Gulf of Mexico and Atlantic Scamp Stock ID Process Final Report

Stock ID Panel

SEDAR68-SID-05

31 March 2020

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SEDAR

Southeast Data, Assessment, and Review

SEDAR 68

Gulf of Mexico and Atlantic Scamp Stock ID Process Final Report

March 2020

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

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1. INTRODUCTION

1.1 *WORKSHOP TIME AND PLACE*

The SEDAR 68 Scamp Stock ID Process was conducted via a series of webinars, including a data scoping webinar (6/19/2019) and two webinars to discuss data analysis (8/17/2019, 9/10/2019).

1.2 *TERMS OF REFERENCE*

Process Goal: Review scamp stock structure and unit stock definitions and consider whether changes are required.

1. Review relevant information on stock structure. Potential sources include genetic studies, growth patterns, movement and migration, existing stock definitions, otolith chemistry, oceanographic and habitat characteristics, and hotspot maps of landings or CPUE.
    a. Evaluate data sources to elucidate possible misidentifications of yellowmouth grouper with scamp.

2. Make recommendations on biological stock structure and the assessment unit stock or stocks to be addressed through SEDAR 68 and document the rationale behind the recommendations. The default boundaries for assessments should be the current Council boundaries, unless there is reasonable evidence for deviation. If a deviation from the

status quo is recommended, an accompanying recommendation on spatial considerations for management should also be provided.

3. Discuss the strength of evidence in support of stock ID recommendations with particular attention paid to recommendations if they result in a mismatch of biological stock structure, assessment unit stock, and existing management boundaries.

4. Provide recommendations for future research on stock structure.

5. Prepare a report providing complete documentation of workshop recommendations and decisions.

1.3 *LIST OF PARTICIPANTS*

Dustin Addis ..... FL FWC, St. Petersburg
Joey Ballenger ..... SCDNR
Andrea Bernard ..... NSU
Ken Brennan ..... SEFSC Beaufort
Roger Brothers ..... SEFSC Beaufort
Steve Cadrin ..... UMASS Dartmouth
Matt Campbell ..... SEFSC Pascagoula
Drew Cathey ..... NCDMF
Tanya Darden (Genetics Working Group Lead) ..... SCDNR
Kelly Fitzpatrick ..... SEFSC Beaufort
Rachel Germeroth ..... FL FWCC
Dawn Glasgow ..... SCDNR
Doug Gregory ..... GMFMC SSC
Linda Lombardi (Life History Working Group Lead) ..... SEFSC Panama City
John Mareska ..... GMFMC SSC
Vivian Matter ..... SEFSC Miami
Matthew Nuttall ..... SEFSC Miami
Andy Ostrowski ..... SEFSC Beaufort
Refik Orhun ..... SEFSC Miami
Dave Portnoy ..... TAMU CC
Jennifer Potts ..... SEFSC Beaufort
Skyler Sagarese (Lead Analyst) ..... NMFS Miami
George Sedberry ..... SAFMC SSC
McLean Seward ..... NCDMF
Kyle Shertzer (Lead Analyst) ..... NMFS Beaufort
Ted Switzer ..... FL FWCC
Kevin Thompson ..... FL FWCC
Jim Tolan ..... GMFMC SSC
Elizabeth Wallace ..... FL FWCC
Chris Wilson ..... NCDMF
Beth Wrege (Spatial Movements and Landings Working Group Lead) ..... SEFSC Miami

Council Representation
Tim Griner ..... SAFMC

Appointed Observers
Jimmy Hull..... SAFMC AP

Attendees
Alisha Gray DiLeone ..... NOAA
Kate Siegfried ..... SEFSC Beaufort
Matt Walker ..... SCDNR

Staff
Julie Neer ..... SEDAR
Kathleen Howington ..... SEDAR
Julia Byrd ..... SAFMC Staff
Mike Errigo ..... SAFMC Staff
Jeff Pulver ..... SERO
Ryan Rindone..... GMFMC Staff

1.4 *LIST OF STOCK ID PROCESS WORKSHOP WORKING PAPERS AND DOCUMENTS*

Document #	Title	Authors	Date Submitted
Documents Prepared for the Stock ID Process			
SEDAR68-SID-01	Brief Summary of FWRI-FDM Tag-Recapture Program	Rachel Germeroth	8 April 2019 Updated: 3 September 2019
SEDAR68-SID-02	Larval dispersal of scamp (*Mycteroperca phenax*) in the waters off the southeastern United States: Connectivity within and between the Gulf of Mexico and Atlantic Ocean	J. R. Brothers, M. Karnauskas, C.B. Paris, and K.W. Shertzer	28 September 2019
SEDAR68-SID-03	Preliminary Genetic Stock Assessment of Scamp	Elizabeth Wallace	26 July 2019

	(Mycteroperca phenax) in Florida Waters		Updated: 20 September 2019
SEDAR68-SID-04	Population Genetic Analyses of Scamp	Darden, T. and M. Walker	26 July 2019 Updated: 22 August 2019
SEDAR68-SID-05	Scamp Stock ID Process Final Report	Stock ID Panel	

Reference Documents		
SEDAR68-RD01	A retrospective (1979-1996) multispecies assessment of coral reef fish stocks in the Florida Keys	Ault et al. 1997
SEDAR68-RD02	Spawning Locations for Atlantic Reef Fishes off the Southeastern U.S.	Sedberry et al. 2006
SEDAR68-RD03	Site Fidelity and Movement of Reef Fishes Tagged at Unreported Artificial Reef Sites off NW Florida	Addis et al. 2007
SEDAR68-RD04	Implications of reef fish movement from unreported artificial reef sites in the northern Gulf of Mexico	Addis et al. 2013
SEDAR68-RD05	Comparison of scamp grouper (*Mycteroperca phenax*), growth off of the West Florida shelf and the coast of Louisiana	Bates 2008
SEDAR68-RD06	Aspects Of The Life History Of The Yellowmouth Grouper, *Mycteroperca interstitialis*, In The Eastern Gulf Of Mexico	Bullock and Murphy, 1994
SEDAR68-RD07	Memoirs of the Hourglass Cruises: Seabasses (Pisces: Serranidae)	Bullock and Smith, 1991

SEDAR68-RD08	Groupers on the Edge: Shelf Spawning Habitat in and Around Marine Reserves of the Northeastern Gulf of Mexico	Coleman et al. 2014
SEDAR68-RD09	Decadal fluctuations in life history parameters of scamp (*Mycteroperca phenax*) collected by commercial hand-line vessels from the west coast of Florida	Lombardi-Carlson et al.
SEDAR68-RD10	A Description of Age, Growth, and Reproductive Life History Traits of Scamps from the Northern Gulf of Mexico	Lombardi-Carlson et al. 2012
SEDAR68-RD11	Incorporating Mortality from Catch and Release into Yield-per-Recruit Analyses of Minimum-Size Limits	Waters and Huntsman 1986
SEDAR68-RD12	Population genetic analysis of red grouper, *Epinephelus morio*, and scamp, *Mycteroperca phenax*, from the southeastern U.S. Atlantic and Gulf of Mexico	Zatcoff et al. 2004
SEDAR68-RD13	Population Assessment of the Scamp, *Mycteroperca phenax*, from the Southeastern United States	Mancooch et al. 1998
SEDAR68-RD14	A Preliminary Assessment of the Populations of Seven Species of Grouper (Serranidae, Epinephelinae) in the Western Atlantic Ocean from Cape Hatteras, North Carolina to the Dry Tortugas, Florida	Huntsman et al.
SEDAR68-RD15	Color Variation And Associated Behavior In The Epinepheline Groupers, *Mycteroperca microlepis* (Goode And Bean) And *M. Phenax* Jordan And Swain	Gilmore and Jones 1992
SEDAR68-RD16	Age, Growth, and Reproduction of Scamp, *Mycteroperca phenax*, in the Southwestern North Atlantic, 1979 –	Harris et al. 2002

	1997	
SEDAR68-RD17	Age, Growth, Mortality, Food and Reproduction of the Scamp, *Mycteroperca phenax*, Collected off North Carolina and South Carolina	Matheson et al. 1986
SEDAR68-RD18	Tagging Studies and Diver Observations of Fish Populations on Live-Bottom Reefs of the U.S. Southeastern Coast	Parker 1990
SEDAR68-RD19	Age and growth of the yellowedge grouper, *Epinephelus flavolimbatus*, and the yellowmouth grouper, *Mycteroperca interstitialis*, off Trinidad and Tobago	Manickchand-Heileman and Phillip 2000
SEDAR68-RD20	Multi-decadal decline in reef fish abundance and species richness in the southeast USA assessed by standardized trap catches	Bachelor and Smart 2016
SEDAR68-RD21	Aspects Of The Life History Of The Yellowmouth Grouper, *Mycteroperca interstitialis*, In The Eastern Gulf Of Mexico	Bullock and Murphy 1994
SEDAR68-RD22	Age, Growth, and Mortality of Yellowmouth Grouper from the Southeastern United States	Burton et al. 2014
SEDAR68-RD23	South Carolina Marine Game Fish Tagging Program 1978 -2009	Robert K. Wiggers
SEDAR68-RD24	Decadal-scale decline of scamp (Mycteroperca phenax) abundance along the southeast United States Atlantic coast	Nathan M. Bacheler and Joseph C. Ballenger
SEDAR68-RD25	Timing and locations of reef fish spawning off the southeastern United States	Nicholas A. Farmer, William D. Heyman, Mandy Karnauskas, Shinichi Kobara, Tracey I. Smart, Joseph C. Ballenger, Marcel J. M.

		Reichert, David M. Wyanski, Michelle S. Tishler, Kenyon C. Lindeman, Susan K. Lowerre-Barbieri, Theodore S. Switzer, Justin J. Solomon, Kyle McCain, Mark Marhefka, George R. Sedberry
SEDAR68-RD26	Developmental patterns within a multispecies reef fishery: management applications for essential fish habitats and protected areas	Kenyon C. Lindeman, Roger Pugliese, Gregg T. Waugh, and Jerald S. Ault
SEDAR68-RD27	Ingress of postlarval gag, Mycteroperca microlepis (Pisces: Serranidae)	Paula Keener, G. David Johnson, Bruce W Stender, Edward B. Brothers and Howard R. Beatty

2. STOCK ID PANEL REPORT

Summary

The Stock ID Workshop for scamp was held as a series of three webinars, including a data scoping webinar (6/19/2019) and two webinars to discuss data analysis (8/17/2019, 9/10/2019). Most workshop participants were appointed to one of three working groups: life history, genetics, or spatial distribution/movement. Recommendations of the Workshop were formed based on the review and analysis of life history characteristics, models of larval distribution, genetics, spatial patterns of landings, and conventional tagging data.

The primary findings of the Stock ID Workshop were twofold. First, there is no evidence in support of biological substructure of the Scamp population off the Southeastern United States. Second, 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. In line with these findings, the 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. Further, the Stock ID Workshop recommended that each assessment (Gulf of Mexico, Atlantic) be conducted on both Scamp and Yellowmouth Grouper jointly, with the two species treated as a single complex.

2.1 LIFE HISTORY WORKING GROUP

Participants:

LHWG member	Affiliation
Linda Lombardi	SEFSC Panama City, group lead
Joey Ballenger	SCDNR
Roger Brothers	SEFSC Beaufort
Andy Ostrowski	SEFSC Beaufort
Jennifer Potts	SEFSC Beaufort
George Sedberry	SAFMC SSC
Jim Tolan	GMFMC SSC

TORs 1. Review the relevant information on stock structure.

The LHWG discussed the life history data available for Scamp in regards to stock structure. To familiarize the group members on previous research for both Scamp and Yellowmouth Grouper the reference documents were summarized. The LHWG focused on the available data for growth, spawning and settlement to determine if Scamp have separate stock structure between the Gulf of Mexico and South Atlantic. Finally, due to the concerns raised during SEDAR49 in regards to the misidentification of Scamp and Yellowmouth Grouper, a comprehensive review of morphometric traits are provided.

Literature Evaluation

The LHWG reviewed 16 relevant publications that described the age, growth, reproductive and spawning seasonality and behavior of Scamp (*Mycteroperca phenax*) and Yellowmouth Grouper (*Mycteroperca interstitialis*). Extensive review of the literature was conducted to locate information regarding the early life history of Scamp, but only limited information was available. A recommendation per publication is provided; plus an overall recommendation for stock boundary based on the reference documents.

