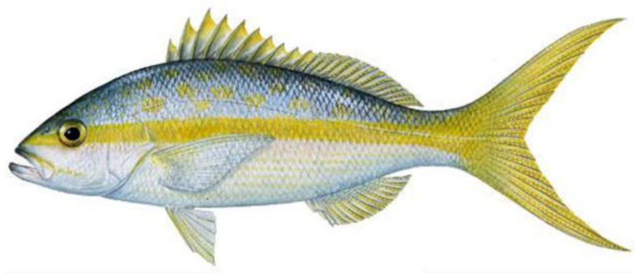

Southeastern U.S. Yellowtail Snapper

SEDAR 64 Executive Summary

December 2020

Stock

This assessment estimates the status of the southeastern U.S. Yellowtail Snapper (*Ocyurus chrysurus*) population through 2017 and projects quotas starting in 2021. While the biological stock extends along the southeastern U.S. beyond Florida and is considered a single unit for management purposes, only data from Florida were considered for assessment modeling purposes. This decision proceeded primarily from 1) the concentration of landings off south Florida and the Florida Keys, and 2) multiple growth patterns exhibited due to the presence of larger and older individuals caught off the Carolinas not subjected to the greater fishing pressure in Florida.

Stock Status

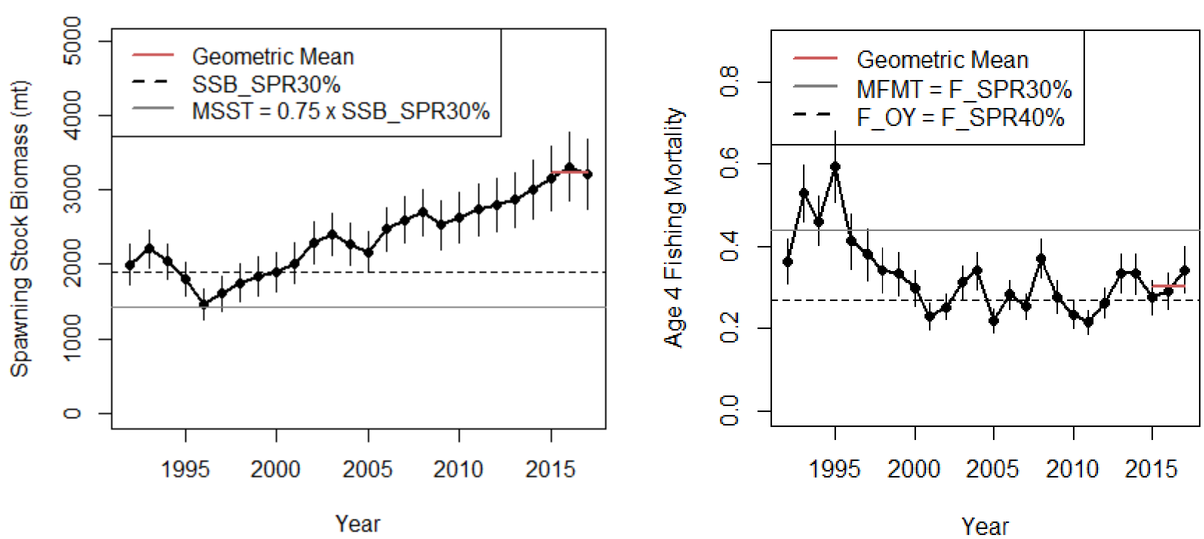

Figure 1. *Spawning stock biomass [left panel] and fishing mortality rates [right panel] for Yellowtail Snapper with 95% asymptotic confidence intervals (vertical bars) from 1992 to 2017, with MSST, MFMT (solid grey lines) and* $SSB_{SPR30\%}$ *,* $F_{SPR40\%}$ *(dotted black lines) denoted.*

The assessment found that Yellowtail Snapper is not overfished nor undergoing overfishing (Figure 1,Table 1) and the spawning biomass (SSB) remains above the target SSB corresponding to 30% Spawning Potential Ratio (SPR) in 2017, where SPR is the ratio of SSB per recruit to its unfished state (SSB_0/R_0). The SSB generally increased during the period of 1996 through 2016 (Figure 1). Fishing mortality rates (F) rose above the maximum fishing mortality threshold (MFMT, fishing mortality rate producing 30% SPR) from 1993 through 1995, then declined considerably through 2001. Fishing mortality rates have remained between $F_{SPR30\%}$ and $F_{SPR40\%}$ rates since 2013 (Figure 1).

Table 1*: Summary of MSRA benchmarks and reference points for SEDAR 64. F is the age-4 instantaneous fishing mortality rate.*

Reference Point Criteria		**Current Benchmarks**	
Base M	0.223	$SSB_{Current}$ (Geometric mean: 2015-2017)	3,223 mt
Steepness	0.808	$F_{Current}$ (Geometric mean: 2015-2017)	0.295
SSB_0 (Unfished)	7,446 mt	$SSB_{Current}$ / $SSB_{SPR30\%}$	1.69
$SSB_{MSY\text{-}proxy} = SSB_{SPR30\%}$	1,904 mt	$SSB_{Current}$ / MSST	2.26
$MSST = 0.75 * SSB_{SPR30\%}$	1,428 mt	--MSST Overfished?	No
F_{MSY}	Not Estimable	$F_{Current}$ / MFMT	0.67
MFMT = $F_{SPR30\%}$	0.438	--Overfishing?	No
$F_{SPR40\%}$	0.271		
Yield @ $F_{SPR40\%}$	1,497 mt		

Scientific and Statistical Committee (SSC) Recommendations

Socioeconomic and Ecosystem Considerations

No attempt was made to investigate episodic types of natural mortality (M; red tides, cold kills, oil spills, etc.) because there were no data on which to base modifications to M. 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 with water temperatures of perhaps 15ºC or lower may occur once or twice a decade in Florida. An extreme cold event during the winter of 2010 caused massive mortality of patch reefs in the Florida Keys which most likely impacted Yellowtail Snapper habitat. Although subtropical fish species in various regions of Florida were affected by this event, there were no specific reports on Yellowtail Snapper mortalities.

