SEDAR

Southeast Data, Assessment, and Review

SEDAR 68

Atlantic Scamp

SECTION II: Data Workshop Report

December 2020

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

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
    - 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.
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

Francesca Forrestal, Co-Lead Analyst	NMFS Miami
Skyler Sagarese, Co-Lead Analyst	NMFS Miami
Churchill Grimes	SAFMC SSC
Will Patterson	GMFMC SSC/UFL
Sean Powers	GMFMC SSC/South Alabama
Marcel Reichert	SCDNR
Alexei Sharov	SAFMC SSC/MD DNR
Kyle Shertzer	NMFS Beaufort
Jim Tolan	GMFMC SSC/TPWD

Data Process Participants

Nate Bacheler	NMFS Beaufort
Beverly Barnett	NMFS Panama City
Veronica Beech	NMFS Panama City
Alan Bianchi	NC DMF
Ken Brennan	NMFS Beaufort
Steve Brown	FWRI, Cedar Key
Wally Bubley	MARMAP/SCDNR
Julia Byrd	SAFMC Staff
Matt Campbell	NMFS Pascagoula
Andrew Cathey	NCDENR
Rob Cheshire	NMFS Beaufort
Judd Curtis	GMFMF SSC/TAMUCC
Amy Dukes	SCDNR
Eric Fitzpatrick	NMFS Beaufort

Kelly Fitzpatrick .... NMFS Beaufort
Claudia Friess .... FL FWC
Keilin Gamboa-Salazar .... SCDNR
Chris Gardner .... NMFS Panama City
Jimmy Hull .... Industry Rep
Deidera Jeffcoat .... Industry Rep
Mandy Karnauskas .... NMFS Miami
Nikolai Klibansky .... NMFS Beaufort
Dominque Lazare .... FWC St. Pete
Robert Leaf .... USM
Sue Lowerre-Barbieri .... FL FWC
Carole Neidig .... Mote Marine Lab
Matt Nuttall .... NMFS Miami
Vivian Matter .... NMFS Miami
Stephanie Martinez .... NMFS Miami
Kevin McCarthy .... NMFS Miami
Randy McKinley .... Industry Rep
Refik Orhun .... NMFS Miami
Andy Ostroski .... NMFS Beaufort
Kate Overly .... NMFS Panama City
Jennifer Potts .... NMFS Beaufort
Jeff Pulver .... NMFS SERO
Mike Rinaldi .... ACCSP
Brendan Runde .... NCSU
Beverly Sauls .... FWC St. Pete
Katie Siegfried .... NMFS Miami
Julie Deflippi Simpson .... ACCSP
Tracey Smart .... MARMAP/SCDNR
Tom Sminkey .... NMFS
Steve Smith .... NMFS Miami
Molly Stevens .... NMFS Miami
Ted Switzer .... FL FWC
Kevin Thompson .... FL FWC
Laura Thornton .... NMFS Panama City
Dave Wynski .... SCDNR
Beth Wrege .... NMFS Miami

Council Representation

Tim Griner .... SAFMC
Paul Mickle .... GMFMC

Staff

Julie Neer .... SEDAR
Mike Errigo .... SAFMC Staff
Kathleen Howington .... SEDAR
Ryan Rindone .... GMFMC Staff

Additional Observers

Rob Ahrens .... SAFMC SSC/UFL
Sarina Atkinson... NMFS Miami
Larry Beerkircher .... NMFS Miami
Gregg Bray .... GSMFC
Myra Brouwer .... SAFMC Staff
Catherine Bruger .... Ocean Conservancy
Jeff Buckel .... SAFMC SSCNCSU
Dave Chagaris .... GMFMC SSCUFL
Chip Collier .... SAFMC Staff
Tanya Darden .... SCDNR
Michael Drexler .... Ocean Conservancy
Guillermo Diaz .... NMFS Miami
Margaret Finch .... SCDNR
Francesca Forrestal .... NMFS Miami
Dawn Franco .... GADNR
Dawn Glasgow .... SCDNR
Homer Hiers .... SCDNR
Allie Iberle .... SAFMC Staff
Jeff Isely .... NMFS Miami
Max Lee .... Mote Marine Lab
Stephen Long .... SCDNR
Alan Lowther .... NMFS Miami
Michelle Masi .... NMFS Galveston
Adyan Rios .... NMFS Miami
Daniel Roberts .... Water Interface
Kayla Rudnay .... SCDNR
George Sedberry .... SAFMC SSC
Allison Shideler .... NMFS Miami
Wiley Sinkus .... SCDNR
Matt Smith .... NMFS Miami
McLean Stewart .... NCDENR
Brendan Turley .... NMFS
Michelle Willis .... MARMAP/SCDNR

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	Rob Cheshire and Nathan Bacheler	7 February 2020

	Mycteroperca interstitialis) from the Southeast Reef Fish Survey		
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, Katherine E. Overly, Matt Campbell	19 February 2020 Updated: 21 October 2020
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
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
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
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	30 October 2020

		Service, Southeast Fisheries Science Center, Beaufort, NC	
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	
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
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
Jennifer Potts	Work Group Co-Lead	NMFS
Beverly Barnett	Work Group Deputy	NMFS
Laura Thornton	Work Group Deputy and Rapporteur	NMFS
Molly Stevens	Work Group member and Rapporteur	NMFS
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
Sue Lowerre-Barbieri	Work Group member, Data Provider	Florida FWC
Kyle Shertzer	Lead Analyst*/ADT	NMFS
Skyler Sagarese	Lead Analyst/ADT	NMFS
Kate Siegfried	Work Group member/Lead Analyst*	NMFS
Francesca Forrestal	Assistant Analyst, Observer	NMFS
Will Patterson	ADT	GMFMC SSC
Sean Powers	ADT	GMFMC SSC
Jim Tolan	ADT	GMFMC SSC
Marcel Reichert	ADT	SAFMC SSC
Adyan Rios	Work Group member	NMFS
Tracey Smart	Work Group member	SCDNR
Judd Curtis	Work Group member	GMFMC SSC
Mandy Karnauskas	Work Group member	NMFS
Carole Neidig	Work Group member	Mote Marine Laboratory
Max Lee	Work Group member	Mote Marine Laboratory
Alexandra Smith	Observer	NMFS
Jessica Carroll	Observer, Data Provider	Florida FWC
Tracy McCulloch	Observer	NMFS
Guillermo Diaz	Observer	NMFS
Nancie Cummings	Observer	NMFS
Margaret Finch	Observer, Data Provider	SCDNR

Michelle Willis	Observer, Data Provider	SCDNR
Eric Fitzpatrick	Data compiler, Observer	NMFS
Rob Cheshire	Observer	NMFS
Jamie Clark	Observer	NMFS
Homer Hiers	Observer	
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 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:

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.

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 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 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 have been recorded as 34 years and 31 years, respectively. A recent bomb radio-carbon 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 an error with samples mixed up during processing, 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 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 population 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 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 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 which 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 1). 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 (Figure 2 and Table 1). The M vector for each stock would use the stock specific growth model (see Section 5) and weight-length equations (see Section 7) 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.

<u>ADT Recommendation</u>:

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

2.4 AGE DATA

The preferred age structure of Scamp are otoliths, but were considered difficult to interpret; thus, staff from the four laboratories contributing data to this SEDAR met for an age 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 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 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 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.

NMFS Beaufort and SCDNR labs contributed age data for the South Atlantic stock, (n = 17,410). The data consisted primarily of Scamp records (n = 16,994), but included limited Yellowmouth Grouper records (n = 416). Samples were collected from commercial fishery landings, recreational fishery landings, and fishery-independent surveys or special projects. A breakdown of commercial and recreational individual samples with ages and number of intercepted trips by year, fishery, gear or fishing mode and state of landing is included in Tables 2 and 3. A thorough review of the sampling methodology of each sample collection program was undertaken to include only those samples randomly collected and to be used for characterizing the commercial and recreational landings. Table 4 includes the count of age data by gear of the fishery-independent Southeast Reef Fish Survey (SERFS). Details of how the age data were treated are included.

Generally, the calendar-, or cohort-, ages of the fish are preferred for the assessment model input. Each fish with an age reading included annuli counts and edge type codes. The edge, or margin, codes refer to the presence of an opaque zone on the edge (code = 1) or the amount of translucent zone on the edge. The translucent zone codes include: 2 = narrow translucent zone (<1/3 of previous translucent zone); 3 = Moderate translucent zone (width 34- 66% of previous translucent zone); and 4 = wide translucent zone (>2/3 of previous zone). The analysis of the timing of opaque zone formation was somewhat problematic for Scamp, because of the difficulty with age reading. Data provided by SCDNR showed a pattern of peak opaque zone formation during June and July, with completed zones evident by the end of August indicating that their ages would be bumped through July 31st. Analyses for NOAA-BFT data indicated that the peak opaque zones were through August, indicating that their ages would be bumped through August 31 st. The fish in the South Atlantic dataset are predominantly from North Carolina and South Carolina. Otoliths from fish in waters off those states tend to have more clearly defined growth zones than the same species in more southerly latitudes (e.g., Florida). Based on these results, the South Atlantic Scamp life history data set will include calendar ages. The criteria for converting annuli counts to calendar ages is as follows:

1. For all fish landed between January 1 and July 31 (SCDNR) or August 31 (NOAA-BFT) with a large translucent zone on the margin (edge type = 3 or 4), calendar age = annuli count + 1.

2. For all fish landed between January 1 and July 31 (SCDNR) or August 31 (NOAA-BFT) with opaque zone on the margin (edge type = 1) or a narrow translucent zone (edge type = 2), then calendar age = annuli count.

3. All fish landed between August/September 1 and December 31, the calendar age = annuli count.

Once the calendar ages were calculated, fractional (biological) ages were calculated for use in the growth models. The fractional ages were based on the calendar ages and the month of peak spawning, which was May, for the South Atlantic stock (Harris et al., 2002). The equation for calculating fractional age for Scamp is

$A_F = A_C + ((M_C - M_S)/12))$, where

A_F = fractional age (years),

A_C = calendar age (years),

M_C = month of capture, and

M_S = month of peak spawning.

In addition to the age data for Scamp, data for Yellowmouth Grouper was included in the full life history data set. NMFS-BFT contributed 379 ages from fish landed in the commercial and recreational fisheries. Age reading methodology, calendar age and fractional age calculations can be found in Burton et al. (2014). SCDNR provided 38 records, primarily from the SERFS fishery-independent survey with 15 samples from fishery landings. These data were treated as part of the Scamp/Yellowmouth Grouper complex and were included in the sample count tables.

2.5 GROWTH

Growth of Scamp/Yellowmouth Grouper in the U.S. South Atlantic was modelled for the population, fishery only, and separately for each sex. To account for growth of the fish throughout the year, the fractional age of each sample was used in the growth model. For the population growth 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 1992 (Amendment 4 of the Snapper Grouper FMP), in effect allowing 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). Due to the increased uncertainty in the age readings of the oldest fish, it was deemed most appropriate for the growth model to assume a constant CV across all ages. To overcome 90% of the South Atlantic age data represented by ages 1-10, 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 parameter values are included in Table 5.

The value of t_0 (-1.845) in the population growth model caused some concern because it did not seem biologically reasonable and could be an important consideration if the age at maturity was very young. In past SEDARs, the value of t_0 has been fixed at -0.5, a more biologically reasonable value, but by fixing the t_0 value, the risk of incorrectly estimating the other parameters, L_∞ and K increases. To verify the t_0 output from the population growth model, a likelihood profile was run on the value of t_0, which supported the value estimated in the model as having the minimum likelihood value (Figure 4). The LHG felt that the freely estimated model parameters provided the best fit to the data (Figure 4). In the South Atlantic stock, female Scamp are 50% mature at age 2.9 years, and the assessment will be modelling fish starting at age-1. The growth model appeared to capture the size of the fish being modelled and the mature biomass.

A growth model based on length at age data from the fishery was run to characterize the average size at age of the fish landed in the fishery. The correction for the minimum size regulations was not used in the fishery growth model, because the model needs to reflect what fish are in the landings, not the whole population. The minimum size limit was enacted in 1992, leading the LHG to investigate fishery growth models pre and post regulation time-periods. The majority of the age data from the fishery landings for the South Atlantic have been collected since 1992 (n = 13,690), compared to only 121 age samples collected during the pre-regulation period, all of which came from the recreational headboat fishery. The pre-1992 samples were not adequate to characterize the commercial and recreational fishery landings during that time, therefore, the group recommended using the population growth model for the pre-regulation time period. The LHG recommended using the age data from fishery samples during the regulation time period to model growth and estimate length at age for the fish landed in the fisheries from 1992 to present. The assumption of constant CV across all ages was used in the model estimation procedure. Parameter results are included in Table 5 and Figure 5.

To calculate reproductive potential in the stock, a measure of fecundity or mature biomass (spawning stock biomass [SSB]) in the population is needed. When a reliable measure of fecundity and spawning periodicity are not available, an estimate of all mature adult, mature female only, or in the case of sperm limitation, mature male size at ages can be used. Because Scamp is a protogynous species, growth models of females only and male only in the population were calculated. Only fish that were histologically identified as functional females and males were used in these sex-specific growth models. To reflect length at age of females and males in the population, the correction to account for the bias on size at age introduced by minimum size regulations and assuming constant CV across all ages were incorporated into the growth models (Figure 6). The estimated growth parameters for each sex are included in Table 5.

ADT Recommendation:

1. The ADT approved the use of the population growth model as presented.

2. The ADT approved the use of the population growth model to characterize the fishery landings prior to 1992.

3. The ADT approved the use of the fishery growth model using only fishery-dependent age samples and no correction for minimum size limits to characterize the fishery landings since 1992.

4. The ADT approved the use of the female and male population growth models, which could be used to estimate SSB in a series of sensitivity runs to see the effects of possible sperm limitation on the stock.

2.6 REPRODUCTION

Fishery-independent and fishery-dependent data for Scamp and Yellowmouth Grouper were collected by the Marine Resources Monitoring Assessment and Prediction (MARMAP) program and the Southeast Area Monitoring and Assessment Program, South Atlantic (SEAMAP-SA) at the South Carolina Department of Natural Resources (SCDNR) and the Southeast Fisheries Independent Survey (SEFIS) at the Southeast Fisheries Science Center (SEFSC), Beaufort. Fishery-independent samples for life history were collected via MARMAP's reef fish survey efforts during 1979 to 2009, and then by the collaborative Southeast Reef Fish Survey (consisting of MARMAP, SEAMAP-SA, and SEFIS) from 2010 to 2017, mostly with chevron traps. Fishery-dependent samples for life history were collected via MARMAP's short-term port sampling efforts or special projects, mostly via snapper reel. Given that the two species are similar in morphology and coloration at smaller sizes, the decision to combine Scamp and Yellowmouth Grouper data was recommended by the SEDAR68 Stock ID Workshop (SEDAR68-SID-05). A total of 5,014 specimens was available for analyses, with 4,546 (mostly Scamp, n=4,518, 99%) having both reproductive and age data. Most (54%) specimens with both data types were from fishery-independent samples and the primary gear types irrespective of source were snapper reel (48%) and chevron trap (42%).

Maturity, sex ratio, and spawning frequency: Gonad tissue samples from Scamp and Yellowmouth Grouper collected by MARMAP or SERFS were processed histologically and examined under a microscope by two readers independently via standard procedures (Brown-Peterson et al. 2011; Smart et al., 2015) to determine sex and reproductive phase. Female specimens with developing or spawning capable gonads were considered functionally mature; this definition of maturity included specimens with oocyte development at or beyond the vitellogenic stage. To estimate calendar age and fork length at maturity, data were filtered to include immature and mature (developing or spawning capable) specimens from February through July. All females (i.e., juvenile and adult) were included in analyses to estimate calendar age and fork length at sex transition, but specimens undergoing sex transition were omitted. Fork length data in millimeters were rounded to the nearest cm to create 10 mm bins. A gonadosomatic index (gonad wt/whole fish weight * 100) was calculated for male Scamp to give insight into their mating strategy.

Maturity: The Logit model provided the best fit for estimating female age and size at functional maturity (Tables 6 and 7). The youngest mature female was Age 2 and all females were mature at Age 7. Estimates of female age and length at 50% maturity were 2.9 years and 375.2 mm FL, respectively (Figures 7 and 8).

Sex Ratio: The Probit model provided the best fit for estimating age and size at sex transition (Tables 8 and 9). Sex transition occurred over a wide range of age, as males ranged from Age 4 to Age 34. Estimates of age and length at 50% sex transition (to male) were 10.6 years and 646.9 mm FL, respectively (Figures 9 and 10). To address the potential for sperm limitation in the S. Atlantic population, sex ratio by fork length interval over time was calculated for three decades (1990-1999, 2000-2009, and 2010-2017; Figure 11). Although the proportion of males is smaller in most size classes in the 2010s, comparisons between periods are not appropriate due to: 1) improved sampling coverage relative to depth and latitude since 2010, and 2) small sample sizes in the larger size intervals. The number of specimens > 650 mm FL was only 49 in 1990-1999, 21 in 2000-2009, and 79 in 2010-2017. The consensus among the LHG members was that sex ratio data alone cannot be used to determine sperm limitation. To address this question requires knowledge of mating strategy and fertilization rate under various sex ratio scenarios, both of which are not known for these two species and challenging to investigate.

Spawning frequency: Spawning frequency (SF, number of batches per individual fish) was determined from histological examination of gonad tissue. Females were categorized as actively spawning if there were indicators of imminent (oocyte maturation, including germinal vesicle migration and hydration) or recent (postovulatory follicle complexes, POC) spawning. The total duration of spawning indicators was estimated to be 48 h. Data were filtered to include all females from the spawning season months (February – July; Harris *et al*., 2002). To maintain comparable sample sizes, ages 14-23 were pooled in the 14+ age group. For each calendar age, the SF was obtained by multiplying the proportion of spawning females by the spawning season duration as described in Gamboa-Salazar *et al*. (2019). Spawning frequency had a significant dome-shaped relationship with calendar age, with the best-fit model being a second order polynomial ($y=-4.710+6.148x-0.425x^2$ with $R^2 = 0.608$, $p = 0.002$; Figure 12). Predicted values of SF were highest for ages 6-8 yr and lowest for the oldest females (Table 10).

Batch Fecundity: Batch fecundity was estimated by applying the power function to the data from Harris *et al.* (2002). The specimens were collected in 1996 (*n*=72) and 1998 (*n*=4) and ranged in fork length (FL) from 406 to 657 mm. Batch Fecundity = b * FL^z, with b= 0.0000316 and z= 3.53 (Figure 13).

Measure of reproductive potential: The consensus reached by the LHG prior to Plenary #2 on 26 May 2020 was to recommend the use of total spawning biomass (vs. total egg production, TEP) in the base model for both regions because of: 1) the use of TEP would omit the reproductive value of males, 2) the standing recommendation of Brooks et al. (2008) to use total spawning biomass for protogynous species, 3) the precedence for using total spawning biomass in previous S. Atlantic assessments of grouper (i.e., Gag, Red Grouper, Snowy Grouper), and 4) the limitations of the available batch fecundity data for the S. Atlantic. The size range of specimens examined by Harris et al. (2002) to estimate batch fecundity was 406-657 mm FL; however, 9.1% of 341 adult females in the SERFS 2010-2017 SERFS chevron trap samples were 651-783 mm FL.

During LHG meetings prior to Plenary #3 on 24 September 2020, there was extended discussion about the design of sensitivity runs, much of which focused on how to incorporate a measure of male reproductive value into the sensitivity runs. Observations of reproductive behavior by Gilmore and Jones (1992) suggest that spawning in Scamp "occurs most frequently in pairs or small groups following elaborate courtship displays." The male GSI supports their conclusion because the GSI is < 1% at its peak (Figure 14), indicating that Scamp are not spawning in large aggregations. Members of the LHG, some of which are on the assessment team at NMFS Beaufort, proposed a matrix of 4 sensitivity runs that would explore the effect of varying levels of male contribution to spawning by either down-weighting or up-weighting the ratio of male to female biomass in the model (Table 11). The male only run will test the impact of sperm limitation. This matrix of sensitivity runs was subsequently adopted as consensus at Plenary #3 and will be utilized in the Scamp/Yellowmouth Grouper assessments for both regions to the extent possible.

<u>ADT Recommendations</u>:

1. Use maturity schedule at age and sex ratio at age as presented: 50% maturity of female age and length at were 2.9 years and 375.2 mm FL, respectively, and sex transition (to male) of age and Length at 50% were 10.6 years and 646.9 mm FL, respectively.
2. Use mature biomass of sexes combined as measure of reproductive potential.
3. Conduct sensitivity runs exploring the contribution or limitations of males to spawning success in the population by varying the ratio of female to male biomass as presented in Table 11.

2.7 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 (mm) and whole, or round, weight (kg), respectively. Meristic data collected on fish landed or surveyed within the SAFMC jurisdiction with paired length types, weight-length and whole weight – gutted weight data were compiled for the regression analyses. Data included were from TIPS, SRHS, MRIP, SERFS, GulfFIN and 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 during SERFS cruises. All lengths were in mm, and all weights were in kg for the various comparisons. Tables 12a and b provides 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 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 (Table 12c).

<u>ADT Recommendation</u>**:**

1. Use the meristic conversion equations as presented in Table 12 for the South Atlantic jurisdiction.

2. Use a combined South Atlantic and Gulf of Mexico whole weight – gutted weight equation to be applied to both areas.

2.8 RESEARCH RECOMMENDATIONS

2.8.1 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

2.8.2 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 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.

2.9 LITERATURE CITED

Charnov, E. L., H. Gislason, and J. G. Pope. 2012. Evolutionary assembly rules for fish life histories. Fish and Fisheries 14(2): 213 – 224.

Brooks, E. N., K. W. Shertzer, T. Gedamke, and D. S. Vaughan. 2008. Stock assessment of protogynous fish: Evaluating measures of spawning biomass used to estimate biological reference points. Fishery Bulletin 106:12-23.

Brown-Peterson, N.J., D. M. Wyanski, F. Saborido-Rey, B. J. Macewicz, and S. K. Lowerre-Barbieri. 2011. A standardized terminology for describing reproductive development in fishes. Marine and Coastal Fisheries [online serial] 3:52–70. DOI: 10.1080/19425120.2011.555724

Burton, M. L., J. C. Potts and D. R. Carr. 2014. Age, Growth, and Mortality of Yellowmouth Grouper from the Southeastern United States, Marine and Coastal Fisheries, 6:1, 33-42, DOI:10.1080/19425120.2013.866998

Gamboa-Salazar, K. R., D. M. Wyanski, W. J. Bubley, and N. Klibansky. 2019. Effects of age and size on spawning and egg production in gag and Scamp grouper off the southeastern United States. ICES Journal of Marine Science 77: 290-299.

Gilmore R. G., and R. S. Jones. 1992. Color variation and associated behavior in the epinepheline groupers, *Mycteroperca microlepis* (Goode and Bean), and *M. phenax* (Jordan and Swain). Bulletin of Marine Science 51: 83–103.

Harris, P. J., D. M. Wyanski, D. B. White, and J. L. Moore. 2002. Age, growth, and reproduction of Scamp, *Mycteroperca phenax*, in the southwestern north Atlantic, 1979–1997. Bulletin of Marine Science 70: 113–132.

Hoenig, J. 1983. Empirical use of longevity data to estimate mortality rates. Fishery Bulletin 82(1):898 – 903.

Lorenzen, K. 1996. The relationship between body weight and natural mortality in juvenile and adult fish: a comparison of natural ecosystems and aquaculture. Journal of Fish Biology 49(4):627 – 642.

McGarvey, R., and A. J. Fowler. 2002. Seasonal growth of King George whiting (*Sillaginodes punctata*) estimated from length-at-age samples of the legal-size harvest. Fishery Bulletin 100(3):545-558.

Smart, T. I., M. J. M. Reichert, J. C. Ballenger, W. J. Bubley, and D. M. Wyanski. 2015. Overview of sampling gears and standard protocols used by the Southeast Reef Fish Survey and its partners. SEDAR41-RD58.

Then, A. Y., J. M. Hoenig, N. G. Hall, and D. A. Hewitt. 2015. Evaluating the predictive performance of empirical estimators of natural mortality rate using information on over 200 fish species. Journal of Marine Science, doi: 10.1093/icesjms/fsu136.

2.10 TABLES

Table 1. 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/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

Table 2. Number of Scamp/Yellowmouth Grouper age samples (number of trips intercepted) from commercial fishery landings, which were determined to be randomly collected and could be used for generating age composition of the landings. Annual sample sizes are listed by gear group and state.

Gear Group	Vertical Hook and Line			Bottom Longline	Spears			Vertical Longline	
Year/State	FL	NC	SC	FL	FL	NC	SC	NC	SC
1996	75 (10)		6 (4)						
1997	23 (7)		2 (2)	11 (4)					
1998	35 (9)								
1999	18 (5)								
2000	24 (6)								
2001	48 (11)		3 (1)						
2002	17 (7)								
2003	27 (8)								
2004	18 (4)	155 (46)							
2005	36 (7)	313 (86)	109 (24)						
2006	11 (3)	374 (116)	568 (147)				15 (5)		
2007	49 (8)	866 (205)	576 (163)				12 (1)		
2008	12 (2)	664 (180)	613 (165)				16 (2)		
2009	59 (11)	496 (117)	324 (143)				47 (12)		
2010	1 (1)	321 (94)	539 (107)			36 (6)	65 (9)		
2011	20 (5)	383 (116)	557 (109)			25 (3)	116 (16)		
2012		395 (98)	448 (89)			24 (4)	9 (2)	2 (1)	
2013	24 (8)	220 (68)	179 (61)			48 (8)	59 (16)	1 (1)	
2014	27 (10)	323 (62)	176 (62)		2 (1)	119 (18)	27 (9)	1 (1)	
2015	4 (1)	168 (52)	130 (48)		1 (1)	31 (8)	13 (5)		
2016	3 (1)	296 (66)	141 (48)			62 (7)	33 (9)		
2017	11 (3)	167 (45)	94 (35)		3 (1)	90 (13)	14 (7)		5 (1)
2018	9 (5)	288 (62)	87 (36)		6 (1)	59 (13)	17 (7)		

Table 3. Number of Scamp/Yellowmouth Grouper age samples (number of trips intercepted) from recreational fishery landings, which were determined to be randomly collected and could be used for generating age composition of the landings. Annual sample sizes are listed by fishing mode and state.

Mode	Headboat				Charter Boat		Private Boat	
Year/State	FL	GA	NC	SC	FL	NC	FL	NC
1979	5 (3)							
1980	33 (19)		6 (3)	2 (2)				
1981	52 (33)	1 (1)	3 (1)					
1982	3 (3)		2 (2)					
1983	6 (4)			1 (1)				
1984	1 (1)							
1985								
1986								
1987								
1988								
1989				5 (3)				
1990								
1991			1 (1)					
1992								
1993			1 (1)					
1994								
1995	3 (2)			9 (1)				
1996	1 (1)	1 (1)	4 (3)	119 (42)				
1997			2 (1)					
1998								
1999								
2000				1 (1)				
2001	1 (1)				6 (4)			
2002				4 (3)	44 (22)			
2003			1 (1)		60 (33)			
2004			3 (3)		87 (42)			
2005	3 (1)		12 (11)		86 (42)			
2006	4 (4)	3 (3)		26 (26)	59 (17)			
2007	8 (6)	1 (1)	4 (4)	33 (33)	15 (5)			
2008	5 (4)		1 (1)	17 (17)				
2009	15 (12)	2 (2)	2 (1)	40 (22)	9 (3)			
2010	7 (4)	1 (1)	7 (6)	27 (17)	2 (1)	7 (2)		2 (1)
2011	2 (2)	1 (1)		6 (6)	1 (1)			
2012	25 (13)		10 (6)	11 (7)				
2013	19 (10)		17 (11)	25 (13)	2 (1)			
2014	16 (12)	1 (1)	19 (9)	6 (4)			1 (1)	
2015	16 (8)		11 (7)	2 (2)				
2016	43 (19)	1 (1)	5 (5)	6 (6)				2 (1)
2017	14 (9)		6 (4)	5 (4)	3 (3)			
2018	6 (3)		8 (5)	13 (8)				5 (4)

Table 4. Number of Scamp/Yellowmouth Grouper age samples from the fishery-independent portion of SERFS by year and gear.

Year	Chevron trap	Hook and Line	Short-Bottom Longline	Experimental trap	FL Antillean trap	Trawls
1976						2
1977						
1978						
1979						
1980		2				
1981		1				
1982		1			1	
1983		4				
1984		7			1	1
1985					5	
1986		1			1	
1987					4	1
1988	17	9				
1989	4	2				
1990	21	7				
1991	53					
1992	51	2				
1993	74	9				
1994	121	2				
1995	183	3				
1996	132	8	1			
1997	191	3				
1998	122	2				
1999	60		21	8		
2000	61	1	2			
2001	60	1	31			
2002	50		9			
2003	42	1	8			
2004	68		14		3	
2005	67	2	13		3	
2006	24	2	23		1	
2007	59	1	28			
2008	13		4			
2009	17	7	18			
2010	54	11	10			
2011	35	24	25	5		
2012	62	22				
2013	63	18	13			
2014	74	38	9			
2015	72	22	12			
2016	53	14	8			
2017	71	17	10			
2018	42	19	6			

Table 5. Growth model parameters of Scamp/Yellowmouth Grouper in the U.S. South Atlantic.

	L_∞ (FL, mm)	K	t_0	C.V.
Population model (*n*= 16778)	787.36 ± 26.35	0.149 ± 0.027	-1.845 ± 0.711	0.1 ± 2.6815e-005
Fisheries Post 1992 model (*n*= 13690)	919.06 ± 17.48	0.076 ± 0.0042	-5.19 ± 0.288	0.1 ± 7.1679e-008
Females only model (*n* = 3568)	761.51 ± 79.21	0.128 ± 0.051	-2.53 ± 1.42	0.118 ± 0.0199
Males only model (*n* = 333)	765.62 ± 63.11	0.145 ± 0.093	-3.34 ± 4.57	0.1 ± 0.00003

Table 6. Best fit for female age at functional maturity in S. Atlantic Scamp/Yellowmouth Grouper during the period 1979-2017. Female specimens with developing or spawning capable gonads were considered mature.

Distribution	N	A_{50} (yr)		Estimate	Std. Error	z value	Pr(>|z|)
Logit	1011	2.9	**(Intercept)**	-6.1129	0.7237	-8.447	<2e-16
			CalAge	2.0936	0.1998	10.477	<2e-16

Table 7. Best fit for female fork length at functional maturity in S. Atlantic Scamp/Yellowmouth Grouper during the period 1979-2017. Female specimens with developing or spawning capable gonads were considered mature.

Distribution	N	L_{50} (mm)		Estimate	Std. Error	z value	Pr(>|z|)
Logit	1085	375.2	**(Intercept)**	-16.7155	1.6901	-9.89	<2e-16
			Fork Length	0.0446	0.0042	10.74	<2e-16

Table 8. Best fit for female age at sex transition in S. Atlantic Scamp/Yellowmouth Grouper during the period 1979-2017. All females (i.e., juvenile and adult) were included, but specimens undergoing sex transition were omitted.

Distribution	N	A_{50} (yr)		Estimate	Std. Error	z value	Pr(>|z|)
Probit	4357	10.6	**(Intercept)**	-3.07207	0.07969	-38.55	<2e-16
			CalAge	0.28968	0.01014	28.56	<2e-16

Table 10. Predicted values of spawning frequency (SF, number of batches per individual fish) at calendar age for S. Atlantic Scamp/Yellowmouth Grouper during the period 1979-2017 from a second-order polynomial regression model, with sample size (N) at each age. Ages 14-23 were pooled. Predicted value of SF for age 14+ was negative (-1.97), therefore the observed value was provided. Model equation $y = -4.710 + 6.148x - 0.425x^2$

Calendar Age (yr)	SF	N
1	1.01	2
2	5.88	46
3	9.91	145
4	13.08	411
5	15.4	603
6	16.87	507
7	17.49	226
8	17.26	115
9	16.18	94
10	14.25	41
11	11.47	25
12	7.84	25
13	3.36	11
14+	0.03	17

Table 11. Consensus reached during Plenary #3 on 24 September 2020 on sensitivity runs for S. Atlantic and Gulf of Mexico assessments. Ratios of female to male biomass for estimating spawning potential biomass in the model.

	Female Only	Male Biomass at 50%	Female Biomass at 50%	Male Only
Female	1	1	0.5	0
Male	0	0.5	1	1

Table 12. Meristic conversion equations for South Atlantic Scamp/Yellowmouth Grouper.

a. Length – length equations

Model: *Y = a + bX*	**n**	**a**	**SE**	**b**	**SE**	**r^2**	**Units**	**range of Independent variable**
FL = TL	1999	19.72	1.31	0.89	0	0.99	mm, mm	267 - 1003
TL = FL	1999	-15.01	1.51	1.11	0	0.99	mm, mm	252 - 898
TL = maxTL	152	-0.30	3.34	0.98	0	0.99	mm, mm	457 - 922
maxTL = TL	152	2.95	3.37	1.01	0	0.99	mm, mm	453 - 916
FL = maxTL	5213	23.03	0.70	0.88	0	0.99	mm, mm	193 - 922
maxTL = FL	5213	-20.42	0.83	1.13	0	0.99	mm, mm	184 - 847
FL = SL	5111	25.38	0.90	1.12	0	0.98	mm, mm	149 - 720
SL = FL	5111	-15.46	0.83	0.88	0	0.98	mm, mm	184 - 847
TL = SL	183	17.00	10.57	1.14	0.02	0.95	mm, mm	374 - 695
SL = TL	183	11.97	8.34	0.77	0.01	0.95	mm, mm	453 - 916
maxTL = SL	5321	5.90	1.18	1.26	0	0.98	mm, mm	149 - 750
SL = maxTL	5321	5.07	0.92	0.78	0	0.98	mm, mm	193 - 925

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)	17614	-16.51	0.04	2.75	0	0.92	kg, mm	178 - 1130	0.04	$WW = 7.03E-08(FL)^{2.75}$
Ln(FL) = Ln(WW)	17614	6.03	0	0.34	0	0.92	kg, mm	0.083 - 20.98	0.00439	$FL = 417.54(WW)^{0.34}$
Ln(WW) = Ln(TL)	2847	-17.44	0.1	2.87	0.02	0.91	kg, mm	183 - 1003	0.04	$WW = 2.78E-08(TL)^{2.87}$
Ln(TL) = Ln(WW)	2847	6.09	0	0.32	0	0.91	kg, mm	0.10 - 11.00	0.00427	$TL = 443.31(WW)^{0.32}$
Ln(WW) = Ln(maxTL)	4805	-18.25	0.06	3.00	0.01	0.95	kg, mm	193 - 922	0.0181	$WW = 1.21E-08(maxTL)^{3.00}$
Ln(maxTL) = Ln(WW)	4805	6.11	0	0.32	0	0.95	kg, mm	0.083 - 15.50	0.0019	$maxTL = 451.20(WW)^{0.32}$
Ln(WW) = Ln(SL)	4749	-17.37	0.06	2.97	0.01	0.94	kg, mm	149 - 750	0.02	$WW = 2.92E-08(SL)^{2.97}$
Ln(SL) = Ln(WW)	4749	5.86	0	0.32	0	0.94	kg, mm	0.083 - 15.50	0.0021	$SL = 351.46(WW)^{0.32}$

c. Whole weight – gutted 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

2.11 FIGURES

Figure 1. Values of *M* estimated for Serranids (groupers) from Then et. Al (2015) data set and regression line.

