,790
1990	895,710	216,342	546,723				717,464	290,254	16,787,633	1,613,174	506,595	17,334,356
1991	1,055,219	17,670	490,070				113,586	132,105	16,489,495	1,168,804	149,775	16,979,565
1992	576,125	20,520	513,244				623,147	230,574	16,957,686	1,199,272	251,094	17,470,930
1993	414,588	41,507	576,894				450,894	279,771	17,380,947	865,482	321,278	17,957,841
1994	456,952	12,042	583,209				278,823	120,700	17,771,476	735,776	132,743	18,354,685
1995	633,920	68,180	693,208				265,412	79,333	18,405,474	899,332	147,513	19,098,682

1996	143,237	31,457	650,088	187,096	212,707	18,383,317	330,333	244,164	19,033,405
1997	152,224	23,822	675,842	199,320	143,274	19,908,220	351,544	167,095	20,584,062
1998	152,418	54,979	656,598	394,671	466,021	21,376,286	547,090	521,000	22,032,884
1999	144,550	21,282	666,626	329,897	282,501	23,454,761	474,447	303,783	24,121,387
2000	83,087	8,147	598,494	280,331	131,876	23,083,653	363,418	140,023	23,682,147
2001	128,291	16,902	622,204	283,327	296,309	25,731,352	411,618	313,211	26,353,556
2002	142,286	17,062	606,183	780,771	683,660	25,015,041	923,058	700,723	25,621,224
2003	144,959	9,885	582,222	980,484	420,015	25,759,681	1,125,443	429,899	26,341,903
2004	191,992	22,708	662,228	784,270	610,291	29,061,390	976,262	632,999	29,723,618
2005	150,953	22,715	579,682	525,209	260,554	28,138,681	676,162	283,269	28,718,363
2006	100,330	10,635	666,576	336,351	234,013	26,013,602	436,681	244,648	26,680,178
2007	81,992	16,857	713,469	314,681	581,304	26,520,209	396,673	598,161	27,233,678
2008	68,659	13,298	665,103	225,331	192,877	28,822,603	293,990	206,175	29,487,706
2009	35,915	65,097	657,134	107,493	232,102	28,052,491	143,408	297,199	28,709,625
2010	30,779	37,761	472,909	255,805	456,281	29,142,688	286,584	494,042	29,615,597
2011	73,557	112,695	595,483	353,819	379,318	29,504,829	427,376	492,014	30,100,312
2012	15,780	63,071	718,252	194,617	587,534	30,808,704	210,397	650,605	31,526,956
2013	30,100	85,685	731,778	282,975	684,105	28,722,437	313,075	769,791	29,454,215
2014	15,421	131,176	592,321	108,214	419,094	20,242,471	123,635	550,270	20,834,792
2015	370	202,416	687,136	50,169	1,545,992	18,925,709	50,540	1,748,408	19,612,845

2016	62,729	358,386	717,394				225,325	1,794,438	20,338,425	288,054	2,152,824	21,055,819
2017	8,967	475,491	719,153				73,824	2,874,019	21,236,945	82,791	3,349,510	21,956,098
2018	45,320	364,917	738,980				137,747	1,629,900	19,666,722	183,067	1,994,816	20,405,702
2019	28,681	295,910	746,964				63,931	1,614,250	17,175,116	92,612	1,910,159	17,922,080
2020	35,939	355,933	828,833				168,557	1,363,499	19,356,174	204,496	1,719,432	20,185,007
2021	44,809	489,124	942,495				60,652	1,872,536	18,336,229	105,461	2,361,660	19,278,724
2022	50,438	305,686	926,284				153,726	2,590,087	20,440,718	204,164	2,895,773	21,367,002
2023	59,791	507,428	912,866				119,115	1,534,110	19,751,275	178,906	2,041,538	20,664,141
2024	35,326	350,522	800,538				158,464	1,723,876	20,747,929	193,791	2,074,398	21,548,467

Table 4.12.2. Annual landings (AB1), discard (B2), and effort (EFF) estimates for Louisiana Gray Triggerfish from the LA Creel survey. Estimates are provided in numbers of fish and angler trips by mode, and those for the private mode are calibrated into MRIP-FES units.

	Cbt			Priv			Total		
Year	**AB1**	**B2**	**EFF**	**AB1**	**B2**	**EFF**	**AB1**	**B2**	**EFF**
2014	43	0	130,622	10,572	0	7,441,673	10,615	0	7,572,295
2015	128	0	159,794	14,275	0	8,043,022	14,403	0	8,202,816
2016	17	92	179,238	10,597	11,033	7,321,861	10,614	11,125	7,501,099
2017	0	0	178,723	1,111	9,003	7,560,183	1,111	9,003	7,738,906
2018	117	31	183,313	7,348	2,077	7,428,797	7,466	2,108	7,612,110
2019	0	456	168,571	1,640	195	6,886,585	1,640	651	7,055,156
2020	5	20	115,424	852	1,246	8,469,878	857	1,266	8,585,302
2021	0	23	163,233	1,157	1,654	6,122,422	1,157	1,677	6,285,655
2022	338	0	162,620	756	774	5,135,536	1,094	774	5,298,156
2023	264	8	177,812	2,545	3,628	5,618,166	2,809	3,636	5,795,978
2024	29	86	151,402	1,892	3,287	5,418,986	1,921	3,373	5,570,388

Table 4.12.3. Annual landings (AB1), discard (B2), and effort (EFF) estimates for Texas Gray Triggerfish from the TPWD survey. Estimates are provided in numbers of fish and angler trips by mode, and those for the private mode are calibrated into MRIP-FES units (SEDAR 74-DW-10).

	Cbt			Priv			Total		
Year	AB1	B2	EFF	AB1	B2	EFF	AB1	B2	EFF
1981	0	0	29,441	7,804	392	7,092,619	7,804	392	7,122,060
1982	0	0	29,441	7,804	4,481	7,092,619	7,804	4,481	7,122,060
1983	0	0	33,666	11,825	13,187	7,091,080	11,825	13,187	7,124,746
1984	0	0	23,029	4,894	14,384	6,553,605	4,894	14,384	6,576,634
1985	0	0	31,627	6,692	44,094	7,633,172	6,692	44,094	7,664,799
1986	0	0	27,050	17,950	1,856	7,370,607	17,950	1,856	7,397,657
1987	74	0	31,084	16,043	0	9,524,327	16,117	0	9,555,411
1988	9	19	28,090	35,214	73,715	9,052,763	35,223	73,734	9,080,853
1989	40	24	42,075	11,629	6,860	7,976,082	11,669	6,884	8,018,157
1990	22	1	35,645	50,745	2,569	7,975,280	50,767	2,570	8,010,925
1991	24	14	47,448	21,514	12,313	7,764,966	21,538	12,327	7,812,414
1992	0	0	49,213	61,677	28,493	8,965,716	61,677	28,493	9,014,929
1993	0	0	54,657	43,007	266,122	9,011,231	43,007	266,122	9,065,888
1994	267	198	90,317	56,609	41,898	9,821,149	56,876	42,096	9,911,466
1995	138	30	74,001	101,000	22,310	9,950,180	101,138	22,341	10,024,181
1996	0	0	75,918	50,168	269	10,192,861	50,168	269	10,268,779
1997	945	450	93,868	42,942	20,441	8,482,200	43,887	20,890	8,576,068
1998	141	129	108,462	62,135	57,064	8,935,940	62,276	57,194	9,044,402
1999	543	249	112,579	24,969	11,430	10,785,527	25,512	11,679	10,898,106
2000	0	0	161,994	69,764	25,307	10,251,717	69,764	25,307	10,413,711
2001	1,519	1,768	141,584	19,019	22,142	8,900,805	20,538	23,911	9,042,389
2002	474	817	136,232	16,010	27,587	8,585,891	16,484	28,403	8,722,123
2003	197	13	117,498	12,850	844	9,400,971	13,047	857	9,518,469
2004	697	271	118,538	33,721	13,109	9,324,533	34,418	13,380	9,443,071
2005	280	271	106,073	44,751	43,351	8,839,997	45,031	43,622	8,946,070
2006	384	62	150,840	59,671	9,668	9,192,171	60,055	9,730	9,343,011
2007	781	527	148,253	28,195	19,034	8,277,571	28,976	19,561	8,425,824

2008	779	159	144,898	38,233	7,828	7,923,028	39,012	7,988	8,067,926
2009	100	719	117,112	14,899	107,097	8,557,970	14,999	107,816	8,675,082
2010	56	0	122,375	3,172	0	8,320,638	3,228	0	8,443,013
2011	32	0	161,208	10,583	0	8,858,407	10,615	0	9,019,615
2012	0	0	220,969	14,735	6,269	8,811,048	14,735	6,269	9,032,017
2013	32	85	142,993	9,722	25,707	9,087,384	9,754	25,792	9,230,377
2014	0	0	138,603	6,790	0	8,913,324	6,790	0	9,051,927
2015	182	0	144,328	10,528	0	8,414,272	10,710	0	8,558,600
2016	0	0	157,452	1,744	1,859	9,955,896	1,744	1,859	10,113,348
2017	0	0	188,501	894	7,241	9,107,944	894	7,241	9,296,445
2018	38	11	298,884	1,875	528	8,476,571	1,913	539	8,775,455
2019	12	13	377,936	2,202	2,435	9,317,226	2,214	2,448	9,695,162
2020	0	0	237,375	1,689	2,558	10,500,343	1,689	2,558	10,737,718
2021	11	16	243,182	796	1,193	8,948,138	807	1,210	9,191,320
2022	0	0	318,026	262	103	9,105,874	262	103	9,423,900
2023	98	103	552,716	5,776	6,065	11,196,487	5,874	6,168	11,749,203
2024	71	128	206,194	534	962	8,110,547	605	1,090	8,316,741

Table 4.12.4. Total recreational landings estimates in numbers (AB1) and pounds (LBS) for Gulf of America Gray Triggerfish combined across all surveys by year and mode. Estimates and their associated coefficients of variation (CV) are provided for recreational landings in numbers of fish (AB1 CV) and in pounds whole weight (LBS CV).

	West				East			
YEAR	AB1	AB1 CV	LBS	LBS CV	AB1	AB1 CV	LBS	LBS CV
1955	44,939	0.58			190,900	0.58		
1956	49,773	0.58			211,434	0.58		
1957	54,607	0.58			231,968	0.58		
1958	59,440	0.58			252,502	0.58		
1959	64,274	0.58			273,036	0.58		
1960	69,108	0.58			293,570	0.58		
1961	71,082	0.58			301,955	0.58		
1962	73,056	0.58			310,339	0.58		
1963	75,029	0.58			318,723	0.58		
1964	77,003	0.58			327,107	0.58		
1965	78,977	0.58			335,492	0.58		
1966	81,605	0.58			346,658	0.58		
1967	84,234	0.58			357,824	0.58		
1968	86,863	0.58			368,991	0.58		
1969	89,491	0.58			380,157	0.58		
1970	92,120	0.58			391,323	0.58		
1971	100,613	0.58			427,403	0.58		
1972	109,107	0.58			463,483	0.58		
1973	117,600	0.58			499,563	0.58		
1974	126,093	0.58			535,643	0.58		

	West				East			
YEAR	AB1	AB1 CV	LBS	LBS CV	AB1	AB1 CV	LBS	LBS CV
1975	134,587	0.58			571,723	0.58		
1976	135,038	0.58			573,640	0.58		
1977	135,489	0.58			575,556	0.58		
1978	135,941	0.58			577,473	0.58		
1979	136,392	0.58			579,390	0.58		
1980	136,843	0.58			581,307	0.58		
1981	87,917	0.50	148,286	0.53	506,603	0.46	1,115,442	0.50
1982	68,712	0.51	83,641	0.52	1,242,253	0.33	3,351,908	0.36
1983	376,569	0.02	1,827,527	0.02	267,332	0.36	623,012	0.38
1984	55,621	0.20	161,395	0.27	98,563	0.49	238,961	0.51
1985	64,316	0.50	292,180	0.81	200,637	0.56	561,834	0.54
1986	45,432	0.18	65,796	0.20	533,553	0.20	1,307,221	0.23
1987	37,961	0.20	56,997	0.19	843,900	0.47	2,326,768	0.49
1988	89,003	0.17	95,049	0.18	734,968	0.27	1,378,942	0.26
1989	133,751	0.52	229,780	0.53	1,247,873	0.20	2,054,995	0.22
1990	241,555	0.32	525,820	0.34	1,553,288	0.18	4,203,634	0.22
1991	112,336	0.18	240,335	0.22	1,167,254	0.26	2,924,127	0.28
1992	156,762	0.10	260,202	0.12	1,214,863	0.17	2,911,565	0.19
1993	98,638	0.12	170,472	0.13	912,823	0.21	2,264,706	0.23
1994	174,934	0.18	348,516	0.19	727,897	0.16	1,598,181	0.23
1995	239,978	0.25	430,965	0.25	858,158	0.25	1,595,306	0.26
1996	99,038	0.14	166,371	0.14	357,986	0.17	668,441	0.23
1997	100,281	0.15	178,695	0.16	358,834	0.14	999,400	0.18
1998	97,801	0.16	171,184	0.26	564,752	0.21	1,197,033	0.22
1999	108,715	0.29	309,872	0.34	432,223	0.12	944,519	0.14
2000	168,122	0.27	404,708	0.29	297,282	0.20	728,359	0.21
2001	59,265	0.44	115,089	0.46	412,946	0.14	792,637	0.15
2002	38,888	0.19	79,279	0.19	954,509	0.24	2,147,548	0.29

	West				East			
YEAR	AB1	AB1 CV	LBS	LBS CV	AB1	AB1 CV	LBS	LBS CV
2003	46,505	0.27	88,370	0.26	1,155,466	0.27	2,292,969	0.38
2004	95,172	0.29	170,620	0.29	971,723	0.18	1,755,471	0.20
2005	63,833	0.08	105,891	0.13	705,630	0.17	1,301,294	0.22
2006	91,584	0.12	140,058	0.23	439,060	0.21	731,634	0.21
2007	61,016	0.20	102,829	0.22	397,383	0.17	717,319	0.19
2008	74,720	0.24	149,062	0.26	280,864	0.19	568,667	0.20
2009	19,900	0.14	32,443	0.25	150,611	0.20	438,450	0.24
2010	3,642	0.05	10,296	0.05	295,622	0.23	901,197	0.26
2011	12,357	0.06	18,302	0.09	442,025	0.19	1,248,379	0.21
2012	29,364	0.33	65,860	0.35	201,690	0.22	645,294	0.25
2013	17,033	0.34	36,613	0.34	315,622	0.36	1,203,388	0.39
2014	17,585	0.06	33,599	0.06	126,417	0.31	394,149	0.33
2015	25,161	0.05	47,959	0.24	51,621	0.48	119,238	0.48
2016	12,728	0.09	40,763	0.19	298,692	0.20	974,112	0.22
2017	2,050	0.09	6,004	0.09	82,792	0.56	209,151	0.55
2018	9,637	0.10	39,036	0.10	198,018	0.37	870,646	0.40
2019	3,930	0.06	10,865	0.06	97,879	0.29	516,021	0.31
2020	2,590	0.05	6,599	0.05	209,663	0.32	998,924	0.35
2021	2,004	0.09	7,598	0.09	110,972	0.25	430,909	0.26
2022	1,421	0.23	4,742	0.25	209,791	0.21	753,356	0.25
2023	8,756	0.04	22,017	0.04	184,273	0.22	666,943	0.24
2024	2,576	0.10	8,203	0.11	198,119	0.20	699,644	0.24

Table 4.12.5. Total recreational discard estimates in numbers (B2) for Gulf of America Gray Triggerfish combined across all surveys by year and mode. Associated coefficients of variation (CV) are also provided.

	West		East	
YEAR	B2	CV	B2	CV
1981	3,439	0.82	63,757	0.61
1982	25,303	0.43	197,885	0.63
1983	392,779	0.00	422,760	0.58
1984	90,191	0.84	131,743	1.00
1985	252,208	0.56	3,865	0.75
1986	3,042	0.32	116,131	0.89
1987	0	0.00	209,715	0.67
1988	99,569	0.18	151,447	0.74
1989	64,217	0.52	324,820	0.28
1990	10,935	0.54	522,657	0.35
1991	46,476	0.70	116,268	0.52
1992	53,131	0.25	228,733	0.21
1993	336,953	0.25	256,192	0.28
1994	87,500	0.28	88,028	0.30
1995	41,559	0.41	132,961	0.35
1996	315	0.15	251,846	0.38
1997	33,822	0.36	159,201	0.32
1998	75,031	0.56	517,465	0.34
1999	46,637	0.33	273,651	0.23
2000	58,818	0.51	108,785	0.40
2001	60,274	0.50	280,973	0.21
2002	51,504	0.28	680,602	0.43
2003	1,937	0.55	431,939	0.46
2004	31,900	0.32	619,486	0.32
2005	50,872	0.11	280,428	0.25
2006	13,085	0.14	243,688	0.31
2007	33,121	0.26	588,983	0.30

	West		East	
YEAR	B2	CV	B2	CV
2008	14,848	0.32	202,691	0.45
2009	135,544	0.19	280,877	0.21
2010	372	0.06	501,614	0.36
2011	531	0.05	507,392	0.24
2012	12,823	0.47	674,278	0.24
2013	43,795	0.36	789,135	0.51
2014	177	0.05	589,924	0.14
2015	272	0.05	1,833,917	0.24
2016	13,247	0.10	2,244,101	0.16
2017	16,371	0.07	3,501,502	0.16
2018	2,759	0.11	2,083,234	0.32
2019	3,234	0.06	1,994,272	0.18
2020	4,049	0.06	1,789,046	0.18
2021	2,899	0.07	2,488,480	0.24
2022	1,811	0.07	3,000,710	0.22
2023	9,904	0.09	2,158,110	0.13
2024	4,464	0.10	2,162,793	0.22

Table 4.12.6. The number of fish and trips, by state, where at-sea observers measured **discarded** Gray Triggerfish for length from the charter and headboat modes.

	Number of Fish						Number of Trips					
	Charter			Headboat			Charter			Headboat		
Year	MS	AL	FL	MS	AL	FL	MS	AL	FL	MS	AL	FL
2005	0	0	0	0	0	10	0	0	0	0	0	10
2006	0	0	0	0	3	10	0	0	0	0	3	10
2007	0	0	0	0	0	11	0	0	0	0	0	11
2009	0	0	159	0	0	52	0	0	20	0	0	20
2010	0	0	201	0	0	115	0	0	38	0	0	34
2011	0	0	540	0	0	249	0	0	59	0	0	52
2012	0	0	435	0	0	292	0	0	57	0	0	50
2013	0	0	432	0	0	212	0	0	57	0	0	40
2015	0	0	983	0	0	738	0	0	94	0	0	103
2016	0	0	1,223	0	0	1,314	0	0	115	0	0	124
2017	0	4	984	0	0	914	0	4	102	0	0	105
2018	0	1	980	0	0	719	0	1	113	0	0	101
2019	0	71	1,590	0	0	1,094	0	19	133	0	0	122
2020	0	0	83	0	0	124	0	0	15	0	0	14
2021	0	0	716	0	0	451	0	0	67	0	0	79
2022	0	99	830	0	129	756	0	27	78	0	11	126
2023	1	275	1,011	0	15	912	1	44	84	0	1	130
2024	0	358	603	0	16	755	0	50	79	0	1	135

Table 4.12.7. The number of fish and trips, in the eastern Gulf of America, where at-sea observers measured harvested and discarded Gray Triggerfish, for length, from charter and headboat modes.