The Gulf of Mexico Fishery Management Council (GMFMC) created a tool called "Something's Fishy" to facilitate input from stakeholders into the stock assessment process. This tool queries stakeholders about a particular species ahead of its assessment through the SEDAR process and was made available to stakeholders for one month prior to the 2019 Data Workshop for SEDAR 64. A total of 364 responses were received after soliciting input via GMFMC press release, Facebook, and agency networking.

Over 98% of Gulf region respondents (n=314) were from or fished off Florida. A similar trend was observed for respondents in the South Atlantic region (n=50). Stakeholder responses to the tool were analyzed manually, and automatically using R to a lexicon library, which analyzed responses at both the comment level and word level to determine positive or negative connotations. This sentiment analysis identified individual words and determined their contribution to a stakeholder comment's connotation of either positive or negative stock condition. Independent reader verification was used to identify emergent themes from the input collected from stakeholders. These themes were varied and often contradictory; however, the stock was perceived to be healthy by 60% of South Atlantic region respondents (n=30) and 83% of Gulf region respondents (n=258). Further, respondents noted changes in abundance and distribution in the species following Hurricane Irma (September 2017), and noted that depredation was an ever-present concern for discarded fish. Lastly, larger fish were observed more frequently in deeper waters compared to smaller fish, most of which were observed in shallower waters.

Projections

Deterministic projections were conducted to estimate Yellowtail Snapper spawning stock biomass for years 2018 – 2037 and landings for years 2021 – 2037. The method used for projecting the assessment results was developed in the R statistical computing environment by assessment scientists at the NOAA Southeast Fishery Science Center (SEFSC). This projection method provided several benefits. First, an iterative process was used to set fishing mortality rates each year and annual fishing mortality rates for each fleet were scaled in order to match the yield associated with a particular projection scenario. Second, values corresponding to fleet-specific landings (either in metric tons or numbers) were incorporated for interim years 2018 – 2020. Lastly, fleet allocations can be specified and kept constant for all years. Due to a bug in Stock Synthesis (SS) v.3.30.14 which did not allow fishing mortality rates to be specified in the forecast file, the SEDAR 64 Base Model needed to be re-run in SS v.3.30.13 for compatibility with the projection R code. Differences in Base Model output between the two version runs were observed to be negligible.

Projections were performed under several assumed conditions. Landings data for the recreational (in numbers) and commercial (in metric tons) fleets for interim years 2018 – 2019 were supplied by data providers and were therefore used as input values. Landings for 2020 were unavailable and therefore assumed to be equal to the average of 2017 – 2019 landings. Recruitment was projected beginning in 2018 by using the stock-recruitment parameters as estimated by the SEDAR 64 Base Model re-run in SS v.3.30.13 and the average recruitment estimated for years 2015 – 2017 (17.969 million fish). Average estimated recruitment for these years was similar to the average estimated recruitment for the assessment timeseries 1992 – 2017 (17.881 million fish). While fleet allocations are not currently specified, projections maintained the average fleet allocations as estimated within the SEDAR 64 Base Model for years 2015 – 2017 (i.e. 56% commercial, 4% headboat, and 40% recreational).

Several projection scenarios were used to explore the effect of various fishing mortality conditions and are ordered by decreasing fishing mortality rate when moving from scenario one to scenario five. The first scenario held fishing mortality rates at $F_{30\%SPR}$ (MFMT), the second scenario used the derived P* value (P* = 0.375), the third explored if fishing mortality rates were 75% of $F_{30\%SPR}$, the fourth scenario held fishing mortality rates at $F_{current}$ (i.e. the geometric mean fishing mortality rate for years 2015 – 2017), and the fifth scenario used the fishing mortality rate at $F_{40\%SPR}$ (defined as F_{OY} in the previous assessment). The P* scenario is the value associated with the 37.5th quantile of the OFL distribution; due to the narrowness of this distribution (the coefficient of variation is 0.09), this equates to 97.5% of the OFL.

Retained yield and spawning stock biomass as estimated from the SEDAR 64 Base Model for assessment years (1992 – 2017), interim years (2018 – 2020), and the forecasted years (2021 – 2037) are shown in Figures 2 and 3, respectively.