Reference Document #: SEDAR68-RD01

Title: A retrospective (1979-1996) multispecies assessment of coral reef fish stocks in the Florida Keys

Synopsis: In the study, the authors used an 18-year fishery-independent retrospective, analytical yield assessment of economically important Florida Keys reef fish stocks to elucidate the effects of fishing and to help define an effective management strategy. Key to the analysis was the use of "average size" (in length) of fish in the exploitable phase of the population as an indicator of stock status; researchers expected that under persistent heavy fishing the average size of the exploitable population would decrease through a "juvenescence" process. The loss of the larger individuals in the population is important in the context of stock and recruitment because the fecundity potential of individual fish generally increases exponentially with size.

Ultimately, they used the available population size structure and abundance data for each species and year to estimate the annual total instantaneous mortality rate Z(t) for each fish stock in each year using a length based method particularly applicable to reef fish population dynamics. The assessment focused on 35 reef fish species in 5 families (Epinephelinae, Lutjanidae, Haemulidae, Labridae (Hogfish only) and the Sphyraenidae (great barracuda only). For the current stock id process, it is important to note that they included both Scamp and Yellowmouth Grouper in their analysis. See Table 2 in the manuscript for the population parameters for each species.

They report finding a similar trend in average size for all groupers, snappers, and grunts from both visual census and headboat data, with a relatively flat trend over the survey period (1979-1996), though specific values for Scamp nor Yellowmouth Grouper are not provided. They also suggest that the average size in the exploitable phase for many economically important reef fish populations was only marginally above the minimum size of capture based on regulations, though once again individual data for Scamp and Yellowmouth Grouper were not presented. That said, Figure 7 does provide an estimate of SPR for both Scamp (~3%) and Yellowmouth Grouper (~22%), with each having terminal SPR estimates less than 30% and thus were likely experiencing overfishing in 1996. Overall the results suggest that the Florida Keys population had been heavily fished over the period 1979-1996, with total fishing effort increasing substantially over this time.

Recommendation: For the question of stock identification of Scamp and Yellowmouth Grouper, this publication provides little useful information. There is very little specific information provided regarding either Scamp or Yellowmouth Grouper, beyond their inclusion in the multispecies assessment and some life history parameter estimates assumed for each species. Many of these life history parameter estimates themselves are taken directly from other studies, and thus are not work original to this manuscript. Further, the study is limited spatially, only covering the area from Key Biscayne, FL, to the Dry Tortugas, FL, where an underwater visual census survey of coral reef fish species was routinely performed. There is no discussion regarding the spatial distribution of Scamp or Yellowmouth Grouper.

Reference Document #: SEDAR68-RD02

Title: Spawning Locations for Atlantic Reef Fishes off the Southeastern U.S.

Synopsis: Spawning condition was determined for 28 species of reef fish collected off the Carolinas, Georgia and east coast of Florida (including the Keys) in depths from 1-686 m. Samples included Scamp (*Mycteroperca phenax*) and Yellowmouth Grouper (*M. interstitialis*) collected primarily off South Carolina. Ovarian histology was used to determine imminent or very recent spawning, and locations of capture of fish in spawning condition were mapped using GIS. Reproductive behavior was observed from submersible. Most Scamp were collected from fishery-independent sampling, with time and location of collection accurately recorded. Some

specimens of Scamp and Yellowmouth Grouper were sampled from fishery landings, and time and location data were approximate. Sampling effort was not equally distributed temporally or spatially, and was concentrated from May through September in the middle of the South Atlantic Bight. Scamp were found mainly on middle- and outer-shelf reefs throughout the region. In spite of some temporal and spatial sampling limitations, it was determined that Scamp spawn from February through August, with a peak from March through May primarily at shelf-edge reefs (50-100 m depth). Scamp (3,759 collected; 2,467 examined histologically; 351 females in spawning condition) were found in spawning condition in depths from 33-93 m, and from 29-32 degrees North latitude (northern Florida to South Carolina). Spawning temperatures ranged from 15.60-24.08 C. Scamp were observed to be engaged in courtship behavior at shelf-edge reefs off northern Florida and South Carolina in summer (July and August) of 2002 and 2004 (56-85 m depth, 17.80-22.03 C). These behaviors were observed in the morning and late afternoon. Spawning was not observed but, as in other groupers, may occur after sunset. Scamp appear to be more common on outer-shelf reefs than on the inner shelf, and spawning occurs in the deeper reefs. Yellowmouth Grouper (29 collected; 18 examined; 9 females in spawning condition) were occasionally taken at middle- and outer-shelf reefs off of South Carolina, where a few females were found in spawning condition in February, March and August off South Carolina at depths of 49-51 m. Only one bottom temperature was recorded at one spawning location (14.47 C). Some spawning sites for these groupers have (subsequent to this study) been designated as no-bottom-fishing MPAs or spawning SMZs.

Recommendation: This study provides useful data on spawning times, depths and temperatures, but limited latitudinal coverage. Sampling was concentrated off SC and in spring-summer, although the months covered appear to cover all months of Scamp spawning, as zero catches of spawning Scamp were found outside of the spawning months reported. Some sample locations were fishery-dependent, and times, dates and locations may not be exact. Samples of Yellowmouth Grouper were very limited (n=18).

Reference Document #: SEDAR68-RD05

Title: Comparison of Scamp grouper (*Mycteroperca phenax*), growth off of the west Florida shelf and the coast of Louisiana

Synopsis: This study investigated size and age composition and growth rates of Scamp in the Gulf of Mexico. They compared Scamp caught in the commercial hand line fishery operating in the eastern Gulf of Mexico off of west Florida and in the western Gulf of Mexico off the coast of Louisiana. Over one decade, 2001-2010, Scamp were significantly larger and older off of Louisiana compared to west Florida shelf for 5 of the 10 years. In an investigation of growth rates of Scamp from 2008 based on otolith radius from the core to each of the first four annuli, no significant differences were found. The author provides several theories for the differences

found, which include habitat type, fishing pressure, selectivity of fish by fishers, and unequal sample sizes. The author also suggests further research into habitat preferences by groupers and other reef fish that may have an impact on life history parameters.

Recommendation: This report provides preliminary statistics on the comparison of Scamp from East and West of the Mississippi River drainage in the Gulf of Mexico. As mentioned in the report, further data collection and investigation into the commercial and recreational Scamp fishery from Louisiana is warranted to properly conclude regional differences within the Gulf of Mexico for Scamp.

Reference Document #: SEDAR68-RD06

Title: Aspects of the life history of the Yellowmouth Grouper, *Mycteroperca interstitialis*, in the Eastern Gulf of Mexico.

Synopsis: In the study, the authors report on several aspects of the life history of Yellowmouth Grouper based on specimens collected by recreational anglers on charter vessels at the Florida Middle Ground (28o15'-45' N, 84o00'-25' W) in the eastern Gulf of Mexico between 1978 and 1992.

Reproduction - Yellowmouth Grouper spawn throughout the year on the Florida Middle Ground, though peak activity occurs in April and May. Histological sections of 'transitional' individuals and changing sex ratios with size and age provide evidence for protogynous hermaphroditism in Yellowmouth. All fish less than 500 mm TL and younger than age-4 were female while all fish larger than 749 mm TL and older than 17 were male. They did observe two females (16 and 17) that were markedly older than most of the other females sampled (next oldest was 13), which authors suggest might indicate some females do not change sex. Yellowmouth Grouper mature as females between 400 mm and 450 mm TL and between 2 and 4 years of age. All females 450 mm TL and larger and 4 years old or older were mature. Transitional fish were 503-643 mm TL and 5-14 years of age. Males first appeared in the population at about 500-549 mm TL and 4 years of age.

Age and growth – The appearance of opaque bands on the edge of the thin sectioned otoliths (using reflective light source) determined annulus deposition from August - October with one being produced per year. Max age observed was 28 years old (n=203). Based on the size of the youngest fish encountered, Yellowmouth Grouper grow rapidly in length and weight during their first 2 years, after which growth slows markedly. A sexes combined growth curve was developed using a von Bertalanffy growth model, with Linf = 828 mm FL, k = 0.076 /year, and t0 = -7.5 years. This curve was fit to 200 fish.

Distribution – The authors suggest that Scamp are found throughout the eastern Gulf of Mexico while Yellowmouth Grouper tend to have a patchy distribution. They suggest this may reflect Yellowmouth Grouper's dependence upon prey such as *Chromis* spp. and its dependence upon high-relief habitat. That said, based on limited information, the feeding habits of Scamp and Yellowmouth Grouper from the eastern Gulf of Mexico appear quite similar (Bullock and Smith 1991).

Species Identification - They also touch on the complicating factor that Yellowmouth Grouper bear a striking resemblance to Scamp, and as such was not identified as being sympatric with Scamp until the mid-1970s. Because of the two species similarity, they report that Yellowmouth Grouper and Scamp are both marketed as Scamp, though Yellowmouth's contribution to 'Scamp' landings are low but exact proportions are unknown. The study suggests the following can aid in distinguishing between Yellowmouth Grouper and Scamp: 1) Yellowmouth Grouper lacks well-separated spots found on Scamp and 2) By the shape of the caudal fin.

Recommendation: This manuscript will be very useful to inform life history parameters (age, growth, reproduction) for Yellowmouth Grouper from the west Florida Shelf; along with comments on species distribution and species mis-identification with Scamp. However, in terms of stock identification of Scamp and Yellowmouth Grouper, this publication provides little useful information.

Reference Document #: SEDAR68-RD07

Title: Memoirs of the Hourglass Cruises: Seabasses (Pisces: Serranidae).

Synopsis: Pages 141-147 of this document provide a general description of the morphology and life history of Scamp (*Mycteroperca phenax*). The information comes from a combination of literature review and description of collected specimens. Bullock and Smith begin with a physical description of Scamp that includes the coloration and meristic features that help distinguish Scamp from other species, including Yellowmouth Grouper (*Mycteroperca interstitialis*). The document reports that Scamp occur throughout the Gulf of Mexico and along the southeastern coast of the United States, and summarizes habitat preferences and depth ranges for various geographic regions. Finally, the document reviews life history information. This includes measurements of eggs, the reported timing of spawning, diet from analyzing stomach contents, a length to weight relationship, and a size frequency distribution of commercially landed Scamp. Most of the information comes from the eastern Gulf of Mexico and the document also has similar information for other species in the family Serranidae, including other groupers (*Epinephelus* spp. and *Mycteroperca* spp.).

Recommendation: This report does provide some limited information on species identification, distribution (within the west Florida Shelf), early life history and general age, growth and reproduction; but given the limited spatial coverage, information on stock boundaries is limited.

Reference Document #: SEDAR68-RD08

Title: Groupers on the Edge: Shelf edge spawning habitat in and around the Marine Reserves of the Northeastern Gulf of Mexico

Synopsis: This manuscript uses acoustic surveys with georeferenced videography to describe potential spawning aggregations for Gag, Red Grouper, Scamp, and Red Snapper within the Madison-Swanson Marine Reserves, west Florida shelf. Sites to sample for spawning fish were identified through cooperative efforts with commercial fishers. Fish were determined to be in spawning aggregations, if females caught contained hydrated oocytes and if direct observations of courtship and changes in color phases (i.e., Scamp, male gray-head phase) were observed. Scamp spawning sites were characterized as high relief areas (Stu's Ridge) along the Madison Ridge at depths of 70-100 m. To determine movement patterns of aggregating Scamp, Scamp were fit with acoustic tags; unfortunately, only 1 male Scamp was tagged and showed little to no movement for nearly 2 years. Spawning Scamp were often associated near spawning Gag.

Recommendation: Taking into consideration the limited spatial coverage (Madison-Swanson Reserves), this manuscript does provide characteristics of potential spawning areas for Scamp. But in terms of stock identification, this publication provides little useful information.

Reference Document #: SEDAR68-RD09

Title: Decadal fluctuations in life history parameters of Scamp (*Mycteroperca phenax*) collected by commercial hand-line vessels from the west coast of Florida

Synopsis: The manuscript provides life history parameters of Scamp captured in the commercial fishery of the eastern Gulf of Mexico across three decades. The samples for this study were restricted to the West Florida Shelf in the northeastern Gulf of Mexico and encompasses the waters off of the Florida panhandle south to Tampa. Minimal shifts in life history parameters were noted amongst the three time periods: 1970s, 1990s and 2000s. The largest shifts were in the reproductive biology with the females maturing at younger ages in the 1990s when fishing was at its highest. Also, Scamp caught in the 1990s appeared to be more fecund at size than the other two time periods. The authors do provide caveats to their data analysis due to changes in fishery management regulations over time which can influence the selectivity of the fish by fishermen. This study provides a good look at the biology of Scamp over time from the northeastern Gulf of Mexico.

