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Introduction

In August 2001, the Southeast Fisheries Science Center (SEFSC) initiated a program to collect commercial fishing vessel discard data from Gulf of Mexico and South Atlantic fisheries. A reporting form was developed that supplements the existing vessel coastal logbook forms that are currently mandatory for those fisheries (Poffenberger and McCarthy, 2004). Discard data from the SEFSC coastal fisheries discard logbook program were used to calculate the number of yellowtail snapper discards from commercial vertical line (handline and electric/hydraulic reel, aka bandit rig) vessels. Approximately 99.1 percent of reported yellowtail snapper discards were from vertical line vessels, therefore, only data from vertical line vessels were included in the analysis.

Data collection for the discard logbook program involves, each year, a 20% random sample of vessels with Gulf of Mexico reef fish, South Atlantic snapper-grouper, king mackerel, Spanish mackerel, dolphin/wahoo, and shark permits selected to report the number of animals discarded by species. To assure that the sample was representative of vessels with those Federal permits fishing in the Gulf of Mexico and South Atlantic, the universe of permitted vessels was stratified by region (Gulf of Mexico and South Atlantic) and gear fished. Fishing gear strata included handline, bandit rig, trolling, longline, fish trap, gillnet, and diving. A random sample was selected, without replacement, from each stratum. The selected fishers were instructed to complete a supplemental discard form for every fishing trip that they made. Trips with no discards were reported as such.

Reported data included the numbers of discards by species, estimated condition of the fish when released, reason for release (due to regulations or unmarketable/unwanted), and the fishing area where the animal was discarded. There are six options for the condition of released fish: all animals are dead, majority of the animals are dead, all animals are alive when released, majority of animals are alive, the fish are kept but not sold, and the condition of the animals is unknown. To calculate species specific discard rates, discard data were matched to the landings and effort data reported (for the appropriate trip) to the coastal logbook program.

Methods

Two approaches were used to calculate yellowtail snapper discards from the commercial handline fishery. The first technique (the 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 (the standard method) calculated discard rates directly from the discard logbook data. Both methods also used total effort of the vertical line fishery as reported to the coastal logbook program to calculate total discards of yellowtail snapper.

SEDAR 27 (continuity) method

The objective of this analysis was to calculate the numbers of yellowtail snapper discarded by commercial vessels that fished for species other than shrimp or other shellfish. The data set included all commercial vertical line fishing trips from federally permitted vessels that reported discards between January 1, 2002

and December 31, 2018, in southern Florida (statistical areas 1-4, 2479-2482, 2579-2580, 2679-2680, and 2779-2780; Figure 1). Reports of yellowtail snapper discards from vessels fishing other gears included less than one percent of all trips reporting yellowtail snapper discards during the period 2002-2018. The available data for those gears were too few for discards to be calculated.

Commercial discards may be under reported. If selected, fishers are required to report to the discard logbook program in order to renew their federal fishing permits. Fishers remain in reporting compliance by returning discard logbooks with reports of "no discards". The percentage of discard reports returned with "no discards" has increased from 49 to 79 percent in southern Florida. Commercial vertical line trips that had fishery observers onboard, however, report less than 10 percent of trips had no discards.

The large discrepancy between observer reports of "no discards" and self-reported "no discards" suggests that under reporting on discard logbooks may be occurring. To reduce the likelihood of using discard rates that were erroneously low, the data set was filtered to remove records from vessels with more than 30 percent "no discards". Due to the low sample size of the observer data set within the region of interest, the frequency of "no discards" retain in the data set was increased from the observer reported 10 percent to 30 percent. In addition, observers reported vessels which had two trips with no discards. Given that vessels with few trips may have had multiple trips with no discards, the records from vessels that had reported six or fewer trips were retained in the data set.