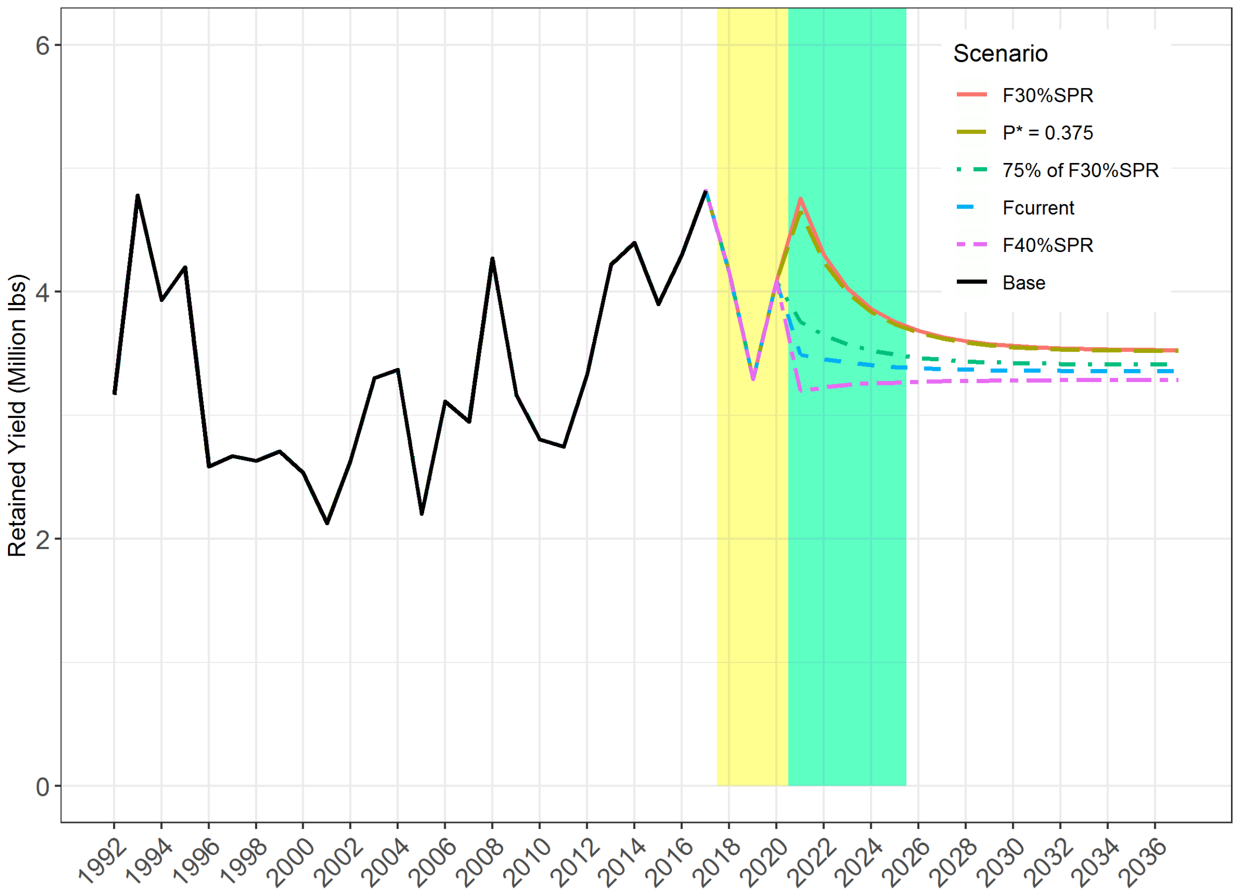

Figure 2. *Retained Yield for projections with fishing at* $F_{SPR30\%}$ *(red line), fishing at a level that corresponds to a P* value of 0.375 (golden line), fishing at 75% of* $F_{SPR30\%}$ *(green dot-dashed line), fishing at* $F_{current}$ *(geometric mean of years 2015 – 2017; blue dashed line), and fishing at* $F_{SPR40\%}$ *(purple line-dashed line). The black solid line is the S64 Base Model run, the yellow region identifies the interim years (2018 - 2020), and the green region highlights the first five years of the projection (2021 – 2025).*