Recommendation: This manuscript provides a temporal comparison of commercial caught Scamp along the west Florida Shelf which is useful information but no inferences can be made for stock identification.

Reference Document #: SEDAR68-RD010

Title: A description of age, growth, and reproductive life history traits of Scamps from the northern Gulf of Mexico

Synopsis: This is the first study to describe the age, growth and reproduction of Scamp in the northern Gulf of Mexico, specifically the west Florida shelf. Samples were collected over a 30-year period from commercial (80%), recreational (16%) and fishery independent samples. Ages ranged from 1-31 years old. While there is a minimum size limit on the fishery, there was little difference in the Von Bertalanffy models when a size-based growth model was run. The uncorrected equation predicted Scamp to have an asymptotic length ($L\infty$) of 772 mm FL, a growth rate (k) of 0.09 mm/year and theoretical age at zero length (t0) of -4.4 years. Histologically, Scamp were found to be protogynous hermaphrodites, were indeterminate spawners, and had a protracted spawning season from January to June, peaking in April. Females reach maturity at age 2 and around 332 mm FL. Scamp transition from female to male around 566 mm FL and 11 years of age.

Recommendation: Considering the importance of life history data needed for assessments and the approach of this study, this data should be considered for use in the upcoming assessment. Due to the limited spatial coverage (west Florida Shelf), no conclusions can be provided for stock identification/boundaries.

Reference Document #: SEDAR68-RD15

Title: Color variation and associated behavior in the Ephinepheline groupers, *Mycteroperca microlepis* (Good and Bean) and *M. phenax* Jordan and Swain

Synopsis: This manuscript provides the first description of behaviors and color phases of Scamp. The study areas were at depths of 20-100 m between latitude 27°30' and 28°00N and longitudes 79°55' and 80°08'W, approximately offshore of Brevard to North Palm Beach counties. Observations of courtship, defensive and other behavior postures, plus color phases were made during submersible dives from February 1977 through September 1982. Scamp were most abundant on living *Oculina* coral at depths of 70-100. Based on courtship behaviors, spawning most likely occurs in pairs or small groups at the shelf edge, near deep water. Three color phases were described: 1) brown phase – most common, small and sub-adults, 35-50 cm SL; 2) "cat's paw" – sub-adult, 35-45 cm SL; and 3) "grey-head" phase – larger adults, >50 cm

SL. Scamp displaying the "grey-head" phase exhibited more dominant behavior and were most likely males, although this color phase is rare on capture to confirm sex through histological examination. Dominant Scamp were also characterized by multiple long caudal fin rays.

Recommendation: Although direct observations of spawning were not observed for Scamp, this manuscript does provide insight on potential spawning locations (e.g., living *Oculina* coral, depth 70-100 m, shelf edge – high relief), courtship and other behaviors for Scamp.

Reference Document #: SEDAR68-RD16

Title: Age, growth, and reproduction of Scamp, *Mycteroperca Phenax*, in the southwestern North Atlantic, 1979 – 1997

Synopsis: This study compared nearly two decades of Scamp age growth and reproduction: 1979-1989 and 1990-1997, from commercial, recreational, and fishery independent sources from Cape Hatteras NC to Cape Canaveral, FL. Differences in median ages between the sample periods and sample sources were documented, with the median age being older during the earlier sampling period. However, no difference in median age (5 years) was identified when the sources were combined. There were differences in median total length between sample source types with larger median lengths for the earlier time period and when combined all together: 610 vs 570 mm TL for 1979-1989 and 1990-1997, respectively. Across all sample periods and sample sources, Scamp ages ranged from 1-30 years old, with a median age of 5 years. A growth model was calculated for each period: $L\infty$ = 846 vs. 897 mm FL, k= 0.17 vs. 0.13 /year, and t0= -1.86 vs. -2.57 years for 1979-1989 and 1990-1997, respectively.

Spawning was also described in this manuscript across time periods. In general, females reached sexual maturity smaller (301-350 vs. 351-400 mm TL) and younger (1.28 vs. 1.72 years) during the 1990-1997 period than 1979-1989, respectively, while fully mature by age 4 no matter what time period. Spawning occurred between late February through mid-July with a peak between March and May, with a periodicity of 2.5 days, and annual fecundity of 1.3-10.5 x 10_6. With a spawning period of 106 days, Scamp could potentially spawn over 40 times a year. Due to Scamp being a protogynous hermaphrodite, this study described the primary transition period between August and November, 401-850 mm TL, and ages 2-16.

Recommendation: The information found in this manuscript should help guide the life history group in the upcoming assessment when compared with updated age and growth data. Due to the sampling effort (majority South Carolina, limited sample collection North Carolina, Georgia, and eastern Florida), no conclusions can be provided for stock identification/biological boundaries.

Reference Document #: SEDAR68-RD17

Title: Age, growth, mortality, food and reproduction of the Scamp, *Mycteroperca phenax*, collected off North Carolina and South Carolina

Synopsis: From 1972 to 1979, fisheries-dependent only samples of nearly 8,000 Scamp (recreational 40%, commercial 60%) were obtained from the South Atlantic Bight region (Cape Hatteras, North Carolina, Charleston, South Carolina, and Georgia), and processed for age, growth, meristic relationships, mortality rate, reproductive cycle, and diet information. Most fished were landed between February and November.

Ageing was determined using sagittal otolith thin cross-sections (N=703), read with reflective light. Most otoliths were read by a single reader due to clearly discernable rings, although when a second reader was needed, agreement in counts was noted to be 90% but only 71.6% of the otoliths could be read. Maximum age was found to be 21 years. Despite lacking samples from January through March, the authors' concluded annual rings deposited in April and May through marginal increment analysis using ocular measurements. The von Bertalanffy parameters report for Scamp (n=503) were Linf=985 mm, K=0.092 /year, and t0=2.45 years.

Using recreational headboat fishery data, catch curve estimation of instantaneous mortality (Z) differed temporally, and ranged from Z = 0.29 to 0.64. Commercial handline Z estimates also had a large range, from 0.57 to 0.91. The authors note that the shape of the catch curves were oddly shaped, with many ages being equally frequent, and a clear downward trend not being seen until age 9 or greater. Age at recruitment to the fishery is reported to be higher for the recreational sector (5.4 years) during the first 3 years of the study, and shifting down to 3.1 years for the remainder. If this shift was due to the change in length determination, it is not noted. For the commercial sector, age at recruitment is reported at 4.0 years.

Maximum yield-per-recruit (~600 g) is reported to be similar to many other reef fish from the South Atlantic, with max Y/R obtained at an F value of 0.3 or less. The authors report that for the years under consideration, instantaneous fishing F for the recreational sector was estimated at 0.26, and ~85% of the potential maximum Y/R was taken. In the commercial sector, a slightly higher F of 0.42 was estimated, leading to the harvest of ~94% of the available Y/R.

Spawning in this protogynous hermaphrodite occurred from April through August with a peak in May and June. Sex determination and reproductive staging (N=383) were completed macroscopically, all spawning information came from the recreational sector. A total of 326 specimens had their stomachs examined, and based on an Index of Relative Importance, the food items consumed were primarily fish, cephalopods, and crustaceans.

Recommendation: Considering the importance of life history data needed for assessments and the approach of this study, this data should be considered for use in the upcoming assessment for the years 1970-1980 for the South Atlantic. However, due to spatial coverage (North Carolina

through Georgia), no conclusions can be provided for biological boundaries. The LHWG also caution the use of reported reproductive parameters that were calculated using only macroscopic classification, whereas for protogynous hermaphrodites it is always recommended to use histological classification.

Reference Document #: SEDAR68-RD19

Title: Age and growth of the Yellowedge Grouper, *Epinephelus flavolimbatus*, and the Yellowmouth Grouper *Mycteroperca interstitialis*, off Trinidad and Tobago

Synopsis: This study sampled otoliths from Yellowedge (n=729) and Yellowmouth (n=116) groupers that were caught in a commercial fishery near Trinidad and Tobago. A fork length at age relationship was reported for Yellowmouth Grouper and a total length at age relationship was reported for Yellowedge Grouper. The authors' note the narrow spacing between growth increments made it difficult to measure marginal increment, so only the proportion opaque edge was used to conclude an annual growth increment deposition from September through January for Yellowmouth Grouper. Growth parameters and meristic relationships per species were also provided (Yellowmouth Grouper, Linf=854 mm FL, K=0.057 /year, t0=-4.6 years, N = 80).

Recommendation: Although this study is outside the scope of our geographical region, it is recommended that this paper be used for discussion in life history parameters for Yellowmouth Grouper.

Reference Document #: SEDAR68-RD22

Title: Age, growth, and mortality of Yellowmouth Grouper from the southeastern United States

Synopsis: Life history parameters were estimated for Yellowmouth Grouper collected through intercepts of commercial and recreational fisheries from data combined from 32 years (n = 391, 1980-2012). Exact capture locations were not reported, very few fish were landed along the east coast of Florida (n=40), and most fish were intercepted through the commercial fishery (N = 312, 2004-2012) in North and South Carolina. There is no mention of whether fish from Monroe County, FL were included in this study.

Thin sectioned sagittal otoliths were used to assign age. Otolith opaque zones were determined to be deposited annually based on edge analysis, with opaque zone formation occurring May-August. Age (range 3-31 years) and length (300-859 mm FL) data were fit to von Bertalanffy growth curves resulting in growth parameters: L_{inf}= 755 mm FL, k = 0.14 /year, to = -1.42 years. Additional life history parameters, length-weight regressions and natural mortality were also provided.

The authors also presented a comparison of growth parameters among other Yellowmouth Grouper and Scamp published values from various locations (Gulf of Mexico, South Atlantic, Trinidad and Tobago), and determined similarities in asymptotic length but not growth rate for Yellowmouth Grouper. The authors also concluded differences in growth parameters between Yellowmouth Grouper and Scamp (Matheson et al. 1986), but did not discuss how the differences in data collection, growth curve calculations, or spatial and temporal coverage could have affected the comparison. Interestingly, the authors did not include results for Scamp from Harris et al. 2002, which had similar date collection, spatial and temporal coverage with their study.

Recommendation: This manuscript will be very useful to inform life history parameters for Yellowmouth Grouper from the South Atlantic. There is still the issue of misidentification (as mentioned by the authors) of Yellowmouth Grouper and Scamp, especially for fish intercepted through the fisheries. In terms of biological boundaries, most Yellowmouth Grouper were collected from North and South Carolina.

Reference Document #: SEDAR68-RD25

Title: Timing and locations of reef fish spawning off the southeastern United States

Synopsis: This paper reports on an assessment of spatiotemporal cues for spawning for six species of reef fish, including Scamp (*Mycteroperca phenax*), using data on individual spawning condition collected by over three decades of regional fishery-independent reef fish surveys, combined with a series of predictors derived from bathymetric features. The authors quantified the size of spawning areas used by reef fish across many years and identified several multispecies spawning locations. Among the species examined, they quantitatively identified cues for peak spawning and generated predictive maps for Scamp. Samples of Scamp (N = 743; 105 spawning females) were found in spawning condition at 14 sites along the shelf-edge reef off South Carolina. Depths ranged from 32-101 m and temperatures were 16-27 C. Females in spawning condition were collected from February through September, with peak spawning indicated in March through June and in September. Spawning appeared to concentrate along complex high-relief shelf-edge reef crests, along cuspate formations found off the Carolina capes. Peak spawning was predicted near the new moon in 19.7-21.6 C waters on the shelf edge (48-51 m) at high-profile ridges off South Carolina. The discussion of findings in relation to the literature noted a decreased percentage of males in the population and a loss of older, larger females. The investigators also identified locations where reconfiguration or expansion of existing marine protected areas would protect spawning Scamp.

Recommendation: The authors discussed limitations of the study and recommended increased sampling off southern Florida, regionally during winter months, and in high-relief, high current habitats. The fishery-independent data contained limited information on larger, longer-lived

species such as Scamp. The paper provides useful information on Scamp spawning times and depths, but limited geographic (latitudinal) coverage.

