Vermilion Snapper Length Frequencies from At-Sea Headboat and Charter Observer Surveys in the South Atlantic, 2005 to 2016

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SEDAR55-WP05

Submitted: 14 November 2017

Please cite this document as:

Lazarre, D., B. Sauls, C. Wilson, and K. Fitzpatrick. 2017. Vermilion Snapper Length Frequencies from At-Sea Headboat and Charter Observer Surveys in the South Atlantic, 2005 to 2016. SEDAR55-WP05. SEDAR, North Charleston, SC. 14 pp.

Vermilion Snapper Length Frequencies from At-Sea Headboat and Charter Observer Surveys in the South Atlantic, 2005 to 2016.

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For:
SEDAR 56, South Atlantic Vermilion Snapper Data Workshop, 2017.

Detailed information on the size and release condition of discarded fish is not collected in traditional dockside surveys of recreational fisheries. At-sea observer surveys have been implemented to fill this data gap, providing valuable information on the size and condition of discarded fish. These surveys have been conducted on headboat vessels in the south Atlantic Ocean since 2004, with data for this report including data collected between 2005 and 2016. In this region, most headboat trips engage in bottom fishing for reef fish species, including vermilion snapper, and other bottom dwelling fish. At-sea coverage was expanded to include charter vessels on the east coast of Florida from 2013-2015. This report provides a summary of available information on the size and disposition of vermilion snapper collected on headboats and charterboats along the south Atlantic coast from North Carolina to Florida (including the Florida Keys).

Sample Methods

Cooperative vessels were randomly selected each month from six sample regions: The Florida Keys (Monroe County), southeast Florida (Dade to Indian River counties), northeast Florida (Broward to Duval counties), Georgia, South Carolina, and North Carolina. Operators from selected vessels were contacted by state biologists and were scheduled to sample a single trip in a selected week. Dependent upon the number of customers on board, one or two biologists accompanied passengers during the scheduled trip. The captain and mates cooperated by making sure fish caught by their anglers were observed by one of the biologists before they were stored in the fish hold or released overboard. Biologists would assist with dehooking fish for data collection, but were not permitted to influence the decision to keep or release a fish. For each fish, biologists recorded the species, disposition, size (fork length in mm), and the condition of fish that were released. Release conditions were not recorded in South Carolina or North Carolina.

A brief interview with each angler observed during a trip was also conducted to collect information on primary and secondary target species, angler avidity, and state and county of residence.

Data Elements

Trip level information for each trip included the area fished, duration of fishing (to the nearest half hour), number of anglers, and minimum and maximum depths (feet) of the fishing sites.

Area fished for North Carolina, South Carolina, southeast and northeast Florida was coded as:
1: 3 miles or less from shore; or
2: more than 3 miles from shore

Area fished for the Florida Keys were coded as:
3: 10 miles or less from shore; or
4: more than 10 miles from shore.

Characterization of Trips duration:
- Half-Day (H): < 6 hours
- Three-Quarter-Day (Q): 6 to 8.5 hours
- Full-day (F): 9 or more hours

Dispostion was coded as:
1: thrown back alive, legal;
2: thrown back alive, not legal;
3: plan to eat;
4: used for bait or plan to use for bait;
5: sold or plan to sell;
6: thrown back dead or plan to throw away.

Sample Weighting
Headboat vessels report fishing effort in logbook trip reports, and effort data were provided by the NMFS Southeast Fisheries Science Center in Beaufort, NC (Table 1). It was important to appropriately weight sample data for headboats before characterizing discards. In Florida, half day headboat trips were over sampled in the fishery observer surveys relative to total effort. The raw Florida discard length frequencies data were weighted to account for the difference in sampling by trip types (Table 2). Trip length information was not provided with the discard data for North Carolina to Georgia, so those discard data were not weighted by trip type.

To obtain the sample weight (W_t), proportional fishing effort for a given trip type was divided by the proportional sampling effort for the same trip type:

$$W_t = N_t/N/n_t/n$$

Where N_t/N is the number of trips of type t divided by total number of trips reported on logbook trip reports, and n_t/n is the number of trips of type t sampled during fishery observer surveys divided by

the total number of sampled trips. Trip-types with $W_t < 1$ are down-weighted to account for oversampling, and trip-types with $W_t > 1$ are inflated to account for undersampling.

A secondary weight was calculated to account for the differences in the number of trips sampled in Florida as compared to the states from North Carolina to Georgia. To obtain the sample weights (W_a) for each region, proportional fishing effort for the south Atlantic was divided by the proportional sampling effort for each region (SEFL – east coast of Florida including the Florida Keys & NC-GA – North Carolina to Georgia:

$$W_a = N_a/N/n_a/n$$

No weights were generated for the charter fishery.

