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Commercial Discard Estimation of South Atlantic Gray Triggerfish

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Introduction

In the South Atlantic, the standard method for estimating commercial discards uses data from the SEFSC coastal fisheries discard logbook program. In SEDAR 41, discards of Gray Triggerfish were estimated from commercial vertical line (handline and electric/hydraulic reel, aka bandit rig) and trap vessels. However, there are concerns about the reliability of this information (SEDAR 41 2016). Therefore, time was spent investigating the use of other data sources for estimating discards of South Atlantic Gray Triggerfish.

In the Gulf of Mexico, a discard estimation method was developed using reef fish observer data for red grouper (Smith et al. 2018). This procedure has since been used in several SEDARs and has been accepted as the improved method for calculating discards in the Gulf of Mexico. However in the South Atlantic, the use of observer data has not been explored due to the sparse coverage in time and space between two different observer programs. From 2007-2016, the Gulf and South Atlantic Fisheries Foundation (GSAFF) collected observer data from the vertical line fishery between North Carolina and eastern Florida (GSAFF, 2008, 2010, and 2013). In 2014, the SEFSC Panama City Laboratory began collecting vertical line observer data in the South Atlantic known here as the South Atlantic Vertical Line Observer Program (SAVLOP) (Enzenauer et al. 2015). Continuous observer coverage under SAVLOP began in 2018.

This working paper applies the standard method for estimating discards using fisher reported discard data and used in the previous SEDAR 41 (Part I). Additionally, the methods developed in the Gulf of Mexico were applied using commercial South Atlantic observer data to estimate discards of Gray Triggerfish (Part II). For the vertical line fishery, discard estimates produced from each method (discard logbook and observer) were compared (Part III). Discard estimates from the trap fishery could only be obtained from discard logbook data.

Data Sources

Discard Logbook

In August 2001, the Southeast Fisheries Science Center (SEFSC) initiated a program to collect commercial fishing vessel discard data from the 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).

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.

However, commercial discards from the supplemental logbook program may be under reported using these data. Fishers remain in reporting compliance by returning discard logbooks with reports of "no discards". For example, from 2002-2010 the percentage of discard reports from vertical line vessels returned with "no discards" increased from 42 to 73 percent in southern Florida (McCarthy, 2011).

Observer Programs

Vertical line observer data collected by the Gulf and South Atlantic Fisheries Foundation (GSAFF) from 2007-2016 and SEFSC Panama City Laboratory (SAVLOP) from 2014-2020 were considered for estimating discards of South Atlantic Gray Triggerfish. For both observer programs, scientific observers on commercial fishing vessels record detailed information on catch and effort for a subset of trips. Catch by species was recorded according to the disposition category: kept (landed), released alive, released dead, released undetermined, and used for bait. Length and weight were recorded for a subsample of individual fish.

While the information being collected under each observer program is similar, the method in which a vessel was selected to have an observer on board differs between programs. Data collected by GSAFF target vessels with valid Snapper-Grouper permits exclusively fishing bandit reels. Fishers voluntarily participated in the project and were compensated for each day an observer was aboard a vessel. Additionally, one crew member may have been displaced to allow space for the observer during the fishing trip (GSAFF, 2008). Since this method could introduce spatial and temporal sampling bias, in 2014 when SEFSC began collecting data under the SAVLOP, a mandatory placement of observers was initiated for the South Atlantic Snapper-Grouper vertical line fishery (Enzenauer et al. 2015). The South Atlantic coast was divided into three subregions for the purposes of vessel selection (the Carolinas, Georgia to Cape Canaveral, Florida, and southern Florida from Cape Canaveral to Key West). Vessels were randomly selected from each subregion based on the fishing effort and landings from the previous year.

Beginning in 2018, there is consistent observer coverage of the South Atlantic Snapper-Grouper vertical line fishery.

Coastal Logbook

The Coastal Fisheries Logbook Program records the commercial fishing and non-fishing activity of fishermen with South Atlantic Snapper and Grouper, Gulf of Mexico Reef Fish, King Mackerel, Spanish Mackerel, and Atlantic Dolphin and Wahoo permits (Atkinson et al. 2021b). Total effort was determined from the commercial logbook data in which fishers reported basic information on effort and catch by species for every trip. For South Atlantic Gray Triggerfish discard estimation, complete calendar years 1993-2020 were considered. The coastal logbook data are used in both the discard logbook and observer program estimation methods.

Relevant Management History of South Atlantic Gray Triggerfish

The minimum size limit for South Atlantic Gray Triggerfish varied depending on where fishing occurred. Off east Florida (EFL), a minimum size limit of 12 inches total length (30.48 cm) was implemented in 1995. In 2015, the minimum size limit off east Florida (EFL) increased to 14 inches fork length (35.56 cm) and a size limit was established off North Carolina, South Carolina, and Georgia (GA-NC) of 12 inches fork length (30.48 cm). It was not until 2020 when the minimum size limit was adjusted off Florida to match the other South Atlantic states. Effective 2020, the minimum size limit for all of the South Atlantic was 12 inches fork length (30.48 cm).

Additionally, annual catch limits resulting in closures began in 2012 for Gray Triggerfish. Details on closures that occurred between 2012-2020 are described in Malone et al. 2022.

Part I - Discard Logbook Estimation

Methods

Discard data from the SEFSC coastal fisheries discard logbook program were used to calculate the number of Gray Triggerfish discards from commercial vertical line (handline and electric/hydraulic reel, aka bandit rig) and trap vessels. The technique used to calculate discards followed the methods recommended in SEDAR 32 (the standard method) by calculating discard rates directly from the discard logbook data. Total effort of the vertical line and trap fisheries as reported to the coastal logbook program was used to calculate total discards of Gray Triggerfish.

Those methods developed for SEDAR 32 have become the standard approach for commercial fishery discard calculation in cases where observer reported data are insufficient for discard calculation. Gray Triggerfish discard calculation was limited to data reported from vertical line and trap trips.

Data Filtering

Data filtering followed the methods recommended during SEDARs 32 and 41 (McCarthy, 2013 and 2015). Data were filtered to exclude trips landing only mackerel species (*Scomberomorus cavalla, Scomberomorus maculatus, Scomberomorus regalis, Scomber japonicus, Scomber scombrus, Auxis thazard,* and *Decapterus macarellus*) 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.

Data were filtered to remove possible erroneous data by eliminating trips that fished in both subregions (GA-NC and EFL) or in the South Atlantic and Gulf of Mexico or the North Atlantic and South Atlantic and trips fishing more than 24 hours per day. Trips with effort values greater than the 99.5 percentile of the distribution of the data (by gear and subregion) were filtered out of analyses. This change in methods resulted in differences in total effort, included more years of data, and accounted for management regulations.

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 43 to 82 percent in Eastern Florida over the period 2002-2020, while GA-NC percentages increased from 11 to 56 percent for vertical line from 2002-2020 and from 2 to 38 percent from 2003-2020 (2002 data unavailable) for trap. During the SEDAR 32 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 SEDAR 32 working group acknowledged that some 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 6 and 29 trips (GA-NC and EFL respectively) and more than 2 and 3 from trap vessel 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 82, data were stratified by subregion. Regions differed from those defined in SEDAR 41.

The subregions were defined for SEDAR 82 as (see Figure 1):

East Florida* = statistical areas above 23° N and below 31° N

North Carolina - Georgia = statistical areas above 31° N and below 37° N

*East Florida includes statistical zones South and East of the Florida Keys and Dry Tortugas

Within each subregion, the mean discard rate from 2002-2020 was calculated as the number of discards per hook hour fished for vertical line vessels and the number of discards per trap used for trap vessels. Annual total effort of all trips by vertical line (hook hours) and trap (number of traps) vessels within each subregion was multiplied by the mean discard rate from the appropriate subregion and gear to calculate total discards of Gray Triggerfish.

Calculated discards per subregion and gear = mean Gray Triggerfish discard rate per subregion and gear annual total effort per subregion and gear*

For years prior to 2002 (the first year of discard data), the mean discard rate, by subregion, for the years 2002-2020 was used to calculate discards for the years 1993-2001 only when effort data were available.

Results and Discussion

The available data set for commercial discard calculation included all trips from vessels that reported discards between January 1, 2002 and December 31, 2020 in the South Atlantic (NC-EFL). During that period, discard forms were submitted for 138,888 trips. Of those trips, discards were reported on 39,319 trips and 99,569 trips reported no animals discarded. Discards of Gray Triggerfish were reported on 1,384 trips or 1% of the submitted discard logbooks. By way of comparison, there were 566,967 trips reported to the coastal logbook program by vessels

that have been issued a Federal permit to fish in the South Atlantic during 2002-2020. Gray Triggerfish landings were reported for 35,143 trips or about 6% of all trips.

Table 1a shows the breakdown of the number of trips reporting discards of Gray Triggerfish compared to other species by vertical line (handline and electric/hydraulic reels), trap, and other gears. The number of Gray Triggerfish reported as discarded by year and gear type are presented in Table 1b. Table 1c shows the breakdown of the number of coastal logbook trips reporting Gray Triggerfish compared to other species by gear. Vertical line accounted for the majority of the trips and landings of Gray Triggerfish in the South Atlantic (Table 1d). Table 2 summarizes the number of trips, pounds landed, and the number of discarded Gray Triggerfish for the two main gears (vertical line and trap) from 2002-2020.

Calculated total discards in numbers of Gray Triggerfish for each year and subregion from vertical line and trap vessels are provided by subregion in Tables 3-5. Discards are reported as the number of fish and discard rate and discard rate CV are reported as ranges of values across strata. Figure 2 shows the annual discards (in number) by subregion and gear from 1993-2020.

Approximately 10% of Gray Triggerfish were reported as dead or the majority of discarded fish were dead when released from vertical lines (Table 6). Fishers reported that more than 90% of discarded Gray Triggerfish were alive or that most of the released fish were alive for both gears. The primary reason reported for discarding Gray Triggerfish was due to regulatory restrictions (not legal size, out of season, other regulations; 92% of discards) (Table 7).

Part I Tables

Table 1a. Number of trips reporting Gray Triggerfish (GT) and other discards by subregion, year and gear fished. Conf indicates confidential data (fewer than three vessels reporting within a cell).

	Vertical Line				Other				Trap			
	EFL		GA-NC		EFL		GA-NC		EFL		GA-NC	
Year	GT	Other	GT	Other	GT	Other	GT	Other	GT	Other	GT	Other
2002	9	494	11	442	-	175	-	136	-	-	6	63
2003	12	807	17	270	-	235	-	159	-	-	3	94
2004	26	559	Conf	171	-	235	-	89	-	3	-	36
2005	4	614	6	265	-	142	-	81	-	11	-	11
2006	4	440	Conf	128	-	87	-	109	-	17	-	Conf
2007	12	896	-	272	-	318	-	84	-	18	Conf	41
2008	73	1139	9	808	3	658	-	248	-	12	34	203
2009	Conf	626	10	443	-	340	-	100	-	5	57	200
2010	27	1116	Conf	654	-	432	-	278	-	-	43	158
2011	33	1229	-	471	-	316	-	218	-	23	5	30
2012	24	1210	12	575	-	361	-	198	Conf	13	17	118
2013	52	1118	41	599	-	249	-	278	10	46	30	126
2014	65	1162	61	893	-	543	-	306	11	8	15	158
2015	90	1156	31	721	-	572	Conf	220	Conf	7	12	89
2016	100	1117	47	898	Conf	564	-	260	Conf	Conf	6	77
2017	69	729	64	838	-	409	-	232	Conf	Conf	4	121
2018	19	677	44	519	-	408	-	166	Conf	6	4	115
2019	19	652	53	363	-	359	-	151	-	-	7	75
2020	24	458	31	382	-	221	-	185	-	-	-	13

Table 1b. Number of discards (number of fish) reported for Gray Triggerfish (GT) and other species by subregion, year and gear fished. Conf indicates confidential data (fewer than three vessels reporting within a cell).

