SEDAR

Southeast Data, Assessment, and Review

SEDAR 98

Gulf of America[1] Red Snapper

SECTION II: Data Workshop Report

April 2025

SEDAR
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[1] As of March 26, 2025, all efforts are made to use "Gulf of America" per E.O. 14172. However, previous NOAA reports (cited herein) may have referred to this water body as the "Gulf of Mexico".

1 INTRODUCTION

1.1 WORKSHOP TIME AND PLACE

The SEDAR 98 Data Workshop was held December 10-13, 2025, in Mobile, AL. In addition to the in-person workshop, a series for webinars were held before (August and November 2024) and after (January 2025) the meeting.

1.2 TERMS OF REFERNCE

1. Utilize the three-area model (west, central, east) developed through the SEDAR 74 red snapper Stock ID process, for the Gulf red snapper unit stock.

2. Review available life history information as it pertains to length and age data collection and processing by areas.
   - 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. Describe any sub-sampling methods employed through time and weighting of length and age compositions. Ensure samples of either length or age from one survey are not input twice.
     - Use documentation from SEDAR 74 working papers as appropriate.
   - Explore differences in growth parameters if length and/or age sampling methods differ from the previous assessment. Utilize appropriate models and diagnostics to describe population and region-specific (if warranted) growth, as 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.

3. Provide fishery-independent measures of population abundance developed for the SEDAR 74 Research Track through the terminal year where possible.

- For recommended indices (and those used in SEDAR 74), extend the index to the new terminal year and document any known or suspected temporal patterns in catchability not accounted for by standardization.
- Evaluate the G-FISHER composite video index for use in the assessment.
    - Consider any changes to the fishery-independent indices comprising the G-FISHER index as provided for SEDAR 74 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 in SEDAR 74.

4. Provide commercial catch statistics as was provided for SEDAR 74, including both landings and discards in both pounds and number extended through the new 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.
- Utilize the new estimates of shrimp fishery effort and bycatch, as appropriate, based on the peer review of such data from SEDAR 87. Document any change in start year from previous data provisions (previous start year 1950).
    - Evaluate the existing composition data and recommend whether the data are sufficient to represent the bycatch by the fleet.
- Document all new methodologies:
    - Address program objectives, methods, coverage, sampling intensity, and other relevant characteristics.
- Provide maps of shrimp fishery effort and any changes to observer coverage.

5. Provide recreational catch statistics by area for each fleet (private boat mode, for-hire charter vessels and headboats) including both landings and discards (for open and closed seasons) in both pounds and number. If state survey landings data are used (e.g., private boat mode), provide a fully calibrated (to a common data unit) time series as necessary.

- Evaluate and discuss the adequacy of available data for characterizing landings and discards (open and closed season) by fleet, mode, or gear.
- Specifically discuss the potential for bias and uncertainty in the data sources.
- Provide length and age distributions for both landings and discards (open and closed season) where feasible.
- Provide estimates of uncertainty around each set of landings and discard (open and closed season) estimates.

6. Consider data available from external surveys (e.g., the Great Red Snapper Count and the LGL Ecological Associates survey off Louisiana coast), such as but not limited to: estimates of absolute abundances; length composition data; and tagging data to inform catchability, region, and fishing mortality in coordination with the PIs of each survey to determine their utility in the assessment.
    - Consider and evaluate the data and analysis available to estimate the catchability and selectivity for each survey. Where possible, conduct additional analyses to determine priors for the catchability of each sampling gear by area.
    - Consider the usefulness of the length composition data for assessment, including spatiotemporal coverage, sample size/units and which gear the composition data represent.

7. Develop an updated Connectivity Modeling Simulation recruitment index for recruitment forecasting.
    - Explore potential hypotheses to link any relevant ecosystem and climatic information identified to population and fishery parameters.

8. 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.

9. 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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1.4 LIST OF DATA WORKSHOP WORKING PAPERS & REFERNCE DOCUMENTS

Document #	**Title**	**Authors**	**Date Submitted**
Documents Prepared for the Data Workshop			
SEDAR98-DW-01	Headboat Data for Red Snapper in the US Gulf of Mexico	Robin T. Cheshire and Matthew E. Green	26 November 2024 Updated: 12 December 2024
SEDAR98-DW-02	Commercial Landings of Gulf of Mexico Red Snapper (*Lutjanus campechanus*) from 1964 - 2023	Sarina Atkinson and Micki Pawluk	22 November 2024 Updated: 31 January 2025
SEDAR98-DW-03	Estimated Commercial Discards of Gulf of Mexico Red Snapper Using Discard Logbook and Observer Data from 1996-2023	Sarina Atkinson, Kevin Thompson, & Gary Decossas	25 November 2024 Updated: 3 December 2024
SEDAR98-DW-04	Recreational Catch Data Consideration Best Practices: SEDAR 98 Gulf of Mexico Red Snapper	SEFSC	25 October 2024

SEDAR98-DW-05	General Recreational Survey Data for Red Snapper in the Gulf of Mexico	Matthew A. Nuttall	22 November 2024 Updated: 10 December 2024 Updated: 18 December 2024
SEDAR98-DW-06	Gulf of America Red Snapper (*Lutjanus campechanus*) Commercial Landings Preliminary Length and Age Compositions	Michaela Pawluk and Samantha M. Binion-Rock	25 November 2024 Updated: 10 March 2025
SEDAR98-DW-07	Gulf of America Red Snapper (*Lutjanus campechanus*) length and age compositions from the recreational fishery	Samantha M. Binion-Rock	22 November 2024 Updated: 10 March 2025
SEDAR98-DW-08	An Update to the FHWAR Method Used to Estimate Historical Recreational Landings	Samantha M. Binion-Rock	22 November 2024
SEDAR98-DW-09	Description of red snapper, *Lutjanus campechanus*, age data collected from the northern Gulf of Mexico from 1980-2023	Steven Garner, Laura Goetz, Beverly Barnett, and Robert Allman	7 November 2024 Updated: 3 February 2025
SEDAR98-DW-10	Proxy Discard Estimates of Red Snapper (*Lutjanus campechanus*) from the US Gulf of Mexico Headboat Fishery	Matthew A. Nuttall	25 November 2024 Updated: 14 January 2025
SEDAR98-DW-11	Length and age information for Gulf of Mexico Red Snapper, *Lutjanus campechanus*, collected in association with fishery-dependent projects	Maria McGirl, Jessica Carroll, and Bridget Cermak	18 November 2024
SEDAR98-DW-12	Electronic Monitoring Documentation of Red Snapper (*Lutjanus campechanus*) in the Gulf of Mexico Commercial Reef Fish Fishery	Katie Harrington, Max Lee, Carole Neidig, and Ryan Schloesser	25 November 2024

SEDAR98-DW-13	Gulf of Mexico red snapper (*Lutjanus campechanus*) smooth age length keys	Lisa E. Ailloud	25 November 2024
SEDAR98-DW-14	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 Red Snapper (*Lutjanus campechanus*) in the Gulf of Mexico	Chloe Ramsay	26 November 2024
SEDAR98-DW-15	A Summary of Gulf Red Snapper Discard Length Data Collected from At-Sea Observers in Recreational Fishery Surveys in Florida	Ellie Corbett	3 December 2024
SEDAR98-DW-16	SEAMAP/GFISHER Reef Fish Video Survey: Relative Indices of Abundance of Red Snapper	Kelsey L. Martin, Matthew D. Campbell, Paul Felts, Joseph Salisbury, Jack Prior	4 December 2024 Updated: 10 December 2024
SEDAR98-DW-17	Indices of Relative Abundance for Red Snapper from the SEFSC Bottom Longline Survey in the Northern Gulf of Mexico	Adam G. Pollack, David S. Hanisko, Kristin Hannan, and William B. Driggers III	5 December 2024
SEDAR98-DW-18	LA Creel/MRIP Red Snapper Private Mode Landings and Discards Calibration Procedure	Office of Fisheries - Louisiana Department of Wildlife and Fisheries	29 October 2024
SEDAR98-DW-19	Red Snapper (*Lutjanus campechanus*) larval indices of relative abundance from SEAMAP Fall Plankton Surveys, 1986 to 2022	David S. Hanisko, Denice M. Drass, Adam G. Pollack, Pamela J. Bond, Glenn Zapfe, and Christian M. Jones	9 December 2024 Updated: 28 January 2025
SEDAR98-DW-20	TPWD Boater Registration Analysis	Hanna Bauer	9 December 2024

SEDAR98-DW-21	Indices of abundance for Red Snapper (*Lutjanus campechanus*) on artificial reefs on the West Florida Shelf from stationary video surveys	Heather M. Christiansen, Justin Lewis, Matthew D. Campbell, Sean F. Keenan, Kelsey Martin, Katherine E. Overly, Theodore S. Switzer, Kevin A. Thompson	11 December 2024 Updated: 7 March 2025
SEDAR98-DW-22	Indices of abundance for Red Snapper (*Lutjanus campechanus*) on natural reefs in the eastern Gulf of Mexico using combined data from multiple video surveys	Heather M. Christiansen, Justin Lewis, Matthew D. Campbell, Sean F. Keenan, Kelsey Martin, Katherine E. Overly, Theodore S. Switzer, Kevin A. Thompson	10 December 2024 Updated: 7 March 2025
SEDAR98-DW-23	Estimation of Commercial Shrimp Effort in the Gulf of Mexico from 1984-2023	Sarina Atkinson, Kyle Dettloff, Cheston Peterson, Steve Smith	31 January 2025 Updated: 26 February 2025
SEDAR98-DW-24	Post-IFQ commercial vertical line abundance index for eastern Gulf Red Snapper using reef fish observer data	Smith, S.G	21 February 2025
SEDAR98-DW-25	Estimation of red snapper bycatch from Gulf of America shrimp trawls	Smith, S.G., S. Atkinson, C. Peterson, K. Dettloff	28 February 2025
SEDAR98-DW-26	Red Snapper Abundance Indices from SEAMAP Groundfish Surveys in the Northern Gulf of Mexico	Adam G. Pollack and David S. Hanisko	4 February 2025
SEDAR98-DW-27	Public comments received during the Data stage of SEDAR 98	SEDAR	26 February 2025

Reference Documents

SEDAR98-RD01	Improving Estimation of Bycatch from Shrimp Trawls in the Gulf of Mexico	Steven G. Smith, Sarina Atkinson, Cheston Peterson, Jo Anne Williams, Kyle Dettloff, and Alan Lowther

SEDAR98-RD02	SEDAR22 DW16: Estimated Recreational Catch in Weight: Method for Filling in Missing Weight Estimates from the Recreational Surveys with Application to Yellowedge Grouper, Tilefish (golden), and Blueline Tilefish	Vivian M. Matter and Stephen C. Turner
SEDAR98-RD03	SEDAR32 DW2: MRFSS to MRIP Adjustment Ratios and Weight Estimation Procedures for South Atlantic and Gulf of Mexico Managed Species	Vivian M. Matter and Adyan Rios
SEDAR98-RD04	Final Report: U.S. Gulf of Mexico Commercial Snapper/Grouper/Black Drum Conversion Factors Validation 2024	GSMFC

2 LIFE HISTORY

2.1 OVERVIEW

The life history working group (LHWG) reviewed and discussed the life history data (historic and newly available) provided for SEDAR98. Members reviewed the available data to determine their quality and utility in the assessment and to decide if any parameter estimates needed updating (i.e., growth) or revised analyses (i.e., region- or stanza-specific estimates). The group provided recommendations to the assessment team regarding data quality and utilization in the assessment model. Specifically, the group examined the final length-at-age data, length and age compositions, conditional age-at-length (CAAL), mean length-at-age (MLAA), and growth. Evaluation of data quality included visual examination of various data distributions and comparisons among data types/sources to determine their representativeness and identify data gaps, periods of low sample size/poor quality, and mismatches, all of which were specific to each fleet in each stock ID region (West, Central, or East). The group conducted a thorough evaluation of subsampling protocols used by the NMFS Panama City lab as well as examined weighting procedures used to remove bias in data collected from fishery-dependent sources. Subsampling protocols and reweighting procedures both have the potential to alter the representativeness of length or age data input into assessment models. The goal of this report is to evaluate the spatial and temporal quality of red snapper age data collected in the northern Gulf of America (GOA) in 1980 and from 1986-2023 and make recommendations regarding their use as direct inputs or to inform parameterizations for the SEDAR98 stock assessment model. A summary of the data presented, discussed, and recommendations made by the LHWG is presented in this document.

2.1.1 Work Group members and participants in Life History webinars

Beverly Barnett – NOAA Fisheries, Panama City, FL
John Mareska – AL DCNR, Mobile, AL
Robert Allman – NOAA Fisheries, Panama City, FL
Ryan Nichols – NOAA Fisheries, St. Petersburg, FL
Samantha Binion-Rock – NOAA Fisheries, Beaufort, NC
Skyler Sagarese – NOAA Fisheries, Beaufort, NC
Steve Garner – NOAA Fisheries/CIMAS, Panama City, FL (Group Lead)

2.1.2 Topics Reviewed by the Life History Group

1. Spatial Distribution of Port Samplers
2. Subsample Representativeness
3. Age-at-Length Data
4. Length Compositions
5. Age Compositions
6. Conditional-Age-at-Length
7. Mean Length-at-Age
8. Growth
9. Summary Recommendations

2.2 SPATIAL DISTRIBUTION OF PORT SAMPLERS

Sample collection protocols used by state and federal port samplers through the trip interview program (TIP), primarily targeting commercial vessels, have changed over the years (for methodological descriptions see GSMFC, 2006; Beggerly and Beerkircher et al., 2017). Prior to 2000, federal (F) and state (S) port samplers were stationed approximately evenly (21 F, 18 S) across the Gulf coast with TX (6F, 7S) and FL (5F, 8S) both having the greatest number of samplers among states (Figure 2.13.1A). From 2000 - 2010, the FL Fish and Wildlife Commission was forced to remove all state samplers due to funding issues, but federal samplers remained in several locations throughout the state (Figure 2.13.1B). During that same period, a total of 4 federal samplers were relocated or removed from TX, MS, and AL leaving only a single federal sampler stationed in MS and one state and federal sampler each in AL. State samplers were repositioned along the FL coast during 2011-2020 at the same station locations prior to their relocation/removal during the previous decade. In 2012, NOAA stationed a port sampler in Brownsville, TX, the southernmost location sampled in the western GOA, but the sampler was subsequently relocated in 2020 due to low COM HL landings at that site (Figure 2.13.1C). One other federal port sampler also was relocated from the TX coast, leaving both remaining federal samplers stationed only in Galveston, while state samplers provided coverage to the remainder of the coast. Two samplers also were removed from LA and one from AL during this period. In 2020, TX stationed two additional port samplers along its coast, while MS also added another sampler. In 2023, the state of FL relocated several of its port samplers with a net loss of 1 individual from Steinhatchee, FL (Figure 2.13.1D). Currently, AL does not have a federal port sampler stationed within the state, but the port sampler stationed in MS is assigned to collect samples from both MS and AL landings.

2.2.1 Research Recommendations

During the SEDAR98 data workshop, the LHWG examined how changes in the spatial distribution of port samplers over time affected length or age sample representativeness, considering regional differences in size-at-age observed among the three GOA regions. We recommend that sample collection methods be examined to determine if different dockside sampling protocols (e.g., quota sampling, length-bin sampling, or proportional sampling) may have biased length or age distributions of sampled fish compared to the landings.

2.2.2 Recommendations for SEDAR 98

Although the employer composition of port samplers (state or federal) has varied over the years, and is currently very disproportionately comprised of state samplers in TX, coverage has been consistent throughout time since samplers were assigned to various ports throughout the coast. Port sampler distribution over time does not appear to have affected the collection of red snapper otolith samples such that it would undermine the spatial representativeness of samples collected during any period. We recommend that no corrections or additional steps be taken to address the potential issue of spatial representativeness of samples collected over time, as related to port sampler distribution.

2.3 SUBSAMPLE REPRESENTATIVENESS

Subsampling protocols at the NMFS Panama City lab (PC Lab) have changed multiple times over the years (see Fitzhugh et al., 2004; SEDAR98-DW-09). During 1993 and 1994, and from 1998-2002, otoliths were selected from among all fleets by randomly sampling from among available port sampler interviews, and processing all samples from each selected collection until meeting the annual sample target. From 2003 to 2012, only the COM HL fleet was subsampled due to the disproportionately large numbers of samples received by the PC Lab. Otoliths were still chosen by randomly selecting from interviews, but were stratified by wave (i.e., every two-months of the year) instead of from all interviews within a year. All samples were processed from each selected collection until reaching the sample target. Currently, the COM HL fleet remains the only subsampled fleet, but wave is no longer considered. Instead, samples are selected in a spatially uniform design based on the proportion of landings from each NMFS statistical grid group (n=6) throughout the GOA. Specifically, samples are randomly selected from each grid according to the grid-specific proportional landings within each grid group with a target of n=500. Ideally, this would result a total of n=3000 age samples from the COM HL fleet for each data year (see SEDAR98-DW-09 for methodological details). However, sufficient otolith samples are not collected from each grid to meet grid-specific sample targets in all years. Since 2013, all samples from fleets other than COM HL have been processed, provided they were received by the PC Lab prior to the start of sample selection and processing. Samples typically have not been processed retroactively if they were not received when sample selection occurred.

The total number of samples received at the PC Lab has changed dramatically over time, increasing from <1000 per year to a peak of nearly 20,000 in 2013 (SEDAR98-DW-09, Figure 4). The number of COM HL samples processed for ageing has remained consistent between ~1500 and 3000 since 1998, due to subsampling protocols, which limit the target number of processed COM HL samples to 3,000. The number of final age estimates from the COM HL fleet is slightly lower due to some proportion of otoliths being deemed unreadable due to processing mistakes or natural processes that affect otolith readability. The target of 500 otoliths from each grid group is reached in most years, however, the number of samples received from NMFS statistical grids 1-4 is low and insufficient to allow for achieving the subsampling target for this grid group in some years. The greatest number of samples within this group typically originate from grid 4, however, current subsampling protocols do not allow for supplemental samples to be selected from an adjacent grid in the same group should the number of samples available be lower than the target number based on that grid's proportion of landings. Protocol changes could allow for excess samples from a grid to supplement samples from another grid in the same group, but it is unknown how many years would be affected by this change in protocol if applied to historical sample totals.

We were able to assess the representativeness of the otoliths subsampled at the PC Lab by comparing the length distributions of aged samples with the length distributions of length-only samples by fleet and region (SEDAR98-DW-06/07). Mismatches in length vs aged-length distributions were observed for some fleets/regions both in early and later years. However, subsampling design does not appear to have meaningfully contributed to length vs aged-length mismatches. For example, mismatches were observed for both commercial fleets in 1993 and 1994 in all three regions (Figure 2.13.2). Sample sizes were very low during these years for the commercial bottom longline (COM LL) fleet in all three regions; they also were low for the COM HL fleet in the East region but high in the West and Central. We conclude that subsampling was not the cause of mismatches during these two years because the same trends in length distribution mismatches were observed in 1991, 1992, and 1995 for this sector, years in which all samples were processed for age estimation at the PC Lab. COM HL sample sizes were low for the East region COM HL fleet in all subsampled years prior to 2003. For recreational fleets, the same was true for charterboat and headboat samples from the East region prior to 2003. However, mismatches were observed in some years for recreational fleets with high sample sizes from a given region. Again, we conclude that subsampling protocols did not meaningfully contribute to these mismatches. Instead, there appears to be a disconnect between the sources of length and age data. In 1998, most length samples collected from the private recreational fleet in the West region were collected by the Texas Parks and Wildlife Department (TPWD), as well as some measurements from the Marine Recreational Information Program

(MRIP), but all age samples were provided by the Marine Recreational Fishing and Statistical Survey (MRFSS). No age samples were provided by TPWD in that year. Alternatively, for the private recreational fleet in the Central region in 1999, there was a mismatch between length measurements provided by TIP and MRIP that carried through to the age data. In both cases, the subsampling routine simply carried the non-representativeness of age samples collected through to the age samples processed rather than directly inducing non-representativeness into the processed age samples. Ideally, we would also compare the length distributions of samples selected versus samples not selected for ageing. However, the morphometric and spatial information for samples not selected for ageing were not entered into the database until 2011 and are not readily available for comparison. Data for these samples would need to be manually entered into the database from the original data sheets stored at the PC Lab.

During the period of subsampling by wave (2003–2012; COM HL only), the number of samples received from the COM HL fleet varied as the derby nature of the fishery made temporal sample collection very inconsistent. The fishery often closed temporarily after only a few days at the beginning of the month or completely after a few months depending on harvest season regulations. Random sample selection by interview/collection was not an ideal method because autocorrelation of fish caught at the same site within a single trip was not accounted for in the sample design. Thus, if the first randomly selected interview contained many samples, autocorrelation among sizes in the sample would be much higher than sampling a few fish from several trips, which increases the effective sample size of the data. However, comparisons of length distributions from length-only versus aged samples indicated nearly complete overlap (i.e., no mismatch) for fish sampled from the West or Central region in all years from 2003-2012. Subsample sizes were high for these two fleets in all years. Mismatches were observed for aged samples from the East region from 2003 to 2008, years in which subsampling targets (n=600) were not reached, while there was near total overlap during years with high (n>450) age sample sizes (2010-2012). A slight bimodal distribution of length samples was observed in 2009, that did not match the length distribution of ages, but 400 lengths and 600 age samples were collected in that year. No mismatches in length distributions between length-only versus lengths-with-age were observed in any year during the current subsampling protocol (Figure 2.13.2; SEDAR98-DW-06). The current protocol also does not directly account for autocorrelation among sizes within a trip but indirectly reduces the number of fish from a single trip because samples are selected from among the entire pool of available samples rather than selecting among interviews (and all samples therein).

2.3.1 Research Recommendations

Updating database infrastructure would allow for further investigation into sample representativeness for samples collected during the mid and early data periods (i.e., prior to 2011), specifically comparisons of length distributions for all samples received versus samples processed for ageing.

The current subsampling protocol for red snapper is based on 5-year average landings by grid and is excessively laborious and time consuming. Evaluate the current otolith subsampling protocol and provide alternatives to streamline the process.

2.3.2 Recommendations for SEDAR 98

We recommend all age-at-length data, excluding outliers, be included in SEDAR98. Low sample sizes, in early years for multiple fleets in multiple regions or for later years for the Central COM LL fleet and East COM HL fleet, may warrant appropriate data aggregation (e.g., pooling, averaging, or mirroring) during some years as is recommended in subsequent sections of this report.

2.4 AGE DATA

Quality age data having high precision without bias are crucial for informing a variety of parameter estimates in stock assessments, particularly age compositions and cohort tracking, as well as growth, reproductive potential, and natural mortality. A total of 276,797 red snapper age samples had an estimated final age and 276,233 (99.8%) could be assigned to a stock ID region. Fleet and region-specific age sample tallies are shown in Table 2.12.1. The remaining 0.2% of age samples had no latitude or longitude, NMFS grid, headboat area, state landed, or county landed information by which to assign them to a region. Samples were collected during 92,841 unique sampling interviews of fishery dependent (FD) trips or collection sites during FI surveys. Prior to 2002, nearly all age samples were received and processed at the Panama City NMFS laboratory (PC Lab) with most of these samples collected from the headboat program. Starting in 2002, GulfFIN collected and processed similar numbers of age samples as the PC Lab with

RECFIN, FIN_BIOSTAT, and TIP programs collecting the majority of samples from 2002 to 2023 (SEDAR98-DW-09, Table 2 and Figure 3; Table 2.12.2). The TIP program provided nearly half (43.5%) of all age samples collected during this period. Samples were collected from only recreational sources from 1980 to 1990, while sample numbers were roughly similar between all commercial or recreational sources since 1991 (Table 2.12.1). Fishery-independent samples were first collected in 1992 and have contributed fewer sample numbers compared to FD sources since 2009 (13.0% of total). Numerous FI studies have intermittently provided age samples throughout the time series, with USA/DISL, FWRI_FIM, and MS Lab's FI sampling programs consistently providing samples annually since the early 2000s. Since 2023, otolith samples (n=5 fish per station) were collected during fishery-independent SEAMAP groundfish (trawl) surveys conducted in the summer and fall of each year to increase the number of small, and presumably very young (i.e., age-0 and age-1) fish samples represented in the age data (Watson and Bane, 1985; Nichols, 2004; Pollack et al. 2025). Additional otolith samples were collected (n=5 per size class) when distinct size classes were observed.

Few COM HL age samples were collected from any grid prior to 1998; samples from the West region increased and remained consistent throughout the rest of the time series while samples from the East were scarce through 2009 and rarely collected from grids 1 or 2 (Figure 2.13.3). Unlike the number of age samples collected from the COM HL fleet, which gradually increased over time throughout the GOA, age samples collected from the COM LL fleet were relatively sparse throughout the time series, but tended to be taken from the same few grids (Figure 2.12.4). Many age samples were collected from COM LL vessels fishing in grids 13-15 and grids 4-6 in various years, especially after 2008 in the East region. Samples were collected from all five Gulf states during most years starting in 1991 with consistent sample numbers collected from all five states from 1998 to 2023 (SEDAR98-DW-09, Table 3). The greatest number of samples were collected in Florida (FL) (46.3%) and the fewest in Mississippi (MS) (4.0%) in most years; MS and Alabama (AL) have collected similar numbers of samples since 2007. The overwhelming majority (81.0%) of age samples were collected via hook-and-line gear in all years, with relatively large sample collections from bottom (9.9%) and vertical longline (4.3%) gears beginning in the early 2000s (SEDAR98-DW-09, Table 4). Few samples (~1% or less) were collected with spear, trap, or trawl gear.

The median age of sampled red snapper was 2-3 yrs throughout the 90s for all three regions, increased to 3-4 yrs during the 2000s, and then to ~5 yrs until around 2016 (SEDAR98-DW-09, Figure 3). Starting in 2016, median ages and the distribution of ages within a region began to diverge. Fish collected in the West region had higher median age and a wider age distribution than aged fish from the other two regions. Since 2020, aged fish from the East region had a higher median age and age distribution than aged fish from the Central region, which appear to decrease in median age during the last four years of the time series from a median age of ~5 yrs to ~2 yrs (SEDAR98-DW-09, Figure 3). Mean ages of fish collected from the recreational sector (charterboats = 4.28 ± 2.11 yrs, headboats = 4.68 ± 2.16 yrs, and private recreational vessels = 4.53 ± 2.22 yrs) were younger than fish collected from commercial (4.91 ± 2.71 yrs) or FI (5.14 ± 3.90 yrs) sources, while samples from tournament fish were older (6.05 ± 3.92 yr). Age samples collected with bottom longline gear (7.82 ± 4.67 yrs; 610.16 ± 112.60 mm FL) were considerably older and larger than fish collected with any other gear, while samples collected with trawls (1.39 ± 1.84 yrs; 211.26 ± 119.52 mm FL) were considerably younger and smaller. Fish sampled south of LA had the highest mean age (5.30 ± 3.37 yrs) and length (506.48 ± 150.52 mm FL), while fish sampled south of MS had the lowest mean age (3.49 ± 2.52 yrs) and were the smallest (408.88 ± 150.52 mm FL).

Median lengths of aged fish were more variable over time among regions than median ages. Median lengths and length distributions were highly inconsistent but increased throughout the late 80s and early 90s until they began to stabilize through the 2000s (SEDAR98-DW-09, Figure 4), likely due to increases in sample numbers. However, trends in length distributions vary among regions. Aged fish from the West region were roughly stable around a median length of 400 mm (FL) throughout the 2000s, then increased to nearly 500 mm FL with a wider length distribution for the remainder of the time series. Aged fish from the Central region were similar in length to fish from the West throughout the 2000s but began to decline in median length and age distribution starting in ~2014 to lengths much lower than fish from the other two regions as time progressed. Aged fish from the East region were much larger than aged fish from the other two regions throughout the 2000s, but have been relatively stable throughout the entire time series around 500 mm FL. Aged fish from the other two regions simply increased to similar sizes as were observed in the East until median lengths of aged fish from the Central region began to decrease in recent years. Boxplots of aged fish indicate strong differences in age and length among gear types with fish collected with bottom longline gear being older and larger than fish collected with any other gear (SEDAR98-DW-09, Figures 5 and 6); fish collected with trawl gear were much younger and smaller than fish collected with other gear types. Median age among the other gear types was 3-4 yrs while median lengths among the other gear types ranged from ~400 to 500 mm FL.

2.4.1 Research Recommendations

As recommended in SEDAR74, additional personnel and database infrastructure resources are still needed to manage large life-history datasets that now exhaust the capabilities of standard computers.

Expanding routine biological sampling in the East region, especially in the southernmost part of the west coast of FL, likely would reduce uncertainty in parameters estimates for the East region, where sample sizes are relatively low compared to the West or Central region.

Evaluate the current otolith subsampling protocol used by the NMFS PC Lab to improve efficiency in sample processing (i.e., sample selection for processing as well as minimum sample sizes needed to maintain age data quality/integrity)

Evaluate the sampling design for observer programs to increase the number of age samples collected, especially for the COM LL fleets.

Continue to evaluate next-gen technologies (e.g., FT-NIRS, epigenetics) to improve age sample processing efficiency for high-volume sample fleets (e.g., COM HL) while maintaining age data quality/integrity.

As recommended in SEDAR74, increase sampling of sublegal fish through fishery independent surveys and the shrimp observer program to better estimate maturity and fecundity of smaller individuals, as well as samples through tournament intercepts to better estimate batch fecundity of larger/older females, especially in the East region where sample sizes are especially low.

2.4.2 Recommendations for SEDAR 98

We recommend all age-at-length data provided for SEDAR98 for use in growth modeling and estimation of age compositions, conditional age-at-length, or mean length-at-age. All age-at-length data, excluding outliers should be included in growth models, while samples designated with size or other type of selection bias should not be included in age compositions. Low sample sizes, in early years for multiple fleets in multiple regions or for later years for the Central COM LL fleet and East COM HL fleet, may warrant appropriate data aggregation (e.g., pooling, averaging, or mirroring) during some years.

2.5 LENGTH COMPOSITIONS

Commercial and recreational length samples used to develop nominal and weighted length compositions were collected via various access point angler interview programs. Weighting procedures were conducted because lengths are opportunistically collected from fishery-dependent sources, which may result in biased length distributions that differ from the distribution for all landings. Compositions were estimated for each fleet in each region and weighted by separating each region into two sub-regions. Strata with less than 30 length samples, or less than 10 unique fishing trips, were not recommended for inclusion in weighting methods and analyses, which initially resulted in the loss of many data years from commercial fleets in the East GOA region. During the data workshop, we explored altering the East region sub-grouping for commercial fleets, and concluded that including samples from area 4 in the E1 grouping (previously grids 744.0001, 748.0001, and 1-3) instead of in the E2 grouping (previously grids 4-6) provided sufficient sample-size increases for the E1 group that many more strata would be available for inclusion in the weighted length composition estimates. This regrouping reduced the number of years with insufficient sample sizes for the COM HL fleet from 21 to 6, most of which were between 1987 and 2014. Samples sizes for West or Central sub-regional groupings met the weighting procedure thresholds in nearly all years and regrouping of length samples was not explored for these two regions. See SEDAR98-DW-06/07 for a full description of the weighting methods and resulting length compositions for the commercial and recreational fleets, respectively.

Nominal length compositions had very good agreement between length-only samples and samples with an age-at-length for samples from the West (Figure 2.13.2) or Central COM HL (Figure 2.13.2) fleet in nearly all years. Composition comparisons indicated mismatches between length-only and aged samples for samples from the East region for most years prior to 2010 but matched well from 2011 to 2023 (Figure 2.13.2). Length compositions were not well estimated for the COM LL fleet in any region for many of the data years. Mismatches were observed in nearly all years for the Central region fleet and prior to 1999 for the East region fleet; mismatches occurred irregularly in several years for the West region fleet (Figure 2.13.2). Length-only vs aged-length samples had varying degrees of mismatches during most of the later years for all three recreational fleets (Figure 2.13.5). Mismatches resulted from low age-sample sizes in many cases, but some years had poor agreement between length distributions despite relatively large sample sizes (e.g., n > 100). For recreational fleets, some mismatches during years with relatively high sample sizes occurred because multiple sampling programs collected length data with different distributions but one or more programs did not provide any otolith samples for age processing or no otolith samples were processed from that source.

2.5.1 Research Recommendations

There are no research recommendations regarding length compositions from the LHWG at the SEDAR98 data workshop.

2.5.2 Recommendations for SEDAR 98

In general, length compositions are not as informative as age compositions for tracking cohorts. However, when directly incorporated into the assessment model, length compositions can help with the estimation of length-based selectivity (as was done in SEDAR 74) and length-based retention patterns. We recommend either using the weighted length compositions to reweight the age compositions or to directly input the weighted length compositions into the assessment model for all fleets/regions when available. If sample sizes for weighted length compositions are insufficient for a specific fleet and region, consider pooling years into an aggregate composition, using the nominal length compositions from that region, or excluding the length compositions for that area and mirroring the selectivity from that fleet in an adjacent region. Ultimately, the use of weighted length compositions directly in the assessment model will depend upon whether the weighted age compositions are used (recommendations provided below in Section 2.6.2). See Table 2.12.3 for year-specific recommendations for each fleet and region.

2.6 AGE COMPOSITIONS

The full set of age samples used in estimating compositions were provided by the PC Lab, which included samples selected in a non-random way (e.g., large fish for reproductive information).

Non-random and potential duplicate samples were removed prior to estimating nominal and weighted age compositions for each fleet and region. Similar to methods for estimating length compositions, any strata with <10 age samples were not recommended for age composition analyses. The nominal age compositions were re-weighted using the Chih (2009) reweighting factor, which is calculated as the weighted length composition for a length bin divided by the proportion of age samples in that length bin rescaled to 1 (SEDAR98-DW-06/07). The reweighting factor reduces any bias associated with non-random sampling of ages (Chih 2009). The length distribution of length-only samples versus samples with length and age were compared to assess the effects of the weighting procedure and the representativeness of the samples included in the strata-specific age composition estimates. Visual inspection of nominal versus weighted age compositions indicated little effect of the re-weighting procedure on estimates of proportions-at-age among fleets (see Figure 2.13.6 for example). However, partitioning age and length samples among the three regions resulted in many strata where sample sizes were insufficient when producing the weighted length compositions used in the reweighting procedure for age compositions.

2.6.1 Research Recommendations

There are no research recommendations regarding age compositions from the LHWG at the SEDAR98 data workshop.

2.6.2 Recommendations for SEDAR 98

Age compositions are critical to assessment models because they represent the harvested population and provide a time series for tracking cohorts. As noted above, weighted age compositions are weighted by the weighted length compositions to better reflect the age composition of all landed fish. When weighted age compositions are included in the assessment model, the length compositions can no longer be directly incorporated into the assessment model to inform length-based processes.

The LHWG identified and discussed a lack of contrast among proportions-at-age (i.e., completely smoothed cohorts) in the compositions estimated for the West COM HL fleet throughout the time series (SEDAR98-DW-06). Since this issue persisted throughout the time series, it was not attributed to an issue with the subsampling procedure. Other hypotheses that were raised were that red snapper in the West are harder to age or had poorer reader agreement but this has not been directly investigated. In contrast, the smoothed pattern was not evident in the age composition estimates for the COM LL in the same region, where proportions-at-age followed a much more typical pattern of contrast and tracking through the age classes over time.

We recommend using nominal age compositions for all fleets/regions when available in combination with weighted length compositions to characterize the landings. Visual inspection of the data indicated that weighted age compositions did not meaningfully affect the age composition information observed for any fleet. Furthermore, using weighted age compositions would, for some dramatically, reduce the number of fleet and region strata that meet the minimum sample-size thresholds necessary for conducting the weighting methodology in some years. See Table 2.12.3 for year-specific recommendations for each fleet and region.

2.7 CONDITIONAL AGE-AT-LENGTH

Year-specific conditional age-at-length (CAAL) was estimated for the COM and REC fleets in each region (see methods and results in SEDAR98-DW-06/07 for COM and REC fleets, respectively). CAAL is the proportion of fish samples in each length bin within each age class and, when data are sufficient, is considered a more informative data source than length/age composition data because it can be used to directly estimate the length-at-age process and the variability in length-at-age (Taylor and Methot, 2013; Piner et al. 2016; Lee et al. 2019). Further, using CAAL avoids double use of fish for both age and length compositions, especially when age compositions are weighted by length compositions (e.g., as presented in weighted age compositions within SEDAR98-DW-06/07). Age composition data can be highly dependent on the length data because the age data are not collected independently. Length samples are often taken without collecting a corresponding otolith, but an otolith sample (and its subsequent age estimate) is nearly always taken with its corresponding length measurement. Thus, the age data are essentially a subset of the length data, not a separate, independent dataset. The use of CAAL data that are not representative of the population can cause bias and imprecision in estimates of various assessment model outputs, but age-based selectivity could be specified to approximate the age-based process, provided the operating model of the system is correctly specified (Lee et al. 2019).

2.7.1 Research Recommendations

There are no research recommendations regarding CAAL from the LHWG at the SEDAR98 data workshop.

2.7.2 Recommendations for SEDAR 98

Considering the potential improvement in model estimation provided by including CAAL data in the assessment, we recommend using CAAL data for all fleets and regions when data are available and sufficiently representative. Lee et al. (2019) show that directly estimating the length-at-age process can 1) stabilize management quantities despite misspecification of other model components and 2) reduce bias and improve precision of growth estimates and SSB-related management quantities even in well specified models. CAAL data also could be used to estimate growth internal to the model without assuming it represents the full population age-structure in each region. We caution that in the age dataset for SEDAR98, CAAL data were not considered of sufficient quality for some fleets and regions in some years, especially during early years of the time series where data appear less robust (i.e., smaller ranges of ages and lengths). A risk averse strategy would be to only use CAAL for fleets and regions in years where data are very well represented (i.e., large annual sample size with relatively large age-specific sample sizes). Age data in SEDAR98 tend to have sufficiently large age sample sizes for most fleets only in recent years. When CAAL data are not very well represented, we recommend using weighted length compositions in combination with nominal age compositions, provided that weighted length and nominal age compositions are available and robust for those respective years. See Table 2.12.3 for year-specific recommendations for each fleet and region.

2.8 MEAN LENGTH-AT-AGE

Year-specific mean length-at-age (MLAA) was estimated for the COM and REC fleets in each region (see methods and results in SEDAR98-DW-06/07 for COM and REC fleets, respectively).

2.8.1 Research Recommendations

There are no research recommendations regarding MLAA from the LHWG at the SEDAR98 data workshop.

2.8.2 Recommendations for SEDAR 98

Inclusion of MLAA data in assessment models provides an informative external data check on model fits, especially when including CAAL data in the model and internally estimating growth parameters. However, we do not recommend using MLAA to directly estimate assessment model parameters or evaluate overall fit. Rather, we recommend using MLAA data for comparison with assessment model predicted length-at-age as a check to internal model fits for each fleet and region, where MLAA data are available and reasonably robust. See Table 2.12.3 for year-specific recommendations for each fleet and region.

2.9 GROWTH

Red snapper growth was modeled with both standard and size-modified von Bertalanffy growth functions fit to unweighted or inverse (i.e., 1/age-specific count) weighted data in AD Model Builder (Diaz et al., 2004; Fournier et al. 2012). Growth models were estimated for 1) a single Gulf-wide (1-area) model, 2) by stock ID region (3-area model), or 3) by time stanza (1-area model). For time-stanza growth models, data were separated into three periods: 1) 1991 to 2008, 2) 2009-2015, and 3) 2016 to 2023. These stanzas were identified in SEDAR74 (SEDAR74, 2024) as having significant shifts in reproductive potential that roughly correspond to changes in stock status over time (i.e., depletion, rebuilding, and approaching asymptotic recovery). In all cases, the variance component was modeled with one of four different parameterizations: 1) constant standard deviation (SD), 2) constant coefficient of variation (CV), 3) CV as a linear function of age, or 4) CV as a linear function of length-at-age. Bootstrapped CIs were estimated for each set of region- or stanza-specific growth parameters (R core team, 2021; Ogle et al., 2022) to evaluate if growth should be modeled for 1) a single or multiple regions and/or 2) a single or multiple time stanzas.

Single population growth parameters indicated a similar L_∞ to the estimate from SEDAR74 but a higher k value (0.175 vs 0.141 in SEDAR74) and a similar t_0 (-0.71). As the stock has rebuilt, length-at-age has not decreased per say, but smaller sizes-at-age have increased in abundance (i.e., a wider distribution of lengths-at-age), hence the consistent lower L_∞ estimated during the last two SEDARs. Similar to results from SEDAR74, models fit to inverse-weighted length-at-age data provided better fits than models fit to unweighted data due to the extremely low relative proportions of length-at-age observations for younger/smaller and older/larger fish compared to the bulk of the dataset. Single population growth parameters were very similar among the time stanzas examined indicating that growth during these periods has not changed in concordance with reproductive output and significant shifts in stock status over time (Figures 2.13.7 and 2.13.8). Parameters estimated with VBGF models that corrected for historical and current minimum length limits were not different from models without corrected size-at-age data and were not included in further analyses.

Region-specific growth models indicated a difference in growth among regions (Figures 2.13.9 and 2.12.10) for parameters estimated with inverse-weighted length-at-age data. Specifically, L_∞ estimated with best-fit VBGF models (constant σ) for the West region was much lower (L_∞ = 808.8 mm FL) than the estimate for the Central (L_∞ = 840.9 mm FL) or East region (L_∞ = 852.6 mm FL). Estimates of the growth coefficient increased from West (k = 0.149) to East (k = 0.166), but 95% confidence intervals (CIs) from bootstrapped parameter estimates indicated that the k value in the East region was not well estimated and had a high degree of overlap with CIs from the other regions. Bootstrapped CIs of the L_∞ parameter indicated there was little overlap between estimates for the West region compared to the Central and East regions, which had a high degree of overlap. Bootstrapped CIs for the t_0 parameter had a high degree of overlap among all three regions. Region specific standard deviations, standard errors, and 95% CIs are shown in Table 2.12.4

2.9.1 Research Recommendations

We recommend that growth functions be fit externally to age-at-length data separately for all three regions during future SEDAR assessments. Growth parameters are not as well estimated for fish from the East region compared to the other two regions, and additional age-at-length data may increase the precision of growth parameter estimates in future assessments such that all three regions may require separate growth parameters.

2.9.2 Recommendations for SEDAR 98

We recommend that data analysts continue to use inverse weighted age data when fitting growth curves external to the assessment model.

If possible, estimate and parameterize growth in the assessment for fish in the West region separately from fish in the Central and East regions. Estimate and parameterize growth for fish in the Central and East regions as one group (i.e., a single set of growth parameters). If not, consider including region-specific (n = 2) growth estimates in sensitivity runs.

Model the variance parameter for growth as constant σ.

Model growth for all years combined without the use of time stanzas.

2.10 SUMMARY RECOMMENDATIONS

The LHWG was unable to identify a single year after which data from all fleets and regions were robust. Most fleets/regions have robust datasets (i.e., relatively large sample sizes with good annual representation across length bins and age classes) starting in 2009. However, data are not well represented or are sparse for the Central COM LL and East REC PR fleets until 2017 and other fleets may have isolated years of data with reduced quality. We have provided year-specific recommendations for each fleet and region Table 2.12.3 to assist the assessment team as they update and develop the previous assessment model for SEDAR98. We acknowledge that specifying several different data types among numerous fleets and regions may be excessively onerous for the assessment team when working with such a complex model. Therefore, the LHWG recommends that CAAL data be used starting in 2009 when the majority of fleets have robust data of this type (excluding the East COM LL and East REC PR fleets). We also acknowledge that utilizing CAAL data in such a complex model dramatically slows the estimation processes in stock synthesis (III). If model parameterization proves debilitatingly inefficient using CAAL data starting in 2009, as an alternative, we recommend using CAAL data starting in 2017, when all fleets and regions have robust CAAL data available. For years where CAAL data are not recommended for use (i.e., prior to 2009 or 2017), we recommend using weighted length compositions in combination with nominal age compositions for each fleet and region. We do not recommend using weighted age compositions for any fleet or region due to 1) the loss of data years associated with weighting procedure thresholds, and 2) a lack of discernible differences between nominal versus weighted age composition data. We recommend using MLAA as an external check to internal model estimates for all fleets/regions where MLAA data are available.

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2.12 TABLES

Table 2.12.1. Number of red snapper (final) age samples collected from the Gulf of America from 1980 to 2023 by fleet (commercial handline, COM HL; bottom longline, COM LL; private recreational, REC PR; recreational charterboat, REC CB; or recreational headboat, REC HB) and region (West, W; Central, C; or East, E). No age samples were processed from 1981-1985.

	COM HL			COM LL			REC PR			REC CB			REC HB		
Year	W	C	E	W	C	E	W	C	E	W	C	E	W	C	E
1980	0	0	0	0	0	0	0	0	0	0	325	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0	526	17	3
1987	0	0	0	0	0	0	0	0	0	0	0	0	148	3	0
1988	0	0	0	0	0	0	0	0	0	0	0	0	354	7	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	83	14	1
1990	0	0	0	0	0	0	0	0	0	0	0	0	36	3	0
1991	25	179	0	0	0	12	0	0	0	526	237	2	102	20	0
1992	214	119	18	0	0	15	0	2	0	485	353	0	26	73	5
1993	344	139	12	29	0	31	24	0	0	189	371	62	913	254	0
1994	507	122	28	0	0	8	0	0	0	0	426	0	388	21	0
1995	97	85	7	0	0	19	0	0	0	0	362	0	10	11	0
1996	0	9	0	0	0	6	0	0	0	0	101	0	0	95	0
1997	0	1	31	0	0	10	0	0	0	0	56	0	0	94	1
1998	1200	186	11	348	0	25	220	240	0	135	946	1	981	647	1
1999	1792	908	70	76	0	102	75	581	0	97	659	0	267	352	14
2000	695	1382	29	345	0	84	3	0	0	3	504	2	252	139	2
2001	1027	1242	66	179	14	77	0	2	0	0	376	12	74	218	1
2002	2422	1155	14	341	10	168	322	309	0	245	2543	14	207	219	0
2003	1395	1474	9	259	27	170	600	353	3	229	6025	35	140	71	2
2004	1892	970	113	640	18	235	627	197	0	400	3815	3	168	63	7
2005	2318	1101	68	252	34	311	815	194	0	422	5089	5	208	48	52
2006	2599	1146	153	556	0	202	1081	251	2	237	3384	5	205	109	78
2007	1447	1077	54	352	93	124	531	64	1	475	402	14	69	185	7
2008	1578	933	23	344	183	315	340	30	10	467	366	7	133	146	44
2009	2127	929	596	271	20	679	323	73	2	427	519	19	429	367	282
2010	2055	1149	451	84	1	882	435	58	13	49	1270	103	394	236	240
2011	1665	2471	906	14	22	551	130	80	13	413	1138	73	660	185	260
2012	2914	3226	951	149	51	228	380	157	0	401	1668	14	364	236	127
2013	1500	1798	767	116	14	705	313	113	7	615	1989	21	1476	668	150
2014	1112	1500	987	77	14	1120	515	314	12	241	838	81	1232	2926	70
2015	1640	2208	644	97	23	846	381	675	0	455	1813	130	1002	2341	203
2016	1681	2545	909	108	31	828	567	860	10	341	1318	24	727	317	39
2017	1235	2961	1282	120	36	528	433	583	267	529	904	66	1082	382	158
2018	1488	3931	925	307	116	537	509	814	40	601	1232	207	1079	709	236
2019	1109	4310	1018	681	53	804	540	713	14	382	1462	207	1060	772	207
2020	908	3208	1117	126	51	291	538	315	12	309	698	62	8	26	0
2021	810	2912	720	175	86	417	585	327	18	418	1011	264	84	217	39
2022	1052	2653	1729	420	146	1659	547	211	30	170	894	172	236	443	115
2023	1028	887	501	406	173	822	817	285	35	348	868	133	258	457	157

Table 2.12.2. Sample availability by sampling program by year. Colors do not indicate the quantity of samples, simply that sample(s) were provided in that year.

Source		1980	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
PCLab		Y						Y	Y			Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
HB			Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
TIP								Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
RECFIN																			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y					
FIN-BIOSTAT	FD surveys																		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
GRFS																																Y	Y	Y	Y	Y	Y	Y	Y	Y
REPBIO																																				Y	Y	Y	Y	Y
SRFS																																					Y	Y	Y	Y
SRH																																		Y	Y	Y	Y	Y	Y	Y
MRFSS															Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y		Y											
FWRI-OBS																										Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
GOP	Observer programs																												Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
FIN-OBS																						Y	Y	Y																
SBLOP																								Y	Y		Y		Y				Y	Y		Y	Y			
MSLab											Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
FWRI-FIM	FI surveys																						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
DISL FI BLL																													Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
DISL FI VLL																													Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
USGS															Y	Y	Y	Y																						
CO-OP																			Y	Y		Y							Y					Y						
CO-OP WARD																											Y													
ALLIANCE																											Y													
DISL SEAMAP V2																											Y													
EASA																												Y												
DISL N2P3	Special studies																																				Y	Y		
LDWF																								Y					Y											
LDWF_SEAMAP																												Y	Y	Y	Y	Y	Y							
USM_GCRL																																	Y	Y	Y	Y	Y			
TAMUCC																													Y	Y	Y	Y								
UF																														Y	Y	Y	Y							
USF																												Y	Y	Y	Y	Y	Y							
UTMSI																								Y																

Table 2.12.3. Final recommendations regarding each fleet's data quality and preference in assessment usage for each data source (nominal vs weighted length compositions, nominal vs weighted age compositions, conditional age-at-length, or mean length-at-age) during each year. Green portions indicate we recommend the data source for input into the assessment due to high quality; yellow indicates the recommended data source should be adjusted from nominal form (e.g., weighted or pooled); gray indicates no data are available for use from any data source for that fleet in that year.