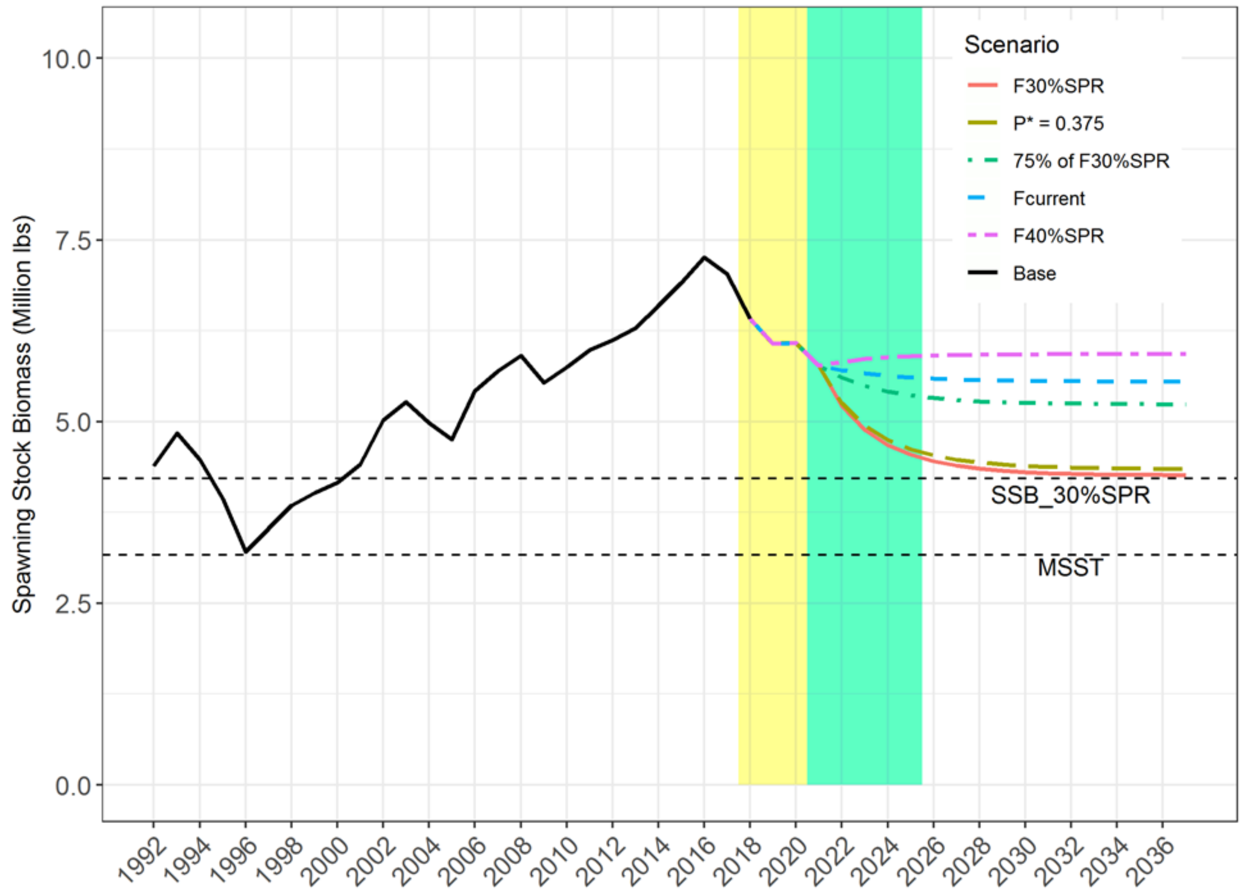

Figure 3. *Spawning Stock Biomass for projections with fishing at* $F_{SPR30\%}$ *(red line), fishing at a level that corresponds to a P* value of 0.375 (golden line), fishing at 75% of* $F_{SPR30\%}$ *(green dot-dashed line), fishing at Fcurrent (geometric mean of years 2015 – 2017; blue dashed line), and fishing at* $F_{SPR40\%}$ *(purple line-dashed line). The black solid line is the S64 Base Model run, the yellow region identifies the interim years (2018 - 2020), and the green region highlights the first five years of the projection (2021 – 2025).*

Data and Assessment

The base model for the SEDAR 64 southeastern U.S. Yellowtail Snapper stock assessment ("Base Model") was developed in Stock Synthesis version 3.30.14. The Base Model was of moderate complexity comprising three fishing fleets (including landings, discards, landings-at-length and -age compositions, and discards-at-length compositions where available), two fishery-independent indices of relative abundance (including length compositions), two fishery-dependent indices of relative abundance or biomass (including length compositions) and fishery-independent age composition data that were not associated with any fleet or survey. All indices of relative abundance or biomass showed increasing trends over the past decade (Figure 4).

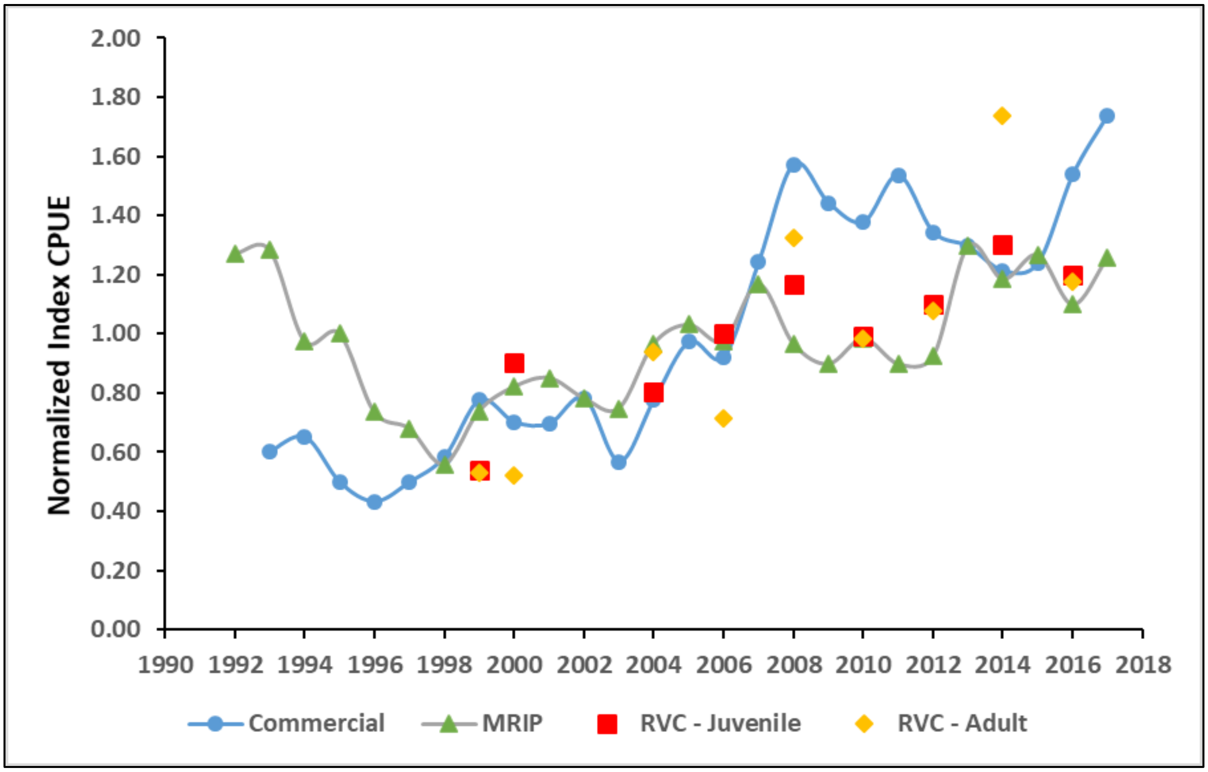

Figure 4. *Yellowtail Snapper index estimates normalized by the mean by fishery and survey from 1992 – 2017 from the SEDAR 64 assessment.*