	Vertical Line				Other				Trap			
	EFL		GA-NC		EFL		GA-NC		EFL		GA-NC	
Year	GT	Other	GT	Other	GT	Other	GT	Other	GT	Other	GT	Other
2002	86	9,675	233	49,431	-	1,036	-	4,779	-	-	266	31,338
2003	51	17,467	228	18,256	-	1,221	-	9,822	-	-	45	22,637
2004	213	15,069	Conf	9,163	-	1,594	-	4,170	-	145	-	2,138
2005	31	25,288	90	13,669	-	3,076	-	11,413	-	481	-	1,061
2006	34	18,724	Conf	11,221	-	471	-	6,469	-	1,190	-	Conf
2007	124	28,247	-	32,657	-	1,643	-	2,498	-	214	Conf	3,325
2008	867	31,843	104	136,813	8	3,874	-	10,698	-	103	693	32,758
2009	Conf	19,282	84	25,137	-	2,341	-	6,853	-	83	390	38,166
2010	252	24,721	Conf	87,962	-	4,588	-	12,836	-	-	483	22,310
2011	314	30,614	-	58,046	-	3,466	-	7,155	-	888	13	5,693
2012	386	27,276	499	61,213	-	3,002	-	5,515	Conf	340	94	38,559
2013	1,750	30,500	4,052	72,507	-	1,816	-	6,765	190	1,089	521	41,437
2014	2,777	35,252	2,747	82,425	-	8,888	-	36,223	415	195	161	34,747
2015	1,796	41,387	1,291	51,504	-	4,437	Conf	12,868	Conf	190	137	20,246
2016	1,891	24,732	957	41,698	Conf	3,820	-	12,966	Conf	Conf	211	6,066
2017	1,249	15,196	838	35,631	-	2,678	-	11,805	Conf	Conf	55	19,239
2018	323	15,715	803	17,326	-	2,896	-	4,929	Conf	137	27	16,036
2019	273	10,778	1,243	12,091	-	2,558	-	5,530	-	-	101	11,905
2020	310	5,233	373	14,770	-	1,424	-	3,780	-	-	-	2,251

Table 1c. South Atlantic coastal logbook trips reported for Gray Triggerfish (GT) and other species by subregion, year and gear. Total trips may not match those reported in the text due to double counting trips (Gray Triggerfish and other species may have been reported on the same trip and that trip would have been included in both "Other" and "GT" totals). Conf indicates confidential data (fewer than three vessels reporting within a cell).

	Vertical Line				Other				Trap			
	EFL		GA-NC		EFL		GA-NC		EFL		GA-NC	
Year	GT	Other	GT	Other	GT	Other	GT	Other	GT	Other	GT	Other
2002	504	13,362	1,544	3,780	57	10,991	14	2,857	Conf	25	172	809
2003	460	14,346	1,175	3,025	33	11,447	6	2,514	-	8	188	792
2004	592	13,229	1,288	2,913	47	8,787	25	2,593	-	22	203	826
2005	546	11,565	1,269	2,974	49	8,300	10	2,449	-	26	95	594
2006	409	12,356	1,241	3,262	46	9,068	5	2,668	Conf	49	177	756
2007	528	12,939	1,441	3,532	85	10,178	14	3,172	-	32	158	596
2008	468	13,524	1,503	3,346	73	9,877	18	2,944	Conf	20	141	544
2009	603	15,737	1,376	3,261	67	11,163	15	3,188	Conf	60	255	717
2010	424	13,768	1,248	2,708	179	9,937	21	2,350	15	66	178	341
2011	504	14,195	1,257	2,302	209	8,747	14	2,436	7	79	98	158
2012	458	12,954	996	2,280	165	8,370	13	2,440	19	67	91	261
2013	301	12,221	670	2,518	104	6,942	11	2,422	12	64	52	310
2014	418	14,416	480	2,884	70	7,400	4	2,982	Conf	27	7	275
2015	508	13,259	859	2,561	96	7,465	9	2,302	Conf	13	25	219
2016	402	13,484	1,146	2,901	109	7,691	25	2,592	Conf	7	30	174
2017	485	13,388	1,339	2,901	136	8,303	61	2,548	11	25	99	273
2018	382	12,811	1,142	2,636	86	7,593	35	2,319	5	7	72	214
2019	360	12,811	961	2,848	92	7,864	28	2,515	Conf	17	43	199
2020	406	10,853	1,133	2,581	64	6,842	43	2,397	-	7	15	61

Table 1d. South Atlantic landings (pounds) reported to the coastal logbook program for Gray Triggerfish (GT) and other species by subregion, year and gear. Conf indicates confidential data (fewer than three vessels reporting within a cell).

	Vertical Line				Other				Trap			
	EFL		GA-NC		EFL		GA-NC		EFL		GA-NC	
Year	GT	Other	GT	Other	GT	Other	GT	Other	GT	Other	GT	Other
2002	34,253	3,548,840	143,380	3,139,440	2,052	4,958,644	17,766	2,612,968	Conf	11,083	3,303	496,093
2003	19,002	3,884,421	147,218	2,637,005	671	5,630,604	810	2,218,637	-	2,467	3,209	563,079
2004	30,723	3,996,663	176,165	2,830,918	2,766	4,366,344	742	2,331,340	-	3,455	6,076	659,513
2005	45,689	3,670,209	203,883	2,951,195	1,326	4,666,152	1,436	2,246,902	-	7,357	3,688	421,195
2006	39,937	3,855,645	196,858	2,965,905	1,836	5,566,443	1,910	2,527,483	Conf	6,576	4,732	532,424
2007	71,435	4,057,937	246,226	3,321,644	2,529	5,156,726	1,430	2,051,648	-	4,467	5,905	411,497
2008	41,522	4,501,897	240,371	3,264,449	2,247	4,544,435	5,555	2,105,039	Conf	3,144	5,517	427,476
2009	47,843	5,743,247	264,976	2,700,850	1,488	5,261,034	1,728	2,713,428	Conf	38,654	13,031	579,810
2010	66,818	5,450,740	317,794	2,414,371	6,907	5,209,402	17,069	2,441,619	313	74,074	7,680	351,570
2011	99,814	5,419,118	337,078	2,129,166	8,952	4,198,924	4,864	2,483,158	57	91,301	5,091	221,435
2012	64,972	4,897,791	199,510	2,008,900	10,516	3,852,156	11,767	2,245,391	660	45,460	1,533	219,897
2013	66,937	4,365,077	206,926	2,086,149	4,582	3,255,403	1,609	2,000,539	939	32,609	2,135	248,496
2014	81,351	5,084,100	166,414	2,119,733	2,049	3,364,846	656	2,719,119	Conf	7,330	283	178,851
2015	91,659	4,820,707	206,269	1,867,334	2,337	3,161,592	147	1,970,790	Conf	2,676	886	173,340
2016	79,435	5,125,898	197,188	1,970,842	2,941	3,100,199	1,225	2,257,853	Conf	1,157	2,660	125,918
2017	72,526	5,453,085	228,544	1,916,180	4,388	3,284,770	1,830	2,022,501	232	4,669	5,112	215,225
2018	54,375	4,552,583	235,221	1,778,201	3,149	3,126,126	2,772	2,040,529	69	1,215	2,069	193,300
2019	74,777	4,612,740	229,418	1,822,935	2,857	3,052,684	1,537	2,243,008	Conf	1,969	4,350	174,128
2020	73,926	3,755,458	208,772	1,773,836	2,542	2,758,701	2,248	1,927,626	-	481	522	43,066

Table 2. South Atlantic vertical line and trap trips and landings from Gray Triggerfish (GT) subregions reported to the coastal logbook program during the years 2002-2020. Discards are reported in the 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 Gray Triggerfish and other species or trips reporting only Gray Triggerfish.

	All Vertical Line Trips				All Trap Trips				All Vertical Line Trips with GT				All Trap Trips with GT			
	Logbook		Discards		Logbook		Discards		Logbook		Discards		Logbook		Discards	
Sub region	Trips	Pounds	Trips	N fish	Trips	Pounds	Trips	N fish	Trips	Pounds	Trips	N fish	Trips	Pounds	Trips	N fish
EFL	259,976	87,953,150	16,863	439,760	701	342,879	202	6,327	8,758	1,156,994	664	12,761	80	2,736	30	1,056
GA-NC	77,281	49,851,262	10,153	845,096	10,218	6,314,093	1,974	353,339	22,068	4,152,210	441	13,576	2,099	77,782	244	3,212

Table 3. Calculated yearly total discards (in number) of Gray Triggerfish from vertical line and trap vessels using SEDAR 32 methods.

Year	Vertical Line	Trap
1993	1,905	1,689
1994	2,275	2,214
1995	2,511	1,891
1996	2,705	2,095
1997	2,693	2,450
1998	2,109	2,520
1999	1,769	2,346
2000	1,774	1,777
2001	1,999	2,097
2002	1,957	1,661
2003	1,650	1,511
2004	1,470	1,508
2005	1,391	1,209
2006	1,495	1,540
2007	1,568	1,253
2008	1,563	908
2009	1,688	1,363
2010	1,421	734
2011	1,301	328
2012	3,939	628
2013	8,874	907
2014	12,136	670
2015	6,794	618
2016	6,143	532
2017	4,739	1,300
2018	4,819	491
2019	5,868	2,163
2020	3,981	35

Table 4. Calculated yearly total discards (in number) of Gray Triggerfish from East Florida (area defined in text) vertical line and trap vessels using SEDAR 32 methods. Discard Rate and Discard Rate CV are reported as ranges of values across strata.

(A) EFL Trap

Year	Trips Reporting Effort	Total Effort	Discard Rate Range	Discard Rate CV Range	Estimated Discards
1995	26	1,430	0.0458	3.86	66
1996	28	2,650	0.0458	3.86	121
1997	34	3,265	0.0458	3.86	150
1998	31	3,315	0.0458	3.86	152
1999	12	110	0.0458	3.86	5
2000	19	1,690	0.0458	3.86	77
2001	11	319	0.0458	3.86	15
2002	21	587	0.0458	3.86	27
2003	8	104	0.0458	3.86	5
2004	20	384	0.0458	3.86	18
2005	26	1,027	0.0458	3.86	47
2006	49	1,162	0.0458	3.86	53
2007	32	1,660	0.0458	3.86	76
2008	20	223	0.0458	3.86	10
2009	63	1,114	0.0458	3.86	51
2010	64	990	0.0458	3.86	45
2011	78	1,389	0.0458	3.86	64
2012	64	1,531	0.0458 - 0.3916	2.16 - 3.86	254
2013	65	1,469	0.0458 - 0.3916	2.16 - 3.86	408
2014	27	566	0.0458 - 0.3916	2.16 - 3.86	196
2015	18	383	0.0458 - 1.25	1.51 - 3.86	279
2016	14	158	1.25 - 1.7613	1.51 - 2.33	244
2017	50	644	1.25 - 1.7613	1.51 - 2.33	1,110
2018	14	192	1.7613	2.33	338
2019	34	1,210	1.25 - 1.7613	1.51 - 2.33	1,902