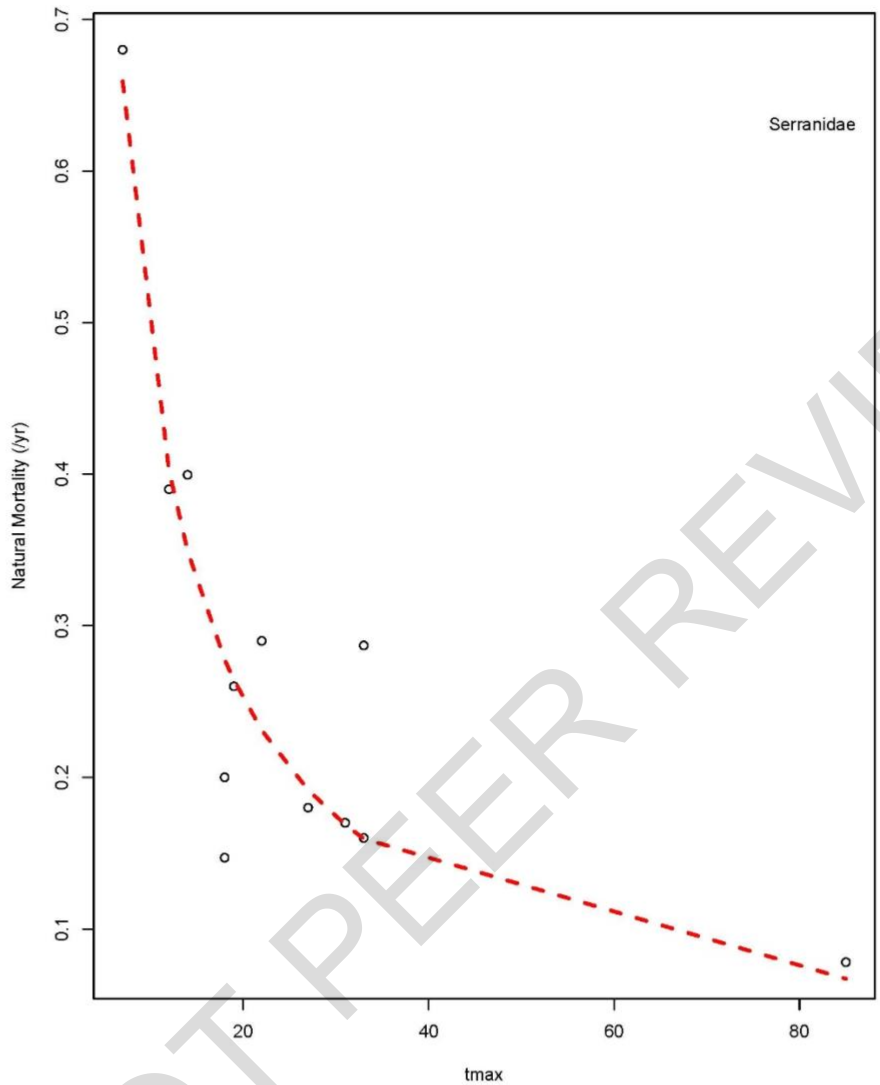
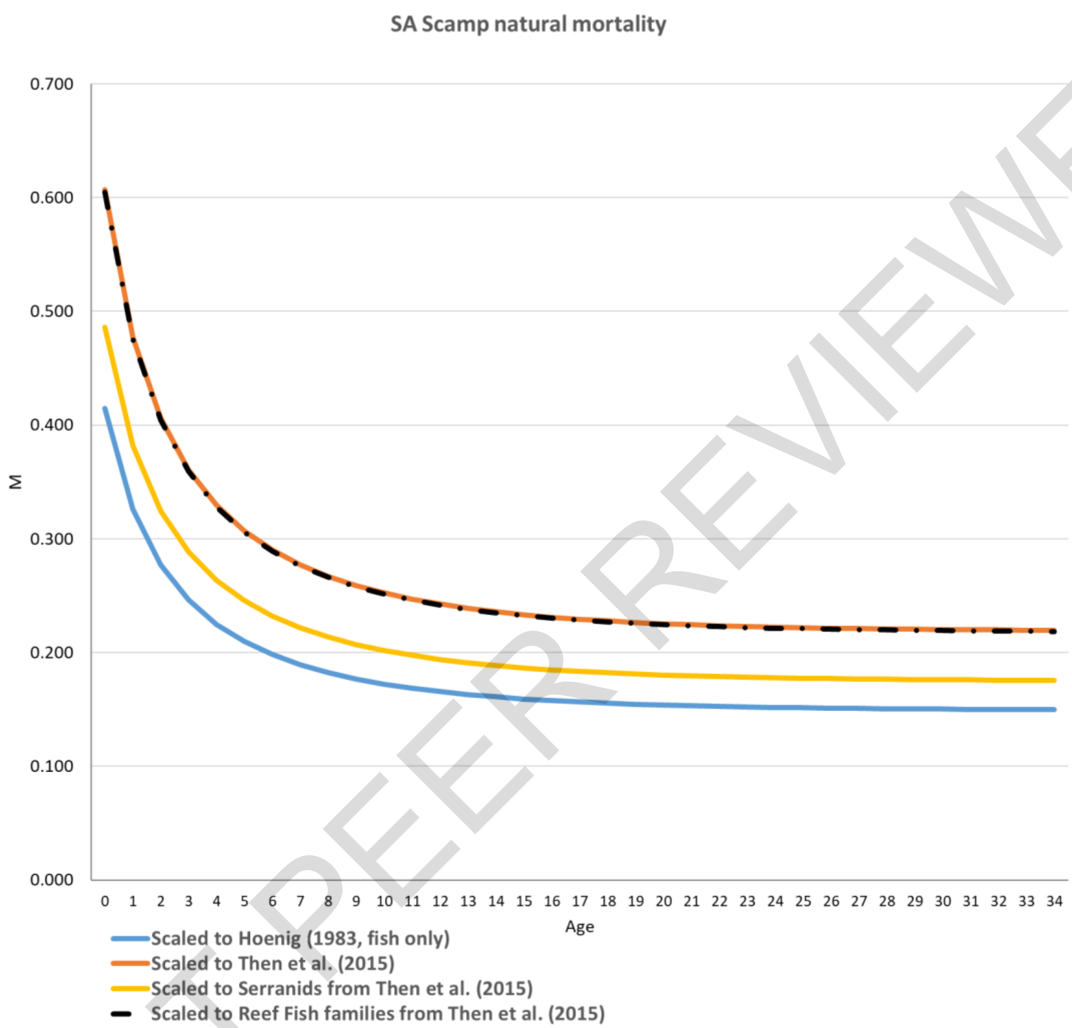


Figure 2. Natural Mortality vector for (a) South Atlantic and (b) Gulf of Mexico stocks. Lorenzen (1996) size-at-age natural mortality scaled to point estimates of *M* based on maximum age in the population, age 34. Recommended values (yellow) are the ones scaled to the point estimate of *M* based on the Serranidae data used in Then et al. (2015).

a.



b.

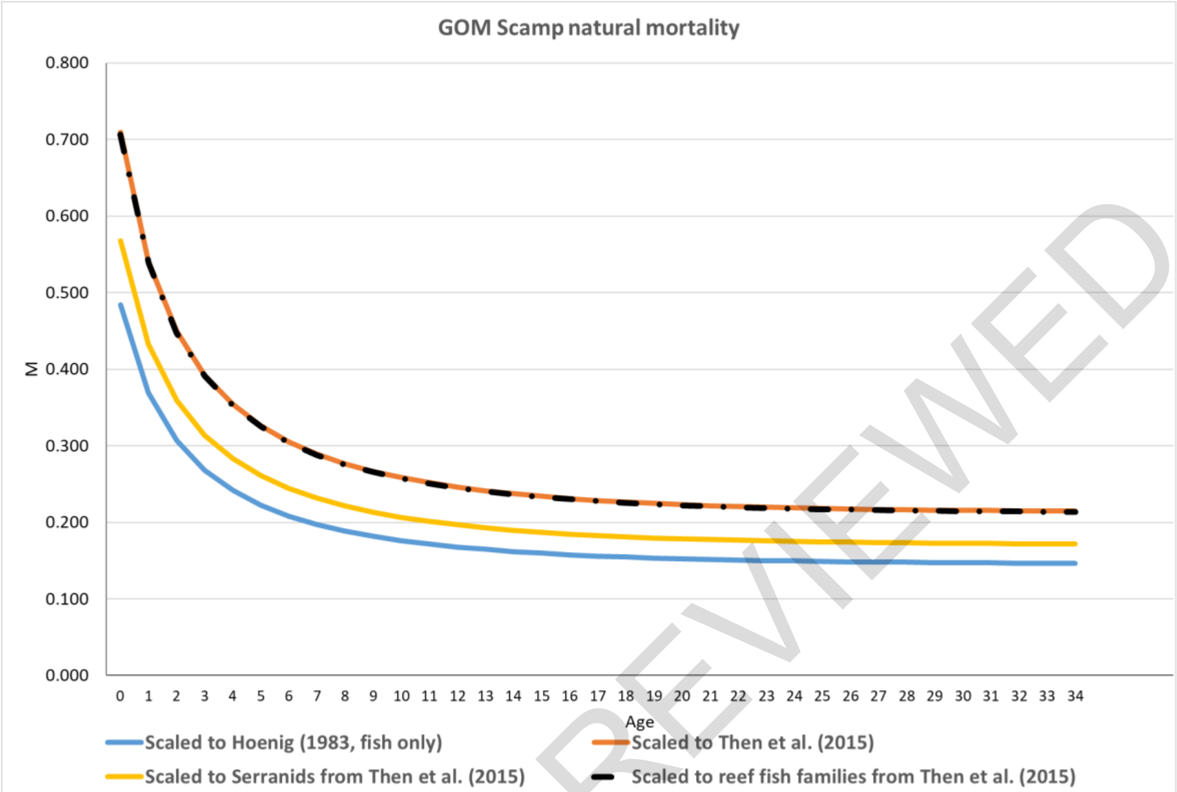

GOM Scamp natural mortality
M
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34
Age
Scaled to Hoenig (1983, fish only)
Scaled to Then et al. (2015)
Scaled to Serranids from Then et al. (2015)
Scaled to reef fish families from Then et al. (2015)

Figure 3. Likelihood profile of the value of t_0 estimated in the population growth model of the South Atlantic Scamp/Yellowmouth Grouper stock.

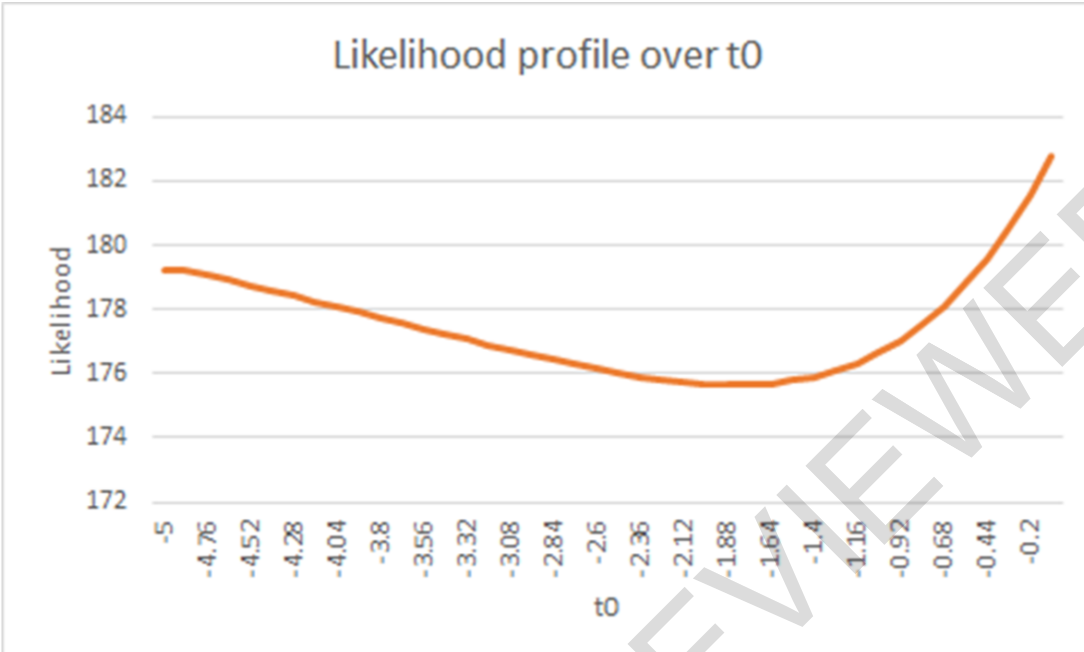


Figure 4. South Atlantic Scamp/Yellowmouth Grouper population growth model using fractional age at length (FL, mm) with correction for left truncated distribution of size at age under minimum size regulations, inverse weighted by sample size at calendar age, and assuming a constant CV across all ages.

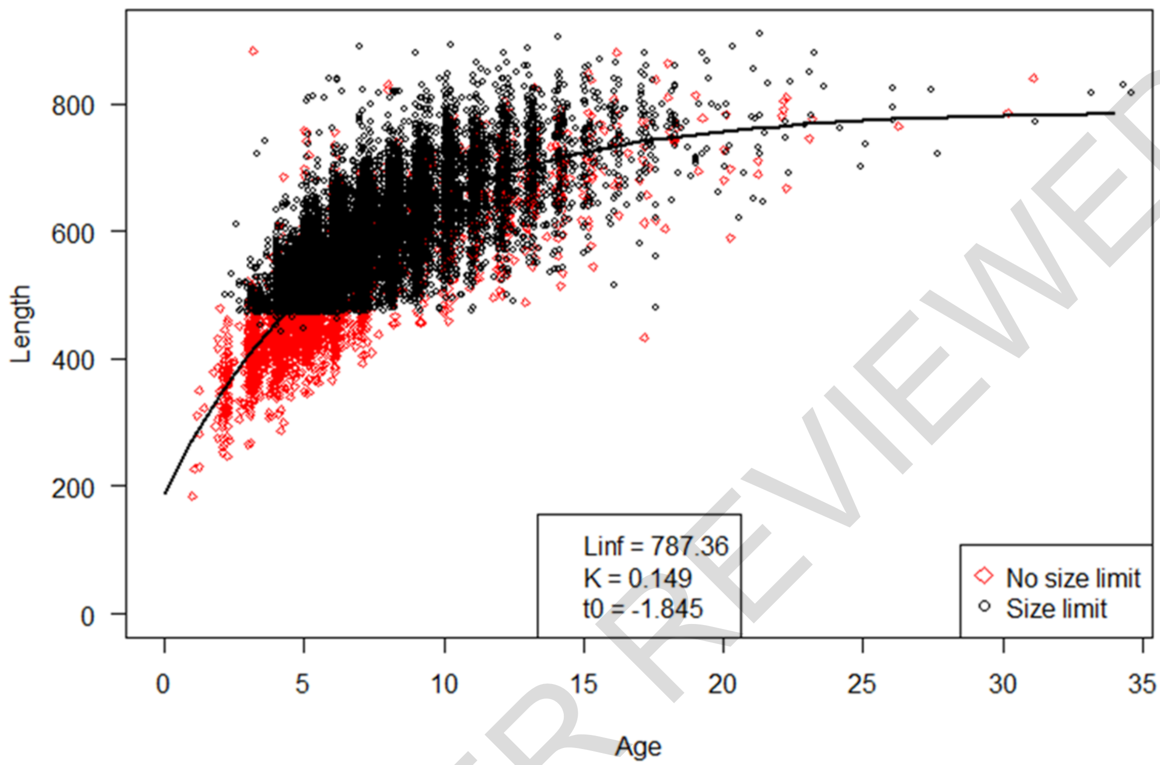


Figure 5. South Atlantic Scamp/Yellowmouth Grouper fishery growth model during minimum size regulations: 1992 – present. Model run on fork length (mm) at fractional age (years) and assuming a constant CV across all ages.

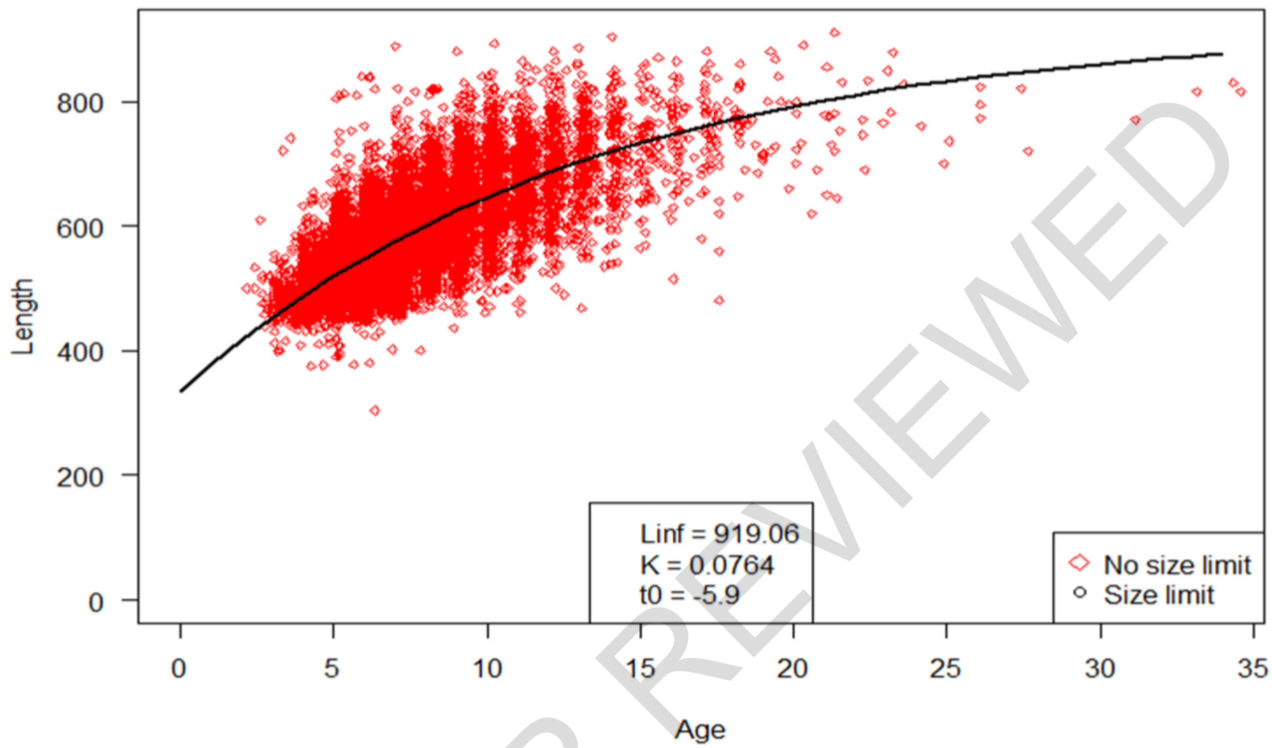
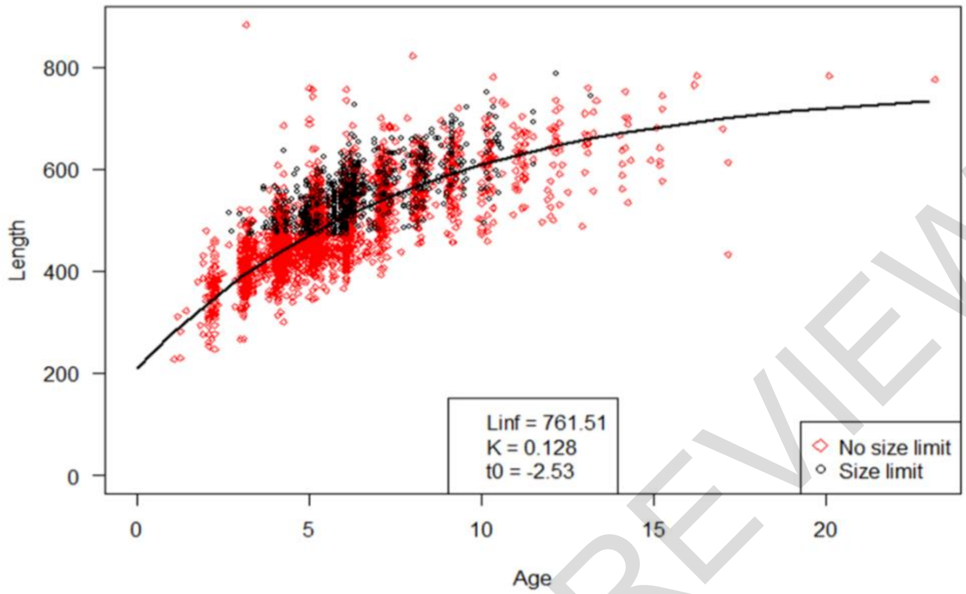


Figure 6. South Atlantic Scamp/Yellowmouth Grouper female only (a) and male only (b) population growth model using fork length (mm) at fractional age with correction for left truncated distribution of size at age under minimum size regulations, inverse weighted by sample size at calendar age, and assuming a constant CV across all ages.

a.



b.

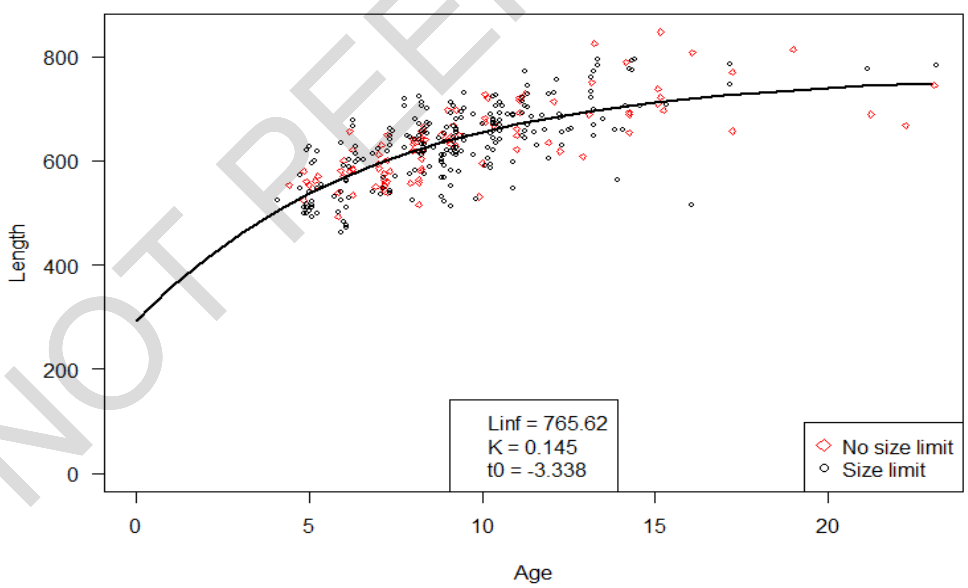


Figure 7. Best fit for female age at functional maturity in S. Atlantic Scamp/Yellowmouth Grouper during the period 1979-2017. Female specimens with developing or spawning capable gonads were considered mature.

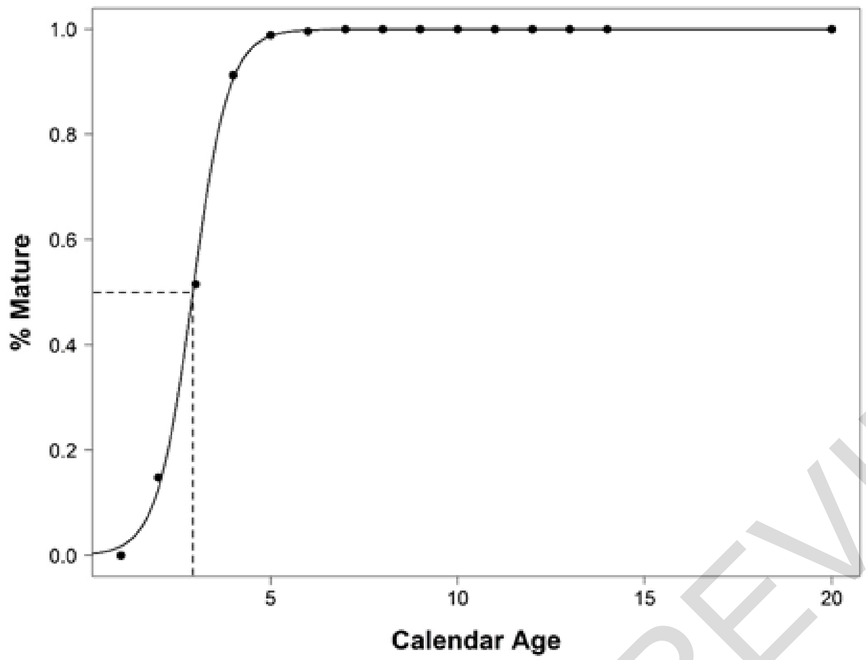


Figure 8. Best fit for female fork length at functional maturity in S. Atlantic Scamp/Yellowmouth Grouper during the period 1979-2017. Female specimens with developing or spawning capable gonads were considered mature.

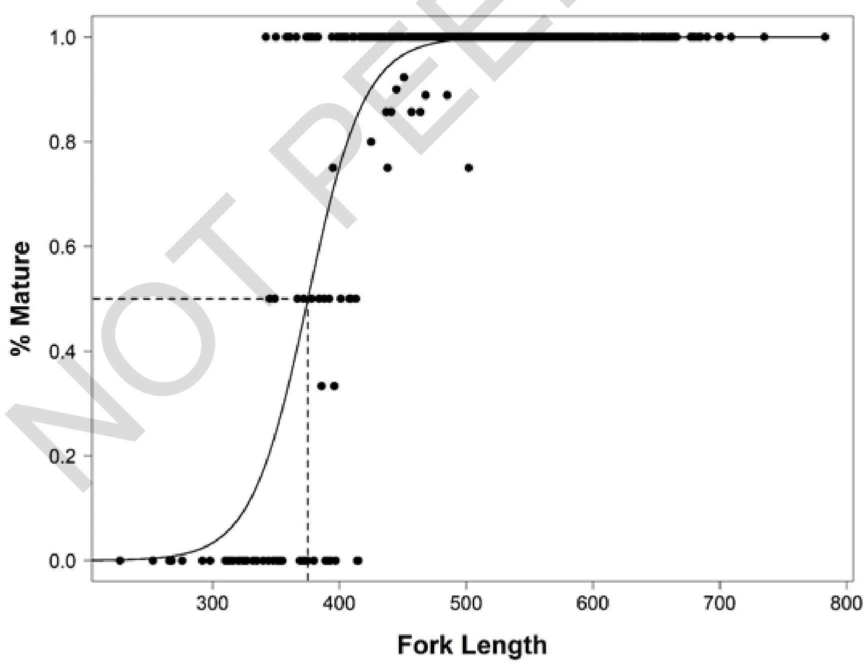


Figure 9. Best fit for female age at sex transition in S. Atlantic Scamp/Yellowmouth Grouper during the period 1979-2017. All females (i.e., juvenile and adult) were included, but specimens undergoing sex transition were omitted.

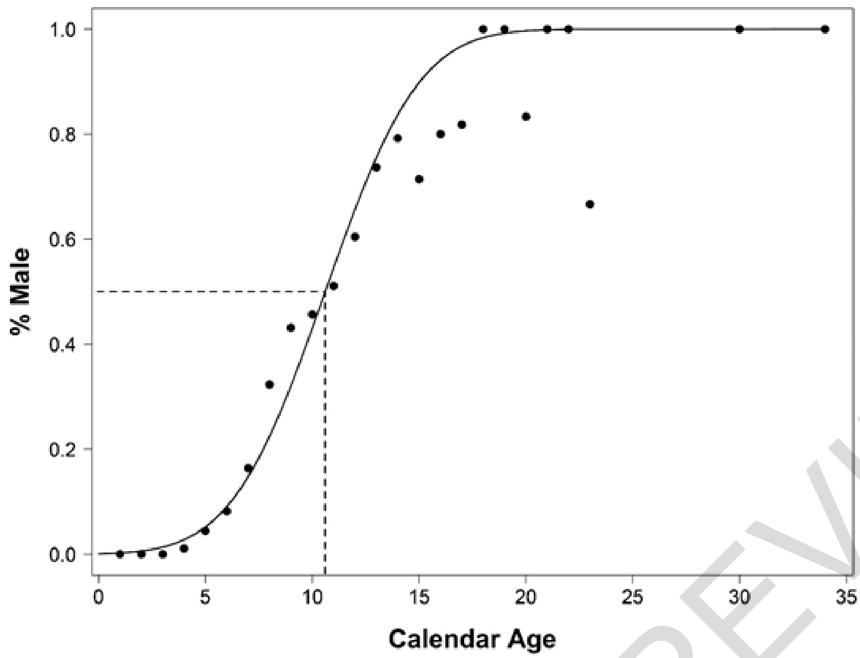


Figure 10. Best fit for female fork length at sex transition in S. Atlantic Scamp/Yellowmouth Grouper during the period 1979-2017. All females (i.e., juvenile and adult) were included, but specimens undergoing sex transition were omitted. [Error in units of length to be corrected to mm]

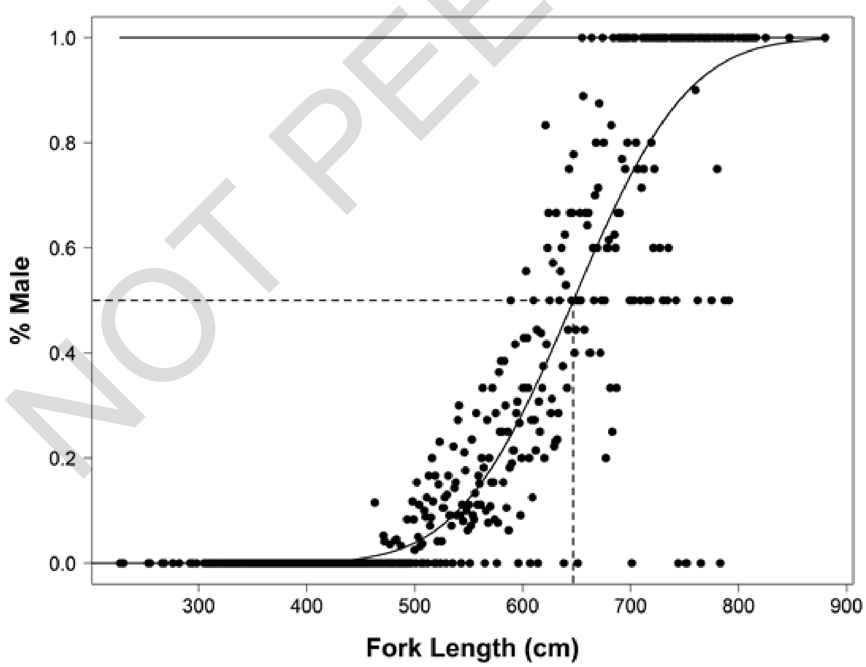


Figure 11. Sex ratio by fork length interval of S. Atlantic Scamp/Yellowmouth Grouper in samples from chevron traps during three decades.

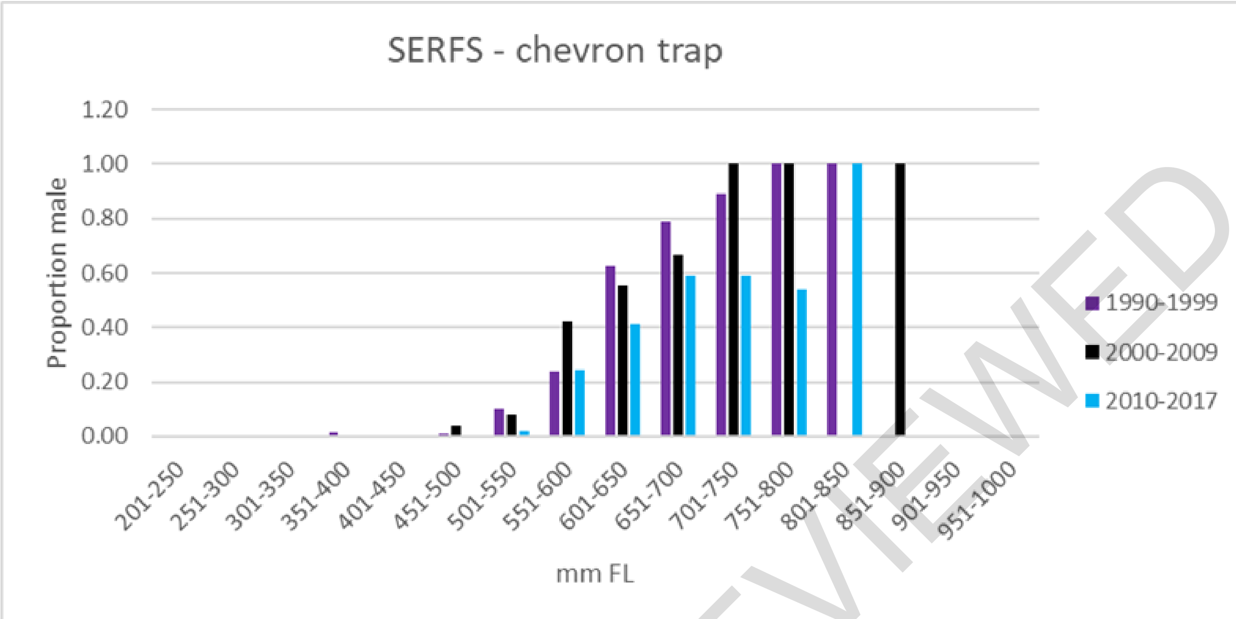


Figure 12. Observed (filled circles) spawning frequency at calendar age for S. Atlantic Scamp/Yellowmouth Grouper during the period 1979-2017. A second-order polynomial regression model was fitted to the data (solid line). Ages 14-23 were pooled. Model equation $y = -4.710 + 6.148x - 0.425x^2$

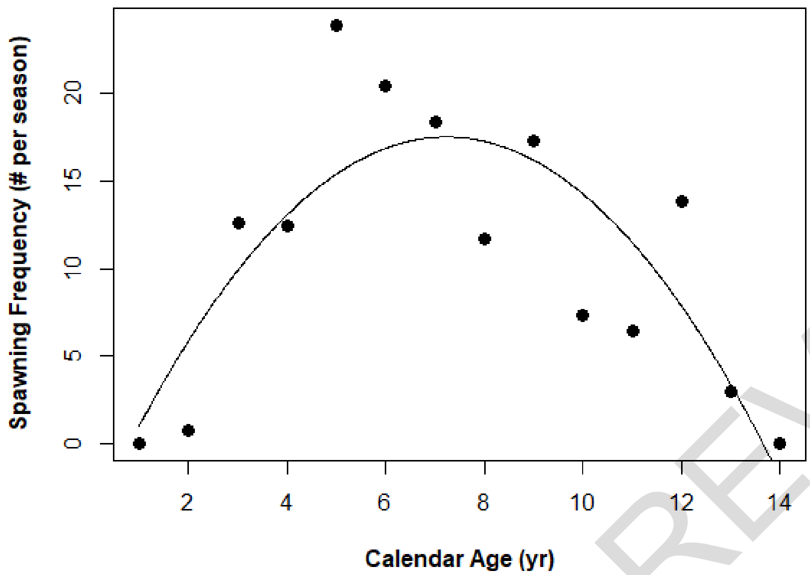


Figure 13. Batch fecundity at fork length (FL) for S. Atlantic Scamp collected during 1996 (n=72) and 1998 (n=4). Batch Fecundity = b * FL^z, with b= 0.0000316 and z= 3.53.

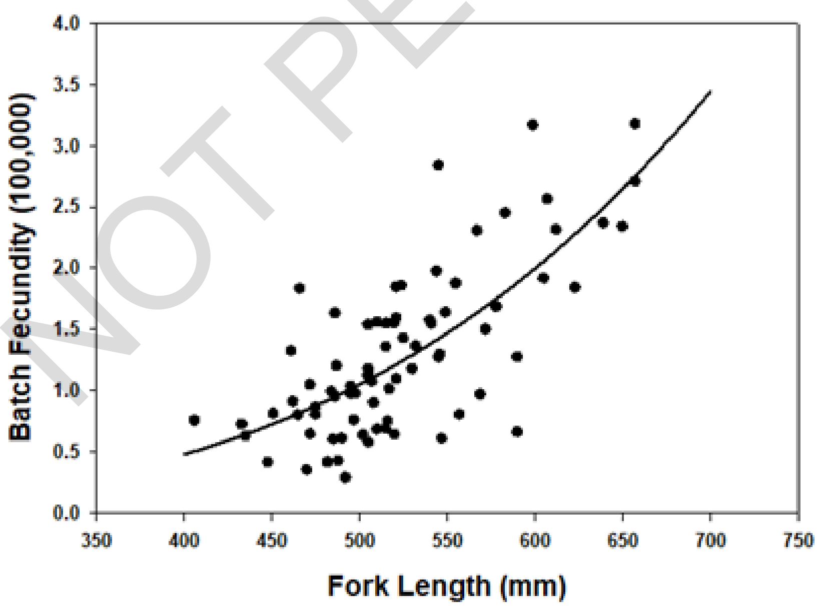


Figure 14. Male gonadosomatic index (GSI) for male Scamp collected by MARMAP during 1979-1998. GSI = (gonad wt/whole fish weight) * 100.