Reference Document #: SEDAR68-RD26

Title: Developmental Patterns Within a Multispecies Reef Fishery: Management Applications for Essential Fish Habitats and Protected Areas

Synopsis: This review summarizes the development patterns of species in the snapper-grouper complex. This includes spawning patterns and locations, larval durations, as well as settlement habitats and distributions. Many species are included, but the only information on Scamp is reported in Table 1 (page 933). This table reports that Scamp are protogynous, spawn in aggregations, and that newly settled stages are typically found in 10-20 meters of depth and are associated with hard bottom habitat. There is more extensive information on other species, including pelagic larval durations for two other Mycteroperca spp.

Recommendation: Limited information regarding spawning and settlement for Scamp.

Reference Document #: SEDAR68-RD27

Title: Ingress of postlarval gag, *Mycteroperca microlepis* (Pisces: Serranidae)

Synopsis: The authors' used nueston nets to target postlarval Gag Grouper (*Mycteroperca microlepis*) and other grouper species from Prince Inlet, South Carolina (1980-1984). Prince Inlet is a highly saline barrier island north of Charleston, South Carolina. Postlarvae are defined as pre-settlement larvae that do not show juvenile pigmentation. A total of 1,137 postlarval Gag Grouper were caught from April through June and measured 9-20mm SL (average 15mm, N = 953, see Table 4 in manuscript). Using daily rings on prepared lapilli otoliths, Gag Grouper were aged to be 33-66 days old (average 43 days, N = 637, see Table 4 in manuscript). Estimates of abundance per species were also calculated. Although there are morphometric similarities among postlarval *Mycteroperca* spp., the authors' noted that Scamp (*M. phenax*) and Yellowmouth (*M. interstitialis*) were absent during sampling.

Recommendation: There is limited information regarding Scamp between larval to juvenile life stages. Therefore, it is recommended inferences may be made from co-species (Gag Grouper) to be used for timing of settlement and for size of postlarvae of Scamp.

Overall Recommendation on Literature Evaluation for Stock Boundary:

After reviewing the reference documents, the LHWG found no evidence in the 16 reference documents to warrant a change to the Council boundary (US 1 in the Florida Keys). A majority of the reference documents had specific spatial coverage from the Gulf of Mexico (e.g., west Florida Shelf, Louisiana) or in general, incorporating samples along the South Atlantic (South Carolina and North Carolina). A few reference documents reported the collection of Scamp and Yellowmouth Grouper from southeastern Florida counties (Monroe, Miami-Dade, Broward, Palm Beach), but the numbers of samples reported from these counties were sparse or were not discussed in detail (i.e., Florida Keys, Dry Tortugas).

Stock structure of Scamp

Growth Patterns

The LHWG recognize a major caveat that would restrict the comparison of age and growth to determine separate stock structure between the South Atlantic and Gulf of Mexico. The size limit for Scamp differs by four inches between the Gulf of Mexico and the South Atlantic. The commercial and recreational size limits in the Gulf of Mexico are 16 inches (established in 1999) and the size limits in the South Atlantic are 20 inches (established in 1992) (see Management History). Any statistical comparison of age and length data would be biased by the size selectivity of the fisheries. This size selectivity would greatly affect the population dynamics of these regions. Therefore, no interpretation of growth patterns can be completed.

Spawning Stock

In order to determine where Scamp spawn and if there is a separation of stocks through spawning locations, three sources of reproductive histology data for Scamp in the northern Gulf of Mexico and southwestern North Atlantic Ocean were combined. Together, these sources provided data for 7,465 histological samples including 1,448 females with hydrated oocytes (i.e. within approximately 24 hours of spawning)(Figure 1). The National Marine Fisheries Service (NMFS) laboratory in Panama City, Florida provided data for 2,718 Scamp histological samples. These samples are overwhelmingly from fish caught in the Gulf of Mexico, are largely fishery dependent samples, and include 796 spawning females. Florida Fish and Wildlife Research Institute (FWRI) provided data for 11 spawning females that were caught in the Gulf of Mexico during fishery independent surveys. South Carolina Department of Natural Resources (SC-DNR) provided data for 4,736 histology samples. These samples were all caught in the southwestern North Atlantic Ocean, are from a combination of fishery dependent (N = 2,521) and fishery independent (N = 2,215) sources, and include 641 spawning females.

In the Gulf of Mexico sampling was concentrated along the west Florida shelf, and most spawning females were caught at depths between 50 and 100 meters. In the southwest North Atlantic Ocean sampling was concentrated off the coast of South Carolina, and most spawning

females were caught at depths between 30 and 100 meters. There are remarkably few samples from the region between the Gulf of Mexico and Atlantic Ocean, so it is difficult to draw conclusions about stock boundaries from these data. The southernmost histological sample from the Atlantic Ocean was caught at latitude 27.27 degrees, and the southernmost spawning female caught in the Atlantic Ocean was from 27.79 degrees. In the Gulf of Mexico there were 61 samples caught south of the Florida Keys (latitude = 24 degrees); these samples, however, only have a low spatial resolution of 1 degree, and none of them were spawning females.

Settlement

Little is known about the settlement habitat of Scamp, and few age 0 and age 1 Scamp have been caught along the west Florida shelf in the northeastern Gulf of Mexico (N = 44; L. Lombardi-Carlson, unpublished data; T. MacDonald, unpublished data)(Figure 2). These young fish were predominantly caught at depths between 10 and 30 meters using a variety of gears (Figure 2). No age 0 and age 1 Scamp have been caught along the US South Atlantic.

Overall Recommendation on Stock Structure:

The LHWG recommends the default boundaries for the assessment to be the current Council boundaries (US 1 in Florida Keys), since the differences in size limits between the Gulf of Mexico and South Atlantic inhibit the comparison of growth patterns. Simulation models of larval dispersals may be useful in informing Scamp population connectivity between the Gulf of Mexico and South Atlantic (SEDAR68-SID-02).

TORs 1.a. Evaluate data sources to elucidate possible misidentifications of Yellowmouth Grouper with Scamp.

Both Scamp and Yellowmouth Grouper are very similar in their external appearances, as the adults of both species reach approximately the same maximum size, have a projecting lobe at the corner of the preopercle, exhibit similar color patterns across numerous color phases, have similar numbers of fin rays, enlarged posterior nostrils, and exserted median fin rays. While Yellowmouth Grouper possess a pronounced yellow color 'inside and on the corners of the mouth', both species can possess a yellow coloration on the exterior maxilla. Habitat requirements and depth ranges where each species can be found are also quite similar, and both range spatially from the Gulf of Mexico through the Florida Keys and northward along the Eastern Seaboard to North Carolina.

Based on the dichotomous key for Serranidae presented in McEachran and Fechhelm (2005), both species are identical morphometrically and meristically until couplet 21 (see Table 1).

While not a large overlap in first arch gill raker counts, it is quite possible to possess a specimen and not be able to positively identify it to the species level.

Other identification resources are equally ambiguous in differentiating Scamp from Yellowmouth, as Hoese et al. (1992) question the occurrence of Yellowmouth in the Western Gulf of Mexico; "The two forms may represent a single, variable species, in which case *M. interstitialis* would be the correct name"; and Grace et al. (1994) relies primarily on the numerous color phases of each to separate the two. Body shape and head length have also been used to differentiate between the two species (M. Campbell and K. Radenmaker, NMFS Pascagoula, personal communication), although these differences are very slight. Scamp are reported in McEachran and Fechhelm (2005) as having a head length of 33%-38% of standard length (SL), and a body depth of 29%-33% of SL, whereas Yellowmouth have a head length of 33%-36% and a body depth of 29%-33%. Similar overlap exists for nearly all external meristics used to identify these species (see Table 2). In terms of coloration, both are highly variable (see Grace et al., 1994), with the head and body of Scamp being pale brown, with a single small reddish brown spot on each scale of the dorsal and lateral surfaces and on medial fins. Scamp are known to display several clusters of dark brown spots resembling cat paw prints on the dorsolateral parts of the body. Yellowmouth are light brownish gray, with dense covering of small brown spots on dorsal and upper lateral sections of the body. Occasionally, specimens are uniformly brown dorsally or have faint irregular bars on the dorsal half of the body. Margins of the pectoral fin (when coloration is present) is also useful in differentiating between the two species, with Yellowmouth sometimes displaying a yellow color, although this species can display the white colored margin commonly seen on adult Scamp.

At much smaller sizes, these two species are also remarkably similar in appearance (as are nearly all of the mycteropercid larvae, see Richards 2006). All meristic counts greatly overlap, and even at these small sizes, the two can only be separated based on first arch gill raker counts (with the same overlap caveat as seen in the adults). It isn't until the juvenile stage that the two can be definitively identified, as Yellowmouth Grouper are distinctly bicolored, and juveniles of Scamp are colored much more like the adults (Stokes, 1984).

Internally, sagittal otolith size and shape, as a function of SL, shows very little promise in separating these two species. While no formal statistical shape analysis was performed for this Stock ID Workshop, external examination of a number of otoliths from a wide range of lengths failed to reveal any obvious difference in the otoliths between Scamp and Yellowmouth.

Overall Recommendation on misidentification between Scamp and Yellowmouth Grouper:

Scamp and Yellowmouth Grouper have very similar morphometric characteristics and are too difficult to accurately identify. Given this, the LHWG would recommend combining all sources

of data (landings, indices, length comps, age comps, discards) of Yellowmouth Grouper with Scamp for the assessment.

References

Grace, M., K.R. Radenmacher, and M. Russell. 1994. Pictorial Guide to the Groupers (Teleostei: Serranidae) of the Western North Atlantic. NOAA Technical Report NMFS 118. 46 pp.

Heemstra, P.C. 2002. Serranidae. In: FAO-WCA: 1308-1369.

Hoese, H.D., R.H. Moore, and V.F Sonnier. 1992. Fishes of the Gulf of Mexico, Texas, Louisiana, and Adjacent Waters. Texas A&M University Press. 327 pp.

McEachran, J.D and J.D. Fechhelm. 2005. Fishes of the Gulf of Mexico. Volume 2. University of Texas Press. 1004 pp.

Richards, W.J. 2006. Early Stages of Atlantic Fishes: An Identification Guide for the Western Central North Atlantic. Volume 1. Taylor & Francis Group. 1335 pp.

Stokes, F.J. 1984. Divers and Snorklers Guide to the Fishes and Sea Life of the Caribbean, Florida, Bahamas, and Bermuda. The Academy of Natural Sciences of Philadelphia. 160 pp.

Tables:

Table 1. Serranidae key (Adapted from Heemstra, 2002), couplet 21 - differentiating Scamp from Yellowmouth Grouper.

21a.	Gill rakes on the first arch 23 to 27; caudal fin rays equally exserted ……. *Mycteroperca interstititalis* p. 167
21b.	Gill rakers on first arch 27 to 41; caudal fin rays exserted in adults only and uneven …….. *Mycteroperca phenax* p. 169

Table 2. Meristic characters of Scamp and Yellowmouth Grouper.