(B) EFL Vertical Line

Year	Trips Reporting Effort	Total Effort	Discard Rate Range	Discard Rate CV Range	Estimated Discards
1993	8,668	473,927	0.0006	16.64	293
1994	10,399	640,283	0.0006	16.64	395
1995	10,421	732,690	0.0006 - 0.0011	16.64 - 18.31	682
1996	11,603	693,674	0.0011	18.31	782
1997	13,592	762,891	0.0011	18.31	860
1998	12,207	526,282	0.0011	18.31	593
1999	11,387	475,256	0.0011	18.31	535
2000	10,485	468,523	0.0011	18.31	528
2001	10,838	423,301	0.0011	18.31	477
2002	11,228	438,146	0.0011	18.31	494
2003	11,408	402,126	0.0011	18.31	453
2004	10,632	370,956	0.0011	18.31	418
2005	9,406	307,467	0.0011	18.31	346
2006	9,028	299,224	0.0011	18.31	337
2007	9,855	355,171	0.0011	18.31	400
2008	9,976	335,414	0.0011	18.31	378
2009	11,401	398,226	0.0011	18.31	449
2010	10,290	305,142	0.0011	18.31	344
2011	10,961	355,119	0.0011	18.31	400
2012	10,233	318,210	0.0011 - 0.0081	11.56 - 18.31	754
2013	9,655	326,026	0.0011 - 0.0081	11.56 - 18.31	1,256
2014	11,876	401,190	0.0011 - 0.0081	11.56 - 18.31	1,994
2015	10,682	420,950	0.0011 - 0.011	11.56 - 24.14	2,025
2016	11,095	381,012	0.0046 - 0.011	15.55 - 24.14	2,502
2017	10,830	355,860	0.0046 - 0.011	15.55 - 24.14	1,747
2018	10,055	316,295	0.0046 - 0.011	15.55 - 24.14	1,683
2019	9,864	298,152	0.0046 - 0.011	15.55 - 24.14	2,056
2020	7,953	270,899	0.0042 - 0.0046	12.15 - 15.55	1,165

Table 5. Calculated yearly total discards (in number) of Gray Triggerfish from North Carolina to Georgia (area defined in text) vertical line and trap vessels for each year using SEDAR 32 methods. Discard Rate and Discard Rate CV are reported as ranges of values across strata.

(A) GA-NC Trap

Year	Trips Reporting Effort	Total Effort	Discard Rate Range	Discard Rate CV Range	Estimated Discards
1993	968	35,805	0.0472	4.75	1,689
1994	1,169	46,937	0.0472	4.75	2,214
1995	989	38,700	0.0472	4.75	1,825
1996	1,146	41,848	0.0472	4.75	1,974
1997	1,312	48,778	0.0472	4.75	2,301
1998	1,195	50,206	0.0472	4.75	2,368
1999	1,076	49,621	0.0472	4.75	2,341
2000	832	36,026	0.0472	4.75	1,699
2001	1,108	44,137	0.0472	4.75	2,082
2002	813	34,646	0.0472	4.75	1,634
2003	794	31,924	0.0472	4.75	1,506
2004	827	31,598	0.0472	4.75	1,490
2005	593	24,633	0.0472	4.75	1,162
2006	755	31,517	0.0472	4.75	1,487
2007	595	24,953	0.0472	4.75	1,177
2008	551	19,040	0.0472	4.75	898
2009	716	27,820	0.0472	4.75	1,312
2010	342	14,589	0.0472	4.75	688
2011	159	5,597	0.0472	4.75	264
2012	261	7,209	0.0472 - 0.0705	4.75 - 5.72	374
2013	310	8,023	0.0472 - 0.0705	4.75 - 5.72	500
2014	278	7,190	0.0472 - 0.0705	4.75 - 5.72	474
2015	218	5,797	0.0213 - 0.0861	4.75 - 8.28	339
2016	175	4,886	0.0213 - 0.0861	5.62 - 8.28	288
2017	273	7,803	0.0213 - 0.0861	5.62 - 8.28	190
2018	213	5,753	0.0213 - 0.0861	5.62 - 8.28	152
2019	199	5,119	0.0213 - 0.0861	5.62 - 8.28	261
2020	61	1,549	0.0213 - 0.0861	5.62 - 8.28	35

(B) GA-NC Vertical Line

Year	Trips Reporting Effort	Total Effort	Discard Rate Range	Discard Rate CV Range	Estimated Discards
1993	3,186	771,776	0.0021	18.24	1,613
1994	4,073	899,678	0.0021	18.24	1,880
1995	4,140	875,526	0.0021	18.24	1,829
1996	3,902	920,405	0.0021	18.24	1,923
1997	4,167	877,616	0.0021	18.24	1,834
1998	4,024	725,525	0.0021	18.24	1,516
1999	3,310	590,471	0.0021	18.24	1,234
2000	2,981	596,431	0.0021	18.24	1,246
2001	3,235	728,288	0.0021	18.24	1,522
2002	3,489	700,554	0.0021	18.24	1,464
2003	2,793	572,874	0.0021	18.24	1,197
2004	2,682	503,288	0.0021	18.24	1,052
2005	2,670	499,955	0.0021	18.24	1,045
2006	2,776	554,341	0.0021	18.24	1,158
2007	3,224	558,836	0.0021	18.24	1,168
2008	3,146	567,096	0.0021	18.24	1,185
2009	3,128	592,932	0.0021	18.24	1,239
2010	2,601	515,396	0.0021	18.24	1,077
2011	2,238	430,946	0.0021	18.24	900
2012	2,214	385,989	0.0021 - 0.0359	6.45 - 18.24	3,185
2013	2,427	421,632	0.0021 - 0.0359	6.45 - 18.24	7,618
2014	2,793	406,698	0.0021 - 0.0359	6.45 - 18.24	10,142
2015	2,456	362,621	0.0021 - 0.0359	6.45 - 18.24	4,768
2016	2,834	368,685	0.0083 - 0.0158	6.97 - 7.63	3,642
2017	2,863	351,503	0.0083 - 0.0158	6.97 - 7.63	2,992
2018	2,623	349,727	0.0083 - 0.0158	6.97 - 7.63	3,137
2019	2,735	338,690	0.0083 - 0.0158	6.97 - 7.63	3,812
2020	2,447	338,490	0.0083 - 0.0158	6.97 - 7.63	2,816

Table 6. South Atlantic discards (in number) by disposition, gear, and subregion. Conf indicates confidential data (fewer than three vessels reporting within a cell). Totals reflect non-confidential data.

	Vertical Line				Trap			
Disposition	EFL	EFL %	GA-NC	GA-NC %	EFL	EFL %	GA-NC	GA-NC %
Alive	11,535	91%	12,446	89%	1,056	100%	3,193	100%
Dead	869	7%	413	3%	-	-	Conf	Conf
Kept	284	2%	1,081	8%	-	-	-	-
Unknown	Conf	Conf	Conf	Conf	-	-	Conf	Conf

Table 7. South Atlantic discards (in number) by reason for discard, gear, and subregion. Conf indicates confidential data (fewer than three vessels reporting within a cell). Totals reflect non-confidential data.

	Vertical Line				Trap			
Discard Reason	EFL	EFL %	GA-NC	GA-NC %	EFL	EFL %	GA-NC	GA-NC %
Market Conditions	54	0.40%	800	6%	-	-	1,485	46%
Regulations	12,590	98%	13,207	94%	1,056	100%	1,727	54%
Unreported	151	1%	Conf	Conf	-	-	-	-

Part I Figures

Figure 1. Coastal logbook statistical areas in the South Atlantic.

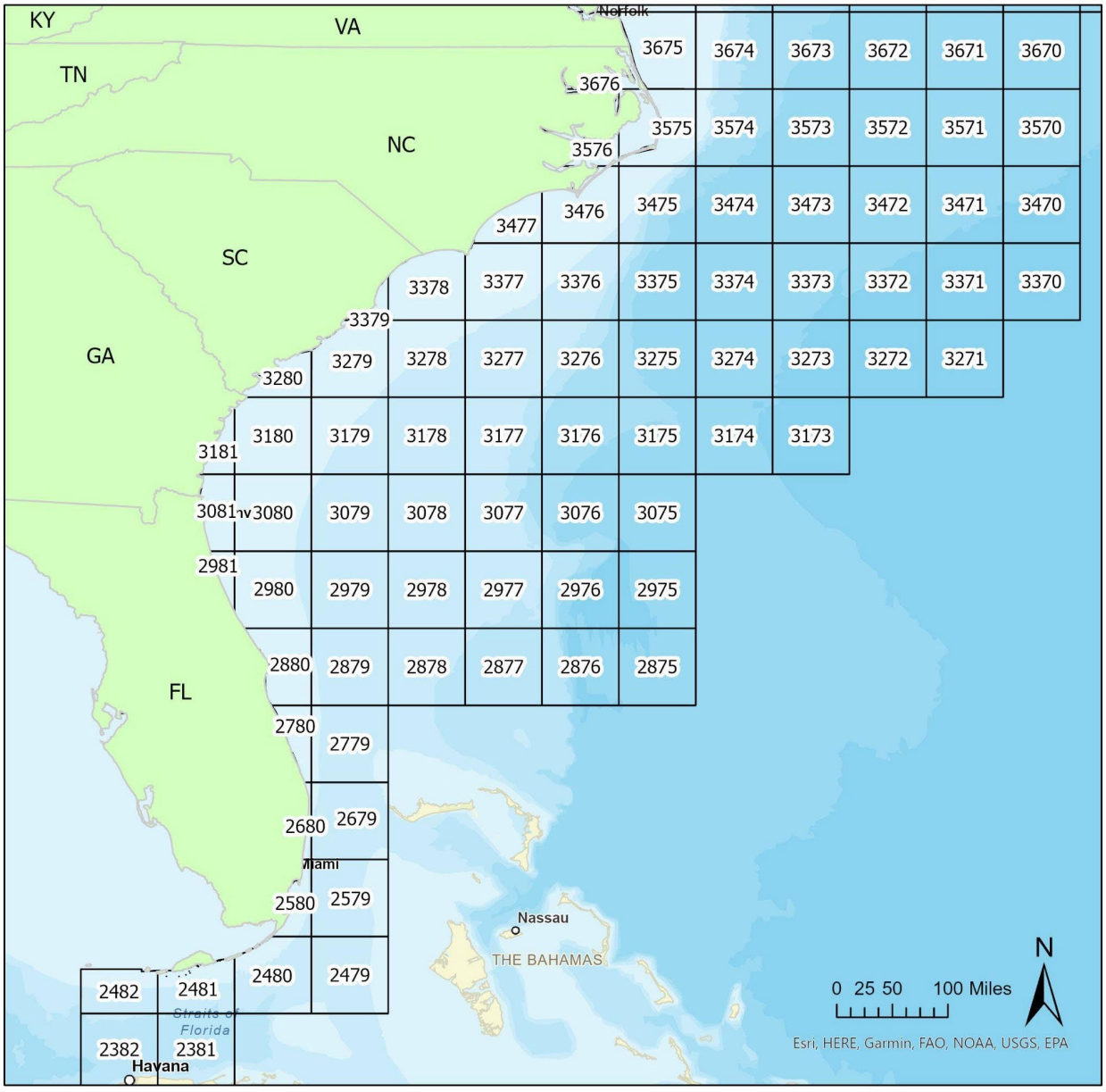
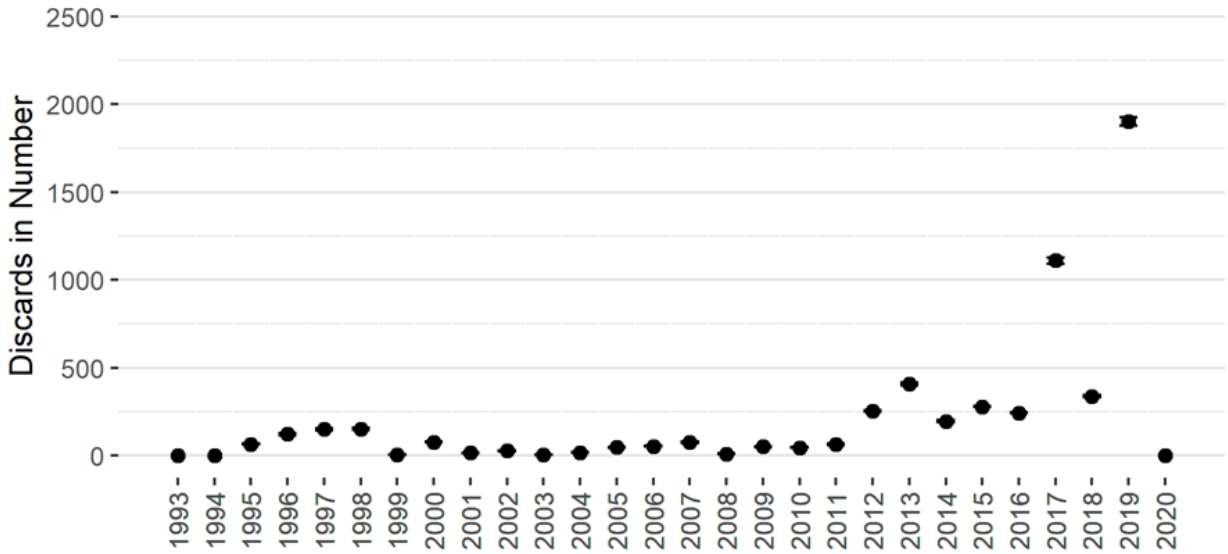
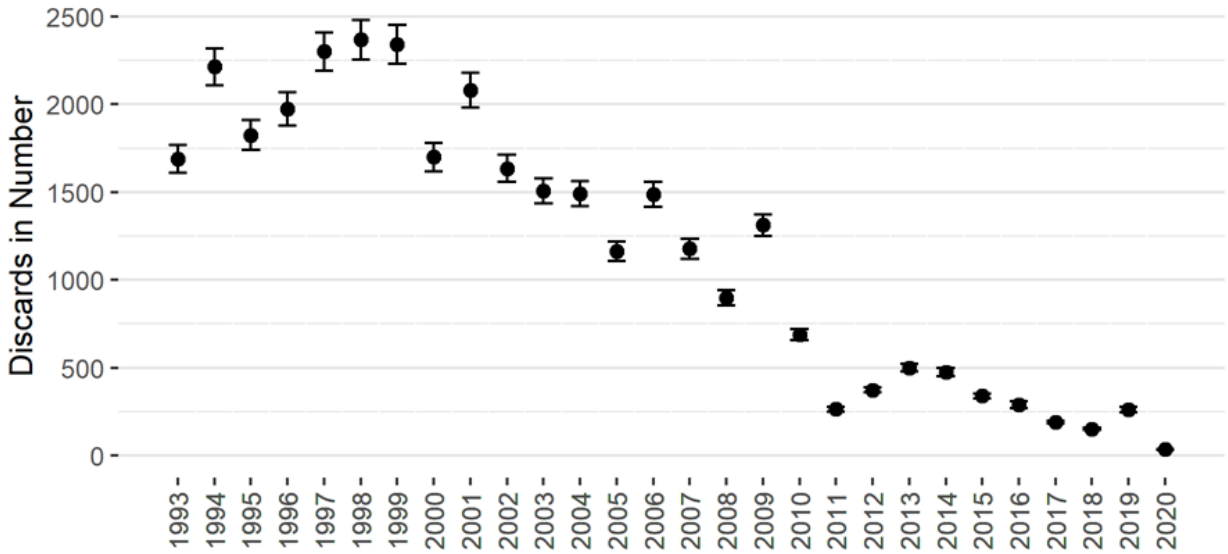


