SEDAR

Southeast Data, Assessment, and Review

SEDAR 68

Gulf of Mexico Scamp

SECTION II: Data Workshop Report

December 2020

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

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1 INTRODUCTION

1.1 WORKSHOP TIME AND PLACE

The SEDAR 68 Data Workshop was scheduled to be held March 16-20, 2020 in Charleston, SC. Due to rising concerns regarding the COVID-16 pandemic, the in-person workshop was cancelled, and a modified process was developed.

- SEDAR 68 Scamp Data Review and Recommendation Process: After the cancellation of the in-person DW, and the mounting evidence that it would be some time before any sort of large gathering would be possible, SEDAR and SEFSC Staff held discussions to determine a path forward, followed by additional discussions with the previously appointed working group leads. The following process is currently underway:
    - Working Groups (Life History, Commercial Statistics, Recreational Statistics, and Indices of Abundance) worked amongst themselves to schedule and held various meetings to review the available data and make pre-decisional recommendations.
    - Several publicly noticed Data Plenary webinars will be held, during which the Working Groups will present the results of the discussions to the entire Data Panel for review and comment.
    - If concerns are raised that require additional analysis, the Working Group will be tasked to complete that request and report back at the next Plenary webinar.
    - Once the Panel is satisfied with the analyses, then the Assessment Development Team (ADT) will make the final decision regarding recommending using the data in the assessment. These recommendations will happen during the Plenary webinars.
    - A Data Process Report will be produced, to document the discussions and decisions of the Panel and the ADT.

1.2 TERMS OF REFERNCE

1. Definition of assessment unit stock will be developed through the Scamp Stock ID process and will be added to TORs once process is complete.

2. Review, discuss, and tabulate available life history information for each stock being assessed.
    - Evaluate age, growth, natural mortality, and reproductive characteristics
        - Explore the validity of age data and methodology across ageing facilities
    - Provide appropriate models to describe population and fleet specific (if warranted) growth, maturation, hermaphroditism including age and size at transition, and fecundity by age, sex, or length as applicable.
    - Evaluate the adequacy of available life history information for conducting stock assessments and recommend life history information for use in population modeling.
    - 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 all life history information.

3. Provide measures of population abundance that are appropriate for stock assessment.
    - Consider all available and relevant fishery-dependent and -independent data sources

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- Document all programs evaluated; address program objectives, methods, coverage, sampling intensity, and other relevant characteristics.
- Provide maps of fishery and independent survey coverage.
- Develop fishery and survey CPUE indices by appropriate strata (e.g., age, size, area, and fishery) and include measures of precision and accuracy.
- Document pros and cons of available indices regarding their ability to represent abundance.
    - Consider potential species identification issues between scamp and yellowmouth grouper and, if present, whether the issue was adequately addressed during index development.
- Categorize the available indices into one of three tiers: Suitable and Recommended, Suitable and Not Recommended, or Not Suitable; *provide justifications for the categorization.*
- For recommended indices, document any known or suspected temporal patterns in catchability not accounted for by standardization.
- Provide appropriate measures of uncertainty for the abundance indices to be used in stock assessment models.

4. Provide commercial catch statistics for each stock being assessed, including both landings and discards in both pounds and number. Consider species identification issues between scamp and yellowmouth grouper and correct for these instances as appropriate.
    - Evaluate and discuss the adequacy of available data for accurately characterizing landings and discards by fishery sector or gear.
    - Provide length and age distributions for both landings and discards if feasible.
    - Provide maps of fishery effort and harvest by fishery sector or gear.
    - Provide estimates of uncertainty around each set of landings and discard estimates.

5. Provide recreational catch statistics for each stock being assessed, including both landings and discards in both pounds and number. Consider species identification issues between scamp and yellowmouth grouper and correct for these instances as appropriate.
    - Evaluate and discuss the adequacy of available data for accurately characterizing landings and discards by fishery sector or gear.
    - Provide length and age distributions for both landings and discards if feasible.
    - Provide maps of fishery effort and harvest by fishery sector or gear.
    - Provide estimates of uncertainty around each set of landings and discard estimates.

6. Recommend discard mortality rates.
    - Review available research and published literature.
        - Consider research directed at scamp as well as similar species from the southeastern United States and other areas.
    - Provide estimates of discard mortality rate by fishery, gear type, depth, and other feasible or appropriate strata.
    - Provide estimates of uncertainty around recommended discard mortality rates
    - Document the rationale for recommended rates and uncertainties.

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7. Describe any known evidence regarding ecosystem, climate, species interactions, habitat considerations, and/or episodic events *(including red tide and upwelling events)* that would reasonably be expected to affect scamp population dynamics, *and the effectiveness of* biological reference points that might ensue.
   - Review available predation studies and summarize diet composition with respect to ontogeny, seasonality, and habitat, where available.
   - Provide species envelopes, i.e. minimum and maximum values of environmental boundaries (e.g. depth, temperature, substrate, relief) based on observations of occurrence.
   - Use available survey datasets to determine species that frequently co-occur or are associated with scamp.
   - Develop hypotheses to link the ecosystem and climatic events identified in addressing this TOR to population and fishery parameters that can be evaluated and modeled.

8. Provide recommendations for future research in areas such as sampling, fishery monitoring, and stock assessment. Include specific guidance on sampling intensity (number of samples including age and length structures) 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 Development 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			
SEDAR68-DW-01	Standardized video counts of Southeast U.S. Atlantic scamp and yellowmouth grouper (*Mycteroperca phenax* and *Mycteroperca interstitialis*) from the Southeast Reef Fish Survey	Rob Cheshire and Nathan Bacheler	7 February 2020
SEDAR68-DW-02	Standardized catch rates of scamp and yellowmouth grouper (*Mycteroperca phenax* and *Myteroperca interstitialis*) in the southeast U.S. from headboat logbook data	Sustainable Fisheries Branch	4 March 2020
SEDAR68-DW-03	Standardized catch rates of scamp and yellowmouth grouper (*Mycteroperca phenax* and *Myteroperca interstitialis*) in the southeast U.S. from commercial logbook data	Sustainable Fisheries Branch	2 March 2020 Updated: 9 March 2020 13 April 2020
SEDAR68-DW-04	Scamp/Yellowmouth Grouper Fishery-Independent Indices of Abundance in US South Atlantic Waters Based on a Chevron Video Trap Survey and a Short Bottom Longline Survey	Walter J. Bubley, Dawn Glasgow, and Tracey I. Smart	20 February 2020
SEDAR68-DW-05	Reproductive Parameters for South Atlantic Scamp and Yellowmouth Grouper in Support of the SEDAR 68 Research Track Assessment	David M. Wyanski, Dawn M. Glasgow, Keilin R. Gamboa-Salazar, and Wally J. Bubley	4 March 2020 Updated: 31 October 2020
SEDAR68-DW-06	Fisheries-independent data for Scamp (*Mycteroperca phenax*) from reef-fish visual surveys in the Florida Keys and Dry Tortugas, 1999-2018	Jessica Keller, Jennifer Herbig, and Alejandro Acosta	19 February 2020
SEDAR68-DW-07	Indices of abundance for Scamp (*Mycteroperca phenax*) using combined data from three independent video surveys	Kevin A. Thompson, Theodore S. Switzer, Mary C. Christman, Sean F. Keenan, Christopher Gardner,	19 February 2020 Updated: 21 October 2020

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		Katherine E. Overly, Matt Campbell	
SEDAR68-DW-08	Recreational Survey data for Scamp and Yellowmouth Grouper in the South Atlantic	Vivian M. Matter and Matthew A. Nuttall	2 March 2020 Updated: 11 March 2020 Updated: 25 August 2020 Updated: 27 October 2020
SEDAR68-DW-09	Recreational Survey data for Scamp and Yellowmouth Grouper in the Gulf of Mexico	Vivian M. Matter and Matthew A. Nuttall	2 March 2020 Updated: 11 March 2020 Updated: 25 August 2020 Updated: 27 October 2020
SEDAR68-DW-10	SEFSC computation of variance estimates for custom data aggregations from the Marine Recreational Information Program	Kyle Dettloff, Vivian M. Matter, and Matthew Nuttall	11 March 2020
SEDAR68-DW-11	Estimates of Historic Recreational Landings of Scamp and Yellowmouth Grouper in the South Atlantic Using the FHWAR Census Method	Ken Brennan	25 February 2020 Updated: 29 May 2020
SEDAR68-DW-12	Estimates of Historic Recreational Landings of Scamp and Yellowmouth Grouper in the Gulf of Mexico Using the FHWAR Census Method	Ken Brennan	25 February 2020 Updated: 29 May 2020
SEDAR68-DW-13	Marine Recreational Information Program Metadata for the Atlantic, Gulf of Mexico, and Caribbean regions	Vivian M. Matter and Matthew A. Nuttall	2 March 2020
SEDAR68-DW-14	SEAMAP Reef Fish Video Survey: Relative Indices of Abundance of Scamp	Matthew D. Campbell, Kevin R. Rademacher, Paul Felts, Brandi Noble, Joseph Salisbury, and John Moser	20 February 2020

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SEDAR68-DW-15	Scamp (*Mycteroperca phenax*) age comparisons between aging labs in the Gulf of Mexico and South Atlantic	Andrew D. Ostrowski, Jennifer C. Potts, and Eric Fitzpatrick	31 March 2020
SEDAR68-DW-16	Commercial Discard Length Composition for South Atlantic Scamp and Yellowmouth Grouper	Sarina F. Atkinson	5 March 2020 Updated: 27 August 2020
SEDAR68-DW-17	Commercial Discard Length Composition for Gulf of Mexico Scamp and Yellowmouth Grouper	Sarina F. Atkinson	5 March 2020 Updated: 27 August 2020
SEDAR68-DW-18	Standardized Catch Rate Indices for Scamp (*Mycteroperca phenax*) and Yellowmouth Grouper (*Mycteroperca interstitialis*) during 1986-2017 by the U.S. Gulf of Mexico Headboat Recreational Fishery	Gulf and Caribbean Branch	2 March 2020 Updated: 9 June 2020 Updated: 10 December 2020
SEDAR68-DW-19	Scamp grouper reproduction on the West Florida Shelf	Susan Lowerre-Barbieri, Hayden Menendez, Ted Switzer, and Claudia Friess	4 March 2020 Updated: 2 April 2020
SEDAR68-DW-20	Summary of preliminary age, length, and reproduction data for U.S. Gulf of Mexico scamp, *Mycteroperca phenax*, submitted for SEDAR68	Veronica Beech, Laura Thornton, Beverly Barnett	3 March 2020
SEDAR68-DW-21	Summary of preliminary age and length data for U.S. Gulf of Mexico yellowmouth grouper, *Mycteroperca interstialis*, submitted for SEDAR68	Laura Thornton, Veronica Beech, Beverly Barnett	3 March 2020
SEDAR68-DW-22	Preliminary Non-Technical Fishery Profile and Limited Data Summary for Scamp, Mycteroperca phenax with Focus on the West Florida Shelf: Application of Electronic Monitoring on Commercial Snapper Grouper Bottom Longline Vessels	Carole L. Neidig, Daniel Roberts, Max Lee, Ryan Schloesser	12 March 2020

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SEDAR68-DW-23	Scamp Length Frequency Distributions from At-Sea Headboat Surveys in the South Atlantic, 2005 to 2017	Dominique Lazarre, Chris Wilson, Kelly Fitzpatrick	1 April 2020
SEDAR68-DW-24	A Summary of Observer Data from the Size Distribution and Release Condition of Scamp Discards from Recreational Fishery Surveys in the Eastern Gulf of Mexico	Dominique Lazarre	1 April 2020
SEDAR68-DW-25	Summary of the SAFMC Scamp Release Citizen Science Pilot Project for SEDAR 68	Julia Byrd	16 April 2020 Updated: 26 August 2020
SEDAR68-DW-26	Voluntary reports of Scamp caught by private recreational anglers in MyFishCount for SEDAR 68	Chip Collier	7 April 2020
SEDAR68-DW-27	Assigning fates in telemetry studies using hidden Markov models: an application to deepwater groupers released with descender devices	Brendan J. Runde, Theo Michelot, Nathan M. Bacheler, Kyle W. Shertzer, and Jeffrey A. Buckel	27 February 2020
SEDAR68-DW-28	Scamp grouper reproduction in the Gulf of Mexico	Susan Lowerre-Barbieri, Veronica Beech, and Claudia Friess	22 May 2020 Updated: 2 September 2020
SEDAR68-DW-29	Standardized Catch Rate Indices for Scamp (*Mycteroperca phenax*) and Yellowmouth Grouper (*Mycteroperca interstitialis*) during 1993-2017 by the U.S. Gulf of Mexico Vertical Line and Longline Fisheries	Gulf and Caribbean Branch, SFD	11 September 2020
SEDAR68-DW-30	CPUE Expansion Estimation for Commercial Discards of Gulf of Mexico Scamp & Yellowmouth Grouper	Steven G. Smith, Kevin J. McCarthy, Stephanie Martinez	23 September 2020
SEDAR68-DW-31	SEFSC Computation of Uncertainty for Southeast Regional Headboat Survey and Total Recreational Landings Estimates, with Applications to SEDAR 68 Scamp and Yellowmouth Grouper	Matthew A Nuttall, Kyle Dettloff, Kelly E Fitzpatrick, Kenneth Brennan, and Vivian M Matter	27 October 2020

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SEDAR68-DW-32	Discards of scamp (*Rhomboplites aurorubens*) for the headboat fishery in the US South Atlantic	Fisheries Ecosystems Branch, National Marine Fisheries Service, Southeast Fisheries Science Center, Beaufort, NC	30 October 2020
SEDAR68-DW-33	Discards of scamp (*Mycteroperca phenax*) for the headboat fishery in the US Gulf of Mexico	Fisheries Ecosystems Branch, National Marine Fisheries Service, Southeast Fisheries Science Center, Beaufort, NC	30 October 2020
SEDAR68-DW-34	South Atlantic U.S. scamp (*Mycteroperca phenax*) age and length composition from the recreational fisheries	Fisheries Ecosystems Branch, National Marine Fisheries Service, Southeast Fisheries Science Center	10 December 2020
SEDAR68-DW-35	Commercial age and length composition weighting for Southeast U.S. scamp and yellowmouth grouper (*Mycteroperca phenax and Mycteroperca interstitialis)*	Sustainable Fisheries Branch, National Marine Fisheries Service, Southeast Fisheries Science Center	12 November 2020
Reference Documents			
SEDAR68-RD28	Survival estimates for demersal reef fishes released by anglers	Mark R. Collins	
SEDAR68-RD29	Commercial catch composition with discard and immediate release mortality proportions off the southeastern coast of the United States	Jessica A. Stephen, Patrick J. Harris	
SEDAR68-RD30	Discard composition and release fate in the snapper and grouper commercial hook-and-line fishery in North Carolina, USA	P.J. Rudershausen, J.A. Buckel, and E.H. Williams	
SEDAR68-RD31	Sink or swim? Factors affecting immediate discard mortality for the Gulf of Mexico commercial reef fish fishery	J.R. Pulver	

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SEDAR68-RD32	SEDAR 33-DW-19: A meta-data analysis of discard mortality estimates for gag grouper and greater amberjack	Linda Lombardi, Matthew D. Campbell, Beverly Sauls, and Kevin J. McCarthy
SEDAR68-RD33	Potential survival of released groupers caught deeper than 40 m based on shipboard and in-situ observations, and tag-recapture data	Raymond R. Wilson, Jr. and Karen M. Burns
SEDAR68-RD34	Scamp Fishery Performance Report	SAFMC Snapper Grouper Advisory Panel
SEDAR68-RD35	Hierarchical analysis of multiple noisy abundance indices	Paul B. Conn
SEDAR68-RD36	SAFMC SSC MRIP Workshop Report	SAFMC SSC
SEDAR68-RD37	Catch Characterization and Discards within the Snapper Grouper Vertical Hook-and-Line Fishery	Gulf and South Atlantic Fisheries Foundation
SEDAR68-RD38	A Continuation of Catch Characterization and Discards within the Snapper Grouper Vertical Hook-and-Line Fishery	Gulf and South Atlantic Fisheries Foundation
SEDAR68-RD39	Continuation of Catch Characterization and Discards within the Snapper Grouper Vertical Hook-and-Line Fishery	Gulf and South Atlantic Fisheries Foundation
SEDAR68-RD40	Descender Devices are Promising Tools for Increasing Survival in Deepwater Groupers	Brendan J. Runde and Jeffrey A. Buckel
SEDAR68-RD41	Something's Fishy with Scamp Response Summary	GMFMC
SEDAR68-RD42	Application of three-dimensional acoustic telemetry to assess the effects of rapid recompression on reef fish discard mortality	Erin Collings Bohaboy, Tristan L. Guttridge, Neil Hammerschlag, Maurits P. M. Van Zinnicq Bergmann, and William F. Patterson III1
SEDAR68-RD43	Length selectivity of commercial fish traps assessed from in situ comparisons with stereo-video: Is there evidence of sampling bias?	Tim J. Langlois, Stephen J. Newman, Mike Cappo, Euan S. Harvey, Ben M. Rome, Craig L. Skepper, Corey B. Wakefield

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SEDAR68-RD44	Changes in Reef Fish Community Structure Following the Deepwater Horizon Oil Spill	Justin P. Lewis, Joseph H. Tarnecki, Steven B. Garner, David D. Chagaris &William F. Patterson III

2 LIFE HISTORY

2.1 OVERVIEW

The Life History Work Group (LHG) was tasked with reviewing all Life history data for Scamp/Yellowmouth Grouper stocks in the U.S. South Atlantic and Gulf of Mexico and providing parameter inputs for the assessment models as appropriate. The LHG evaluated age, growth, and reproductive characteristics for each stock, including age data that could be used to characterize fishery landings, population growth models, maturity schedules, age and size at sexual transition and estimates of fecundity or other measures of reproductive potential. These data were used to inform estimates of natural mortality. The LHG has provided estimates or ranges of uncertainty for all input data parameters.

2.1.1 Work Group members and participants in Life History webinars

Andy Ostrowski	Work Group Co-Lead	NMFS
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Gregg Bray	Work Group member, Data Provider	GSMFC
Veronica Beech	Work Group member, Data Provider	NMFS
Wally Bubley	Work Group member, Data Provider	SCDNR
Dave Wyanski	Work Group member, Data Provider	SCDNR
Claudia Friess	Work Group member, Data Provider	Florida FWC
Nikolai Klibansky	Work Group member	NMFS
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Carole Neidig	Work Group member	Mote Marine Laboratory
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Wiley Sinkus	Observer	SCDNR
Stephen Long	Observer	

2.2 REVIEW OF WORKING PAPERS GREMANE TO LIFE HISTORY

SEDAR68-DW-05: Reproductive Parameters for South Atlantic Scamp and Yellowmouth Grouper in Support of the SEDAR 68 Research Track Assessment

Gonad tissue samples of Scamp and Yellowmouth Grouper were collected from a fishery-independent survey and fishery-dependent port sampling within the US South Atlantic since 1979. Primary gears used to capture the fish were snapper reels (50%) and chevron traps (40%). All gonad tissues were histologically processed. Data recorded included sex of the fish, including transitionals, maturity staging, based on Brown-Peterson et al. (2011), and fecundity estimates. Analyses of the data included sex ratio, age and length at maturity, maturity schedules, age and length at transition, spawning frequency, and batch fecundity. All analyses used recommended SEDAR best practice approaches. Functional maturity for females at calendar age and fork length were estimated by filtering data to include only developing, spawning capable and immature phases from spawning months (Feb–July), with developing and spawning capable phases representing mature females. This definition of maturity included specimens with oocyte development at or beyond the vitellogenic stage. All male specimens were considered sexually mature. Data from all months were used to estimate calendar age and fork length at sex transition. Juvenile females were included in these analyses, whereas transitional specimens were omitted.

The sex ratio data did not include immature females in order to restrict the ratio to the adult population, and transitionals were included with males. All males were considered mature. The measure of female maturity was based on developing, spawning, regressing, or regenerating

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oocytes and included females with oocytes at the cortical alveolar stage or beyond. Spawning frequency, imminent or recent spawning, was modeled on samples collected during spawning months (Feb – July) for ages 2 through 14+. Batch fecundity was modeled with a power function to be consistent with recent SEDARs where fecundity was thought to be a function of volume rather than length.

Recommendation:

The samples that were collected cover the majority of the range of the species in the South Atlantic. By having samples from various gears, they should be representative of the population. Standard procedures for analyzing the data were followed and are current with most up-to-date literature and SEDAR practices. Alternative models for batch fecundity could be explored to find best fit to the data. The reproductive parameters for Scamp/Yellowmouth Grouper complex were updated and further analyses and discussion are included in following report sections. The data and parameters are adequate for stock assessment inputs.

SEDAR68-DW-15: Scamp (*Mycteroperca phenax*) age comparisons between aging labs in the Gulf of Mexico and South Atlantic.

This report compared consistency of Scamp age estimates between labs in the Gulf of Mexico (GOM) and South Atlantic (SA) to ensure no bias would be introduced through these data. A calibration set of 400 samples was split evenly between GOM and SA. Four labs (Florida Fish and Wildlife Conservation Commission Fish and Wildlife Research Institute (FWRI), South Carolina Department of Natural Resources (SCDNR), and NOAA Panama City and Beaufort labs) assigned ages, edge codes, and quality codes for the three analyses (average percent error, age-bias plots, Evans Hoenig & Baker symmetry tests) that calculate precision, illustrate patterns, and evaluate bias. Ranges of APE were satisfactory and there was no clear overaging or underaging bias among labs. Scamp aged 0–10 years were more precise compared to Scamp aged 11+, and represent the bulk of the data. Results indicate high precision among the aging labs within a region submitting data for the assessment.

Recommendation:

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The reported analyses were well done and thorough, and the results indicated that readings are consistent with little bias and low average percent error (APE). There was no indication that these data would introduce bias. Therefore, they should be considered for use in the assessment.

SEDAR68-DW-19: Scamp grouper reproduction on the West Florida Shelf
A more comprehensive working paper was submitted (SEDAR68-DW-28).

SEDAR68-DW-20: Summary of preliminary age, length, and reproduction data for U.S. Gulf of Mexico Scamp, *Mycteroperca phenax*, submitted for SEDAR68
This working paper is a preliminary summary of Scamp life history data provided for the Gulf of Mexico by the NOAA Panama City Laboratory. It is broken out by years, mode and gear, sampling program, and state landed/captured. This is a large portion of the complete data set for Scamp in the Gulf of Mexico and will be very useful for any reproductive-based parameters for the assessment.

Recommendation:
Life history data from other sources, specifically FWRI, should be combined with the data summarized in this report for more robust analyses of growth and reproductive parameters (see following report sections). The data are useful as inputs to the GOM stock assessment.

SEDAR-68-DW-21: Summary of preliminary age and length data for U.S. Gulf of Mexico Yellowmouth Grouper, *Mycteroperca interstitialis*, submitted for SEDAR68
This working paper is a preliminary summary of Yellowmouth Grouper life history data provided for the Gulf of Mexico by the NOAA Panama City Laboratory. It is broken out by years, mode and gear, sampling program, and state landed/captured. The data are considered part of the Scamp/Yellowmouth Grouper complex for the GOM, and will be incorporated into the full GOM life history data set for the species.

Recommendation:
These Yellowmouth Grouper life history data should be combined with the GOM Scamp data for more robust analyses of growth and reproductive parameters (see following report sections). The data are useful as inputs to the GOM stock assessment.

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SEDAR68-DW-28: Scamp grouper reproduction in the Gulf of Mexico

The document summarizes analyses conducted on a combined dataset from the NMFS Panama City Lab and the Florida Fish & Wildlife Commission (FWC). The authors developed histological indicators for Scamp, assessed timing of reproduction, size and age at maturity and sex transition, spawning frequency, batch fecundity, and other aspects of reproductive biology. Most samples were collected by NMFS during 1972–2017 (*n*=4,105) from fishery-dependent, fishery-independent, and unknown sources, with the remaining samples collected by FWC during 2009–2017 (*n*=459) from fishery-independent and fishery-dependent surveys and a study targeting Gag Grouper along the western coast of Florida. Specimen age has not yet been determined for the FWC samples. The authors developed species-specific histological indicators to assess reproductive state and then used the resulting data to investigate maturity, sex ratio, reproductive timing, and spawning frequency of Scamp in the Gulf of Mexico. Various models were applied to estimate size and calendar age at maturity and at sex transition, spawning season duration, and spawning frequency.

Recommendation:

The methods used in this working paper were sound and often represented thoughtful improvements over standard methods. The overall dataset was large, but the samples were somewhat restricted to the western coast of Florida: 84% of the NMFS-Panama City specimens, and 100% of the FWC specimens. Assessing size and age at maturity in females was based on whether or not females were capable of spawning. Therefore, data were restricted to fish caught during the spawning season for analyses. While the definition "Actively Spawning" varies slightly on pages 2 and 3, it is understood to include those specimens with indicators of imminent or recent spawning. This approach will reduce the number of samples available for regression analysis, but relies on very distinct histological characteristics and reduces observation error. Spawning season duration was estimated with a novel approach, which estimates the average start and end dates of the spawning season with binomial regression and calculates the difference between these dates. This should be much more robust than the standard method, which is based on estimates of the extreme start and end dates of the spawning season, and is very sensitive to sampling early and late in the spawning season. Spawning fraction was estimated from the proportion of all females with spawning indicators, which is different than how it is often calculated as a proportion of mature females. Calculating spawning frequency as a

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function of all females is an improvement that avoids the need to even estimate "maturity", and eliminates the uncertainty in maturity staging. Spawning frequency (number of spawns per year) was calculated as a function of spawning fraction, spawning season duration, and an assumed duration of spawning indicators. A regression was then run to estimate spawning frequency as a logistic function of age.

Sources of uncertainty that could potentially be of concern in Scamp are assumptions about duration of spawning indicators, and histological criteria that indicate sex transition, and the uncertain duration of transitional characteristics. This is worth nothing, but these are common issues with studies of this type, that may not be problematic. If the assumed duration of spawning indicators is an over/underestimated, spawning events will tend to appear less/more common which will tend to under/overestimate the number of spawns per season. In protogynous fish, individuals may contain varying amounts of male and female tissue in their gonads, and it is often unclear how quickly transition proceeds. Thus, characterizing fish as "transitional" can be of somewhat limited utility since it is not clear when a "transitional" fish will actually function as male. Regardless, this should not compromise sex-at-age functions reported in this paper, which excluded "transitional" individuals.

The analyses were very informative, and novel in the case of spawning duration, and generated very reliable reproductive inputs for the Gulf of Mexico Scamp/Yellowmouth Grouper assessment. The results of this study are recommended for use in the assessment.

2.3 AGE AND GROWTH DATA

2.3.1 Age calibration among data providers

Otoliths are the preferred age structure of Scamp, but they are considered difficult to interpret; thus, staff from the four laboratories contributing data to this SEDAR met for an ageing workshop to ensure the consistency in age readings of Scamp. They established the best methodology for sectioning the otoliths and interpreting the macrostructure of the otolith sections to assign ages to the samples. Following the ageing workshop, each lab contributed to a calibration set (n = 400) to be shared that was representative of each lab's processing technique, the full age range of available samples, location of fishing activity or surveys, and all months of the year. Overall average percent error (APE) between each pair of labs ranged from 4.63% to

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6.37% and no significant over-ageing or under-ageing bias was found. Within a stock, APE values were 4.24% and 5.14% for the South Atlantic and Gulf of Mexico, respectively. The outcome of the ageing workshop and the exchange of the calibration sets suggested that data sets from the four laboratories could be combined for SEDAR68. Full results of the age comparisons can be found in SEDAR68-DW-15.

For all Scamp aged at Panama City, internal age reader agreements were calculated among the two age readers using a 20% overlap per year. For years prior to 2000, a retrospective reader overlap was completed (n = 567) among the same two age readers and APE was calculated at 6.35%. Due to Yellowmouth Grouper sections appearing significantly similar to Scamp sections, two Yellowmouth Grouper age readers participated in the Scamp ageing workshop as well as the exchange of calibration sets to ensure and maintain consistent ageing methodologies.

2.3.2 Source of samples

The final age data set as presented in this report represent only otoliths for which an observed age estimate was made by an age reader. The Gulf of Mexico Scamp and Yellowmouth Grouper age data set (n = 13,283) for years 1972–2019 was contributed by NMFS Panama City, FWRI Fishery Independent Monitoring (FWRI FIM), and Gulf States Fisheries Information Network (GulfFIN) (Table 1). The data consisted primarily of Scamp records (n = 12,724), but also included limited Yellowmouth Grouper records (n = 559). Data and biological samples were collected from the commercial fishery, recreational fishery, and fishery-independent surveys. The number of age samples provided from the commercial and recreational fisheries are shown in Tables 2 and 3, respectively. The number of age samples provided by fishery independent surveys are shown in Table 4. Due to the large number of fishery dependent samples received, a subsampling protocol is in place to sample Gulf of Mexico Scamp by a randomly selected subset per fishing area grid (NMFS shrimp statistical grid) based on an average of five years of the most recently reported landings. Thus, age data is comparably represented throughout the U.S. Gulf of Mexico (Table 5).

2.3.3 Age and length data

Gulf of Mexico Scamp and Yellowmouth Grouper data were represented by a wide distribution of fork lengths (153 – 1070 mm; 528.87 ± 98.57, mean ± std. dev; n = 13,233). Most (n = 2,620)

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of the fork lengths occurred in the 500 – 550 mm bin. Ages ranged from 0 – 37 years (9.69 ± 4.63, mean ± std. dev; n = 13,233); however, the LHG recommends using a maximum age of 34 ± 2 years (see section 4).

Due to an increase in the number of otoliths from the commercial hand-line and long-line sectors, records (a minimum of n = 500) from each year and gear were sub-sampled randomly based on an average of yearly percentages of commercial landings per the National Marine Fisheries Service (NMFS) Shrimp Statistical Grids. All age data for Scamp from years 2003–2012 ($n \sim 10,254$), provided by NMFS Panama City, were removed due to concerns with otolith processing. The Benetec saw, which is currently used at the NMFS Northeast Fisheries Science Center, was utilized for otolith sectioning for this time series (2003–2012) of samples for Scamp, whereby 25 otoliths were set in epoxy blocks consisting of five rows with each row having five otoliths. Several cuts of the block were made, and a strip of five sections was glued to each slide. The issues in processing included but were not limited to: the initial use of black epoxy smearing, differences in core cuts among the sections on the strips (i.e., some otolith cuts were off-core and other otolith cuts were on-core for sections on the same strip), transposing of sections whereby the strip was flipped and otolith sections did not match up to the specimen number order on slides, several recuts had been made out of order, and a large number of otoliths ($n \sim 1,675$) that were recorded as unreadable by the age reader. The physical blocks as well as the paper grids designed to keep track of otolith section placement were disposed of making data reconciliation irreparable. The number of issues outlined here led to enough concern over using the age data processed on the Benetec saw, that the LHG felt it was best to remove the samples from further analysis. Scamp otoliths remaining in the archive at NMFS Panama City ($n \sim$ 10,500) for years 2003–2012 will be sectioned using traditional, proven methods and equipment, and this age data will be made available for the upcoming SEDAR 68 Operational Assessment scheduled in 2021. Yellowmouth Grouper samples were not affected by the Benetec sectioning method, as they were processed using traditional methods and equipment.

To account for these removed samples, a novel approach was undertaken using otolith weight as a proxy of age that could be used temporarily for developing age compositions for years 2003–2012. Otoliths grow throughout the life of teleost fishes, and the size of otoliths (length and weight) are approximately proportional to fish size (Campana and Fowler 2012). As such, otolith

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size can provide some idea of fish age, similar to the way that fish size can be approximated for fish age (Campana and Fowler 2012). NMFS Panama City has a protocol in place that requires all whole left and/or right otoliths be weighed on an analytical balance prior to the otoliths being sectioned. Having this established protocol afforded the opportunity to analyze the otolith weight – age relationship so that a temporary proxy age could be made available for developing age compositions for years 2003–2012 (i.e., years that the Benetec saw was used to section Scamp otoliths). All samples with an available left otolith weight and an observed age estimate (n = 5,455) across all years, except 2003–2012, were used in linear regression analysis, where age in years was the dependent variable and left otolith weight in grams was the independent variable. No NMFS Panama City Scamp age data were used from years 2003–2012 in the regression analysis (Table 6). Left otolith weight was chosen since there were few right otolith weights available in the NMFS Panama City data set and because the left otolith is most often the only otolith sampled by port samplers. Prior to the regression analyses, assumptions of normality, linearity, and homogeneity of variances were checked with Q-Q plots (normality) and residuals (linearity, homogeneity of variances). Two simple linear regression models were investigated: 1) calendar age regressed on left otolith weight, and 2) fractional age regressed on left otolith weight (Table 7; Figures 1, 2). Seven multiple regression models with calendar age regressed on combinations of left otolith weight with fork length, NMFS grid where fish were caught, month of capture, histological sex, and/or gear type, were also investigated. Since all regression models had similar R^2 values that ranged from 0.6517 to 0.6652, the LHG recommended the simple linear regression model of calendar age regressed on left otolith weight as a model to produce a temporary proxy of age that could be used for developing age compositions of landings for years 2003–2012 (Table 7; Figure 1). For years 2003–2012, there are approximately n = 3,574 records where otolith weight is available for which this linear regression model (i.e., calendar age regressed on left otolith weight) could be used to temporarily provide a proxy of age for the 2003–2012 age compositions of landings.

Calendar, or cohort, ages are assigned based on annual ring counts and edge type codes. The edge, or margin, codes refer to the presence of an opaque zone or the width of a translucent zone that is located on the edge of the otolith beyond the last complete annual ring. Age readers at the NMFS Panama City classify an opaque zone on the edge as edge code = 2, a translucent zone forming with 1/3 to 2/3 of new growth after the last opaque zone as edge code = 4, and a

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translucent zone forming with greater than 2/3 of new growth after the last opaque zone as edge code = 6. GulfFIN and FWRI FIM age readers classify an opaque zone on the margin as edge code = 1, a translucent zone on the margin < 1/3 complete as edge code = 2, a translucent zone on the margin that is 1/3 to 2/3 complete as edge code = 3, and a translucent zone on the margin > 2/3 complete as edge code = 4 (GSMFC 2009). The criteria for converting annuli counts to calendar ages is as follows:

1. For all fish landed between January 1 and June 30 with a wide translucent zone (NOAA PC edge code = 6, GulfFIN and FWRI FIM edge code 3 or 4), calendar age = annuli count + 1.
2. For all fish landed between January 1 and June 30 with an opaque zone on the margin (NOAA PC edge type = 2, GulfFIN and FWRI FIM edge code =1), or a narrow translucent zone (NOAA PC edge type = 4, GulfFIN and FWRI FIM edge code = 2), calendar age = annuli count.
3. For all fish landed between July 1 and December 31, calendar age = annuli count.

In addition to the calendar ages, fractional (biological) ages were also provided for use in the growth models. Fractional ages were based on the calendar ages and the date of peak spawning, April 15, for the Gulf of Mexico stock. Date of peak spawning was based on peak gonadosomatic Index (GSI) occurring in April (see Section 2.5 REPRODUCTION). The equation for calculating fractional age for Scamp and Yellowmouth Grouper in the Gulf of Mexico is:

$A_F = A_C + ((D_C - D_S)/365))$, where
A_F = fractional age (years),
A_C = calendar age (years),
D_C = date of capture, and
D_S = date of peak spawning.

The LHG recommended using all age and growth data for Scamp and Yellowmouth Grouper from all data providers for SEDAR 68 once all of the Scamp age data provided by NMFS Panama City Lab for years 2003–2012 have been removed from the data set. All Yellowmouth Grouper age and growth data provided by the NMFS Panama City Lab for years 2003–2012 should be included since the otoliths were sectioned using traditional methods and equipment. The LHG also recommended the temporary use of the simple linear regression model, calendar age (years) regressed on left otolith weight (grams) to produce a proxy of age that could be used

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temporarily for the landings age compositions for years 2003–2012 (i.e., years for which the Benetec saw was used to section Scamp otoliths).

2.3.4 Modeling Growth

Growth of Scamp and Yellowmouth Grouper in the Gulf of Mexico was modeled for the population using a von Bertalanffy growth model in AD Model Builder (ADMB). To account for growth of the fish throughout the year, the fractional age and fork length of each sample was used in the model. Records that included both fractional ages and fork length provided by all data providers (n = 13,233 out of 13,283) were used in the growth models, including n = 175 Yellowmouth Grouper provided by NMFS Panama City and n = 426 Scamp provided by GulfFIN and FWRI FIM for years 2003–2012 (Table 8). No estimated ages from the otolith weight – age linear regression model for Scamp from years 2003–2012 were used in the growth models as these data were only provided as a temporary placeholder for developing age compositions of landings. For the population model, each age data sample was identified to the source of the sample, specifically commercial fishery, recreational fishery or fishery-independent. These designations were important in the population growth model because the fishery-dependent samples were subject to the minimum size regulations since November 24, 1999 (Reef Fish Amendment 16B), which in effect allows the fastest growers at the youngest ages to be retained in the fishery landings. The population growth model includes a statistical correction for the left-truncated distribution (McGarvey and Fowler, 2002). Multiple model compilations were examined using four different variance structures: constant SD with age, constant CV with age, CV increases linearly with age, and CV increases linearly with size (Table 9). Scamp and Yellowmouth grouper displayed a constant CV with age (Figure 3) and had a similar objective function and growth model parameters as the growth model where CV increases linearly with age (Table 9). Due to the increased uncertainty in the age readings of the oldest fish, the LHG recommended two growth models for consideration: constant CV across all ages (Figure 4) and estimate CV as a linear function of age (Figure 5). Additional models combining females and males together were also run and VBGF predicted growth for combined females and males were overlain on the recommended growth models (Table 9, Figures 6, 7). Only fish that were histologically identified as functional females and males were used in these growth models. To overcome 90% of the Gulf of Mexico age data being represented by ages 1–

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15, each data point was weighted by the inverse of the sample size at each sample's calendar age. Those data were driving the population model and not fitting the size-at-age of the oldest fish well. The growth model parameters are included in Table 9.

ADT Recommendation

Use inverse weighting and the population growth models, Constant CV and CV increases linearly with age, as presented.

2.4 NATURAL MORTALITY

Natural mortality (*M*) of a fish species is often estimated using its life history parameters due to the difficulty in estimating *M* directly. Based on past assessments, the LHG had discussions about maximum age, use of point estimates of *M* and age-varying *M*s based on size-at-age. Many equations to calculate a point estimate of *M* are available, but the equations using maximum age of the population are preferred (Hoenig, 1983; Then et al., 2015). It is believed that the early life stages of a fish make them more vulnerable to natural mortality than the older, mature fish. For that reason, equations that estimate *M* as a function of size-at-age (Lorenzen, 1996; Charnov et al., 2012) were prioritized for this assessment.

The LHG first discussed the maximum age of Scamp in the region. The maximum ages of Scamp in the South Atlantic and the Gulf of Mexico data sets were recorded as 34 years and 35 years, respectively, which is similar to the maximum age of 31 years previously reported for Scamp (Lombardi-Carlson et al. 2012). Two Yellowmouth Grouper samples from the U.S. Gulf of Mexico had maximum ages of 36 and 37 years. A recent bomb radiocarbon study (Pers. comm. Linda Lombardi-Carlson and Beverly Barnett, NMFS Panama City Laboratory) on a limited number of available samples was validated to a maximum age of 25 years (range = 24 – 27 years). However, one sample in the same study was aged 33 years by all four labs engaged in ageing Scamp, but due to Benetec processing issues described above (see section 3.3), the age for this sample could not be validated. A calibration set shared among the four ageing labs (SEDAR68-DW-15) consistently found a maximum age of 34 years. Due to the potential for uncertainty in consistently ageing the oldest fish in the calibration data set, the LHG proposed a range about the single maximum age of 34 years to be used in uncertainty analyses for both regions. From the calibration set ages recorded by all age readers, the error calculated around the

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oldest fish was computed. The LHG recommended a range of ± 2 years to be used. This maximum age is plausible because data from the Gulf of Mexico stock had 14 samples aged 30+, while the South Atlantic data contained six samples. The Gulf of Mexico samples came from fish caught during more recent years and have survived through a time of heavy exploitation. The LHG thinks that a maximum age of 34 years is reasonable since it was found in multiple data sets and across many years. Max age for Yellowmouth Grouper (31 years, Burton et al. 2014) was similar to that found for Scamp in both stocks.

The LHG decided that *M* as a function of size-at-age was the most appropriate data input for the stock assessment because smaller fish are more susceptible to predation than older, larger fish. Two age-varying *M* estimates were initially considered from two approaches: (1) Charnov et al. (2012) and (2) Lorenzen (1996). Recent South Atlantic SEDAR assessments have used Charnov et al. calculations, while Gulf of Mexico SEDAR assessments have used Lorenzen. A member of the LHG reached out to both Lorenzen and Charnov to seek their inputs into their respective data sets used for their calculations of *M*. Lorenzen re-analyzed his estimate of size-varying *M* using his original data set and the data set from Charnov et al. (2012). Lorenzen's data set and estimation procedure better addresses the population level natural mortality, whereas Charnov et al.'s estimator works better at a community level. Lorenzen made a strong argument that the new analyses resulted in an equation more similar to his original equation (manuscript in prep). Lorenzen advised that the natural mortality vector be scaled for the species using the Then et al. (2015) point estimate using t_{max}. His reasoning was that, depending on the species, the mortality vector from his equation may not allow for the fish to survive to the maximum age. Then et al. (2015) recommend that, for each species to which their natural mortality estimator is applied, the analyst evaluate the Then et al. (2015) data set (available at https://www.vims.edu/research/departments/fisheries/programs/mort_db/index.php) and rerun the regression on a subset of species with more similar life history strategies to their focal species. Therefore, we calculated a new *M* estimator for Scamp and Yellowmouth Grouper.

The LHG considered the data used in the Then et al. (2015) point estimate of *M* based on t_{max}, which consisted of 227 data points from across multiple species and families and resulted in M = 0.1938 for Scamp/Yellowmouth Grouper. Criteria for sub-setting the data suggested by members of the LHG include having a sufficient range in maximum ages and enough data points for the

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regression to be robust. It was further suggested that species from similar habitats were important, such as tropical/sub-tropical reef fish or demersal species rather than pelagic or cold-water species. With those criteria set out, the full data set was subsetted based on reef fish families to include Serranidae (groupers), Sparidae (porgies), Pomacanthidae (angelfishes), Pomacentridae (damselfishes), Scaridae (parrotfishes), Malacanthidae (tilefishes), Labridae (wrasses), Lutjanidae (snappers), Haemulidae (grunts), Carangidae (jacks), and Acanthuridae (surgeonfishes) (n = 67). A few families were excluded immediately due to concern over the ageing methodology (e.g., Balistidae [triggerfishes] and Polyprionidae [wreckfishes]). The regression equation including these reef fish families resulted in M = 0.193. Some of the relevant literature cited by Then et al. (2015) was reviewed by various members of the LHG. Many of the studies drew concern over ageing methodology or how M was calculated. Many of the M values were based on catch-curve analysis of unfished or lightly fished stocks. Concern was also raised about including reef fish species that had very different life history strategies or maximum sizes compared to groupers. One suggestion was made to limit the data points to species in the same family that exhibit similar trophic levels to groupers. Thus, the 12 Serranidae species were chosen to rerun the regression. The Serranids ranged in age from 7 to 85 years and estimates of M ranged from 0.078 to 0.68 (Figure 8). The regression based on those 12 data points calculated an M of 0.155. The LHG proposed to use the Lorenzen (1996) mortality vector scaled to the Serranids only point estimate of M for both the South Atlantic and the Gulf of Mexico stocks (Table 10, Figure 9). The M vector for each stock would use the stock specific growth model (see Section 3.4) and weight-length equations (see Section 6) in the calculations. Scaling of the M vector was based on the survivability of the fully recruited ages, ages 6–34 for both stocks. The LHG group did note that a more thorough review of the literature cited in Then et al. (2015) is needed, as well as investigation in the most appropriate way to subset the data for other SEDAR species.

ADT Recommendation:

1. Maximum age of Scamp/Yellowmouth Grouper is 34 years with a range of ± 2 years for both the South Atlantic and the Gulf of Mexico stocks.
2. Use natural mortality vector as a function of mean size-at-age using Lorenzen (1996) equation and scaled to Then et al. (2015) point estimate using a re-calculated t_{max}

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regression based on data gathered for Serranid species. This method will be applied to both the South Atlantic and the Gulf of Mexico stocks.

2.5 REPRODUCTION

A previous study on Scamp reproduction in the GOM (Lombardi-Carlson et al., 2012) provided estimates of size and age at maturity and transition for fish sampled primarily on the west Florida shelf between 1972 and 2002. The data used in that study, provided by NMFS Panama City, were re-analyzed for SEDAR 68 along with new information collected by NMFS Panama City for 2003–2017 and by FWRI for 2009–2017. Since age information was not available for FWRI samples, only NMFS Panama City samples were used for estimating age at maturity and transition, while all samples are included in size at maturity and transition analyses.

2.5.1 Maturity

Scamp are protogynous hermaphrodites (i.e., transition from female to male in their lifetime); therefore, all male or transitioning fish were considered mature in this assessment. Due to testes continuing to have ovarian walls and often large numbers of primary growth oocytes, histological analysis is needed to assign sex. Differences between labs and assignment of maturity over time were discussed, particularly criteria used as maturity indicators. There is no definitive histological indicator to distinguish immature from mature regenerating females, which both have only primary growth (PG) oocytes. However, because maturity is a process, it is possible to use the histological appearance of other aspects of the gonad to distinguish young immature females from old regenerating females. These include: a clearly defined lumen, the density and organization of the PG population, thickness of the ovarian wall, presence of capillaries and sometimes the occurrence of muscle bundles extending from the ovarian wall into the ovarian lamellae—but this last criterion is often difficult to use in groupers (Lowerre-Barbieri et al., 2011; Lowerre-Barbieri et al. 2015). This level of histological detail was not always available for historical samples and immature females were excluded from the historical data (i.e., samples using the 2004 histological classification protocol). Thus, for size and age at maturity estimates we used only spawning capable and immature due to known issues distinguishing between immature and regenerating individuals. Scamp, like Red Grouper (SEDAR 42), exhibit a high degree of parasitism, and there was concern that maturity assignments resulting from the NMFS Panama City 2004 histological protocol were unreliable

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due to the reliance on brown bodies as an indicator of previous spawning which were easily confused with parasites. The NMFS Panama City group is currently reanalyzing their historical slides with the above criteria to evaluate what is needed to standardize assignments throughout their data set.

To minimize the influence of error in assigning maturity status on estimated maturity parameters, the following decisions were made for combining NMFS Panama City and FWRI histology samples:

- Include only immature (reproductive phase 1) and spawning capable (reproductive phase 3 or 4) fish, and exclude immature females from historical NMFS data
- Include only samples collected during the spawning season (defined as the first to last day when females with spawning indicators were sampled, 2 February – 25 July)
- Censor bad histological preparations

The final maturity data set (n = 763) included fish ranging in size from 106 mm FL to 833 mm FL, with the smallest mature female being 281 mm FL (Figure 10). Maturity data for which age information was available (n = 413) included fish ranging from ages 1 to 19. Binomial generalized linear models (GLMs) were used to model maturity at age and length. Different link functions (logit, probit, cloglog and cauchit) were specified, and the best model was chosen via Akaike Information Criterion (AIC). The logit link function provided the best fit to maturity at age data, and the probit link was the best fitting model for maturity at length. The predicted age and length at 50% maturity were 3.41 years and 363.7 mm TL, respectively (Table 11; Figure 11). These estimates are older and larger than those previously presented in Lombardi-Carlson et al. (2012), which used the historical histological criteria and estimated median age and length at maturity to be 2 years and 332 mm FL, respectively.

2.5.2 Sexual Transition

As with maturity, NMFS Panama City and FWRI data were combined and binomial GLMs with different link functions were specified to estimate transition at length and age parameters. The final data set for determining transition at length included 4,412 fish (1,669 males and 2,743 females), and that for transition at age included 1,937 (700 males and 1,237 females). There was significant overlap in size between males and females; however, males were larger on average than females, while fish in transition (i.e., transitionals) were intermediate in size (Figure 12).

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The youngest observed males were three years old and the smallest observed male was 221 mm (there was no age for this individual). Transitional individuals were excluded from modeling due to uncertainty about their functional status as male or female. Transitionals (*n*=136) ranged in size from 299 to 710 mm FL, with a mean size of 499.8 mm FL. Sex change occurred over a wide range of times, as indicated by the collection of transitionals in every month of the year. Estimated size at 50% male was 555.6 mm FL (logit fit; Table 11; Figure 13) and age at 50% male was 10.8 years (probit fit; Table 11; Figure 13). These estimates are similar to those of Lombardi-Carlson et al. (2012): 566 mm FL and 11 years.