	Scamp	Yellowmouth
Dorsal Fin	XI 16-18	XI 16-18
Anal Fin	III 10-12	III 11-12
Pectoral Fin	15-17	16-17
Colored Margin	+/- (white)	+/- (white or yellow)
Caudal Fin Shape	Concave / Emarginate	Concave / Emarginate
Exserted Margin	+/- (Uneven)	+/- (Even)
Lateral Line Scales	76-82	70-74
First Limb Gill Rakers	27-41	23-27
"Yellow" Color on Mouth	+/- Corner (Exterior Only)	+/- Corner (+ Interior)
Maximum Size	900 mm	700 mm

+/- Character may or may not be present at different color phases

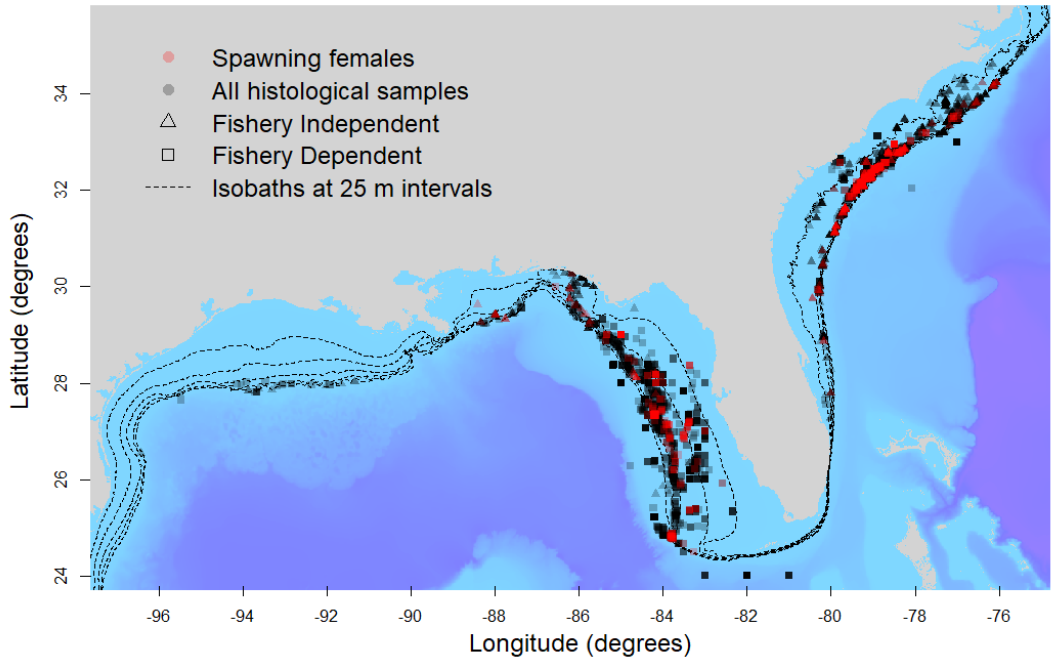

Figure 1. Map of Scamp histological samples. Red data points represent the catch locations for female Scamp with hydrated oocytes (i.e. within approximately 24 hours of spawning), and black data points represent the catch locations of all other Scamp histological samples. Triangles denote samples from fishery independent sources, while squares indicate samples from fishery dependent sources.

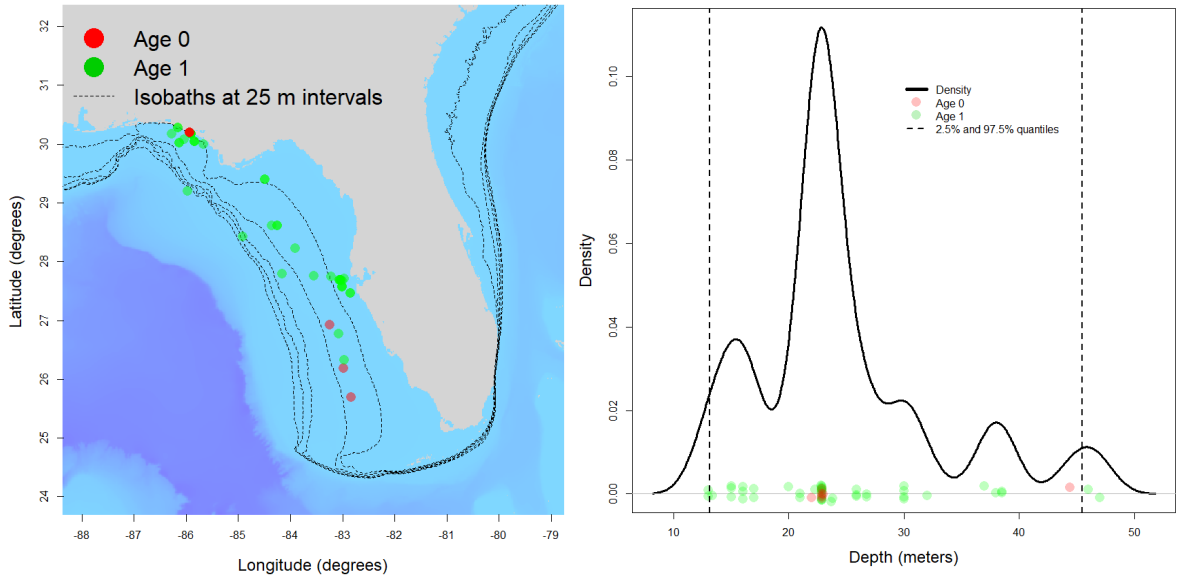

Figure 2. Map (left) and depth distribution (right) of age 0 and age 1 Scamp. Red data points indicate the catch location or depth of age 0 Scamp. Green data points indicate the catch location

or depth of age 1 Scamp. The solid black line (right) represents the depth distribution of young Scamp, and the dashed vertical black lines denote the 2.5% and 97.5% quantiles of the depths at which young Scamp were caught.

2.2 GENETICS WORKING GROUP

ToR#1: Review relevant information on stock structure. Evaluate data sources to elucidate possible misidentifications of yellowmouth grouper with scamp.

Genetics Workgroup Appointed Participants

Tanya Darden (Chair)	SCDNR
Andrea Bernard	NSU
Steve Cadrin	UMASS Dartmouth
John Mareska	GMFMC SSC
Dave Portnoy	TAMU CC
Elizabeth Wallace	FL FWCC

Genetics Workgroup Observers

Matt Walker	SCDNR
Skyler Sagarese	Analyst
Kyle Shertzer	Analyst

Literature and Data Review and Evaluation

The genetics work group reviewed the literature and available data sets relevant to the genetic population structure of Scamp via several webinars and email communication. Working documents that were reviewed by the workgroup included the following:

Working Papers:

• SEDAR68-SID-03: Wallace 2019, Preliminary Genetic Stock Assessment of Scamp in Florida Waters

• SEDAR68-SID-04: Darden & Walker 2019, Population Genetic Analyses of Scamp

Relevant Reference Documents:

• Zatcoff, Ball & Sedberry 2004 (SEDAR68-RD12)

These papers include early exploratory genetic work with Scamp and recent datasets with larger sample sizes, incorporating more powerful molecular methods.

Zatcoff, Ball & Sedberry 2004 (SEDAR68-RD12)

The Zatcoff et al. study included sample collections from 1996-2001 which ranged from Georgia to the Florida panhandle (Fig 1) and sample sizes of 17 to 86 per location. The microsatellite marker panel was composed of six loci with 5 to 29 alleles per locus; three loci exhibited more than 8 alleles. No Hardy-Weinberg equilibrium or linkage disequilibrium issues are detected with the maker panel.

No significant pairwise comparisons were detected from the resulting data and analysis of molecular variance (AMOVA) failed to detect significant among group variation. The paper concludes a genetically homogenous population throughout the sampling range but cautions about the potential existence of unsampled, self-recruiting Scamp populations. The genetics workgroup recognizes the appropriateness of the study design and power at the time conducted but identifies limitations in both sample sizes and power compared to current practices.

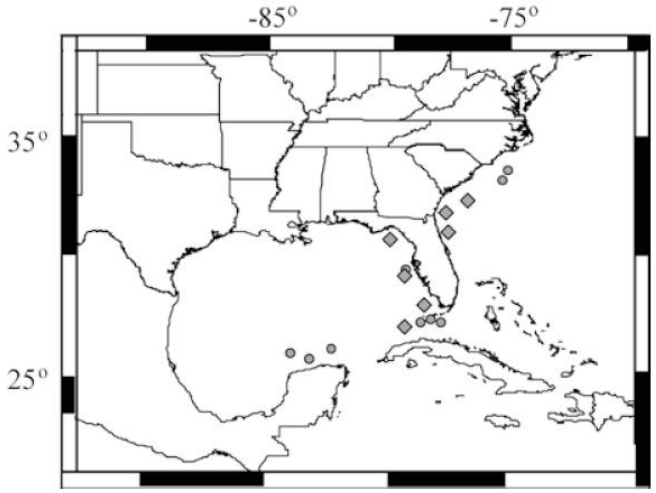

Figure 1. Distribution of Scamp collection locations for Zatcoff et al. study shown as the diamonds. Circles represent a separate species addressed in the same paper.

Wallace 2019 (SEDAR68-SID-03)

The Wallace study included sample collections from 2013-2019 which ranged from the Florida Keys north to the Florida panhandle with a total of 556 samples across five regions (Fig 2). Evaluation of length and weight data indicated a wide range of fish sizes in the collections. The majority of the sample set (n=470) was collected outside of a Jan-Jun spawning period. The microsatellite marker panel was composed of 28 loci with 3 to 22 alleles per locus; seven loci exhibited more than 16 alleles. No linkage disequilibrium was detected with the marker panel,

but collections and combined dataset exhibited several deviations from Hardy-Weinberg equilibrium.

The workgroup recognizes that while the study represents a robust dataset to evaluate Scamp gene flow patterns along the west coast of Florida, it does not contribute an evaluation of gene flow patterns across the current Monroe. Co. stock boundary.

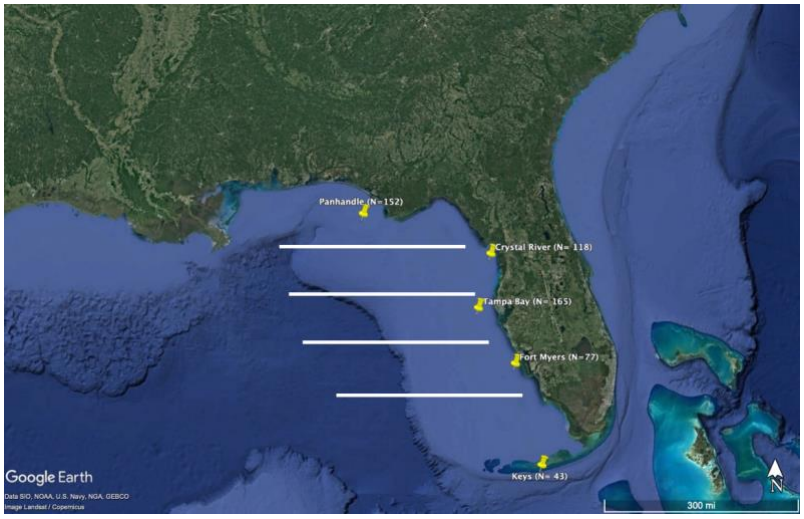

Figure 2. Distribution of Scamp collection locations for Wallace study.

Darden & Walker 2019 (SEDAR68-SID-04)

The Darden & Walker study included sample collections from 1996-2018 which ranged from North Carolina to the Florida panhandle and a single collection location in Mexico water in the western Gulf of Mexico (Fig 3) with similar sampling periods across locations and sample sizes ranging from 24 to 272 per location. Evaluation of year class and length compositions verified that multiple cohorts were present with similar length ranges across collection locations and years.

The microsatellite marker panel was composed of 15 loci with 6 to 54 alleles per locus; nine loci exhibited more than 21 alleles. No Hardy-Weinberg equilibrium or linkage disequilibrium issues were detected with the maker panel. Genetically-determined field mis-identified yellowmouth grouper samples were removed from the dataset for the final analysis. The working paper provides genetic evidence of field mis-identifications of both Yellowmouth Grouper as Scamp and Scamp as Yellowmouth Grouper, supporting the identification challenges previously identified with these species.

Based on preliminary analyses, locations were collapsed to three groups including Gulf of Mexico (Mexico), FL (Panhandle), and Atlantic (NC to FL Gulf). Robust pairwise comparisons,

STRUCTURE analyses and AMOVA failed to detect signals of genetic discontinuities. However, an order of magnitude increase in Fst (a measure of genetic differentiation due to genetic structure) was observed between the Mexico samples and all other locations. Partitioning data into multiple putative spawning seasons did not alter the resulting patterns. The paper concludes a single genetic population throughout the sampling range. The genetic workgroup recognizes a lack of samples from the western Gulf of Mexico prevents any conclusions regarding an alternate genetic boundary in the northern or western Gulf of Mexico.