Figure 2. Discard logbook estimates of South Atlantic Gray Triggerfish for the trap and vertical line fishery by subregion.

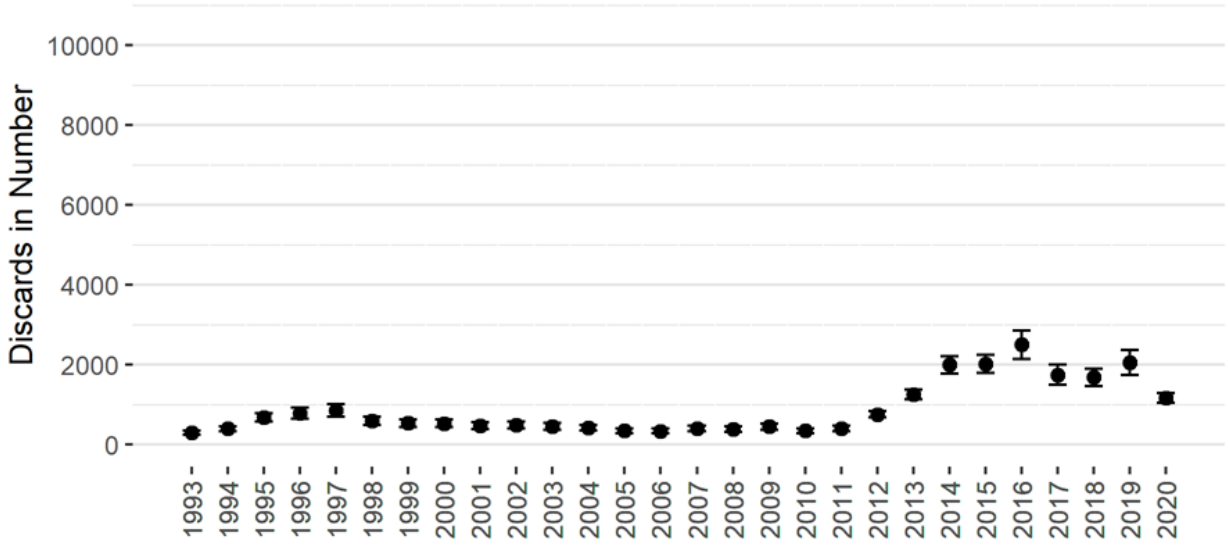
(A) EFL Trap



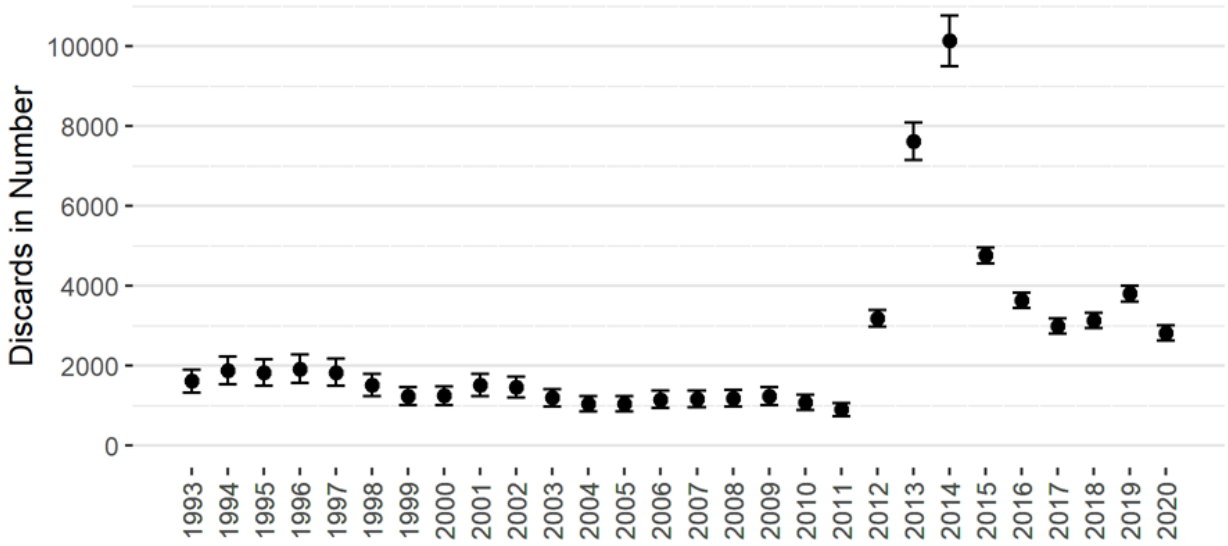
(B) GA-NC Trap



(C) EFL Vertical Line



(D) GA-NC Vertical Line



Part II - Observer Program Estimation

Methods

The general approach for estimating discards for the commercial reef fish fleet in the South Atlantic utilizes catch-per-unit-effort (CPUE) from the vertical line observer programs and total fishing effort from the commercial reef logbook program to estimate total catch,

$$\text{total Catch} = \text{CPUE} \times \text{total Effort} \quad .$$

For discard estimation, CPUE is computed for total discards, including fish released alive, released dead, released in unknown condition, and used for bait. Methods initially developed for SEDAR 61 were applied to Gray Triggerfish.

Observer Programs

Since each observer program has different sampling methods, data were compared during the years of overlap to assess the potential for pooling data for SEDAR 82. Observer coverage overlap spanned from 2014 to 2015. These two years of data were used to assess whether both observer programs could be used for analyses.

For South Atlantic Gray Triggerfish discard estimation, complete calendar years 2007-2020 were considered; with GSAFF observer data from 2007-2016 and SAVLOP data between 2014-2020.

Trip-Level Catch for Observer Data

Observers collected catch data at a sub-trip level (e.g., a specific set and line for vertical line gear), but it was not feasible to sample every set, line, etc., for every trip. Gear-specific procedures were applied to estimate the trip-level landed catch from the observer data (Smith et al. 2018).

Trip-Level Effort for Observer and Logbook Data

For observer data, trip-level effort for vertical lines was computed as the cumulative daily fishing time (hours) from first hook in to last hook out; this time metric included the active fishing time as well as transit time between fishing locations during a given trip day. This effort variable generally matched trip fishing time reported in vessel logbook data (Smith et al. 2018).

The observer data of Gray Triggerfish from 2007-2020 did not include South Florida. Therefore, for computing similar total effort between the observer and logbook data, South Florida trips (below latitude 29 N) were excluded from analyses. Refer to Figure 3 for statistical zones sampled by observers.

Catch Expansion Procedures and Verification

Observer CPUE was calculated using trip-level nominal effort and catch for a given time period. Statistical estimation of total catch and associated variance followed procedures for a (Horvitz-Thompson) survey design ratio estimator (Jones et al. 1995; Lohr 2010):

$$\hat{C} = \overline{CPUE} \times \hat{X} \ ,$$

where $\overline{CPUE}$ is observer mean CPUE and $\hat{X}$ is total logbook nominal effort. Species- and gear-specific logbook total effort was calculated in two steps. First, logbook trip effort by gear was summed over trips reporting landings of the target species. Second, to obtain $\hat{X}$, logbook trip effort was adjusted by the proportion of observer trip effort that reported only discards of the target species. Logbook total trips *N* were calculated in a similar manner.

Mean CPUE was estimated by

$$\overline{CPUE} = \frac{\bar{y}}{\bar{x}} \ ,$$

where $\bar{y}$ is average catch and y_i is observed catch per trip *i*,

$$\bar{y} = \frac{1}{n}\sum_i y_i \ ,$$

$\bar{x}$ is average effort and x_i, is observed effort per trip *i,*

$$\bar{x} = \frac{1}{n}\sum_i x_i \ ,$$

and n is the number of observer trips. Variance of total catch was estimated using

$$var\left[\hat{C}\right] = var[\overline{CPUE}] \times \hat{X}^2 \ ,$$

where the variance of mean CPUE is

$$var[\overline{CPUE}] = \left(1 - \frac{n}{N}\right)\frac{s^2(y|x)}{n\bar{x}^2} \ ,$$

N is the total number of logbook trips, and the sample variance is

$$s^2(y|x) = \frac{\sum_i (y_i - \overline{CPUE}x_i)^2}{n-1} \ .$$

Standard error of total catch was calculated as

$$SE\left[\hat{C}\right] = \sqrt{var\left[\hat{C}\right]} \ .$$

The CV of total catch $\hat{C}$ was estimated by

$$CV\left[\hat{C}\right] = \frac{SE[\hat{C}]}{\hat{C}} \ .$$

A verification step compared annual total landed catch from logbook data with the estimated observer annual total catch $\hat{C}$. Once verified, the catch expansion procedure was used to estimate annual total discards in weight and number.

