SEDAR

Southeast Data, Assessment, and Review

SEDAR 64

Southeastern U.S. Yellowtail Snapper

SECTION II: Data Workshop Report

October 2019

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 64 Data Workshop was held June 25-27, 2019 in Saint Petersburg, Florida.

1.2 TERMS OF REFERNCE

1. Review stock structure and unit stock definitions and consider whether changes are required.
2. Review, discuss, and tabulate available life history information.
   - Evaluate age, growth, natural mortality, and reproductive characteristics
   - Provide appropriate models to describe population growth, maturation, and fecundity by age, sex, and/or length by appropriate strata as feasible.
   - 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. Recommend discard mortality rates.
   - Review available research and published literature
   - Consider research directed at yellowtail snapper 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.
   - Include thorough rationale for recommended discard mortality rates
   - Provide justification for any recommendations that deviate from the range of discard mortality provided in the last benchmark or other prior assessment
   - Provide estimates of uncertainty around recommended discard mortality rates
4. Provide measures of population abundance that are appropriate for stock assessment.
   - Consider and discuss all available and relevant fishery-dependent and -independent data sources
   - Consider species identification issues between yellowtail snapper and other species, and correct for these instances as appropriate
   - Document all programs evaluated; address program objectives, methods, coverage, sampling intensity, and other relevant characteristics
   - Provide maps of fishery and 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
   - Discuss the degree to which available indices adequately represent fishery and population conditions

- Recommend which data sources adequately and reliably represent population abundance for use in assessment modeling
- Provide appropriate measures of uncertainty for the abundance indices to be used in stock assessment models
- Rank the available indices with regard to their reliability and suitability for use in assessment modeling

5. Provide commercial catch statistics, including both landings and discards in both pounds and number.
   - Evaluate and discuss the adequacy of available data for accurately characterizing harvest and discard by fishery sector or gear
   - Provide length and age distributions for both landings and discards if feasible
   - Provide maps of fishery effort and harvest and fishery sector or gear
   - Provide estimates of uncertainty around each set of landings and discard estimates
6. Provide recreational catch statistics, including both landings and discards in both pounds and number.
   - Evaluate and discuss the adequacy of available data for accurately characterizing harvest and discard by species and fishery sector or gear
   - Provide length and age distributions for both landings and discards if feasible
   - Provide maps of fishery effort and harvest and fishery sector or gear
   - Provide estimates of uncertainty around each set of landings and discard estimates
7. Identify and describe ecosystem, climate, species interactions, habitat considerations, and/or episodic events that would be reasonably expected to affect population dynamics.
8. Incorporate socioeconomic information into considerations of environmental events that affect stock status and related fishing effort and catch levels as practicable.
9. 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.
10. Review, evaluate, and report on the status and progress of all research recommendations listed in the last assessment, peer review reports, and SSC report concerning this stock.
11. Prepare the Data Workshop report providing complete documentation of workshop actions and decisions in accordance with project schedule deadlines (Section II of the SEDAR assessment report)

1.3 LIST OF PARTICIPANTS

Workshop Panel

Shanae Allen, Co-Lead Analyst .... FWRI, St. Petersburg
Chris Swanson, Co-Lead Analyst .... FWRI, St. Petersburg
Alejandro Acosta .... FL FWC, Marathon
Dustin Addis .... FL FWC, St. Petersburg

Brittany Barbara .... FL FWC, St. Petersburg
Luiz Barbieri .... FL FWC, St. Petersburg
Mike Birren .... Fisherman, Hernando Beach, FL
Chris Bradshaw .... FWRI, St. Petersburg
Steve Brown .... FWRI, Cedar Key
Jessica Carroll .... FL FWC, St. Petersburg
Bridget Cernel .... FL FWC, St. Petersburg
Kerry Flaherty-Walia .... FWRI St. Pete
Rachel Germeroth .... FL FWC, St. Petersburg
Jennifer Herbig .... FWC Marathon
Liz Herdter .... FWRI, St. Petersburg
Manny Herrera .... Commercial Fisherman, Key West, FL
Walter Ingram .... NMFS, Pascagoula
Dominque Lazare .... FWC St. Pete
Charlotte Marin .... FL FWC, St. Petersburg
Vivian Matter .... NMFS Miami
Robert Muller .... FL FWC, St. Petersburg
Joseph Munyanderaro .... FWRI, St. Petersburg
Kevin McCarthy .... NMFS Miami
James Nance .... GMFMC SSC, Galveston, TX
Jeff Renchen .... FL FWC-DMFM, Tallahassee
Kristen Rynerson .... FWRI, St. Petersburg
Beverly Sauls .... FWC St. Pete
Eric Schmidt .... Industry Rep, Ft. Myers, FL
Steven Scyphers .... GMFMC SSC, Medford, MA
George Sedberry .... SAFMC SSC, Savannah, GA
CJ Sweetman .... FL FWC, Marathon
Jim Tolan .... GMFMC SSC/TPWD
Kyle Williams .... FL FWC, St. Petersburg
Beth Wrege .... NMFS Miami

Attendees

Martha Guyas .... FL FWC, GMFMC Rep, Tallahassee
Michael Larkin .... NMFS SERO St. Pete
Jessica McCawley .... FL FWC, SAFMC Rep, Tallahassee

Staff

Julie Neer .... SEDAR
Mike Errigo .... SAFMC
Lisa Hollensead .... GMFMC
Natasha Mendez .... GMFMC
Ryan Rindone .... GMFMC
Camilla Shireman .... GMFMC

Additional Participants via Webinar

Sarina Atkinson .... NMFS Miami

Erika Burgess .... FL FWC
Ben Duffin .... FL FWC
Jim Eliason .... GMFMC SSC
Adam Pollack .... NMFS Pascagoula
Marcel Reichert .... SCDNR
Allison Shideler .... NMFS Miami

1.4 LIST OF DATA WORKSHOP WORKING PAPERS & REFERNCE DOCUMENTS

Document #	Title	Authors	Date Submitted
Documents Prepared for the Data Workshop			
SEDAR64-DW-01	SEAMAP Reef Fish Video Survey: Relative Indices of Abundance of Yellowtail Snapper	Matthew D. Campbell, Kevin R. Rademacher, Michael Hendon, Paul Felts, Brandi Noble, Ryan Caillouet, Joseph Salisbury, and John Moser	20 Dec 2018
SEDAR64-DW-02	A model-based index of Yellowtail Snapper, *Ocyurus chrysurus*, in the Dry Tortugas using Reef Fish Visual Census data from 1999-2016	Christopher E. Swanson	1 March 2019
SEDAR64-DW-03	Juvenile Yellowtail Snapper, *Ocyurus chrysurus*, collected from short-term fisheries-independent surveys in Florida Bay and the Florida Keys from 1994 – 2003	Christopher E. Swanson, Kerry Flaherty-Walia, and Alejandro Acosta	1 March 2019
SEDAR64-DW-04	A model-based index of Yellowtail Snapper, *Ocyurus chrysurus*, for the Florida Reef Tract from Card Sound through the Florida Keys using Reef Fish Visual Census data from 1997-2016	Christopher E. Swanson and Robert G. Muller	1 March 2019
SEDAR64-DW-05	Fisheries-independent data for Yellowtail Snapper (*Ocyurus chrysurus*) from reef-fish visual surveys in the Florida Keys and Dry Tortugas, 1999-2016	Jennifer Herbig, Jeffrey Renchen, Alejandro Acosta	1 March 2019 Updated: 1 July 2019

SEDAR64-DW-06	A model-based index of Yellowtail Snapper, *Ocyurus chrysurus*, for the Northern Florida Reef Tract from Government Cut through Martin County using Reef Fish Visual Census data from 2012-2016	Christopher E. Swanson	1 March 2019 Updated: 13 June 2019
SEDAR64-DW-07	Accuracy and precision of Yellowtail Snapper (*Ocyurus chrysurus*) age determination	Jessica Carroll, Kristen Rynerson, Brittany Barbara	9 April 2019
SEDAR64-DW-08	Abundance and Distribution of Juvenile Yellowtail Snapper in Nearshore Seagrass Habitat in the Middle Florida Keys	Jennifer Herbig, Alejandro Acosta, Ariel Wile	23 May 2019 Updated: 28 June 2019
SEDAR64-DW-09	Standardized Catch Rates of Yellowtail Snapper (*Ocyurus chrysurus*) from the Marine Recreational Information Program (MRIP) in Southeast Florida and the Florida Keys, 1981-2017	Liz Herdter	28 May 2019 Updated: 28 June 2019
SEDAR64-DW-10	Overview of the Southeast Region Headboat Survey and Data Related to Yellowtail Snapper (*Ocyurus chrysurus*)	Shanae Allen, Liz Herdter, and Kelly Fitzpatrick	28 May 2019 Updated: 5 June 2019 Updated: 19 August 2019
SEDAR64-DW-11	Standardized Catch Rates of Yellowtail Snapper (*Ocyurus chrysurus*) from the U.S. Headboat Fishery in Southeast Florida and the Florida Keys, 1981-2017	Liz Herdter and Shanae Allen	28 May 2019
SEDAR64-DW-12	Recreational Survey Data for Southeast Yellowtail Snapper	Vivian M. Matter and Richard C. Jones	26 June 2019 Updated: 15 August 2019 Updated: 28 August 2019
SEDAR64-DW-13	Historical Commercial Fishery Landings of Yellowtail Snapper in Florida and the Southeastern U.S.	Steve Brown and Chris Bradshaw	17 June 2019 Updated: 22 July 2019
SEDAR64-DW-14	Length frequency distributions for yellowtail snapper collected by	Chris Bradshaw and Steve Brown	17 June 2019

	TIPS in the Southeast from 1984 to 2017		
SEDAR64-DW-15	Length distribution and release discard mortality for southeastern yellowtail snapper	Sarina F. Atkinson, Kevin J. McCarthy, Allison C. Shideler	21 June 2019 Updated: 18 July 2019
SEDAR64-DW-16	A Summary of Observer Data Related to the Size Distribution and Release Condition of Yellowtail Snapper from Recreational Fishery Surveys in Florida	Dominique Lazarre	24 July 2019
SEDAR64-DW-17	Social Dimensions of the Recreational Fishery for Yellowtail Snapper (*Ocyurus chrysurus*) in Florida	Steven Scyphers and Kelsi Furman	7 July 2019
SEDAR64-DW-18	Calculated discards of yellowtail snapper from commercial vertical line fishing vessels in southern Florida	Kevin McCarthy and Jose Diaz	19 Sept 2019

Reference Documents

SEDAR64-RD01	Coral Reef Conservation Program (CRCP) Local Action Strategy (LAS) Project 3B "Southeast Florida Coral Reef Fishery-Independent Baseline Assessment" - 2012-2013 Interim Report	Florida Department of Environmental Protection - Coral Reef Conservation Program
SEDAR64-RD02	Implementing the Dry Tortugas National Park Research Natural Area Science Plan - The 10-Year Report	Florida Fish and Wildlife Conservation Commission
SEDAR64-RD03	Examining movement patterns of yellowtail snapper, *Ocyurus chrysurus*, in the Dry Tortugas, Florida	Jennifer L Herbig, Jessica A Keller, Danielle Morley, Kristen Walter, Paul Barbera, Alejandro Acosta
SEDAR64-RD04	Yellowtail Snapper Fishery Performance Report	SAFMC Snapper Grouper Advisory Panel
SEDAR64-RD05	Reflex impairment and physiology as predictors of delayed mortality in	Francesca C. Forrestal, M. Danielle McDonald, Georgianna Burress and David J. Die

	recreationally caught yellowtail snapper (*Ocyurus chrysurus*)	
SEDAR64-RD06	Preliminary Observations of Abundance and Distribution of Settlement-Stage Snappers in Shallow, Nearshore Seagrass Beds in the Middle Florida Keys	**Claudine T. Bartels and Karole L. Ferguson**
SEDAR64-RD07	*Lutjanus Ambiguus* (Poey), a Natural Intergeneric Hybrid of *Ocyurus Chrysurus* (Bloch) and *Lutjanus Synagris* (Linnaeus)	William F. Loftus
SEDAR64-RD08	A Laboratory Produced Hybrid Between *Lutjanus Synagris* and *Ocyurus Chrysurus* and a Probable Hybrid Between *L. Griseus* and *0. Chrysurus* (Perciformes: Lutjanidae)	M. L. Domeier and M. E. Clarke
SEDAR64-RD09	A Survey to Characterize Harvest and Regulatory Discards in the Offshore Recreational Charter Fishery off the Atlantic Coast of Florida	Beverly Sauls and Oscar Ayala
SEDAR64-RD10	Seagrass Habitats as Nurseries for Reef-Associated Fish: Evidence from Fish Assemblages in and Adjacent to a Recently Established No-Take Marine Reserve in Dry Tortugas National Park, Florida, USA	Kerry E. Flaherty-Walia, Brett Pittinger, Theodore S. Switzer, Sean F. Keenan
SEDAR64-RD11	Fish assemblages in seagrass habitats of the Florida Keys, Florida: spatial and temporal characteristics	A. Acosta, C. Bartels, J. Colvocoresses, and M. F. D. Greenwood
SEDAR64-RD12	Model-estimated conversion factors for calibrating Coastal Household Telephone Survey (CHTS) charterboat 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	Kyle Dettloff and Vivian Matter

2 LIFE HISTORY

2.1 OVERVIEW

The Life History Workgroup (LHW) reviewed and discussed available data for Yellowtail Snapper and offered recommendations. Information was examined on natural mortality, release mortality, age, growth, reproduction, habitat, movements and migrations, size conversions, and episodic events. A summary of the data presented, discussed, and recommendations made is presented below.

2.1.1 Life History Workgroup members

Jessica Carroll (lead)	FWRI, St. Petersburg, FL
Alejandro Acosta (lead)	FWRI, Marathon, FL
Jim Tolan	TPWD, Corpus Christi, TX
George Sedberry	SSC, SAFMC (chair)
CJ Sweetman	FWC-DMFM, Marathon, FL
Joseph Munyandorero	FWRI, St. Petersburg, FL
Kerry Flaherty-Walia	FWRI, St. Petersburg, FL
Kristen Rynerson	FWRI, St. Petersburg, FL
Brittany Barbara	FWRI, St. Petersburg, FL
Kyle Williams	FWRI, St. Petersburg, FL

2.2 REVIEW OF WORKING PAPERS

Three working papers were submitted for review to the LHW:

SEDAR64-DW-03: Juvenile Yellowtail Snapper, *Ocyurus chrysurus*, collected from short-term fisheries-independent surveys in Florida Bay and the Florida Keys from 1994 – 2003.

SEDAR-DW-07: Accuracy and precision of Yellowtail Snapper (*Ocyurus chrysurus*) age determination.

SEDAR64-DW-08: Abundance and Distribution of Juvenile Yellowtail Snapper in Nearshore Seagrass Habitat in the Middle Florida Keys.

Discussion of working papers and other literature reviewed is listed below by topic.

2.3 STOCK DEFINITION AND DESCRIPTION

2.3.1 Classification and Identification Issues

Nelson et al. (2004) present the taxonomic classification of Yellowtail Snapper as follows:

Kingdom: Animalia (animals)
Phylum: Chordata (organisms with a notochord)
Subphylum: Vertebrata (animals with a backbone)
Class: Actinopterygii (ray-finned fishes)
Order: Perciformes
Family: Lutjanidae
Genus: *Ocyurus*
Species: *chrysurus* (Bloch 1791)

Common names: Yellowtail Snapper (English), rubia (Spanish), la colirrubia [Puerto Rico; Figuerola et al. (1998)], pargo canane [Mexico; Mexicano-Cíntora (1999)], la rabirrubia [Mexico; Rincón-Sandoval et al. (2009)], and probably others.

This species is readily recognizable, with a yellow lateral stripe and deeply forked yellow tail (Fig. 2.15.1). Yellowtail Snapper may associate for feeding purposes (e.g., Sikkel and Hardison 1992) with schools of Yellow Goatfish ([*Mulloidichthys martinicus* (Cuvier 1829)] which are superficially similar in appearance but are easily distinguishable. Historically, "yellowtail" was used for reporting commercial landings of Silver Perch (*Bairdiella chrysoura*) only in 1923 on Florida's east coast (U.S. Bureau of Fisheries, 1925), but for Florida's west coast and for other states bordering the Gulf of Mexico the "yellowtail" reporting category referred to Yellowtail Snapper (e.g., U.S. Bureau of Fisheries, 1904, 1920, 1926, and later).

Historically, a natural hybrid between Yellowtail Snapper and Lane Snapper (*Lutjanus synagris*) was described by Poey (1860) as *Lutjanus ambiguus*. Subsequent research comparing meristic and morphometric characteristics (Loftus 1992) and laboratory experiments producing hybrid individuals (Domeier and Clark 1992) concluded that this description is indeed a hybrid between Yellowtail and Lane Snapper and that Yellowtail Snapper could potentially hybridize with Gray Snapper (*Lutjanus griseus*) as well. The incidence of this hybrid is relatively rare (only 30 records or museum specimens were reported from Loftus [1992]), however, it has been encountered recently by scientists on the panel and reported from the public for this assessment via the Gulf of Mexico Fishery Management Council's "Something's Fishy about Yellowtail Snapper" tool.

2.3.2 Stock Definition and Description

The Yellowtail Snapper fishery is managed in the U.S. by the South Atlantic Fishery Management Council (SAFMC) and the Gulf of Mexico Fishery Management Council (GMFMC) as separate stock units with the boundary being U.S. Highway 1 in the Florida Keys west to the Dry Tortugas (Fig. 2.15.2). Additionally, the State of Florida participates in the management of this species in state waters. Other states in the SAFMC and GMFMC jurisdictions defer to the federal management regulations for this species. Both SEDAR 3 (Muller et al. 2003) and SEDAR 27A (O'Hop et al. 2012) used data from genetic analyses available at the time (Hoffman et al. 2003) to treat Yellowtail Snapper in the SAFMC and GMFMC jurisdictions as a single stock for assessment purposes and the LHW continued to recommend this approach.

The species is found in the Western Central Atlantic region, from the U.S. Atlantic coast, Gulf of Mexico, Caribbean Sea, to Brazil. Yellowtail Snapper is an important part of the reef fish assemblage in the western, tropical Atlantic and is caught by both recreational and commercial fisheries in south Florida and the Bahamas (Johnson 1983; Manooch and Drennon 1987; Garcia et al. 2003; Saillant et al. 2012). While the biological stock extends along the southeastern U.S. beyond the coasts of Florida and is considered a single unit for management purposes, the LHW recommended that only data from Florida be considered for assessment modeling and management purposes. This recommendation came largely due to 1) the greater concentration of landings off south Florida and the Florida Keys and 2) the multiple growth patterns exhibited due to the presence of larger and older individuals caught off the Carolinas not subjected to the greater directed fishing pressures in Florida.

2.3.3 Population Genetics

The stock structure of Yellowtail Snapper is not clearly understood, however, populations from southeastern U.S. waters are believed to belong to a single stock. Mitochondrial and microsatellite DNA analyzed from seven locations in southern Florida and Puerto Rico found little evidence of population structuring between the Florida Keys, southeast Florida, and Puerto

Rico (Hoffman et al. 2003; O'Hop et al. 2012). Further support from another study in the Florida Keys and the eastern Caribbean revealed occurrences of up to four groupings (stocks) of Yellowtail Snapper: 1) in the Florida Keys, 2) along the west coast of Puerto Rico, 3) along the east coast of Puerto Rico and St. Thomas, and 4) offshore of St. Croix (Saillant et al. 2012). However, the genetic linkages between the Gulf of Mexico and western Caribbean remain unknown. Vasconcellos et al. (2008) and more recently da Silva et al. (2015) compared mitochondrial DNA and morphometrics of specimens collected off Brazil and Belize and found that Brazilian populations appear to be from a single stock but differed significantly from populations off Belize.

2.3.4 Larval Transport/Connectivity

Despite the ecological and economic importance of western Atlantic Ocean lutjanid species, little is known about their larval stage. Lutjanids, like most marine fishes, have a pelagic egg/larval stage that lasts for several weeks during which time they are highly vulnerable to starvation, predation, and advection away from suitable juvenile habitat, and survival rates may be near zero (Houde 1987; D'Alessandro et al. 2010).

Complete descriptions of larval ontogeny are available for only 6 of the 18 western Atlantic snapper species, and the few studies on lutjanid larvae have been descriptive in nature and/or used captive-bred larvae (Riley et al. 1995, Clarke et al. 1997, Drass et al. 2000, D'Alessandro et al. 2010, D'Alessandro and Sponaugle 2011), or have examined otolith-based traits of late-stage larvae and juveniles to make inferences about pelagic larval life (Tzeng et al. 2003, Denit and Sponaugle 2004). Studies directly examining the early life history of wild-caught larvae beyond coarse distributions at the genus level are largely lacking due in large part to the difficulties involved in adequately sampling diffuse populations of larvae in the open ocean, and in identifying them to the species level (Lindeman et al. 2006, D'Alessandro et al. 2010, D'Alessandro and Sponaugle 2011). D'Alessandro et al. (2010) reported that eight snapper species including Yellowtail Snapper had significant spatiotemporal larval distribution patterns with most snapper larvae occurring from July to September when water temperatures were warmest, and Yellowtail Snapper was most abundant from 0- 25 meters. Despite between-year variability and presence of snapper larvae in most months, temporal distributions of larval abundance, occurrence, and concentration all point to peaks in spawning activity in July to

September, consistent with existing literature and the subtropical area sampled (Thresher 1984, Grimes 1987, Leis 1987).

2.3.5 Distribution, Habitat, and Trophic Structure

Yellowtail Snapper range mainly from the Carolinas southward to southeastern Brazil (Druzhinin 1970, SEDAR8 DW-Figure 1). Occasional reports in Bermuda and off Massachusetts and in the Cape Verde Islands off the Atlantic coast of Africa exist, however these occurrences are not common (Druzhinin 1970). This species is observed most in the Bahamas, south Florida, the Netherlands Antilles, Campeche Bank and throughout the Caribbean (Randall 1967, Fischer 1978, Allen 1985, Hoese and Moore 1998). Yellowtail Snapper are also occasionally found in the eastern Atlantic along with the gray, queen, and lane snappers (Fischer 1978, Allen 1985).

Yellowtail Snapper are considered ubiquitous and utilize a variety of habitat types during their life, making ontogenetic migrations between settlement, sub-adult, and adult developmental stages. It is reported to exhibit a niche requirement close to that of Vermilion Snapper, *Rhomboplites aurorubens*, because unlike many other snapper species, Yellowtail Snapper are usually seen well above the substrate, swimming in large schools or in small groups (Grimes 1976). Juveniles are found in shallow coastal waters over back reefs and on seagrass beds (especially turtle grass, *Thallasia testudinum).* Juveniles have been reported in mangrove habitats off the southwest coast of Puerto Rico and Tortola British Virgin Islands (Kimmel 1985, Boulon 1992, Rooker and Dennis 1991) and off the Netherlands Antilles (Nagelkerken et al. 2001). The extent to which Yellowtail Snapper depend on mangrove prop root habitat as a larval and juvenile nursery area is not clear (Dennis 1998). For juveniles, the mangrove habitat may be important on a seasonal basis as Yellowtail Snapper were reported there only occasionally (Cummings 2004). Bartels and Ferguson (2006) and Herbig et al. (2019c) found individuals in the 16 – 30 mm SL range in nearshore seagrass habitats in the middle Florida Keys. In the Dry Tortugas, Yellowtail Snapper as small as 33 mm SL were collected in seagrass habitats (Flaherty-Walia et al. 2017, Swanson et al. 2019). Adults are associated with coral reefs and other hard bottom substrate and are generally found in schools above the substrate (Hoese and Moore, 1998, Herbig et al. 2019b) and at depths ranging from 32 to 230 feet (10-70 m; GMFMC 2013).

Yellowtail Snapper are carnivorous, with adults and juveniles feeding above the bottom. Detailed information on feeding habits is limited to just a few studies off Cuba, Virgin Islands, south Florida, and the Netherlands Antilles. Longley and Hildebrand (1941, reported in Thompson and Munro 1974) indicated that Yellowtail Snapper did not restrict feeding to nocturnal periods as commonly seen in other lutjanids, but ranged freely throughout the reef and fed both by day and night. Cummings (2004) suggested that Yellowtail Snapper feeds opportunistically throughout the day and Friedlander et al. (2013) suggested that Yellowtail Snapper feed primarily at night. Herbig et al (2019a) reported that tagged fish could be using the hardbottom/coral reef and seagrass habitats to forage from dusk throughout the night and then return at dawn to forage along the reef edge throughout the day. However, foraging in seagrass habitat has previously only been associated with juvenile or subadult individuals (Cummings 2004, Verweij et al. 2008) and the fish in this study were mature adults. Yellowtail Snapper have also been shown to eat the eggs of other spawning fish (Cummings 2004) and may leave the area to take advantage of the many species of fish that spawn in the evening. Other food items include cephalopods and worms (Barbieri and Colvocoresses 2003- south Florida). Several researchers have reported seasonal variability in feeding. de Albornoz and Ramiro (1988) found most stomachs of Yellowtail Snapper sampled off Cuba to be full from January to April, and, a reduction in stomach content from May on, correlating with the observed season of spawning in that region (Mar-August, peaking in June). Collins and Finucane (1989) reported similar observations for fish sampled off south Florida. The diversity of their diet as well as the size of the foraging area increases with the size of the juveniles, possibly reflecting ontogenetic changes in diet with growth.

2.4 NATURAL MORTALITY

Yellowtail Snapper natural mortality was estimated assuming that the instantaneous natural mortality was inversely related to fish length (Lorenzen 2005) and held constant over time. From analyses of ages in the catch, fish were found to be fully vulnerable to fishing gears by age 3. This relation was therefore scaled so that the cumulative instantaneous rate predicted during ages 3-28 agreed with the cumulative rate over these same ages calculated from a constant mortality-at-age estimate derived from maximum age. The LHW recommended using the $\text{Hoenig}_{\text{all taxa}}$ (1983) equation:

$$M = e^{(1.44-0.982*\ln(t_{max}))}$$

where M is the constant mortality-at-age (to be used as the target M) and t_{max} is the observed maximum age for the species. Accordingly, constant mortality-at-age was found to be equal to 0.160 using a maximum age of 28 years.

Length-at-age required for this analysis was predicted using a size-truncated von Bertalanffy growth model to account for size limit effects fit to observed age and length data assuming a hatching date of July 1 (see section 2.6 below). Using these growth parameters and the above constant mortality-at-age value, natural mortality-at-age ($M_{at\text{-}age}$) was found to range from 0.385 – 0.147 (Table 2.14.1, Fig 2.15.3).

2.4.1 Sensitivity Analyses

Sensitivity analyses recommended by SEDAR Best Practices (2016) included using the standard deviation around the average age of older fish or average age of multiple readers of the oldest fish age structure. However, otolith sample sizes for older Yellowtail Snapper are quite limited (e.g. fish >= age 20; n = 19) and only 1 individual has been observed with maximum age 28. Therefore, the LHW recommended varying maximum age to create upper and lower bounds for natural mortality-at-age. The upper bound was set to maximum age 20 years because it is the maximum age observed in Florida. The lower bound was set to maximum age 33 years because it represents a possible future maximum age seen in the next assessment based on the maximum age difference seen between this and the previous assessment (i.e. 5 years maximum age difference [28 – 23] from the previous assessment corresponds to 5 years maximum age difference [33-28] here). Natural mortality-at-age ($M_{at\text{-}age(tmax=20)}$) for the upper bound was found to range from 0.536 – 0.204 (M_{target} = 0.223) and the lower bound ($M_{at\text{-}age(tmax=33)}$) ranged from 0.328 – 0.125 (M_{target} = 0.136; Table 2.14.1, Fig 2.15.3).

The LHW also recommended a sensitivity analysis using the *M/k* ratio, a Beverton-Holt life history invariant (Beverton 1992; Charnov 1993; Jensen 1996; Hordyk et al. 2015). Using the von Bertalanffy *k* parameter (k = 0.200; see section 2.6 below) and the constant mortality-at-age values above (M = 0.160, 0.223, and 0.136 for maximum ages of 28, 20, and 33, respectively), *M/k* ratios were found to be 0.800, 1.115, and 0.680, respectively. The range of these ratio values were less than the invariant *M/k* = 1.5, however they are still within the variability which fish species reportedly exhibit (Hordyk et al. 2015). For the *M/k* ratio of Yellowtail Snapper to be equal to 1.5, following Jensen (1996) where $M = 1.5 * k$, M would equal 0.30 and corresponds to a similar constant mortality-at-age estimate using maximum age of 15 years (M=0.295).

2.4.2 Episodic Mortality Events

No attempt was made to investigate episodic types of natural mortality (red tides, cold kills, oil spills, etc.) because there were no data on which to base such modifications to the M parameter. Red tide blooms are more commonly seen on Florida's Gulf Coast and usually occur well north of the Florida Keys and away from the center of the distribution of Yellowtail Snapper. Cold stuns and kills from water temperatures of perhaps 15ºC or lower (see discussion in Gilmore et al. 1978), while infrequent, may occur once or twice a decade in Florida. There was an account of a cold kill during late January 1940 (Galloway 1941) noting that large numbers of many species including Yellowtail Snapper washed ashore in Key West after water temperature dropped below 14ºC. In other accounts of cold kill events in Florida (even in the Florida Keys; Miller 1940), either a listing of the species affected was not given (e.g., Packard 1871, Finch 1917) or Yellowtail Snapper were not mentioned explicitly [see discussions in Storey and Gudger (1936) and Snelson and Bradley (1978)]. An extreme cold event during the winter of 2010 caused massive mortality of patch reefs in the Florida Keys (Colella et al. 2012) which most likely impacted Yellowtail Snapper habitat. Although subtropical fish species in various regions of Florida were affected by this event (Stevens et al. 2016), no specific reports on Yellowtail Snapper mortalities were reported (Hallac et al. 2010).

2.5 RELEASE MORTALITY

An ad-hoc workgroup comprised of all workshop panelist was convened during the Data Workshop to discuss discard mortality. SEDAR 27A (O'Hop et al. 2012) used headboat observer data to choose a lower bound immediate release mortality rate (10%) and performed sensitivity runs on higher values (20% and 30%) in attempt to account for delayed mortality. Studies on fishing-induced mortality on released Yellowtail Snapper included at-sea sampling methods from the commercial and headboat sectors and were decided to be sufficient to provide an upper and lower bound of immediate release mortality, as well as the range of sizes released (Atkinson et al. 2019). The Workgroup decided on a 10% lower bound for both commercial and recreational fisheries. The upper bound of sensitivity runs for higher values were set at 15% for the commercial sector and 20% and 30% for the recreational sector. This assessment is based on a suitable sensitivity analysis based on different runs at different rates of release mortality. In the absence of any substantive empirical data the panel consider this approach to be a reasonable approximation for a release mortality rate for this species. However, attempts should be made to obtain a more accurate estimate of discard mortality such as the work conducted by Forrestal et al (2017) on the development of physiological parameters to evaluate post release mortality of under-sized Yellowtail Snapper.

2.6 AGE AND GROWTH

2.6.1 Available Age Data

The National Marine Fisheries Service Panama City laboratory (PCLAB), the National Marine Fisheries Service Beaufort laboratory (NCLAB), and the Florida Fish and Wildlife Research Institute (FWRI) age and growth laboratory supplied data from 58,539 otoliths from 1980 – 2017. These otoliths were collected by various federal and state biologists involved in fishery-dependent [Trip Interview Program (TIP), Head Boat Survey (HBS), and Marine Recreational Information Program (MRIP)] and fishery-independent (FWRI's Fisheries Independent Monitoring and Fish Biology) data collection programs on both Atlantic and Gulf of Mexico coasts. Sectioned otoliths are the preferred structures for ageing Yellowtail Snapper (Johnson 1983, Manooch and Drennon 1987, Garcia et al. 2003) and were used to count annuli, score the edge type, and adjust the annuli counts to provide age estimates in years.

Marginal increment analyses (e.g., Garcia et al. 2003; Carroll et al. 2019) have indirectly validated that Yellowtail Snapper form an opaque annulus in the spring (typically March-June) and deposition is assumed to be completed by July 1. Annuli of most snappers (including Yellowtail) are easily discerned and present no special challenges for laboratory analyses. FWRI's quality assurance techniques used multiple reads to develop consensus among the readers and consistency in the annuli counts and edge data. Campana (2001) suggests an average percent error (APE) of 5% or less as an acceptable benchmark for precision. Ageing precision was below this benchmark and can be reliably used for analyses in this assessment (Carroll et al. 2019).

Calendar ages were calculated using annulus count (number of opaque zones), degree of marginal completion, average date of otolith increment deposition, and date of capture. Using these criteria, age was advanced by one year if a large translucent zone was visible on the margin and the capture date was between January 1 and June 30. For all fish collected after June 30, age was assigned to be annulus count. Calendar ages were converted to fractional or monthly biological ages based on a July 1 hatch date and month of capture.

2.6.2 Maximum Age

The current maximum observed age of Yellowtail Snapper based on sectional otoliths (n = 1) is 28 years and represents the maximum age for the entire southeastern U.S. stock. This is an update to the previous assessment which observed maximum age for this species at age 23 years (O'Hop et al. 2012). However, the oldest fish collected from Florida waters is currently age 20. The LHW discussed that fish greater than age 20 (n = 15) were sampled along the northern range of the species (off North Carolina and South Carolina) and not subject to greater levels of fishing pressure which occur within core fishery areas of south Florida waters.

2.6.3 Growth

To model growth, data were filtered to eliminate records: 1) that were identified as outliers, 2) that included a known size or effort bias, and 3) where lengths were collected using a known non-random sampling method or were selected by quota sampling. Data were further restricted to records containing complete information on year, month, and state (or were assigned a state based on area fished or sample location if the area fished was unknown or unassigned). The filtered dataset contained 45,280 length-at-age observations coming from 5 defined regions within Florida waters (northwest, southwest, the Florida Keys, southeast, and northeast Florida) and from waters outside Florida along the southeastern US Atlantic and Gulf of Mexico (Table 2.14.2) For confidentiality purposes, data from areas outside of Florida are defined as either "west of Florida" or "north of Florida". The majority of Yellowtail Snapper within the filtered age data were found to be age-2 and -3 (56.9%) with ages 2 – 6 comprising 89.9% of the age data (Table 2.14.3). Ages sampled from the recreational fishery constituted a total of 52.4%, predominantly from the headboat survey, while ages sampled from the commercial fishery made up 46.9% (Table 2.14.4). Age data from fishery-independent sources comprised <1% for Yellowtail Snapper (Table 2.14.4).

Length-at-age data for Yellowtail Snapper are almost exclusively (99.3%) from the state of Florida (n=44,953 otoliths). Within Florida, 62.4% (n = 28,250 otoliths) come from the Florida Keys region (Monroe County) and 33.2% (n = 15,031 otoliths) come from southeast Florida region (Indian River County south to Miami-Dade County; Table 2.14.2). The amount of length-at-age data collected and available for this assessment has more than doubled what was used since the terminal year (2010) of the previous assessment (O'Hop et al 2012) and the LHW noted the emergence of an additional growth pattern caused by the larger and older fish sampled outside Florida waters (n = 326 otoliths; Figure 2.15.4A). As noted above (Section 2.6.2), these additional fish were sampled in areas not subject to the elevated levels of fishing pressure common in the core fishery areas of south Florida waters and thus experienced longevity not observed in Florida. Since this assessment is focused on providing management advice for the fishery, which is predominantly based in Florida, the inclusion or exclusion of data from the larger and older fish from outside Florida was discussed extensively by the LHW. Ultimately, the non-Florida length-at-age data was deemed not adequately representative of the fishery and attempts at modeling growth yielded poor fits. The LHW therefore recommended the exclusive use of Florida data to model growth for this assessment (n = 44,953 otoliths).