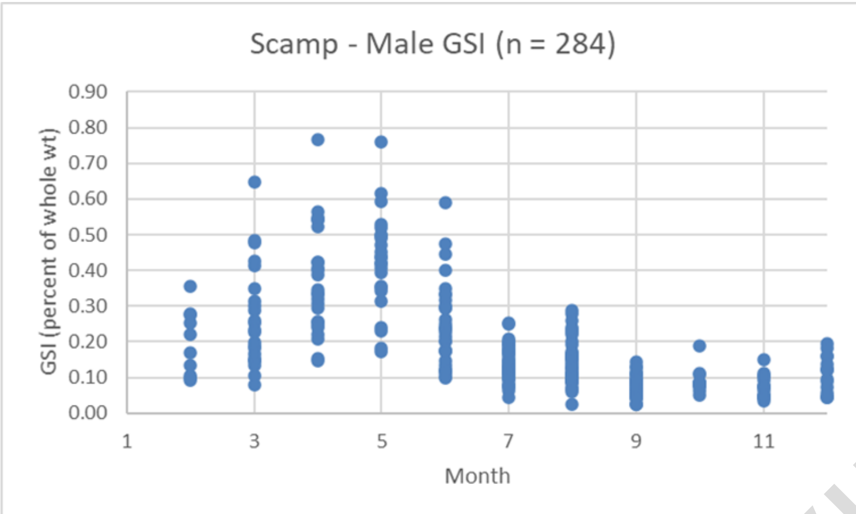
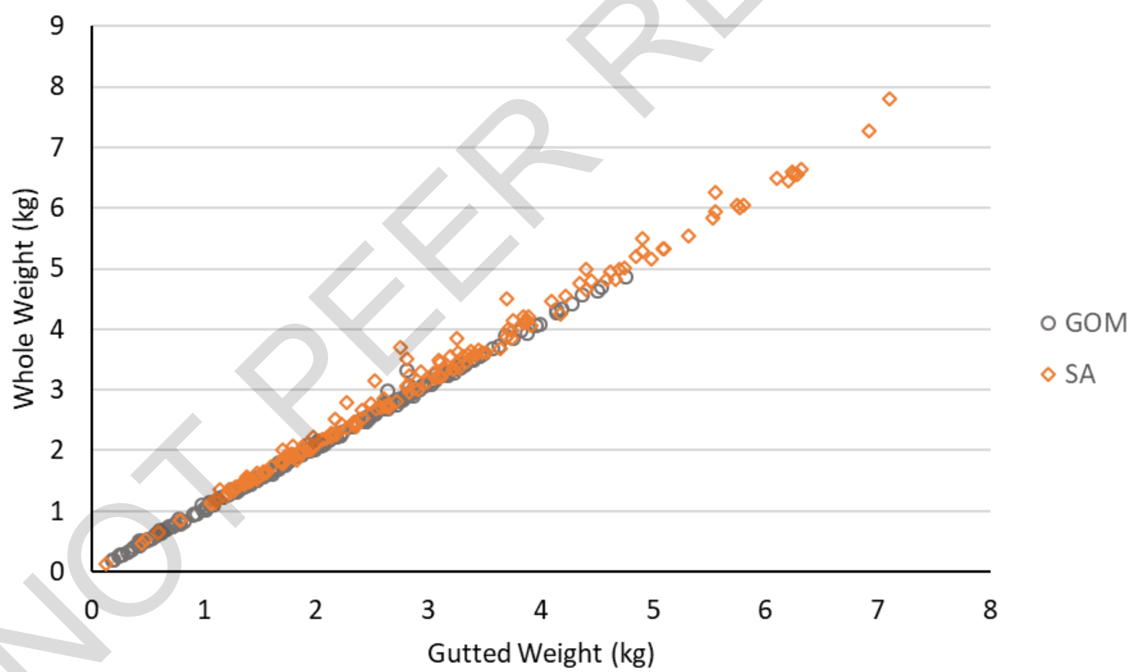


Figure 15. Scamp/Yellowmouth Grouper whole weight – gutted weight data for the entire Southeast region.



3 COMMERCIAL FISHERY STATISTICS

3.1 OVERVIEW

Commercial landings for the US South Atlantic Scamp and Yellowmouth Grouper stock were developed in whole weight pounds for the period 1950-2018 based on federal and state trip ticket databases. The SEDAR 68 Stock ID Workshop established the South Atlantic (SA) and Gulf of Mexico (GoM) Council boundary line as the delimiting stock boundary between SA and GoM stocks.

Scamp and Yellowmouth Grouper discards from the South Atlantic commercial fishery were estimated using two datasets. A discard logbook dataset provided discard rate data and the coastal logbook dataset provided total effort from the fishery. Methods used began with SEDAR 32 and are described in McCarthy, et al. (2020).

3.1.1 Commercial Workgroup Participants

Beth Wrege	Workgroup leader	SEFSC Miami
Julie Defilippi-Simpson	Workgroup leader	ACCSP
Amy Dukes	Data provider	SC DNR
Eric Hiltz	Data provider	SC DNR
Alan Bianchi	Data provider	NC DMF
Julie Califf	Data provider	GA DNR
Steve Brown	Data provider	FWCC
Kevin McCarthy	Data provider	SEFSC Miami
Refik Orhun	Data provider	SEFSC Miami
Sarina Atkinson	Participant	SEFSC Miami
Kyle Shertzer	Participant	NOAA
Molly Stevens	Participant	NOAA
Skyler Sagarese	Participant	NOAA
Carole Neidig	Participant	Mote
Steve Smith	Participant	NOAA
Jay Mullins	Participant	Fisherman
Shannon Calay	Participant	NOAA
Mike Rinaldi	Data provider/rapporteur	ACCSP

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

** See Table 3.7 for full list of attendees

3.1.2 Issues Discussed at the Data Workshop

Issues discussed by the commercial workgroup concerning South Atlantic Scamp and Yellowmouth Grouper landings included species identification issues; data sources for commercial landings; commercial effort products; gear groupings of handline, longline, spears & diving, and others; and proportioning unclassified grouper landings.

3.2 REVIEW OF WORKING PAPERS

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.

SEDAR68-DW-16: Commercial Discard Length Composition for South Atlantic 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 collected by the South Atlantic Fisheries Foundation on volunteer vessels from the snapper grouper vertical hook-and-line fishery. The SBLOP includes data from the bottom longline and vertical line fisheries in the South Atlantic. Data from both sources were analyzed by year and gear, and length compositions were generated.

SEDAR68-DW-25: This working paper presents a summary of the data collected through the South Atlantic Fishery Management Council's (SAFMC) initial citizen science pilot project, SAFMC Scamp Release. This project focuses on collecting data on released Scamp Grouper through the development and use of a mobile app. The SAFMC Release app is designed to collect data on released fish from commercial, for-hire, and recreational fishermen and is being pilot tested on Scamp Grouper. It will expand to collect information on all shallow water grouper in 2021. The app is open access, meaning that any interested fisherman that encounter Scamp can participate in data collection efforts. Data fields for discarded fish include trip type, date, discard time, location, depth, species name, fork length, photo, hook type and location, and release condition and treatment. There is also a separate 'No Release' form within the app to collect limited information on trips where Scamp were not released. The SAFMC Scamp Release project launched in late June 2019. The information collected through SAFMC Scamp Release was presented to the Recreational Work Group, Commercial Work Group, and Discard Mortality Ad-hoc Group.

3.3 COMMERCIAL LANDINGS

Commercial landings of Scamp and Yellowmouth Grouper were compiled from 1950 through 2018 for the Atlantic Coast from the Florida Keys (South of US Route 1) to North Carolina. Sources for landings in the U.S. South Atlantic included the North Carolina Division of Marine Fisheries (NCDMF), South Carolina Department of Natural Resources (SCDNR), Florida Fish and Wildlife Conservation Commission (FWCC), and the Atlantic Coastal Cooperative Statistics Program. Further discussion of how landings were compiled from the above sources can be found in Section 3.3.4.

3.3.1 Commercial Gears

The workgroup investigated reported gears landing Scamp and all other grouper species. Work group discussion on fleet composition and predominant gears resulted in the final gear groupings of handline, longline, spear and diving, and other for the South Atlantic. The list of gear used in the assessment can be found in Table 3.1. Per best practices, ACCSP (FIN) standard gear codes were used.

3.3.2 Stock Boundaries

DW ToR #1*: Define the unit stock for the SEDAR 68 Gulf of Mexico and Atlantic Scamp and stock assessment to include the US Atlantic seaboard, using the boundary between the Gulf of Mexico and South Atlantic Councils as the southwestern boundary for the stock unit to assess.*

Per Data Workshop Term of Reference #1, landings along the entire U.S. Atlantic coast were examined. Landings before 1980 were reported as unclassified grouper (family Serranidae), except for Warsaw and Goliath groupers. Historical landings required proportioning in order to estimate the composition of Scamp and Yellowmouth Grouper. Proportions created with South Atlantic and Gulf landings are only appropriate for use in the South Atlantic and Gulf of Mexico regions. They are not representative of grouper species in other regions of the Atlantic. There are no reported Scamp and Yellowmouth Grouper landings from states north of North Carolina, but unclassified grouper landings exist. In alignment with previous assessments, proportions were not applied to unclassified grouper landings north of NC, and these data will not be used in the assessment.

The Commercial Workgroup considered the southwestern boundary, as defined by Data Workshop Term of Reference #1, of the South Atlantic – Gulf of Mexico Council boundary along US Highway 1 in Monroe County, FL as the dividing line between the South Atlantic and Gulf of Mexico stocks (see Figure 3.1). Commercial Fisheries Logbook Program proportions (see Section 3.3.4, Florida), were used to divide landings in Monroe County. A close up of the southern boundary, as determined by the South Atlantic Council boundary, can be seen in Figure 3.2.

3.3.3 Misidentification of Scamp and Yellowmouth Grouper, Unclassified Groupers

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, it is reported that Yellowmouth Grouper and Scamp are both marketed as Scamp, though Yellowmouth Grouper's contribution to 'Scamp' landings are low, and 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.

Before 1980, all grouper landings except for Warsaw and Goliath Grouper were reported as unclassified (family Serranidae). Therefore, consistent with other grouper-complex SEDARs, proportioning was required in order to estimate the Scamp and Yellowmouth Grouper composition of South Atlantic unclassified landings. Based on input from state data providers, unclassified grouper landings were proportioned by year, state, and gear. Supporting information included the implementation of state trip ticket programs, fishermen knowledge, and existing SEDAR best practices. The proportion methodology can be seen below:

$$\textit{Scamp and Yellowmouth Grouper} \div$$
$$\textit{All identified grouper species (excluding Warsaw and Goliath)}$$

Proportions of Scamp and Yellowmouth Grouper landings were created by year, state, and gear and applied to unclassified landings within the same strata. Average proportions for state and gear were created using the years below:

- Florida 1986-1991
- Georgia 1981-1991
- South Carolina 1980-1991
- North Carolina 1981-1991

Average proportions were then applied to unclassified historical grouper landings by state and year.

3.3.4 Commercial Landings by State

Statistics on commercial landings (1950 to present) for all species on the Atlantic coast are maintained in the ACCSP Data Warehouse. The Data Warehouse is an online database of fisheries dependent data provided by the ACCSP state and federal partners. Data sources and collection methods are illustrated by state in Figure 3.3. The Data Warehouse was queried in December 2019 for all grouper landings (annual summaries by gear category) from 1950 to 2018 from Florida through Maine (ACCSP 2019). Data are presented using the gear categories as determined during the Data Workshop. The ACCSP gear types in each category are listed in Table 3.1. Commercial landings in whole weight pounds were developed based on methods defined by each state data provider. Landings are reported in different conditions (gutted, whole, head off, etc), and weight-weight conversions are state-specific. In order to create a uniform data set for the SEDAR process, whole weight landings were converted into gutted weights using state-specific conversion factors. Gutted weights were then converted back into whole weight using a unified South Atlantic and Gulf of Mexico conversion factor of 1.05. The gutted-to-live conversion was provided by the Life History workgroup. Final data are presented in whole weight pounds for the South Atlantic.

<u>Virginia to Maine</u>

No landings were reported at the species level for Scamp or Yellowmouth Grouper above the NC-VA line.

<u>Georgia</u>

GA DNR staff examined ACCSP landings and compared them to state held versions. It was determined that ACCSP landings were a match, and would be used for the entire time series.

The proportion of Scamp and Yellowmouth Grouper to other grouper species was determined by year and SEDAR gear. These proportions were applied to unclassified landings within the same strata. Proportions from years 1981 to 1991 were averaged. The average proportion was applied to unclassified grouper landings from 1950-1979.

South Carolina

Prior to 1972, commercial landings data were collected by various federal fisheries agents based in South Carolina, either U.S. Fish and Wildlife or National Marine Fisheries Service personnel. In 1972, South Carolina began collecting landings data from coastal dealers in cooperation with federal agents. Mandatory monthly landings reports on forms supplied by the Department are required from all licensed wholesale dealers in South Carolina. Until fall of 2003, those monthly reports were summaries collecting species, pounds landed, disposition (gutted or whole) and market category, gear type and area fished; since September 2003, landings have been reported by a mandatory trip ticket system collecting landings by species, disposition and market category, pounds landed, ex-vessel prices with associated effort data to include gear type and amount, time fished, area fished, vessel and fisherman information.

SCDNR compared trip ticket landings with those from the ACCSP Data Warehouse. Landings were in almost complete alignment from 1950 to 2003, and were sourced from ACCSP. From 2004 to 2018, SCDNR provided landings.

Between 1950 and 1979, non-Warsaw and Goliath Grouper landings were assigned to unclassified grouper landings. In years where both identified and unclassified grouper landings exist, the proportion of Scamp and Yellowmouth Grouper to all other identified grouper (excluding Warsaw and Goliath) were created. These were applied to all years with the same strata. The average proportions by gear from 1980 to 1991 were calculated and applied to unclassified grouper landings from 1950 to 1979.

North Carolina

NCDMF provided North Carolina's landings data from 1928 to 2018. This data set was a collective grouping of historical data collection by the NMFS/NCDMF Cooperative Statistics Program, its predecessors, and the NC Trip Ticket Program. Data collection continuity was sporadic in the earlier years of the dataset prior to 1950. Data continuity and accuracy dramatically increased over time. From 1994 to 2018 landings data collection were provided by the NC Trip Ticket Program and considered the most consistent and inclusive portion of the dataset. In 1999 NCDMF started sharing the landings data with the ACCSP data warehouse.

Final assessment data were provided by the NC Trip Ticket Program due to the need for primary gear reassignments on multi-gear trips. Up to three gears can be listed on a trip ticket therefore, landings were analyzed to look at gear combinations and gear was reassigned where necessary. Data were provided by NCDMF to capture all three gears and contained the most recent edits to the data.

Proportions were applied to unclassified landings within the same strata. Proportions from years 1981 to 1991 were averaged. The average proportion was applied to unclassified grouper landings from 1950-1979.

Florida

Landings from the ACCSP database were used for 1950-1985. 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, and the Florida Trip Ticket data are more complete and are of a longer time series than the CFLP logbook data.

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 1950-1985. This was done for both Monroe county and South Atlantic (non-Monroe) landings separately.

From 1993-2018, the calculated proportion of landings by gear from the CFLP logbook data was applied to the corresponding total annual combined landings of Scamp and Yellowmouth in Florida trip ticket for both Monroe county (by region) and the South Atlantic (non-Monroe) landings. Additionally, the average proportion of landings by gear from 1993-2018 was applied to both the annual combined Scamp and Yellowmouth landings for Monroe (by region) as well as the South Atlantic (non-Monroe) landings from 1986-1992. Calculated South Atlantic (non-Monroe) and South Atlantic Monroe County landings were then combined into a total representing Scamp and Yellowmouth landings harvested from Florida South Atlantic waters.

Combined State Results

Landings are presented in whole weight pounds by gear in Table 3.2. The landings in number of fish are presented in Table 3.3.

Commercial landings, and the approach taken in transforming them, have been approved by the commercial workgroup. Commercial data can be summarized by the following:

- Landings should be reported as whole weight in pounds and number of fish
- Final landings data came from the following sources:
    - NC: 1950-2018 (NCDMF)
    - SC: 1950-2003 (ACCSP)
      2004-2018 (SCDNR)
    - GA: 1950-2018 (ACCSP)
    - FL: 1950-1985 (ACCSP)
      1986-2018 (FLTT)

Whole vs. Gutted Weight

Commercial landings are reported in various states of processing. Data providers' state-specific conversion factors are used to convert the landing condition to whole weights. As outlined in Section 3.3.4, landings by state were converted to gutted weight using appropriate state and federal conversion factors. Landings in gutted weight were converted to whole weight using the 1.05 combined South Atlantic and Gulf of Mexico conversion factor provided by the Life History group.

Uncertainty

The commercial workgroup discussed uncertainty in commercial fishery landings. After consultation with assessment biologists, the work group decided to use uncertainty estimates consistent with those from previous assessments. Estimates of uncertainty are not coefficients of variation, but are estimates of possible reporting error; i.e., represent the range in actual commercial landings relative to the reported landings.

In making these uncertainty estimates, the following assumption was made:

Landings may be underreported during all years; however, underreporting was likely highest during early years of the time series and likely less of an issue in recent years. This assumption was based upon the following information and Data Workshop expert testimony: during the period 1950 (beginning of landings time series) to 1961, landings were summarized annually by state and likely did not include landings from small scale dealers. In the years 1962 to 1977, landings data were collected annually, but under a more all-inclusive program (General Canvass). Monthly landings summaries were collected during the period 1978 to the beginning of trip ticket data collection (NC-1994, SC-2004, GA-2001, FL-1986). The most recent landings data, collected through state trip ticket programs, were assumed to be most reliable and inclusive of all commercial landings.

The group agreed, based upon expert opinion, that both an upper and lower bound be used for the period during which unclassified grouper were present in the landings. The workgroup recommended that an upper bound only be set to account for underreported landings during the period when no unclassified grouper were reported. See Table 3.4 for state-specific bounds.

3.3.5 Converting Landings in Weight to Landings in Numbers

The weight in pounds for each sample was calculated, as was the mean weight by year, state, and gear. The landings in pounds were then divided by the mean weight by the same strata to derive landings in number (Table 3.3). The mean weights, or 'meristic conversions', can be viewed in Table 3.5.

3.4 COMMERCIAL DISCARDS

Scamp and Yellowmouth Grouper discards from the South Atlantic commercial fishery were estimated using data from two datasets. A discard logbook dataset provided discard rate data and the coastal logbook dataset provided total effort from the fishery. Methods followed those used beginning with SEDAR 32 and are described in McCarthy, et al. (2020).

Fisher logbook reported data collection programs provided the only available datasets sufficient to estimate commercial discards of Scamp and Yellowmouth Grouper. Available South Atlantic observer data were limited and insufficient to estimate commercial discards. Observer collected data from commercial fishing vessels in the Gulf of Mexico, however, have been used to estimate commercial discards for several recent stock assessments.

Comparison of Gulf of Mexico discards estimated using observer data to those estimated using discard logbook data consistently result in differences in yearly discards. Estimates of discards are usually greater when using discard logbook data than when using observer data. SEDAR reviewers have had higher confidence in observer data than in logbook reported data. In addition, the estimation method using observer data can be validated by estimating landings using a similar approach to that used to estimate discards. Those estimated landings have closely matched the logbook reported landings. South Atlantic discards estimated using discard logbook data were presumed to be an overestimate of actual discards, as has been found in Gulf of Mexico analyses.

A bias correction factor was proposed for use with South Atlantic commercial vertical line discards to correct for the presumed overestimation of those discards (McCarthy, et al., 2020). The bias correction was calculated as:

$$SA\ Discards\ RFOP = GOM\ Discards\ RFOP \times \frac{SA\ Discards\ DLP}{GOM\ Discards\ DLP}$$

where RFOP = Reef fish observer program and DLP = Discard logbook program.

The associated SA discard standard errors (SE) are derived from the DLP estimates,

$$SE(RFOP) = CV(DLP) \times \text{mean estimate}(RFOP),$$

where CV(DLP) is the DLP standard error divided by the DLP mean estimate (i.e., coefficient of variation for the mean estimate). Thus, the method adjusts the mean value of the discard estimates but does not affect the uncertainty.

South Atlantic vertical line discards and bias corrected discards are provided in Table 3.6.

Bottom longline estimated discards were fewer than 80 fish per year prior to bias correction. In most years estimated Scamp were fewer than 50 fish per year. Such low numbers of discards were presumed to have a negligible effect on the stock assessment.

Discard estimation methods were reviewed and accepted by the commercial workgroup.

SAFMC Scamp Release

The South Atlantic Fishery Management Council's (SAFMC) initial citizen science pilot project, SAFMC Scamp Release, focuses on collecting data on released Scamp Grouper through the development and use of a mobile app. The SAFMC Release app is designed to collect data on released fish from commercial, for-hire, and recreational fishermen and is being pilot tested on Scamp Grouper. It will expand to collect information on all shallow water grouper in 2021. The app is open access, meaning that any interested fisherman that encounter Scamp can participate in data collection efforts. Data fields for discarded fish include trip type, date, discard time, location, depth, species name, fork length, photo, hook type and location, and release condition and treatment. There is also a separate 'No Release' form within the app to collect limited information on trips where Scamp were not released.

The SAFMC Scamp Release project launched in late 2019. Multiple avenues were used to promote and recruit fishermen to participate in the project. There are currently 52 SAFMC Release user accounts split among the four South Atlantic states and among fishing sectors. Limited data have been collected through the app thus far. However, staff are continuing to focus on recruitment and retention of commercial, for-hire, and recreational fishermen to participate in the SAFMC Scamp Release project. Released scamp reported through the app were caught in waters from 80-132 feet and ranged in size from 16-22 inches. They were typically hooked in the jaw and fishermen reported use of circle offset, circle non-offset, and j-hooks. Scamp reported as kept through the 'No Release' reports were caught in waters from 80-265 feet.

While recruiting fishermen to participate in the SAFMC Release app, SAFMC staff had conversations with many fishermen who encounter Scamp. Some common themes heard through these discussions include:

- Scamp Grouper releases are not common during the open shallow water grouper season (May – December). The reason for discards during the open season is typically due to undersized fish (size limit in the South Atlantic is 20in TL), not due to possessions limits. However, many indicated they do not typically see undersized fish. Some thought that could potentially be due to where they are fishing (depths and locations) or bait or hook size.
- Several fishermen, in particular for-hire and recreational fishermen, noted they don't fish as much in the winter and typically bottom fish less when the shallow water grouper season is closed (January – April). Some noted they are more likely to release Scamp Grouper in early spring when fishing effort is starting to increase, but the shallow water grouper closure is still in place.
- Several fishermen noted that Scamp Grouper catches have become less common in recent years. Some indicated this could potentially be due to abundance, others noted it was hard to get bait to the bottom where you would typically catch grouper due to large numbers of Red Snapper.
- Scamp Grouper tend to be in deeper water than other shallow water grouper species. This may impact the number of encounters with Scamp compared to other shallow water grouper species.

Currently, data collected through the SAFMC Release app are limited and cannot be used directly within the assessment. However, SEDAR 68 participants found the information collected through the app and provided by SAFMC Release participants useful when interpreting trends found in other data sources. As more trips are reported and sample size increases, additional analyses will be performed to check for potential biases in data including spatial distribution of releases, angler avidity, and representation of fishing sectors (Jiorle et al. 2016, Venturelli et al. 2016, Bradley et al. 2019).

3.5 COMMERCIAL EFFORT

Map products were created that reflected commercial effort along the South Atlantic and Gulf coasts. The data used in map products for the South Atlantic were reported from 1992 to 2019 in the coastal fisheries logbook program data (CFLP – federal only) from Texas to NC. The data represent the total number of trips per fishing area to reflect fishing effort. Total Cumulative Scamp Effort (in Trips) 1990-2019 for both the Gulf of Mexico and South Atlantic (start 1992) is shown in Figure 3.4.

3.6 BIOLOGICAL SAMPLING

Biological sample data were obtained from the TIP database at NMFS/SEFSC. The group reviewed the data, and no known inadequacies were discovered. TIP data were deemed adequate for use in the assessment.

3.6.1 Sampling Intensity

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 other (longline, diving and other)). 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

Landings data for the assessment analysis are adequate. There is a clear landings history for the available time series. With Scamp and Yellowmouth Grouper combined as one unit, there are no obvious species identification issues. Before the 1980's, all grouper landings (with the exception of Warsaw and Goliath) were reported as unclassified grouper. Grouper landings after 1980 were reported at the species level in state trip ticket programs. These landings have been proportioned according to the specifications of South Atlantic data providers. Uncertainty in landings for the South Atlantic is higher when data represent annual and monthly totals before the implementation of individual state trip ticket programs. Definition of stock boundaries and landed condition (gutted vs. whole) were not an issue.

3.8 RESEARCH RECOMMENDATIONS

- **Recommendation for the use of EM to facilitate the improvement of discard accounting in the South Atlantic**
  - The Center for Electronic Monitoring at Mote (CFEMM) has been applying Electronic Monitoring (EM) in the Gulf of Mexico (GoM) using Saltwater Inc. (SWI) software since 2016. EM is a valuable monitoring tool for researchers to directly observe and permanently document location, identify bycatch hotspots, catch, effort, and discard data to reduce uncertainty in critical finfish and shark fishery data for use by industry and management.
  - In the absence of a robust reef fish observer program in the South Atlantic, the commercial workgroup recognizes EM as a tool to improve discard accounting in the region. Additionally, the COVID-19 pandemic has hampered interactions between the fishing industry and state/federal fisheries data collections. The workgroup recognizes the potential for work pioneered by the CFEMM to advance biological sampling needs without human observers.
  - Continue to explore additional methods, such as citizen science (e.g. SAFMC Scamp Release), to help supplement information to characterize discard size composition
- **Recommendation for South Atlantic and Gulf of Mexico unified methodology in preparation of commercial landings**
  - The SEDAR 68 commercial workgroup has recognized that there are significant differences in the South Atlantic and Gulf of Mexico in the approach to the preparation of commercial landings. These differences were identified specifically in discussions of proportioning, validation, and data provision formats.

  - In order to resolve the issue, the workgroup recommends that SEDAR staff convene and facilitate a joint-regional workshop for commercial workgroup members from both regions in order to follow-up on and confirm the best practices in Procedural Workshop 7.
  - Previous workgroup leaders should be consulted in establishing the TORs for the workshop.
  - The workshop should review past decisions made for various species and summarize best practices, which could greatly simplify the content needed within stock assessment reports (e.g., focus text on details specific to the species being assessed)
- **Recommendation for Expanding Reef Fish Observer Program Coverage to the South Atlantic**
  - Programmatic funding should be allocated to expand existing observer temporal and spatial coverage in the South Atlantic reef fish fishery. Observer coverage should be sufficient to provide for statistically rigorous discard estimation methods and to provide adequate discard size composition data for use in stock assessments.

3.9 LITERATURE CITED

Atlantic Coastal Cooperative Statistics Program. 2020. Annual Landings by Custom Gear Category; generated by Mike Rinaldi using ACCSP Data Warehouse, Arlington, VA: accessed April 2020.

Bradley D, M Merrifield, KM Miller, S Lomonico, JR Wilson, MG Gleason. 2019. Opportunities to improve fisheries management through innovative technology and advanced data systems. Fish and Fisheries 20: 564–583.

Jiorle, RP, RNM Ahrens, MS Allen. 2016. Assessing utility of a smartphone app for recreational fishery catch data. Fisheries 41: 758-766.

McCarthy K., J Diaz, SG Smith. 2020. Estimated discards of Scamp and Yellowmouth Grouper from commercial vertical line fishing vessels in the South Atlantic. SEDAR68-WP-16. SEDAR, North Charleston, SC. 7 pp.

Venturelli, PA, K Hyder, C Skov. 2016. Angler apps as a source of recreational fisheries data: Opportunities, challenges, and proposed standards. Fish and Fisheries 18: 578-595.

3.10 TABLES

Table 3.1 Specific ACCSP gears in each requested gear category for commercial Scamp and Yellowmouth Grouper landings.

	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		
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
	SPEARS/DIVING		
GEAR CODE	**GEAR NAME**	**TYPE CODE**	**GEAR TYPE**
650	HARPOONS	12	SPEARS AND GIGS
660	SPEARS	12	SPEARS AND GIGS
661	SPEARS, DIVING	12	SPEARS AND GIGS
662	GIGS	12	SPEARS AND GIGS
663	POWERHEADS	12	SPEARS AND GIGS
670	HANDHELD HOOKS	12	SPEARS AND GIGS
671	SPONGE HOOKS	12	SPEARS AND GIGS
750	BY HAND, DIVING GEAR	14	BY HAND
760	BY HAND, NO DIVING GEAR	14	BY HAND
761	KNIFE, SEAWEED	14	BY HAND
762	WEEDWACKER, SEAWEED	14	BY HAND
	OTHER		
GEAR CODE	**GEAR NAME**	**TYPE CODE**	**GEAR TYPE**
*	All other gears	*	All other gear types

Table 3.2 South Atlantic Non-Confidential Commercial Scamp and Yellowmouth Grouper Landings by Gear (whole weight pounds)

Year	HANDLINE	LONGLINE	OTHER	SPEARS/DIVING
1950	48,714	677	35	7,937
1951	67,339	990	51	11,599
1952	46,234	680	35	7,964
1953	38,392	564	29	6,613
1954	38,837	571	29	6,690
1955	19,429	286	15	3,347
1956	25,004	297	15	3,478
1957	46,030	514	34	6,020
1958	15,763	169	9	1,977
1959	11,917	146	7	1,707
1960	14,652	192	10	2,252
1961	14,480	195	10	2,289
1962	12,249	179	9	2,101
1963	10,402	152	8	1,783
1964	11,379	163	8	1,908
1965	17,376	175	196	2,046
1966	11,868	158	9	1,849
1967	35,168	280	17	3,282
1968	47,560	498	286	5,833
1969	28,505	397	143	4,654
1970	38,217	483	307	5,661
1971	43,429	504	150	5,900
1972	31,117	391	444	4,584
1973	43,915	343	130	4,015
1974	60,807	449	38	5,260
1975	58,435	689	53	8,077
1976	78,359	568	124	6,657
1977	117,175	611	573	7,161
1978	268,535	739	98	8,565
1979	254,012	676	190	7,918

1980	243,589	690	1,176	7,109
1981	232,638	680	2,990	7,969
1982	369,555	1,420	1,586	6,003
1983	308,116	3,930	2,442	8,341
1984	309,598	3,306	941	6,325
1985	248,842	*	162	5,753
1986	274,753	1,607	3,542	6,496
1987	293,980	20,844	6,531	7,065
1988	323,071	15,068	3,829	6,083
1989	364,002	3,584	*	8,761
1990	429,438	25,532	16,824	12,525
1991	341,481	8,970	37,203	6,505
1992	275,453	2,555	2,728	5,158
1993	304,656	2,671	*	3,372
1994	306,447	450	254	4,179
1995	340,824	*	*	3,079
1996	279,472	*	3,736	3,551
1997	281,187	1,036	*	6,110
1998	256,728	1,465	*	7,724
1999	373,639	319	*	9,369
2000	291,631	302	*	7,535
2001	206,026	*	11,919	8,619
2002	202,813	8,748	14,415	12,375
2003	231,520	3,271	23,092	5,530
2004	246,135		5,192	8,310
2005	265,197	17	*	*
2006	311,410		*	4,049
2007	333,593	25	*	6,495
2008	240,986		*	9,598
2009	238,019	*	18,670	3,950
2010	162,209	24	*	6,131
2011	128,660	3,632	*	6,823
2012	140,493	*	*	*

2013	115,468	930	18,513	6,237
2014	138,640	1,374	13,020	11,501
2015	112,784	2,282	*	5,443
2016	94,402	212	8,041	8,344
2017	87,279	*	11,395	11,424
2018	80,000	*	*	12,904

Table 3.3 South Atlantic Non-Confidential Commercial Scamp and Yellowmouth Grouper Landings by Gear (number of fish)

Year	HANDLINE	LONGLINE	OTHER	SPEARS/DIVING
1950	7,974	171	9	2,008
1951	10,978	250	13	2,934
1952	7,537	172	9	2,015
1953	6,259	143	7	1,673
1954	6,331	144	7	1,692
1955	3,167	72	4	847
1956	4,159	75	4	880
1957	7,694	130	9	1,523
1958	2,643	43	2	500
1959	1,975	37	2	432
1960	2,405	49	2	570
1961	2,374	49	3	579
1962	1,997	45	2	532
1963	1,696	38	2	451
1964	1,860	41	2	483
1965	2,900	44	50	518
1966	1,954	40	2	468
1967	5,739	71	4	830
1968	7,908	126	73	1,476
1969	4,655	100	36	1,177
1970	6,233	122	78	1,432
1971	7,129	127	38	1,493
1972	5,086	99	112	1,160
1973	7,343	87	33	1,016
1974	10,256	114	10	1,331
1975	9,694	174	14	2,043
1976	13,193	144	31	1,684
1977	19,874	155	145	1,812
1978	46,708	187	25	2,167
1979	44,402	171	48	2,003

1980	42,656	175	298	1,798
1981	40,804	172	759	2,016
1982	65,433	361	404	1,519
1983	54,238	1,000	621	2,110
1984	53,551	875	251	1,600
1985	44,369	*	33	1,101
1986	48,741	535	1,008	3,317
1987	56,452	5,413	1,697	1,787
1988	67,271	4,580	1,170	1,539
1989	80,595	1,420	*	2,216
1990	99,481	7,981	5,301	2,706
1991	80,057	3,182	13,056	2,787
1992	53,497	574	629	1,114
1993	58,032	817	*	1,041
1994	55,044	102	43	878
1995	62,398	*	*	760
1996	54,121	*	1,107	1,091
1997	52,067	281	*	1,723
1998	49,783	383	*	2,023
1999	71,245	91	*	2,666
2000	54,560	90	*	2,233
2001	36,423	*	3,027	1,913
2002	36,514	2,255	3,719	3,825
2003	42,638	2,222	16,446	2,154
2004	44,730	0	1,216	1,652
2005	48,460	4	*	*
2006	54,261	0	*	895
2007	59,077	6	*	1,681
2008	41,039	0	*	2,250
2009	39,856	*	4,580	1,533
2010	26,272	6	*	1,535
2011	20,545	1,851	*	3,008
2012	22,419	*	*	*

2013	17,858	225	4,448	1,501
2014	18,409	369	2,693	2,723
2015	16,783	698	*	1,477
2016	14,455	54	2,123	2,177
2017	13,211	*	2,826	2,592
2018	10,984	*	*	2,775

Table 3.4 Uncertainty in commercial landings by year range

Year	NC	SC	GA	FL - EC	Comments
1950-1961	0.25	0.25	0.25	0.25	Annual state summaries, likely missed small scale dealers
1962-1977	0.2	0.2	0.2	0.2	Annual state summaries, more inclusive General Canvas
1978-1985	0.1	0.1	0.1	0.1	Monthly state summaries
1986-1990	0.1	0.1	0.1	0.05	FL starts state trip ticket
1991-1993	0.1	0.1	0.1	0.05	
1994-1995	0.05	0.1	0.1	0.05	NC starts state trip ticket
1996-2000	0.05	0.1	0.1	0.05	
2001-2003	0.05	0.1	0.05	0.05	GA starts state trip ticket
2004-2010	0.05	0.05	0.05	0.05	SC starts state trip ticket
2011- present	0.05	0.05	0.05	0.05	

**The group agreed, based upon expert opinion, that both an upper and lower bound be used for the period during which unclassified grouper were present in the landings. The workgroup recommended that an upper bound only be set to account for underreported landings during the period when no unclassified grouper were reported.*

Table 3.5 Scamp and Yellowmouth Grouper Mean Weights by Gear, Year, and State

Handline					**Other (Longline, Other, Spear/Diving)**			
year	NC	SC	GA	FL	NC	SC	GA	FL
1984	5.649763955	5.7659549	6.1790836	6.1791	3.743317066	3.7433171	3.9528258	3.9528
1985	5.149964072	5.703313	6.9412234	6.9412	3.653223153	3.6532232	5.2278425	5.2278
1986	5.102643416	5.8470656	7.1942509	7.1943	4.337707315	4.3377073	1.9586731	1.9587
1987	4.73912276	5.6242906	5.8530088	5.853	3.847169786	3.8471698	3.9528258	3.9528
1988	4.202464791	5.3851568	6.3906156	6.3906	3.269978823	3.2699788	3.9528258	3.9528
1989	4.022171009	4.8595307	4.6057479	4.6057	2.30263879	2.3026388	3.9528258	3.9528
1990	4.087271498	4.4503878	4.3330454	4.333	3.155798736	3.1557987	4.6278811	4.6279
1991	3.839732077	4.5473469	4.2856386	4.2856	2.871679044	2.871679	2.3342592	2.3343
1992	5.077869793	5.0572425	5.4326855	5.4327	4.228801941	4.2288019	4.6917755	4.6918
1993	4.846820401	5.3833835	5.7622375	5.7622	3.279699986	3.2797	3.2402243	3.2402
1994	5.11044622	5.7121206	5.9978238	5.9978	3.651718519	3.6517185	6.0523324	6.0523
1995	5.331163155	5.3787385	5.7177541	5.7178	3.474591879	3.4745919	4.6357679	4.6358
1996	4.889076696	5.3586144	5.0542055	5.0542	4.457321702	4.4573217	3.2434778	3.2435
1997	5.271236978	5.4620109	5.4042043	5.4042	7.026632649	7.0266326	3.5339737	3.534
1998	5.135414536	5.2266466	5.0283333	5.0283	3.926332122	3.9263321	3.8165381	3.8165
1999	5.047824597	5.3693638	5.0600064	5.06	3.926332122	3.9263321	3.5096184	3.5096
2000	5.286592805	5.4574586	5.1258473	5.1258	3.926332122	3.9263321	3.3551741	3.3552
2001	5.416522062	5.8627942	5.6516872	5.6517	3.926332122	3.9263321	4.6328852	4.6329
2002	5.681450547	5.6762305	5.205533	5.2055	3.926332122	3.9263321	3.1541636	3.1542
2003	5.215532746	5.482357	5.8691182	5.8691	1.397184867	1.3971849	4.2867883	4.2868
2004	5.526174388	5.5645175	5.2866471	5.2866	4.270854442	4.2708544	5.3624789	5.3625
2005	5.4159805	5.5377235	5.306279	5.3063	4.224710688	4.2247107	3.9528258	3.9528
2006	6.082590837	5.5617183	6.0775416	6.0775	3.617204803	3.6172048	4.6066297	4.6066
2007	5.980639972	5.3717967	6.2392404	6.2392	3.642008766	3.6420088	3.8877923	3.8878
2008	5.793891453	5.8367661	6.210561	6.2106	3.697192077	3.6971921	4.4781267	4.4781
2009	5.859105045	5.8469024	6.8775004	6.8775	4.076125268	4.0761253	2.4737566	2.4738
2010	6.367338669	6.0442751	6.610141	6.6101	4.248528437	4.2485284	3.9528258	3.9528
2011	6.286430514	5.9485951	9.9753661	9.9754	4.654515548	4.6545155	1.9464723	1.9465
2012	6.312386067	6.2822057	6.1340396	6.134	4.904432231	4.9044322	5.1039648	5.104

2013	6.778272114	5.9183109	7.9672706	7.9673	4.172158821	4.1721588	4.1353478	4.1353
2014	7.097244795	7.166931	9.2465058	9.2465	4.835089282	4.8350893	3.7233044	3.7233
2015	6.298824834	6.955539	6.7055316	6.7055	4.050032392	4.0500324	3.2713581	3.2714
2016	6.702445654	6.514104	6.3345581	6.3346	3.787459333	3.7874593	3.9528258	3.9528
2017	7.5992396	6.5375132	5.9893542	5.9894	4.031910077	4.0319101	5.8579815	5.858
2018	7.022535017	6.9173042	8.6387977	8.6388	4.880277233	4.8802772	3.5305351	3.5305

Table 3.6 Calculated yearly total discards of Scamp from South Atlantic vertical line vessels using standard estimation methods with discard logbook data and with bias correction applied.