2.5.3 Sex ratio and mating system

Of all fish sampled, there were 1,675 males, 2,754 females and 135 transitionals. The earlier period (1972–2002) had a male sex ratio of 36% (914 males, 1,638 females, and 82 transitionals) compared to 41% in more recent sampling (2003–2017; 761 males, 1,116 females and 53 transitionals). In the 1970s the male sex ratio was estimated at 37.9%, with a decrease to 18–24% in the 1990s (Coleman et al., 1996) and has now increased to 41%. Sex-specific gonadosomatic indices during the core spawning months (March through May), were quite low (female mean: 1.38 +/-1.24; male: 0.27+/-0.11). A similar lack of milt reserves has been documented in Gag Grouper and is considered an indicator of pair spawning (Lowerre-Barbieri et al., 2020).

2.5.4 Fecundity

Spawning season and spawning frequency were estimated for SEDAR 68. However, due to low samples of batch fecundity with weight (*n*=5) and age (*n*=9), annual fecundity could not be estimated. Although the estimate of spawning season length has a large impact on spawning frequency estimates, there is no standardized method to assign spawning season. Due to low numbers of aged samples, it was not possible to estimate age-specific spawning seasons. To assess the total population duration of spawning activity, the first and last dates that female active spawners were observed was defined as the population spawning season. However, due to spawning activity being asynchronous and not evenly distributed over this time period, the core spawning season (i.e., 50% or more of the females were spawning capable) was also estimated using a binomial regression to model calendar date and spawning state data. Spawning capable and developing females were selected to determine the mid-point for the beginning of the spawning season and spawning capable and regressing females were used to estimate when >

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50% of females were no longer spawning capable. Females with spawning indicators were first sampled on 2 February and last sampled on 25 July (spawning season duration=173 d). However, most spawning capable females (88%) were collected in the months of March, April and May. Actively spawning females and female GSI also peaked in April. Using a binomial regression to estimate the time period over which 50% or more of mature females are spawning capable, the estimated spawning season was March 9th through May 26th (79 d) using the cloglog link, and under the probit fit, it was February 28 through June 7 (100 d). The probit model estimate is considered the best, as it better captures the time period when the majority of active spawning was observed.

Due to the need for some fish to still be aged, only 751 females sampled during the spawning season could be used for age-specific spawning fraction estimates. Estimated spawning fraction was zero for ages 1 and 2, then increased for ages 3 and 4, and started plateauing at age 5. The largest spawning fraction was observed for age six (shortest spawning interval of 4.44 days) which was also the age group with the largest available sample size (n_{age6} = 100). After age 12, available samples decreased to fewer than 20, and ages 14 to 19 were pooled due to low sample size. Thus, it is not possible to confirm that the declining apparent spawning fraction with age was not affected by lower sample sizes. Spawning frequency under the logistic model plateaued at 16.5 days per season for the best measure of spawning season duration (100 days; Figure 14). Given that spawning frequency is traditionally estimated as the number of days in the spawning season divided by the spawning interval (reciprocal of spawning fraction), spawning frequency was 28.5 days per season for the longer seasonal duration (173 days) and 13 days for the shortest estimate of the spawning season (79 days).

2.5.5 Measure of reproductive potential

Because Scamp do not exhibit a 1:1 sex ratio and there are significant differences between sexes in size and age, the recommendation is to use combined spawning stock biomass for the base model—thus integrating males into the estimate of reproductive potential (Brooks et al., 2008). However, given that the optimal sex ratio in Scamp is unknown we recommend conducting sensitivity runs that include: female only SSB, male only SSB, and combined runs with the alternating sex down-weighted to 0.5*SSB.

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ADT Recommendation

Use the LHG recommended parameters as the most appropriate reproduction data for the Gulf of Mexico.

2.6 MERISTIC CONVERSIONS

Fishery-dependent monitoring and fishery-independent surveys collect different measurement types on fish, which may need to be converted to standardized types for consistency in data inputs for SEDAR68 Scamp/Yellowmouth Grouper. The SEDAR 68 panel assigned the length type and fish weight for the biological data inputs to be in fork length (cm) and gutted weight (kg), respectively. Meristic data collected on fish landed or surveyed within the GMFMC jurisdiction with paired length types, weight-length and whole weight – gutted weight data were compiled for the regression analyses. Data included were from the Trip Interview Program (TIP), Southeast Region Headboat Survey (SRHS), Marine Recreational Information Program (MRIP), Southeast Reef Fish Survey (SERFS), GulfFIN, and the Shark Bottom Longline Observer Program (SBLOP). Linear regressions for length-length and LN transformed weight and length were modelled. The weight-length equations were converted to the power equation, $W = aL^b$, adding ½ mean squared error (MSE) for transformation bias. Whole weight – gutted weight measurements were collected from fishery-dependent landings data. All lengths were in cm, and all weights were in kg for the various comparisons. Tables 12a, 12b, and 12c provide the parameters, standard errors, sample sizes and ranges of each independent variable.

Comparison of the regression equations from the South Atlantic to those from the Gulf of Mexico revealed similarities and differences. The length – length equations yielded essentially the same results. On the other hand, the weight-length equations were different. Fish from the Gulf of Mexico appeared to be heavier at length than the ones from the South Atlantic after ~700 mm FL. A greater proportion of fish larger than 700 mm FL with accompanying whole weights were recorded in the South Atlantic (18% of 17,614) compared to the Gulf of Mexico (2% of 12,660). The LHG recommended that the conversion equations remain separated by area based on these slight differences.

The LHG reviewed data inputs for the whole weight – gutted weight conversion. The whole weight – gutted weight relationships between the areas were different in the estimated slopes by

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region: 1.07 for the South Atlantic and 1.03 for the Gulf of Mexico. The data source for the South Atlantic was from SCDNR and was primarily from the fishery-independent survey (SERFS) since 2010, while the majority of the data from the Gulf of Mexico was from FWRI fishery dependent monitoring in 1979–1980 of the commercial fishery. The range of the data from the South Atlantic was greater than the Gulf of Mexico (Figure 15). The resulting slope of the combined data was 1.05, which is a value more in line with the conversion factor used for other grouper species. Because of the overall range and sources of the data available, the LHG recommended using results of the combined data for the whole weight – gutted weight conversion, and if needed, a gutted weight – whole weight conversion is also provided for the U.S. Gulf of Mexico (Table 12d).

ADT Recommendation:

Use the meristic conversion equations as presented in Table 12 for the Gulf of Mexico jurisdiction. Use a combined South Atlantic and Gulf of Mexico whole weight – gutted weight equation to be applied to both areas.

2.7 RESEARCH RECOMMENDATIONS

2.7.1 Natural Mortality

- Convene a topical workgroup or other workshop to critically review literature used in Then et al. (2015), discuss recent advancements in ageing approaches (e.g., Gray Triggerfish), and propose best options for selecting species for inclusion in regression analyses for reef fish species in the US Southeast Region to be used in estimating natural mortality.

- Research the Thorson FishLife program for use in natural mortality estimates and measures of uncertainty. https://github.com/James-Thorson-NOAA/FishLife

2.7.2 Reproductive Biology

- Investigate the male contribution to spawning success and the potential for sperm limitation in the population through model simulations and field research that will fill in

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critical gaps in knowledge (i.e., fertilization rate under various sex ratio scenarios, mating strategy) and continue to monitor sex ratio.

- Additional sampling with better spatial and especially temporal coverage to confirm preliminary results that male gonadosomatic index (GSI) indicates that Scamp are spawning in pairs or small groups. This information is lacking for Yellowmouth Grouper.
- Collect all sizes of Yellowmouth Grouper and larger female Scamp (> 650 mm FL) during the spawning season to assess batch fecundity and thereby fill a data gap that prevents estimating total egg production.
- Given the likely smaller population size of Yellowmouth Grouper, samples with a wide range of size/age, from fishery-dependent and fishery-independent sources, are needed to determine reproductive parameters for this species and to allow comparisons with those of Scamp.
- Maturity: Develop standardized histological criteria for assigning maturity, as well as a means of estimating uncertainty associated with incorrect assignments.
- Fecundity: More data on batch fecundity is needed, as is data from older fish to assess age-specific spawning frequency.
- There is a need for spatially-referenced reproductive data to better identify scamp spawning sites, whether scamp aggregate to spawn and if they undertake migrations to specific spawning habitat, as well as to understand if there is a spatial component to where sex change occurs.
- Sex ratios: there is a need to study the scamp mating strategy, which is currently unknown to better understand optimal sex ratios in this species and drivers of sex change.
- Form of reproductive potential: There is a need to develop a decision tree that can help inform what measure of reproductive potential is best, given key metrics observed in hermaphroditic fishes including overlap in sizes and ages and sex ratio.

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2.9 TABLES

Table 1. The number of Scamp and Yellowmouth Grouper otoliths received (number aged) for SEDAR68 by year and data provider. Data providers include Florida Wildlife Research Institute Fisheries Independent Monitoring (FWRI FIM), Gulf States Fisheries Information Network (GulfFIN), NMFS Panama City Age, Growth and Reproduction (AGR) database, and NMFS Panama City Biological Sampling Database (BSD). Shading indicates years 2003 – 2012 for which ages of Scamp were removed from the NMFS Panama City datasets due to processing issues resulting from a new Benetec saw. NMFS Panama City ages shown for 2003 – 2012 are for Yellowmouth Grouper only.

Year	FWRI FIM	GulfFIN	NMFS Panama City - AGR	NMFS Panama City - BSD	Total
1972			6 (6)		6 (6)
1973			8 (7)		8 (7)
1977			47 (36)		47 (36)
1978			37 (23)		37 (23)
1979			293 (203)		293 (203)
1980			197 (140)		197 (140)
1981			118 (114)		118 (114)
1986			51 (43)		51 (43)
1987			11 (8)		11 (8)
1988			13 (13)		13 (13)
1989			19 (19)		19 (19)
1990			4 (4)		4 (4)
1991			320 (253)		320 (253)
1992			196 (170)		196 (170)
1993			439 (346)		439 (346)
1994			324 (244)		324 (244)
1995			242 (201)		242 (201)
1996			287 (241)		287 (241)
1997			106 (101)		106 (101)
1998			127 (120)		127 (120)
1999			184 (176)		184 (176)
2000			232 (211)		232 (211)
2001			1,245 (1,133)		1,245 (1,133)
2002			1,914 (1,703)		1,914 (1,703)
2003			3,138 (8)		3,138 (8)
2004			2,227 (15)		2,227 (15)
2005			2,025 (3)		2,025 (3)
2006	4 (3)		1,591 (10)		1,595 (13)
2007	5 (5)		1,900 (14)		1,905 (19)
2008	12 (11)		2,447 (6)		2,459 (17)
2009	97 (93)	5 (5)	2,087 (13)		2,189 (111)

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2010	206 (195)	4 (4)	2,086 (17)		2,296 (216)
2011	49 (49)	19 (19)	183 (3)	2,266 (17)	2,517 (88)
2012	44 (42)		286 (1)	3,720 (69)	4,050 (112)
2013	136 (134)		376 (345)	3,433 (987)	3,945 (1,466)
2014	23 (23)		221 (212)	2,475 (1,093)	2,719 (1,328)
2015	52 (51)	186 (158)	117 (113)	2,597 (1,085)	2,952 (1,407)
2016	50 (47)	200 (195)	72 (67)	3,745 (1,163)	4,067 (1,472)
2017	42 (42)	44 (43)	66 (58)	2,831 (1,231)	2,983 (1,374)
2018	62 (61)	67 (55)			129 (116)
2019		3 (3)			3 (3)
Total	782 (756)	528 (482)	25,242 (6,400)	21,067 (5,645)	47,619 (13,283)

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Table 2. Number of all Scamp and Yellowmouth Grouper samples aged (number of trips intercepted) from the commercial fishery listed by year, gear, and state landed.

Gear Group	Vertical hook and line					Bottom Longline			Spears	Other		
YEAR	AL	FL	MS	LA	TX	FL	LA	TX	FL	FL	LA	Total
1977		20 (3)										20
1978		15 (3)										15
1979		149 (29)										149
1980		96 (16)										96
1981		102 (10)										102
1991		119 (10)		80 (22)		19 (3)	5 (1)				1 (1)	224
1992		7 (3)		51 (17)		12 (6)	38 (15)					108
1993		123 (25)		138 (44)	4 (1)	27 (7)	12 (2)					304
1994		81 (20)		36 (19)		8 (1)						125
1995		109 (32)		1 (1)		3 (3)						113
1996		64 (19)				21 (6)						85
1997		10 (4)				27 (5)						37
1998		31 (8)				34 (7)						65
1999		26 (8)				70 (26)						96
2000		50 (9)	2 (1)			120 (27)						172
2001		356 (58)	14 (3)	47 (16)	1 (1)	681 (109)				1 (1)		1,100
2002		299 (61)	14 (4)	18 (6)	2 (1)	1,227 (143)	16 (1)			1 (1)		1,577
2003		1 (1)				7 (4)						8
2004		3 (1)				12 (4)						15
2005						3 (3)						3
2006		1 (1)				9 (5)						10
2007				3 (3)		8 (7)						11
2008				1 (1)		5 (3)						6
2009		2 (2)		6 (5)	2 (1)	2 (1)			1 (1)			13
2010				7 (3)	1 (1)	3 (3)		2 (1)				13
2011		1 (1)		14 (7)		2 (2)						17
2012		2 (2)		4 (2)	30 (13)	31 (4)		2 (1)				69
2013	9 (7)	298 (150)		88 (45)	102 (41)	607 (217)	5 (3)	28 (9)	8 (3)			1,145
2014	60 (16)	284 (127)		163 (68)	8 (3)	537 (115)			64 (12)	2 (2)		1,118

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2015	16 (9)	342 (155)	1 (1)	173 (79)	1 (1)	486 (116)	12 (6)		77 (12)			1,108
2016	23 (9)	281 (128)		315 (94)	1 (1)	516 (121)	3 (2)	2 (2)	8 (2)	1 (1)		1,150
2017	21 (7)	373 (120)		247 (71)	4 (1)	488 (122)	54 (12)	2 (2)		1 (1)		1,190
Total	129	3,245	31	1,392	156	4,965	145	36	158	6	1	10,264
Gear group total			4,953				5,146		158	7		10,264
Percent			48.3				50.1		1.5	0.1		100.0

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Table 3. Number of all Scamp and Yellowmouth Grouper samples aged (number of trips intercepted) from the recreational fishery listed by year, gear, and state landed.

Gear Group	Vertical hook and line					Spears		
YEAR	AL	FL	LA	TX	UNKNOWN	FL	LA	Total
1979		11 (5)						11
1980		26 (15)						26
1981		12 (4)						12
1986		9 (7)		19 (15)	9 (9)			37
1987		2 (2)		5 (4)				7
1988		8 (7)		4 (3)				12
1989		19 (12)						19
1990		3 (3)		1 (1)				4
1991		21 (18)	3 (2)	2 (1)				26
1992		50 (38)	3 (3)	9 (6)				62
1993		28 (21)		12 (8)				40
1994		90 (46)	5 (3)	18 (11)			1 (1)	114
1995		81 (40)		2 (2)				83
1996		155 (61)	1 (1)					156
1997		48 (23)				1 (1)		49
1998		53 (21)						53
1999		52 (21)						52
2000	3 (2)	7 (6)	1 (1)					11
2001		8 (6)						8
2002	1 (1)	77 (33)				5		83
2009	5 (3)							5
2010	4 (4)	1 (1)						5
2011	19 (15)	1 (1)						20
2012				1 (1)				1
2013	12 (6)	135 (69)	13 (3)	15 (10)		2 (2)		177
2014	9 (5)	148 (71)	3 (2)	21 (13)				181
2015	4 (3)	206 (118)		25 (18)				235
2016	24 (11)	218 (76)	10 (3)	14 (11)				266
2017	4 (4)	123 (59)		4 (3)				131
2018		54 (40)						54
2019		3 (2)						3
Total	85	1,649	39	152	9	8	1	1,943
Gear group total	1,934					9		1,943
Percent	99.5					0.5		100.0

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Table 4. Number of Scamp and Yellowmouth Grouper samples aged from fishery-independent sources by year, gear, and state landed. Other gear types include kali pole (n=1), spear (n=7), and unknown gear type (n=1).

Gear Group	Vertical hook and line				Longline					Trap			Trawl	Vertical Longline	Other	
YEAR	AL	FL	LA	TX	AL	FL	LA	TX	Unknown	AL	FL	LA	FL	FL	FL	Total
1980									1							
1993											2					
1994		5														
1995		3									1				1	
1997		14										1				
1998		2														
1999		21			1					3	3					
2000		9						2		4	13					
2001		20									3	2				
2002		4			20	1	1				9				7	
2006						1					1				1	
2007				2			1						5			
2008											6		5			
2009		50									34		9			
2010		180									6		6	6		
2011		21				2					27		1			
2012		5									35		2			
2013		75				16					23		6	23		
2014		8	2								14		5			
2015		12	1								38		6			
2016	1	38	1		1	2					1		8	4		
2017	1	31	4	1	1						8		2	2		
2018		46									6		2	7		
Total	2	544	8	3	23	22	2	2	1	7	230	3	57	42	9	955
Gear group total		557					50				240		57	42	9	955
Percent		58.3					5.2				25.1		6.0	4.4	0.9	100.0

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Table 5. Number of all Scamp and Yellowmouth Grouper samples aged categorized into NMFS Statistical Grids within the Gulf of Mexico.

	NMFS Statistical Grid																						
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Unknown	Total
1972					2	4																	6
1973					2	3																2	7
1977				4	3	5																24	36
1978					8	13																2	23
1979			16	25	55	81		3														23	203
1980		5	6	4	57	45																23	140
1981																						114	114
1986																						43	43
1987																						8	8
1988																						13	13
1989																						19	19
1990																						4	4
1991		7				19		67														160	253
1992			1	7	5									15								142	170
1993			3	2	6	1	9	60				1	1	97	2					9		155	346
1994						15		24		1				6	5		6			7		180	244
1995			1	1	5	52		44	10													88	201
1996		2	1		18	7		63	7													143	241
1997		4	13	4	6	10		14									1					49	101
1998		34		3	17	16																50	120
1999		22	7	7	15	10		3	4	7	3											98	176
2000		1	32	23	42	26		14	6	11	2					23		1		1		29	211
2001	3	129	37	115	241	161	7	158	4	37	10	27	3	15		1	2				1	182	1,133
2002	1	223	36	150	537	280	1	47	4	45	12		13	33		12						309	1,703
2003																						8	8
2004																						15	15

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2005																						3	3
2006																						13	13
2007															1		2					16	19
2008																						17	17
2009										5												106	111
2010					1	3			1	3												208	216
2011		2			1	1				21				2	5	7						49	88
2012			2	1	29	1									3	1	2	30				43	112
2013		30	82	173	272	140	52	111	68	59	35		13	25	30	27	22	62	26	5	20	214	1466
2014	20	68	75	139	225	162	91	85	72	61	41	15	28	26	36	50	16	8	9			101	1328
2015	2	60	54	170	273	149	66	117	93	59	37		24	10	54	74	25					140	1407
2016	7	5	36	139	333	151	61	75	85	136	24		14	29	150	126	6					95	1472
2017		45	61	154	286	167	46	53	27	52	49	1	47	63	159	44	5			4	1	110	1374
2018			3		11	8	1	4	25	2												62	116
2019					3																		3
Total	33	637	466	1,121	2,453	1,530	334	942	406	499	213	44	143	321	445	365	87	101	35	26	22	3,060	13,283

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Table 6. Number of Scamp samples with left otolith weight and observed age recorded and used in otolith weight – age linear regression models to provide a temporary proxy age for years 2003–2012 (i.e., years when the Benetec saw was used by Panama City Lab to section Scamp otoliths).

Year	Number of observed ages with otolith weight recorded
1980	8
1981	92
1986	6
1987	3
1988	5
1989	9
1990	2
1991	87
1999	128
2000	168
2001	711
2002	1,393
2013	371
2014	442
2015	1,038
2016	418
2017	574
Total	5,455

NOT PEER REVIEWED

Table 7. Results from simple linear regression models for Scamp age regressed on left otolith weight that provided a proxy of age that could be used temporarily for the landings age compositions for years 2003–2012 (i.e., years for which the Benetec saw was used by Panama City Lab to section Scamp otoliths). Model shaded in gray represents the linear regression model recommended by the LHG.

Model		Estimate	SE	t	Pr(>ItI)	Df	F-stat	R^2	Adj. R^2	p
Calendar age ~ left otolith weight	Intercept	0.8154	0.1023	7.968	<0.001	1 5453	10630	0.6609	0.6608	<0.001
	Left otolith weight	67.8105	0.6578	103.083	<0.001					
Fractional age ~ left otolith weight	Intercept	1.0203	0.1018	10.02	<0.001	1 5453	10770	0.6639	0.6638	<0.001
	Left otolith weight	67.9330	0.6546	103.78	<0.001					

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Table 8. Number of Gulf of Mexico Scamp and Yellowmouth Grouper samples with fractional ages and fork length shown by year and used in the population growth model. Note that samples shown for years 2003–2012 (i.e., years for which the Benetec saw was used by Panama City Lab to section Scamp otoliths) include all Yellowmouth Grouper age samples (n = 175) and only Scamp ages that were provided by FWRI and GulfFIN (n = 426).

Year	SEDAR 68
1972	6
1973	5
1977	36
1978	23
1979	203
1980	140
1981	114
1986	39
1987	7
1988	12
1989	19
1990	3
1991	253
1992	168
1993	346
1994	240
1995	201
1996	222
1997	89
1998	120
1999	176
2000	211
2001	1,133
2002	1,703
2003	8
2004	14
2005	3
2006	13
2007	19
2008	17
2009	111
2010	216
2011	88
2012	112
2013	1,466
2014	1,327
2015	1,407
2016	1,471
2017	1,373
2018	116
2019	3
Total	13,233

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Table 9. Gulf of Mexico Scamp and Yellowmouth Grouper growth model parameters for the population and growth model parameters for females and males combined. All parameter estimates are shown with ± standard deviation. Only fish that were histologically identified as functional females and males were used in the female+male growth models. Growth models shaded in gray represent the population growth models that were recommended by the LHG. Inverse weighting was used in all growth models. AIC = Akaike Information Criterion.

Model Type	Growth Model	Number of observations	Number of parameters	Objective function	L_{inf} (FL, cm) ± std. dev	K ± std. dev	t_0 ± std. dev	Varpar[1]. ± std. dev.	Varpar[2]. ± std. dev.	AIC
Population	Constant Sigma	13,233	4	129.785	71.800 ± 3.243	0.112 ± 0.030	-2.410 ± 1.452	8.011 ± 0.956		267.57
Population	Constant CV	13,233	4	127.210	70.222 ± 2.610	0.134 ± 0.024	-1.762 ± 0.575	0.130 ± 0.016		262.42
Population	Estimate CV as linear function of age	13,233	5	127.147	69.752 ± 2.918	0.139 ± 0.028	-1.689 ± 0.560	0.118 ± 0.034	0.140 ± 0.034	264.29
Population	Estimate CV as linear function of size	13,233	5	127.147	69.808 ± 2.808	0.139 ± 0.029	-1.675 ± 0.559	0.108 ± 0.060	0.134 ± 0.021	264.29
Female + Male	Constant Sigma	1,931	4	87.244	69.190 ± 2.874	0.138 ± 0.034	-1.759 ± 1.223	5.909 ± 0.802		182.49
Female + Male	Constant CV	1,931	4	87.431	68.446 ± 2.924	0.146 ± 0.031	-1.638 ± 0.773	0.107 ± 0.015		182.86
Female + Male	Estimate CV as linear function of age	1,931	5	86.702	68.714 ± 2.512	0.144 ± 0.030	-1.628 ± 0.851	0.138 ± 0.035	0.059 ± 0.036	183.40
Female + Male	Estimate CV as linear function of size	1,931	5	86.848	69.027 ± 2.836	0.141 ± 0.031	-1.680 ± 0.929	0.166 ± 0.070	0.090 ± 0.019	183.70

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Table 10. Parameter estimates for Scamp maturity and transition regression models. Four different link functions (probit, logit, cauchit, and cloglog) were specified, and parameter values for the best-fitting model (as determined by AIC) are displayed here, along with model weight for the best-fitting model (mod_weight) and sample size (N). The inflection point, a derived parameter (intercept/slope) are also shown (i.e., A_{50} for age and L_{50} for length).

Model	Link Fct	Mod_weight	N	Parameter	Estimate	Std Error
Female maturity at age	logit	0.945	413	Intercept	-4.55E+00	7.31E-01
				slope	1.33E+00	1.79E-01
				A_{50}	3.41	
Female maturity at length	probit	0.465	763	Intercept	-7.90E+00	8.50E-01
				slope	2.17E-02	2.13E-03
				L_{50}	363.7	
Transition at age	probit	0.888	1,937	Intercept	-2.15E+00	9.48E-02
				slope	1.99E-01	9.81E-03
				A_{50}	10.8	
Transition at length	logit	1	4,412	Intercept	-9.48E+00	3.05E-01
				slope	1.71E-02	5.65E-04
				L_{50}	555.6	

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Table 11. Natural mortality (*M*) vectors based on Lorenzen (1996) and scaled to Then et al. (2015) Serranidae data for maximum age for both stocks of Scamp and Yellowmouth Grouper (*M* = 0.155). Size-at-Age was calculated on the mid-point of the age (e.g., 0 = 0.5, 1 = 1.5, etc.)

Age	*M* - SA	*M* - GOM
0	0.486	0.567
1	0.382	0.432
2	0.325	0.359
3	0.288	0.314
4	0.264	0.283
5	0.246	0.261
6	0.232	0.244
7	0.222	0.231
8	0.214	0.221
9	0.207	0.213
10	0.202	0.207
11	0.198	0.201
12	0.194	0.197
13	0.191	0.193
14	0.189	0.190
15	0.187	0.187
16	0.185	0.185
17	0.183	0.183
18	0.182	0.181
19	0.181	0.180
20	0.180	0.179
21	0.180	0.177
22	0.179	0.177
23	0.178	0.176
24	0.178	0.175
25	0.177	0.174
26	0.177	0.174
27	0.177	0.174
28	0.177	0.173
29	0.176	0.173
30	0.176	0.172
31	0.176	0.172
32	0.176	0.172
33	0.176	0.172
34	0.176	0.172

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Table 12. Meristic conversion equations for Gulf of Mexico Scamp and Yellowmouth Grouper.

a. Length – length equations

Model: $Y = a + bX$	**n**	**a**	**SE**	**b**	**SE**	**r^2**	**Units**	**range of Independent variable**
FL = Natural TL	3,205	1.77	0.10	0.89	0.000	0.99	cm, cm	16.7 – 97.6
Natural TL = FL	3,205	-1.29	0.11	1.11	0.000	0.99	cm, cm	16.0 – 94.4
Natural TL = maxTL	520	-0.28	0.14	0.99	0.000	0.996	cm, cm	32.5 – 100.1
maxTL = Natural TL	520	0.46	0.14	1.01	0.000	0.996	cm, cm	31.2 – 97.6
FL = maxTL	2,994	2.30	0.07	0.87	0.000	0.99	cm, cm	18.7 – 100.1
maxTL = FL	2,994	-2.28	0.09	1.14	0.000	0.99	cm, cm	17.8 – 94.4
FL = SL	3,042	1.95	0.08	1.12	0.000	0.99	cm, cm	14.6 – 79.8
SL = FL	3,042	-1.34	0.08	0.88	0.000	0.99	cm, cm	17.8 – 94.4
Natural TL = SL	606	0.36	0.34	1.25	0.000	0.97	cm, cm	24.7 – 79.8
SL = Natural TL	606	0.76	0.27	0.78	0.000	0.97	cm, cm	26.0 – 97.6
maxTL = SL	3,258	-0.05	0.10	1.28	0.000	0.99	cm, cm	13.9 – 79.8
SL = maxTL	3,258	0.48	0.08	0.77	0.000	0.99	cm, cm	17.5 – 100.1

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b. Whole weight – length equations. LN transformed weight and length for linear regression analyses. Equations converted to power equation including ½ MSE for transformation bias.

Model: *Y = a + bX*	**n**	**a**	**SE**	**b**	**SE**	**r^2**	**Units**	**range of Independent variable**	**MSE**	**Power Equation: *Y = a(X)^b***
Ln(WW) = Ln(FL)	12,660	-10.92	0.03	2.94	0.01	0.92	kg, cm	16.0 – 124.0	0.03	WW = 1.83E-05(FL)$^{2.94}$
Ln(FL) = Ln(WW)	12,660	3.73	0.00	0.31	0.00	0.92	kg, cm	0.053 – 29.93	0.0035	FL = 41.75(WW)$^{0.31}$
Ln(WW) = Ln(Natural TL)	3,059	-11.00	0.06	2.90	0.02	0.92	kg, cm	16.7 – 117.6	0.04	WW = 1.70E-05(Natural TL)$^{2.90}$
Ln(Natural TL) = Ln(WW)	3,059	3.80	0.00	0.32	0.00	0.92	kg, cm	0.053 – 16.82	0.0045	Natural TL = 44.80(WW)$^{0.32}$
Ln(WW) = Ln(maxTL)	1,972	-10.97	0.05	2.88	0.01	0.96	kg, cm	23.0 – 100.1	0.01	WW = 1.73E-05(maxTL)$^{2.88}$
Ln(maxTL) = Ln(WW)	1,972	3.82	0.00	0.33	0.00	0.96	kg, cm	0.13 – 10.14	0.0015	maxTL = 45.64(WW)$^{0.33}$
Ln(WW) = Ln(SL)	2,092	-10.3	0.04	2.89	0.01	0.97	kg, cm	17.7 – 79.8	0.013	WW = 3.39E-05(SL)$^{2.89}$
Ln(SL) = Ln(WW)	2,092	3.57	0.00	0.33	0.00	0.97	kg, cm	0.13 – 10.14	0.0014	SL = 35.54(WW)$^{0.33}$

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c. Gutted weight – length equations. LN transformed weight and length for linear regression analyses. Equations converted to power equation including ½ MSE for transformation bias.

Model: *Y = a + bX*	**n**	**a**	**SE**	**b**	**SE**	**r^2**	**Units**	**range of Independent variable**	**MSE**	**Power Equation: *Y = a(X)^b***
Ln(GW) = Ln(FL)	30,798	-11.35	0.02	3.04	0.00	0.94	kg, cm	22.0 – 117.0	0.016	GW = 1.19E-05(FL)$^{3.04}$
Ln(FL) = Ln(GW)	30,798	3.75	0.00	0.31	0.00	0.94	kg, cm	0.050 – 25.58	0.002	FL = 42.56(GW)$^{0.31}$
Ln(GW) = Ln(Natural TL)	617	-11.75	0.18	3.08	0.05	0.88	kg, cm	26.7 – 99.0	0.074	GW = 8.19E-06(Natural TL)$^{3.08}$
Ln(Natural TL) = Ln(GW)	617	3.83	0.00	0.29	0.00	0.88	kg, cm	0.05 – 10.35	0.007	Natural TL = 46.22(GW)$^{0.32}$
Ln(GW) = Ln(maxTL)	1,156	-10.94	0.08	2.86	0.02	0.95	kg, cm	34.8 – 87.1	0.009	GW = 1.78E-05(maxTL)$^{2.86}$
Ln(maxTL) = Ln(GW)	1,156	3.83	0.00	0.33	0.00	0.95	kg, cm	0.48 – 8.11	0.001	maxTL = 46.09(GW)$^{0.33}$
Ln(GW) = Ln(SL)	1,131	-10.55	0.07	2.95	0.02	0.96	kg, cm	27.4 – 70.8	0.007	GW = 2.63E-05(SL)$^{2.95}$
Ln(SL) = Ln(GW)	1,131	3.58	0.00	0.33	0.00	0.96	kg, cm	0.45 – 8.62	0.001	SL = 35.89(GW)$^{0.33}$

d. Whole weight – gutted weight, and gutted weight – whole weight conversions.

Model: WW = GW (no intercept; *Y = bX*)	N	B	SE	R^2	Units	Range of Independent variable
South Atlantic	172	1.07	0	0.9977	kg, kg	0.129 – 7.1
Gulf of Mexico	230	1.03	0	0.9981	kg, kg	0.19 – 4.75
Southeast Region	402	1.05	0	0.9946	kg, kg	0.129 – 7.1
Model: GW = WW (no intercept; *Y = bX*)						
Gulf of Mexico	396	0.95	0	0.9987	kg, kg	0.136 – 7.8

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2.10 FIGURES

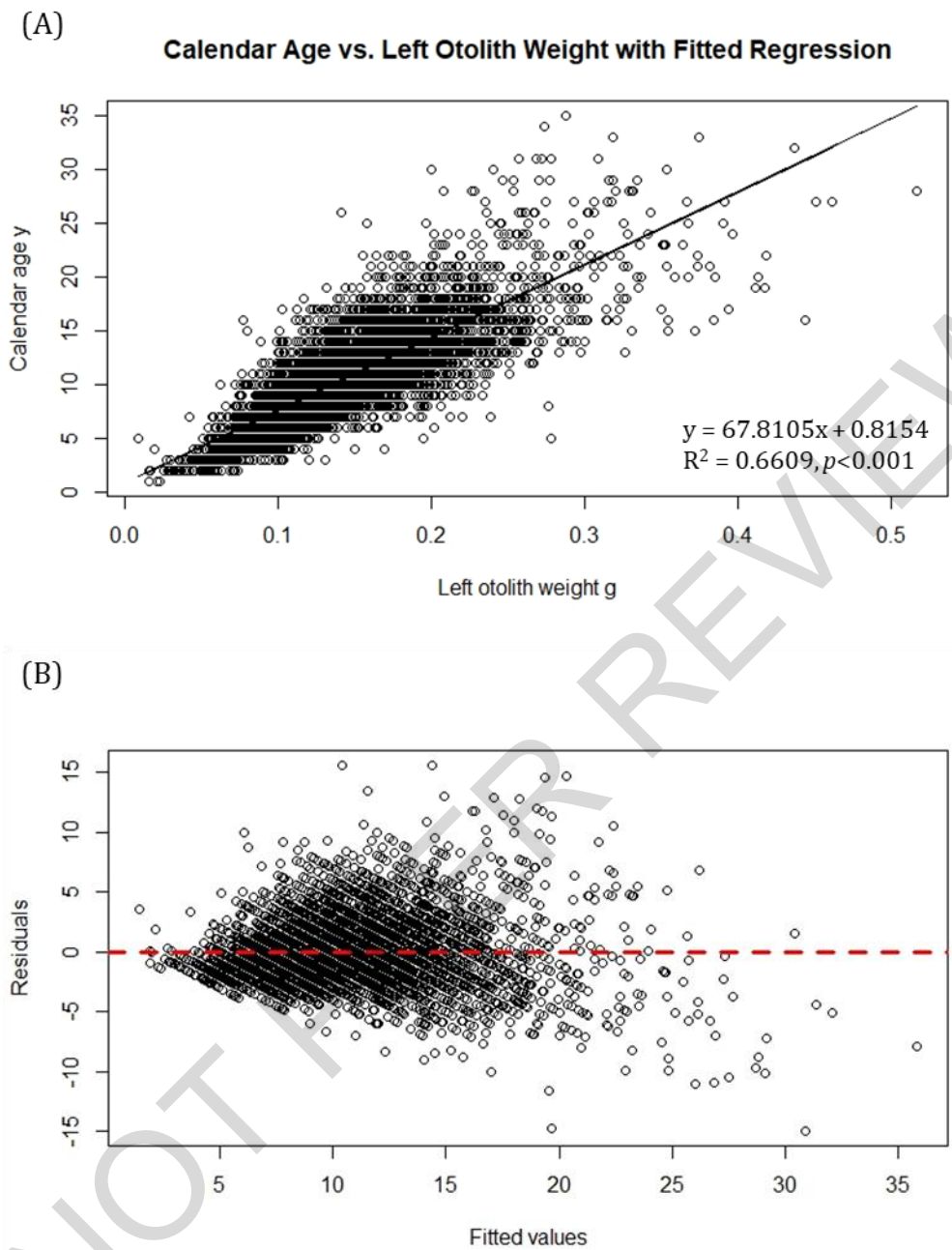

Figure 1. Plots showing the (A) simple linear regression model calendar age (years) regressed on left otolith weight (grams), and (B) residuals versus fitted values from the linear regression. The LHG recommended using this linear regression model to produce a proxy of age that could be used temporarily for the landings age compositions for years 2003–2012 (years for which the Benetec saw was used to section Scamp otoliths).

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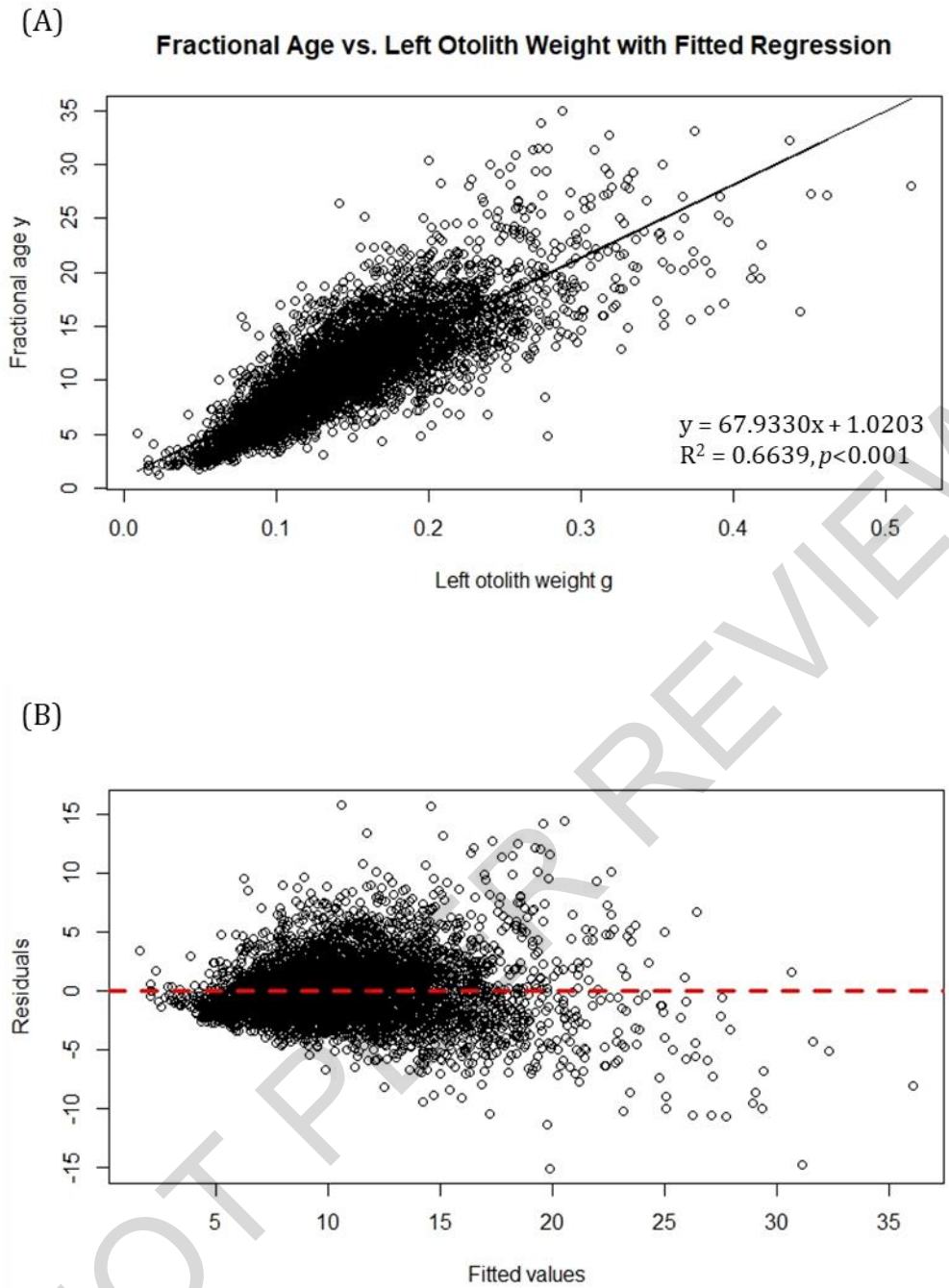

Figure 2. Plots showing the (A) simple linear regression model fractional age (years) regressed on left otolith weight (grams), and (B) residuals versus fitted values from the linear regression model.

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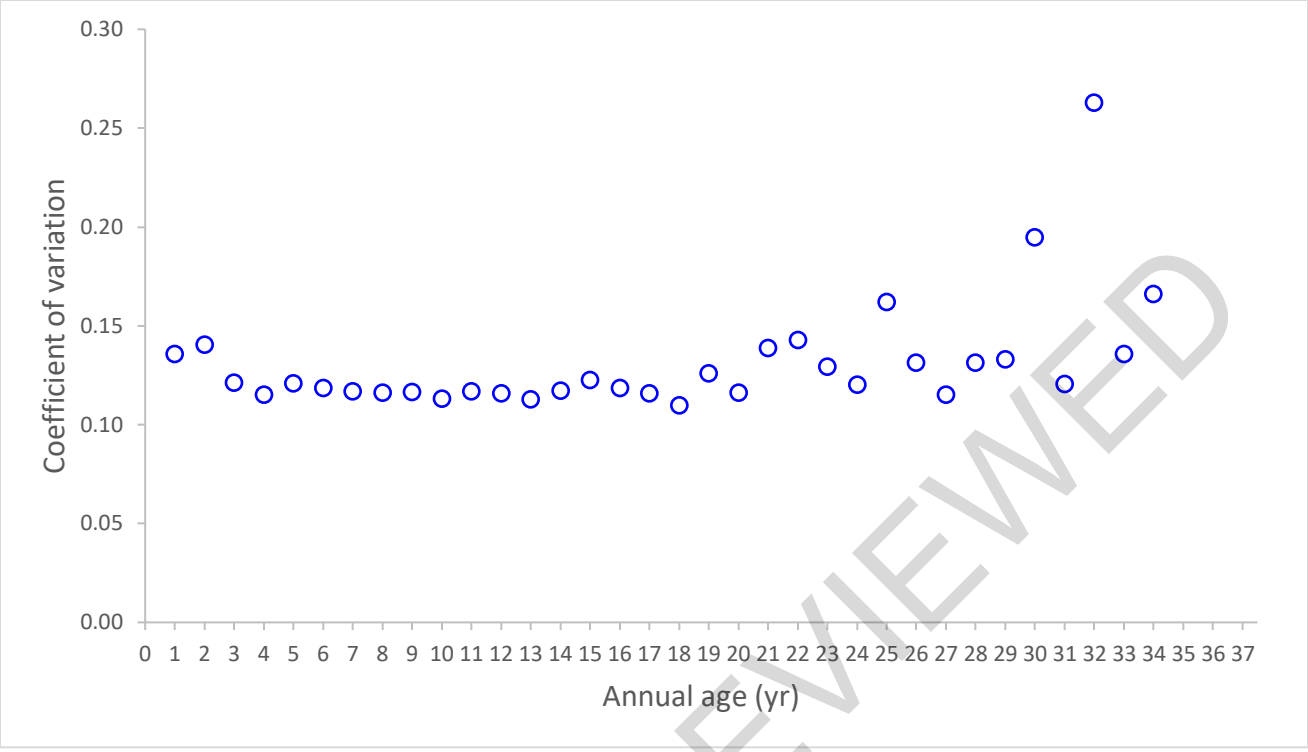

Figure 3. Variance structure for observed size-at-age data for Scamp and Yellowmouth Grouper from the U.S. Gulf of Mexico (1972–2019) showing the coefficient of variation at length for each age group (n = 13,233).

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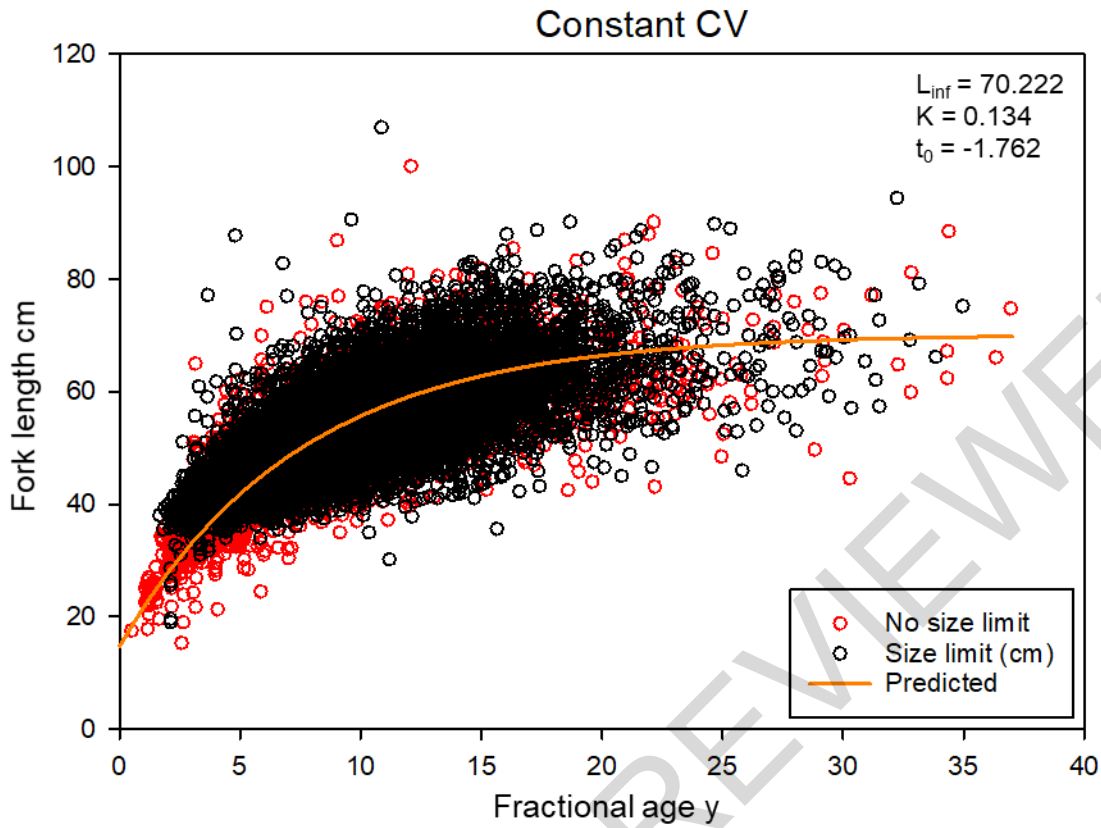

Figure 4. Population growth model for Gulf of Mexico Scamp and Yellowmouth Grouper (*n* = 13,233) using fractional age at fork length (cm) with correction for left truncated distribution of size-at-age under minimum size regulations, inverse weighted by sample size at calendar age, and assuming a constant CV across all ages. Von Bertalanffy growth parameters are shown on figure, and L_{inf} units are in cm.

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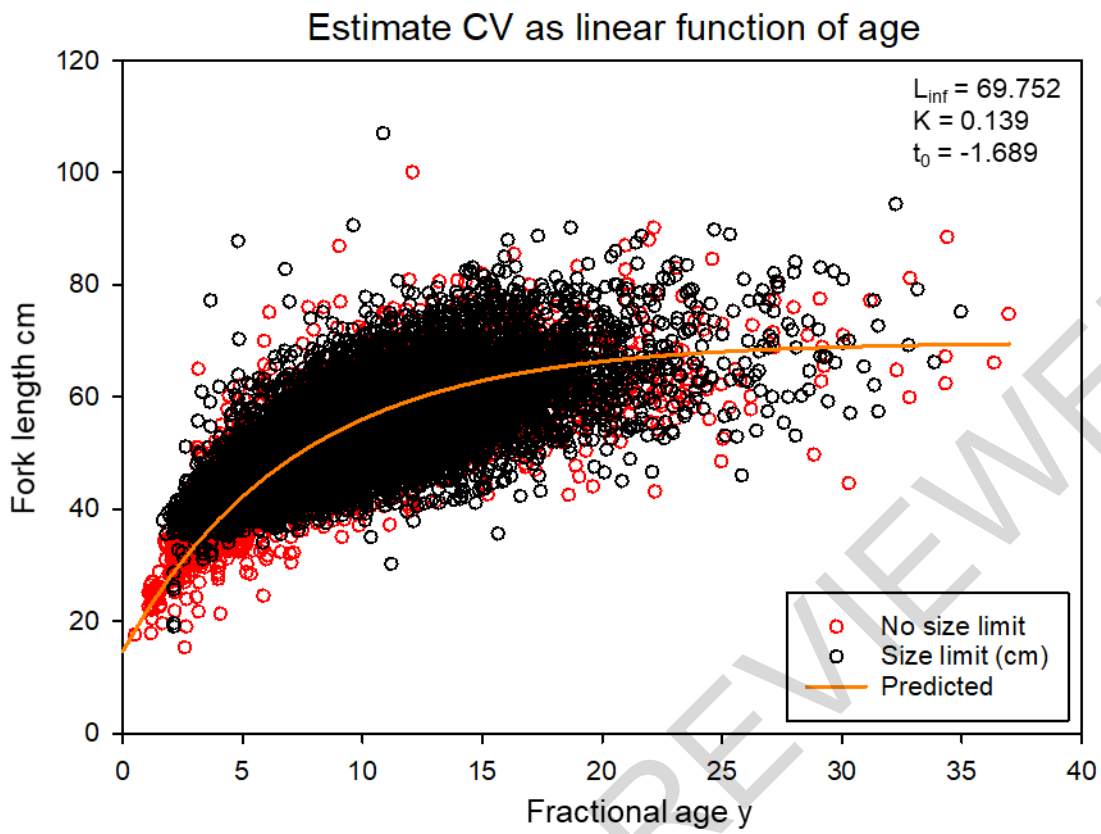

Figure 5. Population growth model for Gulf of Mexico Scamp and Yellowmouth Grouper (*n* = 13,233) using fractional age at fork length (cm) with correction for left truncated distribution of size-at-age under minimum size regulations, inverse weighted by sample size at calendar age, and assuming a variance structure of estimating CV as a linear function of age across all ages. Von Bertalanffy growth parameters are shown on figure, and L_{inf} units are in cm.