Discard rate was defined for vertical line gear as number of yellowtail snapper discarded per hook hour fished. Six factors were considered as possible influences on yellowtail snapper discard rate. In order to develop a well balanced sample design it was necessary to define categories within some of the factors examined:

Factor	**Levels**	**Value**
Year	17	2002-2018
Region	3	Statistical areas 1-4 (gom), 2480-2482 (keys), 2479, 2579-2780 (sa) (Fig. 1)
Days at sea	2	1, 2+
Quarter	4	Jan-Mar, Apr-Jun, Jul-Sep, Oct-Dec
Crew	2	1, 2+ crew members
Hook hours fished[1]	4	0.1-10, >10-16, >16-36, >36

[1] Hook hours fished was examined in the vertical line binomial GLM only.

A delta-lognormal modeling technique (Lo et al. 1992) was used to calculate yearly mean discard rate. This method combines separate general linear model (GLM) analyses of the proportion of trips that discarded yellowtail snapper and the discard rates on trips reporting yellowtail snapper discards to determine a single standardized discard rate. 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 the proportion of trips with discards, a type-3 model was fit, a binomial error distribution was assumed, and the logit link was selected. The response variable was the proportion of trips with yellowtail snapper discards. For the analysis of discard rates on trips with discards, a type-3 model assuming lognormal error distribution was examined. The linking function selected was "normal", and the response variable was log(discards per unit effort, DPUE). The response variable was calculated as: log(DPUE)=ln(pounds of yellowtail snapper/hook hour fished). All 2-way interactions among significant main effects were examined. Higher order interaction terms were not examined.

Final models for the delta-lognormal analysis were constructed using a forward stepwise regression procedure to determine the set of fixed factors and interaction terms that explained a significant portion of the observed variability in discard rate. Each potential factor was added to the null model sequentially and the resulting reduction in deviance per degree of freedom was examined. The factor that caused the greatest reduction in deviance per degree of freedom was added to the base model if the factor was significant based upon a Chi-Square test ($p<0.05$), and the reduction in deviance per degree of freedom was $\geq 1\%$. This model then became the base model, and the process was repeated, adding factors and interactions individually until no factor or interaction met the criteria for incorporation into the final model.

Once a set of fixed factors was identified, the influence of the YEAR*FACTOR interactions 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 model, fit using the SAS macro GLIMMIX (Russ Wolfinger, SAS Institute), were used to calculate discard rates for the years 2002-2018. Discard rate for the period 1993-2001 (prior to discard reporting) was assumed to be the mean discard rate over the years 2002-2018, weighted by sample size. Calculated discard rates were used along with the appropriate yearly total effort reported to the coastal logbook program as ratio estimators of yearly total discards. Discards were reported in numbers of yellowtail snapper.

SEDAR 32 (standard) method

The number of yellowtail snapper discarded from commercial fishing vessels was also calculated using methods developed during SEDAR 32. Those methods have become the standard approach for commercial fishery discard calculation in cases where observer reported data are insufficient for discard calculation. The available data set for commercial discard calculation included all trips from vessels that reported discards between January 1, 2002 and December 31, 2018 in southern Florida. During that period, discard forms were submitted for 89,212 trips. Of those trips, discards were reported on 24,257 trips and 64,955 trips reported no animals were discarded. Discards of yellowtail snapper were reported on 7,032 trips or 7.9% of the submitted discard logbooks. By way of comparison, there were 378,605 trips reported to the coastal logbook program by vessels that have been issued a Federal permit to fish in Southern Florida during 2002-2018. Yellowtail snapper landings were reported for 90,186 trips or about 23.8% of all trips.

Only vertical line (handline and electric/hydraulic reels) reported yellowtail snapper discards on more than a few trips (Table 1a). The numbers of yellowtail snapper reported as discarded by year and gear type are presented in Table 1b. Vertical line trips accounted for the greatest number of trips reporting yellowtail snapper landings in Southern Florida (Table 1c) and the highest landings of the species (Table 1d). Yellowtail snapper discard calculation was limited to data reported from vertical line trips.