Year	Vertical line calculated discards (1,000s of fish)	Bias corrected vertical line calculated discards (1,000s of fish)	Vertical line calculated discards (pounds)	Bias corrected vertical line calculated discards (pounds)	Discard estimate standard error
1993	12.90	0.971	65,584	4,934	194.2
1994	15.95	0.989	81,077	5,028	197.9
1995	16.66	1.133	84,670	5,756	226.6
1996	16.50	1.267	83,854	6,437	253.4
1997	16.95	1.370	86,126	6,963	274.1
1998	12.95	1.257	65,803	6,387	251.5
1999	11.00	1.308	55,922	6,646	261.6
2000	11.03	1.031	56,036	5,240	206.3
2001	11.92	1.214	60,594	6,172	243.0
2002	21.13	1.345	107,406	6,834	269.0
2003	12.08	1.482	61,421	7,534	296.6
2004	6.77	1.429	34,399	7,263	285.9
2005	4.40	1.264	22,369	6,423	252.9
2006	4.54	1.131	23,068	5,747	226.2
2007	4.51	1.078	22,933	5,479	215.7
2008	4.75	0.962	24,166	4,887	192.4
2009	3.48	1.174	17,671	5,969	235.0
2010	2.52	0.847	12,830	4,307	169.6
2011	1.23	0.957	6,257	4,866	191.6
2012	1.50	1.198	7,645	6,088	239.7
2013	2.43	0.987	12,374	5,019	197.6
2014	1.51	0.930	7,673	4,726	186.0
2015	1.65	0.805	8,408	4,094	161.2
2016	1.31	0.976	6,651	4,963	195.4
2017	0.90	0.739	4,596	3,757	147.9
2018	0.64	0.638	3,255	3,243	127.7

Table 3.7 Workshop Attendees

Name	Organization	Call #1 *4/8*	Call #2 *4/14*	Call #3 *4/15*	Call #4 *4/17*	Call #5 *4/27*	Call #6 *5/4*	Call #7 5/20	Call #8 8/19	Call #9 8/27	Call #10 10/07
Alan Bianchi	NC DMF	X	X	x	x	x	x			x	x
Alexandra Smith	NOAA	X	X	x	x		x	x	x		x
Amy Dukes	SC DNR	X	X	x	x		x		x		
Beth Wrege	NOAA	X	X	x	x	x	x	x	x	x	x
Jay Mullins	Gulf fisherman	X	X	x	x	x		x			
Julia Byrd	SAFMC	X		x	x	x	x	x		x	
Julie Simpon	ACCSP	X	X	X	x	x	x	x	x	x	x
Kenneth Roberts			X								
Kevin McCarthy	NOAA	X	X	x	x	x	x			x	x
Kyle Shertzer	NOAA	X	X	x	x	x	x	x			
Mike Rinaldi	ACCSP	X	X	x	x	x	x	x	x	x	
Molly Stevens	NOAA	X	X	x	x	x	x	x	x		x
Randy Mckinley	NC fisherman										
Refik Orhun	NOAA	X	*X*	*x*	x	x	x	x			x
Skyler Sagarese	NOAA	X	X	x	x		x	x	x	x	x
Stephanie Martinez	NOAA	X	X	x	x	x	x		x		
Steve Brown	FL FWCC	X	X	x	x	x	x	x			x
Steve Smith	NOAA	X	X	x	x	x	x	x	x		
Sarina Atkinson	NOAA	X	X	x	x	x	x	x	x	x	
Shannon Calay	NOAA	X	X								
Skyler Sagarese	NOAA	X	X	X	X	X	X		X	X	
Max Lee	Mote Marine Lab	X	X	X	X		X	X	X	X	
Carole Neidig	Mote Marine Lab	X	X	X	X	X	X				x
Daniel Roberts	Mote Marine Lab	X	X	X	X		X	X			
Guillermo Diaz	NOAA	X	X	X							
Nancie Cummings	NOAA	X	X	X	X		X				
Eric Fitzpatrick	NOAA		X	X	X	X	X				x
Francesca Forrestal	NOAA		X	X	X	X	X		X		x
Jeff Pulver	NOAA		X	X	X	X	X			X	
Mandy Karnauskas	NOAA		X								
Matthew Nuttall	NOAA		X								
Matthew Smith	NOAA		X								
Dave Glockner	NOAA		X								x
Rob Cheshire	NOAA		X		X						
Larry Beerkircher	NOAA			X							
Marcel Reichert	NOAA									X	x
Alan Lowther	NOAA										x

3.11 FIGURES

Figure 3.1 South Atlantic Fisheries Management Council Boundaries

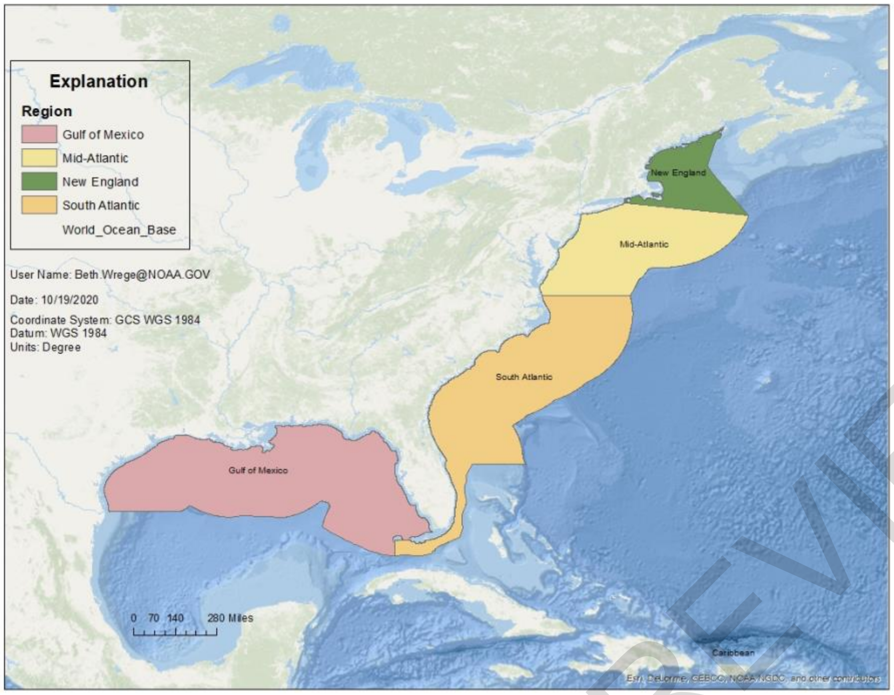


Figure 3.2 Close-up of the southern boundary as defined by the Gulf of Mexico/South Atlantic Council boundary.

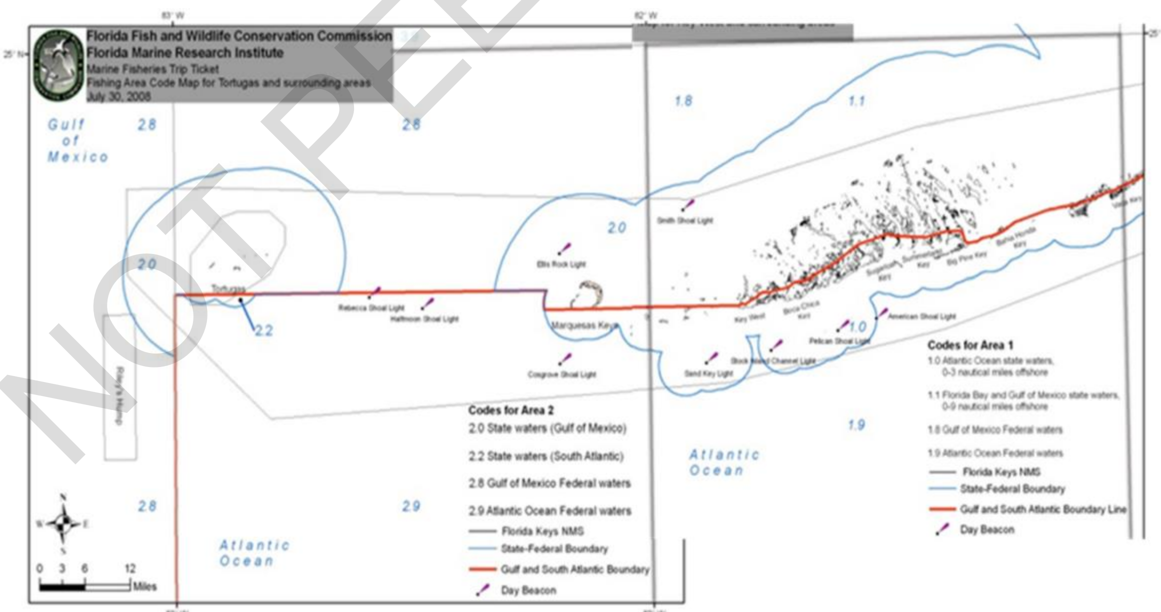


Figure 3.3 ACCSP Data Warehouse Sources and Collection Methodology

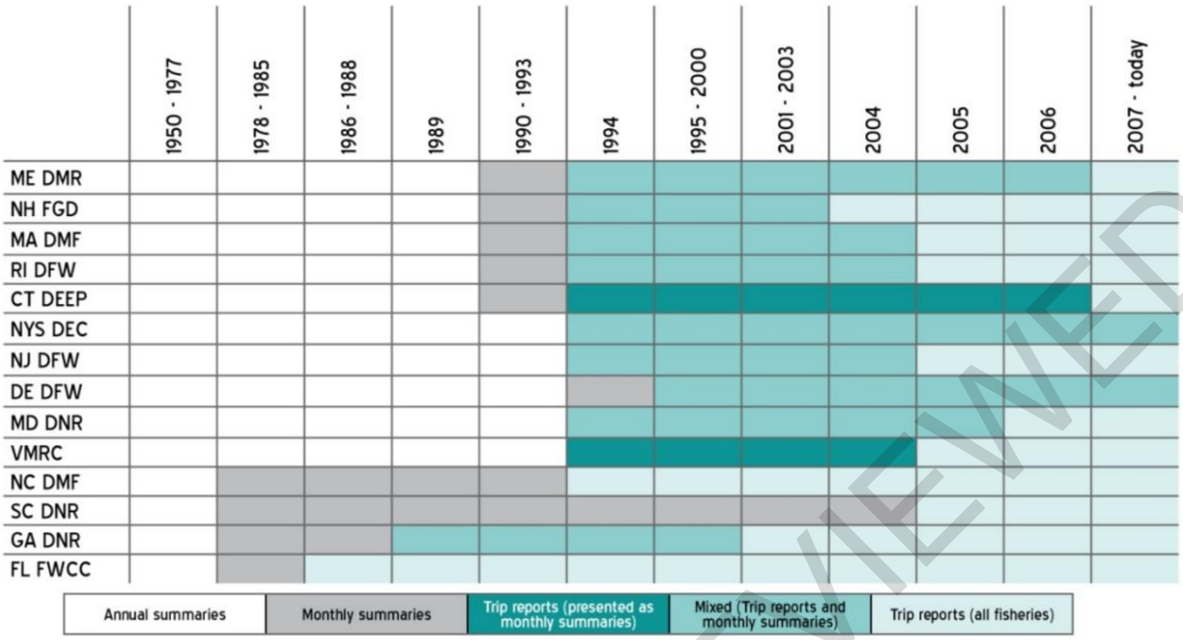
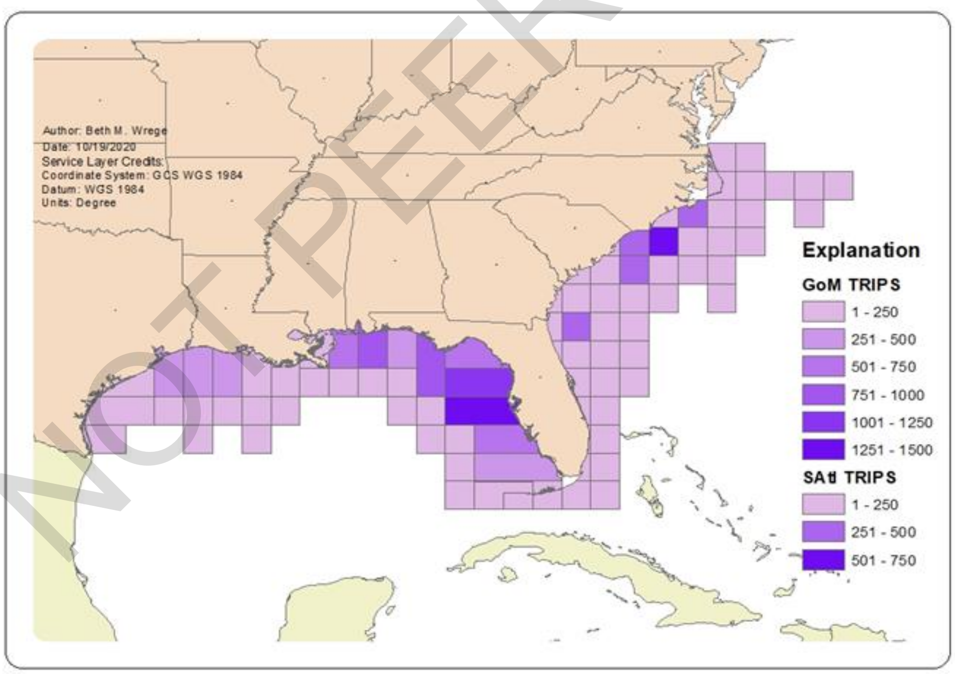


Figure 3.4. Map of Total Cumulative Scamp Effort (Trips) 1990 to 2019 in the Gulf of Mexico and South Atlantic (SATL starts in 1992) as reported to CFLP



4 RECREATIONAL FISHERY STATISTICS

4.1 OVERVIEW

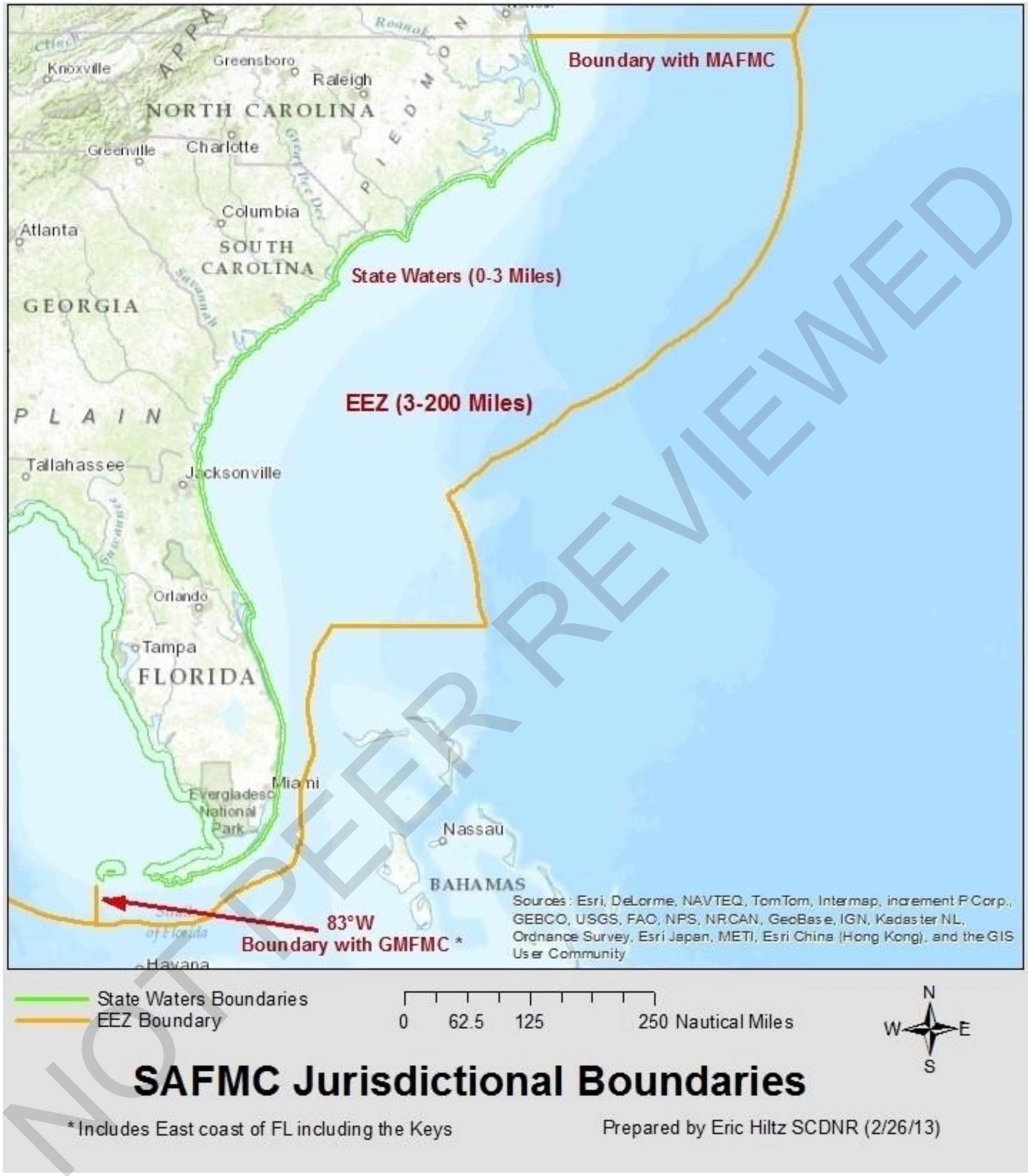
4.1.1 Group Membership

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
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 South Atlantic Fishery Management Council Scamp Group Management Boundaries



4.1.4 Stock ID Recommendations

Geographic boundaries

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

General Recreational Survey data for Scamp and Yellowmouth Grouper in the South Atlantic (SEDAR 68-DW-08)

General recreational data for Scamp and Yellowmouth Grouper from the Marine Recreational Information Program (MRIP) are summarized from 1981 to 2018 for South Atlantic states from North Carolina to eastern Florida, including the Florida Keys. Charter, private, and shore fishing modes are presented. These fully calibrated MRIP estimates take into account the change in the Fishing Effort Survey, the redesigned Access Point Angler Intercept Survey, and the For-hire Survey. Tables and figures presented include calibration comparisons, landing and discard estimates, associated CVs, sample sizes, fish sizes, and effort estimates.

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

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 Grouper and Yellowmouth Grouper in the South Atlantic Using the FHWAR Census Method (SEDAR 68-DW-11)

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 South Atlantic 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.

Scamp length frequency distributions from At-Sea Headboat Surveys in the South Atlantic (SEDAR 68-DW-23)

This report summarizes available size distribution and release condition data for Scamp and Yellowmouth Grouper captured in the headboat for-hire fleet operating along the South Atlantic coast (North Carolina through East Florida).

Summary of the SAFMC Scamp Release Citizen Science Pilot Project for SEDAR 68 (SEDAR68-DW25)

This working paper presents a summary of the data collected through the South Atlantic Fishery Management Council's (SAFMC) initial citizen science pilot project, SAFMC Scamp Release. This project focuses on collecting data on released Scamp Grouper through the development and use of a mobile app. The SAFMC Release app is designed to collect data on released fish from commercial, for-hire, and recreational fishermen and is being pilot tested on Scamp Grouper. It will expand to collect information on all shallow water grouper in 2021. The app is open access, meaning that any interested fisherman that encounter Scamp can participate in data collection efforts. Data fields for discarded fish include trip type, date, discard time, location, depth, species name, fork length, photo, hook type and location, and release condition and treatment. There is also a separate 'No Release' form within the app to collect limited information on trips where Scamp were not released. The SAFMC Scamp Release project launched in late June 2019. The information collected through SAFMC Scamp Release was presented to the Recreational Work Group, Commercial Work Group, and Discard Mortality Ad-hoc Group.

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 South Atlantic (*SEDAR 68-DW-32)*

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

The Marine Recreational Information Program (MRIP), formerly the Marine Recreational Fisheries Statistics Survey, conducted by NOAA Fisheries (NMFS) provides estimates of catch per unit effort, total effort, landings, and discards for six two-month periods (waves) each year. MRIP provides estimates for three main recreational fishing modes: shore-based fishing (Shore), private and rental boat fishing (Priv), and for-hire charter and guide fishing (Cbt). MRIP also provides estimates for headboat mode (Hbt) in the mid and north Atlantic regions. MRIP covers coastal Atlantic states from Maine to Florida. 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 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.

Task 2: In order to maintain a consistent time series, charter estimates were calibrated on the Atlantic prior to 2004 (SEDAR64-RD-12). CHTS and calibrated FHS charter catch estimates for South Atlantic Scamp from 1981 to 2003 are shown in Figure 1 of SEDAR 68-DW-08. Calibrated APAIS and FES estimates for South Atlantic Scamp from 1981 to 2018 are shown in Figure 2 of SEDAR 68-DW-08.

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 and headboat modes were combined into a single mode for estimation purposes. Since the NMFS Southeast Region Headboat Survey

(SRHS) began in the Atlantic in 1981, the MRIP combined charter/headboat mode must be split in order to not double the estimated headboat landings in these early years. The MRIP charter/headboat mode (1981-1985) was split by using a ratio of SRHS headboat angler trip estimates to MRIP charter boat angler trip estimates for 1986-1990. In accordance with SEDAR Best Practices, the mean ratio was calculated by state (or state equivalent to match SRHS areas to MRIP states) and then applied to the 1981-1985 estimates to split out the headboat component (SEDAR-PW-07). To avoid duplication of headboat estimates, the MRIP headboat component from this split was deleted for the South Atlantic region (NC to the Florida Keys) and SRHS estimates are used to represent headboat fishing for all years (1981+). In the Florida Keys, headboats primarily operate along the South Atlantic side and are covered by SRHS areas 12 and 17.

Task 4b: The working group also discussed the validity of the MRIP shore mode estimates for South Atlantic 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 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 Headboat Survey was started in 1972 but only included vessels from North Carolina and South Carolina until 1975. The survey was expanded to Georgia and northeast Florida (Nassau-Indian River counties) in 1976, followed by southeast Florida (St. Lucie-Monroe counties) in 1978. In 1986 the survey expanded to include west Florida, Alabama, Louisiana, and Texas. Mississippi was added to the survey in 2010. For SEDAR 68, only data from North Carolina through eastern Florida were included. Due to headboat area definitions and confidentiality issues, estimates of SRHS catch are combined for eastern Florida and Georgia. The portion of the SRHS covering the South Atlantic generally includes 70-80 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.

4.3.3 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. This coverage continued through 2017. Headboat vessels are 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) (SEDAR68-DW-23).

4.3.4 SAFMC Scamp Release

The South Atlantic Fishery Management Council's (SAFMC) initial citizen science pilot project, SAFMC Scamp Release, focuses on collecting data on released Scamp Grouper through the development and use of a mobile app. The SAFMC Release app is designed to collect data on released fish from commercial, for-hire, and recreational fishermen and is being pilot tested on Scamp Grouper. It was launched in June 2019 and it will expand to collect information on all shallow water grouper in 2021. The app is open access, meaning that any interested fisherman that encounter Scamp can participate in data collection efforts. Data fields for discarded fish include trip type, date, discard time, location, depth, species name, fork length, photo, hook type and location, and release condition and treatment. There is also a separate 'No Release' form within the app to collect limited information on trips where Scamp were not released. There are currently 52 SAFMC Release user accounts split among the four South Atlantic states and among fishing sectors (SEDAR68-DW-25).

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 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-08 and by year in Table 5 of SEDAR 68-DW-08. Estimates are provided by year and mode for all South Atlantic states from eastern

Florida to North Carolina, including the Florida Keys. Final MRIP landings estimates in pounds whole weight are shown by year and state in Table 6 of SEDAR 68-DW-08.

The working group investigated the 2014 landings estimate, which is relatively high compared to neighboring years. The estimate of 38,389 fish for that year came primarily from East Florida, wave 3, private mode, and ocean greater than 3 miles. Five trips contributed to the estimate for this strata, each with a harvest of three fish (not seen by an interviewer), resulting in a landings estimate of 35,893 fish.

4.4.2 SRHS Headboat Logbook Landings

The headboat logbook has changed multiple times throughout the history of the SRHS. In the case of Scamp, the logbook form used in the South Atlantic has listed Scamp since 1973. Yellowmouth Grouper was added to the forms used in GA and FLE in 1980 but was not added to the NC and SC forms until 1984. However, due to species identification issues, it is likely that any Yellowmouth Grouper were identified as Scamp. Prior to 1981 grouper landings were calculated at the genus level (*Mycteroperca*) and cannot be separated.

Task 5: The SRHS has had a logbook form that included Scamp in all of the South Atlantic since 1973. However, Yellowmouth Grouper was not listed on all forms in the South Atlantic until 1984.

- Option 1: Begin landings in 1972. From 1972 to 1980 grouper landings were calculated at the family level (*Mycteroperca)* and include several species.
- Option 2: Begin landings in 1981 due to increased geographical survey coverage. Also, both Scamp and Yellowmouth Grouper are recorded at the species level in nearly all areas beginning in 1981.

The recreational working group recommends that SRHS estimates for Scamp will begin in 1981. Scamp has been included on all SRHS logbook forms since 1973. Although Yellowmouth Grouper was not listed on SRHS forms used in NC and SC until 1984, due to species identification issues, it is likely that any Yellowmouth Grouper were identified as Scamp. Landings prior to 1981 will be calculated according to the FHWAR method (section 4.4.3).

Landing Estimates

Final SRHS landings estimates are shown in Table 4.12.1.

4.4.3 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-11). This information was used to develop an alternative method for estimating recreational landings prior to 1981.

The two key components from these FHWAR surveys that were used in this census method were the estimates of U.S. saltwater anglers and U.S. saltwater days. These estimates are used to calculate the historical effort of South Atlantic saltwater anglers. The mean CPUE from the MRIP estimates from 1981 to 1985 for Scamp is then applied to the historical effort estimates for South Atlantic 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

- 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 and SRHS surveys (1981-2018), shown in Figure 1 of SEDAR 68-DW-11.

- 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.

4.4.4 Total Recreational Landings

Combined landings estimates (MRIP and SRHS) are shown in Table 4.12.3, Figure 4.13.1, and mapped in Figure 4.13.2. The recreational landings in the South Atlantic are about evenly distributed between private, charter, and headboat modes. Geographically, landings mostly come from North Carolina (about 40%), followed by South Carolina (about 30%) and East Florida (about 20%). Scamp landings estimates steadily increased to about the mid-2000s, with some decline in the mid-1990s, and have generally remained low since about 2008.

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. Final MRIP discard estimates and associated coefficients of variation, in numbers of fish, are shown by year and mode in Table 4 of SEDAR 68-DW-08 and by year in Table 5 of SEDAR 68-DW-08. Estimates are provided by year and mode for all South Atlantic states from eastern Florida to North Carolina, including the Florida Keys.

The working group investigated the 2007 discards estimate, which is relatively high compared to the rest of the time series. The estimate of 47,935 fish for that year came primarily from North Carolina, private mode, and ocean greater than 3 miles during two different waves:

- Wave 2- One trip which released ten live fish and resulted in a discards estimate of 21,388 fish. This trip also landed one fish, seen by an interviewer.
- Wave 3- Three trips resulted in a discards estimate of 12,732 fish
  - One trip released five live fish (and landed one fish, seen by an interviewer)
  - One trip released two live fish (and landed three fish, seen by an interviewer)
  - One trip released one live fish

4.5.2 Headboat At-Sea Observer Survey Discards

Self-reported headboat discards (discussed in 4.5.3) 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 SRHS, 10,811 Scamp logbook records were collected in the South Atlantic from 2004-2018. Of these records, 6,692 trips reported discards of Scamp. In the At-Sea Observer Program, only 237 observed trips were positive for Scamp, 172 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 (SEDAR 68-DW-32, 2020). Therefore, the SEDAR 68 recreational working group recommended using the SRHS discard estimates for 2004-2018.

4.5.3 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 the South Atlantic, it is assumed that discards were negligible prior to 1992. The MRIP charter mode, MRIP private mode, and mean MRIP CH:SRHS discard ratio method (SEDAR 28 Assessment Workshop Report, 2013) were considered as sources for proxy discard estimates for headboat discards 1992-2003. Due to variability in the MRIP charter 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 mode and mean MRIP CH:SRHS discard ratio method (SEDAR 68-DW-32, 2020).

Task 8: Proxy for estimated headboat discards from 1992-2003

- Option 1: Apply the MRIP private boat discard:landings ratio to estimated headboat landings to estimate headboat discards from 1992-2003.
- Option 2: Apply the MRIP charter boat discard:landings ratio to estimated headboat landings to estimate headboat discards from 1992-2003.
- Option 3: Apply a three year rolling average MRIP charter boat discard:landings ratio to estimated headboat landings to estimate headboat discards (1992-2003).
- 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 (1992-2003) to estimate the yearly SRHS discard:landings ratio (1992-2003). This ratio is then applied to the SRHS landings (1992-2003) to estimate headboat discards (1992-2003).
- 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 (1992-2003).
- Option 6: Apply a mean SRHS discard:landings ratio (2004-2008) to estimated headboat landings to estimate headboat discards (1992-2003).
- Option 7: Apply a mean SRHS discard:landings ratio (2004-2018) to estimated headboat landings to estimate headboat discards (1992-2003).

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 mode discard ratios in turn affected the mean 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 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 (SEDAR 68-DW-32). 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 South Atlantic. The mean SRHS discard ratio (2004-2018) method had the strongest relationship with the landings with a lag of zero for the South Atlantic. Therefore, the mean SRHS discard ratio (2004-2018) method was recommended as the proxy method for SRHS discard estimates.

Discard Estimates

Final SRHS estimated discards (2004-2018) are presented in Table 4.12.4 along with the proxy discard estimates (1992-2003). SRHS discards in FLW/AL vary through time and correspond to fluctuations in the SRHS landings and effort.

4.5.4 SAFMC Scamp Release

While recruiting fishermen to participate in the SAFMC Scamp Release app, SAFMC staff had conversations with many fishermen who encounter Scamp. Some common themes heard through these discussions include: 1) Scamp Grouper releases are not common during the open shallow water grouper season (May – December) and those that are released are a result of the size limit rather than possession limit; 2) Scamp Grouper releases during the shallow water grouper closed season (January-April) are more likely to occur in the early Spring when for-hire and recreational bottom fishing effort begins to increase at the end of winter; 3) Scamp Grouper catches have become less common in recent years, potentially due to abundance or increased numbers of Red Snapper preventing bait from getting to the bottom; and 4) Scamp Grouper tend to be in deeper water than other shallow water grouper species (SEDAR 68-DW-25). Currently, data collected through the SAFMC Scamp Release app are limited and cannot be used directly within the assessment. However, SEDAR 68 participants found the information collected through the app and provided by SAFMC Scamp Release participants useful when interpreting trends found in other data sources.

4.5.5 Total Recreational Discards

Combined discard estimates (MRIP and SRHS) are shown in Table 4.12.5, Figure 4.13.3, and mapped in Figure 4.13.4. The majority of the recreational discards in the South Atlantic come from the private mode (about 50%). The headboat mode contributes about 30% and the charter boat mode makes up the remaining 20% of the recreational discards. Geographically, over half of the discards come from North Carolina (about 60%). Another 30% of the discards come from East Florida and the Florida Keys. Discard estimates for Scamp appear in the early 1990s and generally increased to about the late-2000s, with some decline in the mid-2000s. With the exception of 2007, discussed above, discards have generally remained low since about 2013.

4.6 BIOLOGICAL SAMPLING

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 South Atlantic by state (1981-2018) are provided in Table 4.12.6 (pounds whole weight) and Table 7 of SEDAR 68-DW-08 (millimeters fork length). Comparable summaries of fish size by mode are provided in Table 10 of SEDAR 68-DW-08 (pounds whole weight) and Table 9 of SEDAR 68-DW-08 (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 *SRHS Biological Sampling: Landings*

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 South Atlantic (1972-2018) 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 South Atlantic stock at the SEDAR 68 Data Workshop:

$$FL\_mm=19.72+0.89*TL\_mm$$

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:

$FL\_mm = 417.54(WW\_kg)^{0.34}$

4.6.1.3 Nominal Length Frequency Distributions of Landings

Task 9: Nominal length frequency distributions were generated for the recreational fleet comparing the combined MRIP charter boat/private boat mode and SRHS headboat mode (Figure 4.13.5). There were two management periods in the South Atlantic: South Atlantic: pre-1992, no minimum size limit; and post-1992, 20" TL minimum size limit. These length frequency distributions indicate that the charter boat/private boat fishery and headboat fishery retain similarly sized fish and that the size limit implemented in 1992 caused a shift toward slightly larger fish in both modes (Figure 4.13.6).

4.6.1.4 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 (mode unknown) by year and state 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 *SAFMC Scamp Release Biological Sampling*

Limited data have been collected through the SAFMC Scamp Release app thus far. However, staff are continuing to focus on recruitment and retention of commercial, for-hire, and recreational fishermen to participate in the SAFMC Scamp Release project. Released scamp reported through the app were caught in waters from 80-132 feet and ranged in size from 16-22 inches. They were typically hooked in the jaw and fishermen reported use of circle offset, circle non-offset, and j-hooks. Scamp reported as kept through the 'No Release' reports were caught in waters from 80-265 feet.

4.6.2.2 Headboat At-Sea Observer Survey Biological Sampling

At-sea sampling of headboat discards was initiated as part of the improved for-hire surveys to characterize the size distribution of live discarded fish in the headboat fishery.

4.6.2.3 Nominal Length Frequency Distributions of Discards

Length measurements from 230 discarded fish from the Headboat at-Sea Observer Survey were used to generate a headboat discard length frequency distribution. The distribution was weighted by region, to account for differences in sampling effort by region. These length data, though sparse, show discarding in the headboat fleet as a function of regulatory discards (Figure 4.13.7). An additional 5 discard lengths from the east Florida charter boat fleet were provided but were not enough to describe the discarding behavior of that fleet. Only the weighted headboat length frequency distribution was recommended for use to describe the size distribution for discarded fish. A full accounting of the weighting procedure applied to the raw length data is provided in SEDAR68-DW-23.