<table>
<tr><th>Data Source</th><th>Fleet</th><th>Region</th><th>1980</th><th>1981</th><th>1982</th><th>1983</th><th>1984</th><th>1985</th><th>1986</th><th>1987</th><th>1988</th><th>1989</th><th>1990</th><th>1991</th><th>1992</th><th>1993</th><th>1994</th><th>1995</th><th>1996</th><th>1997</th><th>1998</th><th>1999</th><th>2000</th><th>2001</th><th>2002</th><th>2003</th><th>2004</th><th>2005</th><th>2006</th><th>2007</th><th>2008</th><th>2009</th><th>2010</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th><th>2021</th><th>2022</th><th>2023</th></tr>
<tr><td rowspan="15">CAAL</td><td rowspan="3">COM HL</td><td>W</td><td colspan="4"></td><td colspan="6">Weighted Length Comps</td><td colspan="6">Wtd Leng Comps/Nom Age Comps</td><td colspan="28">CAAL</td></tr>
<tr><td>C</td><td colspan="4"></td><td colspan="6">Weighted Length Comps</td><td colspan="8">Weighted Len Comps/Pooled Nom Age Comps</td><td colspan="26">CAAL</td></tr>
<tr><td>E</td><td colspan="4"></td><td colspan="13">Pooled Weighted Length Comps</td><td colspan="12">Pooled Weighted Lengths/ Nominal Age Comps</td><td colspan="15">CAAL</td></tr>
<tr><td rowspan="3">COM LL</td><td>W</td><td colspan="4"></td><td colspan="10">Pooled Weighted Length Comps</td><td colspan="30">CAAL (few years may need special treatment: 1999, 2011)</td></tr>
<tr><td>C</td><td colspan="4"></td><td colspan="17">Pooled Weighted Length Comps</td><td colspan="16">Pooled Weighted Length Comps/Nominal Age Comps</td><td colspan="7">CAAL</td></tr>
<tr><td>E</td><td colspan="4"></td><td colspan="6">Pooled Weighted Length Comps</td><td colspan="8">Pooled Weighted Length and Age Comps</td><td colspan="26">CAAL</td></tr>
<tr><td rowspan="3">REC PR</td><td>W</td><td></td><td colspan="18">Weighted Length Comps</td><td colspan="25">CAAL</td></tr>
<tr><td>C</td><td></td><td colspan="21">Weighted Length Comps</td><td colspan="22">CAAL</td></tr>
<tr><td>E</td><td colspan="11">Pooled Weighted Length Comps</td><td colspan="5"></td><td></td><td colspan="2"></td><td></td><td colspan="3"></td><td colspan="14">Weighted Lengths/ Pooled Nominal Age Comps</td><td colspan="7">CAAL</td></tr>
<tr><td rowspan="3">REC CH</td><td>W</td><td></td><td colspan="10">Weighted Length Comps</td><td colspan="33">CAAL</td></tr>
<tr><td>C</td><td colspan="11">Weighted Length Comps</td><td colspan="33">CAAL</td></tr>
<tr><td>E</td><td colspan="3"></td><td colspan="14">Pooled Weighted Length Comps</td><td colspan="12">Weighted Lengths/Nominal Age Comps</td><td colspan="15">CAAL</td></tr>
<tr><td rowspan="3">REC HB</td><td>W</td><td colspan="6"></td><td colspan="38">CAAL (few years may need special treatment: 1992, 1995, 2020)</td></tr>
<tr><td>C</td><td colspan="6"></td><td colspan="10">Weighted Lengths/Pooled Nom Age Comps</td><td colspan="17">Weighted Lengths/Pooled Nominal Age Comps</td><td colspan="11">CAAL</td></tr>
<tr><td>E</td><td colspan="6"></td><td></td><td colspan="2"></td><td></td><td colspan="2"></td><td></td><td colspan="4"></td><td colspan="11">Pooled Weighted Lengths/ Pooled Nominal Age Comps</td><td colspan="16">CAAL</td></tr>
</table>

Table 2.12.4. Region-specific standard deviations, standard errors, and 95% confidence intervals for bootstrapped (n = 999) vonBertalanffy parameter estimates (L_∞, k, or t_0).

Region	n boot	L_∞ SD	L_∞ SE	L_∞ CI	k SD	k SE	k CI	t_0 SD	t_0 SE	t_0 CI
West	999	253.91	8.03	(793.64, 825.38)	0.210	0.007	(0.135, 0.162)	3.87	0.12	(-1.56, -1.08)
Central	999	296.91	9.39	(823.08, 860.11)	0.210	0.007	(0.138, 0.165)	2.98	0.09	(-1.27, -0.91)
East	999	410.90	13.00	(828.88, 879.51)	0.298	0.009	(0.147, 0.184)	3.65	0.12	(-1.24, -0.78)

2.13 FIGURES

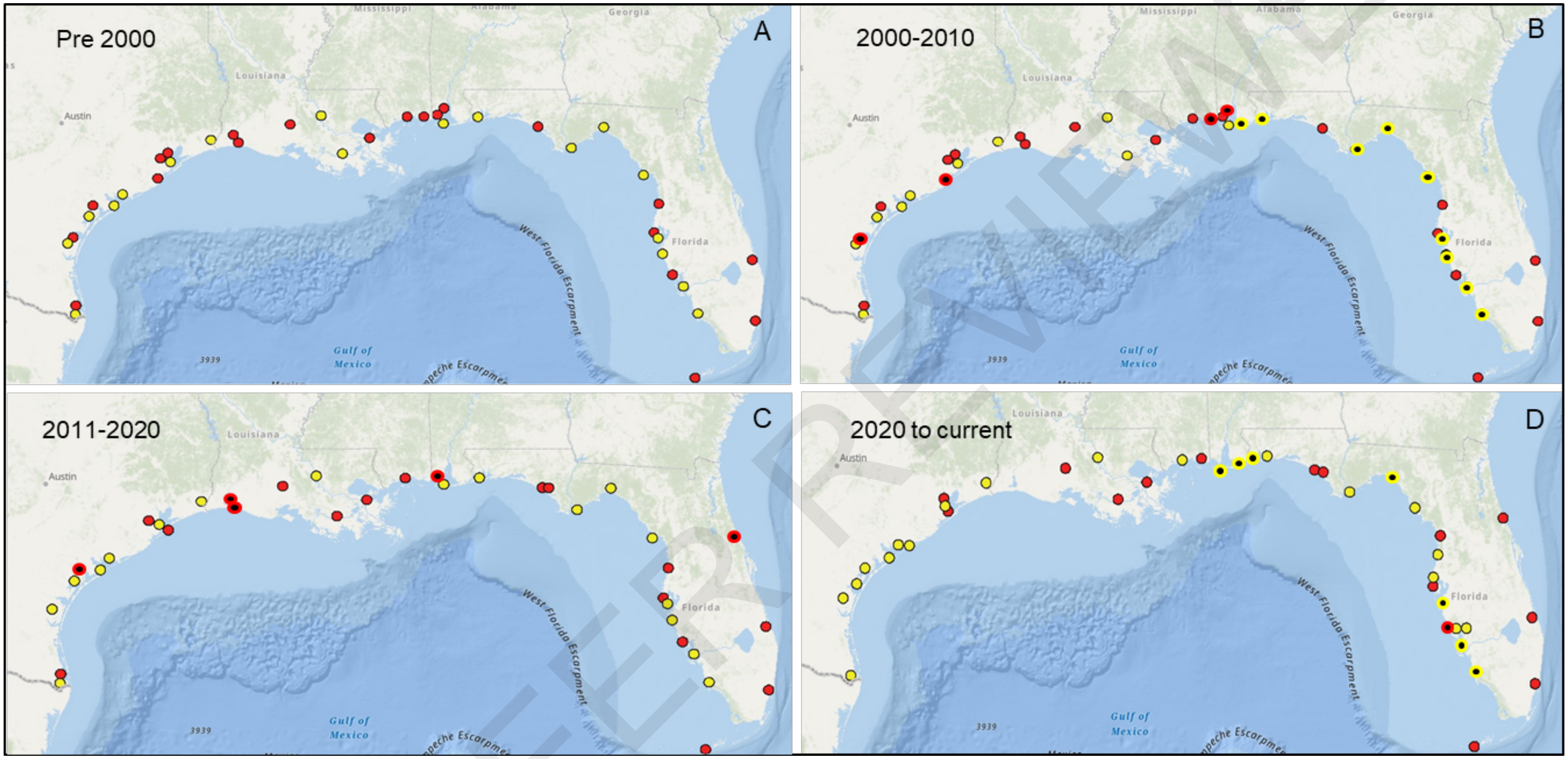

Figure 2.13.1. Locations of state (yellow circles) and federal (red circles) port samplers positioned around the northern GOA by decade. Black filled circles indicate a port sampler location that was removed or repositioned compared to the previous decade.

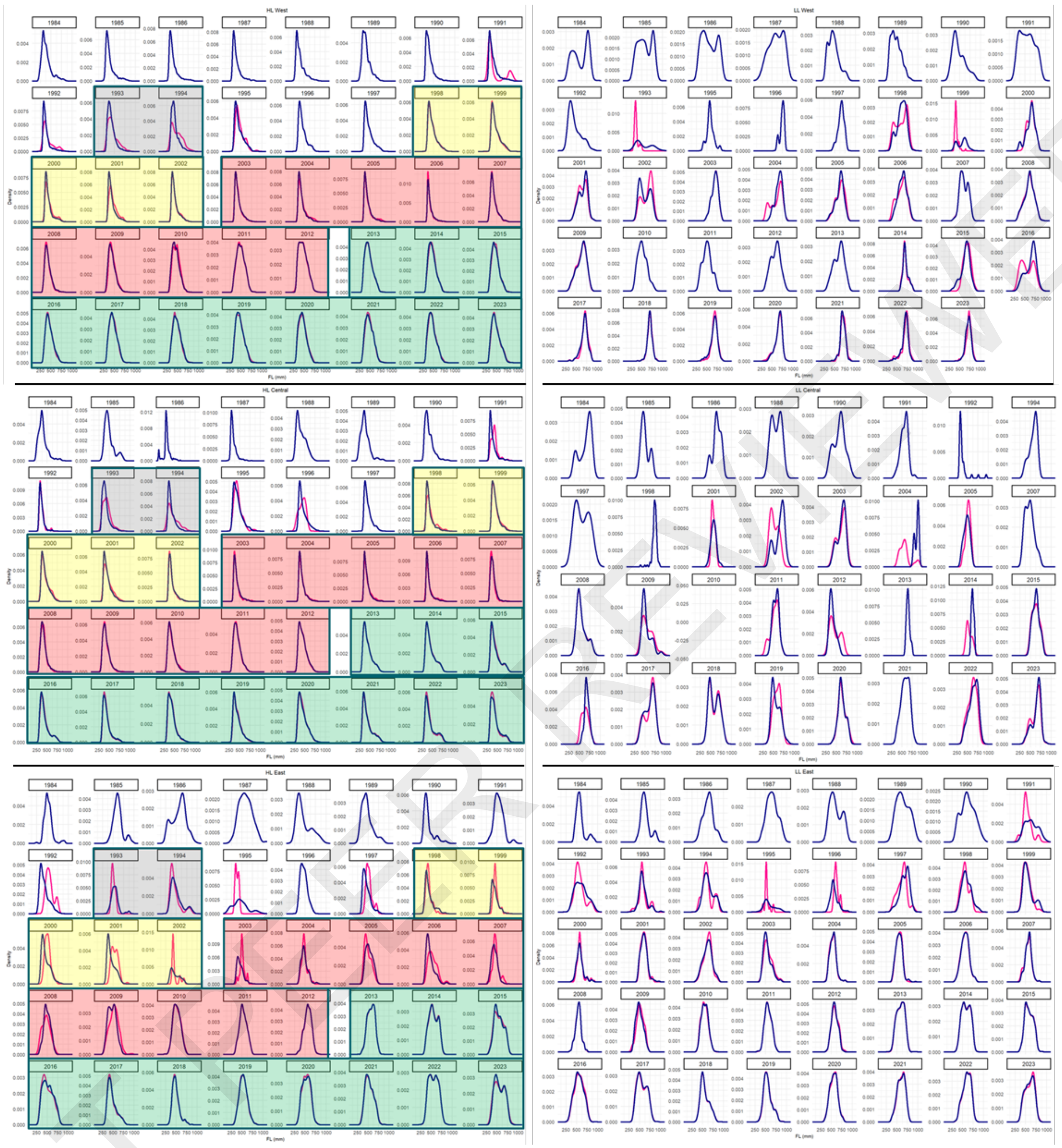

Figure 2.13.2. Length distributions for samples with length-only (blue line) versus samples with length and age (pink line) by year for the commercial handline (left column) and longline (right column) fleets in the West (top panel), Central (middle panel), or East (bottom panel) GOA region. Shaded regions indicate NMFS PC Lab subsampling protocols solely for commercial handline during 1993 and 1994 (gray), 1998 to 2002 (yellow); 2003 to 2012 (red); and 2013 to 2023 (green). Additional details on the subsampling protocol can be found in SEDAR98-WP-09..

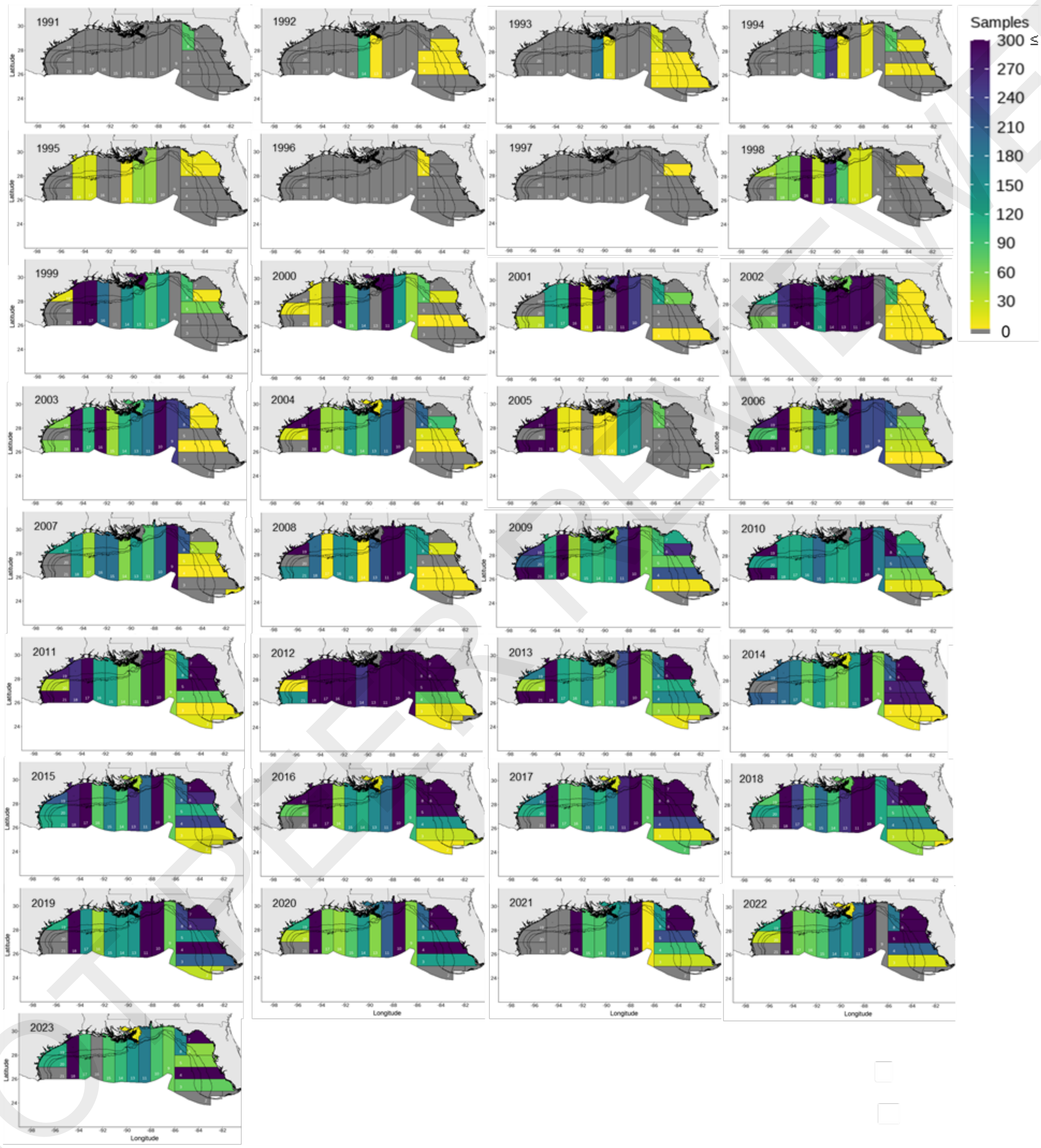

Figure 2.13.3. Number of commercial handline age samples per year by NMFS statistical grid. Gray indicates grids with no samples in a given year, with a maximum number of observed samples capped at 300.

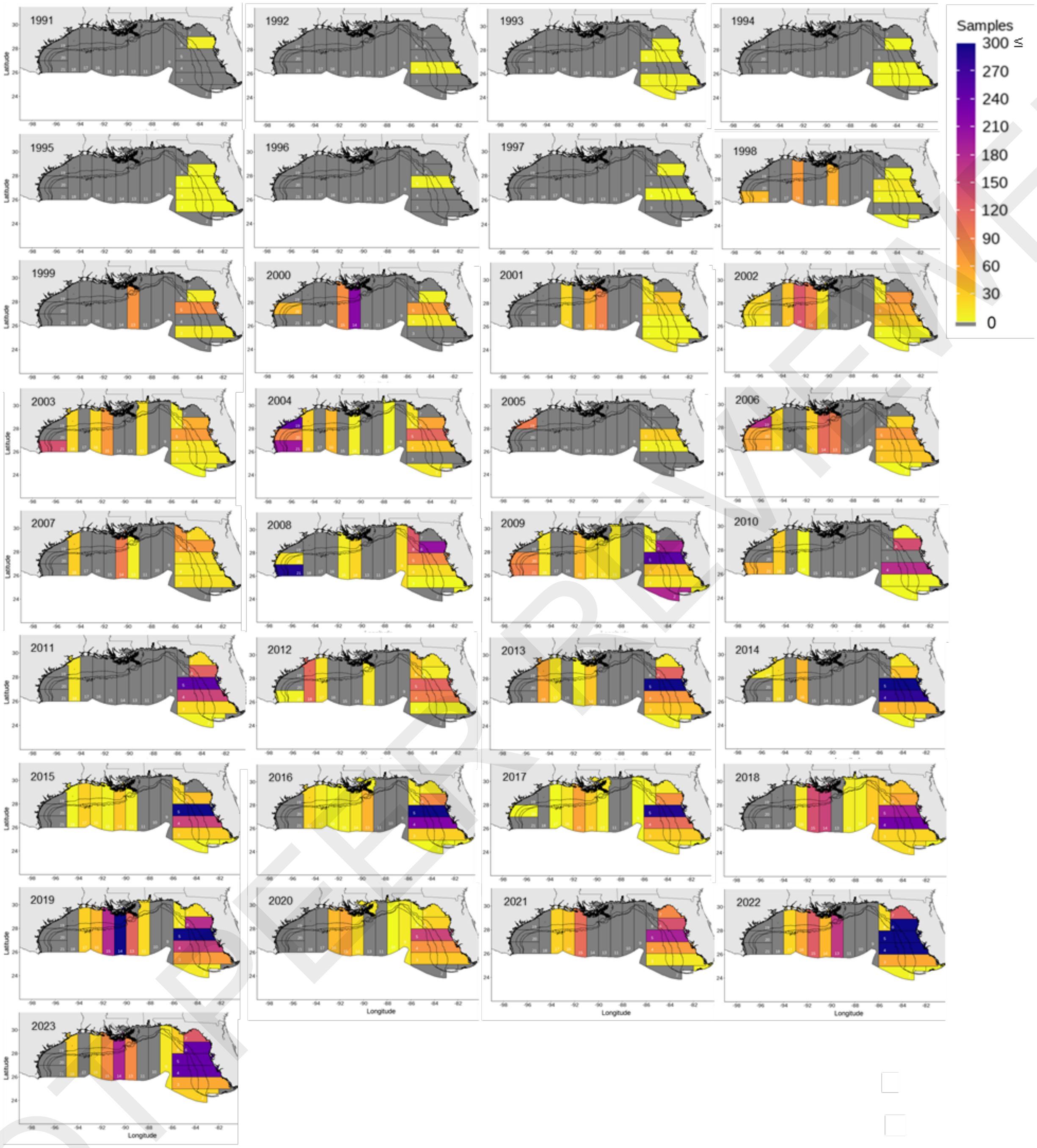

Figure 2.13.4. Number of commercial longline age samples per year by NMFS statistical grid. Gray indicates grids with no samples in a given year, with a maximum number of observed samples capped at 300.

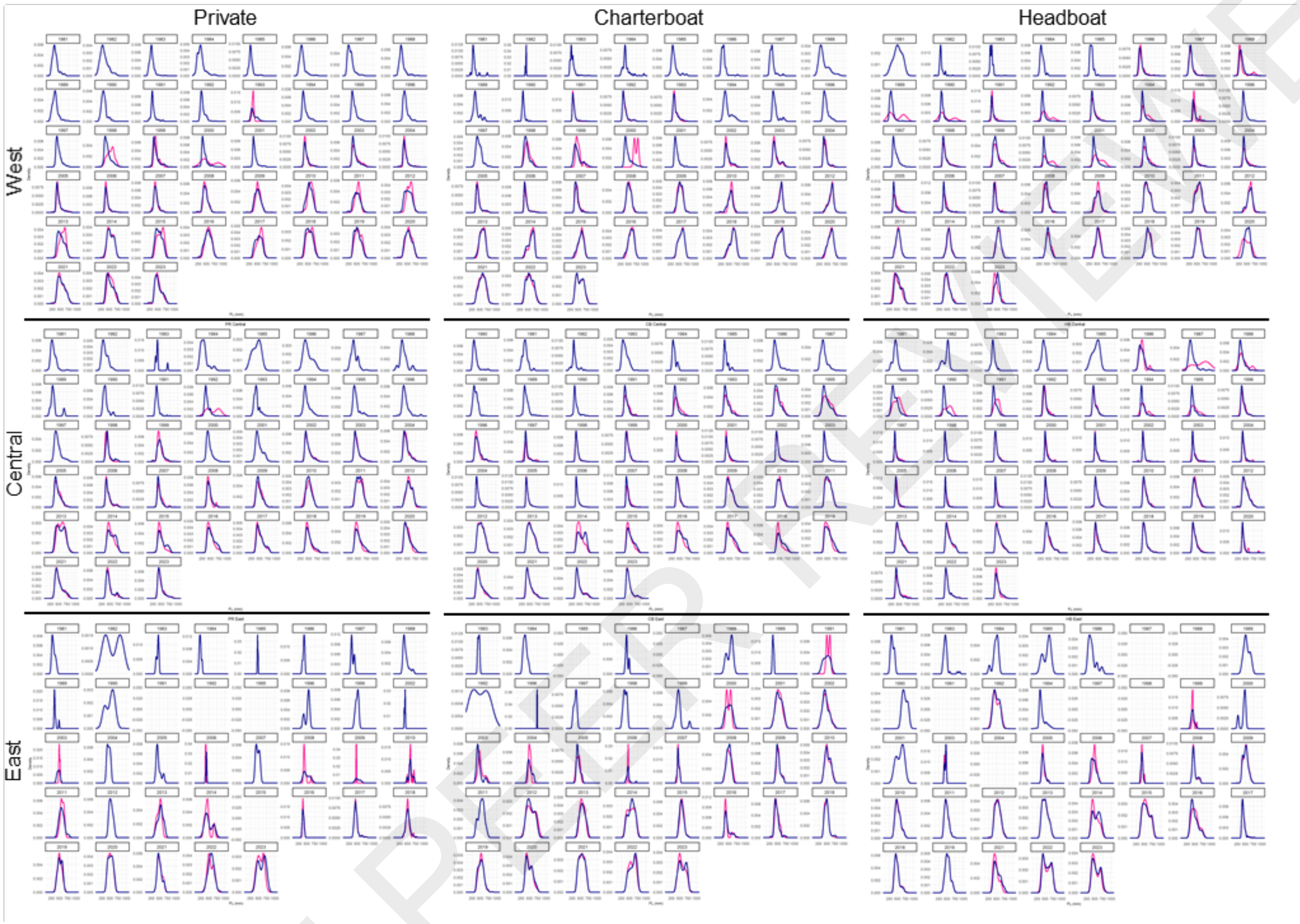

Figure 2.13.5. Length distributions of length-only (blue lines) versus length-with-age data (pink lines) samples from the private (left column), charterboat (middle column), and headboat (right column) in the West (top row), Central (middle row), or East (bottom row) GOA region by year.

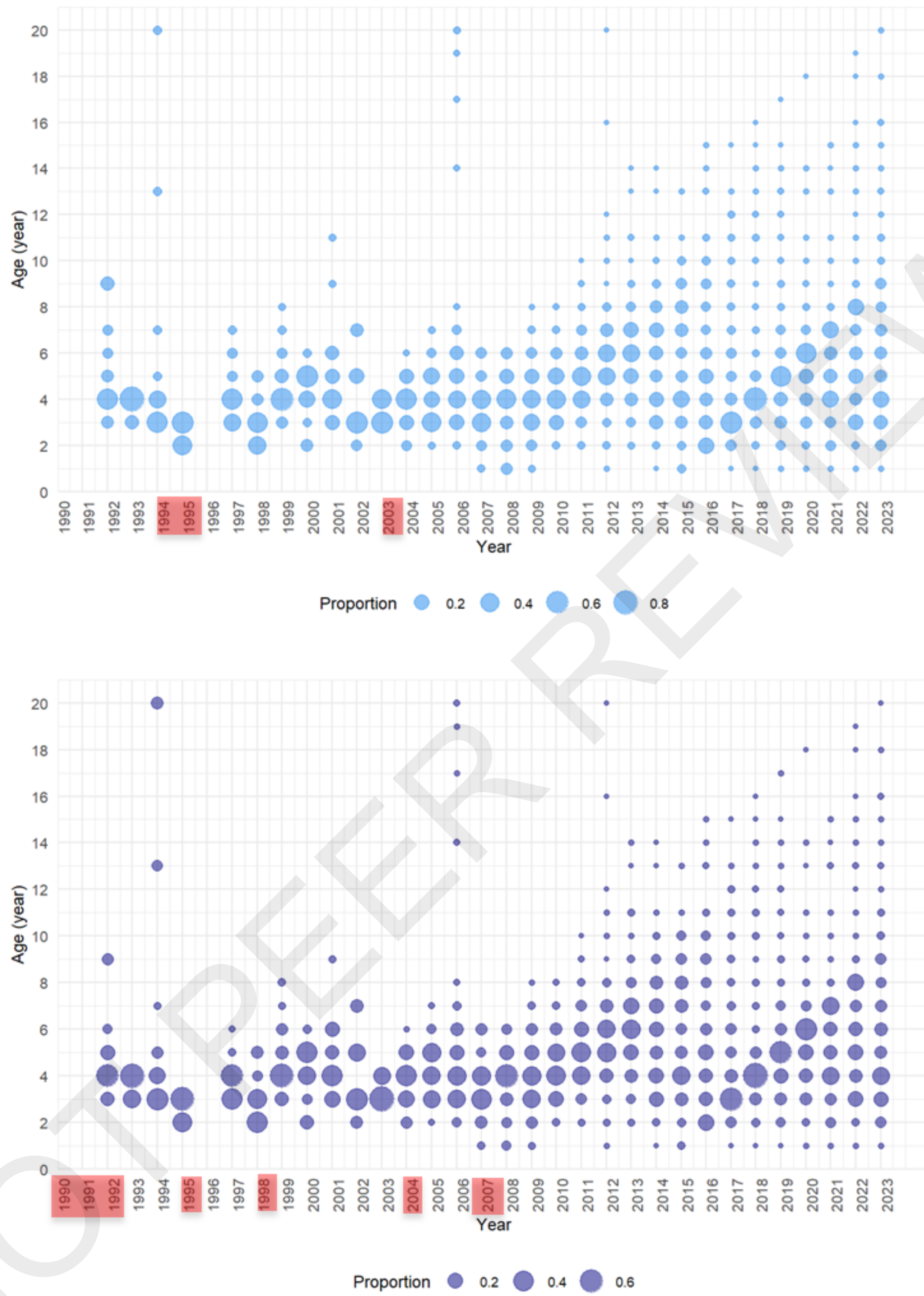

Figure 2.13.6. Nominal (top panel) vs weighted (bottom panel) age compositions for the COM HL fleet in the East region. Years with red shaded boxes indicate sample sizes below the minimum thresholds for inclusion in analyses.

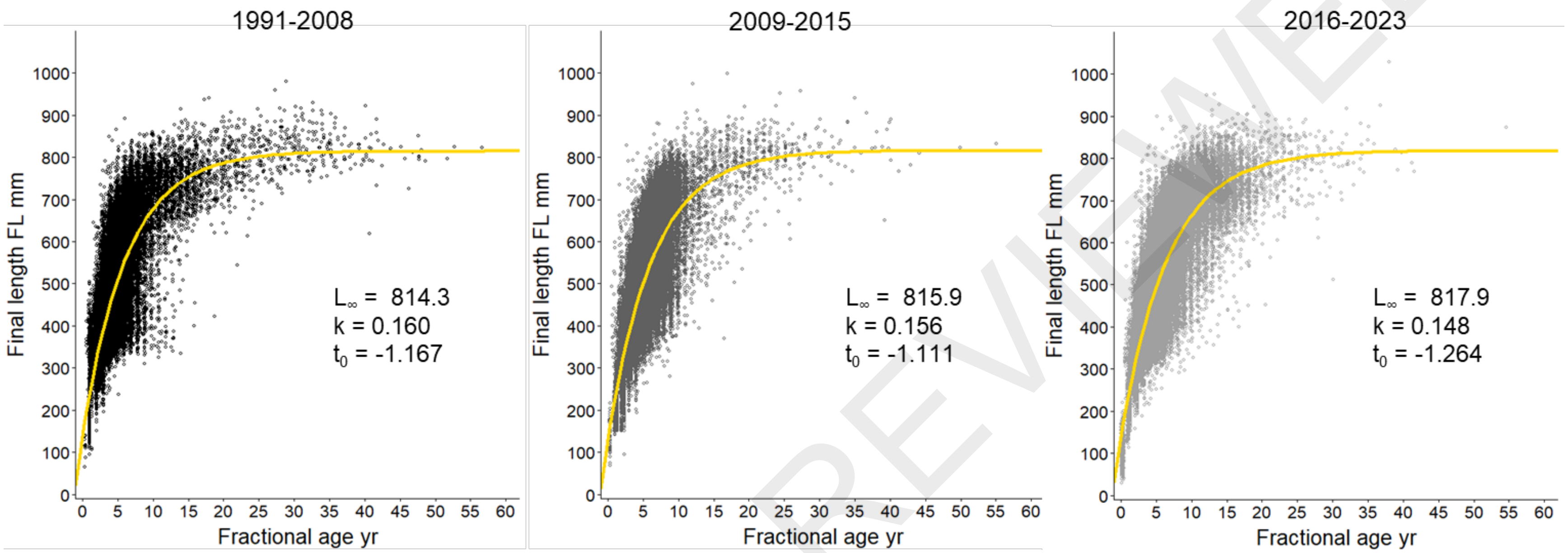

Figure 2.13.7. Scatterplots of red snapper fractional age by final length (mm FL) by time stanza: early (1991-2008, black open circles), mid (2009-2015, dark gray open circles), or late (2016-2023, light gray open circles) overlain with best-fit von Bertalanffy growth functions (yellow line). Parameter estimates for each stanza's growth function are shown on each panel.

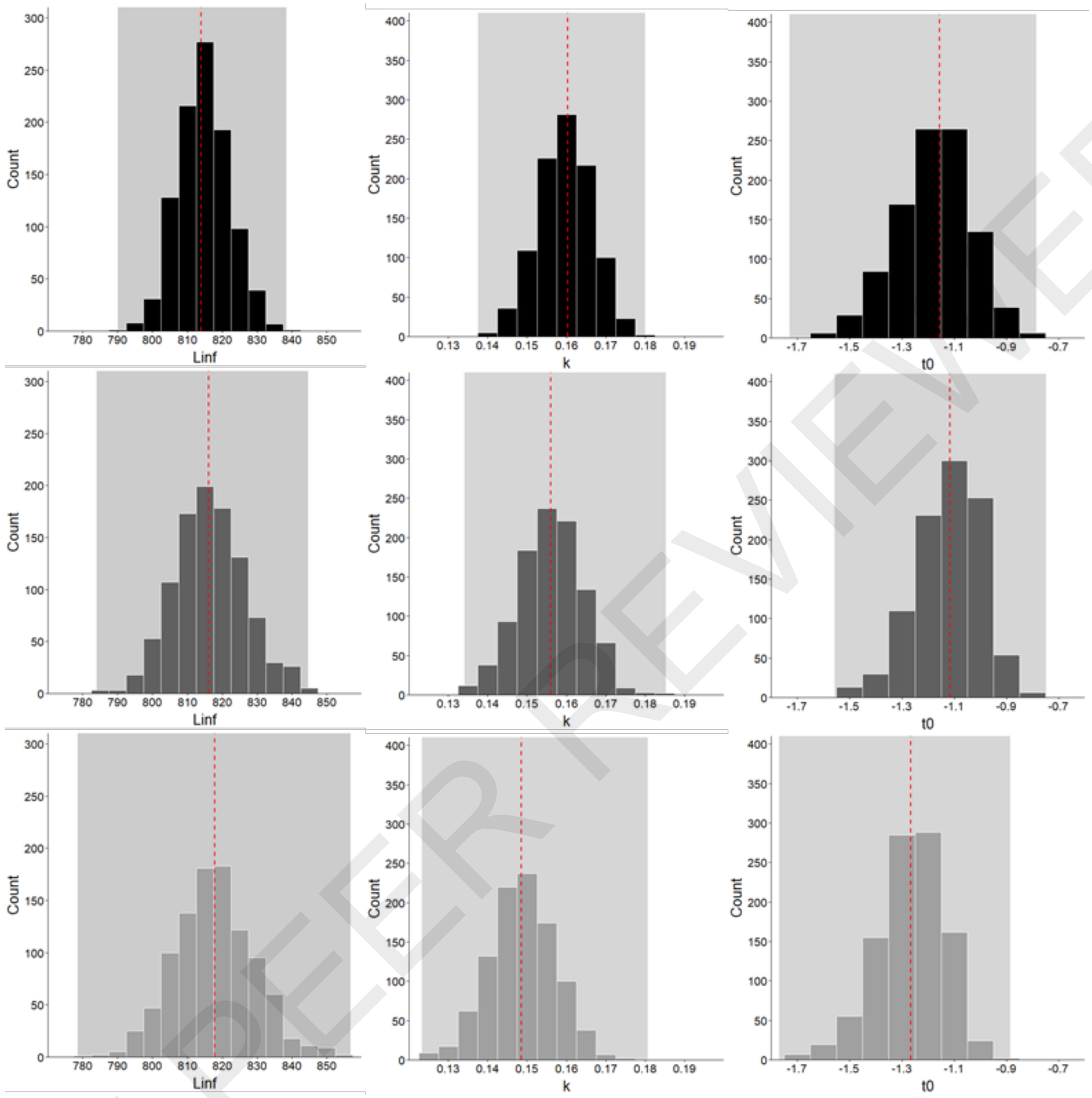

Figure 2.13.8. Histograms of bootstrapped parameter estimates L_∞ (left column), *k* (middle column), or t_0 (right column) for each time stanza: early (1991-2008, black bars), mid (2009-2015, dark gray bars), or late (2016-2023, light gray bars) with 95% confidence intervals for each parameter estimate (gray shaded regions). The vertical dashed line indicates the median value for each parameter estimate.

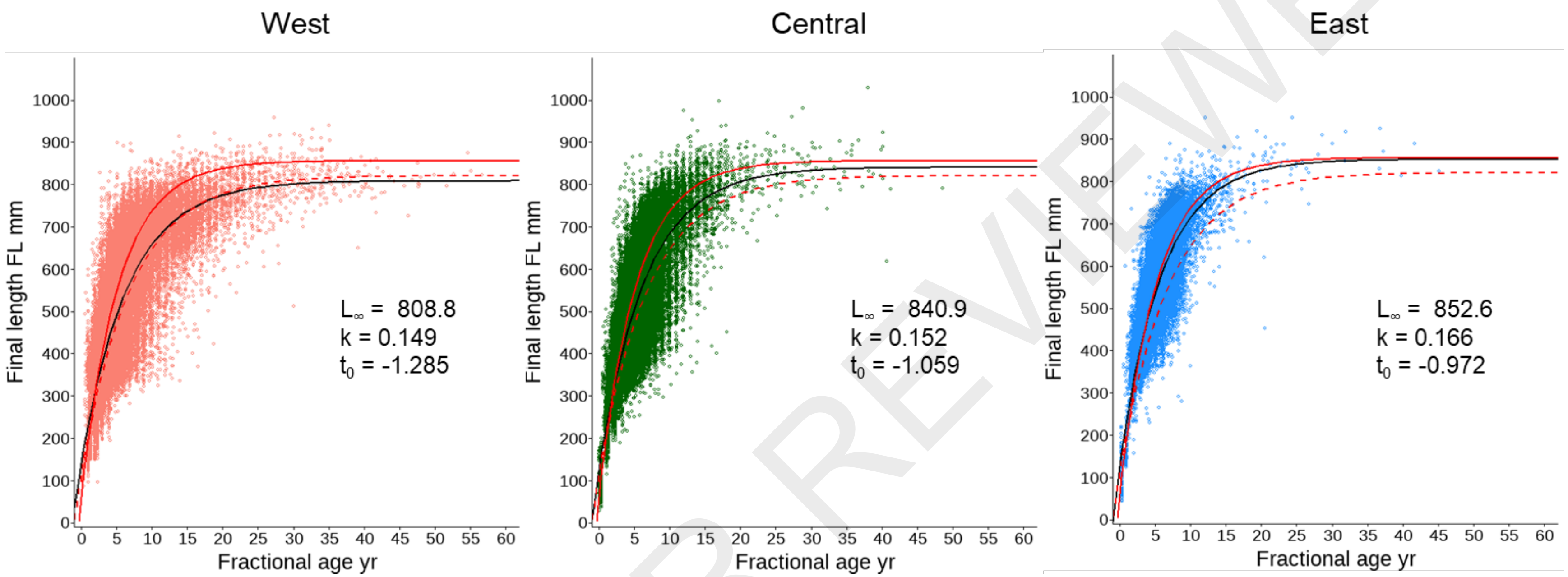

Figure 2.13.9. Scatterplots of red snapper fractional age by final length (mm FL) by stock ID region: West (pink open circles), Central (green open circles), or East (blue open circles) overlain with best-fit von Bertalanffy growth functions (black solid lines). Parameter estimates for each region's growth function are shown on each panel. The red solid line indicates the best-fit von Bertalanffy growth function for the population estimated in SEDAR74 while the red dashed line indicates the von Bertalanffy growth function for the population estimated in SEDAR98.

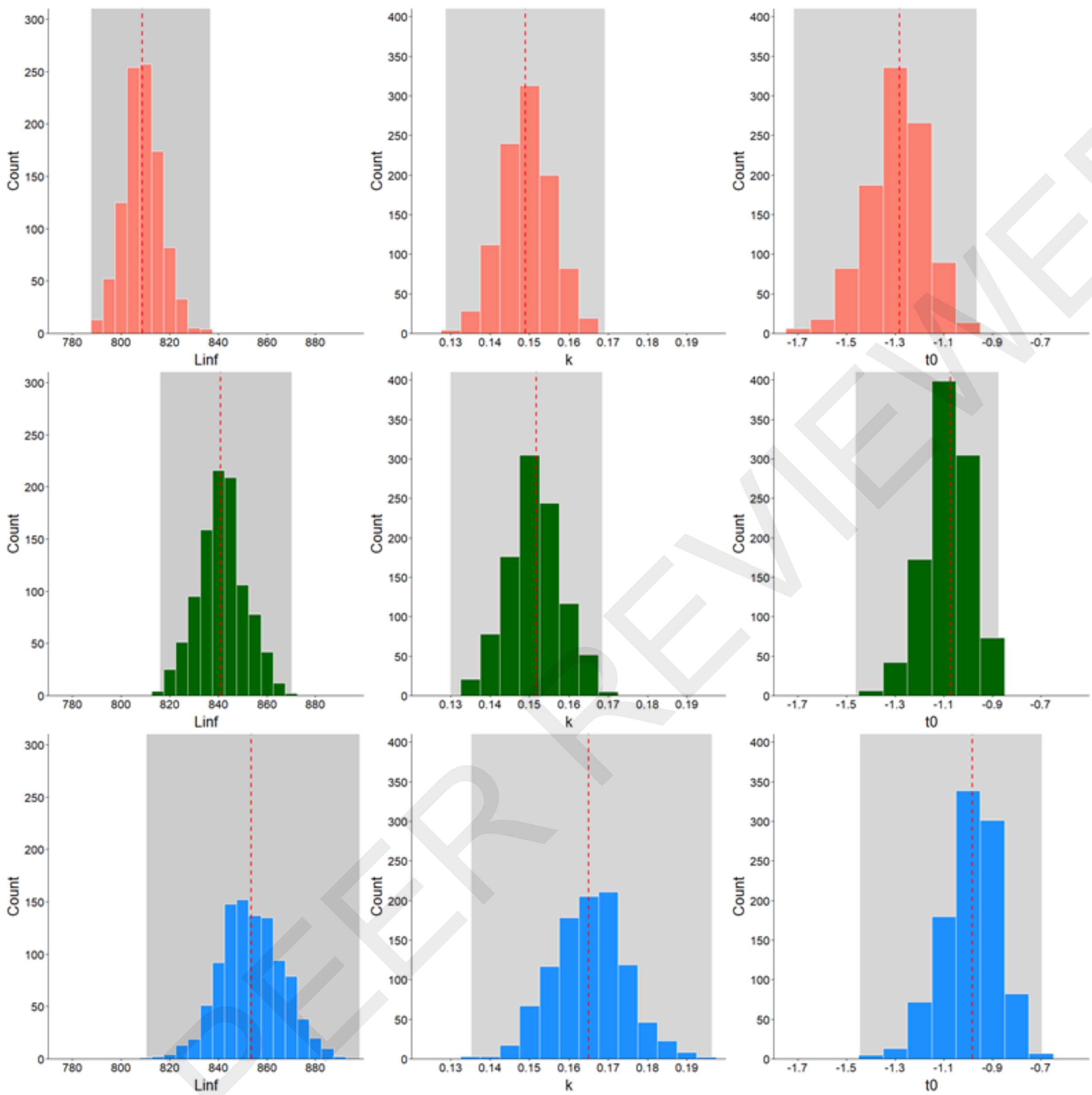

Figure 2.13.10. Histograms of bootstrapped parameter estimates L_∞ (left column), *k* (middle column), or t_0 (right column) for each stock ID region: West (pink bars), Central (green bars), or East (blue bars) with 95% confidence intervals of each parameter estimate (gray shaded regions). The red vertical dashed line indicates the median value for each parameter estimate.

3 COMMERCIAL FISHERY STATISTICS

For this Data Workshop, there was not a Commercial Fisheries Statistics work group. The only commercial data products discussed at the workshop were shrimp bycatch and effort in a combined Indices and Bycatch Workgroup. For documentation purposes, commercial landings and discards 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 74 or through SEDAR best practices. Working papers were provided for these products to thoroughly document the method and differences to SEDAR 74.

SEDAR98-DW-02: Commercial Landings of Gulf of Mexico Red Snapper (*Lutjanus campechanus*) from 1964-2023.

SEDAR98-DW-03: Estimated Commercial Discards of Gulf of Mexico Red Snapper Using Discard Logbook and Observer Data from 1996-2023.

3.1.1 Commercial Landings

Commercial landings of Gulf of America (formerly Gulf of Mexico, hereafter referred to as Gulf) Red Snapper were compiled from the Accumulated Landings System (ALS) and state trip ticket programs (STT) following SEDAR 74 methods. Landings were provided in whole weight pounds and numbers of fish using average Trip Interview Program (TIP) weights from 1964-2023.

The largest change between assessments is the use of a new Gulf States Marine Fisheries Commission (GSMFC) gutted to whole weight conversion factor. The GSMFC conducted a one-year cooperative project with Gulf state partners to update gutted to whole conversion factors for several snapper and grouper species (SEDAR98-RD-04). The previously used conversion factor for Red Snapper was 1.11 which was used in SEDAR 74 and SEDAR 52. The new GSMFC conversion factor for Red Snapper was estimated to be 1.059 which was used for SEDAR 98. This change resulted in as much as a 4.5 percent reduction in annual landings. Additional detail on the preparation of commercial landings for SEDAR 98 are provided in SEDAR98-DW-02.

3.1.2 Commercial Discards

Commercial discards are estimated using two different data sources and methods. An Individual Fishing Quota (IFQ) was implemented in 2007 which is the same year the SEFSC implemented the Reef Fish Observer Program. For this reason and considering this change in management had a significant impact on discard behavior, observer-discard rates were not used to estimate discards prior to the IFQ. Discard estimation from 2007-2023 using observer data followed standard methods also utilized for SEDAR 74. Prior to IFQ, commercial discards were calculated using discard logbook data from 1996-2006 using the same discard logbook method used for SEDAR 74.

In the previous assessment, commercial discards estimates from each respective analysis were input into the assessment model as is without correcting for differences in methodology and data quality. Typically discard-logbook derived estimates are larger in magnitude than observer-derived estimates. For Red Snapper, a reduction in discards in 2007 may be true given the implementation of IFQ. However, since the SEFSC no longer recommends the use of discard logbook data for estimating discards for SEDAR (Alhale et al. 2024), a calibration was developed to adjust the discard logbook-derived estimates to align with the more reliable observer-derived estimates. The observer method is more reliable because there is a verification step to use observer reported kept data to re-estimate the landings of Red Snapper. The commercial discard working paper (SEDAR98-DW-03) documents 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 74.

3.2 ISSUES DISCUSSED AT THE DATA WORKSHOP

Issues discussed at the data workshop include the following topics

- The proposed shrimp fleet effort time series from 1984-2023
- Overview of the new bycatch methodology
- Shrimp bycatch and effort estimates prior to 1984
- Length compositions of the Red Snapper bycatch from the shrimp fleet

3.2.1 Review of Working and Reference Documents

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

SEDAR98-RD-01: Improving Estimation of Bycatch from Shrimp Trawls in the Gulf of Mexico

SEDAR98-DW-23: Estimation of Commercial Shrimp Effort in the Gulf of Mexico from 1984-2023.

SEDAR98-DW-25: Estimation of Red Snapper Bycatch from Gulf Shrimp Trawls.

3.2.2 Workgroup Participants

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

Sarina Atkinson	NMFS (Group Co-lead)
Nicole Beckham	DCNR Alabama
Taylor Beyea	LGL
Matthew Campbell	NMFS
Heather Christiansen	FWC
LaTreese Denson	NMFS (Assessment Co-lead)
Kyle Dettloff	NMFS (Group Co-lead)
Tom Frazer	USF CMS
David Hanisko	NMFS
Frank Hernandez	NMFS
Justin Lewis	FWC
Kelsey Martin	NMFS
James Nance	GSFMC SSC
Craig Newton	DCNR Alabama
Katherine Overly	NMFS
Cheston Peterson	University of Miami/CIMAS
Adam Pollack	NMFS (Group Co-lead)
Steven Smith	University of Miami/CIMAS
Matthew Smith	NMFS (Assessment Co-lead)
Ted Switzer	FWC
Kevin Thompson	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. An overview of the data of each source as well as the overall methods are summarized in SEDAR98-DW-23.

Shrimp bycatch analysts are requesting effort stratified by year, quadrimester (Jan-Apr, May-Aug, Sep-Dec), area (statistical zones 1: 1-6, 2: 7-12, 3: 13-17, 4: 18-21), trawl configuration (2 net vs. 4 net), depth zone (0-10, 10-30, and 30+ fathoms), time of day (day vs. night trawling), and species (brown, pink, and white shrimp). For this reason, shrimp effort was re-estimated from 1984-2023. While port agents started collecting effort information from the shrimp fleet in 1960, key variables such as time of day and trawl configuration were not collected until 1984. Based on analysis from Smith et al. 2023 (SEDAR98-RD-01), time of day and number of nets trawled are important factors when calculating CPUEs and need to be accounted for in bycatch estimation. This is why shrimp effort was re-estimated starting in 1984 and bycatch estimates were provided starting in the same year.

The effort estimates by strata are presented in SEDAR98-DW-23. From 1984-2006 when port agent interview data were used to calculate fleet effort, the main difference from previous estimates is the use of a calibration factor. From 2007-2014, port agents were still conducting interviews of boat captains, LGL Ecological Research Associates were collecting ELB positional data, and the SEFSC Shrimp Observer Program had mandatory coverage. During these years, port agent interview trips were matched to ELB and observer data and compared using a GLM ANOVA. This analysis showed that on average captains overestimate trip trawling effort compared to active trawling effort calculated from positional data or observers. Therefore, a calibration factor of 0.92 was applied to the re-estimated port agent derived shrimp effort to more closely align with ELB derived shrimp effort.

During the data workshop, it was discussed what to do about effort prior to 1984 since shrimp effort is an input into the Red Snapper stock assessment model. The work group proposed using previously estimated shrimp effort data for the offshore fleet, distributing it based on shrimp landings data across the three subregions: East, Central, and West (Figure 1), and applying the 0.92 calibration factor to ensure consistency throughout the entire effort time series. Port agents began conducting interviews in 1960. Proportions were calculated by zone and year to capture slight annual variation. During the entire historic time period (1960-1983), landings and, by association, effort of the offshore shrimp fleet has been stable throughout the Gulf. On average 75 percent of effort was apportioned to the Western Gulf, 14 percent to the Central, and 11 percent to the Eastern zone.