Life history equations and parameters used in the Base Model are reported in Table 2. A fixed length-weight relationship was used to convert body length (cm) to body weight (kg). Length-at-age was estimated within the assessment model using the von Bertalanffy (VB) growth model, which was initialized using an externally modeled, size-truncated VB growth curve (Diaz et al. 2004). An age-specific vector of M (Lorenzen 2005) was fixed within the assessment model and derived using a target M of 0.223 yr^{-1} determined from the Hoenig's (1983) all taxa regression using a maximum age of 20 years, and the externally derived VB growth parameters. A fixed age-based maturity vector was used as developed externally from a logistic regression on available female Yellowtail Snapper histological data. The Base Model was configured as a single gender model where the spawning biomass would be multiplied by a 50% fraction female. The SSB was defined as the amount of mature female biomass and fecundity was configured as linear eggs/kg on body weight and parameterized such that the number of eggs was equivalent to spawning biomass. The Beverton-Holt stock-recruitment model was used and all three parameters (steepness, ln(R0), and sigmaR) were estimated.

Table 2. *Overview of life history equations and parameters used in SEDAR 64. All lengths and weights were reported in fork length (FL) and total weight (kg), respectively.*

Definition	Equation	Parameters
Fork length to Total $length_{max}$	$TL_{max} = a + b * FL$	a= -16.414 mm , b= 1.297
Length to Weight[1]	$W(t) = a * L(t)^b$	a= 2.574E-05 $kg*cm^{-b}$, b= 2.8797

Definition	Equation	Parameters
Age to Length[2]	$L(t)=L_{inf}*(1-e^{-k(t-t0)})$	L_{inf}= 36.23 cm, k= 0.342 yr^{-1}, t_0= -1.636 yr
Base M[1]	$M=\exp(1.44 – 0.982 * \ln(t_{max}))$	t_{max}= 20 yr , M= 0.223 yr^{-1}
Maturity[1]	$y=1 / (1+(\exp(-R* (x-A_{50}))))$	A_{50}= 1.704 yr , R= 2.706
Fecundity[1]	eggs = a + b * wt	a= 0 , b= 1
Recruitment[2]	$R_{yr}=[4hR_0SSB_{yr}]*[SSB_0(1-h)+SSB_{yr}(5h-1)]^{-1}$	h= 0.807, R_0= 19.5 million recruits, sigmaR= 0.25

[1] Parameters were fixed within the Base Model
[2] Parameter estimates from the Base Model

The Base Model was initially developed with a proposed starting year of 1981 following the precedent set in SEDAR 3 and SEDAR 27A. However, the reliability and accuracy of the recreational data for the 1980s (see Section 4.3 of the Data Workshop Report) was questioned in detail by members of the Data and Assessment Workshop panels. The start year 1992 was selected as it began the more data-rich period where available age composition data for the different fleets became more consistent, as well as when some indices of abundance first became available. [See Sections 3.2.6.9 and 3.3.10.7 of the full SEDAR 64 assessment report for more discussion.]

Recruitment

The plot of the stock-recruitment relationship estimated by the Base Model showed that for the time series modeled in this assessment, the stock has occupied a narrow range of spawning stock biomass relative to the origin and the theoretical virgin level (Figure 5). Recruitment estimates increased in trend between 1992 – 2014 and exhibited nearly cyclic patterns with stronger year classes in 1991, 1996, 2000, 2004, 2008, and 2011 – 2014. From 2015 – 2017 recruitment decreased back to levels estimated prior to 2011 and flattened in trend (Figure 6). No clear patterns were evident within the main recruitment deviation estimates. Data prior to 1992 were used to inform early recruitment deviations which in turn were applied to the initial equilibrium age composition. Early recruitment estimates remained near the mean between 1981 – 1985 before decreasing through 1989 (Figure 6).

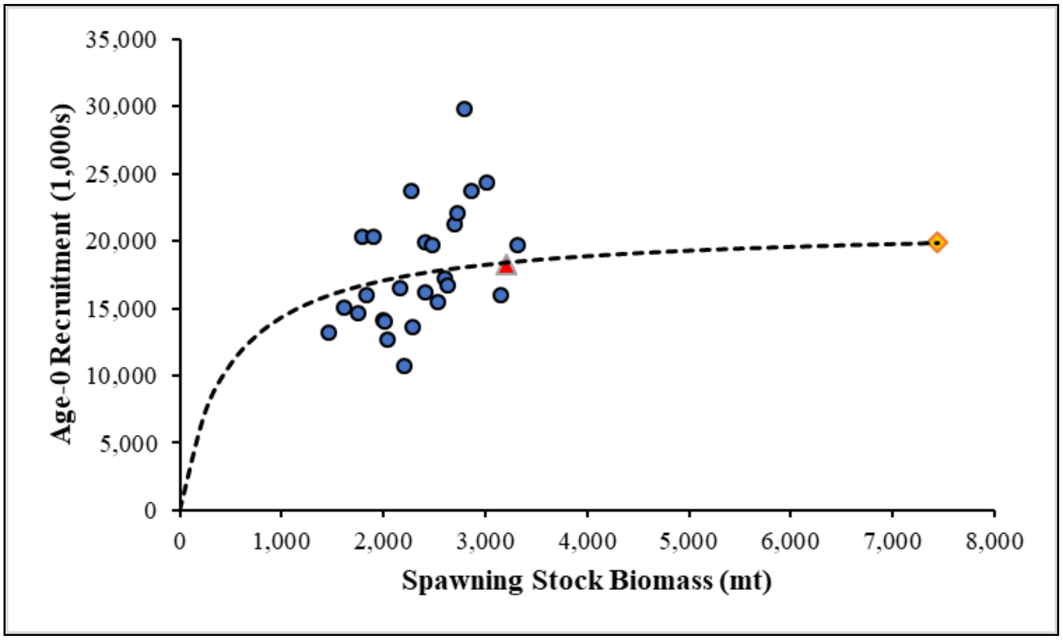

***Figure 5**. Predicted stock-recruitment relationship for southeastern U.S. Yellowtail Snapper. Plotted are the expected recruitment from the stock-recruitment relationship (black dashed line), the predicted annual recruitments from the Base Model (blue circles), the terminal year (2017) predicted annual recruitment (red triangle), and the predicted virgin recruitment (yellow diamond).*