4.7 RECREATIONAL EFFORT

4.7.1 MRIP Effort

MRIP effort estimates are produced via the Fishing Effort Survey (FES) for private/rental boats and shore mode and the For-Hire Survey (FHS) for charter boat mode. MRIP effort is calculated in units of angler trips, which represents a single day of fishing in the specified mode that does not exceed 24 hours and is provided by year and mode in Table 13 of SEDAR 68-DW-08 and by year and state in Table 12 of SEDAR 68-DW-08. These summaries include all South Atlantic states from eastern Florida to North Carolina, including the Florida Keys.

4.7.2 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 South Atlantic, SRHS effort estimates are also provided in units of angler trips to match that provided by the MRIP survey. Monthly estimates of angler trips are calculated as the product of the reported number of anglers and ratios for the estimated number of total trips to the reported number of total trips (SEDAR 28-DW-12).

SRHS effort estimates (in angler days) are provided in Table 4.12.9. Estimated headboat angler days decreased in both the South Atlantic and Gulf of Mexico beginning in 2008 due to the economic down-turn coupled with the high cost of fuel. South Atlantic fishing effort began to recover in 2013 and continued to increase until 2017. The recent decrease in estimated headboat angler days resulted from the removal of state-permitted headboat vessels from the SRHS beginning in 2017, mainly from southeast Florida.

4.7.3 Total Recreational Fishing Effort

Combined effort estimates in angler trips (MRIP and SRHS) are shown 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 South Atlantic and are not specific to Scamp. The vast majority (about 95%) of the general recreational fishing effort in the South Atlantic comes from the private mode. Geographically, the majority of the fishing effort comes from East Florida, including the Florida Keys (about 70%), followed by North Carolina (about 20%). Effort estimates have steadily increased until about the mid-2000s and have generally remained consistent since then.

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
- Limited South Atlantic discard size data are available for Scamp and Yellowmouth Grouper, but the data provided are adequate for describing discard size composition

- Uncertainty for total recreational landing estimates are considered adequate for use in this assessment.

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:

1. ***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.***
2. ***Continue to develop methods to provide uncertainty estimates around landings and discard estimates***
3. ***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***

4.11 Literature Cited

Brennan, K. 2020. SEDAR 68-DW-11. Estimates of Historic Recreational Landings of Scamp and Yellowmouth Grouper in the Gulf of Mexico Using the FHWAR Census Method. National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center (SEFSC) Beaufort Laboratory. Beaufort, NC.

Dettloff, K and V Matter. 2019. SEDAR 64-RD-12. Model-estimated conversion factors for calibrating Coastal Household Telephone Survey (CHTS) charter boat catch and effort estimates with For-hire Survey (FHS) estimates in the Atlantic and Gulf of Mexico with application to red grouper and greater amberjack. National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center (SEFSC) Fisheries Statistics Division. Miami, FL.

Dettloff, K and V Matter. 2019. SEDAR 67-WP-06. Sample Size Sensitivity Analysis for calculating MRIP Weight Estimates. National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center (SEFSC) Fisheries Statistics Division. Miami, FL.

Dettloff, K, V Matter, and M Nuttall. 2020. SEDAR 68-DW-10. SEFSC Computation of Variance Estimates for Custom Data Aggregations from the Marine Recreational Information Program. National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center (SEFSC) Fisheries Statistics Division. Miami, FL.

Fisheries Ecosytems Branch. 2020. SEDAR68-DW32. Discards of scamp (*Mycteroperca phenax*) for the headboat fishery in the South Atlantic. National Marine Fisheries Service (NMFS), Southeast Fisheries Science Center (SEFSC), Beaufort, NC.

Lazarre, D, C Wilson, and K Fitzpatrick. 2020. SEDAR 68-DW-23. Scamp Length Frequency Distributions from At-Sea Headboat Surveys in the South Atlantic, 2005 to 2017. Florida Fish and Wildlife Conservation Commission (FWC), Fish and Wildlife Research Institute (FWRI) Saint Petersburg, FL.

Matter, VM and A Rios. 2013. SEDAR 32-DW-02. MRFSS to MRIP Adjustment Ratios and Weight Estimation Procedures for South Atlantic and Gulf of Mexico Managed Species. National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center (SEFSC) Fisheries Statistics Division. Miami, FL.

Matter, V, N Cummings, J Isely, K Brennan, and K Fitzpatrick. 2012. SEDAR 28-DW-12. Estimated conversion factors for calibrating MRFSS charter boat landings and effort estimates for the South Atlantic and Gulf of Mexico in 1981-1985 with For-hire Survey estimates with application to Spanish mackerel and cobia landings. National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center (SEFSC) Fisheries Statistics Division. Miami, FL.

Matter, V and M Nuttall. 2020. SEDAR 68-WP-08. General Recreational Survey Data for Scamp and Yellowmouth Grouper in the South Atlantic. National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center (SEFSC) Fisheries Statistics Division. Miami, FL.

Matter, V and M Nuttall. 2020. SEDAR 68-DW-13. Marine Recreational Information Program: Metadata for the Atlantic, Gulf of Mexico, and Caribbean Regions. National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center (SEFSC) Fisheries Statistics Division. Miami, FL.

Nuttall, M, K Dettloff, K Fitzpatrick, K Brennan, and V Matter. 2020. SEDAR 68-DW-31. SEFSC Computation of Uncertainty for Southeast Regional Headboat Survey and Total Recreational Landings Estimates. National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center (SEFSC) Fisheries Statistics Division. Miami, FL.

SEDAR Procedural Workshop 7. 2015. SEDAR-PW-07. Data Best Practices. SEDAR, North Charleston, SC.

SEDAR 68 Stock ID Panel. 2020. Gulf of Mexico and Atlantic Scamp Stock ID Process Final Report. SEDAR68-SID-05. SEDAR, North Charleston, SC.

4.12 TABLES

Table 4.12.1. Estimated SRHS headboat landings of South Atlantic 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 eastern Florida and Georgia.

	Number					Pounds			
Year	FLE/GA	NC	SC	Total	CV	FLE/GA	NC	SC	Total
1981	4,839	1,042	1,405	7,286	0.059	17,167	5,775	7,468	30,411
1982	2,585	2,612	2,824	8,021	0.025	11,822	17,606	14,026	43,454
1983	3,587	1,548	3,375	8,510	0.027	17,046	9,673	23,421	50,140
1984	2,306	2,639	2,372	7,317	0.020	11,857	15,166	16,046	43,069
1985	1,822	2,198	4,452	8,472	0.050	10,475	11,636	25,775	47,886
1986	1,829	1,801	4,611	8,241	0.026	8,523	6,302	22,279	37,104
1987	2,340	4,951	7,577	14,868	0.018	8,212	14,745	30,633	53,590
1988	1,286	6,172	6,670	14,128	0.020	3,503	14,206	34,628	52,336
1989	1,321	4,370	6,407	12,098	0.058	4,658	12,236	29,478	46,372
1990	1,819	8,902	7,374	18,095	0.022	7,921	18,173	36,479	62,573
1991	1,597	17,221	4,832	23,650	0.034	12,842	135,120	24,655	172,617
1992	1,082	1,701	9,768	12,551	0.046	8,035	11,637	48,229	67,901
1993	942	1,545	6,766	9,253	0.030	5,148	10,669	38,398	54,216
1994	983	2,433	8,919	12,296	0.016	5,531	10,926	47,135	63,593
1995	1,631	794	13,470	15,585	0.008	6,978	5,085	66,897	78,960
1996	1,052	1,084	7,494	9,397	0.024	5,057	6,607	45,493	57,158
1997	2,150	1,366	11,235	14,206	0.004	7,777	11,590	57,070	76,437
1998	1,678	1,180	13,630	16,095	0.023	7,349	6,110	66,186	79,645
1999	1,547	1,897	14,660	17,697	0.027	6,361	14,599	69,614	90,574
2000	1,742	1,842	9,932	13,162	0.012	10,053	15,034	50,960	76,047
2001	792	2,095	7,766	10,549	0.021	4,879	13,948	50,522	69,349
2002	1,100	2,149	7,531	10,514	0.022	6,619	11,850	44,547	63,017
2003	855	1,202	8,238	10,065	0.013	3,982	7,994	47,341	59,318
2004	1,379	1,057	11,127	13,254	0.025	7,212	7,798	72,846	87,856
2005	1,675	1,237	5,606	8,244	0.018	9,942	10,059	39,736	59,737
2006	1,389	801	8,746	10,571	0.021	7,433	5,530	52,359	65,321
2007	1,041	809	15,034	16,741	0.025	4,482	5,255	91,252	100,989
2008	1,045	535	3,789	5,061	0.017	5,630	2,841	20,600	29,071
2009	884	297	2,620	3,622	0.016	4,930	2,025	17,745	24,701
2010	491	408	2,496	3,285	0.005	3,516	2,331	14,960	20,807
2011	431	207	1,476	2,020	0.010	1,978	2,494	17,459	21,931
2012	390	198	1,547	2,075	0.000	1,639	1,876	9,746	13,261
2013	372	171	1,272	1,790	0.002	2,633	1,662	11,186	15,481
2014	518	189	1,147	1,837	0.000	3,751	1,738	9,990	15,478
2015	717	453	1,079	2,223	0.000	3,209	2,630	6,747	12,585
2016	477	256	1,072	1,782	0.003	3,188	1,517	6,155	10,859
2017	382	194	1,103	1,669	0.000	2,869	1,629	9,870	14,368
2018	208	97	845	1,123	0.008	1,367	711	5,788	7,866

Table 4.12.2. Estimated historical recreational landings for Scamp and Yellowmouth Grouper in the South Atlantic 1955-1980 (CV=0.47).

Year	Number
1955	4,836
1956	5,309
1957	5,781
1958	6,254
1959	6,726
1960	7,199
1961	7,851
1962	8,503
1963	9,155
1964	9,807
1965	10,459
1966	10,520
1967	10,581
1968	10,642
1969	10,704
1970	10,765
1971	11,829
1972	12,893
1973	13,957
1974	15,021
1975	16,084
1976	16,266
1977	16,447
1978	16,629
1979	16,810
1980	16,992

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

Year	Cbt	Priv	Hbt	Total	CV	lbs
1981	1,682	12,364	7,286	21,332	0.59	65,340
1982	1,591	8,859	8,021	18,472	0.41	115,464
1983	1,048	0	8,510	9,558	0.07	57,364
1984	7,500	3,154	7,317	17,971	0.28	84,034
1985	1,307	4,988	8,472	14,767	0.35	91,060
1986	613	2,291	8,241	11,145	0.15	57,114
1987	543	983	14,868	16,395	0.05	64,110
1988	14,133	4,918	14,128	33,179	0.21	134,040
1989	10,571	8,720	12,098	31,389	0.21	116,585
1990	15,496	10,488	18,095	44,079	0.23	119,381
1991	4,277	6,115	23,650	34,041	0.12	209,226
1992	4,101	10,419	12,551	27,071	0.20	154,843
1993	8,998	10,396	9,253	28,647	0.24	150,152
1994	15,496	17,276	12,296	45,068	0.22	212,895
1995	95	0	15,585	15,680	0.01	79,616
1996	3,756	3,838	9,397	16,991	0.26	82,714
1997	578	2,585	14,206	17,370	0.15	99,090
1998	2,085	1,641	16,095	19,820	0.06	102,365
1999	6,970	957	17,697	25,625	0.12	196,310
2000	5,577	24,178	13,162	42,917	0.26	353,103
2001	5,320	9,386	10,549	25,255	0.18	168,082
2002	36,468	11,500	10,514	58,482	0.21	406,273
2003	13,682	21,522	10,065	45,269	0.30	295,353
2004	7,541	20,173	13,254	40,968	0.26	290,522
2005	23,049	3,633	8,244	34,926	0.51	192,024
2006	9,612	32,368	10,571	52,551	0.41	368,903
2007	15,826	26,623	16,741	59,190	0.22	378,934
2008	5,816	21,011	5,061	31,888	0.29	196,342
2009	1,034	13,449	3,622	18,105	0.40	127,788
2010	2,313	5,550	3,285	11,148	0.32	82,033
2011	1,342	3,504	2,020	6,867	0.35	62,988
2012	925	6,073	2,075	9,073	0.36	88,574
2013	2,489	6,304	1,790	10,584	0.34	99,460
2014	569	37,820	1,837	40,226	0.90	419,136
2015	865	4,366	2,223	7,453	0.42	52,258
2016	900	5,908	1,782	8,590	0.40	70,809
2017	12,307	0	1,669	13,976	0.74	98,748
2018	509	2,436	1,123	4,068	0.35	26,801

Table 4.12.4. Estimated SRHS headboat discards of South Atlantic 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 eastern Florida and Georgia.

Year	FLE/GA	SC	NC	Total
1981	0	0	0	0
1982	0	0	0	0
1983	0	0	0	0
1984	0	0	0	0
1985	0	0	0	0
1986	0	0	0	0
1987	0	0	0	0
1988	0	0	0	0
1989	0	0	0	0
1990	0	0	0	0
1991	0	0	0	0
1992	934	1,269	6,661	8,864
1993	814	1,152	4,614	6,580
1994	789	1,815	6,082	8,685
1995	929	592	9,186	10,707
1996	548	808	5,110	6,467
1997	1,014	1,019	7,661	9,695
1998	842	880	9,295	11,016
1999	707	1,415	9,997	12,119
2000	957	1,374	6,773	9,104
2001	523	1,562	5,296	7,382
2002	539	1,603	5,136	7,277
2003	383	896	5,618	6,897
2004	903	701	5,086	6,690
2005	1,216	1,450	2,317	4,983
2006	772	1,044	2,690	4,506
2007	298	1,073	4,348	5,719
2008	815	519	1,806	3,140
2009	839	179	2,092	3,110
2010	577	397	2,064	3,038
2011	398	165	1,065	1,628
2012	442	66	801	1,309
2013	101	38	1,036	1,175
2014	117	131	1,275	1,523
2015	109	224	1,303	1,636
2016	125	177	1,039	1,341
2017	41	115	757	913
2018	42	52	596	690

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

Year	Cbt	Priv	Hbt	Total	CV
1981	0	0	0	0	0.00
1982	0	0	0	0	0.00
1983	0	0	0	0	0.00
1984	0	0	0	0	0.00
1985	0	0	0	0	0.00
1986	0	0	0	0	0.00
1987	0	0	0	0	0.00
1988	0	9,538	0	9,538	1.00
1989	20	0	0	20	1.00
1990	0	4,522	0	4,522	1.00
1991	0	0	0	0	0.00
1992	3,157	0	8,864	12,021	0.40
1993	6,043	10,728	6,580	23,351	0.53
1994	7,143	4,317	8,685	20,145	0.28
1995	4,314	0	10,707	15,021	0.44
1996	3,985	0	6,467	10,452	0.61
1997	6,067	0	9,695	15,762	0.97
1998	1,321	0	11,016	12,338	0.65
1999	1,049	2,613	12,119	15,781	0.48
2000	2,320	4,643	9,104	16,066	0.48
2001	10,216	4,053	7,382	21,650	0.36
2002	9,948	10,429	7,277	27,655	0.29
2003	12,453	11,609	6,897	30,959	0.41
2004	5,967	20,071	6,690	32,728	0.35
2005	4,853	998	4,983	10,834	0.56
2006	2,759	7,257	4,506	14,522	0.37
2007	2,068	45,867	5,719	53,654	0.50
2008	4,313	17,244	3,140	24,696	0.41
2009	2,148	19,771	3,110	25,029	0.48
2010	1,512	9,418	3,038	13,967	0.51
2011	1,090	2,181	1,628	4,899	0.69
2012	665	21,692	1,309	23,665	0.97
2013	688	1,256	1,175	3,120	0.71
2014	7	0	1,523	1,530	1.00
2015	143	3,183	1,636	4,962	0.96
2016	174	1,059	1,341	2,574	0.65
2017	16	0	913	929	1.00
2018	0	3,993	690	4,683	0.68

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.

	FLKeys					FLE					GA					SC					NC				
Year	Fish	Trp	Min	Avg	Max	Fish	Trp	Min	Avg	Max	Fish	Trp	Min	Avg	Max	Fish	Trp	Min	Avg	Max	Fish	Trp	Min	Avg	Max
1981	3	2	0.2	1.5	2.5	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0
1982	0	0	0.0	0.0	0.0	2	2	0.7	2.4	4.1	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0
1983	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	2	3.4	10.2	18.2	0	0	0.0	0.0	0.0
1984	6	2	0.9	2.3	5.5	1	1	1.1	1.1	1.1	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	2	1	3.3	3.3	3.3
1985	0	0	0.0	0.0	0.0	3	3	2.4	3.6	4.4	1	1	16.5	16.5	16.5	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0
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	8	3	1.1	9.3	15.0	0	0	0.0	0.0	0.0
1987	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	3	3	2.3	7.1	12.1	9	5	3.6	8.3	19.6
1988	0	0	0.0	0.0	0.0	0	1	0.0	0.0	0.0	0	0	0.0	0.0	0.0	4	5	2.2	8.9	12.8	13	21	0.9	2.9	5.8
1989	0	0	0.0	0.0	0.0	1	1	1.8	1.8	1.8	0	0	0.0	0.0	0.0	4	4	1.1	9.0	16.5	65	23	0.5	3.7	25.0
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	5	3	0.9	2.4	4.0	74	24	0.6	2.3	5.4
1991	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	9	3	8.2	10.1	15.5	37	15	1.0	3.2	6.9
1992	3	3	1.4	5.4	7.4	1	1	3.1	3.1	3.1	0	0	0.0	0.0	0.0	12	2	4.8	5.6	8.7	54	22	1.6	6.4	21.9
1993	3	3	6.3	11.8	15.7	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	49	16	2.0	4.4	11.0
1994	6	4	5.3	10.1	15.3	0	0	0.0	0.0	0.0	5	1	3.1	4.3	5.2	0	0	0.0	0.0	0.0	103	37	0.5	4.0	8.2
1995	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	2	2	3.1	6.6	10.2
1996	0	0	0.0	0.0	0.0	6	4	2.6	4.6	6.8	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	19	12	0.4	3.1	4.9
1997	1	1	9.3	9.3	9.3	0	0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	17	6	3.3	8.3	16.4	0	0	0.0	0.0	0.0
1998	4	4	3.5	8.2	16.2	2	2	4.5	13.8	23.1	0	0	0.0	0.0	0.0	27	7	0.4	5.9	14.9	3	2	3.3	3.6	3.8
1999	4	4	2.3	4.0	5.6	24	12	4.1	13.0	39.5	23	8	6.6	15.1	21.6	2	2	4.6	6.0	7.4	5	4	2.4	3.4	3.8
2000	1	1	3.5	3.5	3.5	40	18	1.7	9.0	19.3	11	2	5.2	18.7	34.2	29	16	4.0	9.8	23.6	0	0	0.0	0.0	0.0
2001	9	5	2.7	4.6	6.3	29	14	3.0	7.1	15.5	7	5	6.1	9.8	14.2	0	0	0.0	0.0	0.0	24	13	3.6	6.5	14.4
2002	5	4	4.2	6.0	7.0	31	21	2.1	6.4	15.7	7	5	3.5	12.3	22.5	0	0	0.0	0.0	0.0	106	20	3.2	7.4	21.8
2003	3	3	2.9	4.4	5.8	51	19	3.6	9.1	23.0	20	12	4.1	16.6	46.3	3	1	2.6	3.9	6.2	32	11	3.4	6.1	12.9
2004	7	5	1.4	5.0	17.4	16	11	3.0	4.9	11.9	17	10	2.9	7.3	17.4	17	5	3.3	9.8	14.8	37	9	3.4	7.4	13.9
2005	2	2	1.7	3.2	4.6	9	6	2.9	4.6	9.1	10	5	2.9	5.0	8.8	1	1	1.5	1.5	1.5	22	7	3.0	4.9	11.1
2006	3	3	2.1	3.5	4.6	30	16	3.4	6.0	9.9	13	5	2.9	6.3	16.1	17	5	1.5	3.0	6.4	50	10	3.0	6.6	17.5
2007	15	7	1.5	4.4	9.3	38	10	1.6	7.2	12.4	4	3	2.9	8.1	16.1	5	2	1.5	6.2	12.8	36	10	3.3	6.7	15.4
2008	9	6	2.1	6.0	10.9	2	2	4.1	10.1	16.1	7	5	3.3	7.9	16.5	4	2	3.2	8.3	14.1	33	16	3.2	7.0	15.4
2009	1	1	3.1	3.1	3.1	0	0	0.0	0.0	0.0	5	4	4.0	9.5	15.9	9	5	2.6	8.1	17.6	39	14	3.2	7.1	17.6
2010	0	0	0.0	0.0	0.0	4	2	8.0	10.1	13.9	13	4	5.1	10.4	19.8	0	0	0.0	0.0	0.0	50	19	3.2	7.3	19.0

Year	FLKeys					FLE					GA					SC					NC				
	Fish	Trp	Min	Avg	Max	Fish	Trp	Min	Avg	Max	Fish	Trp	Min	Avg	Max	Fish	Trp	Min	Avg	Max	Fish	Trp	Min	Avg	Max
2011	0	0	0.0	0.0	0.0	2	1	4.9	5.7	6.5	2	2	5.1	9.1	13.2	0	0	0.0	0.0	0.0	26	8	3.3	8.7	19.3
2012	0	0	0.0	0.0	0.0	1	1	7.9	7.9	7.9	7	2	3.2	7.6	9.7	1	1	6.4	6.4	6.4	20	6	4.9	11.7	22.0
2013	2	1	2.8	2.8	2.8	3	3	4.3	10.5	13.6	0	0	0.0	0.0	0.0	9	2	4.0	7.9	15.2	18	8	5.4	10.1	23.1
2014	6	2	3.9	5.6	8.4	23	11	4.4	9.0	22.7	1	1	4.0	4.0	4.0	2	1	4.9	5.6	6.4	9	3	6.3	11.7	22.7
2015	0	0	0.0	0.0	0.0	1	1	9.9	9.9	9.9	0	0	0.0	0.0	0.0	8	1	4.0	6.6	13.4	9	4	3.5	8.2	13.9
2016	0	0	0.0	0.0	0.0	9	7	3.8	8.5	15.2	1	1	17.4	17.4	17.4	4	4	4.0	7.9	14.8	4	3	3.5	8.1	14.8
2017	1	1	17.2	17.2	17.2	5	3	3.2	10.8	18.7	0	0	0.0	0.0	0.0	8	2	5.7	8.8	12.3	0	0	0.0	0.0	0.0
2018	1	1	4.0	4.0	4.0	2	2	3.8	6.7	9.6	0	0	0.0	0.0	0.0	2	1	7.3	9.8	12.3	8	4	5.3	11.6	23.1

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.

YEAR	FLE/GA					NC					SC					South Atlantic				
	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)	Fish (n)	Trips (n)	Mean (kg)	Min (kg)	Max (kg)
1972						145	36	4.63	1.59	12.08	231	72	4.52	1.36	19.07	376	108	4.57	1.36	19.07
1973						202	60	3.80	1.14	10.55	179	76	4.65	0.91	14.53	381	136	4.23	0.91	14.53
1974						210	45	3.93	1.14	7.81	185	70	4.81	1.41	9.08	395	115	4.37	1.14	9.08
1975						344	76	4.10	0.25	17.48	130	55	5.58	1.77	10.43	474	131	4.84	0.25	17.48
1976	3	2	7.57	6.72	8.63	771	124	4.53	0.27	8.85	77	40	6.23	1.04	12.03	851	166	6.11	0.27	12.03
1977	18	13	4.39	1.50	9.31	364	78	4.31	0.23	9.40	79	40	6.13	0.86	9.13	461	131	4.94	0.23	9.40
1978	38	24	3.05	0.48	9.74	218	57	4.23	0.50	15.89	57	31	5.58	0.37	11.50	313	112	4.29	0.37	15.89
1979	59	34	1.92	0.36	10.30	112	39	3.73	0.42	9.13	20	11	4.38	1.04	8.15	191	84	3.34	0.36	10.30
1980	83	39	1.93	0.20	9.75	81	31	2.83	0.58	10.70	12	11	3.03	1.45	7.65	176	81	2.60	0.20	10.70
1981	99	61	2.03	0.25	8.10	20	11	2.64	0.50	5.20	9	7	2.17	0.38	5.90	128	79	2.28	0.25	8.10
1982	86	47	2.37	0.50	6.90	145	55	2.93	0.18	10.50	31	23	2.33	0.23	5.10	262	125	2.54	0.18	10.50
1983	190	93	2.14	0.32	8.80	155	64	2.79	0.32	7.50	104	47	3.06	0.42	8.95	449	204	2.66	0.32	8.95
1984	167	82	2.41	0.22	10.70	177	62	2.41	0.40	9.31	148	77	3.11	0.22	8.40	492	221	2.64	0.22	10.70
1985	203	87	2.09	0.10	7.80	150	69	2.25	0.27	8.18	132	57	2.57	0.44	9.30	485	213	2.30	0.10	9.30

1986	86	47	1.89	0.14	8.45	201	99	2.03	0.19	9.15	140	61	2.41	0.22	8.20	427	207	2.11	0.14	9.15
1987	43	27	1.61	0.14	5.65	288	145	1.27	0.14	9.00	234	92	1.90	0.23	8.80	565	264	1.59	0.14	9.00
1988	41	26	1.60	0.08	4.80	301	131	1.12	0.13	11.22	134	66	2.08	0.34	9.73	476	223	1.60	0.08	11.22
1989	21	15	1.67	0.11	3.45	233	90	1.17	0.19	8.60	109	51	1.93	0.17	7.92	363	156	1.59	0.11	8.60
1990	29	20	1.82	0.44	3.80	160	60	0.94	0.09	5.16	150	55	2.12	0.22	8.00	339	135	1.63	0.09	8.00
1991	17	11	3.79	1.26	8.47	324	87	1.33	0.12	10.06	68	36	2.28	0.38	7.33	409	134	2.47	0.12	10.06
1992	20	18	3.68	1.43	10.50	83	38	2.77	0.74	6.60	176	50	2.41	0.69	6.30	279	106	2.95	0.69	10.50
1993	15	14	2.50	1.52	4.77	129	60	3.03	0.72	10.44	195	52	2.54	0.47	8.10	339	126	2.69	0.47	10.44
1994	33	13	2.82	1.28	8.56	33	20	1.98	1.23	6.99	276	72	2.42	0.94	6.68	342	105	2.41	0.94	8.56
1995	29	21	2.15	1.43	4.03	19	13	3.00	1.62	7.14	322	80	2.28	0.18	7.76	370	114	2.48	0.18	7.76
1996	13	12	2.67	1.37	4.62	35	24	2.89	0.76	7.08	234	66	2.65	0.82	7.57	282	102	2.74	0.76	7.57
1997	38	22	2.67	0.50	9.36	57	27	3.55	1.40	8.43	265	68	2.24	0.98	7.55	360	117	2.82	0.50	9.36
1998	44	26	2.67	0.60	10.69	59	32	2.94	1.36	9.66	290	65	2.19	0.93	6.89	393	123	2.60	0.60	10.69
1999	23	15	2.79	1.54	5.04	59	29	3.57	1.35	7.64	265	50	2.20	0.88	7.11	347	94	2.85	0.88	7.64
2000	26	22	3.19	1.47	6.91	74	36	3.88	1.33	9.08	123	41	2.28	1.21	5.54	223	99	3.11	1.21	9.08
2001	19	14	2.85	1.38	7.82	122	55	2.91	0.50	9.96						141	69	2.88	0.50	9.96
2002	21	18	3.64	1.51	8.14	38	14	2.65	1.44	6.11	79	28	2.55	0.88	7.23	138	60	2.95	0.88	8.14
2003	18	11	2.94	1.49	8.36	27	12	2.89	1.67	7.44	164	64	2.52	0.80	7.53	209	87	2.78	0.80	8.36
2004	5	5	4.18	1.76	6.32	31	20	3.22	1.58	9.68	38	16	2.75	0.32	6.86	74	41	3.39	0.32	9.68
2005	6	5	2.31	1.41	4.46	37	22	3.58	1.19	7.56	25	8	3.57	1.02	7.77	68	35	3.16	1.02	7.77
2006	12	8	3.14	1.36	5.80	18	11	2.88	1.35	8.72	62	37	2.66	0.23	6.61	92	56	2.89	0.23	8.72
2007	10	9	2.18	1.58	3.61	21	14	3.02	1.35	4.29	100	45	2.71	1.31	7.80	131	68	2.64	1.31	7.80
2008	12	10	2.76	1.73	6.39	13	7	2.17	1.56	3.25	52	23	2.63	1.32	5.55	77	40	2.52	1.32	6.39
2009	11	10	2.82	1.64	6.87	13	6	3.57	1.82	6.91	68	26	2.77	1.37	6.12	92	42	3.05	1.37	6.91
2010	5	5	3.30	1.62	5.59	9	6	2.46	1.45	3.48	45	19	2.75	1.27	7.09	59	30	2.84	1.27	7.09
2011	3	3	2.96	1.85	4.07	4	3	5.34	1.64	11.00	7	7	2.33	1.34	3.15	14	13	3.55	1.34	11.00
2012	37	17	2.24	1.19	5.38	13	6	4.48	1.62	8.23	16	7	3.00	1.43	6.47	66	30	3.24	1.19	8.23
2013	32	14	2.62	0.85	5.09	24	11	5.14	1.65	10.64	59	19	3.06	1.41	6.27	115	44	3.61	0.85	10.64
2014	19	14	3.20	1.03	7.27	20	9	4.37	0.23	9.20	21	10	4.07	1.68	7.46	60	33	3.88	0.23	9.20
2015	23	12	2.36	1.32	5.94	16	7	2.68	1.59	6.79	4	2	3.20	1.63	4.89	43	21	2.74	1.32	6.79
2016	55	20	2.96	0.70	14.20	8	8	3.02	1.57	5.10	19	13	3.35	1.56	6.90	82	41	3.11	0.70	14.20
2017	16	10	3.55	0.80	7.60	6	6	3.64	1.67	8.25	14	8	3.04	1.58	5.57	36	24	3.41	0.80	8.25
2018	7	3	3.13	1.55	4.53	5	3	3.45	1.37	5.39	32	15	3.36	1.60	8.56	44	21	3.31	1.37	8.56

Table 4.12.8. Number of aged and positive trips sampled in the recreational fishery by year and state, 1972-2018.

	CH				PR				HB (SRHS)					
	FL		NC		FL		NC		FLE/GA		NC		SC	
Year	Fish (n)	Trips (n)	Fish (n)	Trips (n)	Fish (n)	Trips (n)	Fish (n)	Trips (n)	Fish (n)	Trips (n)	Fish (n)	Trips (n)	Fish (n)	Trips (n)
1979									5	3				
1980									33	19	6	3	2	2
1981									53	34	3	1		
1982									3	3	2	2		
1983									6	4			1	1
1984									1	1				
1989													5	3
1991											1	1		
1993											1	1		
1995									3	2			9	1
1996									2	2	4	3	119	42
1997											2	1		
2000													1	1
2001	6	4							1	1				
2002	44	22											4	3
2003	60	33									1	1		
2004	87	42									3	3		
2005	86	42							3	1	12	11		
2006	59	17							7	7			26	26
2007	15	5							9	7	4	4	33	33
2008									5	4	1	1	17	17
2009	9	3							17	14	2	1	40	22
2010	2	1	7	2			2	1	8	5	7	6	27	17
2011	1	1							3	3			6	6
2012									25	13	10	6	11	7
2013	2	1							19	10	17	11	25	13
2014					1	1			17	13	19	9	6	4
2015									16	8	11	7	2	2
2016							2	1	44	20	5	5	6	6
2017	3	3							14	9	6	4	5	4
2018							5	4	6	3	8	5	13	8

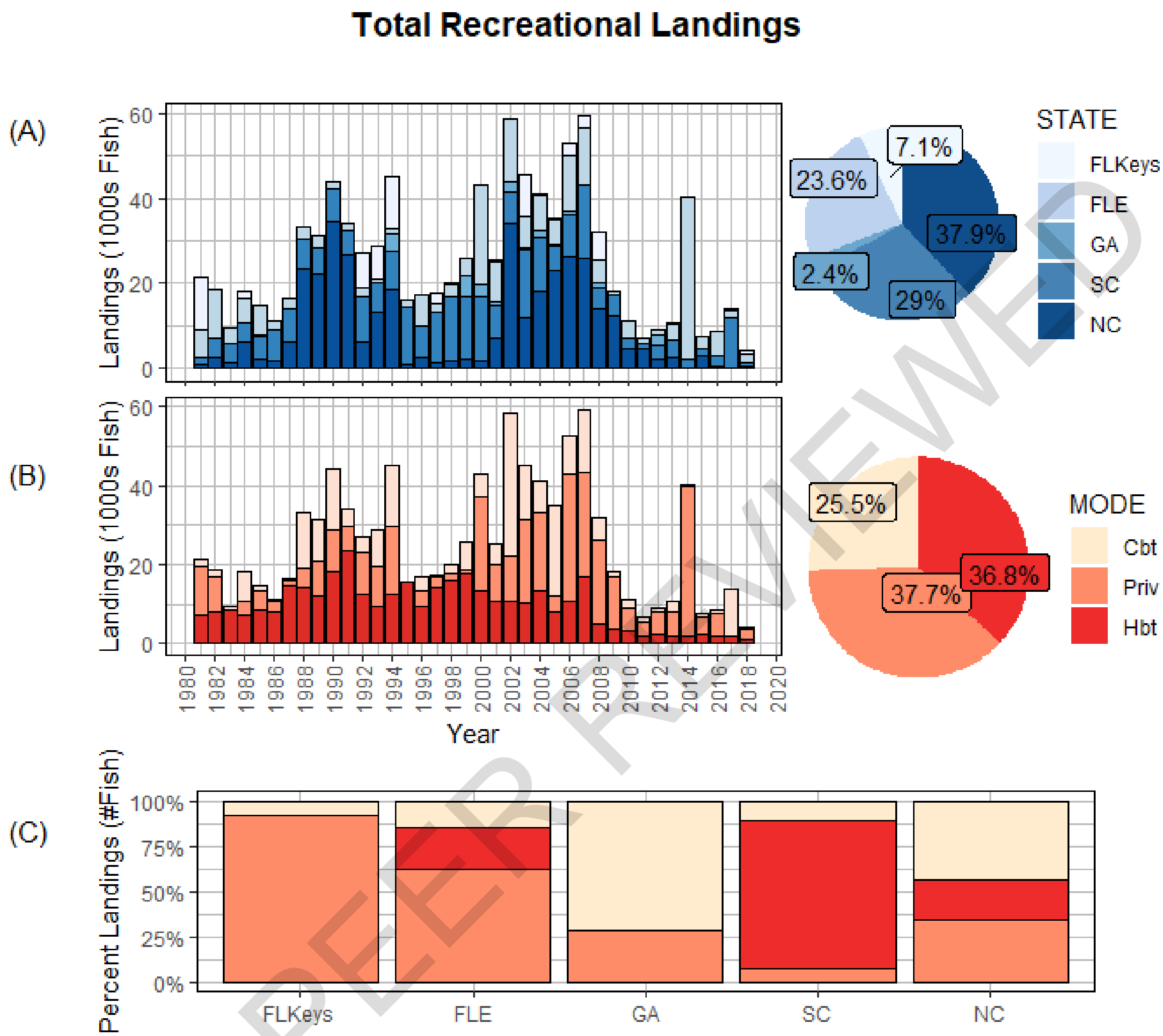
Table 4.12.9. Estimated SRHS headboat effort (in angler days) for South Atlantic anglers. Due to headboat area definitions and confidentiality issues, estimates of SRHS effort are combined for eastern Florida and Georgia.

Year	FLE/GA	NC	SC	Total
1981	298,883	19,374	59,030	377,287
1982	293,133	26,939	67,539	387,611
1983	277,863	23,830	65,733	367,426
1984	288,994	28,865	67,314	385,173
1985	280,845	31,384	66,001	378,230
1986	317,058	31,187	67,227	415,472
1987	333,041	35,261	78,806	447,108
1988	301,775	42,421	76,468	420,664
1989	316,864	38,678	62,708	418,250
1990	322,895	43,240	57,151	423,286
1991	280,022	40,936	67,982	388,940
1992	264,523	41,176	61,790	367,489
1993	236,973	42,786	64,457	344,216
1994	242,781	36,691	63,231	342,703
1995	210,714	40,295	61,739	312,748
1996	199,857	35,142	54,929	289,928
1997	173,273	37,189	60,150	270,612
1998	155,341	37,399	61,342	254,082
1999	164,052	31,596	55,499	251,147
2000	182,249	31,351	40,291	253,891
2001	163,389	31,779	49,265	244,433
2002	151,546	27,601	42,467	221,614
2003	145,011	22,998	36,556	204,565
2004	175,400	27,255	48,763	251,418
2005	172,839	31,573	34,036	238,448
2006	175,522	25,736	56,074	257,332
2007	157,150	29,002	60,729	246,881
2008	123,943	17,158	47,287	188,388
2009	136,420	19,468	40,919	196,807
2010	123,662	21,071	44,951	189,684
2011	132,492	18,457	44,645	195,594
2012	147,699	20,766	41,003	209,468
2013	165,679	20,547	40,963	227,189
2014	195,890	22,691	42,025	260,606
2015	194,979	22,716	39,702	257,397
2016	196,660	21,565	42,207	260,432
2017	126,126	20,170	36,914	183,210
2018	120,560	16,813	37,611	174,984

Table 4.12.10. Total recreational fishing effort (in angler trips) for South Atlantic anglers by mode and year (MRIP, SRHS).