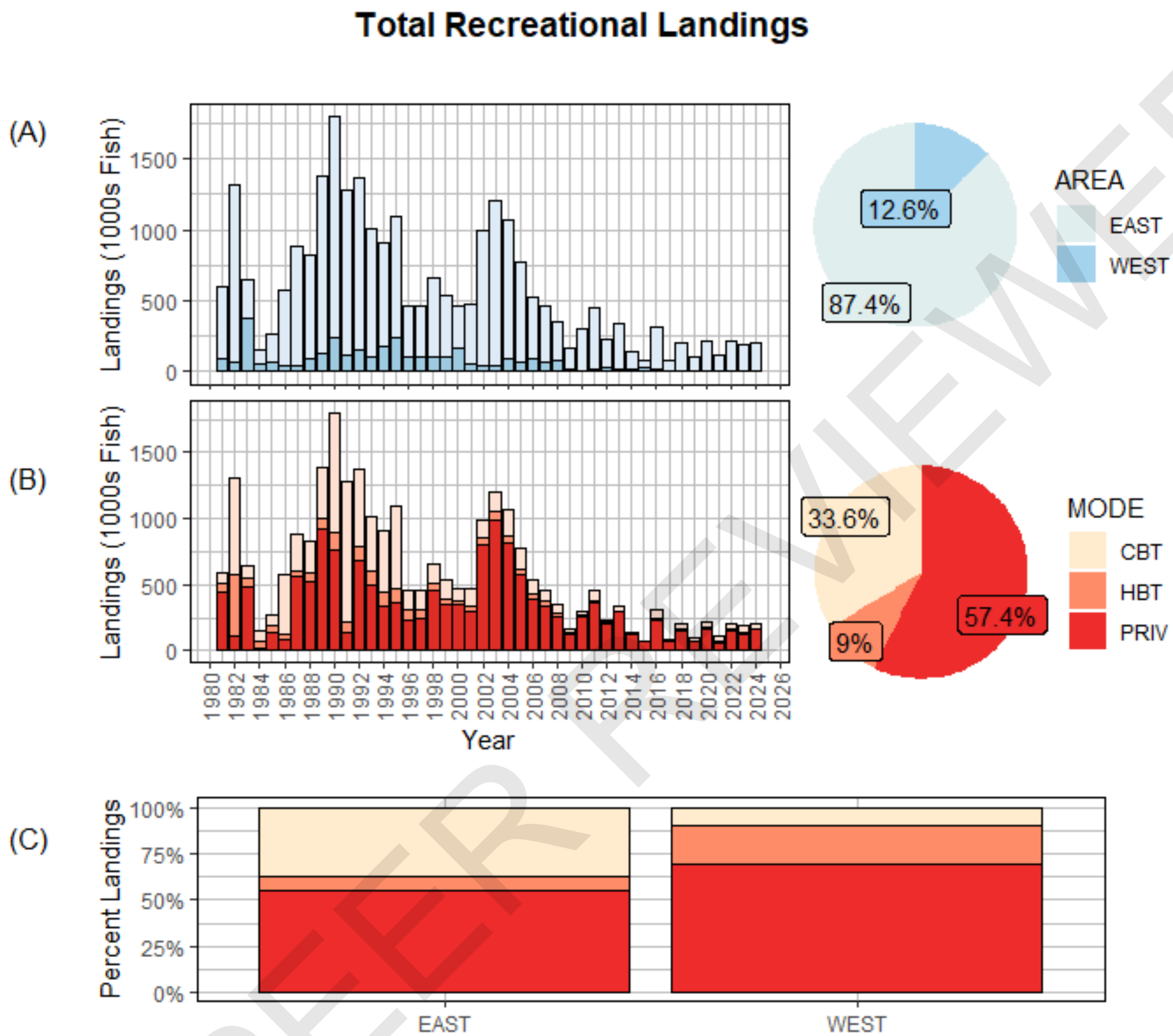
	Charter				Headboat			
	Number of Fish		Number of Trips		Number of Fish		Number of Trips	
Year	Harvest	Discard	Harvest	Discard	Harvest	Discard	Harvest	Discard
2005	0	0	0	0	51	10	51	10
2006	0	0	0	0	68	13	68	13
2007	0	0	0	0	56	11	56	11
2009	38	159	13	20	14	52	8	20
2010	152	201	33	38	32	115	18	34
2011	177	540	52	59	67	249	30	52
2012	62	435	17	57	34	292	15	50
2013	62	432	26	57	21	212	12	40
2015	1	983	1	94	7	738	4	103
2016	123	1,223	30	115	307	1,314	42	124
2017	0	988	0	106	0	914	0	105
2018	105	981	20	114	283	719	25	101
2019	112	1,661	23	152	93	1,094	17	122
2020	0	83	0	15	3	124	2	14
2021	36	716	9	67	14	451	8	79
2022	143	929	33	105	103	885	41	137
2023	100	1,287	40	129	110	927	42	131
2024	96	961	46	129	95	771	42	136

Table 4.12.8. Total recreational fishing effort (in angler trips) for east and west Gulf of America Gray Triggerfish combined across all surveys and modes by year. The combined private-shore mode in the LA Creel survey is allocated as private fishing. MRIP headboat estimates are used for the Gulf of America from 1981-1985, and SRHS from 1986+.

YEAR	East	West
1981	8,807,774	10,570,364
1982	8,789,874	10,728,400
1983	10,856,694	10,933,664
1984	10,660,003	10,132,280
1985	11,695,943	11,257,520
1986	11,342,387	10,836,518
1987	11,243,580	12,906,747
1988	13,746,792	12,352,485
1989	13,184,116	11,484,677
1990	14,010,126	11,710,060
1991	13,510,344	11,600,220
1992	13,798,085	13,031,411
1993	14,176,522	13,209,309
1994	14,638,075	14,018,208
1995	15,295,847	14,191,401
1996	15,003,003	14,636,333
1997	16,342,960	13,117,133
1998	17,739,135	13,664,484
1999	19,324,986	15,913,881
2000	18,489,919	15,904,715
2001	20,987,187	14,680,728
2002	20,615,625	13,987,766
2003	21,268,029	14,868,904
2004	24,965,082	14,477,412
2005	24,447,339	13,457,553
2006	22,294,012	13,977,674
2007	22,519,771	13,469,611
2008	24,285,062	13,485,552

YEAR	East	West
2009	23,016,961	14,632,148
2010	23,601,098	14,666,622
2011	24,288,791	15,112,273
2012	25,927,969	14,932,081
2013	24,089,111	14,888,902
2014	21,091,530	16,680,368
2015	19,872,594	16,821,956
2016	21,324,435	17,672,636
2017	22,221,201	17,091,515
2018	20,666,221	16,443,252
2019	18,171,060	16,805,059
2020	20,369,629	19,375,967
2021	19,545,324	15,563,159
2022	21,604,871	14,801,880
2023	20,874,962	17,609,942
2024	21,736,344	13,943,437

4.13 FIGURES



	EAST	WEST
Cbt	8,379,925	325,763
Hbt	1,664,215	664,082
Priv	12,568,288	2,269,312

Figure 4.13.1. Total recreational landings (AB1) for Gulf of America Gray Triggerfish across all surveys. Landings are provided (A) by area and year in thousands of fish, (B) by mode and year in thousands of fish, and (C) by mode and area in percent numbers of fish.

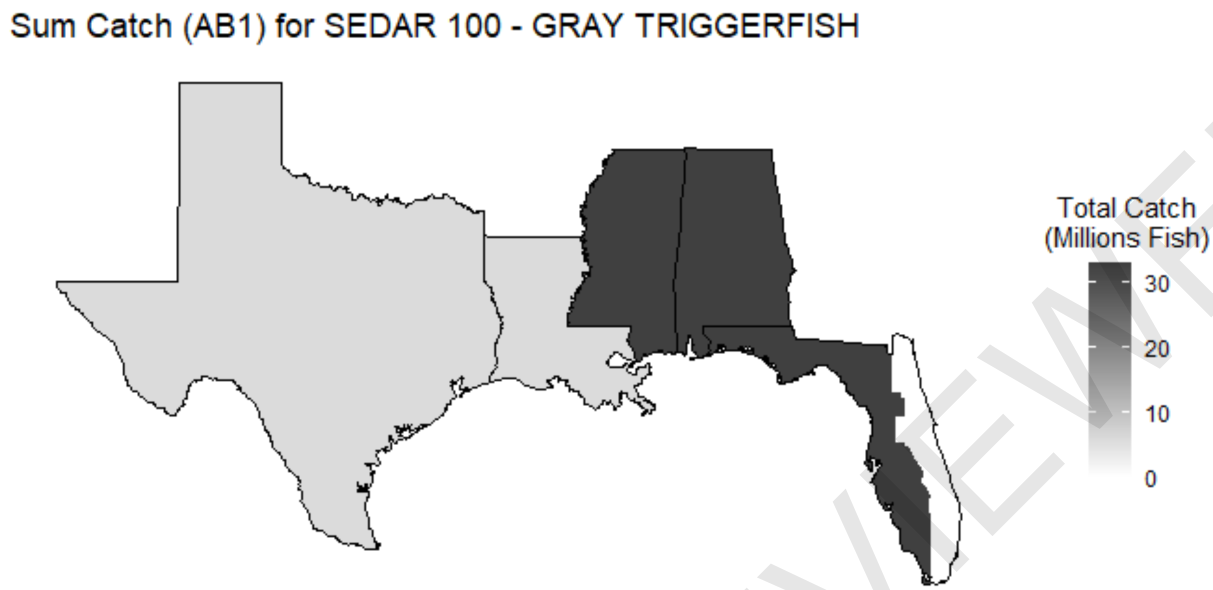


Figure 4.13.2. Distribution of total recreational landings (AB1), in millions of fish, for Gray Triggerfish across the Gulf of America. Estimates are combined across all surveys and years and summarized by region.

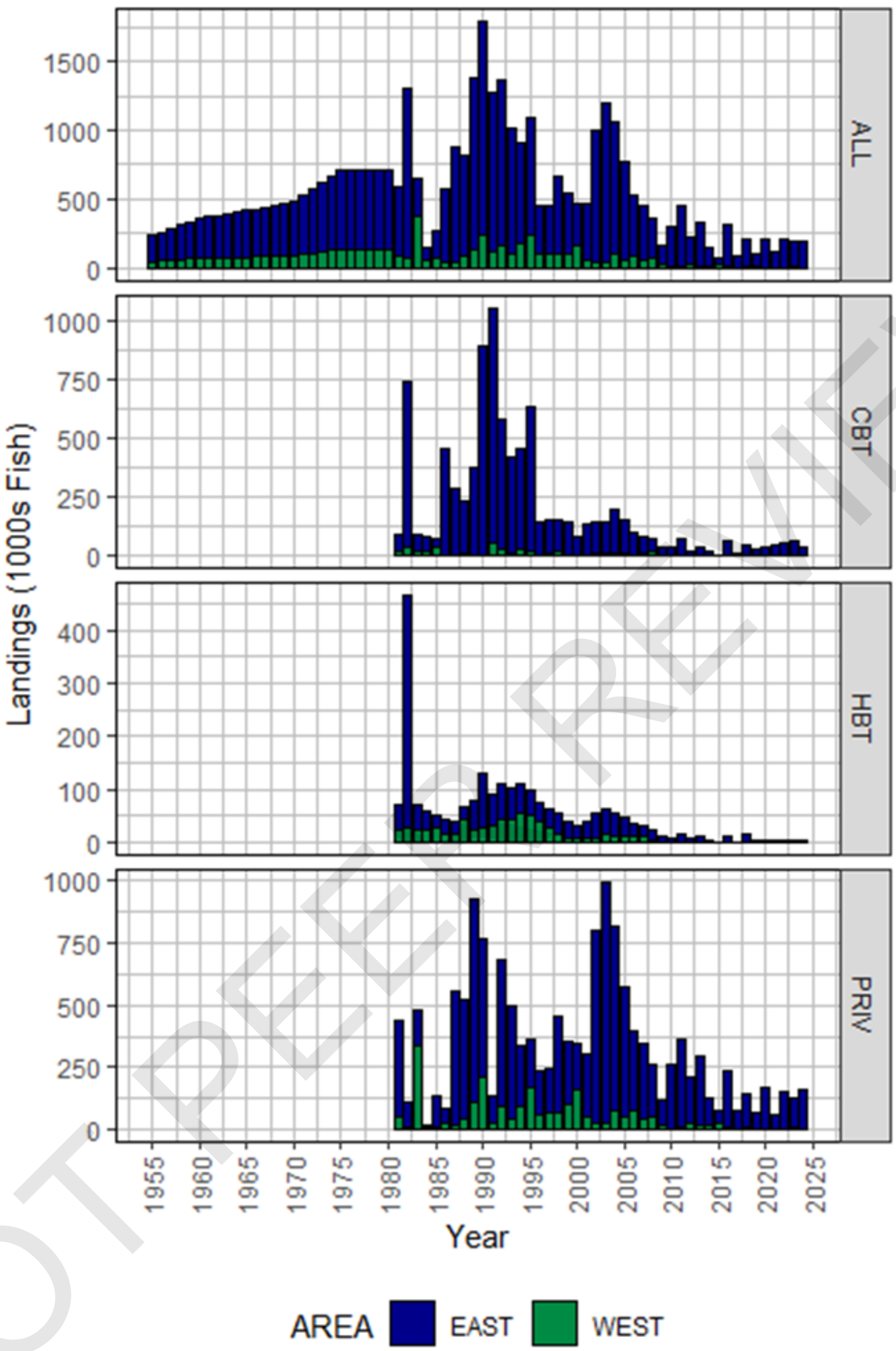
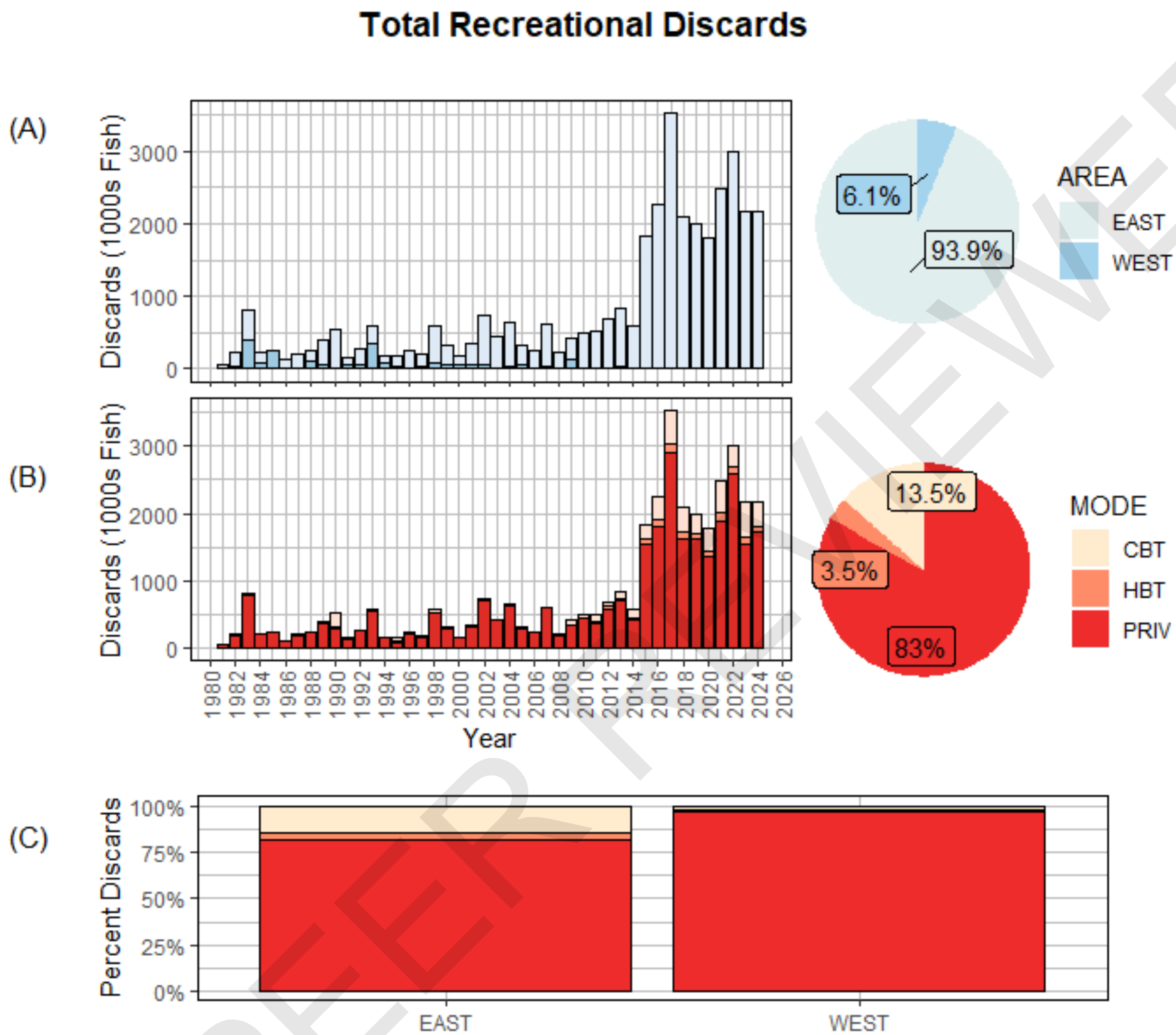


Figure 4.13.3. Recreational landings (AB1) for Gulf of America Gray Triggerfish for each fishing mode. Landings are provided by year and area in thousands of fish. Note that the 'ALL' timeseries includes historical FHWAR estimates (1955-1980) and the sums of mode-specific estimates from other recreational surveys shown in the lower panels (1981+).



	EAST	WEST
Cbt	4,851,619	55,726
Hbt	1,264,026	5,967
Priv	28,090,439	2,170,026

Figure 4.13.4. Total recreational discards (B2) for Gulf of America Gray Triggerfish across all surveys. Discards are provided (A) by area and year in thousands of fish, (B) by mode and year in thousands of fish, and (C) by mode and area in percent numbers of fish.