Data filtering followed the methods recommended during SEDARs 32 and 41 (McCarthy, 2013 and 2014). Data were filtered to exclude trips landing only mackerel because it was generally believed by the SEDAR 32 and 41 panels 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 in this analysis following the recommendation of SEDARs 32 and 41. Fishers remain in reporting compliance by returning discard logbooks with reports of "no discards". 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. During the SEDAR32 data workshop the issue of possible underreporting of commercial discards was discussed at length. The working group recommended that data be filtered to remove records from vessels that never reported discards of any species during a year. The SEDAR32 working group acknowledged that some Southern Florida commercial fishing trips may not have had discards of any species and discussed the likely maximum number of trips by a vessel without a report of discards. Following the SEDAR 32 and 41 commercial working groups' recommendations, data were excluded from vertical line vessels that reported more than 50, 18, or 3 (southeast Florida, Keys, and west Florida, respectively) trips without reporting discards of any species (the mean number of trips prior to the first trip with reported discards plus two standard deviations above that mean).

For SEDAR 64, data were stratified by region. Regions differed from those defined in SEDAR 27. The regions were defined for SEDAR 64 as (see Figure 1):

Southeast Florida = statistical areas 2580, 2680, 2780, 2579, 2679, 2779
Florida Keys = statistical areas 1, 2, 2479, 2480, 2481, 2482
West Florida = statistical areas 3-6

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 does not include effort from trips that landed only mackerel

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.

Results and Discussion

The number of trips, pounds landed, and number of discards reported from Southern Florida vertical line vessels for the years 2002-2018 are provided in Table 2. The number of trips, pounds landed, and number of fish discarded from vertical line vessels reporting yellowtail snapper landings or discards are also provided.

Continuity methods

The final models for the binomial on proportion of trips that reported yellowtail snapper discards and the lognormal on DPUE (discards per unit effort) of trips reporting discards were:

Proportion trips reporting discards = Region + Year

LOG(DPUE) = Seadays + Year + Crew + Region + Quarter + Year*Quarter + Crew*Year + Region*Year + Seadays*Year + Region*Seadays

Calculated yellowtail snapper discards, discard rates, discard rate coefficients of variation, and total effort (hook hours reported to the coastal logbook program) are provided in Table 3. Coefficients of variation for the years prior to 2002 were calculated by using the mean variance from the 2002-2018 discard rates, weighted by sample size.

During the period 2002-2018, discard rates were highest during 2006 and 2016. The highest proportion of trips with yellowtail snapper discards was reported during the period 2006-2008 (0.63-0.59). Lowest discard rates were found during 2004, 2015, and 2017. In addition to yearly variability in discard rate, yearly changes in total effort contributed to the variability in total discards across the years 2002-2018.

Total vertical line vessel yellowtail snapper discards were highest during the period 1993-2002. During that period, yearly total discards varied greatly. For example, total calculated discards in 1994 (highest total effort) were over two times that calculated for 2001 (lowest total effort). Variability in total discards calculated for the period (the years when a mean discard rate was used to calculate discards) was due to changes in total effort reported to the coastal logbook program. Due to the possible under reporting of discards to the coastal logbook discard program, these results may underestimate total yellowtail snapper discards from commercial vertical line vessels.

SEDAR 32 (standard) methods

Calculated total discards in numbers of yellowtail snapper for each year and region from vertical line vessels are provided by region in Tables 4-6. Calculated discards for each region were summed by year to provide yearly total yellowtail snapper vertical line vessel discards in Table 7. Discards are provided in pounds whole weight and in numbers of fish. Table 7 includes total discards and discards calculated using a 10% and 15% discard mortality rate. Those discard mortalities were recommended by the SEDAR 64 data workshop panel.

Less than 12% of yellowtail snapper were reported as dead or the majority of discarded fish were dead when released. Fishers reported that more than 76% of discarded yellowtail snapper were alive or that most of the released fish were alive for both gears. An additional 8.4% were reported as kept but not sold and were either consumed or used as bait. The primary reason reported for discarding yellowtail snapper was due to regulatory restrictions (not legal size, out of season, other regulations; 94% of discards). Market conditions were reported as the reason for discarding yellowtail snapper for fewer than two percent of discards.