Decision 1: Use a previously estimated effort file to estimate shrimp fleet effort from 1960-1983. Apportion the historic effort data to the stock assessment subregions (East, Central, and West) using shrimp offshore landings and apply the 0.92 calibration factor to historic effort estimates to capture only active trawling effort.

A step in the improved bycatch methodology (SEDAR98-RD-01) is to re-estimate the shrimp landings using observer data (Figure 2). In the initial penaeid verification presented at the data workshop, observer-estimated shrimp catch was consistently an underestimate when compared to the landings in the years when there were known deficiencies in ELB data collection. This issue was discussed at the data workshop. It was concluded that effort was the main driver for underestimation because often vessels have incomplete data for a given year if chips were not mailed back or the program was transitioning from LGL to SEFSC. To correct for this bias, effort was adjusted in the following years and quadrimesters: 2013 (incomplete data due to transition of program from LGL to NMFS), 2014 Season 1 (incomplete data during implementation of new NMFS sample), 2020 Season 3 (loss of 3G in December 2020), and 2021-2023 (self-mailed chip retrieval era after loss of 3G).

Decision 2: Final re-estimated shrimp fleet effort uses port agent interview data from 1984-2006 and ELB positional data from 2007-2023 with years 2013, 2014, and 2020-2023 adjusted using observer data to account for known data issues in given years and quadrimesters.

The complete shrimp trawling effort from 1960-2023 by subregion (East, Central, and West) is highlighted in Table 1 and Figure 3. Uncertainty for the re-estimated time series (1984-2023) was calculated from interview or ELB data. Historically-estimated effort does not have associated estimates of uncertainty.

3.3.2 Shrimp Bycatch

Shrimp bycatch of Red Snapper was estimated using the improved methods described in SEDAR98-RD-01 and conducted for Red Snapper in SEDAR98-DW-25. The methodology of SEDAR98-RD-01 was refined and extended to estimate Red Snapper bycatch for the full observer time period, 2007-2023. Concurrent research provided key input time series of commercial shrimp fleet landings (SEDAR87-DW-06) and effort (SEDAR87-DW-01, SEDAR98-DW-23). The verification procedure comparing observer-predicted vs. reported penaeid landings showed improvement in the reliability of bycatch estimates using the refined methodology and input data streams compared to SEDAR98-RD-01, which was in turn a substantial improvement in reliability from the methodology used in SEDAR 52 and prior.

These improvements can be attributed to three main factors: (i) incorporation of trawl configuration (2-nets, 4-nets) and diurnal period (daytime, nighttime) as additional stratification variables to area-season-depth; (ii) development of strata-specific time series of shrimp landings; and (iii) development of strata-specific time series of shrimp effort.

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 Red Snapper 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 52, which relied on SEAMAP trawl data as a proxy for commercial shrimp trawls.

Estimates of Red Snapper bycatch from commercial shrimp trawls for West, Central, and East Gulf regions for 1984-2023 are provided in Table 2 and Figure 4. Bycatch of Red Snapper was 10 or more times higher in the West Gulf compared to the Central and East Gulf. The peak of bycatch in the late 1990s corresponded with the peak in shrimp fleet effort, and the historically lower bycatch of Red Snapper in the past decade matched with historically lower effort during this time. Length compositions showed that bycatch is focused on sublegal sizes of Red Snapper.

Decision 3: The workgroup recommends the bycatch estimates from 1984-2023 following the improved methodology. Updated bycatch estimates were extended back to 1984 when SEFSC port agent interviews of vessel captains began recording species-specific shrimp catch and effort by net configuration and diurnal period. From workshop discussions with the analysts, the bycatch team suggested using the average annual estimate by respective Gulf zone (West, Central, East) for the period 1984-1990 for bycatch prior to 1984.

3.3.3 Shrimp Bycatch Length Composition

Observers obtained 336,228 length observations for Red Snapper during 2007-2023. The length range was 1.5 to 88.5 cm fork length, but 99.2% of the observations were below the minimum legal size of 30.5 cm fork length. Annual length compositions of Red Snapper bycatch were estimated for the West, Central, and East Gulf subregions (SEDAR98-DW-25).

3.4 COMMENTS ON ADEQUACY OF DATA FOR ASSESSMENT ANALYSES

Overall, the Work Group felt the methods for estimating shrimp effort and bycatch from 1984-2023 were appropriate and recommended for use in the assessment model.

3.5 RESEARCH RECOMMENDATIONS

Although the Work Group focused on understanding and evaluating Red Snapper bycatch methods and estimates, the working paper SEDAR98-DW-25 outlines current efforts by SEFSC to improve bycatch estimation in the future. These include:

- 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;
- scoping of field experiments for calibrating SEAMAP and commercial shrimp trawls.

3.6 LITERATURE CITED

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Atkinson, Sarina, Kyle Dettloff, Cheston Peterson, Steve Smith. 2025. Estimation of Commercial Shrimp Effort in the Gulf of Mexico from 1984-2023. SEDAR98-DW-23. SEDAR, North Charleston, SC. 22 pp.

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Smith, Steven G., Sarina Atkinson, Cheston Peterson, Jo Anne Williams, Kyle Dettloff, and Alan Lowther. 2023. Improving Estimation of Bycatch from Shrimp Trawls in the Gulf of Mexico. SEDAR98-RD-01. SEDAR, North Charleston, SC. 38 pp.

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

3.7 TABLES

Table 1. Shrimp effort in trawling days from 1960-2023 by Gulf of America subregion.

Year	West	Central	East
1960	78,901	16,711	15,620
1961	55,345	11,815	12,266
1962	68,219	12,546	15,714
1963	83,157	13,976	12,869
1964	84,068	16,871	18,052
1965	73,990	15,940	15,297
1966	71,148	14,364	14,198
1967	91,692	16,480	8,437
1968	87,436	22,112	10,258
1969	102,062	26,457	11,342
1970	90,876	16,984	10,386
1971	95,168	17,787	9,219
1972	116,644	17,897	10,840
1973	104,073	14,862	16,177
1974	101,592	16,589	17,231
1975	88,353	16,152	14,357
1976	112,193	18,849	11,825
1977	120,224	20,346	13,240
1978	148,165	22,129	16,528
1979	148,831	26,984	19,788
1980	106,763	14,503	12,150
1981	129,325	17,664	16,457
1982	121,942	27,194	11,690
1983	111,336	33,062	14,039
1984	116,137	32,408	20,283
1985	125,966	29,196	19,432
1986	147,191	38,284	16,233
1987	164,966	38,341	19,588
1988	144,962	31,647	15,344

1989	147,450	39,078	15,938
1990	140,942	47,915	15,503
1991	148,214	38,480	13,690
1992	146,284	35,376	17,320
1993	143,148	25,626	14,926
1994	105,250	21,859	17,937
1995	88,145	14,438	21,824
1996	96,463	18,477	27,227
1997	117,574	22,051	24,448
1998	131,623	34,642	28,869
1999	138,286	34,900	17,807
2000	129,580	26,136	13,583
2001	95,349	20,864	16,134
2002	112,875	24,519	12,050
2003	88,406	19,652	11,069
2004	75,277	14,755	9,525
2005	60,039	11,726	7,343
2006	56,197	10,212	5,887
2007	70,354	5,540	7,239
2008	50,566	6,225	5,381
2009	64,080	7,737	5,489
2010	44,400	3,346	2,566
2011	53,520	5,712	3,409
2012	53,423	5,341	3,891
2013	59,275	9,743	1,587
2014	62,201	8,590	5,497
2015	61,825	9,469	4,577
2016	61,443	7,975	4,850
2017	62,641	8,020	6,159
2018	55,443	8,929	7,147
2019	53,063	7,473	6,593
2020	52,164	10,668	7,806

2021	54,074	8,366	6,448
2022	33,293	6,744	5,580
2023	27,739	5,627	3,534

Table 2. Time series (1984-2023) of annual Red Snapper bycatch in numbers and associated CVs for the West, Central, and East Gulf of America subregions.

	West		Central		East	
Year	**Bycatch**	**CV**	**Bycatch**	**CV**	**Bycatch**	**CV**
1984	11,094,823	0.081	1,172,015	0.442	221,140	0.164
1985	12,380,165	0.076	1,087,535	0.439	234,456	0.163
1986	14,318,632	0.071	1,241,663	0.417	181,489	0.172
1987	16,356,390	0.074	1,387,341	0.440	229,635	0.169
1988	15,074,918	0.073	1,260,973	0.447	182,609	0.177
1989	14,585,967	0.074	1,287,579	0.430	185,504	0.183
1990	14,562,641	0.072	1,441,690	0.427	198,253	0.173
1991	14,347,129	0.073	1,292,179	0.448	157,281	0.173
1992	15,164,075	0.072	1,410,090	0.447	159,532	0.181
1993	15,363,625	0.073	1,133,612	0.502	158,781	0.172
1994	11,276,199	0.072	397,458	0.324	207,428	0.184
1995	9,863,335	0.071	373,284	0.294	257,754	0.176
1996	11,272,566	0.069	579,141	0.315	288,297	0.176
1997	13,251,104	0.068	792,867	0.326	258,454	0.180
1998	22,193,429	0.069	1,618,651	0.335	361,226	0.178
1999	21,650,136	0.070	1,633,375	0.361	242,205	0.180
2000	21,069,990	0.068	1,367,943	0.372	195,230	0.181
2001	15,592,406	0.070	1,539,984	0.421	225,587	0.185
2002	18,822,591	0.069	1,564,845	0.404	147,518	0.179
2003	14,157,819	0.070	1,263,123	0.388	127,370	0.178
2004	12,714,229	0.069	942,860	0.385	119,479	0.183
2005	10,298,769	0.068	587,795	0.319	85,795	0.182
2006	9,114,180	0.068	518,089	0.362	65,282	0.182
2007	10,312,639	0.076	238,017	0.238	147,096	0.180
2008	7,790,722	0.083	442,839	0.313	72,784	0.193
2009	11,080,587	0.072	521,565	0.302	111,793	0.192
2010	6,138,575	0.079	260,347	0.298	53,795	0.181
2011	9,400,457	0.068	232,999	0.230	68,894	0.177

2012	7,629,641	0.072	203,434	0.224	66,727	0.181
2013	4,040,861	0.127	796,414	0.441	41,013	0.257
2014	9,446,938	0.083	1,021,709	0.602	100,525	0.145
2015	9,477,171	0.180	663,237	0.138	178,944	0.126
2016	9,009,690	0.167	519,427	0.138	183,612	0.121
2017	8,669,013	0.174	531,606	0.131	213,362	0.133
2018	8,067,892	0.174	586,996	0.158	267,189	0.120
2019	7,117,805	0.164	491,851	0.146	232,380	0.131
2020	6,617,452	0.163	674,810	0.145	233,697	0.117
2021	7,725,846	0.173	566,370	0.160	223,163	0.114
2022	4,867,097	0.197	386,734	0.135	195,031	0.116
2023	4,648,856	0.196	424,468	0.155	112,167	0.109

3.8 FIGURES

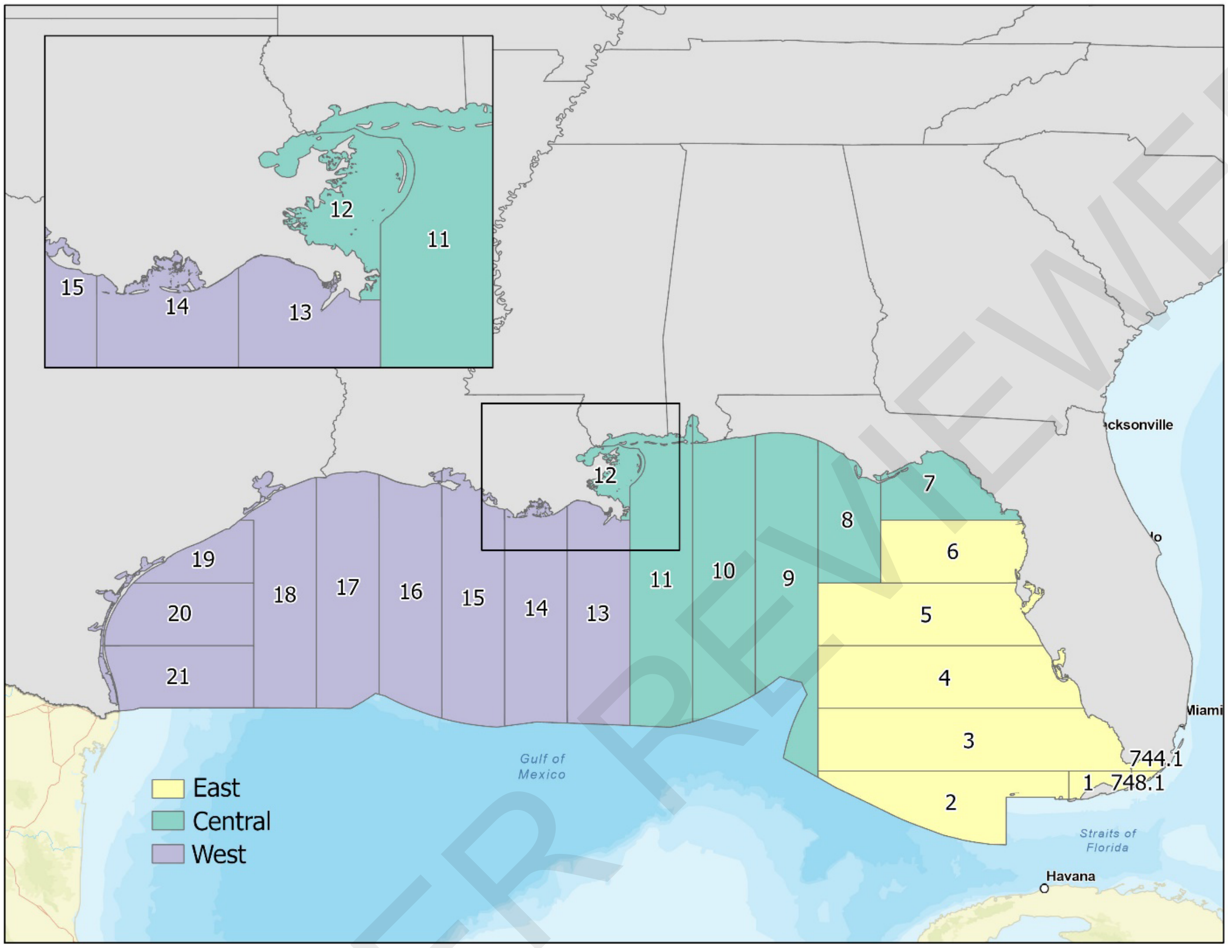


Figure 1. Gulf of America subregions based on commercial landings reported FIN fishing area codes. The East represents statistical zones 1-6, 748.1 and 744.1, Central is 7-12, and the West is 13-21.

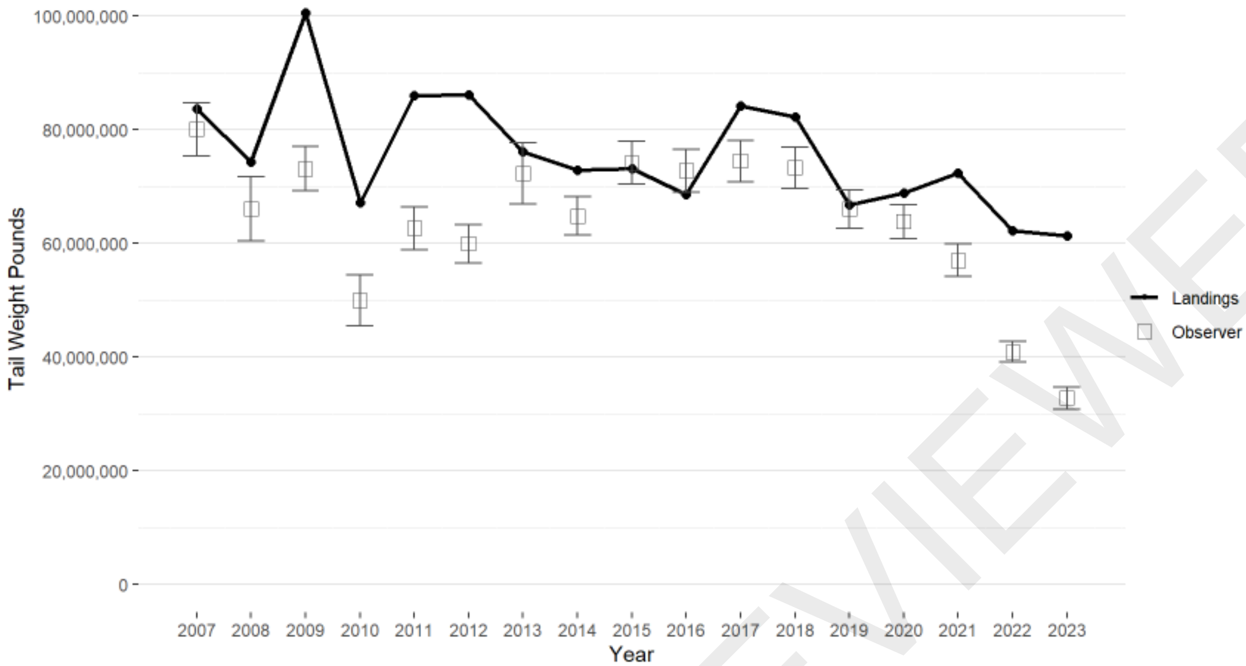


Figure 1. Comparison of penaeid offshore Gulf of America shrimp landings reported on state trip tickets (solid black line) with observer CPUE estimated penaeid landings (open squares) prior to any shrimp effort adjustments. Error bars show standard errors for observer estimates.

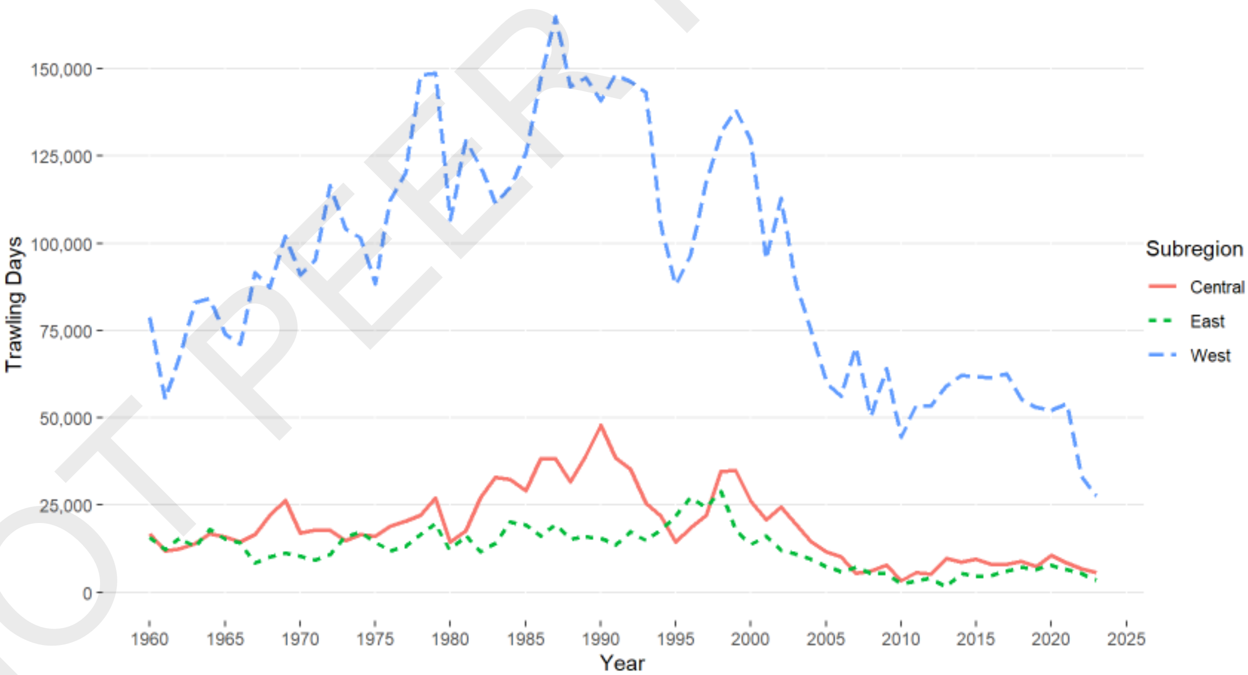


Figure 2. Shrimp trawling effort in 24-hour days from 1960-2023 by Gulf of America subregion (East, Central, and West).

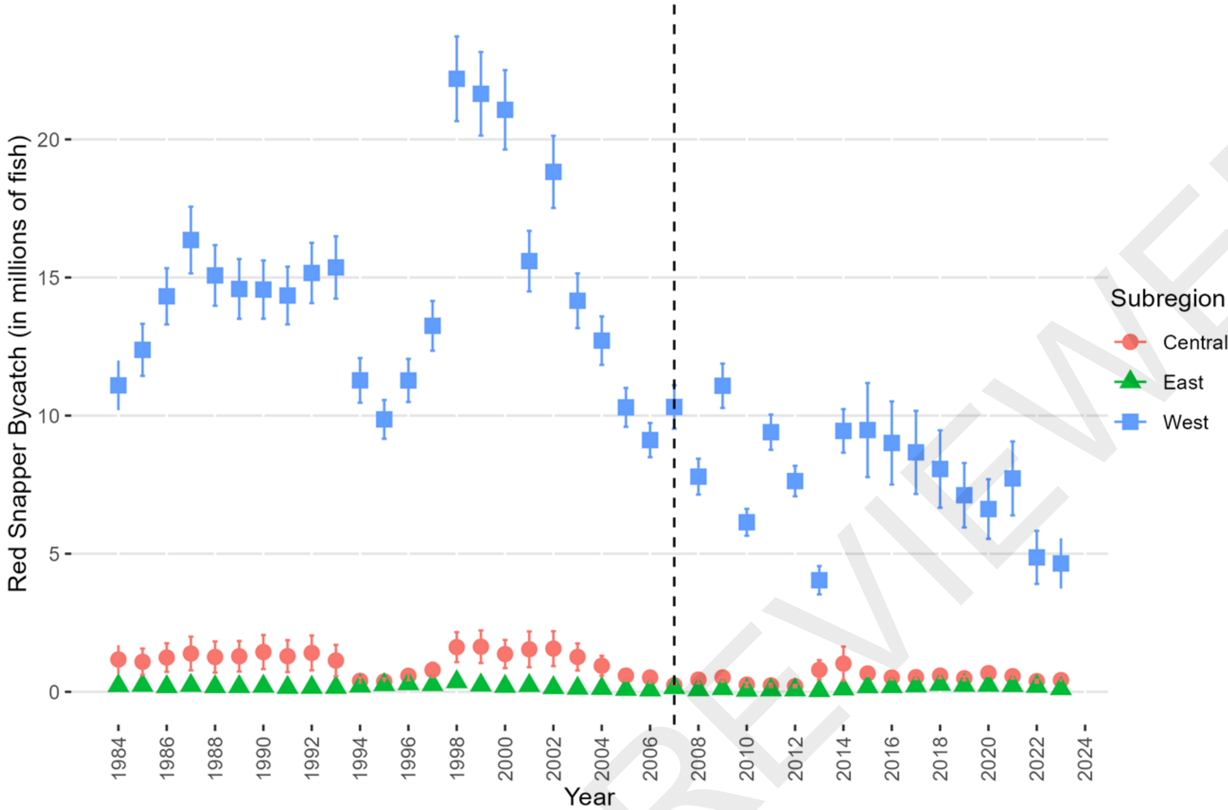


Figure 3. Red Snapper bycatch time series (1984-2023) and associated standard errors for West, Cent

4 RECREATIONAL FISHERY STATISTICS

4.1 OVERVIEW

4.1.1 Group Membership

Leads

Vivian Matter – National Marine Fisheries Service (NMFS) Southeast Fisheries Science (SEFSC) Sustainable Fisheries Division (SFD)
Rob Cheshire - NMFS SEFSC Fisheries Statistics Division (FSD)

Panel Members

Andrew Cathey - NMFS SEFSC FSD
Bob Zales, II - Industry, FL
Chloe Ramsay - Florida Fish and Wildlife Conservation Commission (FWCC)
Dominique Lazarre - NMFS Southeast Regional Office (SERO)
Ellie Corbett - FWCC
Eric Gigli – Mississippi Department of Marine Resources (MDMR)
Jason Adriance- Louisiana Department of Wildlife and Fisheries (LDWF)
John Marquez, Jr. - Industry, MS
Kate Siegfried - NMFS SEFSC SFD
Kevin Anson - Alabama Department of Conservation and Natural Resources (ADCNR)
Maria McGirl - FWCC
Matthew Nuttall - NMFS SEFSC SFD
Mike Jennings- Industry, TX
Richard Cody - NMFS Office of Science and Technology (OST)
Rudy Valenciano - Industry, LA
Samantha Binion-Rock - NMFS SEFSC SFD
Tiffany Hopper - Texas Parks and Wildlife Department (TPWD)
Trevor Montcrief - MDMR

4.1.2 Terms of Reference – Recreational Workgroup

Provide recreational catch statistics by area for each fleet (private boat mode, for-hire charter vessels and headboats) including both landings and discards (for open and closed seasons) in both pounds and number. If state survey landings data are used (e.g., private boat mode), provide a fully calibrated (to a common data unit) time series as necessary.

- Evaluate and discuss the adequacy of available data for characterizing landings and discards (open and closed season) by fleet, mode, or gear.
- Specifically discuss the potential for bias and uncertainty in the data sources.

- Provide length and age distributions for both landings and discards (open and closed season) where feasible.
- Provide estimates of uncertainty around each set of landings and discard (open and closed season) estimates.

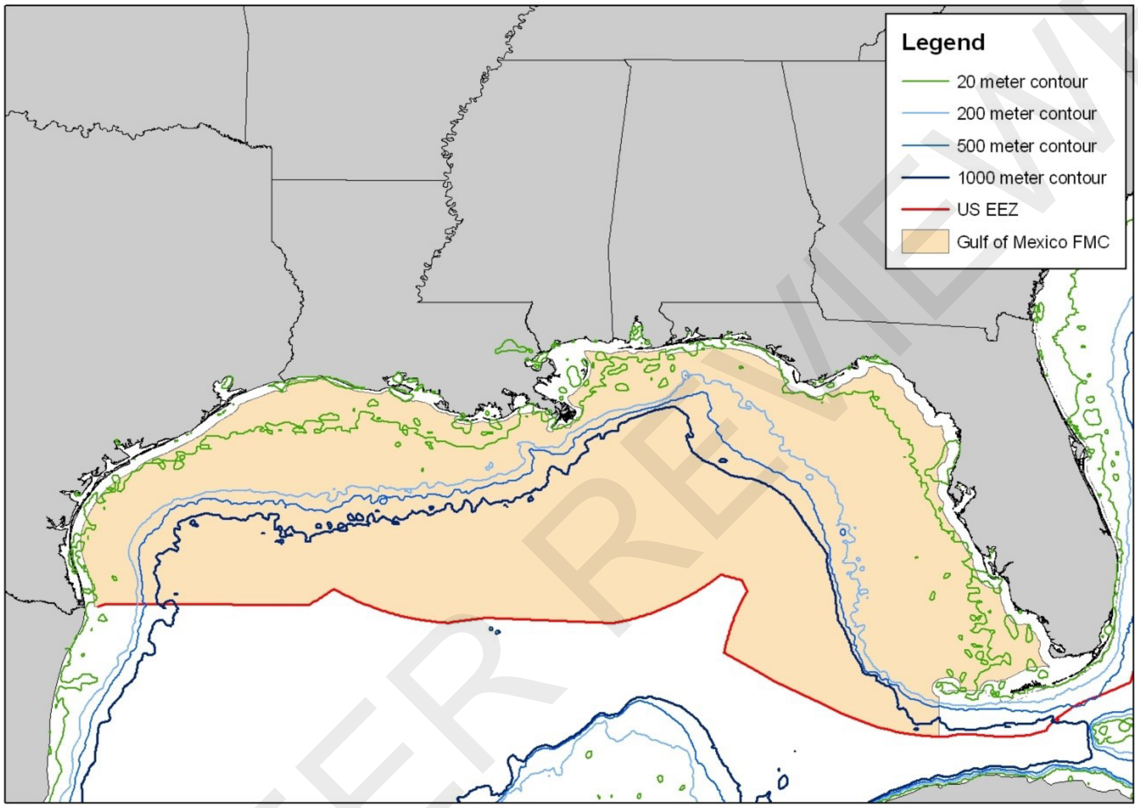
Per the terms of reference, Gulf of America Red Snapper private and charter estimates were provided in the only currently available common data unit, the Marine Recreational Information Program (MRIP).

4.1.3 Tasks

1. Summarize stock identification parameters
2. Review fully calibrated MRIP Fishing Effort Survey (FES)/Access Point Angler Intercept Survey (APAIS) / For-Hire Survey (FHS) landings and discard estimates
3. Allocate MRIP catch estimates from Monroe County to the Gulf of America or South Atlantic
4. Evaluate MRIP catch estimates by mode of fishing to determine appropriate modes for inclusion in the Red Snapper assessment
5. Review calibrations of state survey estimates (TPWD and LDWF creel surveys) into MRIP-FES units
6. Determine when Red Snapper was included in the Southeast Region Headboat Survey (SRHS) universal logbook form
7. 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
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. Provide nominal length distributions for both landings and discards if feasible
11. Evaluate adequacy of available data

12. Provide research recommendations to improve recreational data

4.1.4 Gulf of Mexico Fishery Management Council Scamp Group Management Boundaries



4.1.5 Stock ID Recommendations

Task 1:

Geographic Boundaries

The SEDAR 74 Stock ID Workshop recommended three stock ID regions for Red Snapper. The Western region includes Texas and Louisiana. The Central region includes Mississippi, Alabama, and Northwest Florida, through SRHS area 23 and MRIP Florida sub-region 1 (Dixie County). The Eastern region includes Central and Southwest Florida (SRHS area 21 and MRIP

Florida sub-regions 2 and 3 (Levy to Monroe Counties; SEDAR 74 SID Report). These geographic regions were also used for SEDAR 98.

Species Identification

There were no species misidentification issues for SEDAR 98.

4.2 REVIEW OF WORKING PAPERS

Headboat Data for Red Snapper in the US Gulf of Mexico (SEDAR 98-DW-01)

This document provides an overview of the Southeast Region Headboat Survey (SRHS), the catch estimates of red snapper in number and weight, the uncertainty associated with the estimates, a description of the number of fish measured by the survey, a summary of average lengths and weights, the 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. The lead analysts were provided with a confidential version of the working paper that includes more detailed information and maps of Red Snapper catch.

Recreational Catch Data Consideration Best Practices: SEDAR 98 Gulf of Mexico Red Snapper (SEDAR 98-DW-04)

This document establishes best practice guidance to ensure scientific integrity of recreational data and interpretations, including statistical analyses and stock assessment modeling, is maintained throughout the SEDAR 98 assessment process. It identifies key requirements of any data submitted for consideration in this assessment, including thorough documentation and associated peer-review which are the cornerstone of establishing the necessary evidentiary support for best scientific information available.

General Recreational Survey Data for Red Snapper in the Gulf of Mexico (SEDAR 98-DW-05)

General recreational survey data for Red Snapper from the Marine Recreational Information Program (MRIP), Texas Parks and Wildlife Department (TPWD), and Louisiana Creel Survey (LA Creel) are summarized from 1981 to 2023 for Gulf of America states from Texas to western

Florida. Charter, Headboat (1981-1985), and Private 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.

Gulf of Mexico Red Snapper (Lutjanus campechanus) length and age compositions from the recreational fishery (SEDAR 98-DW-07)

This working paper describes the data and methods used to estimate nominal length and age compositions for the three recreational fleets (e.g. charter, headboat, private) included in the SEDAR 98 Gulf of America Red Snapper Assessment. Changes from SEDAR 74 are also described in this document. During the data workshop, weighted length and age compositions, conditional age-at-length, and mean length-at-age were provided to the Life History Work Group for evaluation. After the Data Workshop, the working paper was updated to provide those final products and describe their methods.

An Update to the FHWAR Method Used to Estimate Historical Recreational Landings (SEDAR 98-DW-08)

The National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (FHWAR) has been conducted every 5 years since 1955 and is one of the oldest and most comprehensive recreational surveys. The FHWAR method utilizes information from these surveys including U.S. angler population estimates and angling effort estimates from 1955–1985 for the Gulf of America region. This method was used in SEDAR 74 to obtain historical Red Snapper landings, prior to 1981, by using estimated saltwater angler trips (1955-1980) from the FHWAR survey and multiplying the average catch rates that are calculated from early years (1981-1989) of the MRIP and SRHS data. Interpolation is used to complete the time series. For SEDAR 98, improvements were made to the FHWAR method to adjust how Florida FHWAR effort was partitioned and to the adjustment for recall bias. These improvements are discussed in this document and the impacts of these improvements are illustrated using the final SEDAR 74 recreational catch data.

Proxy Discard Estimates of Red Snapper (Lutjanus campechanus) from the US Gulf of Mexico Headboat Fishery (SEDAR 98-DW-10)

Discard data were not routinely collected as part of the Southeast Region Headboat Survey (SRHS) until 2004, prior to which SRHS discard estimates are not available. These data are self-reported and not currently validated within the SRHS program. As a form of validation, SRHS discard rates were compared to those from the Headboat At-Sea Observer Program to determine those years for which SRHS discard estimates should be used (SEDAR 52-WP21). The decision was to retain SRHS discard estimates between 2008-2023. For those years prior (1986-2007), proxy discard estimates were calculated using the super-ratio approach, with annual calculations conducted at the StockID level.

Length and Age Information for Gulf of Mexico Red Snapper, Lutjanus campechanus, collected in association with fishery-dependent projects (SEDAR 98-DW-11)

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. This report describes each fishery-dependent research or monitoring project that contributed to the age and length data provided to the Life History Group. During these surveys, priority was given to collecting the left otolith when removing both otoliths was not feasible, to ensure the prompt return of fish to anglers.

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 Red Snapper (Lutjanus campechanus) in the Gulf of Mexico (SEDAR 98-DW-14)

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). Red Snapper *(Lutjanus campechanus)* SRFS estimates for Florida, in the Gulf of America, are provided as part of this report. Additionally, historic MRIP-FCAL estimates for this region have been calibrated into SRFS currency using a peer-reviewed, ratio-based method that has been used in previous assessments (e.g. SEDAR 72, SEDAR 79). This calibration reduced historic MRIP-FCAL landings by 62%, released by 61%, and effort by 56%. Therefore, calibrated MRIP-FCAL or SRFS estimates are provided for this species from 1981-2023.

A Summary of Gulf Red Snapper Discard Length Data Collected from At-Sea Observers in Recreational Fishery Surveys in Florida (SEDAR 98-DW-15)

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 such surveys have been conducted on for-hire vessels in Florida since 2005. For-hire observer surveys have not been consistently funded in Florida, which has led to short breaks in the time series in some regions. In the first three years observer trips were only conducted on headboat vessels, and surveys were expanded after 2008 to include both headboats and charter vessels across a larger geographic area. This report provides a summary of available information on the size composition, release condition, and disposition of Red Snapper collected by trained observers since 2005 during at-sea surveys on for-hire vessels in the eastern Gulf of America.

LA Creel/MRIP Red Snapper Private Mode Landings and Discards Calibration Procedure (SEDAR 98-DW-18)

Beginning in 2014, the Louisiana Department of Wildlife and Fisheries (LDWF) implemented its own creel survey (LA Creel) to provide recreational catch estimates for Louisiana-specific fishery management and stock assessment purposes. Prior to 2014, recreational catch estimates were taken from the National Marine Fisheries Service's Marine Recreational Information Program and the earlier Marine Recreational Fisheries Statistical Survey (NMFS

MRIP/MRFSS). The MRIP and LA Creel surveys were conducted simultaneously in 2015 for benchmarking purposes. Methods were needed to calibrate Red Snapper landings and discards estimates to provide a time series of estimates for SEDAR 98 in common currencies from 1981-2023. A ratio estimator approach is used to hind cast LA Creel recreational landings and discards estimates to 1981 and the MRIP recreational landings and discards estimates to 2023. Tables and figures presented include calibration comparisons, landing and discard estimates in numbers of fish, and associated CVs for LA Creel estimates 2014+.

TPWD Boater Registration Analysis (SEDAR 98-DW-20)

SEDAR 74-DW-10 described a method for ratio calibration of Texas private boat red snapper effort and landings based on a single year of MRIP-FES conducted in Texas in 2016. Because the Texas boater registration database is a census, an analysis of the number of vessels capable of fishing in saltwater and capable of fishing offshore was conducted to compare to the MRIP-based effort estimate to see whether that estimated effort was reasonable given the number of available boats in the state. This report summarizes Texas boater registration data from 2015-2024 and describes the number of trips per vessel that would be required to reach the effort estimated by the 2016 MRIP-FES study in Texas.

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, 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. 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). In the Gulf, MRIP also provided estimates for headboat mode (Hbt) from 1981-85, prior to the onset of the Southeast Region Headboat Survey (SRHS). 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 4.3.2).

Recreational catch and effort 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 charter boat 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 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 (inland, state, and federal waters).

Catch estimates from 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 much 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 at 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 2: In order to maintain a consistent time series, charter estimates were calibrated on the Gulf coast prior to 2000 (SEDAR64-RD-12). CHTS and calibrated FHS charter catch estimates for Gulf of America Red Snapper from 1981 to 1999 are shown in Figure 1 of SEDAR 98-DW-05. Calibrated APAIS and FES estimates for Gulf of America Red Snapper from 1981 to 2017 are shown in Figure 2 of SEDAR 98-DW-05.

Monroe County

Monroe County MRIP landings are included in the official West Florida estimates. 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 (SEDAR68-DW-13). Although Monroe county estimates can be separated using this process, they cannot be partitioned into those from the Atlantic Ocean and those from the Gulf of America (SEDAR-PW-07).

Task 3: For SEDAR 98, MRIP Red Snapper landings from Monroe County were allocated to the Gulf of America because Red Snapper are less common on the extreme south Atlantic coast of Florida. This recommendation is consistent with previous Gulf of America (SEDAR 31, 52, and 74) and South Atlantic (SEDAR 24, 41, and 73) Red Snapper assessments.

Adjustment to Fishing Modes

Task 4a: 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 charter boat 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 for all years after 1985.

During the SEDAR 98 Data Workshop, the Recreational Working Group explored a general shift in magnitude of headboat catch estimates across the 1980s. In particular, headboat landings estimates between 1981-1985 were considered relatively low for the western region when compared to those in subsequent years (1986+), and relatively high for the central region (Figure 4.13.1). Given that headboat estimates for the Gulf of America are calculated from MRIP between 1981 and 1985, and from SRHS after 1986, the Group expressed concern that these shifts may reflect differences in the MRIP and SRHS surveys and not real trends in headboat catch. The Group therefore recommended exploration into alternative estimation approaches, including:

- calibration of MRIP or SRHS catch estimates
- adjustments to the current partitioning method of MRIP for-hire estimates (1981-1985), which is based on uncalibrated ratios of MRIP-charter to SRHS-headboat effort

A similar shift was observed in charter boat catch over this same time period in the western region (albeit in the opposite direction with 1981-1985 catch being relatively high). However, since the charter boat time series is calculated from MRIP estimates, these estimates are already in a single “currency” (i.e., no need to calibrate). The opposite directions of these shifts in western headboat and charter boat catch suggested a need to modify the current partitioning method. Headboat effort estimates were compared between the SRHS and MRIP surveys for years 1981-1985 in the South Atlantic, the only strata offering survey overlap, allowing for evaluation of potential scalars to account for differences in the scale of estimates between these two surveys. This comparison found no temporal trend in the relationship between MRIP and SRHS estimates, but an almost four times greater ratio of MRIP:SRHS effort in North Carolina than those from more southern states (Figure 4.13.1). This spatial pattern is problematic in SEDAR 98 because the Gulf of America offers no overlap between these two surveys and so it is unclear which, if either, of these South Atlantic ratios would be appropriate to apply in the partitioning of MRIP for-hire estimates for this assessment. Going further, the Recreational Working Group expressed concern in being able to defend the application of any South Atlantic ratio to Gulf of America data without an objective evaluation of its suitability. With no clear indication of how best to modify the current partitioning approach, the Group recommends sensitivity analyses be conducted to explore the effect of different “currencies” in the headboat time series, including truncation of this time series (e.g., to 1986) and expansion of FHWAR hindcasting of historical catch through 1985.

Task 4b: MRIP shore mode estimates were excluded from SEDAR 98 because Red Snapper is an offshore species with a strong association with reefs and hard bottoms, and rarely caught from shore (SEDAR 31-DW-04). This recommendation is consistent with decisions made during SEDAR 31, 52, and 74.

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 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. Private and charter modes of fishing are sampled. The program consists 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 who provided a valid telephone number or email address. The for-hire telephone survey samples from a list of Louisiana’s registered for-hire captains who provided a valid telephone number or email address. Both telephone/email surveys are conducted weekly. Dockside/shoreside discard information has been collected since 2016 but only for a subset of finfish species.

Task 5a:

Calibration to MRIP-FES units

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 is used to calibrate private LA Creel landings (2014, 2016-2020) to MRIP FES units as the product of the 2015 MRIP/LA Creel landings ratio and the annual LA Creel landings estimates. Discard estimates between surveys are calibrated using the same methodology as landings (SEDAR 98-DW-18). Effort calibrations were provided by using a ratio estimator of annual 2015 effort estimates from each survey for the private fishing mode.

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 currently utilize data to generate recreational catch and effort estimates from May 1983 onward (SEDAR 70-WP-03). The Coastwide Creel Survey is designed to estimate landings and effort by parsing out seasons based on fishing pressure, high-use from (May 15-November 20) and low-use seasons (November 21-May 14). From there, TPWD disaggregates seasons into waves for all estimates where we determine 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 charter boat fishing trips. While TPWD samples all trips (private, charter boat, 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. Charter boat 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 5b:

The MRIP-FES survey was implemented in Texas in 2016 (S74-RD-110) to compare MRIP-FES effort estimates with the associated 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 was tasked with providing recreational catch statistics by area for each fleet including landings, open season discards, and closed season discards. In accordance with the terms of reference, state survey catch estimates were calibrated to a common data unit in order to be comparable across Gulf states. While concerns were raised regarding the mismatches in angling behavior and estimations between the TPWD creel survey and the 2016 MRIP-FES study, in the absence of a better alternative that allowed for calibration to a common currency, the Recreational Working Group recommended adjusting the private TPWD estimates to MRIP FES as described in SEDAR74-DW-10.

Uncertainty

TPWD provides uncertainty estimates and assigns numbers by matching high- and low-use seasons (the months included in each) to MRIP waves. Data is 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). The 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 Headboat Survey 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 during dockside sampling events. 2) Information about total catch by species and effort are collected via logbooks filled out by vessel personnel for each trip. These logbooks are expanded for missing trips and summarized to generate estimates of catch and effort 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. As in SEDAR 74, the stock ID boundaries were defined as; 1) Louisiana and

Texas as the West Region, 2) Mississippi, Alabama and Northwest Florida as the Central Region, and 3) Southwest Florida (excluding the Florida Keys) as the East Region. The portion of the SRHS covering the Gulf States generally includes 65-70 vessels participating annually.

Texas Headboat Landings (1981-1985)

Landings estimates for Gulf of America headboats between 1981 and 1985 come from the MRIP survey for all states except Texas. As in previous SEDARs, Texas headboat landings for 1981 to 1985 were estimated as a three-year average (1986-1988) 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. The SEDAR 74 approach to calculating 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. For SEDAR 98 an additional step was added to weight the uncertainty by the landings in both number and landings in weight within each region. The weighted proxy CVs by landings in number were recommended for use in characterizing SRHS landings and discard uncertainty in the assessment model:

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

where n is the number of reported trips, N is the number of estimated trips, and L is the landings in number for year i and subregion/region j.

4.3.5 Headboat At-Sea Observer Survey

An observer survey of the recreational headboat fishery was launched in Alabama (AL) in 2004 and in Florida (FL) in 2005 to collect more detailed information on recreational headboat catch, particularly for discarded fish. Sampling in both states was discontinued in 2008, but was started again along western FL in June 2009, with coverage expanded to also include the charter boat fleet. Since 2009, spatial and temporal coverage along the west coast of FL has been variable (Table 1, SEDAR 98-DW-15), but observer coverage has expanded in recent years with the inclusion of Alabama and Mississippi (MS) state-led programs. Cooperative headboat and charter boat vessels were randomly selected each month throughout the year. Biologists board selected vessels with permission from the captain and observe anglers as they fish. Data collected include the species, number, final disposition, and size of landed and discarded fish. Data are also collected on the length of the trip and area fished (inland, state, and federal waters) (SEDAR 98-DW-15).

4.3.6 Texas Hunt and Fish (previously iSnapper)

Since 2015, Texas has given anglers the opportunity to self-report information about their fishing activities including trips targeting red snapper. This capability was originally part of an independent application and website known as iSnapper and was shifted in 2023 to be part of the TPWD harvest reporting app/website which is now called Texas Hunt and Fish. Operating alongside the Texas creel program, this multi-year dataset includes details such as angler license number, number of fish landed, number of fish discarded, and location where fish were landed.

4.4 RECREATIONAL LANDINGS

4.4.1 MRIP Landings

Weight Estimation

The Southeast Fisheries Science Center (SEFSC) used 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 (SEDAR32-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 (SEDAR67-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 (e.g., year and mode), and converted to coefficients of variation (CV). These uncertainty estimates for SEFSC average weights are then combined with those for landings-in-number (Goodman 1960) as an uncertainty estimate for landings-in-weight.

Catch Estimates

Final MRIP landings estimates and associated coefficients of variation, in numbers of fish, are shown by year and mode in Table 3 of SEDAR 98-DW-05 and by year in Table 5 of SEDAR 98-DW-05. Estimates are provided for all Gulf of America states from Louisiana to western Florida. Final MRIP landings estimates in pounds whole weight are shown by year and state in Table 6 of SEDAR 98-DW-05.

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 Red Snapper (2014-2023) are provided in Table 1.1 of SEDAR 98-DW-05. 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 fill in the missing estimates for Texas charter and private boat fishing from 1981 until the survey starts in May 1983. TPWD Red Snapper landings estimates, calibrated to MRIP-FES units for the private mode, from 1981 to 2023 are provided in Table 1.1 of SEDAR 98-DW-05. 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) by stock ID region are shown in Tables 2 and 3, respectively in SEDAR 98-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. CVs weighted by landings in number averaged 0.31, 0.45, and 0.56 across the first 5 years of the SRHS (1986-1990) for the West, Central, and East regions respectively and all decreased to near 0.05 in recent years.

Task 6: The paper headboat logbook forms have changed multiple times throughout the history of the SRHS. The primary changes were to the specific species names listed on the forms, although there have always been blank lines to write in species not listed. Red snapper was listed on the logbook forms from the beginning of the survey in the Gulf. Electronic reporting started in 2013 and all species were available for selection.

4.4.5 Historic Recreational Landings

Introduction

The historic recreational landings time period is defined as pre-1981 for the charter, headboat, and private fishing modes, which represents the start of the Marine Recreational Information Program (MRIP) and the availability of landings estimates for Red Snapper. The Recreational Working Group was tasked with evaluating historical sources and methods to compile landings estimates for Red Snapper 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 and estimates of hunting and fishing effort from surveys conducted by the US Fish and Wildlife Service every 5 years from 1955 to 1985 (SEDAR 68-DW-11). This information was used to develop an alternative method for estimating recreational landings prior to 1981. The two key components from these FHWAR surveys 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. The mean CPUE from the recreational estimates available beginning in 1981 can then be applied to the historical effort estimates for Gulf of America anglers to provide estimates of recreational Red Snapper landings prior to 1981.

Task 7: Estimate historical Red Snapper landings prior to 1981

As done in SEDAR 74, historical landings estimates from the FHWAR method were calculated using the mean CPUE from 1981 to 1989. This longer time period mitigates the higher variability in the MRIP catch estimates from early years of the survey described in section 4.3.1. Further, this time period represents a generally unregulated fishery characteristic of the Red Snapper fishery prior to 1981, during which there were no bag limits. Additionally, size restrictions generally had little effect on recreational fishing. Although the 12” size limit was implemented in November of 1984, headboats were exempted from that size restriction until 1986 and recreational anglers could keep up to 5 fish below the size limit (SEDAR 74-DW-25). There was also generally low enforcement of regulations during this time period. Since SEDAR 74, improvements have been made to the MRIP and SRHS effort provisions. Previously, catch would be imputed for time periods prior to when the survey began (e.g. MRIP 1981 Wave 1), however, corresponding effort was not imputed. For SEDAR 98, effort for MRIP 1981, Wave 1 and all Texas modes from 1981-May 1983 are imputed. The addition of this imputed effort reduced the 1981-1989 mean CPUE from 0.180 in SEDAR 74 to 0.146 in SEDAR 98.

In SEDAR 74, the Recreational Working Group (RWG) was asked by assessment analysts to partition historical landings back in time by fishing mode and stock region. This was accomplished by calculating the mean ratio of recreational landings by mode and stock region from 1981-1989. These mean ratios are then applied to the historical landings from 1955-1980. The RWG discussed the change in the recreational fishing fleet composition back in time. This included firsthand personal accounts by headboat and charter boat captains, who indicated a higher prevalence of charter and headboat fishing in the 1950s and 1960s. It was also noted that there was an increase in the availability and affordability of boats for private anglers to fish offshore from 1955 to 1980 and an increase in population on the coast which led to an increase in potential private boat owners and anglers.

Based on these accounts and the lack of navigational and technological aids available to private recreational anglers fishing for Red Snapper in the past, the SEDAR 74 RWG agreed that the relative proportion of private landings would decrease back in time, while the relative proportion of for-hire landings would have increased. The SEDAR 74 RWG discussed how to adjust for this change, and recommended the following proposed method for partitioning the historical landings estimates back in time by region and stock:

- Assume the same geographic proportions of West, Central, and East Gulf as there was no evidence presented during discussions contradicting these ratios back to 1955.