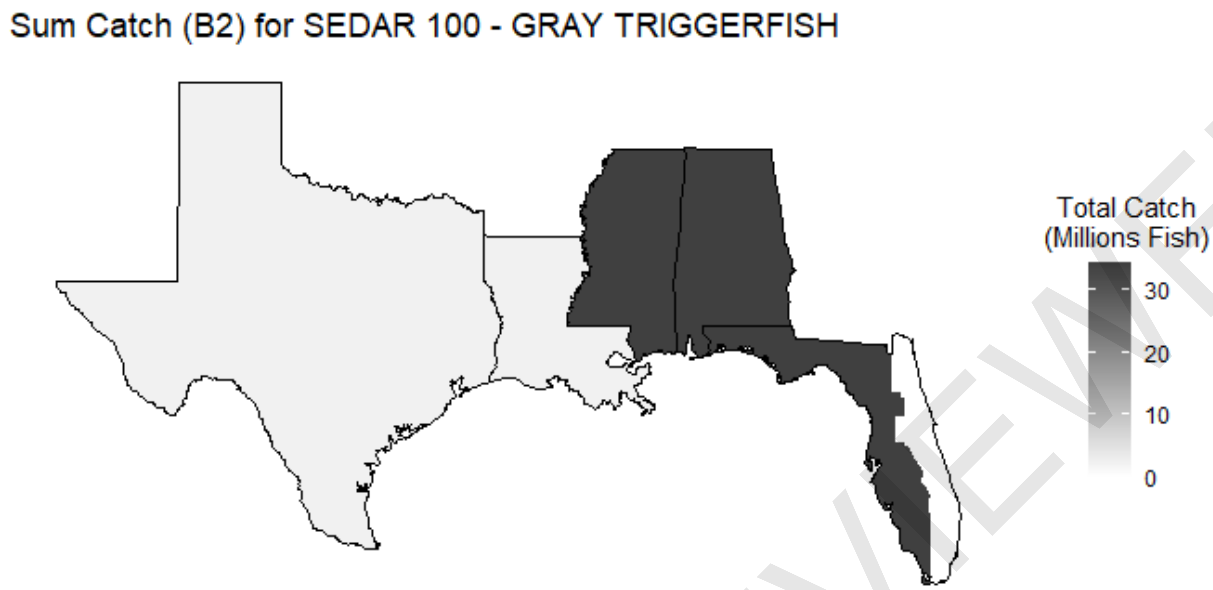


Figure 4.13.5. Distribution of total recreational discards (B2), in millions of fish, for Gray Triggerfish across the Gulf of America. Estimates are combined across all surveys and years and summarized by region.

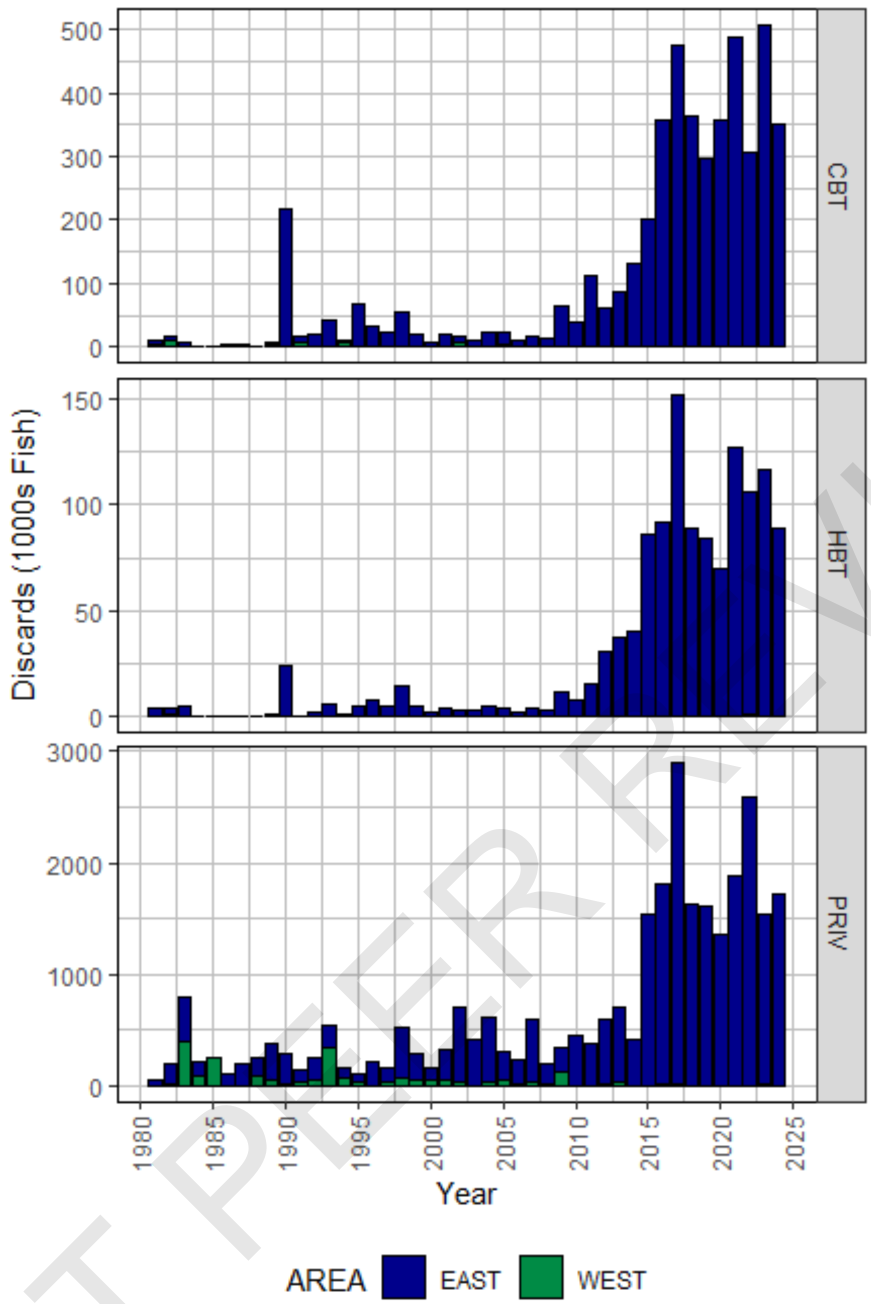


Figure 4.13.6. Recreational discards (B2) for Gulf of America Gray Triggerfish for each fishing mode. Discards are provided by year and area in thousands of fish.

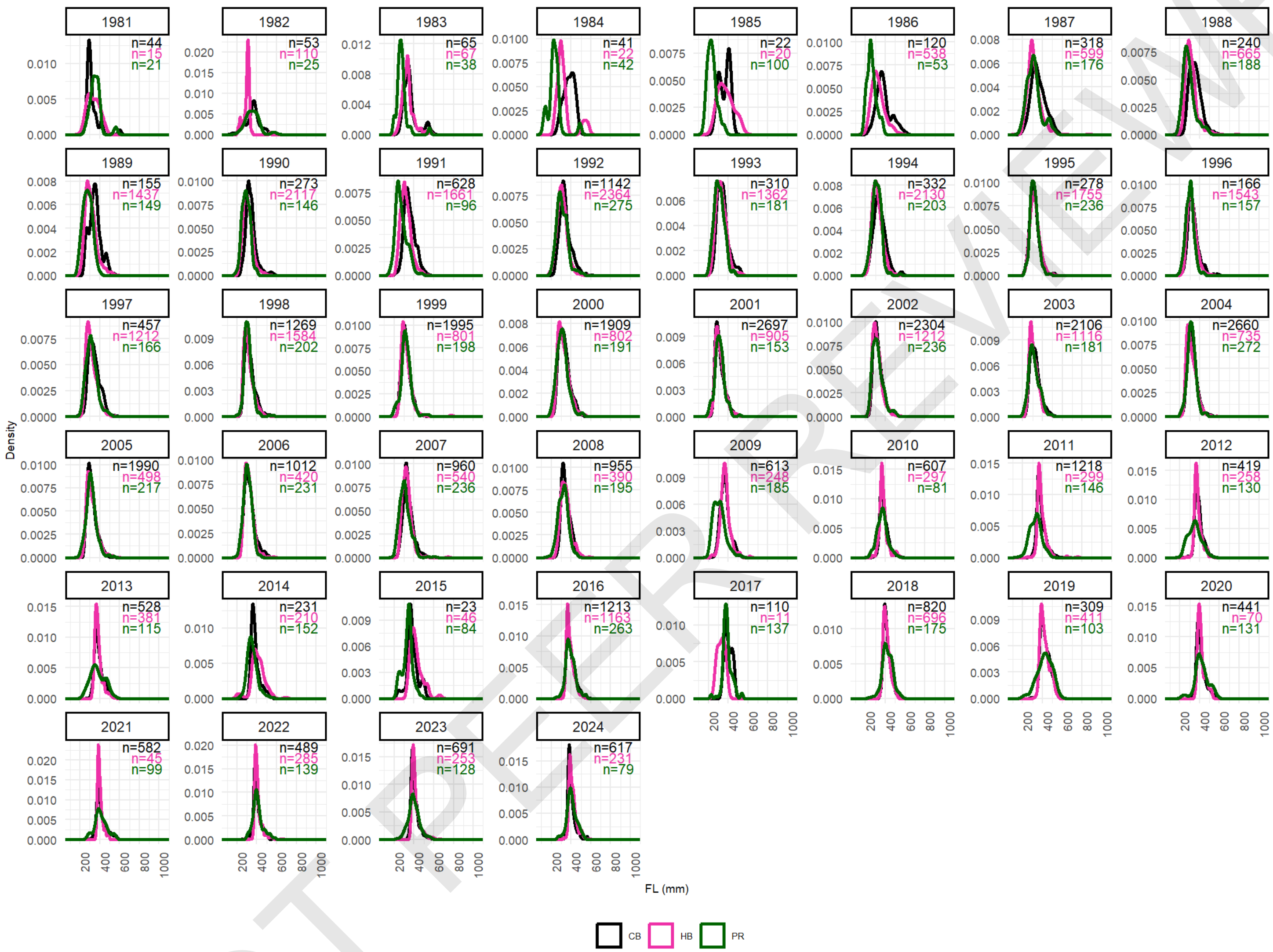


Figure 4.13.7. Nominal length distributions by **mode** (CB= charter, HB = headboat, and PR = private) for Gulf Gray Triggerfish.

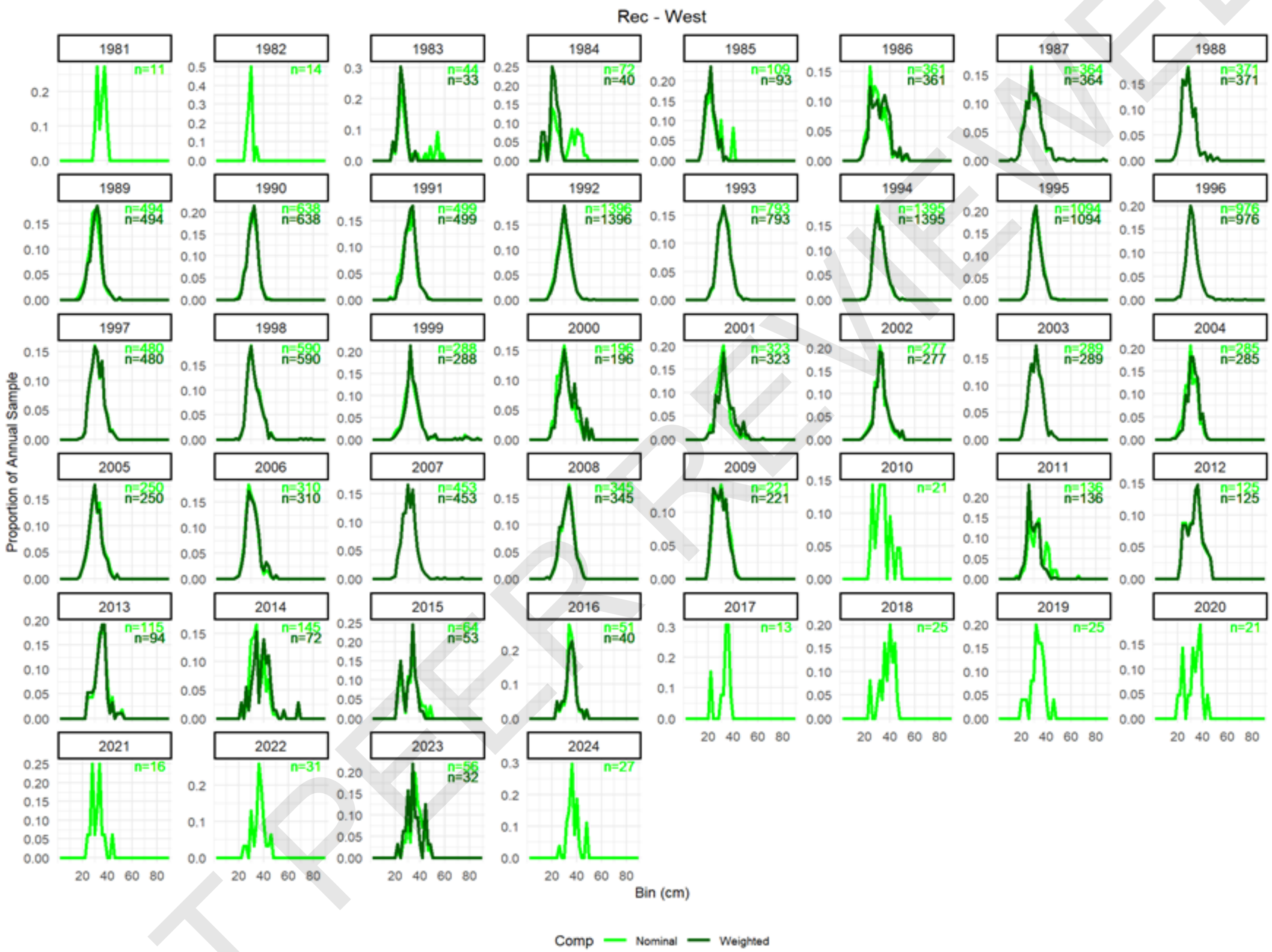


Figure 4.13.8a. Nominal and weighted length distributions for Gulf Gray Triggerfish in the **West** (TX and LA). Refer to Table A2 in SEDAR 100-DW-04 for which years do not meet sample size criteria for inclusion based on weighting.

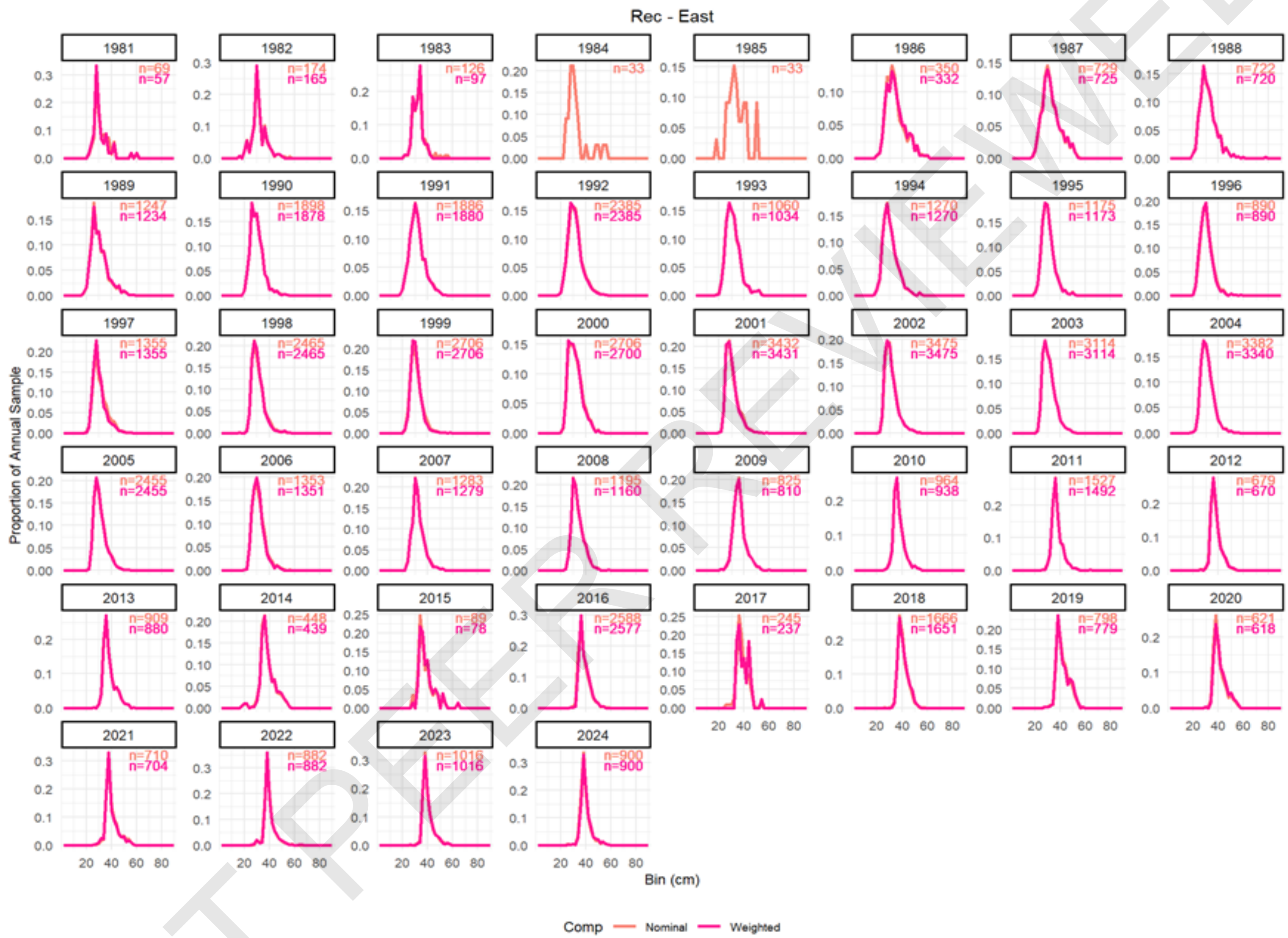


Figure 4.13.8b. Nominal and weighted length distributions for Gulf Gray Triggerfish in the **East** (MS-FL). Refer to Table A2 in SEDAR 100-DW-04 for which years do not meet sample size criteria for inclusion based on weighting.