Year	Cbt	Hbt	Priv	Total
1981	443,445	390,850	11,061,600	11,895,895
1982	543,344	493,679	13,686,090	14,723,113
1983	549,886	442,655	12,624,744	13,617,284
1984	631,740	574,202	15,880,341	17,086,283
1985	647,288	590,477	13,834,345	15,072,111
1986	734,582	624,372	15,120,221	16,479,175
1987	684,175	642,224	16,117,325	17,443,724
1988	574,659	578,118	13,538,214	14,690,992
1989	703,403	591,441	15,444,757	16,739,601
1990	594,310	601,884	14,473,240	15,669,434
1991	615,933	573,907	16,717,086	17,906,926
1992	574,093	548,672	16,543,089	17,665,854
1993	617,079	489,219	17,777,777	18,884,076
1994	632,200	509,688	17,436,754	18,578,642
1995	647,404	468,511	16,353,858	17,469,773
1996	632,194	476,781	17,329,456	18,438,432
1997	574,241	410,943	17,753,982	18,739,166
1998	618,206	376,149	17,065,966	18,060,321
1999	555,961	423,607	17,628,410	18,607,978
2000	514,365	457,442	20,705,579	21,677,385
2001	600,971	416,386	19,463,855	20,481,212
2002	693,754	387,978	20,401,196	21,482,928
2003	658,098	393,916	22,137,279	23,189,293
2004	663,047	457,115	21,673,683	22,793,844
2005	614,999	450,385	22,332,397	23,397,782
2006	588,260	474,955	24,764,335	25,827,551
2007	630,150	376,793	25,901,061	26,908,003
2008	545,399	285,972	24,141,904	24,973,275
2009	558,034	287,905	24,949,760	25,795,698
2010	483,966	285,752	26,837,256	27,606,973
2011	509,413	297,725	24,406,769	25,213,907
2012	537,932	331,077	22,770,757	23,639,766
2013	518,665	357,846	22,554,404	23,430,914
2014	619,611	419,851	24,333,837	25,373,299
2015	693,462	420,472	23,251,246	24,365,180
2016	716,062	428,292	22,540,147	23,684,501
2017	677,522	282,493	22,440,708	23,400,722
2018	723,594	267,265	23,909,857	24,900,716

4.13 FIGURES



	FLKeys	FLE	GA	SC	NC
Cbt	5,786	33,699	16,484	29,597	161,420
Hbt	0	52,284	0	230,267	79,653
Priv	63,754	144,481	6,769	22,724	128,070

Figure 4.13.1. Total recreational landings (AB1) for South Atlantic Scamp and Yellowmouth Grouper across all surveys (MRIP and SRHS). 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). Due to headboat area definitions and confidentiality issues, estimates of SRHS landings are combined for eastern Florida and Georgia, which is allocated as eastern Florida landings.

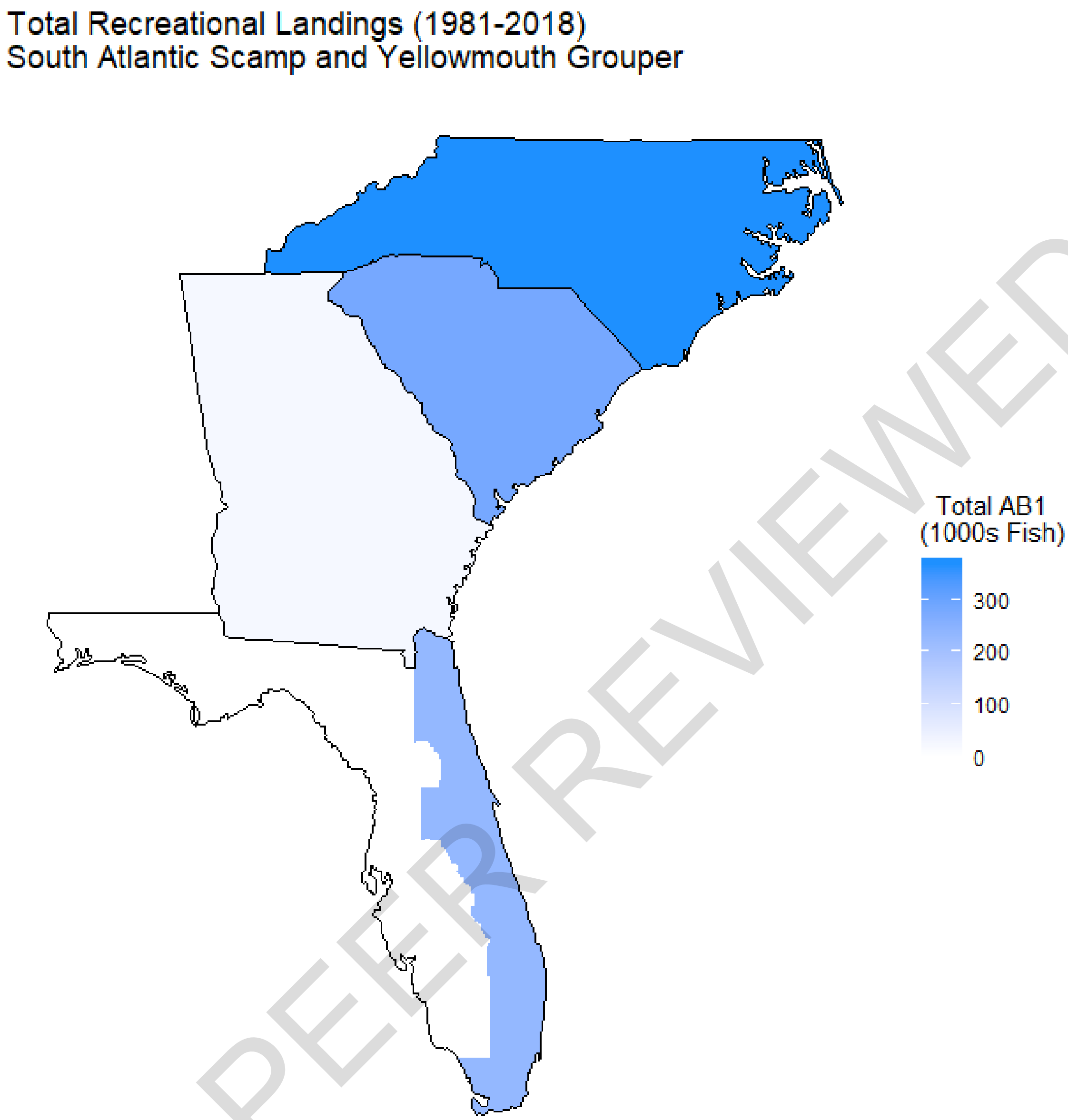
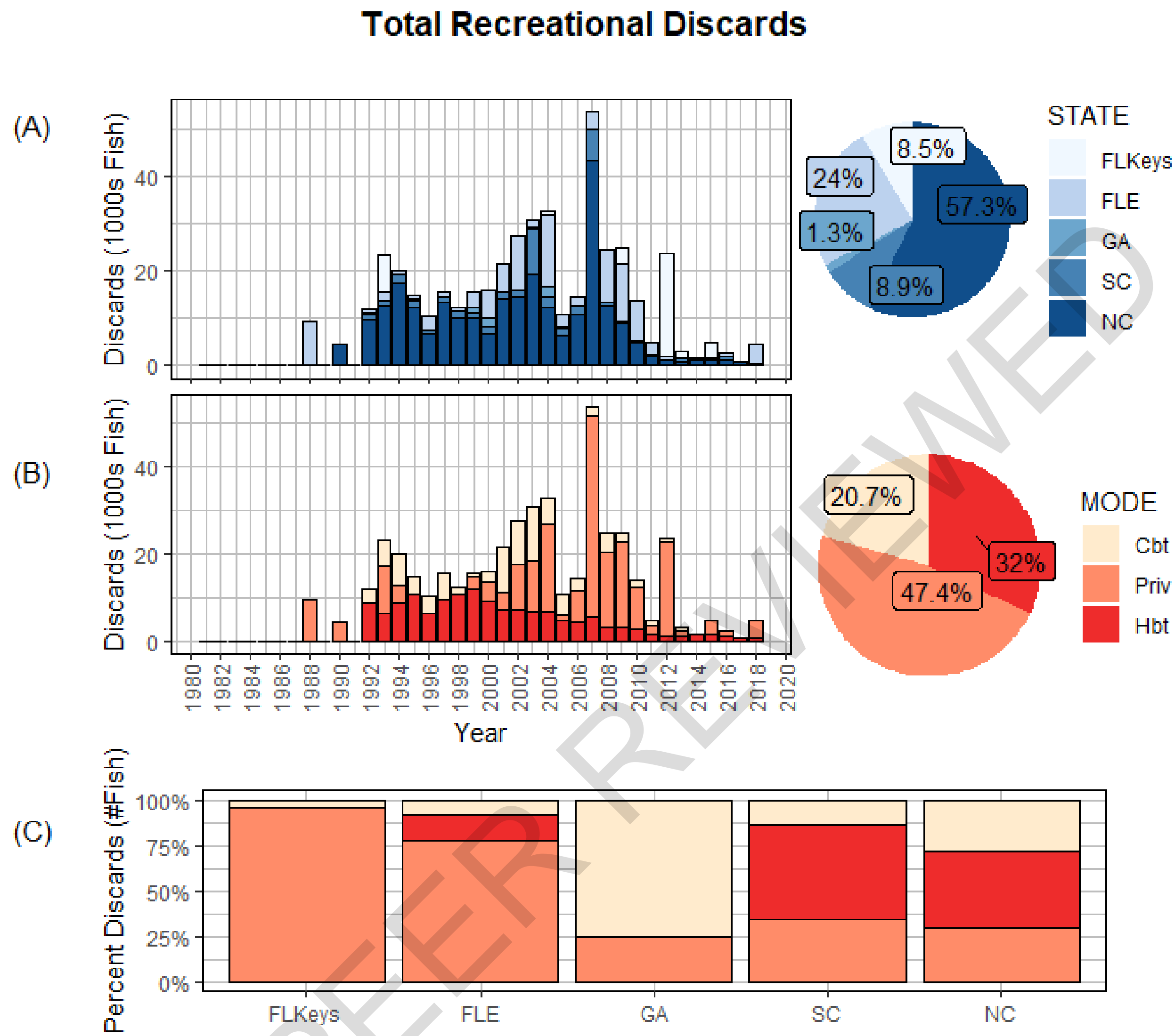


Figure 4.13.2. Distribution of total recreational landings (AB1), in thousands of fish, for Scamp and Yellowmouth Grouper across the South Atlantic. Estimates are combined across all surveys (MRIP and SRHS) and years (1981-2018). East Florida landings include the Florida Keys. Due to headboat area definitions and confidentiality issues, estimates of SRHS landings are combined for eastern Florida and Georgia, which is allocated as eastern Florida landings.



	FLKeys	FLE	GA	SC	NC
Cbt	1,736	8,711	4,578	5,771	73,644
Hbt	0	15,775	0	20,716	109,703
Priv	37,123	85,230	1,507	14,077	78,506

Figure 4.13.3. Total recreational discards (B2) for South Atlantic Scamp and Yellowmouth Grouper across all surveys (MRIP and SRHS). 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). Due to headboat area definitions and confidentiality issues, estimates of SRHS discards are combined for eastern Florida and Georgia, which is allocated as eastern Florida discards.

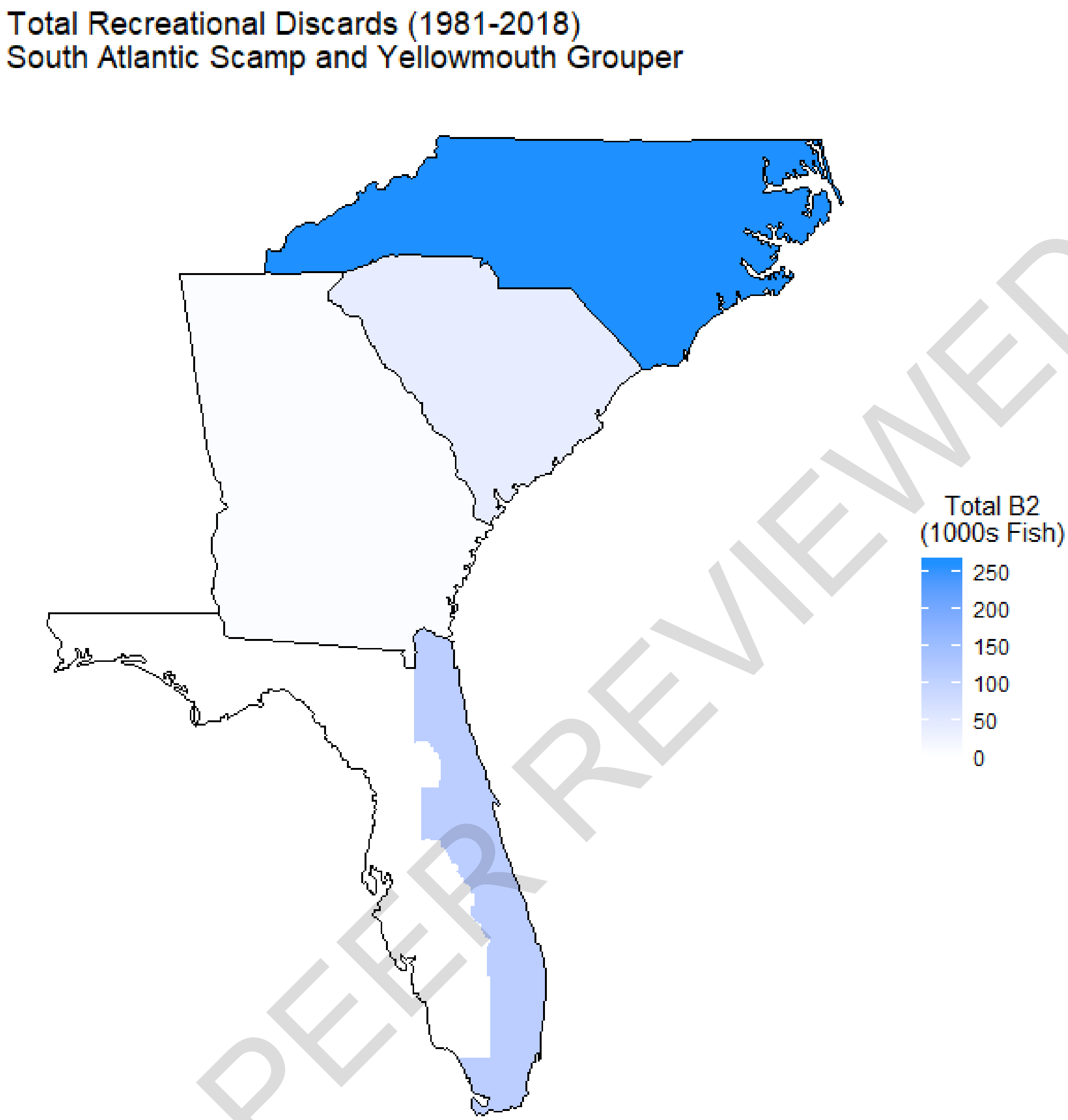
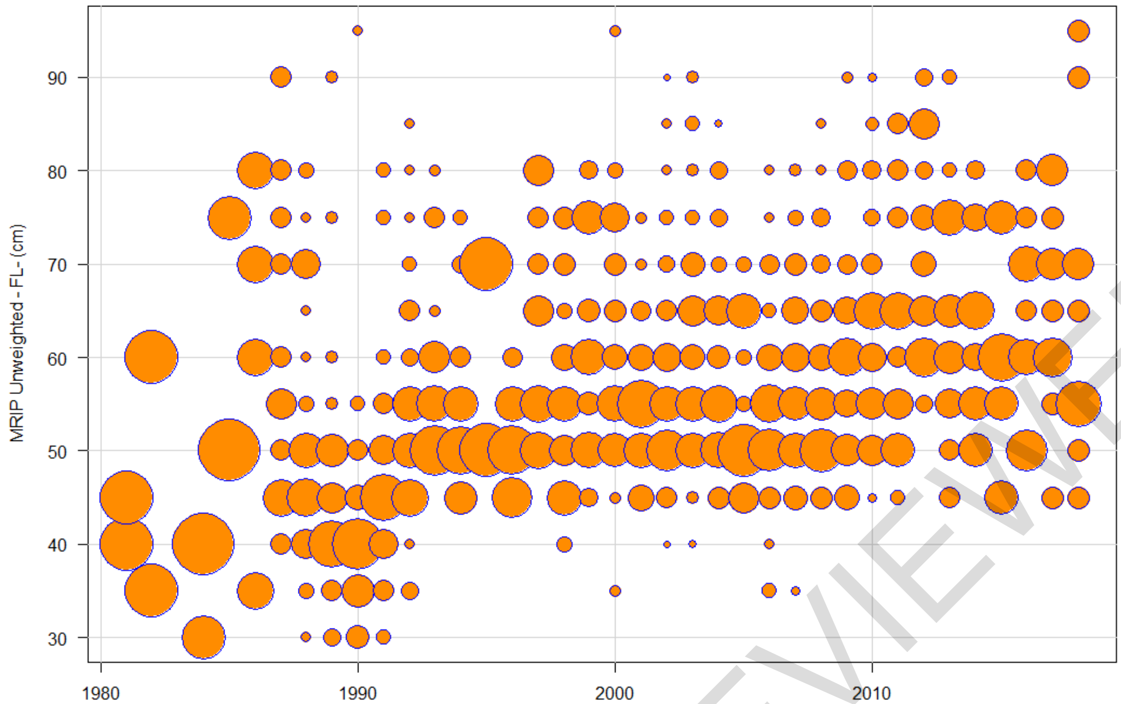
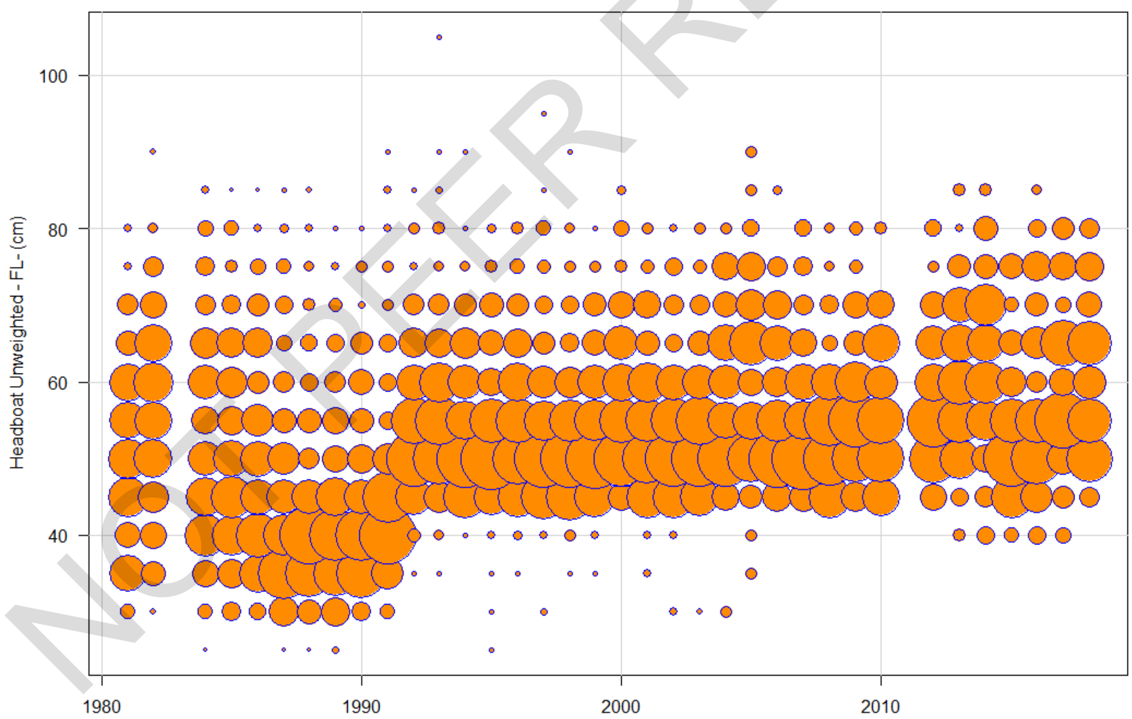


Figure 4.13.4. Distribution of total recreational discards (B2), in thousands of fish, for Scamp and Yellowmouth Grouper across the South Atlantic. Estimates are combined across all surveys (MRIP and SRHS) and years (1981-2018). East Florida landings include the Florida Keys. Due to headboat area definitions and confidentiality issues, estimates of SRHS discards are combined for eastern Florida and Georgia, which is allocated as eastern Florida discards.



(A)



(B)

Figure 4.13.5. Nominal length frequency distribution of the MRIP CHPR (A) and SRHS headboat fishery (B) in the South Atlantic.

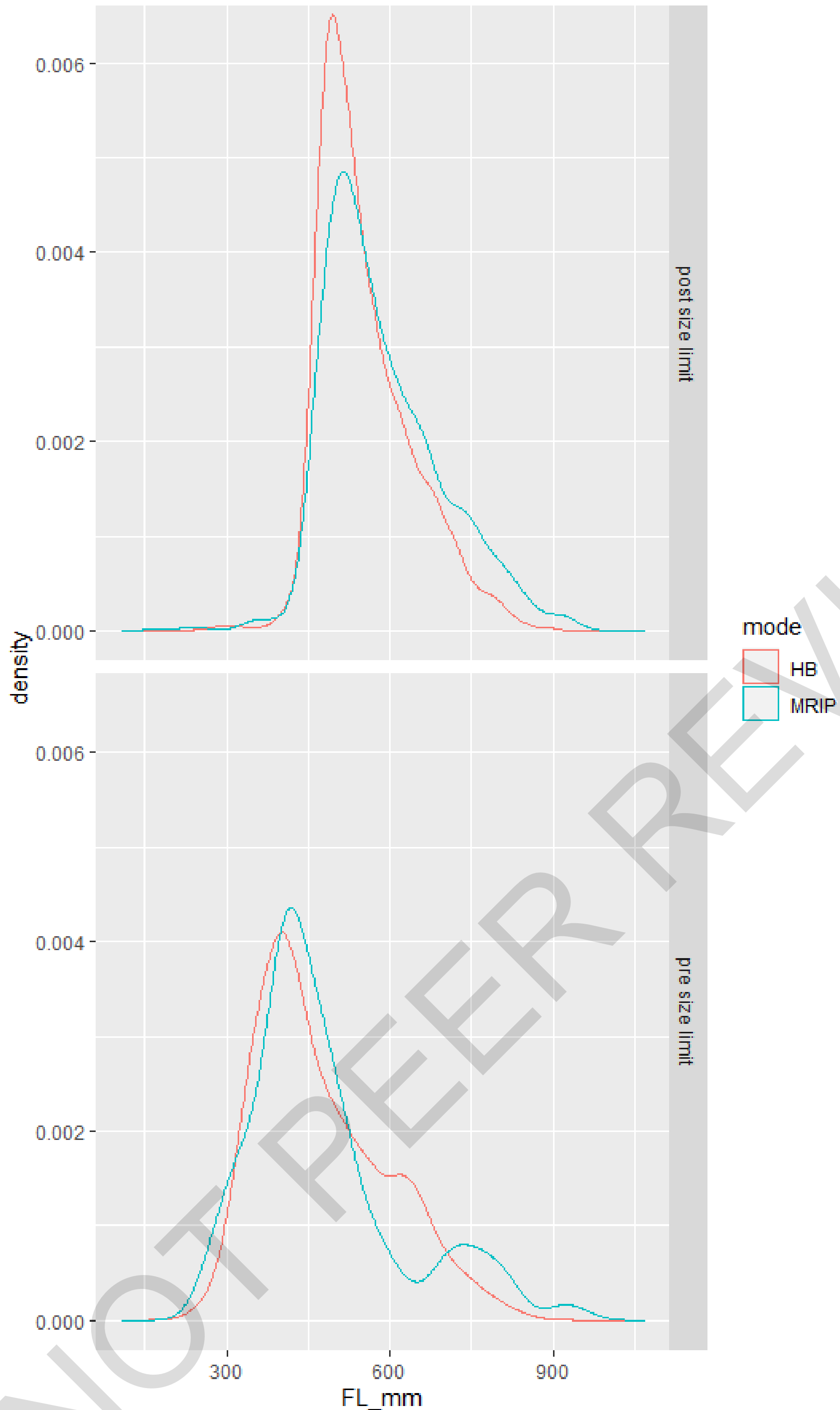


Figure 4.13.6. Nominal length frequency distribution of the MRIP CHPR and SRHS headboat fishery in the South Atlantic pre- and post- size limit.

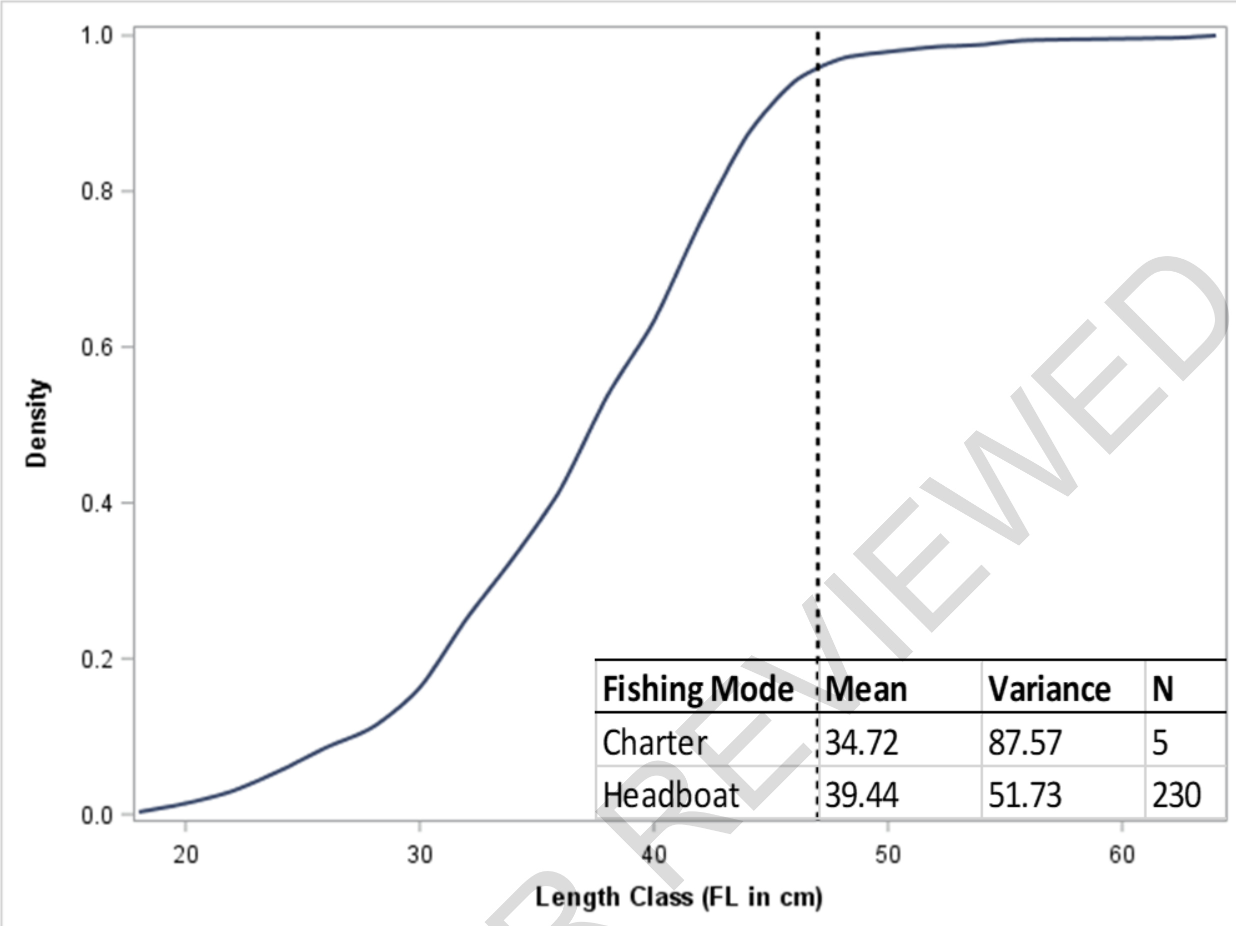


Figure 4.13 7. Cumulative frequency distribution for Scamp and Yellowmouth Grouper discard lengths collected from the South Atlantic headboat fishery from 2005 to 2017, all years combined. The dotted line represents the fork length associated with the current South Atlantic recreational minimum size limit of 20 inches total length.

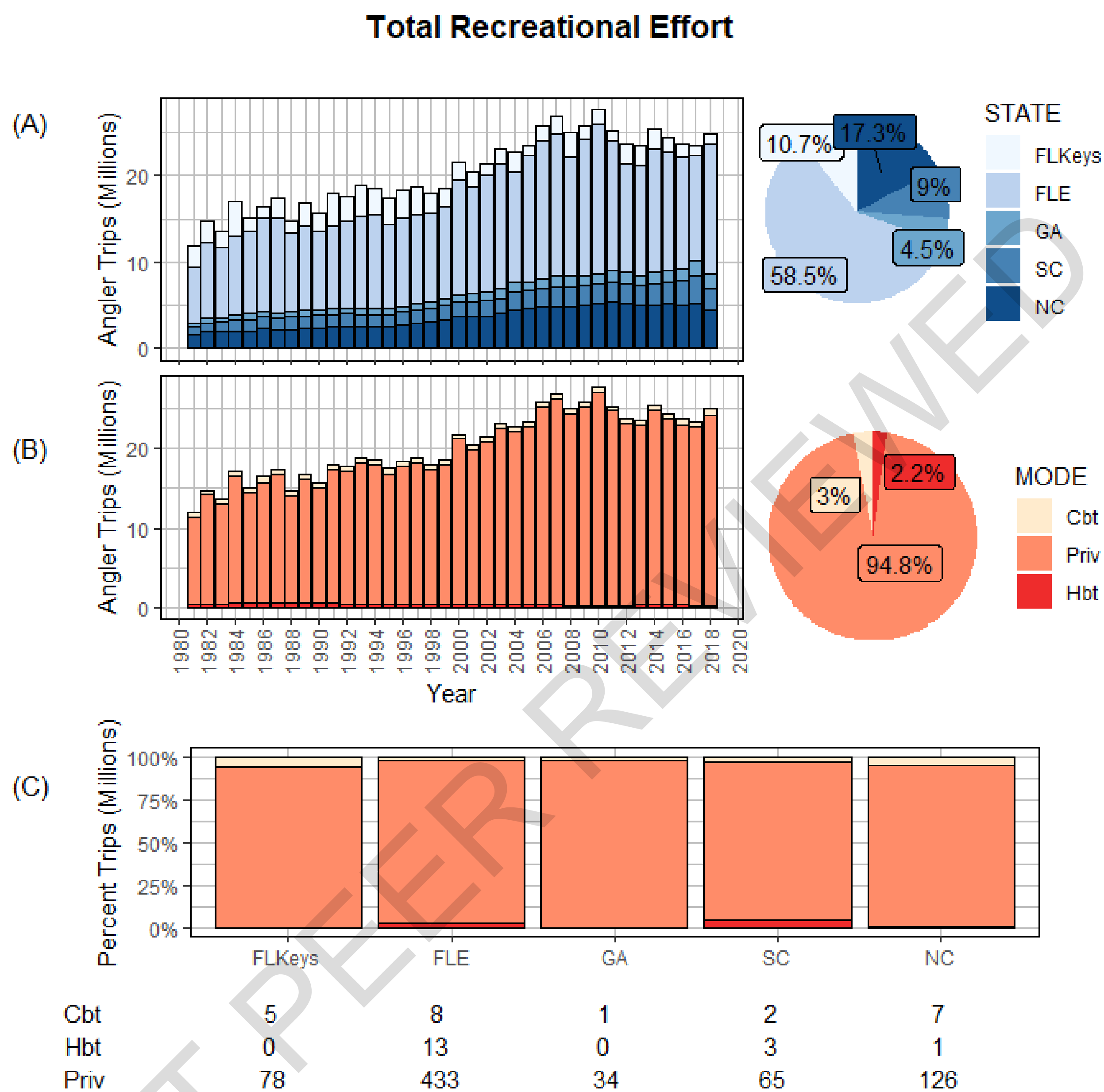


Figure 4.13.8. Total recreational fishing effort for South Atlantic anglers in millions of angler trips (MRIP and SRHS). Effort is provided (A) by state and year (1981-2018), (B) by mode and year, and (C) by mode and state (as a percentage). Due to headboat area definitions and confidentiality issues, estimates of SRHS effort are combined for eastern Florida and Georgia, which is allocated as eastern Florida effort.

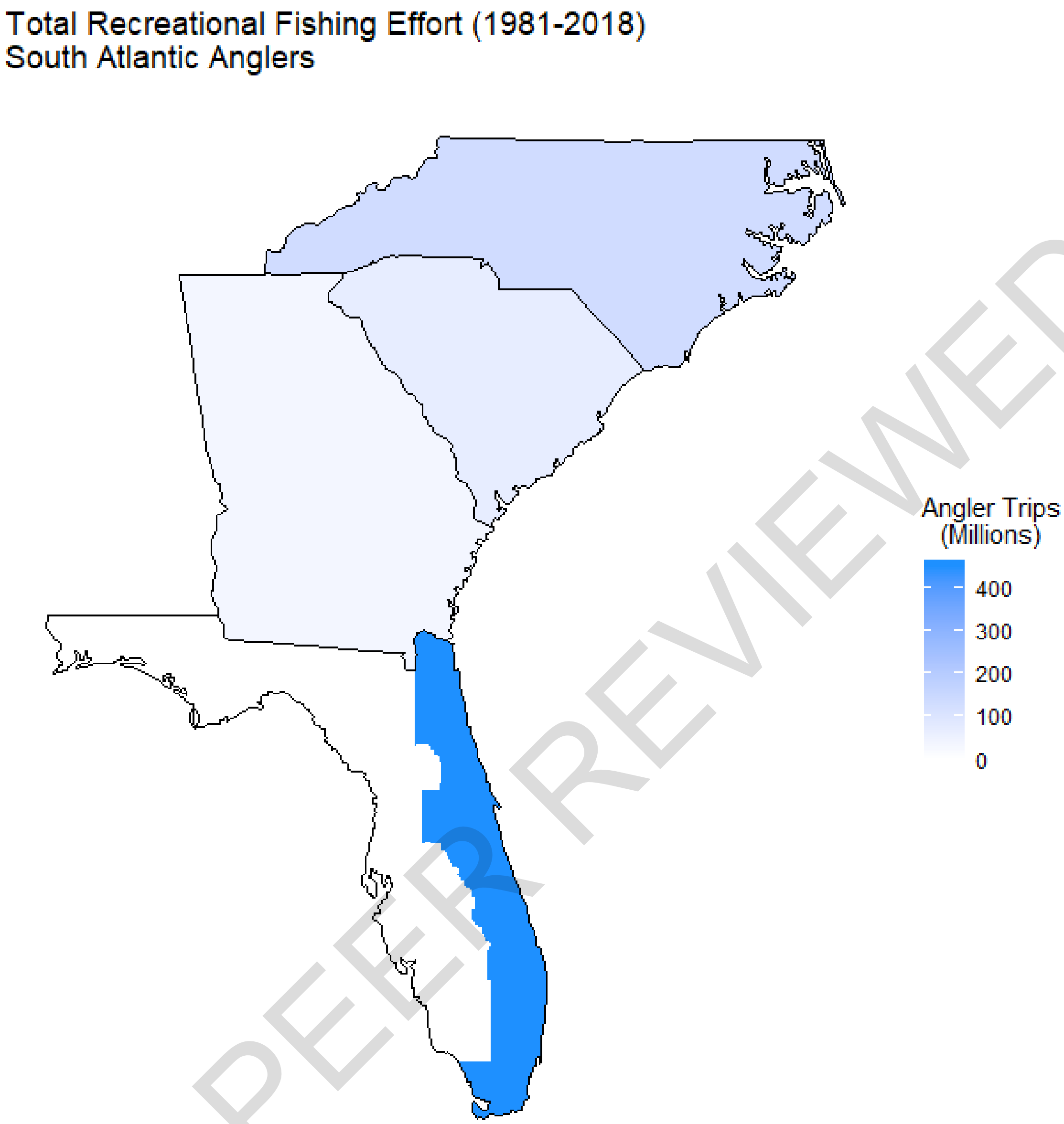


Figure 4.13.9. Distribution of total recreational fishing effort by South Atlantic anglers. Estimates are combined across all surveys (MRIP and SRHS) and years (1981-2018). East Florida landings include the Florida Keys. Due to headboat area definitions and confidentiality issues, estimates of SRHS effort are combined for eastern Florida and Georgia, which is allocated as eastern Florida effort.