Stratification by Trip Catch or Effort Level

Computations of mean CPUE, total catch, and associated standard errors were generalized to include strata for trip catch and/or effort levels of Gray Triggerfish. This enabled accurate estimation of total catch (and discards) in cases where observer sampling was not proportional to the fleet with respect to trip catch or effort (Smith et al. 2019a), e.g., observers sampled fewer or more low-catch trips with respect to logbook low-catch trips, etc. Comparisons of observer vs. logbook frequency distributions for trip-level catch, effort, and CPUE were used to delineate strata for trip catch and/or effort levels (e.g., low, moderate, high, etc.).

Hindcast Procedures

For years prior to 2007, before observer data were collected, hindcast discard estimation procedures for "Trending CPUE" described in Smith et al. (2019a) were applied to Gray Triggerfish. For this method, the ratio of observer CPUE in weight to logbook CPUE was computed for the observer time period, and then multiplied by the annual logbook CPUE for the hindcast time period to produce an estimated annual observer CPUE. Then, the annual observer CPUE was multiplied by annual logbook effort for the pre-observer time period to estimate total catch $\hat{C}$ in weight. An additional step computed the ratio of the observer CPUE in number to observer CPUE in weight. This ratio was then used to compute the observer estimated discards in number from the discards in weight for the hindcast period. Standard errors for the hindcast period were estimated using the respective CVs of total estimated catch $\hat{C}$ kept and discarded as described in Smith et al. (2019a). To guide selection of appropriate time periods for hindcasting, time-series of annual length compositions for kept and discarded fish from observer sampling were evaluated. Verification compared total landed catch from logbook data with the estimated total catch $\hat{C}$ and standard error from observer data for the hindcast time period.

Discard Length Composition

The length frequency distribution for discards for a given management time frame was computed in the following manner. Average discard CPUE in stratum *h* was scaled to stratum total effort $\hat{X}_h$

$$\hat{Y}_h = \overline{CPUE}_h * \hat{X}_h$$

and multiplied by stratum proportion of length L to obtain the stratum total discards $\hat{Y}_h$ at length L,

$$\hat{Y}(L)_h = \hat{Y}_h * p(L)_h \ .$$

These were summed over all strata to obtain the survey frame total $\hat{Y}$ at length L

$$\hat{Y}(L)_{st} = \sum_h \hat{Y}(L)_h \ ,$$

and then converted to relative proportion of length L,

$$p(L)_{st} = \frac{\hat{Y}(L)_{st}}{\sum_h \hat{Y}_h} \ . \ (1)$$

Annual discards-at-length were computed by multiplying eq. (1) and annual estimates of total discards.

Results and Discussion

Comparison of Observer Data between Programs

The number of trips observed in the South Atlantic for Gray Triggerfish are provided in Table 8. Between both observer programs (GSAFF and SAVLOP), a total of 122 trips were observed. Given the management actions for South Atlantic Gray Triggerfish, observer trips were also summarized by subregion (EFL and GA-NC) and season (open and closed) to help determine data availability by strata and inform management regimes when pooling time periods. Since there is overlap in observer coverage from 2014-2015, Figure 4 highlights there was no appreciable difference in the length frequencies of kept Gray Triggerfish between programs. The mean length of a kept Gray Triggerfish between GSAFF and SVLOP data was similar (39.1 to 37.5 cm, respectively). Therefore, both GSAFF and SAVLOP data were used in this analysis. Discard estimates from South Atlantic observer data were estimated for only the vertical line fishery.

Designation of Management Time Periods

The management regimes for South Atlantic Gray Triggerfish were based on patterns in annual logbook CPUE estimates, length composition, and minimum size limit changes. For the observer time period 2007-2020, the logbook annual CPUEs generally increased after 2009 (Figure 5). This seemed to correspond with changes in species targeting resulting from management actions on red snapper. Additionally, there were ACL seasonal closures implemented in 2012, and changes in minimum size limits in 2016.

Given the differences in minimum size limits over time between subregion, it was thought the discard rate would differ by subregion. However, Figure 6 shows similar length distributions of kept fish between regions and across management regimes. The mean length of a kept Gray Triggerfish between EFL and GA-NC data was similar for 2012-2015 (38.3 to 38 cm, respectively) and 2016-2020 (39.3 to 38.7 cm, respectively). Further, Table 9 shows little difference in disposition patterns between regions over time. Therefore, discards were estimated

for the South Atlantic as a single region rather than breaking it up between FL and GA-NC. The percentage of discarded fish generally increased when ACL closures were implemented in 2012. Therefore, the management regimes were classified as 2007-2009, 2010-2011 and 2012-2020 as shown in Figure 5.

Discard Estimation

Catch-effort data for observer trips catching Gray Triggerfish were pooled across years for the respective management regimes. Logbook catch-effort data for Gray Triggerfish trips were pooled in the same manner. These observer and logbook datasets were the basis for subsequent analysis and estimation of catch and discards.

Further analysis of the 2007-2009 time period showed that observers sampled a higher proportion of high effort (>53 hours) Gray Triggerfish trips and a lower proportion of low effort (<=53 hours) trips relative to the commercial fleet (Table 10a). To account for this discrepancy, observer and logbook trips were grouped into strata according to low (L) and high (H) effort for subsequent analysis and estimation. Additionally, analysis of the 2010-2011 and 2012-2020 (open season) management regimes showed that observers sampled a higher proportion of low catch trips (<= 326 lbs for 2010-2011 and <= 82 lbs for 2012-2020) relative to the commercial fleet (Table 10b and 10c, respectively). Therefore, to account for this discrepancy, observer and logbook trips were grouped into low (L) and high (H) catch strata for subsequent analysis and estimation.

The proportions of observer trips and effort encountering Gray Triggerfish that had kept fish are given in Table 11 by management regime and catch or effort level strata. These proportions were used to adjust annual logbook total Gray Triggerfish trips and effort (Table 12) to account for logbook trips that only had discarded fish. Estimates of observer mean CPUE by management regime and catch or effort level strata are given in Table 13. These CPUEs were the basis for expansion estimates of Gray Triggerfish catch and discards. Observer discard CPUEs for the 2007-2009 management regime were the basis for hindcasting discards during 1993-2006. CPUE expansion estimates of annual total landed catch of Gray Triggerfish compared favorably with reported logbook landings for 2007-2020 (Figure 7). CPUE expansion estimates for annual discards in numbers and weight of Gray Triggerfish for 1993-2020 are provided in Table 14. Estimated discards in number ranged from 1,200 to 2,900 fish across the entire time series (average 1,978 fish) (Figure 8A). From 1993-2006 the average number of discarded fish was 1,694. From 2007-2009, the average was 1,831 fish, 2010-2011 was 1,946 fish, and 2012-2020 was 2,476 fish. Discards in weight remained relatively constant from 1993-2020 which accounted for about 1.6% of the total catch (kept + discards) except for a 1% decrease from 2010-2011 (Figure 8B).

Discard Length Composition

Annual discard length frequencies were provided in 3 cm fork length bins using the catch and effort strata by management regime (Figure 9).

Part II Tables

Table 8. Number of total and Gray Triggerfish (GT) observer trips by year and program, subregion, and season for the South Atlantic.

		Program		Subregion		Season	
Year	Total GT Trips	GSAFF	SAVLOP	EFL	GA-NC	Open	Closed
2007	25	25	0	5	20	25	0
2008	5	5	0	0	5	5	0
2009	7	7	0	2	5	7	0
2010	5	5	0	1	4	5	0
2011	12	12	0	3	9	12	0
2012	0	-	-	-	-	-	-
2013	0	-	-	-	-	-	-
2014	10	4	9	4	9	2	11
2015	24	23	1	8	16	14	10
2016	15	15	0	4	11	13	2
2017	0	-	-	-	-	-	-
2018	5	0	5	2	3	5	0
2019	4	0	5	0	5	3	2
2020	5	0	6	4	2	6	0

Table 9. Disposition and Condition of Fish upon Arrival of South Atlantic Gray Triggerfish by management regime and subregion (EFL and GA-NC).

			Disposition %				Further Breakdown of Released Fish: Condition % Upon Arrival to Vessel			
Management Regime	Subregion	N fish	Kept	Released	Bait	Unknown	Alive, Good	Alive, Barotrauma	Dead	Average Depth (m)
2007-2009	EFL	782	98.85	1.15	0.00	0.00	100.0	0.0	0.0	38.9
	GA-NC	1,716	98.08	1.46	0.17	0.29	96.0	4.0	0.0	36.6
2010-2011	EFL	880	96.82	1.14	0.00	2.05	100.0	0.0	0.0	37.8
	GA-NC	1,590	97.99	1.19	0.38	0.44	100.0	0.0	0.0	33.3
2012-2020	EFL	1,224	94.85	5.07	0.00	0.08	59.7	40.3	0.0	38.2
	GA-NC	2,774	95.10	4.72	0.07	0.11	45.8	53.4	0.8	48.3

Table 10. Definition of trip catch and effort level strata for South Atlantic Gray Triggerfish (GT), and corresponding percentages of logbook and observer vertical line trips for each season and management regime.

(A) 2007-2009

Trip Level	Stratum Code	% Trips	
		Logbook	Observer
Low, Effort <= 53 hrs	L	63.9	29.7
High, Effort > 53 hrs	H	36.1	70.3

(B) 2010-2011

Trip Level	Stratum Code	% Trips	
		Logbook	Observer
Low, Catch <= 326 lbs	L	75.1	52.9
High, Catch > 326 lbs	H	24.9	47.1

(C) 2012-2020 (Open Season)

Trip Level	Stratum Code	% Trips	
		Logbook	Observer
Low, Catch <= 82 lbs	L	40.3	53.5
High, Catch > 82 lbs	H	59.7	46.5

Table 11. South Atlantic Gray Triggerfish vertical line trip and effort adjustment factors by management regime and strata level. Catch and effort strata levels are defined in Table 10; level stratum 'A' is all levels (i.e., no stratification) for the management regime, "H" and "L" are high and low, respectively. The proportions of Gray Triggerfish observer trips and effort with kept Gray Triggerfish were used to respectively adjust annual logbook total trips and effort (Table 12) to account for logbook trips that only had discarded fish.

					Proportion of Observer Data with Kept GT	
Management Regime	Season	Stratification Type	Level	Number of Observer Trips (n)	Trips	Effort
2007-2009	Open	Effort	L	11	1	1
2007-2009	Open	Effort	H	26	1	1
2010-2011	Open	Catch	L	9	1	1
2010-2011	Open	Catch	H	8	1	1
2012-2020	Open	Catch	L	23	0.957	0.992
2012-2020	Open	Catch	H	20	1	1
2012-2020	Closed	Catch	A	25	0.84	0.842

Table 12. Annual time-series of vertical line logbook trips (number) and effort (hours) by catch level strata for South Atlantic Gray Triggerfish.