Length-at-age data, based on fractional (monthly biological) ages and observed fork lengths at capture, were modeled using a size-truncated von Bertalanffy growth model (Diaz et al. 2004) executed in ADMB (Auto Differentiate Model Builder). This growth model accounts for minimum size restrictions (using a truncated normal distribution) which influence non-random sampling across ages (e.g. smaller fish not available to sample) and allows for the exploration of alternative variance structures. Model options for variance structures are: 1) constant standard deviation (SD) with age, 2) constant coefficient of variation (CV) with age, 3) variance proportion to the mean, 4) CV increases linearly with age, and 5) CV increases linearly with size at age. This growth model also accommodates data-weighting as a direct input and was explored here using inverse-weighting by $1/n$ of each calendar age or calendar age plus group (Burton et al. 2015). Size truncation was set using the minimum size limit of 12" TL (248 mm FL) first implemented by the SAFMC Snapper-Grouper FMP amendment on 8/31/1983. Model selection criteria was based on model convergence (maximum gradient < 0.0001), model objective function (minimized negative loglikelihood), Akaike Information Criteria (AIC), and model standardized-residual diagnostic plots.

Several models were considered to best fit the data: 1) an unweighted non-truncated model, 2) a size-truncated model using a random selection of no more than 30 length observations per age 3) a size-truncated model using inverse-weighting that includes an age 8+ group, and 4) a size-truncated model using inverse-weighting that includes an age 12+ group. The size-truncated model using inverse-weighting that included an age 12+ group (n = 42,985 otoliths) and estimated a constant CV at age (CV = 0.18) was selected as the final most parsimonious model (Fig 2.15.4B) with equation:

$$L_t = 426\left(1 - e^{-0.20(t+1.93)}\right)$$

Diagnostic plots for the final model are in Fig. 2.15.5. A comparison of the outputs between the four von Bertalanffy growth models can be found in Table 2.14.5 while Figure 2.15.6 compares them against the observed length-at-age data.

2.7 REPRODUCTION

Barbieri and Colvocoresses (2003) used chevron traps and hook and line gear to study several species of snappers (including Yellowtail Snapper) off the coast of Tequesta (southeast Florida) and the Florida Keys. Their reproductive data have been used to inform prior Yellowtail Snapper assessments (Muller et al. 2003; O'Hop et al. 2012) and were used again for this assessment as no new reproductive data have become available. Therefore, following SEDAR Best Practices (2016) a more complete summary and discussion on Yellowtail Snapper reproductive characteristics can be found in Section II, 5.6 of SEDAR 27A (O'Hop et al. 2012) and will not replicated in its entirety here.

2.7.1 Spawning Season

Yellowtail Snapper are gonochoristic (individuals remain the same sex throughout their lifetime) and are multiple (batch) spawners with indeterminate fecundity (Barbieri and Colvocoresses

2003). In the Florida Keys, spawning peaks during April to August but can occur year-round (McClellan and Cummings 1998; Collins and Finucane 1989). Gonadosomatic indices from studies in the Florida Keys (e.g. Collins and Finucane 1989; Pinkard and Shenker 2001; Barbieri and Colvocoresses 2003) reported increasing values beginning in April and remained high through July or August. In Cuban waters, peak spawning occurs in April with another less intensive peak in September (Claro et al. 2001). Large spawning aggregations have been reported to form seasonally off the coasts of Cuba, the Turks and Caicos Islands, U.S. Virgin Islands, and during May – July southwest of Key West, FL, at Riley's Hump off the Dry Tortugas (Lindeman et al. 2000).

2.7.2 Age/Size and Maturity

Maturity data from Barbieri and Colvocoresses (2003) on the reproductive stage of gonads (assessed histologically) from the peak spawning period (April-October) were used to create a size- and age- based maturation schedule for female Yellowtail Snapper following the recommendations of Hunter and Macewicz (1985, 2003). Gonad maturity stages (GMS; Table 2.14.6) were assigned a maturity value of 1 if greater than stage 1 and a value of zero if GMS=1 (immature, primary oocytes only present or sex undetermined due to lack of development). These data were fit to a logistic regression that explicitly provides estimates of both the slope (R) and proportion at 50% of the maximum value (Quinn and DeRiso 1999; PROC NLIN, SAS ver 9.2):

Equation 2.7.2.1 for length:

$$y = \frac{1}{\left(1 + \left(e^{-R*\,(x - L_{50})}\right)\right)}$$

Equation 2.7.2.2 for age:

$$y = \frac{1}{\left(1 + \left(e^{-R*\,(x - A_{50})}\right)\right)}$$

where y is the proportion mature, L50 or A50 is the point at which 50% of individuals are mature, and x is equal to either length or age depending upon the equation used. Both length-at-maturity and age-at-maturity models were significant and explained the majority of variance in the data (Table 2.14.7a, b).

In Florida waters, 50% of females achieved sexual maturity at 192 mm FL (232 mm TL_{max}) and 1.7 years of age (Table 2.14.7(a) and (b) respectively). The age at 50% maturity from the logistic model used in this assessment is consistent with prior assessments, but the length at 50% maturity estimated for SEDAR 3 (Muller et al. 2003) from the same specimens and same histological criteria using another logistic model (SAS Proc Logistic) was 180 mm FL (209 mm TL_{max}). These values are somewhat smaller and younger compared with macroscopic data from Cuba where mean size at maturity was reported to be 250 mm FL (ca. 308 mm TL_{max}) and 2 years of age (Claro et al. 2001). Using histological criteria and specimens of Yellowtail Snapper from all or most months of the year, Figuerola et al. (1998), reported an L_{50} of 224 mm FL (ca. 275 mm TL_{max}) in waters off Puerto Rico and Trejo-Martínez et al. (2011) estimated an L_{50} of 213 mm FL (ca. 261 mm TL_{max}) from the Yucatan's Campeche Banks. The differences between the estimates of size and age at maturity between studies may be due to the analytical methods employed [e.g., histological versus macroscopic determinations and which gonad maturity stages were classed as mature (Lowerre-Barbieri et al. 2011), whether all specimens from a year-round study were used versus only those collected from the peak spawning period (Hunter and Macewicz 1985, 2003), sample sizes available, etc.].

2.7.3 Fecundity

Estimates of fecundity in Yellowtail Snapper are limited. In the Florida Keys, Collins and Finucane (1989) estimated ovarian egg numbers between 11,000 and 1,391,000 from 44 fish ranging in size and weight between 200 – 480 mm FL and 168 – 1,784 g total weight. Egg number estimates from 4 fish off western Cuba reported by Piedra (1969; and corrected by Collins and Finucane 1989) ranged between 99,666 – 618,742 eggs from fish ranging in size and weight between 292 – 382 mm FL and 402 – 920 g total weight. Cummings (2004) cites and presents additional model results of fecundity at-age and at-weight estimates from Collins and Finucane (1989; 60 fish) and de Albornoz and Grillo (1993; 60 fish).

2.7.4 Sex Ratio

Sex ratios in Yellowtail Snapper populations may be approximately equal in most months (see discussion in Cummings [2004]). In the Florida Keys, male:female ratios were 1:1.04 and 1:1.3 and 1:1.4 in Jamaica and Cuba (Grimes 1987). Trejo-Martínez et al. (2011) reported ratios not significantly different from 1:1 on the Campeche Banks.

2.8 MOVEMENTS AND MIGRATIONS

Yellowtail Snapper is unique in the snapper family. It is a semi-pelagic transient species (Harborne et al. 2016, Farmer and Ault 2011), and although its life history and geographic distribution have been well documented, information regarding its movements and migration patterns is limited (Bohnsack and Ault 2002, Lindholm et al. 2005). Movement occurs on small and large scales and includes diel habitat shifts, foraging, seasonal migrations, and ontogenetic movement (Friedlander et al. 2013, Pittman et al. 2014). Herbig et al. (2019a) used acoustic telemetry to show that the movement of tagged Yellowtail Snapper was not completely random, but rather was methodical as fish visited the same sites during most of the year, and some fish demonstrated similar seasonal differences. Similar results were observed by Novak (2018). Yellowtail Snapper demonstrated movement patterns based on diel activity (fewer detections at night) and seasonal patterns (fewer detections and longer movements in summer). Although only a few fish were tagged in this study, the authors concluded that there were indications for site fidelity in Yellowtail Snapper. This analysis revealed that tagged Yellowtail Snapper also had relatively small 50% [x- = 0.42 (SE 0.14) km2] and 95% [x- = 5.45 (SE 1.79) km2] home ranges for a species considered highly mobile (Friedlander et al. 2013). The difference between the 50% and 95% home ranges indicates that the tagged Yellowtail Snapper remained within an area no larger than 1 km^2 for much of the time, but occasionally made larger movements. Feeley et al. (2012) also found that although most recaptured Yellowtail Snapper were caught in the same area in which they had been tagged, some (25%) were caught farther (18.5– 100 km) away.

2.9 MERISTICS AND CONVERSION FACTORS

The management regulations on minimum legal size for Yellowtail Snapper specifies a 12” total length (TL) and that the fish can be measured either with the tail flat in its normal shape (“relaxed”) or with the tips of the tail compressed to its maximum length (“maximum”). Multiple types of length measurements (standard, fork, and total length) are taken for Yellowtail Snapper by the various fishery dependent and independent data collection programs (e.g. TIP, MRIP, Headboat, FWRI-FDM), but fork length is largely measured since this species has a deeply forked tail. The FWRI fishery dependent monitoring program has measured SL, FL, and TL ("relaxed" and "max") measurements in order to provide a way of converting between the different measurement methods. SEDAR 3 (Muller et al. 2003) treated the headboat TL measurements without correction for the $TL_{relaxed}$ measurement method. SEDAR 27A (O'Hop et al. 2012) converted all fork length measurements and HB TL measurements (when a FL was not measured) to "maximum" TL. This assessment converted all total lengths to fork length measurements to match most data collection programs. New length-length (simple linear regression; Table 2.14.8) and length-weight (nonlinear power function; Table 2.14.9) equations were developed for this assessment using more recent length and weight data available for this species. A comparison of conversion equations provided by Johnson (1983) and Garcia et al. (2003) are also included in these tables.

2.10 COMMENTS ON ADEQUACY OF DATA FOR ASSESSMENT ANALYSES

2.10.1 Stock Definition

Genetic analyses available on Yellowtail Snapper supported a single stock for populations in southeastern U.S. and Gulf of Mexico regions, however no additional analyses have been conducted since the previous assessment.

2.10.2 Natural Mortality

The life history data were found sufficient to empirically derive estimates of natural mortality as no direct estimates were available. In addition to the recommended analyses outlined above (Section 2.4), the methods put forth by Then et al. (2015) and Munyandorero (2019) were evaluated by the LHW. Empirical estimates of natural mortality for Yellowtail Snapper derived from maximum age continue to get smaller as maximum age continues to lengthen with each assessment (max. age 17 in SEDAR 3 [Muller et al. 2003]; max. age 23 in SEDAR 27A [O'Hop et al. 2012]; max. age 28 here [see Section 2.6 above]).

2.10.3 Release Mortality

Data on fishing-induced mortality on released Yellowtail Snappers from commercial and headboat at-sea sampling were sufficient to provide rough estimation of immediate release mortality, upper and lower bounds, and the range of sizes released. No studies on delayed release mortality for Yellowtail Snapper were available for consideration. The size frequencies of kept and released (both alive and dead) Yellowtail Snapper observed for all sectors in recent years showed that nearly all legal size fish are kept, and that most of the release mortalities were associated with undersized fish (although these were generally alive and noted to be in 'Good' to 'Fair' condition at the time of release). An initial upper bound estimate of 20% for commercial release mortality was thought by sector-representative panelists to be too high, commenting that "even 10% fishing mortality seemed too high given the surface congregation-based method of fishing utilized by most commercial vessels" (i.e., power-chumming, cane poles, barb-less hooks, etc.). Therefore, a compromise on an upper bound release mortality estimate of 15% for the commercial fishery was reached.

2.10.4 Age and Growth

Through continued efforts of fishery-dependent and -independent sampling, the known maximum age of Yellowtail Snapper in southeastern U.S. and Gulf of Mexico jurisdictions has been lengthened to 28 years from 23 years in SEDAR 27A (O'Hop et al. 2012) and 17 years in SEDAR 3 (Muller et al. 2003). Age sampling data, though restricted to Florida for this assessment, were more than adequate to generate a growth curve; however, length-at-age data came primarily from fishery-dependent sources with active minimum size limits and necessitated the use of a size-truncated growth model. Large overlaps in length-at-age for this species (age 2+) and differences in growth patterns by region exist within the data and may be influenced more by the size-selective nature of the fishery than the biology of the species. Increased biological samples from fishery-independent efforts may address these and preclude the need for this type of growth model in the future.

The definition of edge types and the criteria used to advance ages differed among data providers, leading to some inconsistency in Yellowtail Snapper ages. NCLAB and FWRI use edge types 1-4 to identify an opaque zone on margin to a translucent zone that is 2/3 to fully complete, whereas PCLAB uses edge types 2PC, 4PC, and 6PC to identify an opaque zone on margin, translucent zone forming to ½ complete, and a translucent zone that is ½ to fully complete, respectively. FWRI and NCLAB advance calendar ages to the number of annuli plus one when the translucent zone is 1/3 to fully complete, whereas PCLAB advances calendar ages when the translucent zone is 1/2 to fully complete. Another inconsistency among data sources is the portion of the year when a calendar age can be advanced. FWRI and PCLAB sources use January to the end of June but NCLAB uses January to the end of May. However, since the vast majority of ages were provided by FWRI (51,353 records out of 58,539), these inconsistencies are expected to have little influence on the age distribution and length-at-age relationship of Yellowtail Snapper.

Length-at-age data of Yellowtail Snapper from two studies (Garcia et al. 2003; Vose and Shank 2003) were either currently unavailable or did not have adequate metadata to determine fishery type. However, length-at-age observations from these studies were minimal (n=2,984) compared to the final dataset used to model growth (n=45,280). Furthermore, within Vose and Shank (2003), age assignments were found inconsistent and caused primarily by only two edge types (opaque zone complete or translucent on edge) and ambiguity surrounding the months for which ages were advanced.

2.10.5 Reproduction

Information on size and age at maturity was sufficient for use, as was sex ratio and spawning season information. However, data from one study (Barbieri and Colvocoresses 2003) has been the primary informer of size and age at maturity for southeastern U.S. and Gulf of Mexico Yellowtail Snapper assessments (including here) and should to be expanded. Exploratory analyses may indicate some level of regional differences in size and age at maturity, however sample numbers and the size range of fish processed are limited. Although fecundity estimates were not used in the prior assessment, there were also no new estimates available for the LHW to review.

2.10.6 Movements and Migrations

New movement information continues to suggest Yellowtail Snapper exhibit a greater site fidelity than historically perceived. Currently, movement data is sufficient to suggest assessment modeling on the spatial scale as far as 'areas-as-fleets'. For spatial modeling to move into a multiple area design, tagging studies need to be expanded at least into southeast and southwest Florida as movement rates between there and the Florida Keys remain unclear.

2.10.7 Meristics and Conversion Factors

Programs from both fishery-dependent and fishery-independent sources provided adequate quantities of differing length and weight measurement types to create length-length and length-weight conversion factors.

2.11 RESEARCH RECOMMENDATIONS

2.11.1 Stock Definition

- Investigate the genetic linkages of Yellowtail Snapper populations between Florida and the Carolinas and between the Gulf of Mexico and western Caribbean.
- Investigate the current occurrence of hybrids (e.g., with Lane Snapper) throughout the range of the stock.

2.11.2 Natural Mortality

- As the apparent maximum age of Yellowtail Snapper increased from assessment to assessment, the natural mortality estimates decreased. Estimates of natural mortality that are derived independently from life history parameters would help to validate these methods. Given adequate fishery independent age information, total mortality (fishing mortality plus natural mortality) can be estimated. In addition, telemetry and tag-recapture methods can offer independent estimation of fishing mortality and natural mortality, however these methods rely on high site fidelity of Yellowtail Snapper to reef sites or reliable tag return rates.
- Investigate estimates of natural mortality rates for different life stages of Yellowtail Snapper using ecosystem simulation models (e.g., Ecopath with Ecosim and OSMOSE).

2.11.3 Release Mortality

- On-board observers inform immediate release mortality, however information on delayed mortality is limited. Additional tagging of Yellowtail Snapper with passive and acoustic tags, as well as the continued development of tag-and-recapture models would help to inform delayed release mortality.

2.11.4 Age and Growth

- Expand and increase the amount of length-at-age data coming from fishery-independent biological sampling throughout the range of the stock (especially for fish smaller than the current minimum size limit).
- Continue to sample the population off the Carolinas undergoing reduced targeted fishing pressures and allowing for greater estimates of maximum age.

2.11.5 Reproduction

- Expand information on reproductive characteristics such as age- and size-at-maturity, fecundity, sex ratio, and distribution of spawning aggregations throughout the range of the stock.

2.11.6 Movements and Migrations

- Investigate juvenile ontogenetic shifting from nearshore areas to reef habitat.
- Investigate movement and migration rates between the Florida Keys, southeast Florida, and southwest Florida (e.g. acoustic tagging and stable isotope studies).

2.12 DATA BEST PRACTICES COMMENTS AND SUGGESTIONS

The methods outlined and implemented above for deriving constant and age-specific estimates of natural mortality followed the SEDAR Best Practices (2016) recommendations and the precedent set by other SEDAR assessments (e.g. SEDAR 51). When gathering the age information from the different data providers (e.g. NCLAB, PCLAB, and FWRI), the use of the Best Practices template allowed for easier merging between sources and helped reduce ambiguity within the data. The methods used for predicting length at age also followed Best Practices recommendations.

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2.14 TABLES

Table 2.14.1. Natural mortality-at-age (M_{at-age}) of Yellowtail Snapper with maximum age of 28 years. M_{at-age} is derived following Lorenzen (2005) using the $Hoenig_{all\ taxa}$ (1983) constant mortality-at-age as the target M scaled between vulnerable ages 3 – 28 (M_{target} = 0.160) and the von Bertalanffy growth model parameters (Linf = 425.6; k = 0.1998; t0 = -1.9297). For the upper bound: M_{target} = 0.223; and for the lower bound: M_{target} = 0.136.

Age (yr)	Predicted FL (mm)	$M_{at-age.tmax=28.}$	$M_{at-age.tmax=20.}$ (upper bound)	$M_{at-age.tmax=33.}$ (lower bound)
0	164	0.385	0.536	0.328
1	189	0.297	0.413	0.253
2	232	0.25	0.348	0.213
3	267	0.222	0.308	0.189
4	295	0.203	0.282	0.172
5	319	0.189	0.264	0.161
6	338	0.18	0.250	0.153
7	354	0.173	0.240	0.147
8	367	0.167	0.233	0.142
9	378	0.163	0.227	0.139
10	386	0.16	0.222	0.136
11	393	0.157	0.219	0.134
12	399	0.155	0.216	0.132
13	404	0.153	0.214	0.131
14	408	0.152	0.212	0.129
15	411	0.151	0.210	0.129
16	414	0.15	0.209	0.128
17	416	0.15	0.208	0.127
18	418	0.149	0.207	0.127
19	419	0.148	0.207	0.126
20	420	0.148	0.206	0.126
21	421	0.148	0.206	0.126
22	422	0.148	0.205	0.126
23	423	0.147	0.205	0.125
24	423	0.147	0.205	0.125
25	424	0.147	0.205	0.125
26	424	0.147	0.204	0.125
27	424	0.147	0.204	0.125
28	425	0.147	0.204	0.125

Table 2.14.2. Number of Yellowtail Snapper otoliths by year and region within the filtered dataset. [Region: Northeast Florida (Nassau County south to Brevard County), Southeast Florida (Indian River County south to Miami-Dade County), Florida Keys (Monroe County), Southwest Florida (Levy County south to Collier County), Northwest Florida (Escambia County south to Dixie County), North of Florida (states north of Florida through North Carolina), West of Florida (states west of Florida through Texas)].

Year	Northeast Florida	Southeast Florida	Florida Keys	Southwest Florida	Northwest Florida	North of Florida	West of Florida	Unknown	Total
1980	1	32	153	0	0	0	0	102	288
1981	5	100	242	0	0	0	0	0	347
1982	15	114	60	0	0	0	0	0	189
1983	20	202	12	0	0	1	0	0	235
1984	18	141	0	0	0	2	0	0	161
1985	24	14	0	0	0	0	0	0	38
1986	33	22	0	9	0	0	0	0	64
1987	28	22	0	0	0	0	0	0	50
1988	4	6	0	1	0	0	0	0	11
1989	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0
1991	0	0	28	0	0	0	0	0	28
1992	0	73	1	6	0	0	0	25	105
1993	0	130	32	11	1	0	0	0	174
1994	0	200	96	1	0	4	0	18	319
1995	7	265	108	0	0	0	0	0	380
1996	0	312	85	1	0	10	0	0	408
1997	0	121	240	26	0	0	0	136	523
1998	0	0	187	6	0	0	0	0	193
1999	0	458	172	1	0	2	0	0	633
2000	1	289	191	11	0	0	0	0	492
2001	0	210	296	0	0	0	0	1	507
2002	0	3	447	3	0	0	0	0	453
2003	0	87	211	3	0	0	0	0	301
2004	0	627	262	9	0	2	0	0	900
2005	4	573	756	28	0	28	2	0	1,391
2006	3	781	769	20	0	43	4	0	1,620
2007	6	695	718	32	0	25	0	0	1,476
2008	8	479	1,085	171	0	59	4	25	1,831
2009	29	397	1,223	157	1	40	11	1	1,859
2010	10	342	953	64	0	25	0	0	1,394
2011	8	501	1,016	23	0	13	0	0	1,561
2012	11	696	1,814	20	0	13	0	0	2,554
2013	15	1,164	1,683	8	0	8	0	0	2,878

2014	12	2,025	3,739	30	1	9	0	0	5,816
2015	4	1,963	3,902	92	1	7	0	0	5,969
2016	20	1,273	4,353	170	1	8	0	4	5,829
2017	18	714	3,416	150	2	3	0	0	4,303
Total	304	15,031	28,250	1,053	7	302	21	312	45,280
Percent	0.7	33.2	62.4	2.3	<0.1	0.7	<0.1	0.7	100.0

Table 2.14.3. Number of ages of Yellowtail Snapper sampled by year during 1980 – 2017 within the filtered dataset. Sources of age data include Florida and along the southeastern US Atlantic (states north of Florida through North Carolina) and Gulf of Mexico (states west of Florida through Texas).

	Age (years)																					
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1980	0	6	78	73	48	33	28	8	3	5	4	1	0	0	0	0	0	1	0	0	0	0
1981	0	7	101	89	51	34	18	19	13	7	1	4	2	0	0	0	1	0	0	0	0	0
1982	0	2	25	96	32	16	6	7	4	0	1	0	0	0	0	0	0	0	0	0	0	0
1983	0	5	105	69	37	4	6	3	2	0	2	1	0	0	1	0	0	0	0	0	0	0
1984	0	2	74	50	17	11	4	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0
1985	0	3	16	12	6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	4	33	11	9	4	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	4	28	14	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	4	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	5	3	11	5	0	0	0	1	0	2	1	0	0	0	0	0	0	0	0	0
1992	0	0	23	54	15	4	3	4	0	1	0	1	0	0	0	0	0	0	0	0	0	0
1993	0	0	54	57	21	10	10	6	9	2	2	1	0	0	2	0	0	0	0	0	0	0
1994	0	2	41	140	60	19	11	11	13	4	5	4	3	2	2	0	2	0	0	0	0	0
1995	0	2	86	163	72	26	12	7	5	7	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	18	180	79	49	36	19	5	8	6	2	2	2	0	0	0	0	1	0	0	0	0
1997	0	3	50	126	81	85	75	43	19	16	7	12	5	1	0	0	0	0	0	0	0	0
1998	0	0	12	44	46	26	19	21	11	5	3	5	0	0	1	0	0	0	0	0	0	0
1999	0	55	299	96	66	47	25	17	15	6	4	0	0	1	2	0	0	0	0	0	0	0
2000	0	11	159	93	83	56	33	19	12	13	5	5	0	2	1	0	0	0	0	0	0	0
2001	0	6	125	80	102	61	57	28	13	12	8	6	6	1	0	1	0	1	0	0	0	0
2002	0	0	42	97	91	85	66	24	23	7	7	4	4	1	1	0	1	0	0	0	0	0
2003	0	11	53	69	46	22	33	28	9	12	3	3	7	4	0	1	0	0	0	0	0	0
2004	0	11	385	294	111	42	26	15	7	3	0	3	1	0	1	1	0	0	0	0	0	0
2005	0	15	301	568	231	130	70	29	14	12	7	4	2	2	4	1	1	0	0	0	0	0

2006	0	22	633	345	274	126	68	51	36	26	13	7	9	2	5	1	0	1	0	0	0	1
2007	17	30	399	569	207	101	67	31	19	5	13	4	2	3	3	0	2	2	0	0	1	1
2008	0	39	341	491	454	194	116	68	51	22	10	16	9	5	1	5	4	0	2	0	1	1
2009	0	30	399	444	315	300	135	102	55	26	17	5	11	10	4	4	2	0	0	0	0	0
2010	0	37	309	341	297	155	132	47	28	19	5	9	4	3	2	1	2	0	0	1	0	0
2011	0	78	351	542	255	150	63	64	22	12	7	5	2	2	1	0	1	2	1	1	0	0
2012	0	74	600	721	576	266	137	61	49	15	16	11	9	7	3	3	3	0	1	0	1	0
2013	0	111	1,142	721	362	290	97	72	32	24	12	6	2	1	3	0	0	1	1	0	0	1
2014	1	129	2,087	1,686	761	405	367	172	93	48	33	9	9	7	3	2	0	0	2	0	0	0
2015	4	180	1,495	2,058	1,060	468	264	215	97	57	32	8	12	4	6	4	2	0	2	0	0	0
2016	0	92	1,663	1,370	1,407	696	239	118	110	72	20	16	11	3	6	3	0	0	0	1	1	0
2017	0	69	1,008	1,406	748	553	244	109	59	54	25	14	8	3	1	2	0	0	0	0	0	0
Totals	22	1,058	12,706	13,077	8,005	4,460	2,453	1,408	831	499	264	168	122	64	53	29	21	9	9	3	4	4
Percent	<0.1	2.3	28.1	28.9	17.7	9.8	5.4	3.1	1.8	1.1	0.6	0.4	0.3	0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Table 2.14.4. Number of Yellowtail Snapper otoliths within the filtered dataset by year, fishing sector, and mode of fishing. Sources of age data include Florida and along the southeastern US Atlantic (states north of Florida through North Carolina) and Gulf of Mexico (states west of Florida through Texas). [Fishing sectors: Commercial, Recreational, and Fishery Independent (FI); Fishing modes: Commercial (CM, mainly hook and line), Scientific Survey (SS), Head Boat (HB), Party/Charter (PC), Private/Rental Boat (PR), and Other (OTH)].

		Commercial	FI	Recreational			
Year	Total	CM	SS	HB	PC	PR	OTH
1980	288	16	0	272	0	0	0
1981	347	153	0	194	0	0	0
1982	189	0	0	189	0	0	0
1983	235	0	0	235	0	0	0
1984	161	0	0	161	0	0	0
1985	38	0	0	38	0	0	0
1986	64	0	0	60	4	0	0
1987	50	0	0	50	0	0	0
1988	11	0	0	11	0	0	0
1989	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0
1991	28	0	0	28	0	0	0
1992	105	74	0	31	0	0	0
1993	174	158	0	5	4	7	0
1994	319	255	0	54	0	10	0
1995	380	267	1	112	0	0	0
1996	408	408	0	0	0	0	0

1997	523	502	0	0	5	16	0
1998	193	161	0	0	0	32	0
1999	633	571	0	2	9	51	0
2000	492	481	0	9	2	0	0
2001	507	450	0	0	18	39	0
2002	453	448	0	0	5	0	0
2003	301	213	0	36	51	1	0
2004	900	271	0	503	113	13	0
2005	1,391	566	0	749	70	6	0
2006	1,620	662	0	877	81	0	0
2007	1,476	304	23	1,148	0	1	0
2008	1,831	635	25	1,050	104	17	0
2009	1,859	714	27	1,042	50	26	0
2010	1,394	441	92	753	90	17	1
2011	1,561	492	9	1,049	11	0	0
2012	2,554	820	39	1,695	0	0	0
2013	2,878	984	16	1,847	31	0	0
2014	5,816	3,413	49	2,225	129	0	0
2015	5,969	3,304	32	2,202	431	0	0
2016	5,829	2,764	0	2,875	188	2	0
2017	4,303	1,700	0	1,993	507	103	0
Total	45,280	21,227	313	21,495	1,903	341	1
Percent	100.0	46.9	0.7	47.5	4.2	0.8	<0.1

Table 2.14.5. A comparison of the outputs between the four von Bertalanffy growth models used to predict length-at-age for Yellowtail Snapper from the Florida-exclusive filtered dataset (1980 – 2017). The four models are: 1) an unweighted non-truncated model (n = 44,953 otoliths), 2) a size-truncated model using a random selection of no more than 30 length observations per age (n = 4,803 otoliths) 3) a size-truncated model using inverse-weighting that includes an age 8+ group (n = 42,985 otoliths), and 4) a size-truncated model using inverse-weighting that includes an age 12+ group (n = 42,985 otoliths). The final model selected was the size-truncated model using inverse-weighting that included an age 12+ group and estimated a constant CV at age (model 4).

		Model variance structure				
Model	Parameter	Constant SD	Constant CV	Var/Mean ratio	Increase CV w/ Age	Increase CV w/ Size-at-Age
Unweighted non-truncated	L_{inf}	446.8	422.3	432.4	355.9	405.0
	k	0.120	0.164	0.143	0.380	0.192
	t0	-6.111	-4.417	-5.080	-1.900	-3.913
	var. param. 1	39.691	0.126	4.973	0.073	0.067
	var. param. 2				0.361	0.184
	obj._function	229262.95	227391.07	228241.65	225864.57	226168.60
	max._gradient	5.3558E-03	1.0686E-03	1.2657E-02	5.1856E-05	1.3364E-03
	AIC	458534.00	454790.00	456491.00	451739.00	452347.00
Size-truncated using random selection of 30 lengths per age	L_{inf}	460.5	422.0	441.0	422.2	419.6
	k	0.155	0.192	0.172	0.192	0.195
	t0	-1.987	-2.192	-2.110	-2.194	-2.189
	var. param. 1	61.988	0.189	11.694	0.189	0.183
	var. param. 2				0.189	0.192
	obj._function	24814.61	24694.21	24724.42	24694.20	24694.00
	max._gradient	2.7768E-04	1.0754E-05	6.3102E-09	1.5790E-04	1.5108E-05
	AIC	49637.20	49396.40	49456.80	49398.40	49398.00
Size-truncated using inverse weighting with age 8+ group	L_{inf}	424.8	390.4	407.4	371.0	371.1
	k	0.198	0.266	0.231	0.324	0.305
	t0	-1.906	-1.542	-1.675	-1.329	-1.445
	var. param. 1	51.568	0.174	8.755	0.148	0.128
	var. param. 2				0.250	0.210
	obj._function	45.18	44.41	44.70	44.33	44.32
	max._gradient	1.9868E-08	2.4028E-08	4.6003E-08	4.1865E-07	5.6114E-06
	AIC	98.35	96.82	97.39	98.67	98.64

Size-truncated using inverse weighting with age 12+ group	L_{inf}	484.9	425.6	452.7	412.4	412.3
	k	0.131	0.200	0.163	0.224	0.223
	t0	-2.520	-1.930	-2.185	-1.781	-1.800
	var. param. 1	59.234	0.181	10.522	0.164	0.151
	var. param. 2				0.216	0.197
	obj._function	67.64	66.80	67.08	66.79	66.77
	max._gradient	8.6772E-07	6.8968E-09	4.9125E-06	9.1029E-07	2.8928E-06
	AIC	143.28	141.61	142.17	143.59	143.55

Table 2.14.6. Histological staging criteria used in this assessment for determining the maturity stage of female specimens of Yellowtail Snapper.

Gonadal Maturity Stage (GMS)	Maturity description	Description
1 - Immature	Immature	Only primary growth oocytes present; no atresia; ovarian membrane thin; ovarian membrane should be free of any large folds (indicative of stretching due to previous spawning)
2 - Developing	Mature	Only primary growth, cortical alveoli and a few partially yolked oocytes may be present; there may be minor atresia
3- Fully developed / Partially spent / Redeveloping	Mature	Primary growth to advanced yolked oocytes present; may have some left over hydrated oocytes and POFs from previous spawning; might have atresia of advanced yolked oocytes, but no major atresia (only minor/moderate) of other oocytes
4 – Final oocyte maturation (FOM) / Hydrated	Mature	Primary growth to FOM/hydrated oocytes present; may have minor/moderate atresia of advanced yolked oocytes; germinal vessel migration (beginning of FOM); hydrated oocytes unovulated.
5 – Running ripe	Mature	Primary growth to ovulated, hydrated oocytes present; often minor/moderate atresia of advanced yolked oocytes; occasionally only hydrated and primary growth oocytes present; most of the hydrated oocytes will be

		concentrated in the lumen, giving the ovary cross-section the appearance of a jelly donut.
6 - Regressing	Mature	Primary growth and cortical alveoli oocytes present; yolked oocytes being resorbed; major atresia; may be remnant hydrated oocytes or degenerating POFs.
7 – Resting or Regenerating	Mature	Most oocytes (>90%) are primary growth; may have other oocytes in late stages of atresia; more follicular tissues than immature fish; presence of large folds on the ovarian membrane (indicative of stretching due to previous spawning).

Table 2.14.7. Logistic model fits for maturity related to (a) size and (b) age for Yellowtail Snapper during the peak spawning months of April-October in Florida. SE=standard error, MS=mean squares for model F-tests.

a. Fork Length (mm)

Parameter	Estimate	SE	
R	0.021	0.00566	
L_{50} (FL, mm)	191.9	15.294	
Variance Source	DF	MS	P
Model	2	75.004	< 0.0001
Error	216	0.1342	

b. Age (years)

Parameter	Estimate	SE	
R	2.706	0.657	
A_{50} (years)	1.704	0.089	
Variance Source	DF	MS	P
Model	2	77.317	< 0.0001
Error	203	0.0856	

Table 2.14.8. Length-length .mm. relationships for Yellowtail Snapper. Length-length regressions are in the form Y = a + bX. SL: standard length (mm); FL: fork length (mm); TL: total length (mm); TW: total weight (kg), GW: gutted weight (kg).

Source	**Y (mm)**	**a (mm)**	**b**	**X (mm)**	**n**	**Min X (mm)**	**Max X (mm)**	**Avg. X* (mm)**	**MSE***	**Adj. r^2**	**Σx^2***	**Σxy***	**Σy^2***
SEDAR 64	SL [a]	-8.5525	0.8961	FL	5,873	230	548	309.8	24.19173	0.99	14972186	13416498	12164483
	$TL_{relaxed}$ [b]**	-14.7197	1.2727	FL	16,212	205	550	304.8	75.76723	0.98	32304485	41115136	53556972
	TL_{max} [c]	-16.4139	1.2969	FL	6,827	225	548	308.1	32.20539	0.99	16365228	21223575	27744022
SEDAR 27A	TL_{max}	-14.947	1.29	FL	3,036	233	548			0.99			
SEDAR 3	TL_{max}	-23.117	1.313	FL	409	233	506			0.98			
Johnson (1983)	FL	17.7	0.78	TL_{max}	100					0.97			
Garcia et al. (2003)	FL	7.56	0.79	$TL_{relaxed}$	1,264	240	780			0.95			
SEDAR 27A	$TL_{relaxed}$	-8.604	0.991	TL_{max}	3,008	266	684			0.99			

[a] reverse prediction: FL = 9.5441 + 1.1159 * SL

[b] reverse prediction: FL = 11.5657 + 0.7857 * $TL_{relaxed}$

[c] reverse prediction: FL = 12.6563 + 0.7711 * TL_{max}

Table 2.14.9. Length-weight relationships .nonlinear estimation. for Yellowtail Snapper in waters off Southern Florida. FL: fork length (mm); TL: total length (mm); TW: total weight (kg), GW: gutted weight (kg). Length-weight regressions were calculated with a nonlinear model: weight = a * Length^b.