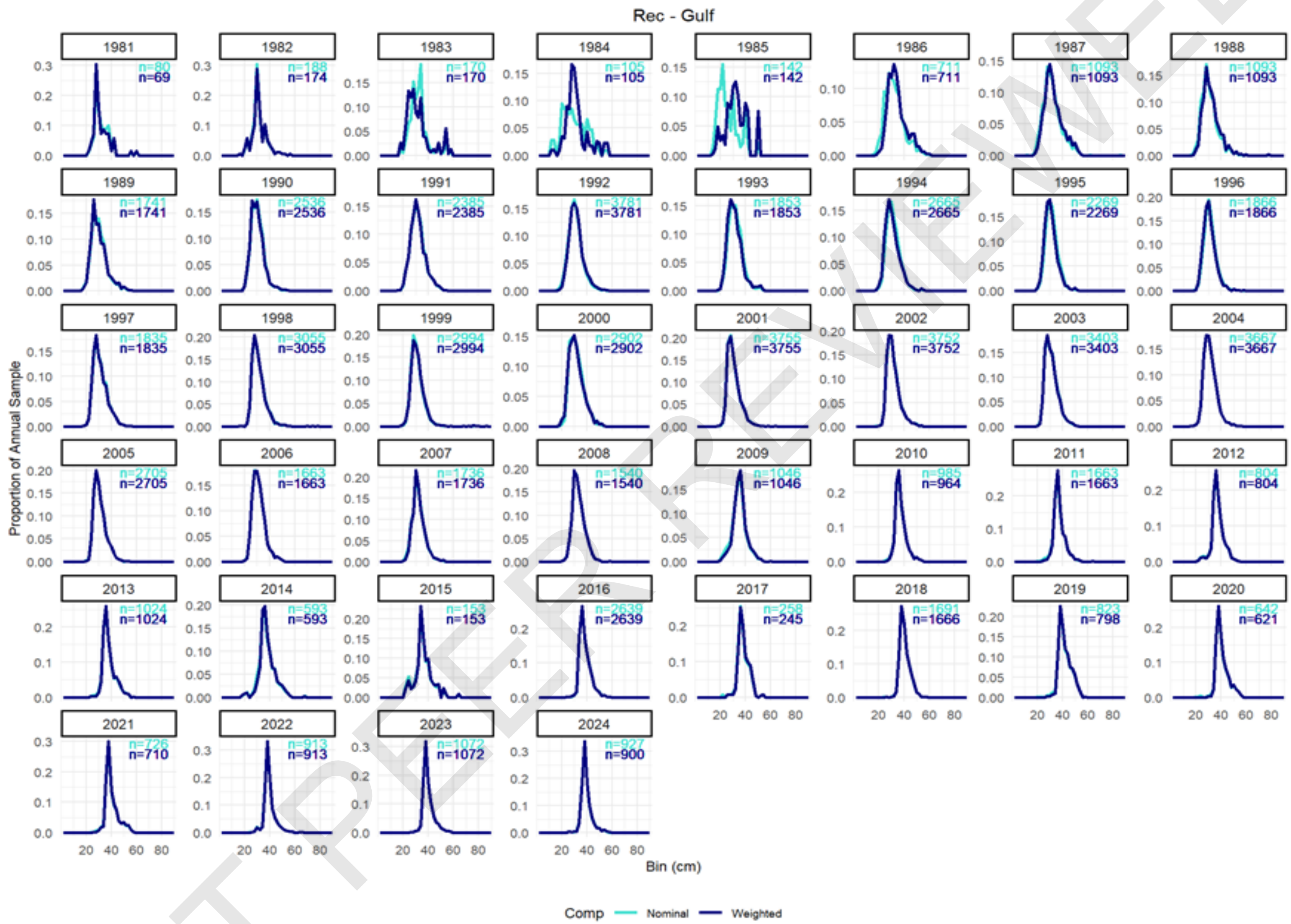


Figure 4.13.8c. Nominal and weighted length distributions for Gulf Gray Triggerfish **Gulf-wide** (TX-FL). Refer to Table A1 in SEDAR 100-DW-04 for which years do not meet sample size criteria for inclusion based on weighting.

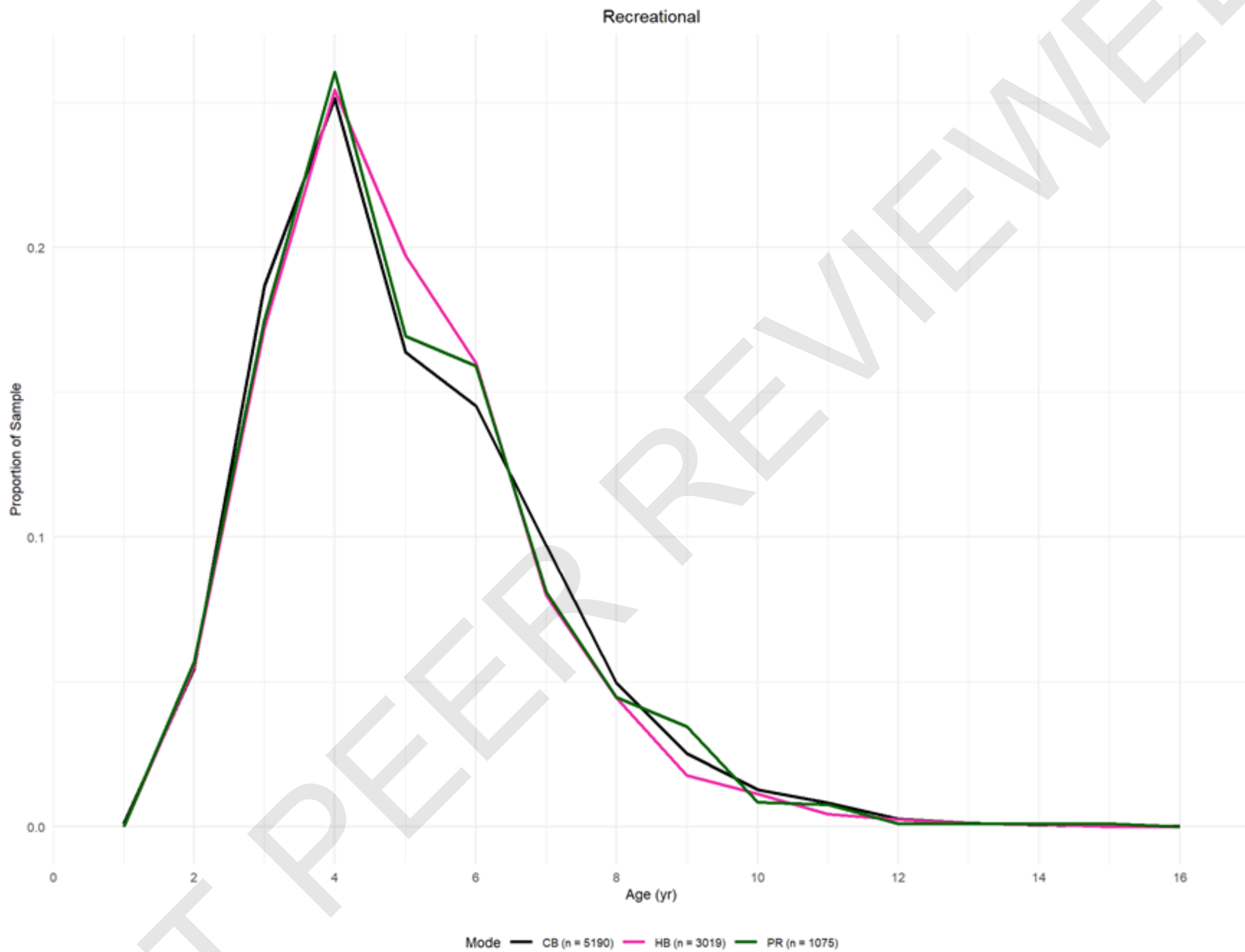


Figure 4.13.9. Nominal age distribution of Gray Triggerfish from the charter (CB), headboat (HB), and private (PR) modes.

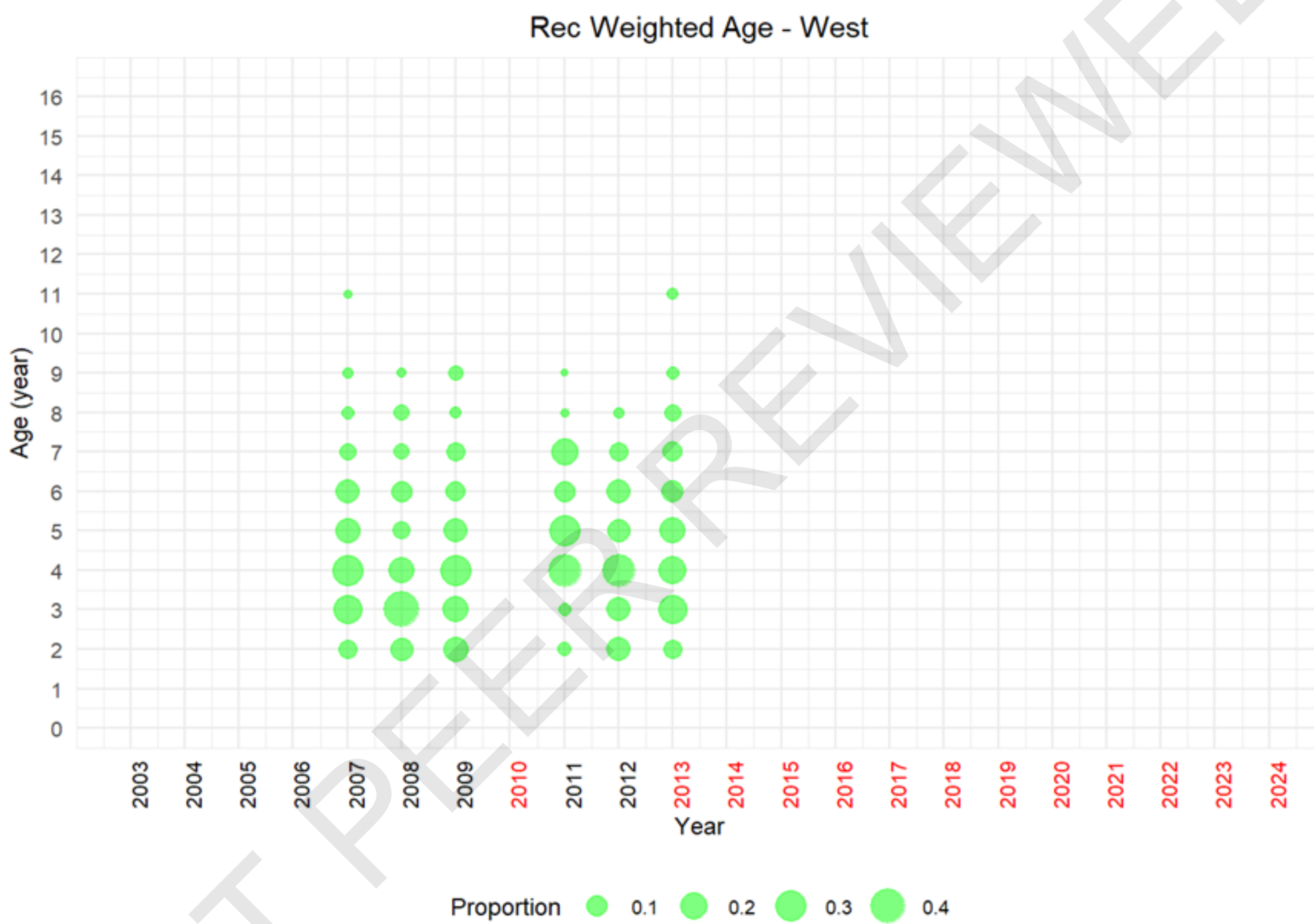


Figure 4.13.10a. Weighted age composition for Gulf Gray Triggerfish from the **West** (TX and LA). The weighted length compositions used for weighting did not meet minimum sample size thresholds for years in red.

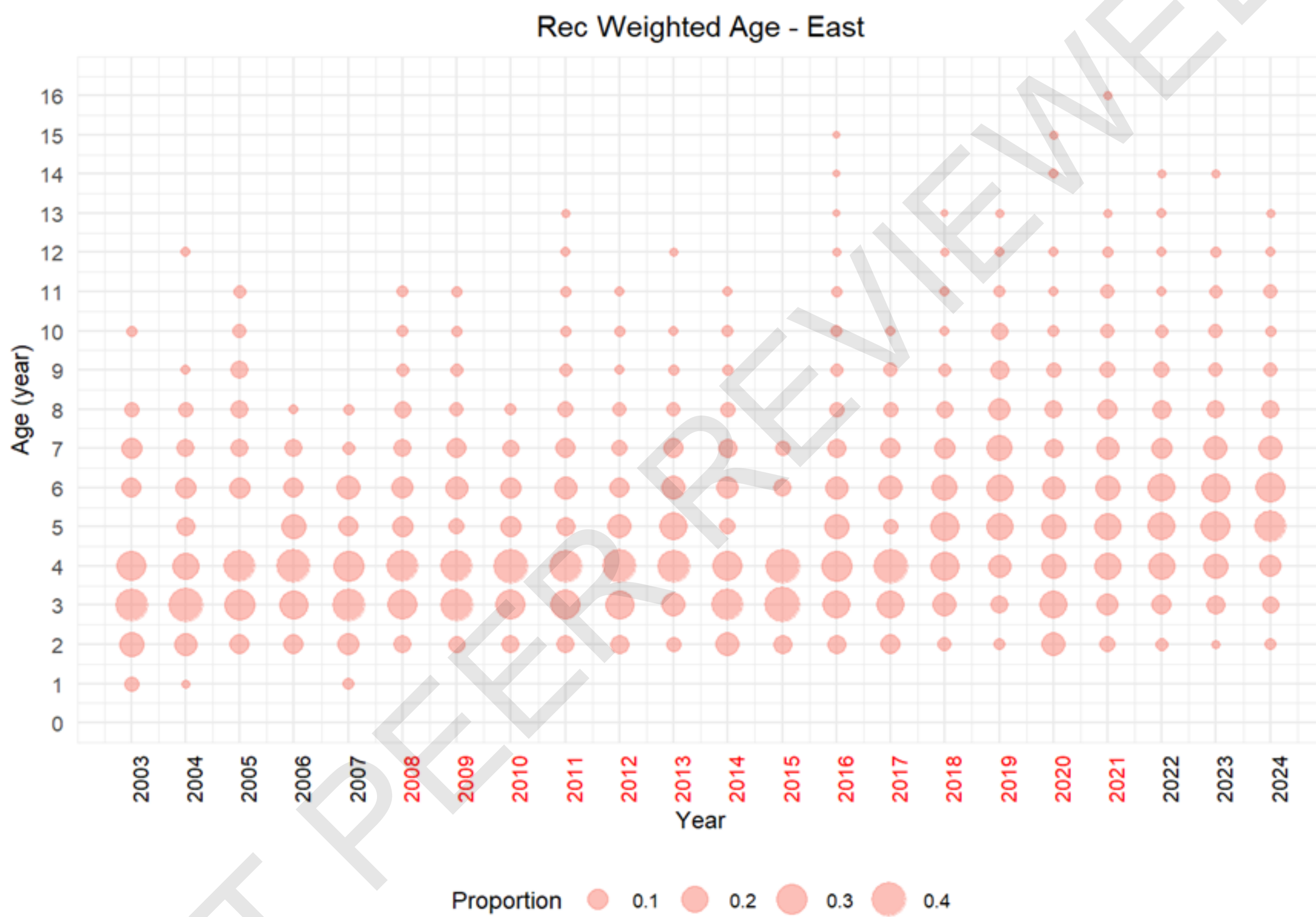


Figure 4.13.10b. Weighted age composition for Gulf Gray Triggerfish from the **East** (MS to FL). The weighted length compositions used for weighting did not meet minimum sample size thresholds for years in red.

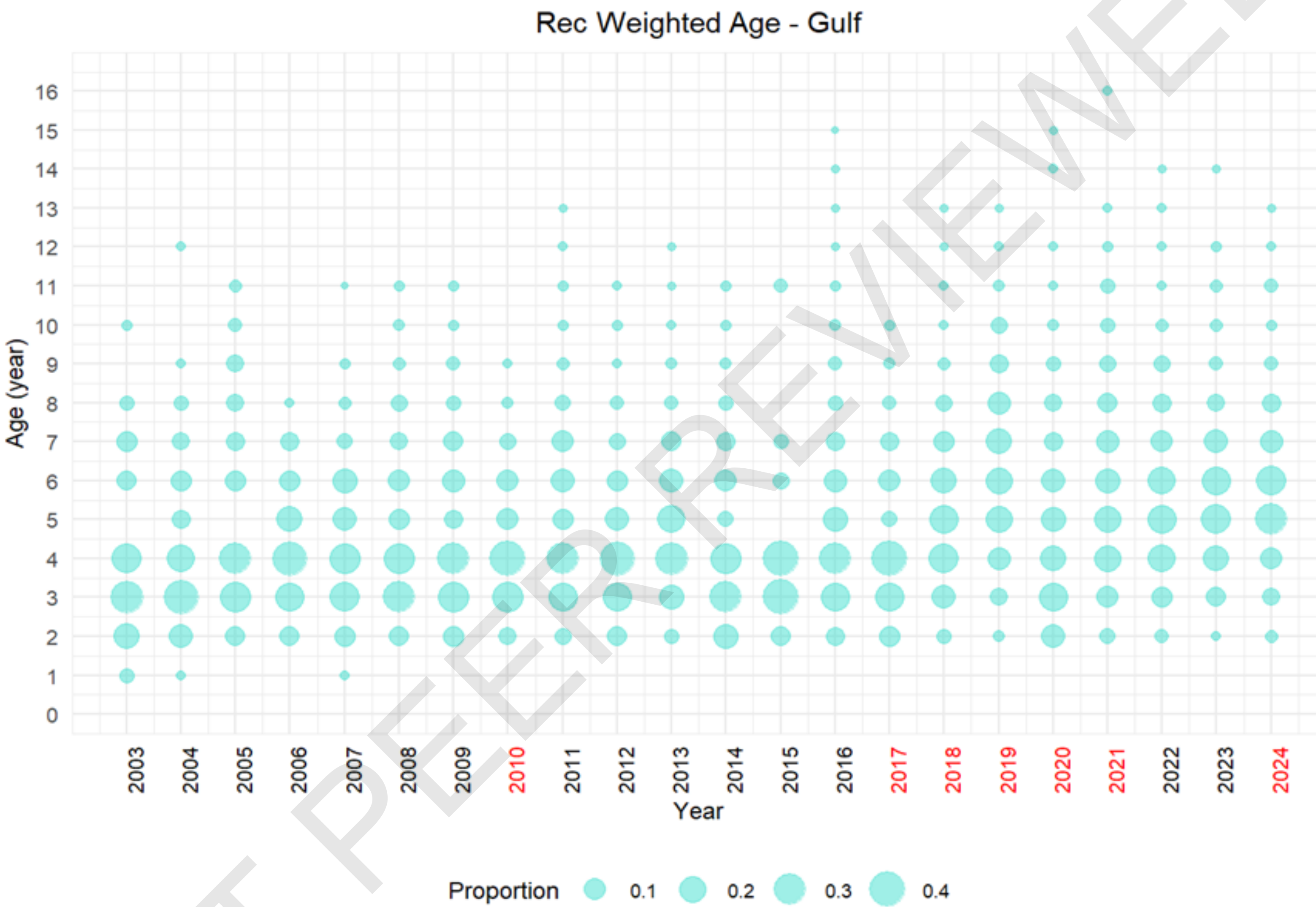


Figure 4.13.10c. Weighted age composition for Gulf Gray Triggerfish **Gulf-wide** (TX-FL). The weighted length compositions used for weighting did not meet minimum sample size thresholds for years in red.