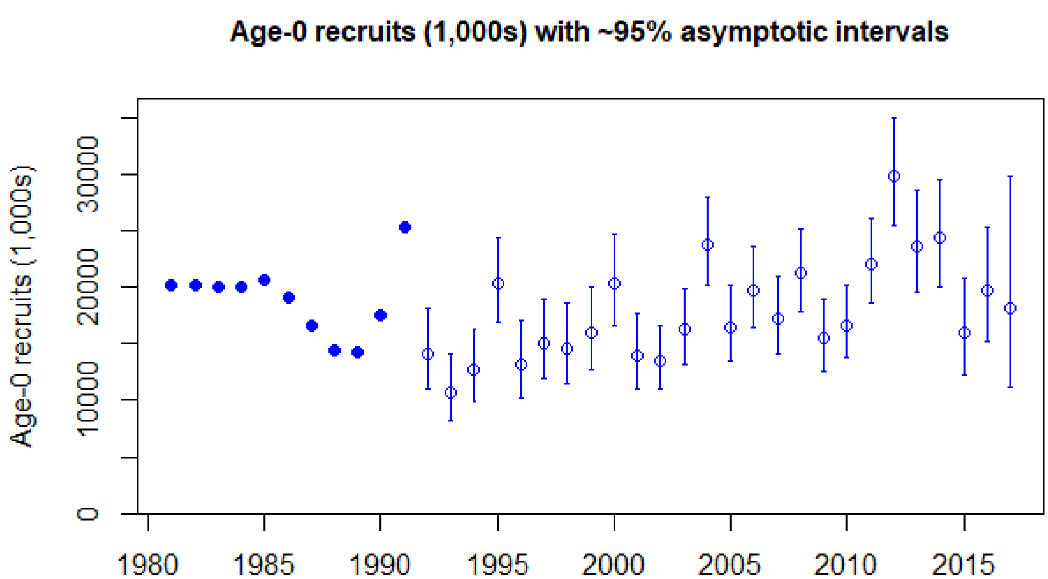

***Figure 6**. Estimated age-0 recruitment (values associated with early recruitment deviations shown in closed blue circles and main recruitment deviations shown in open blue circles) with 95% confidence intervals (blue lines) by the Base Model from 1981 – 2017.*

Landings

Commercial landings of U.S. South Atlantic and Gulf of Mexico (Gulf) Yellowtail Snapper were considered in the SEDAR 64 assessment from 1962 – 2017 and were obtained from Florida's Marine Fisheries Trip Tickets and NOAA Fisheries' Accumulated Landings System (ALS). Florida accounts for nearly all Yellowtail Snapper harvest from Gulf and South Atlantic waters, and nearly 90% of Yellowtail Snapper landings in Florida have occurred in Monroe County (Florida Keys) since 1962. In the assessment, commercial landings were restricted spatially to Florida waters and were predominantly from hook-and-line gear. Estimates of Yellowtail Snapper commercial landings averaged 1.774 million pounds (mp) whole weight (ww) from 1992 to 2017, with a low of 0.978 mp ww in 2007, and a peak of 2.820 mp ww in 2017 (Table A1, Figure 7). [See Table 3.2 of the full SEDAR 64 assessment report for commercial landings in mp and Table 2.9.8 for the landings in metric tons, as used in the assessment.]

Estimates of headboat landings of Yellowtail Snapper from 1981 – 2017 from the U.S. South Atlantic and from 1986 – 2017 from the Gulf were obtained from the Southeast Region Headboat Survey (SRHS). From 1981 – 1985, headboat landings for the Gulf were initially reported by the Marine Recreational Fishery Statistics Survey (MRFSS; later, the Marine Recreational Information Program, or MRIP) and were therefore added after separating headboat from the other modes. Headboat landings for Yellowtail Snapper comprise a small portion (<10%) of the total recreational landings. The headboat fishery was isolated to avoid combining length and age information across all recreational modes. For the Base Model, Florida-exclusive headboat landings averaged 0.141 mp ww from 1992 to 2017, with a low of 0.080 mp ww in 2009 and a peak of 2.698 mp ww in 1993 (Figure 7, Table A1). [See Table 2.9.9 of the full SEDAR 64 assessment report for headboat landings in thousands of fish, as used in the assessment.]

Estimates of recreational landings of Yellowtail Snapper from 1981 – 2017 from the U.S. South Atlantic and Gulf for three recreational fishing modes (shore-based fishing, private and rental boat fishing, and for-hire charter and guide fishing) came from MRIP. Catch data were collected through dockside angler interviews in the Access Point Angler Intercept Survey (APAIS). Catch rates from dockside intercept surveys were then combined with estimates of effort initially from telephone interviews (Coastal Household Telephone Survey; CHTS) and later from a mail survey (Fishing Effort Survey; FES) to estimate landings and discards by coast (Atlantic or Gulf), year, two-month wave, fishing mode, and area fished (inland, state, and federal waters). On the Atlantic coast, charterboat effort data collection changed in 2004 from the CHTS to the For-Hire Survey (FHS) and in 2000 on the Gulf coast. In 2013, MRIP implemented APAIS to help remove sampling bias and in 2015, FES was launched to improve private boat and shore effort estimates. Calibrated APAIS and FES catch estimates (A + B1) for Yellowtail Snapper in Florida waters averaged 1.380 mp ww from 1992 to 2017, with a low of 0.600 mp ww in 2001 and a peak of 2.698 mp ww in 2008 (Figure 7, Table A1). [See Table 2.9.10 of the full SEDAR 64 assessment report for MRIP landings in thousands of fish, as used in the assessment.]