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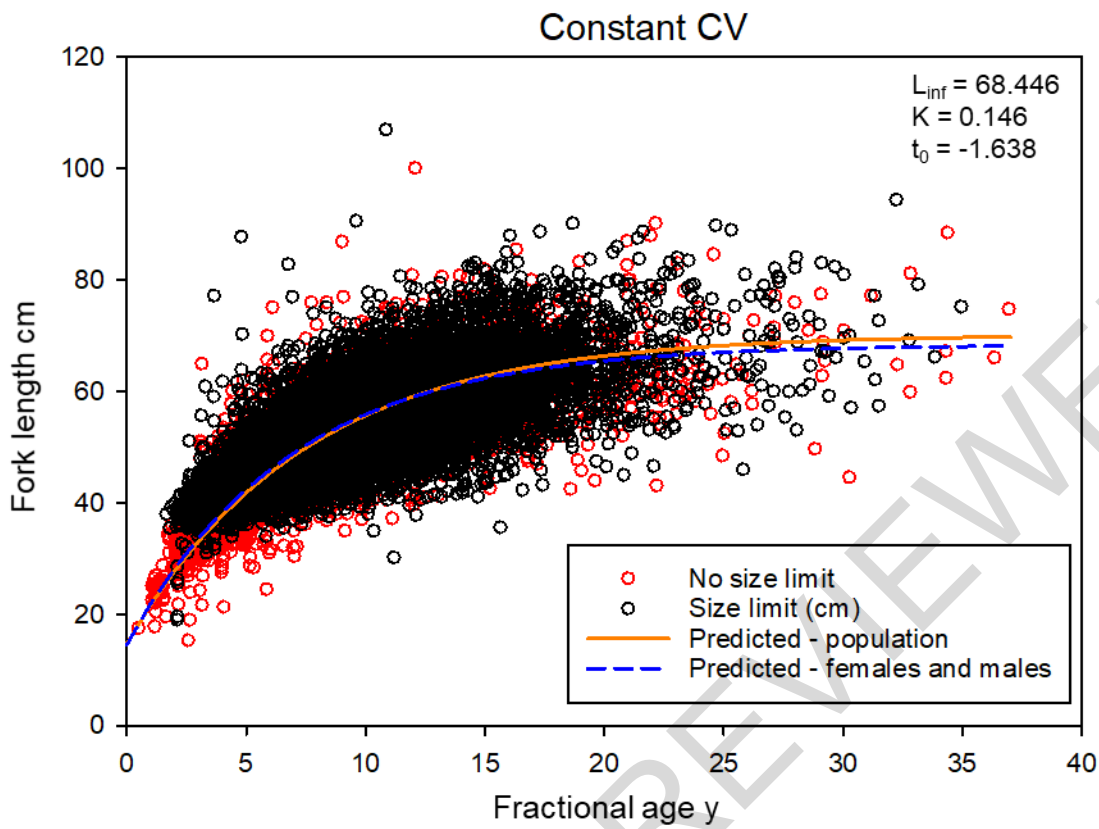

Figure 6. Population growth model for Gulf of Mexico Scamp and Yellowmouth Grouper (n = 13,233) using fractional age at fork length (cm) with correction for left truncated distribution of size-at-age under minimum size regulations, inverse weighted by sample size at calendar age, and assuming a constant CV across all ages. Growth model for females and males combined together (n = 1,931) is overlain on the population growth model. Von Bertalanffy growth parameters are shown on figure, and L_{inf} units are in cm.

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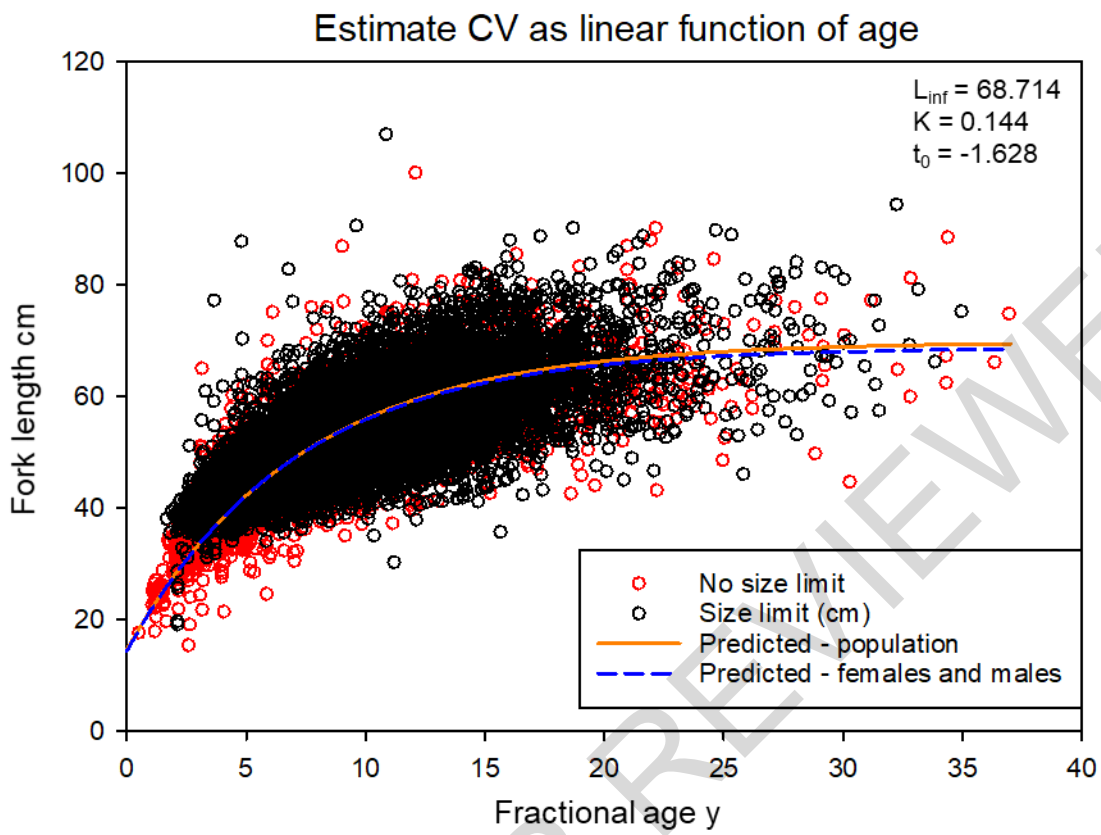

Figure 7. Population growth model for Gulf of Mexico Scamp and Yellowmouth Grouper (n = 13,233) using fractional age at fork length (cm) with correction for left truncated distribution of size-at-age under minimum size regulations, inverse weighted by sample size at calendar age, and assuming a variance structure of estimating CV as a linear function of age across all ages. Growth model for females and males combined together (n = 1,931) is overlain on the population growth model. Von Bertalanffy growth parameters are shown on figure, and L_{inf} units are in cm.

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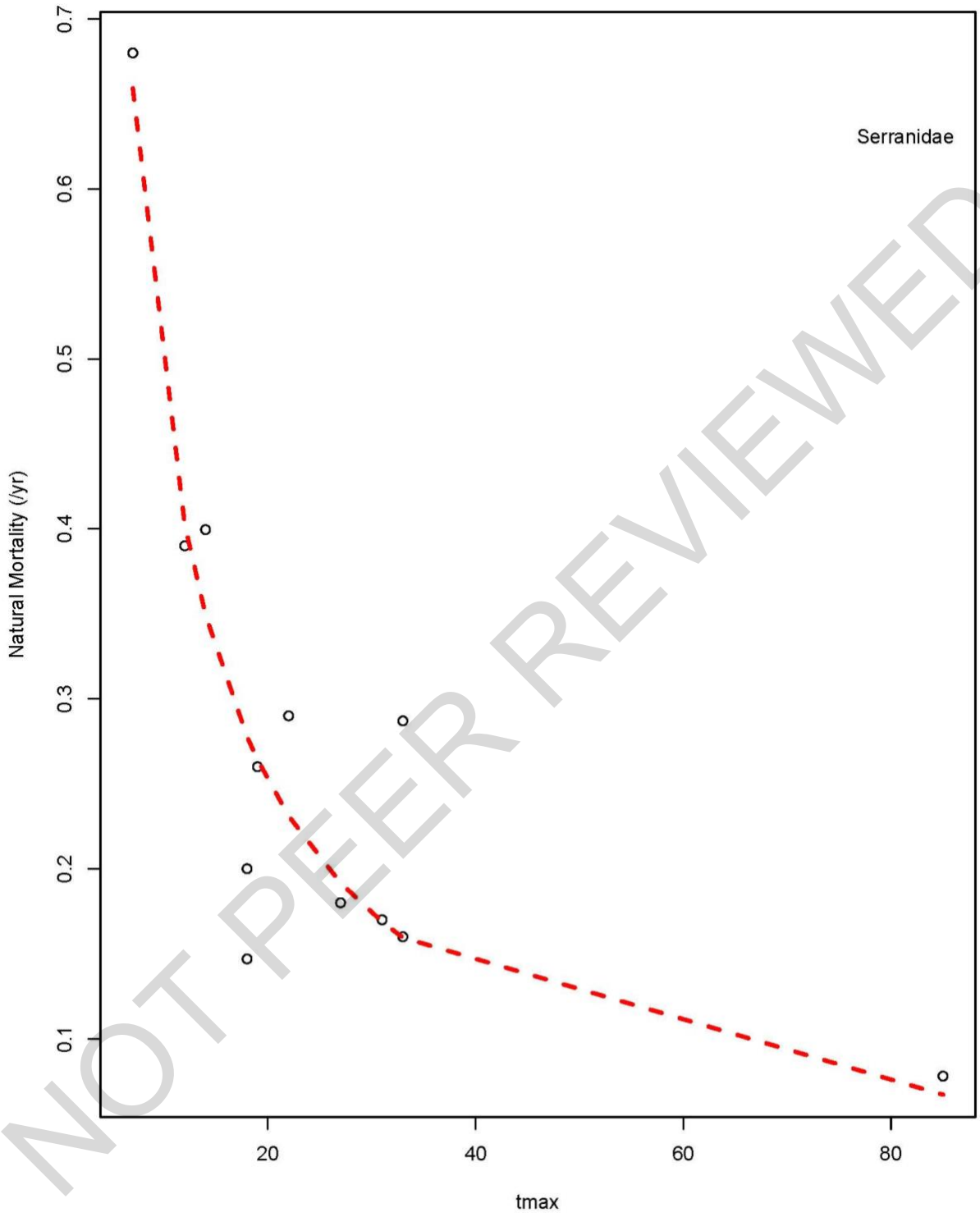

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Figure 8. Values of *M* estimated for Serranids (Groupers) from Then et al. (2015) data set and regression line.

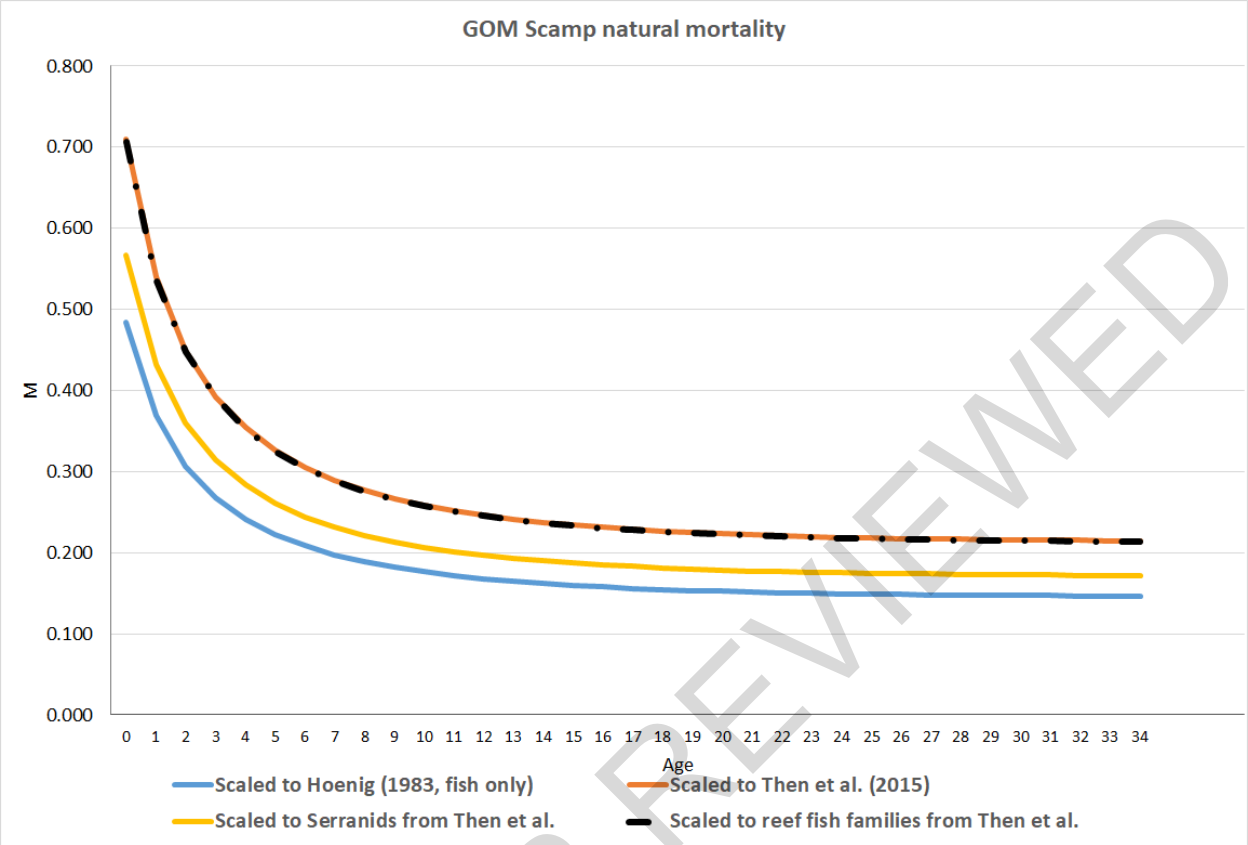

Figure 9. Natural mortality (*M*) vector for Gulf of Mexico Scamp and Yellowmouth Grouper. Lorenzen size-at-age natural mortality scaled to point estimates of *M* based on maximum age in the population, age 34. Recommended values (yellow) are the ones scaled to the point estimate of M based on the Serranidae data used in Then et al. (2015).

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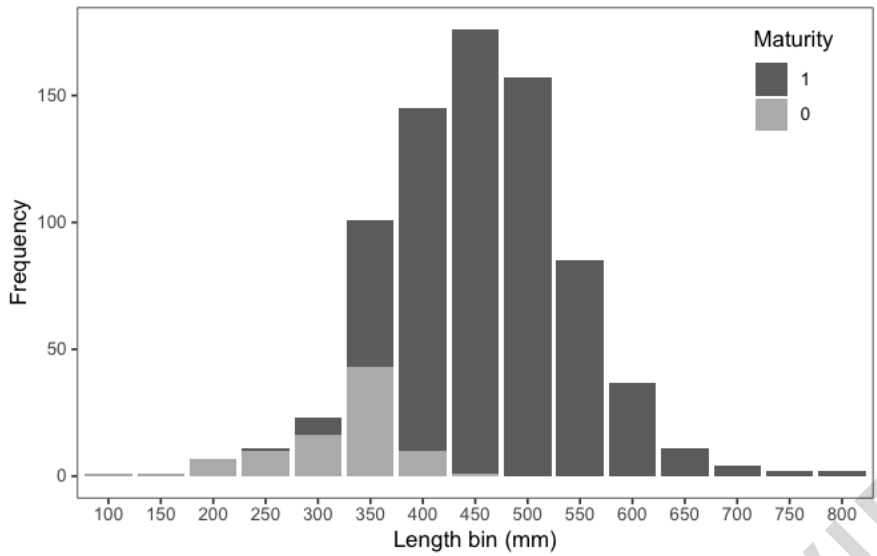

Figure 10. Frequency distributions of immature (light grey) versus mature (dark grey) females for fork length. Mature females shown here included only individuals assigned as spawning capable. 0 = Immature, 1 = Mature.

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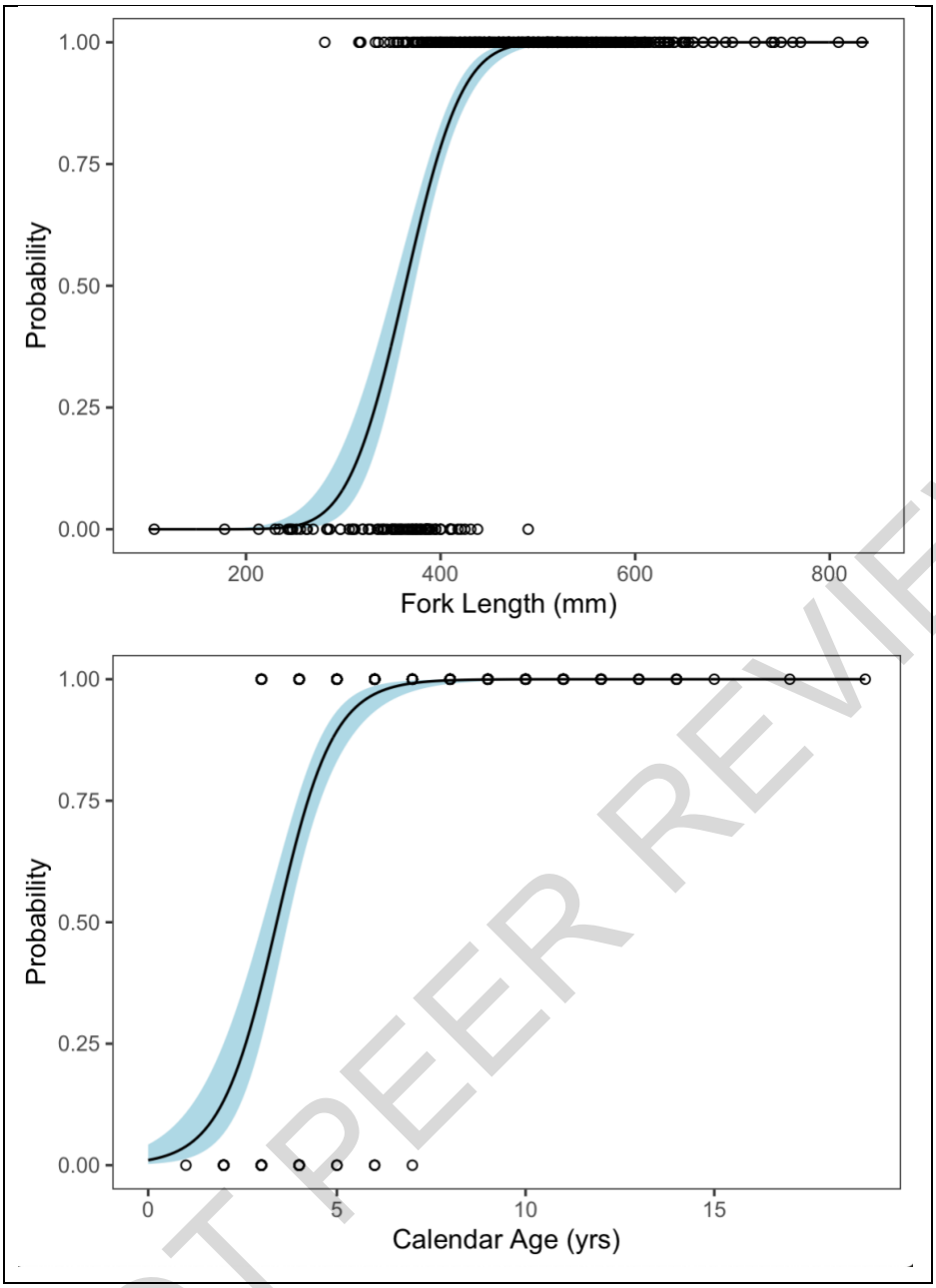

Figure 11. Observed and predicted length (top) and age (bottom) at maturity with 95% confidence intervals. The estimated size at 50% maturity under the best-fitting model (probit) was 363.7 mm FL, and the estimated age at 50% maturity under the best-fitting model (logit) was 3.41 years.

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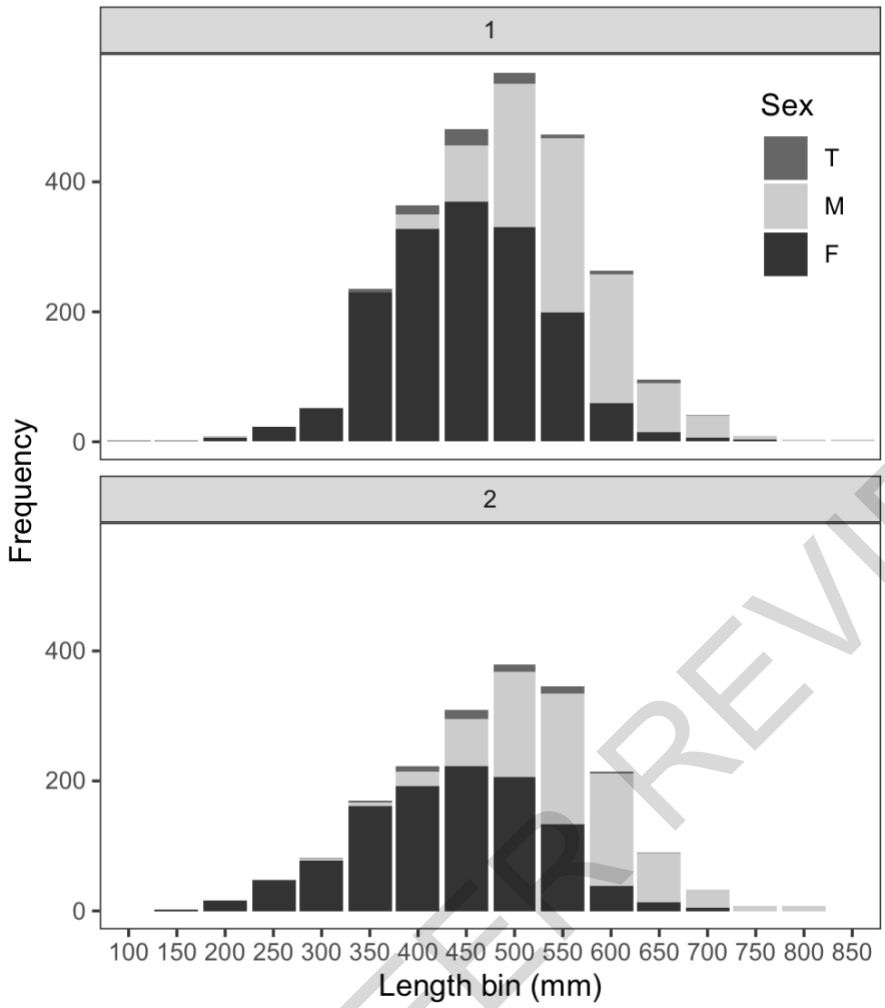

Figure 12. Length frequency distribution by sex (F = female, M = male, T = transitional). The male sex ratio has increased from 36% in the early period (period 1, 1972–2002) to 41% in more recent years (period 2, 2003–2017).

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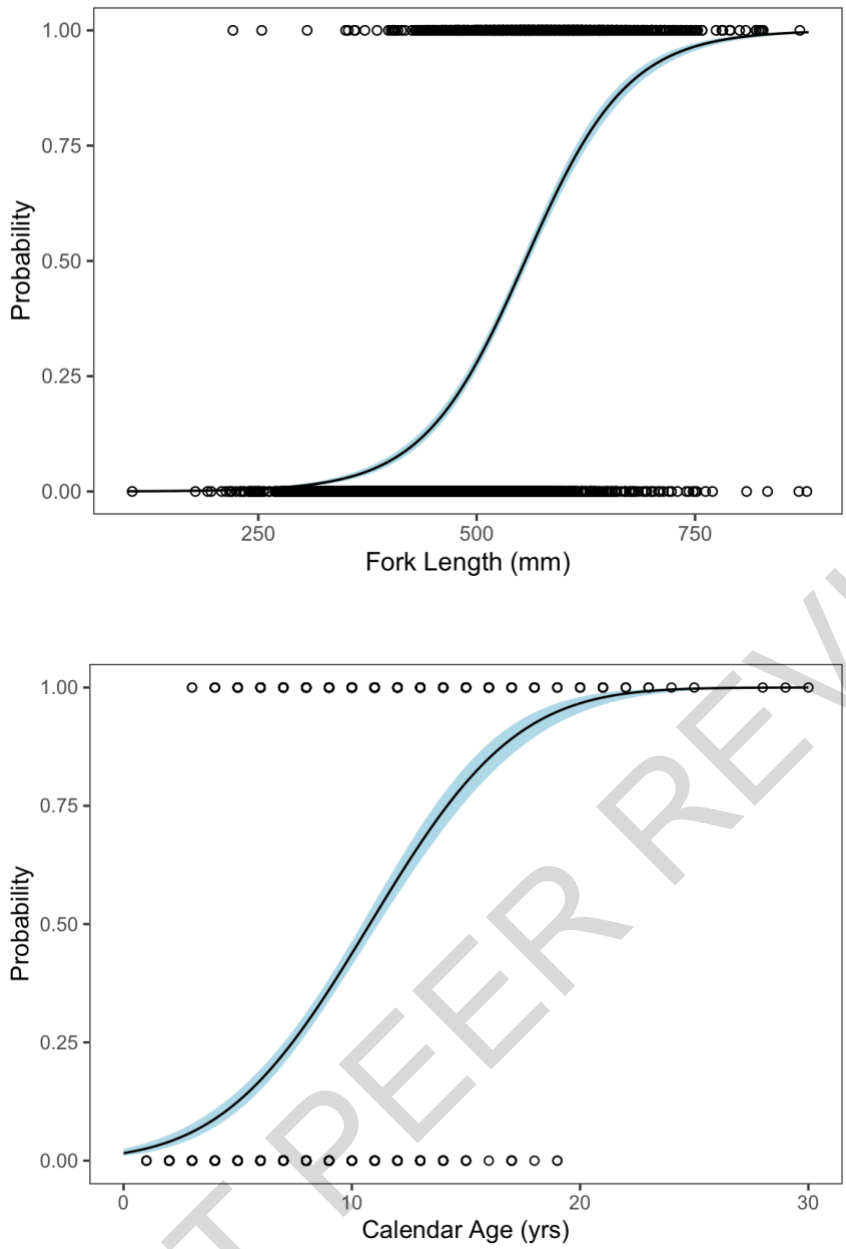

Figure 13. Observed and predicted length (top) and age (bottom) at transition with 95% confidence intervals. Estimated size at 50% male under the best-fitting model (logit) was 555.6 mm FL, and estimated age at 50% male under the best-fitting model (probit) was 10.8 years.

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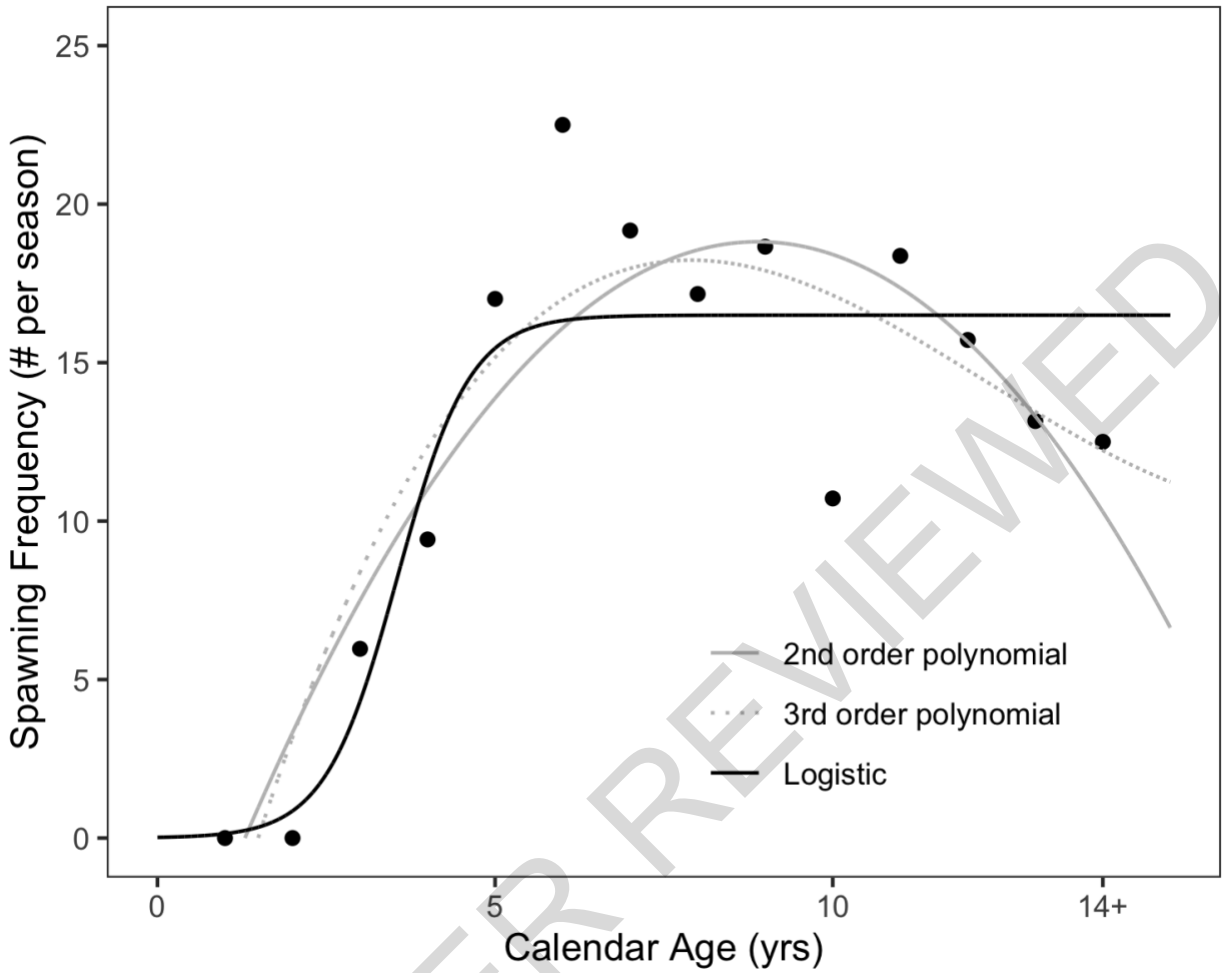

Figure 14. Estimated spawning frequency at age (filled circles) and the three best-fitting models for the base spawning season length of 100 days. The logistic provided the best fit (black line), followed by a second-order polynomial (grey solid line) which was a marginally better fit compared to the third order polynomial (dotted grey line). Ages 14 through 19 were pooled. Spawning frequency was estimated using all (mature and immature) females with available age information.

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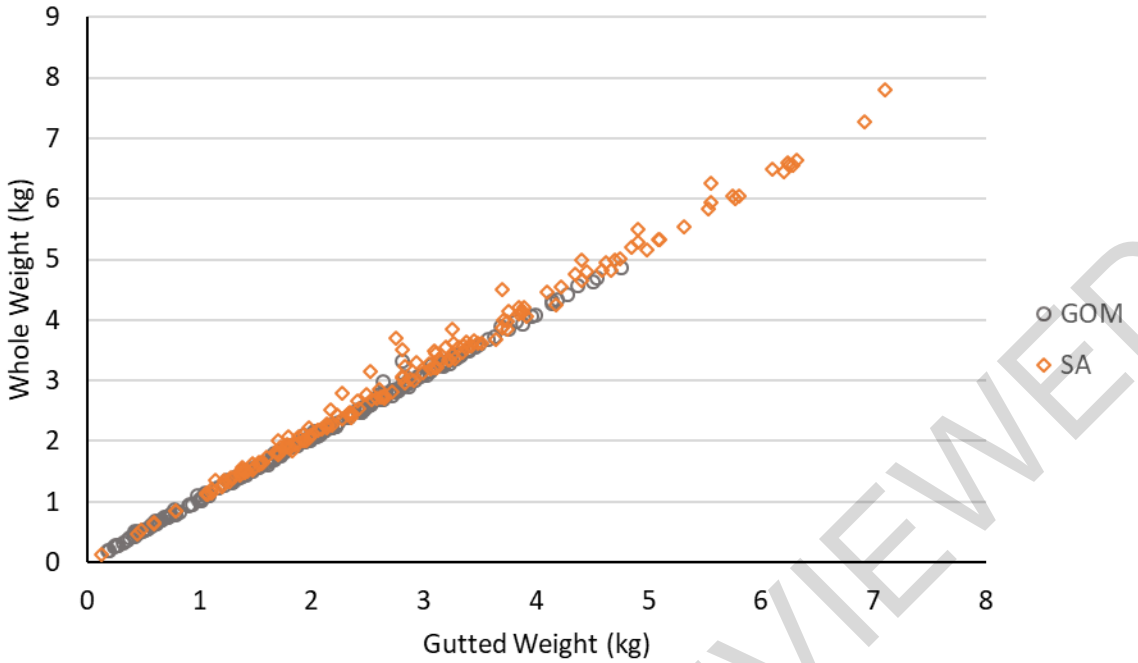

Figure 15. Scamp and Yellowmouth Grouper whole weight – gutted weight data for the entire Southeast region.

3 COMMERCIAL FISHERY STATISTICS

3.1 OVERVIEW

Commercial landings for the US Gulf of Mexico Scamp and Yellowmouth Grouper stock were developed in gutted weight pounds for the period 1962-2018 based on federal and state trip ticket databases. The SEDAR 68 Stock ID Workshop established the South Atlantic and Gulf of Mexico Council boundary line as the delimiting stock boundary between stocks. The Stock Identification Workshop also recommended that, Scamp and Yellowmouth be combined for the U.S. Gulf of Mexico (see section 3.3.3 on Scamp/Yellowmouth Groupers Misidentification). From now on when referring to the "landings", both Scamp and Yellowmouth Grouper landings are included. The landings for non-Florida Gulf of Mexico were constructed primarily using data housed in the NOAA's Southeast Fisheries Science Center's Accumulated Landings System (ALS) from 1986 through 2018. West Florida landings from 1986 through 2018 were obtained from the Florida Trip Ticket program and were preferred over ALS due to the data's finer temporal resolution. Overall most of the methodologies used to produce landings for the Gulf of Mexico were similar to those used in the last grouper benchmark assessment, SEDAR 42, for Red Grouper. Scamp (and Yellowmouth Grouper) are part of the "Other Shallow Water

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Grouper" complex designated by the NMFS Southeast Regional Office, which has been managed under an Individual Fishing Quota (IFQ) program since 2010. Gear grouping for the final landings were provided by year and gear, i.e. Handline, Longline, and Other gears.

Discards were calculated for the directed fishery using discard rates from the Reef Fish Observer Program multiplied by total fishing effort from the Coastal Fisheries Logbook Program. Discard estimation was conducted separately for two gears, vertical line and bottom longline. A verification step compared annual total landed catch from logbook data with the estimated observer annual total landed catch. Once verified, annual total discards in weight and number were estimated for the observer data period 2007-2018, and then hind casted for the period 2000-2006.

Scamp and Yellowmouth Grouper length samples were reviewed for the years 1984-2018 using available TIP length data. Commercial landings length frequency distributions were provided by year and gear (Handline, Longline). Commercial discard lengths from observer data were provided for 2006-2018. Commercial landings ages were weighted by the length frequency distributions and will be provided by year and gear.

3.1.1 Commercial Workgroup Participants

Beth Wrege	Workgroup Leader	NMFS Miami
Julia Defilippi Simpson	Workgroup Leader	ACCSP
Mike Rinaldi	Workgroup Rapporteur	ACCSP
Alan Bianchi	Workgroup Co-Rapporteur	North Carolina DMF
Steve Brown	Data provider	Florida FWC
Amy Dukes	Data Provider	South Carolina DNR
Julia Byrd	Data Provider	SAFMC
Max Lee	Data Provider	Mote Marine Lab
Refik Orhun	Data provider	NMFS Miami
Kevin McCarthy	Data provider	NMFS Miami
Sarina Atkinson	Data provider	NMFS Miami
Steven Smith	Data provider	NMFS Miami
Molly Stevens	Data provider	NMFS Miami
Carole Neidig	Rapporteur/Data provider	Mote Marine Lab
Jeff Pulver	Data provider	NMFS SERO
Marcel Reichert	ADT	South Carolina DNR
Skyler Sagarese	Analyst	NMFS Miami
Kyle Shertzer	Analyst	NMFS Beaufort
Jay Mullins	Data Provider	Gulf Fisherman

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Randy Mckinley	Data Provider	North Carolina Fisherman
Jimmy Hull	Data Provider	Hull Seafood
Kenneth Roberts	Participant	Louisiana Sea Grant
Alexandra Smith	Participant	NMFS Miami
Stephanie Martinez	Participant	NMFS Miami
Shannon Calay	Participant	NMFS Miami
Katie Siegfried	Participant	NMFS Miami

*Workshop done via webinar format due to COVID-19 Pandemic

3.1.2 Issues Discussed at the Data Workshop

Commercial landings issues the workgroup addressed included historical landings, gears, Florida Trip Ticket data, and IFQ reported landings. The commercial workgroup was briefed on the Stock ID Workshop previous to this SEDAR (SEDAR68) in which the boundary designation was verified and the species composition determined to include both the Scamp and Yellowmouth. Other topics of discussion included unclassified grouper landings, and west Florida data source and proportioning.

3.2 REVIEW OF WORKING PAPERS

The workgroup considered data and analyses presented from the following workshop working papers.

SEDAR68-DW-17: Commercial Discard Length Composition for Gulf of Mexico Scamp and Yellowmouth Grouper. This working paper provided summary data from the NOAA Fisheries Reef Fish Observer Program (RFOP) and Shark Bottom Longline Observer Program (SBLOP). RFOP data were from bottom longline and vertical line gears in the Gulf of Mexico. The SBLOP includes data from only the bottom longline fishery in the eastern Gulf of Mexico. Data from both sources were analyzed by year and gear and length compositions were generated.

SEDAR68-DW-22: The group reviewed the working paper on Mote Marine Lab's Scamp data from their participating electronic monitoring (EM) fisheries. C. Neidig presented on the results of linking EM data with observer, dealer, and TIP (dockside) sampling data. The group agreed that EM data may support mortality, and depth of occurrence, but will primarily inform SEDAR from a qualitative perspective.

3.3 COMMERCIAL LANDINGS

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Commercial landings of Scamp and Yellowmouth Grouper in the Gulf of Mexico were compiled from 1962 - 2018, from now on referred to as "Landings". Gulf States landings from Texas to Alabama were obtained from the SEFSC's Accumulated Landings System (ALS) maintained in the SEFSC's Oracle database. The west Florida landings 1986 – 2018 collected by the Florida Trip Ticket Program were obtained from the ACCSP database.

The total combined landings for the Gulf of Mexico are shown in Table 3.1 and Figure 3.4 by year and gear (Handline, Longline, and Other). There are several situations where the commercial landings data, as they change temporally (annual to month to trip-level/daily), may not have the desired level of resolution. Thus, the recommendation was made to limit the commercial landings data to begin in 1986. This was not accepted. The following issues were identified:

Florida Trip Ticket Program

Comparisons were made between the commercial Florida Trip Ticket Program and NMFS SEFSC CFLP (Coastal Fisheries Logbook Program) logbook data. Both datasets were very similar in landings trends and level of landings reported for matching years. While no direct comparison was made between Florida Trip Ticket Program (FTT) and ALS General Canvass, it was decided to use the total landings from the Florida Trip Ticket data over the General Canvass and CFLP logbook since General Canvass data are Florida Trip Ticket data since 1997, the Florida Trip Ticket data are more complete and are of a longer time series than the CFLP logbook data.

One issue arose with regard to Scamp landings from Florida Gulf of Mexico waters: how to apportion Scamp from unclassified grouper. Since Scamp have been coded to species since 1986, it was decided to apportion Scamp from unclassified grouper on trips where only unclassified grouper was reported. The rationale was that if grouper were coded to species on trips that also included unclassified grouper, the dealer was probably diligent in reporting major grouper species correctly. To apportion Scamp from unclassified only grouper, Florida Trip Ticket data were used to calculate the ratio of Scamp to total identified grouper which was then applied to unclassified only grouper landings by year and gear from 1962-1985.

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The quantity of Gulf Scamp from the Florida Trip Ticket Program (FTT) data was determined by calculating the annual Gulf Scamp stratified by area and gear from the CFLP logbook data. The decision to use CFLP logbook data for proportioning gear and area was based on the general acceptance that effort and location data are more accurate on fisher reported logbook records than on dealer reported trip tickets. Proportions were calculated by dividing the amount of Gulf Scamp by area and gear into total Scamp for each year from 1992-2018. Since reliable CFLP logbook data were not available prior to 1993, gear and area data were retained for Florida from the ALS General Canvass but were scaled to the Florida Trip Ticket total.

The average proportion of landings was applied to the corresponding Monroe Scamp and Yellowmouth landings from 1986 – 1992. Gulf of Mexico (non-Monroe) and calculated Gulf of Mexico Monroe County landings were then combined into a total representing Scamp and Yellowmouth landings for the west coast of Florida. This assures there were no duplication. This was done by dividing landings for each gear into total Florida Gulf of Mexico landings, then applying those proportions to the Florida Trip Ticket Gulf of Mexico landings by year from 1993 to 2013.

The average proportion of CFLP logbook landings from 1993 through 2009, by gear, was then applied to trip ticket landings from 1986 to 1992. Data later than 2009 were not used in calculating a mean due to the beginning of IFQ fisheries and a temporary hook limitation on long line gears in 2010, as well as seasonal closures on bottom long line. Data from 2010-2013 were not used in calculating a mean as there were closed seasons.

Texas to Alabama Landings

For ALS landings data in Texas, Mississippi, and Alabama, CFLP logbook data has been used to assign gear and area information for 1993 forward. The same treatment (assignment of gear and area) was applied to the Louisiana landings, but for 1990-1999. The Texas trip ticket program began in 2000. Further details regarding the data in ALS and General Canvass can be found in Appendix A.

1. For Louisiana, gear and fishing area are not available for 1990 - 1999

2. For Texas, gear and fishing area are not available for 1990 - 2011.

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***Decision 1*:** It was the workgroup's recommendation to use Florida trip ticket data when available (1986-2018).

This decision was approved by the plenary.

***Decision 2*:** It was the workgroup's recommendation to use logbook data to apportion annual state landings to gear and area.

This decision was approved by the plenary.

3.3.1 Commercial Gears

Work group discussion on fleet composition and predominant gears resulted in the final three gear groupings of Handline, longline, and other Handline including hook and line, electric/hydraulic (a.k.a., bandit) reels, and trolling. The list of gears used in the assessment can be found in Table 3.2a for Non-FL States and Table 3.2b for West Florida, respectively. The non-FL states (TX-AL) used ALS data with NMFS gear codes; whereas West Florida used the Florida Trip Ticket data with FIN gear codes.

Based on previous benchmark information from SEDAR 22 Yellowedge Grouper, it was discussed that longline fisheries for grouper species did not begin until 1979 in the Gulf of Mexico.

Decision 3: The workgroup suggested three gear groupings to characterize the Scamp fishery (Handline, longline, and other). Handline include hook and line, electric/hydraulic bandit reels, and trolling.

This decision was approved by the plenary.

***Decision* 4**: It was decided by the commercial working group that there was no longline fishery prior to 1979. There were only two fisheries from 1962 – 1979, Handline and other. After 1979, there were three gear groupings, Handline, longline, and other.

This decision was approved.

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3.3.2 Boundaries

DW ToR #1: Review stock structure and unit stock definitions and consider whether changes are required. There was a species identification workshop where the stock boundary was covered. Figure 3.1 shows the US Fisheries Management Regions of the Atlantic seaboard and the Gulf of Mexico. Gulf of Mexico landings are spatially distributed using the statistical areas 1 to 21, reaching from statistical area 1 in the Florida Keys to statistical area 21 bordering Mexico, see Figure 3.2. The CFLP landings are reported by statistical area 1-21. ALS landings are reported by waterbody. When available, water body code is converted to statistical areas using the first two digits of the water body codes. When ALS water body is not available, the county of landing was used.

The Gulf of Mexico and South Atlantic stock boundary lays in CFLP Statistical areas 1 and 2. The Gulf of Mexico landings from areas 1 and 2 are taken from water bodies north of highway U.S. 1 in the Florida Keys and north of the boundary line that extends from Key West to the Dry Tortugas. Waters west of the Dry Tortugas are considered to be the Gulf of Mexico (Figure 3.3).

***Decision 5*:** The workgroup's recommendation was to maintain the region boundaries as defined by the Gulf of Mexico Council boundaries between CFLP statistical grid areas 1 and 21.

This decision was approved by the plenary.

3.3.3 Scamp/Yellowmouth Groupers Misidentification

Both Scamp and Yellowmouth Grouper are very similar in their external appearances, and the adults of both species reach approximately the same maximum size. Because of the two species' similarity, they report that Yellowmouth Grouper and Scamp are both marketed as Scamp, though Yellowmouth's contribution to 'Scamp' landings are low but exact proportions are unknown. Therefore, Scamp and Yellowmouth Grouper landings will be combined for all sources of data (landings, indices, length comps, age comps, discards) for the assessment.

***Decision 6*:** The workgroup's recommendation is to combine Yellowmouth Grouper with the Scamp landings, since they cannot be differentiated from Scamp, and as recommended in the Scamp/Yellowmouth Stock-Id workshop.

This decision was approved by the plenary.

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3.3.4 Unclassified Groupers

Prior to 1986 all grouper landings, with the exception of Goliath and Warsaw, were reported as unclassified grouper. After this time unclassified grouper can still be found to varying degrees but are very minor since 2000. After groupers began to be classified in 1986 a mean Scamp proportion was created using data for 1986-1989, and applied back in time to unclassified grouper landings beginning in 1962.

Since Scamp have been identified to species since 1986, it was decided to apportion Scamp from unclassified grouper on trips where only unclassified grouper was reported. The rationale was that if grouper were coded to species on trips that also included unclassified grouper, the dealer was probably diligent in reporting major grouper species correctly.

To apportion Scamp from unclassified only grouper, landings were used to calculate the ratio of Scamp to total identified grouper. The proportion of Scamp to the total identified grouper {(Scamp)/ (all identified grouper species)} was developed for each year and state. It was then applied to unclassified only grouper landings by year and gear from 1962-2018.

<u>For West Florida</u>

Landings from the ACCSP database were selected for 1962-1985. Data were originally sourced from the NMFS General Canvass survey. All base data reported unclassified groupers. Data were separated between the South Atlantic and Gulf of Mexico using the subregion code, county landed, and/or the reported fishing area. Proportions of Gulf of Mexico Scamp and Yellowmouth Grouper to unclassified grouper were calculated for 1986-1991. Gulf of Mexico gear proportions were also created for the same years. Species proportions were applied to unclassified grouper landings by year. Gear proportions were applied as well, with the following caveat.

***Decision 7*:** The workgroup recommended using a mean Scamp proportion from 1986 through 1989 for grouper landings prior to 1986 for Non-FL Gulf of Mexico states to remain consistent with SEDARs 42 and 12 for Red Grouper. For the Gulf of Mexico, the unclassified groupers were only available 1962 and after. All of Florida was processed with the rest of the South Atlantic states by ACCSP. Calculated Scamp proportions were applied to *West* Florida landings of unclassified groupers starting in 1962.

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This decision was approved by the plenary.

3.3.5 IFQ Landings

The Scamp Individual Fishing Quota program (IFQ) is an online system where all transactions (share, allocation, and landing transfers) are recorded immediately upon entry by Scamp and Yellowmouth Grouper-IFQ participants. Landing transactions contain the following information: shareholder, vessel, and dealer name, landing date/time, landing location, species and pounds landed, and a landing confirmation number. Landings transactions cannot be completed for more pounds than are allocated to the vessel at the time of the landing and are not completed until approved by both the dealer and shareholder. Scamp is part of the Other Shallow-Water Grouper (OTHER SWG) IFQ program which records weights in gutted-pounds. Individual landings were summed for 'annual total pounds landed'. Additional information concerning the IFQ program can be found in Appendix B. Landings from IFQ and ALS/TTP were compilated and adjusted for 2010 through 2018 (Table 3.3).

***Decision 8*:** Use IFQ landings to adjust compilated landings from 2010 through 2018. Apply the differences between the compilated and IFQ landings across all strata.