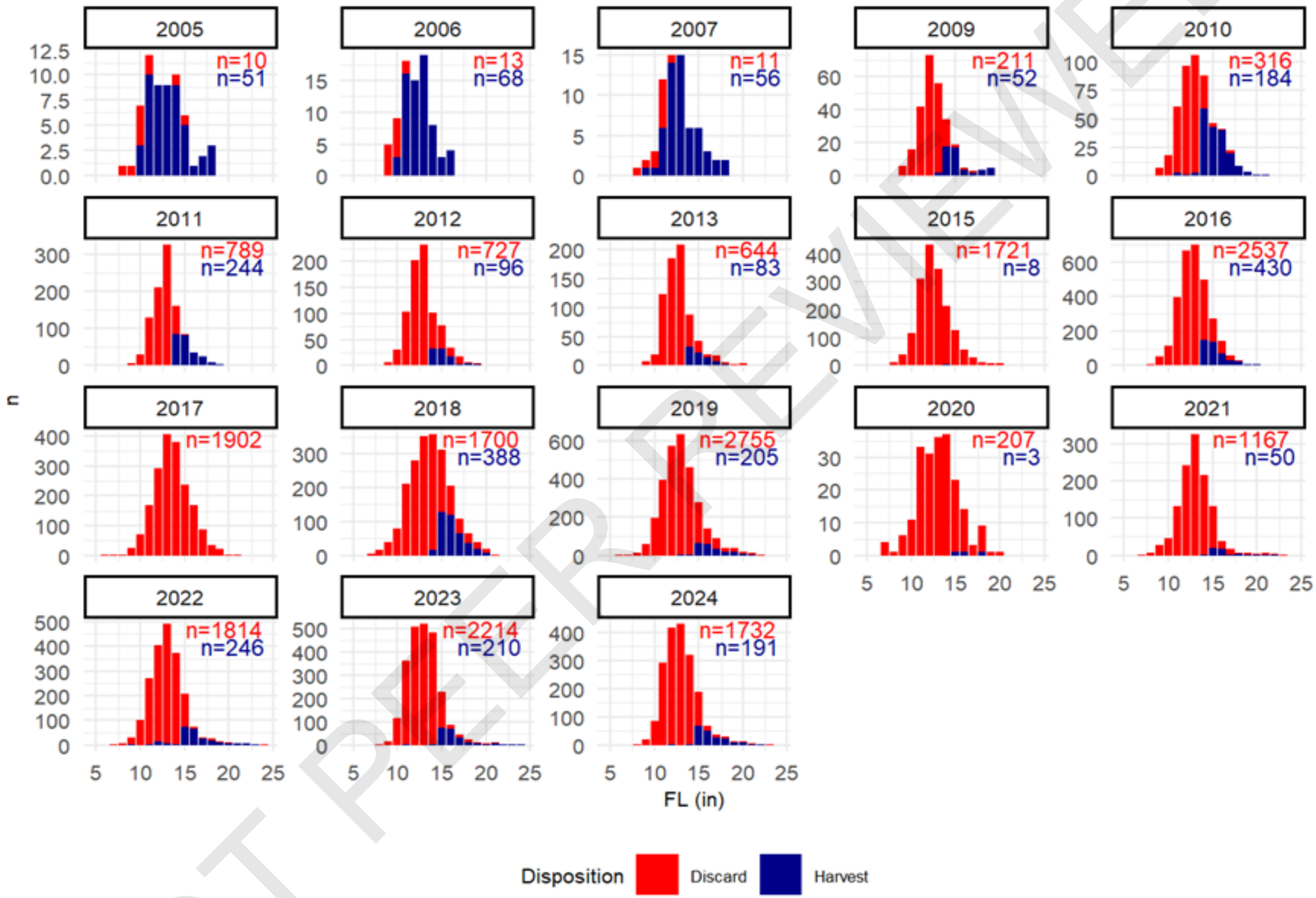


Figure 4.13.11. Length distribution of discarded and harvested Gulf Gray Triggerfish sampled by at-sea observers.

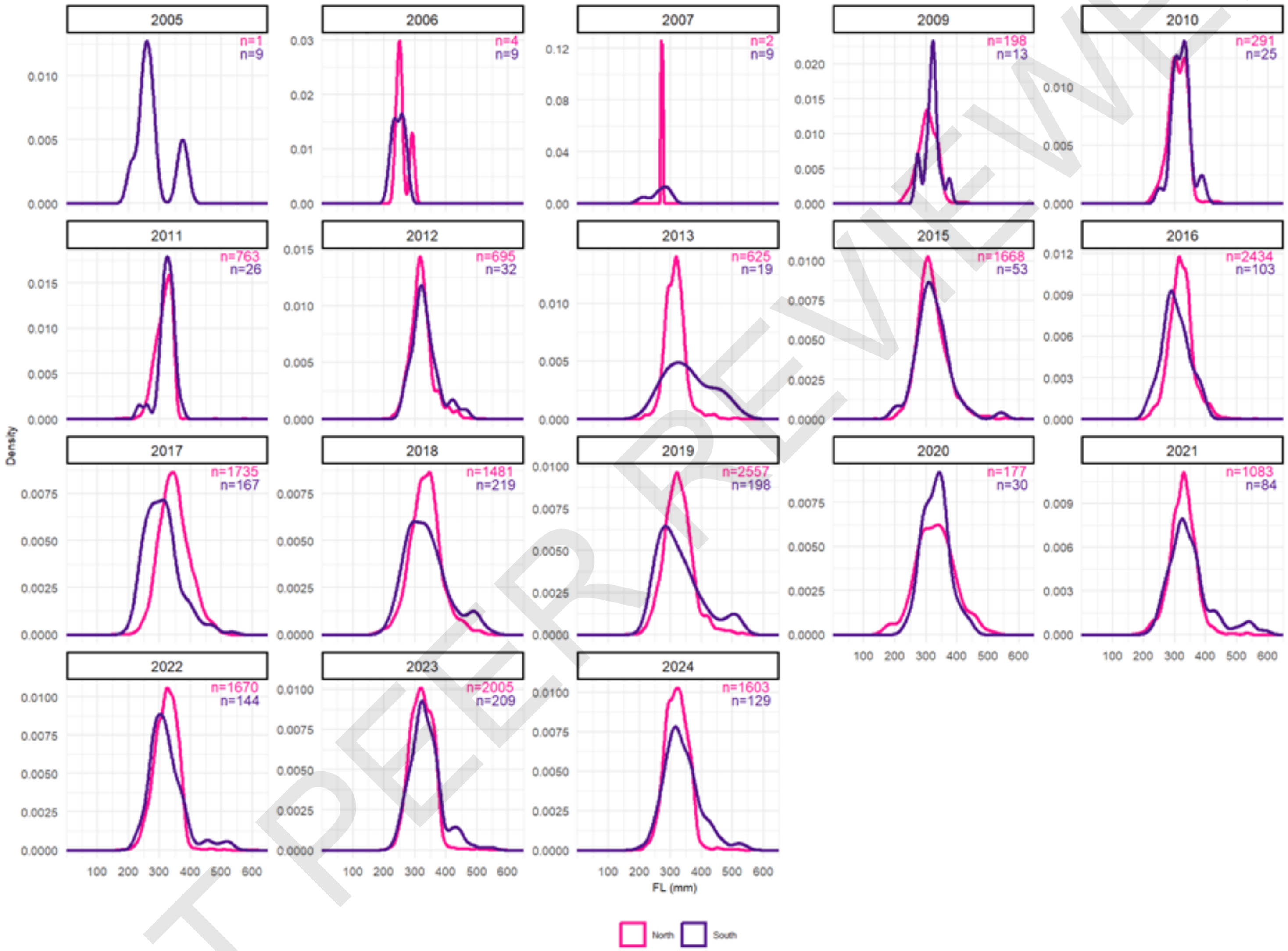


Figure 4.13.12. Comparison of discard length distributions from Gray Triggerfish sampled from the North (MS-FL panhandle) and South (FL peninsula) weighting subregions.

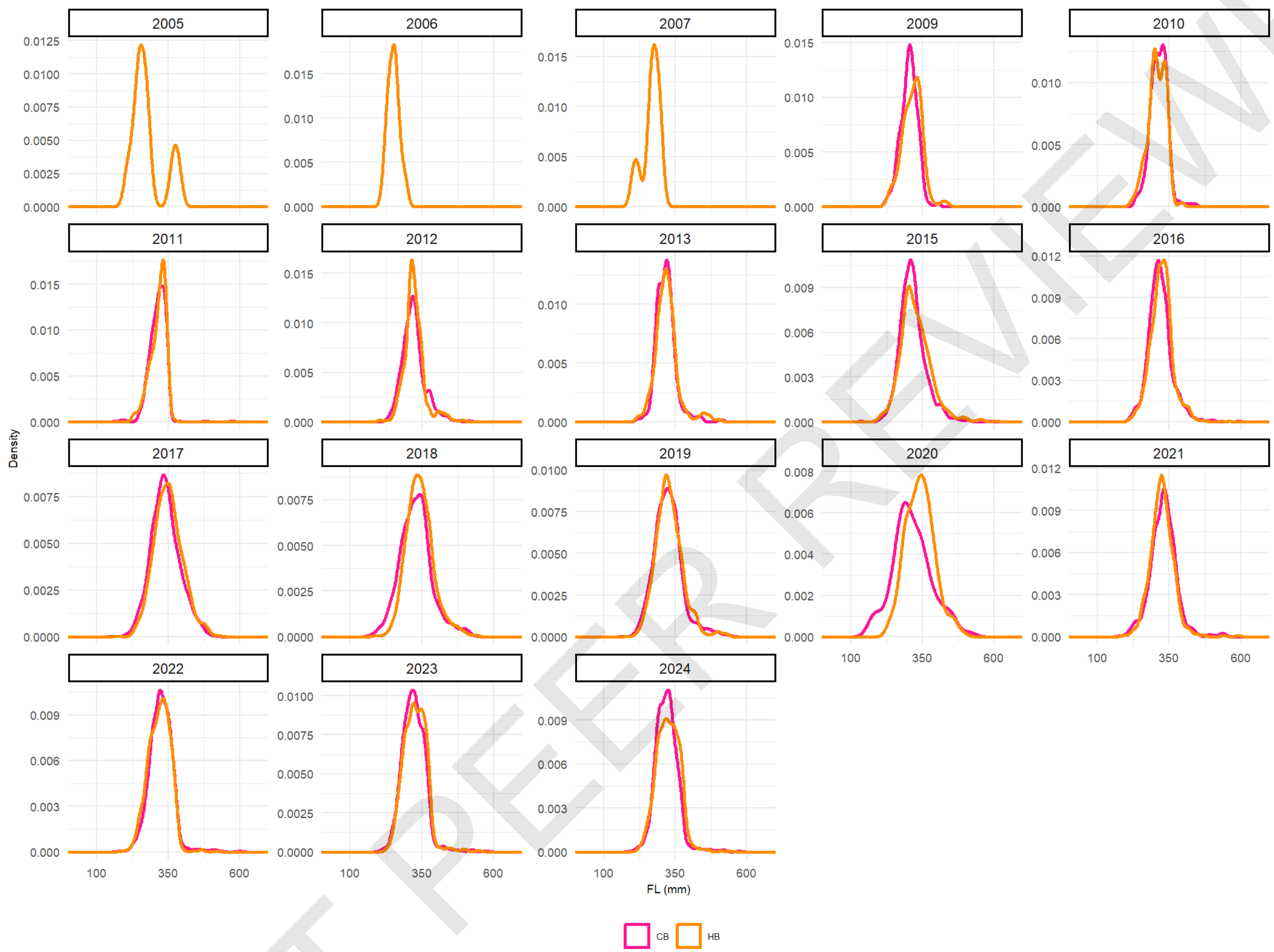


Figure 4.13.13. Discard length distributions by mode (CB = charter, HB = headboat) from Gulf Gray Triggerfish sampled by at-sea observers.

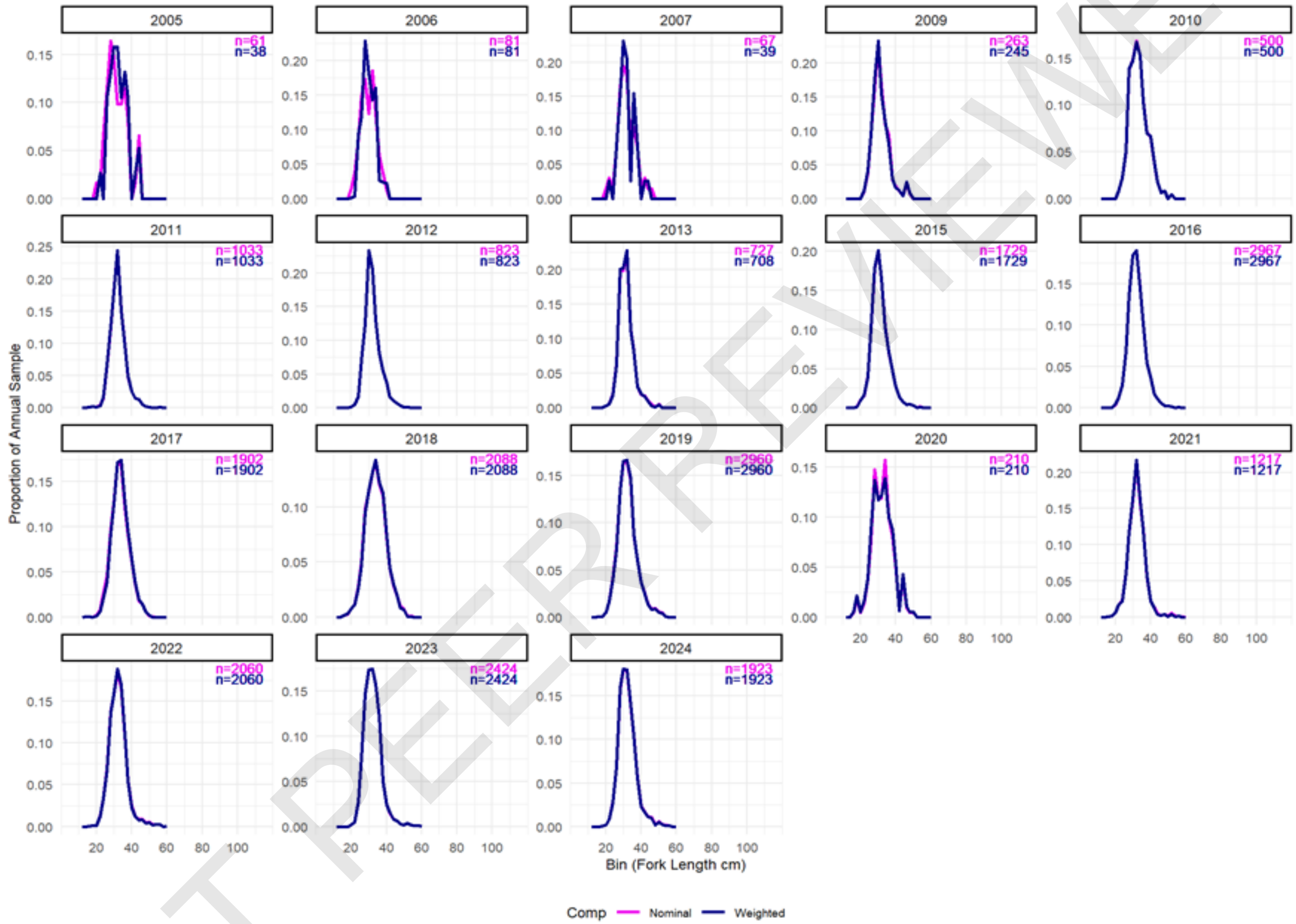
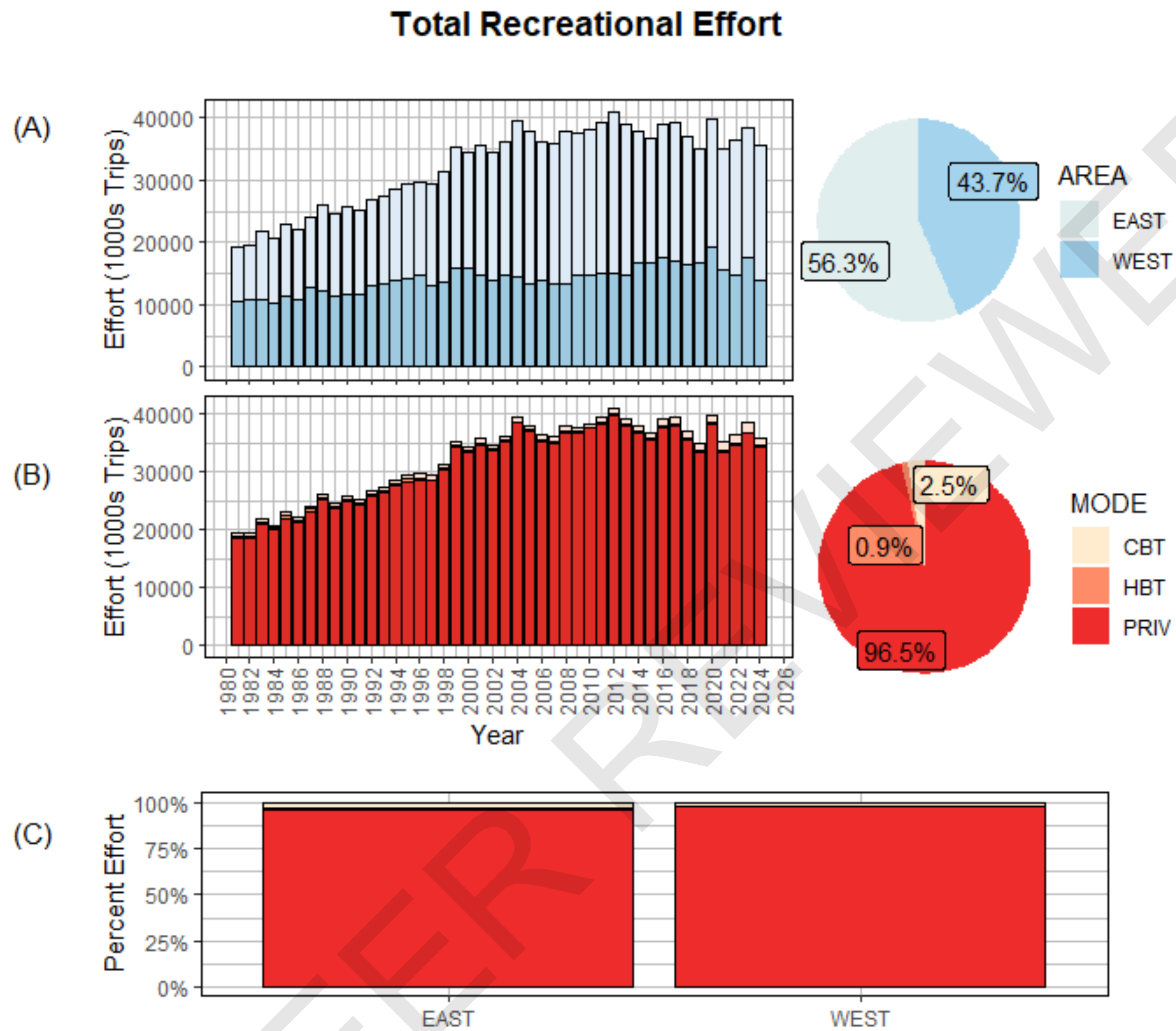


Figure 4.13.14. Nominal and weighted discard length distributions of Gulf Gray Triggerfish (MS-FL) sampled by at-sea observers.