- Apply mean ratio of recreational landings by mode and stock region from 1981-1989 to the time period 1975 to 1980 (Table 4.12.1). During this time period the radio navigation system, Loran-C became more prevalent and affordable to private anglers.

- Approximate the relative proportion of landings by mode within each stock ID region prior to 1975 considering technological changes that influenced the prevalence of private and for-hire fishing (Table 4.12.1).

    - 1965 -1974 – Loran-A is mostly used by commercial and for-hire vessels; advent of Loran-C

    - 1955 - 1964 - Limited availability of Loran-A (military surplus) some being used as means for navigation by commercial and for-hire fishing vessels. Very limited for private anglers.

In SEDAR 74, the ratios used to partition the historical landings by region and mode for the 1955-1964 and 1965-1974 were rounded and this resulted in a small rounding error where the ratios summed to 1.005 and 1.003, respectively. When these ratios were applied to total historical landings, the sum of the apportioned landings was larger than the historical landings estimate produced using the FHWAR method (SEDAR 98-DW-08). In SEDAR 98, these ratios were not rounded before they were applied to historical landings by region and mode and the annual sums of the apportioned landings are equal to the estimates produced using the FHWAR method.

Historical Red Snapper estimates in number of fish are shown in Table 4.12.2 and Figure 4.13.2 by stock ID and mode. Historical landings estimates in pounds whole weight were calculated by using the average weight (calculated as catch in numbers/catch in pounds) from 1981-1989 by mode and stock ID region for the same time periods. These average weights were applied to the landings in number by mode, stock ID region and time periods. Historical Red Snapper landings estimates in pounds are shown in Table 4.12.3.

Uncertainty

CVs calculated using the FHWAR method for total recreational landings is 0.592. Since these estimates were further partitioned into stock ID and mode, the Recreational Working Group recommended increasing the uncertainty for the historical estimates (in number and weight) by stock region and mode to 1.0. These regional and mode specific estimates are highly uncertain given the limited information available to describe the fisheries back in time.

4.4.6 Total Recreational Landings

Combined landings estimates from all sources by stock ID region are shown in Table 4.12.4 and Figure 4.13.3 and mapped in Figure 4.13.4. The majority of the recreational landings in the Gulf of America come from the private mode (73.8%). Geographically, over half of the landings come from the Central region (55.6%), followed by the West region which accounts for 41.4%. Comparisons of landings across stock ID regions for individual modes are shown in Figure 4.13.5.

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 landing-in-weight. Generally speaking, the estimates for private, charter, and headboat all showed relatively high CVs over the first 5-10 years of their respective time series. Exceptions to this include private and charter estimates in the Eastern region, which produced fewer intercepts of red snapper than the other two regions and relatively high CVs across the entire time series. Headboat estimates for 1981-1985 in the Western region were also less uncertain than that seen in the other two regions, a function of these estimates being largely imputed from subsequent SRHS estimates (1986-1988) and not solely estimated from MRIP data as in the Central and Eastern regions.

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 species identification 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 and associated coefficients of variation, in numbers of fish, are shown by year and mode in Table 4 of SEDAR 98-DW-05 and by year in Table 5 of SEDAR 98-DW-05. Estimates are provided for all Gulf of America states from Louisiana to western Florida.

Discards by Open vs. Closed Season

At the request of assessment analysts, discard estimates were separated into "open" vs. "closed" fishing seasons. This partitioning was done using trip-level intercept data, assigning seasonal designations to each intercept reporting Red Snapper catch from the associated date of those intercepts. Assignments for the charter mode were made solely from federal fishing seasons, whereas those for the private mode were made from both federal and state-specific fishing seasons. The SEDAR 98 Recreational Working Group decided to include state seasons for the private mode given concerns that private anglers may fish freely in both state and federal waters but simply claim activity in the area that happened to be open at that time. The Group also highlighted some initial confusion in the boundaries of state vs. federal waters, with some states claiming waters out to 9 miles that gave anglers confidence that they were permitted to fish in federal waters, even during a closed fishing season.

With all assignments made to the raw intercept data, the relative number of discards from each (open vs. closed) season was then applied to partition discard estimates at the finest possible stratification (i.e., year, wave, region, state, mode, area-fished). This approach differs from that described in the general recreational working paper submitted for SEDAR 98 (SEDAR 98-DW-05), which assigned "open" vs. "closed" solely from the federal fishing seasons. This approach also differs from that applied in SEDAR 74, which applied the percent days-open of a given fishing season to partition strata-level discard estimates (SEDAR 74-DW-35). The SEDAR 74 approach assumes the probability of landing/discarding a red snapper is equivalent across all days within a particular stratum (e.g., all days within a wave are weighted equally), which may not be true if anglers target different species, fish in different areas, or apply different angling methods when the red snapper fishing season is open or closed. Overall, there appears to be little difference in the resultant partitioning between the SEDAR 74 and SEDAR 98 approaches, but the SEDAR 98 approach did assign more discards to the open season. The Recreational Working Group discussed and attributed this trend to fishing effort being more concentrated on Red Snapper during open seasons. The Group considers the updated SEDAR 98 approach as an improvement and recommends its use in this assessment.

4.5.2 LA Creel Discards

Red Snapper are a target species of the LA Creel survey and discard estimates are available starting in 2016. LA Creel discard estimates of Red Snapper in 2014 and 2015 are imputed as the product of the ratio of annual discards to harvest in the 2016 LA Creel survey (Table 2, SEDAR 98-DW-18) and the 2014 and 2015 LA Creel harvest estimates. The 2016 LA Creel estimates were chosen to form the ratio of discards to harvest to calculate the 2014 and 2015 LA Creel discards estimates due to the similarity between the 2014-2016 Louisiana Red Snapper fishing seasons (i.e., similar federal and state season lengths) prior to fishery management changes implemented in 2017. Private mode LA Creel discard estimates, calibrated to MRIP FES units for Louisiana Red Snapper (2014-2023), are provided in Table 1 of SEDAR 98-DW-18.

Discards by Open vs. Closed Season

Discard estimates were separated into those specific to fishing from "open" vs. "closed" fishing seasons. This partitioning was done using the same approach for MRIP discards above (in Section 4.5.1), using relative catch from trip-level intercept data to partition strata-level discard estimates between seasons.

4.5.3 TPWD Discards

Self-reported catch is not monitored by the TPWD survey and so discards of Red Snapper from Texas are not estimable from 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 and mode) from Louisiana catch estimates and multiplied by TPWD landings estimates. Texas estimates of Red Snapper discards (1981-2023) are included in Table 1.1 from SEDAR 98-DW-05. It should be noted that Red Snapper harvest is open year-round in Texas state waters, and discarding in Louisiana is likely not representative of the entire western region. However, this is the only method currently available to estimate discards in Texas. As a form of validation, the SEDAR 98 Recreational Working Group compared discard rates (B2:AB1) of Gulf of America Red Snapper between Texas Hunt and Fish and LA Creel (Figure 4.13.6), which were similar enough to give confidence to the application of LA discard rates in imputing Texas discards.

Discards by Open vs. Closed Season

Discard estimates were separated into those specific to fishing from "open" vs. "closed" fishing seasons. This partitioning was done using the same approach for MRIP discards above (in Section 4.5.1), using relative catch from trip-level intercept data to partition strata-level discard estimates between seasons.

4.5.4 Headboat At-Sea Observer Survey Discards

Self-reported headboat discards (discussed in 4.5.5) are not currently validated within the SRHS. However, discard information from the At-Sea Observer Survey is used to validate the SRHS discard estimates and determine whether SRHS discards should be used for the entire time series (2004-2019) or for a partial time series. In the Gulf of America, the At-Sea Observer Survey operates mainly in western Florida, with limited coverage in Alabama in certain years. No trips were sampled in the At-Sea Observer Survey in 2008. During SEDAR 52 the SRHS discard proportions were compared to the MRIP At-Sea Observer program discard proportions for validation purposes and to determine whether the SRHS discard estimates should be used for a full or partial time series (SEDAR 52- DW-21). Based on those findings and the SEDAR 74 decisions it was determined that the SRHS discard estimates should be used for a partial time series (2008-2023), while using the MRIP CH: SRHS discard ratio method to calculate headboat discards for 1981-2007 for SEDAR 98.

4.5.5 SRHS 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 January 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 standardizing the determination. The form now collects only the total number of fish released, regardless of condition. The discard data provided for the assessment is in total discards for all years.

Closed and open season discard estimates were calculated since the estimates are expanded for missing trips by year, month, trip duration, and vessel which does not align with the closure dates. The standard estimation values were used for all months that were fully open or closed. For months partially closed, the reported discards were summed across the open and closed days. The difference between the estimated and reported discards was then added to the closed and open summaries based on the proportion of days open or closed. For example, a month with 20 of 30 days open and a difference of 100 fish between estimated and reported discards would require adding 67 fish to open and 33 fish to closed discard summaries. Fortunately, the time period over which discards were reported aligned with high compliance and more accurate reporting so the difference between reported and estimated discards was relatively small. Open and closed season SRHS discard estimates for 2008-2023 are shown in Tables 4 and 5, respectively, in SEDAR 98-DW01.

As a proxy for headboat discards from 1981-2007 for the West Region and 1986 - 2007 for the Central and East Regions, 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, 1981-2007 in TX) to estimate the yearly SRHS discard: landings ratio (1986-2007, 1981-2007 in TX). This ratio was then applied to the SRHS landings (1986-2007, 1981-2007 in TX) to estimate headboat discards (1986-2007, 1981-2007 in TX).

Task 9: The SEDAR 98 Recreational Working Group recommended using the MRIP CH: SRHS discard ratio proxy method 1981-2007 described above and the SRHS estimated discards 2008-2023. The MRIP CH: SRHS discard ratio proxy method is the current SEDAR Best Practice method and allows for changes in management and year class effects to be incorporated into the assessment (SEDAR-PW-07). Final headboat proxy discard estimates are summarized in Table 1 and Figure 2 of SEDAR 98-DW-10.

Uncertainty

Uncertainty in SRHS discards for 2008-2023 use the same method described for the landings. Prior to 2008, uncertainty estimates for SRHS proxy discards are calculated from SRHS estimates of landings and the associated uncertainty for that year (Table 13 in SEDAR 98-DW-01) and estimates of the applied discard rate and associated variance. Final uncertainty estimates for headboat discards are shown in Figure 2 in SEDAR 98-DW-10.

Open vs closed season discards

For SRHS proxy discard estimates (1981-2007), this partitioning was done using the percent days-open for a given fishing season (SEDAR 98-DW-10), the same approach applied in SEDAR 74 (SEDAR 74-DW-35) but which differs from the trip-level intercept approach applied to partition MRIP (Section 4.5.1), LA Creel (Section 4.5.2), and TPWD (Section 4.5.3) discards in this assessment. While proxy discards could have been imputed using relative catch from trip-level (logbook) data, this would have required separate SRHS landings estimates for each season, which was not required for SEDAR 98. Even if requested, there were also precision concerns with proxy discards being estimated for the "closed" fishing season, likely to be calculated by expanding relatively small landings estimates by a relatively high discard rate.

4.5.6 Total Recreational Discards

Combined discard estimates from all sources by stock ID region are shown in Table 4.12.5 and Figure 4.13.7 and mapped in Figure 4.13.8 The majority of the recreational discards in the Gulf of America come from the private mode (87.9%). Geographically, most discards come from the Central region (74.0%), followed by the West (22.4%) and East regions (3.6%). Discard estimates steadily increased between the late 1980s and early 2000s and have remained consistently high. Comparisons of discards across stock ID regions for individual modes are shown in Figure 4.13.9.

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). Like that for landings, uncertainty in private discards tended to be relatively high over the first 5-10 years of the time series for all three regions, with subsequent declines in the early 1990s for the Central region and in the early 2010s for the East and West regions. Uncertainty in charter discards declined in the early 1990s for both the West and Central regions, and again in the mid-2010s for the West region. Charter CVs for the East region tended to stay relatively high throughout the time series. Uncertainty in headboat discards was relatively high for all three modes until ~2008, after which uncertainty remained low. Headboat CVs in the Central region also showed a decrease through the early 1990s.

4.6 BIOLOGICAL SAMPLING

4.6.1 Landed Fish

4.6.1.1 MRIP Biological Sampling

The MRIP angler intercept survey includes the collection of fish lengths from the harvested catch (landed, whole condition). Up to 15 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). In those fish with a forked tail, this measure would typically be referred to as a fork length. In those fish that do not have a forked tail, it would typically be referred to as a total length, with the exception of some fish that have a single, or few, caudal fin rays that extend further. 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. Discarded fish size is not collected by MRIP for any fishing mode.

Summaries of fish size (pounds whole weight) for MRIP-sampled Red Snapper in the Gulf of America by region and fishing mode (1981-2023) are provided in Table 7 of SEDAR 98-DW-05. Table 8 in SEDAR 98-DW-05 provides annual summaries for all regions and fishing modes combined. These summaries include the number of Red Snapper weighed, number of angler trips from which Red Snapper were weighed, and the minimum, average, and maximum weights. The number of Red Snapper sampled for lengths by MRIP are available in Table 1 of SEDAR 98-DW-07. Length distributions of Red Snapper sampled by MRIP are available in Figures A1-A9 of SEDAR 98-DW-07.

4.6.1.2 LA Creel Biological Sampling

Size, weight, and age structures of recreationally landed Red Snapper have been collected from the LDWF Biological Sampling Program starting in 2014. During open Red Snapper season, size measurement targets are 30 fish sampled per area per mode (charter and private) per week. Size measurements are maximum total lengths. Weight measurements are 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 Red Snapper in the Gulf of America by mode (2014-2023) are provided in Table 9 of SEDAR 98-DW-05. These summaries include the number of Red Snapper weighed, number of angler trips from which Red Snapper were weighed, and the minimum, average, and maximum weights. The number of Red Snapper sampled for age by LDWF is available in Table 2 of SEDAR 98-DW-07. The number of Red Snapper sampled for lengths by LDWF are available in Table 1 of SEDAR 98-DW-07. Length distributions of Red Snapper sampled by LDWF are available in Figures A1 and A7 of SEDAR 98-DW-07.

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). Total length is measured by compressing the caudal fin lobes dorsoventrally to obtain the maximum possible total length. 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 Red Snapper sampled for lengths by TPWD are available in Table 1 of SEDAR 98-DW-07. Length distribution of samples collected by TPWD are shown in Figures A1 and A7 of SEDAR 98-DW-07.

4.6.1.4 SRHS Biological Sampling

Lengths have been collected by headboat dockside samplers 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 gonads) are also collected routinely and processed for aging, diet studies, and maturity studies.

The number of Red Snapper sampled by SRHS for lengths is available in Table 1 and the number sampled for age is available in Table 2 of SEDAR 98-DW-07. The length distributions of fish sampled by SRHS are shown in Figures A4-A6 of SEDAR 98-DW-07. Mean weights by year and state from biologically sampled Red Snapper in the SRHS are summarized in Table 27 of SEDAR 98-DW-01.

4.6.1.5 Nominal Length Frequency Distributions of Landings

Length data from the recreational fisheries of the Gulf of America are collected by federal and state agencies including TPWD, LDWF, MDMR, AMRD, and FWRI. Sources utilized include data collected in each state (described above) and warehoused by Gulf States Marine Fisheries Commission (GSMFC) in the GulfFIN database (2001-2023), MRIP (1981-2023), and SRHS (1986-2023). Improvements in data provision, facilitated by the Life History Template, allowed for the inclusion of more length samples in SEDAR 98 than were available for SEDAR 74. Unique records (n=79,438) in the age data were added to the length-only data for inclusion in nominal length compositions. In SEDAR 74, data for Snapper Check were excluded because of concerns samples were being duplicated in MRIP. When Snapper Check first began, there were a small number of lengths (n=382) that were submitted to both Snapper Check and MRIP. This no longer occurs and a sample is now only submitted to a single program. Biologists at ALDCNR are able to use the date and sampling identification number to match which samples were submitted to both programs. ALDCNR submitted their data using the Life History Template and flagged these samples using the 'Duplicate_Lengths' field (Anson, pers comm 2024). Samples that were flagged as duplicates were removed and 22,581 samples were retained for length compositions.

Length sample sizes from all data sources by mode and stock ID region are shown in Table 4.12.6. For all fleets, sample sizes are the lowest for the East region and only beginning in 2017 are sample sizes sufficient to provide annual nominal length compositions. For the West and Central regions, sample sizes are typically sufficient to produce nominal length compositions, except in the 1980s where some sample sizes were less than 30 fish per year.

Task 10a: Nominal length frequencies were generated for recreational data by fleet and stock ID region (Figure 4.13.10) At the request of the stock analysts, length compositions were generated using 1-cm length bins. In both the West and Central regions, there were multiple years where the charter fleet length distributions skewed slightly larger than distributions from the private and headboat fleets. Low sample sizes in the East region makes inference difficult for most years, however, there is no clear trend in later years where sample sizes are higher.

4.6.1.6 Aging Data

Age samples for the headboat fleet are collected primarily as part of the SRHS sampling protocol. Age samples collected from the private/rental boat and charter boat fleets, in addition to some headboat samples, come from a number of sources including state fishery-dependent sampling programs (described above) and special projects (Table 2 in SEDAR 98-DW-07). The largest numbers of age samples were collected by FIN-BIOSTAT (n=33,293), RECFIN/REPBIO (n=24,908), and SRHS (n=21,545). Descriptions of FIN-BIOSTAT and RECFIN/REPBIO are provided in SEDAR 98-DW-07. The numbers of Red Snapper aged from the recreational fishery by year, stock, and fleet are summarized in Table 4.12.7. For all fleets, sample sizes are lowest in the East region. Sample sizes are higher for the charter and headboat fleets compared to the private fleet.

4.6.1.7 Nominal Age Compositions

Nominal age distributions were generated for recreational data by fleet and stock ID region (Figures 4.13.11). In all regions, the age compositions among the fleets were most similar in the early 2000s. In the more recent years, the nominal age distributions from the charter fleet in the West and Central regions include older fish.

4.6.2 Discarded Fish

4.6.2.1 For-Hire At-Sea Observer Survey Biological Sampling

At-sea sampling of headboat (2005 to present) and charter boat (2009 to present) discards were initiated as part of the improved for-hire surveys to characterize the size distribution of live discarded fish. Headboat observer data was collected in both Florida and Alabama from 2005 to 2007 but continued in Florida after 2009 to the present. A summary of the live discard length data from Florida and Alabama from 2005-2007 was provided to analysts and described in

SEDAR 74-DW-18. Data collections in Florida are conducted year-round. During the data workshop discussions, additional data from at-sea observer sampling conducted in Mississippi from 2016-2020 and Alabama from 2017-2019 were identified. In both states, new initiatives have allowed for the collection of additional discard length data from both the headboat and charter fleets. Data collection in Mississippi and Alabama only occurs during the open Red Snapper season. Sample sizes for open and closed season observer discards are shown for the headboat and charter modes in the East region (Table 4.12.8), for the headboat mode in the Central region (Table 4.12.9), and for the charter mode in the Central region (Table 4.12.10).

4.6.2.2 Nominal Length Frequency Distributions of Discards

Task 10b:

Eastern stock ID region

- Headboat lengths in this stock ID region are available from 2005 to 2023. The procedure for weighting headboat data to account for uneven sampling of different trip durations in each Florida region was discussed. This is particularly necessary to address oversampling of multi-day trips in Florida, in comparison to the proportion of multi-day trips reported by the headboat fleet (SEDAR 98-DW-15). Annual headboat discard length compositions for the East region by open and closed season are presented in Figure 4.13.12.
- Charter boat lengths in this stock ID region are available from 2009 to 2023. Charter discard length frequency data has not been weighted by trip type in past SEDAR assessments, with only nominal discard length compositions generated. Annual charter boat discard length compositions for the East region for open and closed season are presented in Figure 4.13.13.

Central stock ID region

Length measurements from fish were used to generate headboat and charter boat discard length frequency distributions from the central stock ID region. The introduction of data from Mississippi and Alabama during this assessment led to additional data investigations to determine how to incorporate the new data with northwest Florida data. Using data from all states would generate a more complete representation of discard length data in the central stock assessment region.

- Headboat fleet was sampled for discarded Red Snapper lengths from the 2005 to 2023 in Florida and 2005 to 2007, 2022, and 2023 in Alabama (Table 4.12.9). Nominal headboat compositions from Alabama were compared to NWFL length compositions (Figure 4.13.14) and found to overlap closely for the time periods when data were collected in both states. Similar to the headboat trips in the East region, NWFL and AL data are weighted by trip type to correct for sampling of different trip lengths. Annual headboat discard length compositions for the Central region by open and closed season are presented in Figure 4.13.15.
- Charter boat lengths in this stock ID region are available from 2009 to 2023 in Florida, 2017 to 2019 in Alabama, and 2016 to 2020 in Mississippi (Table 4.12.10). Charter discard length frequency data has not been weighted by trip type in past SEDAR assessments. Nominal charter boat lengths compositions from Alabama, Mississippi, and Florida were compared (Figure 4.13.16). Charter boat data show a similar trend to headboat data, where generally the central tendencies of the length frequencies overlap. Combined charter boat central discard compositions were weighted by discard estimates to ensure compositions are representative of the actual removals from the population. Charter mode lengths were weighted with discard estimates by year and subregion. Two subregions within the Central stock ID region were used 1) NWFL and 2) combined Alabama and Mississippi. This was done for open and closed seasons independently. Weighted and nominal discard length compositions are shown in Figure 4.13.17. Mississippi discard lengths in 2022 and 2023 are generally smaller than those in NWFL, particularly in the closed season. By weighting the proportions of discards by subregion, the impact of the smaller Mississippi discard lengths is down-weighted because the proportion of discards in the Alabama/Mississippi subregion is low compared to NWFL. The Recreational Working Group recommended combining all Mississippi, Alabama, and NWFL data to create the weighted charter boat discard length composition for the central stock assessment region (Figure 4.13.18).

Western stock ID region

There is no discard length information available from the Western region.

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 charter boat 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. Effort is included in the year and mode summaries provided by Table 11 in SEDAR 98-DW-05. This table includes MRIP effort estimates for all Gulf of America states from Louisiana to western Florida.

4.7.2 LA Creel Effort

Louisiana effort estimates (in angler trips) are provided by LA Creel for years 2014-2023. These estimates are included in Table 11.1 of SEDAR 98-DW-05, which summarizes effort by year and mode and includes the calibration of LA Creel private effort estimates to MRIP-FES units.

4.7.3 TPWD Effort

Texas effort estimates (in angler trips) are provided by TPWD for years 1983-2023. TPWD average estimates from 1983 to 1985 (by wave and mode) were used to fill in the missing estimates for Texas charter and private boat fishing from 1981 until the survey starts in May 1983. These estimates are included in Table 11.1 of SEDAR 98-DW-05, which summarizes effort by year and mode and includes the calibration of TPWD effort estimates to MRIP-FES units.

4.7.4 SRHS Effort

Effort data from the SRHS is provided as the number of anglers on a given trip, 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 check the logbook trip reports 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 (e.g. direct contact with captain or crew, social media posts, public video camera streams, etc.). 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) by stock ID region are provided in Table 19 and Figure 10 of SEDAR 98-DW-01. Estimated headboat angler days have remained relatively stable in the Gulf of America in recent years. The most obvious factor which impacted the headboat fishery in both the Atlantic and Gulf of America was the effect of COVID in 2020. Reports from industry staff, captains/owners, and port agents indicated health concerns and restrictions affected the number of trips and number of passengers, reducing overall fishing effort.

In order to summarize all recreational fishing effort across the Gulf of America, SRHS effort estimates are also provided in the coarser units of angler trips to match that 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 (SEDAR 28-DW-12). SRHS effort estimates (in angler trips) by stock ID region are provided in Table 20 and Figure 10 of SEDAR 98-DW-01.

4.7.5 Total Recreational Fishing Effort

Combined effort estimates in angler trips from all sources by stock ID region are shown in Table 4.12.11, Figure 4.13.19, and mapped in Figure 4.13.20. These effort estimates depict all recreational fishing activity in the Gulf of America and are not specific to Red Snapper. The majority of the recreational effort in the Gulf of America comes from the private mode (96.3%). Geographically, similar amounts of effort are noted from the West and East regions (each at 39.9%), with the remaining 20.2% from the Central region. Effort estimates have steadily increased between the early 1980s and mid-2000s and have since remained consistently high. Comparisons of effort across stock ID regions for individual modes are shown in Figure 4.13.21.

4.8 COMMENTS OD ADEQUACY OF DATA FOR ASSESSMENT ANALYSES

Task 11: Regarding the adequacy of the available recreational data for assessment analyses, the Recreational Working Group discussed the following:

- Calibrations to MRIP-FES units for TPWD (1981-2023) and LA Creel (2014-2023) were presented and recommended for use during the Data Workshop. Historical landings (1955-1980) have a high uncertainty based on data availability and assumptions made in the methodology, including partitioning out the historical landings by mode and stock ID region. Nonetheless, these estimates are the best information available for consideration to the Recreational Working Group during SEDAR 98. Landings, as adjusted, appear to be adequate for the time period covered (1955-2023).

- Since there are no discard estimates from Texas, a proxy discard rate from Louisiana was used to fill in this data gap. Similarly, headboat mode 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 (1981-2023).

- Size data appear to adequately represent the landed catch for all modes.

- Discard size data from the headboat and charter boat fleets appear to be adequate for describing the size composition of discarded Red Snapper**.**

4.9 Itemized List of Tasks for Completion following Workshop

Weighted length and age compositions are typically completed for the Assessment Workshop (completion of Task 9). However, these have already been completed by the Age Composition Working Group and documented in that section of this report.

4.10 RESEARCH RECOMMENDATIONS

4.10.1 Research Recommendations for SEDAR 98

Task 12:

1. ***Investigate potential options to smooth the ratios used to delineate historic recreational landings by region and fishing mode across time blocks.***

2. ***Develop a Gulf wide interstate calibration between all states***

   a. Evaluate future Creel surveys in MS and AL against LA Creel survey to determine if surveys are in equivalent units (Are the landings streams 1 to 1?)
   b. If creel surveys in LA, MS, and AL are in equivalent units, evaluate whether a Creel survey unit is equivalent to a SRFS unit
   c. Compare TPWD to the other Gulf state units

3. ***Evaluate the for-hire partitioning in the MRIP 1981-1985 years***

4. ***Continue investigations into iSnapper/Texas Hunt and Fish app as a suitable source of discard and landings estimates for TX.***

5. ***Evaluate additional sources of mortality from shark and marine mammal predation.***

6. ***Research and compile Gulf hurricanes areas and dates over time.***

4.10.2 Evaluation and Progress of Research Recommendations from Last Assessment

Research recommendations from SEDAR 74 were evaluated and progress on each item is outlined below:

1. SSC to add TOR to operational assessment to include a topical working group to review and evaluate the results of the Gulf of America transition plan to optimize the use of state and federal data.

   - The SEDAR 74 operational assessment was canceled and so no topical working group was formed.
   - The SEDAR 98 Terms of Reference included language to “provide a fully calibrated (to a common data unit) time series as necessary.”
   - No update was provided on the Gulf of America transition plan during SEDAR 98.

2. Integrate TPWD into the Gulf Transition Team in order to further evaluate the proposed calibration between TPWD and MRIP units and identify alternative methods that may be implemented, including increased benchmarking (e.g. 3-year benchmark period).

- TPWD has become a contributing member of the Transition Team
- Alternative calibration methods have been identified and discussed
  - Foster Method (S74-DW-10), by-year and by-wave, FHWAR Method
- S98 RecWG recommends future study aimed at benchmarking

3. Gulf Transition Team should investigate the drivers of high MRIP wave specific effort estimates for recreational modes during traditionally low effort waves (e.g. winter waves, particularly in MS).

- Mentioned in the Transition Team
- No progress noted

4. Develop and implement methods in the western Gulf region to collect vital statistics on the size distribution of recreational discards and directly estimate the magnitude of recreational discards in Texas.

- Gulf-wide IRA proposal to collect discards

5. Investigate the need for weighting headboat discard length composition data from new data streams. Determine if data need to be weighted due to over or under sampling of any particular trip types. If so, provide total number of trips sampled by state (or headboat region) and year, dock to dock hours for each trip, fleet (charter vs headboat), and catch type (harvest vs discard).

- Return Em Right targeting federal waters and reef fish.
- Randomly selected trip types.

6. Investigate methods for weighting charter discard length composition data (to account for uneven sampling of trip types) or determine if weighting by trip type is necessary for that fleet.

- No progress noted

7. Develop methods to properly weight discard length composition data from different states relative to the proportional magnitude of discards.

- Weight by the discard estimates in similar manner as landings comps

8. Develop statistically valid methods to identify outlier estimates (e.g. extremely high catches) and adjust sample weights for records that have a disproportionately high influence on total catch estimates. Establish new SEDAR best practice methods.

- Small area estimation and precision threshold working groups
- Additional information provided in working papers about high estimates

9. Provide working paper or presentations during the data workshop group meeting documenting collection methods and caveats for new data streams being evaluated / used.

- SRFS (SEDAR98-DW-14)
- LA Creel (SEDAR98-DW-18)
- Best practice document (SEDAR98-DW-04)

10. Develop a list of qualitative information about the snapper-grouper fishery from stakeholders and methods to evaluate validity.

- Seagrant project with oral histories
- Red snapper participatory modeling project
- CMP stakeholder engagement workshops

11. Research of additional reference points for historical landings.

- Edit: reference periods rather than reference points
- Updates to FHWAR methodology

12. Estimate and publish historical landings for major species (or species groups) in a single initiative to ensure a consistent methodology.

- No longer recommended

13. General evaluation of start year of existing models and value of historical data.

    - Conducted in the assessment phase taking into consideration all data inputs.
    - Recommended sensitivity in SEDAR 98

14. Evaluate how changes in fishing outcomes (fish for freezer vs. offshore experience with a few filets for dinner) have impacted fishing behavior over time. Important for determining validity of some historical landings assumptions.

    - No progress noted
    - Addition of regulatory impacts

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4.12 TABLES

Table 4.12.1. Ratios used to delineate historical landings by fleet and region. CB = charter, PR = private, and HB = headboat.

Region	Fleet	1955-1964	1965-1974	1975-1980
W	CB	0.279	0.173	0.066
W	PR	0.099	0.269	0.440
W	HB	0.229	0.165	0.102
C	CB	0.159	0.130	0.100
C	PR	0.080	0.123	0.167
C	HB	0.090	0.075	0.060
E	CB	0.045	0.025	0.006
E	PR	0.018	0.037	0.057
E	HB	0.002	0.002	0.002

Table 4.12.2. Estimated historical recreational landings in numbers of fish for Red Snapper in the Gulf of America from 1955-1980. CB = charter, PR = private, and HB = headboat.

Year	W_CB	W_HB	W_PR	C_CB	C_HB	C_PR	E_CB	E_HB	E_PR	Total
1955	308,931	253,765	110,333	176,532	99,299	88,266	49,650	2,348	19,860	1,108,985
1956	342,160	281,060	122,200	195,520	109,980	97,760	54,990	2,601	21,996	1,228,267
1957	375,388	308,355	134,067	214,508	120,661	107,254	60,330	2,854	24,132	1,347,548
1958	408,617	335,650	145,935	233,495	131,341	116,748	65,671	3,106	26,268	1,466,830
1959	441,845	362,944	157,802	252,483	142,022	126,242	71,011	3,359	28,404	1,586,112
1960	475,074	390,239	169,669	271,471	152,702	135,735	76,351	3,611	30,540	1,705,394
1961	488,656	401,396	174,520	279,232	157,068	139,616	78,534	3,715	31,414	1,754,149
1962	502,238	412,552	179,371	286,993	161,434	143,496	80,717	3,818	32,287	1,802,905
1963	515,819	423,709	184,221	294,754	165,799	147,377	82,900	3,921	33,160	1,851,660
1964	529,401	434,865	189,072	302,515	170,165	151,258	85,082	4,024	34,033	1,900,415
1965	336,718	322,542	524,927	252,859	145,885	240,172	49,446	4,138	72,483	1,949,171
1966	347,919	333,272	542,390	261,270	150,738	248,161	51,091	4,276	74,895	2,014,014
1967	359,121	344,002	559,853	269,682	155,592	256,151	52,736	4,414	77,306	2,078,857
1968	370,323	354,732	577,315	278,094	160,445	264,141	54,381	4,551	79,717	2,143,700
1969	381,524	365,462	594,778	286,506	165,298	272,131	56,026	4,689	82,129	2,208,543
1970	392,726	376,192	612,241	294,918	170,151	280,121	57,671	4,827	84,540	2,273,386
1971	428,936	410,878	668,692	322,110	185,840	305,949	62,988	5,272	92,335	2,482,999
1972	465,147	445,565	725,142	349,303	201,528	331,777	68,306	5,717	100,130	2,692,613
1973	501,358	480,251	781,593	376,495	217,217	357,605	73,623	6,162	107,924	2,902,227
1974	537,568	514,937	838,044	403,687	232,905	383,433	78,941	6,607	115,719	3,111,841
1975	220,493	338,130	1,461,430	332,537	199,531	554,904	19,483	7,070	187,876	3,321,454
1976	221,233	339,265	1,466,336	333,653	200,201	556,767	19,548	7,094	188,506	3,332,604
1977	221,974	340,400	1,471,242	334,769	200,871	558,630	19,614	7,117	189,137	3,343,754

Year	W_CB	W_HB	W_PR	C_CB	C_HB	C_PR	E_CB	E_HB	E_PR	Total
1978	222,714	341,536	1,476,148	335,886	201,540	560,493	19,679	7,141	189,768	3,354,904
1979	223,454	342,671	1,481,054	337,002	202,210	562,355	19,744	7,165	190,398	3,366,054
1980	224,194	343,806	1,485,960	338,118	202,880	564,218	19,810	7,188	191,029	3,377,204

Table 4.12.3. Estimated historical recreational landings in **pounds** whole weight for Red Snapper in the Gulf of America from 1955-1980.

Year	W_CB	W_HB	W_PR	C_CB	C_HB	C_PR	E_CB	E_HB	E_PR	Total
1955	1,161,930	363,958	202,113	432,905	196,321	191,599	150,562	6,557	44,586	2,750,531
1956	1,286,906	403,105	223,853	479,468	217,438	212,208	166,756	7,262	49,382	3,046,377
1957	1,411,883	442,252	245,592	526,031	238,554	232,816	182,950	7,968	54,177	3,342,223
1958	1,536,859	481,399	267,331	572,594	259,670	253,424	199,145	8,673	58,973	3,638,069
1959	1,661,836	520,546	289,070	619,157	280,786	274,033	215,339	9,378	63,769	3,933,915
1960	1,786,813	559,693	310,810	665,720	301,903	294,641	231,533	10,084	68,564	4,229,761
1961	1,837,896	575,694	319,695	684,752	310,534	303,065	238,153	10,372	70,525	4,350,685
1962	1,888,979	591,695	328,581	703,784	319,165	311,488	244,772	10,660	72,485	4,471,609
1963	1,940,062	607,697	337,467	722,817	327,796	319,912	251,391	10,948	74,445	4,592,533
1964	1,991,145	623,698	346,352	741,849	336,427	328,335	258,010	11,237	76,405	4,713,458
1965	1,266,438	462,600	961,591	620,078	288,425	521,341	149,945	11,554	162,728	4,444,700
1966	1,308,569	477,989	993,580	640,706	298,020	538,685	154,933	11,939	168,141	4,592,562
1967	1,350,699	493,379	1,025,569	661,334	307,615	556,028	159,921	12,323	173,555	4,740,423
1968	1,392,830	508,768	1,057,559	681,962	317,210	573,372	164,909	12,708	178,968	4,888,285
1969	1,434,960	524,157	1,089,548	702,590	326,805	590,715	169,897	13,092	184,382	5,036,147
1970	1,477,091	539,547	1,121,537	723,218	336,400	608,058	174,886	13,476	189,795	5,184,008
1971	1,613,284	589,295	1,224,946	789,902	367,417	664,124	191,011	14,719	207,295	5,661,991
1972	1,749,477	639,043	1,328,356	856,585	398,434	720,189	207,136	15,961	224,795	6,139,974
1973	1,885,669	688,791	1,431,765	923,268	429,451	776,254	223,261	17,204	242,295	6,617,957
1974	2,021,862	738,539	1,535,175	989,951	460,469	832,319	239,386	18,447	259,794	7,095,940
1975	829,303	484,957	2,677,130	815,470	394,486	1,204,532	59,081	19,740	421,788	6,906,487
1976	832,087	486,585	2,686,116	818,208	395,810	1,208,576	59,279	19,806	423,204	6,929,671
1977	834,871	488,213	2,695,103	820,945	397,134	1,212,619	59,478	19,872	424,620	6,952,856

Year	W_CB	W_HB	W_PR	C_CB	C_HB	C_PR	E_CB	E_HB	E_PR	Total
1978	837,655	489,841	2,704,090	823,683	398,459	1,216,663	59,676	19,938	426,036	6,976,040
1979	840,439	491,469	2,713,077	826,420	399,783	1,220,706	59,874	20,005	427,452	6,999,225
1980	843,223	493,097	2,722,064	829,158	401,107	1,224,750	60,073	20,071	428,867	7,022,409

Table 4.12.4a. Total recreational landings estimates (AB1) for Gulf of America Red Snapper 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) and in pounds whole weight (LBS). Estimates are provided for the WEST region.

	Cbt				Hbt				Priv			
YEAR	AB1	CV	LBS	CV	AB1	CV	LBS	CV	AB1	CV	LBS	CV
1981	225,895	0.55	740,540	0.62	354,536	0.18	507,923	0.19	3,075,407	0.65	6,823,416	0.66
1982	274,792	0.95	449,503	0.95	358,850	0.19	439,374	0.18	1,863,327	0.39	3,794,947	0.61
1983	422,065	0.29	916,363	0.39	371,323	0.17	479,291	0.17	3,553,822	0.33	5,445,431	0.64
1984	378,268	0.43	1,745,872	0.45	368,374	0.18	467,064	0.17	789,515	0.27	1,661,525	0.64
1985	613,132	0.60	3,726,195	0.70	388,339	0.18	498,293	0.19	1,272,721	0.85	1,654,596	0.86
1986	77,146	0.21	143,087	0.45	316,090	0.40	372,643	0.40	1,730,541	0.72	2,823,515	0.76
1987	64,283	0.26	147,827	0.32	319,348	0.39	384,748	0.39	520,875	0.34	813,776	0.40
1988	15,018	0.81	32,384	0.81	423,024	0.34	581,361	0.34	805,754	0.33	1,387,250	0.48
1989	63,291	0.71	124,057	0.71	372,473	0.23	962,620	0.23	531,468	0.27	1,504,265	0.39
1990	28,440	0.58	82,345	0.59	187,006	0.30	342,555	0.30	395,835	0.31	597,948	0.44
1991	115,403	0.28	443,086	0.37	264,686	0.31	448,516	0.31	470,728	0.27	973,515	0.40
1992	123,052	0.31	438,313	0.37	413,056	0.21	872,859	0.21	625,422	0.18	1,642,224	0.31
1993	81,765	0.30	289,947	0.42	458,772	0.24	1,300,057	0.24	1,043,435	0.25	3,843,594	0.29
1994	57,285	0.26	291,985	0.39	497,738	0.22	1,441,644	0.22	1,205,383	0.21	4,117,430	0.29
1995	73,649	0.50	374,258	0.55	354,550	0.19	1,282,724	0.19	1,528,465	0.23	6,180,941	0.27
1996	57,143	0.49	353,393	0.52	349,266	0.32	1,324,394	0.32	1,066,610	0.18	4,266,101	0.23
1997	68,148	0.29	403,789	0.35	347,424	0.24	1,183,785	0.24	1,047,979	0.17	4,045,191	0.21
1998	106,153	0.34	606,743	0.37	244,738	0.14	940,659	0.14	1,012,251	0.25	6,390,569	0.28
1999	56,808	0.43	358,131	0.51	98,699	0.22	503,005	0.22	657,069	0.18	2,899,063	0.27
2000	20,477	0.25	119,230	0.37	111,410	0.19	585,453	0.19	656,299	0.20	3,159,977	0.27
2001	19,278	0.30	95,356	0.35	116,358	0.21	405,872	0.21	467,863	0.19	1,714,137	0.23
2002	54,462	0.25	280,393	0.27	138,475	0.09	607,223	0.09	428,249	0.18	1,657,626	0.23
2003	56,438	0.26	328,286	0.28	157,905	0.41	569,760	0.41	382,113	0.19	1,302,727	0.22
2004	81,847	0.26	304,521	0.33	110,329	0.12	503,163	0.12	360,469	0.19	1,168,984	0.22
2005	74,152	0.27	379,636	0.30	99,988	0.21	379,858	0.21	557,898	0.18	1,997,565	0.22
2006	95,019	0.21	360,127	0.25	121,177	0.21	450,708	0.21	696,553	0.17	2,313,846	0.20

	Cbt				Hbt				Priv			
YEAR	**AB1**	**CV**	**LBS**	**CV**	**AB1**	**CV**	**LBS**	**CV**	**AB1**	**CV**	**LBS**	**CV**
2007	64,282	0.20	227,916	0.23	110,314	0.57	313,255	0.57	537,811	0.17	1,992,092	0.19
2008	25,413	0.38	154,118	0.41	57,569	0.24	222,711	0.24	418,097	0.22	1,955,043	0.24
2009	29,388	0.40	205,165	0.42	75,998	0.09	491,339	0.09	418,994	0.18	2,416,245	0.20
2010	7,674	0.32	51,635	0.38	51,514	0.06	284,081	0.06	256,270	0.22	1,478,530	0.24
2011	10,449	0.37	84,424	0.42	50,656	0.05	309,919	0.05	380,196	0.20	2,196,484	0.22
2012	27,758	0.43	273,939	0.44	54,283	0.09	440,874	0.09	448,726	0.19	2,373,024	0.22
2013	19,921	0.46	195,032	0.51	43,743	0.05	240,316	0.05	578,628	0.19	3,120,266	0.21
2014	11,271	0.16	83,080	0.19	35,511	0.05	195,438	0.05	587,008	0.18	3,845,957	0.20
2015	28,729	0.09	225,254	0.12	63,033	0.05	356,570	0.05	713,784	0.15	4,605,056	0.16
2016	33,720	0.07	291,691	0.11	61,137	0.05	352,210	0.05	456,093	0.17	3,145,450	0.19
2017	36,780	0.08	293,007	0.12	60,068	0.07	344,966	0.07	564,237	0.16	3,610,786	0.19
2018	25,772	0.13	226,640	0.15	62,595	0.05	371,114	0.05	634,352	0.13	4,289,648	0.15
2019	28,781	0.12	236,529	0.16	67,126	0.06	417,573	0.06	941,672	0.14	5,800,148	0.16
2020	17,914	0.13	162,710	0.16	70,161	0.05	368,121	0.05	576,289	0.13	4,124,355	0.14
2021	27,856	0.12	220,529	0.16	83,724	0.05	605,964	0.05	550,690	0.15	3,613,328	0.17
2022	26,562	0.10	198,210	0.15	84,263	0.05	430,181	0.05	439,210	0.14	2,868,770	0.17
2023	43,052	0.09	312,881	0.15	78,862	0.05	402,913	0.05	706,101	0.13	4,126,204	0.16

Table 4.12.4b. Total recreational landings estimates (AB1) for Gulf of America Red Snapper 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) and in pounds whole weight (LBS). Estimates are provided for the **CENTRAL** region.

	Cbt				Hbt				Priv			
YEAR	AB1	CV	LBS	CV	AB1	CV	LBS	CV	AB1	CV	LBS	CV
1981	68,050	0.82	138,525	0.82	43,279	0.82	103,262	0.83	1,814,671	0.55	3,171,312	0.59
1982	409,279	0.42	721,369	0.59	247,419	0.43	315,483	0.43	211,587	0.43	481,274	0.56
1983	760,147	0.32	1,175,692	0.36	475,424	0.32	948,069	0.36	751,639	0.56	1,034,920	0.62
1984	211,197	0.37	378,253	0.41	132,091	0.37	343,976	0.47	272,732	0.60	312,352	0.63
1985	238,864	0.38	565,477	0.47	149,394	0.38	341,450	0.40	612,117	0.55	1,552,825	0.64
1986	507,401	0.21	1,821,590	0.26	14,903	0.89	34,204	0.89	261,562	0.68	1,030,043	0.72
1987	457,049	0.24	1,383,726	0.28	9,256	0.71	25,022	0.71	491,587	0.26	1,226,559	0.36
1988	358,245	0.32	1,110,397	0.37	12,881	0.22	30,605	0.22	365,960	0.48	1,013,440	0.51
1989	203,867	0.27	586,813	0.45	10,357	0.24	22,824	0.24	588,397	0.75	1,834,497	0.81
1990	143,525	0.33	759,517	0.43	15,393	0.19	35,331	0.19	348,726	0.37	826,123	0.42
1991	189,578	0.21	556,070	0.30	15,349	0.26	34,585	0.26	806,726	0.25	2,405,285	0.34
1992	352,497	0.18	1,069,803	0.33	33,832	0.19	77,060	0.19	1,422,294	0.20	4,193,230	0.23
1993	835,952	0.34	2,853,069	0.36	36,735	0.15	82,788	0.15	1,434,811	0.19	5,615,766	0.27
1994	373,415	0.21	1,488,624	0.24	28,771	0.19	83,204	0.19	1,002,018	0.24	4,356,660	0.30
1995	297,069	0.27	948,406	0.30	22,980	0.14	74,562	0.14	646,795	0.26	2,609,813	0.35
1996	423,073	0.31	1,833,650	0.35	28,314	0.09	84,173	0.09	506,756	0.20	1,867,540	0.33
1997	543,756	0.15	2,690,301	0.22	48,398	0.13	120,501	0.13	817,821	0.20	3,823,800	0.28
1998	871,474	0.10	3,544,826	0.12	76,455	0.14	183,412	0.14	563,447	0.19	2,345,196	0.29
1999	632,460	0.09	2,856,854	0.11	64,725	0.17	187,746	0.17	1,301,022	0.22	6,801,667	0.30
2000	376,376	0.08	1,744,329	0.09	56,399	0.11	173,964	0.11	864,523	0.18	3,864,135	0.22
2001	396,042	0.09	1,815,952	0.11	50,343	0.13	164,165	0.13	1,392,687	0.18	8,187,188	0.24
2002	556,133	0.09	2,571,420	0.11	74,945	0.16	217,093	0.16	1,871,975	0.20	9,070,895	0.25
2003	526,142	0.09	2,504,005	0.17	70,539	0.25	220,615	0.25	1,288,415	0.19	6,016,086	0.25
2004	531,741	0.09	1,862,784	0.09	62,020	0.25	185,771	0.25	1,633,282	0.27	6,125,700	0.30
2005	385,562	0.10	1,300,106	0.11	41,612	0.25	128,016	0.25	899,696	0.22	3,938,056	0.29
2006	388,459	0.11	1,239,569	0.11	46,744	0.39	122,689	0.39	985,369	0.19	3,421,054	0.24

YEAR	Cbt				Hbt				Priv			
	AB1	CV	LBS	CV	AB1	CV	LBS	CV	AB1	CV	LBS	CV
2007	475,791	0.11	1,515,067	0.12	62,842	0.43	171,338	0.43	1,526,397	0.22	4,952,465	0.28
2008	265,441	0.09	1,024,999	0.10	60,630	0.09	180,280	0.09	898,069	0.17	4,043,048	0.20
2009	205,255	0.16	1,102,839	0.17	78,421	0.05	300,227	0.05	1,079,273	0.21	4,596,019	0.23
2010	68,837	0.17	374,822	0.19	33,932	0.06	136,540	0.06	1,032,623	0.31	5,326,288	0.32
2011	153,432	0.19	954,409	0.20	66,156	0.05	306,287	0.05	1,242,753	0.19	7,971,276	0.22
2012	150,032	0.17	1,012,090	0.18	51,710	0.08	265,255	0.08	1,160,659	0.21	9,099,821	0.23
2013	165,648	0.35	1,132,367	0.37	41,303	0.05	192,471	0.05	2,091,560	0.31	14,466,985	0.32
2014	35,280	0.19	225,564	0.21	40,547	0.05	176,566	0.05	893,063	0.21	6,119,131	0.22
2015	204,965	0.22	1,331,390	0.24	42,346	0.05	204,629	0.05	1,023,321	0.22	6,711,504	0.23
2016	217,938	0.21	1,653,817	0.22	35,553	0.05	162,091	0.05	1,281,042	0.13	7,849,149	0.15
2017	239,362	0.25	1,486,665	0.26	50,271	0.05	211,776	0.05	2,568,119	0.17	15,859,962	0.20
2018	229,198	0.23	1,450,586	0.24	56,764	0.05	244,814	0.05	1,751,099	0.24	10,520,171	0.25
2019	282,023	0.27	1,672,666	0.28	41,097	0.05	163,298	0.05	1,946,996	0.20	10,841,563	0.23
2020	292,256	0.32	1,689,051	0.33	31,632	0.05	179,595	0.05	1,482,194	0.18	8,272,751	0.21
2021	223,751	0.16	1,170,049	0.17	28,351	0.05	118,425	0.05	1,272,367	0.23	8,289,766	0.26
2022	302,051	0.19	1,979,114	0.20	24,034	0.05	88,230	0.05	1,427,585	0.17	10,394,653	0.19
2023	361,635	0.17	2,043,005	0.18	33,715	0.05	116,883	0.05	1,222,024	0.20	7,821,348	0.26

Table 4.12.4c. Total recreational landings estimates (AB1) for Gulf of America Red Snapper 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) and in pounds whole weight (LBS). Estimates are provided for the EAST region. Any confidential estimates are hidden using *** in the table below.**

	Cbt				Hbt				Priv			
YEAR	AB1	CV	LBS	CV	AB1	CV	LBS	CV	AB1	CV	LBS	CV
1981	21,631	0.83	51,606	0.89	13,529	0.83	34,949	0.84	568,244	0.64	968,168	0.64
1982	4,058	1.00	9,178	1.00	2,538	1.00	3,700	1.00	11,959	0.80	29,420	0.84
1983	37,321	0.41	56,543	0.41	23,342	0.41	65,432	0.51	580,760	1.00	1,294,876	1.00
1984	31,915	0.64	63,097	0.64	18,865	0.68	53,916	0.69	21,342	0.72	45,675	0.77
1985	11,182	0.77	28,496	0.77	6,866	0.78	24,922	0.81	157,060	0.71	445,067	0.72
1986	61,607	0.51	287,385	0.55	1,461	0.59	3,644	0.59	181,242	0.50	494,520	0.52
1987	3,429	0.90	7,350	0.92	429	0.76	1,274	0.76	106,125	0.53	314,634	0.53
1988	5,934	0.66	19,082	0.66	951	0.67	2,195	0.67	49,105	0.49	167,438	0.49
1989	11,474	1.00	49,037	1.00	440	0.57	1,004	0.57	142,386	0.69	322,181	0.69
1990	0	0.00	0	0.00	146	0.22	429	0.22	42,071	0.53	148,042	0.53
1991	75	1.00	187	1.00	231	0.08	576	0.08	17,216	0.61	67,366	0.61
1992	2,627	0.64	6,860	0.77	41	0.11	152	0.11	3,580	0.71	10,015	0.71
1993	0	0.00	0	0.00	540	0.09	1,557	0.09	0	0.00	0	0.00
1994	57	1.00	202	1.00	227	0.24	615	0.24	0	0.00	0	0.00
1995	0	0.00	0	0.00	*****	*****	*****	*****	3,298	1.00	15,433	1.00
1996	387	1.00	1,632	1.00	74	0.43	225	0.43	36,610	0.64	96,980	0.64
1997	1,729	0.67	8,657	0.70	41	0.33	137	0.33	0	0.00	0	0.00
1998	8,037	0.69	22,864	0.70	304	0.59	685	0.59	0	0.00	0	0.00
1999	802	0.35	2,776	0.38	2,707	0.55	8,222	0.55	11,548	0.52	39,730	0.55
2000	397	0.70	1,446	0.70	1,241	0.61	3,877	0.61	2,321	1.00	8,914	1.00
2001	1,516	0.52	5,369	0.53	946	0.61	3,454	0.61	0	0.00	0	0.00
2002	523	0.38	1,729	0.38	*****	*****	*****	*****	7,709	0.62	30,192	0.62
2003	1,599	0.38	5,289	0.39	482	0.41	1,529	0.41	2,828	0.80	10,343	0.80
2004	440	0.35	1,576	0.35	1,462	0.33	4,348	0.33	7,039	0.92	22,213	0.92
2005	1,743	0.35	5,732	0.35	5,179	0.26	18,468	0.26	81,014	0.60	390,336	0.64
2006	10,948	0.79	35,052	0.78	1,138	0.26	2,845	0.26	18,542	0.79	59,250	0.79

	Cbt				Hbt				Priv			
YEAR	**AB1**	**CV**	**LBS**	**CV**	**AB1**	**CV**	**LBS**	**CV**	**AB1**	**CV**	**LBS**	**CV**
2007	840	0.69	2,550	0.69	761	0.25	2,416	0.25	41,336	0.82	142,701	0.83
2008	3,285	0.46	12,472	0.46	1,356	0.07	4,965	0.07	5,624	1.00	28,942	1.00
2009	1,893	0.62	10,482	0.65	3,169	0.05	14,334	0.05	18,935	0.56	61,133	0.56
2010	4,390	0.60	27,534	0.59	2,011	0.10	8,909	0.10	3,200	0.51	19,788	0.52
2011	0	0.00	0	0.00	3,031	0.07	14,362	0.07	16,390	0.61	81,478	0.61
2012	3,002	0.82	18,651	0.82	2,468	0.05	17,955	0.05	14,641	0.67	94,788	0.67
2013	487	0.76	2,987	0.77	2,682	0.05	12,493	0.05	3,574	0.79	21,457	0.79
2014	3,890	0.62	28,612	0.64	2,210	0.05	10,289	0.05	5,175	0.75	35,204	0.77
2015	8,019	0.68	48,168	0.69	3,116	0.05	19,032	0.05	1,901	1.00	14,097	1.00
2016	8,143	0.54	58,200	0.55	2,896	0.05	12,278	0.05	27,199	0.62	138,378	0.75
2017	19,437	0.51	103,256	0.52	8,339	0.05	27,176	0.05	77,403	0.42	348,975	0.44
2018	23,394	0.62	133,770	0.63	8,690	0.05	36,716	0.05	101,256	0.46	479,172	0.47
2019	18,048	0.31	102,888	0.33	8,645	0.05	48,405	0.05	106,202	0.53	638,478	0.54
2020	26,398	0.53	143,900	0.56	7,161	0.05	40,658	0.05	37,813	0.51	174,652	0.53
2021	45,338	0.47	275,608	0.48	10,460	0.05	68,006	0.05	79,991	0.68	540,293	0.72
2022	34,005	0.42	235,153	0.43	11,133	0.05	77,704	0.05	116,229	0.51	722,026	0.62
2023	49,631	0.33	299,684	0.34	9,391	0.05	68,922	0.05	153,203	0.48	1,177,934	0.49

Table 4.12.5a. Total recreational discard estimates (B2) for Gulf of America Red Snapper combined across all surveys by year and mode. Associated coefficients of variation (CV) are also provided. Estimates are provided for the WEST region.