Approximately 12% of vertical line trips reported yellowtail snapper discards in southern Florida. Yellowtail snapper accounted for 13.5% of the reported vertical line discarded fish in the region. Stratification of the available data was limited because of those small sample sizes and, therefore, likely does not capture much of the variation in numbers of discards within the yellowtail snapper vertical line fishery. How that may affect the number of calculated discards (over or under estimate) is unknown.

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Table 1a. Number of southern Florida trips reporting discards by year and gear fished.

Year	Diving		Gillnet		Vertical line		Longline		Other Gear		Trap		Trolling	
	other	yellowtail	other	yellowtail	other	yellowtail	other	yellowtail	other	yellowtail	other	yellowtail	other	yellowtail
2002	27		Conf		1,156	307	123		27		22		491	Conf
2003	89		Conf		1,858	533	153		103		33	Conf	704	
2004	121	Conf			1,668	253	147		70		21		506	Conf
2005	73		15		1,468	384	95		74		27	Conf	295	Conf
2006	54				1,156	239	95		Conf		22		411	
2007	80				2,485	551	165		141		9		885	Conf
2008	174	Conf	53		4,251	671	151		85				2,093	Conf
2009	114	Conf	17		2,464	444	112		65				1,349	Conf
2010	153		28		3,865	463	220		250				2,451	
2011	176		26		4,547	578	302		178				2,286	Conf
2012	164		70		4,057	489	191		145				1,598	
2013	222		92		4,553	492	202		112		Conf		1,086	Conf
2014	343	Conf	137		4,209	385	235		65		Conf		1,331	
2015	349	Conf	101		4,281	372	255		52		Conf		1,417	
2016	212		41		4,876	424	187		117				1,792	
2017	259		26		4,029	283	187		202	Conf			2,276	
2018	144	Conf	54		3,426	164	212		132				1,540	
Total	**2,754**	**Conf**	**660**		**54,349**	**7,032**	**3,032**		**1,818**	**Conf**	**134**	**Conf**	**22,511**	**Conf**

Conf = confidential data (fewer than three vessels reporting within a cell).

Table 1b. Number of southern Florida discards (number of fish) reported by year and gear fished.

Year	Diving		Gillnet		Vertical line		Longline		Other Gear		Trap		Trolling	
	other	yellowtail	other	yellowtail	other	yellowtail	other	yellowtail	other	yellowtail	other	yellowtail	other	yellowtail
2002	299		Conf		23,140	3,211	19,338				4,967		299	Conf
2003	1,210		Conf		50,588	5,623	17,851		160		76,839	Conf	539	
2004	565	Conf			25,466	2,061	43,574		117		16,990		668	Conf
2005	426		308		22,383	3,264	12,040		123		3,644	Conf	222	Conf
2006	584				17,645	2,831	22,682		Conf		3,715		383	
2007	234				28,964	6,158	44,759		6		53		1,185	Conf
2008	409	Conf	81		39,117	9,029	13,733		68				1,772	Conf
2009	563	Conf			32,725	4,768	13,722		1,371				1,302	Conf
2010	507		88		35,137	5,262	26,409		10,292				1,415	
2011	268				35,244	6,759	99,204		0				1,074	Conf
2012	257		7,496		39,091	6,733	61,293		718				1,041	
2013	447		1,325		29,883	6,714	64,201		5		Conf		675	Conf
2014	860	Conf	1,014		19,032	4,997	50,031		64		Conf		879	
2015	407	Conf	985		29,074	3,978	56,070		167		Conf		1,204	
2016	627		287		32,379	5,899	40,681		296				1,681	
2017	159		38		47,786	3,454	47,557		182	Conf			1,059	
2018	68	Conf	8		25,825	2,536	79,149		125				1,626	
Total	**7,890**	**Conf**	**11,630**		**533,479**	**83,277**	**712,294**		**13,694**	**Conf**	**106,208**	**Conf**	**17,024**	**Conf**

Conf = confidential data (fewer than three vessels reporting within a cell).

Table 1c. Southern Florida trips reported to the coastal logbook program. Total trips may not match those reported in the text due to double counting trips (yellowtail snapper and other species may have been reported on the same trip and that trip would have been included in both "other" and "yellowtail" totals).