Source	Y (kg)	a	b	X(mm)	n	Min (mm)	Max (mm)	MSE
SEDAR 64	TW	3.40E-08	2.8797	FL	16,540	202	550	0.002
	TW	4.04E-08	2.7487	$TL_{relaxed}$	10,792	247	697	0.00267
	TW	3.21E-08	2.7849	TL_{max}	1,763	284	654	0.00367
	GW	6.15E-08	2.7691	FL	4,052	232	548	0.00311
	GW	5.16E-08	2.7086	$TL_{relaxed}$	1,955	277	662	0.0043
	GW	5.27E-08	2.6935	TL_{max}	1,838	281	684	0.00403
SEDAR 27A	TW	6.14E-08	2.779	FL	8,273	146	792	0.0082

Source	Y (kg)	a	b	X(cm)	n	Min (cm)	Max (cm)	MSE
SEDAR 64	TW	2.07E-05	2.8797	FL	16,540	20.2	55	0.002
	TW	2.46E-05	2.7487	$TL_{relaxed}$	10,792	24.7	69.7	0.00267
	TW	1.96E-05	2.7849	TL_{max}	1,763	28.4	65.4	0.00367
	GW	3.75E-05	2.7691	FL	4,052	23.2	54.8	0.00311
	GW	3.14E-05	2.7086	$TL_{relaxed}$	1,955	27.7	66.2	0.0043
	GW	3.21E-05	2.6935	TL_{max}	1,838	28.1	68.4	0.00403
SEDAR 27A	TW	3.74E-05	2.779	FL	8,273	14.6	79.2	0.0082

2.15 FIGURES

Figure 2.15.1. A Yellowtail Snapper over natural live bottom in the Florida Keys

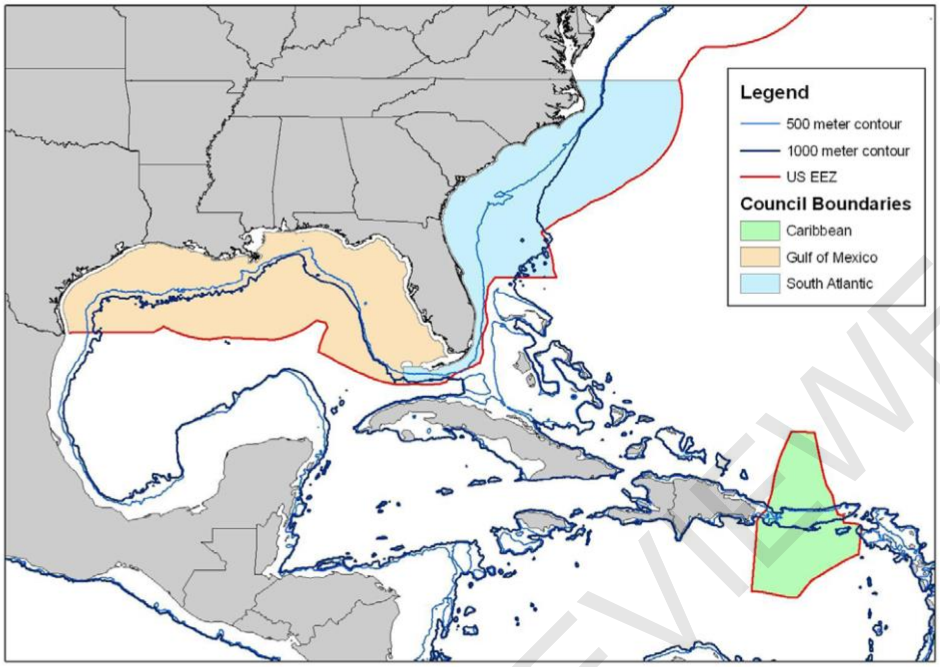

Figure 2.15.2. Jurisdictional boundaries in the Southeast Region for the South Atlantic Fishery Management Council, the Gulf of Mexico Fishery Management Council, and the Caribbean Fishery Management Council.

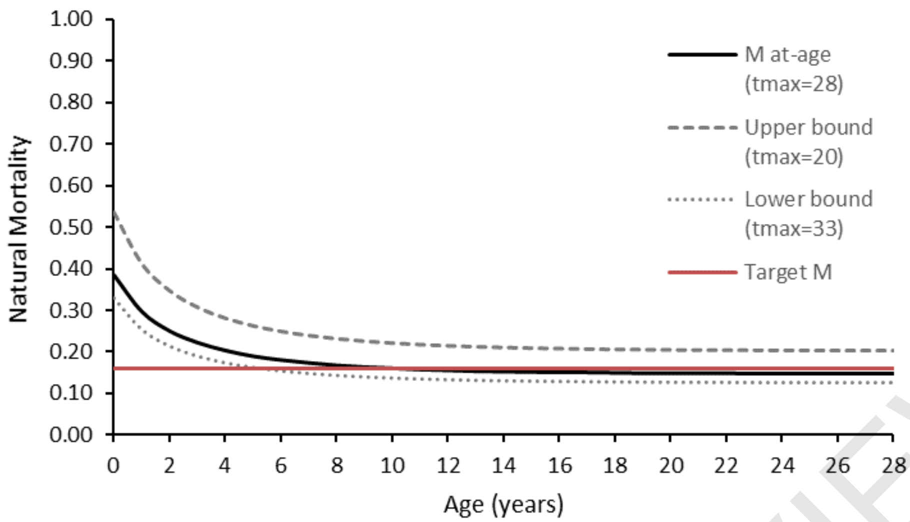

Figure 2.15.3. Natural mortality-at-age ($M_{at\text{-}age}$) of Yellowtail Snapper with maximum age of 28 years. $M_{at\text{-}age}$ is derived following Lorenzen (2005) using the $Hoenig_{all\ taxa}$ (1983) constant mortality-at-age as the target M scaled between vulnerable ages 3 – 28 (M_{target} = 0.160) and the von Bertalanffy growth model parameters (Linf = 425.6; k = 0.1998; t0 = -1.9297). For the upper bound: M_{target} = 0.223 for maximum age 20 years; and for the lower bound: M_{target} = 0.136 for maximum age 33 years.

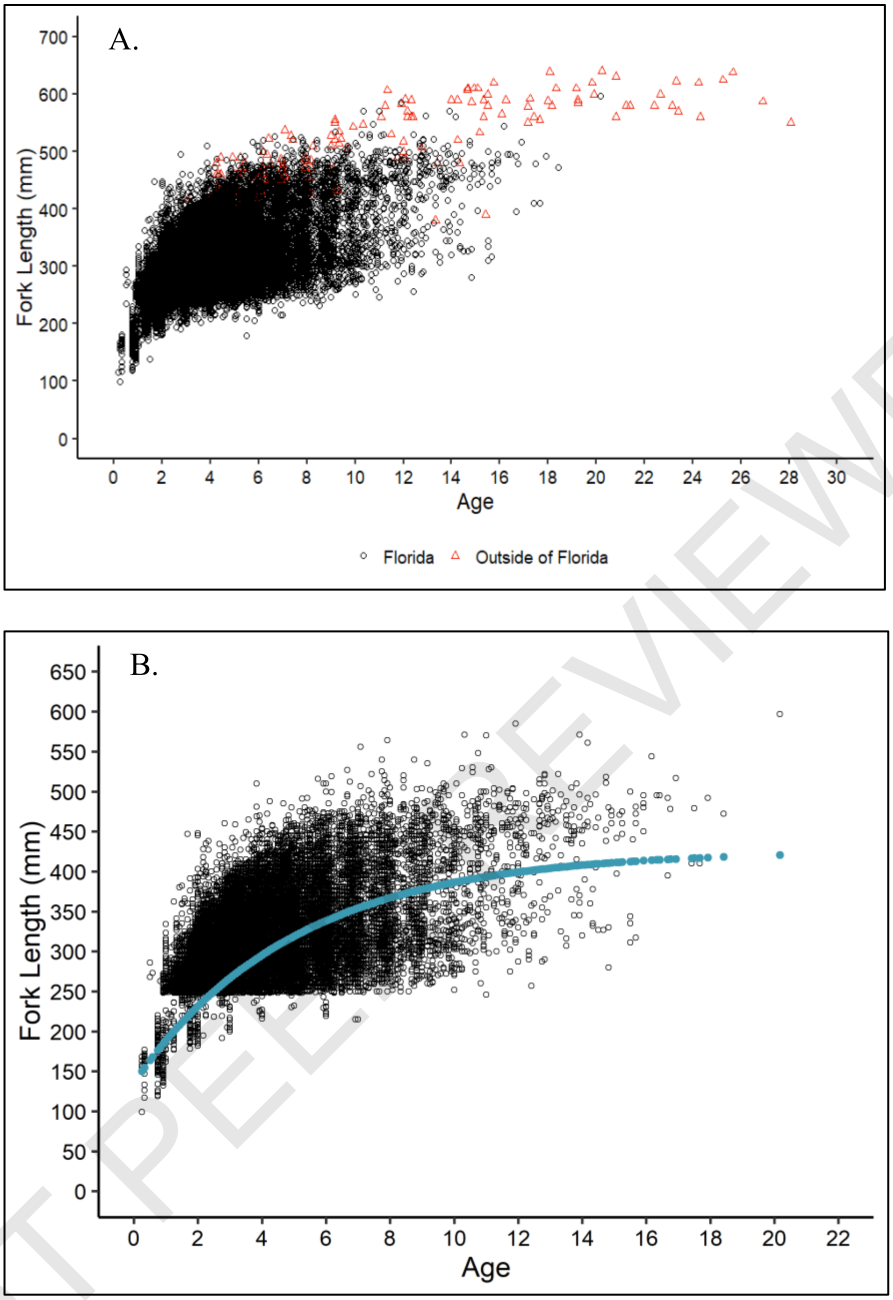

Figure 2.15.4. Yellowtail Snapper (1980 – 2017) observed ages (years) and fork lengths (mm). The upper panel (A) shows non-truncated length-at-age data collected from Florida and outside of Florida along the southeastern US Atlantic and Gulf of Mexico (n=45,280 otoliths). The lower panel (B) displays Florida-exclusive data (n = 42,985 otoliths) with a predicted growth curve (blue dots) using a size-truncated von Bertalanffy growth model. Data were inversely weighted by 1/*n* of each calendar age, included an age 12+ group, and size-truncated at 248 mm fork length. The model variance structure estimated a constant CV with age.

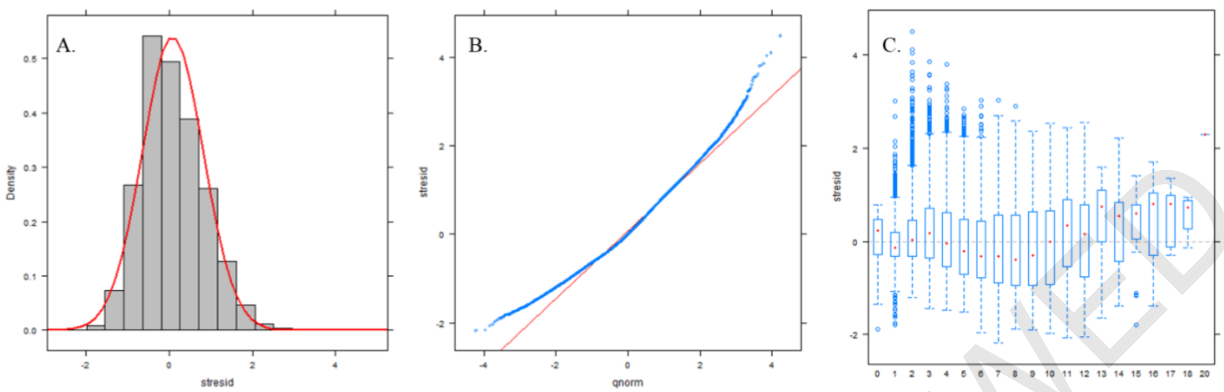

Figure 2.15.5. Standardized residual diagnostic plots: a) density distribution, b) normal probability plot (quantiles vs standardized residuals), and c) standardized residuals by age for the Yellowtail Snapper size-truncated von Bertalanffy growth model. The data were inversely weighted by 1/*n* of each calendar age and included an age 12+ group. The model variance structure estimated a constant CV with age. Boxplots include the median, upper and lower quartiles, and outliers (open circles).

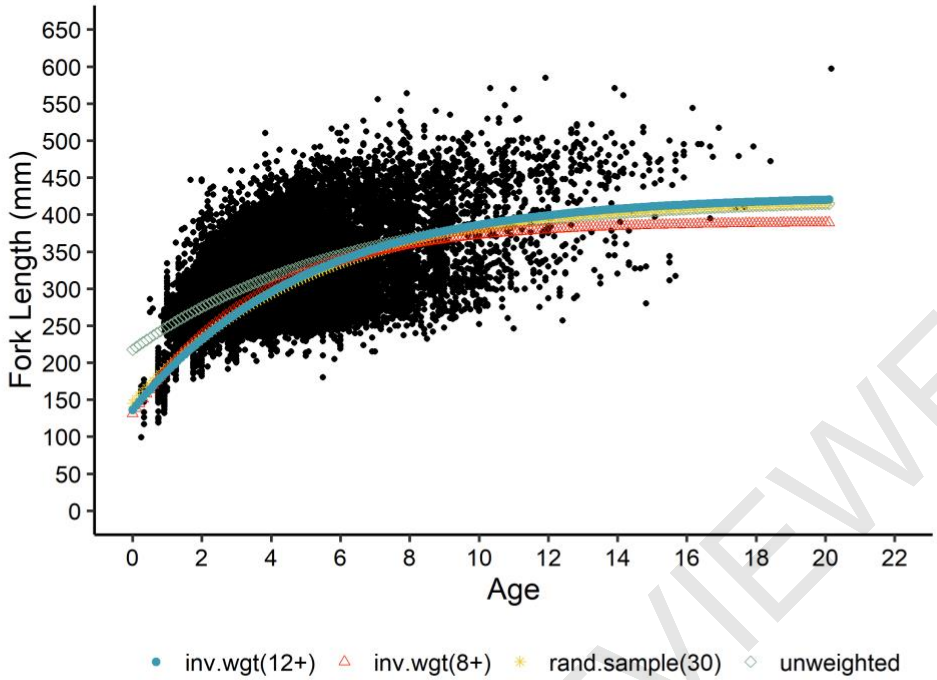

Figure 2.15.6. A comparison of the outputs between the four von Bertalanffy growth models used to predict length-at-age for Yellowtail Snapper (1980 – 2017) in Florida waters: 1) an unweighted non-truncated model (green diamond; n = 44,953 otoliths), 2) a size-truncated model using a random selection of no more than 30 length observations per age (yellow star; n = 4,803 otoliths) 3) a size-truncated model using inverse-weighting that includes an age 8+ group (red triangle; n = 42,985 otoliths), and 4) a size-truncated model using inverse-weighting that includes an age 12+ group (blue dots; n = 42,985 otoliths). All models shown included a variance structure which estimated a constant CV with age. All length-at-age observations (black dots; n = 44,953) were exclusively from Florida.

3 COMMERCIAL FISHERY STATISTICS

3.1 OVERVIEW

Commercial landings of Yellowtail Snapper for Florida and the Southeastern United States. were tallied by year, month, region, and gear (hook/line and other) in pounds whole weight for the period 1981−2017 based on federal and state databases. Corresponding landings in numbers were calculated by applying mean weights estimated from the Trip Interview Program (TIP) by year, month, region, and gear.

Commercial discards were calculated from federally permitted vessels fishing in the US South Atlantic and Gulf of Mexico using data from the Coastal Fisheries Logbook Program (CFLP) from 1993–2018.

Sampling for Yellowtail Snapper lengths and ages by year, region, and gear were extracted from the Trip Interview Program (TIP). Most sampling occurred in the Florida Keys which shows sufficient number of length samples for all years. Other regions show few samples prior to 1992 where Southeast Florida had the next largest number of samples outside the Florida Keys. Hard parts were collected for aging and sufficient age samples are available starting in 2002. Most age samples are from the Florida Keys and to a lesser extent, Southeast Florida.

3.1.1. Commercial Workgroup Participants

Steve Brown	Workgroup co-leader	FL FWC
Chris Bradshaw	Workgroup co-leader	FL FWC
Elizabeth Herdter	Stock Assess/rapporteur	FL FWC
Beth Wrege	Data provider	SEFSC Miami
Kevin McCarthy	Data provider	SEFSC Miami
Manny Hererra	Commercial	Miami, FL
Michael Birren	Commercial	Hudson, FL
Charlotte Marin	Biological Field Staff	FL FWC

3.1.2 Issues Discussed at the Data Workshop

Issues discussed by the commercial workgroup concerning Yellowtail Snapper landings included sources of data for historical landings, potential unreported or mis-reported catch, gear groupings, and regional definitions. The group also discussed available data for discards from NOAA Fisheries Coastal Logbook and observer programs, and available biological sampling data from TIP.

3.2 REVIEW OF WORKING PAPERS

SEDAR64-DW-13: This working paper provided summary landings by year, region, and gear from Florida and the Southeastern U.S. Data were provided from Florida's Marine Fisheries Trip Ticket, NOAA Fisheries Accumulated Landings System, and NOAA Fisheries Coastal Logbook program. Data were compared among all three data sources to establish historical landings of Yellowtail Snapper. Landings data indicate most of the harvest occurs in Florida, with the highest landings coming from the Florida Keys. Effort data were provided as number of trips and participation and were compared to historical landings by year and region. Additional analyses provided a comparison of landings by fishing zone (state or federal) and region.

SEDAR64-DW-14: This working paper provided summary data for length and weight from biological sampling of Yellowtail Snapper through the NOAA Fisheries Trip Interview Program. Data provided were collected by both state and federal samplers. Data were analyzed for length composition for both fork length (FL) and maximum total length (maxTL) by year, region and gear. Outliers were identified and flagged for potential removal from further analyses. A length weight conversion provided weights for samples missing weights. Gear types were identified, and length frequency histograms were generated by region for both FL and maxTL.

SEDAR64-DW-15: This working paper provided summary data on release discard mortality and discard length distribution for Yellowtail Snapper from the NOAA Fisheries Reef Fish Observer Program (RFOP) and Shark Observer Program (SOP). RFOP data were from bottom longline and vertical line gears in the Gulf of Mexico. The SOP includes data from both the Gulf and South Atlantic for bottom long line as well as some voluntary data from the Snapper-Grouper vertical line fishery in the South Atlantic. Data from both sources were analyzed by region and gear and length distributions were generated. Discard mortality was estimated by depth.

3.3 COMMERCIAL LANDINGS

Commercial landings of Yellowtail Snapper were compiled from 1950-2018 for the Southeast U.S. by Florida coast and other states combined (Table 3.1). Data sources for the landings include Florida's Marine Fisheries Trip Ticket, NOAA Fisheries Accumulated Landings System

(ALS), as well as NOAA Fisheries Coastal Logbook program. Florida accounts for nearly all Yellowtail Snapper harvest from Gulf of Mexico and South Atlantic waters, and nearly 90% of Yellowtail Snapper landings in Florida have occurred in Monroe county since 1962 (Table 3.2). Less than 1% of reported landings were from the other Gulf and South Atlantic states combined since 1982. No Yellowtail Snapper landings were reported from any state other than Florida prior to 1982.

3.3.1 Commercial Gears

The workgroup investigated reported gears landing Yellowtail Snapper from the data sources identified in Section 3.3 and determined the predominate gear to be hook and line gear types. Landings were then categorized into two gear groups: hook and line, and other. Hook and line include rod and reel, electric/hydraulic (a.k.a., bandit) reels, trolling, hand lines, and long line. A list of gears included in the hook and line category can be found in Table 3.3. On average, more than 98% of Yellowtail Snapper were reported landed by hook and line gears in the Southeastern U.S. from 1962 to 2018 (Figure 3.1).

3.3.2 Commercial Regions

Since most Yellowtail Snapper landings occur in Florida, the stock assessment group asked that the landings be separated by region using the Marine Recreational Information Program (MRIP) for-hire regions in Florida (Figure 3.2). Landings were separated into seven different for-hire survey (FHS) regions based first on area fished, and then county landed, if area fished was not present. Any landings reported west of Florida in the Gulf of Mexico were categorized as FHS region 0, and any landings reported north of Florida on the Atlantic coast were placed is FHS region 6. The five FHS regions within Florida were defined as: Northwest=1, Southwest=2, Florida Keys=3, Southeast=4, and Northeast=5.

3.3.3 Misidentification and Unclassified Yellowtail Snapper

The workgroup decided early on that there were no issues of misreporting with regard to Yellowtail Snapper. Industry representatives and scientists both agreed that because of its distinct appearance and dissimilarity to other snapper species, Yellowtail Snapper were unlikely to be classified as another snapper species. Industry representatives also confirmed that reporting Yellowtail Snapper as unclassified snapper was unlikely, especially in South Florida where most Yellowtail Snapper are landed, and that fishers would want to have Yellowtail Snapper reported separately from other snapper species. There was some concern about potential under reporting, particularly in the earlier years before the trip ticket program. The workgroup decided that establishing estimates of uncertainty in landings could address this issue.

3.3.4 Commercial Landings by Region and Gear

Comparisons were made between Florida's commercial trip ticket data (1986-2018) to both the NMFS ALS (1962-2018) and logbook data (1992-2018). The ALS data are of a longer time series than Florida trip ticket, but both datasets appear identical when comparing statewide landings from 1986-2018 (Figure 3.3). The NMFS logbook data are of a shorter time series, and do not capture much of Yellowtail Snapper that may be harvested in state waters (Kevin McCarthy, personal communication). Additional comparisons also show that Florida trip ticket and ALS show similar landings by FHS region, particularly for the Florida Keys and Southeast Florida where the majority of Yellowtail Snapper are landed (Figure 3.4). Though similar in trend after 1992, the logbook data show fewer landings by region. Because gear data were not available in Florida trip ticket until 1991, the workgroup decided combined landings from both Florida trip ticket (1992-2018) and NMFS ALS (1962-1991 for all states, 1962-2018 for non-Florida states) would be used to establish final commercial landings by FHS region and gear. Figure 3.5 presents Yellowtail Snapper landings in pounds by region averaged over the last three years (2015-2017). Table 3.4 shows annual Yellowtail Snapper landings in whole weight pounds by region and gear. Though landings will be provided by defined FHS region and gear for the assessment, Table 3.4 shows landings by more general regions to address confidentiality issues. Most landings of Yellowtail Snapper were reported in gutted weight and converted to whole weight using a conversion of 1.11 where:

$$\text{Whole weight} = 1.11 * \text{gutted weight}$$

<u>Confidentiality Issues</u>

Landings of Yellowtail Snapper were aggregated among states (except for Florida) to meet the rule of 3 and ensure confidential landings were not presented in this report. Any cell of data still deemed confidential was masked by an '*'. These landings account for less than 0.1% of the annual totals. Landings by year, month, FHS region, and gear will be provided to assessment staff for use in the assessment.

Uncertainty

After consultation with assessment biologists, the commercial workgroup estimated uncertainty in commercial fishery landings by using a similar methodology and modifying the uncertainty estimates used in SEDAR 41 (Red Snapper) and SEDAR 50 (Blueline Tilefish). These estimates of uncertainty are not coefficients of variation but are estimates of possible reporting error such that they represent the range in actual commercial landings relative to the reported landings.

Because of its unique appearance and that misidentification would be unlikely, a single assumption was used in establishing uncertainty estimates for commercial landings of Yellowtail Snapper:

Landings may be underreported during all years; but underreporting was likely highest during early years of the time series and landings were more accurate in recent years. This assumption was based upon the following information and data workshop expert testimony: during the period of 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 (starting dates vary among states). The most recent landings data, collected through the Florida trip ticket program, were assumed to be most reliable and inclusive of all commercial landings. Based on this information Table 3.5 shows estimated uncertainties by multi-year blocks for Yellowtail Snapper.

3.3.5 Converting Landings in Weight to Landings in Numbers

Commercial landings in whole weight kilograms were converted to landings in numbers based on mean weight (in kilograms whole weight) from the TIP data for each year, FHS region, and gear. These data were generally available from 1984 to 2017 for hook and line gears, especially in the Florida Keys. Data for the other gear category and for FHS regions North and West of South Florida were more sparse (annual sample sizes by year, FHS region, and gear are summarized in Table 3.6). Because so few samples were available outside of South Florida, data from FHS regions west of FL and Northwest Florida were combined with Southwest Florida as West, and data from FHS regions north of FL and Northeast FL were combined with Southeast as East. Subsequent mean weights calculated for the East and West regions were then later applied to all three FHS regions within each larger region. For 1984-2017, annual estimates of mean weight by year and region for both hook and line and other gear were applied to the corresponding landings in weight when the TIP sample size (number of fish) was greater than or equal to 50. For years when samples size was less than 50, a mean weight calculated from adjacent 5-year blocks was applied by region for each gear category back through 1981. Calculated numbers of fish can be found in Table 3.7 and Figure 3.6. Like landings in pounds, Table 3.7 shows numbers of fish aggregated by general FHS region and gear to mask any potential confidential data. Summary data for the assessment will be provided by defined FHS region and gear. Mean weights by year, region, and gear are provided in Table 3.8.

3.4 COMMERCIAL DISCARDS

Three possible approaches were investigated for the calculation of Yellowtail Snapper discards from the commercial handline fishery. The first technique (continuity method) followed the methods used in SEDAR 27 (McCarthy, 2011) by modeling discard rates. The second technique followed the methods recommended in SEDAR 32 (standard method) where discard rates were directly calculated from discard logbook data. Finally, calculating discards using available observer data was investigated.

The SEDAR 64 Commercial Work Group recommended the standard method as the preferred method for commercial discard calculation because that method has been used for all SEDAR assessments since SEDAR 32 in cases where observer data is unavailable or insufficient for use.

Available observer data were not representative of Yellowtail Snapper trips and use of those data for providing discard estimates was not recommended. The Work Group did not recommend the continuity method because the standard method was judged to be more appropriate.

Yellowtail snapper discard calculation used data reported between January 1, 2002 and December 31, 2018 in southern Florida from vertical line trips. Yellowtail snapper discards were not reported on more than a few trips using other gears. Data filtering followed the methods recommended during SEDARs 32 and 41 (McCarthy, 2013 and 2014). Data were also filtered to exclude trips landing only mackerel because the SEDAR 32 and 41 panels (and accepted by the SEDAR 64 working group) noted that for trips targeting mackerel only, the likelihood of catching species other than mackerel was extremely low. To avoid removing mixed effort trips, however, only trips with 100% mackerel landings were excluded.

A final data filter designed to address possible underreporting of commercial discards was included following the recommendation of SEDARs 32 and 41. The percentage of discard reports returned with "no discards" from vertical line trips has increased from 49 to 79 percent in southern Florida over the period 2002-2018. The working group recommended that data be filtered to remove records from vessels that never reported discards of any species during a year. Following the SEDAR 32 and 41 commercial working groups' recommendations, data from vessels that reported many more trips than the fleet average before a discard was reported (the mean number of trips prior to the first trip with reported discards plus two standard deviations above that mean) were excluded. Filtered logbook data were assigned to one of three regions by reported area fished. Each logbook region coincides with the FHS regions established in Figure 3.2 (West Florida – FHS 2, Florida Keys – FHS 3, and Southeast Florida – FHS 4).

Yearly discard rates of vertical line vessels were calculated as the mean rate (discards per hook hour fished) within each region during the years 2002-2018. Yearly total effort (hook hours) of all trips by vertical line vessels within each region was multiplied by the yearly mean discard rate from the appropriate region to calculate total discards of yellowtail snapper by vertical line vessels.

*Calculated discards per region = yearly mean yellowtail snapper discard rate per region*total effort per region*[1]

[1]total effort post data filtering

For years prior to 2002 (the first year of discard data), the mean discard rate, by region, for the years 2002-2006 was used to calculate discards for the years 1993-2001 when only effort data were available.

*Calculated discards per region = 02-06 mean yellowtail snapper discard rate per region*total effort per region*[1]

[1]total effort post data filtering

Total discards are provided in Table 3.9 by region in number of fish and pounds whole weight.

Immediate release mortality was assessed by depth for vertical line trips in the Florida Keys from the reef fish observer data (Table 3.10.). Based on the fishing depth distribution of all discards, depth was categorized into five-meter bins with the last bin representing fishing depth deeper than 20 meters. Percent release mortality was calculated based on the observer reported discard disposition of yellowtail snapper within each depth bin. Percent release mortality was the highest at the shallow (< 5m) and deep (> 20m) depth bins as 17% and 22%, respectively. Disposition was then compared to the initial condition of the fish when hauled on board the vessel (alive, dead, or barotrauma). This showed that most fish discarded dead were initially alive when brought on board. This suggests delayed release may have been due to extended observer handling times before fish were discarded resulting in high release mortality when caught less than five meters from the surface. Additionally, a single trip accounted for 35% of the fish released dead within the five-meter depth bin. Due to this presumed effect of handling time, the work group did not recommend using these results to inform commercial discard mortality. See working paper SEDAR64-DW-15 for a detailed description of methods.

Discard mortality estimates for commercial Yellowtail Snapper were set at a lower and upper bound of 10% and 15%, respectively. During the plenary session, an estimate of 20% upper bound was proposed but thought to be too high by industry. Commercial fishers would be more apt to release their fish quickly thereby reducing potential predation and interruption in fishing activity. These new estimates are similar to the calculated estimate of 11.5% from SEDAR 27A. Table 3.11 shows the amount of estimated discard mortality by year and region in both numbers of fish and pounds whole weight.

3.5 COMMERCIAL EFFORT

Figure 3.7 presents the number of commercial Yellowtail Snapper trips with Florida landings by region averaged over 2015-2017. The commercial workgroup looked at both number of licenses reporting Yellowtail Snapper landings as well as the number of trips on which Yellowtail Snapper were caught as potential measures of effort in the fishery. A comparison of number of trips and landings by year for the three regions of major harvest (FL Keys, Southeast Florida, and Southwest Florida) show that prior to 2008, both number of trips and landings in each region changed somewhat similarly from year to year (Figure 3.8). But starting in 2008, the FL Keys region showed a dramatic increase in landings while the number of trips decreased. Additionally, the number of state commercial fishing licenses harvesting Yellowtail Snapper has also declined in all three regions of South Florida, particularly in the FL Keys since about 1990 (Figure 3.9). The number of federal snapper-grouper permits active in the South Atlantic has decreased as well (Figure 3.10). This inverse relationship between effort and landings could be attributed to more efficient fishing methods, and possibly a more abundant population of Yellowtail Snapper during this time.

There was some concern as to where most of the Yellowtail Snapper harvest was taking place with respect to changes in state and federal regulations in the Gulf and South Atlantic. Figure 3.11 shows commercial Yellowtail Snapper landings by state and federal waters for each of the

South Florida subregions from Florida trip ticket data. While area fished was always a data element on the trip ticket, it was not required to be reported until 1995. Also, early area fished coding did not separate state and federal waters initially. We consider 1996 to be a good starting year for reporting landings by area fished. Yellowtail Snapper landings in the Southwest region are almost exclusively from federal waters while landings from Southeast Florida tend to be more from state waters. The Florida Keys show a mixture of landings from state and federal waters with most of the fish coming from federal waters. Commercial industry participants generally agreed with these observed fishing trends.

3.6 BIOLOGICAL SAMPLING

Biological samples from the commercial fishery primarily come from the Trip Interview Program System (TIPS). These data are collected by state and federal port agents who meet the vessel at the dock upon return from its fishing activities and sample their catch. Data collected from the catch include lengths, weights, and hard parts for aging whenever possible in addition to trip and effort information from the fishers. This information is then entered into the TIPS database housed at the NOAA Fisheries Southeast Fisheries Science Center. All data for Yellowtail Snapper were provided in Microsoft Access and converted into SAS data sets for processing and analysis using methods approved by the working group. A series of length/length and length/weight regressions were used to fill any missing data.

3.6.1 Sampling Intensity Length/Age/Weight

Sampling for Yellowtail Snapper lengths for TIPS occurred from 1984 to 2017 (terminal year of SEDAR 64) and from Louisiana to North Carolina. Lengths were compiled by region based on the FHS region definitions in Figure 3.2 using area fished when available and county landed when area fished was not available. The number of FL records for each region are shown in Table 3.12. Over 99% of samples came from Florida with the majority of those (~81%) coming from the Florida Keys. Flags were set up to mark data for exclusion as outliers in length frequency distributions based on extreme lengths, non-commercial data, size or effort bias, no region assigned, and non-random records. Other factors were examined but not found to alter the mean or SD of lengths (i.e. if the catch is landed sorted, complete/incomplete landings, interview type, etc.). The Florida Keys has adequate samples for all years, but other regions have few to no samples for early years until 1992 when sample size in Southeast Florida increased (Table 3.13). No other regions consistently have enough samples. TIPS records show gutted or whole weight for 14.3% of samples. The remaining weights were computed from FL or TL max length-weight equations. These computed weights were used to create mean weights for calculating the number of fish landed in section 3.3.5.

Hard parts for aging Yellowtail Snapper were collected from TIPS sampled fish. The ages from these samples were obtained from age and growth labs at NOAA Fisheries (Panama City and Beaufort) and from FWC's Fish and Wildlife Research Institute (FWRI) in St. Petersburg. Preliminary age data were lacking TIPS interview numbers for samples collected before 2002. We requested a complete download of yellowtail data from the age and growth labs and were able to match the TIP data from 1992 to 2017. Age data from the Florida Keys are sufficient starting in 2002 and from Southeast Florida starting in 2004. The ages were combined with the TIPS length data to create an age at length key.

3.6.2 Length/Age Distributions

Length and age distributions were reviewed by the workgroup. More details on length frequency distributions are shown in working paper S64_DW_14_TIPS_LFD.pdf. Data from the Florida Keys and Southeast Florida generated robust distributions (Figure 3.12) and mean length was very similar between the Florida Keys and southeast Florida (Table 3.12). Plots showing the proportion of age by year indicate Yellowtail Snapper were mostly 3-5 years old in the Florida Keys (Figure 3.13) and 2-3 years old in Southeast Florida (Figure 3.14). The Florida Keys also had a much broader age distribution than Southeast Florida. A box plot of mean age by FHS region (Figure 3.15) shows Yellowtail Snapper in the northern regions reach larger lengths and mean ages. The North of Florida region had the oldest (23 years) and largest fish (~840 mm TL max) in the dataset. The age and growth workgroup noted they will not be including the very old fish from outside Florida for their analyses.

3.6.3 Adequacy for Characterizing Catch

The workgroup had determined that these data are adequate for characterizing catch because the data corroborate the landings. We have identified items that could be improved and have included them in the research recommendations.

3.6.4 Alternatives for Characterizing Discard Length/Age

Discard data presently comes from the observer program and commercial logbooks. Size composition data from the Reef Fish and Shark Observer Programs were provided to the FWRI data compiler. Based on data availability and coverage, shark observer data were only sufficient for vertical line trips in the Florida Keys. It should be noted that the shark observer data were not representative because length data were only available for trips taken within a single year by a single vessel. Reef fish observer data were supplied for both longline and vertical line trips in the Florida Keys and along the western Florida coast. All lengths were converted to both fork length (cm) and total length (cm) and binned to one-centimeter increments. See working paper SEDAR64-DW-15 for a detailed description of methods.

Beginning a program of on-board sampling for discards in the South Atlantic commercial fleet would be an alternative for the present fisher reported data and would supplement the logbook program and the Gulf of Mexico observer programs greatly. This could be done with sampling predominantly day trips and some multiday trips to characterize yellowtail catch. Head boat discard data was suggested as a proxy, but the group determined that the fishing behavior differences and higher discard mortality would make it a poor fit.

3.7 COMMERCIAL CATCH-AT-AGE/LENGTH (DIRECTED AND DISCARD)

These data are currently still under review and will be provided in the assessment report.

3.8 COMMENTS ON ADEQUACY OF DATA FOR ASSESSMENT ANALYSES

The commercial workgroup considered the landings data from Florida to be adequate for assessment analyses. Misidentification or misclassification of Yellowtail Snapper were not significant issues. There is some concern that landings prior to 1986 (beginning of the trip ticket program) may have been underreported. However, uncertainty estimates for the landings were developed to address the issue of accuracy and completeness in the landings. Gear data missing from Florida trip ticket were supplemented by ALS landings by gear prior to 1991. Also, the workgroup recommended that landings be aggregated by gear as most of the Yellowtail Snapper harvest is by vertical line.

While the amount of discard data captured from the observer programs seems inadequate for the calculation of discards, these data may be useful for comparison and potential development of discard length composition. Although self-reported, the coastal logbook program was able to provide much more discard data and the workgroup agreed is the best data available for the calculation of discard rates of commercial Yellowtail Snapper. CVs were provided as an estimate of uncertainly in the mean discard rates.