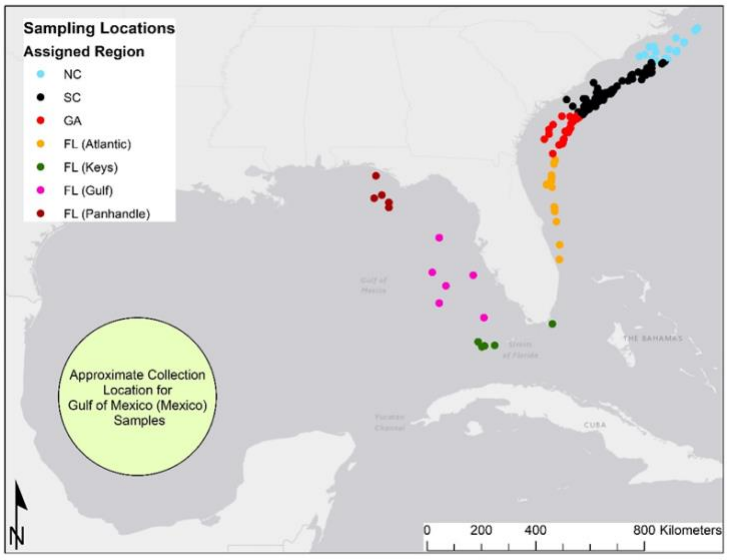

Figure 3. Distribution of Scamp collection locations for Darden & Walker study.

ToR#2: Make recommendations on biological stock structure and the assessment unit stock or stocks to be addressed through SEDAR 68 and document the rationale behind the recommendations. The default boundaries for assessments should be the current Council boundaries, unless there is reasonable evidence for deviation. If a deviation from the status quo is recommended, an accompanying recommendation on spatial considerations for management should also be provided.

Neither current datasets nor previous genetic publications could reject genetic homogeneity among geographic samples from North Carolina south around the Florida peninsula and north along the Florida Gulf of Mexico coast to the Florida panhandle area. Pairwise comparisons between Mexico and all other samples were significant before but not after correction. However, due to relatively low sample size and restricted temporal sampling in Mexico, the conclusion that these results indicate stock structure must be treated with caution. A lack of genetic data from Scamp in the western Gulf of Mexico prevents conclusions regarding geneflow patterns within the western Gulf and between the western and eastern Gulf.

Therefore, analyses of genetic data do not support the Monroe Co. line as a ***genetic*** stock boundary for Scamp. However, the geographic sampling limitations of the available datasets does not allow for the identification of an alternate ***genetic*** stock boundary. Additionally, given the long larval duration of groupers and limited post-settlement movement, we caution against the use of the absence of a ***genetic*** boundary to define a ***biological*** stock boundary for Scamp and recommend the current Monroe Co. line as the assessment boundary.

ToR#3: Discuss the strength of evidence in support of stock ID recommendations with particular attention paid to recommendations if they result in a mismatch of biological stock structure, assessment unit stock, and existing management boundaries.

Although the early paper (RD12) had limitations in terms of sample size and marker power, the two recent datasets (SID-03, SID-04) demonstrated substantial increases in strength of evidence through both higher sample sizes and more powerful marker suites. The two studies (RD12, SID-04) that were able to address gene flow patterns across the Monroe Co. line yielded similar conclusions of a single, genetic population within the sample ranges. However, lack of samples from the western Gulf of Mexico in any of the studies prevented an evaluation of gene flow across putative distribution discontinuities within the northern and western Gulf of Mexico.

ToR#4: Provide recommendations for future research on stock structure.

The Genetic Workgroup provides the following recommendations for future genetic research on Scamp stock structure:

- Genetic evaluation of Scamp samples from the western Gulf of Mexico to assess gene flow patterns given potential distribution breaks within the area.
- Further evaluation of genetic species identification of Scamp and Yellowmouth groupers as well as potential hybridization implications.

2.3 SPATIAL MOVEMENTS AND LANDINGS WORKING GROUP

Overview

The SEDAR 68 Stock ID Working Group met through Google Hangouts for a series of stock ID webinars from August 2019 through January 2020. This report summarizes the findings of the Spatial Distribution and Movement group. The meetings specifically addressed terms of reference (TOR) 1 – 5. Topics of discussion included the spatial distribution of commercial, recreational and headboat fisheries. Additionally, known mark-recapture and identified visual data were presented and discussed. A Google drive

(https://drive.google.com/open?id=1t6nkeKN1MubWik_R8lRvcEtrz-KGFql5) was made available to store and distribute working documents.

Participants

Beth M. Wrege (Chair), Dustin Addis, Nate Bacheler, Kenneth Brennan, Matthew Campbell, Drew Cathey, Kelly Fitzpatrick, Rachel Germeroth, Dawn Glasgow, Doug Gregory, Vivian Matter, Matthew Nuttall, Refik Orhun, Ryan Rindone, Mclean Seward, Ted Switzer, Kevin Thompson, and Chris Wilson.

Terms of Reference

The goal of the Stock ID workshop was to review scamp stock structure and unit stock definitions, in addition to considering whether changes are required. The Spatial Distribution and Movement Working Group was responsible for evaluating the spatial distribution in the South Atlantic and Gulf of Mexico (GOM), and to evaluate any studies that indicated movement across the proposed boundary.

Selected portions of the Terms of Reference (TORs) specifically related to the spatial distribution of Scamp used by this group are as follows:

TOR 1. Review relevant information on stock structure. Potential sources include … *movement and migration*, existing stock definitions, . . . and hotspot maps of landings or CPUE.
   a. Evaluate data sources to elucidate possible misidentifications of yellowmouth grouper with scamp.

Response: It was determined during the general Scamp-ID panel discussion that Scamp and Yellowmouth grouper are not recorded separately and are to be combined. For the purpose of this report, the scamp landings imply that scamp and yellowmouth grouper were combined, unless specified otherwise.

TOR 2. The default boundaries for assessments should be the current Council boundaries, unless there is reasonable evidence for deviation. If a deviation from the status quo is recommended, an accompanying recommendation on spatial considerations for management should also be provided.

Response: No evidence to deviate from the proposed council boundaries was presented.

TOR 3. Discuss the strength of evidence in support of stock ID recommendations with particular attention paid to recommendations if they result in a mismatch of biological stock structure, assessment unit stock, and existing management boundaries.

Response: Scamp may have a probable range of 0-44 miles travel supported by tag-recapture data. Based on the compiled 1986-2018 commercial landings distribution the default council

boundaries are supported. Hot spot analysis indicated two distinct population centers: one on the west coast of Florida and one off the North and South Carolina boundary region.

Response: The majority of tagged fish traveled <10 miles.

TOR 4. Provide recommendations for future research on stock structure.

Response: Additional tag-recapture data were recommended.

Response: Research topic – the utilization of the spatial time series of commercial landings may be a means of evaluating movement.

TOR 5. Prepare a report providing complete documentation of workshop recommendations and decisions.

Response: This report satisfies this requirement.

DATA

Two types of data were presented to evaluate the stock boundary: fishery independent and fishery dependent.

Fishery Independent

FWC - FWRI Tag-Recapture Program

The Florida Fish and Wildlife Conservation Commission (FWC) Fish and Wildlife Research Institute's Fisheries Dependent Monitoring (FWRI-FDM) tag-recapture program has been operating since 2009.
Staff ride along on head-boat and charter fishing trips in order to measure and tag reef fish released as a consequence of harvest restrictions. The project has tagged 1,231 scamp grouper (*Mycteroperca phenax*) (Fig. 1.). Fifty-five individual scamp (4.6%) were recaptured, with two which were recaptured twice for a total of 57 tag returns (Fig. 2). Days at large ranged from 6 – 1,106, with an average of 173 and a median of 91 days at large. Thirty-two tag returns had only recapture location or vessel departure port provided: twenty-eight were recaptured in the same general area (<10 miles) and four may have moved more than ten miles, with a possible range of 11-25 miles. Twenty-five of the original 57 tag returns had associated GPS coordinates: six of the tag returns with associated GPS coordinates did not move, sixteen moved less than ten miles, and three moved more than ten miles. Of these tag returns, the movement range was zero to 44 miles. Length frequencies of tagged and encountered scamp by year are shown in figure 3.

Comment: Scamp have a probable range of 0-44 miles travel supported by the Tag-Recapture data.

Gulf stereo-camera surveys from NMFS – MS, NMFS – PC, and FWRI, Florida Keys reef fish visual census and South Atlantic trap-mounted cameras from SERFS

Fishery-independent data for Scamp were compiled from visual and video-based surveys across the GOM (Gulf of Mexico) and South Atlantic to contribute to analysis of population distribution and connectivity. The data were compiled from several sources with the time series range from 2011 – 2017. Within the sources, the visual census began in 2012 and reports a different abundance metric than the video surveys.

Stereo-video data were used from three surveys in the GOM and one in the South Atlantic, and one visual survey was available from the South Atlantic. The GOM surveys consisted of stereo baited remote videos (S-BRUVs) collected by three research groups: National Marine Fisheries Service (NMFS) Pascagoula Southeast Area Monitoring and Assessment Program (SEAMAP), NMFS Panama City, and Florida Fish and Wildlife Research Institute (FWRI). The three surveys were developed to evaluate reef fish on rugose habitats throughout the GOM. They use similar gear and generate the same fish metric, MaxN, the maximum number of individuals on a single video screen during a 20-minute recording. The surveys vary in extent and initial year, but ultimately provide a dataset, with some gaps in coverage, from west Texas to the Dry Tortugas in Florida (Fig 4). The other video-based survey that contributed data was conducted in the South Atlantic as part of the Southeast Reef Fish Survey (SERFS) from Cape Hatteras, North Carolina to St. Lucie inlet, Florida. Videos obtained from video cameras attached to baited chevron traps as part of a long-term monitoring program. The video metric recorded for this survey was SumCount, the sum of individuals observed over 41 video screen shots. The visual survey used in these analyses was the Reef Visual Census (RVC) carried out by FWRI in the Dry Tortugas and Florida Keys reef tract. This survey occurs annually in the Florida Keys and biannually in the Dry Tortugas, with sites in both regions stratified by reef type and region. Divers sampled the sites and provide the average N of individuals observed by a pair of divers at each site.

Given the different initial date for these surveys and metrics used, data were subset for spatial evaluation of Scamp in the GOM and South Atlantic regions. The first shared year in which the surveys occurred was 2010, so data were limited to 2011-2017 at the time of analysis. Similarly, the varying metrics used to evaluate abundance among the surveys required reduction of data to presence/absence at a site. A series of annual maps were produced to illustrate the overall sampling sites and positive occurrences for Scamp in these regions (Fig. 4). The notable gaps in coverage when using these surveys were primarily in Western GOM and in the South Florida area of the Atlantic between the northern extent of the RVC and southern extent of SERFS in south Florida. However, with these gaps, the general pattern for every year showed that Scamp were distributed throughout the entirety of the sampled regions across multiple habitats and depth strata. As such, there was no clear evidence of a natural population break to warrant an alternative approach than that used in most assessments of separating stocks at the Dry Tortugas.

The visual-based Fishery-Independent survey data are presented as yearly time-steps beginning in 2011 – 2017 as presence/absence with red being present. (Fig. 4)

Fishery Dependent

Headboat Survey

This analysis is based on catch records from the Southeast Regional Headboat Survey (SRHS) using data from 1973-2018. The number of fish reported as caught, released alive, or released dead were summed for each record to compute the total number of fish associated with each record. To estimate a single value of the number of fish for each LOC4Dig polygon, the total number of fish for unique records were summed. To aid in displaying a discernible gradient of values in plots, total number of fish was transformed as log10 (total number of fish +1) (Fig.5).

In calculating effort, the number of hours each angler fished were estimated from the trip Type code, which corresponds to a range approximating the trip duration. The midpoint of each range was used to estimate the mean number of angler hours (per angler). The number of anglers on the trip was multiplied by the mean number of angler hours to estimate the total number of angler hours for the trip (anglerHoursTotal; i.e. effort).

A concatenation of LOC4Dig (polygons), YEAR, and MONTH yields the grouping variable LOC4DigYrMo. Catch per unit effort (CPUE) was calculated at the scale of LOC4DigYrMo as nFish/anglerHoursTotal. To estimate a single value of CPUE for each LOC4Dig polygon a mean CPUE was calculated among values for each LOC4DigYrMo. To aid in displaying a discernible gradient of values in plots, CPUE was converted to units of nFish per 10000 angler hours, and transformed as log10(cpue+1) (Fig. 6). In all plots, positive values were binned into 10 bins of even width, associated with a gradient of color, with an additional bin for zero values in gray. Bin ranges are displayed in a legend with associated colors using interval notation to indicate which bin the limits are included in. Polygons where catch was caught by fewer than three vessels are considered confidential and filled in black. Polygons that are not filled indicate that no fish of any species, in this data set, have been caught there. Numeric values are plotted in each polygon and confidential values are abbreviated "conf". Results indicate two concentrations of landings: North Carolina and west coast of central Florida.