5 INDICES OF POPULATION ABUNDANCE

5.1 OVERVIEW

For the South Atlantic U.S. region, four fishery independent data sets were considered for use as an index of abundance (Table 5.1). During the data webinar prior to the DW, one of these datasets was discarded because of small sample sizes and limited geographic extent. Two fishery independent data sets were retained for further consideration at the DW: SERFS chevron traps and SERFS video survey.

For the South Atlantic U.S. region, five fishery dependent data sets were considered for use as an index of abundance (Table 5.1). During the data webinars, three were recommended for further consideration at the DW. Ultimately, the DW recommended indices from two of these fishery dependent data sets for potential use in the assessment model: recreational headboat logbook index and commercial handline logbook index.

In total, the DW recommended two fishery independent indices (SERFS chevron traps and video survey) and two fishery dependent indices (recreational headboat index and a commercial handline 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-01, SEDAR 68-DW-02, SEDAR 68-DW-03, SEDAR 68-DW-04 and SEDAR 68-DW-06). 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

Until 2009, virtually all fishery independent sampling of reef fishes in southeast U.S. Atlantic waters was conducted by the Marine Resources Monitoring, Assessment, and Prediction (MARMAP) program. In 2009, the Southeast Area Monitoring and Assessment Program – South Atlantic (SEAMAP-SA) program joined the chevron trap survey through their Reef Fish Complement. In 2010, the Southeast Fisheries Independent Survey (SEFIS) was created and joined the chevron trap survey. The partner-led survey is now referred to as the Southeast Reef Fish Survey (SERFS). With the advent of the partner programs, sampling coverage in the region has expanded, primarily in Florida. SERFS now samples between Cape Hatteras, North Carolina and St. Lucie Inlet, Florida, and it targets a sampling universe of approximately 4,300 sites of hard-bottom habitats between approximately 15 and 100 meters deep.

5.3.1 Chevron trap

5.3.1.1 Methods, Gears, and Coverage

Chevron traps were baited with whole and cut Clupeids and deployed at stations randomly selected by computer from a database of live bottom stations on the continental shelf and shelf edge and soaked for approximately 90 minutes.

An index of abundance was developed by standardizing catch (number of scamp and yellowmouth grouper caught) using a zero-inflated negative binomial model (SEDAR68-DW-04; Zuur et al. 2009). Effort (trap soak minutes) was included as an offset in the regression. Analyses were computed using the *pscl* library in R (Jackman 2008; Zeileis et al 2008; R Development Core Team 2014). Model covariates included sampling characteristics and environmental data.

5.3.1.2 Sampling Intensity and Time Series

Chevron traps were deployed from 1990 through 2018, ranging from 224 to 1736 traps per year meeting the covariate criteria for this analysis. SERFS/MARMAP chevron trap sampling adequately covers the center of distribution of Scamp/Yellowmouth Grouper (SC/NC) since the inception of the survey. Proportion positive catches have consistently been under 0.05 since 2008. The cause of this is unknown, but could be related to a combination of reduced abundance and a sampling artefact of increased effort in areas of lower abundance, such as Florida. The annual number of traps (collections) used to compute the index is shown in Table 5.3.

5.3.1.3. Size/Age data

The ages of scamp and yellowmouth grouper collected by chevron traps (1990-2018) ranged from 0 to 30 (median = 5, mean = 6.5, n= 1897), and sizes ranged from 18 to 88 cm fork length. Age composition data are available for estimating the selectivity of this gear.

5.3.1.4. Catch Rates

Standardized catch rates are shown in Table 5.3 and in Figure 5.1 (top panel). The units on catch rates are in numbers of fish. Effort was modeled as an offset, rather than as the denominator in the response variable.

5.3.1.5. Uncertainty and Measures of Precision

Measures of precision were computed using a bootstrap procedure, in which 5,000 sampling events were drawn at random with replacement. The CVs are shown in Table 5.3.

5.3.1.6 Comments on Adequacy for Assessment

This index was considered to be adequate for the assessment, with sample sizes in the time series being sufficiently large to create a meaningful index. Recent years of the survey show a reduced proportion positive, but the cause is unknown. Because the chevron trap index is fishery independent and has accompanying selectivity information (lengths and ages), it was considered by the IWG to be the highest ranking source of information on trends in population abundance.

One issue discussed by the group, was the non-independence between chevron traps and the video survey and the potential for different selectivities between gears. In recent assessments for different species, the chevron trap and video indices were combined and a common selectivity was assigned because the video index did not have any age or length compositions directly associated with it to inform selectivity. There was discussion as to how to treat the two indices, whether to combine them and either assign one selectivity or explore a means to assign a selectivity to each component or to have them input as separate indices even though they are not independent.

5.3.2 Video Survey

5.3.2.1 Methods, Gears, and Coverage

The Marine Resources Monitoring, Assessment, and Prediction (MARMAP) program has conducted most of the historical fishery-independent sampling in the U.S. South Atlantic (North Carolina to Florida). MARMAP has used a variety of gears over time, but chevron traps are one of the primary gears used to monitor reef fish species and have been deployed since the late 1980s. In 2009, MARMAP began receiving additional funding to monitor reef fish through the SEAMAP-SA program. In 2010, the SouthEast Fishery-Independent Survey (SEFIS) was initiated by NMFS to work collaboratively with MARMAP/SEAMAP-SA using identical methods to collect additional fishery-independent samples in the region. Together, these three programs are now called the Southeast Reef Fish Survey (SERFS). In 2010, video cameras were attached to some traps deployed by SERFS, and beginning in 2011 all traps included video cameras.

The SERFS currently samples between Cape Hatteras, North Carolina and St. Lucie Inlet, Florida. This survey targets hardbottom habitats between approximately 15 and 100 meters deep. SERFS began affixing high-definition video cameras to chevron traps on a limited basis in 2010 (Georgia and Florida only), but since 2011 has attached cameras to all chevron traps as part of their normal monitoring efforts. In 2015, the video cameras were changed from Canon to GoPro, to implement a wider field of view and thus observe more fish. A calibration study (detailed below) with both camera types used simultaneously was undertaken to account for differences in fish counts.

Hard-bottom sampling stations were selected for sampling in one of three ways. First, most sites were randomly selected from the SERFS sampling frame that consisted of approximately 3,000 sampling stations on or very near hard bottom habitat. Second, some stations in the sampling frame were sampled opportunistically even though they were not randomly selected for sampling in a given year. Third, new hard-bottom stations were added during the study period through the use of information from various sources including fishermen, charts, and historical surveys. These new locations were investigated using a vessel echosounder or drop cameras and sampled if hard bottom was detected. Only those new stations landing on hardbottom habitat were included in the analyses. All sampling for this study occurred during daylight hours between April and October on the R/V *Savannah*, R/V *Palmetto*, R/V *Sand Tiger*, or the NOAA Ship *Pisces* using identical methodologies as described below. Samples were intentionally spread out spatially on each cruise.

Chevron traps were constructed from plastic-coated, galvanized 2-mm diameter wire (mesh size = 3.4 cm^2) and measured 1.7 m × 1.5 m × 0.6 m, with a total volume of 0.91 m^3. Trap mouth openings were shaped like a teardrop and measured approximately 18 cm wide and 45 cm high. Each trap was baited with 24 menhaden (*Brevoortia* spp.). Traps were typically deployed in groups of six, and each trap in a set was deployed at least 200 m (usually > 400 m) from all other traps to provide some measure of independence between traps. A soak time of 90 minutes was targeted for each trap deployed.

Canon Vixia HFS-200 high-definition video cameras in Gates underwater housings were attached to chevron traps in 2011–2014, facing outward over the mouth. In 2015, Canon cameras were replaced with GoPro Hero 4 cameras over the trap mouth. Fish were counted exclusively using cameras over the trap mouth. A second high-definition GoPro Hero video or Nikon Coolpix S210/S220 still camera was attached over the nose of most traps in an underwater housing, and was used to quantify microhabitat features in the opposite direction. Cameras were turned on and set to record before traps were deployed, and were turned off after trap retrieval. Trap-video samples were excluded from our analysis if videos were unreadable for any reason (e.g., too dark, camera out of focus, files corrupt) or the traps did not fish properly (e.g., bouncing or dragging due to waves or current, trap mouth was obstructed).

In advance of the switch to GoPro cameras exclusively in 2015, we conducted a calibration study in the summer of 2014 where Canon and GoPro cameras were attached to traps side-by-side and fish were counted at the same time. A total of 54 side-by-side comparisons were recorded. Twelve samples observed scamp for both cameras and were used to develop a calibration. There were no yellowmouth grouper observed in the calibration data set.

Relative abundance of reef fish on video has been estimated using the *MeanCount* approach (Conn 2011; Schobernd et al. 2014). *MeanCount* was calculated as the mean number of individuals of each species over a number of video frames in the video sample. Video reading time was limited to an interval of 20 total minutes, commencing 10 minutes after the trap landed on the bottom to allow time for the trap to settle. One-second snapshots were read every 30 seconds for the 20-minute time interval, totaling 41 snapshots read for each video. The mean number of individuals for each target species in the 41 snapshots is the *MeanCount* for that species in each video sample. Zero-inflated modeling approaches described below require count data instead of continuous data like *MeanCount*. Therefore, these analyses used a response variable called *SumCount*, which was simply the sum of all individuals seen across all video frames. *SumCount* and *MeanCount* track exactly linearly with one another when the same numbers of video frames are used in their calculation (Bacheler and Carmichael 2014). Therefore, *SumCount* values were only used from videos where 41 frames were read (~93% of all samples).

SERFS employed video readers to count fish on videos. There was an extensive training period for each video reader, and all videos from new readers were re-read by fish video reading experts until they were very high quality. After that point, 10% or 15 videos (whichever was larger) were re-read annually by fish video reading experts as part of quality control. Video readers also quantified microhabitat features (biotic density and substrate composition), in order to standardize for habitat types sampled over time. Water clarity was also scored for each sample as poor, fair, or good. If bottom substrate could not be seen, then water clarity was considered poor, and if bottom habitat could be seen but the horizon was not visible, water clarity was considered fair. If the horizon could be seen in the distance, water clarity was considered to be good. Including water clarity in index models allowed for a standardization of fish counts based on variable water clarities over time and across the study area. A CTD cast was also taken for each simultaneously deployed group of traps, within 2 m of the bottom, and water temperature from these CTD casts was available for standardization models.

5.3.2.2 Sampling Intensity and Time Series

Overall, there were 11,590 survey videos with data available covering a period of 8 years (2011–2018). Although data were available from 2010, they were not considered here due to limitations in spatial overlap of the survey area and the spatial occupancy of scamp and yellowmouth grouper, consistent with recommendations from the Southeast Reef Fish Survey Video Index Development Workshop (SEDAR41-RD23). For the years considered, several data filters were applied. We removed any data points in which the survey video was considered unreadable by an analyst (e.g., too dark, corrupt video file), or if the trapping event was flagged for any irregularity that could have affected catch rates (e.g., trap dragged or bounced). Additionally, any survey video for which fewer than 41 video frames were read was removed from the full data set. Standardizing the number or readable frames for any data point was essential due to our use of *SumCount* as a response variable (see above). We also identified any video sample in which corresponding predictor variable were missing and removed them from the final data set.

Of the 10,107 video samples considered for inclusion, 1,785 were removed based on the data subsetting guidelines described above, leaving 9805 sampling events for the analysis, of which 1201 were positive for scamp or yellowmouth grouper (12.2%). The spatial distribution of the videos included in the analysis cover the area from NC to South Florida.

5.3.2.3. Size/Age data

As currently implemented, the size and age composition of populations sampled with the SERFS video survey gear are limited, and therefore selectivity of the gear cannot be estimated from data. However, in a different system, Langlois et al. (2015) compared length compositions of snappers and groupers caught in traps to those observed on video cameras, and found those length compositions to be quite similar. Based on that, previous IWG have recommended applying selectivity of chevron traps to the video gear, in one of two ways: 1) if chevron trap selectivity is flat-topped, the video gear selectivity should mirror that of the chevron traps, or 2) if chevron trap selectivity is dome-shaped, the video gear selectivity should mirror only the ascending portion and then assume flat-topped selectivity.

This recommendation was based on the expectation that the video gear should be flat-topped, because older, larger fish are present throughout the depths sampled and because there is no known reason why larger (older) individuals would be less observable on video than smaller (younger) individuals. The SEDAR 68 IWG recognized the need for age/size compositions of the video survey.

Selectivity of the SERFS chevron trap and video gear were discussed at the DW. In previous assessments these indices have been combined but there were concerns with this approach due to potential differences in selectivity. During the spring DW there were insufficient stereo length data from the video survey to determine if larger individuals were present in the videos while not being captured in the chevron traps. Following the delay of SEDAR 68, SERFS staff were able to provide video stereo lengths of scamp and yellowmouth grouper (Figure 5.2). At the final DW webinar, the consensus recommendation was to keep these indices separate in light of the new evidence provided by the SERFS staff while also recognizing the dependency of the gears. These two indices are developed from gear that are attached and sampling the same locations. It was also mentioned at the DW plenary that additional research is needed regarding combining indices that may have different selectivity but are sampling the same site.

5.3.2.4. Catch Rates

Annual standardized index values for scamp and yellowmouth grouper, including CVs, are presented in Table 5.4 and in Figure 5.3.

5.3.2.5. Uncertainty and Measures of Precision

Using a bootstrap procedure with 1000 replicates, confidence intervals of 2.5% and 97.5% were calculated for each year of the survey (Figure 5.3), as were CVs (Table 5.4).

5.3.2.6 Comments on Adequacy for Assessment

The scamp and yellowmouth grouper video index (2010-2018) was recommended for use in the assessment. The resulting index was ranked second of the two fishery independent sources based on the absence of information concerning the age composition of the video sampling gear. Non-independence between the video survey and chevron traps was discussed and identified as a topic for future research.

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

The headboat fishery in the south Atlantic includes for-hire vessels that typically accommodate 11-70 passengers and charge a fee per angler. The fishery uses hook and line gear, generally targets hard bottom reefs as the fishing grounds, and generally targets species in the snapper-grouper complex. This fishery is sampled separately from other fisheries, and the available data were used to generate a fishery dependent index.

Headboats in the south Atlantic are sampled from North Carolina to the Florida Keys (Figure 5.4). Data have been collected since 1972, but logbook reporting did not start until 1973. In addition, only North Carolina and South Carolina were included in the earlier years of the data set. In 1976, data were collected from North Carolina, South Carolina, Georgia, and northern Florida, and starting in 1978, data were collected from southern Florida.

Variables reported in the data set include year, month, day, area, location, trip type, number of anglers, species, catch, and vessel identification. Biological data and discard data were recorded for some trips in some years.

The IWG, along with headboat captains, discussed several key issues related to this index:

- Beginning in 1992, a 20” TL minimum size regulation was implemented. In some cases, the size limit may have influenced the fishing behavior of headboats that relied heavily on scamp and yellowmouth grouper catch. Thus, the IWG recommended modeling the change in selectivity that likely resulted from the size limit, and further acknowledged that the assessment model could be configured to allow for time-varying catchability.

- The scamp and yellowmouth grouper closure starting in 2010 led to a shift in fishing behavior (avoidance). Because of that, and because this index is based on landings only (i.e., no discards included), the IWG decided to end the index in 2009.

5.4.1.1 Methods of Estimation

Data Filtering

The headboat data and programmatic evaluation (SEDAR41-46) found a small percentage of logbook reports to be extreme outliers. Those values were likely erroneous and were removed from the data set prior to deriving the index.

Trips to be included in the computation of the index need to be determined based on effective effort for scamp and yellowmouth grouper. This may not be straightforward, because some trips caught scamp and yellowmouth grouper only incidentally, and some trips likely directed effort at scamp and yellowmouth grouper unsuccessfully. Given that direct information on species targeted is not available, effective effort must be inferred.

To determine which trips should be used to compute the index, the method of Stephens and MacCall (2004) was applied. The Stephens and MacCall method uses multiple logistic regression to estimate a probability for each trip that the focal species was caught, given other species caught on that trip. Species compositions differ across the south Atlantic; thus, the method was applied separately for two different regions: north (areas 2-10) and south (areas 11, 12, and 17) (Shertzer *et al.* 2009). To avoid rare species, the number of species in each analysis was limited to those species that occurred in 1% or more of trips. The most general model therefore included all species in the snapper-grouper complex which occurred in 1% or more of trips as main effects, excluding red porgy. Red porgy was removed because of regulations (closure followed by strict bag limits), which could erroneously remove trips likely to have caught scamp and yellowmouth grouper in recent years. A backward stepwise AIC procedure (Venables and Ripley 1997) was then used to perform further selection among possible species as predictor variables. In this procedure, a generalized linear model with Bernoulli response was used to relate presence/absence of scamp and yellowmouth grouper in headboat trips to presence/absence of other species.

Model Description

Response and explanatory variables

The response variable, catch per unit effort (CPUE), has units of fish/angler and was calculated as the number of scamp and yellowmouth grouper caught divided by the number of anglers. All explanatory (predictor) variables were modeled as categorical, rather than as continuous.

Years – 1981-2009

Area – Initially, the three areas include the Carolinas (CAR), Georgia and North Florida (to Cape Canveral, FL), South Florida (South of Cape Canaveral, FL) but due to low number of positive trips from south of Cape Canaveral, FL, the three areas chosen were North Carolina, (NCAR), South Carolina (SCAR) and Georgia-Florida (GAFL). These areas were defined due to shelf characteristics and associated fishing behavior as well as species compositions.

Season – A third of the months were dropped due to the spawning closure for the longer index, while retained for the truncated index. The patterns in the remaining positive scamp and yellowmouth grouper trips by month and region show few trips in the Carolinas for Nov and Dec. However, Nov and Dec have the most positive scamp and yellowmouth grouper trips for South Florida. The seasonal pattern in cpue across months seems consistent across areas with slightly higher values for Sep. - Dec. compared to May-Aug. Season was chosen as the explanatory variable.

Vessel Size– A factor was developed for the number of anglers using the quartiles of the number of anglers across all trips as breaks for the factors. Given the large range of vessel sizes, a trip with 20 anglers could be either almost full or almost empty. Here we develop a factor for vessel size and crowding separately using the number of anglers. The proxy for vessel size is the maximum anglers reported over all trips for a vessel. This was then divided into two factors based on visual inspection of the density plots into: 1. fewer than 60 maximum anglers 2. 60 or more maximum anglers.

Percent Full – The number of anglers reported for a trip was divided by the maximum number of anglers for a vessel to obtain an estimate of crowding. This was initially developed using quartiles but upon further inspection of the density plot the factor was then divided into 2 factors; 1. less than 50% full and 50% or more full.

Standardization

CPUE was modeled using the delta-glm approach (Lo *et al*. 1992; Dick 2004; Maunder and Punt 2004). In particular, fits of lognormal and gamma models were compared for positive CPUE. Also, the combination of predictor variables was examined to best explain CPUE patterns (both for positive CPUE and the Bernoulli submodels). All analyses were performed in the R programming language (R Development Core Team 2014), with much of the code adapted from Dick (2004).

Bernoulli submodel. One component of the delta-GLM is a logistic regression model that attempts to explain the probability of either catching or not catching scamp and yellowmouth grouper on a particular trip. First, a model was fit with all main effects to determine which effects should remain in the binomial component of the delta-GLM. Stepwise AIC (Venables and Ripley1997) with a backward selection algorithm was then used to eliminate those that did not improve model fit. In this case, the stepwise AIC procedure did not remove any predictor variables. No concerning patterns were apparent in the quantile residuals (Dunn and Smyth 1996).

Positive CPUE submodel. To determine predictor variables important for describing positive CPUE, the positive portion of the model was fitted with all main effects using both the lognormal and gamma distributions. Stepwise AIC (Venables and Ripley1997) with a backward selection algorithm was then used to eliminate those that did not improve model fit. In this case, no predictor variables were removed for either error term.

Both submodels (Bernoulli and either lognormal or gamma) were then combined, and the models were compared using AIC. In this case, the delta-lognormal distribution performed best and used in the final analysis. No concerning patterns were apparent in standard diagnostic plots of residuals.

5.4.1.2 Sampling Intensity

The resulting data set contained more than 26,000 trips across years with approximately 60% positive for scamp and yellowmouth grouper. Annual numbers of trips used to compute the index are shown in Table 5.5.

5.4.1.3 Size/Age data

The sizes/ages represented in this index should be the same as those of landings from the corresponding fleet (See section 4 of the DW report).

5.4.1.4 Catch Rates

Standardized catch rates and associated error bars are shown in Figure 5.5, and tabulated in Table 5.5. The units on catch rates were number of fish landed per angler.

5.4.1.5 Uncertainty and Measures of Precision

Measures of precision were computed using the bootstrap procedure. Annual CVs of catch rates are tabulated in Table 5.5.

5.4.1.6 Comments on Adequacy for Assessment

The index of abundance created from the headboat data was considered by the IWG to be adequate for use in the assessment. The data cover a wide geographic range relative to most of the stock, and logbooks are intended to represent a census of the headboats. The data set has an adequately large sample size and has a long enough time series to provide potentially meaningful information for the assessment. For the duration of the index, sampling was consistent over time, and some of the data were verified by port samplers and observers.

The primary caveat concerning this index was that it was derived from fishery dependent data. Headboat effort generally targets snapper-grouper species and not necessarily the focal species, which should minimize changes in catchability relative to fishery dependent indices that target more effectively. The headboat index was truncated in 2009 due to the potential effects of the management regulations on the adequacy of the index.

5.4.2 Commercial Handline Index

Landings and fishing effort of commercial vessels operating in the southeast U.S. Atlantic have been monitored by the NMFS Southeast Fisheries Science Center through the Coastal Fisheries Logbook Program (CFLP). The program collects information about each fishing trip from all vessels holding federal permits to fish in waters managed by the Gulf of Mexico and South Atlantic Fishery Management Councils. Initiated in the Gulf in 1990, the CFLP began collecting logbooks from Atlantic commercial fishers in 1992, when 20% of Florida vessels were targeted. Beginning in 1993, sampling in Florida was increased to require reports from all vessels permitted in coastal fisheries, and since then has maintained the objective of a complete census of federally permitted vessels in the southeast U.S.

Catch per unit effort (CPUE) from the logbooks was used to develop an index of abundance for scamp and yellowmouth grouper landed with vertical lines (manual handline and electric reel), the dominant gear for this scamp and yellowmouth grouper stock. The time series used for construction of the index spanned 1993−2009, when all vessels with federal snapper-grouper permits were required to submit logbooks on each fishing trip. Management regulations beginning in 2010 were a concern for those in the IWG discussion, specifically how these regulations may affect the subsetting method for identifying effective effort in the scamp fishery.

5.4.2.1 Methods of Estimation

Data Treatment

For each fishing trip, the CFLP database included a unique trip identifier, the landing date, fishing gear deployed, areas fished, number of days at sea, number of crew, gear-specific fishing effort, species caught, and weight of the landings. Fishing effort data available for vertical line gear included number of lines fished, hours fished, and number of hooks per line. For this southeast U.S. Atlantic stock, areas used in analysis were those between 24 and 37 degrees latitude, inclusive of the boundaries (Figure 5.6.

Data were restricted to include only those trips with landings and effort data reported within 45 days of the completion of the trip. Reporting delays beyond 45 days likely resulted in less reliable effort data (landings data may be reliable even with lengthy reporting delays if trip ticket reports were referenced by the reporting fisher). Also excluded were records reporting multiple gears fished, which prevents designating catch and effort to specific gears. Therefore, only those trips that reported one gear fished were included in the analyses. Where trips reported multiple areas, the first area reported was used in the analysis. Only the latitude from the area designated was used in the analysis assuming most trips with multiple areas fished were moving across the shelf rather than north and south.

Clear outliers (>99.5 percentile) in the data were also excluded from the analyses. These outliers were identified for all snapper/grouper trip manual handlines as records reporting more than 6 lines fished, 8 hooks per line fished, 10 days at sea, 5 crew members or 105 hours fished; outliers were identified for electric reels as records reporting more than 6 lines fished, 10 hooks per line fished, 12 days at sea, 5 crew members or 143 hours fished. Trips reporting fewer than 4 hours fished for both gears were removed. Positive scamp and yellowmouth grouper trips reporting greater than 24 pounds/hook-hr were excluded for both gears.

To determine which trips should be used to compute the index, the method of Stephens and MacCall (2004) was applied. The Stephens and MacCall method uses multiple logistic regression to estimate a probability for each trip that the focal species was caught, given other species caught on that trip. Species compositions differ across the south Atlantic; thus, the method was applied separately for areas north and south of Cape Canaveral, which has been identified as a zoogeographical boundary (Shertzer et al. 2009). Cape Canaveral falls in the middle of the one degree commercial sampling grid and was assigned to the south with the split at 29 degrees. To avoid rare species, the number of species in each analysis was limited to those species that occurred in 1% or more of trips. The most general model therefore included all species in the snapper-grouper complex which occurred in 1% or more of trips as main effects, excluding red porgy. Red porgy was removed because of regulations (closure followed by strict bag limits), which could erroneously remove trips likely to have caught scamp and yellowmouth grouper in recent years. A backward stepwise AIC procedure (Venables and Ripley 1997) was then used to perform further selection among possible species as predictor variables. In this procedure, a generalized linear model with Bernoulli response was used to relate presence/absence of scamp and yellowmouth grouper in commercial trips to presence/absence of other species. An alternative generalized linear model with Bernoulli response related the catch in pounds of other species to the presence/absence of scamp and yellowmouth grouper. Although the alternative method theoretically may be more efficient at identifying species associations, the IWG rejected the method due to concerns that the increase in trip limits in recent years may bias the results.

Model Description

Response and explanatory variables

The response variable, CPUE, was calculated for each trip as,

CPUE = pounds of scamp and yellowmouth grouper/hook-hour

where hook-hours is the product of number of lines fished, number of hooks per line, and total hours fished. Explanatory variables, all categorical, are described below.

The explanatory variables were year, season, latitude, crew size, and days at sea, each described below:

Years – Year was necessarily included, as standardized catch rates by year are the desired outcome. Years modeled were 1993–2009.

Season – Season included two levels: summer (May - August) and fall (September-December).

Lat – Areas reported in the logbook on a one degree grid. The majority of the positive trips and catch for commercial handline is in the Carolina. Initially, a regional split at Cape Canaveral was considered but due to the limited samples in the SF region the coast was divided into two areas split at 32 degrees Latitude near Savannah, GA..

Days at sea – Days at sea (sea days) were pooled into three levels: one day (one), two to four days (twotofour), and five or more days (fiveplus)

Crew size – Crew size (includes Captain) could influence the total effort during a trip and could be a psuedo-factor for vessel size. The quartile split values (at 25, 50, and 75%) for scamp and yellowmouth grouper crew size fall at 1, 2, and 3 plus crew per trip.

Standardization

CPUE was modeled using the delta-glm approach (Lo et al. 1992; Dick 2004; Maunder and Punt 2004). In particular, fits of lognormal and gamma models were compared for positive CPUE. Also, the combination of predictor variables was examined to best explain CPUE patterns (both for positive CPUE and the Bernoulli submodels). All analyses were performed in the R programming language (R Development Core Team 2014), with much of the code adapted from Dick (2004).

Bernoulli submodel. One component of the delta-GLM is a logistic regression model that attempts to explain the probability of either catching or not catching scamp and yellowmouth grouper on a particular trip. First, a model was fit with all main effects to determine which effects should remain in the binomial component of the delta-GLM. Stepwise AIC (Venables and Ripley1997) with a backward selection algorithm was then used to eliminate those that did not improve model fit. In this case, the stepwise AIC procedure did not remove any predictor variables. No concerning patterns were apparent in the quantile residuals (Dunn and Smyth 1996).

Positive CPUE submodel. To determine predictor variables important for describing positive CPUE, the positive portion of the model was fitted with all main effects using both the lognormal and gamma distributions. Stepwise AIC (Venables and Ripley1997) with a backward selection algorithm was then used to eliminate those that did not improve model fit. In this application, the lognormal distribution outperformed the gamma distribution, and was therefore used to compute the index.

Both submodels (Bernoulli and lognormal) were then combined into a single delta-lognormal model (1993-2009), with all predictor variables used for both submodels. No concerning patterns were apparent in standard diagnostic plots of residuals.

5.4.2.2 Sampling Intensity

Annual numbers of trips used to compute the index is typically greater than 1000, as shown in Table 5.7.

5.4.2.3 Size/Age data

The sizes/ages represented in this index should be the same as those of landings from the corresponding fleet (See section 3 of the DW report).

5.4.2.4 Catch Rates

Standardized catch rates and associated error bars are shown in Figure 5.7 and are tabulated in Table 5.7. The units on catch rates were pounds of fish landed per hook-hour.

5.4.2.5 Uncertainty and Measures of Precision

Estimates of variance were based on 1000 bootstrap runs where trips were chosen randomly with replacement (Efron and Tibshirani 1994). Annual CVs of catch rates are tabulated in Table 5.6.

5.4.2.6 Comments on Adequacy for Assessment

The index of abundance created from the commercial logbook data was considered by the IWG to be adequate for use in the assessment. The data cover a wide geographic range relative to that of the stock, and logbooks represent a census of the fleet. The data set has an adequately large sample size and has a long enough time series to provide potentially meaningful information for the assessment.

Several concerns were discussed by the IWG, all related to this index coming from fishery dependent data. First, commercial fishermen may target different species through time. If changes in targeting have occurred, effective effort can be difficult to estimate. However, the DW recognized that the method of Stephens and MacCall (2004), used here to identify trips for the analysis, can accommodate changes in targeting, as long as species assemblages are consistent. Second, the data are self-reported and largely unverified. Some attempts at verification have found the data to be reliable. Third and probably foremost, the data are obtained from a directed fishery and therefore the index could contain problems associated with any fishery dependent index. Fishing efficiency of the fleet has likely improved over time due to improved electronics. In addition, overall efficiency may have changed throughout the time series if fishermen of marginal skill have left the fishery at a greater rate than more successful fishermen. Also of concern is whether catch rates in a directed fishery are density-dependent. As fish abundance decreases, fishermen may maintain relatively high catch rates, and as fish abundance increases, catch rates may saturate. Due to increases in management regulations beginning in 2010, the index was truncated, 1993-2009.

5.5 OTHER DATA SOURCES CONSIDERED DURING THE DW

Several data sources were discussed during the pre-DW webinar for the potential to support indices of abundance, and some of these were discarded based on initial summaries of data. Three data sources were recommended during the webinar for further consideration, but were subsequently not recommended by the DW for use in the assessment: SCDNR charterboat logbooks, the South Atlantic ROV data and the MARMAP short bottom longline survey.Reasons for their exclusion are provided in Table 5.1. The nominal index for the SCDNR chartboat logbook was provided and compared to the other indices from the working group to help corroborate the other indices relative to South Carolina. The SCDNR charterboat nominal index is higher in the earlier years but tends to show a similar downward trend in the last 20-25 years.

5.6 CONSENSUS RECOMMENDATIONS AND SURVEY EVALUATIONS

The DW recommended two fishery independent indices(chevron trap and video) and two fishery dependent indices (headboat logbook and commercial handline logbook) for potential use in the scamp and yellowmouth grouper stock assessment. Pearson correlations and significance values (p-values) between indices are presented in Table 5.8. All recommended indices and their CVs are in Table 5.9, and the indices are compared graphically in Figure 5.8.

The IWG discussed relative ranking of the ability of each index to represent true population abundance. Based on these discussions, the indices recommended for the assessment were ranked as follows, with pros and cons of each listed in Table 5.2.

1. Chevron traps
2. Video
3. Headboat index
4. Commercial handline index

Note that these rankings were made during the DW and are based solely on *a priori* information about each index. Therefore, the rankings should be considered preliminary, as they do not benefit from viewing indices for consistency with other data sets (e.g., age comp data). The assessment panel, with all data in hand, will be in a better position to judge the indices for use in the assessment.

5.7 LITERATURE CITED

Conn, P. B. 2011. An Evaluation and Power Analysis of Fishery Independent Reef Fish Sampling in the Gulf of Mexico and U. S. South Atlantic. NOAA Tech. Memorandum NMFS-SEFSC-610.

Dick, E.J. 2004. Beyond 'lognormal versus gamma': discrimination among error distributions for generalized linear models. Fish. Res. 70:351−366.

Dunn, K. P. and G.K. Smyth. 1996. Randomized quantile residuals. J. Comp. Graph. Stat. 5:1−10.

Efron, B. and R. J. Tibshirani. 1994. Modern An Introduction to the bootstrap. Chapnam & Hall/CRC, Boca Raton, FL.

Jackman S. 2008. *pscl*: Classes and Methods for R Developed in the Political Science Computational Laboratory, Stanford University. Department of Political Science, Stanford University. Stanford, California. R package version 1.04.1. https://pscl.stanford.edu/.

Langlois, T.J., Newman, S.J., Cappo, M., Harvey, E.S., Rome, B.M., Skepper, C.L., Wakefield, C.B. 2015. Length selectivity of commercial fish traps assessed from in situ comparisons with stereo-video: Is there evidence of sampling bias?. Fish. Res. 161:145−155.

Lo, N.C., Jacobson, L.D., Squire, J.L. 1992. Indices of relative abundance from fish spotter data based on delta-lognormal models. Can. J. Fish. Aquat. Sci. 49:2515−2526.

Maunder, M.N., Punt, A.E. 2004. Standardizing catch and effort data: a review of recent approaches. Fish. Res. 70:141−159.

Schobernd, Z. H., N. M. Bacheler, and P. B. Conn. 2014. Examining the Utility of Alternative

Video Monitoring Metrics for Indexing Reef Fish Abundance. CJFAS. 71:464-471.

Shertzer, K.W., E.H. Williams, and J.C. Taylor. 2009. Spatial structure and temporal patterns in a large marine ecosystem: Exploited reef fishes of the southeast United States. Fish. Res. 100:126−133.

Stephens, A. and A. MacCall. 2004. A multispecies approach to subsetting logbook data for purposes of estimating CPUE. Fish. Res. 70:299−310.

Venables, W.N. and B.D. Ripley. 1997. Modern Applied Statistics with S-Plus, 2nd Edition. Springer-Verlag, New York.

R Development Core Team (2014). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org

Zeileis A., C. Kleiber, and S. Jackman. 2008. Regression modesl for count data in R. Journal of Statistical Software 27(8). http://www.jstatsoft.org/v27/i08/.

Zuur, A.F., E.N. Ieno, N.J. Walker, A.A. Saveliev, and G.M. Smith. 2009. Mixed Effects Models and Extensions in Ecology with R. Springer, New York.

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	NC-FL	1981-2009	N kept/ angler*hour	Delta-GLM	Fishery dependent, self reported	Yes
Recreational	Headboat-at-sea-observer	NC-FL	2005-2018	N caught ≤20”/ angler		Low sample size.	No
Recreational	SCDNR charterboat logbook	SC	1993-2018	N caught/ angler-hr	Nominal	Limited geographic coverage; low sample size (1% proportion positive), Serves as additional corroborative evidence to support the other indices.	No
Commercial	Commercial logbook handline	NC-FL	1993-2009	lb kept/ hook-hour	Delta-GLM	Fishery dependent, self reported	Yes
Independent	SERFS: chevron trap	NC-FL	1990-2018	N caught	Zero inflated negative binomial	Expanded spatial coverage through time	Yes
Independent	SERFS: video survey	NC-FL	2010-2018	N observed	Zero inflated negative binomial	Ages/sizes unknown	Yes
Independent	ROV South Atlantic					Few samples, imperfect survey design around MPA, not suitable for a standardized index, individuals possibly being double counted	No
Independent	MARMAP: blackfish trap	Mostly SC	1981-1987			Few samples	No
Independent	MARMAP: Florida trap	Mostly SC	1981-1987			Few samples	No
Independent	MARMAP: Short-bottom longline	Mostly SC	1993-2018			Few samples, missing year, limited spatial coverage, few trips and fish. Serves as additional corroborative evidence to support the other indices.	No

Table 5.2. Table of the pros and cons for each data set considered at the data workshop. Note that several data sources were considered (Table 5.1), but discarded, prior to the DW.