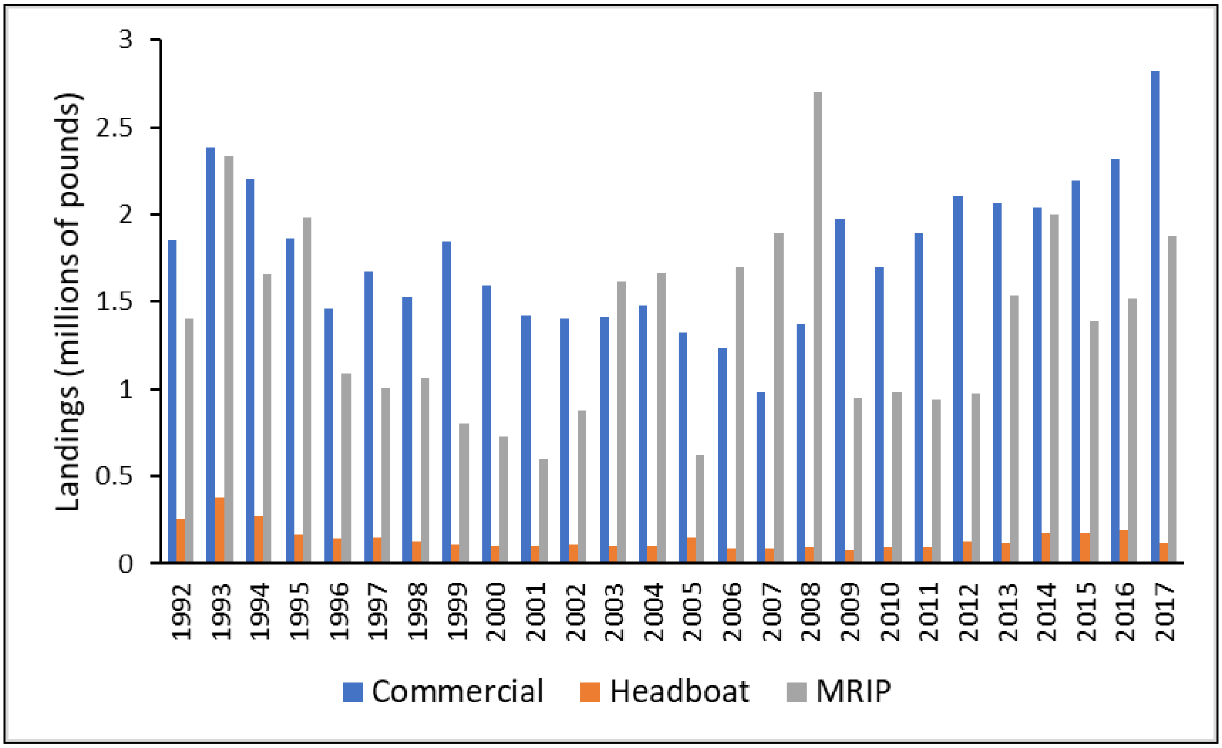

Figure 7. *Final Yellowtail Snapper landings estimates for commercial and recreational fisheries (in millions of pounds) for 1992 – 2017 from the SEDAR 64 assessment.*

Discards

For the Base Model, discard mortality rates were treated as fixed inputs equal to the values recommended by the Data Workshop panel: 10% discard mortality rate for the commercial, headboat, and MRIP fleets. Sensitivity runs were also performed using a 15% discard mortality rate for the commercial fleet and then a 20% and 30% discard mortality rate for the recreational (headboat and MRIP) fleets.

Commercial discard data came from the Southeast Fisheries Science Center coastal fisheries discard logbook program (CFLP) for vertical line trips in southern Florida beginning in 2002. Yearly total effort (hook hours) of all trips by vertical line vessels was multiplied by the yearly mean discard rate to calculate total discards of Yellowtail Snapper by vertical line vessels. To estimate the commercial discards for years 1993 – 2001, when only effort data were available, the mean discard rate for the years 2002 – 2006 was multiplied by annual effort. Commercial vertical line fleet discards averaged 74,763 fish from 1993 – 2017, with a low of 23,527 fish in 2015 and a peak of 139,401 fish in 1997 (Figure 8).

Headboat discards were obtained from the SRHS logbook data from 2004 – 2017. Yellowtail Snapper discards from headboats for years prior to 2004 in Florida were estimated using the MRIP Charter:SRHS discard ratio as a proxy. Headboat fleet discards averaged 47,745 fish from 1992 – 2017, with a low of 15,812 fish in 2005 and a peak of 88,120 fish in 1997 (Figure 8).

Discarded live fish from the MRIP fleet were compiled from the shore, private, and charter modes for years 1981 – 2017. Mode-specific discards are based on dockside interviews (intercepts) of anglers and represent the self-reported number of fish discarded alive. MRIP fleet discards were the highest of all the fleets and averaged 2.609 million fish from 1992 – 2017, with a low of 1.100 million fish in 2001 and a peak of 4.887 million fish in 2013 (Figure 8).