3.4 COMMERCIAL DISCARDS

The general approach for estimating discards for the commercial reef fish fleet in the Gulf of Mexico utilizes catch-per-unit-effort (CPUE) from the coastal reef fish observer program and total fishing effort from the commercial reef logbook program to estimate total catch.

For discard estimation, CPUE was computed for total discards, including fish released alive, released dead, released in unknown condition, and used for bait. Discard estimation for Gulf of Mexico Scamp/Yellowmouth Grouper was conducted separately for two gears, vertical line and bottom longline. A verification step compared annual total landed catch from logbook data with the estimated observer annual total landed catch. Once verified, Scamp/Yellowmouth Grouper annual total discards in weight and number were estimated for the observer data period 2006-2017, and then hind casted for the period 2000-2006. Full details of the methodology applied to Gulf of Mexico Scamp/Yellowmouth Grouper are described in the working paper SEDAR68-DW-30 (Smith et al. 2020).

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CPUE expansion estimates for annual discards in numbers and weight of GOM Scamp/Yellowmouth Grouper for 2000-2018 are provided in Table 3.4.1 for vertical line gear. Estimated discards in number ranged from 3,000 to 4,000 fish during the pre-IFQ management regime 2000-2009, and averaged about 2,500 fish during the IFQ management regime 2010-2018 (Fig. 3.4.1 A). Discards in weight accounted for about 3% of the total catch (kept + discards) during 2000-2009 and 3.5 to 5% of the total catch during 2010-2018 (Fig. 3.4.1 B).

CPUE expansion estimates for annual discards in numbers and weight of GOM Scamp/Yellowmouth Grouper for 2000-2018 are provided in Table 3.4.2 for bottom longline gear.

Estimated discards in number averaged about 500 fish for 2000-2018 (Fig. 3.4.2 A). Discards in weight accounted for about one to 1.5% of the total catch (kept + discards) during 2000-2018 (Fig.3.4.2 B).

Working Paper reference:

Smith, S.G., S. Martinez, K.J. McCarthy. 2020. CPUE Expansion Estimation for Commercial Discards of Gulf of Mexico Scamp and Yellowmouth Grouper. SEDAR68-DW-30. SEDAR, North Charleston, SC. 27 pp.

3.5 COMMERCIAL EFFORT

Spatial distribution of commercial effort is aggregated from the Coastal Fisheries Logbook Program (CFLP) and presented in the NMFS Area Code grid also called the NMFS Statistical Area grid (Figure 3.5.1). Total Cumulative Scamp Effort (in Trips) 1990 - 2019 for both the Gulf of Mexico and South Atlantic (start 1992) is shown in Figure 3.5.2. Mean Annual Effort (in Trips) for 1990 - 2019 for both the Gulf of Mexico and South Atlantic (starts in 1992) is shown in Figure 3.5.3. Total Cumulative Effort and Mean Annual Effort (in Trips) for the Gulf Mexico are shown in Figure 3.5.4 and Figure 3.5.5, respectively. The distribution of directed commercial effort in trips by year for the Gulf of Mexico 1990 -2019 is shown in Figure 3.5.6.

3.6 BIOLOGICAL SAMPLING

Biological sample data for Scamp and Yellowmouth Grouper were obtained from the TIP database housed at NMFS-SEFSC (1984-2018) and the Gulf States Marine Fisheries

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Commission's Fisheries Information Network (GulfFIN, 2002-2018). Data were filtered to eliminate records that included a size or effort bias and non-random collection of length data.

3.6.1 Sampling Intensity

The bulk of the samples came from Florida, where there was a high of 3,300 fish sampled for LONGLINE gear and 2,168 for HANDLINE gear, both occurring in 1999. The average number of fish caught via HANDLINE per year for FL, AL, MS, LA, and TX were 909, 84, 30, 309, and 60, respectively. The average number of fish caught via LONGLINE per year for FL, AL, LA, and TX were 1214, 11, 24, and 40, respectively, with no samples for this gear from MS. Following the Data Workshop, weighted compositions were developed, and minimum sample size cutoffs were explored for both number of fish and number of trips. Details pertaining to these sample sizes can be found in the working paper that will be available following the release of the Data Workshop report and prior to the Assessment Workshop.

3.6.2 Length/Age distributions

Scamp and Yellowmouth Grouper length samples were reviewed for the years 1984-2018 using available TIP length data. Commercial landings length frequency distributions will be provided by year and gear (Handline and Longline). Commercial discard lengths from observer data were provided for 2006-2018. Commercial landings ages were weighted by the length distribution frequency distributions and will be provided by year and gear. Details of these compositions will be provided in a working paper following the Data Workshop.

3.6.3 Adequacy for Characterizing Catch

Adequacy of length data and length sampling fractions will be reported in the Assessment Workshop Report.

3.7 ADEQUACY OF DATA FOR ASSESSMENT ANALYSES

Overall the workgroup felt the landings were adequate for assessment analyses. Landings after 1986 should be considered most accurate as this is when trip tickets went into place and landings were generally reported to species (e.g. reported as red grouper instead of 'unclassified' grouper). IFQ landings used for 2010 through 2018 were also agreed upon as being the most accurate.

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The workgroup felt the commercial landings length samples appear be adequate for assessment analyses. There appears to be an adequate number of samples for most years for predominant gears, especially Handline and Longline. There were fewer age samples, but the workgroup felt those data were best available science and should be weighted by length frequency distributions.

3.8 RESEARCH RECOMMENDATIONS

- **Recommendation for assigning annual uncertainty estimates.**
  - Assign annual uncertainty estimates (e.g., SE) to historic and recent commercial landings by fishery, which would allow the assessment to include all available landings data while accounting for greater uncertainty in the historic period.
- **Recommendation for sustained investment in EM infrastructure for the GoM.**
  - Support a sustained investment in Electronic Monitoring (EM) infrastructure for the GoM commercial reef fish fishery. The strides taken by the Center for Electronic Monitoring at Mote (CFEMM) in applying EM in the commercial reef fish fishery has resulted in permanent imagery and sensor documentation of over 300 BLL and VL reef fish trips, >100,000 detailed catch records, from over 2,300 sea days and counting. Continuing this valuable monitoring effort will provide additional CPUE metrics for consideration in stock assessments. This monitoring tool is for researchers to directly observe and permanently document location, identify bycatch hotspots, catch, effort, and discard data, which may help to reduce uncertainty in stock assessments.
  - EM has proven to be effective for permanently documenting the time and location of bycatch events to quantify bycatch rates and identify bycatch hotspots, and importantly, discard condition data which may reduce uncertainty in discard mortality estimation, especially regarding bottom longline trips.
- **Support the application of EM with biological sample collection for priority species.**
  - The COVID-19 pandemic has hampered interactions between the fishing industry and state/federal fisheries data collections. The working group recognizes the potential for work pioneered by the CFEMM to advance biological sampling needs without human observers while providing accurate georeferenced capture data.

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- **Provide regional support for machine learning (ML) activities.**
    - Develop EM ML efforts and leverage over 200 terabytes of species video imagery footage and CFEMM data to improve regional capabilities to advance artificial intelligence (AI), and support the development of image recognition to automatically identify species presence, species of fish, and their weight estimates.

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3.9 TABLES

Table 3.1 Annual Scamp and Yellowmouth Grouper Landings in gutted pounds for 1962 -2018.

YEAR	HANDLINE	LONGLINE	OTHER
1962	188,783	-	3,546
1963	171,674	-	3,016
1964	176,900	-	3,430
1965	189,173	-	3,630
1966	166,558	-	3,297
1967	149,936	-	3,368
1968	157,703	-	3,608
1969	166,414	-	3,621
1970	170,984	-	3,912
1971	163,337	-	3,854
1972	163,993	-	5,185
1973	132,827	-	4,139
1974	148,264	-	3,453
1975	166,498	-	3,480
1976	155,337	-	4,238
1977	121,154	-	2,555
1978	113,050	-	4,792
1979	148,139	-	3,576
1980	155,965	-	4,160
1981	112,248	107,395	21,394
1982	140,378	138,315	13,675
1983	110,837	103,459	17,626
1984	121,491	117,803	4,242
1985	126,997	144,820	4,416
1986	178,419	174,428	5,427
1987	180,055	154,071	5,340
1988	155,529	110,414	3,919
1989	160,144	127,059	4,220
1990	98,192	109,171	57,821
1991	126,139	129,427	59,509

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1992	166,389	76,227	59,245
1993	157,538	102,138	60,858
1994	107,612	57,454	50,830
1995	130,757	60,779	44,332
1996	127,484	66,711	38,874
1997	136,524	79,514	76,299
1998	98,858	85,243	36,720
1999	103,403	85,405	71,820
2000	114,610	73,528	11,721
2001	133,561	112,002	22,235
2002	149,583	118,036	37,010
2003	164,034	136,708	11,874
2004	151,845	151,716	15,581
2005	154,666	141,964	12,184
2006	115,796	86,283	16,040
2007	134,089	120,265	20,565
2008	122,179	138,725	17,138
2009	141,611	89,656	19,705
2010	75,921	64,936	15,197
2011	75,374	60,415	10,095
2012	141,093	93,246	16,090
2013	125,540	103,610	16,077
2014	96,973	62,095	9,394
2015	91,383	80,820	6,310
2016	141,099	143,307	1,629
2017	84,706	77,086	1,185
2018	71,279	68,711	2,616

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Table 3.2 A SEFSC ALS Non-FL States Gear Groups with NMFS Gear Codes

HANDLINE	
NMFS GEAR CODE	**GEAR DESCRIPTION**
600	COMBINED GEARS
610	COMBINED GEARS, LINES HAND, OTHER
611	COMBINED GEARS, ROD AND REAL
612	REEL, MANUAL
613	REEL, ELECTRIC OR HYDRAULIC, COMBINED GEARS
616	COMBINED GEAR
657	LINES TROLL, GREEN-STICK
660	LINES TROLL, OTHER
661	LINES POWER TROLL, OTHER
LONGLINE	
NMFS GEAR CODE	**GEAR DESCRIPTION**
614	BUOY GEAR, VERTICAL
675	COMBINED GEARS, LINES LONG WITH HOOKS
674	COMBINED GEARS, LINES LONG, REEF FISH
677	COMBINED GEARS, LINES LONG, SHARK
OTHER	
NMFS GEAR CODE	**GEAR DESCRIPTION**
*	ALL OTHER GEARS

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Table 3.2 B ACCSP West Florida Trip Ticket Program Gear Groups with Fin Gear Codes.

HANDLINE			
GEAR CODE	**GEAR NAME**	**TYPE CODE**	**GEAR TYPE**
300	HOOK AND LINE	7	HOOK AND LINE
301	HOOK AND LINE, MANUAL	7	HOOK AND LINE
302	HOOK AND LINE, ELECTRIC	7	HOOK AND LINE
303	ELECTRIC/HYDRAULIC, BANDIT	7	HOOK AND LINE
304	HOOK AND LINE, CHUM	7	HOOK AND LINE
305	HOOK AND LINE, JIG	7	HOOK AND LINE
306	HOOK AND LINE, TROLL	7	HOOK AND LINE
307	HOOK AND LINE, CAST	7	HOOK AND LINE
308	HOOK AND LINE, DRIFTING EEL	7	HOOK AND LINE
309	HOOK AND LINE, FLY	7	HOOK AND LINE
310	HOOK AND LINE, BOTTOM	7	HOOK AND LINE
320	TROLL LINES	7	HOOK AND LINE
321	TROLL LINE, MANUAL	7	HOOK AND LINE
322	TROLL LINE, ELECTRIC	7	HOOK AND LINE
323	TROLL LINE, HYDRAULIC	7	HOOK AND LINE
324	TROLL LINE, GREEN-STICK	7	HOOK AND LINE
330	HAND LINE	13	HAND LINE
331	TROLL & HAND LINE CMB	13	HAND LINE
340	AUTO JIG	13	HAND LINE
700	HAND LINE	13	HAND LINE
701	TROLL AND HAND LINES CMB	13	HAND LINE
702	HAND LINES, AUTO JIG	13	HAND LINE
LONGLINE (1981-onward)			
GEAR CODE	**GEAR NAME**	**TYPE CODE**	**GEAR TYPE**
400	LONG LINES	8	LONG LINES
401	LONG LINES, VERTICAL	8	LONG LINES
402	LONG LINES, SURFACE	8	LONG LINES
403	LONG LINES, BOTTOM	8	LONG LINES
404	LONG LINES, SURFACE, MIDWA	8	LONG LINES
405	LONG LINES, TROT	8	LONG LINES
406	LONG LINES, TURTLE HOOKS	8	LONG LINES
407	LONG LINES, DRIFT W/HOOOKS	8	LONG LINES
408	BOUY GEAR	8	LONG LINES
OTHER			
GEAR CODE	**GEAR NAME**	**TYPE CODE**	**GEAR TYPE**
*	All other gears	*	All other gear types

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Table 3.3 Annual IFQ correction factors from ALS to IFQ.

Year	IFQ Correction Factors
2010	0.984611
2011	1.025188
2012	0.996947
2013	0.989045
2014	0.996538
2015	1.020419
2016	0.996953
2017	0.996735
2018	1.001332

Table 3.4.1 Time-series of CPUE expansion estimates for GOM Scamp & Yellowmouth Grouper vertical line discards in weight (lbs.) and number (with associated standard errors).

Year	Estimated Discards in Weight	SE of Estimated Discards in Weight	Estimated Discards in Number	SE of Estimated Discards in Number
2000	4,035.2	1,556.7	2,946.0	1,149.4
2001	4,727.3	1,823.7	3,469.9	1,353.9
2002	5,239.0	2,021.1	3,842.2	1,499.1
2003	5,790.0	2,233.7	4,235.7	1,652.6
2004	5,582.6	2,153.7	4,083.2	1,593.1
2005	4,913.5	1,895.5	3,611.2	1,409.0
2006	4,416.5	1,703.8	3,230.8	1,260.6
2007	4,186.5	1,615.0	3,080.2	1,201.8
2008	3,746.5	1,490.8	2,747.8	1,113.3
2009	4,562.8	1,833.7	3,356.1	1,382.2
2010	3,910.7	2,175.9	2,421.5	1,019.3
2011	4,418.2	2,458.3	2,735.7	1,151.5

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2012	5,528.0	3,075.8	3,422.9	1,440.8
2013	4,557.2	2,535.6	2,821.7	1,187.8
2014	4,291.1	2,387.6	2,657.0	1,118.4
2015	3,717.3	2,068.3	2,301.7	968.9
2016	4,506.3	2,507.3	2,790.3	1,174.5
2017	3,411.2	1,898.0	2,112.2	889.1
2018	2,944.6	1,638.4	1,823.3	767.5

NOT PEER REVIEWED

Table 3.4.2 Time-series of CPUE expansion estimates for GOM Scamp & Yellowmouth Grouper bottom longline discards in weight (lbs.) and number (with associated standard errors).

Year	Estimated Discards in Weight	SE of Estimated Discards in Weight	Estimated Discards in Number	SE of Estimated Discards in Number
2000	1,237.0	773.0	461.9	229.5
2001	1,547.5	967.1	564.2	280.3
2002	1,453.6	908.4	532.8	264.7
2003	1,728.2	1,080.0	643.1	319.5
2004	1,900.6	1,187.7	688.0	341.8
2005	1,925.4	1,203.2	691.9	343.8
2006	1,354.6	846.5	510.0	253.4
2007	1,518.0	948.6	536.8	266.7
2008	1,895.6	1,184.6	667.3	331.6
2009	1,232.5	770.2	429.8	213.6
2010	460.8	180.8	250.5	83.3
2011	742.1	291.2	403.4	134.2
2012	697.6	273.7	379.2	126.1
2013	842.0	330.4	457.7	152.2
2014	963.7	378.1	523.9	174.3
2015	1,136.9	446.1	618.1	205.6
2016	1,220.9	479.0	663.7	220.8
2017	1,184.1	464.6	643.7	214.1
2018	1,039.3	407.8	565.0	187.9

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3.10 FIGURES

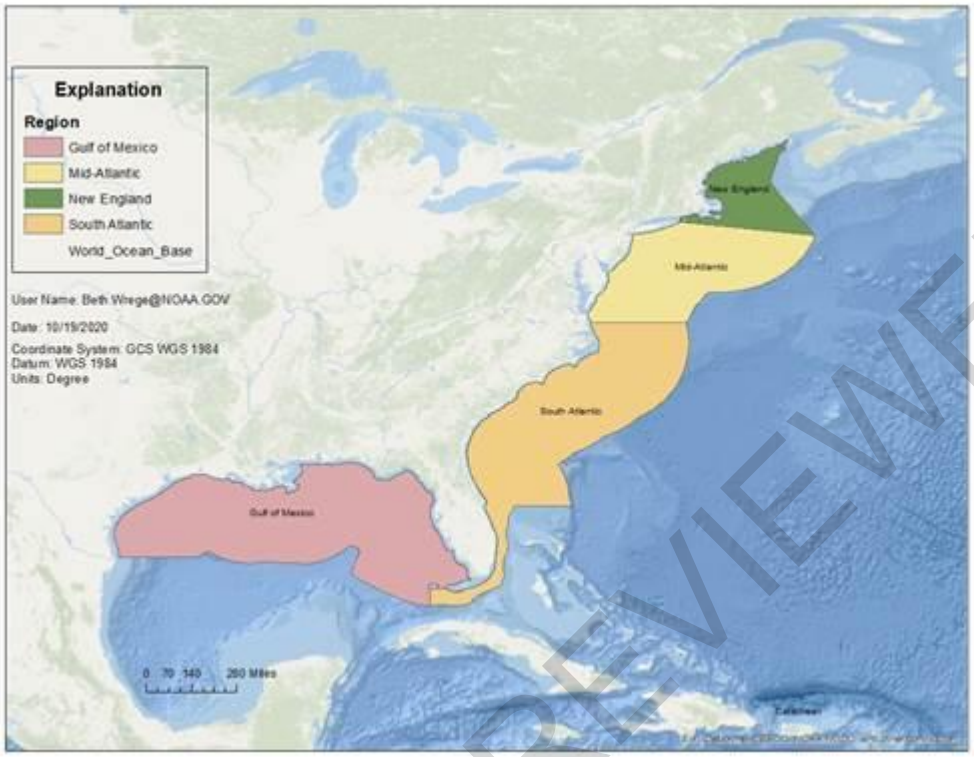

Figure 3.1 Map showing Fisheries Management Region in the Atlantic Ocean.

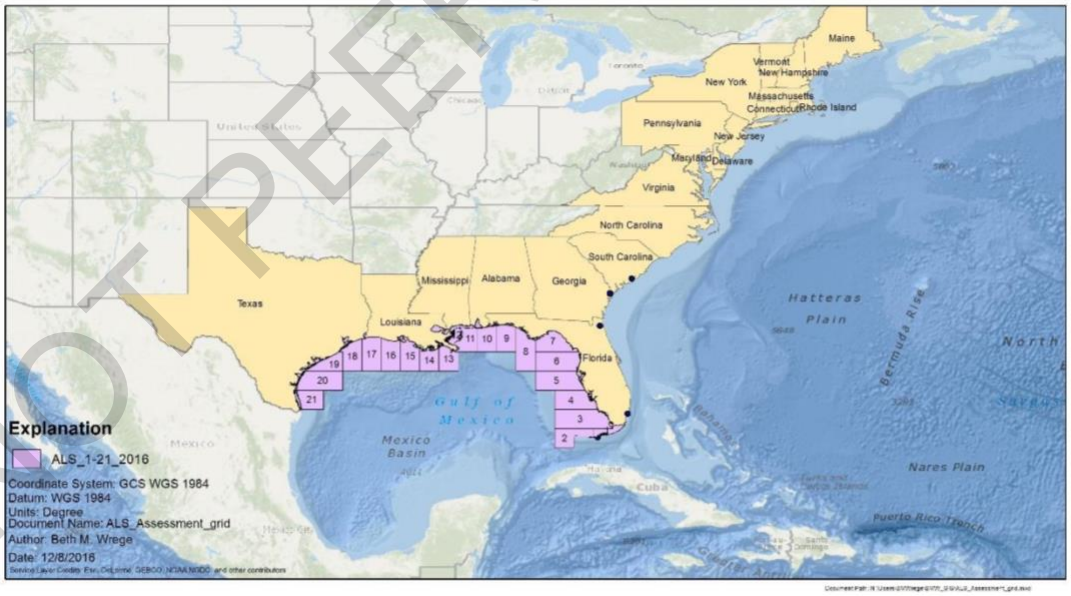

Figure 3.2 Map showing the NMFS Area code/Statistical areas 1-21 from Key West at the Southern tip of Florida to the Texas/Mexico border

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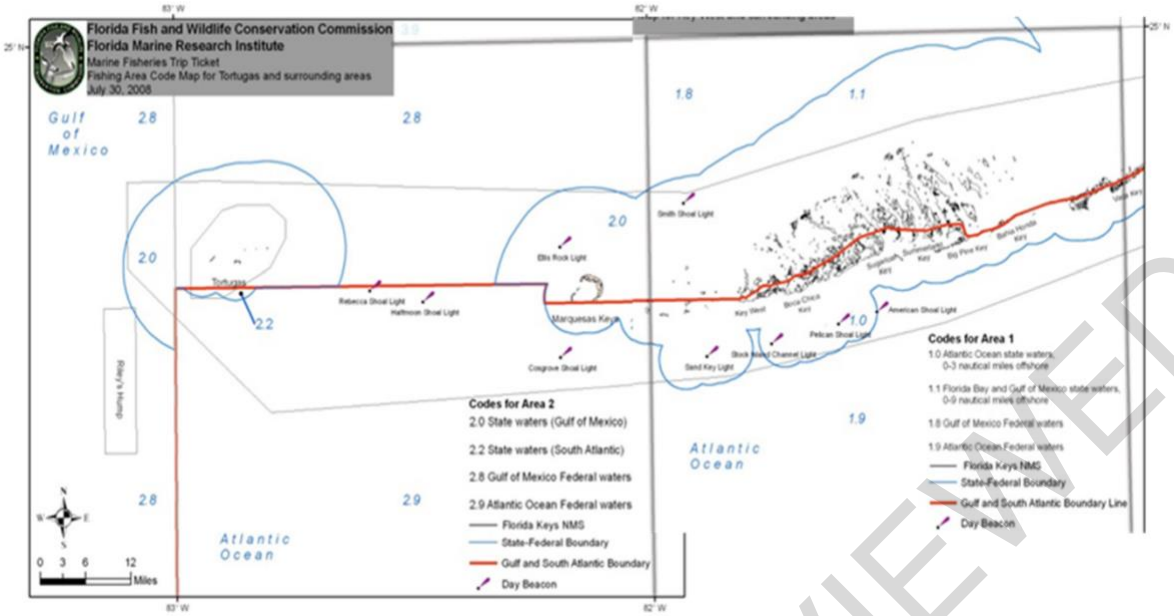

Figure 3.3 Close-up of the southern boundary as defined by the Gulf of Mexico/South Atlantic Council boundary.

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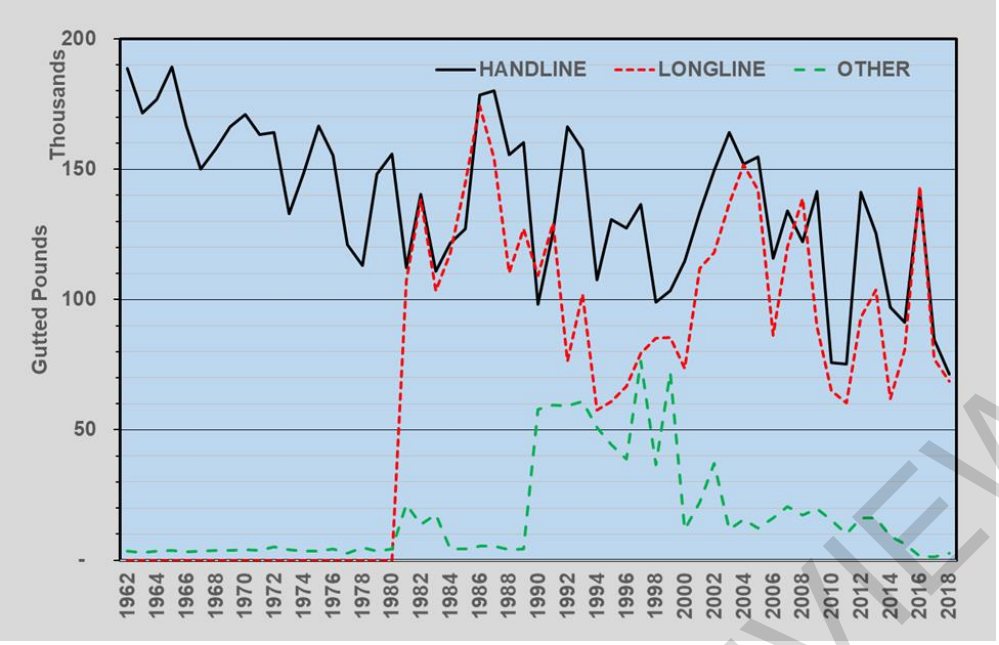

Figure 3.3a Scamp (and YM) Gulf of Mexico landings 1962-2018, in gutted-weight pounds by gear groups.

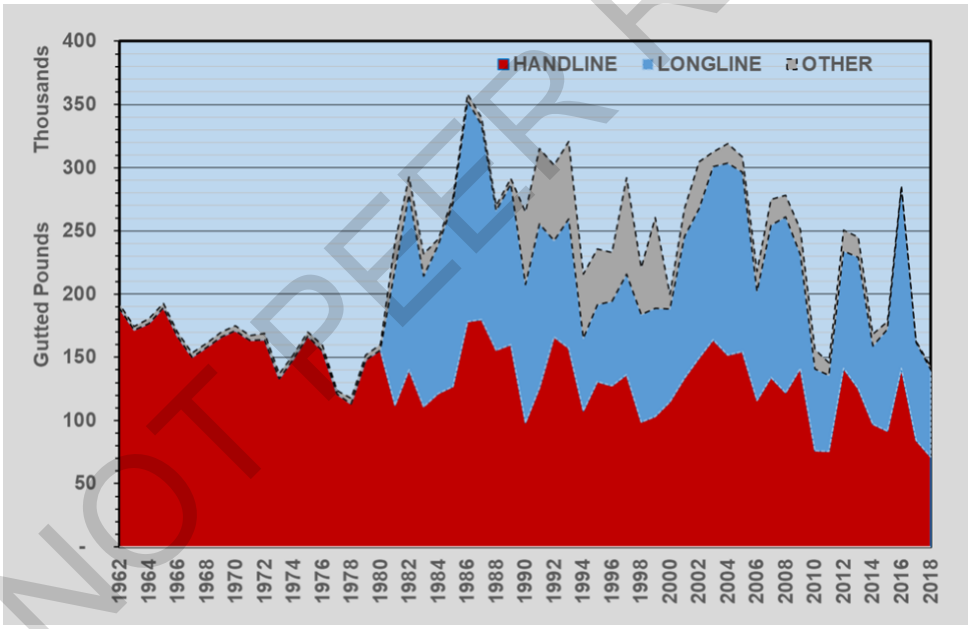

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Figure 3.3b Stacked Scamp (and YM) Gulf of Mexico landings 1962-2018, in gutted-weight pounds by gear groups.

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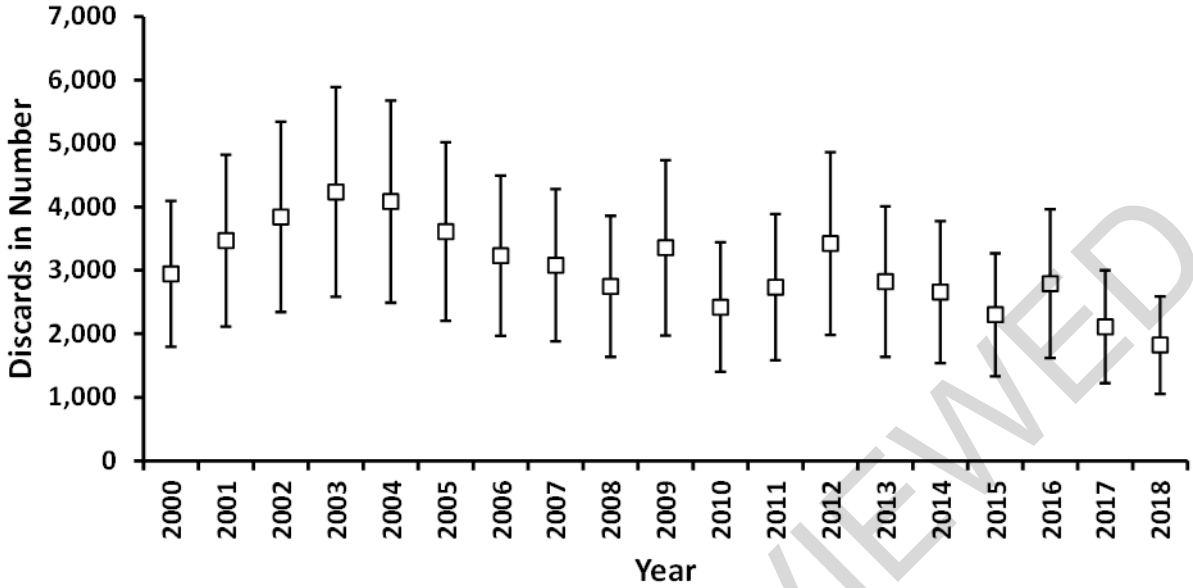
(A) Discards in Number



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(B) Discards in Weight, Percentage of Total Catch

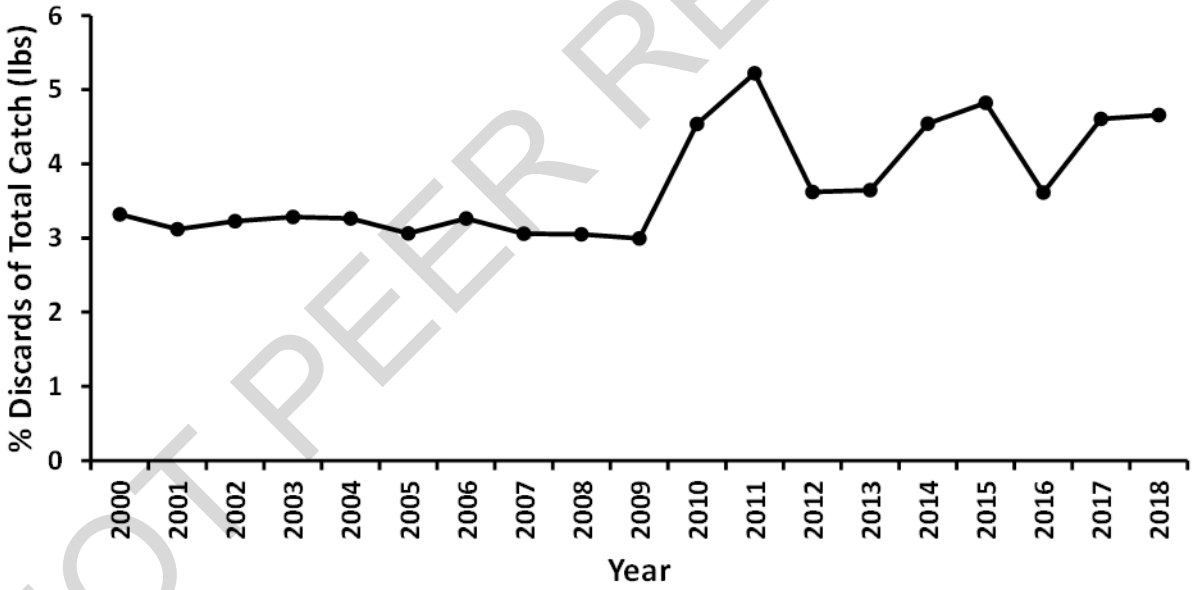

Figure 3.4.1 Observer CPUE expansion estimates of GOM Scamp/Yellowmouth Grouper vertical line annual discards (±SE) in (A) number and (B) weight expressed as percentage of total catch (kept + discards) for 2000-2018.

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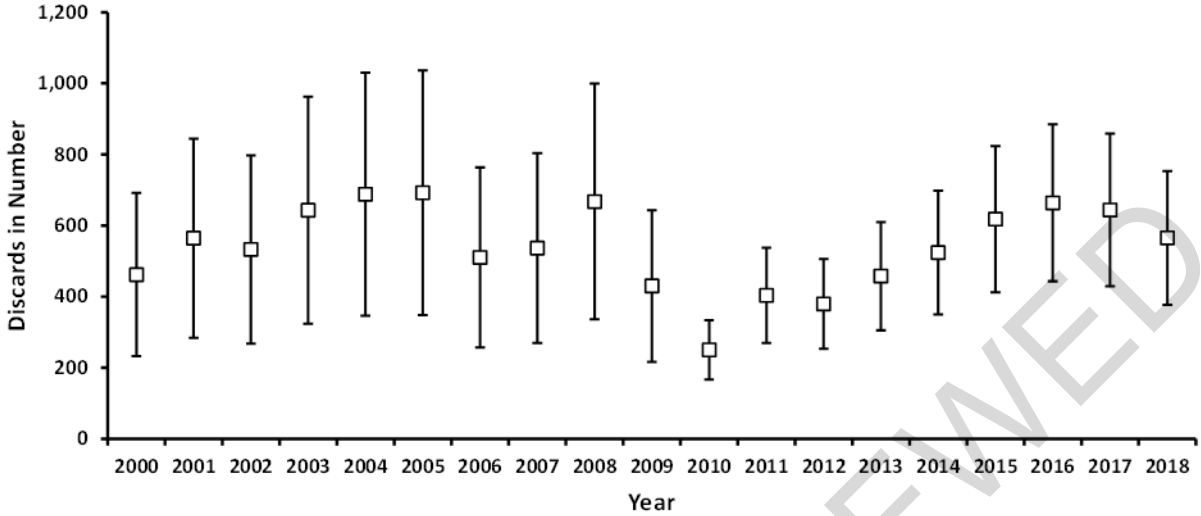
(A) Discards in Number



(B) Discards in Weight, Percentage of Total Catch

Figure 3.4.2 Observer CPUE expansion estimates of GOM Scamp/Yellowmouth Grouper bottom longline annual discards (±SE) in (A) number and (B) weight expressed as percentage of total catch (kept + discards) for 2000-2018.

NOT PEER REVIEWED

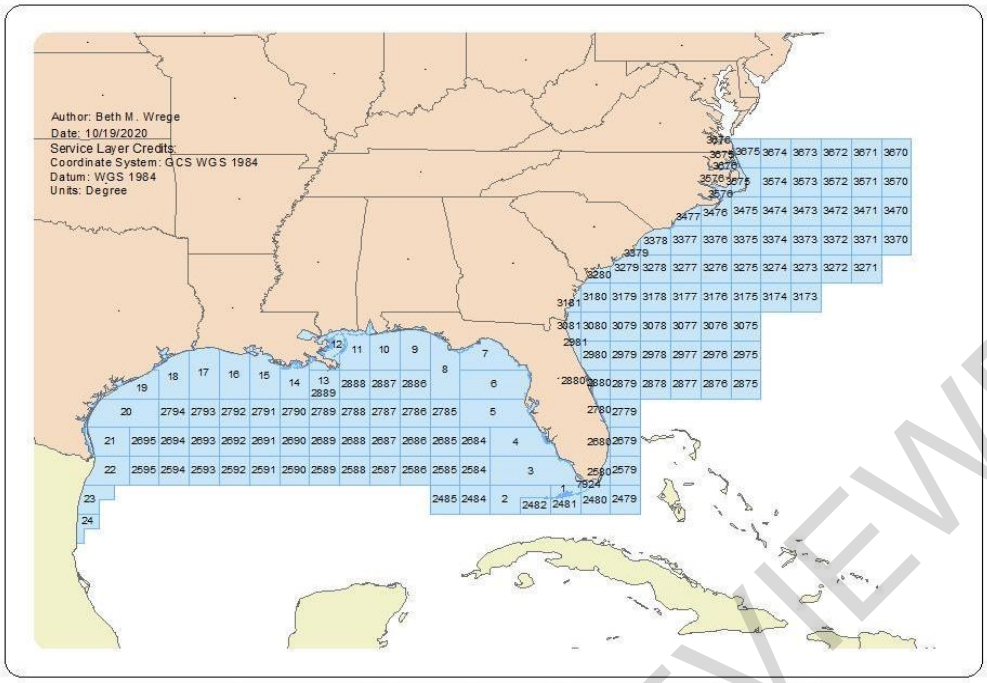


Figure 3.5.1 Map showing the extent of Southeastern Fisheries Management Region areas for the SEDAR 68 Scamp assessment data compilation.

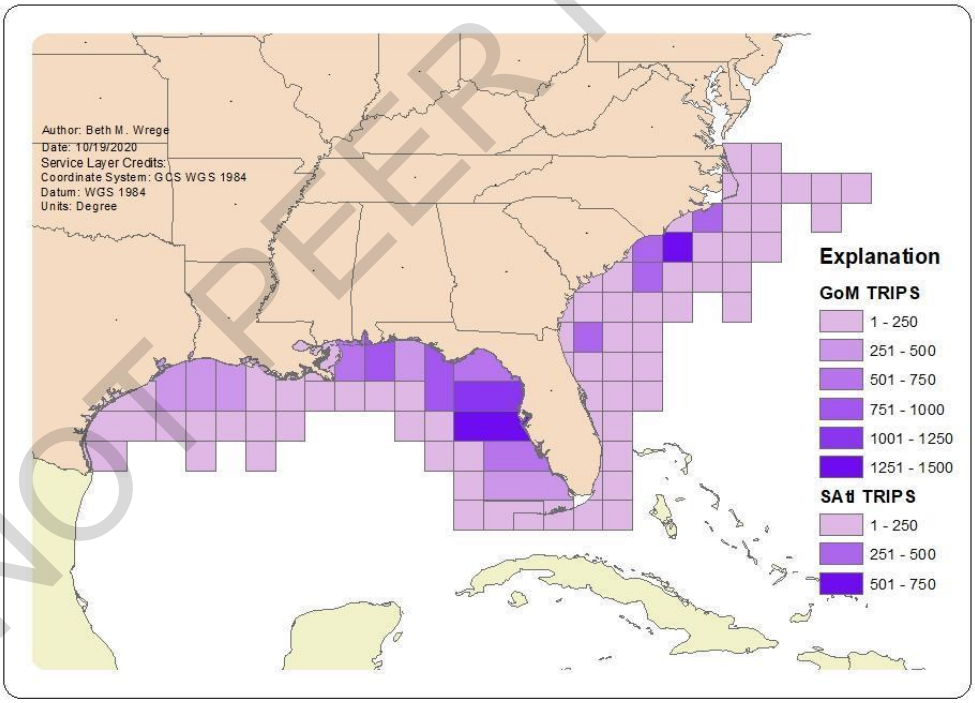


Figure 3.5.2 Map of Total Cumulative Scamp Effort (Trips) 1990 - 2019 in the Gulf of Mexico and South Atlantic (SATL starts in 1992) as reported to CFLP.

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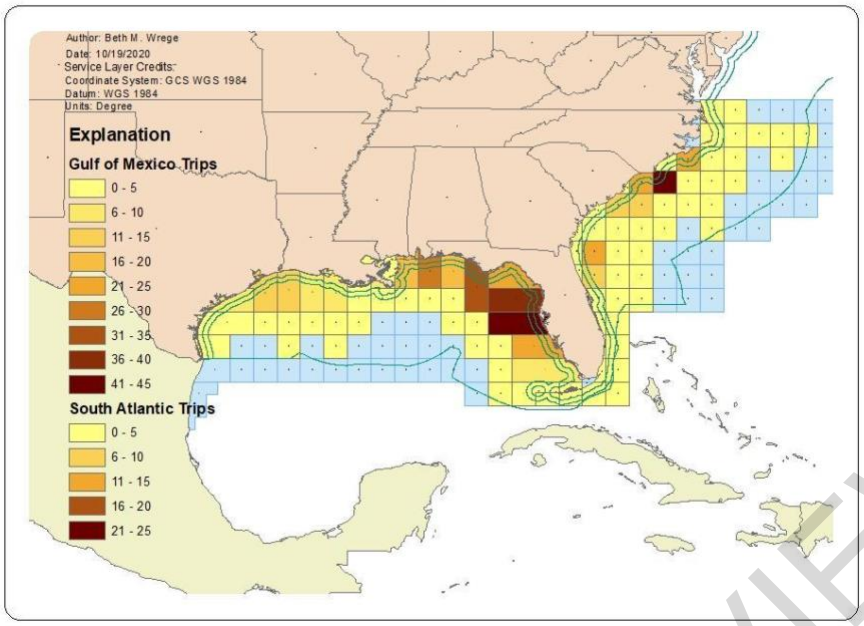

Figure 3.5.3 Map of Mean Annual Scamp Effort (Trips) 1990 - 2019 in the Gulf of Mexico and South Atlantic (SATL starts in 1992) as reported to CFLP.

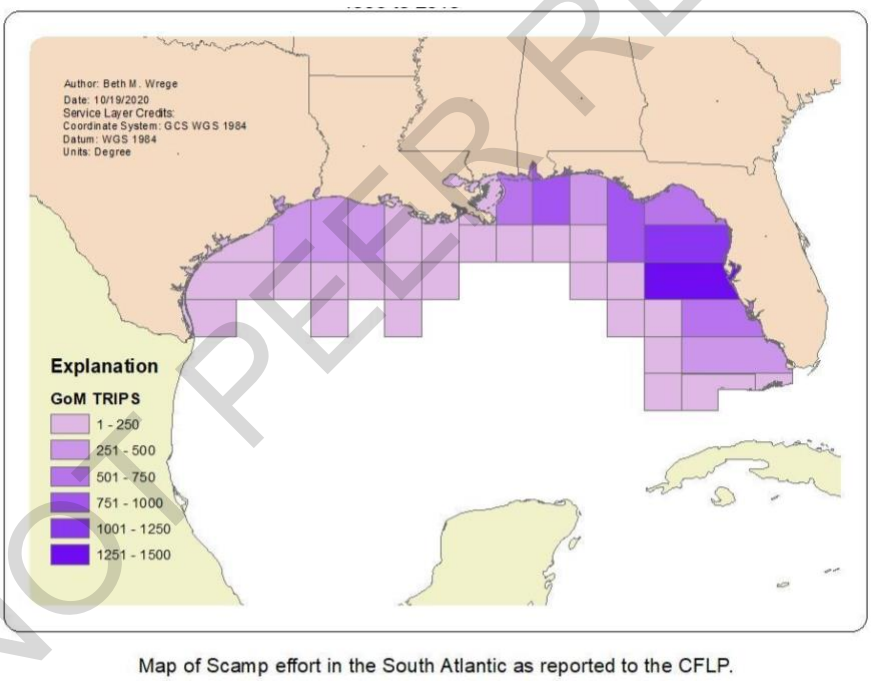

Figure 3.5.4 Map of Total Cumulative Scamp Effort (Trips) 1990 - 2019 in the Gulf of Mexico as reported to CFLP.

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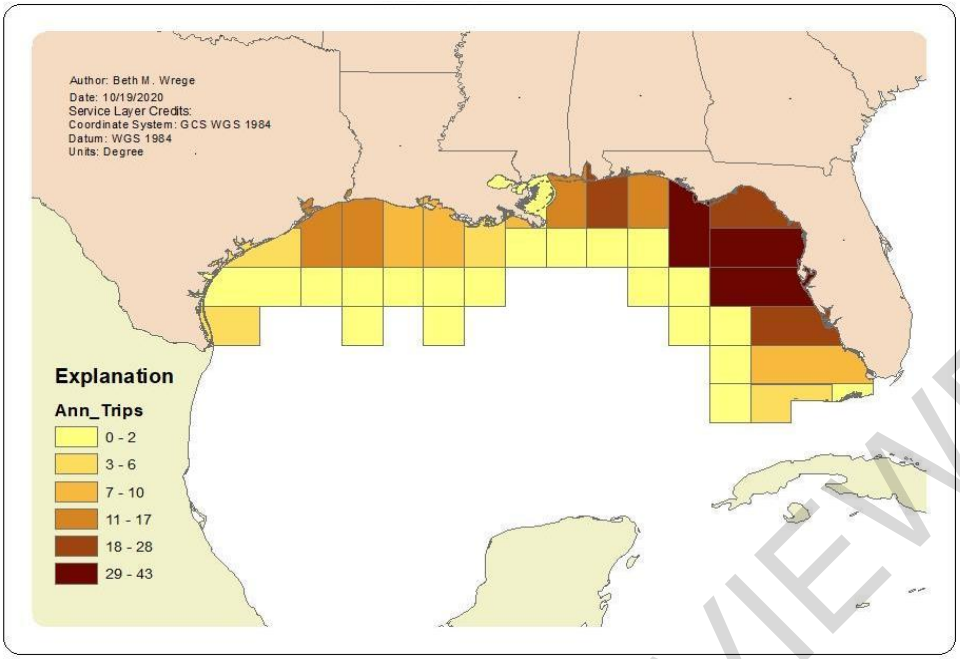

Figure 3.5.5 Map of Mean Annual Scamp Effort (Trips) 1990 - 2019 in the Gulf of Mexico as reported to CFLP.

Figure 3.5.6 Commercial Annual Scamp Effort (in Trips that landed Scamp or Yellowmouth Grouper) 1990 - 2019 in the Gulf of Mexico (GOM) as reported to CLFP.

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3.11 APPENDIX A - ALS

NMFS SECPR Accumulated Landings System (ALS)

Information on the quantity and value of seafood products caught by fishermen in the U.S. has been collected starting in the late 1800s (inaugural year is species dependent). Fairly serious collection activity began in the 1920s. The data set maintained by the Southeast Fisheries Science Center (SEFSC) in the SECPR database management system is a continuous dataset that begins in 1962.

In addition to the quantity and value, information on the gear used to catch the fish, the area where the fishing occurred and the distance from shore are also recorded. Because the quantity and value data are collected from seafood dealers, the information on gear and fishing location are estimated and added to the data by data collection specialists. In some states, this ancillary data are not available.

Commercial landings statistics have been collected and processed by various organizations during the 1962-to-present period that the SECPR data set covers. During the 16 years from 1962 through 1978, these data were collected by port agents employed by the Federal government and stationed at major fishing ports in the southeast. The program was run from the Headquarters Office of the Bureau of Commercial Fisheries in Washington DC until 1970. After 1970 it was run by the newly created National Marine Fisheries Service, which had replaced the Bureau of Commercial Fisheries. Data collection procedures were established by Headquarters and the data were submitted to Washington for processing and computer storage. In 1978, the responsibility for collection and processing was transferred to the SEFSC.

In the early 1980s, the NMFS and the state fishery agencies within the Southeast began to develop a cooperative program for the collection and processing of commercial fisheries statistics. With the exception of two counties, one in Mississippi and one in Alabama, all of the General Canvass statistics are collected by the fishery agency in the respective state and provided to the SEFSC under a comprehensive Cooperative Statistics Program (CSP). The purpose of this documentation is to describe the current collection and processing procedures that are employed for the commercial fisheries statistics maintained in the SECPR database.

1960 - Late 1980s
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Although the data processing and database management responsibilities were transferred from the Headquarters in Washington DC to the SEFSC during this period, the data collection procedures remained essentially the same. Trained data collection personnel, referred to as fishery reporting specialists or port agents, were stationed at major fishing ports throughout the Southeast Region. The data collection procedures for commercial landings included two parts.

The primary task for the port agents was to visit all seafood dealers or fish houses within their assigned areas at least once a month to record the pounds and value for each species or product type that was purchased or handled by the dealer or fish house. The agents summed the landings

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and value data and submitted these data in monthly reports to their area supervisors. All of the monthly data were submitted in essentially the same form.

The second task was to estimate the quantity of fish that were caught by specific types of gear and the location of the fishing activity. Port agents provided this gear/area information for all of the landings data that they collected. The objective was to have gear and area information assigned to all monthly commercial landings data.

There are two problems with the commercial fishery statistics that were collected from seafood dealers. First, dealers do not always record the specific species that are caught and second, fish or shellfish are not always purchased at the same location where they are unloaded, i.e., landed. Dealers have always recorded fishery products in ways that meet their needs, which sometimes make it ambiguous for scientific uses. Although the port agents can readily identify individual species, they usually were not at the fish house when fish were being unloaded and thus, could not observe and identify the fish.

The second problem is to identify where the fish were landed from the information recorded by the dealers on their sales receipts. The NMFS standard for fisheries statistics is to associate commercial statistics with the location where the product was first unloaded, i.e., landed, at a shore-based facility. Because some products are unloaded at a dock or fish house and purchased and transported to another dealer, the actual 'landing' location may not be apparent from the dealers' sales receipts. Historically, communications between individual port agents and the area supervisors were the primary source of information that was available to identify the actual unloading location.

Cooperative Statistics Program
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In the early 1980s, it became apparent that the collection of commercial fisheries statistics was an activity that was conducted by both the Federal government and individual state fishery agencies. Plans and negotiations were initiated to develop a program that would provide the fisheries statistics that are needed for management by both Federal and state agencies. By the mid-1980s, formal cooperative agreements had been signed between the NMFS/SEFSC and each of the eight coastal states in the southeast, Puerto Rico and the US Virgin Islands.