The discard calculations rely on self-reported discard and effort data. Perhaps the most important source of error in the commercial discard calculations was misreporting and non-reporting of discards, both of yellowtail snapper and other species. An effort was made to minimize that potential error by removing data from vessels that never reported discards of any species during a year or reported many more trips than the fleet average before a discard was reported. Although such clear instances of discard non-reporting were identified and excluded, other cases of non-reporting and misreporting have not been quantified. The degree to which continued nonreporting or misreporting may have affected the discard calculations is unknown.

The discard totals provided may represent a minimum estimate of the number of yellowtail snapper discarded from the commercial vertical line fishery. The conclusion of the commercial working group was that given the very limited and non-representative nature of available observer data, fisher reported discard data represent the best available information on commercial yellowtail snapper discards. This decision was approved in plenary session of the Data Workshop.

The workgroup agreed that length samples from the TIP program appear to be adequate for assessment analyses as there were a relatively high number of samples for most years in the core areas (Florida Keys and Southeast Florida).

3.9 RESEARCH RECOMMENDATIONS

Improve or develop new methods for collecting discard data. Expand observer coverage to the entire range for Yellowtail Snapper (i.e. Atlantic) to document discard length and mortality. Find a better method to address false zeros in self-reported logbook data. Explore recall bias/rounding issue: discards 5,10, 15 – recall bias – 1-10, units of 5 after that.

Study smaller fish for possible correlation between sex and tail length. Industry has seen robust fish with short tails and skinny fish with longer tails and believe them to be evidence of a secondary sex characteristic.

Perform genetic analysis of commercial samples to determine if Yellowtail Snapper is a single stock in the Southeastern United States (very old and large fish North of Florida along the Atlantic coast possibly indicating different stocks).

So little data is available on YOY/juvenile Yellowtail Snapper. There may be an opportunity to increase these samples as commercial fishers who participated in the workgroup have offered to assist fisheries scientists to obtain samples of YOY/juvenile Yellowtail Snapper. Industry believes they can get fisheries independent scientists' access to these fish by taking scientists to areas where many YOY/juvenile fish have been observed, or by providing them with area and gear recommendations based on the results of commercial fishing activities for Yellowtail Snapper.

Survey fishers for when then encounter small sub-legal fish (on board observer or email/mail). When they see small fish, they often leave the site which is not captured by logbook or gulf observer program. Modifying API of e-logbook or putting more onboard observers in the keys could provide more data on behavior. Onboard observers could also obtain discard information. Could use VMS to account for target species switching.

Ensure consistent and adequate levels of funding for continued TIPS sampling. These data were critical in providing age, length, weight, and trip information which can help validate reported landings information.

3.10 DATA BEST PRACTICES COMMENTS AND SUGGESTIONS

While the topic of unclassified/misidentified fish did not seem to be an issue for Yellowtail Snapper, the workgroup recommends the continued practice of evaluating this potential issue on a species by species basis.

The availability of duplicate datasets allows for the comparison, validation, and potential synthesis of multiple datasets for development of best available data. The workgroup recommends continued use of this practice.

The Commercial Workgroup still supports the recommendation from the Best Practices Report to hold a workshop or meeting to determine specific methods for quantifying uncertainty in commercial landings in such a way that is appropriate and informative to the model.

3.11 LITERATURE CITED

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3.12 TABLES

Table 3.1. U.S. commercial landings (in pounds) of Yellowtail Snapper by Florida coast and other states combined. Data from NOAA Fisheries and FL FWC.

Year	FL West Coast	FL East Coast	Out-of-State
1950	249,900	96,500	0
1951	210,000	227,600	0
1952	215,400	174,600	0
1953	213,200	134,400	0
1954	200,100	133,700	0
1955	143,800	92,600	0
1956	163,700	100,400	0
1957	296,500	146,800	0
1958	261,300	86,500	0
1959	406,300	86,400	0
1960	527,600	98,200	0
1961	639,900	95,000	0
1962	909,800	88,300	0
1963	729,000	102,700	0
1964	896,500	144,100	0
1965	941,700	123,000	0
1966	752,500	77,700	0
1967	849,900	112,600	0
1968	1,025,300	162,900	0
1969	807,800	162,300	0
1970	986,900	209,300	0
1971	948,900	144,400	0
1972	865,500	154,700	0
1973	835,500	107,100	0
1974	937,900	104,900	0
1975	675,400	122,300	0
1976	922,300	55,400	0
1977	762,400	46,400	0
1978	830,400	40,200	0
1979	731,700	48,300	0
1980	606,438	45,017	0
1981	694,188	37,434	0
1982	1,334,831	35,884	1,358
1983	894,385	67,326	31
1984	911,608	35,697	160
1985	784,095	41,126	766
1986	1,026,456	92,318	46
1987	1,265,459	88,544	10,054
1988	1,299,430	111,936	1,210
1989	1,711,275	137,021	3,231
1990	1,627,159	128,102	352
1991	1,711,518	148,832	1,292

Year	FL West Coast	FL East Coast	Out-of-State
1992	1,675,050	176,462	4,830
1993	2,193,092	185,641	506
1994	2,037,469	168,384	434
1995	1,728,856	127,934	124
1996	1,350,073	109,127	136
1997	1,529,064	144,842	277
1998	1,398,046	126,385	177
1999	1,735,291	110,862	253
2000	1,490,704	101,016	226
2001	1,324,607	95,974	203
2002	1,315,257	94,687	755
2003	1,304,558	105,449	2,452
2004	1,377,250	102,689	706
2005	1,212,587	111,960	780
2006	1,153,822	83,061	423
2007	881,060	96,905	609
2008	1,258,882	111,120	799
2009	1,814,961	160,137	1,672
2010	1,502,395	191,557	1,449
2011	1,682,877	210,667	1,312
2012	1,937,097	170,213	1,084
2013	1,947,817	113,326	1,866
2014	1,984,270	59,010	824
2015	2,164,831	33,139	2,253
2016	2,259,559	55,347	748
2017	2,780,951	39,489	272
2018	1,955,100	24,822	743

Table 3.2. Monroe county (FL Keys) landings of Yellowtail Snapper as a percent of the Florida statewide total from 1962-2018.

Year	Monroe County	Statewide	% Monroe
1962	892,700	998,100	89.4%
1963	716,600	831,700	86.2%
1964	885,400	1,040,600	85.1%
1965	915,100	1,064,700	85.9%
1966	735,000	830,200	88.5%
1967	828,800	962,500	86.1%
1968	947,700	1,188,200	79.8%
1969	755,800	970,100	77.9%
1970	915,100	1,196,200	76.5%
1971	836,100	1,093,300	76.5%
1972	741,000	1,020,200	72.6%
1973	726,700	942,600	77.1%
1974	798,600	1,042,800	76.6%
1975	591,700	797,700	74.2%
1976	810,500	977,700	82.9%
1977	653,700	808,800	80.8%
1978	735,100	870,600	84.4%
1979	656,800	780,000	84.2%
1980	535,531	651,455	82.2%
1981	639,863	731,622	87.5%
1982	1,257,985	1,370,715	91.8%
1983	846,222	961,711	88.0%
1984	861,773	947,305	91.0%
1985	762,048	825,221	92.3%
1986	991,101	1,118,774	88.6%
1987	1,234,050	1,354,016	91.1%
1988	1,259,673	1,411,366	89.3%
1989	1,639,195	1,848,305	88.7%
1990	1,576,733	1,755,261	89.8%
1991	1,673,075	1,860,350	89.9%
1992	1,594,981	1,850,852	86.2%
1993	2,135,552	2,378,313	89.8%
1994	2,005,681	2,205,051	91.0%
1995	1,696,420	1,856,806	91.4%
1996	1,335,745	1,458,799	91.6%
1997	1,523,527	1,673,603	91.0%
1998	1,393,145	1,524,370	91.4%
1999	1,726,777	1,846,119	93.5%
2000	1,500,692	1,591,912	94.3%
2001	1,318,381	1,420,654	92.8%
2002	1,310,039	1,410,125	92.9%
2003	1,294,918	1,410,177	91.8%
2004	1,372,617	1,480,041	92.7%
2005	1,209,201	1,324,612	91.3%
2006	1,148,783	1,236,987	92.9%
2007	878,227	978,082	89.8%
2008	1,257,655	1,370,089	91.8%
2009	1,812,237	1,975,533	91.7%
2010	1,501,385	1,694,057	88.6%
2011	1,679,163	1,893,636	88.7%
2012	1,892,442	2,069,485	91.4%
2013	1,940,670	2,061,217	94.2%
2014	1,933,005	2,043,302	94.6%
2015	2,146,870	2,198,334	97.7%

Year	Monroe County	Statewide	% Monroe
2016	2,237,346	2,314,725	96.7%
2017	2,765,302	2,819,733	98.1%
2018	1,918,402	1,963,363	97.7%

Table 3.3. Specific gears by data source in the hook and line category for Yellowtail Snapper.

NOAA FISHERIES ALS	
GEAR CODE	**DESCRIPTION**
610	LINES HAND, OTHER
678	LINES LONG DRIFT WITH HOOKS
675	LINES LONG SET WITH HOOKS
676	LINES LONG, REEF FISH
677	LINES LONG, SHARK
614	LINES LONG, VERTICAL
660	LINES TROLL, OTHER
613	REEL, ELECTRIC OR HYDRAULIC
612	REEL, MANUAL
611	ROD AND REEL
616	ROD AND REEL, ELECTRIC (HAND)
600	TROLL & HAND LINES CMB
FLORIDA FWC	
GEAR CODE	**DESCRIPTION**
6770	BOUY DROP LINE
6130	ELECTRIC REEL
6120	HAND REEL
6100	HOOK & LINE, UNCL.
6760	LONG LINE, BOTTOM
6750	LONG LINE, SURFACE/MIDWATER
6740	LONG LINE, UNCL.
6110	ROD AND REEL
6200	TROLL LINES
6210	TROLL LINES, MANUAL

Table 3.4. U.S. Southeast commercial Yellowtail Snapper landings (whole pounds) by year, YS region, and gear. Data from NOAA Fisheries ALS (yellow) and FL Trip Ticket (green). Landings with an * are considered confidential and account for less than 0.1% of the annual total.

	Region by Gear							
	FL Gulf of Mexico		FL Keys		FL South Atlantic		Out-of-State	
Year	H&L	Other	H&L	Other	H&L	Other	H&L	Other
1962	17,100		892,700		88,300			
1963	12,400		716,600		102,700			
1964	10,400		885,400		144,100		700	
1965	17,000		915,900		123,000		8,800	
1966	1,700		745,700		77,700		5,100	
1967			849,300		112,600		600	
1968			1,025,000		162,900		300	
1969			807,500		162,300		300	
1970			986,900		209,300			
1971	100		948,600		144,400		200	
1972	589,800		275,600		154,700		100	
1973	21,800		813,500		107,100		200	
1974	28,200		909,200		104,900		500	
1975	17,500		657,700		122,300		200	
1976	29,300		893,000		55,400			
1977	11,600		750,800		46,400			
1978	15,200		833,200	2,600	17,000	2,600		
1979	58,900		609,300	81,100	30,700			
1980	35,979	2,014	525,097	62,648	25,717			
1981	27,396		652,540	29,694	21,992			
1982	51,701		1,287,777	5,809	25,428		1,358	
1983	26,929		865,519	16,618	28,113	24,532	31	
1984	37,254		857,119	17,235	35,296	401	12	148
1985	13,124	198	718,847	32,113	60,820	119	766	
1986	17,471	17,154	608,186	419,317	35,517	21,615	46	
1987	18,138	136	1,247,185	1,383	75,063	13,494	8,353	318
1988	25,231	173	1,218,183	39,063	98,267	31,633	26	
1989	59,980	1,439	1,585,008	55,448	117,492	30,290	1,879	
1990	41,493	795	1,536,655	40,992	114,174	21,152	134	218
1991	21,710	1,372	1,630,109	37,856	155,631	13,672	1,243	49
1992	78,875	693	1,495,350	39,758	235,469	1,368	4,827	12
1993	47,609	9,737	1,911,737	156,739	235,653	17,258	454	54
1994	30,304	1,077	1,811,735	91,646	260,762	9,981	414	20
1995	36,702	1,642	1,528,688	59,162	227,147	3,450	84	40
1996	26,507	2,028	1,158,819	36,599	231,681	3,463	145	20
1997	16,848	882	1,268,681	37,237	344,787	5,470	230	47
1998	6,447	354	1,177,292	46,546	287,381	6,411	166	
1999	18,363	1,668	1,494,992	43,251	282,623	5,245	141	123
2000	6,385	357	1,346,558	22,547	212,247	3,626	226	
2001	5,142	983	1,192,509	2,216	218,943	344	642	*
2002	2,457	537	1,159,472	4,158	240,493	418	3,157	*
2003	5,558	565	1,144,728	1,033	252,997	373	2,454	
2004	4,684	*	1,243,834	1,160	230,162	81	695	*

Year	Region by Gear							
	FL Gulf of Mexico		FL Keys		FL South Atlantic		Out-of-State	
	H&L	Other	H&L	Other	H&L	Other	H&L	Other
2005	4,533	122	1,131,715	1,017	186,745	415	772	*
2006	5,977	145	1,110,201	632	119,735	191	416	*
2007	3,098	*	853,443	4,620	116,756	45	567	*
2008	4,615	*	1,255,458	6,563	103,134	228	782	*
2009	2,830	107	1,822,814	947	148,232	168	1,353	319
2010	596	*	1,525,772	2,181	165,392	*	1,176	273
2011	4,413	*	1,766,022	915	121,568	616	572	733
2012	13,007	*	1,960,463	2,906	130,464	394	656	449
2013	10,731	*	1,973,924	5,559	70,772	151	1,725	141
2014	9,881	*	1,958,699	4,698	69,485	461	828	17
2015	12,399	467	2,078,140	3,224	103,267	457	546	*
2016	13,878	496	2,204,120	1,111	95,244	57	699	*
2017	13,322	861	2,739,383	1,779	64,809	272	282	*
2018	20,772	253	1,899,479	742	58,557	104	746	*

Table 3.5. Commercial landings uncertainty estimates for Yellowtail Snapper.

Year Range	TX-AL	NW FL	SW FL	FL Keys	SE FL	NE FL	GA-NC
1950-1961	0.25	0.25	0.25	0.25	0.25	0.25	0.25
1962-1977	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1978-1985	0.2	0.1	0.1	0.1	0.1	0.1	0.2
1986-2001	0.2	0.1	0.05	0.05	0.05	0.1	0.2
2002-2018	0.2	0.1	0.05	0.05	0.05	0.1	0.2

Table 3.6. Number of Yellowtail Snapper measured by FHS region and gear from the Trip Interview Program (TIP) database, 1984-2017.

	Hook and line							Other						
Year	W of FL	FL NW	FL SW	FL Keys	FL SE	FL NE	N of FL	W of FL	FL NW	FL SW	FL Keys	FL SE	FL NE	N of FL
1984	2			1126			6				153			
1985				2003							451			
1986			1	2560	25	2	7			60	199			
1987				1758			13				13			
1988			10	1867	3		11				74			
1989				2632			2				274			
1990	1		5	4734	31	11	9				169			
1991	11		150	5196	5	8	22			61	611			10
1992			117	3871	1301	21	1			6	13			3
1993	17		42	5103	214	5	9			16	157	150		
1994	1	1	36	5469	192	16	10			1	170	72		
1995	3	95	24	5998	455	82	25				246			12
1996	6		253	3565	672	2	7			68	132			4
1997	1		96	5658	1859	19	6			8	202		1	8
1998		7	23	5419	1496	14	9			2	108			8
1999		5	146	5973	2081	32	75		2	1	308			14
2000			105	2654	2021	97	18		1		38		1	12
2001			109	4972	3250	26				1	12	11	2	5
2002			38	5951	1447	8	14			4	17	39		22
2003	1		44	3649	621	11	29				1			1
2004			16	3136	834		43				2	180		
2005	1		85	2569	827	2	95	1		1	108	112		
2006	4		20	1324	758	23	56				27	352		1
2007			6	1656	809	19	33			44	56	60	1	
2008	4		85	2447	577		74	1		76	2	108	2	
2009			230	2906	547	10	72			35	265	23	2	
2010			31	1462	378		30				136	144	8	4
2011	6		22	2559	994		15				375	85		
2012	5		24	5790	408		16				1260	88	14	
2013	1		15	3365	593		8			1	1343	222	2	
2014	4	1	51	3985	1313	2	9			19	1036	10	1	1
2015		1	105	3450	936	3	7			45	496	5	7	
2016	2	6	52	2822	428		12			22	137	54	2	
2017	2	2	66	3344	355		1			52	247	4	1	1

Table 3.7. Yellowtail Snapper landings in numbers of fish by general FHS region and gear, 1981-2017. * denotes confidential data per table 3.4.

	Hook and Line				Other			
Year	FL Gulf	FL Keys	FL Atlantic	Out-of-State	FL Gulf	FL Keys	FL Atlantic	Out-of-State
1981	19,533	498,724	12,439			18,748		
1982	36,862	984,223	14,383	768		3,668		
1983	19,200	661,504	15,901	18		10,492	19,786	
1984	26,562	563,199	19,964	7		10,450	323	119
1985	9,357	488,037	34,401	545	267	18,766	96	
1986	15,088	780,075	58,618	28	140	21,442	6,859	
1987	12,932	979,856	42,457	5,955	183	873	10,883	256
1988	17,990	1,057,970	55,582	16	233	31,108	25,513	
1989	42,765	1,276,120	110,897	1,340	1,738	36,807	24,430	
1990	29,584	1,366,854	68,925	81	960	29,018	17,060	263
1991	16,685	1,355,624	146,895	966	1,625	39,714	11,027	55
1992	60,264	1,160,510	230,903	4,731	836	33,120	1,103	14
1993	25,886	1,560,957	221,173	425	11,757	123,514	15,471	65
1994	26,669	1,446,580	195,356	339	1,481	64,804	7,021	28
1995	45,114	1,429,761	178,926	66	2,258	60,063	1,662	55
1996	22,398	1,047,519	238,751	144	2,987	32,721	1,668	29
1997	14,277	1,064,500	352,112	200	1,214	26,322	2,635	65
1998	5,674	1,035,124	274,522	159	487	32,043	3,088	
1999	14,253	1,207,119	259,501	124	2,295	49,749	2,029	169
2000	4,008	1,048,065	188,622	158	491	24,584	1,402	
2001	3,099	1,034,973	188,319	434	1,352	2,416	133	*
2002	1,575	931,767	214,705	2,160	739	4,534	168	*
2003	3,563	886,073	202,820	1,627	2,864	1,126	144	
2004	2,796	965,207	200,198	541	*	815	70	*
2005	2,597	830,377	143,738	575	66	672	343	*
2006	3,568	793,471	90,851	301	78	444	211	*
2007	1,849	603,092	103,844	469	*	3,836	42	*
2008	2,881	904,548	79,700	591	*	4,608	217	*
2009	2,426	1,333,201	129,002	1,175	67	810	152	205
2010	424	1,052,728	144,060	990	*	1,901	4	151
2011	3,142	1,291,242	113,585	526	*	798	549	395
2012	9,262	1,596,768	102,825	503	*	2,540	317	332
2013	5,524	1,544,557	70,902	1,481	*	4,254	142	108
2014	5,561	1,602,780	69,927	705	*	3,973	299	11
2015	8,413	1,723,077	110,250	548	315	2,998	296	*
2016	8,511	1,837,862	87,156	609	367	925	39	*
2017	7,032	2,116,984	66,349	261	653	1,516	176	*

Table 3.8. Mean whole weight (kilograms) of Yellowtail Snapper by year, region, and gear derived from length compositions from the U.S. South Atlantic TIP database, 1981-2017.

	Hook and Line			Other		
Year	West	FL Keys	East	West	FL Keys	East
1981	0.636	0.593	0.802	0.337	0.718	0.562
1982	0.636	0.593	0.802	0.337	0.718	0.562
1983	0.636	0.593	0.802	0.337	0.718	0.562
1984	0.636	0.690	0.802	0.337	0.748	0.562
1985	0.636	0.668	0.802	0.337	0.776	0.562
1986	0.636	0.556	0.802	0.337	0.634	0.562
1987	0.636	0.577	0.802	0.337	0.718	0.562
1988	0.636	0.522	0.802	0.337	0.570	0.562
1989	0.636	0.563	0.481	0.376	0.683	0.562
1990	0.636	0.510	0.751	0.376	0.641	0.562
1991	0.590	0.545	0.481	0.383	0.432	0.562
1992	0.594	0.584	0.463	0.376	0.545	0.562
1993	0.834	0.556	0.483	0.376	0.576	0.506
1994	0.515	0.568	0.605	0.330	0.641	0.645
1995	0.369	0.485	0.576	0.330	0.447	0.942
1996	0.537	0.502	0.440	0.308	0.507	0.942
1997	0.535	0.541	0.444	0.330	0.642	0.942
1998	0.515	0.516	0.475	0.330	0.659	0.942
1999	0.584	0.562	0.494	0.330	0.394	1.173
2000	0.723	0.583	0.510	0.330	0.416	1.173
2001	0.753	0.523	0.527	0.330	0.416	1.173
2002	0.708	0.564	0.508	0.330	0.416	1.130
2003	0.708	0.586	0.566	0.842	0.416	1.173
2004	0.760	0.585	0.521	0.842	0.646	0.524
2005	0.792	0.618	0.589	0.842	0.686	0.548
2006	0.760	0.635	0.598	0.842	0.646	0.410
2007	0.760	0.642	0.510	0.871	0.546	0.490
2008	0.727	0.630	0.587	0.819	0.646	0.477
2009	0.529	0.620	0.521	0.723	0.530	0.502
2010	0.637	0.657	0.521	0.842	0.521	0.482
2011	0.637	0.620	0.485	0.842	0.520	0.509
2012	0.637	0.557	0.576	0.613	0.519	0.563
2013	0.881	0.580	0.453	0.613	0.593	0.481
2014	0.806	0.554	0.451	0.613	0.536	0.700
2015	0.668	0.547	0.425	0.674	0.488	0.700
2016	0.740	0.544	0.496	0.613	0.545	0.665
2017	0.859	0.587	0.443	0.599	0.532	0.700

Table 3.9. Amount of Yellowtail Snapper discards by year and region (a=Florida Keys, b=Southeast Florida, c=West Florida) from 1993-2018. Data are from NMFS Coastal Fisheries Logbook Program. Discards are in number of fish and pounds whole weight.

a) Florida Keys

Year	Total Effort (hook hours)	Trips Reporting Effort	Mean Discard Rate	Trips Reporting Discards	CV Discard Rate	Total Discards (number of fish)	Total Discards (pounds)
1993	317173.2	7835	0.275027	3906	2.254803	87,231	91,536
1994	357590	8696	0.275027	3906	2.254803	98,347	103,200
1995	414053.5	9206	0.275027	3906	2.254803	113,876	119,496
1996	403791.5	9253	0.275027	3906	2.254803	111,054	116,534
1997	478473.5	10603	0.275027	3906	2.254803	131,593	138,087
1998	330883.6	8737	0.275027	3906	2.254803	91,002	95,493
1999	362593.4	8983	0.275027	3906	2.254803	99,723	104,644
2000	354032.1	8168	0.275027	3906	2.254803	97,369	102,174
2001	296854.7	8457	0.275027	3906	2.254803	81,643	85,672
2002	282726.6	8009	0.261483	671	1.844513	73,928	77,576
2003	246587.5	7947	0.3152	1110	1.889972	77,724	81,560
2004	228999.5	7302	0.207186	655	2.500164	47,445	49,787
2005	195380.5	6359	0.222223	868	2.801261	43,418	45,561
2006	193964	5903	0.366002	602	2.307079	70,991	74,495
2007	154537.5	5562	0.51708	1041	2.043995	79,908	83,852
2008	148880	5785	0.313663	1306	2.331052	46,698	49,003
2009	184699	6073	0.319083	994	1.821567	58,934	61,843
2010	151427.5	5322	0.322927	1074	2.761632	48,900	51,313
2011	177147	5259	0.336128	1114	2.045451	59,544	62,483
2012	198969	5249	0.186444	1562	2.8973	37,096	38,927
2013	181474	4872	0.243113	1236	4.977136	44,119	46,296
2014	189570	5545	0.306127	1068	3.505844	58,033	60,896
2015	206618.5	5284	0.091896	1198	3.443187	18,987	19,924
2016	188053	5584	0.236573	1329	2.289697	44,488	46,684
2017	153585.5	5199	0.182811	794	2.212199	28,077	29,463
2018	144825	4614	0.146023	674	3.29938	21,148	22,191

b) Southeast Florida

Year	Total Effort (hook hours)	Trips Reporting Effort	Mean Discard Rate	Trips Reporting Discards	CV Discard Rate	Total Discards (number of fish)	Total Discards (pounds)
1993	70534.5	2678	0.066102	985	3.74769	4,662	4,893
1994	99934	3553	0.066102	985	3.74769	6,606	6,932
1995	105041	3352	0.066102	985	3.74769	6,943	7,286
1996	90202.5	3442	0.066102	985	3.74769	5,963	6,257
1997	118117	4037	0.066102	985	3.74769	7,808	8,193
1998	104920.3	3938	0.066102	985	3.74769	6,935	7,278
1999	85567	3415	0.066102	985	3.74769	5,656	5,935

Year	Total Effort (hook hours)	Trips Reporting Effort	Mean Discard Rate	Trips Reporting Discards	CV Discard Rate	Total Discards (number of fish)	Total Discards (pounds)
2000	93411.5	3156	0.066102	985	3.74769	6,175	6,479
2001	89288.7	3352	0.066102	985	3.74769	5,902	6,193
2002	84161.5	3941	0.151788	133	2.574713	12,775	13,405
2003	91458	4350	0.044748	280	4.214544	4,093	4,295
2004	88442.5	4054	0.045476	259	3.774309	4,022	4,220
2005	78377	3576	0.069464	206	3.951195	5,444	5,713
2006	80602.5	3635	0.05893	107	4.050197	4,750	4,984
2007	86746	4232	0.046903	595	5.182482	4,069	4,269
2008	87415	4064	0.021592	1053	6.249249	1,887	1,981
2009	101319	4810	0.01317	559	7.170827	1,334	1,400
2010	99997.5	4842	0.006395	1186	21.61366	639	671
2011	109208	5512	0.006097	1412	13.38943	666	699
2012	93296	4870	0.021111	1248	8.926608	1,970	2,067
2013	81319.4	4472	0.023177	1094	5.087743	1,885	1,978
2014	108249.5	5327	0.010382	1222	7.318741	1,124	1,179
2015	87411	4300	0.015109	717	8.807575	1,321	1,386
2016	93645	4567	0.002565	908	9.317938	240	252
2017	80801	4138	0.051743	560	4.942359	4,181	4,387
2018	79891	3861	0.099801	653	6.080124	7,973	8,367

c) West Florida

Year	Total Effort (hook hours)	Trips Reporting Effort	Mean Discard Rate	Trips Reporting Discards	CV Discard Rate	Total Discards (number of fish)	Total Discards (pounds)
1993	663958.8	2300	0	1370		0	0
1994	637970.2	2734	0	1370		0	0
1995	690881.6	2820	0	1370		0	0
1996	750681.5	2925	0	1370		0	0
1997	714304	3113	0	1370		0	0
1998	703378.6	3151	0	1370		0	0
1999	768056	3490	0	1370		0	0
2000	724358.9	3507	0	1370		0	0
2001	610663	3128	0	1370		0	0
2002	591682	2843	0	222		0	0
2003	621863.3	2835	0	428		0	0
2004	868284.2	2703	0	305		0	0
2005	540335.5	2329	0	233		0	0
2006	588116.5	2120	0	182		0	0
2007	437366	1623	0	215		0	0
2008	402756.4	1715	0.003428	389	15.58041	1,380	1,698
2009	617119	2102	0	330		0	0
2010	444616	1354	0	210		0	0
2011	408938	1349	0	312		0	0
2012	492644	1533	0.000808	259	11.35782	398	489

Year	Total Effort (hook hours)	Trips Reporting Effort	Mean Discard Rate	Trips Reporting Discards	CV Discard Rate	Total Discards (number of fish)	Total Discards (pounds)
2013	629909	1837	0.002012	495	9.688243	1,267	1,559
2014	678754	2087	0	402		0	0
2015	767123	2284	0.004196	610	17.04694	3,219	3,959
2016	817913	2180	1.35E-05	386	19.64688	11	14
2017	590473	2079	0.009532	597	7.701527	5,628	6,923
2018	541765	1697	0.001542	249	8.864824	836	1,028

Table 3.10**.** Release Discard Mortality for the Florida Keys.

Fishing Depth (m)	Number of Discarded Fish	% Total Discards	Number Released Alive (%)	Number Released Dead (%)
< 5 m	330	38%	274 (83%)	56 (17%)
6 – 10 m	219	25%	203 (92.7%)	16 (7.3%)
11 – 15 m	202	25%	192 (95%)	10 (5%)
16 – 20 m	110	13%	98 (89.1%)	12 (10.9%)
> 20 m	18	2%	14 (77.8%)	4 (22.2%)
Total	879		781 (88.9%)	98 (11.1%)

Table 3.11. Estimates of discard mortality based on lower (10%) and upper (15%) bound mortality rates of commercial Yellowtail Snapper by year and region (a=Florida Keys, b=Southeast Florida, c=West Florida) from 1993-2018. Discard mortality estimates are in numbers of fish and pounds whole weight.

a) Florida Keys

Year	Dead Discards (number of fish, mortality 10%)	Dead Discards (pounds, mortality 10%)	Dead Discards (number of fish, mortality 15%)	Dead Discards (pounds, mortality 15%)
1993	8,723	9,154	13,085	13,730
1994	9,835	10,320	14,752	15,480
1995	11,388	11,950	17,081	17,924
1996	11,105	11,653	16,658	17,480
1997	13,159	13,809	19,739	20,713
1998	9,100	9,549	13,650	14,324
1999	9,972	10,464	14,958	15,697
2000	9,737	10,217	14,605	15,326
2001	8,164	8,567	12,246	12,851
2002	7,393	7,758	11,089	11,636
2003	7,772	8,156	11,659	12,234
2004	4,745	4,979	7,117	7,468
2005	4,342	4,556	6,513	6,834
2006	7,099	7,449	10,649	11,174
2007	7,991	8,385	11,986	12,578
2008	4,670	4,900	7,005	7,350
2009	5,893	6,184	8,840	9,276
2010	4,890	5,131	7,335	7,697
2011	5,954	6,248	8,932	9,372
2012	3,710	3,893	5,564	5,839
2013	4,412	4,630	6,618	6,944
2014	5,803	6,090	8,705	9,134
2015	1,899	1,992	2,848	2,989
2016	4,449	4,668	6,673	7,003
2017	2,808	2,946	4,212	4,419
2018	2,115	2,219	3,172	3,329

Table 3.11 (continued). Estimates of discard mortality based on lower (10%) and upper (15%) bound mortality rates of commercial Yellowtail Snapper by year and region (a=Florida Keys, b=Southeast Florida, c=West Florida) from 1993-2018. Discard mortality estimates are in numbers of fish and pounds whole weight.

b) Southeast Florida

Year	Dead Discards (number of fish, mortality 10%)	Dead Discards (pounds, mortality 10%)	Dead Discards (number of fish, mortality 15%)	Dead Discards (pounds, mortality 15%)
1993	466	489	699	734
1994	661	693	991	1,040
1995	694	729	1,042	1,093
1996	596	626	894	939
1997	781	819	1,171	1,229
1998	694	728	1,040	1,092
1999	566	594	848	890
2000	617	648	926	972
2001	590	619	885	929
2002	1,277	1,341	1,916	2,011
2003	409	429	614	644
2004	402	422	603	633
2005	544	571	817	857
2006	475	498	712	748
2007	407	427	610	640
2008	189	198	283	297
2009	133	140	200	210
2010	64	67	96	101
2011	67	70	100	105
2012	197	207	295	310
2013	188	198	283	297
2014	112	118	169	177
2015	132	139	198	208
2016	24	25	36	38
2017	418	439	627	658
2018	797	837	1,196	1,255

Table 3.11 (continued).

c) West Florida

Year	Dead Discards (number of fish, mortality 10%)	Dead Discards (pounds, mortality 10%)	Dead Discards (number of fish, mortality 15%)	Dead Discards (pounds, mortality 15%)
1993	0	0	0	0
1994	0	0	0	0
1995	0	0	0	0
1996	0	0	0	0
1997	0	0	0	0
1998	0	0	0	0
1999	0	0	0	0
2000	0	0	0	0
2001	0	0	0	0
2002	0	0	0	0
2003	0	0	0	0
2004	0	0	0	0
2005	0	0	0	0
2006	0	0	0	0
2007	0	0	0	0
2008	138	170	207	255
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	40	49	60	73
2013	127	156	190	234
2014	0	0	0	0
2015	322	396	483	594
2016	1	1	2	2
2017	563	692	844	1,038
2018	84	103	125	154

Table 3.12. The number of commercial fork length (FL) samples in millimeters (applying the frequency column), mean FL, FL standard deviation, minimum FL, maximum FL, and percentage of total records by FHS region for Yellowtail Snapper.

FHS Region	N Obs	Mean	Std Dev	Minimum	Maximum	N	Percentage
FL Northeast	580	357	66.66	220.8	600	580	0.34%
FL Northwest	127	283	37.61	238.2	427.1	127	0.07%
FL Southeast	28414	299	37.74	146.8	605	28405	16.70%
FL Southwest	2541	325	54.96	180	637.5	2537	1.49%
Keys	137514	314	48.96	178	920	137452	80.84%
North of FL	857	397	103.22	217	910	854	0.50%
West of FL	74	403	85.67	266	608	74	0.04%

Table 3.13. Number of commercial fork length samples available in TIPS for Yellowtail Snapper by year and FHS region.

Year	FL Northeast	FL Northwest	FL Southeast	FL Southwest	Keys	North of FL	West of FL	Total
1984	.	.	.	.	1279	6	2	1287
1985	.	.	.	.	2454	.	.	2454
1986	2	.	25	61	2759	7	.	2854
1987	.	.	.	.	1771	13	.	1784
1988	.	.	3	10	1941	11	.	1965
1989	.	.	.	.	2906	2	.	2908
1990	11	.	31	5	4903	9	1	4960
1991	8	.	5	211	5807	32	11	6074
1992	21	.	1301	123	3884	4	.	5333
1993	5	.	364	58	5260	9	17	5713
1994	16	1	264	37	5639	10	1	5968
1995	82	95	455	24	6244	37	3	6940
1996	2	.	672	321	3697	11	6	4709
1997	20	.	1859	104	5860	14	1	7858
1998	14	7	1496	25	5527	17	.	7086
1999	32	7	2081	147	6281	89	.	8637
2000	98	1	2021	105	2692	30	.	4947
2001	28	.	3261	110	4984	5	.	8388
2002	8	.	1486	42	5968	36	.	7540
2003	11	.	621	44	3650	30	1	4357
2004	.	.	1014	16	3138	43	.	4211
2005	2	.	939	86	2677	95	2	3801
2006	23	.	1110	20	1351	57	4	2565
2007	20	.	869	50	1712	33	.	2684
2008	2	.	685	161	2449	74	5	3376
2009	12	.	570	265	3171	72	.	4090
2010	8	.	522	31	1598	34	.	2193
2011	.	.	1079	22	2934	15	6	4056
2012	14	.	496	24	7050	16	5	7605
2013	2	.	815	16	4708	8	1	5550
2014	3	1	1323	70	5022	10	4	6433
2015	10	1	941	150	3946	7	.	5055
2016	2	6	482	74	2959	12	2	3537
2017	1	2	359	118	3591	2	2	4075
Total	457	121	27149	2530	129812	850	74	160993

3.13 FIGURES

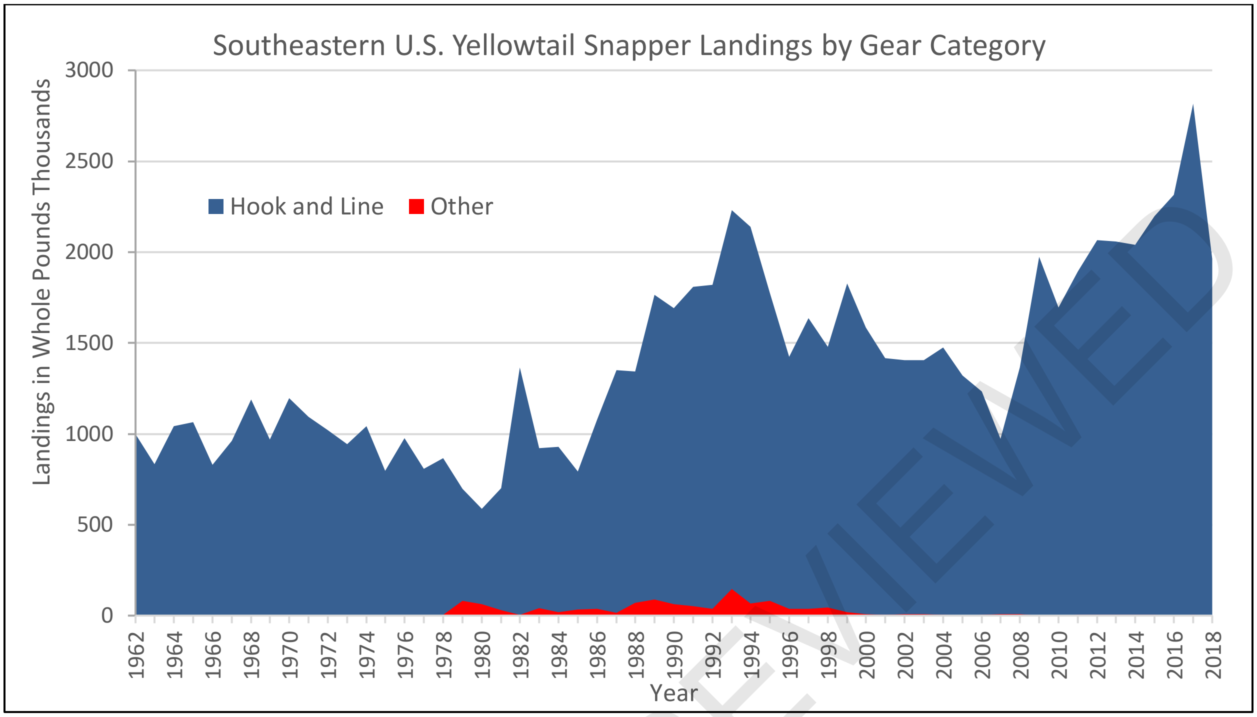


Figure 3.1. Yellowtail Snapper landings by gear category for the Southeastern. U.S. from 1962-2018.