Characterization of Discards:
Fish mid-line lengths (in mm) for discarded fish were tranformed to total length using the total length to midline length relationship provided by Jennifer Potts for SEDAR 17.

$$TL = 7.21 + (1.09 * FL)$$

Transformed lengths were placed in one cm length bin categories (100 cm bin = fish 99.51cm to 100.50cm). Fish in each length bin category were summed by region and trip-type for Florida and multipled by the weight (W_t) for each trip type to generate weighted discard frequencies for each length bin. The weighted frequency of fish in a single length bin (x) was calculated as follows:

$$L_{x_{1\ldots n}} = \sum L_H * W_H + \sum L_Q * W_Q + \sum L_F * W_F$$

Where L_H equals the number of fish in each length bin x for discarded fish collected on half day trips, L_Q correspong with ¾ day trips, and L_F coorespond with full day trips.

The weighted frequencies from Florida and the raw length frequencies from NC to Georgia were then multiplied by the regional weights calculated based on the number of trips by region and year. The proportion of fish in a single length bin (p_x) was calculated as follows:

$$p_x = \frac{\sum L_{SEFL} * W_{SEFL} + \sum L_{NC-GA} * W_{NC-GA}}{\sum (bin = i = 1\ldots n[\sum L_{SEFL} * W_{SEFL} + \sum L_{NC-GA} * W_{NC-GA}]}$$

Where L_a equals the number of fish in length bin x for a discarded fish in Florida; and W_a is the weighting factor for each region: SEFL = discarded fish from the southeast Florida and the Florida Keys and NC-GA = discarded fish from North Carolina to Georgia. The denominator is the sum of all numerators from length bin 1 to length bin n.

The discard length frequency for charter vessels was calculated by summing the raw number of fish by disposition (harvest or discard) and length bin and dividing this by the total number of fish by disposition.

Results
Weighted length frequency histograms for released (discarded) vermilion snapper for each sample year are presented in the figures below for both the headboat and charter fisheries (Figure 1 and Figure 2). Summary statistics for fish captured on headboat vessels are presented in Table

4. The ratio and percent of harvested to discarded fish are presented in Table 5, for the headboat fishery. Lastly, summary statistics for fish captured on charter vessels are presented in Table 6.

Table 1. Headboat at-sea observer trips sampled by state and year.

Year	NC (n_i)	SC (n_i)	GA (n_i)	SEFL (n_i)	Sum (n)
2005	97	58	6	174	335
2006	88	45	7	161	301
2007	91	52	8	165	316
2008	78	39	3	128	248
2009	69	34	9	128	240
2010	83	26	3	142	254
2011	79	22	3	136	240
2012	78	36	11	148	273
2013	55	41	11	147	254
2014	70	41	12	138	261
2015	57	27	10	133	227
2016	76	28	9	160	273
Total	921	449	92	1760	3222

Table 2. Sample weights applied to Florida headboat discards, based on length of trips (trip types).

Year	Half Day	3/4 Day	Full Day
2005	0.829	0.413	2.673
2006	0.823	0.229	5.397
2007	0.906	0.269	3.765
2008	1.171	0.303	1.466
2009	1.107	0.245	2.920
2010	1.062	0.269	1.768
2011	1.098	0.382	1.690
2012	1.285	0.290	1.419
2013	1.189	0.453	0.926
2014	1.118	0.600	0.760
2015	1.156	0.681	0.513
2016	1.100	0.793	0.660

Table 3. Sample weights applied to south Atlantic discards by region.

Year	SEFL	NC-GA
2005	1.148	0.840
2006	1.073	0.916
2007	1.090	0.902
2008	1.369	0.606
2009	1.369	0.578
2010	1.283	0.641
2011	1.231	0.698
2012	1.337	0.601
2013	1.331	0.545
2014	1.519	0.418
2015	1.393	0.444
2016	1.318	0.550

Table 4 . Summary statistics for Atlantic coast vermilion snapper lengths (fork lengths) observed in the headboat fishery. Harvest includes fish kept, used for bait, or discarded dead.