		Cbt		Hbt		Priv	
YEAR	FED_CLOSED	B2	CV	B2	CV	B2	CV
1981	CLOSED	0	0.00	0	0.00	0	0.00
1982	CLOSED	0	0.00	0	0.00	0	0.00
1983	CLOSED	0	0.00	0	0.00	0	0.00
1984	CLOSED	0	0.00	0	0.00	0	0.00
1985	CLOSED	0	0.00	0	0.00	0	0.00
1986	CLOSED	0	0.00	0	0.00	0	0.00
1987	CLOSED	0	0.00	0	0.00	0	0.00
1988	CLOSED	0	0.00	0	0.00	0	0.00
1989	CLOSED	0	0.00	0	0.00	0	0.00
1990	CLOSED	0	0.00	0	0.00	0	0.00
1991	CLOSED	0	0.00	0	0.00	0	0.00
1992	CLOSED	0	0.00	0	0.00	0	0.00
1993	CLOSED	0	0.00	0	0.00	0	0.00
1994	CLOSED	0	0.00	0	0.00	0	0.00
1995	CLOSED	0	0.00	0	0.00	0	0.00
1996	CLOSED	0	0.00	0	0.00	0	0.00
1997	CLOSED	0	0.00	12,973	0.73	0	0.00
1998	CLOSED	0	0.00	11,978	0.78	56,614	0.53
1999	CLOSED	356	0.54	3,244	0.83	54,315	0.40
2000	CLOSED	158	0.34	10,757	0.72	247,325	0.40
2001	CLOSED	0	0.00	18,044	0.81	65,750	0.50
2002	CLOSED	1,617	0.36	18,986	0.71	613,726	0.74
2003	CLOSED	2,181	0.28	32,912	0.75	622,788	0.68
2004	CLOSED	1,209	0.31	47,641	0.70	2,476,636	0.86
2005	CLOSED	24,110	0.32	52,556	0.71	994,555	0.59
2006	CLOSED	6,380	0.26	51,082	0.69	393,903	0.42
2007	CLOSED	1,369	0.23	42,676	0.79	132,917	0.37
2008	CLOSED	22,816	0.47	29,168	0.24	796,528	0.51
2009	CLOSED	14,931	0.51	18,141	0.09	612,734	0.45
2010	CLOSED	870	1.00	10,146	0.06	187,964	1.06
2011	CLOSED	610	0.76	11,798	0.05	838,075	0.59
2012	CLOSED	1,308	0.42	8,040	0.09	86,309	0.49
2013	CLOSED	10,234	0.54	7,227	0.05	175,797	0.47
2014	CLOSED	679	0.34	6,985	0.05	37,281	0.33
2015	CLOSED	1,730	0.26	5,664	0.05	45,708	0.33
2016	CLOSED	1,653	0.24	6,407	0.05	23,819	0.33
2017	CLOSED	4,641	0.18	4,787	0.07	85,892	0.28
2018	CLOSED	2,563	0.21	4,378	0.05	277,138	0.28
2019	CLOSED	17,405	0.23	3,977	0.06	321,895	0.25

		Cbt		Hbt		Priv	
YEAR	**FED_CLOSED**	**B2**	**CV**	**B2**	**CV**	**B2**	**CV**
2020	CLOSED	3,558	0.21	3,916	0.05	449,321	0.27
2021	CLOSED	2,313	0.15	4,460	0.05	247,047	0.31
2022	CLOSED	4,113	0.25	2,533	0.05	97,435	0.31
2023	CLOSED	2,331	0.14	2,224	0.05	146,675	0.29
1981	OPEN	0	0.00	0	0.00	30,293	0.65
1982	OPEN	13,299	0.98	7,954	1.06	6,491	0.75
1983	OPEN	1,552	0.71	650	0.71	0	0.00
1984	OPEN	0	0.00	0	0.00	0	0.00
1985	OPEN	0	0.00	0	0.00	438,402	0.81
1986	OPEN	2,521	0.41	4,338	0.77	0	0.00
1987	OPEN	1,802	0.84	3,761	0.94	120,038	0.98
1988	OPEN	1,213	0.86	14,355	1.10	529,273	0.55
1989	OPEN	4,604	0.98	11,382	1.13	371,122	0.55
1990	OPEN	64,074	0.67	176,989	0.94	422,258	0.71
1991	OPEN	140,526	0.33	135,399	0.74	410,625	0.97
1992	OPEN	111,920	0.37	157,824	0.74	450,630	0.33
1993	OPEN	67,206	0.32	158,411	0.73	528,829	0.32
1994	OPEN	107,784	0.32	393,427	0.72	1,213,187	0.53
1995	OPEN	89,025	0.49	180,040	0.84	1,942,650	0.48
1996	OPEN	90,822	0.47	233,200	0.84	413,058	0.49
1997	OPEN	61,416	0.33	118,559	0.73	488,430	0.51
1998	OPEN	48,023	0.49	34,533	0.78	735,054	0.53
1999	OPEN	12,521	0.54	6,154	0.83	1,983,076	0.40
2000	OPEN	9,829	0.34	12,070	0.72	478,639	0.40
2001	OPEN	15,101	0.56	20,247	0.81	448,855	0.50
2002	OPEN	36,103	0.36	21,303	0.71	173,885	0.74
2003	OPEN	57,242	0.28	36,931	0.75	1,129,394	0.68
2004	OPEN	177,321	0.31	53,457	0.70	710,292	0.86
2005	OPEN	172,778	0.32	58,973	0.71	1,029,971	0.59
2006	OPEN	195,955	0.26	57,318	0.69	1,846,480	0.42
2007	OPEN	124,251	0.23	47,886	0.79	937,294	0.37
2008	OPEN	45,381	0.47	12,366	0.24	811,091	0.51
2009	OPEN	18,194	0.51	12,833	0.09	512,690	0.45
2010	OPEN	0	0.00	8,265	0.06	53,842	1.06
2011	OPEN	6,775	0.76	11,294	0.05	497,160	0.59
2012	OPEN	17,852	0.42	7,868	0.09	603,666	0.49
2013	OPEN	17,473	0.54	2,622	0.05	1,660,446	0.47
2014	OPEN	3,685	0.34	1,582	0.05	569,940	0.33
2015	OPEN	9,392	0.26	4,050	0.05	698,775	0.33
2016	OPEN	11,402	0.24	3,375	0.05	504,875	0.33
2017	OPEN	5,280	0.18	5,491	0.07	753,863	0.28
2018	OPEN	4,381	0.21	5,124	0.05	588,495	0.28
2019	OPEN	16,556	0.23	7,335	0.06	1,333,841	0.25

		Cbt		Hbt		Priv	
YEAR	FED_CLOSED	B2	CV	B2	CV	B2	CV
2020	OPEN	4,128	0.21	5,723	0.05	769,776	0.27
2021	OPEN	13,338	0.15	32,334	0.05	760,003	0.31
2022	OPEN	4,394	0.25	18,744	0.05	480,125	0.31
2023	OPEN	12,383	0.14	10,425	0.05	902,316	0.29

Table 4.12.5b Total recreational discard estimates (B2) for Gulf of America Red Snapper combined across all surveys by year and mode. Associated coefficients of variation (CV) are also provided. Estimates are provided for the CENTRAL region.

		Cbt		Hbt		Priv	
YEAR	FED_CLOSED	B2	CV	B2	CV	B2	CV
1981	CLOSED	0	0.00	0	0.00	0	0.00
1982	CLOSED	0	0.00	0	0.00	0	0.00
1983	CLOSED	0	0.00	0	0.00	0	0.00
1984	CLOSED	0	0.00	0	0.00	0	0.00
1985	CLOSED	0	0.00	0	0.00	0	0.00
1986	CLOSED	0	0.00	0	0.00	0	0.00
1987	CLOSED	0	0.00	0	0.00	0	0.00
1988	CLOSED	0	0.00	0	0.00	0	0.00
1989	CLOSED	0	0.00	0	0.00	0	0.00
1990	CLOSED	0	0.00	0	0.00	0	0.00
1991	CLOSED	0	0.00	0	0.00	0	0.00
1992	CLOSED	0	0.00	0	0.00	0	0.00
1993	CLOSED	0	0.00	0	0.00	0	0.00
1994	CLOSED	0	0.00	0	0.00	0	0.00
1995	CLOSED	0	0.00	0	0.00	0	0.00
1996	CLOSED	0	0.00	0	0.00	0	0.00
1997	CLOSED	9,098	0.25	4,445	0.42	25,119	0.25
1998	CLOSED	92,790	0.11	9,130	0.34	355,949	0.22
1999	CLOSED	147,541	0.09	18,103	0.35	384,751	0.22
2000	CLOSED	97,097	0.08	21,275	0.32	1,201,625	0.23
2001	CLOSED	74,229	0.10	20,435	0.33	2,389,241	0.19
2002	CLOSED	74,976	0.09	21,042	0.34	2,680,205	0.22
2003	CLOSED	35,885	0.09	21,622	0.39	1,778,042	0.20
2004	CLOSED	67,103	0.09	20,132	0.39	1,035,622	0.19
2005	CLOSED	70,343	0.09	17,363	0.39	1,500,300	0.18
2006	CLOSED	135,886	0.11	27,186	0.48	939,923	0.16
2007	CLOSED	74,557	0.11	25,452	0.51	1,179,154	0.16
2008	CLOSED	310,138	0.11	56,879	0.09	2,064,538	0.21
2009	CLOSED	246,030	0.12	47,634	0.05	1,931,694	0.17
2010	CLOSED	161,189	0.15	38,892	0.06	2,462,830	0.19
2011	CLOSED	242,995	0.12	60,342	0.05	2,119,875	0.17
2012	CLOSED	149,796	0.12	54,252	0.08	2,830,261	0.16
2013	CLOSED	287,443	0.21	53,459	0.05	987,871	0.30
2014	CLOSED	267,981	0.17	54,095	0.05	2,424,149	0.22
2015	CLOSED	177,816	0.15	34,162	0.05	1,714,139	0.19
2016	CLOSED	257,929	0.19	44,069	0.05	2,597,602	0.17
2017	CLOSED	230,885	0.20	62,415	0.05	3,413,244	0.17
2018	CLOSED	197,631	0.15	51,321	0.05	2,289,737	0.19

		Cbt		Hbt		Priv	
YEAR	**FED_CLOSED**	**B2**	**CV**	**B2**	**CV**	**B2**	**CV**
2019	CLOSED	287,351	0.25	44,819	0.05	2,448,587	0.17
2020	CLOSED	177,230	0.22	30,588	0.05	1,741,196	0.14
2021	CLOSED	432,119	0.16	51,500	0.05	1,541,024	0.17
2022	CLOSED	203,626	0.27	40,326	0.05	2,809,909	0.15
2023	CLOSED	189,454	0.13	30,077	0.05	1,325,786	0.16
1981	OPEN	488	0.71	305	0.71	179,403	0.73
1982	OPEN	7,736	1.00	4,839	1.00	13,169	0.66
1983	OPEN	0	0.00	0	0.00	4,470	1.00
1984	OPEN	3,784	1.00	2,367	1.00	0	0.00
1985	OPEN	2,285	1.00	1,429	1.00	925	1.00
1986	OPEN	7,325	0.63	128	0.95	13,528	0.85
1987	OPEN	42,598	0.40	514	0.80	113,799	0.37
1988	OPEN	64,906	0.86	1,393	0.93	9,133	0.47
1989	OPEN	35,092	0.45	1,064	0.61	323,028	0.59
1990	OPEN	80,687	0.40	5,165	0.59	772,205	0.59
1991	OPEN	196,019	0.29	9,473	0.50	1,587,532	0.29
1992	OPEN	317,612	0.20	18,196	0.42	1,315,577	0.17
1993	OPEN	260,033	0.45	6,820	0.62	1,657,182	0.23
1994	OPEN	273,364	0.24	12,572	0.45	940,422	0.24
1995	OPEN	401,693	0.43	18,548	0.58	226,084	0.32
1996	OPEN	486,469	0.29	19,433	0.50	1,014,854	0.26
1997	OPEN	839,173	0.25	40,623	0.42	2,242,913	0.25
1998	OPEN	584,163	0.11	26,320	0.34	756,893	0.22
1999	OPEN	710,911	0.09	34,337	0.35	2,299,239	0.22
2000	OPEN	407,647	0.08	23,872	0.32	1,360,721	0.23
2001	OPEN	497,309	0.10	22,931	0.33	1,983,516	0.19
2002	OPEN	480,149	0.09	23,612	0.34	3,745,662	0.22
2003	OPEN	537,467	0.09	24,261	0.39	2,571,116	0.20
2004	OPEN	546,528	0.09	22,589	0.39	3,469,432	0.19
2005	OPEN	501,609	0.09	19,483	0.39	2,527,755	0.18
2006	OPEN	667,315	0.11	30,506	0.48	3,233,186	0.16
2007	OPEN	610,537	0.11	28,560	0.51	4,516,822	0.16
2008	OPEN	176,351	0.11	37,173	0.09	2,291,594	0.21
2009	OPEN	229,826	0.12	46,567	0.05	1,904,934	0.17
2010	OPEN	65,464	0.15	13,920	0.06	1,963,080	0.19
2011	OPEN	132,950	0.12	21,762	0.05	1,609,640	0.17
2012	OPEN	108,662	0.12	17,324	0.08	1,141,050	0.16
2013	OPEN	115,507	0.21	26,554	0.05	3,883,518	0.30
2014	OPEN	13,566	0.17	5,732	0.05	1,440,845	0.22
2015	OPEN	80,594	0.15	19,184	0.05	1,443,623	0.19
2016	OPEN	158,880	0.19	37,747	0.05	2,884,993	0.17
2017	OPEN	307,057	0.20	52,991	0.05	4,853,390	0.17
2018	OPEN	224,399	0.15	43,908	0.05	2,735,708	0.19

YEAR	FED_CLOSED	Cbt B2	Cbt CV	Hbt B2	Hbt CV	Priv B2	Priv CV
2019	OPEN	209,806	0.25	32,609	0.05	3,316,097	0.17
2020	OPEN	170,302	0.22	28,888	0.05	2,162,309	0.14
2021	OPEN	187,979	0.16	70,801	0.05	2,224,826	0.17
2022	OPEN	370,369	0.27	55,692	0.05	3,053,693	0.15
2023	OPEN	257,568	0.13	24,887	0.05	2,036,081	0.16

Table 4.12.5c. Total recreational discard estimates (B2) for Gulf of America Red Snapper combined across all surveys by year and mode. Associated coefficients of variation (CV) are also provided. Estimates are provided for the EAST region.

		Cbt		Hbt		Priv	
YEAR	FED_CLOSED	B2	CV	B2	CV	B2	CV
1981	CLOSED	0	0.00	0	0.00	0	0.00
1982	CLOSED	0	0.00	0	0.00	0	0.00
1983	CLOSED	0	0.00	0	0.00	0	0.00
1984	CLOSED	0	0.00	0	0.00	0	0.00
1985	CLOSED	0	0.00	0	0.00	0	0.00
1986	CLOSED	0	0.00	0	0.00	0	0.00
1987	CLOSED	0	0.00	0	0.00	0	0.00
1988	CLOSED	0	0.00	0	0.00	0	0.00
1989	CLOSED	0	0.00	0	0.00	0	0.00
1990	CLOSED	0	0.00	0	0.00	0	0.00
1991	CLOSED	0	0.00	0	0.00	0	0.00
1992	CLOSED	0	0.00	0	0.00	0	0.00
1993	CLOSED	0	0.00	0	0.00	0	0.00
1994	CLOSED	0	0.00	0	0.00	0	0.00
1995	CLOSED	0	0.00	0	0.00	0	0.00
1996	CLOSED	0	0.00	0	0.00	0	0.00
1997	CLOSED	0	0.00	0	1.31	0	0.00
1998	CLOSED	310	0.53	13	0.91	52,945	0.59
1999	CLOSED	0	0.00	964	0.90	23,419	0.46
2000	CLOSED	89	0.74	164	0.93	1,556	0.69
2001	CLOSED	2,682	0.73	350	0.93	0	0.00
2002	CLOSED	0	0.00	0	0.00	0	0.00
2003	CLOSED	2,578	0.90	176	0.92	2,920	0.72
2004	CLOSED	693	0.53	468	0.69	0	0.00
2005	CLOSED	1,044	0.60	947	0.62	36,258	0.48
2006	CLOSED	3,396	0.53	374	0.91	24,378	0.54
2007	CLOSED	2,001	0.63	411	0.90	0	0.00
2008	CLOSED	11,884	0.76	3,243	0.07	33,252	0.62
2009	CLOSED	16,676	0.65	4,355	0.05	62,761	0.67
2010	CLOSED	4,049	0.77	912	0.10	105,442	0.56
2011	CLOSED	1,948	0.95	4,332	0.07	1,485,977	0.98
2012	CLOSED	0	0.00	1,846	0.05	0	0.00
2013	CLOSED	256	0.92	1,133	0.05	8,516	0.49
2014	CLOSED	1,585	0.54	1,534	0.05	5,303	0.59
2015	CLOSED	6,091	0.66	1,078	0.05	757	0.63
2016	CLOSED	31,528	0.43	7,014	0.05	515,204	0.66
2017	CLOSED	130,808	0.71	10,465	0.05	133,425	0.34
2018	CLOSED	36,845	0.37	8,372	0.05	426,915	0.40
2019	CLOSED	6,495	0.38	6,979	0.05	244,439	0.36

		Cbt		Hbt		Priv	
YEAR	**FED_CLOSED**	**B2**	**CV**	**B2**	**CV**	**B2**	**CV**
2020	CLOSED	4,300	0.38	3,637	0.05	184,041	0.38
2021	CLOSED	30,206	0.43	2,918	0.05	36,258	0.55
2022	CLOSED	12,304	0.35	2,887	0.05	102,080	0.65
2023	CLOSED	129,628	0.72	2,549	0.05	48,348	0.34
1981	OPEN	0	0.00	0	0.00	76,357	0.71
1982	OPEN	396	1.00	247	1.00	0	0.00
1983	OPEN	0	0.00	0	0.00	0	0.00
1984	OPEN	3,594	1.00	2,248	1.00	82,405	0.79
1985	OPEN	1,007	1.00	630	1.00	41,324	0.81
1986	OPEN	17,128	0.45	175	0.82	11,688	0.71
1987	OPEN	1,642	1.00	88	1.16	3,103	0.71
1988	OPEN	0	0.00	0	0.00	35,687	0.48
1989	OPEN	0	0.00	0	0.00	7,022	0.71
1990	OPEN	0	0.00	0	0.00	21,540	1.00
1991	OPEN	0	0.00	0	0.00	78,277	0.42
1992	OPEN	1,018	0.68	6	1.07	80,073	0.44
1993	OPEN	0	0.00	0	0.00	29,726	0.47
1994	OPEN	57	1.00	98	1.38	38,864	0.59
1995	OPEN	0	0.00	0	0.00	13,967	0.78
1996	OPEN	0	0.00	0	0.00	35,811	0.49
1997	OPEN	543	1.00	5	1.31	25,990	1.00
1998	OPEN	2,765	0.53	37	0.91	12,660	0.59
1999	OPEN	1,918	0.78	1,829	0.90	26,440	0.46
2000	OPEN	170	0.74	185	0.93	66,169	0.69
2001	OPEN	76	0.73	393	0.93	5,729	1.00
2002	OPEN	0	0.00	0	0.00	6,874	1.00
2003	OPEN	300	0.90	198	0.92	2,069	0.72
2004	OPEN	0	0.00	525	0.69	92,594	0.75
2005	OPEN	522	0.60	1,062	0.62	92,921	0.48
2006	OPEN	14,282	0.53	419	0.91	30,938	0.54
2007	OPEN	230	0.63	462	0.90	43,270	0.52
2008	OPEN	4,222	0.76	676	0.07	7,229	0.62
2009	OPEN	980	0.65	1,486	0.05	40,073	0.67
2010	OPEN	0	0.00	618	0.10	24,026	0.56
2011	OPEN	0	0.00	1,963	0.07	14,601	0.98
2012	OPEN	1,344	0.89	253	0.05	14,288	1.00
2013	OPEN	10,940	0.92	442	0.05	0	0.00
2014	OPEN	7,494	0.54	286	0.05	44,083	0.59
2015	OPEN	9,051	0.66	411	0.05	23,244	0.63
2016	OPEN	10,754	0.43	4,336	0.05	192,957	0.66
2017	OPEN	29,195	0.71	4,803	0.05	127,302	0.34
2018	OPEN	22,182	0.37	5,885	0.05	220,124	0.40
2019	OPEN	18,665	0.38	5,701	0.05	150,713	0.36

		Cbt		Hbt		Priv	
YEAR	**FED_CLOSED**	**B2**	**CV**	**B2**	**CV**	**B2**	**CV**
2020	OPEN	9,496	0.38	2,593	0.05	55,887	0.38
2021	OPEN	36,529	0.43	3,882	0.05	212,682	0.55
2022	OPEN	31,386	0.35	5,206	0.05	196,067	0.65
2023	OPEN	37,390	0.72	5,747	0.05	283,178	0.34

Table 4.12.6a. Number of retained fish (nfish) and associated trips (ntrip) sampled from the charter (CB), headboat (HB), and private (PR) fleets for **length** in the **West** region.

Year	nfish_CB	nfish_HB	nfish_PR	ntrip_CB	ntrip_HB	ntrip_PR
1981	22	10	35	3	1	4
1982	5	134	153	3	16	33
1983	442	416	463	72	55	101
1984	220	26	437	30	4	100
1985	134	62	631	8	17	105
1986	360	6,252	390	40	413	88
1987	265	5,966	452	31	392	99
1988	31	4,591	491	8	299	113
1989	29	6,291	329	7	287	83
1990	90	4,263	349	21	247	95
1991	824	3,523	449	63	217	104
1992	787	7,898	666	68	329	160
1993	381	7,144	826	33	336	182
1994	166	6,578	1,101	31	306	245
1995	192	8,325	1,869	25	357	408
1996	193	5,260	1,425	29	241	330
1997	168	3,996	1,348	35	231	309
1998	297	6,552	1,159	37	342	266
1999	127	3,284	759	24	221	185
2000	187	3,194	966	29	150	222
2001	130	2,531	832	26	187	191
2002	652	2,480	1,349	73	210	247
2003	737	2,086	1,620	87	183	269
2004	952	894	1,493	93	86	270
2005	837	1,017	2,087	95	91	354
2006	1,076	883	2,416	111	71	409
2007	1,386	768	1,485	138	65	266
2008	800	401	1,105	84	37	210
2009	859	866	1,336	92	63	247
2010	135	796	986	19	40	140
2011	681	978	945	57	53	190
2012	775	456	1,032	77	35	178
2013	850	2,335	1,270	80	120	234

Year	nfish_CB	nfish_HB	nfish_PR	ntrip_CB	ntrip_HB	ntrip_PR
2014	733	4,773	2,271	61	142	238
2015	1,413	4,013	2,229	113	193	322
2016	1,260	3,793	1,894	89	149	229
2017	1,848	2,887	2,319	132	130	341
2018	1,993	3,936	2,772	176	201	405
2019	1,273	3,788	2,853	104	204	455
2020	1,098	138	2,635	111	13	399
2021	1,305	916	2,747	139	44	415
2022	994	1,518	3,024	133	78	414
2023	1,363	2,533	4,055	148	108	513

Table 4.12.6b. Number of retained fish (nfish) and associated trips (ntrip) from the charter (CB), headboat (HB), and private (PR) fleets for length in the Central region.

Year	nfish_CB	nfish_HB	nfish_PR	ntrip_CB	ntrip_HB	ntrip_PR
1980	337	0	0	29	0	0
1981	82	32	91	13	12	15
1982	79	57	82	19	46	23
1983	197	113	8	24	43	3
1984	17	10	15	7	7	4
1985	38	14	7	9	12	5
1986	152	141	12	27	64	7
1987	464	191	176	79	99	60
1988	235	194	26	46	93	11
1989	150	280	8	46	122	6
1990	167	330	55	33	114	17
1991	974	516	193	144	153	39
1992	1,751	771	562	234	206	97
1993	1,109	430	237	183	137	55
1994	971	717	199	168	116	45
1995	626	452	119	97	119	37
1996	331	521	104	81	122	31
1997	1,262	1,144	192	212	167	48
1998	3,157	2,239	141	352	264	39
1999	8,292	860	751	678	133	156
2000	8,241	1,132	444	703	137	103
2001	6,736	655	497	512	89	116
2002	11,586	1,267	962	1,326	131	142
2003	13,747	1,095	795	4,482	134	165
2004	9,714	571	632	3,435	106	184
2005	10,661	301	348	4,806	46	124
2006	7,419	466	444	2,723	80	131
2007	4,853	1,264	396	544	113	106
2008	2,235	1,375	263	417	232	75
2009	1,475	1,130	282	393	278	77
2010	2,458	899	264	1,432	246	71
2011	2,202	898	339	882	209	127
2012	2,822	684	477	1,365	143	162

Year	nfish_CB	nfish_HB	nfish_PR	ntrip_CB	ntrip_HB	ntrip_PR
2013	2,427	1,356	511	1,695	260	175
2014	1,958	2,637	2,415	808	307	686
2015	3,520	2,384	1,803	497	158	449
2016	3,148	723	2,581	437	52	673
2017	2,506	1,220	2,476	320	101	574
2018	3,012	1,088	2,071	393	111	446
2019	5,411	1,805	3,114	696	146	697
2020	3,617	222	2,346	493	19	493
2021	4,976	558	1,679	722	71	362
2022	2,155	602	1,096	390	88	332
2023	2,746	602	1,061	512	99	341

Table 4.12.6c. Number of retained fish (nfish) and associated trips (ntrip) sampled from the charter (CB), headboat (HB), and private (PR) fleets for length in the East region.

Year	nfish_CB	nfish_HB	nfish_PR	ntrip_CB	ntrip_HB	ntrip_PR
1981	0	3	30	0	3	5
1982	0	0	2	0	0	2
1983	7	42	7	1	29	1
1984	24	10	6	3	10	2
1985	1	3	5	1	3	1
1986	10	23	6	6	10	4
1987	1	1	3	1	1	3
1988	3	1	16	1	1	6
1989	8	6	8	1	4	4
1990	0	3	3	0	2	3
1991	3	1	1	2	1	1
1992	4	6	1	3	2	1
1993	0	0	0	0	0	0
1994	0	498	0	0	28	0
1995	0	0	1	0	0	1
1996	2	0	4	1	0	3
1997	5	1	0	3	1	0
1998	30	0	0	11	0	0
1999	12	45	9	6	6	4
2000	3	5	0	3	1	0
2001	15	5	0	5	2	0
2002	27	0	3	15	0	2
2003	51	3	6	10	2	5
2004	10	1	10	8	1	2
2005	16	21	7	3	20	4
2006	22	41	7	7	31	5
2007	16	16	8	4	3	2
2008	24	49	17	13	49	12
2009	70	355	5	69	322	5
2010	139	313	16	121	298	14
2011	73	378	20	73	366	15
2012	30	192	5	16	166	3
2013	46	163	10	23	148	9

Year	nfish_CB	nfish_HB	nfish_PR	ntrip_CB	ntrip_HB	ntrip_PR
2014	116	86	19	36	6	15
2015	175	187	1	26	11	1
2016	69	60	16	22	15	8
2017	155	213	410	34	29	96
2018	303	263	73	58	45	25
2019	331	214	66	68	33	21
2020	76	0	57	14	0	20
2021	411	131	40	78	21	16
2022	315	462	70	64	36	17
2023	371	419	73	76	35	19

Table 4.12.7a. Number of retained fish (nfish) and associated trips (ntrip) sampled from the charter (CB), headboat (HB), and private (PR) fleets for age in the West region.

Year	nfish_CB	nfish_HB	nfish_PR	ntrip_CB	ntrip_HB	ntrip_PR
1986	0	349	0	0	59	0
1987	0	142	0	0	46	0
1988	0	350	0	0	69	0
1989	0	82	0	0	28	0
1990	0	36	0	0	11	0
1991	526	102	0	29	5	0
1992	485	26	0	27	6	0
1993	222	910	24	7	107	1
1994	0	241	0	0	29	0
1995	0	10	0	0	2	0
1998	135	962	212	6	92	10
1999	97	263	75	1	33	10
2000	2	250	3	1	54	1
2001	0	74	0	0	19	0
2002	246	205	324	24	42	34
2003	232	139	652	34	23	61
2004	400	168	627	35	31	68
2005	438	205	878	47	28	116
2006	277	205	1,114	28	27	91
2007	479	67	532	52	13	52
2008	467	133	340	41	11	43
2009	427	428	326	52	50	51
2010	49	393	435	4	31	26
2011	423	660	130	32	44	20
2012	419	361	380	34	30	29
2013	635	1,476	349	47	120	39
2014	241	1,231	527	26	135	58
2015	529	998	398	51	153	53
2016	489	723	595	44	87	62
2017	766	1,072	484	77	80	61
2018	857	1,065	617	126	131	82
2019	523	1,060	609	66	139	75
2020	356	8	552	47	3	63

Year	nfish_CB	nfish_HB	nfish_PR	ntrip_CB	ntrip_HB	ntrip_PR
2021	436	84	628	64	14	93
2022	191	236	549	28	46	54
2023	394	258	847	68	14	101

Table 4.12.7b. Number of retained fish (nfish) and associated trips (ntrip) sampled from the charter (CB), headboat (HB), and private (PR) fleets for age in the Central region.

Year	nfish_CB	nfish_HB	nfish_PR	ntrip_CB	ntrip_HB	ntrip_PR
1980	325	0	0	29	0	0
1981	0	0	0	0	0	0
1982	0	0	0	0	0	0
1983	0	0	0	0	0	0
1984	0	0	0	0	0	0
1985	0	0	0	0	0	0
1986	0	13	0	0	7	0
1987	0	3	0	0	3	0
1988	0	7	0	0	7	0
1989	0	14	0	0	14	0
1990	0	3	0	0	3	0
1991	237	20	0	43	10	0
1992	347	70	2	67	23	2
1993	399	254	0	73	90	0
1994	423	21	0	73	10	0
1995	360	11	0	52	8	0
1996	100	95	0	29	31	0
1997	56	93	0	11	44	0
1998	945	646	237	43	141	19
1999	658	351	581	44	74	13
2000	504	139	0	64	30	0
2001	376	215	1	56	35	1
2002	2,521	219	307	146	46	38
2003	6,022	70	301	3,974	24	57
2004	3,815	63	197	2,974	37	85
2005	5,073	48	131	4,287	12	45
2006	3,343	109	218	2,494	44	69
2007	398	185	62	136	46	21
2008	366	146	30	165	146	10
2009	519	367	70	242	219	22
2010	1,269	236	58	1,132	142	20
2011	1,128	185	80	680	113	64
2012	1,650	228	157	1,204	114	73

Year	nfish_CB	nfish_HB	nfish_PR	ntrip_CB	ntrip_HB	ntrip_PR
2013	1,971	668	77	1,639	256	53
2014	838	2,925	302	692	1,606	261
2015	1,733	2,337	658	276	280	138
2016	1,170	307	832	160	50	229
2017	667	370	457	109	60	121
2018	976	699	706	150	101	156
2019	1,320	771	632	226	125	149
2020	651	26	263	123	9	84
2021	981	217	280	195	53	74
2022	873	430	209	194	87	72
2023	822	457	255	159	93	98

Table 4.12.7c. Number of retained fish (nfish) and associated trips (ntrip) sampled from the charter (CB), headboat (HB), and private (PR) fleets for age in the East region.

Year	nfish_CB	nfish_HB	nfish_PR	ntrip_CB	ntrip_HB	ntrip_PR
1986	0	1	0	0	1	0
1987	0	0	0	0	0	0
1988	0	0	0	0	0	0
1989	0	1	0	0	1	0
1990	0	0	0	0	0	0
1991	2	0	0	1	0	0
1992	0	5	0	0	1	0
1993	0	0	0	0	0	0
1994	0	0	0	0	0	0
1995	0	0	0	0	0	0
1996	0	0	0	0	0	0
1997	0	1	0	0	1	0
1998	1	1	0	1	1	0
1999	0	14	0	0	3	0
2000	2	1	0	2	1	0
2001	11	1	0	3	1	0
2002	14	0	0	4	0	0
2003	35	2	3	15	2	3
2004	3	1	0	3	1	0
2005	5	52	0	5	52	0
2006	5	78	2	5	78	2
2007	14	7	1	14	7	1
2008	7	46	10	6	46	10
2009	52	316	2	52	316	2
2010	106	240	13	106	240	13
2011	73	260	13	73	260	13
2012	14	126	0	14	126	0
2013	19	150	7	19	150	7
2014	81	67	12	29	32	12
2015	141	203	0	22	24	0
2016	24	39	10	9	13	6
2017	66	158	342	16	24	79
2018	207	236	40	39	40	14

Year	nfish_CB	nfish_HB	nfish_PR	ntrip_CB	ntrip_HB	ntrip_PR
2019	208	207	26	46	32	10
2020	55	0	50	10	0	15
2021	276	39	22	49	14	10
2022	172	115	30	40	22	8
2023	133	157	35	38	30	12

Table 4.12.8. Number of fish (F) and trips (T) sampled for discards in the open (O) and closed (C) season from the charter (CB) and headboat (HB) fleets in the **East** region.

Year	CB_OF	CB_CF	HB_OF	HB_CF	CB_OT	CB_CT	HB_OT	HB_CT
2005	-	-	47	86	-	-	7	7
2006	-	-	52	208	-	-	7	10
2007	-	-	23	89	-	-	4	9
2008	-	-	-	-	-	-	-	-
2009	8	10	57	151	2	6	12	5
2010	22	6	21	262	3	3	7	8
2011	0	3	57	470	0	2	9	10
2012	14	2	3	93	2	1	2	8
2013	9	0	32	52	3	0	4	7
2014	-	-	-	-	-	-	-	-
2015	123	0	7	14	11	0	2	1
2016	84	107	136	222	6	17	6	20
2017	154	85	142	102	10	14	7	15
2018	156	265	204	211	12	17	8	11
2019	150	126	212	285	13	19	5	19
2020	23	38	0	0	2	4	0	0
2021	159	110	19	3	13	10	3	2
2022	190	127	25	45	15	7	2	3
2023	196	112	58	205	10	9	2	5

Table 4.12.9. Number of fish (F) and trips (T) sampled by each state for discards in the open (O) and closed (C) season from the **headboat** fleet in the **Central** region.

Year	AL_OF	AL_CF	NWFL_OF	NWFL_CF	AL_OT	AL_CT	NWFL_OT	NWFL_CT
2005	1,097	100	1,168	504	23	4	30	15
2006	1,252	159	1,258	780	27	5	22	18
2007	1,105	60	1,644	1,144	20	2	28	23
2008	-	-	-	-	-	-	-	-
2009	-	-	182	241	-	-	15	12
2010	-	-	200	206	-	-	13	18
2011	-	-	85	493	-	-	11	39
2012	-	-	110	686	-	-	7	41
2013	-	-	119	436	-	-	12	30
2015	-	-	55	468	-	-	12	66
2016	-	-	143	724	-	-	12	82
2017	-	-	125	672	-	-	14	62
2018	-	-	136	500	-	-	15	46
2019	-	-	161	640	-	-	16	61
2020	-	-	2	105	-	-	1	9
2021	-	-	287	198	-	-	21	24
2022	54	85	258	376	5	8	19	48
2023	0	105	114	327	0	3	20	47

Table 4.12.10. Number of fish (F) and trips (T) sampled by each state for discards in the open (O) and closed (C) season from the **charter** fleet in the **Central** region.

Year	MS_OF	MS_CF	AL_OF	AL_CF	NWFL_OF	NWFL_CF	MS_OT	MS_CT	AL_OT	AL_CT	NWFL_OT	NWFL_CT
2009	-	-	-	-	286	243	-	-	-	-	15	19
2010	-	-	-	-	850	323	-	-	-	-	36	23
2011	-	-	-	-	208	1,081	-	-	-	-	17	56
2012	-	-	-	-	138	747	-	-	-	-	13	56
2013	-	-	-	-	291	664	-	-	-	-	17	53
2014	-	-	-	-	-	-	-	-	-	-	-	-
2015	-	-	-	-	110	328	-	-	-	-	14	61
2016	154	0	0	0	253	588	27	0	0	0	18	61
2017	0	0	47	14	398	406	0	0	8	4	17	49
2018	195	0	0	5	186	574	18	0	0	1	15	56
2019	193	0	157	315	123	658	18	0	11	14	23	65
2020	124	0	0	0	44	21	9	0	0	0	5	3
2021	64	0	0	0	482	307	9	0	0	0	33	20
2022	332	54	260	166	215	480	20	2	22	23	16	42
2023	332	50	432	287	85	255	30	2	30	26	19	41

Table 4.12.11. Total recreational fishing effort (in angler trips) for Gulf of America Red Snapper combined across all surveys by year and mode. 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+.

	WEST			CENTRAL			EAST		
YEAR	Cbt	Hbt	Priv	Cbt	Hbt	Priv	Cbt	Hbt	Priv
1981	112,608	79,590	10,374,727	100,813	43,891	3,152,987	205,851	106,202	7,831,685
1982	108,239	79,233	10,541,310	258,200	137,252	2,837,465	291,431	116,772	7,673,280
1983	125,356	80,360	10,728,331	193,924	85,454	2,371,474	320,524	163,025	9,567,170
1984	119,360	80,765	9,932,536	200,779	97,182	3,634,221	280,455	136,610	10,368,065
1985	124,223	80,439	11,053,240	169,617	83,937	5,626,228	358,028	185,486	6,675,184
1986	95,949	70,752	10,669,817	233,049	113,266	4,881,068	306,934	161,070	6,971,520
1987	117,907	81,749	12,707,090	354,826	81,574	4,549,524	221,501	186,017	8,263,928
1988	125,860	83,764	12,142,861	269,988	89,839	4,375,597	165,651	170,887	9,950,151
1989	153,414	75,876	11,255,386	298,724	83,495	4,342,397	262,506	189,644	10,559,047
1990	138,019	76,780	11,495,260	203,569	86,057	2,736,932	329,791	212,237	12,548,217
1991	159,484	81,337	11,359,400	311,368	91,359	2,929,846	264,410	148,622	13,535,909
1992	156,120	96,090	12,779,200	248,411	93,415	2,717,482	280,064	155,093	13,197,651
1993	167,343	100,043	12,941,923	278,841	103,730	3,904,041	338,681	158,781	13,049,759
1994	204,199	118,160	13,695,849	291,234	95,943	4,175,935	330,960	175,422	12,616,507
1995	189,196	105,772	13,896,433	321,550	99,130	3,531,534	430,644	154,326	13,961,044
1996	189,925	107,764	14,338,643	355,761	88,637	4,106,273	337,673	137,464	13,329,241
1997	210,156	94,157	12,812,819	266,302	92,456	3,911,918	390,600	111,017	14,809,162
1998	225,179	90,553	13,348,752	271,509	94,472	4,076,075	412,702	140,016	15,053,774
1999	231,097	48,435	15,634,350	297,159	60,200	5,622,320	344,852	111,006	14,986,982
2000	247,426	72,056	15,585,234	249,153	81,876	5,999,721	383,788	143,374	13,800,980
2001	267,924	64,516	14,348,287	237,119	77,104	7,111,168	414,969	131,235	14,842,138
2002	232,849	69,614	13,685,303	253,721	78,282	6,535,509	438,705	114,102	14,559,599
2003	246,990	82,703	14,539,211	253,435	88,820	7,359,201	359,193	104,811	14,904,967
2004	260,405	65,024	14,151,982	275,823	89,440	8,659,644	415,559	121,456	17,729,380
2005	228,535	62,093	13,166,925	234,442	70,467	8,049,871	360,612	108,046	16,748,668
2006	330,102	77,265	13,570,306	250,705	93,998	9,100,702	376,844	78,657	14,120,517
2007	290,761	144,368	13,034,482	280,888	97,819	9,690,632	442,659	91,350	14,052,639
2008	296,541	29,253	13,159,759	239,033	86,463	9,293,163	428,988	99,423	16,866,891
2009	285,253	58,088	14,288,807	230,831	95,887	8,713,701	411,350	110,494	15,025,847
2010	198,615	49,273	14,418,734	125,729	55,895	8,715,899	405,290	103,763	15,750,729
2011	257,995	51,748	14,802,529	262,264	110,713	9,482,632	385,671	118,573	15,094,221
2012	329,426	61,315	14,541,340	275,000	114,601	10,735,788	510,293	125,435	16,327,654
2013	264,864	60,035	14,564,002	279,468	111,534	9,025,293	507,462	121,851	16,280,391
2014	269,225	56,145	13,391,945	284,955	123,512	7,535,770	512,429	133,220	14,846,796
2015	304,122	60,540	13,254,802	370,346	120,003	7,877,969	536,523	139,778	12,545,628
2016	336,690	58,190	14,362,410	333,618	124,667	8,764,593	599,637	143,949	12,861,680
2017	367,224	56,164	13,657,887	336,785	123,448	10,137,744	545,357	141,619	12,033,494
2018	482,197	55,687	12,947,443	341,321	129,001	9,120,022	597,816	131,509	11,566,078

YEAR	WEST Cbt	WEST Hbt	WEST Priv	CENTRAL Cbt	CENTRAL Hbt	CENTRAL Priv	EAST Cbt	EAST Hbt	EAST Priv
2019	546,507	54,741	13,461,778	378,050	119,006	8,194,723	762,322	129,996	10,222,218
2020	352,799	52,947	15,597,768	365,987	94,833	7,790,696	675,641	89,789	12,773,897
2021	406,415	86,183	12,632,795	418,338	124,552	8,180,930	758,123	142,048	11,837,663
2022	480,646	79,823	12,196,594	391,684	111,636	9,372,409	749,764	126,169	12,555,532
2023	715,913	64,718	13,771,689	434,072	106,401	9,088,714	651,427	104,421	12,555,729

4.13 FIGURES

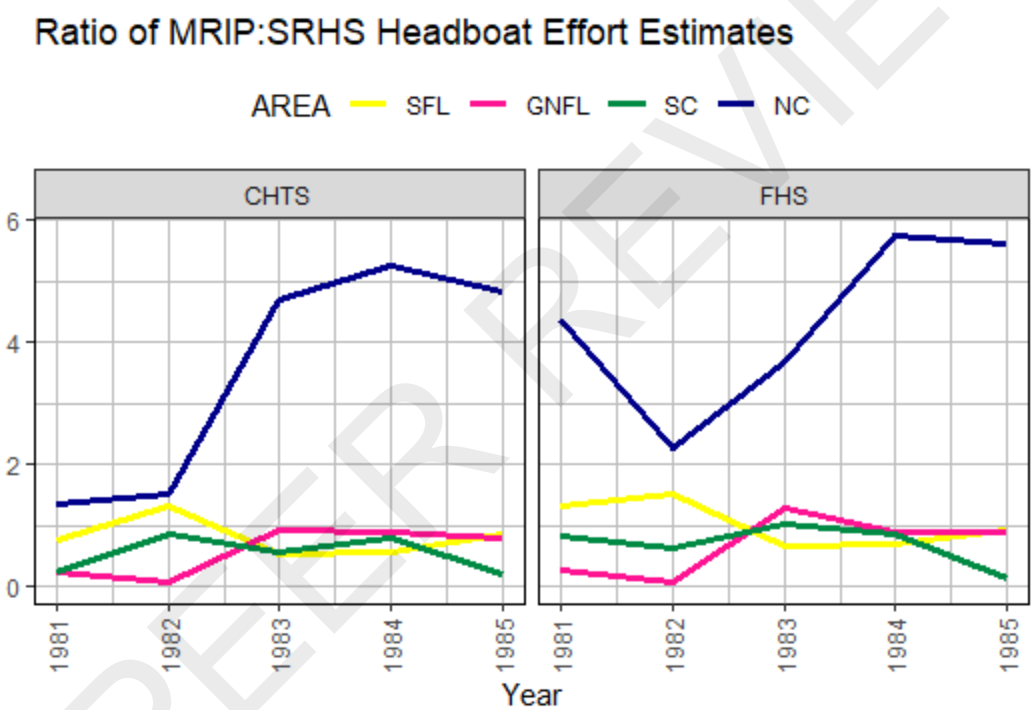


Figure 4.13.1. Relationship between annual MRIP: SRHS catch estimates produced for the South Atlantic in 1981-1985.