Year	Diving		Gillnet		Vertical line		Longline		Other Gear		Trap		Trolling	
	other	yellowtail	other	yellowtail	other	yellowtail	other	yellowtail	other	yellowtail	other	yellowtail	other	yellowtail
2002	1,113	54	503		14,541	7,029	1,646	22	655	10	390	10	5,842	61
2003	917	30	351		15,793	7,193	1,799	28	799	6	332	7	6,468	44
2004	930	19	277		14,763	6,478	1,686	23	816	Conf	283	4	4,969	64
2005	809	31	386		12,313	5,788	1,528	28	875	Conf	221	Conf	4,076	43
2006	658	22	493		12,809	5,376	1,734	42	865	3	265	14	4,312	18
2007	789	19	387		12,118	5,039	1,363	31	834	Conf	18		5,074	23
2008	740	20	312		12,378	5,074	1,235	27	439	Conf	Conf		5,385	16
2009	699	19	242		14,260	5,411	875	10	473	Conf	Conf		6,075	36
2010	663	11	216		12,874	4,375	672	13	927	3	Conf		5,613	40
2011	854	10	239		13,306	4,661	874	20	747	10	Conf		4,833	25
2012	855	20	312		12,414	4,668	932	19	620	20	Conf		3,662	26
2013	882	32	447		11,656	4,247	797	23	455	21	Conf		2,983	34
2014	1,004	28	370		13,409	4,893	829	37	507	28	Conf		3,241	7
2015	1,007	32	439		12,243	4,479	743	67	420	30	Conf		3,524	7
2016	826	33	266		12,143	5,150	868	81	500	21	5		3,923	8
2017	740	38	139		11,929	4,603	843	102	571	19			4,736	10
2018	644	23	192		11,007	3,914	695	112	463	8			4,189	6
Total	**14,130**	**441**	**5,571**		**219,956**	**88,378**	**19,119**	**685**	**10,966**	**179**	**1,514**	**35**	**78,905**	**468**

Conf = confidential data (fewer than three vessels reporting within a cell).

Table 1d. Southern Florida landings (pounds) reported to the coastal logbook program

Year	Diving		Gillnet		Vertical line		Longline		Other Gear		Trap		Trolling	
	other	yellowtail	other	yellowtail	other	yellowtail	other	yellowtail	other	yellowtail	other	yellowtail	other	yellowtail
2002	241,701	744	867,405		5,101,491	1,365,579	7,024,977	250	511,476	64	1,168,799	411	1,158,909	4,384
2003	211,142	241	1,502,806		5,102,147	1,331,271	7,745,505	868	770,054	45	935,534	113	1,430,332	1,909
2004	206,049	373	903,478		5,574,220	1,330,037	7,853,954	209	741,009	Conf	982,798	109	1,164,868	8,114
2005	202,308	147	1,595,847		5,081,567	1,179,396	6,578,940	691	707,620	Conf	713,935	Conf	1,006,000	8,555
2006	159,796	290	1,447,102		5,072,310	1,127,249	6,794,661	1,048	686,954	24	755,586	88	1,179,401	3,191
2007	168,401	218	1,213,655		4,610,998	911,394	4,769,336	427	570,779	Conf	39,580		1,400,909	325
2008	191,379	221	1,039,587		4,919,725	1,247,648	4,919,558	140	336,651	Conf	Conf		1,500,752	167
2009	198,400	443	1,671,240		6,276,561	1,783,624	3,051,464	101	447,605	Conf	Conf		1,631,245	1,087
2010	225,232	108	892,500		5,843,624	1,472,057	2,627,489	51	1,225,514	40	Conf		1,803,260	2,106
2011	241,431	510	862,006		5,955,588	1,651,701	4,605,665	110	699,876	222	Conf		1,454,718	790
2012	233,644	461	833,100		5,909,788	1,787,445	4,522,970	89	515,888	1,046	Conf		1,048,390	2,047
2013	213,595	865	854,781		5,118,535	1,737,603	4,711,927	131	265,811	380	Conf		874,448	1,924
2014	334,963	467	887,597		6,271,152	1,762,104	5,843,304	399	497,891	459	Conf		949,230	1,159
2015	286,690	776	955,066		5,744,661	1,822,231	4,687,301	450	290,299	254	Conf		876,457	452
2016	223,274	593	969,279		5,505,610	1,883,760	5,296,786	869	396,353	185	628		1,117,593	109
2017	230,373	668	686,761		5,274,958	2,117,839	4,007,076	720	409,415	79			1,390,996	143
2018	211,887	698	778,430		4,628,280	1,405,999	3,320,115	1,355	270,997	27			1,298,888	322
Total	**3,780,267**	**7,823**	**17,960,639**		**91,991,214**	**25,916,938**	**88,361,027**	**7,907**	**9,344,193**	**2,825**	**4,596,860**	**721**	**21,286,399**	**36,782**