Region	Year	HARVESTED				RELEASED ALIVE			
		Number Measured	*Minimum*	*Maximum*	*Mean*	*Number Measured*	*Minimum*	*Maximum*	*Mean*
North Carlina	2005	672	240	444	328	202	110	375	231
	2006	297	209	440	313	180	145	291	228
	2007	462	274	422	331	121	122	307	232
	2008	471	229	421	328	236	104	290	241
	2009	139	268	439	324	118	141	387	256
	2010	478	215	450	325	289	166	435	267
	2011	395	270	422	329	191	128	353	253
	2012	521	225	459	330	314	109	438	280
	2013	399	167	433	330	207	171	529	261
	2014	147	226	391	319	58	142	320	253
	2015	117	183	386	312	49	182	303	252
	2016	416	230	424	318	340	179	401	271
South Carolina	2005	809	203	491	322	191	181	309	233
	2006	275	249	484	335	20	205	271	250
	2007	402	200	433	336	79	192	360	264
	2008	185	212	438	320	69	150	327	241
	2009	-	-	-	-	12	109	269	201
	2011	173	253	449	339	278	168	440	278
	2012	122	243	449	352	92	122	382	285
	2016	118	281	417	339	64	219	338	283

Georgia	2006	28	288	395	369	6	255	276	267
	2007	9	320	401	369	60	169	302	250
	2008	45	266	411	315	51	220	288	256
	2009	178	260	423	300	96	204	318	257
	2010	27	278	375	320	12	242	364	286
	2012	56	273	378	324	37	211	420	301
	2013	193	268	412	321	22	207	317	263
	2014	217	265	399	315	15	217	271	255
	2015	105	261	410	327	39	228	376	311
	2016	75	270	425	318	27	225	353	266
East Florida	2005	291	121	451	279	259	132	299	230
	2006	188	102	435	273	308	162	318	235
	2007	410	142	400	261	753	100	303	244
	2008	381	109	701	259	735	149	332	243
	2009	274	164	466	277	1260	111	350	250
	2010	176	132	806	285	466	154	455	255
	2011	125	176	348	287	249	166	345	259
	2012	237	227	475	308	183	202	344	274
	2013	277	221	516	307	176	175	382	259
	2014	343	160	359	296	252	125	294	229
	2015	372	157	421	296	513	174	286	237
	2016	449	172	407	294	571	156	313	239
South Atlantic	2005	1772	121	491	328	652	110	375	232
	2006	788	102	484	369	514	145	318	245
	2007	1283	142	433	369	1013	100	360	247
	2008	1082	109	701	328	1091	104	332	246
	2009	591	164	466	324	1486	109	387	241
	2010	681	132	806	325	767	154	455	269
	2011	693	176	449	339	718	128	440	263
	2012	936	225	475	352	626	109	438	285
	2013	869	167	516	330	405	171	529	261
	2014	707	160	399	319	325	125	320	245
	2015	594	157	421	327	601	174	376	267
	2016	1058	172	425	339	1002	156	401	265

Table 3. Ratio and percent of vermilion snapper released alive from sampled trips in the headboat at-sea observer survey.

Region	Year	Number Killed	Number Released Alive	Release Ratio[1]	Release Percent[2]
North Carolina	2005	202	672	0.3006	23.11
	2006	180	297	0.6061	37.74
	2007	121	462	0.2619	20.75
	2008	236	471	0.5011	33.38
	2009	118	139	0.8489	45.91
	2010	289	478	0.6046	37.68
	2011	191	395	0.4835	32.59
	2012	314	521	0.6027	37.60
	2013	207	399	0.5188	34.16
	2014	58	147	0.3946	28.29
	2015	49	117	0.4188	29.52
	2016	340	416	0.8173	44.97
South Carolina	2005	191	809	0.2361	19.10
	2006	20	275	0.0727	6.78
	2007	79	402	0.1965	16.42
	2008	69	185	0.3730	27.17
	2009	12	-	-	-
	2011	278	173	1.6069	61.64
	2012	92	122	0.7541	42.99
	2016	64	118	0.5424	35.16
Georgia	2006	6	28	0.2143	17.65
	2007	60	9	6.6667	86.96
	2008	51	45	1.1333	53.13
	2009	96	178	0.5393	35.04
	2010	12	27	0.4444	30.77
	2012	37	56	0.6607	39.78
	2013	22	193	0.1140	10.23
	2014	15	217	0.0691	6.47
	2015	39	105	0.3714	27.08
	2016	27	75	0.3600	26.47
East Florida	2005	259	291	0.8900	47.09
	2006	308	188	1.6383	62.10
	2007	753	410	1.8366	64.75
	2008	735	381	1.9291	65.86
	2009	1260	274	4.5985	82.14