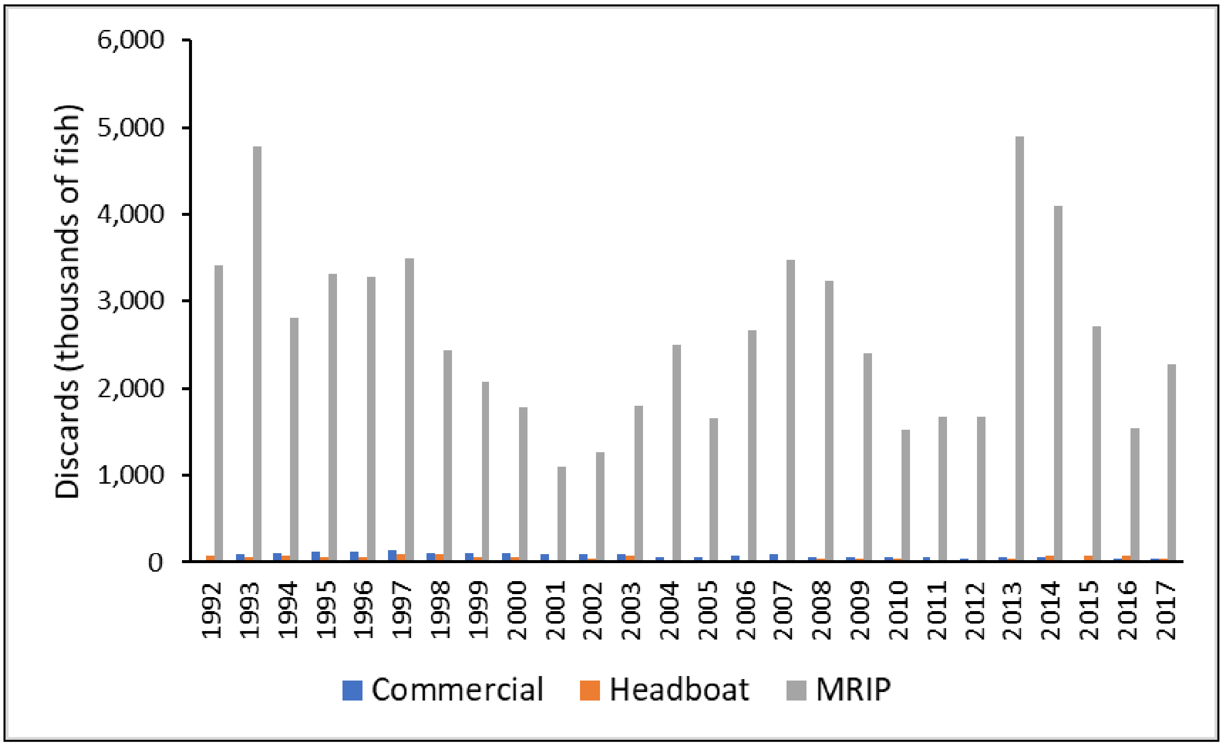

Figure 8. *Final Yellowtail Snapper discard estimates for commercial and recreational fisheries (in thousands of fish) for 1992 – 2017 from the SEDAR 64 assessment.*

The full SEDAR 64 southeastern U.S Yellowtail Snapper stock assessment report can be found at *http://sedarweb.org/docs/sar/S64_SAR_FINAL.pdf*

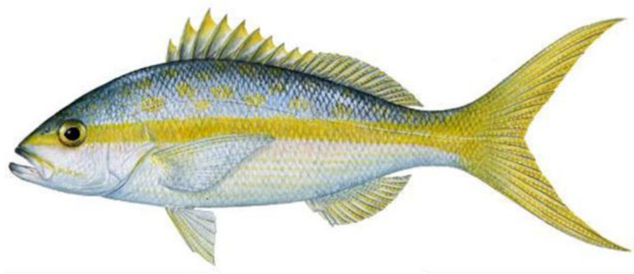

Table A1. *Yellowtail Snapper landings in pounds provided for the Commercial, Headboat, and MRIP fleets, and Total landings from 1992 – 2017. MRIP data used FES-calibrated landings and effort data.*

Year	Commercial	Headboat	MRIP	Total
1992	1,851,510	258,950	1,400,647	3,511,107
1993	2,378,730	378,807	2,334,717	5,092,255
1994	2,205,503	269,870	1,656,934	4,132,307
1995	1,856,788	163,936	1,980,260	4,000,983
1996	1,459,095	140,935	1,087,893	2,687,924
1997	1,673,903	149,911	1,008,943	2,832,757
1998	1,524,429	122,895	1,061,541	2,708,865
1999	1,846,140	105,929	804,271	2,756,340
2000	1,591,718	97,521	729,810	2,419,049
2001	1,420,136	99,547	600,318	2,120,001
2002	1,407,534	110,936	870,838	2,389,307
2003	1,410,003	97,199	1,615,512	3,122,714
2004	1,479,937	104,071	1,668,828	3,252,836
2005	1,324,545	148,936	622,470	2,095,950
2006	1,236,880	85,399	1,701,112	3,023,391
2007	977,964	84,753	1,889,692	2,952,410
2008	1,369,997	94,070	2,697,920	4,161,987
2009	1,975,095	80,118	949,370	3,004,583
2010	1,693,951	89,739	978,430	2,762,119
2011	1,893,542	92,552	943,810	2,929,903
2012	2,107,288	121,417	972,774	3,201,479
2013	2,061,140	114,676	1,532,100	3,707,916
2014	2,043,257	177,331	1,998,309	4,218,897
2015	2,197,951	177,597	1,391,931	3,767,479
2016	2,314,902	188,058	1,522,151	4,025,111
2017	2,820,423	117,929	1,880,002	4,818,354