				Logbook Trips		Logbook Effort	
Year	Season	Stratification Type	Level	Reported	Adjusted (N)	Reported	Adjusted ($\hat{X}$)
2007	Open	Effort	L	919	919	23,986	23,986
2007	Open	Effort	H	570	570	45,910	45,910
2008	Open	Effort	L	1,037	1,037	26,477	26,477
2008	Open	Effort	H	513	513	42,523	42,523
2009	Open	Effort	L	941	941	22,910	22,910
2009	Open	Effort	H	554	554	46,407	46,407
2010	Open	Catch	L	964	964	41,265	41,265
2010	Open	Catch	H	296	296	16,664	16,664
2011	Open	Catch	L	1,028	1,028	40,282	40,282
2011	Open	Catch	H	365	365	18,294	18,294
2012	Open	Catch	L	446	466	15,030	15,152
2012	Open	Catch	H	573	573	22,413	22,413
2012	Closed	Catch	A	84	100	3,427	4,072
2013	Open	Catch	L	218	228	7,131	7,189
2013	Open	Catch	H	399	399	15,529	15,529
2013	Closed	Catch	A	118	140	4,291	5,098
2014	Open	Catch	L	183	191	3,735	3,765
2014	Open	Catch	H	425	425	14,082	14,082
2014	Closed	Catch	A	71	85	3,376	4,011
2015	Open	Catch	L	386	404	10,404	10,489
2015	Open	Catch	H	643	643	21,488	21,488
2015	Closed	Catch	A	94	112	3,492	4,149
2016	Open	Catch	L	584	611	16,882	17,020
2016	Open	Catch	H	756	756	26,612	26,612
2016	Closed	Catch	A	12	14	514	611
2017	Open	Catch	L	665	695	18,158	18,306
2017	Open	Catch	H	757	757	25,761	25,761
2017	Closed	Catch	A	56	67	1,456	1,730
2018	Open	Catch	L	489	511	11,840	11,937
2018	Open	Catch	H	700	700	24,933	24,933
2018	Closed	Catch	A	93	111	3,135	3,725
2019	Open	Catch	L	336	351	7,159	7,217
2019	Open	Catch	H	740	740	25,544	25,544

				Logbook Trips		Logbook Effort	
Year	Season	Stratification Type	Level	Reported	Adjusted (N)	Reported	Adjusted ($\hat{X}$)
2019	Closed	Catch	A	28	33	1,196	1,421
2020	Open	Catch	L	577	603	15,922	16,052
2020	Open	Catch	H	762	762	29,197	29,197
2020	Closed	Catch	A	9	11	194	231

Table 13. Estimated observer mean CPUE in weight and numbers by management regime and catch level strata for expansion estimates of vertical line South Atlantic Gray Triggerfish catch and discards.

				Observer CPUE, pounds per hour		Observer CPUE, numbers per hour	
Management Regime	Season	Strata Type	Level	Kept	Discard	Kept	Discard
2007-2009	Open	Effort	L	6.126	0.145	2.246	0.060
2007-2009	Open	Effort	H	2.350	0.011	0.788	0.008
2010-2011	Open	Catch	L	1.619	0.021	0.737	0.020
2010-2011	Open	Catch	H	13.774	0.081	5.057	0.065
2012-2020	Open	Catch	L	0.974	0.029	0.347	0.026
2012-2020	Open	Catch	H	10.702	0.123	3.635	0.085
2012-2020	Closed	Catch	A	1.522	0.208	0.485	0.084

Table 14. Time-series of CPUE expansion estimates for South Atlantic Gray Triggerfish vertical line discards in weight (lbs.) and number (with associated standard errors).

Year	Estimated Discards in Weight	SE of Estimated Discards in Weight	Estimated Discards in Number	SE of Estimated Discards in Number
1993	2,987	1,936	1,344	646
1994	4,347	2,817	1,932	929
1995	5,172	3,352	2,289	1,101
1996	4,237	2,746	1,882	905
1997	6,263	4,059	2,751	1,323
1998	5,442	3,527	2,346	1,128
1999	4,035	2,615	1,756	845
2000	2,805	1,818	1,234	593
2001	2,979	1,930	1,319	634
2002	2,865	1,857	1,262	607
2003	2,767	1,793	1,203	578
2004	3,152	2,043	1,390	668
2005	3,602	2,335	1,591	765
2006	3,172	2,056	1,423	684
2007	4,009	2,599	1,811	871
2008	4,332	2,808	1,933	929
2009	3,859	2,501	1,750	842
2010	2,235	834	1,903	792
2011	2,346	876	1,990	828
2012	4,033	1,215	2,632	741
2013	3,174	956	1,931	543
2014	2,672	805	1,628	458
2015	3,802	1,145	2,440	687
2016	3,881	1,169	2,744	772
2017	4,047	1,219	2,799	788
2018	4,178	1,258	2,734	769
2019	3,638	1,095	2,470	695
2020	4,092	1,232	2,906	818

Part II Figures

Figure 3. Map of sampling areas in the South Atlantic. These statistical areas are only reported for GSAFF data; however, both observer programs provide latitude and longitude set locations.

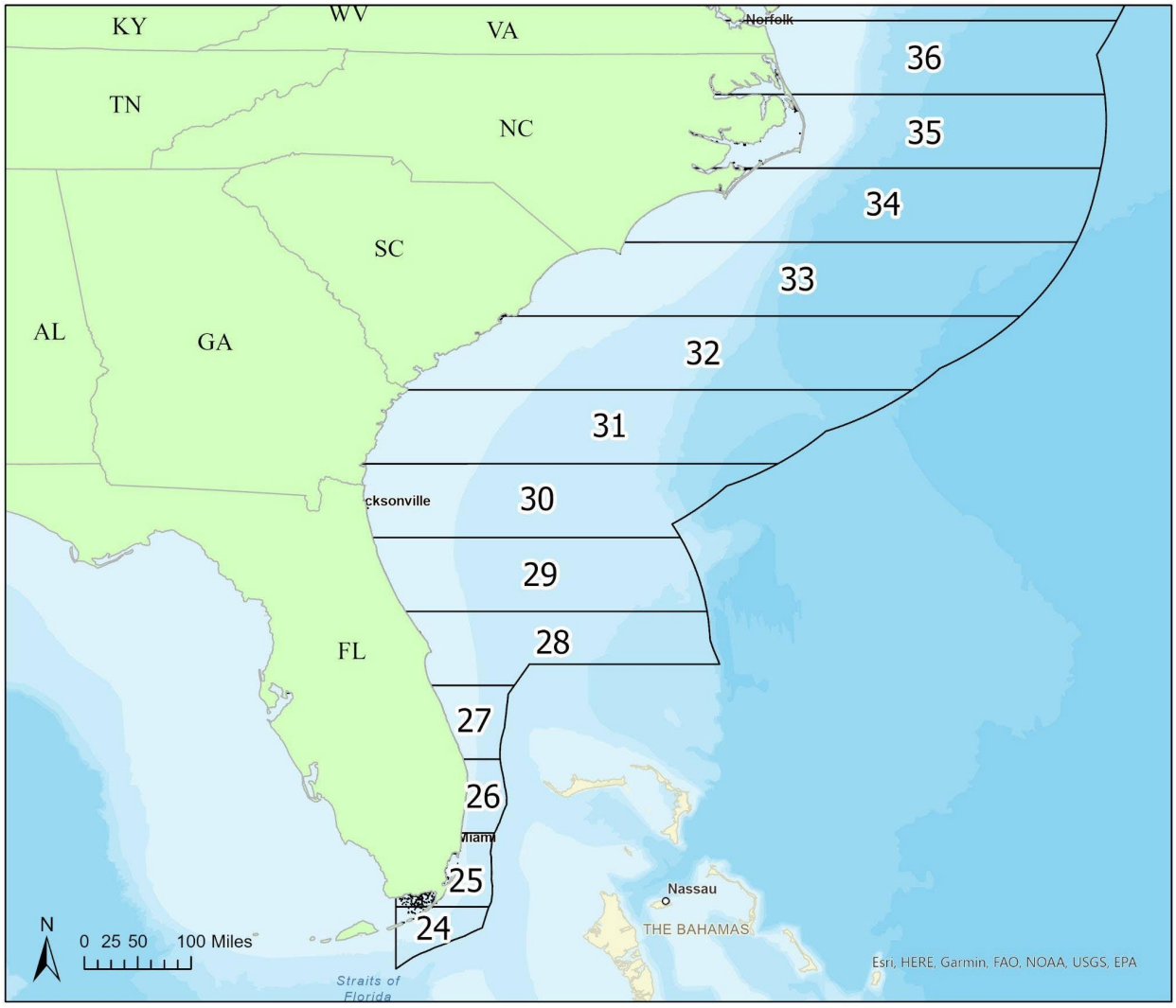


Figure 4. Length frequency comparison between Foundation (GSAFF) and SEFSC Panama City (SAVLOP) collected observer data for South Atlantic Gray Triggerfish. This comparison is for 2014-2015 years of overlap coverage. The dotted line indicates the 12 inch total length (27 cm fork length) minimum size limit for East FL.

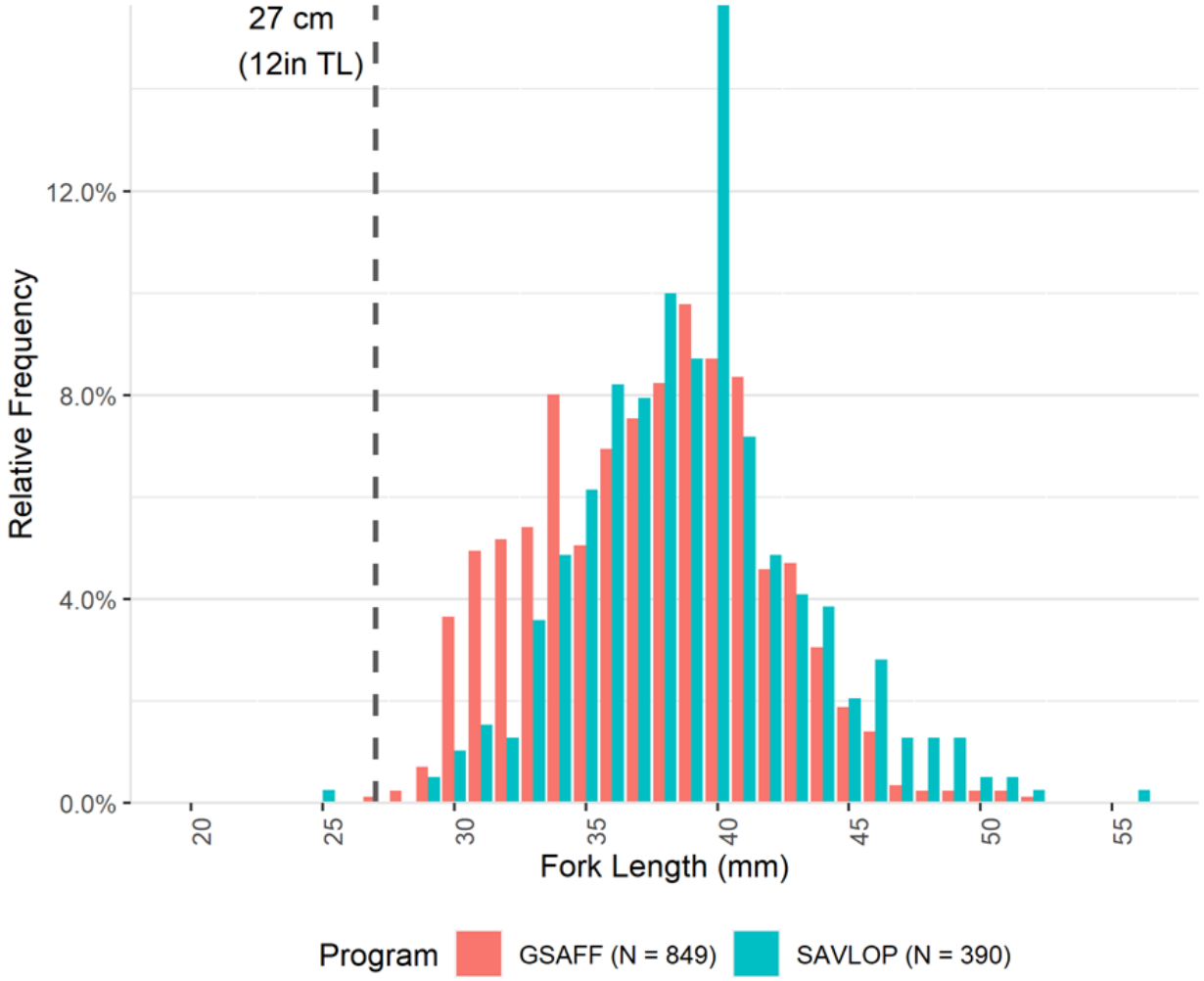


Figure 5. CPUE (catch in whole pounds per hour) time-series for logbook data from 2007 - 2020 for vertical line trips landing South Atlantic Gray Triggerfish.