Commercial Data

The distribution of commercial landings from 1986 – 2018 indicated two distinct population centers (Fig. 7). Landings were concentrated in two zones, one on the Central west coast of Florida and secondly off the South Carolina and North Carolina coasts. (Fig. 8). Landings ranged from North Carolina to Texas with minimal landings in the Florida Keys. In the GOM, 79% of landings (1986-2018) came from west Florida, and 15% came from Louisiana. In the

South Atlantic, 64% of landings (1986-2018) came from three South and North Carolina counties. Forty-seven percent of landings came from South Carolina and 31% came from North Carolina. East Florida landings accounted for 12% of total South Atlantic landings.

Scamp and yellowmouth commercial landings were analyzed as annual time-steps. These analyses were reviewed by the working group. The use of landings as monthly, seasonal or annual time-steps as a surrogate for movement was discussed and it was determined that this required more time than available and could be followed up as a research topic.

Comment: Research topic – the utilization of the spatial time series of commercial landings may be a means of evaluating movement. Further studies are recommended but outside the scope of this report.

Recommendation

Based on the compiled 1986-2018 commercial landings distribution the default boundaries are supported.

Recreational Data

Recreational data came from the Marine Recreational Intercept Program (MRIP), the Louisiana LA Creel program and the Texas Parks and Wildlife Department (TPWD) creel program for 1981-2018. A summary of Scamp and Yellowmouth Grouper landings in number-of-fish by state (Fig.9) showed that most recreational landings came from the west coast of Florida through Louisiana, and from North Carolina. Results are consistent with other data reviewed.

Discussion

As this is the first SEDAR assessment of Scamp and Yellowmouth grouper, there are no previously determined stock boundaries. "The default boundaries for assessments should be the current Council boundaries, unless there is reasonable evidence for deviation." Based on the compiled 1986-2018 commercial, recreational and headboat landings distributions and results of a single mark-recapture program, the default boundaries are supported.

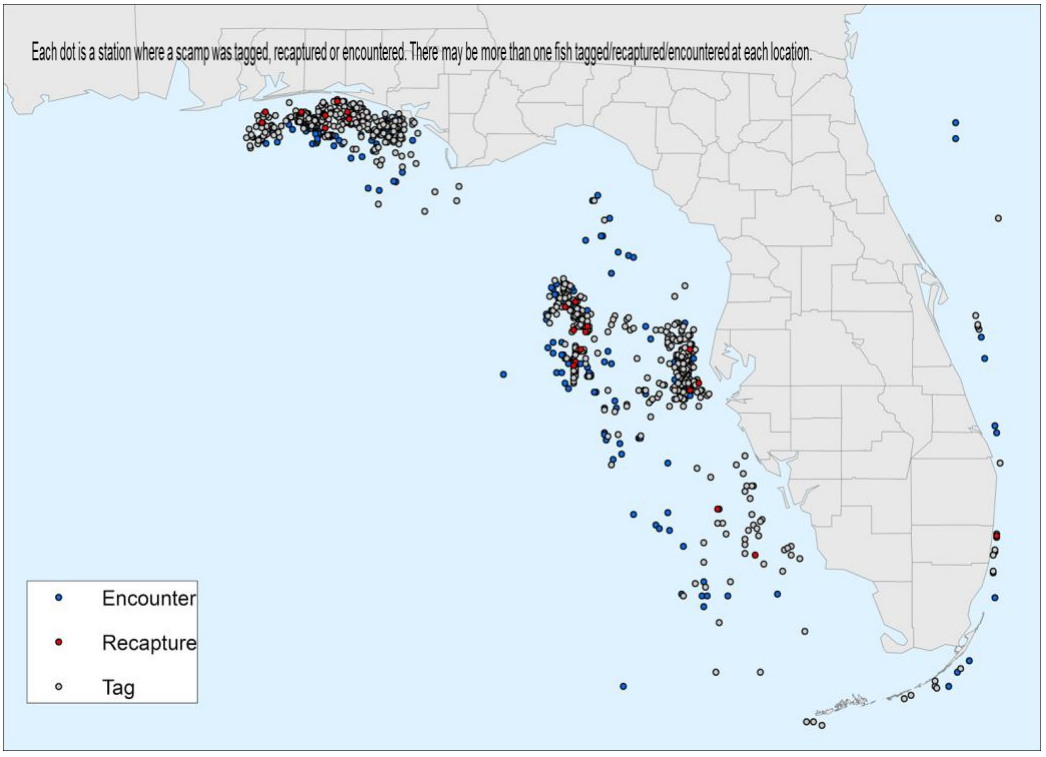

Figure 1. Map of scamp tags, encounters, and recaptures.

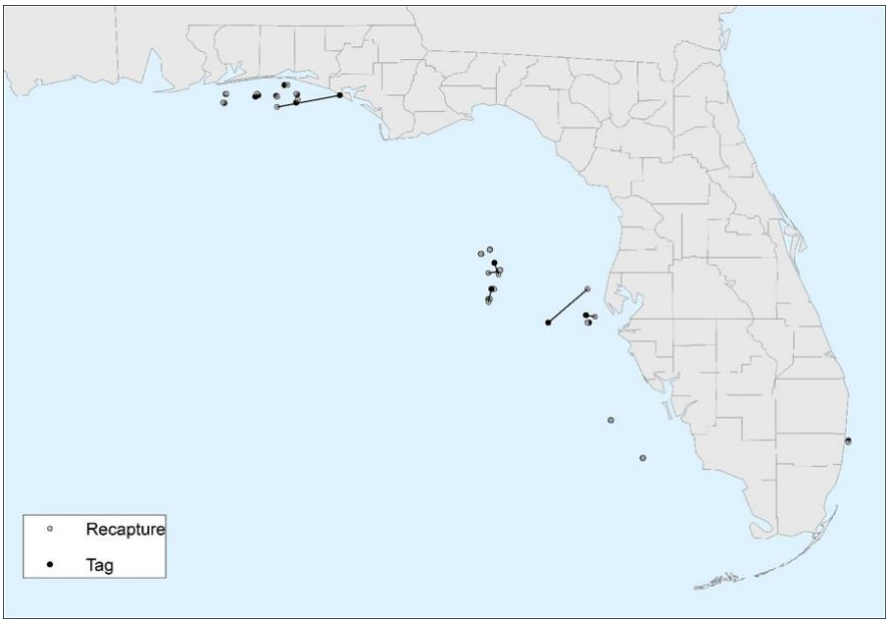

Figure 2. Map of scamp movement based on tags and recaptures with coordinates. Points represent stations where scamp were tagged (black) or recaptured (gray). Each point may represent more than one fish. Lines between points represent distance between the tag and recapture location of individual fish. Gray recapture points without a line to a black tag point indicate fish that did not move.

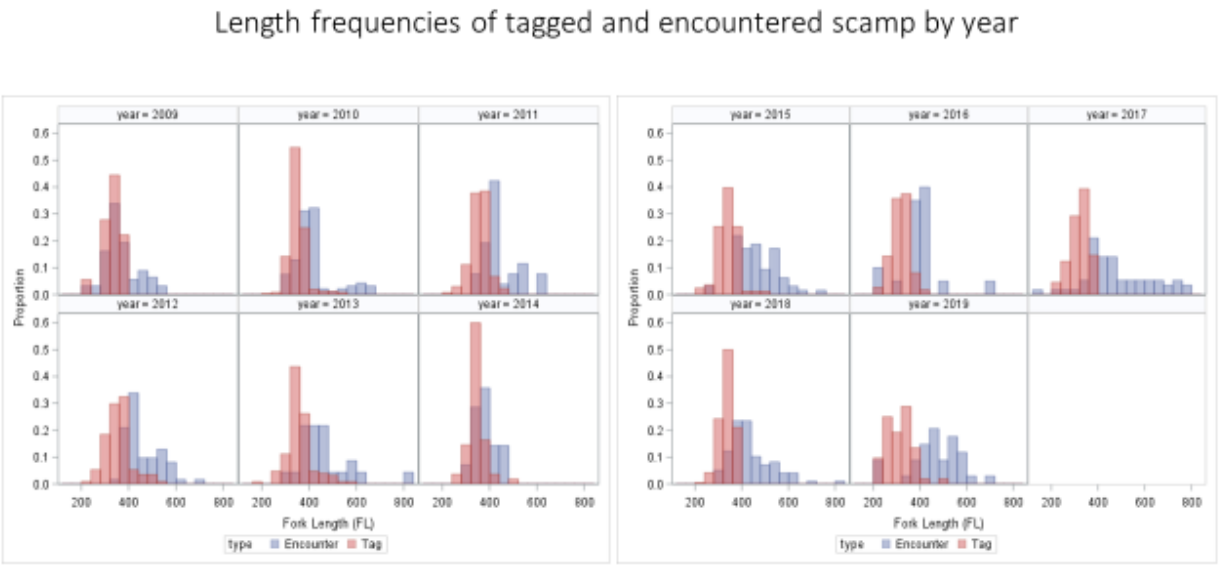

Figure 3. Chart showing Length frequency of tagged and encountered scamp by year.

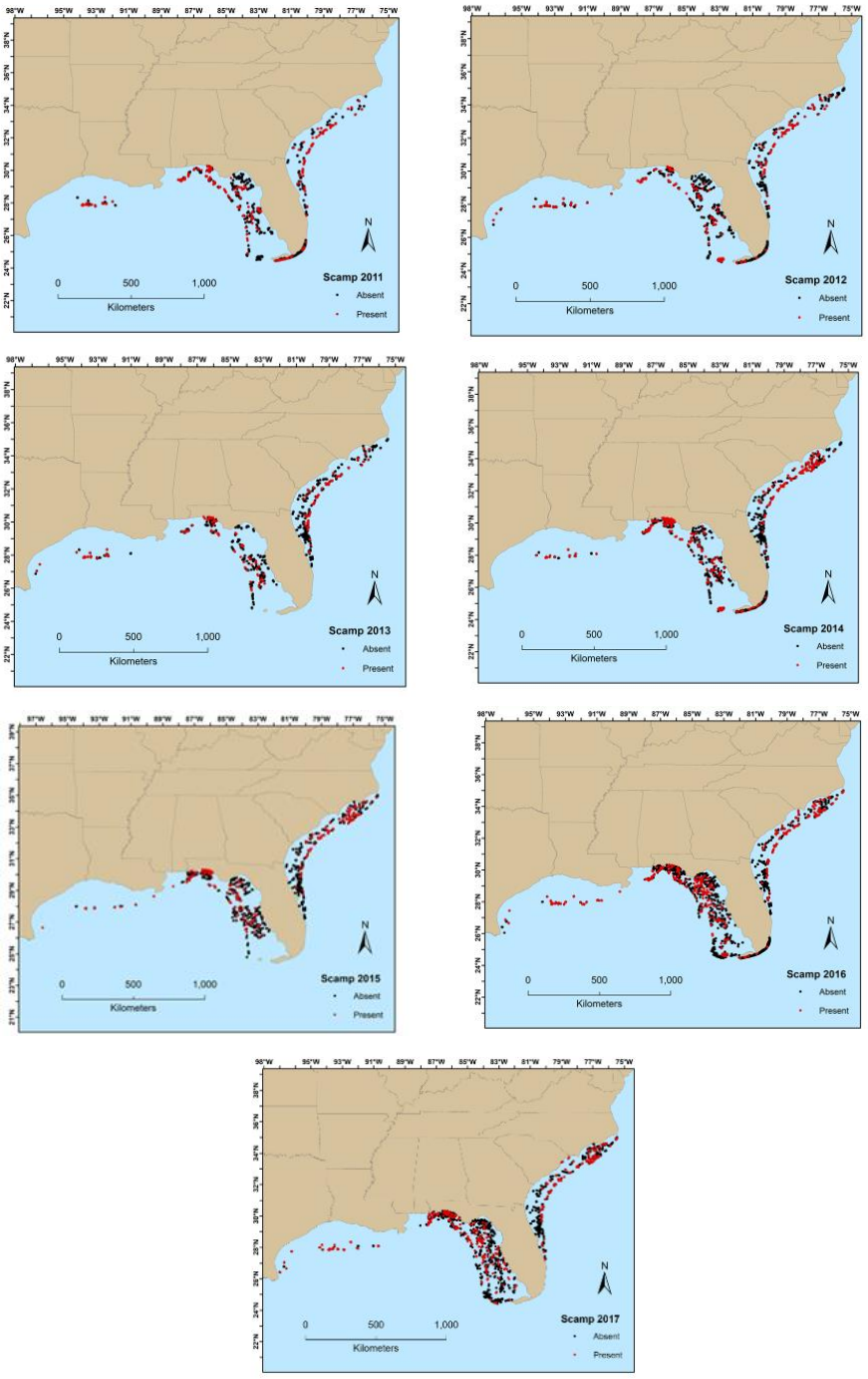

Figure 4. Visual-Based Fishery-Independent Survey Data for Scamp for 2011-2017.