Initially, the data collection procedures that were used by the states under the cooperative agreements were essentially the same as the historical NMFS procedures. As the states developed their data collection programs, many of them promulgated legislation that authorized their fishery agencies to collect fishery statistics. Many of the state statutes include mandatory data submission by seafood dealers.

Because the data collection procedures (regulations) are different for each state, the type and detail of data varies throughout the Region. The commercial landings database maintained in SECPR contains a standard set of data that is consistent for all states in the Region.

A description of the data collection procedures and associated data submission requirements for each state follows.

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Florida
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Prior to 1986, commercial landings statistics were collected by a combination of monthly mail submissions and port agent visits. These procedures provided quantity and value, but did not provide information on gear, area or distance from shore. Because of the large number of dealers, port agents were not able to provide the gear, area and distance information for monthly data. This information, however, is provided for annual summaries of the quantity and value and known as the Florida Annual Canvas data (see below).

Beginning in 1986, mandatory reporting by all seafood dealers was implemented by the State of Florida. The State requires that a report (ticket) be completed and submitted to the State for every trip. Dealers have to report the type of gear as well as the quantity (pounds) purchased for each species. Information on the area of catch can also be provided on the tickets for individual trips. As of 1986 the ALS system relies solely on the Florida trip ticket data to create the ALS landings data for all species other than shrimp.

NMFS SECPR Annual Canvass Data for Florida

The Florida Annual Data files from 1976–1996 represent annual landings by county (from dealer reports) which are broken out on a percentage estimate by species, gear, area of capture, and distance from shore. These estimates are submitted by Port agents, which were assigned responsibility for the particular county, from interviews and discussions from dealers and fishermen collected throughout the year. The estimates are processed against the annual landings totals by county on a percentage basis to create the estimated proportions of catch by the gear, area and distance from shore. The sum of percentages for a given Year, State, County, Species combination will equal 100.

Area of capture considerations: ALS is considered to be a commercial landings database which reports where the marine resource was landed. With the advent of some State trip ticket programs, the definition is more loosely applied. As such one cannot assume reports from the ALS by State or county will accurately inform you of Gulf vs. South Atlantic vs. Foreign catch. To make that determination you must consider the area of capture.

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3.12 APPENDIX B

Brief overview on Gulf of Mexico Grouper-Tilefish IFQ programs

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263 13th Ave S, St. Petersburg, FL 33701
Date Written: 12/08/2014

I. Background

The first year of fishing in the Grouper-Tilefish IFQ (GT-IFQ) program began on January 1, 2010. Initial shares were issued based on the amount of grouper-tilefish logbook landings reported under each entity's qualifying permit during 1999 through 2004, with an allowance for dropping one year of data. Initial shares were issued in five different IFQ categories: deep-water grouper, gag, red grouper, other shallow-water grouper, and tilefish. For the first five years of the program, shares and allocation can only be sold to and fished by an entity that owns a valid commercial Gulf reef fish permit and has an active GT-IFQ online account. After January 1, 2015, all U.S. citizens and permanent resident aliens will be eligible to purchase GTIFQ shares and allocation, although a valid Gulf reef fish permit will still be required to harvest, possess, and land any allocation.

The GT-IFQ program is a multi-species program with five share categories: gag, red grouper, other shallow-water groupers, deep-water groupers, and tilefishes. Each share category has distinct shares and associated allocations. Shares are a percentage of the commercial quota, while allocation refers to the poundage that is possessed, landed, or sold during a given calendar year. At the beginning of each year, allocation is distributed based on the annual quota and the share percentages held by a GT-IFQ shareholder account. Allocation can then be used to harvest GT-IFQ species or sold to another valid shareholder account. Adjustments in quota can occur if the status of a stock changes as a result of new assessments or through the reallocation of quota between fishing sectors. Adjustments in quota are distributed proportionately among shareholder accounts based on the percentage of shares each account holds at the time of the adjustment. All transactions (share transfers, allocation transfers, landings, and cost recovery fees) in the GT-IFQ program are completed online.

There are three main account roles in the GT-IFQ system: shareholder, vessel, and dealer accounts. All accounts were assigned to users based on the unique entity (single or combination of individuals and/or business) that held either a Gulf of Mexico (Gulf) dealer or reef fish permit. Shareholder accounts with valid Gulf reef fish permits may transfer GT-IFQ shares and allocation to and from their accounts, as well as land GT-IFQ species at an approved dealer. Shareholder accounts that do not have a valid Gulf reef fish permit can only transfer shares and allocation to other accounts, and may not increase their holdings. A list of all accounts that hold

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shares is available through the NMFS Southeast Regional Office (SERO) Freedom of Information Act website. Vessel accounts, which belong to shareholder accounts, only hold allocation that is debited from the account through landing transactions. Shareholder accounts may have multiple vessel accounts. Dealer accounts were assigned to a unique entity that has a valid Gulf reef fish dealer permit, and functions are limited to completing landing transactions and paying cost recovery fees.

The GT-IFQ program has several built-in flexibility measures to accommodate the multi-species nature of the fishery and reduce bycatch. Two share categories, gag and red grouper, have a multi-use provision that allows a portion of the red grouper to be harvested under the gag allocation, or vice versa. The three remaining categories (shallow-water grouper, deep-water grouper, and tilefish) are multiple-species categories, designed to capture species complexes that are commonly caught together. Three grouper species (Scamp, Warsaw grouper, and speckled hind) are found in both shallow and deep water. Flexibility measures in the GT-IFQ program allow for these species to be landed under both share categories. Scamp are designated as a shallow-water grouper species and may be landed using deep-water grouper allocation once all shallow-water grouper allocation in an account has been harvested. Warsaw grouper and speckled hind are designated as deep-water grouper species and may be landed using shallow-water grouper allocation once all deep-water grouper allocation in an account has been harvested. The GT-IFQ program has a built-in flexibility measure to allow a once-per-year allocation overage per share category for any GT-IFQ account that owns shares in that share category. For these accounts, a vessel can land 10% more than their remaining allocation on the vessel. This overage is then deducted from the shareholder's allocation at the start of the following fishing year. Because overages need to be deducted in the following year, GT-IFQ accounts without shares cannot land an excess of their remaining allocation and GT-IFQ accounts with shares are prohibited from selling shares that would reduce the account's shares fewer than the amount needed to repay the overage in the following year.

When harvesting GT-IFQ species, vessels are required to have a GOM reef fish permit, and to hail out before leaving port. While at-sea, vessels are monitored using vessel monitoring systems. When returning to port, vessels landing GT-IFQ species must provide a landing notification indicating the time and location of landing, the intended dealer, and the estimated pounds landed. Landing may occur at any time, but fish may not be offloaded between 6 p.m. and 6 a.m. A landing transaction report is completed by the GT-IFQ dealer and validated by the fisherman. The landing transaction includes the date, time, and location of the transaction; weight and actual ex-vessel value of fish landed and sold; and the identity of shareholder account, vessel, and dealer. For current total GT-IFQ landings go to: https://portal.southeast.fisheries.noaa.gov/cs/main.html# and past landings are recorded under 'Additional Documents'. All current landings data are updated in a real-time basis as the landing transaction is processed.

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II. Data Description

The GT-IFQ program is a real-time online system, with all transactions recorded immediately upon entry. Data is entered directly by the GT-IFQ participants for all transactions that occur within the system. The GT-IFQ program directly links to the Southeast Regional Office's Permits database in order to validate all vessel and dealer accounts. There are three types of transactions that occur in the GT-IFQ program: share transfer, allocation transfers, and landing transactions. Share transactions contain the following information: transferor, transferee, transaction completion date/time, share category, share percentage transferred, and a confirmation number. Share transfers can only occur between shareholder accounts. Allocation transfers contain similar information as share transfers and include: transferor, transferee, transfer date/time, share category, pounds transferred, and confirmation number. Allocation transfers can occur between a shareholder and his vessel, between two shareholder accounts, or from a shareholder account to another shareholder's vessel account. Landing transactions contain the following information: shareholder account, vessel account, dealer account, landing date/time, landing location, species, pounds, and a landing confirmation number. Additional tables in the GT-IFQ program contain address information for each participant in the GT-IFQ program. The primary contact's address information is used when connecting address information to any transaction.

III. Database Structure

The data is stored in a relational database system that is fishermen-vessel based and accounts are based on unique entities associated with the account, where no account contains the exact same entities as another account. Many vessel accounts may be associated with one shareholder account, if the permit holder is the same on each vessel. This allows the GT-IFQ system to link to the Permits database and establish a validity status for each vessel account. Establishing vessel accounts also allowed IFQ program staff and law enforcement to verify that a vessel has sufficient allocation at the time of a landing notification.

IV. Data Quality

The Vessel Monitoring Systems (VMS) staff provides quality control over GT-IFQ data when vessels are out at sea. Vessels are required to notify VMS staff each time they leave dock (hail out) and complete a landing notification (hail in) prior to landing. While at sea, VMS staff is able to monitor vessel locations hourly to determine if the vessel is fishing in approved areas. GT-IFQ landing notifications can be submitted directly from the GT-IFQ system through VMS units.

The online system has a series of built-in quality assurance measures that reduce the possibility of errors within the system. Pre-designed web-based screens direct the GT-IFQ participants through a detailed process for each transaction. Transactions are not completed until pertinent information has been completed. The system will not allow the completion of any transaction if

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any of the participating accounts is in a suspended or inactive status. Share transactions are not completed until verified by both the transferor and transferee. Similarly, landing transactions are not completed until the shareholder enters their vessel personal identification number. In 2012, the system was updated to allow for the selection of the associated 3-hour notification for each landing transaction. Dealers can also enter an associated trip ticket number with an IFQ landing transaction, although this is an optional field currently.

IFQ staff provides additional quality control which includes but is not limited to: adjusting landings based on submitted Landing Correction Forms, and auditing landing notifications and transactions. IFQ staff continues to work with system developers to improve data quality and accuracy and ensure that all web-based screen shots capture required information.

4 RECREATIONAL FISHERY STATISTICS

4.1 OVERVIEW

4.1.1 Group Membership

Members - Ken Brennan (Co-leader/NMFS SEFSC Beaufort), Julia Byrd (SAFMC), Kelly Fitzpatrick (NMFS SEFSC Beaufort), Dominique Lazarre (FWCC, FL), Vivian Matter (Co-leader/NMFS SEFSC Miami), Matthew Nuttall (NMFS SEFSC Miami), Alexandra Smith (CIMAS/NMFS SEFSC Miami), Molly Stevens (NMFS SEFSC Miami)

4.1.2 Tasks

1. Identify potential species misidentification issues

2. Review fully calibrated MRIP FES/APAIS/FHS landings and discard estimates

3. Determine whether MRIP catch estimates from Monroe County belong to the Gulf of Mexico or South Atlantic stock

4. Evaluate MRIP catch estimates by mode of fishing to determine appropriate modes for inclusion in the Scamp assessment

5. Determine when Scamp was included in the SRHS universal logbook form

6. Evaluate usefulness of historical data sources such as the Fishing, Hunting, and Wildlife-Associated Recreation Survey (FHWAR) to generate estimates of landings prior to 1981

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7. Provide estimates of uncertainty around each set of landings and discard estimates

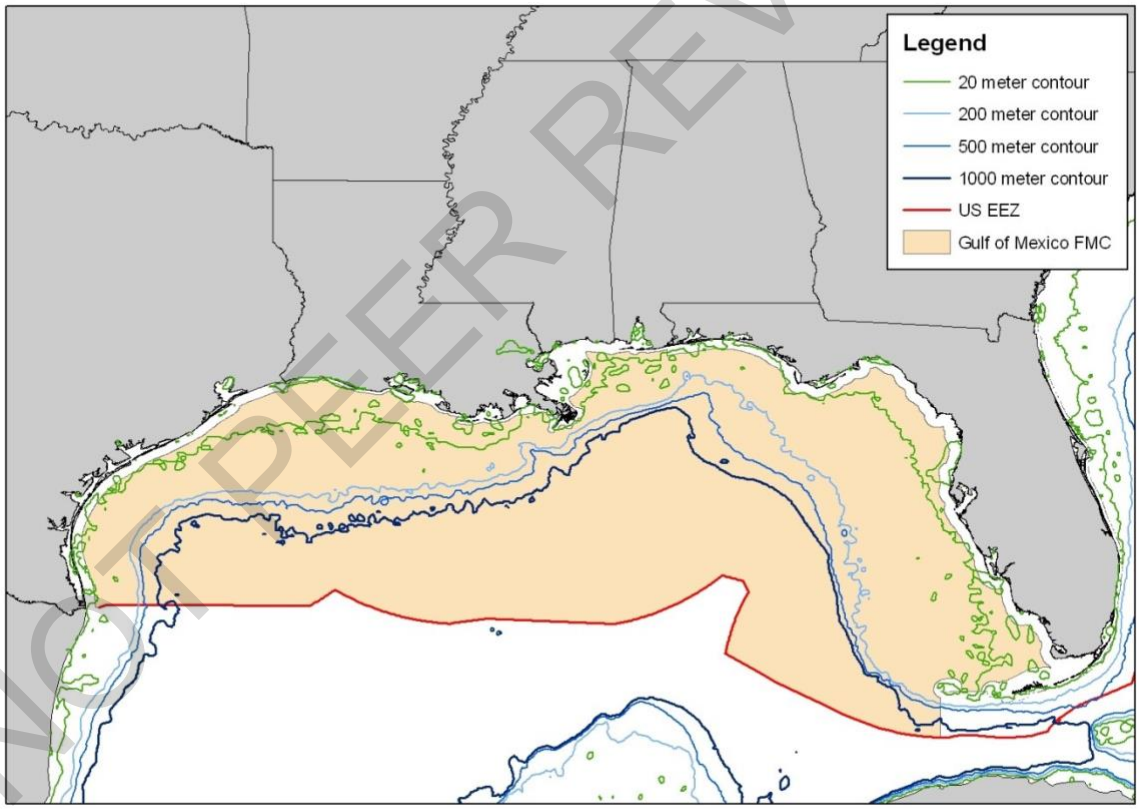
8. Review whether SRHS discard estimates (2004+) are reliable for use and determine if there are other sources of data prior to 2004 that could be used as a proxy to estimate headboat discards

9. Provide nominal length distributions for both landings and discards if feasible

10. Evaluate adequacy of available data

11. Provide research recommendations to improve recreational data

4.1.3 Gulf of Mexico Fishery Management Council Scamp Group Management Boundaries



4.1.4 Stock ID Recommendations

Geographic boundaries

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The SEDAR 68 Stock ID Workshop "recommended that two stock assessments be conducted, separated by the default boundary between the Gulf of Mexico and Atlantic waters, as defined by the Councils' jurisdictions" (SEDAR68-SID-05).

Species identification

Task 1: The SEDAR 68 Stock ID Workshop found that "Scamp are very difficult to distinguish from Yellowmouth Grouper, even for trained biologists, and thus much of the assessment data likely represent both species in unknown proportions". It was recommended that the Scamp assessment "be conducted on both Scamp and Yellowmouth Grouper jointly, with the two species treated as a single complex" (SEDAR68-SID-05). As such, the recreational working group included both Scamp and Yellowmouth Grouper when providing recreational data for this stock assessment. Subsequent references to Scamp in this Recreational Data Workshop report include both Scamp and Yellowmouth Grouper.

4.2 ABSTRACTS OF WORKING PAPERS

Recreational Survey data for Scamp and Yellowmouth Grouper in the Gulf of Mexico (SEDAR 68-DW-09)

General recreational survey data for Scamp and Yellowmouth Grouper from the Marine Recreational Information Program (MRIP), Texas Parks and Wildlife Department (TPWD), and Louisiana Creel Survey (LA Creel) are summarized from 1981 to 2018 for Gulf of Mexico states from Texas to western Florida, not including the Florida Keys. Charter boat, private, shore, and headboat (1981-1985) fishing modes are presented. These estimates include fully calibrated MRIP estimates that 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.

SEFSC computation of variance estimates for custom data aggregations from the Marine Recreational Information Program (SEDAR 68-DW-10)

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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.

Estimates of Historic Recreational Landings of Scamp and Yellowmouth Grouper in the Gulf of Mexico Using the FHWAR Census Method (SEDAR 68-DW-12)

The National Survey of Fishing, Hunting, and Wildlife-Associated Recreation Survey (FHWAR) has been conducted every 5 years since 1955 and is one of the oldest and most comprehensive recreational surveys. The FHWAR census method utilizes information from these surveys including U.S. angler population estimates and angling effort estimates from 1955–1985 for the Gulf of Mexico region. To obtain historical Scamp landings prior to 1981, estimated saltwater angler trips (1955-1980) are multiplied by average catch rates that are calculated from early years (1981-1985) of recreational data. Interpolation is used to complete time series.

Marine Recreational Information Program Metadata for the Atlantic, Gulf of Mexico, and Caribbean regions (SEDAR 68-DW-13)

The Marine Recreational Information Program (MRIP), formerly the Marine Recreational Fisheries Statistics Survey (MRFSS), is conducted by the NOAA National Marine Fisheries Service (NMFS) to provide estimates of catch per unit effort, total effort, landings, and discards for six two-month periods (waves) per year. MRIP provides estimates for three main recreational fishing modes: shore-based fishing, private and rental boat fishing, and for-hire charter boat and guide boat fishing. MRIP also provides estimates for the headboat mode in the mid and north Atlantic regions and in the early years (1981-1985) in the South Atlantic and Gulf of Mexico. Methodologies through time, spatiotemporal coverage, and field descriptions are summarized in this metadata paper.

A Summary of Observer Data from the Size Distribution and Release Condition of Scamp Discards from Recreational Fishery Surveys in the Eastern Gulf of Mexico (SEDAR 68-DW-24)

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This report summarizes available size distribution and release condition data for Scamp and Yellowmouth Grouper captured in the for-hire fleets (Headboats and Charter boats) operating along the Gulf coast of Florida.

SEFSC Computation of Uncertainty for Southeast Regional Headboat Survey and Total Recreational Landings Estimates (SEDAR 68-DW-31)

Coefficient of variation (CV) estimates for recreational catch totals are provided as uncertainty measures for use in stock assessments by the Southeast Fisheries Science Center (SEFSC). Variances for landings estimates from the Southeast Region Headboat Survey (SRHS) are calculated at the vessel level from reported logbook landings. Uncertainty in total recreational landings are calculated as the sum total of variances from reported SRHS logbook landings and landings data from the Marine Recreational Information Program.

Discards of Scamp (*Mycteroperca phenax*) for the headboat fishery in the US Gulf of Mexico (SEDAR 68-DW-33)

The Southeast Region Headboat Survey (SRHS) was modified in 2004 to collect self-reported discards for each reported trip. These self-reported data are currently not validated within the SRHS. 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 (2004-2018). Discard estimates prior to 2004 are calculated using a proxy method. For Scamp, MRIP CH mode, MRIP PR mode, and the mean MRIP CH:SRHS discard ratio method were considered as sources for proxy discard estimates for headboat discards. Due to variability in the MRIP CH mode and PR mode discard and landings estimates, a mean SRHS discard ratio method was also considered, as well as a three year rolling average of the MRIP CH mode and mean MRIP CH:SRHS discard ratio method.

4.3 RECREATIONAL DATA SOURCES

4.3.1 Marine Recreational Information Program (MRIP)

Introduction

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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 boat and guide boat fishing (Cbt). MRIP also provides estimates for headboat mode (Hbt) in the mid and north Atlantic regions. MRIP covers all Gulf of Mexico states from western Florida to Mississippi. Louisiana was covered by the survey until 2014. Texas does not participate in MRIP as the state conducts its own recreational survey (discussed below in 4.3.2). When the survey first began in Wave 2 (Mar/Apr) of 1981, headboats were included in the for-hire mode, but were excluded after 1985 to avoid overlap with the Southeast Region Headboat Survey (SRHS), conducted by the NMFS Beaufort laboratory.

Recreational catch, effort, and participation were estimated through a suite of independent but complementary surveys that are described in SEDAR 68-DW-13. Over the years, effort data have been collected from three different surveys: (1) the Coastal Household Telephone Survey (CHTS) which used random digit dialing of coastal households to obtain information about recreational fishing trips, (2) the weekly For-Hire Survey which interviews charter boat operators (captains or owners) to obtain trip information and replaced the CHTS for the charter boat mode (in 2000 for the Gulf of Mexico 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). Sample sizes in the dockside intercept portion have been increased over time to improve precision of catch estimates.

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Task 2: In order to maintain a consistent time series, charter boat estimates were calibrated on the Gulf coast prior to 2000 (SEDAR64-RD-12). CHTS and calibrated FHS charter boat catch estimates for Gulf of Mexico Scamp from 1981 to 1999 are shown in Figure 1 of SEDAR 68-DW-09. Calibrated APAIS and FES estimates for Gulf of Mexico Scamp from 1981 to 2018 are shown in Figure 2 of SEDAR 68-DW-09.

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 Mexico (SEDAR-PW-07).

Task 3: For SEDAR 68, MRIP Scamp landings from Monroe County were allocated to the South Atlantic region because it is more likely that this deep-water species would be caught on the Atlantic side of the Florida Keys than the Florida Bay side.

Adjustment to Fishing Modes

Task 4a: Between 1981 and 1985, MRIP charter boat 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 boat/headboat mode must be split in order to provide estimates of headboat landings in these early years. The MRIP charter boat /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 (SEDAR-PW-07). The MRIP headboat component from this split was used to represent headboat fishing in the Gulf (West Florida to Louisiana) from 1981-1985. Since Texas does not participate

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in MRIP, headboat estimates from Texas for these early years are informed from SRHS (discussed below in 4.3.4). SRHS estimates represent headboat fishing starting in 1986 for all Gulf states.

Task 4b: The working group also discussed the validity of the MRIP shore mode estimates for Gulf of Mexico Scamp. The working group recommended that all shore mode estimates be excluded because:

- Shore landings are sporadic and generally extremely low compared to other modes or based on only a few intercepts that have expanded the estimates greatly
- Scamp are primarily a deep-water species
- Legal sized fish aren't likely to be caught during a shore trip
- Scamp identified during shore mode trips may be a result of misidentification

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

The TPWD Sport-Boat Angling Survey samples fishing trips made by sport-boat anglers fishing in Texas marine waters. All sampling takes place at recreational boat access sites. The raw data include information on catch, effort and length composition of the catch for sampled boat-trips. These data are used by TPWD to generate recreational catch and effort estimates starting in May 1983 (SEDAR 70-WP-03). The survey is designed to estimate landings and effort by high-use (May 15-November 20) and low-use seasons (November 21-May 14). Since SEDAR 16 in 2008, SEFSC personnel have disaggregated the TPWD seasonal estimates into waves (2 month periods) using the TPWD intercept data. This was done 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

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are associated with private boats fishing in bay/pass, as these trips represent most of the fishing effort. Charter boat trips in ocean waters are the least encountered in the survey. Additional information on the TPWD survey can be found in SEDAR 70-WP-03.

4.3.3 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 boat modes of fishing are sampled. The program is comprised of three separate surveys: a shoreside intercept survey, a private telephone survey, and a for-hire telephone survey. The 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 survey samples from a list of people who possess either a LA fishing license or a LA offshore fishing permit and provided a valid telephone number. The for-hire telephone survey samples from a list of Louisiana's registered for-hire captains who provided a valid telephone number. Both telephone surveys are conducted weekly. Discard information has been collected since 2016 but only for a subset of finfish species; Scamp are not a target species of the LA Creel survey.

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 Mexico. 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 for ageing studies during dockside sampling events. 2) Information about total catch and effort are collected via the logbook, a form filled out by vessel personnel and containing total catch and effort data for individual trips. These logbooks are summarized by vessel to generate estimated landings by species, area, and time strata.

The SRHS began in 1972 in North Carolina and South Carolina. In 1975 the SRHS 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

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Florida, Alabama, Louisiana, and Texas. Mississippi was added to the survey in 2010. For SEDAR 68, only data from western Florida through Texas were included. Due to headboat area definitions and confidentiality issues, estimates of SRHS catch are combined for: (i) Texas, Louisiana, and Mississippi and (ii) Alabama and western Florida. The portion of the SRHS covering the Gulf of Mexico generally includes 70-80 vessels participating in the area annually.

Uncertainty

As an associated measure of uncertainty for landings estimates from the Southeast Region Headboat Survey (SRHS), the variance in reported landings from SRHS logbooks is computed at the vessel level for each area-month strata. Because the SRHS is designed to be a census, this calculation also includes a finite population correction factor where uncertainty equals zero when the entire headboat fleet is covered by the survey (i.e., reported landings = actual landings). Details of this approach are outlined in SEDAR 68-DW-31.

4.3.5 Headboat At-Sea Observer Survey

An observer survey of the recreational headboat fishery was launched in NC and SC in 2004 and in GA and FL in 2005 to collect more detailed information on recreational headboat catch, particularly for discarded fish. Sampling in western FL was discontinued in 2008 but started again in June 2009, and started to include sampling of the charter boat fleet. The coverage for both fleets continued through 2017. Headboat and charter boat vessels were randomly selected throughout the year in each state. Biologists board selected vessels with permission from the captain and observe anglers as they fish on the recreational trip. 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 68-DW-24).

4.4 RECREATIONAL LANDINGS

4.4.1 MRIP Landings

Weight Estimation

The Southeast Fisheries Science Center used the MRIP 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

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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.

Landing 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 68-DW-09 and by year in Table 5 of SEDAR 68-DW-09. Estimates are provided by year and mode for all Gulf of Mexico states from Texas to western Florida, excluding the Florida Keys. Final MRIP landings estimates in pounds whole weight are shown by year and state in Table 6 of SEDAR 68-DW-09 (MRIP landings for LA through 2003 and FLW to MS for all years).

4.4.2 TPWD Landings

TPWD average estimates from 1983 to 1985 (by wave and mode) are typically used to fill in the missing estimates for Texas charter boat and private boat fishing from 1981 until the survey starts in May 1983. However, due to sparse TPWD Scamp estimates in 1983-1985, Scamp landings between 1981 and May 1983 are considered negligible. TPWD estimates of Scamp landings from 1983 to 2018 are provided in Table 1 of SEDAR 68-DW-09.

4.4.3 LA Creel Landings

Starting in 2014, recreational data for Louisiana are only available from the LA Creel survey. LA Creel landings estimates for Louisiana Scamp (2014-2018) are provided in Table 1 of SEDAR 68-DW-09.

4.4.4 SRHS Headboat Logbook Landings

The headboat logbook has changed multiple times throughout the history of the SRHS. In the case of Scamp, both Scamp and Yellowmouth Grouper were included on the SRHS logbooks used throughout the Gulf since 1986.

Task 5: Since the SRHS has had a universal logbook form that included Scamp and Yellowmouth Grouper for all Gulf of Mexico headboat areas since 1986, the SRHS estimates for this assessment will start in 1986.

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Landing Estimates

Final SRHS landing estimates are shown in Table 4.12.1. Headboat landing estimates from 1981-1985 come from the MRIP survey for all states except Texas. Headboat landings for Texas 1981 to 1985 were estimated using a 5 year average (1986-1990) from SRHS Texas landings.

4.4.5 Historic Recreational Landings

Introduction

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

FHWAR Census Method

The 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (FHWAR) presents summary tables of U.S. population estimates, along with estimates of hunting and fishing participation and effort from surveys conducted by the US Fish and Wildlife Service every 5 years from 1955 to 1985 (SEDAR 68-DW-12). 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 Mexico saltwater anglers. The mean CPUE from the MRIP estimates from 1981 to 1985 for Scamp is then applied to the historical effort estimates for Gulf of Mexico anglers to provide estimates of recreational Scamp landings prior to 1981 (Table 4.12.2).

Task 6: Historical Scamp landings are available from 1955-1980

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- Option 1: Use historical Scamp landings from the FHWAR method (Table 4.12.2; 1955-1980) and non-historical Scamp landings estimates from the MRIP, SRHS, TPWD, and LA Creel surveys (1981-2018), shown in Figure 1 of SEDAR 68-DW-12.
- Option 2: Use only non-historical Scamp landings estimates (1981-2018)

The SEDAR 68 recreational working group recommended to include historical landings estimates from the FHWAR method (option 1) because this method has been accepted as a best practice for SEDARs and is the most representative method available for characterizing recreational landings prior to standardized data collection programs.

4.4.6 Total Recreational Landings

Combined landings estimates (MRIP, SRHS, TPWD, and LA Creel) are shown in Table 4.12.3, Figure 4.13.1, and mapped in Figure 4.13.2. The majority of the recreational Scamp landings in the Gulf of Mexico come from the private mode (about 65%). The charter boat mode contributes about 30% and the headboat mode is almost negligible (about 5%). Geographically, landings mostly come from West Florida (about 80%), followed by Alabama (about 10%). Scamp landings estimates show a major decline in the late 1980s and remained low throughout the 1990s. Scamp landings have generally increased since the early 2000s, with some decline in late 2000s and the most recent years.

Uncertainty

Task 7: To provide an associated measure of uncertainty for total recreational landings estimates, coefficients of variation (CVs) are calculated from the sum total of variance in reported SRHS logbook landings and MRIP landings data. Details of this approach are outlined in SEDAR 68-DW-31.

4.5 RECREATIONAL DISCARDS

4.5.1 MRIP Discards

Fish reported to have been discarded alive are not seen by MRIP interviewers and so neither the identity nor the quantities of discarded fish can be verified. The size and weight of discarded fish are also unknown for all modes of fishing. MRIP discard estimates and associated coefficients of

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variation, in numbers of fish, are shown by year and mode in Table 4 of SEDAR 68-DW-09 and by year in Table 5 of SEDAR 68-DW-09. Estimates are provided by year and mode for all Gulf of Mexico states from Texas to western Florida, excluding the Florida Keys.

The working group investigated the 2010 discards estimate, which is the highest estimate in the time series. The estimate of 232,070 fish for that year came primarily from West Florida, private mode, and ocean greater than 10 miles during two different waves:

- Wave 1- Six trips resulted in a discards estimate of 54,354 fish
    - Four trips released three live fish
    - Two trips released one live fish
- Wave 5- Seven trips resulted in a discards estimate of 93,486 fish
    - One trip released thirteen live fish
    - One trip released twelve live fish (and landed six fish, seen by an interviewer)
    - One trip released eleven live fish
    - Two trips released five live fish
    - One trip released five live fish (and landed two fish, seen by an interviewer)
    - One trip released one live fish

4.5.2 LA Creel Discards

Scamp are not a target species of the LA Creel survey and so discard estimates are not provided. However, since Louisiana MRIP discards from 1981 to 2013 are sparse and negligible relative to the Gulf-wide discards estimates, Louisiana Scamp discards since 2014 are also considered negligible.

4.5.3 TPWD Discards

Self-reported catch is not monitored by the TPWD survey and so Texas discards are not estimable from this survey (SEDAR 70-WP-03). Typically, MRIP/LA Creel discard ratios (Gulf-wide or LA) are applied to the TPWD landings as a proxy (SEDAR-PW-07). However, because Scamp landings from the TPWD are negligible, discards of Scamp from Texas are also assumed to be negligible.

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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 (2004-2018) or for a partial time series. In the Gulf of Mexico, the At-Sea Observer Survey operates mainly in west Florida, with limited coverage in Alabama in certain years. No trips were sampled in the At-Sea Observer Survey in 2008. In the SRHS, 14,204 Scamp logbook records were collected in the Gulf of Mexico from 2004-2018. Of these records, 6,181 trips reported discards of Scamp. In the At-Sea Observer Program, only 495 observed trips were positive for Scamp, 437 of which had Scamp discards. Due to the differences in magnitude of the number of trips sampled within the At-Sea Observer Program and SRHS, the discard proportion was compared only for those trips where Scamp were discarded. The SRHS and At-Sea Observer discard proportions exhibit the same pattern and degree of magnitude (SEDAR68-DW-33, 2020). Therefore, the SEDAR 68 recreational working group recommended using SRHS discard estimates for 2004-2018.

4.5.5 SRHS Headboat Logbook Discards

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

Due to the lack of a Scamp size limit in federal waters of the Gulf of Mexico, it is assumed that discards were negligible prior to 2000. Florida did have a size limit in the 1990s, however, an analysis of the length data showed no impact on the size distribution of the landings (discussed below in 4.6.1.4). The MRIP charter boat mode, MRIP private mode, and mean MRIP CH:SRHS discard ratio method (SEDAR 28 Assessment Workshop Report, 2013) were considered as

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sources for proxy discard estimates for headboat discards 2000-2003. Due to variability in the MRIP charter boat mode and private mode discard and landings estimates, a mean SRHS discard ratio method was also considered, as well as a three year rolling average of the MRIP charter boat mode and mean MRIP CH:SRHS discard ratio method (SEDAR68-DW-33).

Task 8: Proxy for estimated headboat discards from 2000-2003

- Option 1: Apply the MRIP private boat discard:landings ratio to estimated headboat landings to estimate headboat discards from 2000-2003.
- Option 2: Apply the MRIP charter boat discard:landings ratio to estimated headboat landings to estimate headboat discards from 2000-2003.
- Option 3: Apply a three year rolling average MRIP charter boat discard:landings ratio to estimated headboat landings to estimate headboat discards (2000-2003).
- Option 4: Mean MRIP CH:SRHS discard ratio method: Calculate the ratio of the mean ratio of SRHS discard:landings (2004-2018) and MRIP CH discard:landings (2004-2018). Apply this ratio to the yearly MRIP charter boat discard:landings ratio (2000-2003) to estimate the yearly SRHS discard:landings ratio (2000-2003). This ratio is then applied to the SRHS landings (2000-2003) to estimate headboat discards (2000-2003).
- Option 5: Apply a three year rolling average of the mean MRIP CH:SRHS discard ratio method to estimated headboat landings to estimate headboat discards (2000-2003).
- Option 6: Apply a mean SRHS discard:landings ratio (2004-2008) to estimated headboat landings to estimate headboat discards (2000-2003).
- Option 7: Apply a mean SRHS discard:landings ratio (2004-2018) to estimated headboat landings to estimate headboat discards (2000-2003).

For years prior to 2004, the working group recommended option 7 as a proxy method for SRHS headboat discards because the MRIP private and charter boat modes showed highly variable discard ratios which did not agree with the SRHS discard ratios and were not recommended for use. The variability within the MRIP charter boat mode discard ratios in turn affected the mean

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MRIP CH:SRHS discard ratio method. In an effort to reduce the variability of the MRIP charter boat mode and MRIP CH:SRHS discard ratio methods, a three year rolling average discard ratio from each method was applied to the SRHS landings estimates. A mean SRHS discard:landings ratio was also examined, using a mean of years 2004-2008 and 2004-2018. The MRIP charter boat mode three year rolling average, mean MRIP CH:SRHS discard ratio method three year rolling average, mean SRHS discard ratio (2004-2008), and mean SRHS discard ratio (2004-2018) were compared to the SRHS discard estimates (SEDAR68-DW-33). The cross correlation analysis was used to first determine if lagging the discard estimates with the landings would identify a stronger relationship (strong year class in one year (discards) could be seen in following years (landings)), and secondly provide an objective approach to identify a preferred recommendation. A lag of zero had the highest correlation for the Gulf of Mexico. The mean SRHS discard ratio (2004-2018) method had the strongest relationship with the landings with a lag of zero for the Gulf of Mexico. Therefore, the mean SRHS discard ratio (2004-2018) method was recommended as the proxy method for SRHS discard estimates.

Discard Estimates

Final estimated discards (2004-2018) are presented in Table 4.12.4 along with the proxy discard estimates (2000-2003). Discards of Scamp are nearly negligible west of Alabama. SRHS discards in FLW/AL vary through time and correspond to fluctuations in the SRHS landings and effort.

4.5.6 Total Recreational Discards

Combined discard estimates (MRIP, SRHS, TPWD, and LA Creel) are shown in Table 4.12.5, Figure 4.13.3, and mapped in Figure 4.13.4. Due to the recommendation for SRHS discards to start in 2000 (section 4.5.5), MRIP headboat discards from 1981-1985 were not included in the final discard estimates. The vast majority of the recreational discards in the Gulf of Mexico come from the private mode (about 95% of the discards by mode) and from West Florida (about 90% of the discards by state). Discard estimates for Scamp have generally increased since the late 1990s with considerable inter-annual variability.

4.6 BIOLOGICAL SAMPLING

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4.6.1 Landings

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 due to the time required to collect aging structures. Discarded fish size is unknown for all modes of fishing covered by MRIP.

Summaries of fish size for MRIP-sampled Scamp in the Gulf of Mexico by state (1981-2018) are provided in Table 4.12.6 (pounds whole weight) and Table 7 of SEDAR 68-DW-09 (millimeters fork length). Comparable summaries of fish size by mode are provided in Table 10 of SEDAR 68-DW-09 (pounds whole weight) and Table 9 of SEDAR 68-DW-09 (millimeters fork length). These summaries include the number of measured Scamp, number of angler trips from which Scamp were measured, and the minimum, average, and maximum size of all measured Scamp.

4.6.1.2 TPWD Biological Sampling

Length composition of the catch of Texas sport-boat anglers has been sampled by the TPWD since the high-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 a length-weight equation (SEDAR 70-WP-03).

Summaries of fish size, in millimeters total length, for TPWD-sampled Scamp in the Gulf of Mexico by mode (1983-2018) are provided in Table 12 of SEDAR 68-DW-09. These summaries include the number of measured Scamp, number of angler trips from which Scamp were measured, and the minimum, average, and maximum size of all measured Scamp.

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4.6.1.3 SRHS Biological Sampling

Lengths were collected by headboat dockside samplers beginning in 1972. From 1972 to 1975, only North Carolina and South Carolina were sampled whereas Georgia and northeast Florida sampling began in 1976. The SRHS conducted dockside sampling throughout the southeast portion of the US (from the NC-VA border to the Florida Keys) beginning in 1978. SRHS dockside sampling has been conducted in all Gulf states since 1986, except for Mississippi where sampling started in 2010. Weights are typically collected for the same fish measured during dockside sampling. Biological samples (scales, otoliths, spines, stomachs, and gonads) are also collected routinely and processed for aging, diet studies, and maturity studies.

Summaries of fish size, in kilograms whole weight, for SRHS-sampled Scamp in the Gulf of Mexico (1986-2018) are provided in Table 4.12.7. These summaries include the annual number of measured Scamp, the number of trips from which Scamp were measured, and the minimum, average, and maximum size of Scamp measured by SRHS dockside samplers.

Any existing total length measurements without an associated fork length measurement were converted using the following equation derived by the Life History Working Group for the Gulf of Mexico stock at the SEDAR 68 Data Workshop:

FL_mm=17.74+0.89*TL_mm

Any existing whole weight measurements without an associated fork length measurement were converted using the following equation derived by the Life History Working Group for the Gulf of Mexico stock at the SEDAR 68 Data Workshop:

$FL_mm = 417.17(WW_kg)^{0.31}$

4.6.1.4 Nominal Length Frequency Distributions of Landings

Task 9: Nominal length frequencies were generated for recreational data by mode and source. Length compositions were shown aggregated by management period for the headboat, charter boat, and private fleets. There were 4 distinct management periods for minimum size limits in Florida: (1) 1981-1989, no minimum size limits; (2) 1990-1999, 20” TL in state waters and no size limit in federal waters; (3) 2000-2003, 20” TL in state waters and 16” TL in federal waters; (4) 2004-2018, 16” TL size limit. These length compositions indicate that only the federal

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regulations had an impact on the length frequency distribution of Scamp and Yellowmouth Grouper landings in Florida (Figure 4.13.5). This is consistent with anecdotal knowledge that these species tend to be caught in deeper waters outside of state jurisdiction. The length frequencies pre- and post- federal size limit for the Gulf are provided by fleet in Figure 4.13.6.

4.6.1.5 Aging Data

Age samples are collected as part of the SRHS sampling protocol. Age samples collected from the private/rental boat, charter boat, and shore modes are not typically collected as part of the MRIP sampling protocol. These samples come from a number of sources including state agencies, special projects, and sometimes as add-ons to the MRIP survey. The number of Scamp aged from the recreational fishery by year, state, and mode is summarized in Table 4.12.8. The recreational landings ages will be weighted by the length frequency distributions by year and fleet.

4.6.2 Discards

4.6.2.1 Headboat At-Sea Observer Survey Biological Sampling

At-sea sampling of headboat (starting in 2005) and charter boat (starting in 2009) discards were initiated as part of the improved for-hire surveys to characterize the size distribution of live discarded fish in the headboat fishery.

4.6.2.2 Nominal Length Frequency Distributions of Discards

Length measurements from 1,684 discarded fish were used to generate headboat and charter boat discard length frequency distributions. The headboat length data were weighted by trip duration and region to account for differences in sampling frequency across the Gulf coast of Florida. Charter boat length data were not weighted. The distributions for the headboat and charter boat fleets are very similar, with both fleets showing that releases appear to be regulatory discards (Figure 4.13.7). The group recommended the use of the weighted length distribution for the headboat fleet, as it corrects for under or over-sampling. While the charter boat length data are un-weighted, they provide additional discard information for the charter boat fleet. A full accounting of the weighting procedure applied to the raw length data is provided in SEDAR 68-DW-24.

4.7 RECREATIONAL EFFORT

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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 and is provided by year in Table 13 of SEDAR 68-DW-09. This table includes MRIP effort estimates for Louisiana until 2013, Mississippi, Alabama, and western Florida, excluding the Florida Keys.

4.7.2 TPWD Effort

Texas effort estimates (in angler trips) are provided in Table 13 of SEDAR 68-DW-09 for years 1983-2018.

4.7.3 LA Creel Effort

Louisiana effort estimates (in angler trips) are provided by LA Creel for years 2014 to 2018 in Table 13 of SEDAR 68-DW-09.

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 collect these logbook trip reports and check for accuracy and completeness. Although reporting via the logbooks is mandatory, compliance is not 100% and is variable by location. To account for non-reporting, a correction factor is developed based on sampler observations, angler numbers from office books, and any available information. This information is used to provide estimates of total catch by month and area, along with estimates of effort.

In order to summarize recreational fishing effort across the Gulf of Mexico, SRHS effort estimates are also provided in 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).

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SRHS effort estimates (in angler days) are provided in Table 4.12.9. Estimated headboat angler days have increased in the Gulf of Mexico in recent years, following a decrease in effort which began with high fuel prices in both the South Atlantic and Gulf of Mexico in the 2000s (Table 4.12.9). This coupled with the economic downturn starting in 2008 and the Deepwater Horizon oil spill in 2010 resulted in a marked decline in angler days in the Gulf of Mexico headboat fishery. Reports from industry staff, captains/owners, and port agents indicated fuel prices, the economy and fishing regulations are the factors that most affected the number of trips, number of passengers, and overall fishing effort.

4.7.5 Total Recreational Fishing Effort

Combined effort estimates in angler trips (MRIP, SRHS, TPWD, and LA Creel) are shown by year and mode in Table 4.12.10, Figure 4.13.8, and mapped in Figure 4.13.9. These effort estimates depict all recreational fishing activity in the Gulf of Mexico and are not specific to Scamp. The vast majority (about 95%) of the general recreational fishing effort in the Gulf of Mexico comes from the private mode. Geographically, the majority of the fishing effort comes from West Florida, not including the Florida Keys (about 65%), followed by Louisiana (about 20%). Effort estimates have steadily increased until about the early-2010s, after which effort declined and has remained low. It is worth noting that the Louisiana effort estimates since 2014 have been collected under a different survey methodology.

4.8 COMMENTS OD ADEQUACY OF DATA FOR ASSESSMENT ANALYSES

Task 10: Regarding the adequacy of the available recreational data for assessment analyses, the recreational working group discussed the following:

- Catch estimates (landings and discards) appear to be adequate for the time period covered (1955-2018)
- 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 regulatory discards
- Uncertainty for total recreational landing estimates are considered adequate for use in this assessment.

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4.9 Itemized List of Tasks for Completion following Workshop

- Weighted length and age compositions will be completed for the Assessment Workshop

4.10 RESEARCH RECOMMENDATIONS

4.10.1 Research Recommendations for SEDAR 68

Task 11:

- Continue to develop methods to provide uncertainty estimates around landings and discard estimates
- Increase sampling of the recreational fishing fleet, particularly the charter boat and private angler sector, to improve discard data collection. Discard length data and discard mortality are two areas of importance that should be included.
- Investigate the implications of the MRIP imputed lengths and weighting factors for a range of data-rich to data-limited species, where the length frequency distributions become erratic

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4.12 TABLES

Table 4.12.1. Estimated SRHS headboat landings of Gulf of Mexico Scamp and Yellowmouth Grouper. Landings are provided in number of fish and pounds whole weight; CVs are not available in weight units. Due to headboat area definitions and confidentiality issues, estimates of SRHS catch are combined for: (i) Texas, Louisiana, and Mississippi and (ii) Alabama and western Florida.

	Number				Pounds		
Year	TX/LA/MS	FLW/AL	Total	CV	TX/LA/MS	FLW/AL	Total
1981	871		871		3,285		3,285
1982	871		871		3,285		3,285
1983	871		871		3,285		3,285
1984	871		871		3,285		3,285
1985	871		871		3,285		3,285
1986	1,397	5,866	7,263	0.058	3,942	14,053	17,995
1987	797	3,780	4,577	0.046	5,139	6,559	11,698
1988	1,121	2,278	3,399	0.049	4,150	4,395	8,545
1989	467	8,843	9,310	0.030	1,159	23,016	24,175
1990	677	1,711	2,388	0.033	2,339	4,594	6,933
1991	922	1,134	2,056	0.019	3,199	4,313	7,512
1992	709	902	1,611	0.011	1,529	2,679	4,208
1993	438	1,247	1,685	0.006	1,247	2,876	4,123
1994	356	781	1,137	0.040	1,445	1,493	2,938
1995	644	726	1,370	0.102	2,167	1,548	3,715
1996	479	334	813	0.069	1,811	674	2,484
1997	531	634	1,165	0.041	1,658	1,192	2,850
1998	456	785	1,241	0.026	2,589	2,474	5,063
1999	301	763	1,064	0.021	1,055	1,678	2,733
2000	281	747	1,028	0.030	1,530	2,876	4,406
2001	337	279	616	0.032	1,110	665	1,775
2002	388	317	705	0.046	1,281	542	1,823
2003	246	429	675	0.026	1,067	801	1,867
2004	307	1,008	1,315	0.063	754	2,254	3,007
2005	307	768	1,075	0.018	868	1,365	2,233
2006	273	316	589	0.040	1,983	594	2,576
2007	169	499	668	0.042	688	1,668	2,356
2008	173	435	608	0.016	1,019	1,049	2,068
2009	220	378	598	0.005	543	877	1,420
2010	451	541	992	0.005	2,802	1,089	3,891
2011	312	503	815	0.000	1,675	2,722	4,396
2012	204	892	1,096	0.000	1,397	2,239	3,636
2013	231	1,157	1,388	0.001	1,627	2,834	4,461
2014	377	1,723	2,100	0.000	2,709	4,253	6,962
2015	389	2,224	2,613	0.000	2,867	6,376	9,242
2016	486	1,244	1,730	0.000	2,952	2,818	5,769
2017	499	1,038	1,537	0.000	2,302	2,023	4,325
2018	651	1,215	1,866	0.000	4,629	3,089	7,718

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Table 4.12.2. Estimated historical recreational landings for Scamp and Yellowmouth Grouper in the Gulf of Mexico 1955-1980 (CV=0.67).

Year	Number
1955	18,673
1956	20,667
1957	22,661
1958	24,655
1959	26,649
1960	28,642
1961	29,599
1962	30,555
1963	31,511
1964	32,467
1965	33,423
1966	34,447
1967	35,470
1968	36,494
1969	37,518
1970	38,541
1971	42,117
1972	45,693
1973	49,268
1974	52,844
1975	56,420
1976	56,648
1977	56,877
1978	57,105
1979	57,334
1980	57,563

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Table 4.12.3. Total recreational landings estimates (AB1) for Gulf of Mexico Scamp and Yellowmouth Grouper combined across all surveys (MRIP, SRHS, TPWD, and LA Creel) by year and mode in numbers of fish. The associated coefficients of variation (CV) are provided for total recreational catch (in numbers). Annual landings are also provided in pounds whole weight (lbs); CVs are not available in weight units.