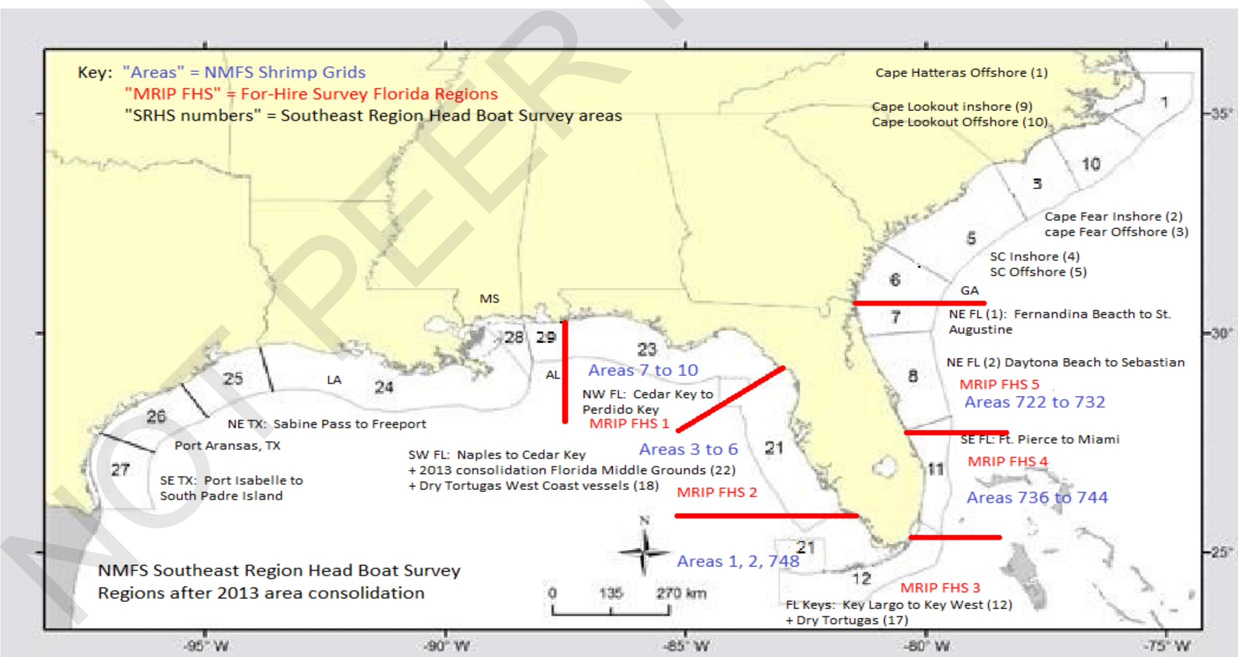


Figure 3.2. Region definitions for Yellowtail Snapper based on the for-hire survey regions in Florida from the Marine Recreational Information Program (MRIP).

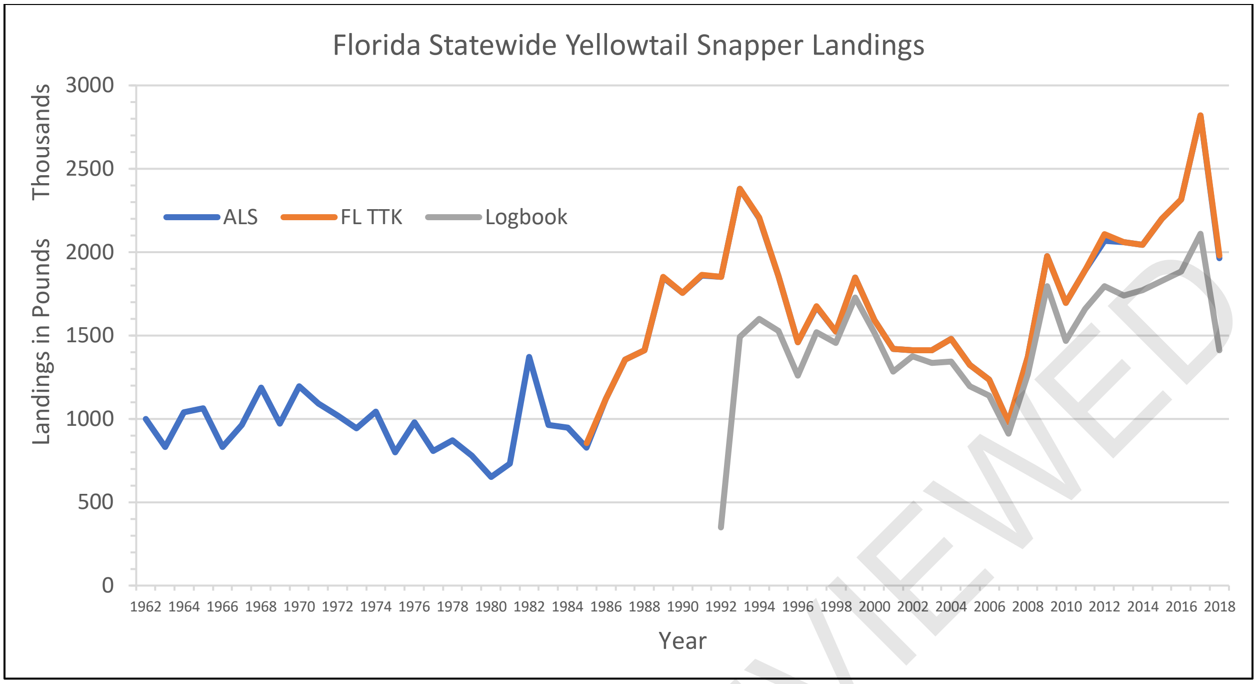


Figure 3.3. Commercial Yellowtail Snapper landings in Florida by data source, 1962-2018. (ALS=NMFS Accumulated Landings System, FL TTK=Florida Trip Ticket, Logbook=NMFS Coastal Logbook).

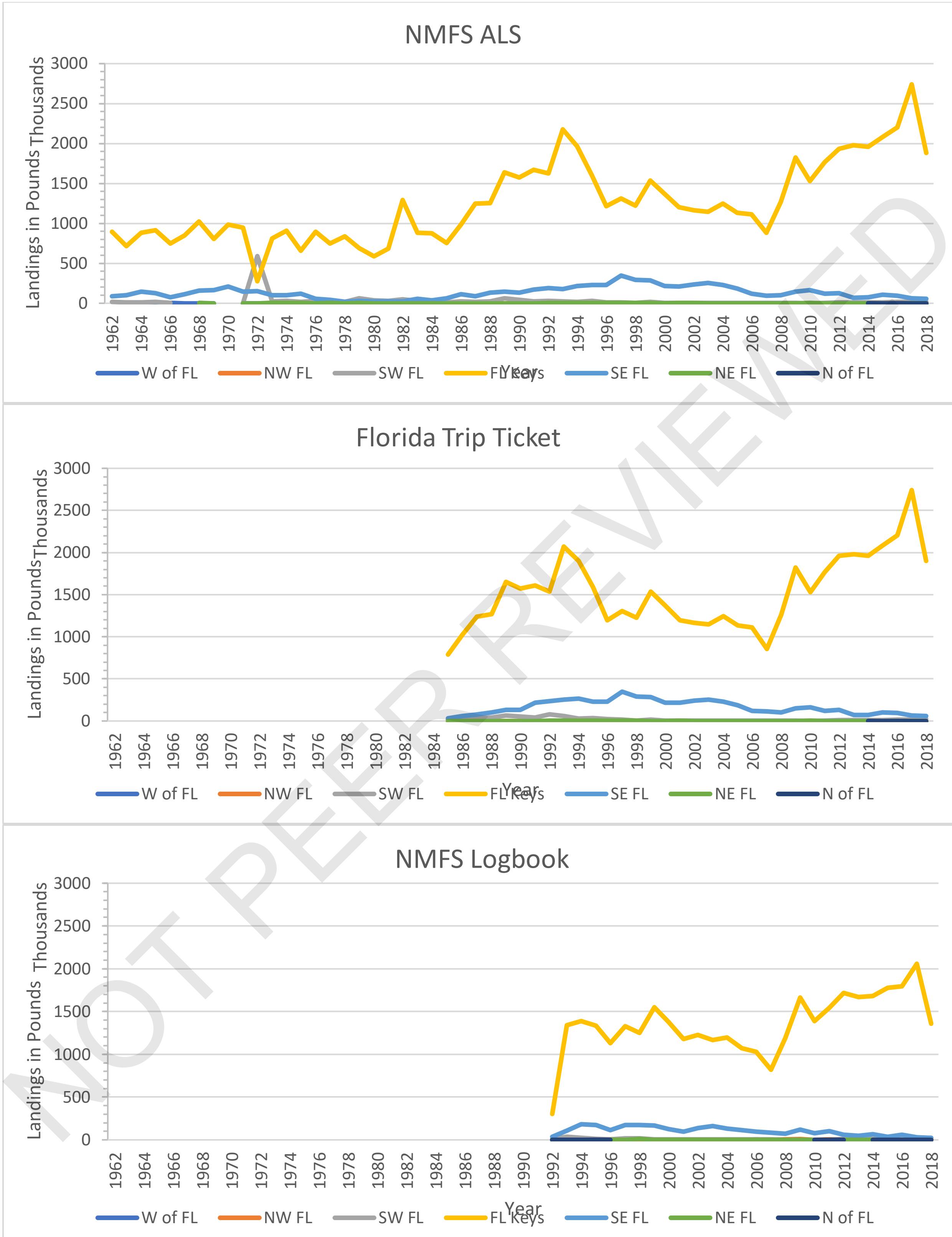


Figure 3.4. Comparison of Yellowtail Snapper landings by FHS region and data source, 1962-2018.

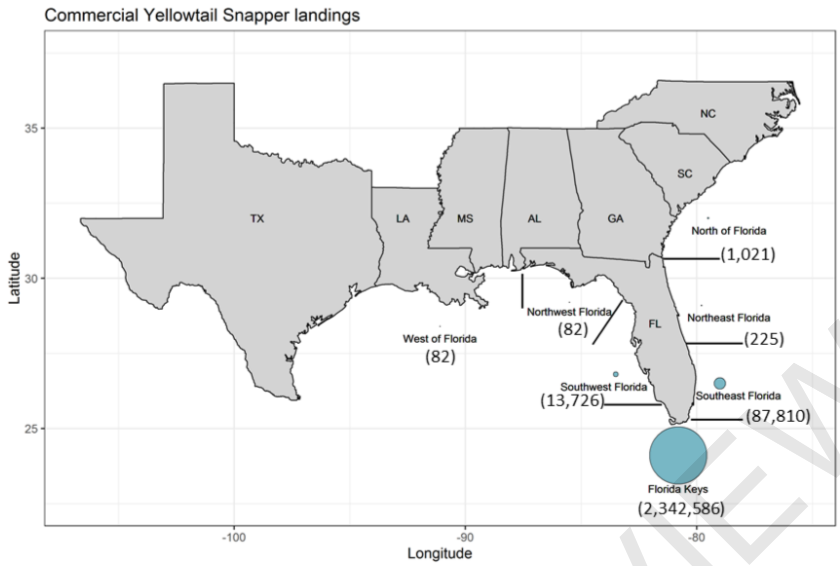


Figure 3.5. Commercial Yellowtail Snapper landings in pounds by region averaged over 2015-2017.

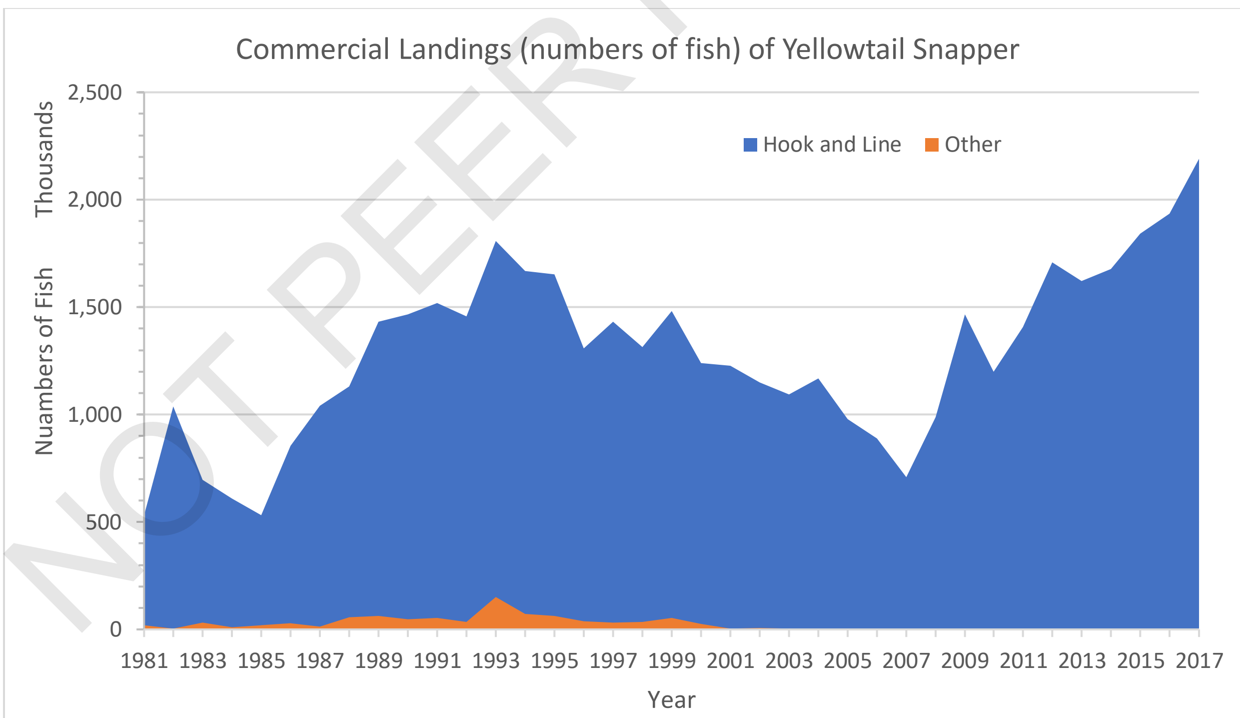


Figure 3.6. Commercial Yellowtail Snapper landings in numbers of fish by gear for all FHS regions combined, 1981-2017.

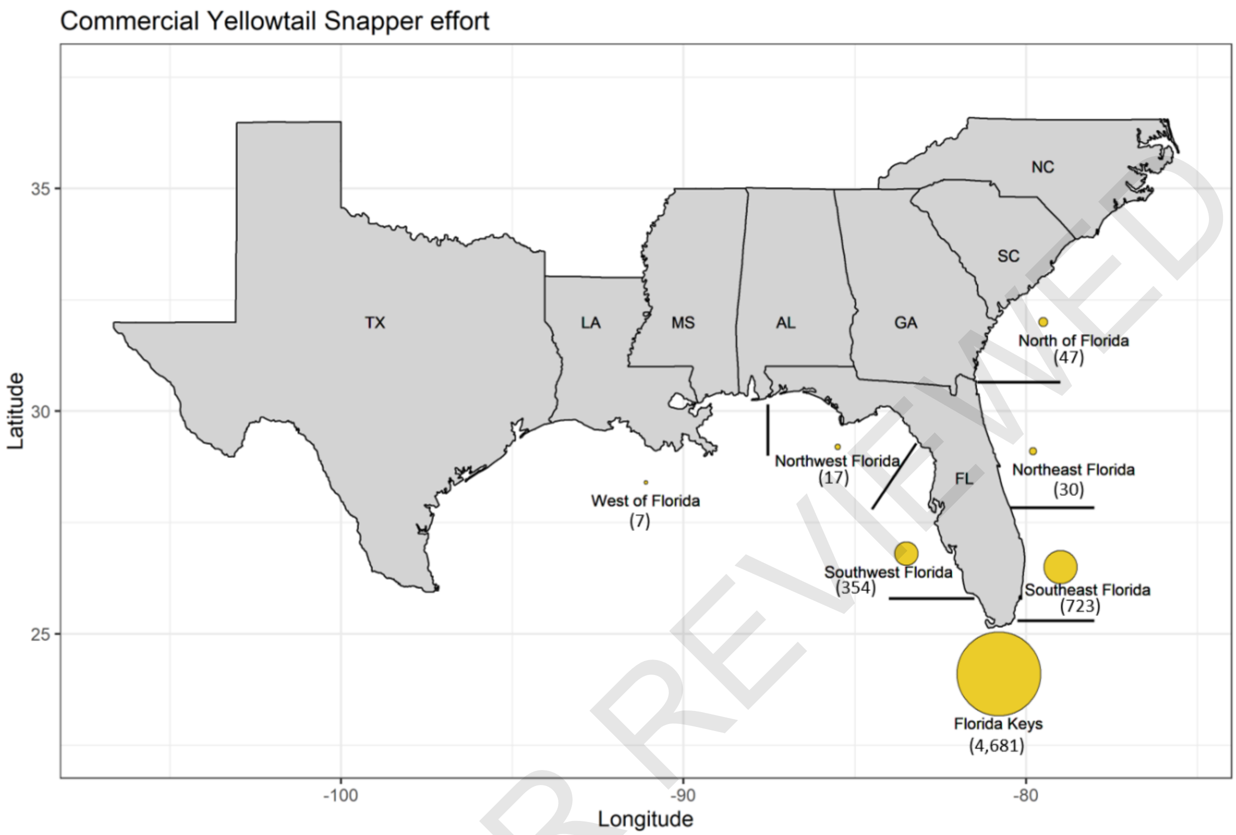


Figure 3.7. Number of commercial Yellowtail Snapper trips by region averaged over 2015-2017.

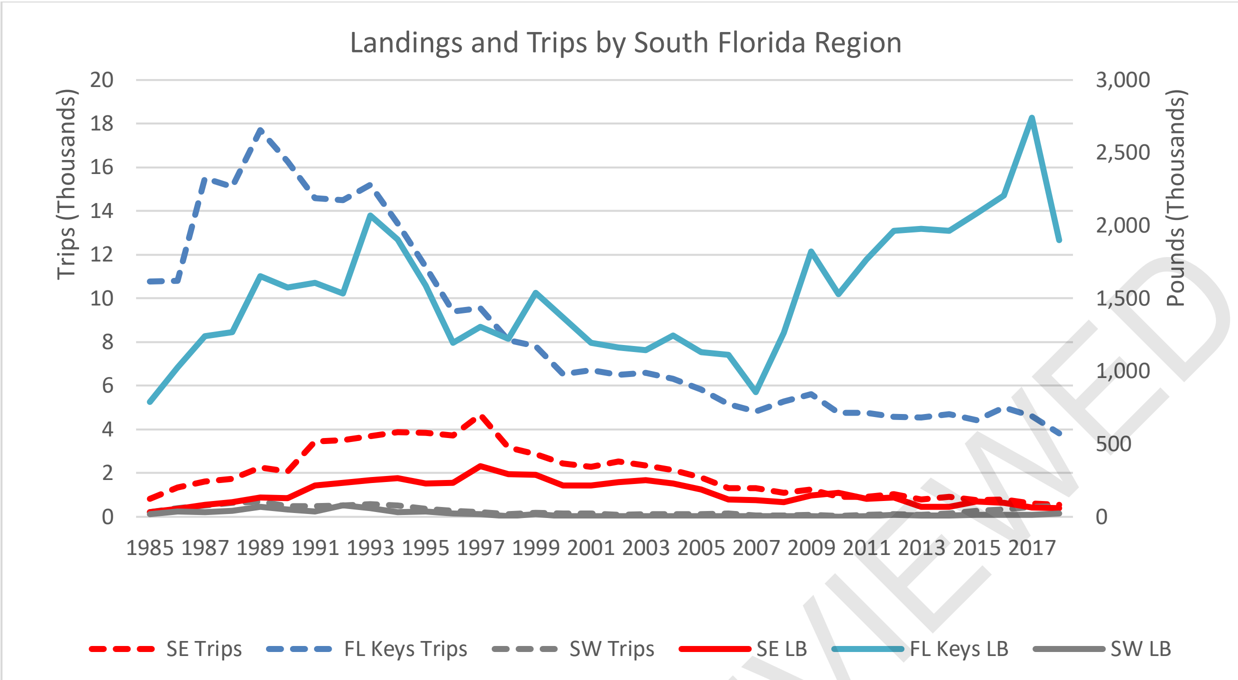


Figure 3.8. Number of commercial Yellowtail Snapper trips and landings by region in South Florida, 1985-2017.

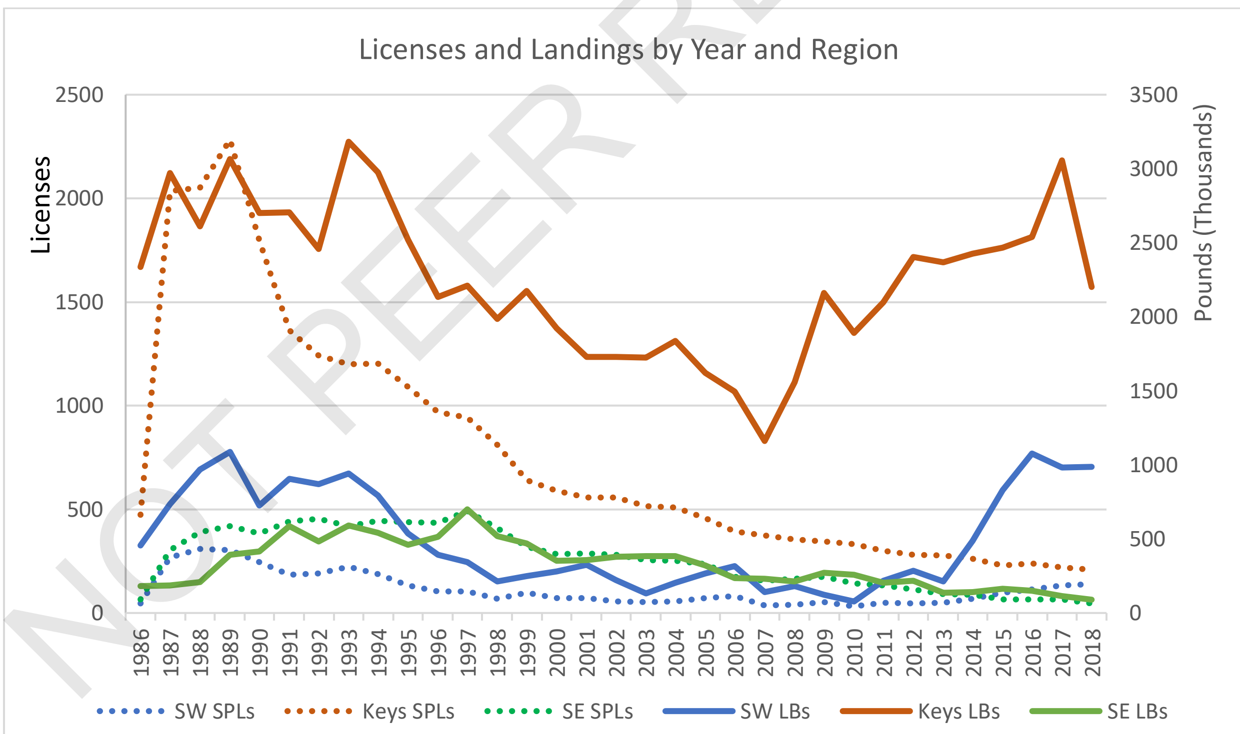


Figure 3.9. Number of state commercial fishing licenses (SPL) and landings by region in South Florida from commercial trips harvesting Yellowtail Snapper, 1986-2018.

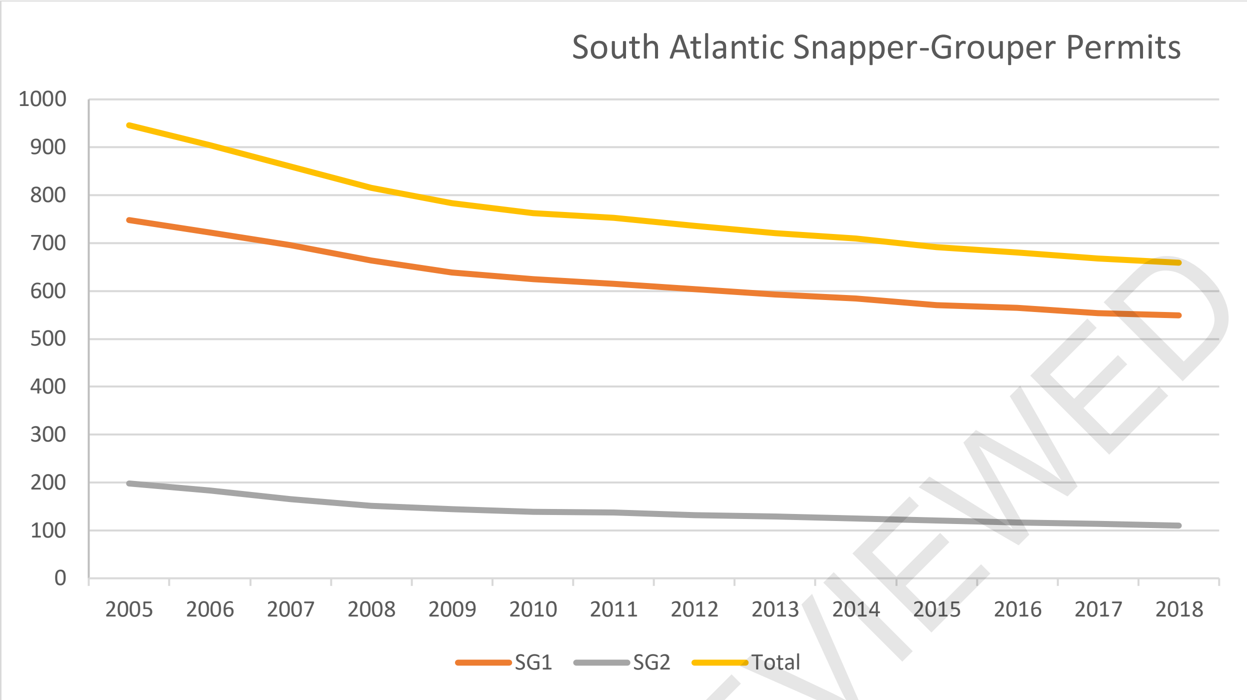


Figure 3.10. Active South Atlantic Snapper-Grouper permits by year, 2005-2018. Data from NOAA Fisheries.

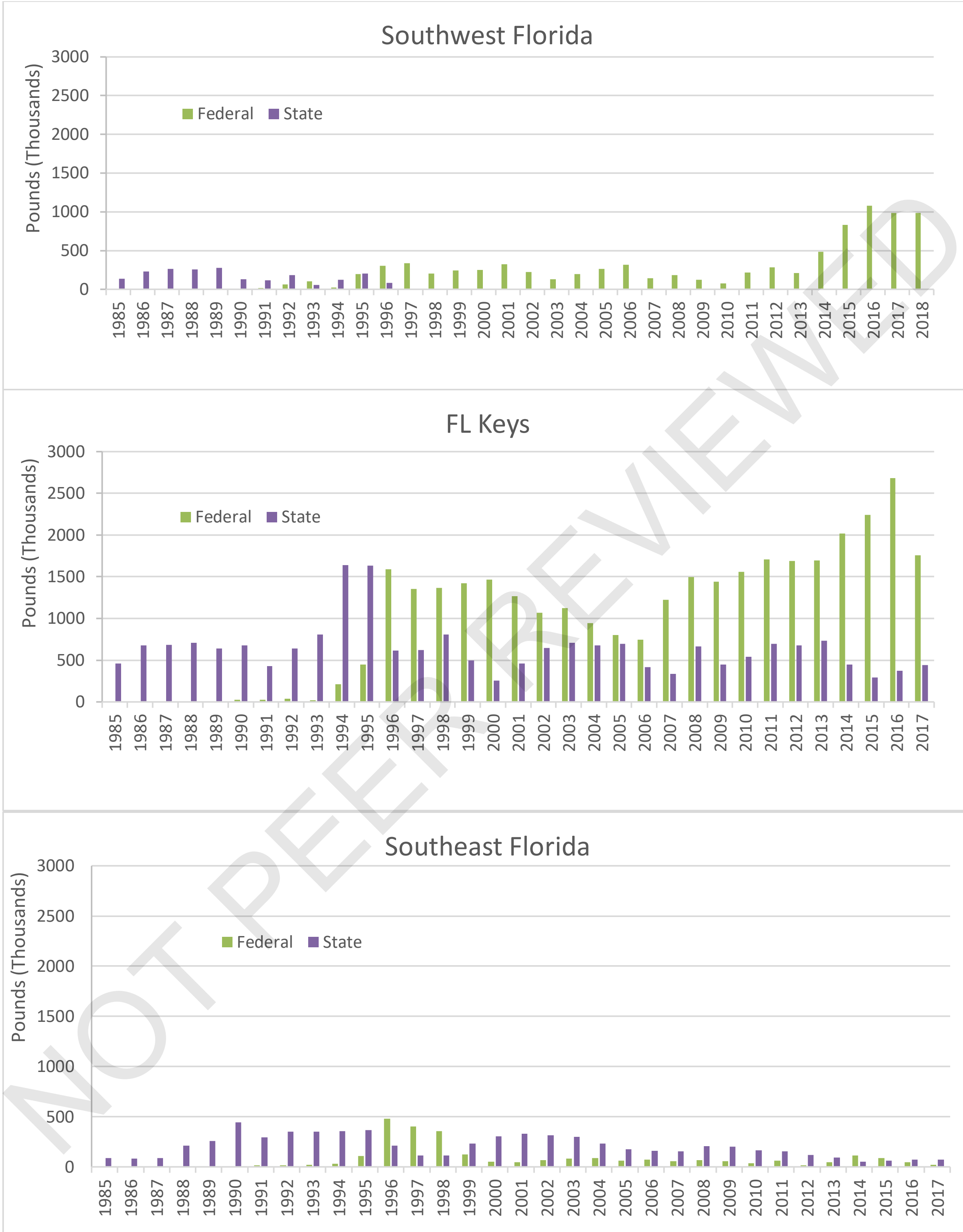


Figure 3.11. Commercial Yellowtail Snapper landings by region and state-federal waters zone, 1985-2017.

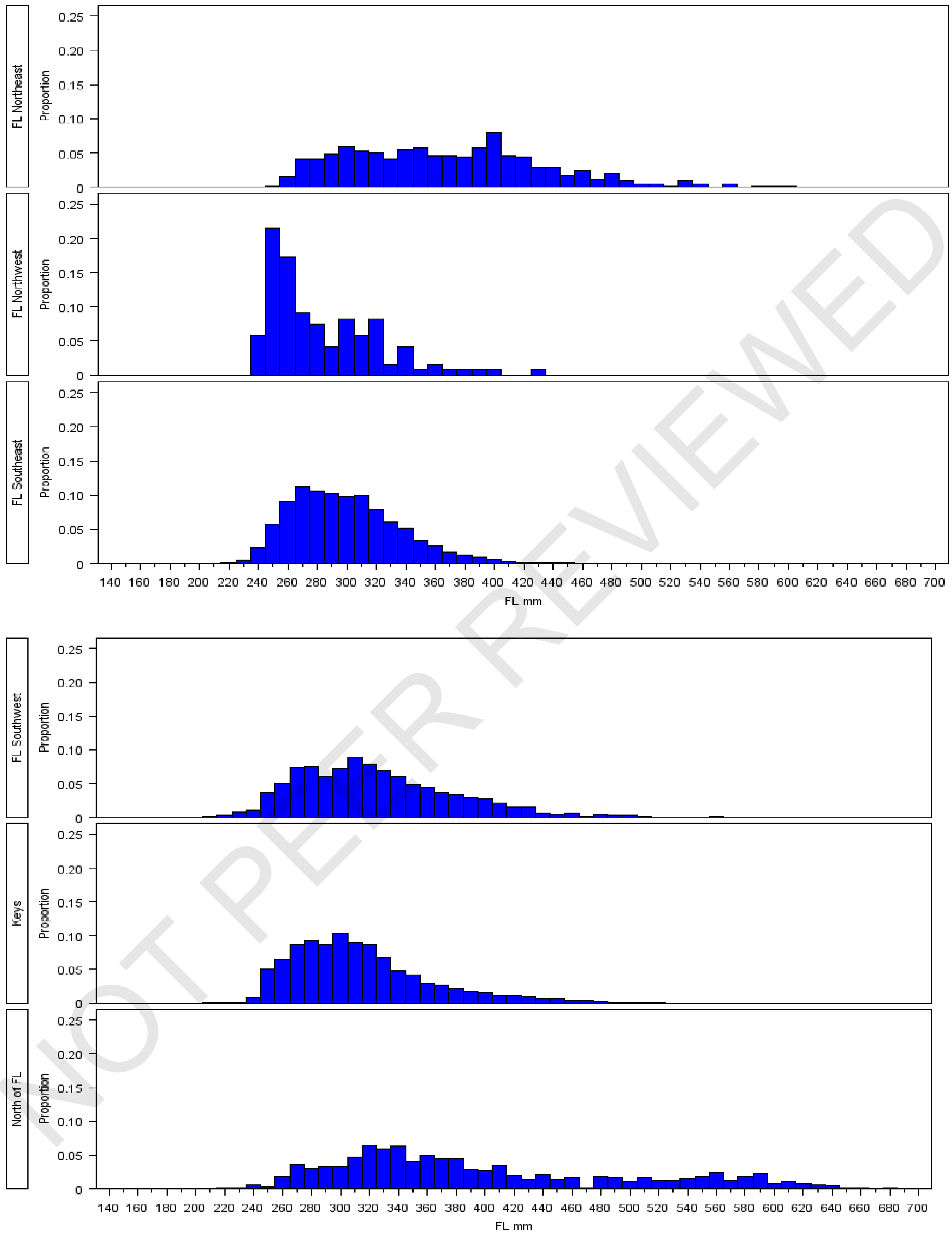


Figure 3.12. Length frequency distribution in fork length (mm) by FHS region for commercial Yellowtail Snapper. Data from TIPS.