Conf = confidential data (fewer than three vessels reporting within a cell).

Table 2. Southern Florida vertical line trips and landings from yellowtail snapper regions reported to the coastal logbook program during the years 2002-2018. Discards are reported in number of fish. Trips that reported fishing in more than one region are double counted. Totals may not match those in Tables 1a-1d due to double counting of trips reporting yellowtail snapper and other species or trips reporting only yellowtail snapper.

Region	All Vertical line Trips				Vertical line Trips with Yellowtail snapper			
	Logbook		Discards		Logbook		Discards	
	Trips	Pounds	Trips	N fish	Trips	Pounds	Trips	N fish
SE Florida	110,302	33,356,929	24,796	53,292	12,744	1,423,594	719	7,565
Keys	106,458	44,077,090	26,633	129,966	73,645	24,342,750	6,268	75,033
W Florida	37,232	40,474,133	6,949	433,498	1,997	151,645	45	679

Table 3. Calculated yearly total discards of yellowtail snapper from vertical line vessels using SEDAR 27 (continuity) methods. Discards are reported as number of fish.

Year	Trips (discards)	Trips (total effort)	Discard Rate	Discard Rate CV	Total Effort in Hook Hours	Calculated Discards
1993		11,529	0.19200407	0.52	744,952	143,034
1994		13,360	0.19200407	0.52	1,313,018	252,105
1995		13,706	0.19200407	0.52	831,195	159,593
1996		14,328	0.19200407	0.52	868,133	166,685
1997		16,215	0.19200407	0.52	1,020,653	195,969
1998		14,991	0.19200407	0.52	768,989	147,649
1999		14,943	0.19200407	0.52	867,850	166,631
2000		13,534	0.19200407	0.52	944,623	181,371
2001		14,220	0.19200407	0.52	644,888	123,821
2002	585	14,273	0.22643	0.48	696,344	157,673
2003	767	15,285	0.13983	0.47	550,403	76,963
2004	539	14,112	0.09274	0.50	487,630	45,223
2005	532	12,126	0.1418	0.48	420,438	59,618
2006	313	12,716	0.41372	0.51	448,275	185,460
2007	742	12,659	0.22605	0.45	407,073	92,019
2008	860	12,861	0.29527	0.43	396,890	117,190
2009	611	14,560	0.17236	0.47	504,375	86,934
2010	671	13,294	0.18557	0.47	447,373	83,019
2011	853	13,943	0.17162	0.46	451,087	77,415
2012	581	12,739	0.14225	0.50	448,473	63,795
2013	545	11,875	0.1679	0.50	429,640	72,137
2014	410	13,584	0.22114	0.49	561,940	124,267
2015	425	12,261	0.09905	0.52	589,288	58,369
2016	519	12,830	0.32941	0.51	597,284	196,751
2017	381	12,177	0.09113	0.58	482,152	43,938
2018	266	11,168	0.14333	0.65	461,730	66,180

Table 4. Calculated yearly total discards of yellowtail snapper from Florida Keys (area defined in text) vertical line vessels for each year using SEDAR 32 methods. Discards are reported as number of fish.