	EAST	WEST
Cbt	24,548,657	11,325,271
Hbt	10,169,208	3,258,550
Priv	767,722,509	607,062,381

Figure 4.13.15. Total recreational effort (angler trips) for Gulf of America Gray Triggerfish across all surveys. Effort is provided (A) by area and year in thousands of trips, (B) by mode and year in thousands of trips, and (C) by mode and area in percent numbers of trips.

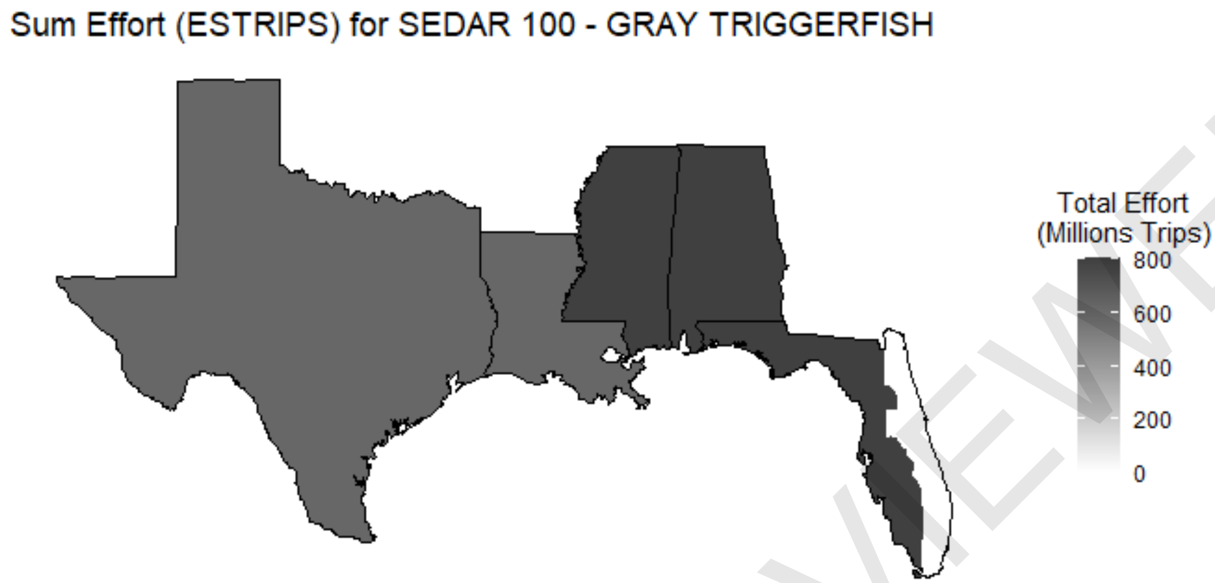


Figure 4.13.16. Distribution of total recreational effort (angler trips), in millions of trips, for Gray Triggerfish across the Gulf of America. Estimates are combined across all surveys and years and summarized by region.

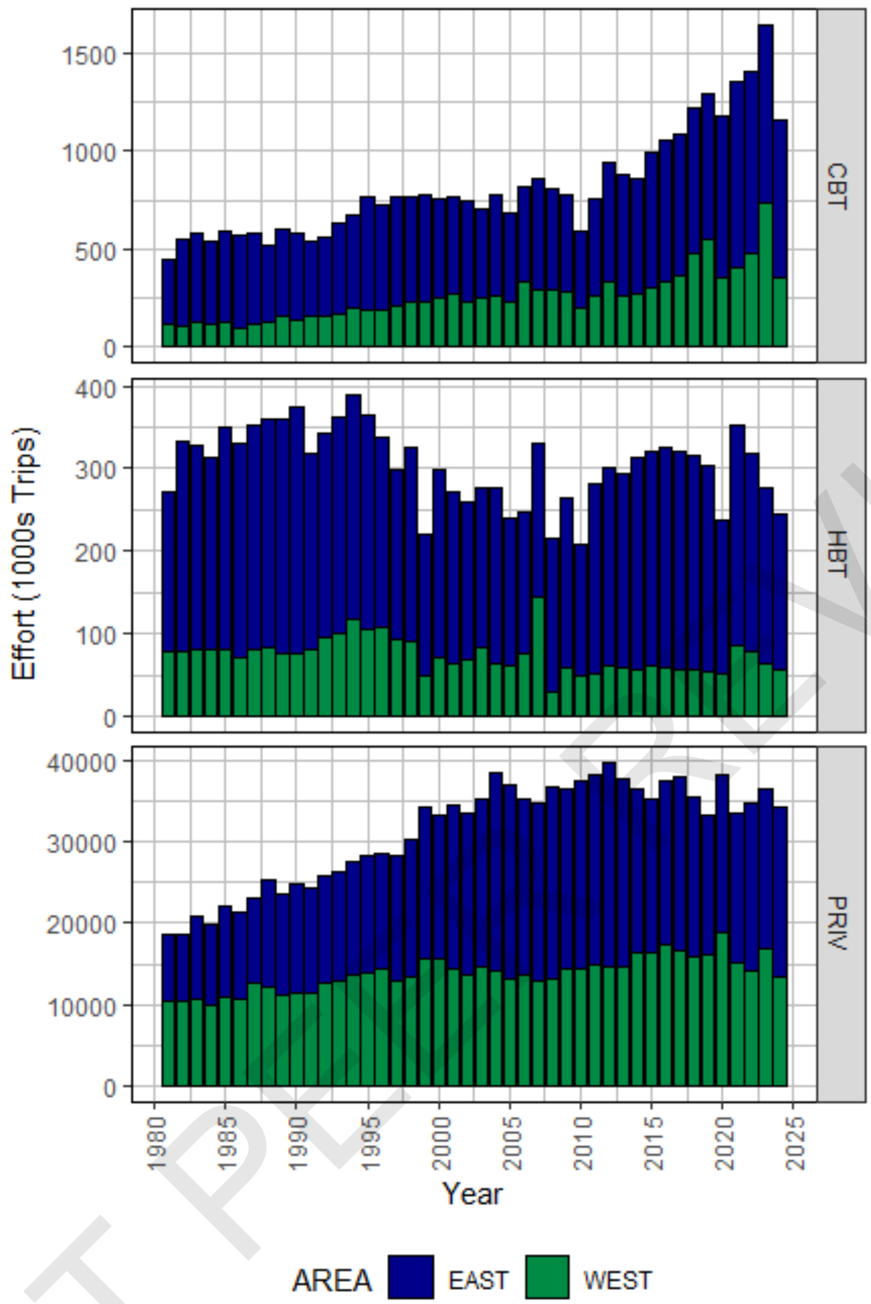


Figure 4.13.17. Recreational effort (angler trips) for Gulf of America Gray Triggerfish for each fishing mode. Effort is provided by year and area in thousands of trips.

5 INDICES OF POPULATION ABUNDANCE

5.1 OVERVIEW

The combined Index and Bycatch Working Group (IBWG) reviewed relative abundance indices and accompanying analyses from six fishery-independent datasets and two fishery-dependent datasets that represented relative abundance trends in the Gulf for gray triggerfish. For this assessment, the IBWG was tasked with making recommendations for two different spatial configurations for the stock assessment model, with one being for a full Gulf-wide stock assessment model and the second being a two-area stock assessment model that would be split into West and East regions.

Full descriptions of the datasets, analytical methods and model diagnostics reviewed by the IBWG can be found in Section 5.2. The IBWG reviewed and evaluated indices independently for the entire Gulf and for each of the two regions (West and East) following the criteria listed in Section 5.3. Relative spatial coverage of "Suitable" and "Suitable and Recommended" indices are included in Figures 5.9.1 and 5.9.2, respectively. Rationalizations for the recommendation or exclusion of an index (Table 5.8.1) are given in the 'Comments on Adequacy for Assessment' in Sections 5.4 (fishery-independent) and 5.5 (fishery-dependent).

For the Gulf-wide model, three fishery-independent and one fishery-dependent indices of abundance are recommended for use in the assessment by the IBWG. Relative abundance and the coefficient of variation on the mean (CV, standard error/mean) for recommended indices Gulf-wide are shown in Table 5.8.2, and overall trends in Figure 5.9.3.

Recommended	Not Recommended
SEAMAP Summer and Fall Groundfish Old (1987 – 2008)	SEAMAP Fall Groundfish Old (1987 – 2007)
SEAMAP Summer and Fall Groundfish New (2009 – 2024)	SEAMAP Fall Groundfish New (2008 – 2024)
SEAMAP / G-FISHER Reef Fish Video (1993 – 2023)	SEAMAP Fall Plankton (1986 – 2023)
Headboat Survey (1986 – 2007)	Commercial Handline (1993 – 2024)

For the West, three fishery-independent and one fishery-dependent indices of abundance are recommended for use in the assessment by the IBWG. Relative abundance and the coefficient of variation on the mean (CV, standard error/mean) for recommended indices in the West are shown in Table 5.8.3, and overall trends in Figure 5.9.4.

Recommended	Not Recommended
SEAMAP Summer and Fall Groundfish Old (1987 – 2008)	SEAMAP Fall Groundfish Old (1987 – 2007)
SEAMAP Summer and Fall Groundfish New (2009 – 2024)	SEAMAP Fall Groundfish New (2008 – 2024)
SEAMAP / G-FISHER Reef Fish Video (1993 – 2023)	SEAMAP Fall Plankton (1986 – 2023)
Headboat Survey (1986 – 2007)	Commercial Handline (1993 – 2024)

For the East, two fishery-independent and one fishery-dependent indices of abundance are recommended for use in the assessment by the IBWG. Relative abundance and the coefficient of variation on the mean (CV, standard error/mean) for recommended indices in the East are shown in Table 5.8.4, and overall trends in Figure 5.9.5.

Recommended	Not Recommended
SEAMAP Summer and Fall Groundfish New (2009 – 2024)	SEAMAP Fall Groundfish New (2008 – 2024)
SEAMAP / G-FISHER Reef Fish Video (1993 – 2023)	SEAMAP Fall Plankton (1986 – 2023)
Headboat Survey (1986 – 2007)	Commercial Handline (1993 – 2024)

5.1.1 Terms of reference

The IBWG was tasked with completing objectives associated from the Data Workshop Terms of Reference (note that the numbering tracks the original Terms of Reference):

4. Provide fishery-independent measures of population abundance developed through the terminal year where possible.

- Evaluate the G-FISHER composite video index for use in the assessment.
- Consider any changes to the fishery-independent indices comprising the GFISHER index as provided for the previous assessment and evaluate the representativeness through time of the composition data.
- Evaluate the compositions available. Recommend modifications needed to inform differences in catchability and selectivity of the surveys.
- Provide appropriate measures of uncertainty for all fishery-independent abundance indices and effort time series considered.

The IBWG was also tasked with examining the follow objective (specific items bolded) from the Assessment Process Terms of Reference:

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

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

5.1.2 Group membership

Members of the IBWG included: Adam Pollack (co-lead), Cheston Peterson (co-lead), Kate Overly, Kevin Thompson, Matthew Nuttall, Ted Switzer, Heather Christiansen, Kyle Dettloff, Sarina Atkinson, David Hanisko, Matthew Campbell, Frank Hernandez, and Glenn Zapfe.

5.2 REVIEW OF WORKING PAPERS

The IBWG reviewed the following working papers:

SEDAR100-DW-09	-	Standardized Catch per Unit Effort for US Gulf of America Gray Triggerfish (*Balistes capriscus*) from the Southeast Region Headboat Survey
SEDAR100-DW-15	-	Standardized catch rates of Gray Triggerfish from the United States Gulf of America commercial handline fishery, 1993-2024
SEDAR100-DW-16	-	Gray Triggerfish Abundance Indices from SEAMAP Groundfish Surveys in the Northern Gulf of America

SEDAR100-DW-18	-	Indices of abundance for Gulf Gray Triggerfish (*Balistes capriscus*) using data from multiple video surveys
SEDAR100-DW-19	-	Gray Triggerfish (*Balistes capriscus*) indices of relative abundance from SEAMAP Fall Plankton Surveys, 1986 to 2023

5.3 CONSENSUS RECOMMENDATIONS AND SURVEY EVALUATIONS

All indices presented to the IBWG were evaluated based on the following criteria:

- Type of Survey (Fishery Dependent or Independent)
- Data Sources
- Temporal Range
- Spatial Range
- Survey Design (e.g., fixed sampling sites, stratified random etc.)
- Sampling Methodology (e.g., gear, vessels, effort etc.)
- Ages and/or sizes represented
- Appropriate Analytical Methods

After an index was evaluated, it was deemed either Suitable or Not Suitable, following the guidance in the Terms of Reference from SEDAR 74. Once all the indices were evaluated on their own merits and determined to be Suitable or Not Suitable, they entered the second stage of review to determine a recommendation for use in the assessment. Indices were then assigned one of the following categories.

- Suitable and Recommended: Based on the criteria listed above, the index met the minimum requirements for being considered for use in the assessment and was deemed to be a representative example of the population trends for a given area.

- Suitable and Not Recommended: Based on the criteria listed above, the index met the minimum requirements for being considered for use in the assessment but was deemed not to be a representative example of the population trends for a given area.

- Not Suitable (Not Recommended): Based on the criteria listed above, the index did not meet the minimum requirements for being considered for use in the assessment.

5.4 FISHERY-INDEPENDENT INDICES

5.4.1 SEAMAP Groundfish Survey

The NOAA Fisheries Southeast Fisheries Science Center (SEFSC) Population and Ecosystem Monitoring Division Trawl and Plankton Branch and state partners have conducted standardized fall groundfish surveys under the Southeast Area Monitoring and Assessment Program (SEAMAP) in the Gulf of America (GOA) since 1987. SEAMAP is a collaborative effort between federal, state and university programs, designed to collect, manage and distribute fishery independent data throughout the southeast region. The primary objective of this trawl survey is to collect data on the abundance and distribution of demersal organisms. This survey, which is conducted semi-annually (summer and fall), provides an important source of fisheries independent information on many commercially and recreationally important species throughout the GOA occupying low-relief, sand and mud habitats across the shelf.

Major changes in the SEAMAP sample design occurred between the 2008 summer and fall surveys. The time of day stratification was dropped, tow time was standardized to 30 minutes, and sampling effort was allocated proportionally by each combination of shrimp statistical zone (SSZ) and depth zone spatial area. While the change in sample design occurred in 2008, it is important to note that the state partners did not adopt the new sample design until 2010. Additionally, minor changes to depth zones were made during subsequent years with the current design utilizing two depth zones, which have been consistent since 2013.

In 2008, SEAMAP received supplemental funding that provided the opportunity to conduct experimental bottom trawl surveys on the West Florida Shelf. Based on the success of the experimental trawl surveys by the state of Florida, the surveys were fully expanded in 2010 to include the area from Mobile Bay, AL to Key West, FL. The survey gear consists of a 12.8-m (42 ft) semi-balloon shrimp trawl with a 12.8-m headrope and does not contain a turtle excluder device (TED) or any bycatch reduction devices (BRD).

5.4.1.1 Methods of Estimation

Working Paper Number: SEDAR100-DW-16
Data Type: Fishery Independent
Time Series: 1987 – 2008, 2009 – 2024
Sampling Intensity: Table 1 (summer), Tables 2 (fall) in working paper.
Size/Age Data: Predominantly juveniles, see Figures 3 – 5 in working paper for length and age distributions
Data Filtering Techniques: Standard filtering protocols to remove problematic stations.

Standardization: Delta-lognormal following methods outlined by Lo *et al.* (1992)

Submodel Variables

Gulf-wide – SEAMAP Summer and Fall Groundfish (old design, 1987 – 2008)

Binomial submodel: Year, SSZ, Season, Depth
Lognormal submodel: Year, SSZ, Season, Time of Day, Depth

Gulf-wide – SEAMAP Summer and Fall Groundfish (new design, 2009 – 2024)

Binomial submodel: Year, SSZ, Season, Depth

Lognormal submodel: Year, SSZ, Time of Day, Depth

West Gulf – SEAMAP Summer and Fall Groundfish (old design, 1987 – 2008)

Binomial submodel: Year, SSZ, Season, Depth
Lognormal submodel: Year, SSZ, Season, Time of Day, Depth

West Gulf – SEAMAP Summer and Fall Groundfish (new design, 2009 – 2024)

Binomial submodel: Year, SSZ, Season, Depth
Lognormal submodel: Year, SSZ, Time of Day, Depth

East Gulf – SEAMAP Summer and Fall Groundfish (new design, 2009 – 2024)

Binomial submodel: Year, SSZ, Season, Weight of Sponge, Depth
Lognormal submodel: Year, SSZ, Season

Abundance Indices: Addendum Table 1 (Gulf-wide – old design), Addendum Table 2 (Gulf-wide – new design), Addendum Table 3 (West Gulf – old design), Addendum Table 4 (West Gulf– new design), Addendum Table 5 (East Gulf– new design) in SEDAR100-DW-16

5.4.1.2 Comments on Adequacy for Assessment

Initially, only indices from the SEAMAP Fall Groundfish Survey Old Design (1987 – 2008) and SEAMAP Fall Groundfish Survey New Design (2009 – 2024) were presented for use in the assessment following what had been done for previous SEDARs. Both indices represent a long-term fishery-independent survey that has good spatial and temporal coverage. Indices were presented for the Gulf-wide model and for the West for the SEAMAP Fall Groundfish Survey Old Design and for all three regions (East, West, and Gulf-wide) for the SEAMAP Fall Groundfish Survey New Design. However, during the course of the Data Workshop, we examined combining the summer and fall survey data into a single index. Length data were compared and no apparent differences in the distribution were noted, aside from a shift in lengths that would be expected from the fish being older when captured in the fall survey.

Due to the recommendation for combining Summer and Fall survey data, indices from the fall survey were deemed "Suitable and Not Recommended".

The survey coverage across all regions showed broad spatio-temporal sampling, with the entire area being covered in most years. Therefore, the IBWG deemed the summer and fall combined indices for all of the regions "Suitable and Recommended".