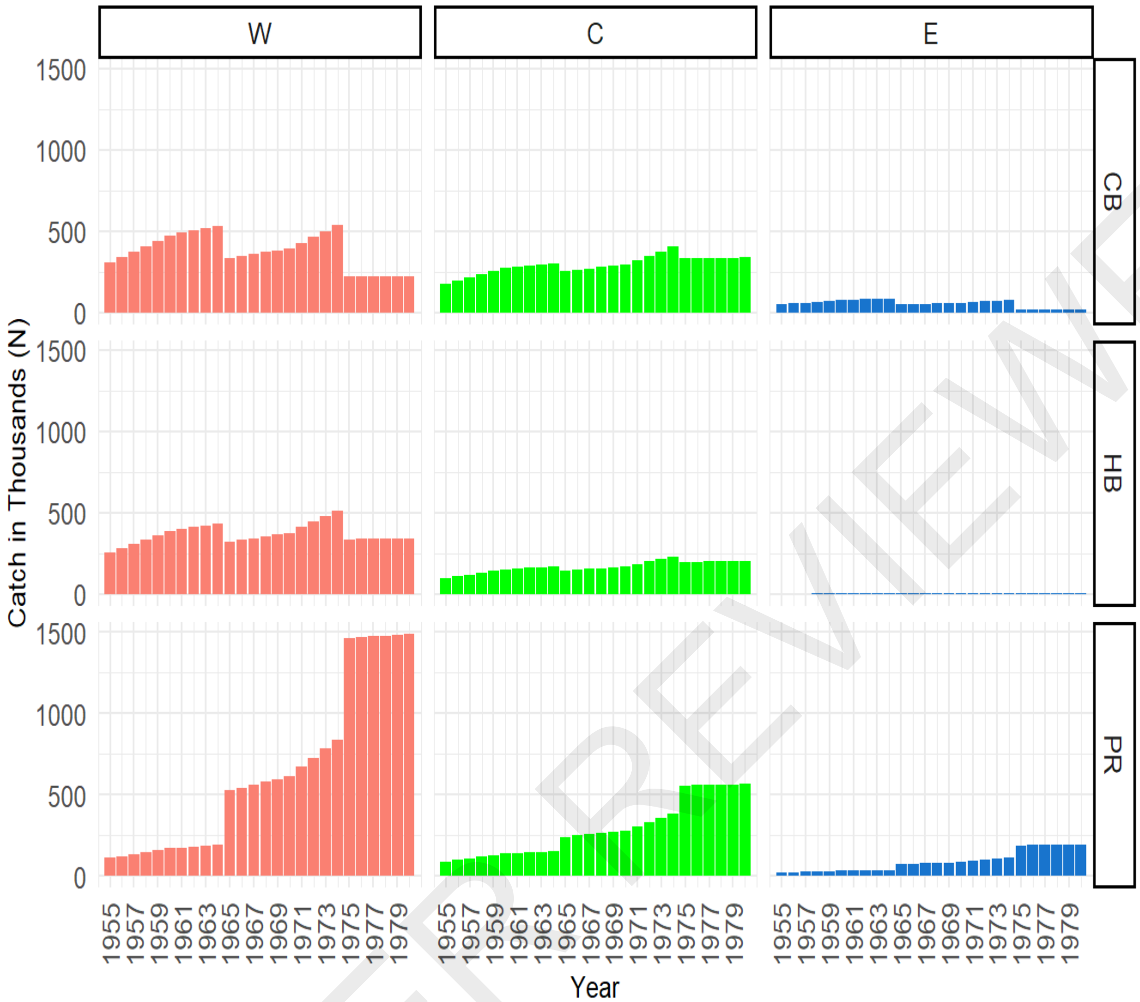


Figure 4.13.2. Historical catch in numbers (thousands) estimated using the FHWAR method.

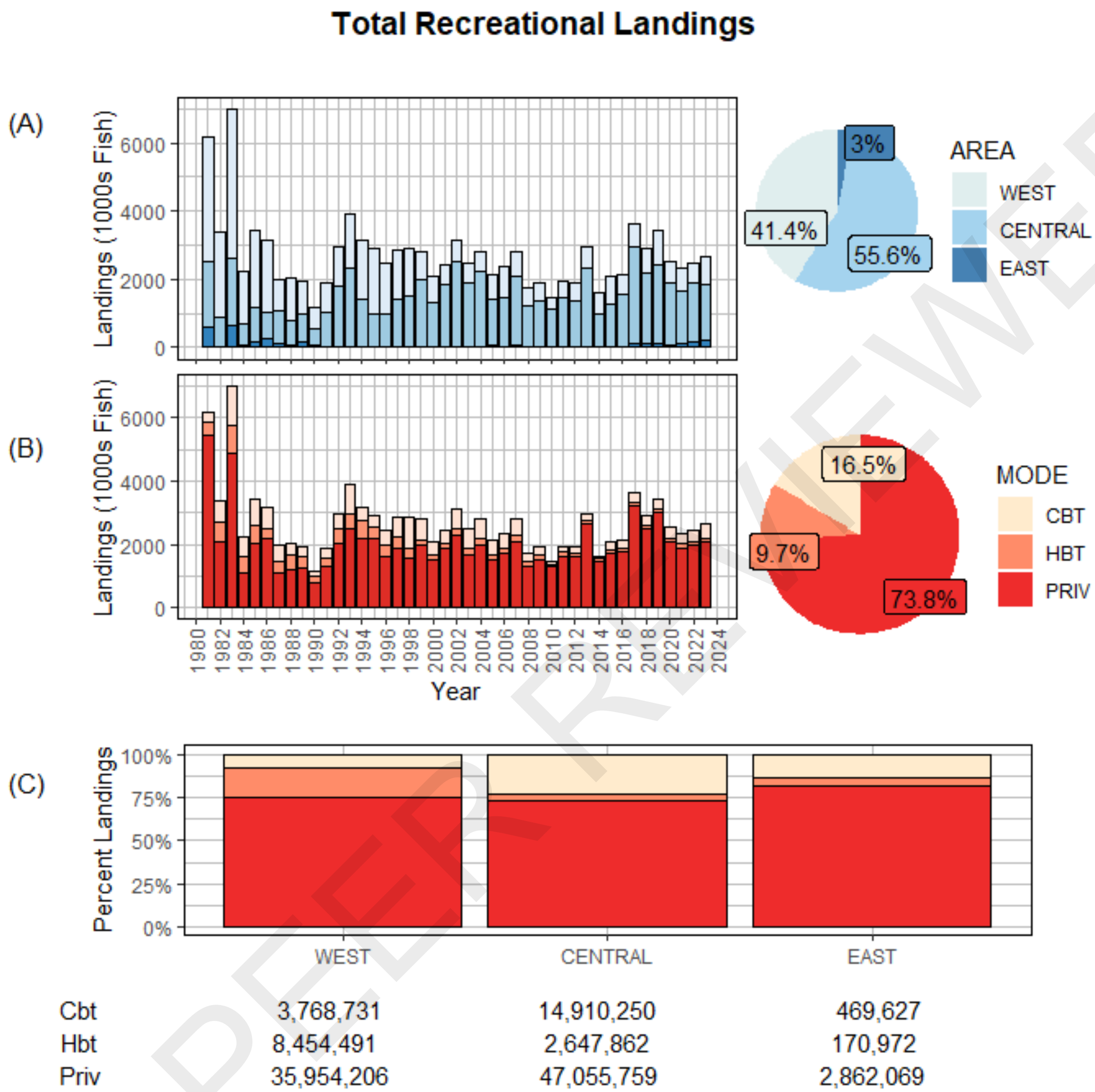


Figure 4.13.3. Total recreational landings (AB1) for Gulf of America Red Snapper across all surveys. Landings are provided (A) by state and year in thousands of fish, (B) by mode and year in thousands of fish, and (C) by mode and state in percent numbers of fish.

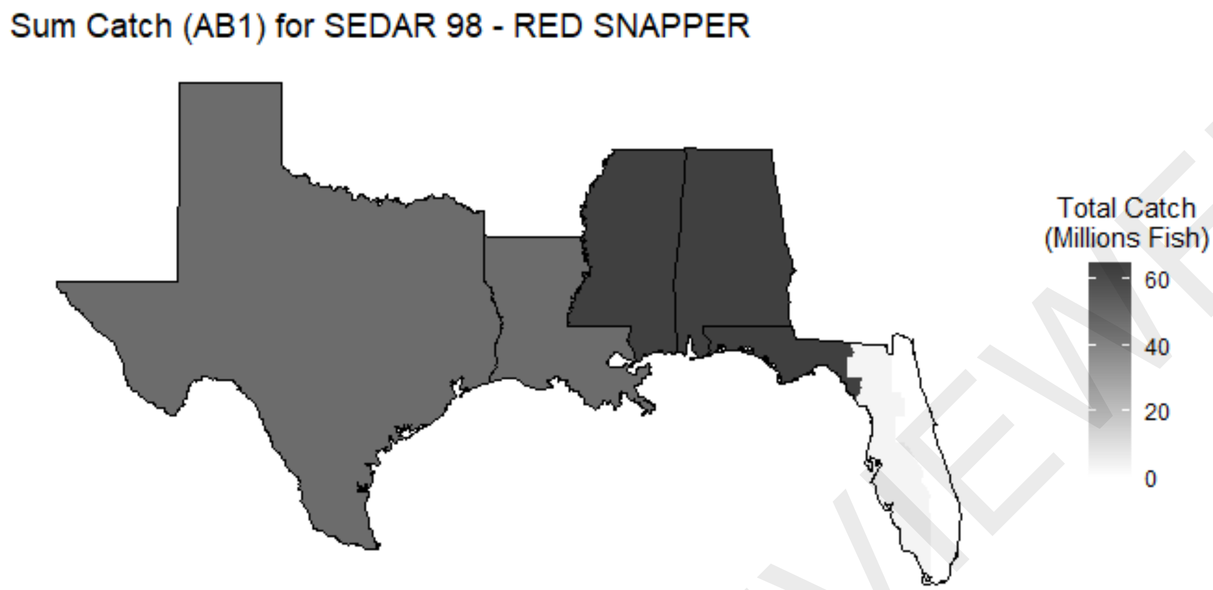


Figure 4.13.4. Distribution of total recreational landings (AB1), in thousands of fish, for Red Snapper across the Gulf of America. Estimates are combined across all surveys and years.

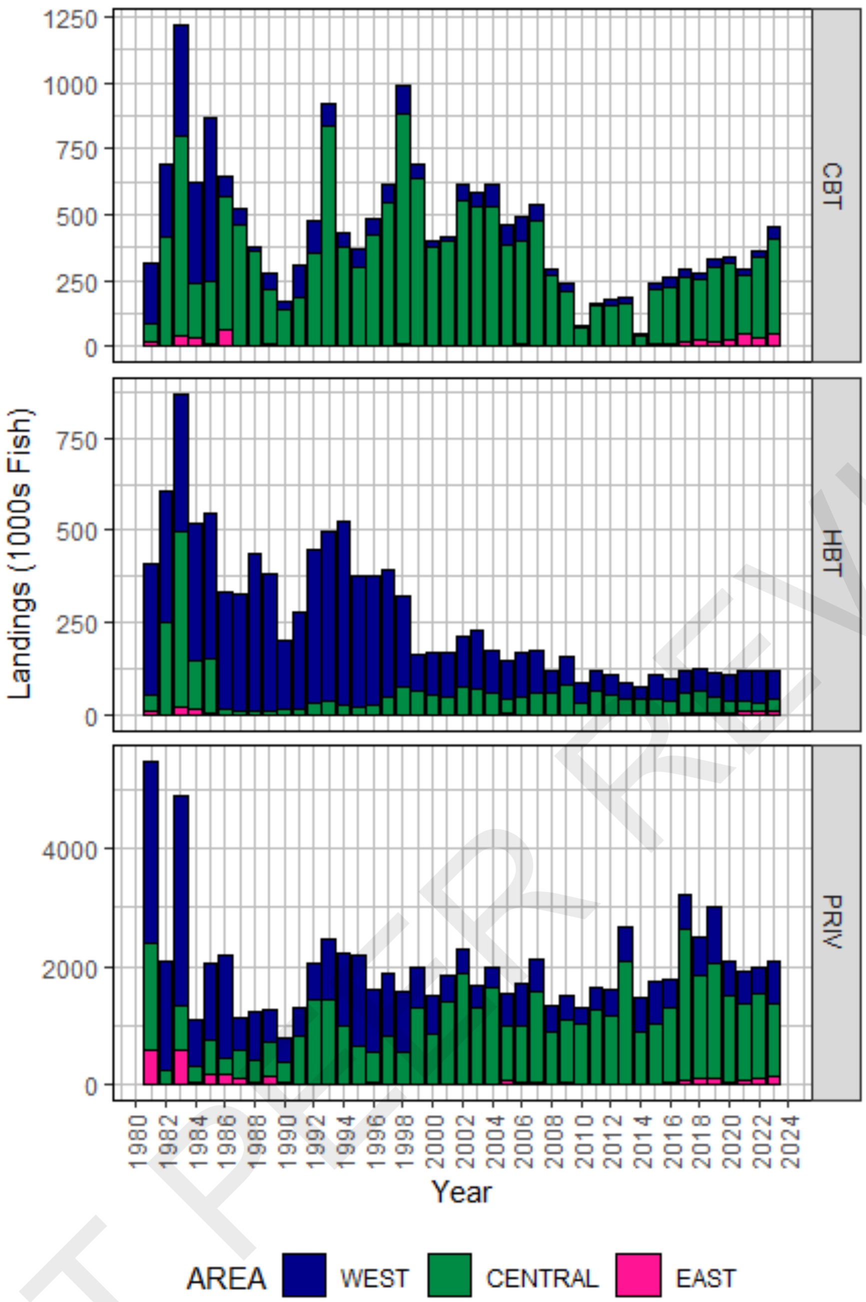


Figure 4.13.5. Recreational landings (AB1) for Gulf of America Red Snapper for each fishing mode. Landings are provided by year and SID domain in thousands of fish.

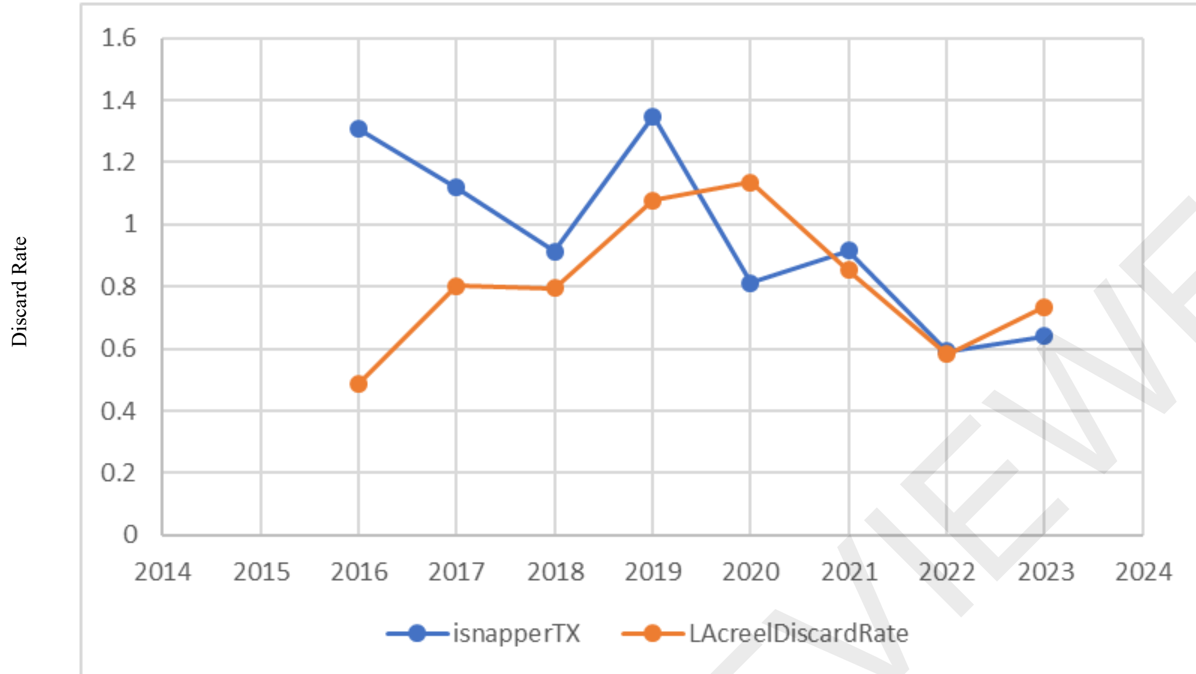
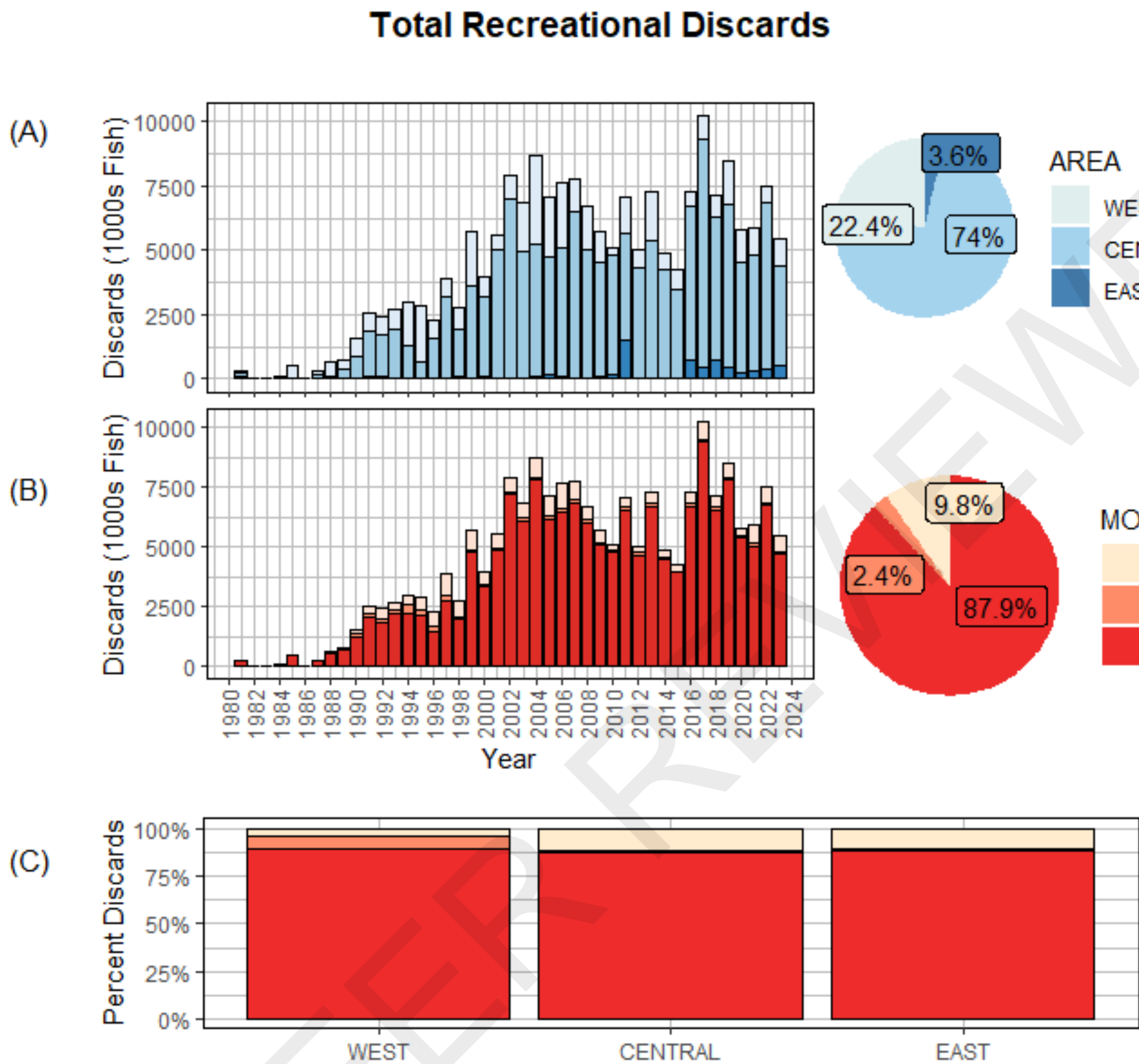


Figure 4.13.6. Discard rates of Red Snapper from LA Creel and the Texas Hunt and Fish program.



	WEST	CENTRAL	EAST
Cbt	1,926,633	16,071,302	712,674
Hbt	2,527,293	1,896,094	120,016
Priv	38,427,277	123,996,321	6,102,148

Figure 4.13.7. Total recreational discards (B2) for Gulf of America Red Snapper across all surveys. Discards are provided (A) by state and year in thousands of fish, (B) by mode and year in thousands of fish, and (C) by mode and state in percent numbers of fish.

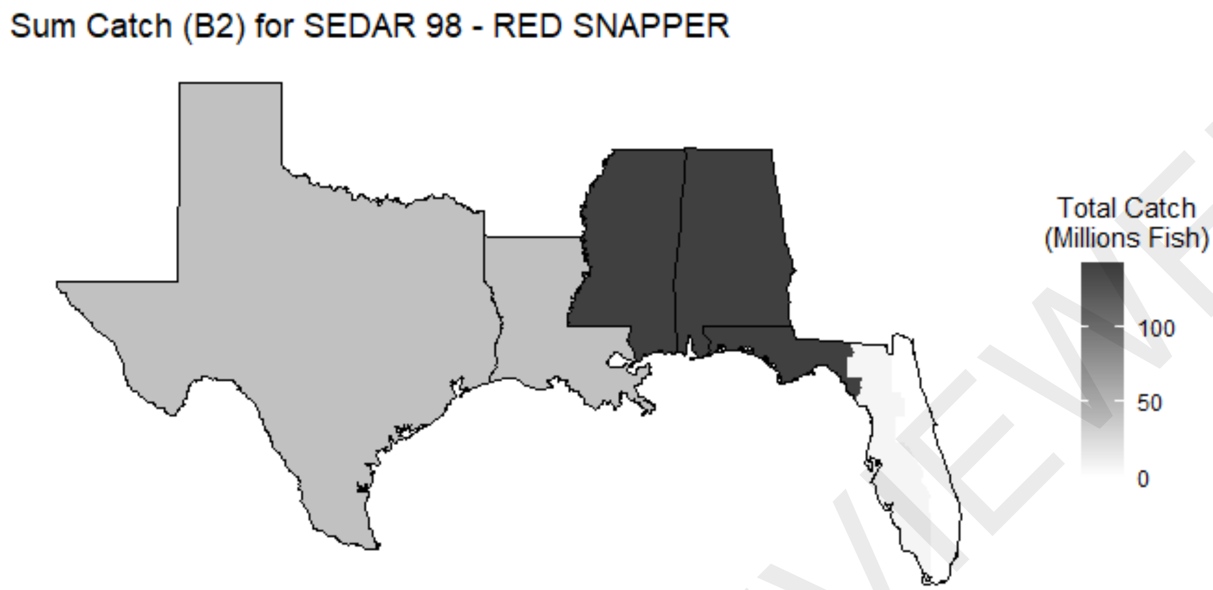


Figure 4.13.8. Distribution of total recreational discards (B2), in thousands of fish, for Red Snapper across the Gulf of America. Estimates are combined across all surveys and years.

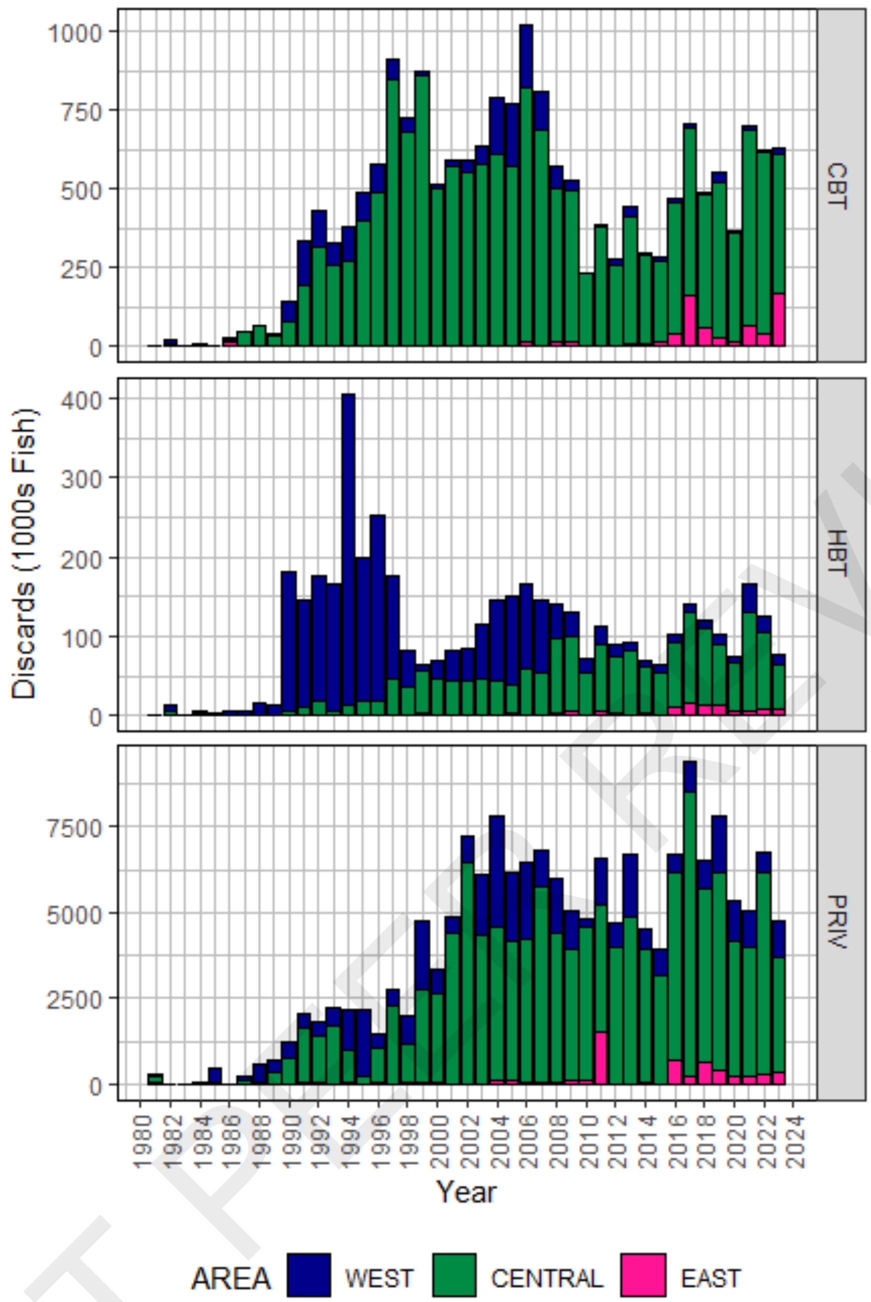


Figure 4.13.9. Recreational discards (B2) for Gulf of America Red Snapper for each fishing mode. Discards are provided by year and SID domain in thousands of fish.

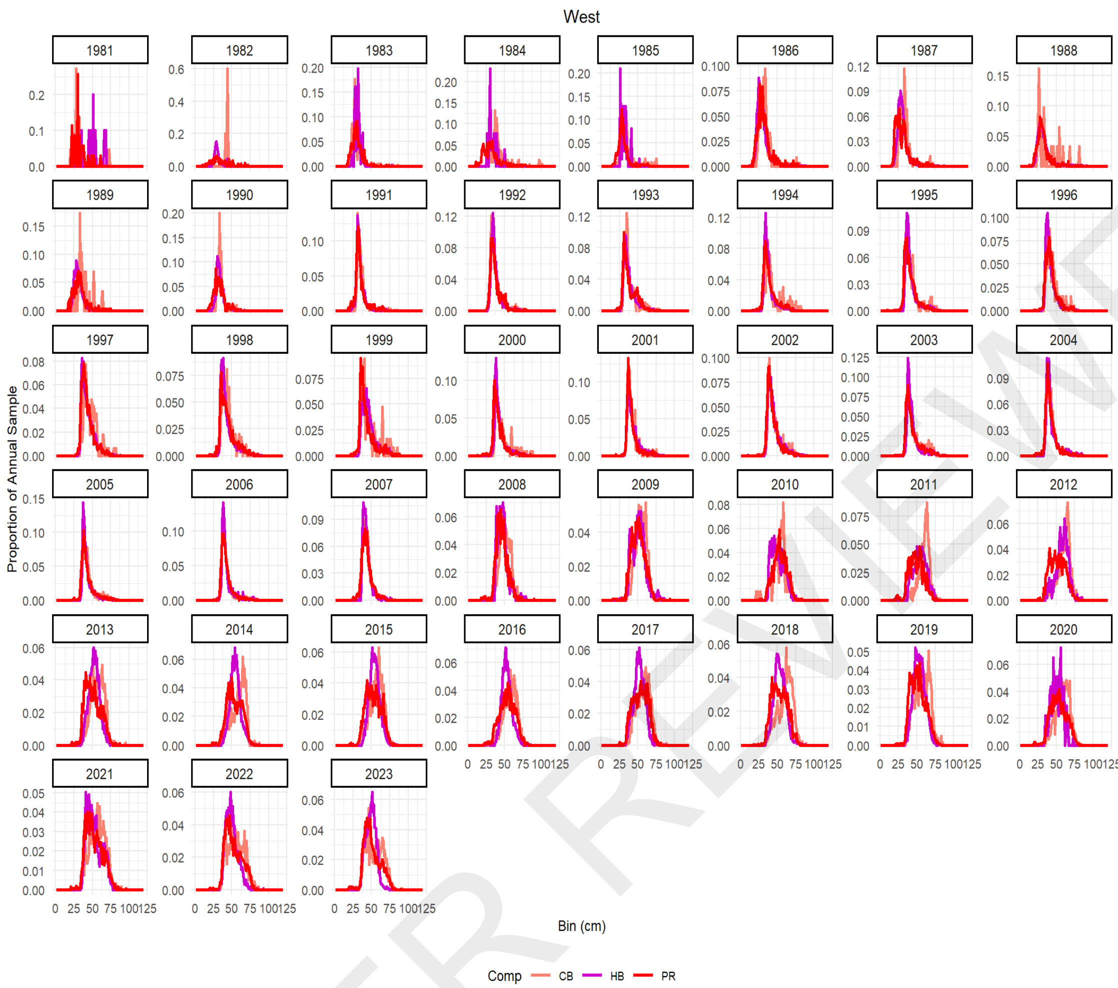


Figure 4.13.10a. Nominal length distribution for fish sampled in the charter, headboat, and private fleets in the **West** region.

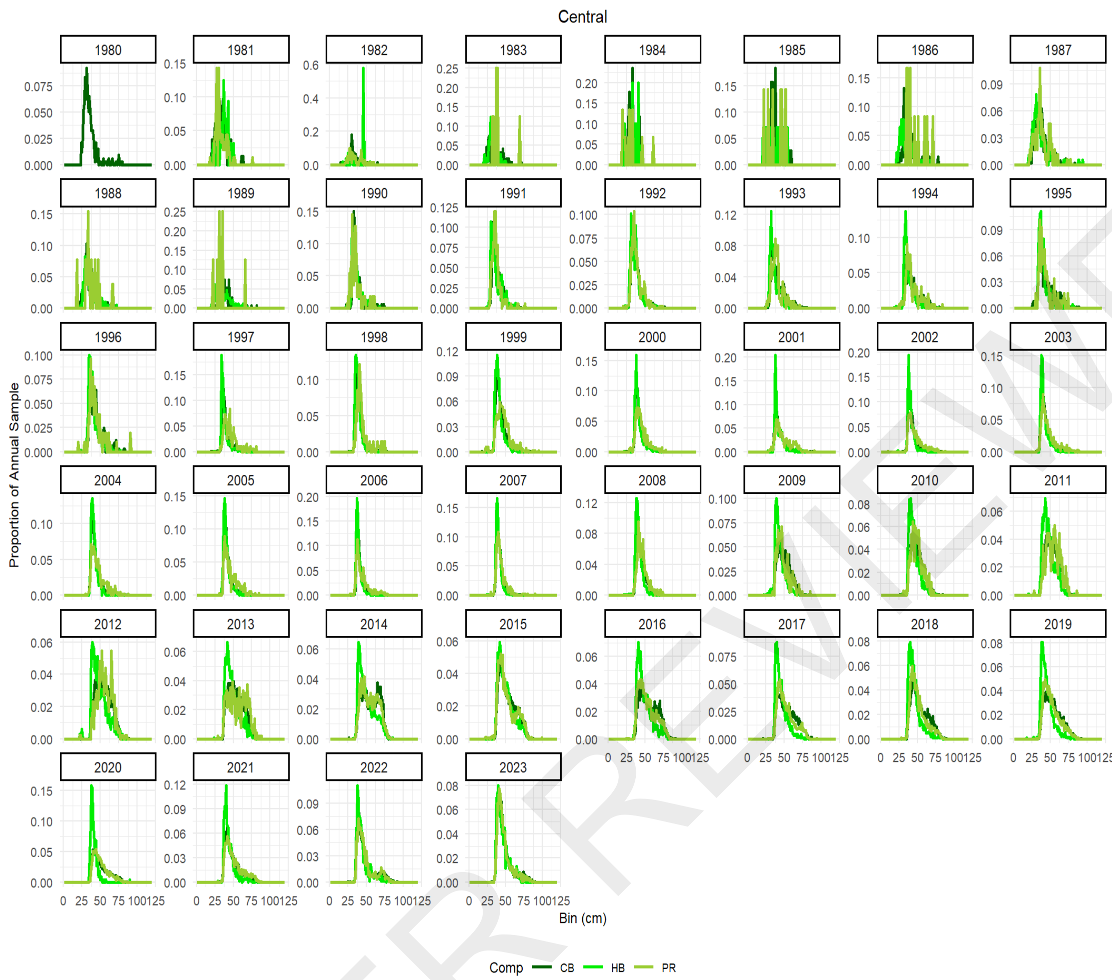


Figure 4.13.10b. **Nominal length** distribution for fish sampled in the charter, headboat, and private fleets in the **Central** region.

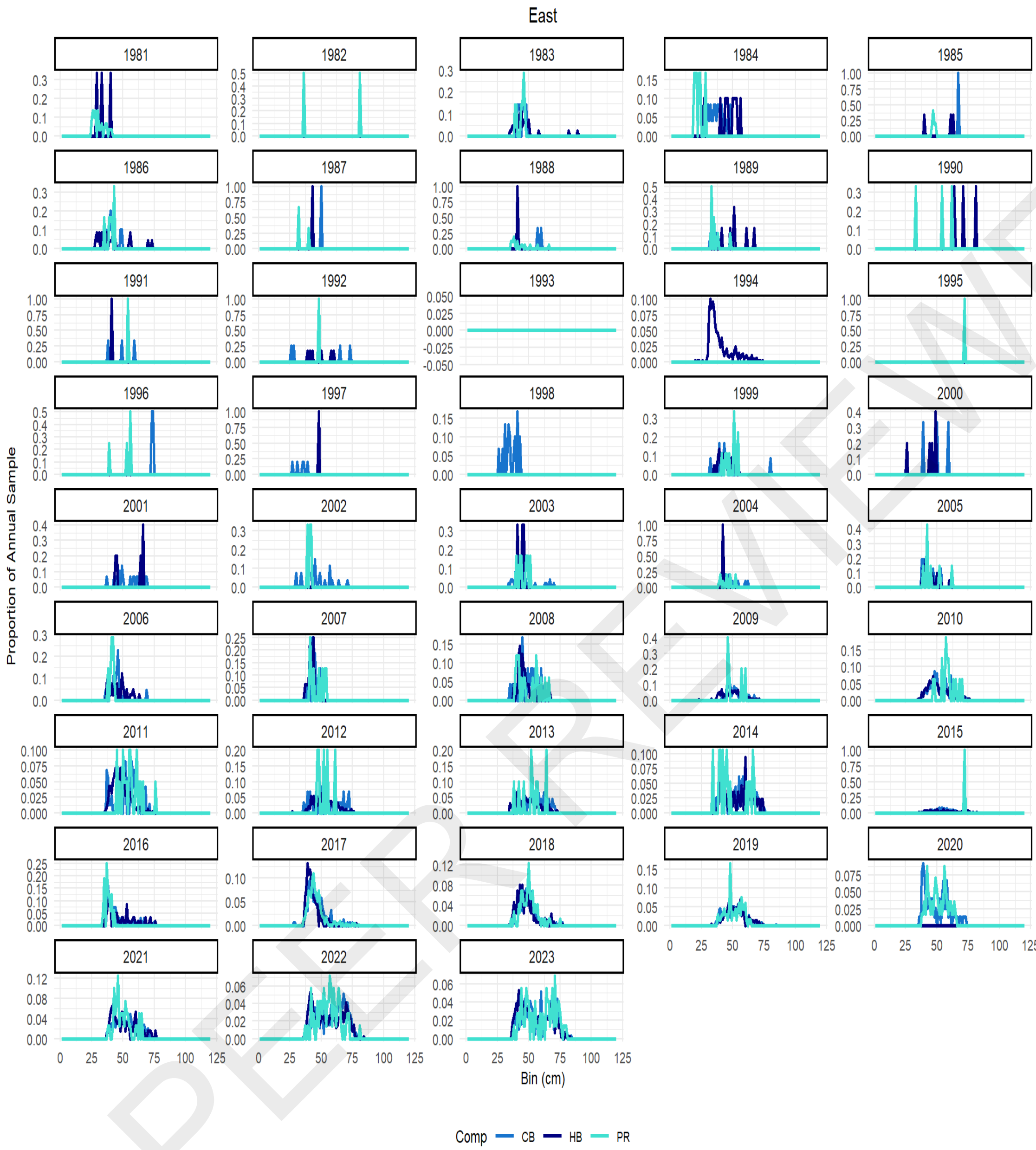


Figure 4.13.10c. **Nominal length** distribution for fish sampled in the charter, headboat, and private fleets in the **East** region.

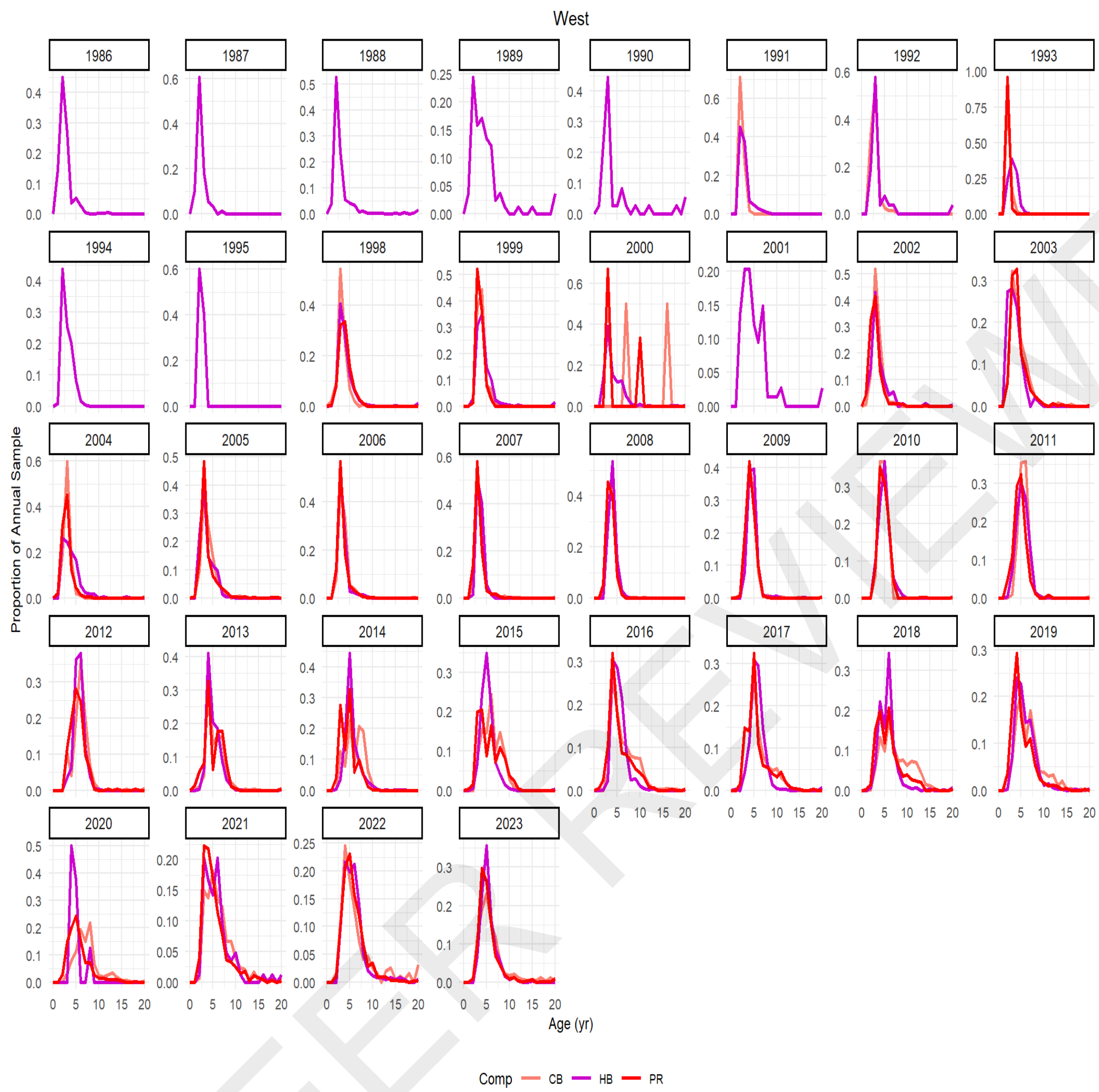


Figure 4.13.11a. **Nominal age** distribution for fish sampled in the charter, headboat, and private fleets in the **West** region.

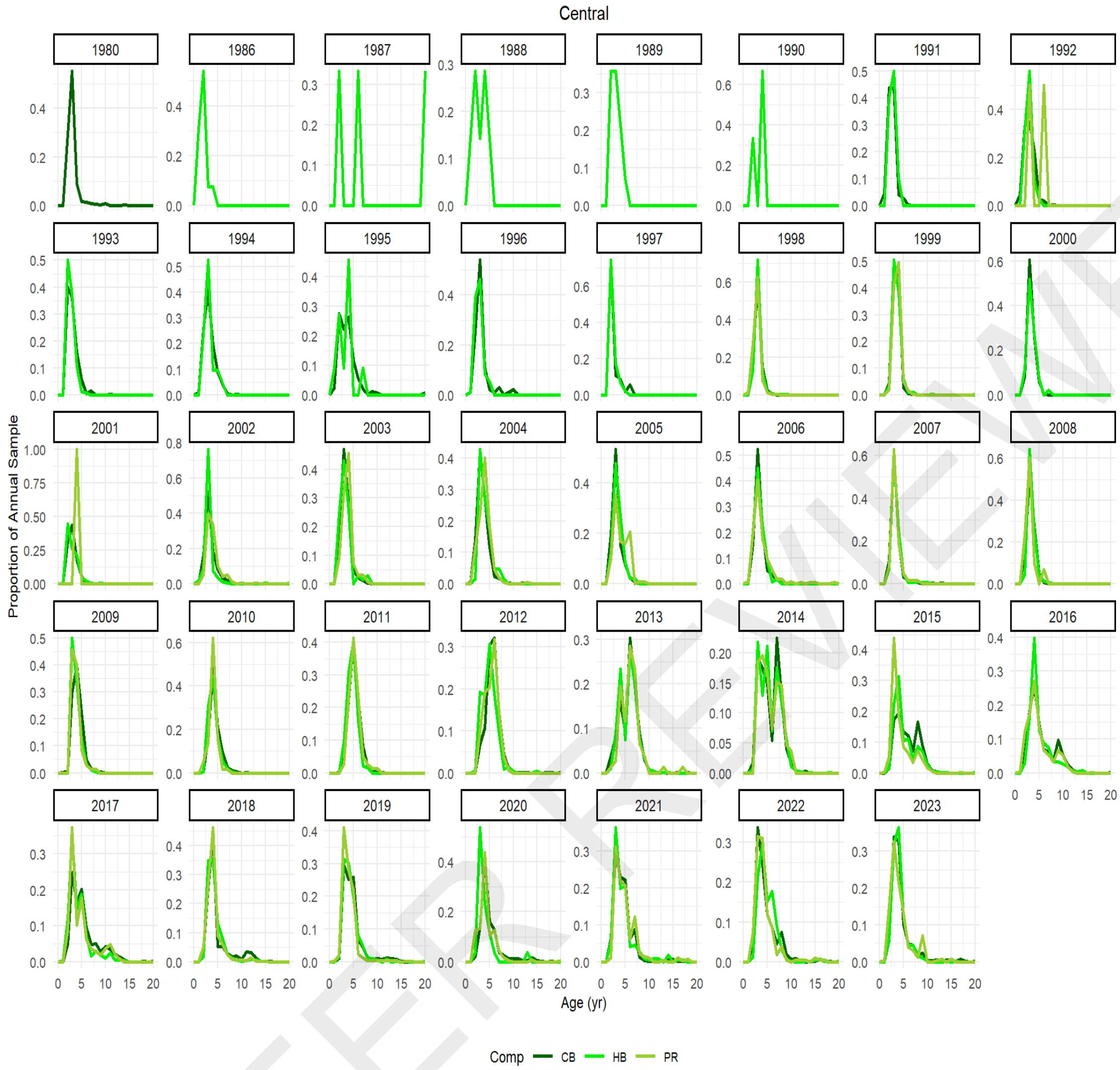


Figure 4.13.11b. **Nominal age** distribution for fish sampled in the charter, headboat, and private fleets in the **Central** region.

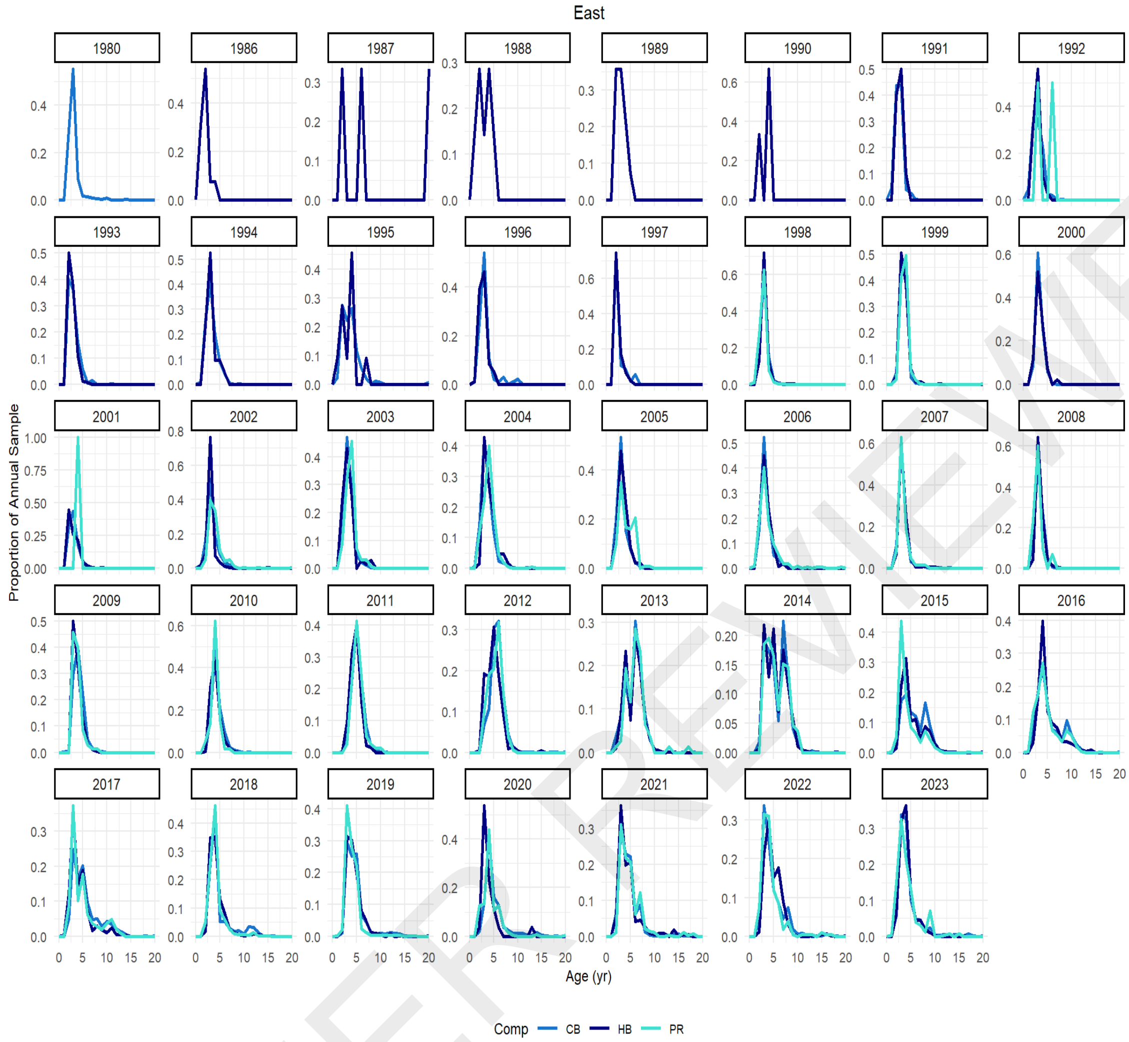


Figure 4.13.11c. **Nominal age** distribution for fish sampled in the charter, headboat, and private fleets in the **East** region.

Figure 4.13.12. Final discard length compositions for Red Snapper by open and closed season for the **headboat** fleet in the **East** region.