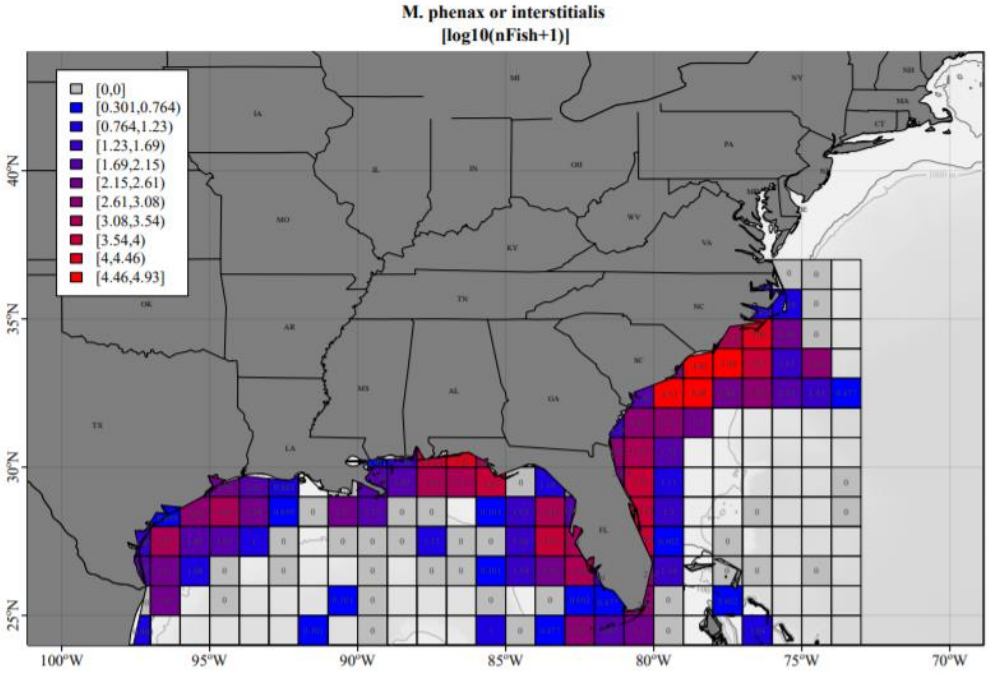

Figure 5. Scamp and yellowmouth grouper, Number of fish, from Headboat Catch Records.

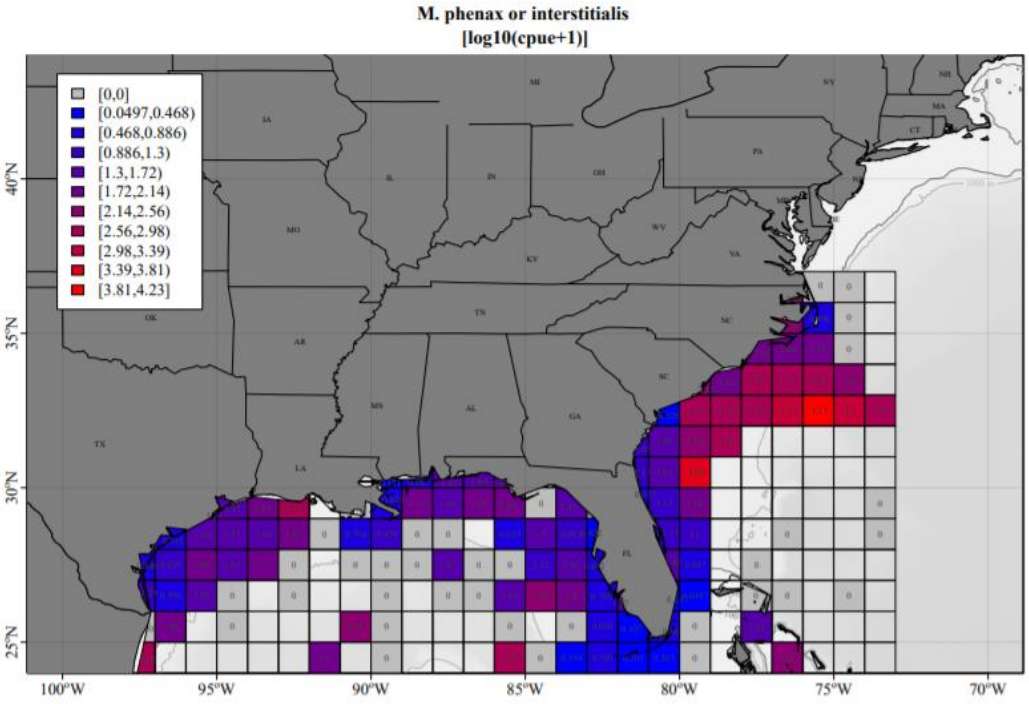

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Figure 6. Scamp and yellowmouth grouper, Catch per Unit effort (CPUE), from Headboat Catch Records, effort based on number of hours fished.

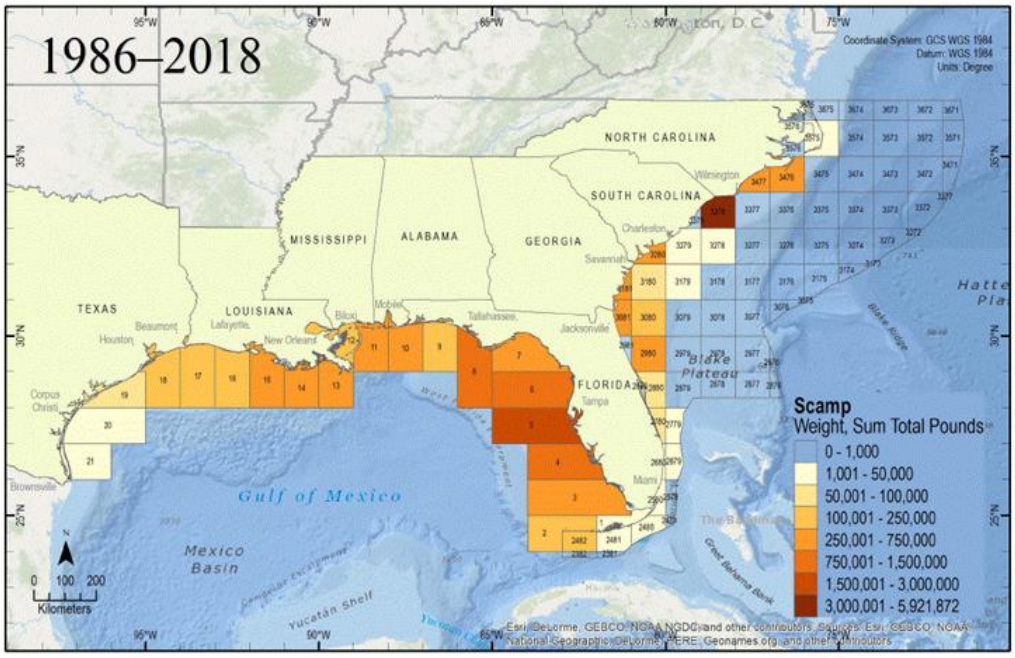

Figure 7: Aggregated Scamp Commercial landings from 1986 through 2018 for the Gulf of Mexico and South Atlantic.

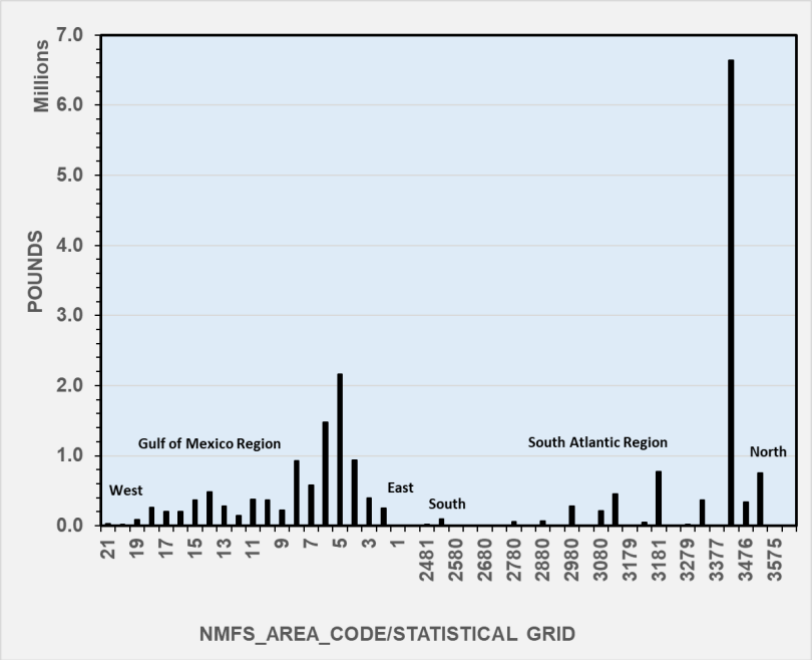

Figure 8. Total landed pounds of commercial landings of Scamp from 1986 – 2018 shown from West to East for the Gulf of Mexico region and from South to North for the South Atlantic region.

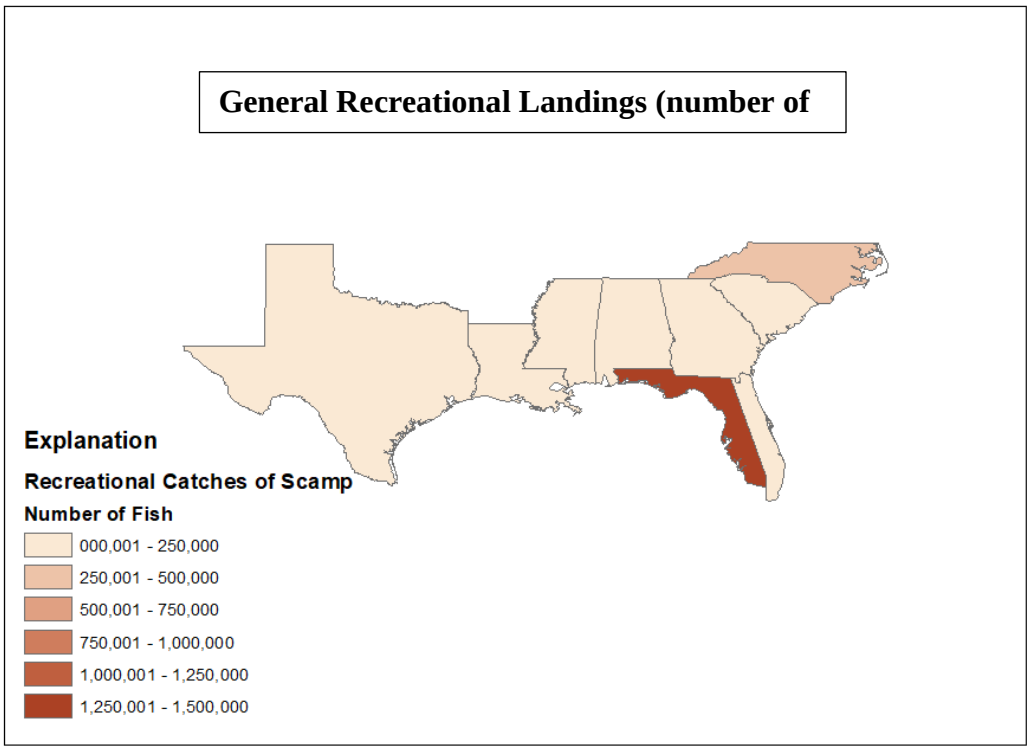

Figure 9. Scamp and Yellowmouth Grouper recreational landings in number of fish from MRIP, LA Creel, and TPWD for 1981-2018.