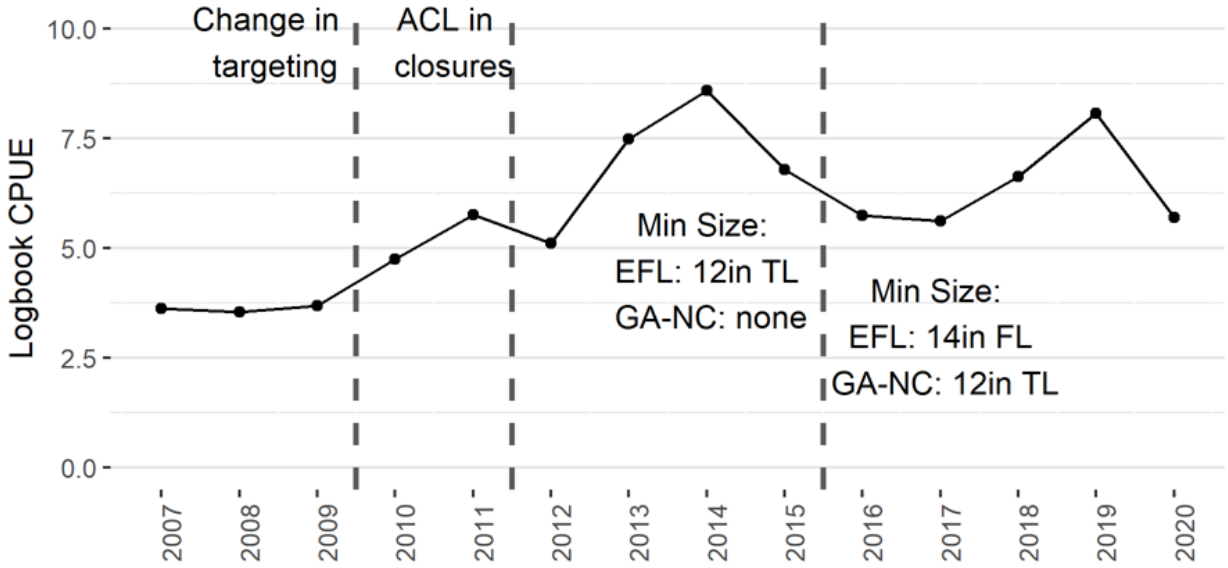


Figure 6. Length frequency comparison of kept fish by subregion (EFL and GA-NC). The plots by time period coincide with management actions. The dotted line indicates the 12 inch total length (27 cm fork length) minimum size limit for East FL. In July 2015, the minimum size limit of East FL increased to 14 inches fork length (35 cm) and a size limit was established off North Carolina, South Carolina, and Georgia (GA-NC) of 12 inches fork length (30cm).

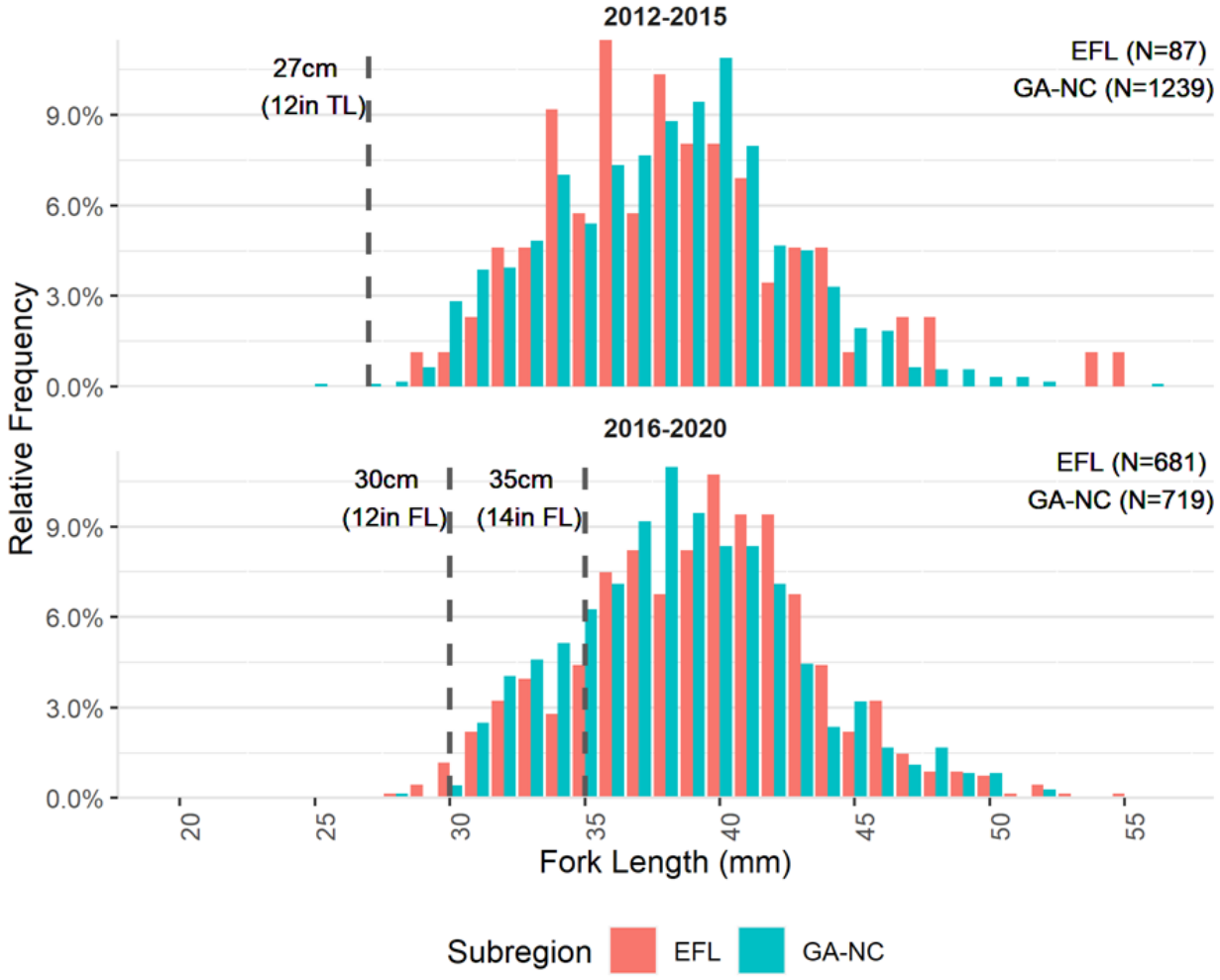


Figure 7. Comparison of vertical line reported annual logbook landings of South Atlantic Gray Triggerfish (solid black line) with CPUE expansion estimates from observer data (open squares). Error bars (SE) are shown for observer estimates.

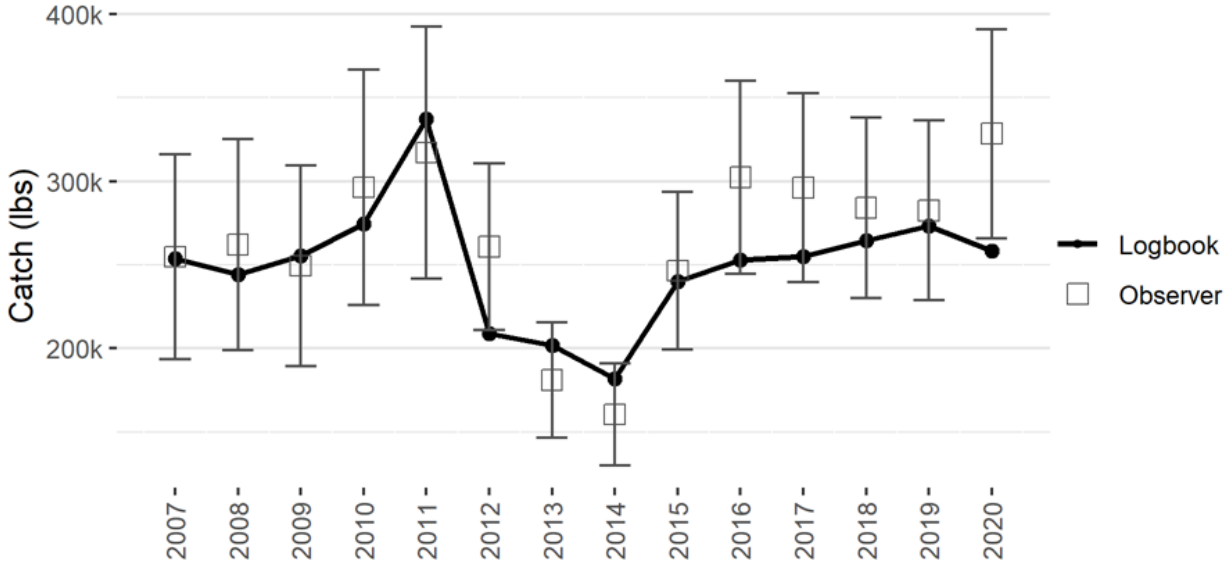
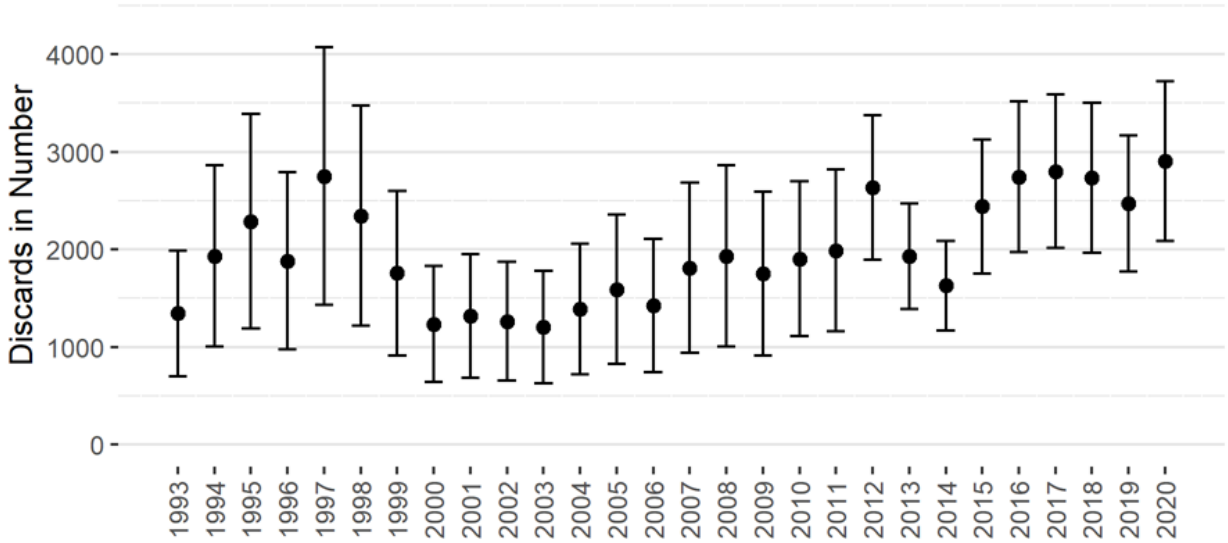


Figure 8. Observer CPUE expansion estimates of South Atlantic Gray Triggerfish vertical line annual discards (+/-SE) in (A) number and (B) weight expressed as percentage of total catch (kept + discards) for 2007 - 2020.