Year	Hbt	Cbt	Priv	Total	CV	lbs
1981	7,211	10,137	37,194	54,542	0.50	103,469
1982	9,222	13,353	80,044	102,620	0.34	228,909
1983	13,650	20,432	16,305	50,387	0.52	205,864
1984	4,478	5,768	0	10,246	0.46	35,583
1985	4,433	5,714	11,386	21,533	0.63	76,658
1986	7,263	22,873	24,902	55,038	0.28	221,874
1987	4,577	10,150	58,366	73,093	0.60	290,968
1988	3,399	11,175	28,352	42,926	0.26	153,563
1989	9,310	12,590	6,021	27,921	0.25	110,112
1990	2,388	6,450	74	8,912	0.65	30,565
1991	2,056	5,170	9,703	16,929	0.63	55,704
1992	1,611	10,118	3,534	15,262	0.33	64,930
1993	1,685	14,397	9,036	25,119	0.40	132,689
1994	1,137	12,769	99	14,005	0.53	56,008
1995	1,370	4,296	34	5,700	0.49	19,432
1996	813	12,281	32	13,126	0.55	47,088
1997	1,165	10,200	4,519	15,885	0.33	107,305
1998	1,241	20,104	629	21,974	0.20	140,080
1999	1,064	26,794	12,935	40,794	0.27	161,466
2000	1,028	5,297	5,265	11,591	0.34	48,313
2001	616	10,311	3,263	14,190	0.20	66,219
2002	705	10,832	13,631	25,168	0.27	94,570
2003	675	11,725	33,667	46,067	0.50	159,813
2004	1,315	31,443	20,665	53,423	0.25	140,523
2005	1,075	17,904	43,379	62,358	0.47	172,859
2006	589	17,974	87,416	105,979	0.77	326,910
2007	668	11,912	28,549	41,129	0.30	104,987
2008	608	9,168	50,681	60,457	0.46	250,828
2009	598	12,582	36,665	49,845	0.55	203,628
2010	992	6,260	21,147	28,399	0.45	93,336
2011	815	14,872	29,077	44,764	0.26	114,936
2012	1,096	11,210	64,982	77,288	0.34	235,918
2013	1,388	14,262	62,888	78,538	0.25	270,883
2014	2,100	18,497	57,838	78,436	0.28	274,026
2015	2,613	13,668	92,326	108,607	0.52	355,556
2016	1,730	24,430	44,122	70,282	0.32	255,152
2017	1,537	14,916	31,528	47,981	0.41	199,274
2018	1,866	7,121	47,118	56,105	0.33	239,033

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Table 4.12.4. Estimated SRHS headboat discards of Gulf of Mexico Scamp and Yellowmouth Grouper. Discards are provided in number of fish. Due to headboat area definitions and confidentiality issues, estimates of SRHS catch are combined for: (i) Texas, Louisiana, and Mississippi and (ii) Alabama and western Florida.

Year	TX/LA/MS	FLW/AL	Total
1986	0	0	0
1987	0	0	0
1988	0	0	0
1989	0	0	0
1990	0	0	0
1991	0	0	0
1992	0	0	0
1993	0	0	0
1994	0	0	0
1995	0	0	0
1996	0	0	0
1997	0	0	0
1998	0	0	0
1999	0	0	0
2000	0	1,811	1,811
2001	0	676	676
2002	0	768	768
2003	0	1,040	1,040
2004	1	1,609	1,610
2005	0	685	685
2006	42	427	469
2007	14	657	671
2008	24	2,775	2,799
2009	6	2,676	2,682
2010	3	1,757	1,760
2011	88	1,848	1,936
2012	5	1,904	1,909
2013	17	1,878	1,895
2014	17	2,953	2,970
2015	0	3,500	3,500
2016	6	1,874	1,880
2017	0	1,689	1,689
2018	3	2,173	2,176

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Table 4.12.5. Total recreational discard estimates (B2) for Gulf of Mexico Scamp and Yellowmouth Grouper combined across all surveys (MRIP, SRHS, TPWD, and LA Creel) by year and mode in numbers of fish. The associated coefficients of variation (CV) are provided for total recreational discards (in numbers).

Year	Hbt	Cbt	Priv	Total	CV
1981	0	0	0	0	0.00
1982	0	1,411	50,137	51,548	0.43
1983	0	1,089	0	1,089	0.62
1984	0	1,389	0	1,389	0.63
1985	0	7,453	0	7,453	0.66
1986	0	30,041	24,077	54,118	0.67
1987	0	605	823	1,428	0.72
1988	0	323	3,378	3,701	0.92
1989	0	1,858	0	1,858	0.68
1990	0	4,395	36,301	40,696	0.66
1991	0	0	3,128	3,128	1.00
1992	0	4,443	27,406	31,849	0.54
1993	0	2,723	37,345	40,068	0.52
1994	0	2,007	10,786	12,792	0.71
1995	0	1,922	2,859	4,780	0.63
1996	0	114	816	930	0.88
1997	0	3,554	3,471	7,025	0.63
1998	0	1,661	2,884	4,545	0.51
1999	0	661	8,983	9,645	0.57
2000	1,811	2,153	61,616	65,579	0.87
2001	676	3,792	51,082	55,550	0.74
2002	768	8,637	11,268	20,673	0.36
2003	1,040	5,886	164,133	171,059	0.42
2004	1,610	20,433	156,051	178,094	0.33
2005	685	6,051	20,881	27,617	0.33
2006	469	1,650	17,476	19,596	0.48
2007	671	6,408	82,688	89,767	0.33
2008	2,799	9,896	104,783	117,478	0.37
2009	2,682	5,081	138,261	146,024	0.50
2010	1,760	7,153	224,917	233,830	0.40
2011	1,936	1,698	29,744	33,378	0.46
2012	1,909	1,370	183,013	186,292	0.68
2013	1,895	3,009	25,356	30,260	0.53
2014	2,970	5,941	119,954	128,865	0.32
2015	3,500	5,988	178,674	188,162	0.53
2016	1,880	17,399	41,688	60,967	0.36
2017	1,689	5,222	71,870	78,780	0.67
2018	2,176	2,181	8,669	13,026	0.76

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Table 4.12.6. Summary of weight measurements (pounds whole weight) from MRIP-intercepted Scamp and Yellowmouth Grouper by state and year. Summaries include the number of fish weighed by MRIP (Fish), the number of angler trips from which those fish were weighed (Trp), and the minimum (Min), geometric mean (Avg), and maximum (Max) size of fish weights. MRIP catch estimates for western Florida exclude the Florida Keys. LA weights are available from MRIP only until 2013.

	LA					MS					AL					FLW				
Year	Fish	Trp	Min	Avg	Max	Fish	Trp	Min	Avg	Max	Fish	Trp	Min	Avg	Max	Fish	Trp	Min	Avg	Max
1981	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	1	1	6.6	6.6	6.6	49	21	0.9	1.9	11.5
1982	0	0	0.0	0.0	0.0	25	4	1.0	1.3	2.2	9	4	0.9	1.7	5.5	18	16	0.7	3.0	10.4
1983	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	1	1	4.9	4.9	4.9	28	21	0.9	4.3	10.9
1984	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	16	8	1.1	2.8	6.3
1985	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	11	11	0.9	4.9	8.9
1986	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	78	45	0.5	3.9	8.1
1987	2	1	0.4	0.8	1.1	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	35	23	0.7	3.7	11.5
1988	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0	3	0.0	0.0	0.0	15	20	0.6	2.5	5.4
1989	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	1	2	2.0	2.0	2.0	23	11	0.7	4.3	8.2
1990	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	4	3	1.3	3.4	5.9
1991	5	2	1.6	2.2	2.9	0	0	0.0	0.0	0.0	1	1	7.6	7.6	7.6	11	6	1.3	3.3	7.9
1992	4	4	2.4	3.1	3.4	0	0	0.0	0.0	0.0	12	6	2.1	5.0	9.2	21	10	1.9	4.6	11.4
1993	1	1	2.8	2.8	2.8	0	0	0.0	0.0	0.0	3	2	3.7	5.7	8.0	46	11	1.2	4.9	17.1
1994	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	1	1	2.3	2.3	2.3	21	9	1.1	4.1	10.3
1995	1	1	4.4	4.4	4.4	0	0	0.0	0.0	0.0	1	1	4.3	4.3	4.3	2	2	1.2	2.5	3.9
1996	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	1	1	2.2	2.2	2.2	5	3	3.7	5.7	9.0
1997	3	2	9.5	10.7	12.9	0	0	0.0	0.0	0.0	1	1	8.3	8.3	8.3	76	27	2.0	6.9	16.6
1998	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	7	5	0.7	5.5	12.1	159	65	1.1	6.1	17.1
1999	6	5	2.3	7.0	16.0	0	0	0.0	0.0	0.0	6	3	3.6	16.0	28.5	299	86	0.8	3.8	15.5
2000	4	3	1.6	14.7	28.6	0	0	0.0	0.0	0.0	4	4	1.4	2.7	5.7	125	68	0.6	4.0	16.2
2001	3	3	1.7	8.8	19.1	0	0	0.0	0.0	0.0	9	6	1.4	4.3	10.0	269	77	1.1	4.6	18.1
2002	9	6	2.5	5.8	10.5	0	0	0.0	0.0	0.0	14	10	0.9	4.1	18.7	310	114	0.8	3.7	15.3
2003	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	13	12	1.4	3.1	4.7	379	125	0.8	3.5	17.4
2004	4	3	1.8	2.3	3.3	0	0	0.0	0.0	0.0	69	22	1.0	3.5	16.6	645	255	1.0	2.9	18.5
2005	13	5	1.9	3.9	10.1	0	0	0.0	0.0	0.0	47	27	1.3	2.5	16.9	460	182	1.0	3.0	18.6
2006	33	12	1.2	5.6	17.1	0	0	0.0	0.0	0.0	40	15	1.1	2.6	7.7	299	119	1.2	3.0	19.5
2007	3	3	1.7	1.8	2.1	0	0	0.0	0.0	0.0	28	13	1.2	3.2	5.5	241	114	1.4	3.0	16.3
2008	7	3	1.8	3.3	4.2	0	0	0.0	0.0	0.0	11	5	1.4	2.9	6.0	165	72	1.3	3.6	11.7
2009	1	1	3.6	3.6	3.6	0	0	0.0	0.0	0.0	1	1	1.7	1.7	1.7	127	50	1.5	4.2	13.4

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	LA					MS					AL					FLW				
Year	Fish	Trp	Min	Avg	Max	Fish	Trp	Min	Avg	Max	Fish	Trp	Min	Avg	Max	Fish	Trp	Min	Avg	Max
2010	7	2	1.8	5.2	12.9	0	0	0.0	0.0	0.0	7	7	1.3	2.2	4.5	101	56	1.2	3.3	13.5
2011	9	1	3.5	4.0	5.1	0	0	0.0	0.0	0.0	27	14	1.7	2.5	4.4	373	131	1.2	2.6	9.5
2012	25	7	2.5	5.3	11.7	0	0	0.0	0.0	0.0	5	5	2.0	3.2	4.9	185	91	1.4	3.1	12.0
2013	9	4	2.3	6.7	16.5	5	1	5.2	8.3	14.4	28	14	1.6	3.6	8.3	87	31	1.4	3.4	10.2
2014						0	0	0.0	0.0	0.0	25	13	1.4	4.1	14.0	123	53	1.1	3.3	10.7
2015						0	0	0.0	0.0	0.0	36	15	1.4	4.2	11.0	128	61	1.5	3.2	12.5
2016						0	0	0.0	0.0	0.0	20	7	0.9	4.0	7.2	145	52	1.3	4.3	12.3
2017						0	0	0.0	0.0	0.0	24	10	1.8	5.0	8.8	41	23	1.5	4.2	10.8
2018						1	1	3.1	3.1	3.1	43	10	2.2	4.2	8.3	27	14	1.5	4.4	10.8

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Table 4.12.7. Summary of weight measurements (kilograms whole weight) from SRHS-intercepted Scamp and Yellowmouth Grouper by state and year. Summaries include the number of fish weighed by SRHS (Fish), the number of angler trips from which those fish were weighed (Trips), and the geometric mean (Mean), minimum (Min), and maximum (Max) size of fish weights.

	TX/LA/MS					FLW/AL					Gulf of Mexico				
YEAR	Fish (n)	Trips (n)	Mean (kg)	Min (kg)	Max (kg)	Fish (n)	Trips (n)	Mean (kg)	Min (kg)	Max (kg)	Fish (n)	Trips (n)	Mean (kg)	Min (kg)	Max (kg)
1986	79	60	1.25	0.23	5.80	98	67	1.42	0.23	6.30	177	127	1.34	0.23	6.05
1987	49	35	1.97	0.21	18.60	98	67	1.32	0.30	4.92	147	102	1.65	0.25	11.76
1988	16	16	1.51	0.26	4.41	72	60	1.10	0.21	4.48	88	76	1.31	0.24	4.45
1989	19	17	1.21	0.40	7.46	185	84	1.08	0.28	9.90	204	101	1.14	0.34	8.68
1990	24	17	1.46	0.32	4.73	99	38	1.29	0.27	7.36	123	55	1.38	0.30	6.05
1991	6	5	0.49	0.41	0.57	43	21	1.58	0.28	4.52	49	26	1.03	0.35	2.55
1992	27	21	0.90	0.41	2.87	36	24	1.29	0.26	4.39	63	45	1.09	0.34	3.63
1993	10	9	1.37	0.61	3.18	38	24	0.99	0.42	4.82	48	33	1.18	0.52	4.00
1994	33	23	1.56	0.52	3.58	44	33	0.83	0.36	4.35	77	56	1.20	0.44	3.97
1995	28	21	1.56	0.43	4.12	40	30	1.11	0.35	5.27	68	51	1.33	0.39	4.70
1996	13	11	2.60	0.50	9.90	40	26	0.93	0.45	2.71	53	37	1.76	0.48	6.31
1997	12	10	1.25	0.36	5.19	19	15	0.86	0.38	3.98	31	25	1.06	0.37	4.59
1998	12	11	3.34	0.77	8.78	25	17	1.25	0.60	4.14	37	28	2.30	0.69	6.46
1999	12	10	1.66	0.47	4.58	26	19	0.94	0.35	1.97	38	29	1.30	0.41	3.28
2000	2	2	2.14	1.08	3.19	33	22	1.78	0.50	7.77	35	24	1.96	0.79	5.48
2001	6	6	2.18	0.68	3.82	21	17	1.12	0.55	2.04	27	23	1.65	0.62	2.93
2002	4	4	1.33	0.58	2.07	40	18	0.99	0.49	8.14	44	22	1.16	0.54	5.11
2003	11	7	1.97	0.63	4.69	154	50	0.88	0.19	7.58	165	57	1.42	0.41	6.14
2004	5	5	0.88	0.49	1.28	41	31	1.03	0.63	6.81	46	36	0.96	0.56	4.05
2005	6	6	2.12	0.84	3.94	22	13	0.80	0.59	1.33	28	19	1.46	0.72	2.64
2006	10	8	2.48	1.27	4.86	42	28	0.93	0.49	2.48	52	36	1.70	0.88	3.67
2007	5	3	1.98	1.46	2.32	58	38	0.92	0.59	2.99	63	41	1.45	1.03	2.66
2008	3	1	4.46	2.63	5.90	38	26	1.03	0.64	4.17	41	27	2.74	1.64	5.04
2009	5	4	1.96	1.15	2.77	36	20	0.93	0.64	1.79	41	24	1.44	0.90	2.28
2010	4	3	3.21	1.12	5.86	46	29	0.90	0.21	2.02	50	32	2.05	0.67	3.94
2011	1	1				59	35	0.97	0.33	3.19	60	36	0.97	0.33	3.19
2012	44	31	2.99	0.05	10.49	53	31	1.30	0.14	5.43	97	62	2.15	0.10	7.96
2013	48	27	2.66	0.63	6.10	38	24	1.41	0.39	5.09	86	51	2.04	0.51	5.60
2014	51	30	1.89	0.43	6.20	24	18	1.89	0.69	11.86	75	48	1.89	0.56	9.03
2015	69	36	3.03	0.62	8.35	35	23	1.23	0.60	3.91	104	59	2.13	0.61	6.13
2016	66	31	3.17	0.77	7.16	19	15	1.18	0.39	4.30	85	46	2.18	0.58	5.73
2017	48	26	2.55	0.30	6.60	18	12	0.97	0.53	2.23	66	38	1.76	0.41	4.42
2018	71	33	2.58	0.60	7.49	23	15	1.35	0.55	5.01	94	48	1.96	0.58	6.25

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Table 4.12.8. Number of age samples (number of trips intercepted) from the recreational fishery by year, state and mode.

	Charter boat			Private		Headboat			
Year	**LA**	**AL**	**FL**	**AL**	**FL**	**TX**	**LA**	**AL**	**FL**
1979									11 (5)
1980			9 (5)						17 (10)
1981			12 (4)						
1986						19 (15)			9 (7)
1987						5 (4)			2 (2)
1988						4 (3)			8 (7)
1989									19 (12)
1990						1 (1)			3 (3)
1991			5 (4)			2 (1)			16 (14)
1992			10 (10)		1 (1)	9 (6)	3 (3)		39 (27)
1993			10 (6)			12 (8)			18 (15)
1994			59 (22)			18 (11)	4 (2)		31 (24)
1995			51 (16)			2 (2)			30 (24)
1996			113 (34)		5 (1)		1 (1)		37 (25)
1997			27 (10)		1 (1)				21 (13)
1998			47 (15)						6 (6)
1999			45 (18)		2 (1)				5 (4)
2000	1 (1)		3 (3)					3 (2)	4 (3)
2001			6 (4)						2 (2)
2002			52 (22)		7 (3)			1 (1)	23 (7)
2009		4 (2)		1 (1)					
2010		3 (3)		1 (1)					1 (1)
2011		19 (15)							1 (1)
2012						1 (1)			
2013			111 (53)			15 (10)	13 (3)	12 (6)	24 (17)
2014			121 (56)		14 (6)	21 (13)	3 (2)	9 (5)	13 (10)
2015			148 (76)		17 (13)	25 (18)		4 (3)	41 (29)
2016		17 (5)	158 (50)		26 (12)	14 (11)	10 (3)	7 (6)	34 (13)
2017			71 (30)		5 (4)	4 (3)		4 (4)	44 (23)
2018			28 (20)		4 (4)				22 (16)
2019			3 (2)						

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Table 4.12.9. Estimated SRHS headboat effort (in angler days) for Gulf of Mexico anglers. Due to headboat area definitions and confidentiality issues, estimates of SRHS effort are combined for: (i) Louisiana and Mississippi and (ii) Alabama and western Florida.

Year	TX	LA/MS	FLW/AL	Total
1986	56,568	5,891	240,077	302,536
1987	63,363	6,362	217,049	286,774
1988	70,396	7,691	195,948	274,035
1989	63,389	2,867	208,325	274,581
1990	58,144	6,898	213,906	278,948
1991	59,969	6,373	174,312	240,654
1992	76,218	9,911	184,802	270,931
1993	80,904	11,256	207,898	300,058
1994	100,778	12,651	204,562	317,991
1995	90,464	10,498	182,410	283,372
1996	91,852	10,988	154,913	257,753
1997	82,207	9,008	149,442	240,657
1998	77,650	7,854	185,331	270,835
1999	58,235	8,026	176,117	242,378
2000	58,395	4,952	159,331	222,678
2001	55,361	6,222	157,243	218,826
2002	66,951	6,222	141,831	215,004
2003	74,432	6,636	144,211	225,279
2004	64,990	0	158,430	223,420
2005	59,857	0	130,233	190,090
2006	70,789	5,005	124,049	199,843
2007	63,764	2,522	136,880	203,166
2008	41,188	2,945	130,176	174,309
2009	50,737	3,268	142,438	196,443
2010	47,154	715	111,018	158,887
2011	47,284	3,657	157,025	207,966
2012	51,776	3,680	161,975	217,431
2013	55,749	3,406	174,731	233,886
2014	51,231	3,257	191,365	245,853
2015	55,135	3,587	194,383	253,105
2016	54,083	2,955	199,978	257,016
2017	51,575	3,189	196,657	251,421
2018	52,160	3,235	191,847	247,242

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Table 4.12.10. Total recreational fishing effort (in angler trips) for Gulf of Mexico anglers by mode and year (MRIP, SRHS, TPWD, and LA Creel). MRIP headboat estimates are used from 1981-1985 and SRHS from 1986+. The combined private-shore mode in the LA Creel survey is allocated as private fishing.

Year	Cbt	Hbt	Priv	Total
1981	393,653	184,590	9,788,741	10,366,984
1982	523,703	260,912	11,539,636	12,324,250
1983	577,982	256,493	14,486,938	15,321,413
1984	538,634	242,211	14,092,265	14,873,111
1985	590,627	277,516	15,254,933	16,123,076
1986	568,071	330,173	14,774,401	15,672,645
1987	589,079	351,541	14,797,442	15,738,062
1988	514,257	359,278	17,206,317	18,079,852
1989	598,554	358,847	16,639,761	17,597,162
1990	582,562	374,904	17,643,786	18,601,252
1991	538,436	318,585	17,342,858	18,199,879
1992	562,637	343,636	17,960,471	18,866,744
1993	632,103	362,102	18,369,691	19,363,896
1994	674,540	390,133	18,879,440	19,944,112
1995	767,107	364,384	19,483,060	20,614,552
1996	728,968	337,152	19,486,760	20,552,880
1997	775,426	299,961	20,868,517	21,943,905
1998	770,950	326,333	22,378,087	23,475,370
1999	785,377	219,374	24,652,366	25,657,117
2000	764,302	298,776	24,235,439	25,298,517
2001	779,587	271,970	26,736,316	27,787,873
2002	747,306	260,044	25,968,811	26,976,162
2003	705,784	276,561	26,781,055	27,763,400
2004	784,050	275,804	30,051,274	31,111,128
2005	693,307	240,459	29,101,391	30,035,158
2006	824,855	248,496	27,001,186	28,074,537
2007	867,716	329,881	27,430,701	28,628,298
2008	815,284	214,982	29,704,327	30,734,593
2009	777,345	264,403	28,971,676	30,013,424
2010	598,246	209,111	30,041,475	30,848,832
2011	761,822	281,137	30,443,129	31,486,088
2012	942,070	301,077	31,766,244	33,009,390
2013	872,550	293,420	29,690,881	30,856,851
2014	864,446	312,881	23,290,379	24,467,706
2015	994,732	320,287	22,093,560	23,408,580
2016	1,058,564	326,815	23,433,797	24,819,176
2017	1,092,177	321,252	24,321,168	25,734,596
2018	1,230,739	316,205	22,674,462	24,221,405

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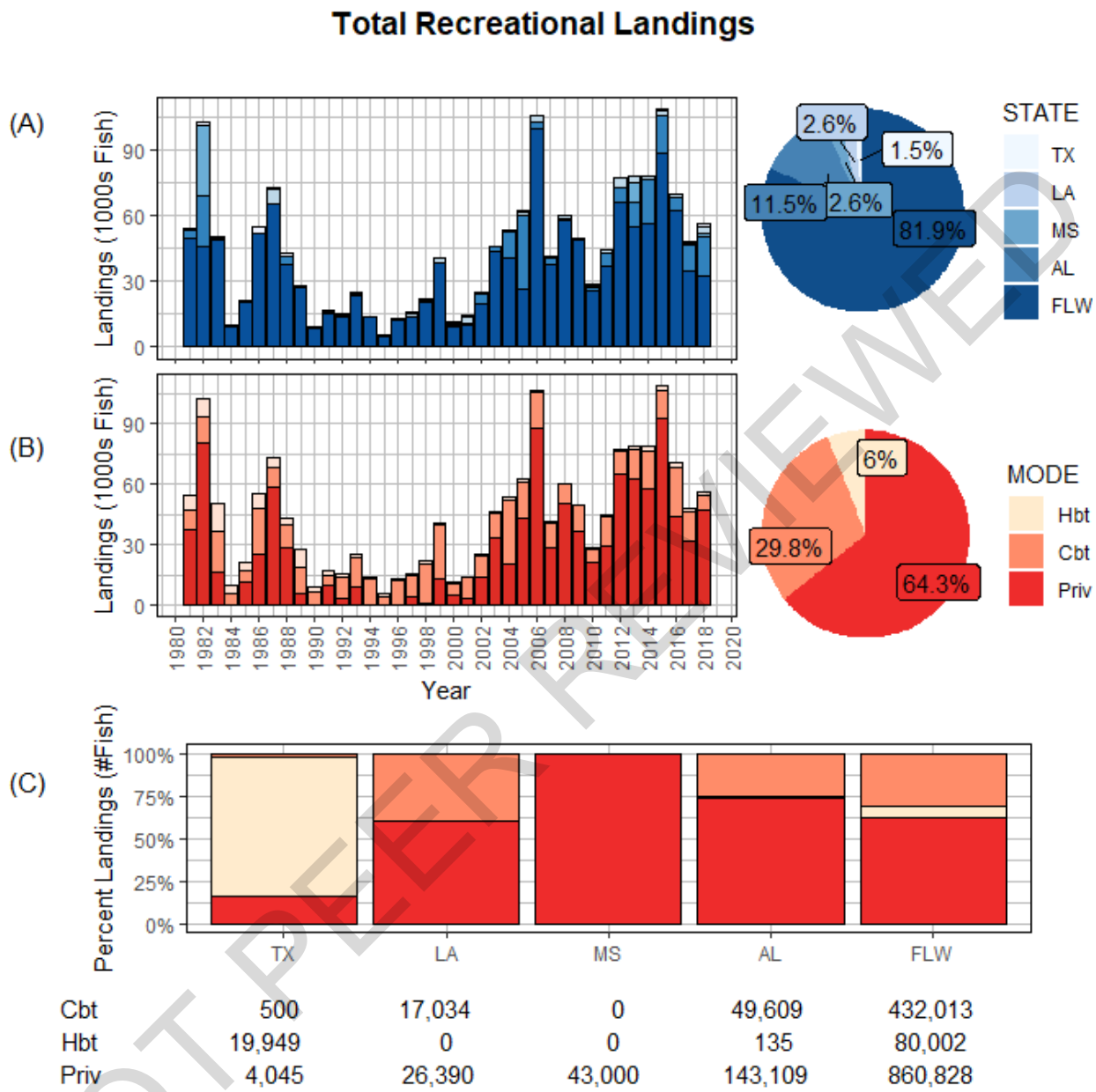
4.13 FIGURES



	TX	LA	MS	AL	FLW
Cbt	500	17,034	0	49,609	432,013
Hbt	19,949	0	0	135	80,002
Priv	4,045	26,390	43,000	143,109	860,828

Figure 4.13.1. Total recreational landings (AB1) for Gulf of Mexico Scamp and Yellowmouth Grouper across all surveys (MRIP, SRHS, TPWD, and LA Creel). Landings are provided (A) by state and year (1981-2018) in thousands of fish, (B) by mode and year in thousands of fish, and (C) by mode and state in numbers of fish (as a percentage). MRIP landings estimates for western Florida exclude the Florida Keys. Due to headboat area definitions and confidentiality issues, estimates of SRHS landings are combined for: (i) Texas, Louisiana, and Mississippi and (ii) Alabama and western Florida, which are allocated as (i) Texas and (ii) western Florida landings respectively. MRIP headboat estimates are used from 1981-1985 and SRHS from 1986+. The combined private-shore mode in the LA Creel survey is allocated as private fishing.

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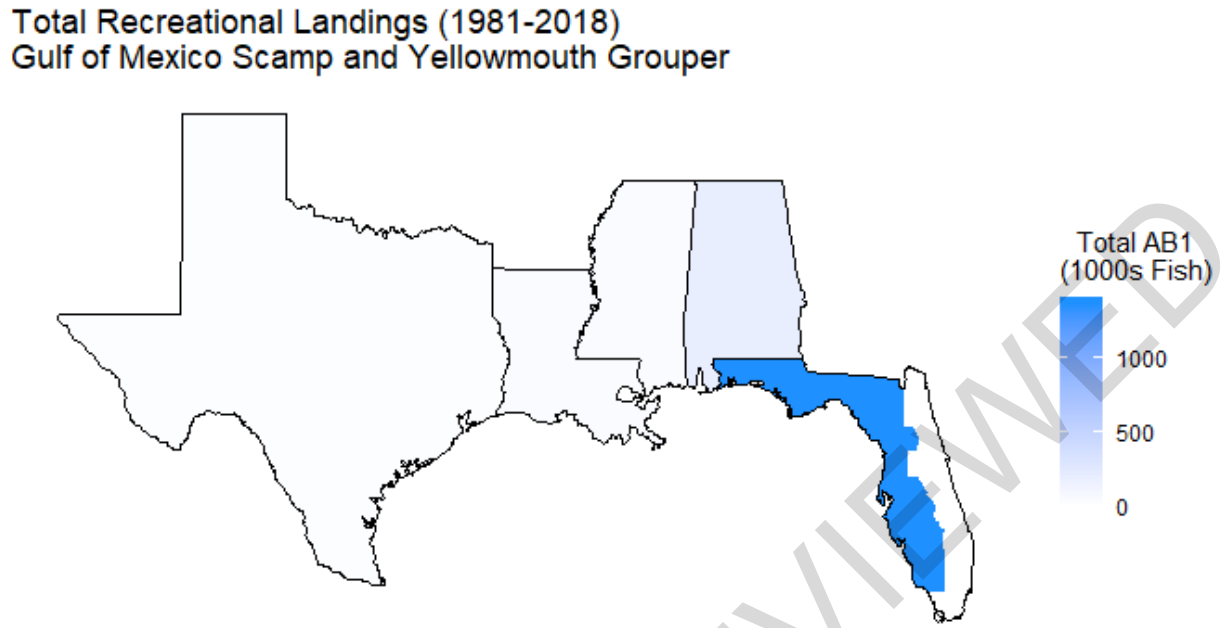

Figure 4.13.2. Distribution of total recreational landings (AB1), in thousands of fish, for Scamp and Yellowmouth Grouper across the Gulf of Mexico. Estimates are combined across all surveys (MRIP, SRHS, TPWD, and LA Creel) and years (1981-2018). MRIP landings estimates for western Florida exclude the Florida Keys. Due to headboat area definitions and confidentiality issues, estimates of SRHS landings are combined for: (i) Texas, Louisiana, and Mississippi and (ii) Alabama and western Florida, which are allocated as (i) Texas and (ii) western Florida landings respectively.

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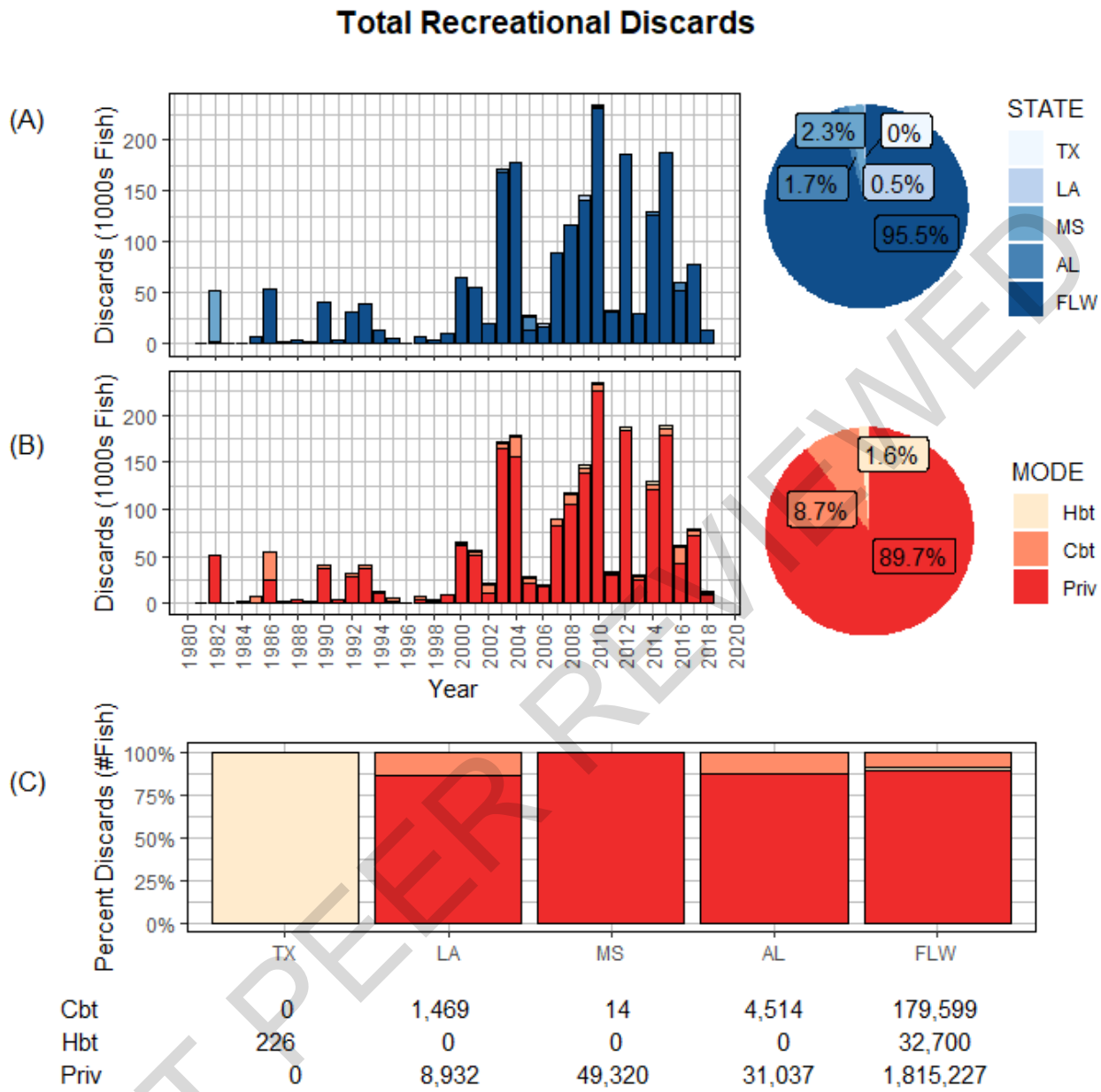

Figure 4.13.3. Total recreational discards (B2) for Gulf of Mexico Scamp and Yellowmouth Grouper across all surveys (MRIP, SRHS, TPWD, and LA Creel). Discards are provided (A) by state and year (1981-2018) in thousands of fish, (B) by mode and year in thousands of fish, and (C) by mode and state in numbers of fish (as a percentage). MRIP discards estimates for western Florida exclude the Florida Keys. Due to headboat area definitions and confidentiality issues, estimates of SRHS discards are combined for: (i) Texas, Louisiana, and Mississippi and (ii) Alabama and western Florida, which are allocated as (i) Texas and (ii) western Florida discards respectively. MRIP headboat estimates are used from 1981-1985 and SRHS from 1986+. The combined private-shore mode in the LA Creel survey is allocated as private fishing.

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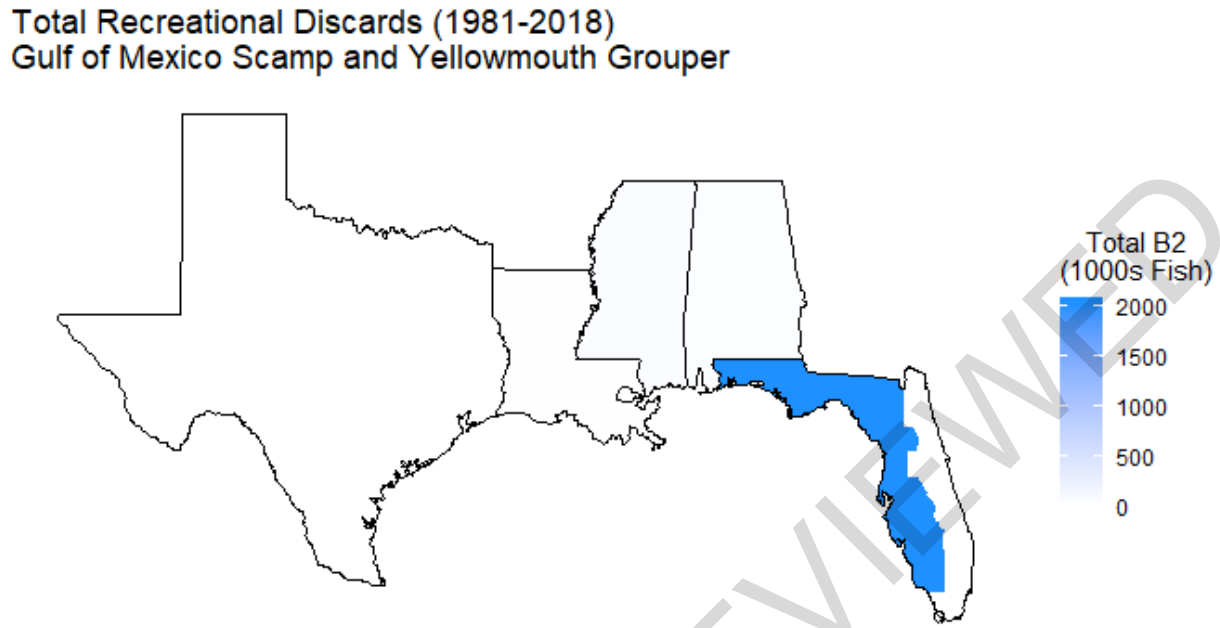

Figure 4.13.4. Distribution of total recreational discards (B2), in thousands of fish, for Scamp and Yellowmouth Grouper across the Gulf of Mexico. Estimates are combined across all surveys (MRIP, SRHS, TPWD, and LA Creel) and years (1981-2018). MRIP discards estimates for western Florida exclude the Florida Keys. Due to headboat area definitions and confidentiality issues, estimates of SRHS discards are combined for: (i) Texas, Louisiana, and Mississippi and (ii) Alabama and western Florida, which are allocated as (i) Texas and (ii) western Florida discards respectively.

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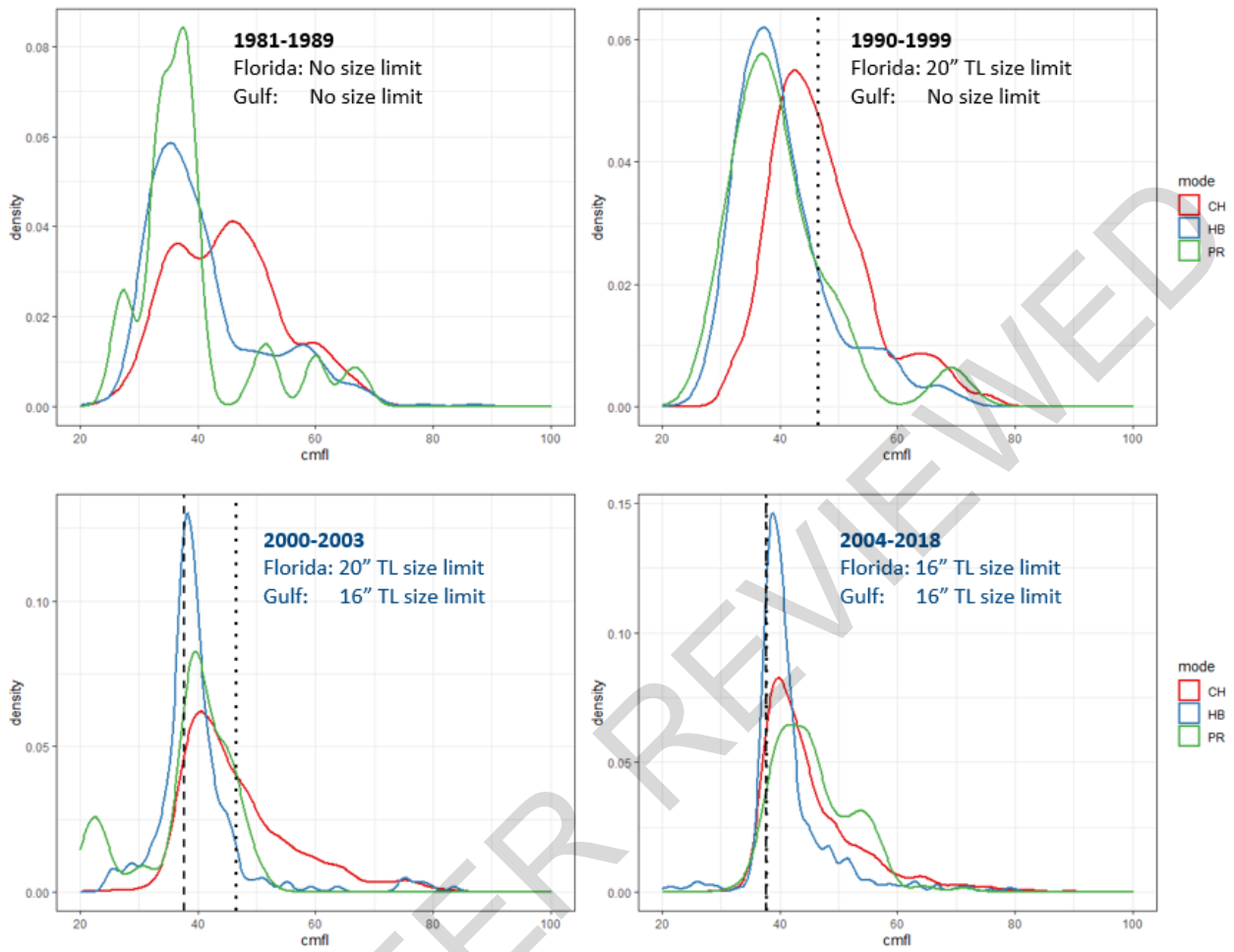

Figure 4.13.5. Florida landings length frequency distributions of recreational fleets (CH=Charter boat, PR=Private, HB=Headboat) by management period. The top two panels represent a single management period, and the bottom two show the impacts of the federal 16" TL size limit.

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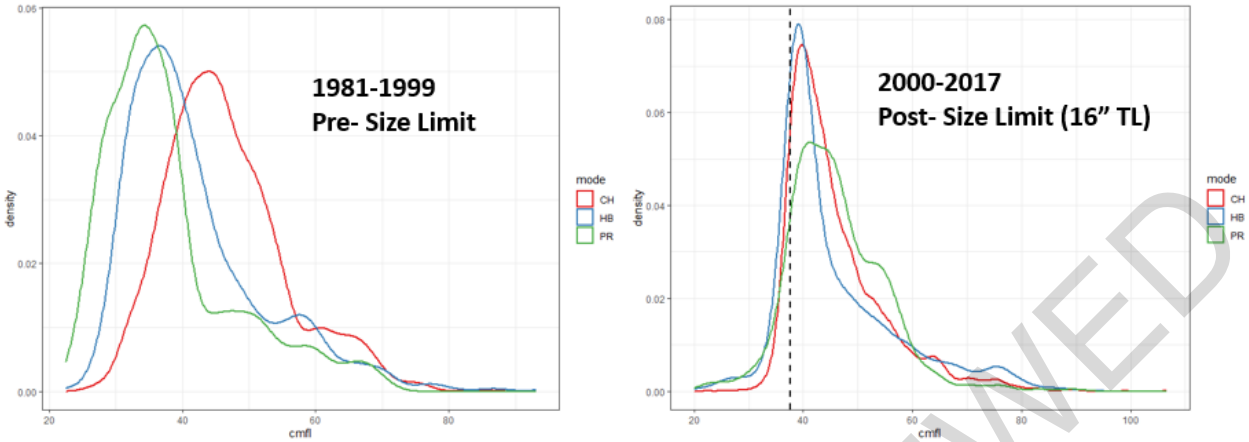

Fishing Mode	Mean	Variance	n
Charter boat	46.58	81.24	850
Private	37.95	99.48	124
Headboat	41.88	108.17	1285

Fishing Mode	Mean	Variance	n
Charter boat	45.90	79.45	4435
Private	45.91	74.65	436
Headboat	45.73	126.36	1164

Figure 4.13.6. Length frequency distributions of recreational landings by mode (CH=Charter boat, PR=Private, HB=Headboat) pre- and post- size limit. Mean, variance, and sample size (n) are included for each time period.

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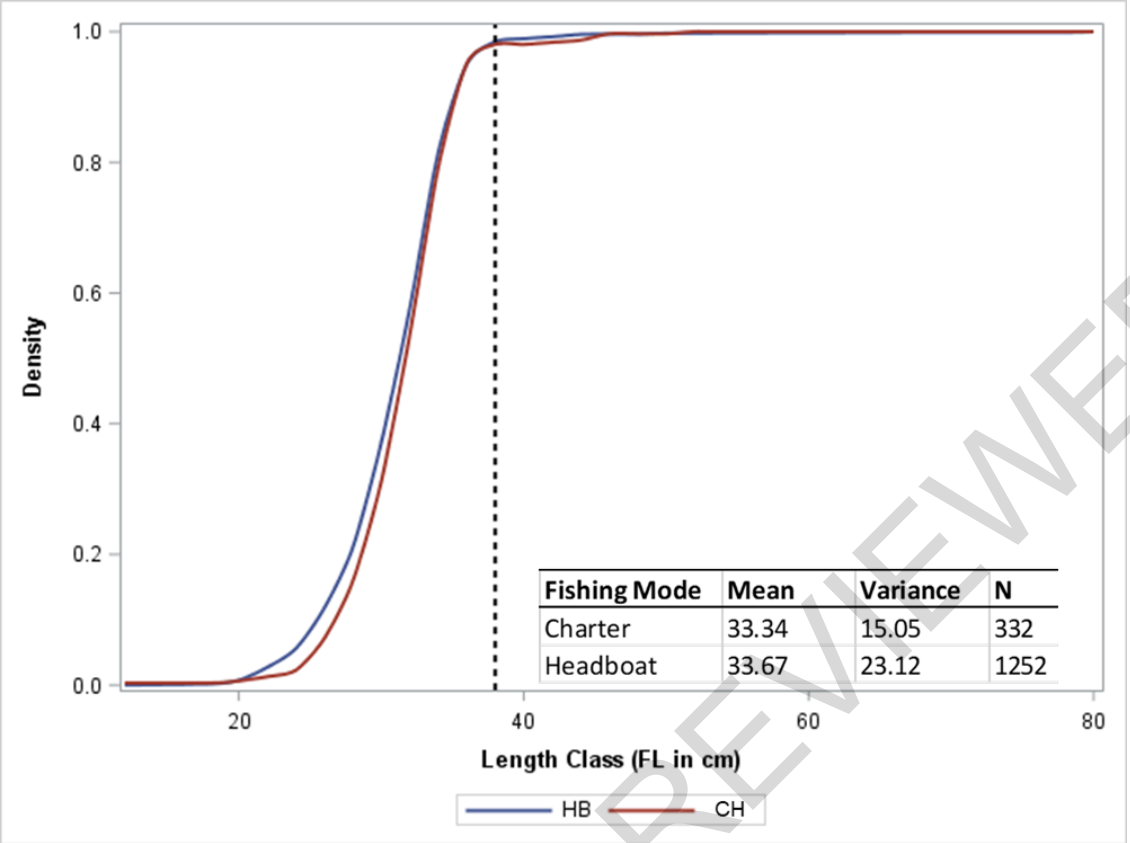

Figure 4.13.7. Cumulative frequency distribution for Scamp and Yellowmouth Grouper discard lengths collected from the Gulf of Mexico headboat and charter boat fisheries from 2005 to 2017, all years combined. The dotted line represents the fork length associated with the current Gulf of Mexico recreational minimum size limit of 16 inches total length.

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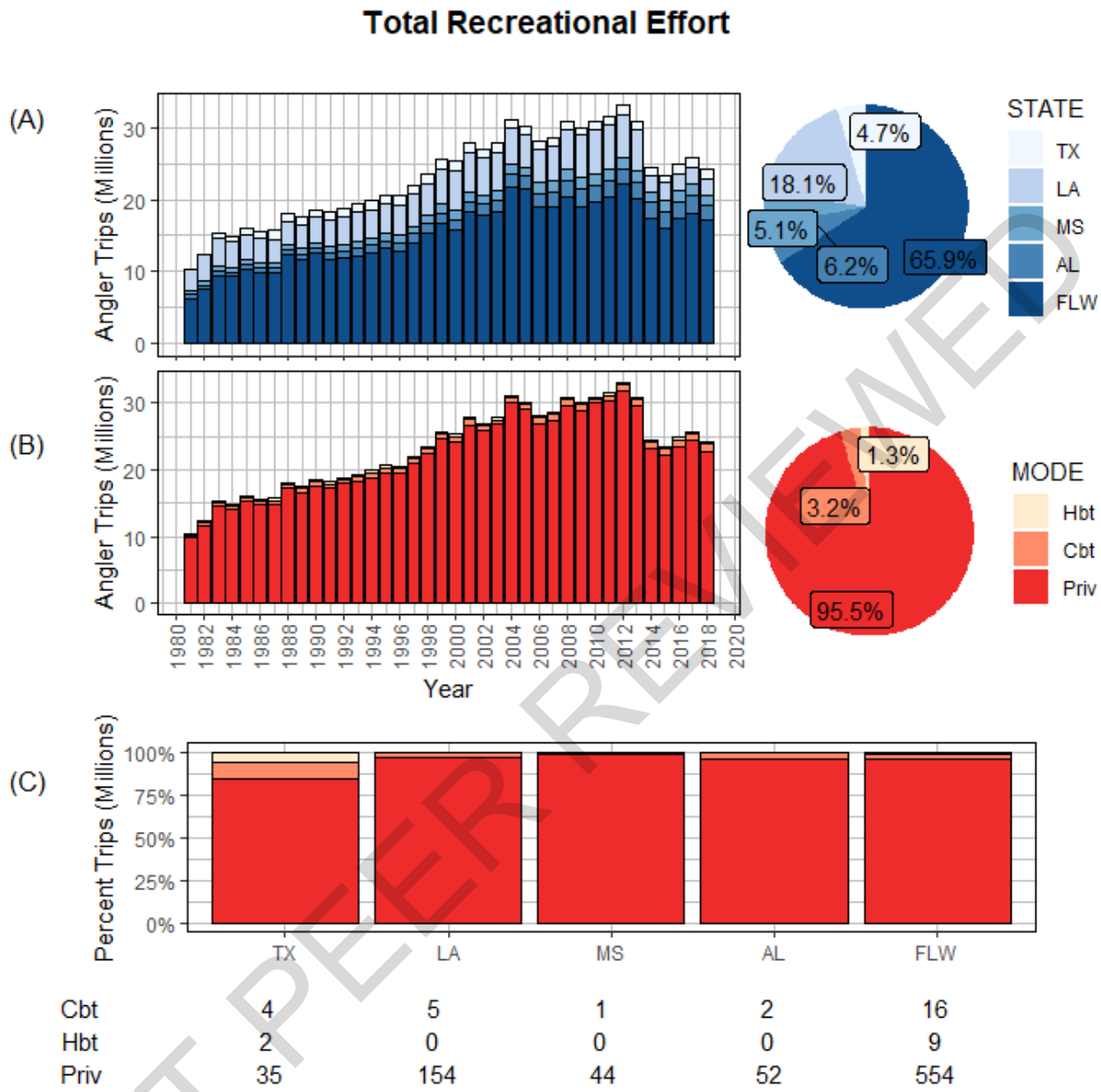

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Figure 4.13.8. Total recreational fishing effort for Gulf of Mexico anglers in millions of angler trips (MRIP, SRHS, TPWD, and LA Creel). Effort is provided (A) by state and year (1981-2018), (B) by mode and year, and (C) by mode and state (as a percentage). MRIP effort estimates for western Florida exclude the Florida Keys. Due to headboat area definitions and confidentiality issues, estimates of SRHS effort are combined for: (i) Louisiana and Mississippi and (ii) Alabama and western Florida, which are allocated as (i) Louisiana and (ii) western Florida effort respectively. MRIP headboat estimates are used from 1981-1985 and SRHS from 1986+. The combined private-shore mode in the LA Creel survey is allocated as private fishing.