<u>Fishery independent index</u>

SERFS Chevron Trap Index (*Recommended for use*)

Pros:

- Fishery independent random hard bottom survey
- Adequate regional coverage
- Standardized sampling techniques
- All fish caught are aged and measured

Cons:

- Change in spatial coverage since 2008

SERFS Video Index (*Recommended for use*)

Pros:

- Fishery independent random hard bottom survey
- Adequate regional coverage
- Standardized sampling techniques
- Relatively high detection probabilities
- Likely to be less selective than capture gears

Cons:

- Change in spatial coverage in early years
- Ages/sizes observed are unknown

MARMAP/SEAMAP-SA Short Bottom Longline Index (*Not recommended for use*)

Pros:

- Fishery independent random hard bottom survey
- Standardized sampling techniques
- All fish caught are aged and measured

Cons:

- Limited regional coverage
- Small sample size
- Gaps in the time series

<u>Fishery dependent indices</u>

Recreational Headboat (*Recommended for use*)

Pros:

- Complete census
- Covers the entire management area
- Some data are verified by port samplers and observers
- Large sample size
- Strongly correlated with headboat at-sea-observer index
- Generally non-targeted for focal species, which should minimize changes in catchability relative to fishery dependent indices that target specific species

Cons:

- Fishery dependent (i.e., potentially affected by regulations, targeting, hyperdepletion, hyperstability)
- Little information on discard rates, particularly before mid-2000s
- Catchability may vary over time or with abundance
- Effective effort is difficult to identify

Commercial Logbook – Handline (*Recommended for use*)

Pros:

- Complete census
- Covers the entire management area
- Large sample size

Cons:

- Fishery dependent (i.e., potentially affected by regulations, targeting, hyperdepletion, hyperstability)
- Data are self-reported and largely unverified
- Catchability may vary over time or with abundance
- Landings could be cross-referenced with other data sources, but effective effort difficult to identify
- No information on discard rates
- Potential shifts in species targeted; commercial fishermen more skillful than general recreational fishermen at targeting focal species

SCDNR Charterboat *(Not recommended for use)*

Pros:

- Census

Cons:

- Fishery dependent (i.e., potentially affected by regulations, targeting, hyperdepletion, hyperstability)

- South Carolina only, limited geographic coverage relative to south Atlantic
- Low proportion of positive scamp and yellowmouth trips (1%)
- No field validation

Table 5.3 The number of trapping events (N), standardized index, and CV for the scamp and yellowmouth grouper index computed from SERFS chevron traps.

					Nominal CPUE	ZINB Standardized CPUE	
Year	Included Collections	Positive Collections	Proportion Positive	Total Fish	Normalized	Normalized	CV
1990	313	32	0.1	63	1.34	1.33	0.17
1991	272	30	0.11	48	1.18	1.17	0.17
1992	288	29	0.1	49	1.13	1.42	0.19
1993	392	41	0.1	72	1.22	1.53	0.17
1994	387	71	0.18	127	2.19	1.41	0.12
1995	361	52	0.14	117	2.16	2.1	0.14
1996	361	41	0.11	69	1.27	1.35	0.16
1997	406	69	0.17	162	2.66	2.1	0.12
1998	426	51	0.12	120	1.88	1.87	0.15
1999	233	25	0.11	49	1.4	1.24	0.22
2000	298	43	0.14	60	1.34	1.2	0.16
2001	245	35	0.14	60	1.63	1.16	0.17
2002	244	25	0.1	37	1.01	1	0.22
2003	224	24	0.11	41	1.22	1.63	0.22
2004	282	36	0.13	54	1.28	1.64	0.19
2005	303	33	0.11	61	1.34	1.23	0.17
2006	297	10	0.03	15	0.34	0.36	0.34
2007	337	40	0.12	61	1.21	0.96	0.16
2008	303	10	0.03	13	0.29	0.28	0.33
2009	404	12	0.03	17	0.28	0.35	0.32
2010	725	31	0.04	47	0.43	0.74	0.2
2011	726	27	0.04	30	0.28	0.37	0.2
2012	1,174	42	0.04	58	0.33	0.55	0.18
2013	1,360	49	0.04	55	0.27	0.4	0.15
2014	1,472	53	0.04	72	0.33	0.38	0.18
2015	1,463	55	0.04	70	0.32	0.41	0.15
2016	1,484	41	0.03	51	0.23	0.22	0.16
2017	1,541	58	0.04	72	0.31	0.38	0.14
2018	1,736	29	0.02	39	0.15	0.19	0.2
Totals	18,057	1,094	0.06	1,789			

Table 5.4 The nominal index (*SumCount*), number of trapping events (N), proportion positive, standardized index, and CV for the scamp and yellowmouth grouper index computed from the SERFS video survey.

Year	Relative nominal (*SumCount*)	N	Proportion positive	Standardized index	CV
2011	1.124	586	0.157	1.424	0.15
2012	0.752	1076	0.096	1.156	0.14
2013	1.110	1221	0.091	1.165	0.14
2014	0.820	1381	0.154	1.137	0.11
2015	1.322	1394	0.134	0.978	0.12
2016	1.222	1393	0.150	0.948	0.11
2017	1.057	1333	0.124	0.743	0.12
2018	0.594	1318	0.081	0.450	0.16

Table 5.5 The number of trips (N), nominal CPUE, relative nominal CPUE, standardized index, and CV for scamp and yellowmouth grouper from headboat logbook data, 1976-2009.

Year	N	Proportion Positive	Nominal CPUE	Relative nominal	Standardized CPUE	CV
1981	706	0.44	0.00	0.22	0.55	0.07
1982	1031	0.53	0.01	0.42	0.64	0.06
1983	1118	0.53	0.01	0.37	0.55	0.05
1984	970	0.53	0.01	0.38	0.58	0.06
1985	1009	0.56	0.01	0.55	0.74	0.05
1986	943	0.56	0.01	0.50	0.68	0.05
1987	1098	0.58	0.01	0.68	0.86	0.04
1988	1193	0.57	0.01	0.63	0.78	0.05
1989	614	0.54	0.02	0.74	0.79	0.07
1990	695	0.68	0.02	1.10	1.23	0.05
1991	760	0.71	0.03	1.30	1.29	0.07
1992	850	0.66	0.02	1.14	0.95	0.06
1993	895	0.66	0.02	0.94	0.77	0.06
1994	962	0.64	0.02	1.00	0.95	0.05
1995	1044	0.62	0.03	1.18	1.16	0.06
1996	931	0.64	0.02	0.82	0.85	0.05
1997	1070	0.72	0.03	1.31	1.30	0.05
1998	1172	0.64	0.03	1.29	1.36	0.04
1999	1092	0.68	0.03	1.46	1.61	0.04
2000	1039	0.67	0.03	1.59	1.38	0.05
2001	927	0.60	0.03	1.24	1.09	0.05
2002	828	0.64	0.03	1.53	1.25	0.05
2003	631	0.63	0.03	1.53	1.35	0.06
2004	846	0.59	0.03	1.37	1.33	0.05
2005	826	0.57	0.02	1.14	1.20	0.05
2006	662	0.64	0.03	1.51	1.19	0.06
2007	884	0.60	0.03	1.56	1.29	0.05
2008	688	0.52	0.02	0.89	0.76	0.07
2009	714	0.50	0.01	0.65	0.53	0.06

Table 5.7. The number of trips (N), proportion positive, relative nominal CPUE, standardized index, and CV for scamp and yellowmouth grouper from commercial logbook data (handlines).

Year	N	Nominal CPUE	Relative nominal	Standardized CPUE	Proportion Positive	CV
1993	1323	0.35	0.89	0.90	0.75	0.04
1994	1504	0.32	0.80	0.78	0.75	0.04
1995	1902	0.36	0.91	0.96	0.77	0.03
1996	1719	0.33	0.84	0.87	0.77	0.03
1997	1821	0.37	0.93	0.94	0.76	0.03
1998	1641	0.38	0.95	0.96	0.72	0.04
1999	1615	0.43	1.09	1.12	0.69	0.04
2000	1508	0.45	1.14	1.17	0.77	0.03
2001	1657	0.37	0.94	0.94	0.77	0.03
2002	1765	0.38	0.97	0.94	0.76	0.03
2003	1381	0.44	1.11	1.08	0.78	0.04
2004	1299	0.39	0.98	0.92	0.79	0.04
2005	1347	0.44	1.11	1.09	0.78	0.04
2006	1298	0.49	1.24	1.28	0.81	0.04
2007	1586	0.46	1.17	1.22	0.77	0.03
2008	1606	0.39	1.00	0.96	0.78	0.04
2009	1349	0.36	0.92	0.87	0.78	0.04

Table 5.8. Pearson correlation values for indices recommended for use. P-values (in parentheses) represent the probability of obtaining the Pearson value under the null hypothesis of correlation=0. Trap= SERFS trap, CVT=chevron traps, HB=headboats, and Comm=commercial handline.

	HB	cHL	Trap	Video
HB	1			
cHL	0.66	1		
Trap	0.54	0.20	1	
Video	0.59	0.59	0.35	1

Table 5.9. Scamp and yellowmouth grouper standardized indices of abundance and annual CVs recommended for potential use in the stock assessment. CVT=chevron traps, HB=headboats, and Comm=commercial handline. Each index is scaled to its mean.

	Standardized indices				**CVs**			
Year	HB	CVT	Video	Comm	HB	CVT	Video	Comm
1981	0.55				0.07			
1982	0.64				0.06			
1983	0.55				0.05			
1984	0.58				0.06			
1985	0.74				0.05			
1986	0.68				0.05			
1987	0.86				0.04			
1988	0.78				0.05			
1989	0.79				0.07			
1990	1.23	1.34			0.05	0.17		
1991	1.29	1.18			0.07	0.17		
1992	0.95	1.13			0.06	0.19		
1993	0.77	1.22		0.90	0.06	0.17		0.04
1994	0.95	2.19		0.78	0.05	0.12		0.04
1995	1.16	2.16		0.96	0.06	0.14		0.03
1996	0.85	1.27		0.87	0.05	0.16		0.03
1997	1.30	2.66		0.94	0.05	0.12		0.03
1998	1.36	1.88		0.96	0.04	0.15		0.04
1999	1.61	1.40		1.12	0.04	0.22		0.04
2000	1.38	1.34		1.17	0.05	0.16		0.03
2001	1.09	1.63		0.94	0.05	0.17		0.03
2002	1.25	1.01		0.94	0.05	0.22		0.03
2003	1.35	1.22		1.08	0.06	0.22		0.04
2004	1.33	1.28		0.92	0.05	0.19		0.04
2005	1.20	1.34		1.09	0.05	0.17		0.04
2006	1.19	0.34		1.28	0.06	0.34		0.04
2007	1.29	1.21		1.22	0.05	0.16		0.03
2008	0.76	0.29		0.96	0.07	0.33		0.04
2009	0.53	0.28		0.87	0.06	0.32		0.04
2010		0.43				0.20		
2011		0.28	1.42			0.20	0.15	
2012		0.33	1.16			0.18	0.14	
2013		0.27	1.17			0.15	0.14	
2014		0.33	1.14			0.18	0.11	
2015		0.32	0.98			0.15	0.12	
2016		0.23	0.95			0.16	0.11	
2017		0.31	0.74			0.14	0.12	
2018		0.15	0.45			0.20	0.16	

5.9 FIGURES

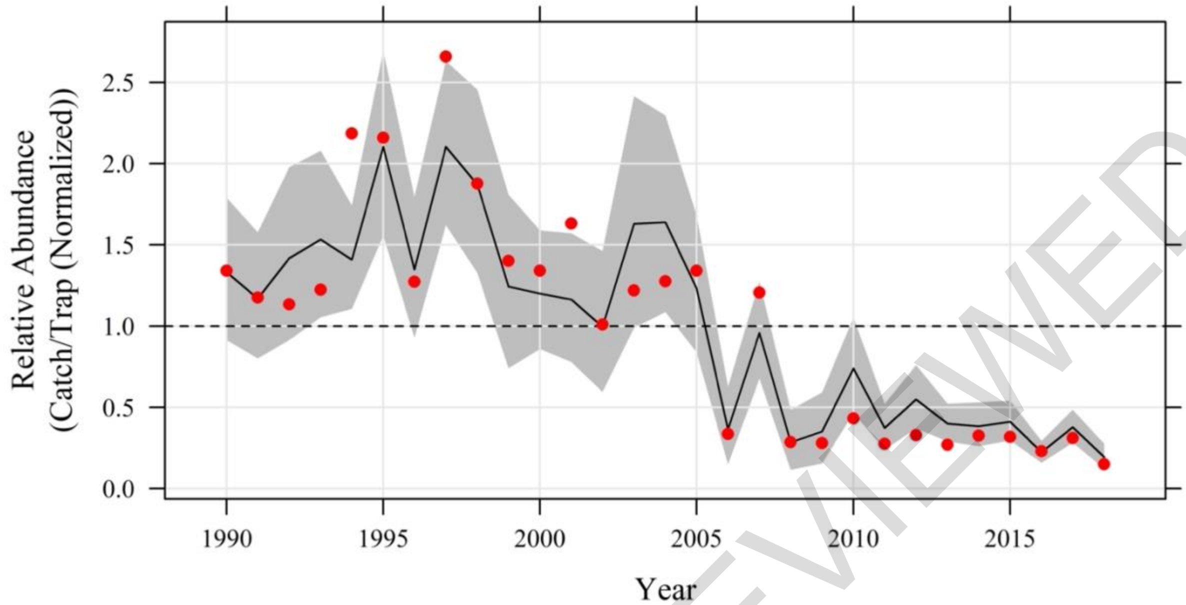


Figure 5.1. The nominal (red dots) and standardized index (solid black line) for scamp and yellowmouth grouper computed from SERFS chevron traps. Gray shaded area represents 95% confidence interval as estimated from 10,000 bootstraps.

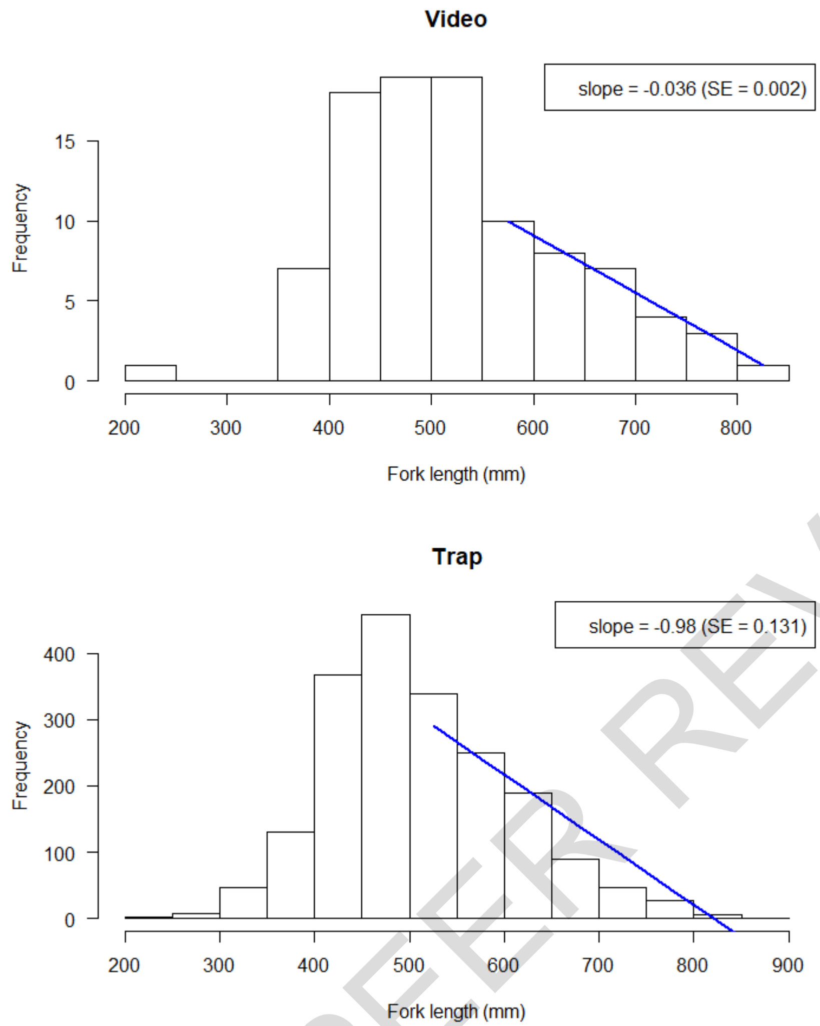


Figure 5.2. Comparison of lengths of scamp and yellowmouth grouper from SERFS chevron traps and SERFS video sampling gear in the South Atlantic.

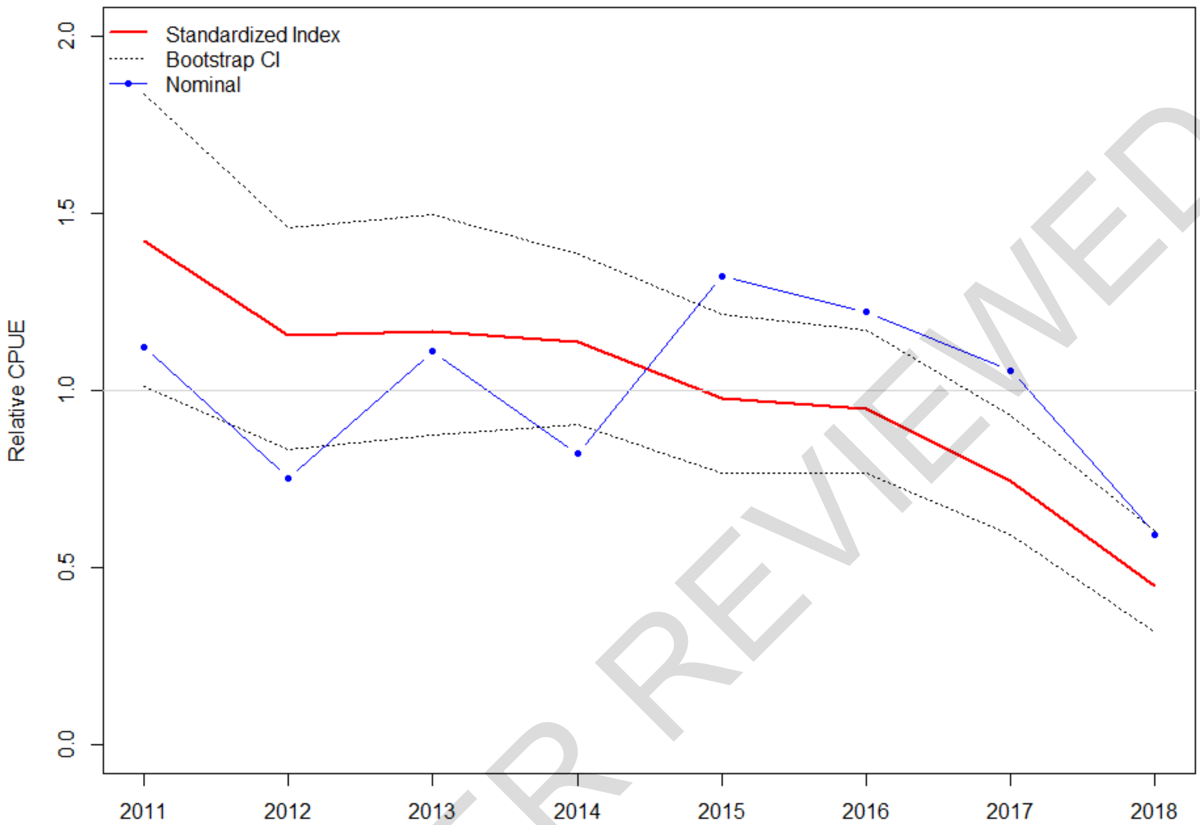


Figure 5.3. The nominal and standardized index for scamp and yellowmouth grouper computed from the SERFS video survey.

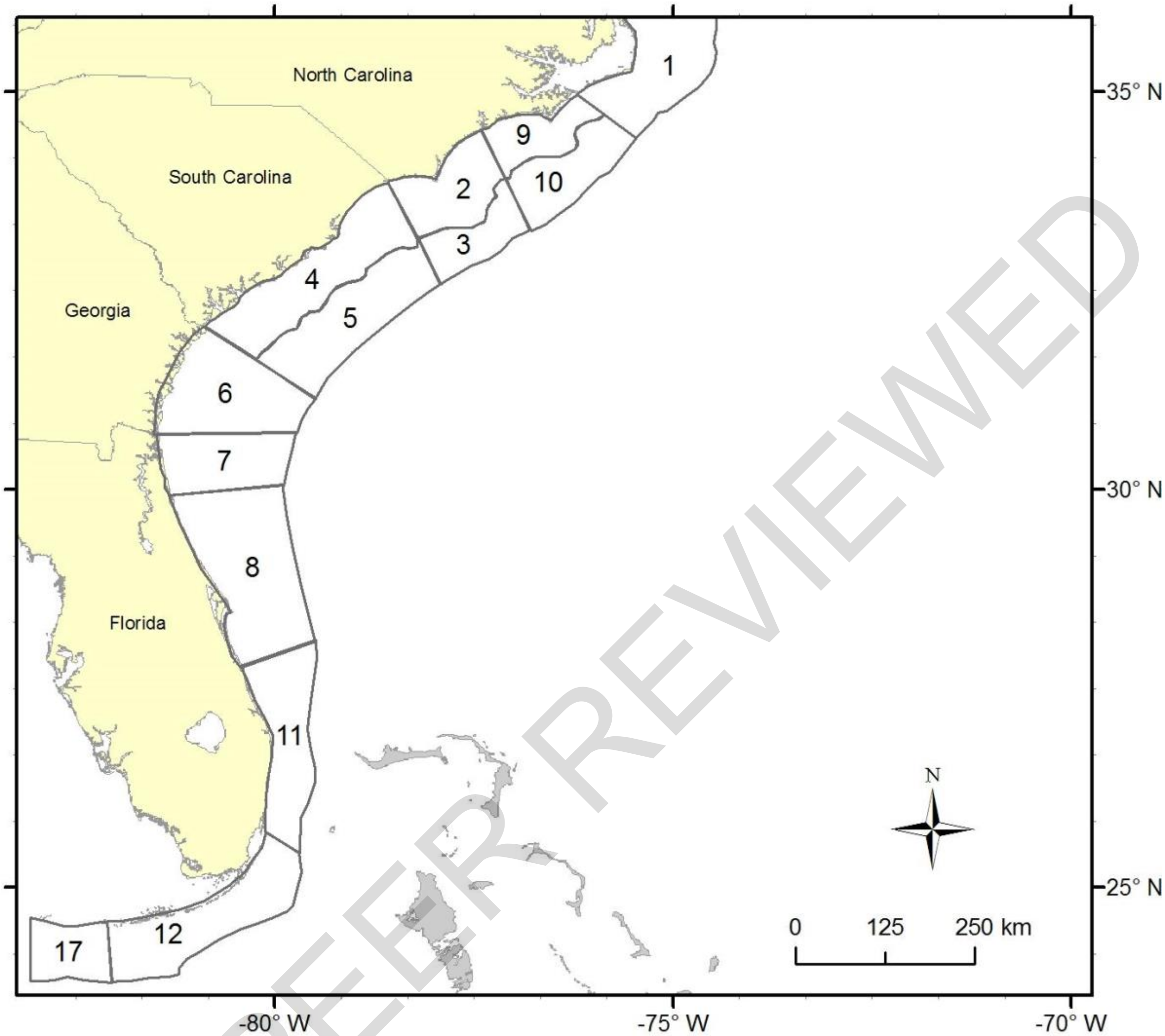


Figure 5.4. Map of headboat sampling area definitions. For analysis, areas were pooled as described in the text.

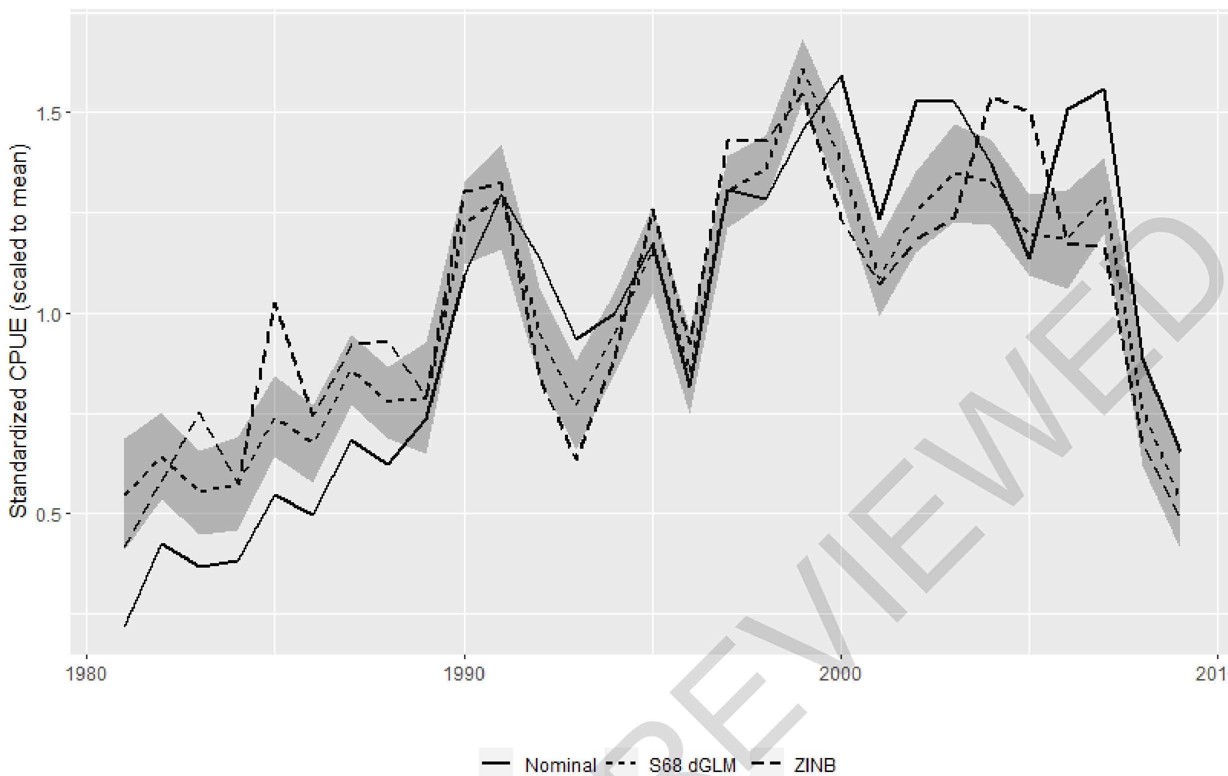


Figure 5.5. The nominal and standardized index for scamp and yellowmouth grouper computed from headboat data, 1981-2009. Shaded region represent approximate 95% confidence intervals.

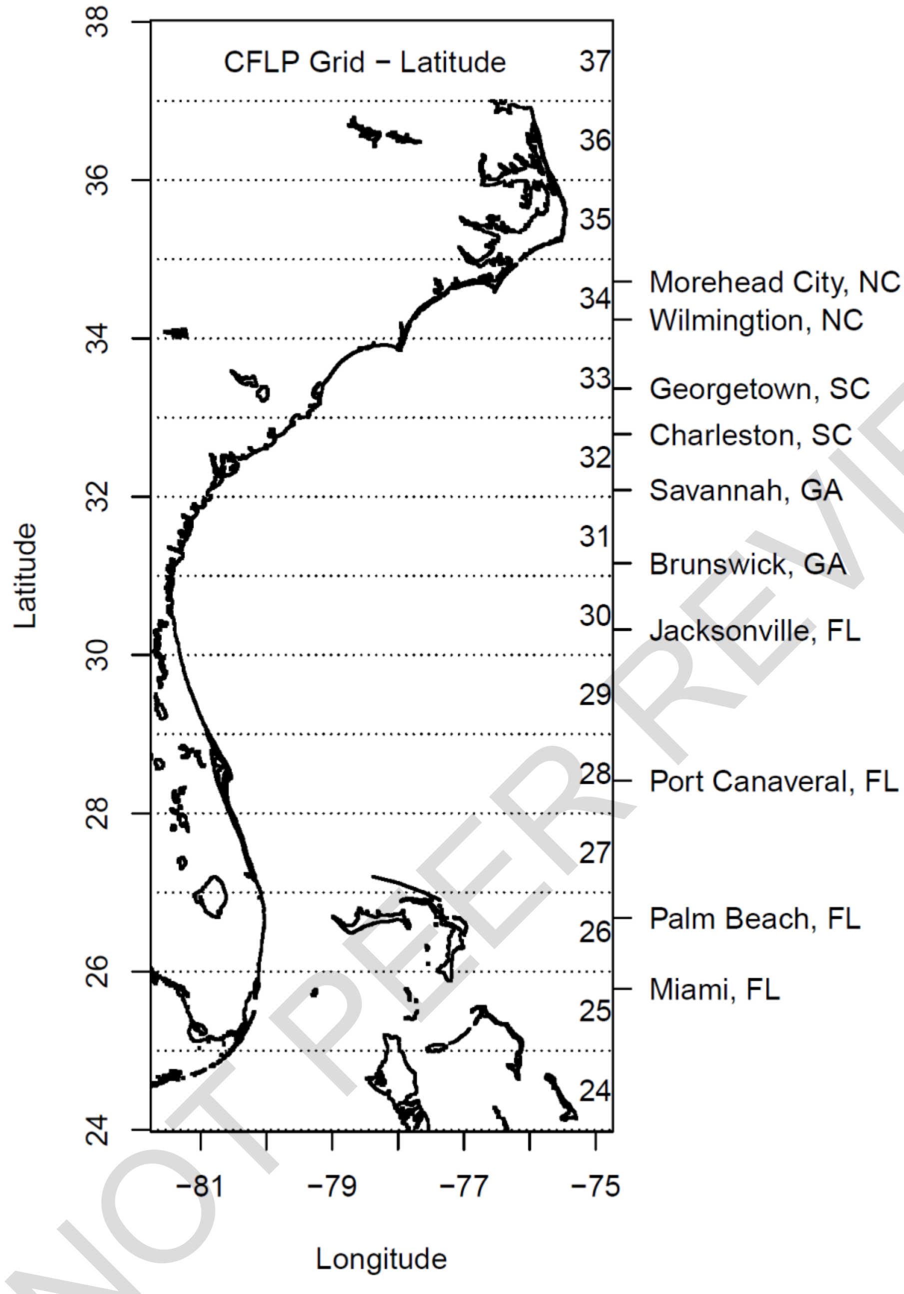


Figure 5.6. Latitude reported in the Coastal Fisheries Logbook Program (CFLP, commercial logbooks). Area is recorded in degrees where the first two digits signify degrees latitude, second two degrees longitude. Only latitude was used in this analysis.

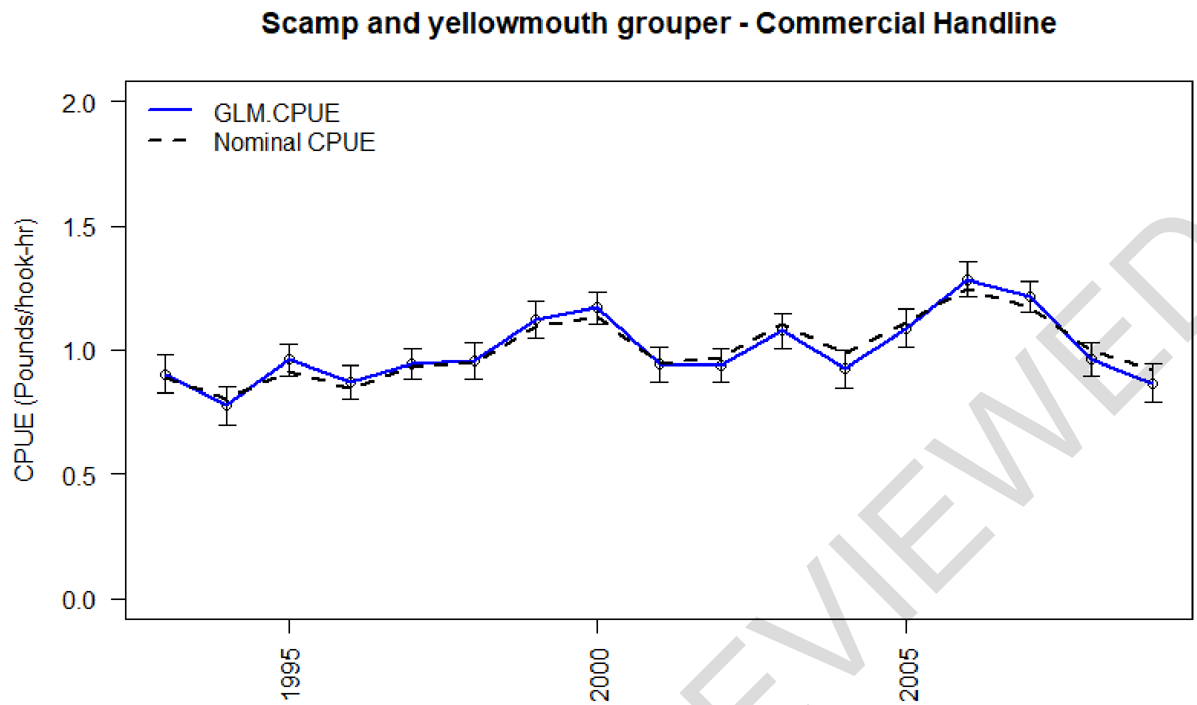


Figure 5.7. The nominal and standardized index for scamp and yellowmouth grouper computed from commercial logbook handline data, 1993–2009. Error bars represent approximate 95% confidence intervals.

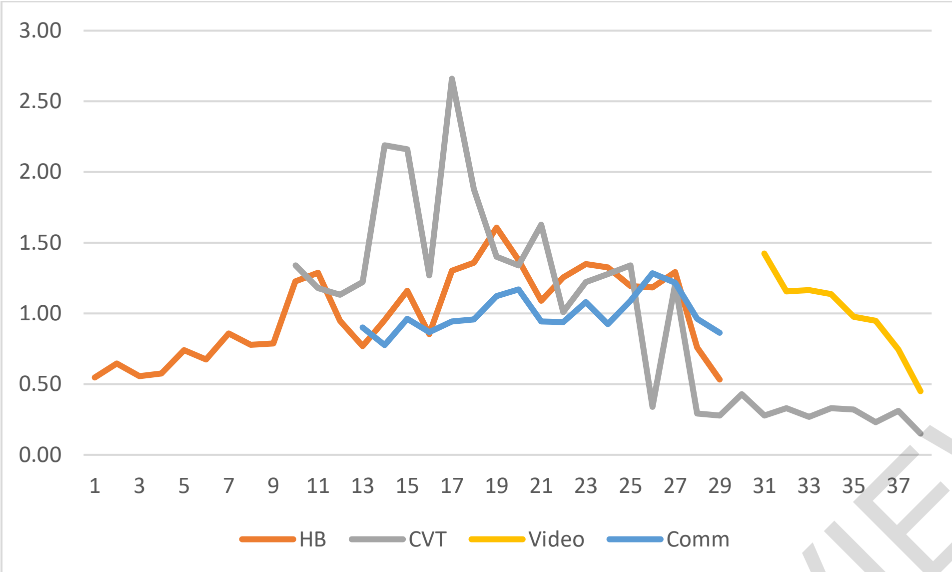


Figure 5.8. All indices (scaled to their respective means) recommended for potential use in the scamp and yellowmouth grouper stock assessment. CVT=Chevron traps, and HB=Headboat,

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.

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:

- 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

Atkinson, Sarina F. 2020. Commercial Discard Length Composition for South Atlantic Scamp and Yellowmouth Grouper. SEDAR68-DW-16. SEDAR, North Charleston, SC. 8 pp.

Atkinson, Sarina F. 2020. Commercial Discard Length Composition for Gulf of Mexico Scamp and Yellowmouth Grouper. SEDAR68-DW-17. SEDAR, North Charleston, SC. 14 pp.

Byrd, Julia. 2020. Summary of the SAFMC Scamp Release Citizen Science Pilot Project for SEDAR 68. SEDAR68-DW-24. SEDAR, North Charleston, SC. 5 pp.

Collier, Chip. 2020. Voluntary reports of Scamp caught by private recreational anglers in MyFishCount for SEDAR 68. SEDAR68-DW-26. SEDAR, North Charleston, SC. 3 pp.

Lazarre, Dominique, Chris Wilson, Kelly Fitzpatrick. 2020. Scamp Length Frequency Distributions from At-Sea Headboat Surveys in the South Atlantic, 2005 to 2017. SEDAR68- DW-23. SEDAR, North Charleston, SC. 11 pp.

Lazarre, Dominique. 2020. 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. SEDAR68-DW-24. SEDAR, North Charleston, SC. 20 pp.

Neidig, Carole, L., Daniel Roberts, Max Lee, Ryan Schloesser. 2020. 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. SEDAR68-DW-22. SEDAR, North Charleston, SC. 15 pp.

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.

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%*