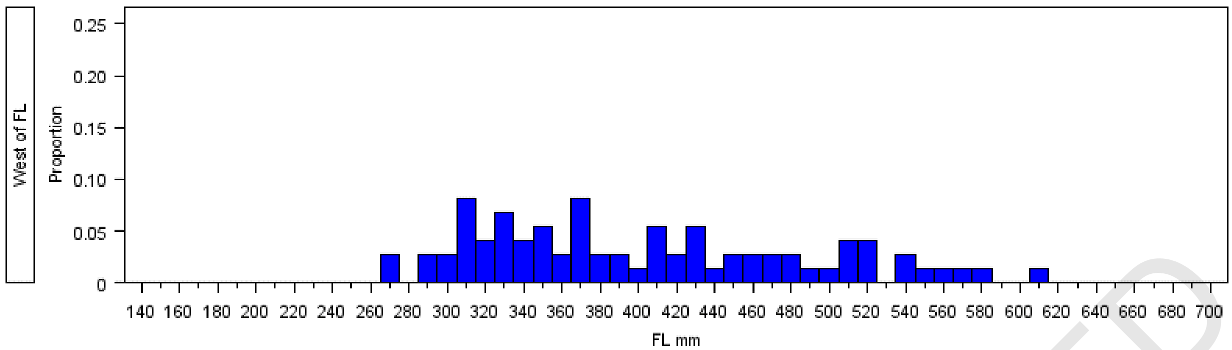


Figure 3.12 (cont). Length frequency distribution in fork length (mm) by FHS region for commercial Yellowtail Snapper. Data from TIPS.

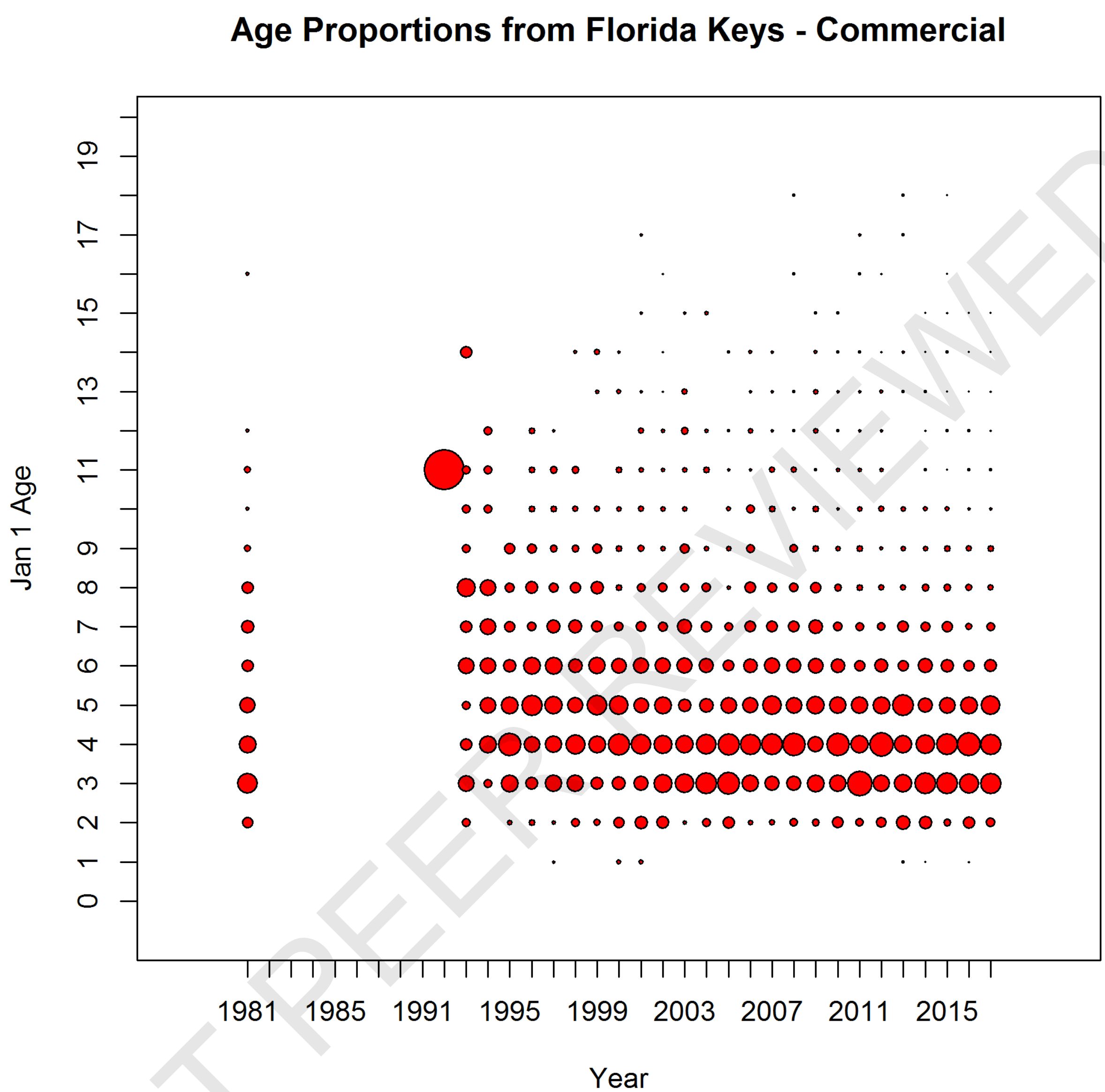


Figure 3.13. Plot showing the proportion of ages of Yellowtail Snapper by year for the Florida Keys.

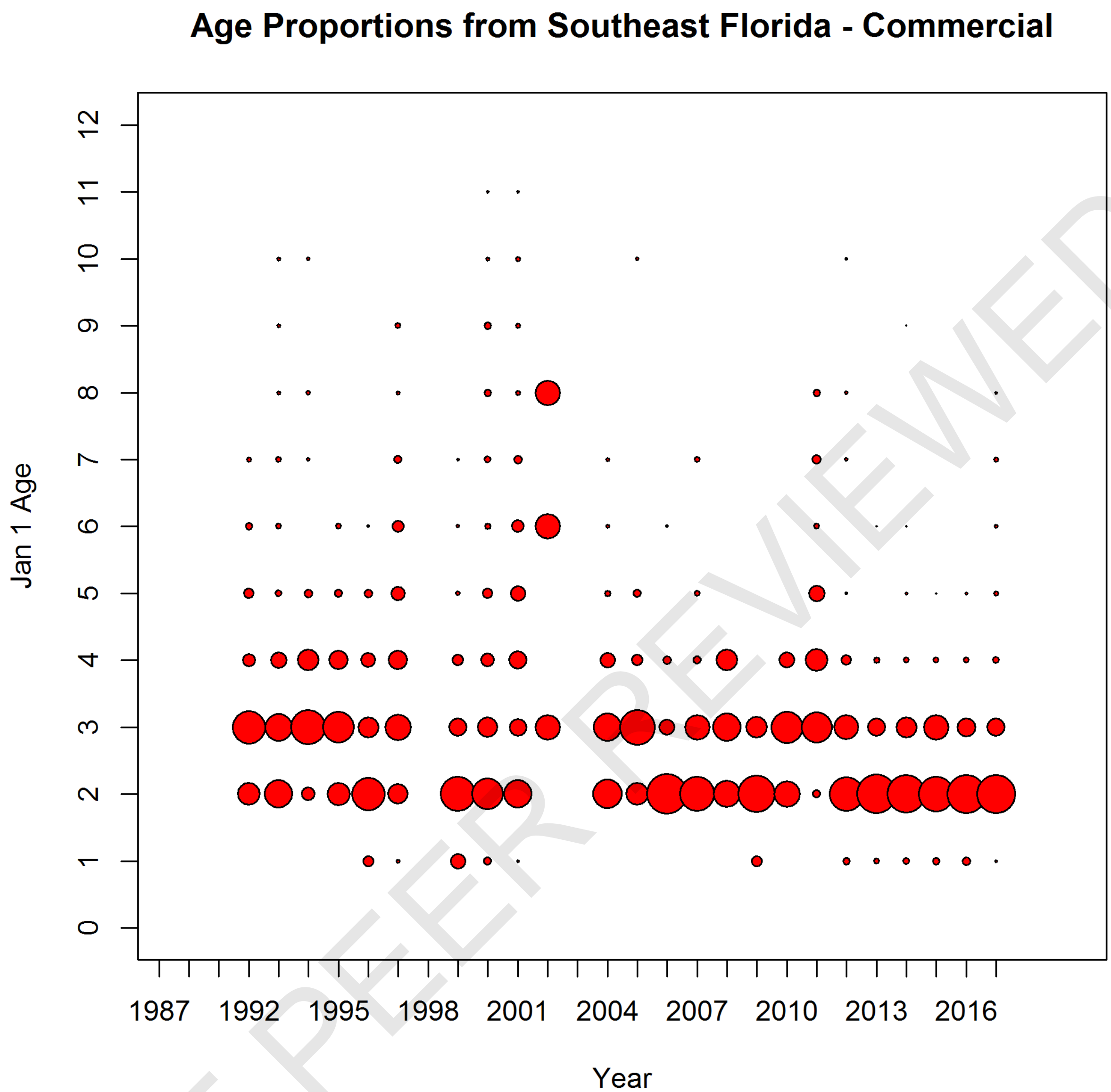


Figure 3.14. Plot showing the proportion of ages of Yellowtail Snapper by year from Southeast Florida.

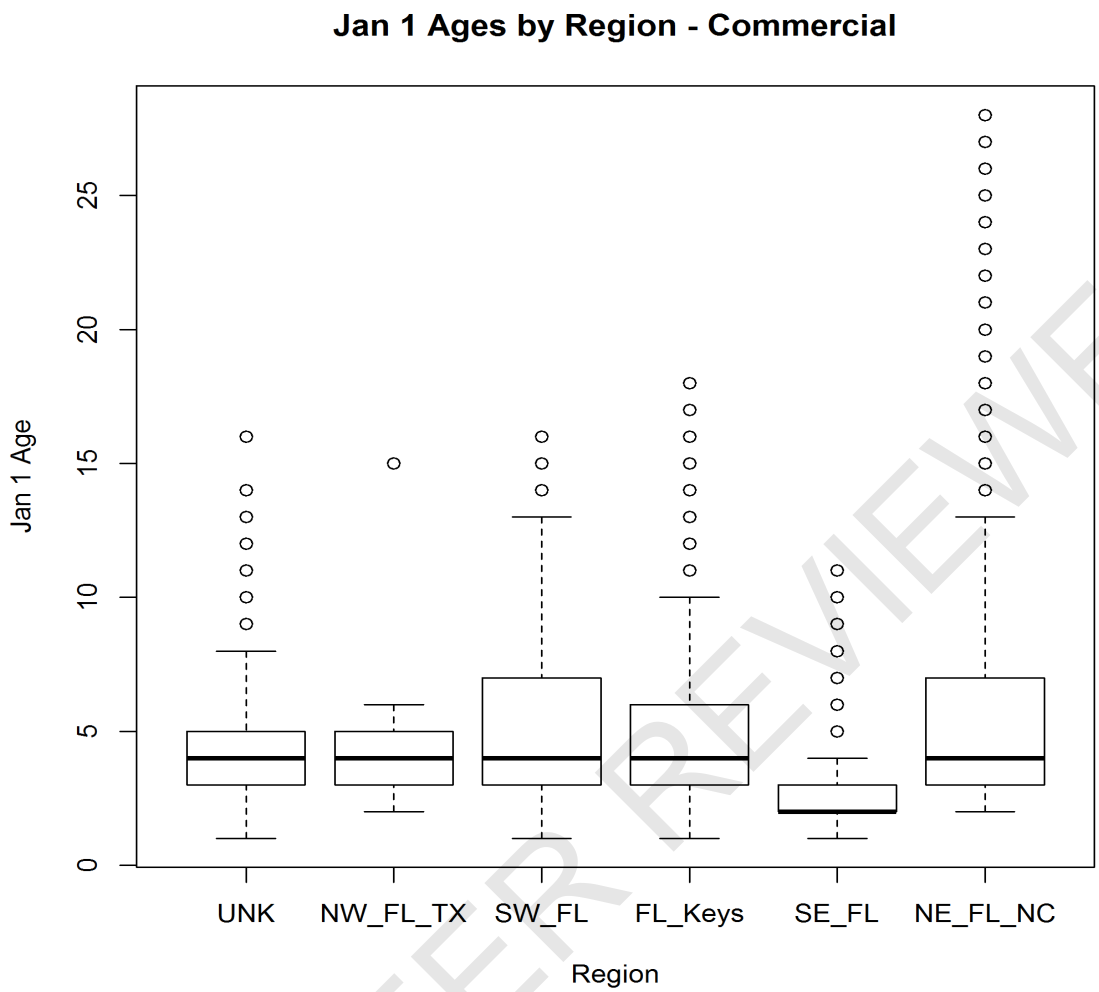


Figure 3.15. Box plot of mean age for Yellowtail Snapper by FHS region from TIPS records. Each box shows the range of ages with associated 95% confidence limits.

4 RECREATIONAL FISHERY STATISTICS

4.1 OVERVIEW

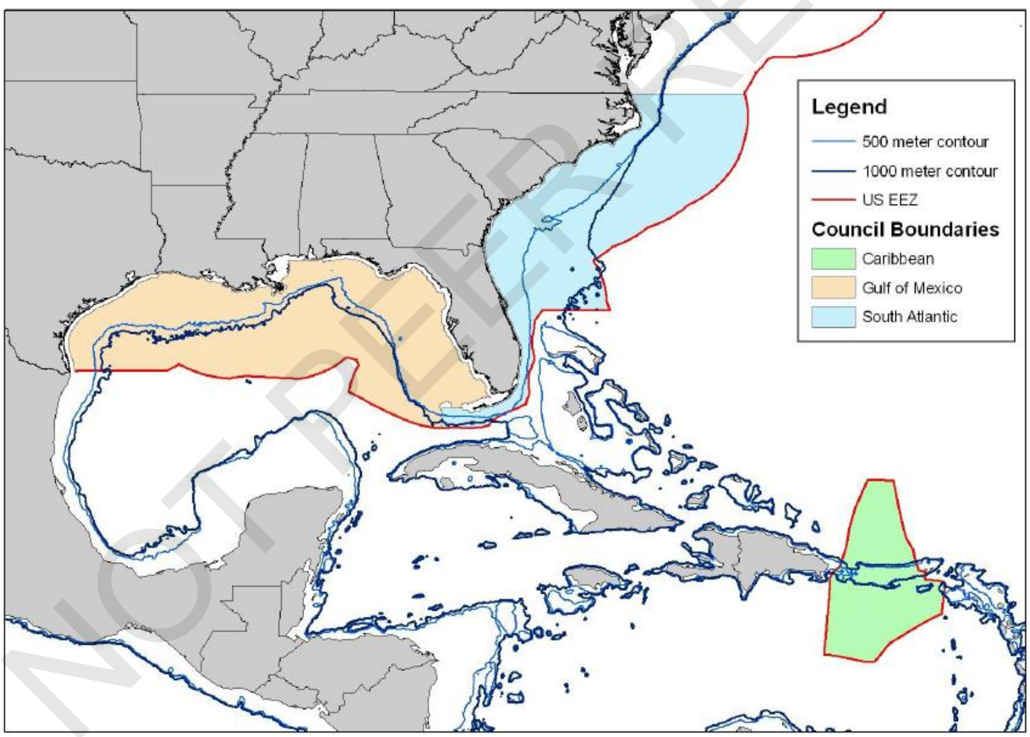
4.1.1 Recreational Workgroup (RWG) Members

Kelly Fitzpatrick (via phone; NMFS Beaufort, NC), Eric Schmidt (Headboat Industry Representative, FL), Dominique Lazarre (Co-leader, FWCC, FL), Shanae Allen (Co-leader, FWCC, FL), Vivian Matter (NMFS Miami, FL), Beverly Sauls (FWCC, FL), and Steven Scyphers (Northeastern University, MA)

4.1.2 Issues Discussed at the Data Workshop

1) Possible causes of reduced effort (angler days) in FL Keys and SE FL for the SRHS in 2016-2017.
2) Measures of uncertainty for headboat landings and discards.
3) Headboat discards from 2004-2017 and back-calculation prior to 2004.
4) Investigation of high MRIP discards in 1991 and high MRIP landings in some years prior to 1992.
5) Adequacy of adjusting sampling weights for at-sea observer discards using only daytime fishing trips versus using both night and daytime fishing trips.
6) Distributions of length and proportions of landings by strata. Use of imputed lengths and effective sample size.

4.1.3 Gulf of Mexico Fishery Management Council Jurisdictional Boundaries



4.2 REVIEW OF WORKING PAPERS

SEDAR 64-DW-10: Overview of the Southeast Region Headboat Survey and Data Related to Yellowtail Snapper (*Ocyurus chrysurus*). Shanae Allen, Elizabeth Herdter, and Kelly Fitzpatrick.

This report provides an overview of the Southeast Region Headboat Survey and presents Yellowtail Snapper landings, discards, effort, and sampled length data.

SEDAR 64-DW-12: Recreational Survey Data for Southeast Yellowtail Snapper. Vivian Matter and Richard Jones.

This report summarizes recreational landings, discards, effort, and sampled length data for Yellowtail Snapper from the following separate sampling programs: Marine Recreational Information Program (MRIP), Texas Parks and Wildlife Department (TPWD), and Louisiana Creel survey program (LA Creel).

SEDAR 64-DW-16: A Summary of Observer Data Related to the Size Distribution and Release Condition of Yellowtail Snapper from Recreational Fishery Surveys in Florida. Dominique Lazarre.

This report documents the size distribution, hook trauma, and release condition of Yellowtail snapper captured by for-hire vessels (Headboat and Charterboat) operating in Florida.

SEDAR 64-DW-17: Social Dimensions of the Recreational Fishery for Yellowtail Snapper (*Ocyurus chrysurus*) in Florida. Steven Scyphers and Kelsi Furman.

This report describes a series of survey results, which were conducted as part of a broader study on the social dimensions of saltwater recreational fisheries, comparing groups of fishers representing various levels of engagement with Yellowtail Snapper. The specific survey questions and results described here focus on:

1) Importance of Yellowtail Snapper as a Target Species

2) Recreational Fishery Demographics & Fishing Characteristics

3) Current Satisfaction with Availability of Catch, Size of Catch, and Fishing Regulation

4.3 RECREATIONAL LANDINGS

Recreational landings of Yellowtail Snapper were compiled from 1981 through 2017 for the U.S. South Atlantic and Gulf of Mexico from the Southeast Region Headboat Survey (SRHS), Marine Recreational Information Program (MRIP), Texas Parks and Wildlife Department (TPWD), and Louisiana Creel survey program (LA Creel, Figure 4.11.1). Total recreational Yellowtail Snapper landings by region and year are illustrated in Figure 4.11.2. Recreational landings outside of Florida comprise less than 0.1% of the overall landings. Table 4.10.1 summarizes Florida recreational landings by year and region. Figure 4.11.3 presents Florida landings by year and source (MRIP, headboat). Headboat landings comprise less than 10% of the overall recreational landings.

Further discussion of how landings were compiled from the SRHS can be found in the working paper (SEDAR 64-DW-10) in the Methods section and associated tables and figures are presented in the Results section. Tables 2 and 3 present landings in numbers and pounds, respectively. Figure 5 in the working paper presents overall SRHS landings by region and Figure 6 presents mean landings by month per region.

Landings from all other sources are summarized in the Catch Estimates and Weight Estimation sections in the working paper SEDAR 64-DW-12. A comparison of landings estimates from 1981 to 2017 under the MRIP base, Access Point Angler Intercept Survey (APAIS) calibrated, and fully calibrated APAIS and Fishing Effort Survey (FES) is shown in Figures 2 and 3. Fully calibrated landings were estimated to be much higher for Gulf of Mexico (including the FL Keys) in years 1981-1982, 1984, and 1989-1991.

Additionally, charterboat estimates were calibrated for the Gulf of Mexico prior to 2000 and on the Atlantic coast prior to 2004 in order to adjust for the change in effort estimation from the Coastal Household Telephone Survey (CHTS) to the For-Hire Survey (FHS) producing a consistent time series of charterboat estimates (Detloff and Matter, 2019). Figure 1 in the working paper illustrates charterboat landing and discard estimates of Yellowtail Snapper from the CHTS and the FHS from both the Gulf of Mexico (GOM) and the South Atlantic (SA) between years 1981 and 1999 (for GOM) and 1981 to 2003 (for SA). The greatest divergence of landings between the two methods estimates occurred in the GOM from 1983-1985.

Tables 1 and 2 in the working paper present landings by region and fishing mode, respectively. Table 3 presents coefficients of variance (CVs) associated with landings and landings in pounds by region are tabulated in Table 5. Figures 4 and 6 illustrate the number of fish landed and discarded by region, while Figure 5 shows the contribution by mode per year. These figures show that the vast majority of landings originate from the private mode in FL Keys and Southeast FL. The contribution of charterboat landings have increased slightly over time, while the contribution of the shore mode has decreased. Figure 7 in the working paper presents average fish weight, landings in pounds, and landings in numbers over time.

Issue:

Variance estimates are not currently available for the SRHS catch estimates because of the survey design. Further research is required to develop a suitable method to calculate variance.

Recommendation:

Without a suitable method to calculate the variance of the headboat estimates, the RWG recommended to assume zero variance. Headboat landings and discards are minimal compared to other sources such that they may be combined with other sources and their variances may be ignored.

Issue:

The working group investigated high landings in the MRIP APAIS in 1981-1982, 1984, and 1989-1991 and found that landings in all years except 1989 had the majority of landings originating in more than one stratum (i.e. year-wave-mode-area). The sources of high landings in 1989 were two interviews on the same day for private mode/Ocean>10mi that caught 35 and 40 Yellowtail Snapper. High landing years also had relatively low CVs (e.g., in the FL Keys, all years except 1991 had CV < 0.50).

Recommendation:

Most high landing years had catch originating from more than one stratum and the scale of landings in these exceptional years are comparable. The RWG recommends using these estimates without further manipulation, but whether to start the model after these high landings years in 1992 remains an AW Panel decision.

4.4 RECREATIONAL DISCARDS

Recreational discards of Yellowtail Snapper were compiled from 1981 through 2017 for the U.S. South Atlantic and Gulf of Mexico from the same sources as the landings. Total recreational Yellowtail Snapper discards by region and year are illustrated in Figure 4.11.4. Recreational discards outside of Florida comprise less than 0.1% of the overall landings. Table 4.10.2 summarizes Florida recreational discards by year and region. Figure 4.11.5 presents Florida discards by year and source (MRIP, headboat). Headboat discards comprise less than 5% of the overall recreational landings.

Headboat discards were estimated according to methods in the Estimating Discards section from the working paper (SEDAR 64-DW-10). The Results section presents annual discards in numbers by region in Table 4 and Figure 7. As shown, 1991 is an outlying high year because estimates are based on the adjusted MRIP charterboat discard:landings ratio from 1981-2003.

Discards from all other sources are summarized in the Catch Estimates section in the working paper SEDAR 64-DW-12. A comparison of landings and discards estimates from 1981 to 2017 under the MRIP base, APAIS calibrated, and fully calibrated APAIS and FES is shown in Figures 2 and 3. Fully calibrated discards were estimated to be much higher for Gulf of Mexico (including the FL Keys) in 1991. Figure 1 in the working paper illustrates charterboat landing and discard estimates of Yellowtail Snapper from the CHTS and the FHS from both the Gulf of Mexico (GOM) and the South Atlantic (SA) between years 1981 and 1999 (for GOM) and 1981 to 2003 (for SA). Discards are similar between the two surveys.

Tables 1 and 2 in the working paper present discards by region and fishing mode, respectively. CVs by year and region associated with discards are presented Table 4. Figures 4 and 6 illustrate the number of fish landed and discarded by region, while the contribution by mode per year is shown in Figure 5. The majority of discards originate from the private mode in the FL Keys and Southeast Florida regions.

Issue:

The working group investigated high discards in 1991 and found it is mainly originating from the private mode. The high estimates, however, do not come from a single wave or area fished. This suggests that the spike in discards is not the result of one or two unusual intercepts reporting many discards. In addition, effort estimates from the Florida Keys greatly increased in 1991. CVs for discards in 1991 are also relatively low (e.g., in 1991 the FL Keys had CV = 0.21).

Recommendation:

High discards in 1991 did not originate from a single wave or area fished. The RWG recommends using these estimates without further manipulation, but whether to start the model in 1992 remains an AW Panel decision.

Issue:

The working group discussed whether headboat discards should be estimated and alternative methods to do so.

Recommendation:

The RWG recommends using the method presented in the working paper (SEDAR 64-DW-10) to estimate discards prior to 2004 and to use self-reported discards from logbooks from 2004-2017.

4.5 BIOLOGICAL SAMPLING

4.5.1 Sampling Intensity Length/Age/Weight

Biological samples for length, weight, and age of Yellowtail Snapper were compiled from 1981 through 2017 for the U.S. South Atlantic and Gulf of Mexico. Recreational sources for biological samples include the SRHS Biological Sampling and other headboat-directed programs (e.g., MRFSS Headboat), MRFSS/MRIP Biological Sampling (including the Gulf Reef Fish Survey [GRFS] and the Marine Fisheries Initiative Program [MARFIN]), the Florida At-Sea Observer Sampling, in addition to other programs (FL Fish and Wildlife Research Institute [FWRI], and the Trip Interview Program [TIP]). The number of length, weight, and age samples by year for each data source is presented in Tables 4.10.3 and 4.10.4 and the associated number of trips those samples originated from are presented in Tables 4.10.5 and 4.10.6.

At-sea observers have collected length and discard information from reef fish species caught by the for-hire fleet in Florida from 2005-2017. Survey design and data related to Yellowtail Snapper are described in detail in the working paper (SEDAR 64-DW-16). At-sea observer spatial and temporal coverage is presented in Table 1 of the working paper and Table 2 presents the number of trips by region, year and trip duration for the headboat and charter recreational fleets. Tables 4 and 5 contain the number of discarded and harvested fish observed on headboat and charterboat trips, respectively, by region and year. The depth of capture, release condition and hook location for released fish are also summarized in Tables 6 and 7.

SRHS biological sampling effort by region is presented in Table 4 in the respective working paper (SEDAR 64-DW-10). This table presents Florida only data, as biological data outside of Florida are negligible (< 0.2%), and it includes all measurements, even those that were later removed due to data quality issues (see Figures 8 and 9). Tables 7 and 8 provides summary statistics of filtered and predicted fork lengths (mm) and whole weights (g), respectively.

Summary statistics for MRIP intercepted Yellowtail Snapper fork lengths (mm) by region and year are presented in Table 6 in the working paper (SEDAR 64-DW-12). Similarly, Table 7 presents summary statistics for weights. Sample sizes in these tables include imputed (i.e. predicted) lengths and weights.

Issue:

An investigation of the headboat logbook data and discussion with industry representatives revealed that a portion of headboat trips for Yellowtail occur at night. The catch rates for day and night trips could potentially vary greatly. Subsequently, the at-sea headboat data was evaluated to determine if the observer trips comprised both day/night trips, if an additional weighting factor was necessary to represent the ratio of day to night trips observed in headboat logbook data, or if the headboat weights should be re-calculated for day trips only. It was determined that only a small portion of trips in the headboat logbook/at-sea observer data represented night trips (Table 4.10.7).

Recommendation:

The group recommended not re-calculating the weight, and to proceed with the weighted length frequencies provided.

4.5.2 Length-Age Distribution

Summaries of length information (number, minimum, mean, and maximum lengths; fork length) were provided in working papers for each data source by year and region (Table 5 in SEDAR 64-DW-16 presents this information for both harvested and discarded fish observed by at-sea observers; Table 7 in SEDAR 64-DW-10 shows this information for the SRHS, all other recreational lengths are presented in Table 6 in SEDAR 64-DW-12). Length distributions sampled by SRHS are also illustrated in Figures 10-15 in the working paper (SEDAR 64-DW-10).

Figure 4.11.6 presents an overview of age data from all recreational sources and a summary table can be found in Table 4.10.8. The number of fish aged in each fork length bin (2 cm) for all recreational sources is provided in Table 4.10.9. Most ages originate from the SRHS after 2003. There does appear to be some differences in age distributions in the FL Keys and SE FL (Figure 4.11.7).

4.6 RECREATIONAL EFFORT

Total recreational effort is summarized below by survey. Effort by mode is summarized for all marine fishing, regardless of what was caught. A map summarizing MRIP effort in angler trips is included in Figure 4.11.9. A map summarizing SRHS effort in angler days is included in Figure 4.11.10.

4.6.1 MRFSS/MRIP Effort

Survey methods to estimate effort as well as MRIP effort estimates by region and mode are described in the working paper (SEDAR 64-DW-12) and in Tables 9 and 10, respectively. Effort estimates are shown in angler trips and are not specific to Yellowtail Snapper. An angler-trip is a single day of fishing in the specified mode, not to exceed 24 hours.

4.6.2 SRHS Effort

Details on effort estimation and tables and figures of non-directed effort (in angler days) are presented in the working paper (Table 5 and Figure 8). SRHS effort, particularly in SE FL has been highly variable since the mid-2000s and declined considerably in 2017. One contributing factor to the decline may be that in recent years, some federally permitted headboats surveyed by the SRHS have chosen not to renew their federal reef fish permits, relieving them of the requirement to provide logbooks or be sampled by federal headboat port samplers. These vessels, concentrated in southeast Florida (59% of headboats operating in southeast Florida), now target popular reef fish species solely in state waters. No federally administered surveys have absorbed these vessels into their sample frames, eliminating opportunities for these vessels to report landings or fishing effort; however, state surveys continue to collect biological data from these vessels through at-sea observer trips and a dockside intercept surveys utilized to collect biological samples.

4.6.3 Fishery Demographics and Fishing Characteristics

The working paper SEDAR 64-DW-17 summarizes Yellowtail Snapper recreational fishery demographics and fishing characteristics in accordance with TOR item #8 that aims to: “Incorporate socioeconomic information into considerations of environmental events that affect stock status and related fishing effort and catch levels as practicable". This study indicated that Yellowtail Snapper is a commonly targeted sport fish and that they are targeted in both offshore waters (3 or more miles from shore) and nearshore waters, mostly by boat. Also, the majority of respondents indicated that they are currently satisfied with the availability of the catch, size of catch, and fishing regulations.

4.7 COMMENTS ON THE ADEQUACY OF DATA FOR ASSESSMENT

Regarding the adequacy of the available recreational data for assessment analyses, the RWG discussed the following:

- Recreational landings are very high for Yellowtail Snapper in some years, particularly for the private mode, while headboat landings and discards are low in comparison. Based on the available data sources, the landings and discards represented in this report appear to be adequate for the time period covered.
- Age and size data appear to adequately represent the landed catch for the headboat sector. These data are lacking for the private mode; however, there does not appear to be divergent size distributions among recreational modes.

4.8 ADDITIONAL RECOMMENDATIONS

4.8.1 Research

- Continue to collect discard length and age data from headboat and charterboat sectors.
- Increase research efforts to collect discard and retained length and age data from the private sector.
- Increase at-sea observer coverage for nighttime trips.
- Assess the impact of headboats that do not renew their federal reef fish permits and target popular reef fish species solely in state waters on the SRHS coverage.

4.8.2 SEDAR Data Best Practices

Recommend methods to estimate uncertainty in headboat landings and discards.

4.9 LITERATURE CITED

Dettloff, K. and V.M. Matter 2019. SEDAR61-WP19: Model-estimated conversion factors for calibrating Coastal Household Telephone Survey (CHTS) charterboat catch and effort estimates with For-Hire Survey estimates in the Atlantic and Gulf of Mexico with application to red grouper and greater amberjack. National Marine Fisheries Service Southeast Fisheries Science Center, Fisheries Statistics Division, Miami, FL., National Marine Fisheries Service Southeast Fisheries Science Center, Sustainable Fisheries Division, Miami, FL.

4.10 TABLES

Table 4.10.1. Recreational Florida landings in number of fish by region, 1981-2017.

Year	NW FL	SW FL	FL KEYS	SE FL	NE FL	Total
1981	0	0	4,235,300	1,384,827	616	5,620,743
1982	0	737	5,162,783	1,684,625	6,637	6,854,782
1983	0	44,072	1,625,732	427,252	16,477	2,113,533
1984	0	37,429	4,155,231	207,031	462	4,400,153
1985	77,869	3,127	1,137,671	820,044	793	2,039,504
1986	1,806	3,022	1,140,488	534,450	1,495	1,681,261
1987	18,926	26,680	1,230,244	119,760	2,304	1,397,914
1988	37	8,844	1,174,873	243,396	2,161	1,429,311
1989	0	13,872	4,660,690	176,300	1,248	4,852,110
1990	213	8,257	3,405,080	243,950	2,023	3,659,523
1991	4	28,038	4,156,078	236,731	2,146	4,422,997
1992	97	59,806	839,814	271,325	3,907	1,174,949
1993	266	50,530	1,571,989	559,275	1,590	2,183,650
1994	727	17,949	1,213,168	302,079	10,924	1,544,847
1995	3	3,058	1,832,567	181,373	441	2,017,442
1996	212	3,000	871,393	134,321	31	1,008,957
1997	216	1,645	815,435	104,141	4,375	925,812
1998	72	4,450	816,059	167,571	10,947	999,099
1999	97	55,170	552,702	147,309	13,489	768,767
2000	289	5,837	620,012	194,532	11,072	831,742
2001	37	13,233	507,580	93,105	9,517	623,472
2002	89	9,352	959,292	93,370	10,894	1,072,997
2003	0	9,691	1,454,034	130,721	5,975	1,600,421
2004	33	31,191	1,189,738	356,125	1,104	1,578,191
2005	59	38,341	360,557	344,532	15,233	758,722
2006	7	71,864	1,013,235	527,897	13,060	1,626,063
2007	14	21,875	1,005,743	614,439	42,878	1,684,949
2008	19	6,883	2,061,495	385,556	923	2,454,876
2009	14	31,880	619,539	361,202	1,229	1,013,864
2010	5	12,724	621,815	313,535	3,629	951,708
2011	14	32,189	475,592	210,310	178	718,283
2012	5	2,237	755,082	264,175	222	1,021,721
2013	1	5,534	1,349,747	480,648	642	1,836,572
2014	0	14,554	773,619	1,281,591	951	2,070,715
2015	3	52,879	753,688	688,463	625	1,495,658
2016	0	20,745	893,514	794,187	721	1,709,167
2017	39	312,384	915,442	427,345	5,767	1,660,977
Total	101,173	1,063,079	56,927,021	15,507,493	206,686	73,805,452

Table 4.10.2. Recreational Florida discards in number of fish by region, 1981-2017.

Year	NW FL	SW FL	FL KEYS	SE FL	NE FL	Total
1981	0	20,827	273,882	647,480	32	942,221
1982	0	0	964,997	77,679	83,509	1,126,185
1983	0	4,952	506,578	120,278	3,318	635,126
1984	0	766	3,752,994	92,897	121	3,846,778
1985	28,955	0	201,901	92,532	8	323,396
1986	3,445	0	539,912	523,218	118	1,066,693
1987	88,405	7,874	1,849,768	349,717	1,940	2,297,704
1988	0	0	1,332,785	61,565	2,114	1,396,464
1989	1,530	809	3,024,027	119,409	301	3,146,076
1990	0	3,817	1,716,402	444,301	1,790	2,166,310
1991	0	17,277	13,937,312	766,026	12,126	14,732,741
1992	14	94,241	2,518,141	864,001	395	3,476,792
1993	0	87,134	4,093,900	647,137	2,531	4,830,702
1994	0	45,390	2,434,270	409,498	196	2,889,354
1995	0	8,545	2,946,207	419,969	180	3,374,901
1996	0	27,104	2,965,469	346,865	13	3,339,451
1997	0	148,972	3,181,517	242,567	165	3,573,221
1998	23	64,371	2,171,754	283,765	92	2,520,005
1999	4	176,051	1,527,357	412,995	12,875	2,129,282
2000	27	14,114	1,379,248	421,177	14,597	1,829,163
2001	39	102,173	801,095	215,991	3,566	1,122,864
2002	3	72,864	981,064	244,114	5,635	1,303,680
2003	0	15,990	1,508,993	338,382	1,614	1,864,979
2004	0	11,045	2,027,040	489,096	54	2,527,235
2005	0	259,660	986,701	417,707	51	1,664,119
2006	0	121,022	1,963,097	596,770	2,710	2,683,599
2007	6,299	46,229	2,783,099	659,652	13,216	3,508,495
2008	2	22,838	2,699,771	552,011	256	3,274,878
2009	0	14,961	1,475,421	940,595	1,035	2,432,012
2010	0	6,411	1,249,387	303,442	3,595	1,562,835
2011	0	19,589	1,473,558	196,516	156	1,689,819
2012	0	8,166	1,447,555	250,346	130	1,706,197
2013	0	6,132	3,676,598	1,243,814	532	4,927,076
2014	0	35,391	3,061,836	1,056,882	2,657	4,156,766
2015	0	31,846	1,438,557	1,304,699	2,289	2,777,391
2016	0	15,773	1,026,027	565,720	638	1,608,158
2017	0	116,616	1,695,830	494,203	1,991	2,308,640
Total	128,746	1,628,950	81,614,050	17,213,016	176,546	100,761,308

Table 4.10.3. Number of biological samples of Yellowtail Snapper from headboat and MRIP data sources.