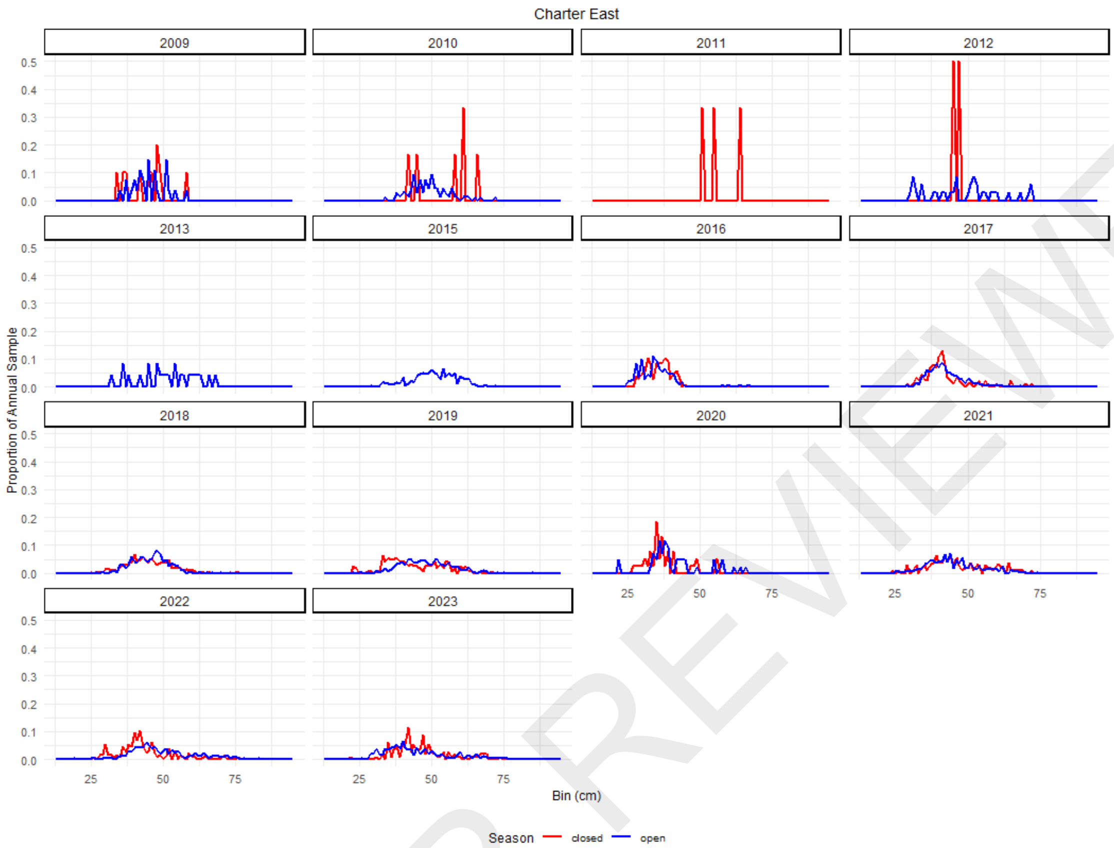


Figure 4.13.13. Final discard length compositions for Red Snapper by open and closed season for the **charter** fleet in the **East** region.

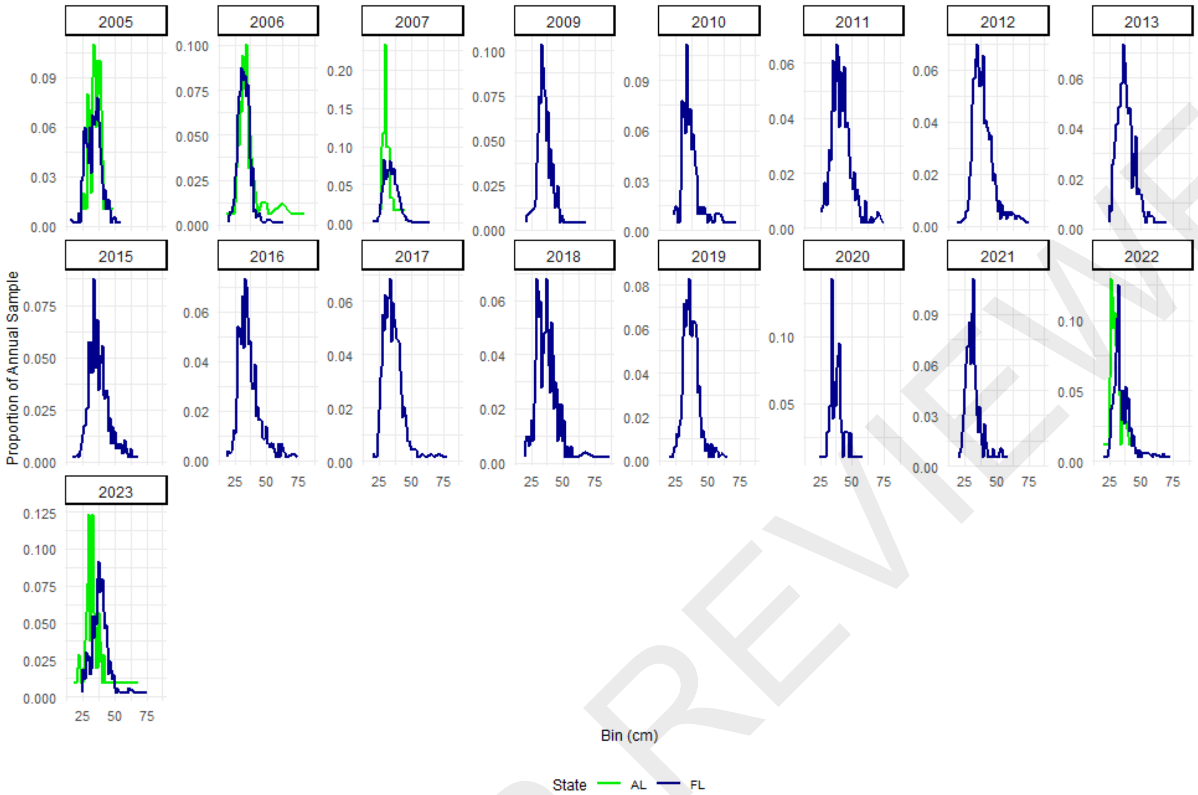


Figure 4.13.14a. **Headboat closed** season nominal length compositions **by state** and year for Red Snapper in the **Central** region

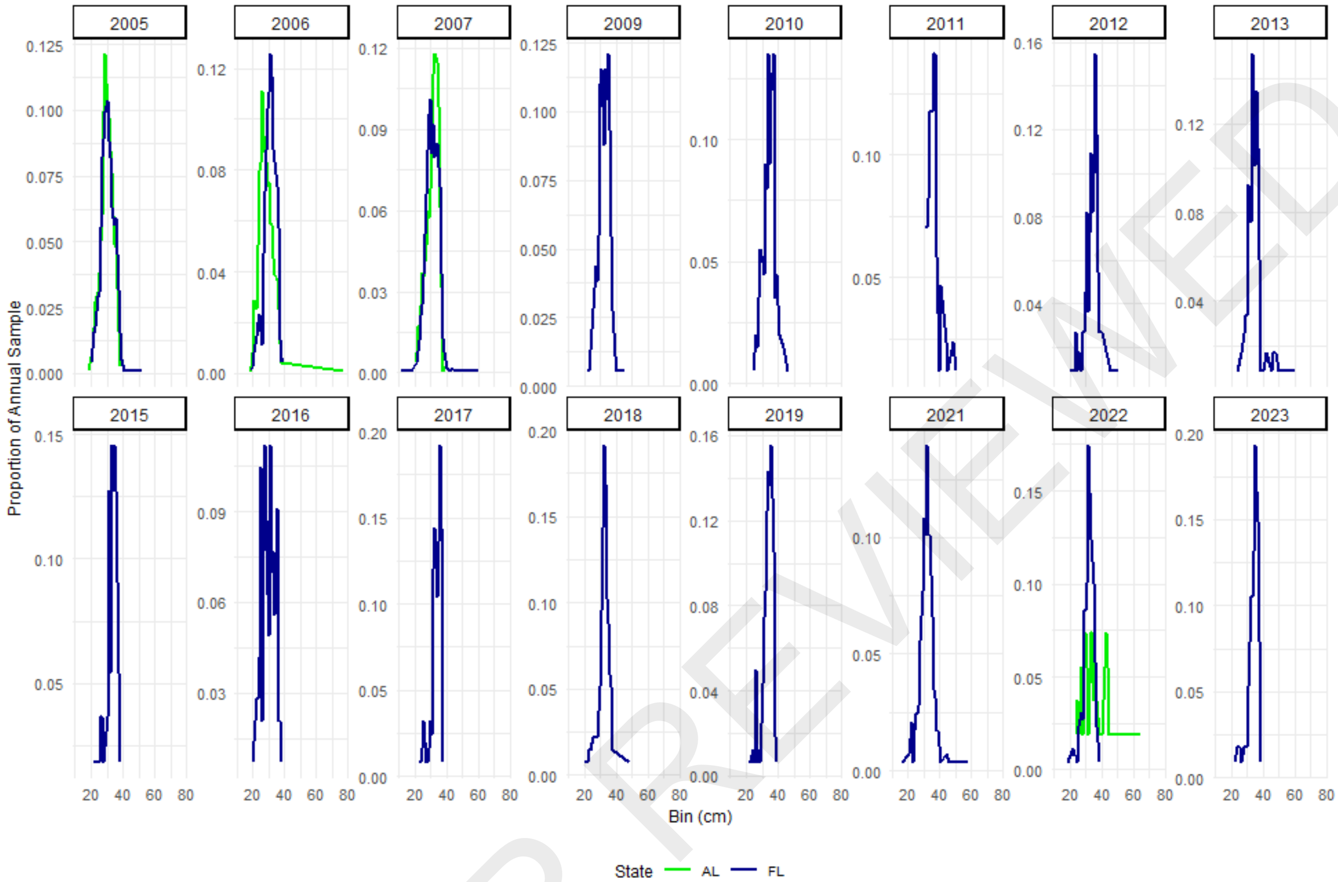


Figure 4.13.14b. **Headboat open** season nominal length compositions **by state** and year for Red Snapper in the **Central** region

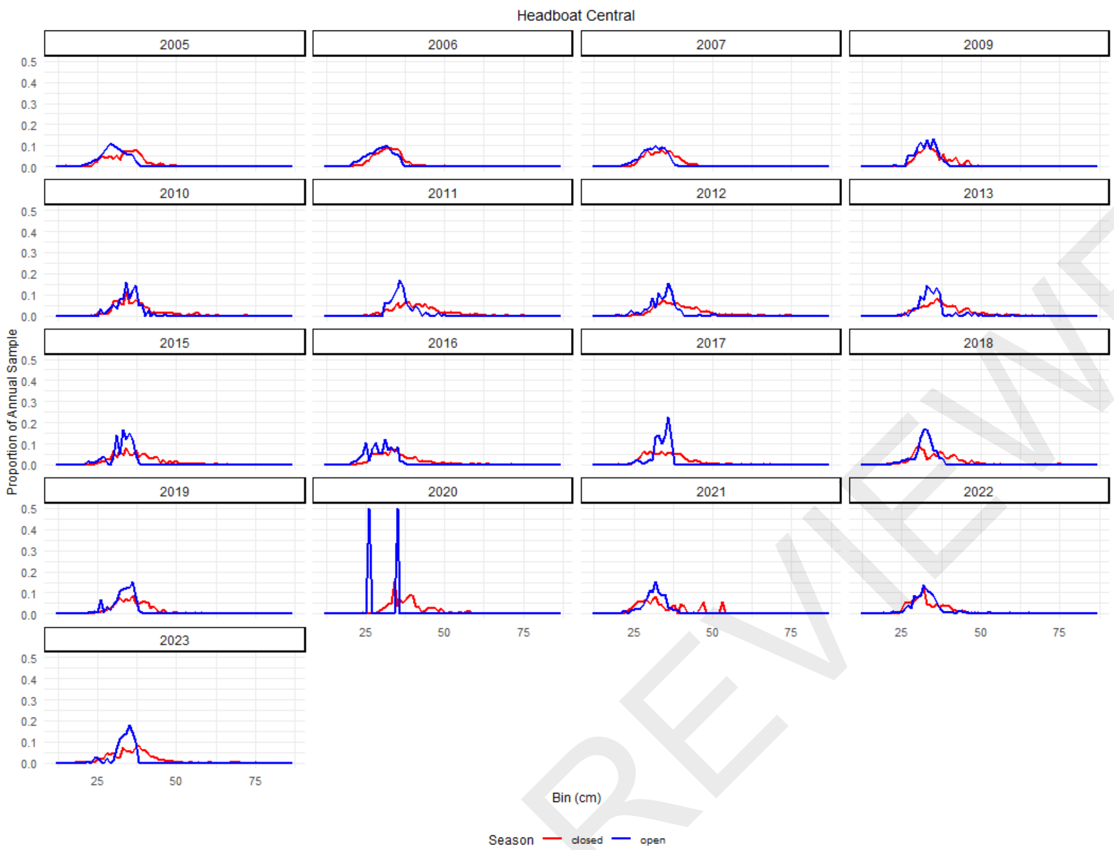


Figure 4.13.15. Final discard length compositions for Red Snapper by open and closed season for the **headboat** fleet in the **Central** region.

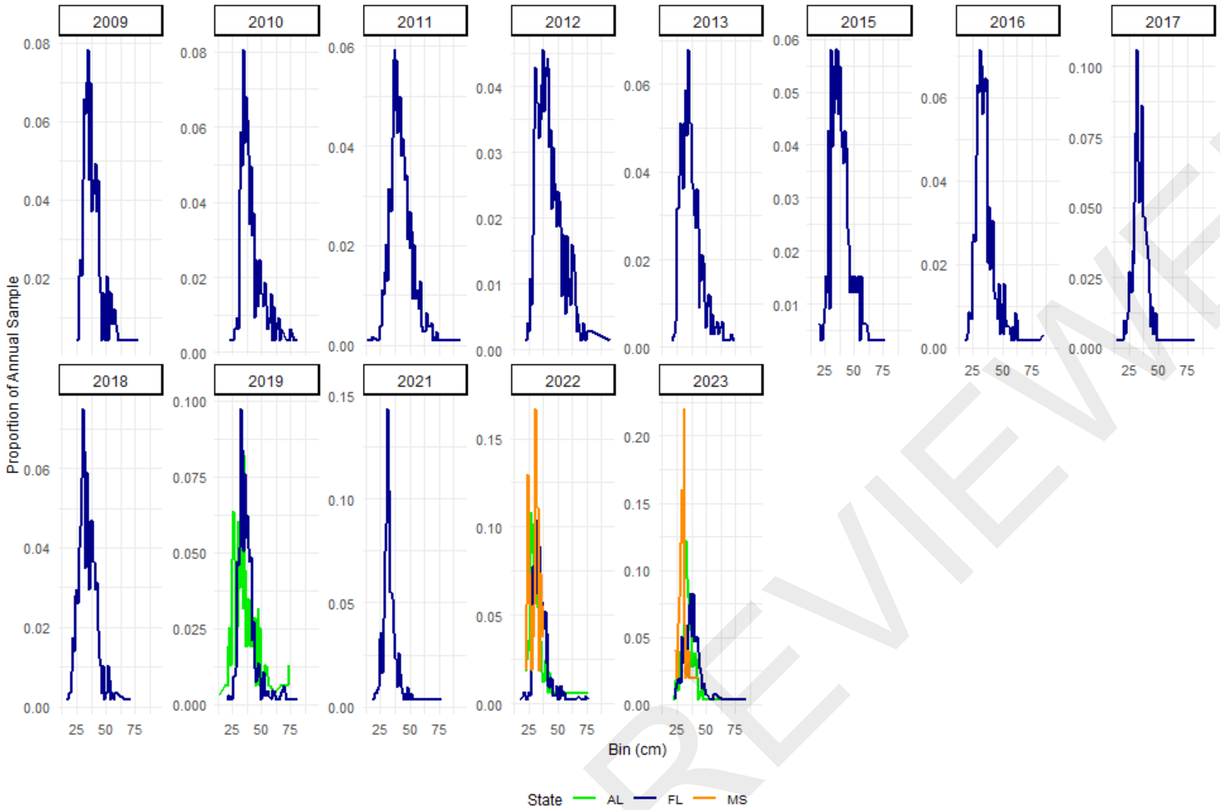


Figure 4.13.16a. **Charter closed** season nominal length compositions **by state** and year for Red Snapper in the **Central** region

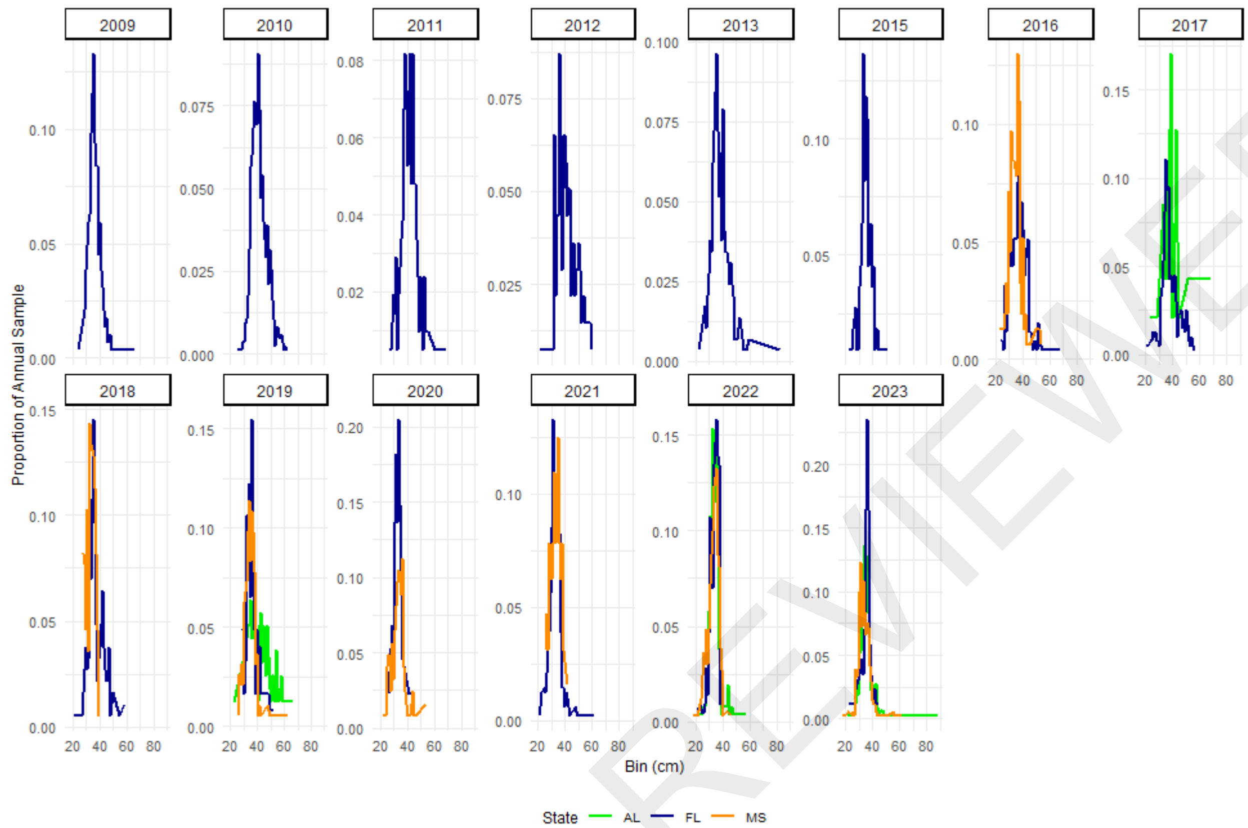


Figure 4.13.16b. **Charter open** season nominal length compositions **by state** and year for Red Snapper in the **Central** region

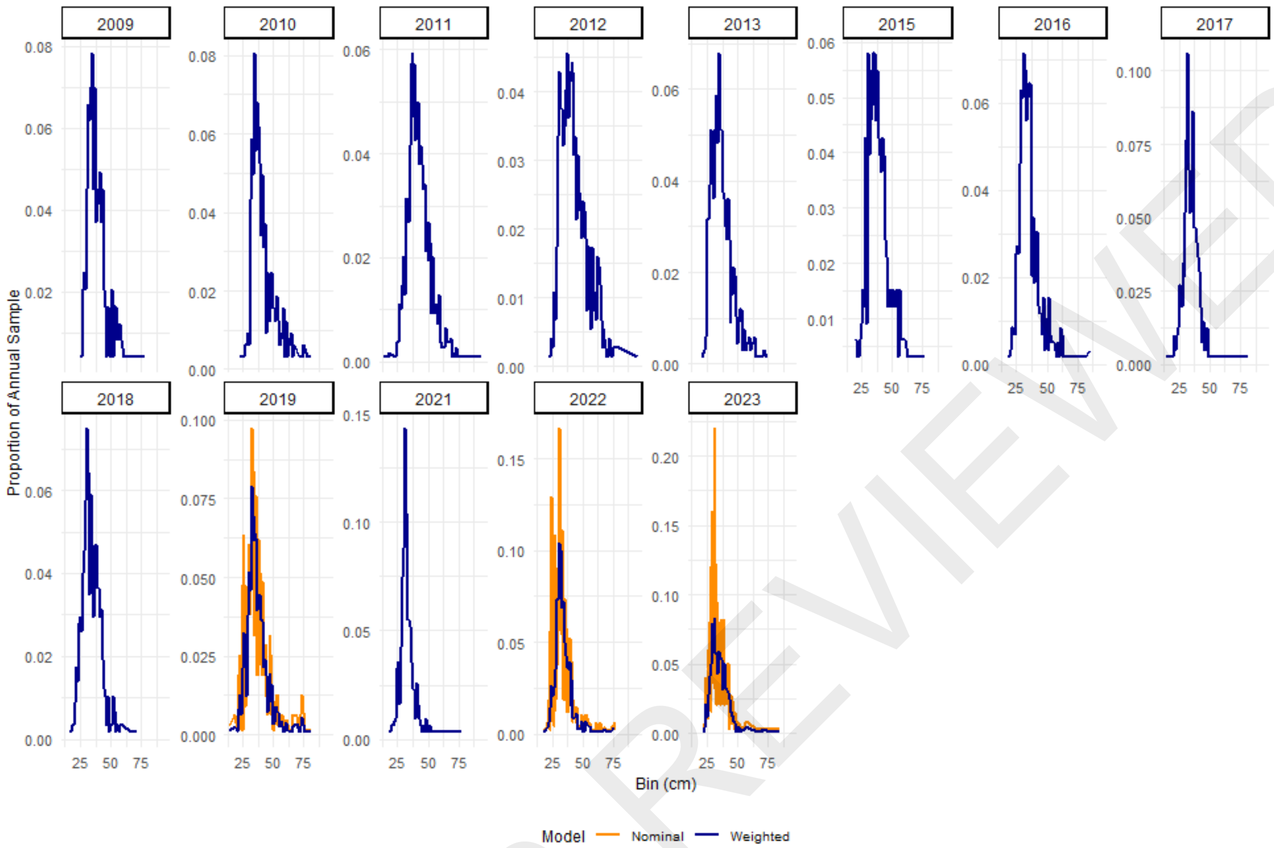


Figure 4.13.17a. **Charter closed** season **weighted and nominal** length compositions for Red Snapper in the **Central** region. Weighting values were calculated by subregion total annual discards where FL was one subregion and MS and AL were combined into the second subregion.

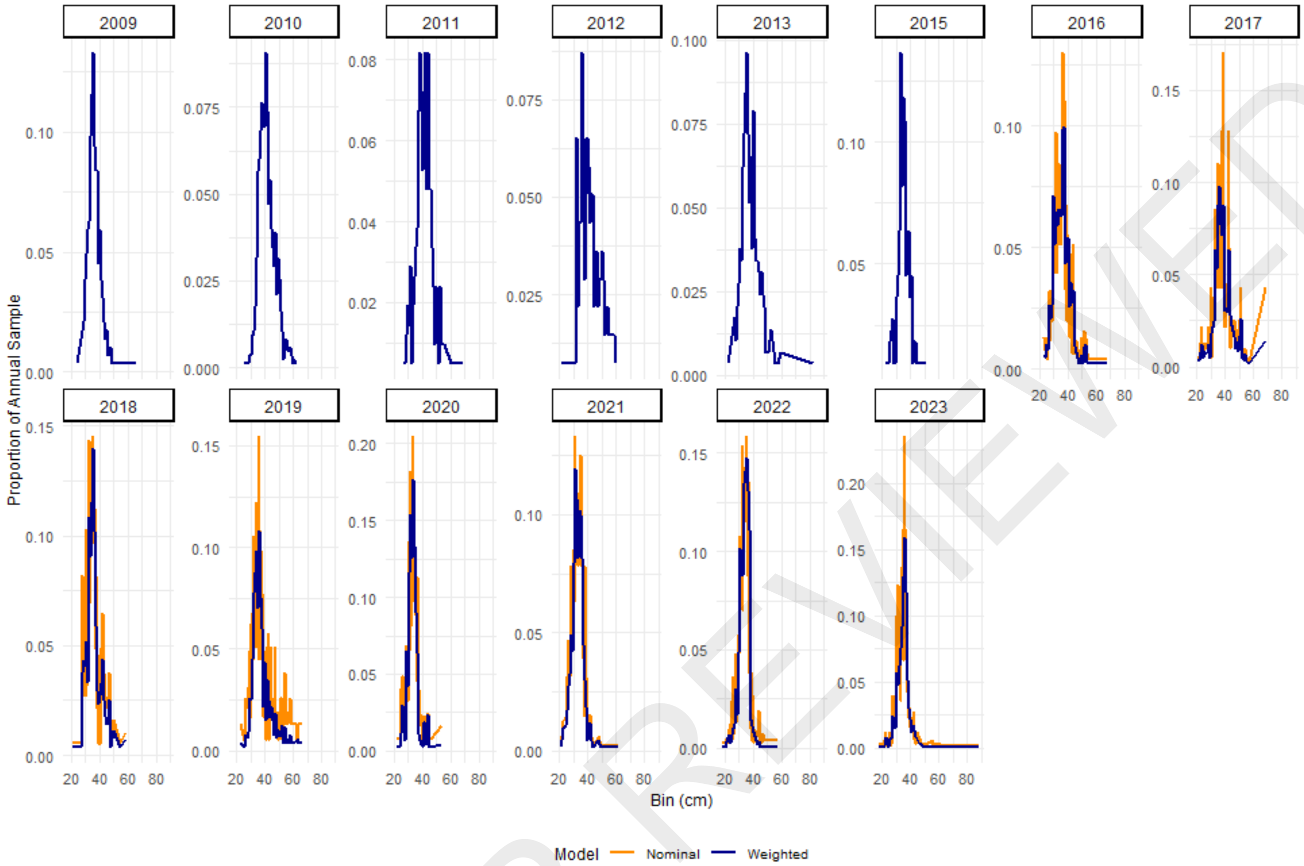


Figure 4.13.17b. **Charter open** season **weighted and nominal** length compositions for Red Snapper in the **Central** region. Weighting values were calculated by subregion total annual discards where FL was one subregion and MS and AL were combined into the second subregion.

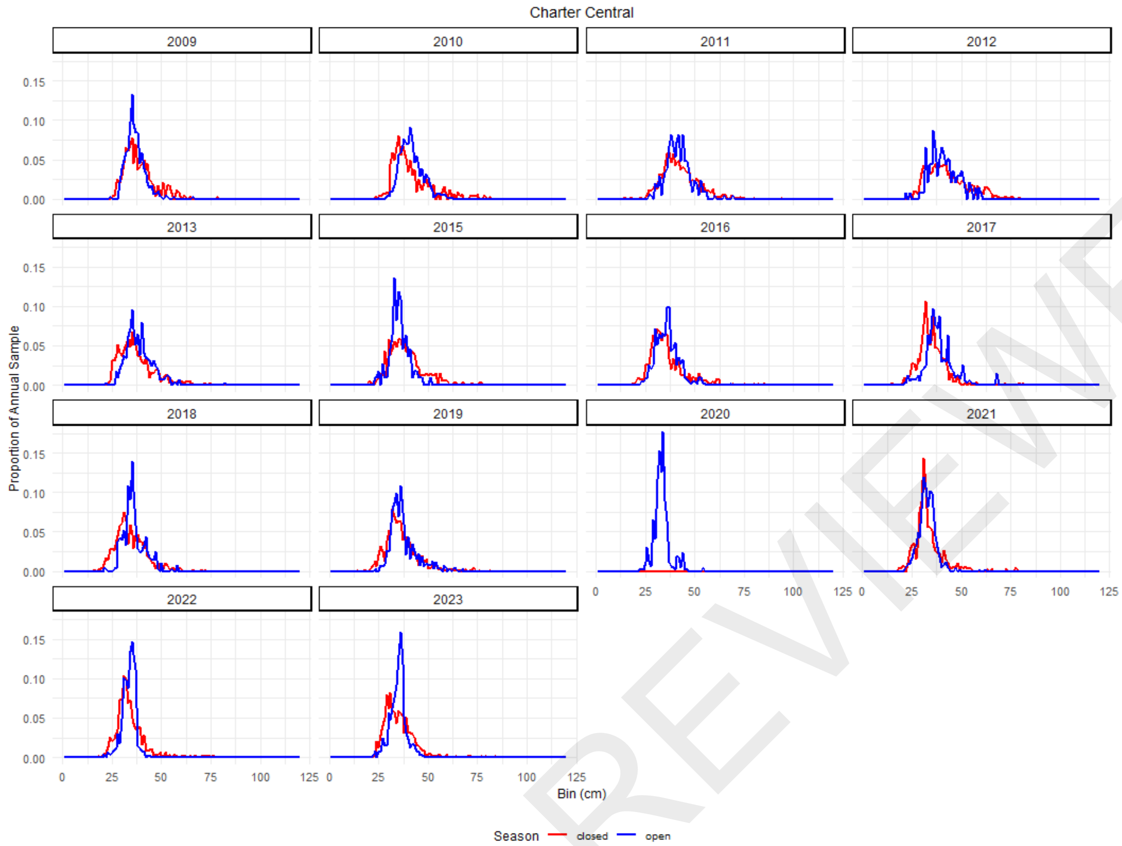
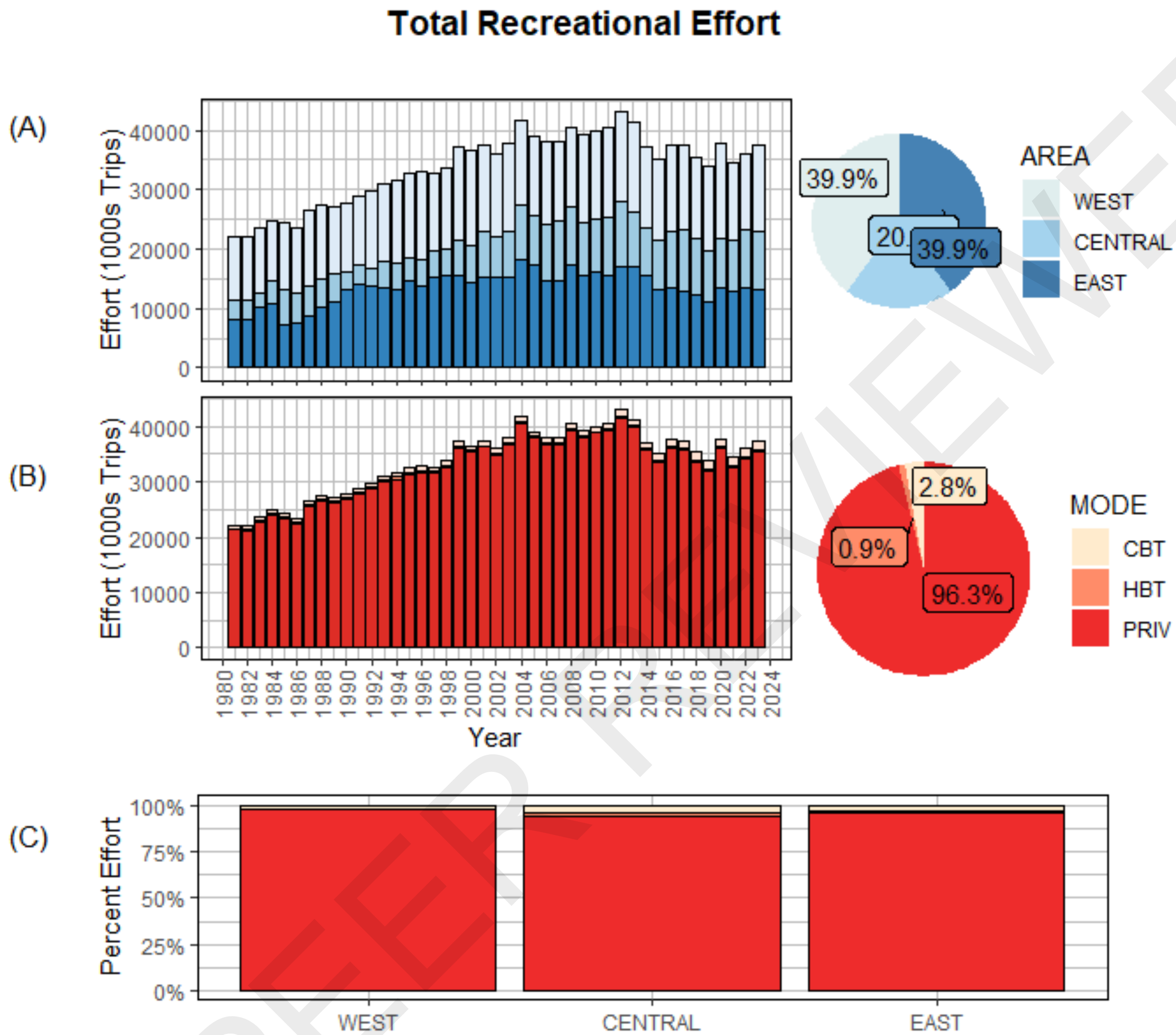


Figure 4.13.18. Final discard length compositions for Red Snapper by open and closed season for the **charter** fleet in the **Central** region.



	WEST	CENTRAL	EAST
Cbt	10,953,060	12,028,393	18,103,682
Hbt	3,204,110	4,151,248	5,774,765
Priv	564,839,940	278,019,812	554,851,613

Figure 4.13.19. Total recreational effort (angler trips) for Gulf of America across all surveys. Effort is provided (A) by state and year in thousands of trips, (B) by mode and year in thousands of trips, and (C) by mode and state in percent numbers of trips.

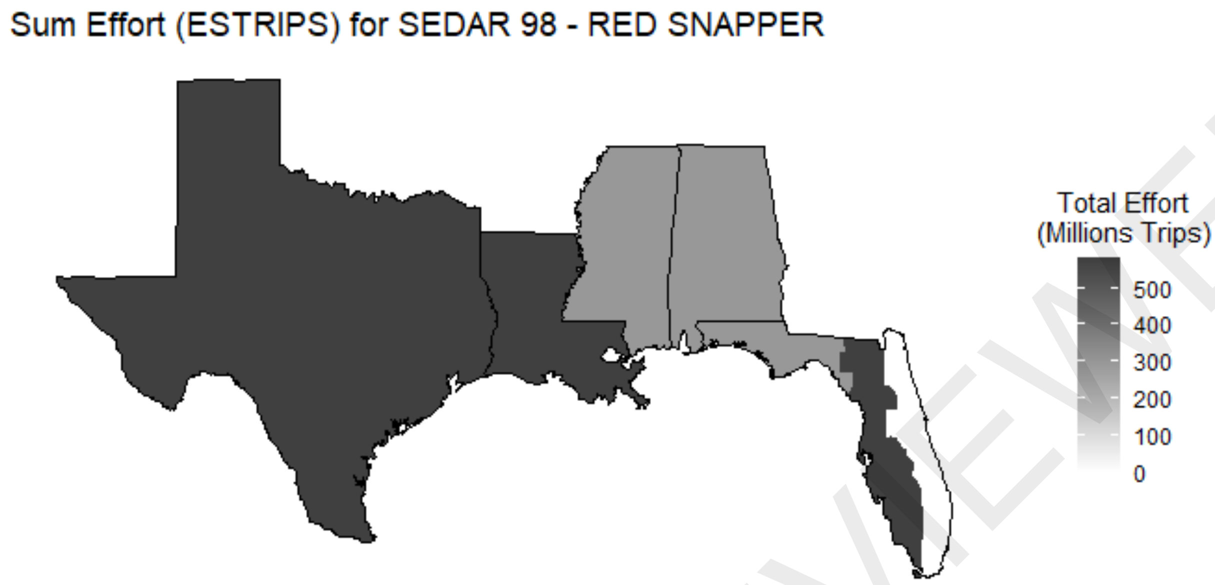


Figure 4.13.20. Distribution of total recreational effort (angler trips), in thousands of trips, across the Gulf of America. Estimates are combined across all surveys and years.

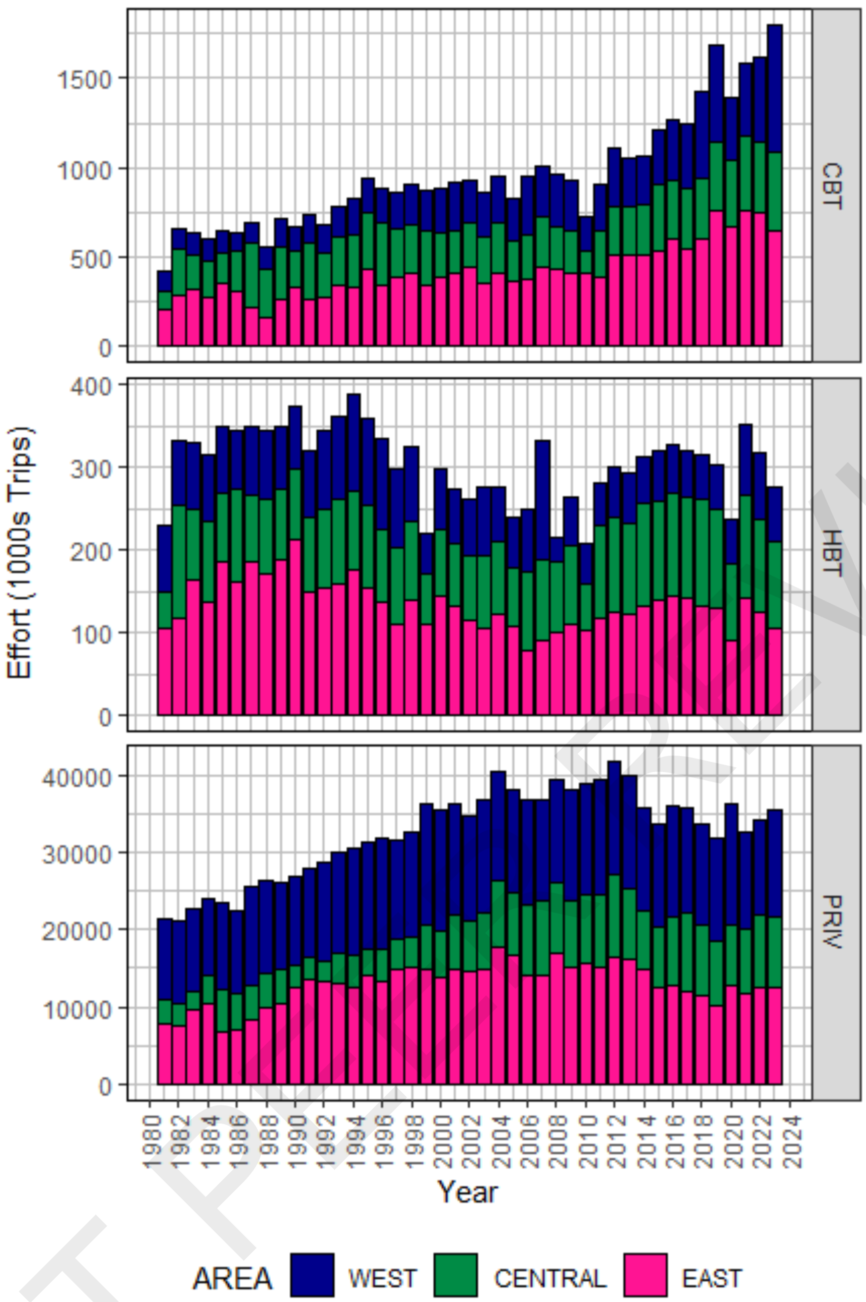


Figure 4.13.21. Recreational effort (angler trips) for Gulf of America by fishing mode. Effort are provided by year and SID domain in thousands of trips.

5 INDICES OF POPULATION ABUNDANCE

5.1 OVERVIEW

The combined Index and Bycatch Working Group (IBWG) reviewed indices and accompanying analyses from 21 fishery-independent datasets and one fishery-dependent dataset that represented regional relative abundance trends in the west, central, or east Gulf of America (GOA) as defined by the SEDAR 74 Stock ID Workshop (SEDAR 74 Stock ID 2021). 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 each of the three regions in the GOA following the criteria listed in Section 5.3. Relative spatial coverage of "Suitable" and "Suitable and Recommended" indices are included in Figure 5.9.1 and 5.9.2, respectively. Rationalizations for the recommendation or exclusion of an index are given in the 'Comments on Adequacy for Assessment' in Sections 5.4 (fishery-independent) and 5.5 (fishery-dependent).

In the west GOA, five fishery-independent indices of abundance are recommended for use in the assessment by the IBWG, with two fishery-independent indices being carried forward from the previous assessment. Relative abundance and the coefficient of variation on the mean (CV, standard error/mean) for recommended indices in the west region are shown in Table 5.8.1, and overall trends in Figure 5.9.3.

Recommended	Not Recommended
SEFSC Bottom Longline	
SEAMAP Summer Groundfish Old (1982-2008) *	
SEAMAP Summer Groundfish New (2009-2019)	
SEAMAP Fall Groundfish Old (1988-2007) *	
SEAMAP Fall Groundfish New (2008-2019)	
SEAMAP Fall Plankton	
G-FISHER Reef Fish Video	

*Recommendation carried from SEDAR 74.

In the central GOA, five fishery-independent indices of abundance are recommended for use in the assessment by the IBWG, while three fishery-independent indices were not recommended. Relative abundance and CV for the recommended indices in the central region are shown in Table 5.8.2, and overall trends in Figure 5.8.4.

Recommended	Not Recommended
SEFSC Bottom Longline	SEAMAP/DISL Summer Groundfish New
SEAMAP Summer Groundfish New (2009-2019)	SEAMAP/DISL Fall Groundfish New
SEAMAP Fall Groundfish New (2008-2019)	G-FISHER Artificial Reef Video
SEAMAP Fall Plankton	
G-FISHER Reef Fish Video	

In the east GOA, four fishery-independent indices of abundance and one fishery-dependent index of abundance are recommended for use in the assessment by the IBWG, while two fishery-independent indices were not recommended. Relative abundance and CV for recommended indices in the east region are shown in Table 5.8.3, and overall trends in Figure 5.9.5.

Recommended	Not Recommended
SEFSC Bottom Longline	SEAMAP Fall Plankton
SEAMAP Summer Groundfish New (2009-2019)	G-FISHER Artificial Reef Video
SEAMAP Fall Groundfish New (2008-2019)	
G-FISHER Reef Fish Video	
Observer Post-IFQ Commercial Vertical Line	

5.1.1 Terms of reference

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

3. Provide fishery-independent measures of population abundance developed for the

SEDAR 74 Research Track through the terminal year where possible.

- For recommended indices (and those used in SEDAR 74), extend the index to the new terminal year and document any known or suspected temporal patterns in catchability not accounted for by standardization.
- Evaluate the G-FISHER composite video index for use in the assessment.
  - Consider any changes to the fishery-independent indices comprising the G-FISHER index as provided for SEDAR 74 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 in SEDAR 74.

8. 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.

9. Prepare a Data Workshop report providing complete documentation of workshop actions and decisions in accordance with project schedule deadlines.

5.1.2 Group membership

Members of the IBWG included: Adam Pollack (co-lead), Kyle Dettloff (co-lead), Sarina Atkinson (co-lead), David Hanisko, Matthew Campbell, Kelsey Martin, Ted Switzer, Kate Overly, Justin Lewis, Heather Christiansen, Shannon Calay, Craig Newton, Nicole Beckham, Taylor Beyea, Steve Smith, Frank Hernandez, Tom Frazer, Cheston Peterson, Kevin Thompson, LaTreese Denson

5.2 REVIEW OF WORKING PAPERS

The IBWG reviewed the following working papers:

SEDAR98-DW-16	-	SEAMAP/GFISHER Reef Fish Video Survey: Relative Indices of Abundance of Red Snapper
SEDAR98-DW-17	-	Indices of Relative Abundance for Red Snapper from the SEFSC Bottom Longline Survey in the Northern Gulf of Mexico
SEDAR98-DW-19	-	Red Snapper (*Lutjanus campechanus*) larval indices of relative abundance from SEAMAP Fall Plankton Surveys, 1986 to 2022
SEDAR98-DW-21	-	Indices of abundance for Red Snapper (*Lutjanus campechanus*) on artificial reefs on the West Florida Shelf from stationary video surveys
SEDAR98-DW-22	-	Indices of abundance for Red Snapper (*Lutjanus campechanus*) on natural reefs in the eastern Gulf of Mexico using combined data from multiple video surveys
SEDAR98-DW-24	-	Post-IFQ commercial vertical line abundance index for eastern Gulf Red Snapper using reef fish observer data
SEDAR98-DW-26	-	Red Snapper Abundance Indices from SEAMAP Groundfish Surveys in the Northern Gulf of Mexico

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 and 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 NOAA Fisheries SEFSC Bottom Longline Survey

The NOAA Fisheries Southeast Fisheries Science Center (SEFSC) Population and Ecosystem Monitoring (PEM) Division Oceanic and Coastal Pelagics Branch has conducted standardized bottom longline surveys in the Gulf of America (GOA), Caribbean, and Western North Atlantic Ocean (Atlantic) since 1995. The objective of these surveys is to provide fisheries independent data for stock assessment purposes for as many species as possible. The survey fishes a one nautical mile bottom longline, with 100 baited hooks for one hour.

5.4.1.1 Methods of Estimation

Working Paper Number: SEDAR98-DW-17
Data Type: Fishery Independent
Time Series: 2001 – 2023
Sampling Intensity: Tables 4 (west), 6 (central) and 8 (east) in working paper.
Size/Age Data: Primarily age-2+ adult fish.
Data Filtering Techniques: Standard filtering protocols to remove problematic stations.
Standardization: Delta-lognormal

Submodel Variables

West:
Binomial: Year + Zone + Depth
Positive Observations: Year + Time of Day

Central:

Binomial: Year + Zone
Positive Observations: Year

East:
Binomial: Year + Zone
Positive Observations: Year

Abundance Indices: Tables 4 (west), 6 (central) and 8 (east) in working paper.

5.4.1.2 Comments on Adequacy for Assessment

Indices from the SEFSC Bottom Longline Survey were presented for the west, central, and east regions. Overall, the IBWG deemed all of the regional indices were suitable for further examination based on the broad spatial and temporal coverages, fishery independent methods, and stratified random statistical design used to conduct the survey. In the east region, concerns were raised about the lack of positive occurrences over several years and a single positive occurrence in other years. However, since this survey primarily indexes larger adult fish, it was suggested that the east index be recommended for the assessment to help show the presence of these larger adults as the stock recovers/expands. In addition, both the indices for the west and central regions were deemed suitable. After reviewing all of the indices for all three regions, the indices were deemed "Suitable and Recommended".

5.4.2 SEAMAP Summer Groundfish Survey (New Design)

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 in the GOA. 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 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).

5.4.2.1. Methods of Estimation

Working Paper Number: SEDAR98-DW-26
Data Type: Fishery Independent
Time Series: 2009-2023
Sampling Intensity: Addendum Table 2 (west), Tables 12 (central) and 14 (east) in working paper.
Size/Age Data: Primarily age-1 red snapper
Data Filtering Techniques: Standard filtering protocols to remove problematic stations.
Standardization: Delta-lognormal

Submodel Variables

West:
Binomial: Year + Depth + Statistical Zone
Positive Observations: Year + Depth + Statistical Zone

Central:
Binomial: Year + Statistical Zone
Positive Observations: Year + Statistical Zone

East:
Binomial: Year + Statistical Zone
Positive Observations: Year

Abundance Indices: Addendum Table 2 (west), Tables 12 (central) and 14 (east) in working paper.

5.4.2.2. Comments on Adequacy for Assessment

The SEAMAP Summer Groundfish Survey (New Design), was deemed acceptable as it was a long time series and was the only time series that surveys subadult (primarily age-1) red snapper. 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 indices for all of the regions "Suitable and Recommended".

5.4.3 SEAMAP Fall Groundfish Survey (New Design)

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 region. This survey is identical to the Summer Groundfish Survey of which a full description can be found in Section 5.4.2.

5.4.3.1. Methods of Estimation

Working Paper Number: SEDAR98-DW-26
Data Type: Fishery Independent
Time Series: 2008-2023
Sampling Intensity: Tables 8 (west), 14 (central) and 16 (east) in working paper.
Size/Age Data: Primarily age-0 red snapper
Data Filtering Techniques: Standard filtering protocols to remove problematic stations.
Standardization: Delta-lognormal

Submodel Variables

West:
Binomial: Year + Statistical Zone
Positive Observations: Year + Depth + Statistical Zone

Central:
Binomial: Year + Depth + Statistical Zone
Positive Observations: Year + Depth + Statistical Zone

East:
Binomial: Year + Depth + Statistical Zone
Positive Observations: Year + Statistical Zone

Abundance Indices: Tables 8 (west), 14 (central) and 16 (east) in working paper.

5.4.3.2. Comments on Adequacy for Assessment

The SEAMAP Fall Groundfish Survey (New Design), the survey design was deemed acceptable because it provided a long time series and was the only time series that surveys subadult (primarily age-0) red snapper. The survey coverage across all regions was spatiotemporally broad, with the entire area covered in most years. Therefore, the IBWG deemed the indices for all of the regions "Suitable and Recommended".