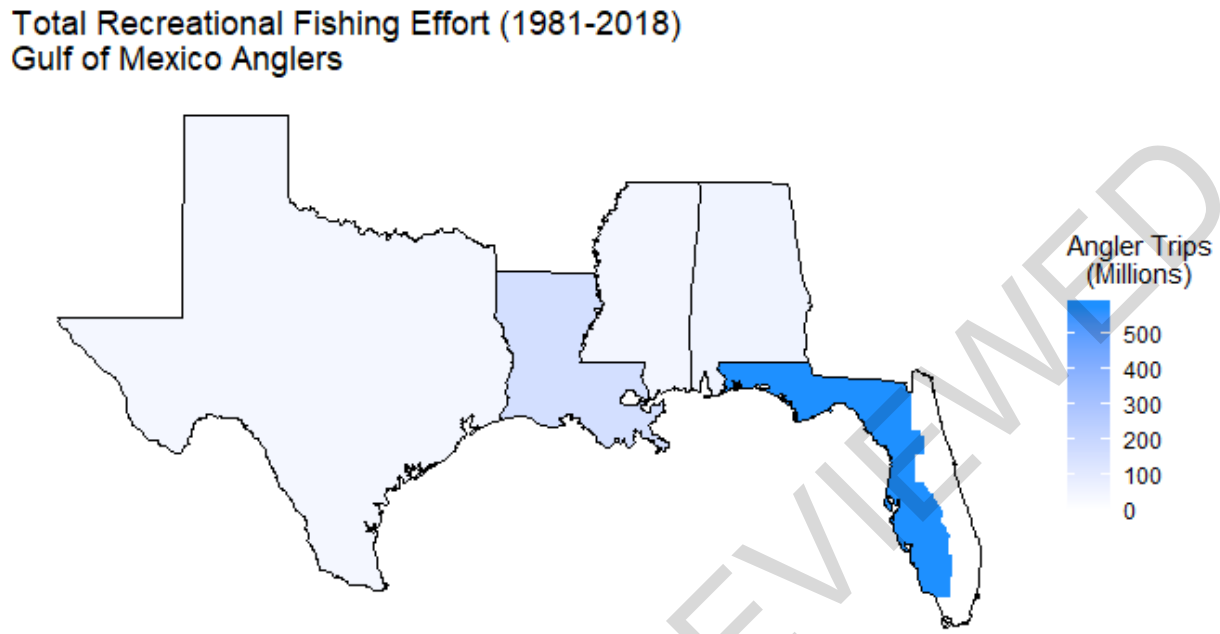

Figure 4.13.9. Distribution of total recreational fishing effort by Gulf of Mexico anglers. Estimates are combined across all surveys (MRIP, SRHS, TPWD, and LA Creel) and years (1981-2018). MRIP effort estimates for western Florida exclude the Florida Keys. Due to headboat area definitions and confidentiality issues, estimates of SRHS effort are combined for: (i) Louisiana and Mississippi and (ii) Alabama and western Florida, which are allocated as (i) Louisiana and (ii) western Florida effort respectively.

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5 INDICES OF POPULATION ABUNDANCE

5.1 OVERVIEW

For the Gulf of Mexico (GOM) U.S. region, three fishery-independent data sets were considered for use in developing an index of abundance (Table 5.1). Only one was retained for use in this assessment following discussions at the DW, the combined video survey.

For the GOM U.S. region, seven fishery-dependent data sets were considered for use in developing an index of abundance (Table 5.1). Ultimately, the DW recommended indices from three of these fishery-dependent data sets for potential use in the assessment model: recreational

headboat logbook index, commercial pre-Individual Fishing Quota (pre-IFQ) vertical line logbook index, and a novel reef-fish observer index characterizing the commercial vertical line fishery. An emerging fishery dependent, video and electronic monitoring survey conducted by Mote Marine Laboratory was also presented; however, the limited time series prevented consideration of this index for this assessment. This data source was presented during this research track as an introduction for future assessments, with its utility likely to increase as its spatial coverage increases and additional years of data are collected.

In total, the DW recommended one fishery-independent index (combined video survey) and three fishery-dependent indices (recreational headboat index, commercial pre-IFQ vertical line index, and reef-fish observer index) for potential use in the Scamp and Yellowmouth Grouper stock assessment. These indices are listed in Table 5.1, with pros and cons of each in Table 5.2.

5.1.1 Group membership

Membership of this DW Index Working Group (IWG) included Nate Bacheler, Wally Bubley, Rob Cheshire, Eric Fitzpatrick, Chris Gardner, Robert Leaf, Kevin McCarthy, Kate Overly, Will Patterson, Skyler Sagarese, Alexei Sharov, Kyle Shertzer, Tracy Smart, Ted Switzer, Kevin Thompson and Jim Tolan. Several other DW panelists and observers contributed to the IWG discussions throughout the Data Workshop webinars.

5.2 REVIEW OF WORKING PAPERS

The relevant working papers describing index construction were presented to the IWG (SEDAR 68-DW-06, SEDAR 68-DW-07, SEDAR 68-DW-14, SEDAR 68-DW-18, SEDAR 68-DW-29, and the observer index WP, SEDAR 68-DW-XX). In most cases, the IWG recommended modifications to the initial modeling attempts, such that data treatments and/or model specifications were updated during the DW. Final working papers reflect decisions made during the DW, using addenda if necessary.

The index working papers provide information on methodology, sample sizes, diagnostics of model fits, and in some cases, maps of catch and effort. A summary of each index is provided below.

5.3 FISHERY-INDEPENDENT INDICES

5.3.1 Combined stereo-video index

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Historically, three different stationary video surveys were conducted for reef fish in the GOM. The NMFS SEAMAP reef fish video survey, carried out by NMFS Mississippi Laboratory (Pascagoula), has the longest running time series (1993-1997, 2002, and 2004+) on primarily deep, high relief habitats. This was followed by the NMFS Panama City lab survey (PC; 2005+), with the most recent survey being the Florida Fish and Wildlife Research Institute video survey (FWRI, starting year 2010; Table 1 in SEDAR68-DW-07). While the surveys use standardized deployment, camera field of view, and fish abundance methods to assess fish abundance on reef or structured habitat, there are variations in survey design and habitat characteristics collected in addition to the time period and area sampled. Traditionally each survey has submitted independent indices, however, combining indices across datasets likely increases predictive capabilities by allowing for the largest possible sample sizes in model fitting and encompassing a greater proportion of the distribution of the stock. Previous research has indicated that combining data across changing spatial areas and surveys and using a year only model, can yield spurious conclusions regarding stock abundance (Campbell 2004; Ye et al. 2004). As such, a habitat-based approach was used to combine relative abundance data for generating annual trends for Scamp throughout the GOM.

5.3.1.1 Methods of Estimation

Data Filtering

For all surveys, video reads were excluded if they were unreadable due to turbidity or deployment errors. For the Pascagoula survey, data included in this index are from 1993 and on, due to different counting methods in 1992. The entire spatial extent of the Panama City data was used from 2006 on with 2005 excluded because of an incomplete survey. For the FWRI data, prior to 2010 was excluded due to the earlier years not including side-scan geoform as a variable which was determined to be important as an explanatory variable in the analyses. FWRI data were spatially limited to zones 4 and 5 due to the other areas of the WFS not having enough years of sampling. These zones represent key areas where Scamp are caught (SEDAR68-SID-05).

For this assessment, the Stock ID Workshop and initial scoping calls indicated that data should be combined for Scamp and the congener Yellowmouth Grouper (*Mycteroperca interstitialis*) due to difficulties distinguishing them apart across all gears and surveys. As such, the MaxN

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values used were the sum of Scamp and Yellowmouth Grouper. However, counts of Yellowmouth Grouper were rare in the PC and FWRI survey (less than 3 observations total) so they were excluded for those datasets. Pascagoula's survey had more occurrences of Yellowmouth Grouper or fish deemed to be either Yellowmouth or Scamp (45 occurrences for a total of 52 fish) and therefore these observations were included in analyses.

Model Description

Response and explanatory variables

The response variable, MaxN, is the maximum number of individuals of each species viewed in a single frame within a 20-minute time frame for each site sampled.

Years-categorical from 1993-2018

Survey-the categorical survey that the site was part of; Pascagoula East, Pascagoula West, Panama City, and FWRI

Hab- categorical variable designating the quality of the habitat for each site as Fair, Good or Poor. Assigned by individual survey CART analyses using several variables regarding space, habitat at the landscape level, and localized, visual described habitats (e.g. presence of sponge). Variables were across surveys however some were survey specific. Additional details are provided in SEDAR68-DW-07.

Standardization

The index was fit using a Generalized Linear Model (GLM) with a negative binomial distribution. The estimated MaxN means provided by the GLM were adjusted to account for the variation in survey area, differences in area mapped with known habitat, and the distribution of Fair, Good, and Poor habitats by survey by year. The known potential survey universe for each of the three surveys was first multiplied by the proportion of habitat mapping grids that had reef habitat to provide an area weight. This was then multiplied by each year x Survey x hab combination (up to 12 for the final years with three surveys and three habitat levels), providing a weighting factor for each of the mean estimates. Weighted index values were then standardized to the grand mean.

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5.3.1.2 Sampling Intensity

The resulting data set used in creating this index was over 10,000 video samples, with larger sample sizes in later years as surveys were added to the time series. Sets with Scamp present were between ~15% and 40% depending upon the year (Table 5.3).

5.3.1.3 Size/Age data

Collection and processing of fish length measurements have varied through time for the surveys. Starting with the Pascagoula survey in 1995, fish lengths were measured from video using lasers attached on the camera system with known geometry. The Panama City survey also used this laser-based approach from 2007 to 2009. However, the frequency of hitting targets with the laser was low and to increase sample size any measurable fish during the video read was measured (i.e. not just at the MaxN). Therefore, fish could have potentially been measured twice. Subsequent years from 2008 in Pascagoula and 2010 in Panama City used a stereo-video approach, which is the only method used in the entirety of the FWRI dataset. Vision Measurement System (VMS, Geometrics Inc.) was used to estimate size of fish up to 2014 for all three surveys and all switched to SeaGIS software (SeaGIS Pty. Ltd.) and have used them for the remainder of the timeseries. Length composition data were compared across the surveys to check that similar sized fish were targeted by each survey. No age data are collected during video surveys.

5.3.1.4 Catch Rates

Standardized catch rates and associated error bars are shown in Figure 5.1 and tabulated in Table 5.3. The unit of annual abundance is average MaxN for each year, relativized to the grand mean.

5.3.1.5 Uncertainty and Measures of Precision

Annual CVs of MaxN were calculated from the weighted model standard errors and means and are tabulated in Table 5.3.

5.3.1.6 Comments on Adequacy for Assessment

The index of abundance created from the combined stereo video survey was considered by the IWG to be adequate for use in the assessment. Initial presentations of this index only included data from the eastern GOM, following previous assessments where this approach has been applied with species that were not abundant in the western GOM (e.g., Red Grouper, SEDAR61)

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or were assessed with two regional sub models (e.g., Vermilion Snapper, SEDAR67). As such, following discussions in the IWG, this index was adjusted for the first incorporation of western GOM data from the Pascagoula survey along with the standard eastern Pascagoula, Panama City and FWRI datasets. Following this adjustment, the opinions of the IWG were that this index was of significant value given the fishery-independent nature of the data, its lengthy time series, geographic scope and gear that allowed for the largest possible range of fish lengths to be observed on a wide variety of habitats. Further details regarding sampling and model fitting, especially regarding survey-specific habitat models can be reviewed in SEDAR 68-DW-07.

5.4 FISHERY-DEPENDENT INDICES

In general, indices derived from fishery-independent surveys are believed to represent abundance more accurately than those from fishery-dependent data sources. This is because fishery-dependent indices can be strongly affected by factors other than abundance, such as management regulations on the focal or other species, shifts in targeting, changes in fishing efficiency (technology creep), and density-dependent catchability (hyperdepletion or hyperstability). The standardization procedures attempt to account for some of these issues to the extent possible.

5.4.1 Recreational Headboat Index

Rod and reel catch and effort from party (head) boats in the GOM have been monitored by the NMFS Southeast Region Headboat Survey (conducted by the NMFS Beaufort Laboratory) since 1986. The Headboat Survey collects data on the catch and effort for a vessel trip. Reported information includes landing date and location, vessel identification, the number of anglers, a single fishing location (10’ x 10’ rectangle of latitude and longitude) for the entire trip, trip duration and/or type (half/three-quarter/full/multi-day, day/night, morning/afternoon), and catch by species in number and weight. These data were used to construct an index of Scamp and Yellowmouth Grouper catch rates in the GOM. The index was constructed using Generalized Linear Models, and a delta-lognormal approach.

Catch per unit effort (CPUE) for each trip was estimated as the number of Scamp and Yellowmouth Grouper landed on a trip divided by the fishing effort, where effort was the product of the number of anglers and the total hours fished. To estimate effort for each trip type

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(i.e., trip duration), the following assumptions were adopted: Half day trip = 5 hours fished; Three-quarter day trip = 7.5 hours fished, and Full day trip = 10 hours fished.

5.4.1.1 Methods of Estimation

Data Filtering

Observations were included from all states across the GOM and from half-day trips, three-quarter day trips, and full-day trips. Data were excluded from analyses for vessels that had fewer than 30 trips in the headboat logbook database and for trips with six or fewer anglers. Trips with possible errors in catch and effort information and trips during the closed season for shallow-water groupers were excluded. Lastly, the top 0.5% of values for catch, CPUE, and the number of anglers were excluded from analyses.

The Stephens and MacCall (2004) approach was used to restrict the dataset to trips that likely encountered Scamp and Yellowmouth Grouper. This approach uses the species composition of each trip in a logistic regression of species presence/absence to infer if effort on a given trip occurred in habitat similar to that preferred by Scamp and Yellowmouth Grouper. This approach was applied separately for the Eastern and Western U.S. GOM due to suspected differences in species compositions between regions. In applying the Stephens and MacCall (2004) approach, the species considered in this analysis were limited to reef fish species that were on the headboat logbook forms across all years and species without seasonal or quota closures in recent years.

Standardization

A two-stage delta-lognormal generalized linear model (GLM; Lo et al. 1992) was used to develop standardized catch rate indices. This method combines two separate GLM analyses of the proportion of trips that caught at least one Scamp and Yellowmouth Grouper (i.e., proportion of positive trips) and the catch rates of the positive trips to construct a single standardized index of abundance. A forward stepwise approach was used during the construction of each GLM. The factors in the table below were examined as possible influences on the proportion of positive trips, and the catch rates on positive trips.

Submodel Variables

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Factor	DF	Details
Year	32	1986-2017
Season	4	Dec-Feb, Mar-May, Jun-Aug, Sep-Nov
Area	4	CenTX_SWTX, NWFL_AL, NWTX_LA, SW_FL
Trip Type*	3	Full day, Half day, Three quarter day
Anglers*	7	7-10, 11-20, 21-30, 41-50, 51-60, 61+

*Only explored as factors for modeling success because these factors were confounded with effort for the CPUE response variable in the lognormal model.

Once a set of fixed factors was identified, first level interactions were examined. YEAR*FACTOR interaction terms were included in the model as random effects. The final delta-lognormal model was fit using the SAS macro GLIMMIX (glmm800MaOB.sas: Russ Wolfinger, SAS Institute) and the SAS procedure PROC MIXED (SAS Institute Inc. 1997) following the procedures by Lo et al. (1992). The variation in catch rates by vessel was examined using a "repeated measures" approach (Littell et al., 1998). The term 'repeated measures' refers to multiple measurements taken over time on the same experimental unit (i.e. vessel). Specifying the repeated measure "VESSEL" and the subject "VESSEL(YEAR)" allows PROC MIXED to model the covariance structure of the data. This is particularly important because catch rates may vary by vessel and because catch rates by a given vessel that are close in time can have a higher correlation than those far apart in time (Littell et al., 1998).

Annual Abundance Indices

The final models for the binomial and lognormal components were:

Proportion Positive = YEAR

ln(CPUE) = YEAR + AREA + SEASON + YEAR*AREA

5.4.1.2 Sampling Intensity and Time Series

Table 5.4 shows the annual number of trips and the number of positive trips that were included in this analysis.

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5.4.1.3 Size/Age Data

Recreational size limits for Scamp have been in place since 1990 in Florida state waters, where the size limit remained at 20 inches total length (TL) until 2002. The federal size limit of 16 inches TL was imposed in late 1999. It is assumed that the size range of Scamp targeted by headboats is comprised of legal sized fish.

5.4.1.4 Catch Rates

Standardized catch rates are presented in Table 5.4 and Figure 5.2.

5.4.1.5 Uncertainty and Measures of Precision

Annual CVs of catch rates are presented in Table 5.4.

5.4.1.6 Comments on Adequacy for Assessment

The headboat index was deemed adequate for use in the assessment by the IWG. This decision was largely based on the long time series and large spatial coverage associated with the Headboat Survey, as this survey often represents the longest time series for GOM reef fish stocks. For Scamp, the lack of targeting by anglers suggests that this index may be reflective of abundance, which was a topic of discussion by the IWG. The final headboat index recommended for the GOM was based on improved data filtering and modifications to the trip selection approach as used in the South Atlantic region and detailed in SEDAR68-DW-18. Developing the GOM index using these enhanced procedures as applied in Beaufort was possible during this research track because time allowed a thorough comparison of how both NMFS Beaufort and NMFS Miami develop indices of abundance. Ultimately, and after confirming that there were no clear trends in nominal CPUE between the Eastern and Western GOM, the IWG supported the final headboat index discussed in SEDAR69-DW18.

Additional research was suggested, including the need to explore alternative trip selection approaches which may be more appropriate for the U.S. Gulf of Mexico and South Atlantic recreational fisheries.

5.4.2 Coastal Fisheries Logbook Program

The National Marine Fisheries Service (NMFS) collects information on catch and fishing effort from the commercial fishing industry in the Southeastern Region through the Southeast Fisheries

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Science Center's Coastal Fisheries Logbook Program (CFLP). Individuals who carry commercial federal fishing permits are required to provide information on their landings and fishing effort for each trip that they take. The CFLP in the GOM began in 1990 with the objective of a complete census of reef fish fishery permitted vessel activity. Florida was the exception, where a 20% sample of vessels was targeted. Beginning in 1993, the sampling in Florida was increased to require reports from all vessels permitted in the reef fish fishery and a complete census was obtained.

The CFLP collects data on the catch and effort for individual commercial fishing trips. Reported information includes a unique trip identifier, the landing date, fishing gear deployed, areas fished (equivalent to NMFS shrimp statistical grids), number of days at sea, number of crew, gear specific fishing effort, species caught and whole weight of the landings. Logbook data were used to characterize abundance trends of Scamp and Yellowmouth Grouper in the U.S. GOM, with catch-per-unit-effort (CPUE) calculated on an individual trip basis for each fishery.

The implementation of the Grouper-Tilefish Individual Fishing Quota (IFQ) program in 2010 by Amendment 29 aimed to reduce overcapacity of the grouper-tilefish fishing fleet, increase harvesting efficiency, and eliminate the race to fish. Additional information on the IFQ program can be found at the NMFS's Southeast Regional Office webpage on limited access programs at http://portal.southeast.fisheries.noaa.gov/cs/main.html. This major change to the fishery, which has been suggested to impact fishing behavior and potentially catchability, has resulted in the exploration and development of separate indices both pre- and post-IFQ for GOM reef fish in recent stock assessments (Red Grouper, SEDAR 42 and Gag Grouper, SEDAR 33).

Indices were developed for Scamp and Yellowmouth Grouper for both the pre-IFQ and IFQ time periods. Pre-IFQ indices were developed for the vertical line and longline fisheries separately for the years 1993 to 2009. Post-IFQ indices were developed for the vertical line and longline fisheries for the years 2010 to 2017. All indices used data from the Coastal Fisheries Logbook Program and were developed following standardization methodologies consistent with previous analyses for other GOM grouper species. Improved data filtering techniques and modifications to

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the trip selection approach were made as implemented in the South Atlantic region.

CFLP Data Filtering

General data exclusions using CFLP data for analyses were as follows:

12. Multiple areas fished may be recorded for a single fishing trip. In such cases, assigning catch and effort to specific locations was not possible; therefore, only trips in which one area fished was reported were included.

13. Multiple fishing gears may be recorded for a single fishing trip. In such cases assigning catch and effort to a particular gear type was not possible. Trips fishing multiple gears were excluded in these analyses.

14. Logbook reports submitted 45 days or more after the trip completion data were excluded due to the lengthy gap in reporting time.

5.4.3 Commercial Vertical Line

Electric reel (bandit) and manual handline were combined into a single vertical line fishery as they are often reported together on the same trip, or one gear may be reported in place of the other. As a result, it is not possible to apportion fishing effort separately by electric or manual handlines. Fishing effort data available for handline and electric reel (bandit gear) trips include the number of lines fished, total hours fished, and the number of hooks per line.

5.4.3.1 Methods of Estimation

Data Filtering Techniques

Data exclusions using CFLP data subset to vertical line trips for analyses (both pre- and post-IFQ where applicable) for Scamp and Yellowmouth Grouper were as follows:

A. Vertical line trips with reported fishing more than 24 hours per day were excluded.

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B. Trips that fell outside the 99.5th percentile were considered to represent mis-reported data or data entry errors and were excluded for the following variables: number of, number of hooks per line, the hours fished per day, number of hook hours, the number of days at sea (trip duration), and the number of crew members.

C. Seasonal closures and regulatory closures have been employed to manage the commercial shallow-water grouper fishery. Closures in the pre-IFQ period were implemented on the following dates: November 15, 2004 – December 31, 2004; and October 10, 2005 – December 31, 2005. The dataset was restricted to time periods for which fishing on Scamp and Yellowmouth Grouper was allowed.

D. No shallow-water grouper trip limits were reached between 2005 and 2008 in the pre-IFQ period.

The Stephens and MacCall (2004) multispecies approach was used to restrict the dataset to trips that likely encountered Scamp and Yellowmouth Grouper. This approach uses the species composition of each trip in a logistic regression of species presence/absence to infer if effort on that trip occurred in similar habitat occupied by Scamp and Yellowmouth Grouper. This approach was applied separately for the Eastern and Western GOM due to suspected differences in species compositions between regions. In applying the Stephens and MacCall (2004) approach, the species considered were limited to reef fish species. Lastly, any trips that may have caught exclusively Scamp and Yellowmouth Grouper were kept in the dataset and included in the analysis following previous decisions for other GOM grouper analyses.

For the pre-IFQ period, the percentage of trips catching Scamp and Yellowmouth Grouper was 21-23% on average before trip selection and 65% after trip selection for both the Eastern and Western GOM. For the post-IFQ period, the percentage of trips catching Scamp and Yellowmouth Grouper was 25-29% on average before trip selection and 72-83% after trip selection for both the Eastern and Western GOM.

Catch rate calculation

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For the vertical line fishery, CPUE for each trip was defined as the whole weight of Scamp and Yellowmouth Grouper landed on a trip divided by the effort, where effort was the product of the number of lines fished, the hooks per line, and the total hours fished. For each trip, CPUE was calculated as:

ln(CPUE)=ln(whole pounds of Scamp and Yellowmouth Grouper)/(number of lines fished x hooks per line x total hours fished))

Standardization

The delta lognormal modeling approach (Lo et al. 1992) was used to construct the standardized indices of abundance. Parameterization of each model was accomplished using the GENMOD procedure of SAS 9.2 (SAS Institute, 2008) to quantify the relative importance of the explanatory factors. For the GLM analysis of proportion positive trips, the response variable was the proportion of successful trips, a type-3 model was fit, a binomial error distribution was assumed, and the logit link function was selected. For the GLM analysis of catch rates on successful trips, the response variable was ln(CPUE), a type-3 model was fit, a lognormal error distribution was assumed, and the normal link function was selected. All two-way interactions among significant main effects were examined. Higher order interaction terms were not examined.

A forward stepwise regression procedure was used to determine the set of fixed factors and interaction terms that explained a significant portion of the observed variability. Each potential factor was added to the null model sequentially and the resulting reduction in deviance per degree of freedom was examined. The factor that caused the greatest reduction in deviance per degree of freedom was added to the base model if the factor was significant based upon a Chi-Square test ($p<0.05$), and the reduction in deviance per degree of freedom was ≥1%. This model then became the base model, and the process was repeated, adding factors and interactions individually until no factor or interaction met the criteria for incorporation into the final model. Once a set of fixed factors was identified, the influence of the YEAR*FACTOR interactions was examined. YEAR*FACTOR interaction terms were included in the model as random effects. Selection of the final model was based on the Akaike's Information Criterion (AIC) and a Chi-Square test of the difference between the negative log likelihood statistics between successive

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model formulations (Littell et al. 1996). The final delta-lognormal models were fit using the SAS GLIMMIX macro (Russ Wolfinger, SAS Institute). To facilitate visual comparison, relative indices and relative nominal CPUE series were calculated by dividing each value in the series by the mean CPUE of the series.

Submodel Variables

Pre-IFQ

For the pre-IFQ index construction, five factors were considered as possible influences on the proportion of trips that landed Scamp and Yellowmouth Grouper and on the catch rate of Scamp and Yellowmouth Grouper. An additional factor, number of hook hours fished (indicated by gray and an *), was examined solely for its effect on the proportion of positive trips because this factor was confounded with effort for the CPUE response variable in the lognormal model. In order to develop a well-balanced sample design, it was necessary to define categories within some of the factors examined:

Factor	DF	Details
Year	17	1993-2009
Month	12	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec
Area	4	1 (areas 1-7), 2 (area 8), 3 (areas 9-11), 4 (areas 12-21)
Crew	3	1 (1-2 crew), 2 (3 crew), 3 (4-6 crew)
Away	4	1 (1-2 days), 2 (3-4 days), 3 (5-6 days), 4 (7-12 days)
Hookhrs*	4	1 (1-180), 2 (181-660), 3 (661-2,400), 4 (2,401-12,400)

Post-IFQ

For the post-IFQ index construction, seven factors were considered as possible influences on the proportion of trips that landed Scamp and Yellowmouth Grouper and on the catch rate of Scamp and Yellowmouth Grouper. Two additional factors were considered: (1) depth and (2) Scamp IFQ. Total Scamp IFQ allocation was assumed to be the sum of shallow-water and deep-water allocation available to a vessel on a fishing trip, where provided (note that some trips did not have allocation assigned).

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Factor	DF	Details
Year	8	2010-2017
Month	12	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec
Area	4	1 (areas 2-6), 2 (areas 7-8), 3 (areas 9-10), 4 (areas 11-21)
Crew	3	1 (1-2 crew), 2 (3 crew), 3 (4-7 crew)
Away	4	1 (1-4 days), 2 (5 days), 3 (6-7 days), 4 (8-14 days)
Scamp IFQ	4	1 (NA), 2 (0-650 pounds), 3 (651-1,659 pounds), 4 (1,660-3,636 pounds), 5 (3,637-129,440 pounds)
Depth	4	1 (0-120 m), 2 (121-175 m), 3 (176-200 m), 4 (201-700 m)
Hookhrs*	4	1 (0.3-300), 2 (301-1,760), 3 (1,761-4,032), 4 (4,033-15,000)

Annual Abundance Indices

Pre-IFQ

The final models for the binomial and lognormal components of the pre-IFQ index were:

Proportion Positive = YEAR + AWAY + HOOKHRS

ln(CPUE) = YEAR + AREA + AWAY + CREW+ YEAR*AREA

Nominal and standardized abundance indices for the pre-IFQ index are provided in Table 5.5 and Figure 5.3. Relative abundance has remained fairly stable throughout the time series, with peak predicted abundance in 1997 and the lowest abundance in 2000. As observed for both Red Grouper (SEDAR 42) and Gag Grouper (SEDAR 33), relative abundance declined rather sharply between 2005 and 2006, which is likely related to the severe 2005 red tide event that occurred on the West Florida Shelf (SEDAR33-DW-08).

Post-IFQ

The final models for the binomial and lognormal components of the post-IFQ index were:

Proportion Positive = YEAR + AWAY + DEPTH + SCAMP IFQ + CREW+ DEPTH*CREW

ln(CPUE) = YEAR + AREA + AWAY + CREW + DEPTH+ AREA*DEPTH

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Nominal and standardized abundance indices for the post-IFQ index are provided in Table 5.6 and Figure 5.4. Relative abundance has remained fairly stable throughout the time series, with peak abundance in 2016 and the lowest value in 2011.

5.4.3.2 Sampling Intensity and Time Series

Data were available from fisher-reported commercial logbooks for the years 1993-2017. Reporting to the coastal logbook program is mandatory for commercial fishers with federal fishing permits since 1993 and, therefore, is presumed to be a census of commercial Scamp and Yellowmouth Grouper fishing. Numbers of reported trips per year are provided in Table 5.5 for the pre-IFQ period and Table 5.6 for the post-IFQ period.

5.4.3.3 Size/Age Data

No size information is directly available in the commercial coastal logbook data set (reports were in pounds landed); however, size composition presumably matches that provided in Trip Interview Program data for commercial vertical line landings.

5.4.3.4 Catch Rates

Nominal and standardized CPUE (whole pounds landed per hook hour fished) are provided in Table 5.5 for the pre-IFQ period and Table 5.6 for the post-IFQ period.

5.4.3.5 Uncertainty and Measures of Precision

Coefficients of variation per year for the constructed index are provided in Table 5.5 for the pre-IFQ period and Table 5.6 for the post-IFQ period.

5.4.3.6 Comments on Adequacy for Assessment

Pre-IFQ index

The IWG found that the index was properly constructed and recommended its use in the assessment model. The diagnostics for both the binomial and lognormal models were satisfactory, suggesting that the assumptions behind each analysis were appropriate.

IFQ index

This index was not recommended for use in the assessment for several reasons. First, the diagnostics for the binomial model were poor, suggesting that the assumptions were not

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appropriate for the data. Strong patterns in residuals were observed in all factors included in the model. Second, the IWG discussed concerns over using CFLP data to develop indices reflective of trends in relative abundance of the population of Scamp and Yellowmouth Grouper since the implementation of the IFQ program in 2010. Since CFLP data reflect landings only and do not include reliable data on discarded fish, any changes to discarding procedures since the implementation of the IFQ program could change the catchability and render trends not reflective of population abundance. Another potential limitation of the logbook data discussed was that the data collected on depth fished for a trip may be unreliable when reported. The logbook data forms contain a single line for entry of a single area and a single depth, which may not allow for accurate characterization of the various areas or depths fished during a single trip. Lastly, the implementation of the IFQ program in 2010 changed the way the fisheries operated by reducing the race to fish and striving for reduced discards. Fishermen were allowed more flexibility in their fishing practices (e.g., seasonal targeting or regional targeting depending upon species they have quota for or market prices). Most importantly, changes in catchability may mask true trends in population abundance.

5.4.4 Commercial Longline

Fishing effort data available for longline trips include the number of sets and number of hooks per set.

5.4.4.1 Methods of Estimation

Data Filtering Techniques

Data exclusions using CFLP data subset to longline trips for analyses (both pre- and post-IFQ) for Scamp and Yellowmouth Grouper were as follows:

A. Longline trips fishing more the 24 longline sets per day were excluded.

B. Trips that fell outside the 99.5th percentile were considered to represent mis-reported data or data entry errors and were excluded for the following variables: number of sets, number of hooks per set, the longline length, the number of days at sea (trip duration), and the number of crew members.

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C. Seasonal closures and regulatory closures have been employed to manage the commercial shallow-water grouper fishery. Closures in the pre-IFQ period were implemented on the following dates: November 15, 2004 – December 31, 2004; and October 10, 2005 – December 31, 2005. The dataset was restricted to time periods for which fishing on Scamp and Yellowmouth Grouper was allowed.

D. No shallow-water grouper trip limits were reached between 2005 and 2008 in the pre-IFQ period.

The Stephens and MacCall (2004) multispecies approach was used to restrict the dataset to trips that likely encountered Scamp and Yellowmouth Grouper. This approach uses the species composition of each trip in a logistic regression of species presence/absence to infer if effort on that trip occurred in similar habitat occupied by Scamp and Yellowmouth Grouper. This approach was applied separately for the Eastern and Western GOM due to suspected differences in species compositions between regions. In applying the Stephens and MacCall (2004) approach, the species considered were limited to reef fish species. Lastly, any trips that may have caught exclusively Scamp and Yellowmouth Grouper were kept in the dataset and included in the analysis following previous decisions for other GOM grouper analyses.

For the pre-IFQ period, the percentage of trips catching Scamp and Yellowmouth Grouper was 19-45% before trip selection and 64-78% after trip selection for both the Eastern and Western GOM. For the post-IFQ period, the percentage of trips catching Scamp and Yellowmouth Grouper was 7-62% before trip selection and 77-87% after trip selection for both the Eastern and Western GOM.

Catch rate calculation

For the longline fishery, CPUE for each trip was defined as the whole weight of Scamp and Yellowmouth Grouper landed on a trip divided by the effort, where effort was the product of the number of longline sets and the number of hooks per set. For each trip, catch per unit effort was calculated as:

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ln(CPUE)=ln(whole pounds of Scamp and Yellowmouth Grouper)/(number of longline sets x number of hooks per set))

Standardization

Given the high proportion of positive trips, a GLM assuming a binomial error distribution was deemed inappropriate. A GLM assuming a lognormal error distribution was used to examine the above factors for effects on Scamp and Yellowmouth Grouper CPUE. Factors that significantly affected CPUE were then identified using the GLM assuming a lognormal error distribution. The index was fit using the Proc Mixed procedure in SAS. All factors were modeled as fixed effects except two-way interaction terms containing YEAR that were modeled as random effects.

Submodel Variables

Pre-IFQ

For the pre-IFQ index construction, six factors were considered as possible influences on the proportion of trips that landed Scamp and Yellowmouth Grouper and on the catch rate of Scamp and Yellowmouth Grouper. In order to develop a well-balanced sample design, it was necessary to define categories within some of the factors examined:

Factor	DF	Details
Year	17	1993-2009
Month	12	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec
Area	3	1 (areas 1-4), 2 (area 5), 3 (area 6), 4 (areas 7-21)
Length	3	1 (0.5-4), 2 (4.1-5), 3 (5.1-6), 4 (6.1-60)
Crew	4	1 (1-2 crew), 2 (3 crew), 3 (4-6 crew)
Away	4	1 (1-7 days), 2 (8-10 days), 3 (11-13 days), 4 (14-20 days)

Post-IFQ

For the post-IFQ index construction, nine factors were considered as possible influences on the proportion of trips that landed Scamp and Yellowmouth Grouper and on the catch rate of Scamp and Yellowmouth Grouper. Three additional factors were considered: (1) depth, (2) season related to the closure inside 35 fathoms east of Cape San Blas, Florida, and (3) Scamp IFQ. Total

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Scamp IFQ allocation was assumed to be the sum of shallow-water and deep-water allocation available to a vessel on a fishing trip, where provided (note that some trips did not have allocation assigned).

Factor	DF	Details
Year	8	2010-2017
Month	12	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec
Area	3	1 (areas 1-4), 2 (area 5), 3 (area 6-21)
Length	3	1 (1-4), 2 (4.1-5), 3 (5.1-10)
Crew	4	1 (1-2 crew), 2 (3 crew), 3 (4 crew), 4 (5-6 crew)
Away	4	1 (1-9 days), 2 (10-12 days), 3 (13-14 days), 4 (15-21 days)
Depth	4	1 (20-150 m), 2 (151-200 m), 3 (201-250 m), 4 (251-1,000 m)
Season	2	1 (35 ftms), 2 (open)
IFQ	4	1 (NA), 2 (0-1,765 pounds), 3 (1,766-5,145 pounds), 4 (5,146-11,311 pounds), 5 (11,312-171,562 pounds)

Annual Abundance Indices

Pre-IFQ

The final model for the lognormal component of the pre-IFQ index was:

ln(CPUE) = YEAR + AWAY

Nominal and standardized abundance indices for the pre-IFQ index are provided in Table 5.7 and Figure 5.5. Relative abundance remained fairly stable throughout the first half of the time series, with peak predicted abundance in 2009 and the lowest value in 1994. As observed above for the vertical line index, relative abundance declined rather sharply between 2005 and 2006, which is likely related to the severe 2005 red tide event that occurred on the West Florida Shelf (SEDAR33-DW-08).

Post-IFQ

The final model for the lognormal component of the post-IFQ index was:

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ln(CPUE) = YEAR + DEPTH

Nominal and standardized abundance indices for the post-IFQ index are provided in Table 5.8 and Figure 5.6. Relative abundance has remained fairly stable throughout the time series, with peak abundance in 2013 and the lowest value in 2014.

5.4.4.2 Sampling Intensity and Time Series

Data were available from fisher-reported commercial logbooks for the years 1993-2017. Reporting to the coastal logbook program is mandatory for commercial fishers with federal fishing permits since 1993 and, therefore, is presumed to be a census of commercial Scamp and Yellowmouth Grouper fishing. Numbers of reported trips per year are provided in Table 5.7 for the pre-IFQ period and Table 5.8 for the post-IFQ period.

5.4.4.3 Size/Age Data

No size information is directly available in the commercial coastal logbook data set (reports were in pounds landed); however, size composition presumably matches that provided in Trip Interview Program data for commercial longline landings.

5.4.4.4 Catch Rates

Nominal and standardized CPUE (whole pounds landed per hook fished) are provided in Table 5.7 for the pre-IFQ period and Table 5.8 for the post-IFQ period.

5.4.4.5 Uncertainty and Measures of Precision

Coefficients of variation per year for the constructed index are provided in Table 5.7 for the pre-IFQ period and Table 5.8 for the post-IFQ period.

5.4.4.6 Comments on Adequacy for Assessment

Pre-IFQ index

This index was not recommended for use in the assessment for a number of reasons. First, the diagnostics for the lognormal model were poor, suggesting that the assumptions were not appropriate for the data. Strong patterns in residuals were observed in all factors included in the model. Second, the IWG discussed concerns over using CFLP data to develop indices reflective of trends in relative abundance of the population of Scamp and Yellowmouth Grouper. In this case, discussions centered around the potential influence of regulations on the trend in the index.

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For example, the large increase towards the end of the 2000s may be the result of regulations that went into place to reduce sea turtle bycatch (74 FR 53889).

Post-IFQ index

This index was not recommended for use in the assessment for a number of reasons. As discussed above for the commercial vertical line index, the IWG discussed concerns over using CFLP data to develop indices reflective of trends in relative abundance of the population of Scamp and Yellowmouth Grouper since the implementation of the IFQ program in 2010. Since CFLP data reflect landings only and do not include reliable data on discarded fish, any changes to discarding procedures since the implementation of the IFQ program could change the catchability and render trends not reflective of population abundance. Another potential limitation of the logbook data discussed was that the data collected on depth fished for a trip may be unreliable when reported. The logbook data forms contain a single line for entry of a single area and a single depth, which may not allow for accurate characterization of the various areas or depths fished during a single trip. Lastly, the implementation of the IFQ program in 2010 changed the way the fisheries operated by reducing the race to fish and striving for reduced discards. Fishermen were allowed more flexibility in their fishing practices (e.g., seasonal targeting or regional targeting depending upon species they have quota for or market prices). Most importantly, changes in catchability may mask true trends in population abundance.

5.4.5 Reef Fish Observer Program

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 GOM. For example, discards of Scamp and Yellowmouth Grouper were primarily smaller fish at or below the legal minimum length before IFQs were implemented in 2010; however, discards post-IFQ included larger legal-sized fish as well as sublegal fish (Smith et al. 2020). These findings suggest that a fundamental change may have occurred in the catch-effort relationship of legal-sized fish, the basis for commercial fleet CPUE indices of abundance, before and after implementation of IFQs. To address these concerns, a novel CPUE index was developed for the commercial fleet using data from the reef fish observer program. Observer observations of catch include both kept and discarded fish, and

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are thus not directly impacted by changes in management regulations (e.g., minimum size, catch quotas, etc.).

5.4.5.1 Methods of Estimation

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 the full range of Scamp/Yellowmouth Grouper observed depths (20-150 m) in the Western and Eastern GOM. Analysis techniques were developed to account 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.

Data Filtering

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, and subsequent restriction of observations to the observed Scamp depth range of 20-150 m.

Scamp/Yellowmouth Grouper length frequency distributions were found to differ with respect to hook type (j-hooks vs. circle hooks) as well as hook size. Data were subsequently filtered to include circle hooks, which accounted for over 90% of observations, for two distinct hook size categories (medium and large) based on a combination of hook length and hook point-to-shaft length measurements taken by observers.

Species co-occurrence analysis following methods of Mackenzie et al. (2006) was used to identify valid Scamp/Yellowmouth Grouper sample units, i.e., sample units with a non-zero probability of catching Scamp: fishing samples were included if either Scamp/Yellowmouth Grouper or a positively-associated species were captured.

Analyses identified line-hours as the most appropriate effort variable for CPUE estimation. High values of line-hours exceeding the 99th percentile were excluded as outliers.

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Standardization

Line-hours were standardized for the two hook size categories using the fishing power approach (Robson 1966), which estimates the relative catchability (q) between two gears, and then converts effort of one gear in terms of the second gear. Estimation of fishing power was carried out using a compound pdf generalized linear model (GLM), which analyzed presence-absence using a logistic regression model and catch-when-present using a gamma pdf GLM. Effort for large circle hooks was converted to that of medium circle hooks, and the data were pooled for estimating the CPUE index.

5.4.5.2 Sampling Intensity and Time Series

After data filtering, the final sample size used in this index was over 14,000 and is shown in Table 5.9. While the RFOP covers about 2 percent of the vertical line vessels in the GOM (SEDAR68-DW-17), this index was developed on sets which reflect a substantial sample size.

5.4.5.3 Size/Age Data

The commercial Reef Fish Observer Program (RFOP) provides extensive information on fish hauled onboard a vessel including: condition (alive, dead, barotrauma), disposition (kept, discarded dead, discarded alive, etc.), whether the fish was vented before release, length, and weight.

5.4.5.4 Catch Rates

Annual estimates of Scamp/Yellowmouth Grouper CPUE and associated variance were estimated using a Hurwitz-Thompson ratio-of-means estimator for a stratified sample frame (Lohr 2010). Analysis of subregion (West vs. East GOM) and depth stratification variables identified a depth-only scheme with three levels of depth—20-50m, 50-75m, and 75-150m—as the most effective with respect to spatial partitioning of sample variance for CPUE. Spatial strata weighting controlled for potential bias of stock-wide CPUE estimates due to disproportionate sampling in relation to depth strata.

Estimates of the reef fish observer abundance index for GOM Scamp/Yellowmouth Grouper for 2007-2018 are provided in Table 5.9 for the commercial vertical line fleet. The standardized index (scaled to mean CPUE for 2007-2018) time-series is graphed in Fig. 5.7, which also shows

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the 95% confidence intervals. The estimates suggest that Scamp/Yellowmouth Grouper abundance was relatively stable in the GOM during 2007-2018, but indicate generally lower abundance during 2010-2011 compared to other years.

5.4.5.5 Uncertainty and Measures of Precision

Coefficients of variation per year for the constructed index are provided in Table 5.9.

5.4.5.6 Comments on Adequacy for Assessment

The RFOP index was deemed adequate for use in the assessment by the IWG. This decision was the result of several factors. Primarily, the index provides valuable fishery-dependent data that includes both landed fish and discards, unique to this dataset. Furthermore, Scamp and Yellowmouth Grouper are rarely a primarily targeted species and the IWG considered this index to be potentially more representative of population abundance rather than effort or response to management. This dataset also fills in later years of the assessment where other fishery-dependent data (vertical line logbook) were not used due to the implementation of IFQs. Considerable effort went into developing this index in terms of data selection, model development and evaluation and stratification of effort in space to. As such, this novel index was approved for use and methods evaluated thoroughly for this and potentially, future assessments.

5.5 OTHER DATA SOURCES CONSIDERED DURING THE DW

Additional data sources were discussed during the IWG webinar for the potential to support indices of abundance, and some of these were discarded after review. These were the reef fish visual survey in the FL Keys and Tortugas, the SEAMAP stand-alone video survey, and the Recreational Marine Recreational Information program survey. Reasons for not recommending are given in Tables 5.1 and 5.2. An additional, emerging, electronic monitoring dataset of the commercial vertical line fishery was presented by the Mote Marine Laboratory; however, data were limited and didn't have consideration as a potential data set. However, this data set is to be expected to be valuable to future assessments as data continue to be collected.

5.6 CONSENSUS RECOMMENDATIONS AND SURVEY EVALUATIONS

The DW recommended one fishery-independent (combined stereo-video) and three fishery dependent indices (headboat logbook index, commercial vertical line logbook, and reef fish observer program) for potential use in the Scamp and Yellowmouth Grouper stock assessment.

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Pearson correlations between indices are presented in Table 5.10. All recommended indices are compared graphically in Figure 5.8 with standardized index values and CVs for each in Table 5.11.

5.7 LITERATURE CITED

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5.8 Tables

Table 5.1. Table of the data sources considered for indices of abundance.

Fishery Type	Data Source	Area	Yrs	Units	Standardization Method	Issues	Use?
Recreational	Headboat	TX-FL	1986-2017	N kept/ angler*hour	Delta-GLM	Fishery-dependent, logbook-reported, landings only	Yes
Recreational	MRIP	TX-FL	1986-2017	Not calculated	No model fit	Limited data, low proportion positive	No
Commercial	Vertical line, Pre-IFQ	TX-FL	1993-2009	Pounds/hook* hour	Delta-GLM	Fishery-dependent, logbook reported, landings only	Yes
Commercial	Vertical line, Post-IFQ	TX-FL	2010-2017	Pounds/hook* hour	Delta-GLM	Fishery-dependent, logbook reported, landings only. Post-IFQ management changes effects on fishery behavior	No
Commercial	Longline, Pre-IFQ	TX-FL	1993-2009	Pounds/hooks	Lognormal-GLM	Fishery-dependent, logbook reported, landings only. Low catch rate for species.	No
Commercial	Longline, Post-IFQ	TX-FL	2010-2017	Pounds/hooks	Lognormal-GLM	Fishery-dependent, logbook reported, landings only. Low catch rate for species.	No
Commercial	Reef fish observer program	TX-FL	2007-2018	N/line*hour	Design based model	Fishery-dependent	Yes
Independent	Reef-fish visual survey	FL Keys, Tortugas	1999-2018	N/visual cylinder	Strata-weighted	Small area of survey not likely fully representative of recruitment dynamics of GOM	No
Independent	Combined stereo-video survey	TX-FL	1993-2018	MaxN	Negative Binomial-GLM	Changing spatial extent through time	Yes
Independent	SEAMAP video survey	TX-FL	1993-2018	MaxN	Delta-GLM	Subset of combined video survey, limited depth range	No

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Table 5.2. Table of the pros and cons for each data set considered at the Data Workshop.