5.4.2 SEAMAP/G-FISHER Reef Fish Video Survey- East (EGOA), West (WGOA) and Gulf-wide (GOA)

Historically, three different stationary video surveys were conducted to assess trends in reef fish relative abundance in the Gulf of America (GOA). The NMFS SEAMAP reef fish video survey (SRFV), carried out by NMFS Mississippi Laboratory, has the longest running time series (1993-1997, 2002, and 2004+), followed by the NMFS Panama City lab survey (PC; 2005+), with the most recent survey being the Florida Fish and Wildlife Research Institute video survey (FWRI, starting year 2010). Survey efforts were integrated under a unified design as the Gulf Fishery Independent Survey of Habitat and Ecosystem Resources (G-FISHER) beginning in 2020. Given the surveys use standardized deployment, camera field of view, and fish abundance methods to assess fish abundances on reef or structured habitat, combining indices across datasets allows for the largest possible sample sizes in model fitting and encompassing a greater proportion of the distribution of the stock. Gray Triggerfish, found throughout the GOA, is considered a single stock based on its prolonged, indeterminate larval stage. As requested for this assessment, indices of abundance were provided for the East GOA (EGOA, > -89° longitude), West GOA (WGOA; < -89° longitude), and Gulf-wide GOA (GOA) regions.

5.4.2.1. Methods of Estimation

Working Paper Number: SEDAR100-DW-18
Data Type: Fishery Independent
Time Series: 1993-2023 (All indices; EGOA, WGOA, GOA)
Sampling Intensity: See Table 1 for total number of stations sampled per region per year in SEDAR100-DW-18
Size/Age Data: Data represents juveniles through adult. 10 - 88 cm (EGOA), 16 - 68 cm (WGOA), 10 – 88 cm (GOA). See Figure 19 in SEDAR100-DW-18

Data Filtering Techniques: For all surveys, video reads were excluded if they were unreadable due to low visibility or deployment errors. Data from the SRFV survey collected in 1992 were excluded from the EGOA, WGOA and GOA index calculations because of differences in counting methods in this first year, and no survey data are available for years 1998-2001 and 2003. Additionally, PC survey data from 2005 was excluded because of an incomplete survey. Due to COVID restrictions on field sampling, no data were collected in the WGOA in 2020. As a result, 2020 data were excluded from analysis in the WGOA index. Final sample sizes by region, survey and year can be found in Table 1 and spatial coverage is shown in Figures 1 and 2 in SEDAR100-DW-18. Data were separated into EGOA (zones 2-11) and WGOA (zones 13-21) and GOA (zones 2-21) regions following the Stock ID identified in SEDAR 9, and analyses were completed for each of these regions independently. The same data reduction procedures were applied to the video length data set such that annual size composition vectors were generated solely from stations used to generate standardized indices for each stock.

Standardization: Relative abundance indices were generated using a stepwise approach. First a habitat variable was created that included each of the separate survey individual variables that could be applied to all the data. This was done so final index models can account for changing sampling effort and habitat allocation through time rather than limiting the model to be predicted only by year and survey. We first determined the percentage of sites that occurred on High, Medium, or Low (H, M, L) proportion positive habitats for each survey and region independently. For this we used a categorical regression tree approach (CART). These subsequent variables were then used in a negative-binomial GLM along with year and survey to predict annual abundances for each region independently.

Submodel Variables:

EGOA CART variables by survey:
SFRV east: *presence/absence of sponge, presence/absence of soft coral, combined maximum relief, latitude, and longitude*
PC: *longitude, general habitat category, and relief*
FWRI: *latitude, longitude, presence/absence of sponge, geoform, depth*
GF east: *latitude, longitude, presence/absence of rock, presence/absence of sponge*

WGOA CART variables by survey:
SFRV west: *depth, latitude, presence/absence of rock, presence/absence of silt/sand/clay*
GF west: *depth*

GOA CART variables by survey:
SFRV east: *presence/absence of sponge, presence/absence of soft coral, combined maximum relief, latitude, and longitude*
SFRV west: *depth, latitude, presence/absence of rock, presence/absence of silt/sand/clay*
PC: *longitude, general habitat category, and relief*
FWRI: *latitude, longitude, presence/absence of sponge, geoform, depth*
GF east: *latitude, longitude, presence/absence of rock, presence/absence of sponge*
GF west: *depth*

Annual Abundance Indices: See Table 8 and Figure 16 for EGOA, Table 9 and Figure 17 for WGOA, and Table 10 and Figure 18 for GOA in SEDAR100-DW-18.

5.4.2.2. Comments on Adequacy for Assessment

All three indices were deemed suitable and recommended by the IBWG at the SEDAR100 Data Workshop in Tampa, FL.

Prior to the G-FISHER survey, previous SEDARs utilized different methods for calculating the abundance indices between multiple reef fish video surveys. SEDAR 62 combined three separate surveys (SRFV, PC, FWRI) to derive estimated annual abundances for the combined EGOA index. This was achieved by fitting a GLM to data using CART-derived habitat groups as a shared variable. This approach predated the formal standardization of the survey universe and design established by G-FISHER. Separately, the WGOA index was derived exclusively from the SRFV dataset, as PC and FWRI did not sample that region at the time. (SRFV also produced standalone EGOA and GOA-wide indices). For all three regions, the SRFV analysis utilized a negative binomial model.

Following SEDAR 62, the G-FISHER survey came online (2020), sampling GOA-wide with a standardized sampling universe, design and methodologies. Additionally, we developed GOA-wide model-weighting methods that allowed us to account for the variation in spatial footprint in the surveys when combining data (current and historical), allowing for a more representative index of regional relative abundance trends. Ultimately, for this assessment we used this updated habitat-based approach to combine relative abundance data for generating annual trends for gray triggerfish (Balistes capriscus) in the EGOA, WGOA, and GOA-wide. This combined approach resulted in low CVs (2021-2024 8-7%). Due to the wide range of the stock being covered in terms of spatial coverage and habitats sampled, the large sample sizes of video sets, and the size range of this species being indexed the combined G-FISHER approach was supported for the EGOA, WGOA, and GOA-wide indices. While we provided all three, the analytical team can use their discretion to determine which index/indices are ultimately included.

Review of the length compositions and survey designs of the independent video surveys did not uncover any obvious differences that would warrant the implementation of time varying selectivity and catchability be applied, and the combined length frequencies across years were similar among surveys (Fig. 19). However, the analytical team can use their discretion to explore time-varying parametrizations if they are determined to be warranted during model development.

5.4.3 SEAMAP Fall Plankton Survey

The Southeast Area Monitoring and Assessment Program (SEAMAP) has supported the collection and analysis of ichthyoplankton samples from fishery-independent resource surveys in the Gulf since 1982 with the goal of producing a long-term database on the early life stages of fishes.

5.4.3.1. Methods of Estimation

Working Paper Number: SEDAR100-DW-19
Data Type: Fishery Independent
Time Series: 1986 to 2023
Sampling Intensity: See Table 4 in SEDAR100-DW-19
Size/Age Data: Intended to index adult spawning stock

Data Filtering Techniques: Preliminary indices of abundance were based on the occurrence and catch per unit effort (CPUE) from SEAMAP Fall Plankton Surveys. Year to year variability in spatial coverage from Fall Plankton Survey data was addressed by limiting observations to samples taken at systematic grid stations that were sampled during at least (~66%) of all years for which there was consistent spatial coverage. Based on this protocol, the core data of the Gulf index includes all samples taken during at least 19 of the 28 years of available data with the years

1992, 1998, 2004, 2005, 2008, 2015, 2017, 2021 and 2023 excluded. Years in which gray triggerfish were not observed were removed prior to the generation of indices.

Standardization: Generalized linear modeling (GLM) methods were used to estimate the proportion of positive occurrence (PPOS) and relative catch per unit effort (CPUE) of larval and juvenile gray triggerfish in neuston nets. PPOS was modeled utilizing a binomial distribution with a logit link. CPUE was estimated by a log linked negative binomial model based on counts of larvae with effort (minutes fished) as an offset. The factors Year, Time of Day (TOD), Region and Depth were examined as possible influences on PPOS and CPUE.

Annual Abundance Indices: See Table 4 for the preliminary PPOS index and Table 5 for the preliminary negative binomial CPUE index in SEDAR100-DW-19.

5.4.3.2. Comments on Adequacy for Assessment

Gray triggerfish indices of CPUE derived from SEAMAP Fall Plankton Surveys have been used as an estimate of adult spawning biomass in previous assessments. Detailed analysis of length composition carried out for SEDAR 62 and SEDAR 100 indicate that gray triggerfish in SEAMAP neuston nets are dominated by older larvae (>5 mm Body Length [BL]) and juvenile stages (>10 mm BL) which account respectively for 12.1% and 78.7% of fish collected in samples. Therefore, CPUE and PPOS indices derived from SEAMAP neuston net samples are primarily composed of juvenile stages (> 10 mm BL) which are much further removed from the larval stages (< 10 mm BL) typically used to reflect trends in adult spawning stock. Larval gray triggerfish at or below 5 mm BL from neuston tows could potentially index spawning stock biomass, but larvae in this size range are rare and only occur in 2% of samples over the time series. Given that gray triggerfish CPUE and PPOS is primarily driven by juvenile fish further removed from the larval stages (< 10 mm BL) typically used to reflect trends in adult spawning stock, the authors of the working paper recommended that the SEAMAP Fall Plankton Survey CPUE and PPOS indices not be included in the assessment as a spawning stock index. This recommendation was discussed and adopted by the IBWG.

Indexing the relative abundance of gray triggerfish from neuston net collections is complicated by their consistent association with floating Sargassum. Examination of gray triggerfish in SEAMAP neuston tows (2006 to 2022) with paired observations of Sargassum catch indicate that older larvae and juveniles co-occur with Sargassum 78% of the time and primarily when Sargassum exceeds 1 liter / 10 min tow. In contrast, larvae at 5 mm BL or less only co-occur with Sargassum 22% of the time and when little (< 1 liter/ 10 min tow) or no Sargassum is observed in the sample. Although, catches of gray triggerfish greater than 5 mm BL are associated with Sargassum catch, a clear relationship with increasing catch of gray triggerfish and increasing catches of Sargassum was not apparent in our data. However, we did see a pattern of extreme (outliers) gray triggerfish CPUE in samples associated with large catches of Sargassum. Our ability to elucidate the relationship between gray triggerfish and Sargassum CPUE may be limited by the methods used to quantify Sargassum in neuston net tows. Currently, the protocols only record liters of Sargassum taken in the net, but information on the type of Sargassum aggregation, relative density at the surface, at depth and patchiness along or near the neuston tow may be needed to determine a relationship, and account for the seen pattern of extreme observations we see in our data. The use of satellite imagery products is being evaluated to provide a more detailed measurement of Sargassum abundance. This data will be used in future analyses to examine the intricate link between Sargassum abundance and variability of gray triggerfish recruitment in the northern Gulf of America.

At this time, the SEAMAP larval CPUE and PPOS from neuston nets primarily represent an incomplete picture of late-stage larvae and juvenile recruitment to Sargassum habitat. These fish may rely on Sargassum for refuge and transport to suitable benthic habitat for settlement, but major questions regarding these mechanisms are yet unanswered. The IBWG briefly discussed the potential merits of the SEAMAP Fall Plankton Survey CPUE and PPOS indices as an index of recruitment, but ultimately decided that the SEAMAP trawl surveys better represented a more direct recruitment path to the fishery.

5.4.4 Sargassum

As discussed above, indexing the relative abundance of gray triggerfish from neuston net collections is complicated by their consistent association with floating Sargassum. A clear relationship with increasing catch of gray triggerfish and increasing catches of Sargassum was not apparent in our data. The use of satellite imagery products is being evaluated to provide a more detailed measurement of Sargassum abundance. This data will be used in future analyses to examine the intricate link between Sargassum abundance and variability of gray triggerfish recruitment in the northern Gulf of America.

5.5 FISHERY-DEPENDENT INDICES

5.5.1 SRHS Headboat Index

The Southeast Region Headboat Survey (SRHS) collects catch, effort, and biological information from recreational headboats operating throughout the southeast region. First implemented in the Carolinas in 1972, the spatial extent of this survey has since grown, covering the entire South Atlantic by 1978 and the Gulf by 1986. Designed to be a census, SRHS catch records capture the majority of headboat fishing activity across the southeast, with compliance being near 100 percent since permits became tied to reporting requirements in 2008. These catch records are from industry-reported logbooks, which were submitted via paper forms until 2013 when the survey switched to electronic reporting.

5.5.1.1. Methods of Estimation

Working Paper Number: SEDAR100-DW-09
Data Type: Fishery Dependent
Time Series: 1986-2007

Sampling Intensity: The SRHS Working Paper (SEDAR100-DW-01) summarizes the number of headboats actively fishing (Tables 5-7) and their total fishing effort (Tables 14-17, Figure 7)

Size/Age Data: The SRHS Working Paper (SEDAR 100-DW-01) summarizes the lengths and weights of those landed fish sampled by SRHS port samplers (Tables 20-23, Figures 8-9)

Data Filtering Techniques: Standard filtering protocols to remove vessels with infrequent participation in the fishery, trips that reported six or fewer anglers, and trips with suspected data errors. Trips conducted during the closed season for Gulf Gray Triggerfish were also excluded.

SRHS logbook records after 2007 were excluded following perceived effects of management regulations on Gray Triggerfish catch rates (e.g., circle hook mandate, size and bag limits, spatial and seasonal fishery closures). Trip selection was conducted using the guild approach, which retained trips that were positive for those reef fish species believed well-sampled by the SRHS program.

Standardization: delta-lognormal

Submodel Variables

East:
Binomial: Year + Area + Year*Area
Positive Observations: Year + Area + Season + Year*Area

West:
Binomial: Year + Trip Duration + Day/Night + Year*Trip Duration
Positive Observations: Year + Season + Red Snapper Season

Gulf:
Binomial: Year + Area + Year*Area
Positive Observations: Year + Area + Season + Year*Area

Annual Abundance Indices: Table 2 (East), Table 4 (West), and Table 6 (Gulf)

5.5.1.2. Comments on Adequacy for Assessment

The IBWG found the provided SRHS Headboat Indices "Suitable and Recommended" for all regions. These indices provide one of the longest time series (1986+) and have widespread spatial coverage compared to other regional indices. It covers a time period over which fishery-independent indices are generally not available, and was truncated to account for the potential effects of management, including regulations aimed at Gray Triggerfish but also other reef fish that may interact with Gray Triggerfish.

5.5.2 Commercial Vertical Line

This index uses landings data from the Coastal Fisheries Logbook Program (CFLP) to characterize population trends of Gray Triggerfish as represented by the commercial vertical line (handline and electric reel) fishery. This index was used in both SEDAR 43 and 62 and the methods presented here are generally similar to those analyses. However, notable improvements were made to the subsetting routine for the Stephens MacCall procedure, the subsequent spatial zones used in the index, and the final model form which are more reflective of current best practices for indices produced with this dataset.

5.5.2.1. Methods of Estimation

Working Paper Number: SEDAR100-DW-15
Data Type: Fishery Dependent
Time Series: 1993-2024
Sampling Intensity: Between 614-1,982 trips (N) per year
Size/Age Data: Reflective of the commercial landings from handline

Data Filtering Techniques: Initial filtering was for East and West where, due to proportion positive catch of Gray Triggerfish, the East was defined by SEAMAP zones 5-12 and West included zones 13-20 (Table 1 in SEDAR 100-DW-15). Data were then further filtered for trips with incomplete information and for extreme outliers (99th percentile). Stephens MacCall was then used to subset to trips that are considered reflective of Gray Triggerfish habitat using other species associations. Species found positively and negatively associated with Gray Triggerfish in this assessment were generally in line with the previous indices provided in SEDAR 43 and 62.

Standardization: Delta models were used with a binomial component and a positive CPUE component with a gamma distribution for East, West and Gulf-wide.

> **Submodel Variables** Backwards selection with AIC evaluation was used and all three models had all possible variables in the final model for both the binomial and positive catch components. Variables included were:
>
> YEAR – Year was necessarily included, as standardized catch rates by year are the desired outcome. Years modeled were 1993-2024
> **SEASON – Season included four levels: (Jan-Mar, Apr-Jun, Jul-Sep, Oct-Dec)**

AREA – The SEAMAP zone as a factor with the East including zones 5-12, and the West with zones 13-20 (8 levels each)

DAYS AT SEA – Days at sea (sea days) were pooled into four levels as quartiles of the data for the respective dataset (East, West, or Gulf-wide)

CREW SIZE – Crew size was included as a factor with levels from 1-6 (min to max value)

HOOK HOURS – Trip total hook hours as a four-level factor pooled into quartiles of the data for the respective dataset (East, West, or Gulf-wide)

Annual Abundance Indices: SEDAR100-DW-15 Tables 2-4.

5.5.2.2. Comments on Adequacy for Assessment

This index was deemed suitable based on the time series, segment of the population represented in both length composition and spatial extent, and modeling methodology. However, it was not recommended for use in the assessment. The changing management through time of this species in regards to trip limits, size limits, and reduced season duration make this fishery dependent time series difficult to decouple from these impacts on fishery behavior. Furthermore, it was deemed duplicative in terms of length composition and habitats sampled as the independent, G-FISHER survey which was recommended for use in this assessment.

5.6 RESEARCH RECOMMENDATIONS

- Evaluate potential red tide impacts
- Explore incorporating artificial reef / platform data from G-FISHER (short time series)
- Understanding the connection between sargassum habitat and abundance / life history of gray triggerfish
    - Daily aging of sub-age 0 gray triggerfish
    - Is sargassum obligate?

5.7 LITERATURE CITED

Lo, N.C.H., L.D. Jacobson, and J.L. Squire. 1992. Indices of relative abundance from fish spotter data based on delta-lognormal models. Canadian Journal of Fisheries and Aquatic Science 49: 2515-2526.

5.8 TABLES

Table 5.8.1. Breakdown of the fishery independent (top) and fishery dependent (bottom) surveys considered for use in the assessment along with their final determination. (S/R – Suitable and Recommended, S/NR – Suitable and Not Recommended, * - recommended with the understanding that the survey is spatially limited in the eastern gulf)

Fishery Independent Surveys	Gulf-wide	West	East
SEAMAP Fall Groundfish (1987 - 2007)	S/NR	S/NR	
SEAMAP Fall Groundfish (2008 - 2024)	S/NR	S/NR	S/NR
SEAMAP/G-FISHER Reef Fish Video (1993 - 2023)	S/R	S/R	S/R
SEAMAP Fall Plankton (1986 - 2023)	S/NR	S/NR	S/NR
SEAMAP Summer + Fall Groundfish (2009 - 2024)	S/R	S/R	S/R
SEAMAP Summer + Fall Groundfish (1987 - 2008)	S/R*	S/R	

Fishery Dependent Surveys	Gulf-wide	West	East
Commercial Handline (1993 - 2024)	S/NR	S/NR	S/NR
Headboat (1986 - 2007)	S/R	S/R	S/R

Table 5.8.2. Relative abundance (Index) scaled to a mean of one for each time series and the coefficient of variation on the mean (CV, standard error/mean) of Gulf of America indices recommended for consideration in the assessment.