(A) Discards in Number



(B) Discards in Weight, Percentage of Total Catch

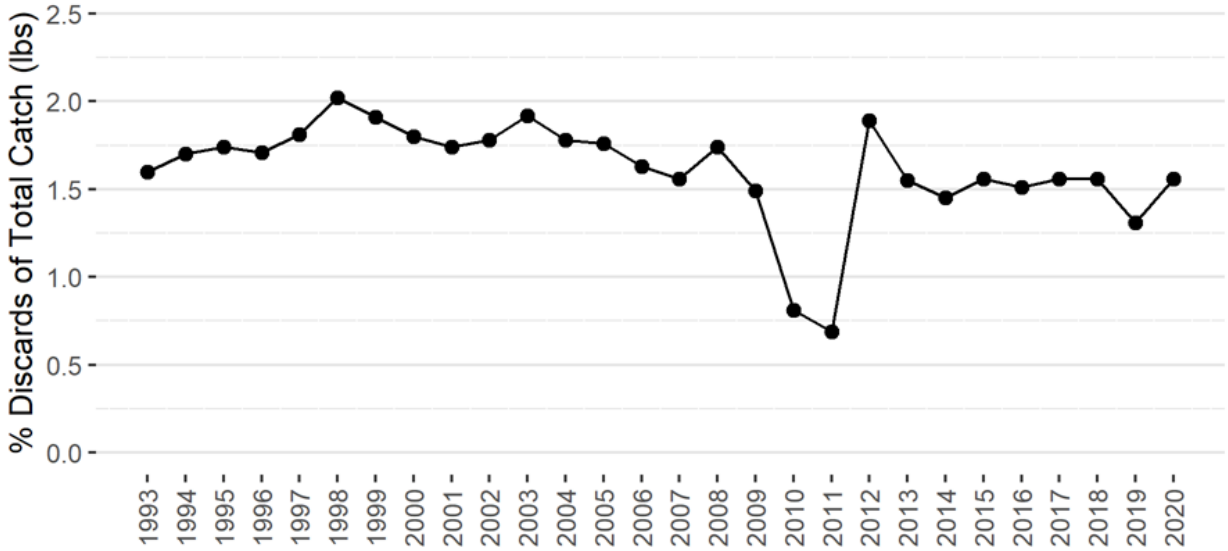
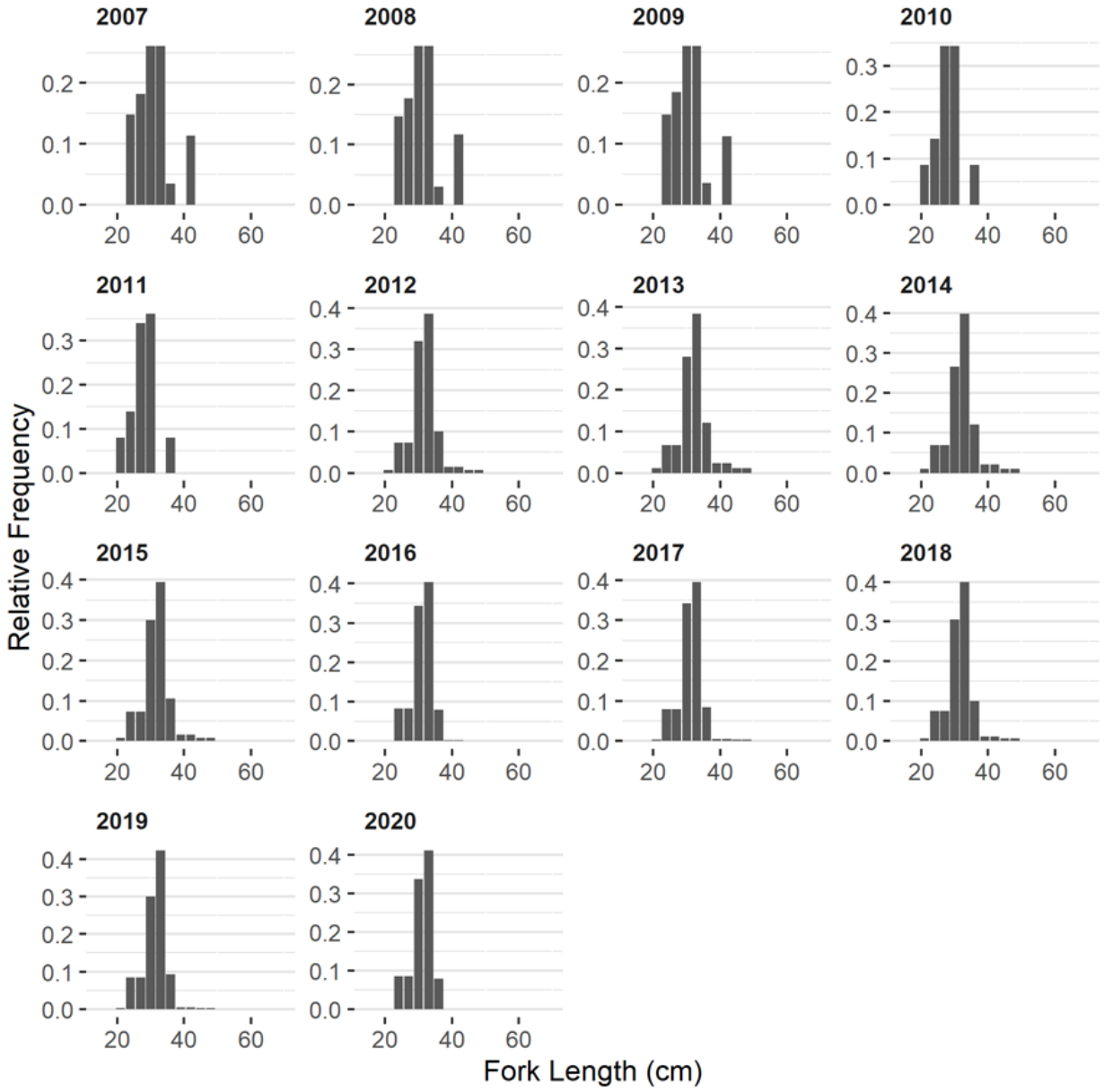


Figure 9. Annual discard length compositions for South Atlantic Gray Triggerfish, accounting for catch and effort level stratification by management period.



Part III - Comparison of Vertical Line Discard Estimates

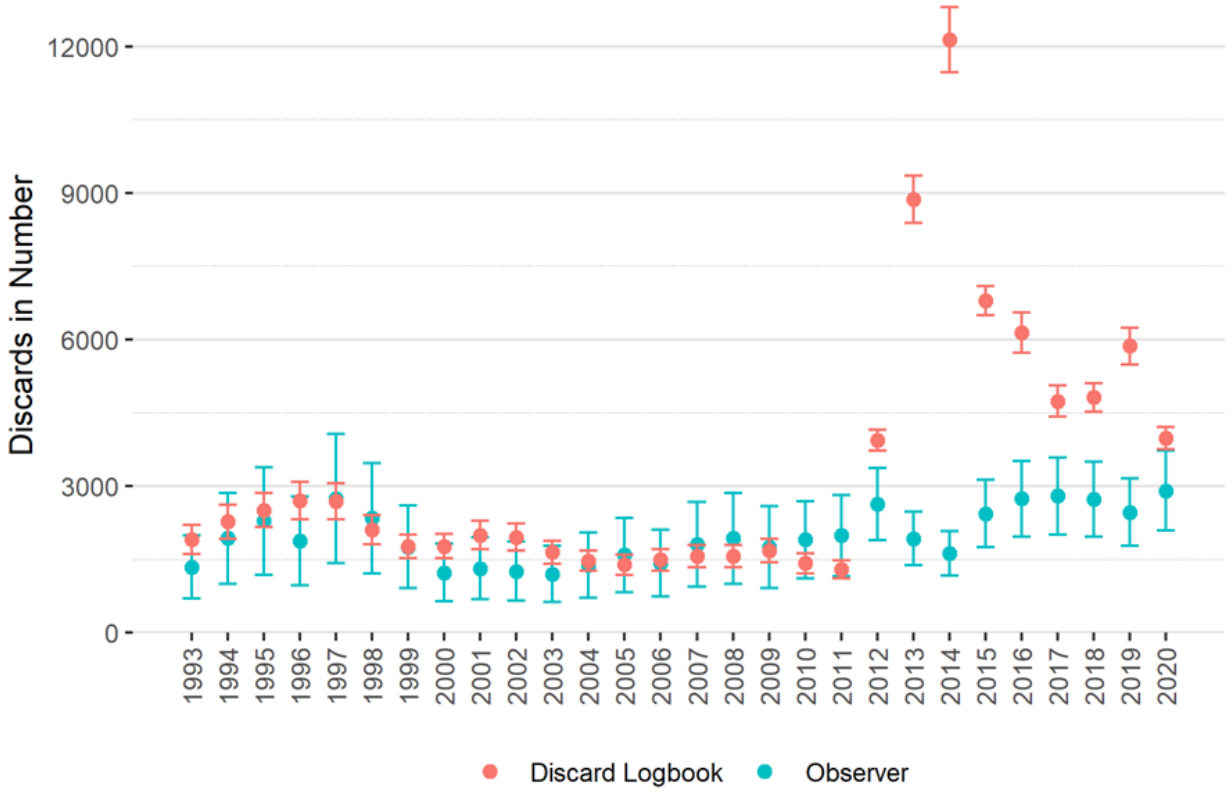
For the vertical line fishery, discard estimates from the discard logbook and observer methods were compared (Figure 10). Early in the time series (1993-2011), discard logbook estimates were comparable to observer discard estimates as most discard logbook estimates fell within one standard error of the observer discard estimates. However, from 2012 and on, discard logbook estimates were larger than estimated discards from the observer program. From 1993-2011, differences in logbook discard estimates and observer discard estimates were relatively small (20% mean average percentage error, ~ 359 fish average absolute difference) compared to post-2011 (54% mean average percentage error, ~ 3,890 fish average absolute difference). The post-2011 difference is mainly due to large discrepancies in estimated efforts for the 2013-2015 time period (~7,270 fish average absolute difference). The other years (2012, 2016-2020) in this time frame generally have larger differences compared to the pre-2012 time period (~ 2,200 fish average absolute difference) as well.

Recommendations

The discard team recommends that the observer program methodology for calculating discards be utilized for SEDAR 82. The observer discard approach has a built in verification procedure which has proven to be reliable in discard estimation in the Gulf of Mexico. This paper has shown this methodology can be translated to the South Atlantic. In contrast, the discard logbook methodology has been documented to have reliability issues due to accuracy in reporting trips with and without discards.

Part III Figures

Figure 10. Comparison of vertical line discard estimates (in number) between the discard logbook method (Part I) and observer method (Part II).



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