Year	Trips (discards)	Trips (total effort)	Discard Rate	Discard Rate CV	Total Effort in Hook Hours	Calculated Discards
1993	3,906	7,835	0.27502735	2.25	317,173	87,231
1994	3,906	8,696	0.27502735	2.25	357,590	98,347
1995	3,906	9,206	0.27502735	2.25	414,054	113,876
1996	3,906	9,253	0.27502735	2.25	403,792	111,054
1997	3,906	10,603	0.27502735	2.25	478,474	131,593
1998	3,906	8,737	0.27502735	2.25	330,884	91,002
1999	3,906	8,983	0.27502735	2.25	362,593	99,723
2000	3,906	8,168	0.27502735	2.25	354,032	97,369
2001	3,906	8,457	0.27502735	2.25	296,855	81,643
2002	671	8,009	0.261482521	1.84	282,727	73,928
2003	1,110	7,947	0.315200148	1.89	246,588	77,724
2004	655	7,302	0.207185995	2.50	229,000	47,445
2005	868	6,359	0.22222346	2.80	195,381	43,418
2006	602	5,903	0.36600183	2.31	193,964	70,991
2007	1,041	5,562	0.517079827	2.04	154,538	79,908
2008	1,306	5,785	0.313663079	2.33	148,880	46,698
2009	994	6,073	0.319082913	1.82	184,699	58,934
2010	1,074	5,322	0.32292749	2.76	151,428	48,900
2011	1,114	5,259	0.336127968	2.05	177,147	59,544
2012	1,562	5,249	0.186443524	2.90	198,969	37,096
2013	1,236	4,872	0.243112597	4.98	181,474	44,119
2014	1,068	5,545	0.30612723	3.51	189,570	58,033
2015	1,198	5,284	0.09189576	3.44	206,619	18,987
2016	1,329	5,584	0.23657269	2.29	188,053	44,488
2017	794	5,199	0.182811451	2.21	153,586	28,077
2018	674	4,614	0.14602306	3.30	144,825	21,148

Table 5. Calculated yearly total discards of yellowtail snapper from Southeast Florida (area defined in text) vertical line vessels for each year using SEDAR 32 methods. Discards are reported as number of fish.

Year	Trips (discards)	Trips (total effort)	Discard Rate	Discard Rate CV	Total Effort in Hook Hours	Calculated Discards
1993	985	2,678	0.066102102	3.75	70,535	4,662
1994	985	3,553	0.066102102	3.75	99,934	6,606
1995	985	3,352	0.066102102	3.75	105,041	6,943
1996	985	3,442	0.066102102	3.75	90,203	5,963
1997	985	4,037	0.066102102	3.75	118,117	7,808
1998	985	3,938	0.066102102	3.75	104,920	6,935
1999	985	3,415	0.066102102	3.75	85,567	5,656
2000	985	3,156	0.066102102	3.75	93,412	6,175
2001	985	3,352	0.066102102	3.75	89,289	5,902
2002	133	3,941	0.151787952	2.57	84,162	12,775
2003	280	4,350	0.044747926	4.21	91,458	4,093
2004	259	4,054	0.045475961	3.77	88,443	4,022
2005	206	3,576	0.069463708	3.95	78,377	5,444
2006	107	3,635	0.058930426	4.05	80,603	4,750
2007	595	4,232	0.046903428	5.18	86,746	4,069
2008	1,053	4,064	0.021592308	6.25	87,415	1,887
2009	559	4,810	0.013169776	7.17	101,319	1,334
2010	1,186	4,842	0.00639492	21.61	99,998	639
2011	1,412	5,512	0.006097256	13.39	109,208	666
2012	1,248	4,870	0.021111275	8.93	93,296	1,970
2013	1,094	4,472	0.02317659	5.09	81,319	1,885
2014	1,222	5,327	0.010381652	7.32	108,250	1,124
2015	717	4,300	0.015108855	8.81	87,411	1,321
2016	908	4,567	0.002564652	9.32	93,645	240
2017	560	4,138	0.051742725	4.94	80,801	4,181
2018	653	3,861	0.099800869	6.08	79,891	4,662

Table 6. Calculated yearly total discards of yellowtail snapper from West Florida (area defined in text) vertical line vessels for each year using SEDAR 32 methods. Discards are reported as number of fish.