Year	SEAMAP Summer + Fall Groundfish - Old		SEAMAP Summer + Fall Groundfish - New		SEAMAP / G-FISHER		Headboat	
	Scaled Index	CV	Scaled Index	CV	Scaled Index	CV	Scaled Index	CV
1986							0.87078	0.28836
1987	0.56835	0.19422					0.725005	0.29970
1988	0.4953	0.18968					0.87672	0.28776
1989	0.94459	0.16063					1.30915	0.27191
1990	0.45549	0.19061					2.047945	0.23935
1991	2.12051	0.12036					1.470091	0.24176
1992	0.27423	0.20794					1.480927	0.24418
1993	1.38049	0.14471			0.414269	0.19035	1.244823	0.24951
1994	1.45428	0.12897			0.933006	0.48495	1.27111	0.26385
1995	0.91974	0.15517			0.467131	0.30182	1.047011	0.29284
1996	0.65535	0.1858			0.375482	0.15845	1.122074	0.29087
1997	0.56956	0.17321			1.5776	0.20402	1.06009	0.28747
1998	0.10533	0.32013					0.941592	0.27705
1999	1.23651	0.13952					0.999605	0.26817
2000	1.96108	0.12436					0.542469	0.29785
2001	2.97053	0.13786					0.448137	0.30606
2002	0.94186	0.15086			0.900191	0.69144	0.623839	0.30017
2003	0.49846	0.18469					0.731692	0.29248
2004	0.50154	0.16484			0.652346	0.35212	0.797104	0.27902
2005	0.83504	0.15025			0.627868	0.21874	1.021499	0.26247
2006	1.38013	0.15047			1.200054	0.17882	0.642355	0.28554
2007	0.77025	0.16508			1.044374	0.19354	0.725984	0.28789
2008	0.96138	0.12369			1.085496	0.15869		
2009			0.61897	0.11589	1.48863	0.13915		
2010			0.70009	0.14607	0.741284	0.16141		
2011			0.90649	0.13997	0.840483	0.15283		
2012			1.21177	0.12073	0.688465	0.15174		
2013			0.64263	0.17613	0.568017	0.13420		
2014			0.93016	0.12766	0.666497	0.10558		
2015			1.26452	0.10983	0.858797	0.09649		
2016			0.47892	0.17682	1.266416	0.06667		
2017			0.75718	0.13612	1.072754	0.07404		
2018			0.98507	0.12388	1.041269	0.08434		
2019			1.14612	0.13527	0.905208	0.07928		
2020			0.78121	0.20421	1.556289	0.15459		
2021			1.3194	0.12839	1.653959	0.10195		
2022			1.86293	0.12511	1.74845	0.09047		
2023			1.72429	0.11596	1.625666	0.08137		
2024			0.67024	0.16309				

Table 5.8.3. Relative abundance (Index) scaled to a mean of one for each time series and the coefficient of variation on the mean (CV, standard error/mean) of west Gulf of America indices recommended for consideration in the assessment.

Year	SEAMAP Summer + Fall Groundfish - Old		SEAMAP Summer + Fall Groundfish - New		SEAMAP / G-FISHER		Headboat	
	Scaled Index	CV	Scaled Index	CV	Scaled Index	CV	Scaled Index	CV
1986							0.683745	0.23507
1987	0.56304	0.19792					0.812996	0.21658
1988	0.45253	0.20054					1.087124	0.19699
1989	0.95888	0.16346					1.050667	0.21867
1990	0.47975	0.19439					1.589953	0.17919
1991	2.119	0.12341					2.52238	0.15202
1992	0.26502	0.21294					1.807058	0.16429
1993	1.36879	0.15369			0.149586	0.625	1.681793	0.17305
1994	1.41369	0.13303			1.459932	0.812	1.582176	0.17579
1995	0.96362	0.15656			0.194915	0.638	1.164559	0.18289
1996	0.55524	0.19615			0.33414	0.24	1.338432	0.19055
1997	0.59367	0.17437			3.192575	0.271	0.816146	0.21127
1998	0.11264	0.33014					0.640204	0.21981
1999	1.28985	0.14009					0.452752	0.26216
2000	1.93435	0.12721					0.215218	0.26512
2001	3.1296	0.14041					0.316262	0.23869
2002	0.96754	0.15502			1.764596	0.96	0.470578	0.21605
2003	0.46774	0.20036					0.673872	0.19449
2004	0.49796	0.1731			1.247655	0.495	0.749522	0.18561
2005	0.80951	0.15419			1.06584	0.335	0.785661	0.17293
2006	1.35775	0.15563			0.911536	0.563	0.660336	0.17953
2007	0.78665	0.16702			0.988967	0.405	0.898565	0.17474
2008	0.91316	0.1275			1.283476	0.331		
2009			0.30954	0.18981	0.568642	0.353		
2010			0.54099	0.22447	1.261437	0.396		
2011			0.87263	0.18966	1.774749	0.326		
2012			1.58582	0.16013	1.786139	0.271		
2013			0.4783	0.27617	0.99117	0.279		
2014			0.68605	0.20383	0.826124	0.291		
2015			1.31314	0.16091	0.327755	0.586		
2016			0.2088	0.3106	0.732415	0.307		
2017			0.67187	0.20299	1.170404	0.229		
2018			0.92783	0.18334	0.726635	0.218		
2019			0.86136	0.22143	0.241806	0.328		
2020			0.80129	0.27829				
2021			1.45306	0.16381	0.728675	0.22		
2022			2.76839	0.17071	0.544817	0.228		
2023			2.22968	0.15389	0.726014	0.22		
2024			0.29125	0.31778				

Table 5.8.4. Relative abundance (Index) scaled to a mean of one for each time series and the coefficient of variation on the mean (CV, standard error/mean) of east Gulf of America indices recommended for consideration in the assessment.

Year	SEAMAP Summer + Fall Groundfish - Old		SEAMAP Summer + Fall Groundfish - New		SEAMAP / G-FISHER		Headboat	
	Scaled Index	CV	Scaled Index	CV	Scaled Index	CV	Scaled Index	CV
1986							0.92459	0.38094
1987							0.655596	0.43189
1988							0.757932	0.41019
1989							1.330944	0.36396
1990							2.332684	0.30268
1991							1.362103	0.31348
1992							1.418992	0.31090
1993					0.768665	0.198	1.076832	0.33190
1994					0.923364	0.234	1.132578	0.35826
1995					0.961285	0.322	0.962184	0.41655
1996					0.651515	0.2	0.969531	0.41463
1997					0.831543	0.176	1.030454	0.40226
1998							1.025469	0.35667
1999							1.215352	0.32928
2000							0.650139	0.38151
2001							0.446371	0.40803
2002					0.538689	0.198	0.659246	0.38689
2003							0.734911	0.38879
2004					0.432993	0.225	0.818797	0.36721
2005					0.551896	0.181	1.156903	0.33669
2006					1.555499	0.164	0.630368	0.38627
2007					1.386453	0.212	0.708025	0.38449
2008					1.105631	0.166		
2009			1.26805	0.13895	2.132814	0.139		
2010			1.00236	0.18506	0.681176	0.143		
2011			0.97905	0.2075	0.66574	0.12		
2012			0.85167	0.18818	0.471503	0.131		
2013			0.89383	0.21944	0.461266	0.135		
2014			1.2116	0.15712	0.661946	0.106		
2015			1.2081	0.14859	1.136682	0.096		
2016			0.90836	0.20037	1.433038	0.07		
2017			0.78901	0.17841	1.089281	0.081		
2018			0.94298	0.16406	1.196008	0.108		
2019			1.39336	0.16137	1.052933	0.083		
2020			0.6052	0.30197	1.296986	0.111		
2021			0.95653	0.21544	1.255586	0.081		
2022			1.02324	0.18347	1.410275	0.071		
2023			1.02242	0.17948	1.347235	0.068		
2024			0.94424	0.17638				

5.9 FIGURES

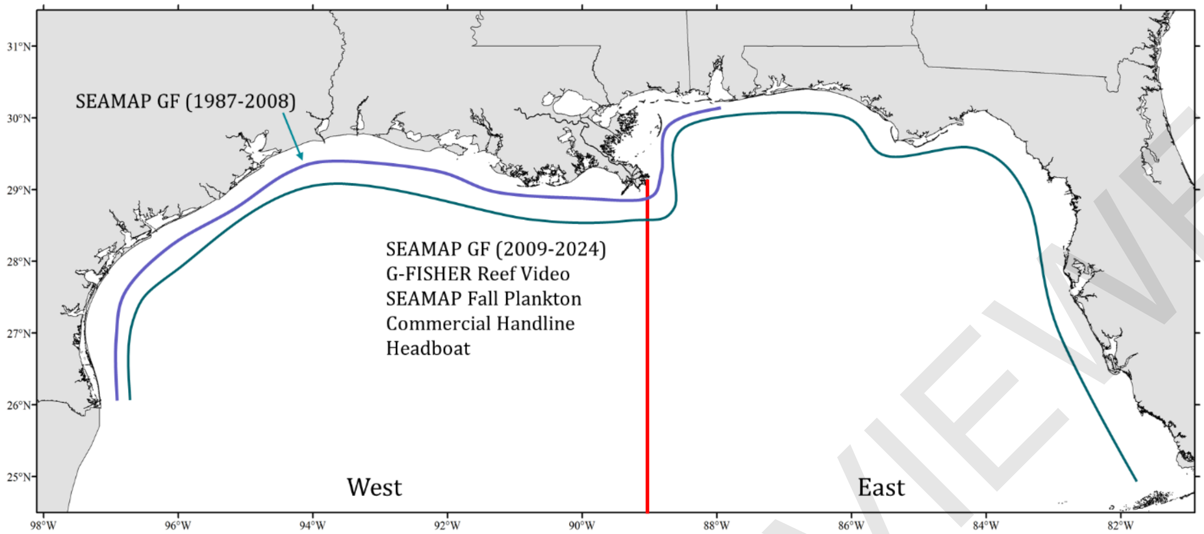


Figure 5.9.1. Relative spatial extent of indices found to be suitable for further review. Red line represents the boundary between the regions as defined in SEDAR43.

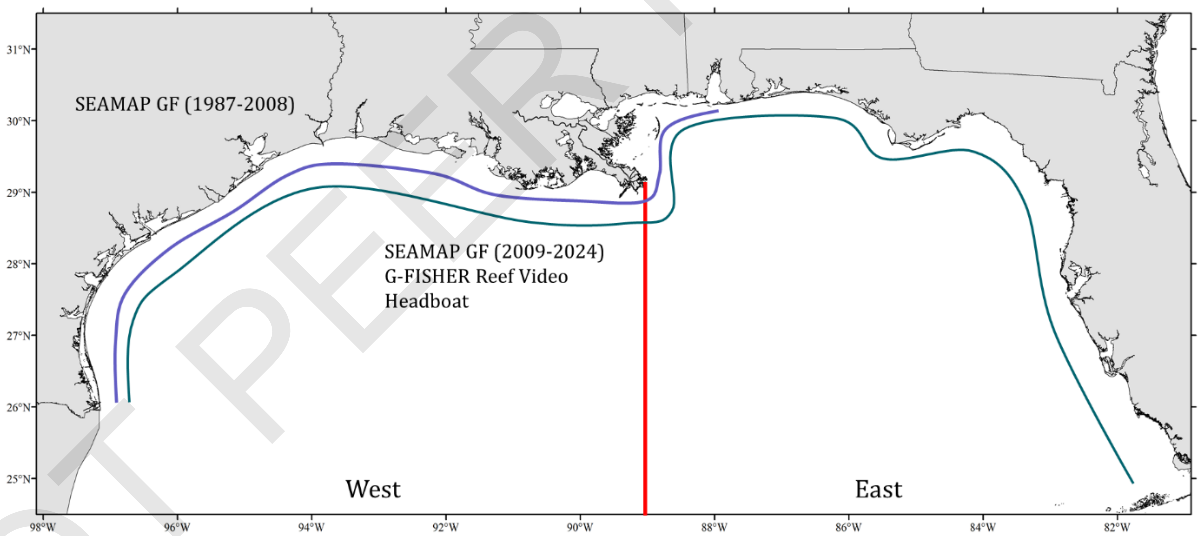


Figure 5.9.2. Relative spatial extent of indices found to be "Suitable and Recommended" for use in the assessment. Red line represents the boundary between the regions as defined in SEDAR43.

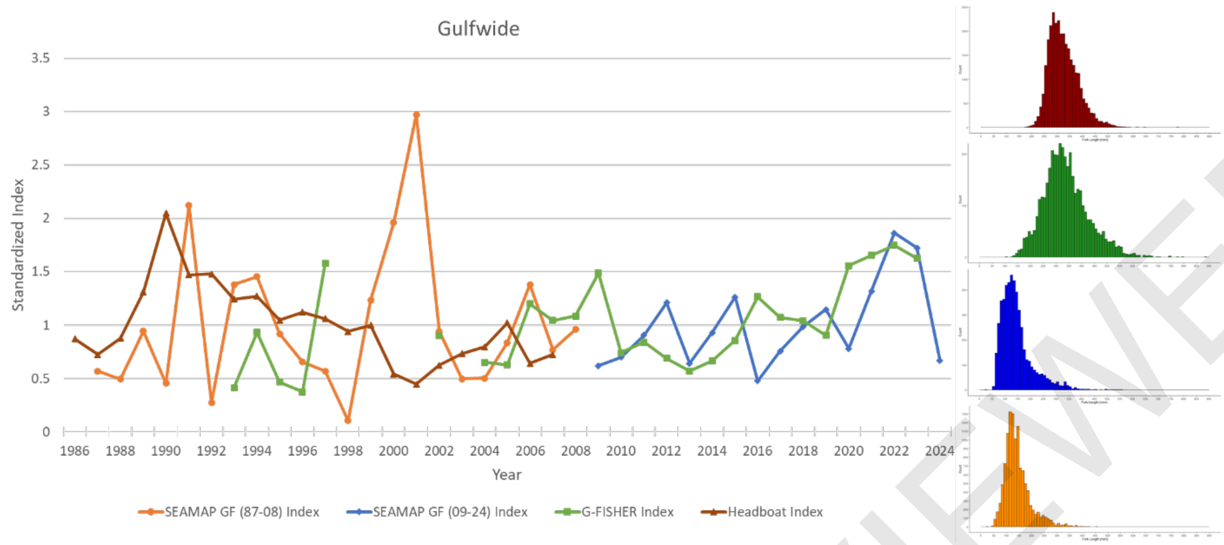


Figure 5.9.3. Recommended relative abundance indices for the Gulf of America, scaled to a mean of one for each time series. Length distribution of gray triggerfish for each time series is displayed in the corresponding color. Note the x-axis on the length distribution is from 0 to 900 mm, with 50 mm breaks.

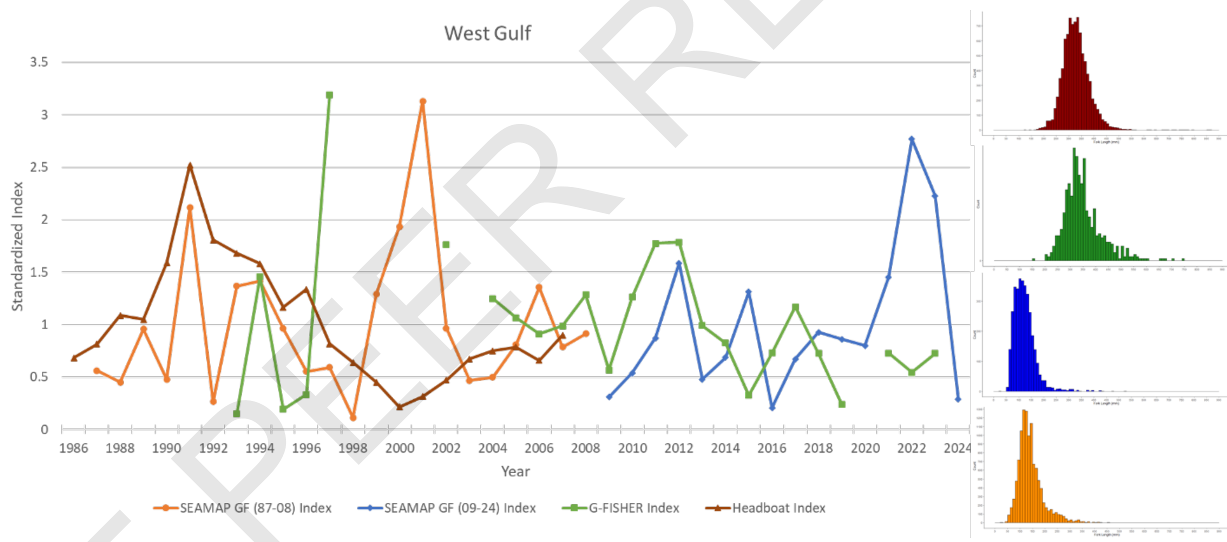


Figure 5.9.4. Recommended relative abundance indices for the western Gulf of America, scaled to a mean of one for each time series. Length distribution of gray triggerfish for each time series is displayed in the corresponding color. Note the x-axis on the length distribution is from 0 to 900 mm, with 50 mm breaks.

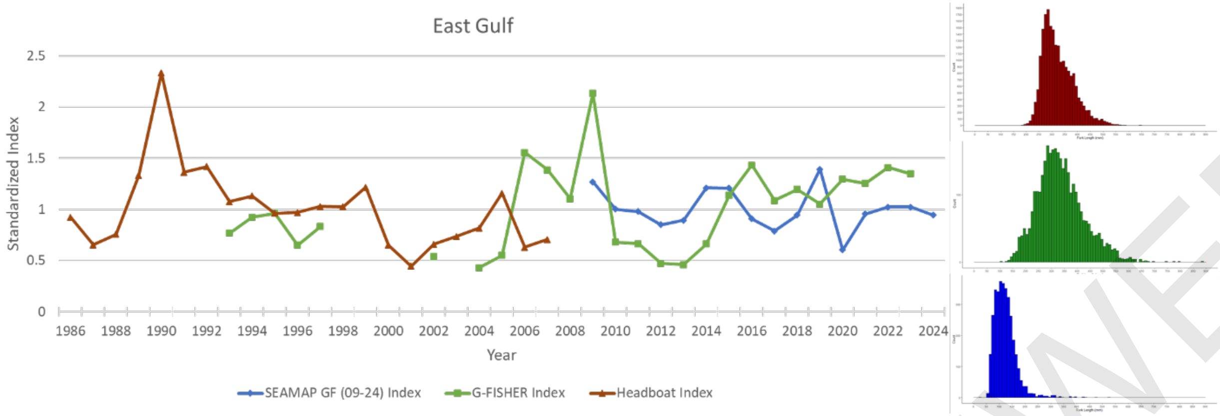


Figure 5.9.5. Recommended relative abundance indices for the eastern Gulf of America, scaled to a mean of one for each time series. Length distribution of gray triggerfish for each time series is displayed in the corresponding color. Note the x-axis on the length distribution is from 0 to 900 mm, with 50 mm breaks.