Fishery-independent indices

Combined stereo-video index (*Recommended for use*)

Pros:

- Fishery-independent and stratified-random
- GOM-wide coverage
- No size selectivity of gear
- Size measurements provided for species of interest
- Index weighted to account for spatial and habitat variation by survey

Cons

- Shifts in coverage through years as surveys are added
- Differences in mapping/habitat description by survey

SEAMAP stereo-video survey (*Not recommended for use*)

Pros:

- Fishery-independent and stratified-random
- GOM-wide coverage
- No size selectivity of gear
- Size measurements provided for species of interest
- Longest time series for fishery-independent surveys

Cons

- Limited to deep, high relief habitats
- Subset of the combined video index that includes greater habitat and spatial coverage

Reef-fish visual survey (*Not recommended for use*)

Pros:

- Fishery-independent
- Provides data on smaller fish and recruits to nearshore
- Provides data on reef-building coral

Cons:

- Gaps in years of sampling
- Area not likely representative of entire GOM recruitment dynamics
- Low Scamp counts with high CVs of annual estimates

Fishery-dependent indices

Recreational headboat logbook (*Recommended for use*)

Pros:

- Complete census

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- Covers the entire management area
- Large sample size
- Generally non-targeted for focal species, which should minimize changes in catchability relative to fishery dependent indices that target specific species
- Update to methods to follow standardized South Atlantic protocols in relation to trip selection and data processing

Cons:

- Fishery dependent (i.e., potentially affected by regulations on both the focal species and other species, targeting, hyperdepletion, hyperstability)
- No information on discard rates
- Catchability may vary over time or with abundance
- Effective effort is difficult to identify

Commercial logbook-vertical line (*Pre-IFQ recommended for use, Post-IFQ not recommended*)

Pros:

- Complete census
- Covers the entire management area
- Large sample size
- Generally non-targeted for focal species, which should minimize changes in catchability relative to fishery dependent indices that target specific species
- Relatively high frequency of trips with Scamp after trip selection model
- Pre-IFQ management consistent enough that variance in effort is similar to baseline fishery dependent data

Cons:

- Fishery-dependent (i.e., potentially affected by regulations on both the focal species and other species, targeting, hyperdepletion, hyperstability)
- No information on discard rates
- Catchability may vary over time or with abundance
- Effective effort is difficult to identify
- Post-IFQ changes in annual catchability may mask trends in population abundance

Commercial logbook-longline (*Pre-IFQ and Post-IFQ not recommended*)

Pros:

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- Complete census
- Covers the entire management area
- Large sample size
- Generally non-targeted for focal species, which should minimize changes in catchability relative to fishery dependent indices that target specific species
- Pre-IFQ management consistent enough that variance in effort is similar to baseline fishery dependent data

Cons:

- Fishery-dependent (i.e., potentially affected by regulations on both the focal species and other species, targeting, hyperdepletion, hyperstability)
- Low catch rates for Scamp in the fishery
- Poor model fit and diagnostics
- No information on discard rates
- Catchability may vary over time or with abundance
- Effective effort is difficult to identify

Reef fish observer program

Pros:

- Covers the entire management area
- Large sample size
- Observer data includes kept fish and discards and therefore catch is less affected by regulations
- Used vertical line gear with high frequency of Scamp caught
- Analytical approach accounts for gear and effort variation
- Spatial strata weighting adjusts for bias in sampling through the spatial extent of the stock

Cons:

- Fishery-dependent (i.e., potentially affected by regulations, targeting, hyperdepletion, hyperstability)
- Variation in gear and effort by locations adjusted for 500m-squared grid cells
- Assumes sampling within a stratum representative of habitat in that stratum
- Catchability may vary over time or with abundance

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Table 5.3. Number of stations sampled (N) combined across surveys and year, proportion of positive sets, standardized index, standardized nominal index, and CV for the annual Combined video index of the Gulf of Mexico.

Year	N	Prop present	Std. Index	Std. Nominal	CV	Lower 95% CI	Upper 95% CI
1993	180	0.217	0.870	0.952	0.173	0.650	1.091
1994	160	0.150	0.497	0.526	0.235	0.326	0.668
1995	125	0.224	0.565	0.627	0.255	0.354	0.776
1996	312	0.218	0.778	0.753	0.175	0.579	0.977
1997	296	0.236	0.645	0.884	0.134	0.518	0.773
2002	260	0.419	1.758	1.841	0.142	1.393	2.123
2004	200	0.305	1.990	2.246	0.175	1.479	2.501
2005	414	0.290	1.499	1.628	0.134	1.205	1.793
2006	545	0.169	0.941	0.878	0.169	0.709	1.174
2007	585	0.287	1.532	1.435	0.121	1.260	1.803
2008	429	0.273	1.131	1.150	0.147	0.887	1.376
2009	555	0.265	1.228	1.193	0.127	0.999	1.458
2010	640	0.239	1.071	1.062	0.124	0.876	1.267
2011	834	0.254	1.182	1.242	0.097	1.013	1.351
2012	872	0.182	0.673	0.727	0.120	0.555	0.791
2013	594	0.215	0.729	0.761	0.118	0.602	0.856
2014	799	0.208	0.876	0.830	0.117	0.725	1.027
2015	603	0.226	0.938	0.841	0.132	0.757	1.119
2016	750	0.245	0.790	0.869	0.102	0.672	0.907
2017	738	0.225	0.751	0.801	0.116	0.624	0.878
2018	642	0.181	0.555	0.642	0.108	0.467	0.642

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Table 5.4. Numbers (N) of total and positive trips, proportion of positive trips (PPT), relative nominal CPUE, and standardized abundance index statistics for Scamp and Yellowmouth Grouper in the U.S. Gulf of Mexico NMFS Southeast Region Headboat Survey index.

Year	N	Positive N	PPT	Relative Nominal CPUE	Relative Index	Lower 95% CI	Upper 95% CI	CV
1986	240	144	0.600	1.826	2.015	1.534	2.648	0.137
1987	317	144	0.454	1.005	1.384	1.046	1.833	0.141
1988	365	163	0.447	1.248	1.477	1.137	1.919	0.131
1989	352	90	0.256	0.667	0.817	0.624	1.070	0.135
1990	367	120	0.327	0.964	1.172	0.899	1.529	0.133
1991	393	100	0.254	0.734	0.979	0.744	1.289	0.138
1992	471	107	0.227	0.582	0.708	0.542	0.923	0.133
1993	411	102	0.248	0.699	0.745	0.571	0.972	0.134
1994	506	155	0.306	0.877	0.863	0.662	1.125	0.133
1995	493	165	0.335	0.986	1.208	0.923	1.583	0.136
1996	385	99	0.257	0.793	0.846	0.639	1.120	0.141
1997	445	108	0.243	0.743	0.764	0.562	1.038	0.154
1998	336	101	0.301	0.816	0.967	0.721	1.298	0.148
1999	268	49	0.183	0.665	0.679	0.491	0.938	0.163
2000	389	98	0.252	0.666	0.806	0.600	1.083	0.148
2001	516	91	0.176	0.687	0.667	0.489	0.911	0.156
2002	476	125	0.263	1.223	1.005	0.756	1.338	0.144
2003	492	108	0.220	1.234	0.791	0.579	1.082	0.157
2004	317	121	0.382	1.520	1.329	1.006	1.757	0.140
2005	359	141	0.393	1.427	1.287	0.972	1.704	0.141
2006	349	86	0.246	1.286	0.943	0.687	1.294	0.159
2007	377	146	0.387	1.643	1.546	1.126	2.124	0.160
2008	618	223	0.361	1.563	1.440	1.075	1.929	0.147
2009	716	198	0.277	1.066	0.912	0.685	1.214	0.144
2010	286	66	0.231	0.832	0.708	0.505	0.994	0.171
2011	438	230	0.525	2.068	1.757	1.301	2.372	0.151
2012	680	236	0.347	1.223	1.066	0.813	1.397	0.136
2013	826	197	0.238	0.663	0.676	0.490	0.932	0.162
2014	934	228	0.244	0.658	0.733	0.550	0.977	0.144
2015	957	280	0.293	0.747	0.785	0.589	1.045	0.144
2016	1080	197	0.182	0.448	0.461	0.348	0.611	0.141
2017	870	156	0.179	0.441	0.460	0.336	0.629	0.158

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Table 5.5. Numbers (N) of total and positive trips, proportion of positive trips (PPT), relative nominal CPUE, and standardized abundance index statistics for Scamp and Yellowmouth Grouper in the U.S. GOM for the Pre-IFQ vertical line index.

Year	N	Positive N	PPT	Relative Nominal CPUE	Relative Index	Lower 95% CI	Upper 95% CI	CV
1993	1006	645	0.641	0.870	0.986	0.591	1.643	0.260
1994	1239	735	0.593	0.857	0.849	0.511	1.410	0.258
1995	1380	867	0.628	1.104	1.254	0.755	2.082	0.258
1996	1475	898	0.609	0.978	1.048	0.631	1.741	0.258
1997	1876	1238	0.660	1.099	1.314	0.792	2.179	0.257
1998	1874	1111	0.593	0.837	0.991	0.598	1.644	0.257
1999	2131	1283	0.602	0.860	0.954	0.576	1.581	0.257
2000	1643	930	0.566	0.538	0.634	0.382	1.052	0.257
2001	1818	1082	0.595	1.095	1.005	0.606	1.666	0.257
2002	2166	1378	0.636	0.923	0.991	0.598	1.642	0.257
2003	2335	1602	0.686	1.007	0.948	0.571	1.571	0.257
2004	1996	1411	0.707	1.270	1.081	0.652	1.795	0.257
2005	1629	1148	0.705	1.299	1.302	0.784	2.162	0.258
2006	1561	1026	0.657	1.116	0.847	0.510	1.405	0.257
2007	1242	953	0.767	1.325	1.001	0.603	1.662	0.257
2008	1274	978	0.768	0.899	0.966	0.581	1.604	0.258
2009	1404	1075	0.766	0.921	0.829	0.499	1.376	0.258

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Table 5.6. Numbers (N) of total and positive trips, proportion of positive trips (PPT), relative nominal CPUE, and standardized abundance index statistics for Scamp and Yellowmouth Grouper in the U.S. GOM for the Post-IFQ vertical line index.

Year	N	Positive N	PPT	Relative Nominal CPUE	Relative Index	Lower 95% CI	Upper 95% CI	CV
2010	924	673	0.728	0.555	0.956	0.811	1.126	0.082
2011	969	698	0.720	0.345	0.632	0.535	0.747	0.084
2012	1256	948	0.755	1.154	1.149	0.995	1.327	0.072
2013	1047	787	0.752	2.187	1.183	1.014	1.381	0.077
2014	1052	778	0.740	0.561	0.903	0.767	1.064	0.082
2015	972	718	0.739	1.640	1.018	0.864	1.199	0.082
2016	1150	881	0.766	0.890	1.274	1.082	1.501	0.082
2017	959	673	0.702	0.669	0.885	0.744	1.051	0.086

Table 5.7. Numbers (N) of total trips, relative nominal CPUE, and standardized abundance index statistics for Scamp and Yellowmouth Grouper in the U.S. GOM for the Pre-IFQ longline index.

Year	N	Relative Nominal CPUE	Relative Index	Lower 95% CI	Upper 95% CI	CV
1993	362	0.521	0.677	0.579	0.790	0.078
1994	378	0.571	0.582	0.498	0.681	0.078
1995	361	0.781	0.667	0.571	0.779	0.078
1996	366	0.517	0.696	0.597	0.812	0.077
1997	494	0.799	0.885	0.778	1.006	0.064
1998	519	1.679	0.935	0.825	1.059	0.062
1999	552	0.954	0.755	0.666	0.855	0.062
2000	473	0.669	0.654	0.570	0.750	0.069
2001	501	0.908	0.893	0.786	1.014	0.064
2002	474	1.128	1.014	0.891	1.153	0.064
2003	574	0.988	1.074	0.956	1.208	0.058
2004	592	1.108	1.215	1.085	1.362	0.057
2005	545	1.501	1.559	1.388	1.751	0.058
2006	605	0.778	0.858	0.763	0.965	0.059
2007	418	1.055	1.098	0.959	1.257	0.068
2008	469	1.340	1.376	1.214	1.560	0.063
2009	226	1.703	2.062	1.734	2.453	0.087

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Table 5.8. Numbers (N) of total trips, relative nominal CPUE, and standardized abundance index statistics for Scamp and Yellowmouth Grouper in the U.S. GOM for the Post-IFQ longline index.

Year	N	Relative Nominal CPUE	Relative Index	Lower 95% CI	Upper 95% CI	CV
2010	184	1.237	1.181	1.004	1.389	0.081
2011	281	0.998	0.790	0.688	0.908	0.070
2012	246	1.507	1.242	1.079	1.429	0.070
2013	255	1.447	1.329	1.159	1.524	0.069
2014	299	0.484	0.720	0.628	0.825	0.069
2015	371	0.774	0.908	0.805	1.023	0.060
2016	451	1.045	1.101	0.989	1.225	0.054
2017	415	0.508	0.729	0.649	0.820	0.059

Table 5.9. Reef fish observer CPUE index time-series for GOM Scamp/Yellowmouth Grouper for the commercial vertical line fleet. Effort units are standardized line-hours. The relative index was scaled to mean CPUE for 2007-2018.

Year	n	Mean Catch	Mean Effort	Nominal CPUE	Relative Index	CV
2007	698	1.984	0.264	0.133	0.923	0.103
2008	499	2.333	0.335	0.144	0.998	0.178
2009	433	2.047	0.289	0.141	0.979	0.187
2010	804	1.763	0.173	0.098	0.682	0.200
2011	1431	1.898	0.164	0.087	0.602	0.130
2012	3638	1.844	0.320	0.174	1.206	0.059
2013	1192	1.682	0.260	0.154	1.072	0.220
2014	1167	1.650	0.205	0.124	0.864	0.095
2015	2251	1.690	0.278	0.164	1.142	0.074
2016	1476	1.723	0.310	0.180	1.251	0.098
2017	769	1.707	0.262	0.153	1.066	0.126
2018	384	2.094	0.366	0.175	1.215	0.123

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Table 5.10. Pearson correlation values for indices recommended for use.

	Headboat logbook	Combined stereo-video	Reef fish observer	Vertical Line Logbook (Pre-IFQ)
Headboat logbook	1			
Combined stereo-video	0.524	1		
Reef fish observer	0.482	0.604	1	
Vertical Line Logbook (Pre-IFQ)	0.282	0.023	0.454	1

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Table 5.11. Scamp and Yellowmouth Grouper standardized indices of abundance and annual CVs recommended for potential use in the stock assessment.

	Standardized Index Values				CVs			
year	Combined stereo-video	Headboat Logbook	Vertical Line Logbook	Reef fish observer	Combined stereo-video	Headboat Logbook	Vertical Line Logbook	Reef fish observer
1986		2.02				0.137		
1987		1.38				0.141		
1988		1.48				0.131		
1989		0.82				0.135		
1990		1.17				0.133		
1991		0.98				0.138		
1992		0.71				0.133		
1993	0.87	0.75	0.99		0.173	0.134	0.26	
1994	0.50	0.86	0.85		0.235	0.133	0.258	
1995	0.57	1.21	1.25		0.255	0.136	0.258	
1996	0.78	0.85	1.05		0.175	0.141	0.258	
1997	0.65	0.76	1.31		0.134	0.154	0.257	
1998		0.97	0.99			0.148	0.257	
1999		0.68	0.95			0.163	0.257	
2000		0.81	0.63			0.148	0.257	
2001		0.67	1.01			0.156	0.257	
2002	1.76	1.01	0.99		0.142	0.144	0.257	
2003		0.79	0.95			0.157	0.257	
2004	1.99	1.33	1.08		0.175	0.14	0.257	
2005	1.50	1.29	1.30		0.134	0.141	0.258	
2006	0.94	0.94	0.85		0.169	0.159	0.257	
2007	1.53	1.55	1.00	0.92	0.121	0.16	0.257	0.103
2008	1.13	1.44	0.97	1.00	0.147	0.147	0.258	0.178
2009	1.23	0.91	0.83	0.98	0.127	0.144	0.258	0.187
2010	1.07	0.71		0.68	0.124	0.171		0.2
2011	1.18	1.76		0.60	0.097	0.151		0.13
2012	0.67	1.07		1.21	0.12	0.136		0.059
2013	0.73	0.68		1.07	0.118	0.162		0.22
2014	0.88	0.73		0.86	0.117	0.144		0.095
2015	0.94	0.78		1.14	0.132	0.144		0.074
2016	0.79	0.46		1.25	0.102	0.141		0.098
2017	0.75	0.46		1.07	0.116	0.158		0.126
2018	0.55			1.21	0.108			0.123

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5.8 FIGURES

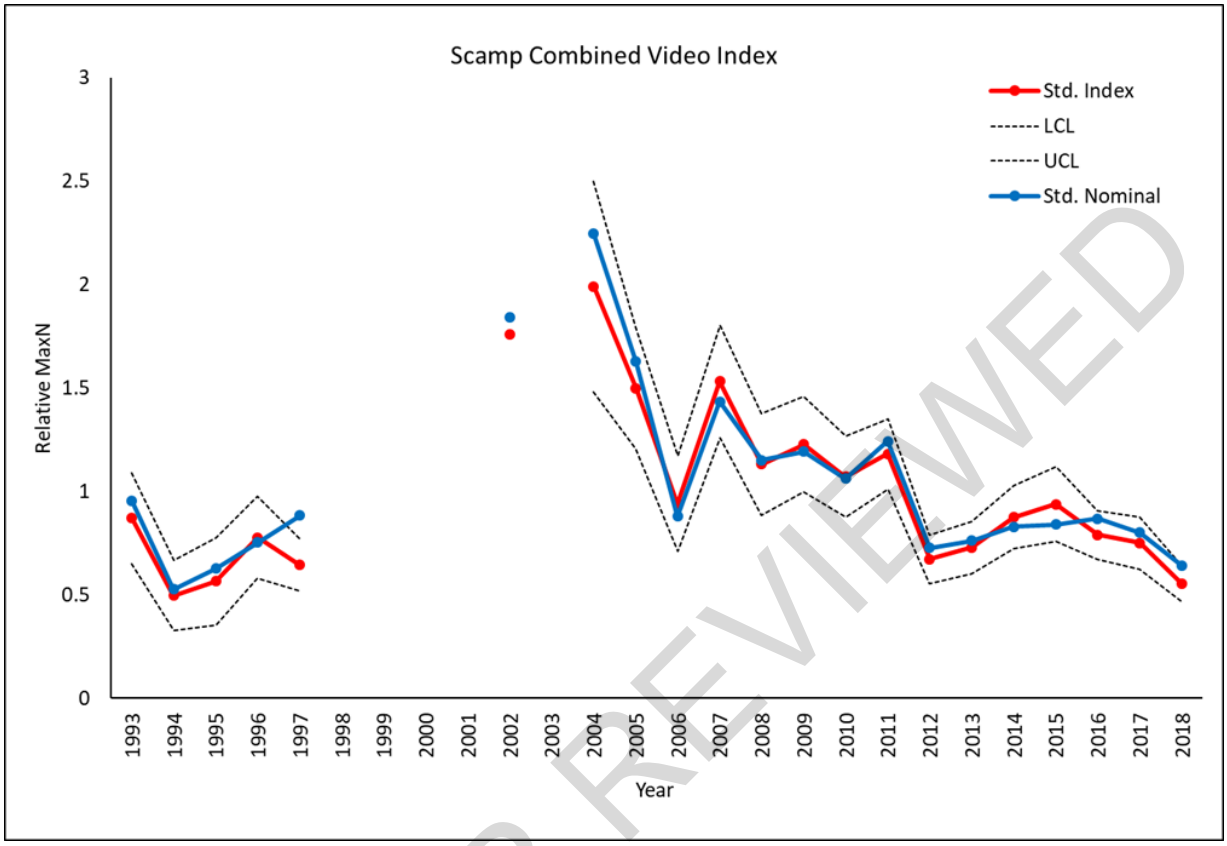

Figure 5.1. Standardized index (solid red line) with 2.5% and 97.5% confidence intervals (black dotted lines) and nominal index (solid blue line) for Scamp CPUE (MaxN) using the integrated GOM stereo-video data. This index was recommended for use.

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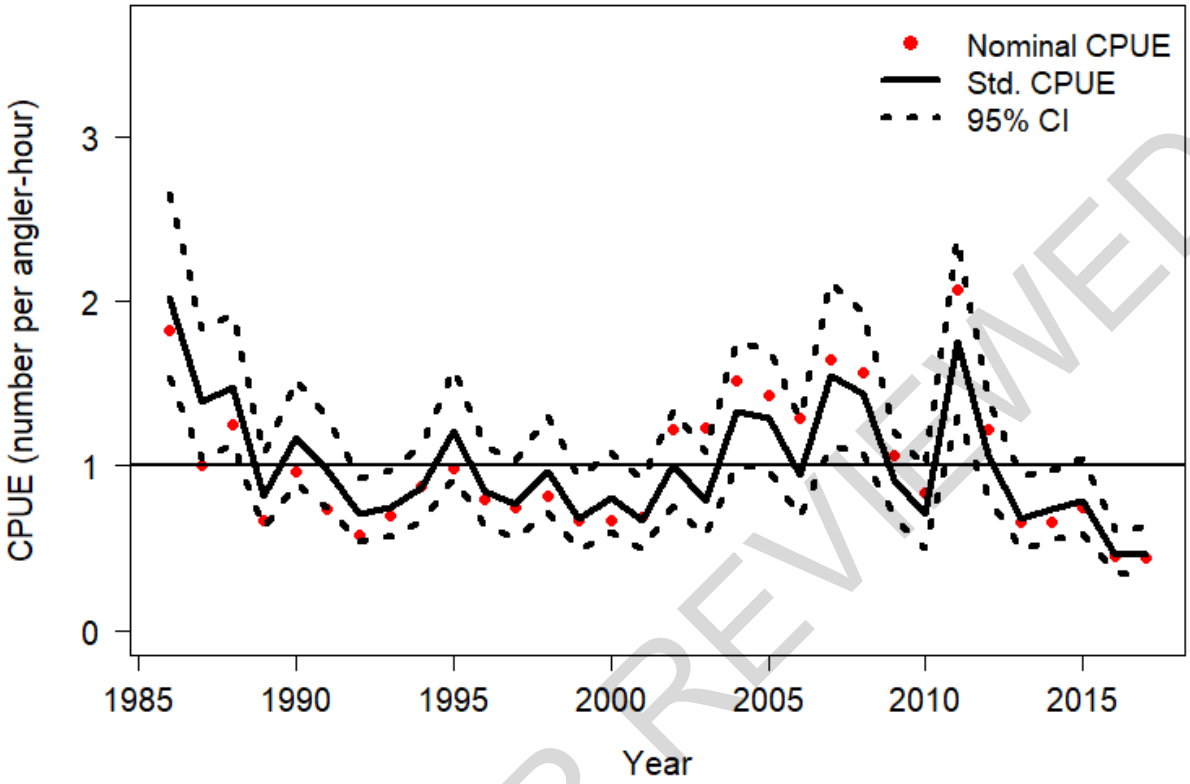

Figure 5.2. Standardized index with 95% confidence interval, and nominal CPUE for Scamp and Yellowmouth Grouper in the U.S. Gulf of Mexico for the Headboat fishery. The index was scaled to the mean value of the entire time series. This index was recommended for use.

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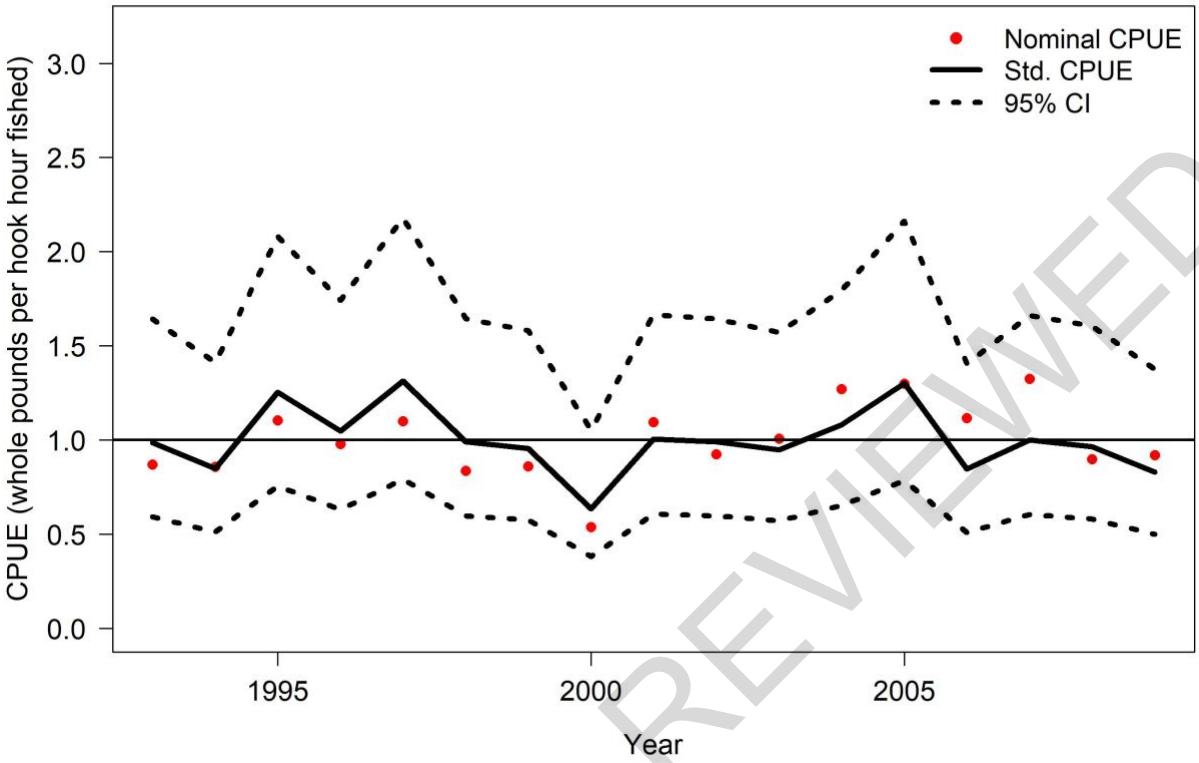

Figure 5.3. Standardized index with 95% confidence interval, and nominal CPUE for Scamp and Yellowmouth Grouper in the U.S. GOM for the Pre-IFQ Vertical Line fishery. The index was scaled to the mean value of the entire time series. This index was recommended for use.

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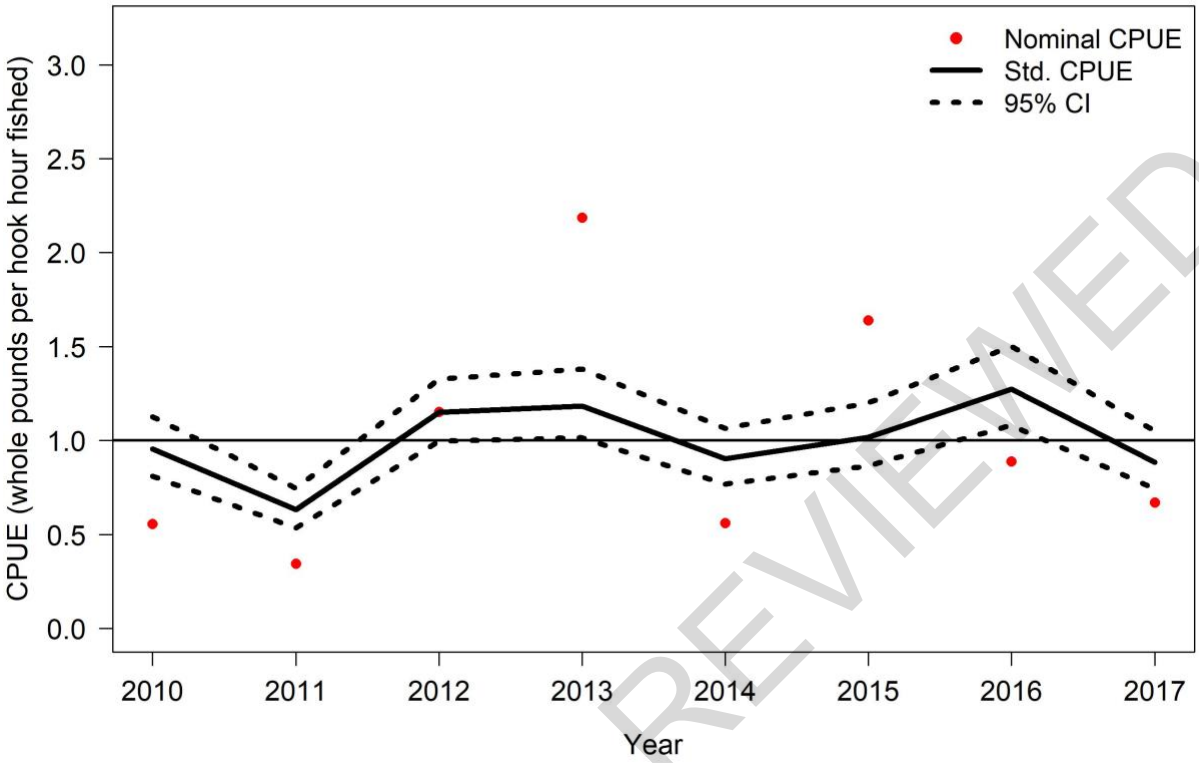

Figure 5.4. Standardized index with 95% confidence interval, and nominal CPUE for Scamp and Yellowmouth Grouper in the U.S. GOM for the Post-IFQ Vertical Line fishery. The index was scaled to the mean value of the entire time series. This index was not recommended for use.

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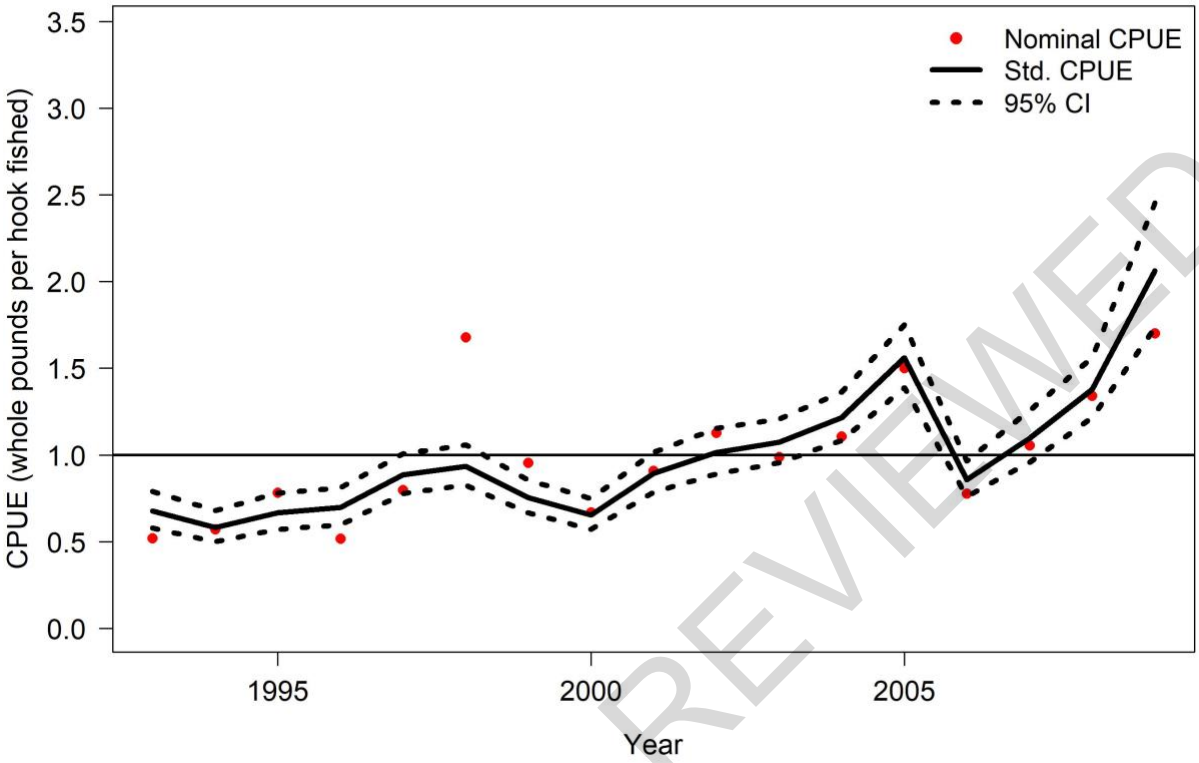

Figure 5.5. Standardized index with 95% confidence interval, and nominal CPUE for Scamp and Yellowmouth Grouper in the U.S. GOM for the Pre-IFQ longline fishery. The index was scaled to the mean value of the entire time series. This index was not recommended for use.

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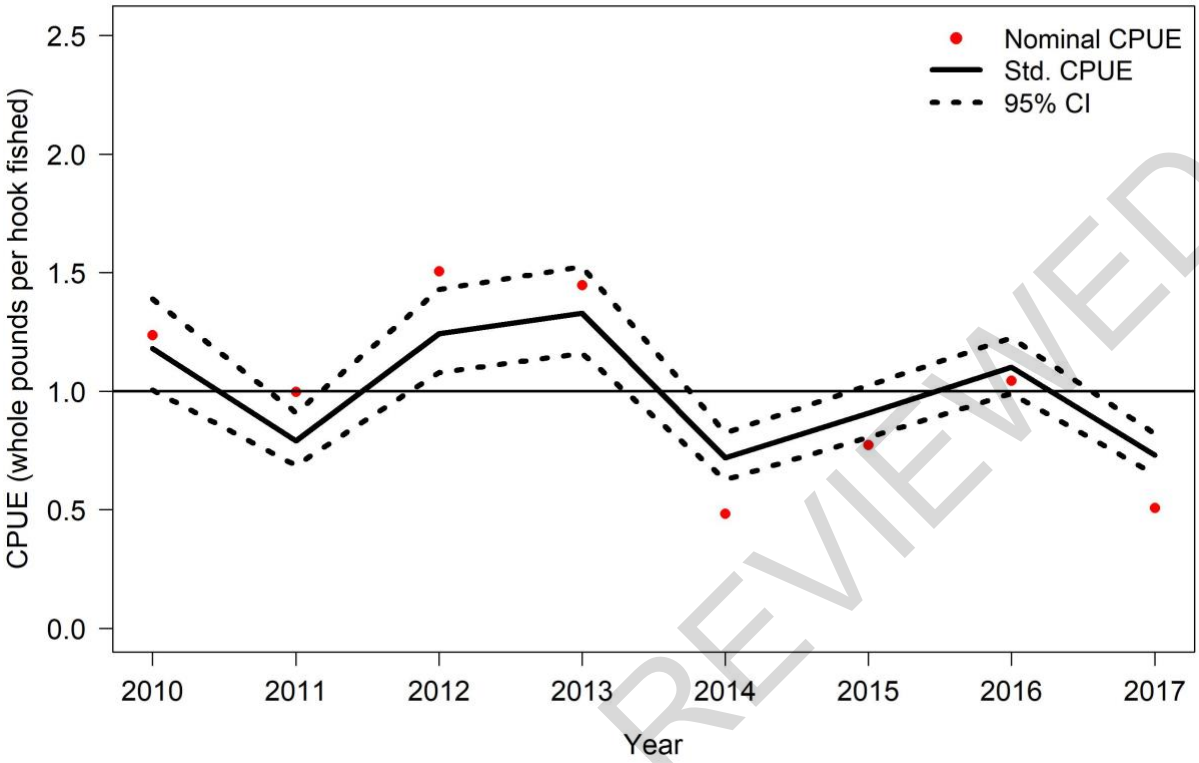

Figure 5.6. Standardized index with 95% confidence interval, and nominal CPUE for Scamp and Yellowmouth Grouper in the U.S. GOM for the Post-IFQ longline fishery. The index was scaled to the mean value of the entire time series. This index was not recommended for use.

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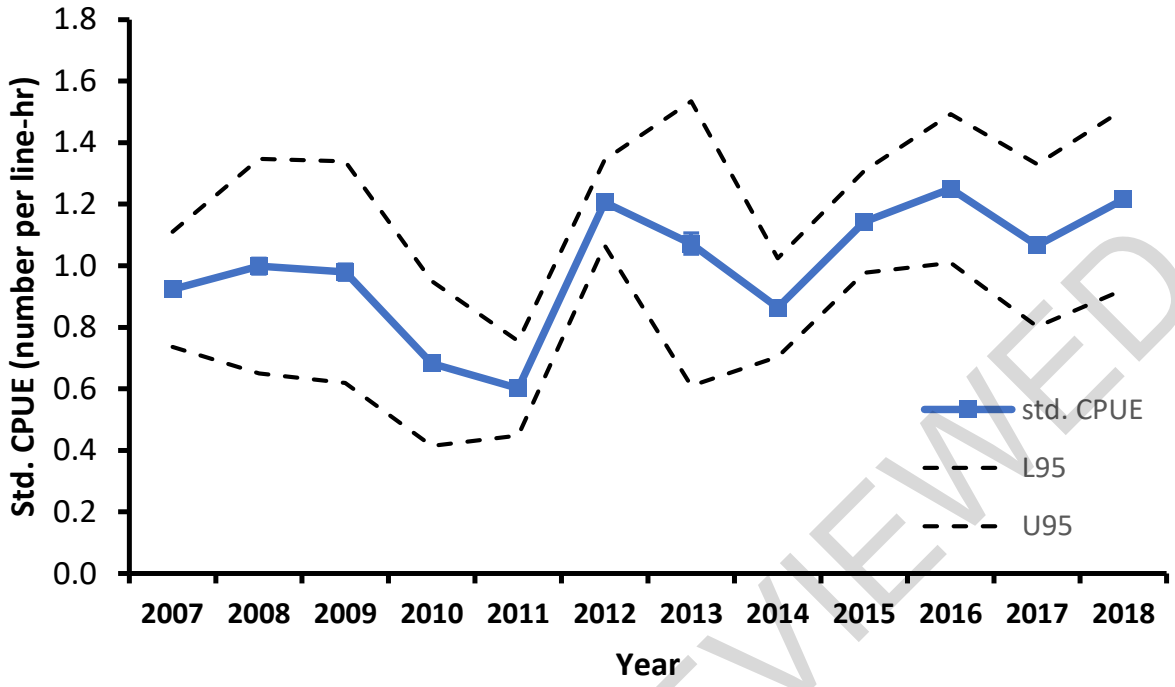

Figure 5.7. Time-series graph of reef fish observer standardized CPUE index (±95% CI) for GOM Scamp/Yellowmouth Grouper for the commercial vertical line fleet.

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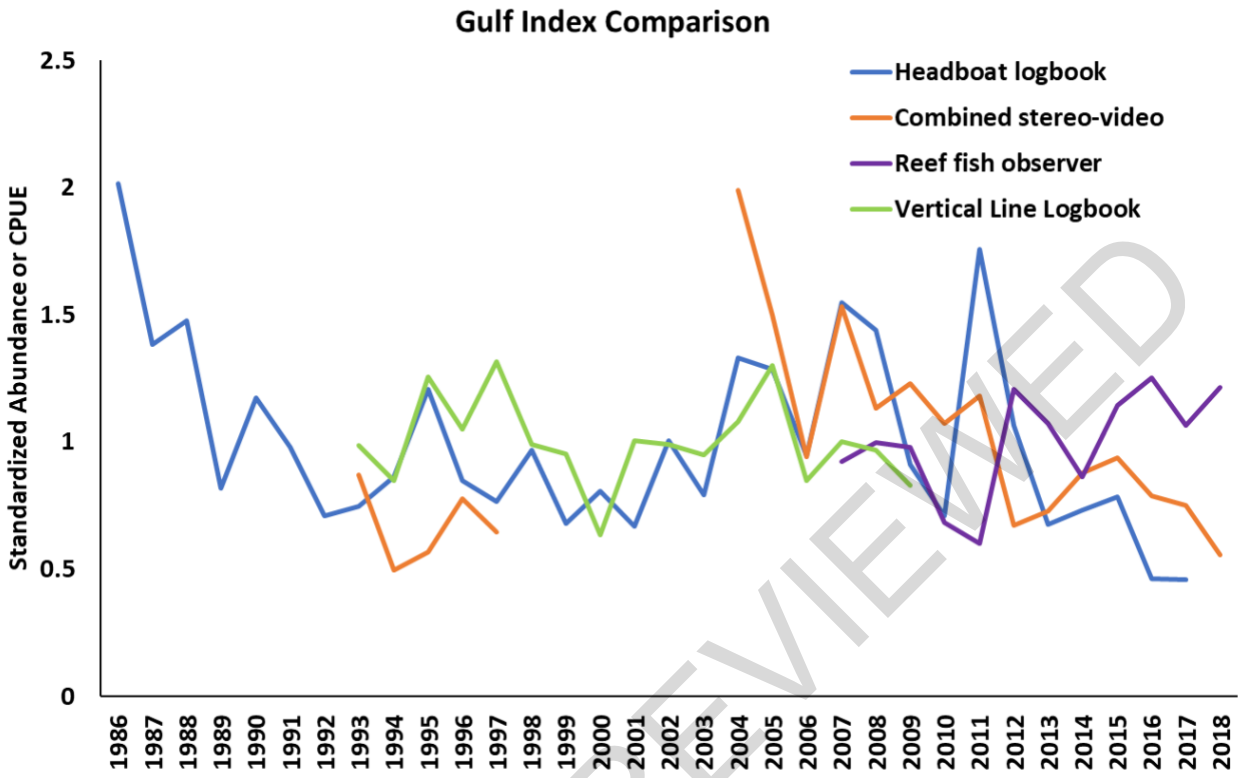

Figure 5.8. All indices (scaled to their respective means) recommended for potential use in the Scamp and Yellowmouth grouper stock assessment for the GOM region.

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6 DISCARD MORTALITY AD-HOC WORKING GROUP

Data workshop panelists and data providers convened two ad-hoc working group meetings (led by Dominique Lazarre, FL FWCC/FWRI, St. Petersburg, FL) to present and discuss available data that could be used to inform recommendations for discard mortality rates for SEDAR 68. Anecdotal information, observed/assumed immediate mortality, and estimates of survival from an empirical study were presented by five data providers, representing both the Gulf of Mexico and South Atlantic regions. Commercial data sources included Mote Marine Laboratory (SEDAR68-DW-22) and the NOAA Reef Fish Observer / Shark Bottom Longline Observer Programs (SEDAR68-DW-16, SEDAR68-DW-17). Mote observed discarding of Scamp (N = 804) on commercial vessels in the Gulf of Mexico between 2016 and 2019 through their electronic monitoring program. These data indicated a low proportion of Scamp discards; 3.35% of Scamp were released, with only 0.75% of Scamp released dead. The NOAA Observer Programs have monitored discarding in both the bottom longline and vertical line fisheries in the

Gulf of Mexico since 2006. A range of immediate mortality estimates were provided, with the lower bound representing only observed dead Scamp (immediate mortality) and the upper bound including both dead discards and all discarded Scamp displaying barotrauma injury (assumed mortality). The observed to assumed immediate mortality ranged from 6.6% to 69.2% in the bottom longline fishery (N=228) and 0% to 41.8% in the vertical line fishery in the Gulf of Mexico (N=592, Table 1). The observed to assumed range of immediate mortality estimates was also provided for the vertical line fishery in the South Atlantic, 0.2%-16.5% (N = 491, Table 1).

Observations of immediate mortality in the recreational for-hire fisheries were provided by the Florida Fish and Wildlife Conservation Commission for both the Gulf of Mexico and South Atlantic (SEDAR68-DW-23, SEDAR68-DW-24). A summary of depth data from Scamp positive trips intercepted during state dockside intercept surveys and the at-sea observer data indicate the for-hire and private recreational fisheries tend to occur in depths shallower than 45 meters. Observations of discarding on for-hire vessels were summarized in a similar manner as those provided by the NOAA Observer Programs, the lower bound represents immediate observed mortality (immediate mortality) in the fisheries and the upper bound represents both immediate mortality and any fish observed with injuries (assumed mortality). In the Gulf of Mexico, the range of observed to assumed immediate mortality was reported to be 0.30% to 4.19% in the charter fishery (N = 334) and 2.13% to 11.64% in the headboat fishery (N = 1,452; SEDAR68-DW-24). Data from the South Atlantic were limited for the charter fishery, with no immediate mortality observed, from the six individuals observed. The observed to assumed immediate mortality for the headboat fishery ranged from 2.61% to 24.3% (N = 115). In addition to observer data, trip reports from two self-reporting platforms, MyFishCounts and the SAFMC Release applications, were summarized by representatives of the South Atlantic Fishery Management Council (SEDAR68-DW-25, SEDAR68-DW-26). These data provided primarily anecdotal information on the discarding behavior from participating anglers. The reports describe some rationale for discarding behavior and fishing practices, primarily that discarding during the open season occurs as a result of undersized fish being captured. Additionally, anglers reported that Scamp may be found in deeper water than some of the other shallow water grouper species being targeted, reducing interactions with this species.

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Lastly, an empirical study that estimated survival of Scamp and Yellowmouth Grouper descended upon release was presented. Researchers captured 18 Scamp / Yellowmouth Grouper in depths ranging from 60 to 116 meters. Acoustic telemetry was used to track the fate of 16 Scamp that were descended, resulting in a survival estimate of 0.47 (0.27, 0.80). Two fish were released at the surface; one floated after release and was determined to be dead the second was tracked with telemetry, with its mortality documented later the same day. The working paper associated with this study provided an updated analysis that includes survival estimates for a complex of deepwater groupers (Gag, Red Grouper, Scamp, Snowy Grouper, Speckled Hind, and Yellowmouth Grouper). This updated analysis provided a survival estimate of 0.46 (0.33, 0.80; N=40) for groupers released with descender devices on the continental shelf break (SEDAR68-DW-27).

All the data provided were discussed in a second ad-hoc discard mortality session to determine how to use the available data to recommend discard mortality rates by fleet and jurisdictions. The group discussed the need for more empirical studies, as it is not likely that the surface release data provided by observer coverage fully captures post-release mortality. The group discussed the wide range of discard mortality estimates provided in the literature. It was widely accepted by the group that use of empirical studies that directly measure mortality / survival is optimal. It was also acknowledged that many of the empirical studies that estimate mortality / survival are conducted in depths that may not be representative of the commercial and recreational fleets. The group decided to use an approach that would combine available depth data that represents each fishery in conjunction with the species-specific logistic regression approach used by Pulver (2017) to estimate immediate mortality to provide point estimates for each commercial fleet. This analysis will be updated to provide upper and lower bounds during the assessment workshop. The group decided that a similar approach would be applied for the recreational fleet, with Jeff Pulver updating his analysis to create a model for recreational fisheries using observer data to fit the model. While these analyses are being updated, the group determined that the mean depth for each fishery would be used to provide a placeholder estimate in the assessment models.

Throughout the discussions, research recommendations were suggested that may help improve the available discard mortality estimates. These include:

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- Conduct more empirical studies to investigate post-release mortality particularly in depth ranges that are representative of the fisheries
- Encourage use of modeling approaches to incorporate depth data into estimates of immediate mortality from the surface release data, potentially collaborating with empirical studies to generate more realistic estimates
- Improve data collection of depth data for each fleet, to allow additional modeling approaches to be employed to estimate a range of post-release mortality, particularly in the private boat recreational fleet
- Explore the use of descending devices and other barotrauma mitigation techniques (e.g. venting) on discard mortality estimates

An additional assessment working paper will be generated to document the additional analyses that will be conducted to generate point estimates with updated versions of the commercial and recreational models of the Pulver (2017) model.

6.1 LITERATURE CITED

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Pulver, Jeff J. 2017. Sink or swim? Factors affecting immediate discard mortality for the Gulf of Mexico commercial reef fish fishery. Fisheries Research 188:166-172.

Runde, Brendan J., Theo Michelot, Nathan M. Bacheler, Kyle W. Shertzer, and Jeffrey A. Buckel. 2020. Assigning fates in telemetry studies using hidden Markov models: an application to deepwater groupers released with descender devices. SEDAR68-DW-27. SEDAR, North Charleston, SC. 42 pp.

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6.2 TABLES

Table 1. Proxy for release mortality observed in the NOAA Observer Programs. The lower bound classifies dead scamp using only onboard condition and the upper bound classifies dead camp using a combination of onboard condition and disposition. † Included scamp alive with barotrauma. ‡ Included scamp with barotrauma and released dead.

Gear	**Depth Bin (m)**	**Lower Bound of Release Mortality**				**Upper Bound of Release Mortality**			
		Number Discarded	*Number of Trips*	*Percent Alive*†	*Percent Dead*	*Number Discarded*	*Number of Trips*	*Percent Alive*	*Percent Dead*‡
SOUTH ATLANTIC									
Vertical Line	<40	146	24	100.00%	0.00%	146	24	84.90%	15.10%
	41-60	343	24	100.00%	0.00%	343	24	76.00%	24.00%
	>60	2	15	99.40%	0.60%	2	15	89.70%	10.30%
	Total	*491*	*43*	*99.80%*	*0.20%*	*491*	*43*	*83.50%*	*16.50%*
GULF OF MEXICO									
Vertical Line	<40	251	92	100.00%	0.00%	248	91	82.70%	17.30%
	41-80	216	107	100.00%	0.00%	216	107	55.60%	44.40%
	>80	125	23	100.00%	0.00%	125	23	14.40%	85.60%
	Total	*592*	*202*	*100.00%*	*0.00%*	*589*	*202*	*58.20%*	*41.80%*
Bottom Longline	<70	74	46	97.30%	2.70%	74	46	32.40%	67.60%
	71-100	124	53	91.10%	8.90%	123	52	27.60%	72.40%
	>100	30	12	93.30%	6.70%	30	12	40.00%	60.00%
	Total	*228*	*95*	*93.40%*	*6.60%*	*227*	*94*	*30.80%*	*69.20%*

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