5.4.4 SEAMAP/G-FISHER Reef Fish Video Survey - West

The Gulf Fishery Independent Survey of Habitat and Ecosystem Resources (G-FISHER) survey is the combination of integrating three historic surveys (SEAMAP reef fish video, Panama City video, and FWC video) under a unified design beginning in 2020. The surveys use standardized deployment, camera field of view, and fish abundance methods to assess fish abundances on reef or structured habitat. Combining these indices across datasets allows for the largest possible sample sizes in model fitting and encompass a greater proportion of the distribution of the stock. The primary objective of the survey, is to provide an index of the relative abundances of fish species associated with topographic features (e.g., reefs, banks, and ledges) located on the continental shelf of the Gulf of America (GOA) from Brownsville, TX to the Dry Tortugas, FL. Secondary objectives include quantification of habitat types sampled (video, multi-beam and side-scan), and collection of environmental data. Because the survey is conducted on topographic features the species assemblages targeted are typically classified as reef fish (e.g., red snapper, *Lutjanus campechanus*), but occasionally fish more commonly associated with pelagic environments are observed (e.g., Amberjack, *Seriola dumerili*). The survey has been executed from 1992-1997, 2001-2002, 2004-2019, and 2021-present and historically takes place from April - May, however in more recent years the survey was conducted through the end of August. The 2001 survey was abbreviated due to ship scheduling and the only sites that were completed were located in the western GOA. Data were not collected in the west Gulf in 2020 due to the COVID outbreak. Types of data collected during the survey include diversity, abundance (MinCount, i.e., MaxN), fish length, habitat type, habitat coverage, bottom topography and water quality. The size of fish sampled with the video gear is species specific however red snapper sampled over the history of the survey had fork lengths ranging from 82 – 1450 mm, and mean annual fork lengths ranging from 371 – 582 mm (Table 5). Age and reproductive data cannot be collected with the camera gear but beginning with the 2012 survey, a vertical line component was coupled with the video drops to collect hard parts, fin clips, and gonads and was included in the life history information provided by the NMFS Panama City Laboratory. Vertical line deployments were discontinued when the SEAMAP vertical line survey was cancelled by Gulf States partners.

5.4.4.1. Methods of Estimation

Working Paper Number: SEDAR98-DW-16
Data Type: Fishery Independent
Time Series: 1993-1997, 2001-2002, 2004-2019, 2021-2023
Sampling Intensity: See Table 4 column 2 for sampling effort in SEDAR98-DW-16
Size/Age Data: represents juvenile through adult biomass; see figures 31-54 in SEDAR98-DW-16
Data Filtering Techniques: Manual filtration of low sample years (1998-2000, and 2003). Manual reduction of the dataset to the western Gulf only as prescribed in the red snapper stock ID process. For all surveys, video reads were excluded if they were unreadable due to turbidity or deployment errors.
Standardization: Negative-binomial
Submodel Variables Year, reef variable, depth
Annual Abundance Indices: Table 4 in working paper

5.4.4.2. Comments on Adequacy for Assessment

The index was recommended for use in the assessment model given the history of its continued use in benchmark and update assessments. From 2008-2010, length measurements were provided by both lasers and stereo-length measurements. The working group recommended that laser measurements during the overlap period be removed from analysis, due to this method generating minimal positive hits. Necessary adjustments were made to address this recommendation, but the number of measurements for those years remained unchanged. This indicates that the filtering of these measurements had either already taken place or that, as predicted, minimal data was available. The survey shows reasonable precision with CV's ranging from 18-30%. Importantly, this index is the only fisheries independent survey data that is collected on sensitive reef environments where trawl and longline gears cannot be deployed. Therefore, the IBWG deemed the indices for all of the regions "Suitable and Recommended".

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 or catchability in the assessment model. The IBWG recommends that constant selectivity and catchability be applied to the video surveys for all stock ID regions. However, the analytical team can use their discretion to explore time-varying parametrizations if they are determined to be warranted during model development.

5.4.5 G-FISHER Reef Fish Video Survey – Central and East

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 (SFRV), 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 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 encompasses a greater proportion of the distribution of the stock. As such, we used a habitat-based approach to combine relative abundance data for generating annual trends for red snapper (*Lutjanus campechanus*) throughout the eastern GOA (eGOA) for the Central and East regions as defined in the Stock ID process for SEDAR74.

5.4.5.1. Methods of Estimation

Working Paper Number: SEDAR98-DW-22
Data Type: Fishery Independent
Time Series: 1993-2023 (Central); 2010-2023 (East)
Sampling Intensity: See Table 1 for both regions by survey in SEDAR98-DW-22
Size/Age Data: represents juvenile through adult biomass; see figures 14-16 in SEDAR98-DW-22

Data Filtering Techniques: For all surveys, video reads were excluded if they were unreadable due to turbidity or deployment errors. For the SRFV survey, data included in this index began in 1993 due to different counting methods being used in 1992 and the complete loss of those videos during Hurricane Katrina, which prevented them from being reread. The spatial extent of NMFS Panama City data was used beginning in 2006 with 2005 excluded because of an incomplete survey. The FWRI data prior to 2010 was excluded due to the importance of including side-scan geoform as an explanatory variable in the analyses, which was not available until 2010. Following SEDAR74, the East index was limited to 2010-2023.

Standardization: Relative abundance indices were generated using a stepwise approach. First, a habitat variable was created comprising variables from the separate surveys that could be applied across the whole dataset. Our first step was to determine the percentage of sites that occurred on High, Medium, or Low (H, M, L) proportion positive habitats for each survey and region independently using a categorical regression tree (i.e., CART) analysis. The subsequent variables were then used in a negative-binomial GLM as a weighting factor along with year and survey to predict annual abundances for each region independently. This statistical approach was used so that final index models can account for changing sampling effort and habitat allocation through time, rather than limiting the model to year and survey variables only.

Submodel Variables:

Central CART variables by survey:
SFRV: *presence/absence of soft corals, presence/absence of rock, presence/absence of shell, maximum relief, longitude*
PC: *longitude, depth, presence/absence of soft corals*
FWRI: *geoform, longitude, maximum relief, depth*
GF: *longitude, presence/absence of rock, maximum relief, depth*

East CART variables by survey:
SFRV: *presence/absence of seawhips, longitude, latitude*
PC: *depth*
FWRI: *longitude, latitude, presence/absence of relief, depth, habitat strata*
GF: *longitude, habitat strata, latitude, depth*

Annual Abundance Indices: see Table 5 for Central region and Table 6 for East in SEDAR98-DW-22

5.4.5.2. Comments on Adequacy for Assessment

Both the Central and East indices were deemed both "Suitable and Recommended" for this assessment. This decision was 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 large size range of this species being indexed.

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 or catchability in the assessment model. The IBWG recommends that constant selectivity and catchability be applied to the video surveys for all stock ID regions. However, the analytical team can use their discretion to explore time-varying parametrizations if they are determined to be warranted during model development.

5.4.6 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 of America since 1982 with the goal of producing a long-term database on the early life stages of fishes. Red snapper (*Lutjanus campechanus*) larvae captured in bongo net samples during the SEAMAP Fall Plankton Surveys were used to develop indices of relative abundance from 1986 to 2019. The indices represent trends in the adult spawning stock biomass.

5.4.6.1. Methods of Estimation

Working Paper Number: SEDAR98-DW-19

Data Type: Fishery Independent

Time Series: 1986-2022

Sampling Intensity: See Addendum Table 1 (West) and Addendum Table 3 (Central) and Table 8 (East) for sampling effort by Stock ID region in SEDAR98-DW-19.

Size/Age Data: Represents the adult spawning stock

Data Filtering Techniques:

Occurrence and catch per unit area (CPUA) used in the recommended indices were based on larvae greater than 3.75 mm and less than 9.75 mm in body length to account for the identification uncertainty of smaller snapper larvae and the effects of gear avoidance by larger rarely caught larvae. Year to year variability in spatial coverage from Fall Plankton Survey data was addressed by limiting observations to SEAMAP stations that were sampled during at least two-thirds (~66%) of all years for which there was consistent spatial coverage respectively to the western, central, and eastern Gulf of America. Core data for the west index included all samples taken during at least 21 of the 32 years of available data, whereas the core data for the central index included all samples taken during at least 23 of the 35 years of available data, and finally the core data for the east index included all samples taken during at least 19 of 28 years of available data. Years in which red snapper were not observed, respective to the western, central and east Gulf of America were removed prior to the generation of indices.

Standardization: Delta-lognormal generalized linear models were used to generate age corrected abundance indices for the western and central Gulf of America. A binomial generalized linear model was used to generate a relative index based on the proportion of positive occurrence in the eastern Gulf of America.

Submodel Variables:

West:
Binomial: Year + Time of Day + Depth
Positive Observations: Year + Time of Day + Subregion

Central:
Binomial: Year + Subregion
Positive Observations: Year + Subregion + Depth

Eastern:
Binomial: Year

Annual Abundance Indices: See Table 4 (Western), Addendum Table 1 (Central) and Table 7 (Eastern) in SEDAR98-DW-19.

5.4.6.2. Comments on Adequacy for Assessment

Initial indices presented the IBWG at the December 2024, Data Workshop included delta-lognormal standardized indices of age corrected larval abundance for the west and central regions, and a proportion of positive occurrence for the east region. The eastern index is not recommended for use in the assessment and is provided to track potential spawning in the east Gulf of America.

The west index of larval of abundance indicated an extremely sharp increase in the terminal year (2022) of the index. Age corrected catch per unit area (CPUA) in the terminal year was roughly two times greater than the previous year, and the highest value estimated over the time series. The raw data indicated that the number of individual stations with very high CPUAs in 2022 was much greater than in previous years. However, these high abundance values were similar to previously recorded high CPUA catches throughout the later part of the time series.

The age corrected CPUA of 11.2 days old larvae are back calculated based on age at length and estimated daily mortality. During the Data Workshop delta-lognormal indices of larval abundance without age correction were generated on the same base data to determine if the sharp increase in the terminal year CPUA of the west index was a result of the age correction process. The west and central indices of abundance with the age correction removed showed nearly identical trends and CVs as those based on age corrected CPUA. In essence, the age correction process simply scales up the annual estimates. Given the near identical results in trend between the age corrected and non-age corrected indices, the IBWG recommended the use of the west and central larval indices of abundance without age correction for inclusion in the assessment process. These indices were deemed "Suitable and Recommended"

5.4.7 G-FISHER Artificial Reef Video Survey

The Fish and Wildlife Research Institute (FWRI) began using stereo-baited remote underwater video survey (S-BRUV) to assess trends in reef fish species in 2008 on the West Florida Shelf (WFS) to supplement ongoing NOAA surveys that focused on natural habitats or were limited in geographic scope. These initial efforts were focused on natural reefs offshore of Tampa Bay and Charlotte Harbor but funding through the National Fish and Wildlife Fund (NFWF) expanded the survey to cover the entirety of the WFS region from statistical zones 2-10. The underlying survey design for artificial reef sampling is separate from the selection for natural reefs (SEDAR98-DW-16 and 22). Part of this expansion was the inclusion of artificial reef habitats as a separate sampling stratum within the established mapping and sampling protocol. Efforts on these habitats began in 2014 in the Panhandle and in 2016 for the remainder of the state. These efforts have continued under the Gulf Fishery Independent Survey of Habitat and Ecosystem Resources (G-FISHER) through funding from the NOAA Restore Science program starting in 2020. Given the time series of these surveys as well as ongoing interest in incorporation information from artificial reef habitats into the red snapper assessment, we developed an index for these habitats for the east and central regions. Artificial reef sampling did not begin in the west GOA until 2021 following funding allocation and sampling issues due to COVID and therefore this index could not be developed for the west region.

5.4.7.1. Methods of Estimation

Working Paper Number: SEDAR98-DW-21
Data Type: Fishery Independent
Time Series: 2014-2023 (Central); 2020-2023 (East)
Sampling Intensity: See Table 1 for both regions by survey in SEDAR98-DW-21
Size/Age Data: represents juvenile through adult biomass; see figures 5 & 6 in SEDAR98-DW-21

Data Filtering Techniques: For all surveys, video reads were excluded if they were unreadable due to turbidity or deployment errors. Sampling is conducted on artificial structures that were identified during randomized side-scan mapping or from other knowledge (e.g., Hugh Swingle Permit Zone).

Standardization: Due to the zero-inflated distribution of these data, as with other indices using the video data, a negative binomial GLM was fit to estimate annual MaxN. All potential habitat variables were initially used in the model which included spatial data such as latitude, longitude, and depth, as well as the landscape level geoform data on reef type. We also incorporated site-specific video annotation variables including vertical relief, and the presence/absence of sponge, rock, algae, hard corals, soft corals, unknown sessile organisms, and seagrass. Models for each region were backwards selected by sequentially removing non-significant variables to find the most parsimonious model using AIC as criteria. Final models for the two regions were:

Submodel Variables:

> **Central:** *year +longitude + depth +presence/absence of algae + presence/absence of artificial*
>
> **East:** *year +longitude + presence/absence of relief*

Annual Abundance Indices: see Table 2 SEDAR98-DW-21

5.4.7.2. Comments on Adequacy for Assessment

Following discussions within the IBWG, initial analyses were re-run to exclude early years in the time series for the East given the generally low observation rates and sampling effort in the time series prior to survey expansion under G-FISHER in 2020. The final index values submitted reflect this exclusion. The index for the East region was determined to be “Suitable, but not Recommended” due to the short time series. The Central region was suitable yet not recommended for the short time series, smaller spatial footprint, and relatively flat trend in abundance. However, the IBWG and overall panel recommended the continuation of data collection, as well as exploring the possibility of integrating artificial reef data with natural reef data through appropriately weighted design-based analyses (e.g., instead of treated separately).

5.5 FISHERY-DEPENDENT INDICES

5.5.1 Observer Post-IFQ Commercial Vertical Line

There are concerns that catch-per-unit-effort (CPUE) abundance indices based on commercial fleet landings may not be valid after implementation of individual fishing quotas (IFQs) for selected grouper-snapper species in the Gulf. To address these concerns, a novel CPUE index was developed in 2020-2021 for scamp and yellowmouth grouper for the commercial fleet using data from the reef fish observer program (Smith et al. 2021). Observer observations of catch include both kept and discarded fish, and are thus not directly impacted by changes in management regulations (e.g., minimum size, catch quotas, etc.). The methodology was subsequently applied to develop commercial fleet CPUE indices for red snapper for SEDAR 74 for the years 2007-2019 (Smith 2022). The Indices Working Group for SEDAR 74 determined that the abundance index for the eastern Gulf was appropriate for use in the red snapper stock assessment. For SEDAR 98, an updated abundance index was provided for red snapper in the eastern Gulf for 2007-2023.

5.5.2 Methods of Estimation

Working Paper Number: SEDAR98-DW-24
Data Type: Fishery Dependent
Time Series: 2007-2023
Sampling Intensity: Average annual sample size: 502 sample units (500 x 500 m grid cells)
Size/Age Data: Length composition was collected by observers; see abundance indices below.

Methods Overview:

Reef fish observer data for vertical line gear have much in common with fishery-independent surveys utilizing fishing gears, including: latitude-longitude coordinates were recorded at each specific fishing location, catches were recorded for individual species, and lengths were recorded for individual fish (Scott-Denton et al. 2011). A probability survey approach was thus used for estimation of the reef fish observer CPUE index. The spatial sample frame was delineated as

500x500 m grid cells (i.e., sample units) encompassing red snapper observed depths in the eastern Gulf. Analysis techniques accounted for varying gear characteristics (e.g., hook types, hook sizes, etc.) and varying effort (e.g., number of lines, fishing time at a location, etc.) in the estimation procedure. Updated data filtering, analysis, and estimation methods were presented to the Index Working Group, and are documented in the accompanying working paper (Smith 2025).

Data Filtering Techniques:

Initial filtering steps restricted data to vertical line gears, and excluded observations with missing location information (i.e., latitude-longitude). This enabled assignment of observations at specific fishing locations to a unique 500x500 m grid cell with associated depth information. Additional filtering restricted the dataset to circle hooks and for sample units with a non-zero probability of catching red snapper based on species co-occurrence analysis (Smith 2022).

Effort Standardization:

Line-hours were standardized for two circle hook size categories and two reel types (hand and mechanical) using a compound pdf generalized linear model (GLIM), which analyzed presence-absence using a logistic regression model and catch-when-present using a gamma pdf GLIM.

Annual Abundance Indices:

Annual CPUE and associated variance were estimated using a Hurwitz-Thompson ratio-of-means estimator for a depth-stratified sample frame (Lohr 2020), which accommodated varying levels of fishing effort among observer samples. Estimates of the reef fish observer abundance index for eastern Gulf red snapper for 2007-2023 are provided in Table 1 for the commercial vertical line fleet. The standardized index (scaled to mean CPUE for 2007-2023) time-series is graphed in Fig. 1, which also shows the 95% confidence intervals. The annual CVs of the estimates ranged from 5.3 to 27.9%, with an average of 12.9%. Strata-weighted annual length compositions were computed following the procedures of Smith (2025). The standardized CPUE time-series and accompanying length compositions for the eastern Gulf were provided to the stock assessment analysts.

5.5.3 Comments on Adequacy for Assessment

During the SEDAR 98 data workshop, the indices working group reviewed the observer post-IFQ commercial vertical line index with the goal of determining if it was both suitable and recommended for assessment. An index was classified as suitable for use if it was determined to have been constructed from data appropriate for index development using well documented statistical methods that produced standardized indices of abundance and measures of uncertainty. If an index was deemed suitable for use in assessment, it was then evaluated alongside all other suitable indices within a given stock ID area. Recommended indices were those that used the highest quality data and/or covered a year-range or age/size-structure that was not represented by the other recommended indices.

Upon review by the SEDAR 98 IBWG, the observer post-IFQ commercial vertical line index for the East stock ID area was determined to be "Suitable and Recommended" for use in assessment.

5.6 RESEARCH RECOMMENDATIONS

- Consider incorporating artificial reef video with natural bottom video data

5.7 LITERATURE CITED

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5.8 TABLES

Table 5.8.1. 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 Fall Plankton		SEAMAP Groundfish Summer - Old		SEAMAP Groundfish Summer - New		SEAMAP Groundfish Fall - Old	
	Scaled Index	CV	Scaled Index	CV	Scaled Index	CV	Scaled Index	CV
1982								
1983								
1984			0.74713	0.28624				
1985			1.11016	0.3086				
1986	0.1747	0.5963	0.29356	0.43855				
1987	0.3295	0.5982	0.71006	0.22079				
1988			0.34651	0.24776			0.42781	0.14968
1989	0.4715	0.5829	0.25619	0.30539			0.85672	0.14082
1990	0.4762	0.4721	2.26208	0.16018			0.90854	0.12376
1991	0.2043	0.6817	1.02087	0.18827			1.02731	0.11777
1992	0.2026	0.4492	0.64442	0.1977			0.31611	0.15075
1993	0.2373	0.4474	0.70395	0.19391			0.57429	0.14108
1994	0.2117	0.5981	1.34549	0.17943			1.62501	0.12146
1995	0.6783	0.3155	1.17612	0.1702			1.74663	0.11071
1996	0.4921	0.3886	1.30854	0.17055			0.86993	0.12869
1997	0.6975	0.3009	0.99397	0.17211			1.29003	0.12559
1998			0.88587	0.1919			0.59505	0.14396
1999	0.2549	0.4165	0.75858	0.19287			1.37449	0.11653
2000	0.8662	0.2954	1.39109	0.15399			0.90717	0.1181
2001	0.5342	0.4432	0.78658	0.26337			0.68066	0.13467
2002	0.6155	0.3281	1.09421	0.17058			0.64987	0.13396
2003	0.9400	0.2792	0.61355	0.21065			1.15195	0.12107
2004	0.5183	0.3359	1.33104	0.16223			1.79825	0.1094
2005			1.50193	0.16631			1.27156	0.10272
2006	1.0087	0.3310	1.41881	0.14692			1.08383	0.12343
2007	0.7813	0.2772	1.16578	0.1824			0.84479	0.14374
2008			1.13354	0.15471				
2009	1.0419	0.2698			0.36361	0.15274		
2010	0.4139	0.4147			0.86093	0.14849		
2011	1.2348	0.3141			1.19283	0.14733		
2012	1.3866	0.2702			0.81785	0.14107		
2013	0.8036	0.2783			1.26194	0.16587		
2014	1.2483	0.3008			0.77079	0.16175		
2015					1.06421	0.14954		
2016	2.6095	0.2486			0.86779	0.15053		
2017	0.5515	0.3306			0.83622	0.16044		
2018	1.2279	0.2585			1.61682	0.13944		
2019	2.5940	0.2206			1.11119	0.15522		
2020								
2021	2.7003	0.2634			0.70229	0.19744		
2022	5.4928	0.2181			0.87569	0.17885		
2023					1.65784	0.16594		

Table 5.8.1.(continued) 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 Groundfish Fall - New		G-FISHER Reef Fish Video		SEFSC Bottom Longline	
	Scaled Index	CV	Scaled Index	CV	Scaled Index	CV
1982						
1983						
1984						
1985						
1986						
1987						
1988						
1989						
1990						
1991						
1992						
1993			0.0415	0.1979		
1994			0.1613	0.1821		
1995			0.2258	0.2291		
1996			0.2718	0.2771		
1997			0.5575	0.2426		
1998						
1999						
2000						
2001					0.28296	0.26035
2002			0.5022	0.2972	0.21888	0.22402
2003					0.24806	0.28663
2004			0.4700	0.2386	0.30282	0.288
2005			0.4193	0.2348		
2006			0.1751	0.2129	0.2343	0.3539
2007			0.4515	0.2695	0.25224	0.35259
2008	0.47272	0.1008	0.3317	0.2662		
2009	1.59835	0.09207	0.4976	0.2442	0.46513	0.26217
2010	0.74961	0.13057	1.1150	0.2454	0.23182	0.46389
2011	0.87343	0.12282	0.7602	0.2309	0.54755	0.25091
2012	1.6972	0.12308	0.8892	0.2350	1.05852	0.27812
2013	0.71151	0.18201	1.1657	0.2304	1.01483	0.25331
2014	0.9774	0.12776	1.5942	0.2070	0.7194	0.30977
2015	1.78556	0.11746	1.1565	0.2117	1.81458	0.23184
2016	1.18958	0.15221	1.2072	0.2754	1.5098	0.22233
2017	0.82426	0.14685	2.1978	0.2193	2.2948	0.166
2018	1.15566	0.1264	2.8151	0.2293	1.32473	0.22584
2019	0.8983	0.14795	1.4928	0.2492	1.97225	0.22791
2020	0.46152	0.16814				
2021	0.90683	0.13807	2.1332	0.2639	1.85662	0.23152
2022	0.98003	0.16192	2.1056	0.2558	1.64646	0.2577
2023	0.71805	0.15064	2.2623	0.2279	2.00423	0.19979

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 central Gulf of America indices recommended for consideration in the assessment.

Year	SEAMAP Fall Plankton		SEAMAP Groundfish Summer - New		SEAMAP Groundfish Fall - New		G-FISHER Reef Fish Video	
	Scaled Index	CV	Scaled Index	CV	Scaled Index	CV	Scaled Index	CV
1982								
1983								
1984								
1985								
1986								
1987								
1988								
1989								
1990								
1991	0.1127	1.1576						
1992								
1993							0.0964	0.6151
1994	0.0561	1.1668					0.0870	0.7313
1995	0.0601	1.1649					0.0059	1.1216
1996							0.0454	0.8145
1997	0.0530	1.1659					0.2196	0.3663
1998								
1999	0.3285	0.6748						
2000	0.8214	0.5803						
2001	0.2503	0.6679						
2002							0.3601	0.2424
2003	0.4438	0.5777						
2004	0.1166	1.1669					1.2467	0.2258
2005							0.7349	0.1583
2006	0.7026	0.6714					1.4082	0.2323
2007	0.8774	0.4632					1.5639	0.2989
2008	0.1522	1.1658			0.60506	0.33924	1.3325	0.1678
2009	0.6112	0.6721	0.46672	0.27112	2.34988	0.19049	1.9412	0.1555
2010	2.0729	0.3853	1.04846	0.31742	0.65684	0.30568	1.3742	0.1288
2011	0.7473	0.6749	0.5585	0.4217	0.63736	0.34401	1.3461	0.1250
2012	0.8638	0.4958	1.09876	0.31375	1.34038	0.29332	0.7895	0.1429
2013	0.9674	0.5094	1.34962	0.38274	0.69239	0.40033	0.6927	0.1503
2014	1.0338	0.5146	0.53875	0.38859	0.97389	0.29582	0.6912	0.1257
2015	0.1526	1.1680	0.87901	0.37398	1.25908	0.27923	0.7364	0.1408
2016	1.3263	0.4205	1.07544	0.31857	0.99257	0.41543	1.4553	0.0818
2017	3.7488	0.2631	1.66393	0.24855	0.49498	0.34958	1.4713	0.0832
2018	1.5081	0.3898	1.45292	0.33279	1.4031	0.32026	1.2448	0.1216
2019	3.6994	0.2872	0.76875	0.38666	0.68105	0.32934	1.2508	0.0869
2020					0.54663	0.36408	1.4706	0.1485
2021	2.6880	0.3109	0.67681	0.49714	0.64691	0.41103	1.8882	0.0908
2022	1.6056	0.4178	0.94266	0.41102	0.94228	0.33158	1.5771	0.0856
2023			1.47967	0.34373	1.77758	0.33243	0.9700	0.0885

Table 5.8.2.(continued) 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 central Gulf of America indices recommended for consideration in the assessment.

Year	SEFSC Bottom Longline	
	Scaled Index	CV
1982		
1983		
1984		
1985		
1986		
1987		
1988		
1989		
1990		
1991		
1992		
1993		
1994		
1995		
1996		
1997		
1998		
1999		
2000		
2001	0.17154	0.90295
2002	0.11619	0.90651
2003	0.26883	0.74712
2004	0.11012	1.24497
2005	0.09292	1.24442
2006	0.15915	1.25344
2007		
2008		
2009	0.36519	0.75299
2010	1.32104	0.51904
2011	2.16142	0.34721
2012	1.16829	0.74775
2013	0.52957	0.76061
2014	2.1998	0.47541
2015	2.47894	0.42965
2016	2.68569	0.46512
2017	0.69921	0.65484
2018	1.22473	0.58516
2019	1.97059	0.64038
2020		
2021	0.85143	0.90657
2022	1.27474	0.74024
2023	0.15062	1.24154

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 east Gulf of America indices recommended for consideration in the assessment.

Year	SEFSC Bottom Longline		SEAMAP Groundfish Summer - New		SEAMAP Groundfish Fall - New		G-FISHER Reef Fish Video	
	Scaled Index	CV	Scaled Index	CV	Scaled Index	CV	Scaled Index	CV
2001	0.0988	1.16057						
2002								
2003	0.34131	0.8198						
2004	0.55415	0.66732						
2005	0.41107	1.15534						
2006	0.20295	1.15227						
2007	1.35797	0.80408						
2008					0.65799	0.78389		
2009	0.91578	0.5763	0.10936	0.89048	0.33529	0.52567		
2010	1.45216	0.50176	0.04201	1.22713	0.66418	0.42289	0.4815	0.3310
2011	1.45176	0.36518	1.14828	0.48129			0.5797	0.2150
2012	0.39133	0.8144	0.57759	0.42456	0.86551	0.76815	0.4433	0.2230
2013	2.32244	1.14938	0.16436	0.887	0.14692	0.77396	0.8337	0.2270
2014	0.28087	1.14752	0.38791	0.42464	2.82983	0.3447	0.5436	0.1720
2015			3.41335	0.32509	1.03856	0.29778	1.2954	0.2990
2016	1.36269	0.6573	2.06264	0.2769	1.25309	0.42123	2.5467	0.1480
2017	0.51478	0.80929	1.50911	0.34612	0.67378	0.35757	1.8127	0.1610
2018	0.4162	0.82455	1.21644	0.32356	0.2748	0.55476	1.5094	0.1860
2019	0.74593	0.81187	0.53286	0.51652	0.65644	0.39618	1.1729	0.1780
2020	2.11316	0.54033			0.25524	0.67806	0.7439	0.1480
2021	0.62715	0.80674	0.85875	0.41373	3.5542	0.30786	0.6574	0.1560
2022	2.13825	0.816	1.06256	0.42151	1.32541	0.35627	0.6577	0.1760
2023	2.30124	0.56297	0.91479	0.37841	0.46876	0.4356	0.7222	0.1660

Table 5.8.3.(continued) 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	Observer Post-IFQ Commercial Vertical Line	
	Scaled Index	CV
2001		
2002		
2003		
2004		
2005		
2006		
2007	0.325	0.146
2008	0.39	0.14
2009	0.672	0.142
2010	0.683	0.099
2011	0.696	0.073
2012	0.574	0.053
2013	0.611	0.081
2014	0.685	0.111
2015	0.744	0.19
2016	1.657	0.085
2017	1.221	0.279
2018	1.432	0.141
2019	0.94	0.204
2020	1.531	0.139
2021	1.676	0.111
2022	1.96	0.097
2023	1.202	0.1

5.9 FIGURES

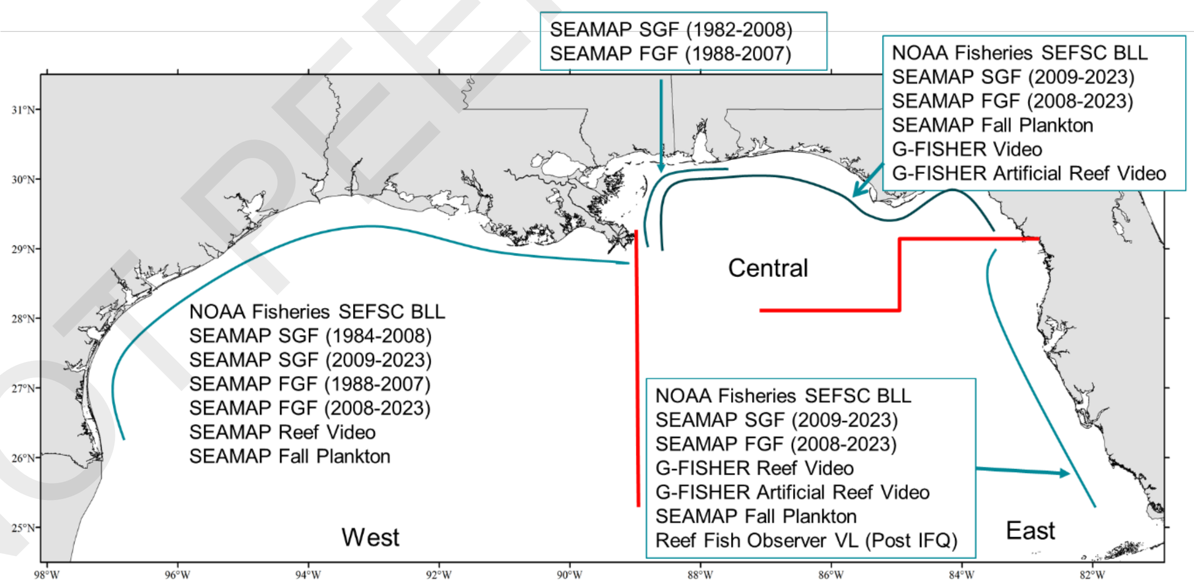

Figure 5.9.1. Relative spatial extent of indices found to be suitable for further review. Red lines represent the boundaries between the regions as defined at the SEDAR74 Stock ID Workshop.

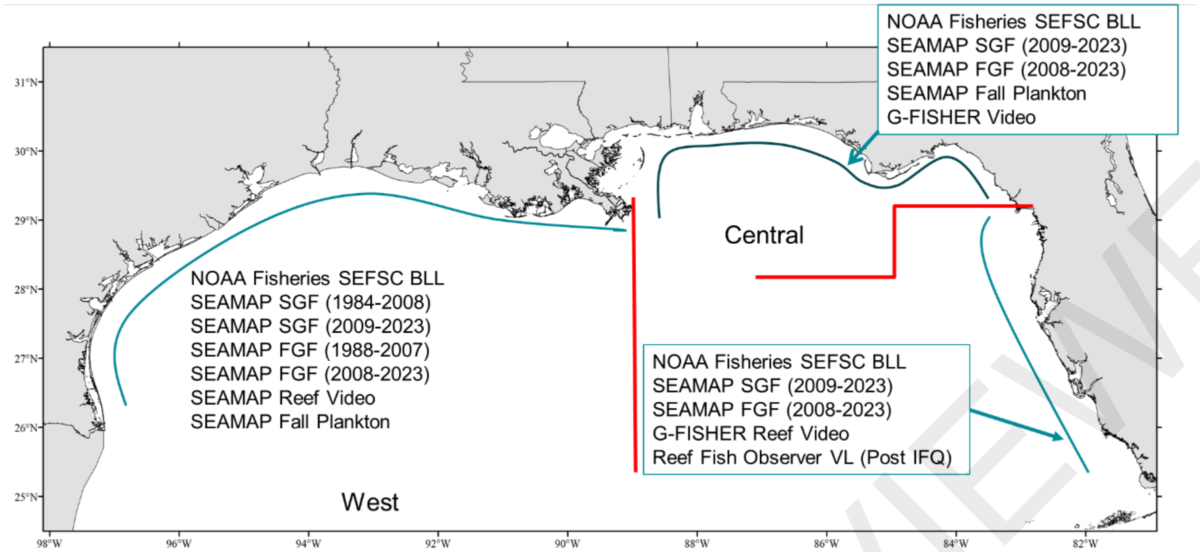

Figure 5.9.2. Relative spatial extent of indices found to be "Suitable and Recommended" for use in the assessment. Red lines represent the boundaries between the regions as defined at the SEDAR74 Stock ID Workshop.

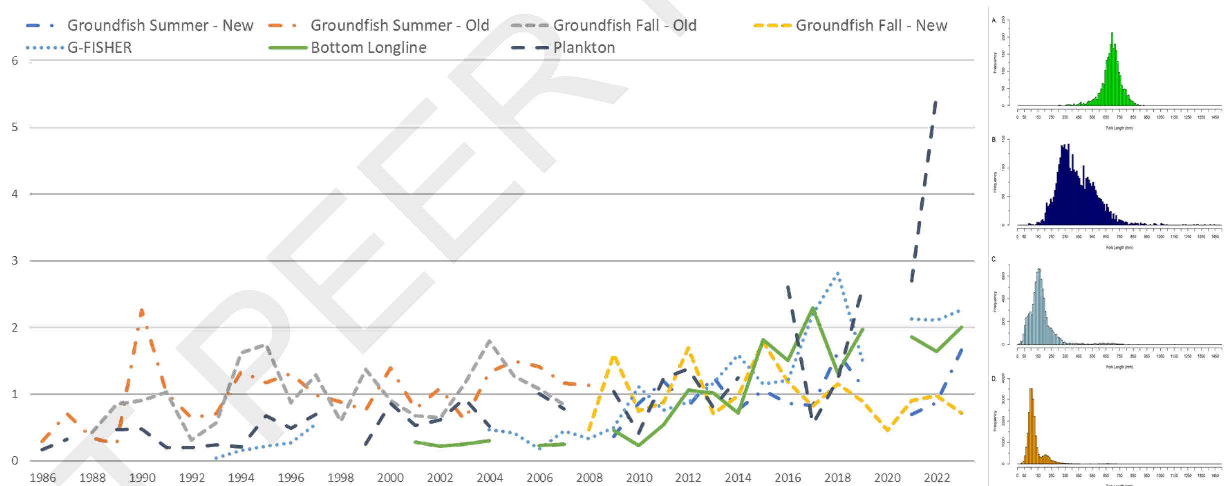

Figure 5.9.3. Recommended relative abundance indices for the west Gulf of America, scaled to a mean of one for each time series.

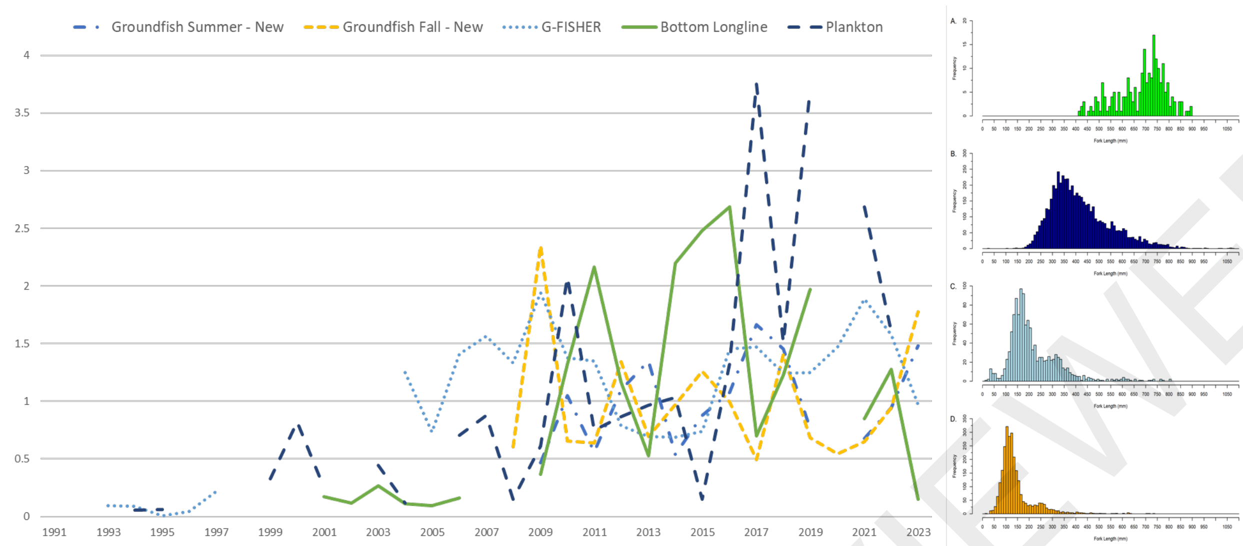

Figure 5.9.4. Recommended relative abundance indices for the central Gulf of America, scaled to a mean of one for each time series.

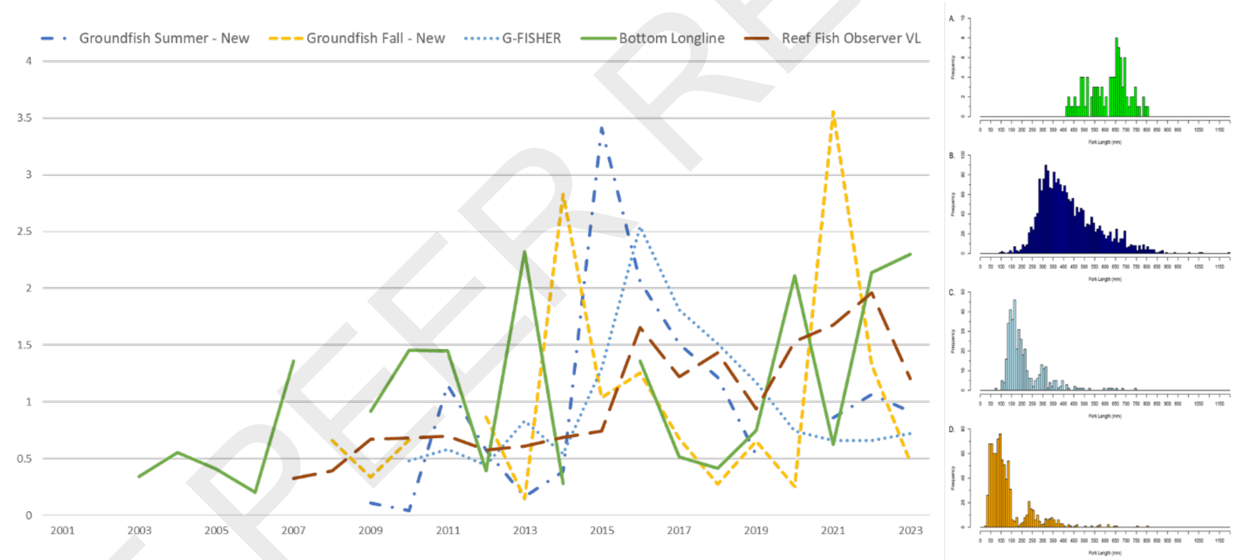

Figure 5.9.5. Recommended relative abundance indices for the east Gulf of America scaled to a mean of one for each time series.

6 EXTERNAL SURVEYS

6.1 GROUP PARTICIPANTS

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The External Surveys Working Group (ESWG) evaluated two external abundance estimates: the "Great Red Snapper Count" (GRSC, Stunz et al. 2021), which was conducted across the Gulf of America (formerly Gulf of Mexico; hereafter referred to as Gulf), and the LGL Ecological Associates, Inc. study (LGL study, LGL 2022) off Louisiana (collectively, external abundance estimates). These external abundance estimates both estimated absolute abundance of age-2 and older red snapper across five habitat types (artificial reefs, natural banks, uncharacterized bottom [UCB], pipeline crossings, and oil platforms) and were evaluated within depth strata across the Gulf. These depth strata differed somewhat between the GRSC and LGL studies but are deemed comparable by the ESWG.

The GRSC was conducted between 2018 and 2019, with analyses completed thereafter, and was a multi-institutional collaborative research effort to generate an estimate of absolute abundance of age-2 and older red snapper. The GRSC used a variety of gears to survey red snapper abundance, including towed camera arrays, hydroacoustic gear, and remotely operated vehicles (ROVs). The GRSC was initially evaluated by the Gulf of Mexico Fishery Management Council's (Council) Scientific and Statistical Committee (SSC) in conjunction with three independent peer reviewers in March 2021[1]. This peer-review provided feedback to the study's principal investigators (PIs), which set about making recommended modifications. The National Marine Fisheries Service's (NMFS) Southeast Fisheries Science Center (SEFSC) recommended additional modifications, including the further stratification of the shallowest depth strata for the data off Florida. This SEFSC recommendation split that shallowest depth stratum (10 – 40 meters [m]) into two strata (10 – 25 m, 25 – 40 m), based on the SEFSC assertion that the

[1] https://sedarweb.org/documents/gulf-ssc-review-of-sedar-74-gulf-red-snapper/

abundance estimate from the original stratum was likely overrepresented by the deeper half of that stratum (25 – 40 m). This assertion was based on the low biomass of age-2 and older red snapper found in NMFS fishery independent surveys conducted in waters shallower than 25 m. Ultimately, the SSC agreed that the post-stratification analysis for Florida was appropriate and should be included in the overall estimate of age 2+ red snapper in the Gulf.

Originally, data for Louisiana in the GRSC were largely informed by similar data collected off Texas waters. This was due to a variety of reasons, but generally, because of logistical limitations which prevented direct sampling off Louisiana during the GRSC. In response, the State of Louisiana commissioned LGL Ecological Associates, Inc. to complete a similar study off Louisiana. The LGL study was designed for model-based estimation of red snapper abundance through field surveys from hydroacoustic surveys and submerged rotating video cameras. The SSC reviewed the LGL study in March 2022, and determined that it would be an improvement in comparison to the data utilized for Louisiana in the GRSC, which was extrapolated from nearby Texas waters. The SSC then recommended an updated overfishing limit and acceptable biological catch for Gulf red snapper based on the updated estimate of absolute abundance of red snapper in the Gulf, using the combination of the Florida depth-stratified GRSC data and the substitution of the GRSC data for Louisiana with that produced in the LGL study. This new estimate of absolute abundance (revised combined estimate) projected that 85.6 million red snapper age-2 and older were present in the Gulf as of 2019.

The revised combined estimate was incorporated into the SEDAR 74 base model with stock assessment region-specific uncertainty derived from the GRSC and LGL studies (SEDAR 74). The research track assessment process that guided the SEDAR 74 assessment did not include comprehensive diagnostic analyses and therefore reviewers were unable to evaluate model performance relative to many decisions, including the manner in which the revised combined estimate was used. During the Center for Independent Experts (CIE) peer review of SEDAR 74[2,3,4] CIE reviewers indicated that the data from the external abundance estimates were used as

[2] https://sedarweb.org/documents/sedar-74-cie-reviewer-report-cieri/

[3] https://sedarweb.org/documents/sedar-74-cie-reviewer-report-cordue/

[4] https://sedarweb.org/documents/sedar-74-cie-reviewer-report-fuglebakk/

an index of absolute abundance, which was not how the CIE reviewers interpreted the data from the GRSC. They argued the abundance estimates should be treated with weighted catchability estimates that needed to have been calculated as part of the GRSC study. The ESWG generally concurred with this recommendation by the SEDAR 74 peer-review; however, numerous technical impediments to implementing this recommendation were noted.

In the revised combined estimate, the assumption across gears was that the catchability coefficient (q) across regions was equivalent to 1 for all red snapper age-2 and older. The SEDAR 74 peer-review contested this for various reasons by gear and region. The ESWG discussed this determination and argued that it was not presently possible to test and re-evaluate q-values by gear and region beyond what was already done within the respective external abundance estimates. It was noted that q could be less than 1 in the west (Texas and Louisiana) due to issues with counting fish near the sea floor and shadow effects, and greater than 1 in the east (Mississippi and Alabama, and Florida) due to double counting of fish moving as the ROV or towed camera arrays completed video survey transects (fish movement, attraction). Without the ability to refute the null hypothesis, that q = 1, the ESWG contended that q should continue to be fixed at 1 in future consideration of the external abundance estimates. Further, the ESWG reasoned that the external abundance estimates were in fact estimates of abundance, and not absolute "counts" of age-2 and older red snapper. Lastly, the ESWG discussed a floating q, or one estimated using a prior. This approach was attempted in SEDAR 74 and resulted in the model ignoring the revised combined estimate by 'floating' q to match the SEDAR 74 assessment results; however, reconsidering this approach with updated catchability parameters from the study PIs as priors may be worthwhile. This exercise will only be worthwhile if updated calculated catchability parameters by assessment strata are provided to the assessment team.

The ESWG proposed consideration of length composition data for the external abundance estimates, to be compiled by region, with those length data stratified by habitat type (artificial reefs, natural reefs, and unconsolidated bottom [UCB]) and depth strata (10 – 25 m, 25 – 40 m, 40 – 100 m, and 100 – 160 m for Florida; 10 – 40 m, 40 – 100 m, and 100 – 160 m for Mississippi and Alabama, and Texas; and 10 – 45 m, 45 – 100 m, and 100 – 150 m for Louisiana). The PIs for the respective studies can generate length compositions from their data by these strata, delineated based on the proposed stock structure boundaries defined for the current three-area model being considered for SEDAR 98. However, this additional work would be contingent on the availability of funding and time for the PIs and their staff. The ESWG discussed the ability to consider the length compositions from Louisiana, which derived those data from directed hook-and-line surveys using 6/0 and 11/0 circle hooks. These data differ from other regions (Mississippi and Alabama, and Florida), as those regions collected length data from passive survey techniques like video and hydroacoustic gear. Examinations of hook selectivity indicated that the 6/0 and 11/0 hooks used by LGL did not appear to select many age-2 fish; however, LGL study participants also noted the lack of small fish captured by concurrently deployed passive survey gear like ROVs. Thus, the catchability of the hooks used in the LGL study may be less than 1, despite those hooks selecting for those age-2 fish. Length composition data for Texas and Louisiana were recommended to be treated separately from the other regions by the ESWG. Texas length composition data were also collected via hook-and-line sampling but will need to be post-stratified by the aforementioned method before being considered for SEDAR 98. The length compositions from the oil pipeline surveys remained outstanding as of the conclusion of the Data Workshop.

The treatment of the UCB used in the revised combined estimate was discussed at length, and it was noted that no other fishery-independent index was available which provided adequate coverage of the UCB. The ESWG considered dropping the UCB data from consideration for this reason, and because the proportion of the stock being targeted in other fishery-independent and fishery-dependent surveys largely occurs in waters shallower than those which make up the majority of the UCB. The PIs indicated that length composition data could be provided exclusive of the UCB for consideration, again depending on the availability of funding and time for PIs and their staff. The subsequent modified abundance estimates by region, when excluding the portions of the estimates attributable to the UCB, could then be compared to the biomass estimate from the previous stock assessment (SEDAR 52 2018). The ESWG thought that excluding the UCB may prove difficult, because both landings and some survey coverage comes from the deepest depth stratum (100 – 160 m) from the external abundance estimates. If only the two shallowest depth strata used (10 – 25 m and 25 – 40 m, and 40 – 100 m, for Florida; 10 – 40 m, and 40 – 100 m for Mississippi and Alabama, and Texas; and 10 – 45 m, and 45 – 100 m for Louisiana), those data will likely capture the signal from where the majority of the directed fisheries occurs. However, if the UCB is excluded, and the spawning stock biomass (SSB) is measured in terms of egg production, then such exclusion of the UCB will underestimate SSB. Ultimately, the ESWG did not make a final recommendation about whether to include the UCB or not, but thought the positives and negatives of each choice merited further evaluation.

ESWG assessment model recommendations:

The ESWG recommends that the SEDAR 98 Gulf red snapper analytical team attempt to incorporate the results of the GRSC and LGL studies as direct model inputs to the assessment. The following should be considered:

- The analytical team should compile length composition data collected as part of the external surveys and, where appropriate and to the extent possible given data limitations, construct weighted length frequency distributions by stock assessment area to inform selectivity estimation for the survey gear.
- Catchability coefficients should be:
  - Estimated independently of the assessment model, by the external survey PIs, for each stock assessment area and fixed as known in the assessment model.
  - If externally derived estimates of catchability coefficients are unavailable, then the parameters should either be fixed at 1 as was the case for SEDAR 74 or estimated within the assessment model either with or without informative priors.
- External survey data should be weighted the same as all other data sources utilizing unscaled (i.e., not standardized to a common mean CV across all indices) estimated coefficients of variation to incorporate uncertainty.
  - Explorations of additional uncertainty around the abundance estimates may be warranted as part of model development.

6.2 REFERENCE DOCUMENTS

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

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

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