Year	Headboat*			MRIP**		
	Length Samples	Weight Samples	Age Samples	Length Samples	Weight Samples	Age Samples
1981	1737	1737	194	214	215	0
1982	2469	2471	189	223	219	0
1983	2787	2786	234	101	100	0
1984	2887	2891	159	95	88	0
1985	2746	2748	38	31	32	0
1986	3217	3219	64	80	74	0
1987	2947	2944	50	133	131	0
1988	1687	1689	11	158	32	0
1989	2374	2370	0	126	78	0
1990	1353	1356	0	74	78	0
1991	1727	1730	28	160	153	0
1992	1284	1281	31	205	151	0
1993	1891	1895	0	265	259	0
1994	2269	2270	53	296	259	0
1995	1669	1669	112	175	160	0
1996	1508	1508	0	133	122	0
1997	2421	2422	0	246	245	0
1998	2274	2276	0	513	511	0
1999	1659	1651	0	649	645	0
2000	1535	1534	9	588	594	1
2001	1416	1416	0	515	475	13
2002	1770	1765	0	622	587	5
2003	2648	2640	36	892	659	52
2004	2333	2189	504	881	632	123
2005	2438	2286	736	688	596	88
2006	2706	2517	874	952	785	81
2007	3238	3049	1147	942	684	0
2008	2125	2066	1048	700	666	7
2009	1743	1728	1030	431	358	0
2010	1378	1372	738	658	622	0
2011	2032	1900	1047	516	470	6
2012	3505	3399	1695	891	813	0
2013	3876	3713	1846	853	819	0
2014	3610	3299	2224	882	870	32
2015	4387	4101	2199	979	979	60
2016	4865	4073	2527	678	636	2
2017	3527	3150	1816	602	601	390

*Headboat: MRFSS-HEADBOAT, CRP HEADBOAT, SRHS. **MRIP: GRFS, MRFSS, MARFIN.

Table 4.10.4. Number of biological samples of Yellowtail Snapper from the at-sea observer program and other data sources.

Year	AT-SEA Observers		Other*
	Length Samples	Age Samples	Age Samples
1993	0	0	16
1994	0	0	10
1997	0	0	21
1998	0	0	32
1999	0	0	60
2000	0	0	1
2001	0	0	44
2005	2001	0	0
2006	2459	0	0
2007	3301	0	0
2008	307	0	114
2009	356	1	75
2010	748	28	92
2011	456	0	7
2012	1677	0	0
2013	2159	31	0
2014	1348	97	0
2015	1709	374	0
2016	2935	536	0
2017	2364	395	0

source*	Programs
Other	SEFL-CRP, TIP, FWRI

Table 4.10.5. Number of trips that collected biological samples of Yellowtail Snapper from headboat and MRIP data sources*. *Headboat: MRFSS-HEADBOAT, CRP HEADBOAT, SRHS. *MRIP: GRFS, MRFSS, MARFIN.

Year	Headboat*			MRIP*		
	Length Trips	Weight Trips	Age Trips	Length Trips	Weight Trips	Age Trips
1981	343	343	120	27	27	0
1982	385	386	63	34	34	0
1983	539	538	99	21	21	0
1984	558	558	97	32	32	0
1985	558	558	25	12	13	0
1986	585	586	42	21	25	0
1987	497	496	31	32	37	0
1988	361	361	9	38	6	0
1989	400	400	0	33	32	0
1990	253	253	0	22	20	0
1991	276	275	18	39	44	0
1992	240	240	8	48	41	0
1993	317	317	0	69	68	0
1994	291	291	14	69	63	0
1995	304	304	36	39	36	0
1996	255	255	0	44	42	0
1997	426	426	0	42	42	0
1998	434	435	0	90	86	0
1999	361	357	0	99	95	0
2000	343	343	5	107	107	1
2001	315	315	0	81	79	5
2002	361	360	0	122	117	1
2003	461	460	16	114	100	8
2004	431	416	192	113	100	18
2005	388	382	246	104	96	30
2006	365	358	266	119	109	11
2007	420	413	323	135	125	0
2008	328	326	264	97	94	2
2009	326	325	281	71	65	0
2010	270	269	222	76	79	0
2011	307	303	224	78	73	1
2012	404	398	334	129	124	0
2013	390	383	317	129	129	0
2014	399	378	328	154	152	4
2015	434	415	371	145	145	9
2016	467	443	414	145	140	1
2017	316	304	289	115	114	65

Table 4.10.6. Number of trips that collected biological samples of Yellowtail Snapper from the at-sea observer program and other data sources.

Year	AT-SEA Observers		Other*
	Length Trips	Age Trips	Age Trips
1993	0	0	6
1994	0	0	1
1997	0	0	4
1998	0	0	4
1999	0	0	10
2000	0	0	1
2001	0	0	15
2005	118	0	0
2006	111	0	0
2007	111	0	0
2008	48	0	23
2009	55	1	20
2010	74	15	27
2011	59	0	2
2012	92	0	0
2013	145	10	0
2014	83	31	0
2015	152	66	0
2016	150	64	0
2017	171	93	0

source*	Programs
Other	SEFL-CRP, TIP, FWRI

Table 4.10.7. The total number of night trips (starting after 6:00 pm) in the at-sea observer data conducted in each for-hire survey region and the total number of trips in each region of Florida. The gray highlighted portion of the table is used to identify the regions of Florida that have the highest proportion of trips where Yellowtail snapper were observed.

FHS Region	**Headboat**		**Charter**	
	Night Trips	*Total Trips*	*Night Trips*	*Total Trips*
NW FL	1	659	2	814
SW FL	7	819	9	681
FL Keys	8	257	7	473
SE FL	16	646	1	285
NE FL	18	413	1	197
Total	50	2794	20	2450

Table 4.10.8. Number of fish measured for length, average fork length in centimeters, coefficient of variation (CV), minimum fork length observed (Min), and maximum fork length observed (Max) by sex and age calculated from available Florida biological data for the recreational fleet.

Sex	Age	n	Average	CV	Min	Max
Female	1	230	25.9	0.06	21.7	33
	2	1992	28.36	0.09	19.5	44.7
	3	1289	31.58	0.11	22.7	45.9
	4	416	33.36	0.13	24.6	44.8
	5	166	32.93	0.18	23.8	47.5
	6	78	33.25	0.17	24.2	51.9
	7	44	34.7	0.17	25.3	47.5
	8	22	35.63	0.2	25.8	49.6
	9	16	40.91	0.16	26.9	50.2
	10	8	36.08	0.19	29.5	46.5
	11+	11	39.73	0.16	32.4	49.5
Male	1	232	25.81	0.07	21	38
	2	1933	28.08	0.09	20.8	43.5
	3	1240	31.5	0.1	22	43.7
	4	354	33.32	0.13	24.1	45.7
	5	143	32.68	0.16	23.8	48
	6	66	35.01	0.16	25.3	46.9
	7	41	33.86	0.18	25.5	50.1
	8	22	38.45	0.2	26.2	54
	9	18	37.04	0.19	26.5	50.3
	10	3	36	0.18	30	43
	11+	11	44.35	0.13	31.6	50
Unknown	1	255	25.6	0.06	17.8	31.6
	2	3447	26.97	0.09	20.3	44.5
	3	5165	28.58	0.11	21.6	41.5
	4	3137	29.86	0.14	22	47.2
	5	1593	30.26	0.15	20.9	48.5
	6	736	31.01	0.16	23.2	51
	7	432	31.67	0.17	24	55.6
	8	234	32.57	0.17	23.7	56.4
	9	126	33.38	0.18	23.2	53.5
	10	62	34.67	0.2	25.2	51
	11+	99	39.23	0.2	25.7	59.7

Table 4.10.9. Number of fish aged per length bin (2 cm fork length) for all recreational data sources. Dark grey indicates there were no ages sampled in a length bin and light grey indicates the number of fish aged was less than 10.

Year	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	Total
1980	1	4	11	16	28	38	37	33	24	25	13	13	6	5	10	4	3	1	0	0	0	0	272
1981	0	5	13	11	21	22	27	32	11	13	12	10	7	3	4	1	2	0	0	0	0	0	194
1982	0	1	1	11	6	17	20	34	33	24	13	6	9	4	5	2	1	2	0	0	0	0	189
1983	0	1	2	4	15	24	41	37	32	25	14	15	9	4	4	4	2	1	0	0	1	0	235
1984	0	1	0	2	12	28	21	24	24	19	8	8	5	5	3	0	0	1	0	0	0	0	161
1985	0	0	4	0	2	4	7	13	3	2	0	2	0	5	0	1	0	0	0	0	0	0	38
1986	0	0	5	6	5	9	12	7	4	4	1	3	3	3	1	0	1	0	0	0	0	0	64
1987	0	0	1	2	6	11	10	6	8	3	1	0	1	0	1	0	0	0	0	0	0	0	50
1988	0	0	0	0	1	3	1	3	1	0	1	1	0	0	0	0	0	0	0	0	0	0	11
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
1991	0	0	0	0	6	3	7	4	2	0	2	2	0	1	2	1	0	0	0	0	0	0	28
1992	0	0	0	1	1	6	5	7	3	2	1	2	2	1	3	1	0	0	0	0	0	0	31
1993	0	0	0	0	2	1	0	2	2	1	0	1	3	2	2	0	0	0	0	0	0	0	16
1994	2	2	5	4	17	17	16	12	3	3	3	1	1	0	0	1	0	0	0	0	0	0	64
1995	0	0	0	3	38	45	59	70	44	23	5	8	3	1	0	0	0	0	0	0	0	0	112
1996	0	0	0	4	10	17	14	6	4	3	0	1	0	0	0	0	0	0	0	0	0	0	59
1997	0	0	0	2	28	28	18	9	3	3	2	2	2	2	2	0	0	0	1	0	0	0	21
1998	0	0	0	10	30	37	23	15	4	4	1	2	2	1	0	0	0	0	0	0	0	0	32
1999	0	0	0	4	10	10	14	8	10	8	3	2	2	3	0	1	0	0	0	0	0	0	62
2000	0	0	0	1	2	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	11
2001	0	0	0	1	12	12	10	6	4	3	2	1	2	3	1	0	0	0	0	0	0	0	57
2002	0	0	0	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
2003	0	0	0	3	19	15	15	19	3	6	4	2	2	0	0	0	0	0	0	0	0	0	88
2004	0	0	0	20	149	162	119	84	50	28	5	6	3	2	0	0	0	0	1	0	0	0	629
2005	0	0	2	33	191	188	138	129	74	45	12	5	1	4	2	0	1	0	0	0	0	0	825
2006	0	0	2	40	239	242	186	112	68	32	16	5	6	6	0	2	0	0	1	0	0	0	958
2007	0	2	7	61	302	232	170	170	112	58	13	8	5	4	3	0	2	0	0	0	0	0	1149
2008	0	0	4	56	286	252	214	149	110	64	17	10	5	3	5	1	0	0	0	0	0	0	1171
2009	0	2	2	72	342	269	157	86	70	37	26	18	9	10	8	6	1	0	0	0	0	0	1118
2010	0	2	6	41	218	184	154	113	49	45	25	9	3	4	4	3	0	0	0	0	0	0	861
2011	0	0	2	72	275	270	186	102	80	31	19	9	0	3	1	1	1	0	0	0	0	0	1060
2012	0	0	2	87	399	362	245	173	139	117	66	43	30	19	5	4	2	2	0	0	0	0	1695
2013	0	0	2	130	463	385	311	194	145	110	63	41	15	8	5	4	1	1	0	0	0	0	1878
2014	0	0	3	207	556	504	384	284	170	116	59	31	15	13	3	3	0	0	0	1	0	0	2354
2015	0	1	2	210	626	546	452	300	213	144	69	31	21	7	3	1	3	1	0	0	0	0	2633
2016	0	0	7	253	794	676	493	361	217	122	61	35	25	11	4	1	1	0	1	1	1	1	3065
2017	0	1	19	325	554	535	403	282	173	125	79	46	21	13	16	8	1	1	0	0	0	0	2603

4.11 FIGURES

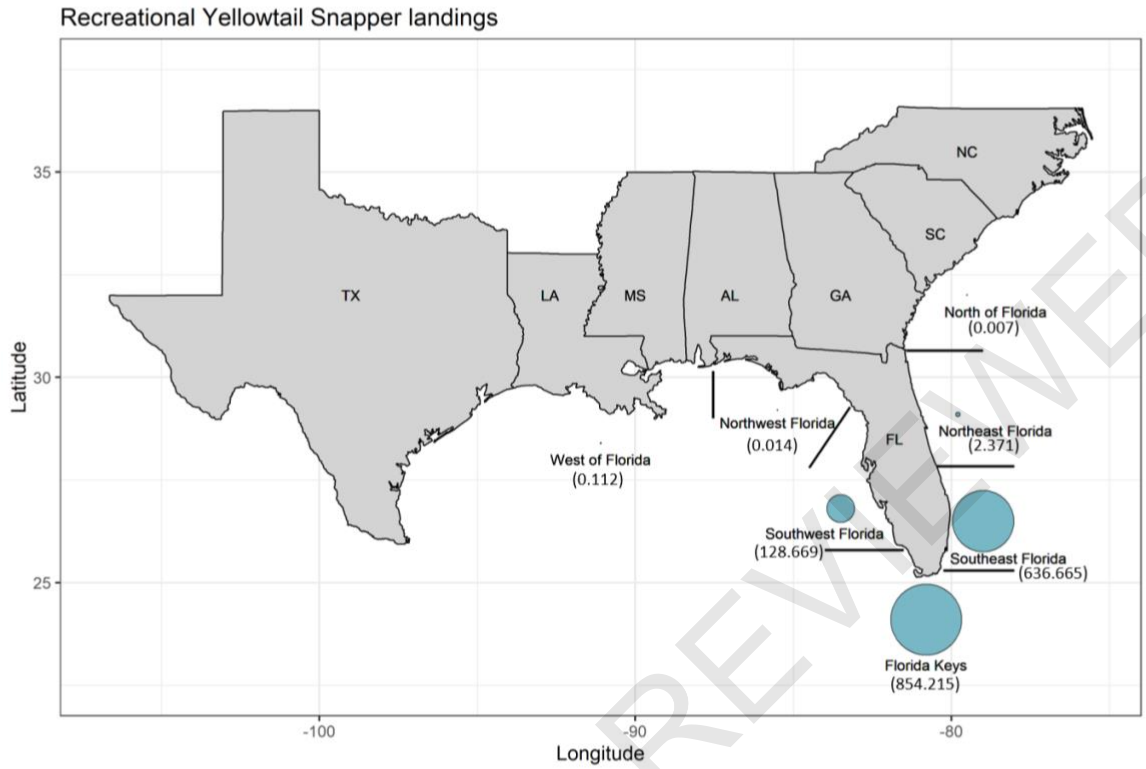


Figure 4.11.1. Average Yellowtail Snapper recreational landings (in thousands of fish) by region, 2015-2017.

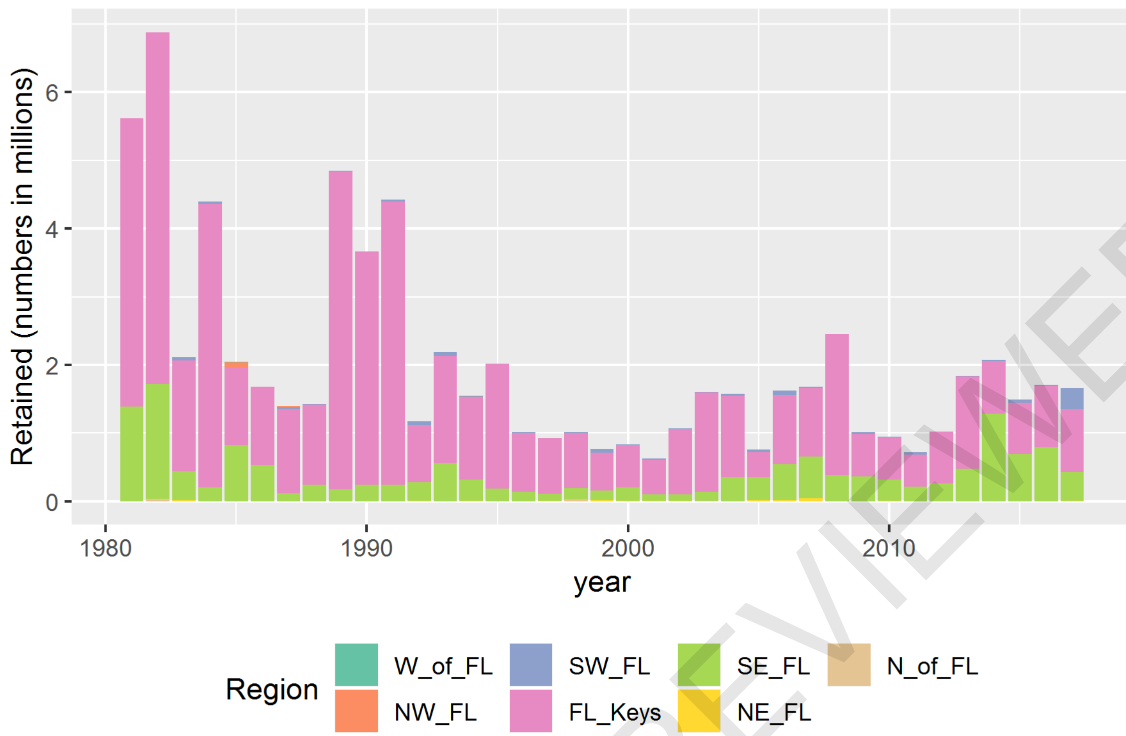


Figure 4.11.2. Yellowtail Snapper landings by region and year, 1981-2017.

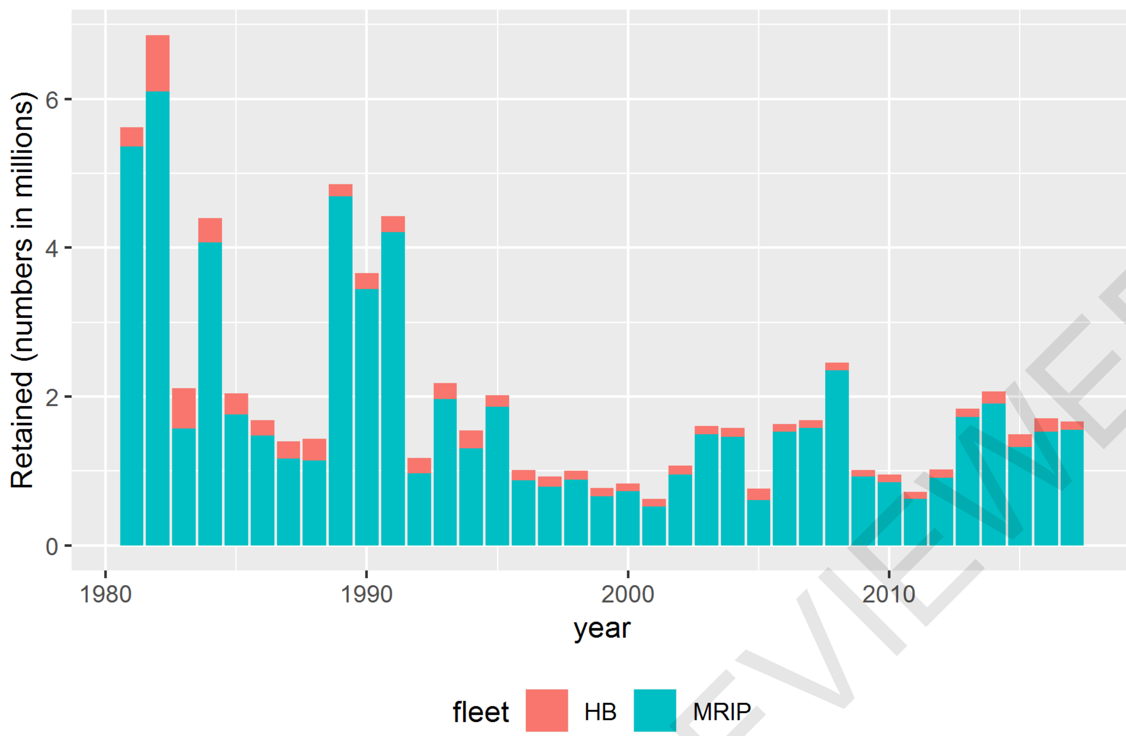


Figure 4.11.3. Yellowtail Snapper landings in Florida by data source 1981-2017. Note that from 1981-1985 headboat landings in the Gulf of Mexico originated from MRIP.

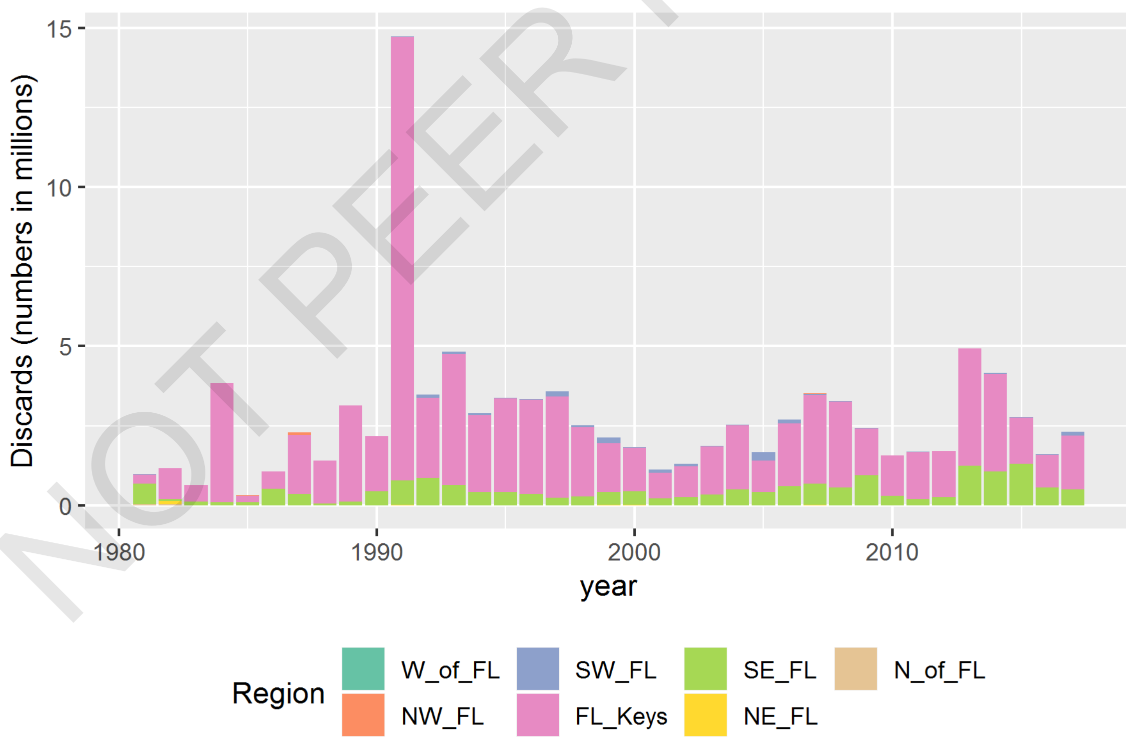


Figure 4.11.4. Yellowtail Snapper discards by region and year, 1981-2017.

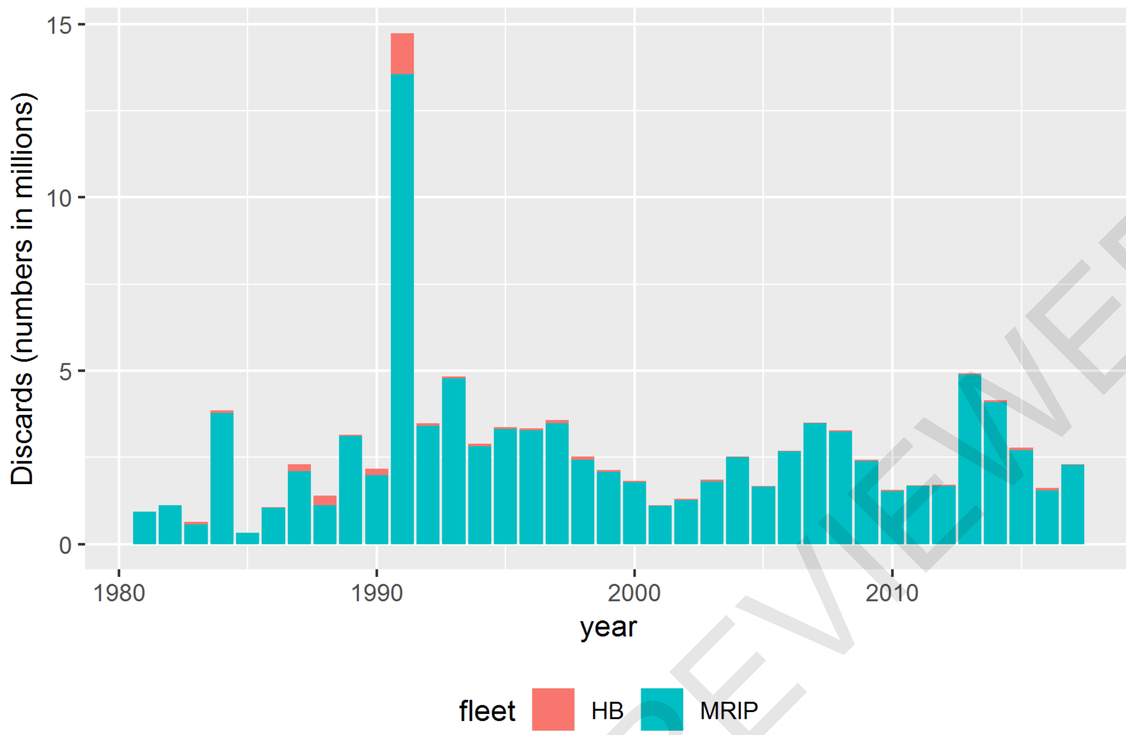


Figure 4.11.5. Yellowtail Snapper discards in Florida by data source 1981-2017. Note that from 1981-1985 headboat discards in the Gulf of Mexico originated from MRIP.

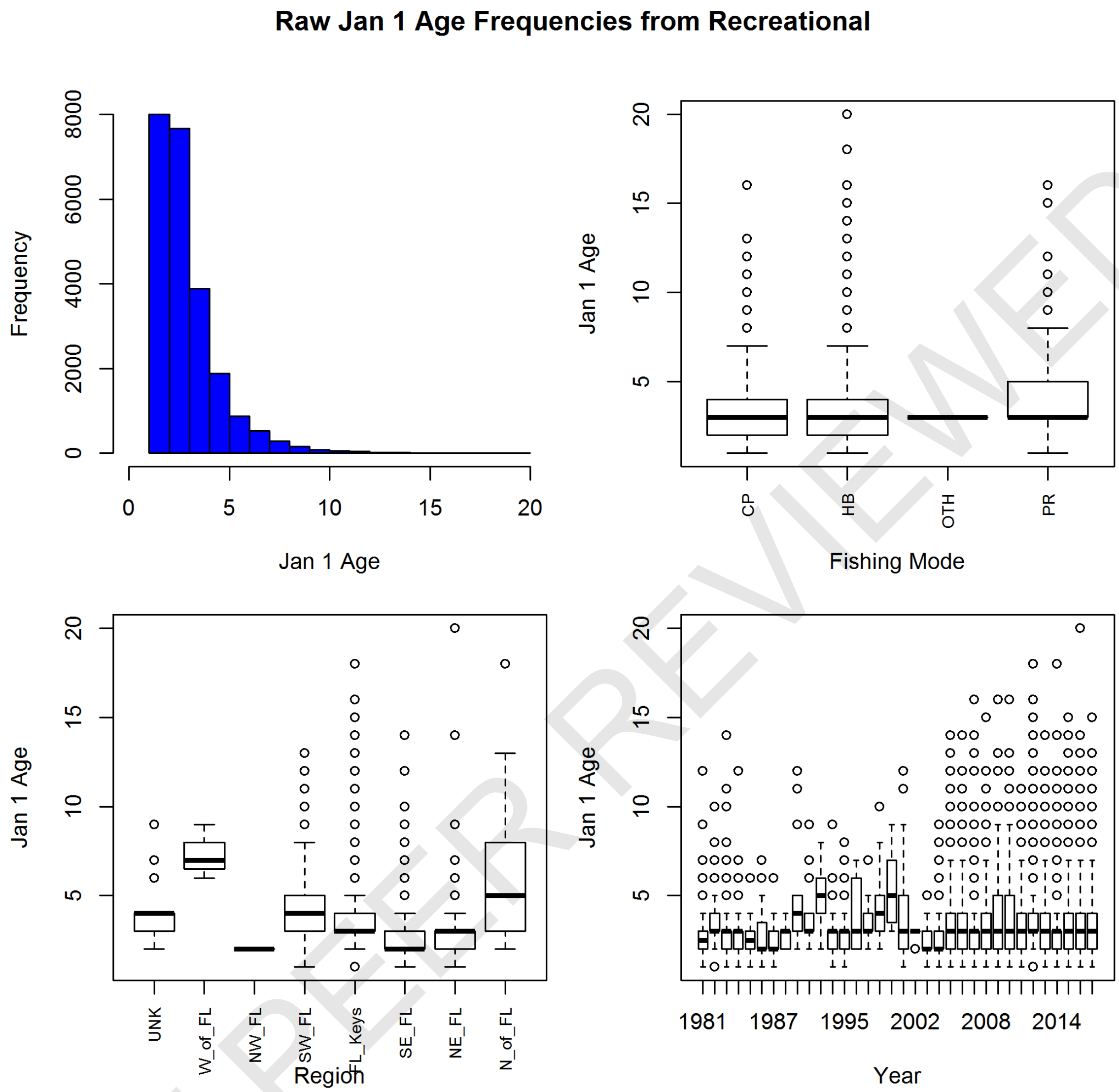


Figure 4.11.6. An overview of Yellowtail Snapper age data from recreational sources, 1981-2017.

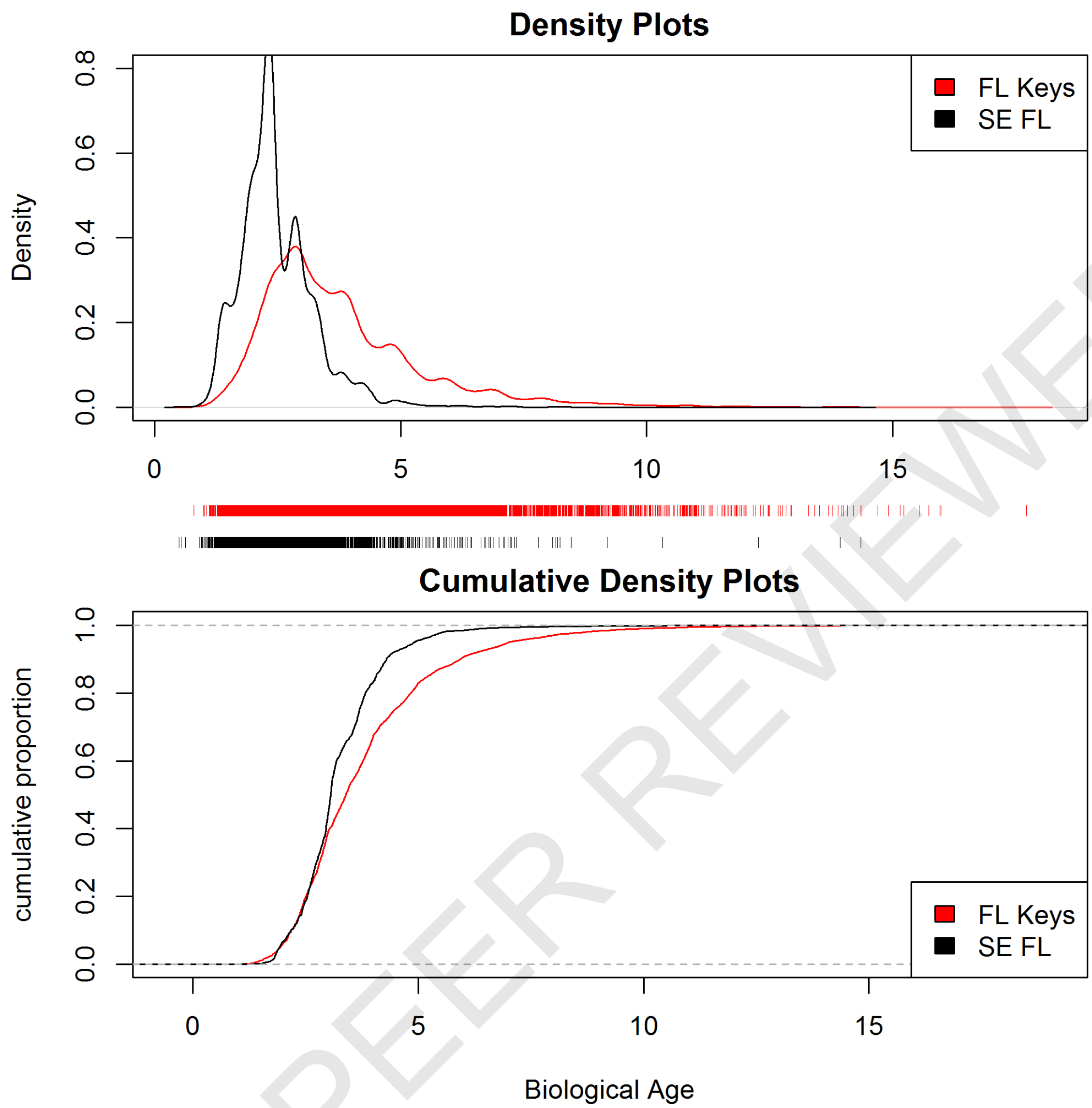


Figure 4.11.7. A comparison of Yellowtail Snapper age distributions from recreational sources in the FL Keys and SE FL.