Year	Trips (discards)	Trips (total effort)	Discard Rate	Discard Rate CV	Total Effort in Hook Hours	Calculated Discards
1993	0	2,300	0		663,959	0
1994	0	2,734	0		637,970	0
1995	0	2,820	0		690,882	0
1996	0	2,925	0		750,682	0
1997	0	3,113	0		714,304	0
1998	0	3,151	0		703,379	0
1999	0	3,490	0		768,056	0
2000	0	3,507	0		724,359	0
2001	0	3,128	0		610,663	0
2002	0	2,843	0		591,682	0
2003	0	2,835	0		621,863	0
2004	0	2,703	0		868,284	0
2005	0	2,329	0		540,336	0
2006	0	2,120	0		588,117	0
2007	0	1,623	0		437,366	0
2008	0.0034276	1,715	0.003427592	15.58	402,756	1,380
2009	0	2,102	0		617,119	0
2010	0	1,354	0		444,616	0
2011	0	1,349	0		408,938	0
2012	0.0008076	1,533	0.000807593	11.36	492,644	398
2013	0.0020118	1,837	0.002011846	9.69	629,909	1,267
2014	0	2,087	0		678,754	0
2015	0.0041961	2,284	0.00419609	17.05	767,123	3,219
2016	0.0000135	2,180	1.3472E-05	19.65	817,913	11
2017	0.0095318	2,079	0.009531753	7.70	590,473	5,628
2018	0.0015422	1,697	0.001542203	8.86	541,765	836

Table 7. Yearly calculated yearly discards of yellowtail snapper from vertical line vessels; all regions (Keys, Southeast Florida, and West Florida) combined using SEDAR 32 methods. Discards are reported as number of fish and pounds whole weight.

Year	Total discards (number of fish)	Total discards (pounds WW)	Dead discards (number), 10% discard mortality	Dead discards (pounds WW), 10% discard mortality	Dead discards (number), 15% discard mortality	Dead discards (pounds WW), 15% discard mortality
1993	91,894	97,244	9,189	9,724	13,784	14,587
1994	104,953	111,063	10,495	11,106	15,743	16,659
1995	120,819	127,853	12,082	12,785	18,123	19,178
1996	117,016	123,829	11,702	12,383	17,552	18,574
1997	139,401	147,517	13,940	14,752	20,910	22,128
1998	97,937	103,639	9,794	10,364	14,691	15,546
1999	105,379	111,514	10,538	11,151	15,807	16,727
2000	103,543	109,571	10,354	10,957	15,531	16,436
2001	87,545	92,642	8,755	9,264	13,132	13,896
2002	86,703	91,751	8,670	9,175	13,005	13,763
2003	81,817	86,580	8,182	8,658	12,273	12,987
2004	51,467	54,464	5,147	5,446	7,720	8,170
2005	48,862	51,707	4,886	5,171	7,329	7,756
2006	75,741	80,151	7,574	8,015	11,361	12,023
2007	83,977	88,866	8,398	8,887	12,597	13,330
2008	49,966	52,875	4,997	5,288	7,495	7,931
2009	60,269	63,777	6,027	6,378	9,040	9,567
2010	49,540	52,424	4,954	5,242	7,431	7,864
2011	60,210	63,715	6,021	6,372	9,031	9,557
2012	39,464	41,761	3,946	4,176	5,920	6,264
2013	47,271	50,023	4,727	5,002	7,091	7,503
2014	59,156	62,600	5,916	6,260	8,873	9,390
2015	23,527	24,897	2,353	2,490	3,529	3,735
2016	44,739	47,344	4,474	4,734	6,711	7,102
2017	37,886	40,092	3,789	4,009	5,683	6,014
2018	29,956	31,701	2,996	3,170	4,493	4,755

Figure 1. Coastal logbook statistical areas.