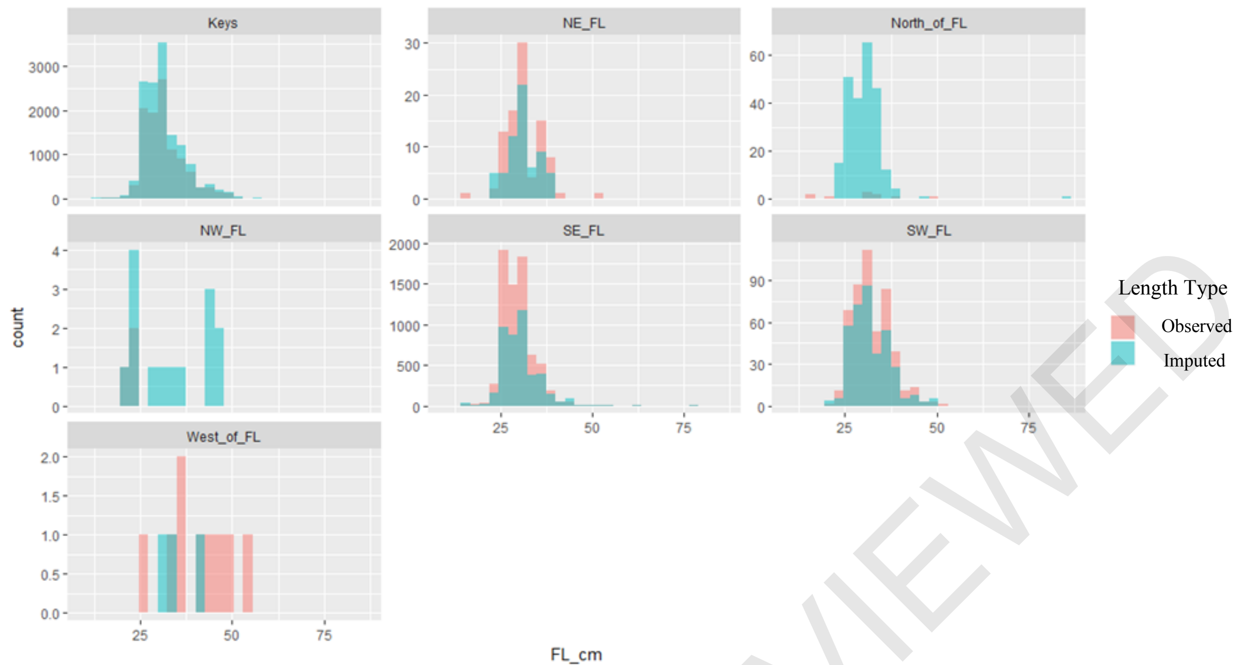


Figure 4.11.8. Comparison of MRIP length distributions for Yellowtail Snapper derived from observed and imputed fork lengths (cm).

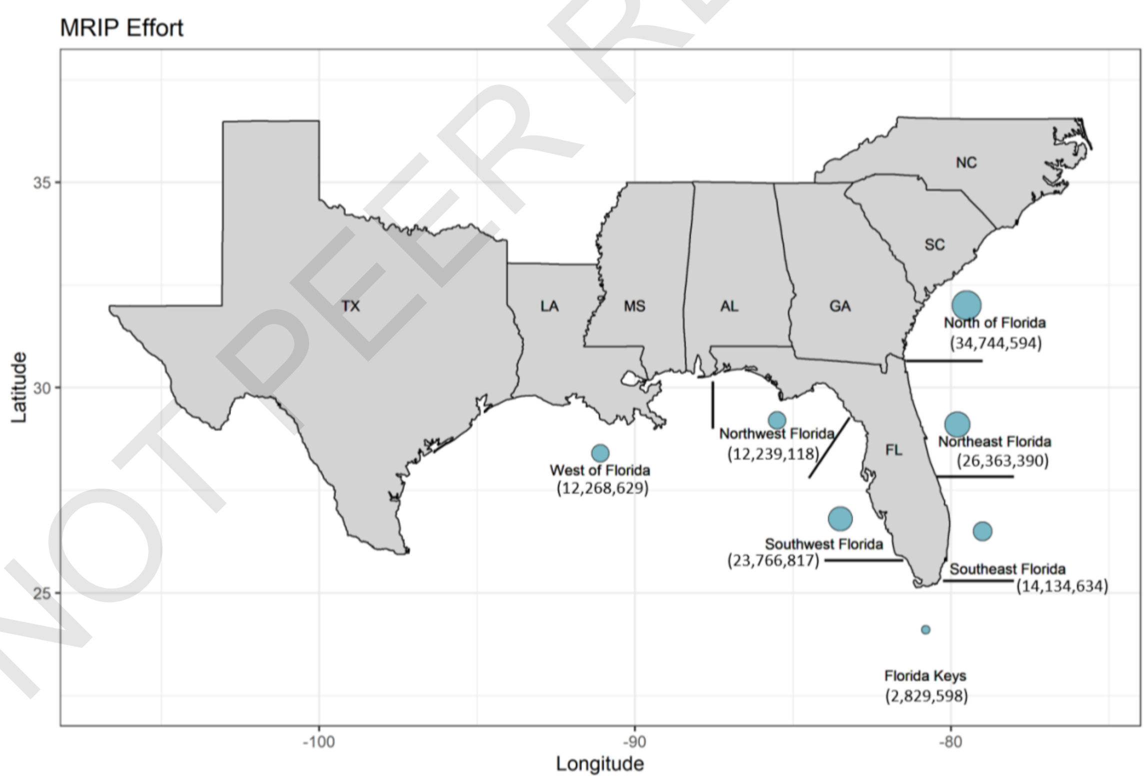


Figure 4.11.9. Average Yellowtail Snapper MRIP angler-days by region, 2015-2017.

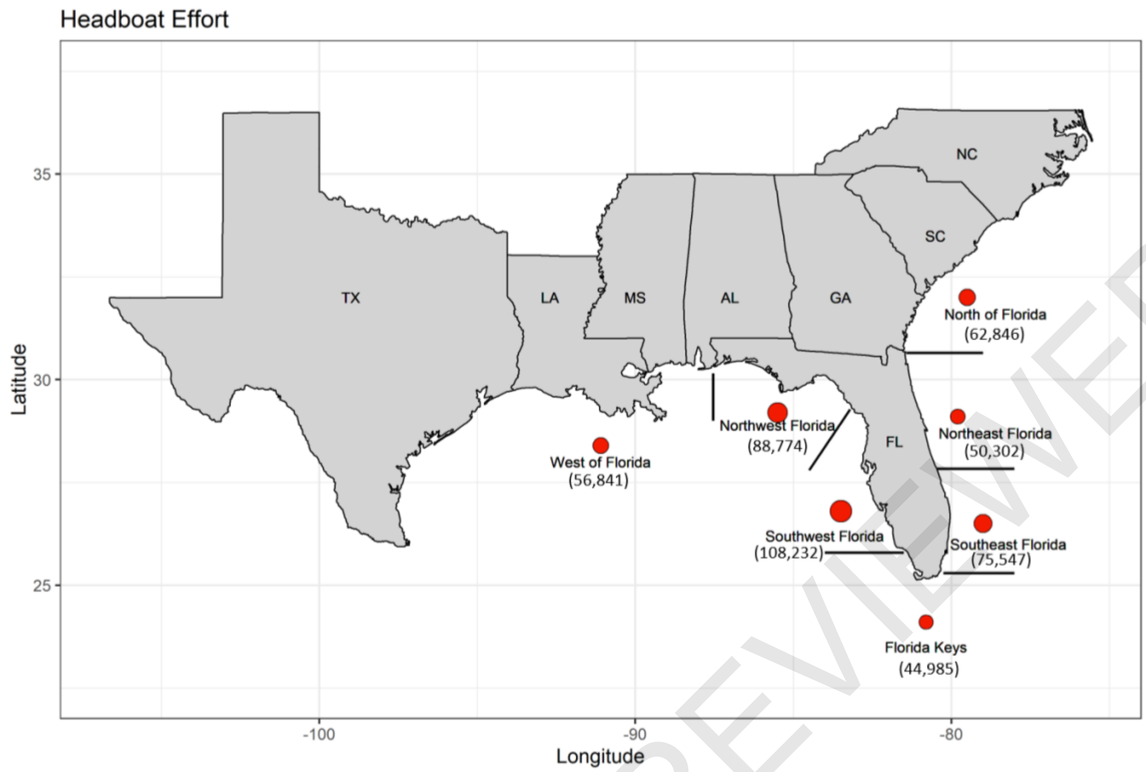


Figure 4.11.10. Average Yellowtail Snapper Headboat angler-days by region, 2015-2017.

5 MEASURES OF POPULATION ABUNDANCE

The Population Abundance Workgroup (PAW) was tasked to review indices of relative abundance for Yellowtail Snapper from fishery-independent and fishery-dependent surveys for inclusion in the stock assessment model. Each survey index was individually evaluated according to SEDAR Best Practices (SEDAR 2016) with considerations to factors such as survey design, sampling gear, spatial coverage, temporal coverage, analytical methodology, data limitations, and size/age classes sampled. Discussions for each index focused on whether they adequately represented fishery and population conditions and whether modifications to analytical methods could be made to improve the quality of the index.

5.1.1 Group Membership

Christopher Swanson (lead)	FWRI, St. Petersburg, FL
Jeff Renchen	FWC-DMFM, Tallahassee, FL
Walt Ingram	NOAA SEFSC, Pascagoula, Mississippi
Jim Nance	GMFMC SSC, Tampa, FL
Kerry Flaherty-Walia	FWRI, St. Petersburg, FL
Jennifer Herbig	FWRI, Marathon, FL
Mike Errigo	SAFMC, Charleston, SC
Elizabeth Herdter Smith	FWRI, St. Petersburg, FL
Eric Schmidt	Headboat captain, Ft. Myers, FL
Robert Muller	FWRI, St. Petersburg, FL
Kevin McCarthy	NOAA SEFCS, Miami, FL

5.2 REVIEW OF WORKING PAPERS

Eight working papers were submitted for review to the PAW. Five papers covered fishery-independent surveys, while the other three covered fishery-dependent surveys. Each working paper described the source data, information on quality control, and subsetting methodology used to produce final datasets for the index. The papers also contained diagnostic plots and, where appropriate, more detailed information about the survey design. Indices were prepared for this assessment from the following five programs: the Reef Fish Visual Census (RVC; a multi-agency collaborative underwater survey), the NMFS' Southeast Area Monitoring and Assessment Program's (SEAMAP) reef fish video survey, the NMFS' Coastal Fisheries Log Book Program (CFLP), the NMFS' Marine Recreational Information Program (MRIP), and the NMFS' Southeast Region Headboat Survey (SRHS).

SEDAR 64-DW-01: SEAMAP Reef Fish Video Survey: Relative Indices of Abundance of Yellowtail Snapper

SEDAR 64-DW-02: A model-based index of Yellowtail Snapper, *Ocyurus chrysurus*, in the Dry Tortugas using Reef Fish Visual Census data from 1999-2016

SEDAR 64-DW-04: A model-based index of Yellowtail Snapper, *Ocyurus chrysurus*, for the Florida Reef Tract from Card Sound through the Florida Keys using Reef Fish Visual Census data from 1997-2016

SEDAR 64-DW-05: Fisheries-independent data for Yellowtail Snapper (*Ocyurus chrysurus*) from reef-fish visual surveys in the Florida Keys and Dry Tortugas, 1999-2016

SEDAR 64-DW-06: A model-based index of Yellowtail Snapper, *Ocyurus chrysurus*, for the Northern Florida Reef Tract from Government Cut through Martin County using Reef Fish Visual Census data from 2012-2016

SEDAR 64-DW-09: Standardized Catch Rates of Yellowtail Snapper (*Ocyurus chrysurus*) from the Marine Recreational Information Program (MRIP) in Southeast Florida and the Florida Keys, 1981-2017

SEDAR 64-DW-11: Standardized Catch Rates of Yellowtail Snapper (*Ocyurus chrysurus*) from the U.S. Headboat Fishery in Southeast Florida and the Florida Keys, 1981-2017

5.3 FISHERY INDEPENDENT SURVEYS

5.3.1 Reef Fish Visual Census (RVC)

Personnel from the National Marine Fisheries Service began the Reef Fish Visual Census (RVC) in 1979 to provide long term monitoring data for reef fish populations along the Florida Reef Tract (Bohnsack and Bannerot 1986; Bohnsack et al. 1999; Ault et al. 2001; and Smith et al. 2011). The survey is now conducted by several agencies in three regions of the south Florida coral reef ecosystem domain: (1) the Florida Keys (Key Biscayne to west of Key West; domain size = 559 km^2); (2) the Dry Tortugas (domain size = 339 km^2); and (3) the southeast Florida region (Key Biscayne to Martin County; domain size = 365 km^2). They employed a two-stage stratified random survey design (Cochran 1977; Brandt et al. 2009; Smith et al. 2011) in shallow water (<30 m) with sampling frames by hard-bottom habitat that were created by dividing the Florida Reef Tract into 200-m x 200-m grid cells, or primary sampling units (PSUs), and listing the habitat strata in each PSU. The PSU size was later reduced to 100-m x 100-m in 2014 to improve spatial resolution. This change, however, does not affect the index because the measuring unit for Yellowtail Snapper is the average abundance within a secondary sampling unit (SSU). The number of PSUs sampled in each stratum was based on the area of each strata within the sampling region and the variance in abundance (Smith et al. 2011). Strata with higher variance were allocated more samples to increase survey accuracy. Once the estimated number of PSUs needed to achieve a 20% coefficient of variation (CV) were allocated to each stratum, PSUs were randomly chosen from the habitat sampling domain.

The RVC data were first assessed on a regional basis. Based on the results, the PAW determined that the Florida Keys and Dry Tortugas regions should be combined into a single index reflecting the core spatial areas for Yellowtail Snapper while the southeast Florida region (the northern extent of the core area) would be removed due to limited sampling years. Two approaches were discussed: a design-based modeling approach (Smith et al. 2011; Herbig et al. 2019) and a model-based approach (Swanson and Muller 2019, Swanson 2019a, Swanson 2019b). While both approaches have been used in assessments, the PAW ultimately recommended the design-based approach that weights the abundance of fish by habitat strata to account for the increased sampling effort over strata with higher variances. Yellowtail Snapper abundance was therefore assessed for the combined Florida Keys and Dry Tortugas regions between April and December using only the years that contained sampling information from both regions (1999, 2000, 2004, 2006, 2008, 2010, 2012, 2014, 2016). Based on Yellowtail Snapper life history and length compositions collected for each region, the PAW further partitioned the RVC data into two indices. Data from Yellowtail Snapper less than 19 cm fork length (FL; age 0 juveniles; range: 1 – 18 cm) were used to develop a recruitment index while data from fish 19 cm FL or greater (range: 19 – 66 cm) were used for development of an adult (age 1+) index. From 1999 to 2016, the abundance for both juvenile and adult Yellowtail Snapper showed a slightly increasing trend (Table 5.9.1, Fig 5.10.1).

5.3.2 SEAMAP Reef Fish Video Survey

The primary objective of the annual Southeast Area Monitoring and Assessment Program (SEAMAP) reef fish video survey is to provide an index of the relative abundances of fish species associated with topographic features (e.g. reefs, banks, and ledges) located on the continental shelf of the Gulf of Mexico (GOM) from Brownsville, TX to the Dry Tortugas, FL. The survey has been executed from 1992-1997, 2001-2002, and 2004-present and historically takes place from April - May, however in limited years the survey was conducted through the end of August. In 2001, the survey was abbreviated due to ship scheduling, during which, the only sites that were completed were located in the western Gulf of Mexico. The survey collects data on diversity, abundance (min-count), fish length, habitat type, habitat coverage, bottom topography and water quality.

A delta (hurdle) model with three different error distributions (lognormal, Poisson and negative binomial) was used to standardize relative abundance indices for Yellowtail Snapper (Lo et al. 1992). Because there were very few observations of Yellowtail Snapper from sites outside of the Dry Tortugas region, the data were spatially restricted to that area. The delta-lognormal model was selected as the best fitting model by evaluating the conditional likelihood, over-dispersion parameter (Pearson chi-square/DF), and visual interpretation of the Q/Q plots. The size of fish sampled with the baited video gear is species specific and Yellowtail Snapper sampled over the history of the survey ranged in size from 8 – 73 cm FL with mean annual fork lengths ranging from 19 – 31 cm. A review and discussion about the survey design, specific data caveats, index, and diagnostic plots can be found in Campbell et al. (2018).

5.4 FISHERY-DEPENDENT MEASURES

5.4.1 Coastal Fisheries Logbook Program (CFLP) Commercial Index

The Coastal Fisheries Logbook Program (CFLP) available catch per unit effort (CPUE) data were used to construct standardized abundance indices for Yellowtail snapper. The index was constructed using data reported from commercial vertical line (handline and bandit rig) trips in southern Florida. Yellowtail Snapper data were sufficient to construct indices of abundance including the years 1993-2018.

Several data filters were used in constructing the final data set. Trips reporting multiple gears or areas fished were excluded. Data were restricted to include only those trips with landings and effort data reported within 45 days of the completion of the trip due to the assumption that longer reporting delays likely resulted in less reliable effort data. Clear outliers in the data, e.g., values falling outside the 99.9 percentile of the data, and logical inconsistencies (e.g., reports of fishing more than 24 hours/day) were also excluded from the analyses. Yellowtail Snapper trips were identified using a data subsetting technique (modified from Stephens and MacCall 2004) intended to restrict the data set to trips with fishing effort in presumptive Yellowtail snapper habitat. Three commercial closures (2015, 2017, and 2018) were implemented that affected construction of indices of abundance using the logbook dataset. In each case, data reported during the closure were excluded from the analyses.

Two indices were constructed using coastal logbook commercial vertical line data following the methods of McCarthy (2011). The first index (south Florida index) included effort and landings data reported from statistical areas 1, 2, 3, 4, 2482, 2481, 2480, 2479, 2579, 2580, 2679, 2680, 2779, and 2780 (see Figure 5.10.2). The second index (core area index) included data reported from areas 1, 2, 2482, 2481, 2480, 2579, 2580, 2679, and 2680. Vertical line catch rate was calculated as weight of landed Yellowtail snapper per hook hour fished.

Five factors were considered as possible influences on the proportion of trips that landed Yellowtail Snapper and on the catch rate of Yellowtail Snapper. An additional factor, number of hooks fished, was examined for its effect on the proportion of positive trips.

1

Factor	**Levels**	**Value**
Year	26	1993-2018
Season	4	Jan-Mar, Apr-Jun, Jul-Sep, Oct-Dec
Subregion	7/5	Areas as defined above: 7 in south Florida; 5 in core area
Days at sea	2	1, 2+ days
Crew	3	1, 2, 3+ crew members
Hooks hours fished[1]	4	South Florida index: <8, 8-15, >15-23, >23 hook hours Core area index: 0.1-8, >8-15, >15-24, >24 hook hours

Hooks fished was examined only for the proportion positive analyses.

The delta lognormal model approach (Lo et al. 1992) was used to construct standardized indices of abundance. Parameterization of each model was accomplished using a GLM analysis (GENMOD; Version 8.02 of the SAS System for Windows © 2000. SAS Institute Inc., Cary, NC, USA). For each GLM analysis of proportion positive trips, a type-3 model was fit, a binomial error distribution was assumed, and the logit link was selected. The response variable was proportion successful trips. During the analysis of catch rates on successful trips, a type-3 model assuming lognormal error distribution was examined. The linking function selected was "normal", and the response variable was log(CPUE) where log(CPUE)=ln(pounds of yellowtail snapper/hook hours fished). All 2-way interactions among significant main effects were examined. Higher order interaction terms were not examined.

A forward stepwise regression procedure was used to determine the set of fixed factors and interaction terms that explained a significant portion of the observed variability. Once a set of fixed factors was identified, the influence of the YEAR*FACTOR interactions were examined. YEAR*FACTOR interaction terms were included in the model as random effects. Selection of the final mixed model was based on the Akaike's Information Criterion (AIC), Schwarz's Bayesian Criterion (BIC), and a chi-square test of the difference between the –2 log likelihood statistics between successive model formulations (Littell et al. 1996).

The final delta-lognormal models were fit using a SAS macro, GLIMMIX (Russ Wolfinger, SAS Institute). The PAW recommended using the south Florida area index over the similarly trending core area index due to the greater spatial representation and smaller CVs (Table 5.9.1, Fig 5.10.1). This index was also chosen for use in the prior assessment (O'Hop et al. 2012).

5.4.2 Marine Recreational Informational Program (MRIP) Index

yellowtail Snapper are caught by recreational anglers primarily in south Florida from Palm Beach County to Monroe County. Since the Marine Recreational Information Program (MRIP) collects data on both harvested (observed landings=A; dead discards not observed=B1) and live released fish (B2), a total catch (A + B1 + B2) by species for an angler-trip can be calculated. Therefore, trip level data using only hook and line gear were used to construct total catch rate indices of Yellowtail Snapper for the Florida Keys (including the Dry Tortugas; Monroe County) and Southeast Florida (Palm Beach, Broward, and Miami-Dade Counties) from 1981 – 2017. A combined area index was also produced using the selected trip data from the Florida Keys and southeast Florida. Species clustering (Shertzer and Williams 2008) was used to identify trips that were either directly or indirectly targeting Yellowtail Snapper.

Generalized linear models and a delta-lognormal approach were used to generate the indices (Lo et al. 1992; Dick 2004; Maunder and Punt 2004). Due to inconsistencies in the methods used to collapse catch by trip between the earlier (up to 1990) and later portions of the MRIP data set, and considering the research recommendations made by SEDAR 27A (O'Hop et al. 2012), the PAW recommended the index start year be set at 1991 for this assessment. Model residuals indicated good overall fit to both the positive and binomial sub-models for both regions and the combined area model. Observed (non-imputed) measurements taken for Yellowtail Snapper in southeast Florida and the Florida Keys ranged in size from 11 – 79 cm FL. Since there was no indication that recreational fishers were targeting different portions of the population between the two areas, the PAW recommended the use of the combined area index as it better represents the core population area. The combined area index decreased in trend from 1991 – 1998 then variably increased through 2017 (Table 5.9.1, Fig 5.10.1). A further review and discussion about the MRIP survey design, specific data caveats, index, and diagnostic plots can be found in Herdter (2019).

5.4.3 Southeast Region Headboat Survey (SRHS) Index

Headboats are vessels with a capacity for carrying six or more recreational anglers. The Southeast Region Headboat Survey (SRHS), administered by the NOAA Southeast Fishery Science Center laboratory in Beaufort, NC, has operated along the east coast since 1972 and in the Gulf of Mexico since 1986. Catch and effort records from every trip are provided using self-reported logbooks and biological samples are collected from dockside intercepts by port agents. Catch and effort information from the SRHS were used to construct indices of Yellowtail Snapper catch rates in the Florida Keys (including the Dry Tortugas; areas 12 and 17) and southeast Florida (area 11) from 1981 – 2017. A combined area index was also produced using the selected trip data from the Florida Keys and southeast Florida. Only retained catch estimates were available beginning in 1981, however, total catch estimates became available beginning in 2008 when mandatory logbook reporting was implemented and required for permit renewal.

Species clustering (Shertzer and Williams 2008) was used to identify trips that were either directly or indirectly targeting Yellowtail Snapper.

Generalized linear mixed effects models and a delta-lognormal approach were used to generate the indices (Lo et al. 1992; Dick 2004; Maunder and Punt 2004); 'Vessel ID' was included as a random effect in both positive and binomial sub-models. Reporting issues during the middle portion of the time series caused poor model fit for all models. Two types of SRHS indices were considered where catch rates were defined as 1) retained catch per trip from 1981 – 2017 or 2) as total catch per trip from 2008 – 2017. A further review and discussion about the SRHS design, specific data caveats, index, and diagnostic plots can be found in Herdter and Allen (2019).

5.5 CONSENSUS RECOMMENDATIONS AND SURVEY EVALUATIONS

During the Data Workshop and webinar, the PAW evaluated several indices from five survey programs for use in the Yellowtail Snapper stock assessment model. Ultimately, the PAW recommended the following four relative abundance indices for use: RVC – Juvenile index, RVC – Adult index, MRIP index, and the CFLP Commercial index. The values for each individual index and their respective CVs are presented in Table 5.9.1 and index values normalized to their means are presented in Table 5.9.2 and Figure 5.10.1. Below are the evaluations for each of the surveys and their respective indices.

5.5.1 Reef Fish Visual Census – Juvenile

The Reef Fish Visual Census juvenile index was recommended for use in the assessment. This fishery-independent survey collects information on juvenile sizes not yet recruited to the fishery, spatially operates in core Yellowtail Snapper habitat along the Florida Reef Tract, and contains sufficient temporal coverage.

5.5.2 Reef Fish Visual Census – Adult

The Reef Fish Visual Census adult index was recommended for use in the assessment. This survey spatially operates in core Yellowtail Snapper habitat along the Florida Reef Tract, adequately targets population size ranges vulnerable to the fishery, and contains sufficient temporal coverage.

5.5.3 *SEAMAP Reef Fish Video Survey*

The SEAMAP Reef Fish Video Survey index was not recommended for use in the assessment. The survey overlaps in spatial and temporal coverage with the RVC index, targets similarly sized fish, but is limited to the Dry Tortugas and therefore not representative of total population abundance.

5.5.4 *Marine Recreational Information Program*

The MRIP index was recommended for use in the assessment because it contains adequate spatial and temporal coverage in the core Yellowtail Snapper habitat, includes the larger sized fish in the estimate, and is similar in trend to the fishery-independent indices.

5.5.5 *Coastal Fisheries Logbook Program*

The Commercial index was recommended for use in the assessment after confirming proper calculation of index variance estimates. Temporal and spatial coverage were adequate in the Yellowtail Snapper south Florida area in the opinion of the PAW. TIP data inform the size composition of the fish included in this CPUE series.

5.5.6 *Southeast Region Headboat Survey*

The Headboat survey index was not recommended for use in the assessment due to poor reporting compliance and model fit through 2008, numerous data uncertainties, and survey overlap in spatial and temporal coverage with other fishery-dependent indices. In addition, annual headboat landings averaged only 5% of the total annual Yellowtail Snapper landings.

5.6 RESEARCH RECOMMENDATIONS

During the review and evaluation of the various program datasets and indices presented during the Data Workshop, the PAW identified the following research recommendations to further improve the indices of relative abundance:

- Develop fishery-independent surveys throughout the Florida Keys which successfully target settlement sized Yellowtail Snapper in seagrass/mangroves habitats before ontogenetically shifting to reef habitats. This habitat shift is observed throughout the Caribbean but not well documented for Florida.
- Develop or extend fishery-independent reef fish surveys into deeper waters (>30 m) along the Florida Keys for greater overlap with exploited portions of the population.

5.7 DATA BEST PRACTICES COMMENTS AND SUGGESTIONS

By familiarizing ourselves with the SEDAR Best Practices Living Document (SEDAR 2016), several potential issues described therein were avoided by the PAW during the Data Workshop. The recommendations within SEDAR 2016 streamlined the DW process and allowed each member to follow similar protocols. There was more time for discussion on the particulars of each index because we were not required to complete the index report cards. Additionally, having evaluation criteria promoted constructive discussion regarding index inclusion, rejection, or modification. Finally, re-organization of the Data Workshop Report section limited redundancy and allowed for clearer communication regarding final recommendations.

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5.9 TABLES

Table 5.9.1. Recommended relative abundance index values and CVs for Yellowtail Snapper from 1991 – 2017.

Year	RVC Index Juvenile		RVC Index Adult		MRIP Index		Commercial Index	
	Index	CV	Index	CV	Index	CV	Index	CV
1991					3.84	0.09		
1992					2.96	0.09		
1993					2.99	0.10	2.34	0.18
1994					2.27	0.13	2.53	0.18
1995					2.33	0.12	1.93	0.18
1996					1.71	0.13	1.69	0.18
1997					1.58	0.12	1.94	0.18
1998					1.30	0.09	2.27	0.18
1999	1.59	0.13	1.35	0.19	1.72	0.09	3.02	0.17
2000	2.67	0.08	1.33	0.12	1.91	0.09	2.73	0.18
2001					1.98	0.08	2.71	0.18
2002					1.82	0.09	3.05	0.18
2003					1.74	0.09	2.21	0.18
2004	2.38	0.12	2.40	0.18	2.25	0.09	3.02	0.18
2005					2.40	0.08	3.78	0.18
2006	2.96	0.11	1.82	0.25	2.27	0.08	3.59	0.18
2007					2.72	0.08	4.84	0.18
2008	3.45	0.07	3.38	0.13	2.25	0.09	6.12	0.18
2009					2.09	0.09	5.62	0.18
2010	2.94	0.11	2.51	0.12	2.29	0.11	5.36	0.18
2011					2.09	0.09	5.98	0.18
2012	3.26	0.07	2.75	0.09	2.15	0.09	5.23	0.18
2013					3.02	0.08	5.04	0.18
2014	3.85	0.10	4.44	0.17	2.76	0.08	4.72	0.18
2015					2.95	0.09	4.82	0.19
2016	3.55	0.10	3.01	0.12	2.56	0.09	5.98	0.18
2017					2.93	0.11	6.77	0.19

Table 5.9.2. Recommended relative abundance index values (normalized to their means) and CVs for Yellowtail Snapper from 1991 – 2017.

Year	RVC Index Juvenile		RVC Index Adult		MRIP Index		Commercial Index	
	Index	CV	Index	CV	Index	CV	Index	CV
1991					1.65	0.09		
1992					1.27	0.09		
1993					1.28	0.10	0.60	0.18
1994					0.97	0.13	0.65	0.18
1995					1.00	0.12	0.50	0.18
1996					0.73	0.13	0.43	0.18
1997					0.68	0.12	0.50	0.18
1998					0.56	0.09	0.58	0.18
1999	0.54	0.13	0.53	0.19	0.74	0.09	0.78	0.17
2000	0.90	0.08	0.52	0.12	0.82	0.09	0.70	0.18
2001					0.85	0.08	0.70	0.18
2002					0.78	0.09	0.78	0.18
2003					0.75	0.09	0.57	0.18
2004	0.80	0.12	0.94	0.18	0.97	0.09	0.78	0.18
2005					1.03	0.08	0.97	0.18
2006	1.00	0.11	0.71	0.25	0.97	0.08	0.92	0.18
2007					1.17	0.08	1.24	0.18
2008	1.17	0.07	1.32	0.13	0.97	0.09	1.57	0.18
2009					0.90	0.09	1.44	0.18
2010	0.99	0.11	0.98	0.12	0.98	0.11	1.38	0.18
2011					0.90	0.09	1.54	0.18
2012	1.10	0.07	1.08	0.09	0.92	0.09	1.34	0.18
2013					1.30	0.08	1.30	0.18
2014	1.30	0.10	1.74	0.17	1.19	0.08	1.21	0.18
2015					1.27	0.09	1.24	0.19
2016	1.20	0.10	1.18	0.12	1.10	0.09	1.54	0.18
2017					1.26	0.11	1.74	0.19

5.10 FIGURES

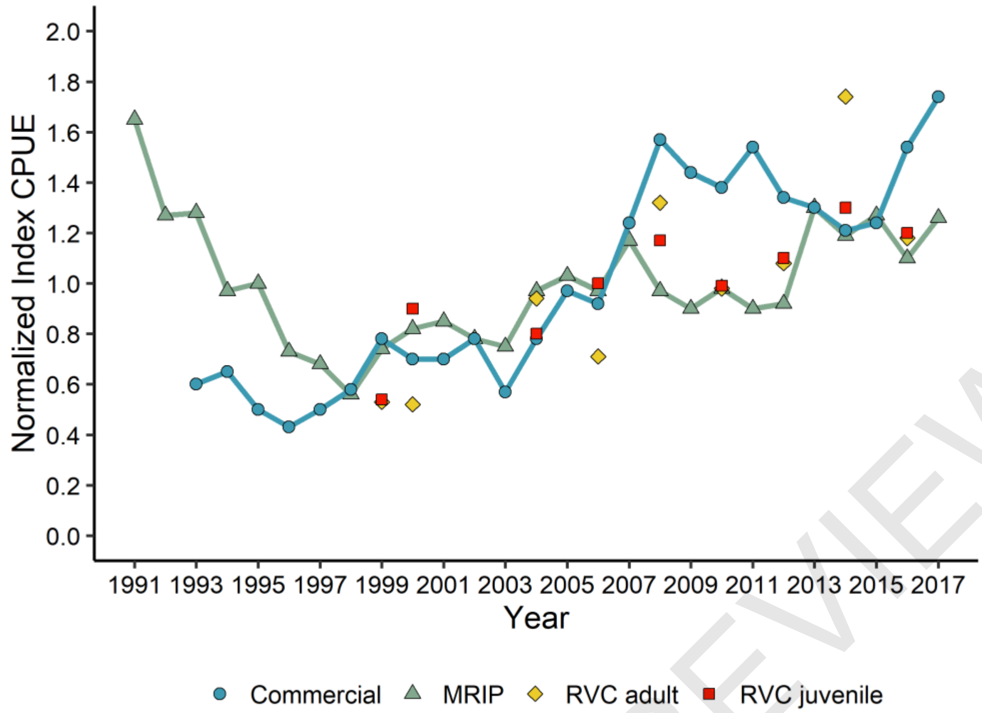

Figure 5.10.1. Recommended normalized indices of relative abundance for Yellowtail Snapper from 1991 – 2017. MRIP surveys were conducted from 1991-2017, the commercial CFLP index was from 1993 – 2017, and RVC surveys were conducted in 1999, 2000 and biennially from 2004 -2016.

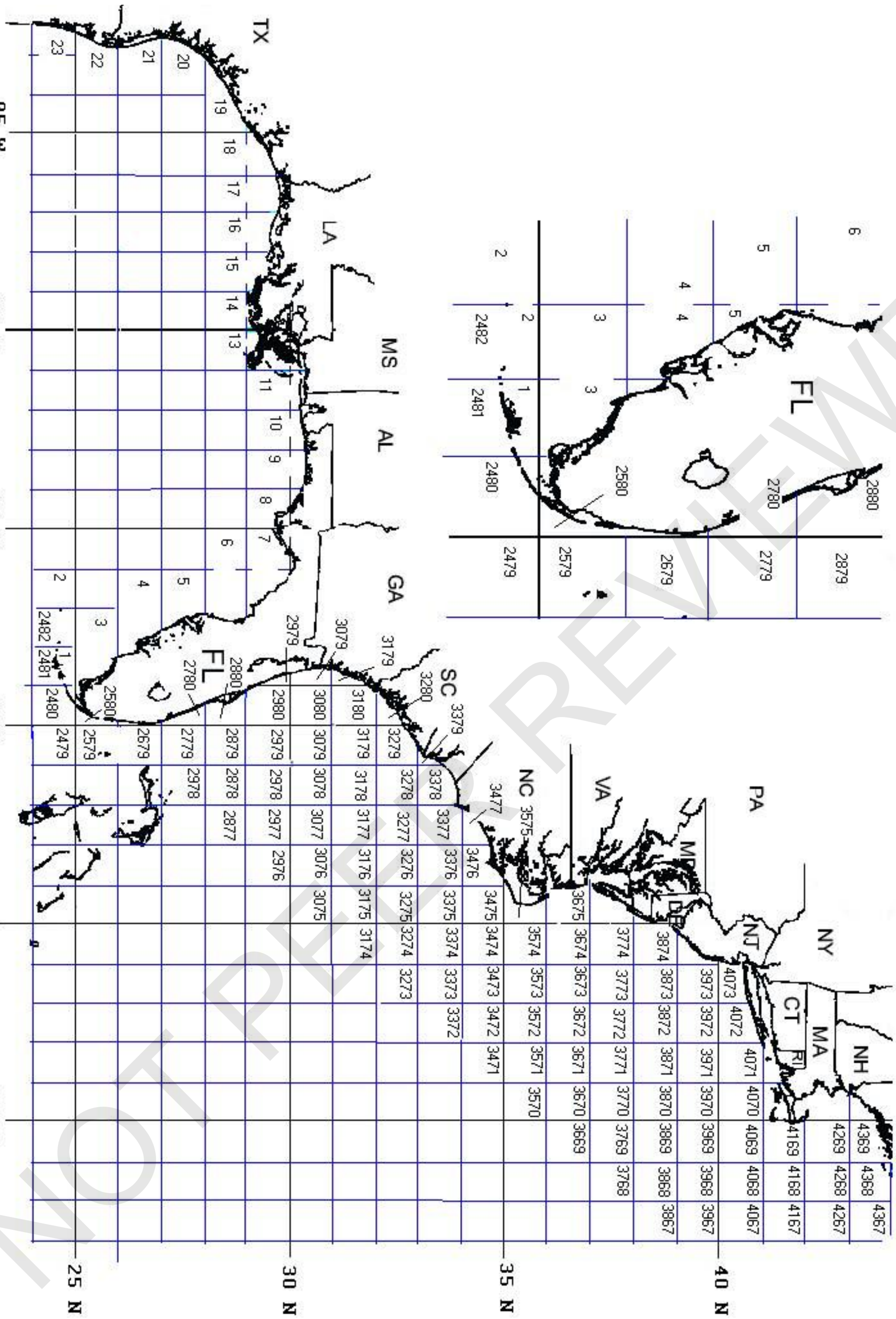

Figure 5.10.2. Grid system currently used in the reporting data to the NMFS Coastal Fisheries Logbook Program.