	2010	466	176	2.6477	72.59
	2011	249	125	1.9920	66.58
	2012	183	237	0.7722	43.57
	2013	176	277	0.6354	38.85
	2014	252	343	0.7347	42.35
	2015	513	372	1.3790	57.97
	2016	571	449	1.2717	55.98
South Atlantic	2005	652	1772	0.3679	26.90
	2006	514	788	0.6523	39.48
	2007	1013	1283	0.7896	44.12
	2008	1091	1082	1.0083	50.21
	2009	1486	591	2.5144	71.55
	2010	767	681	1.1263	52.97
	2011	718	693	1.0361	50.89
	2012	626	936	0.6688	40.08
	2013	405	869	0.4661	31.79
	2014	325	707	0.4597	31.49
	2015	601	594	1.0118	50.29
	2016	1002	1058	0.9471	48.64

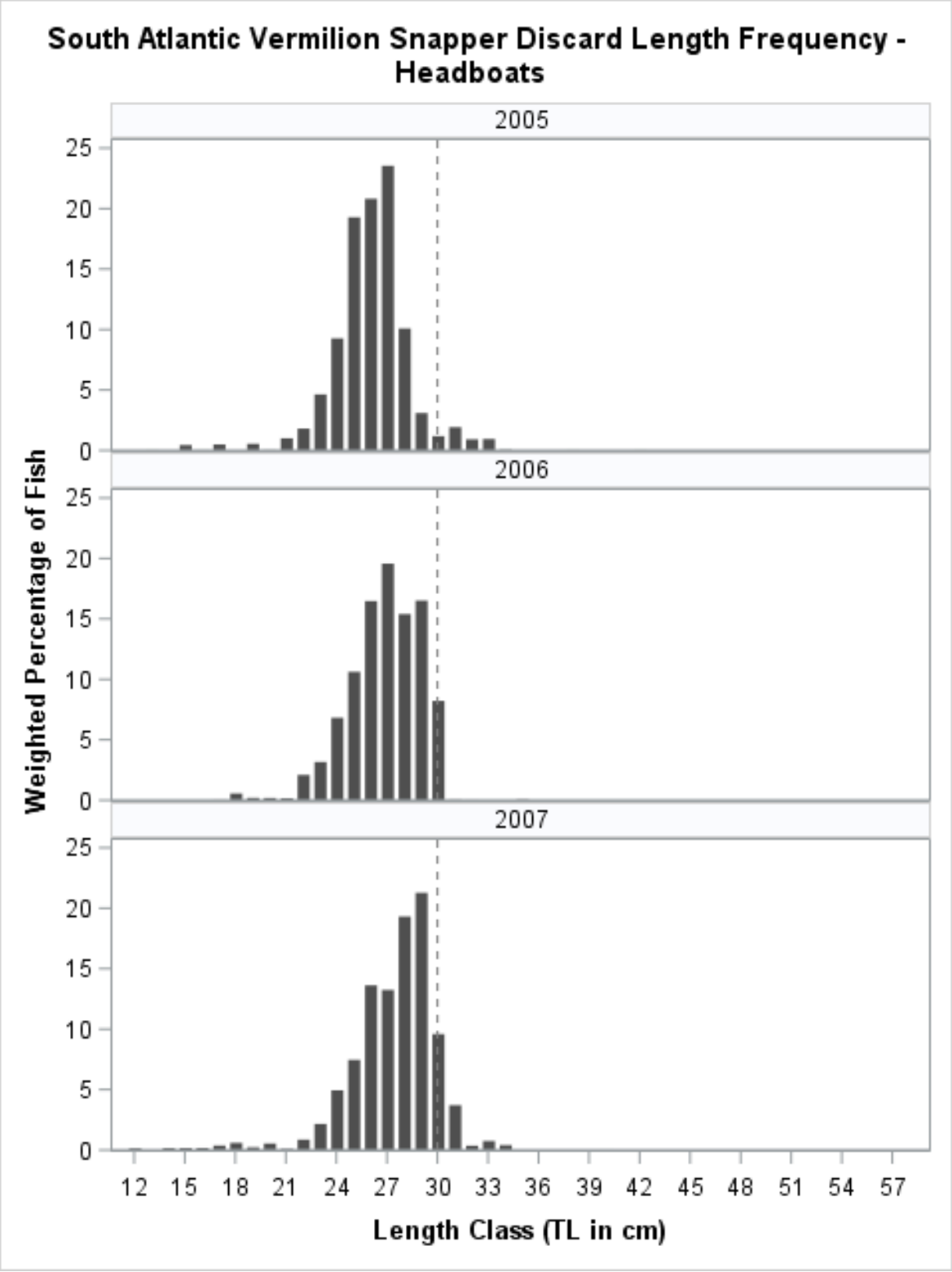
[1] Release ratio – Total fish released alive / Total fish killed (Harvested, used for bait, or released dead).

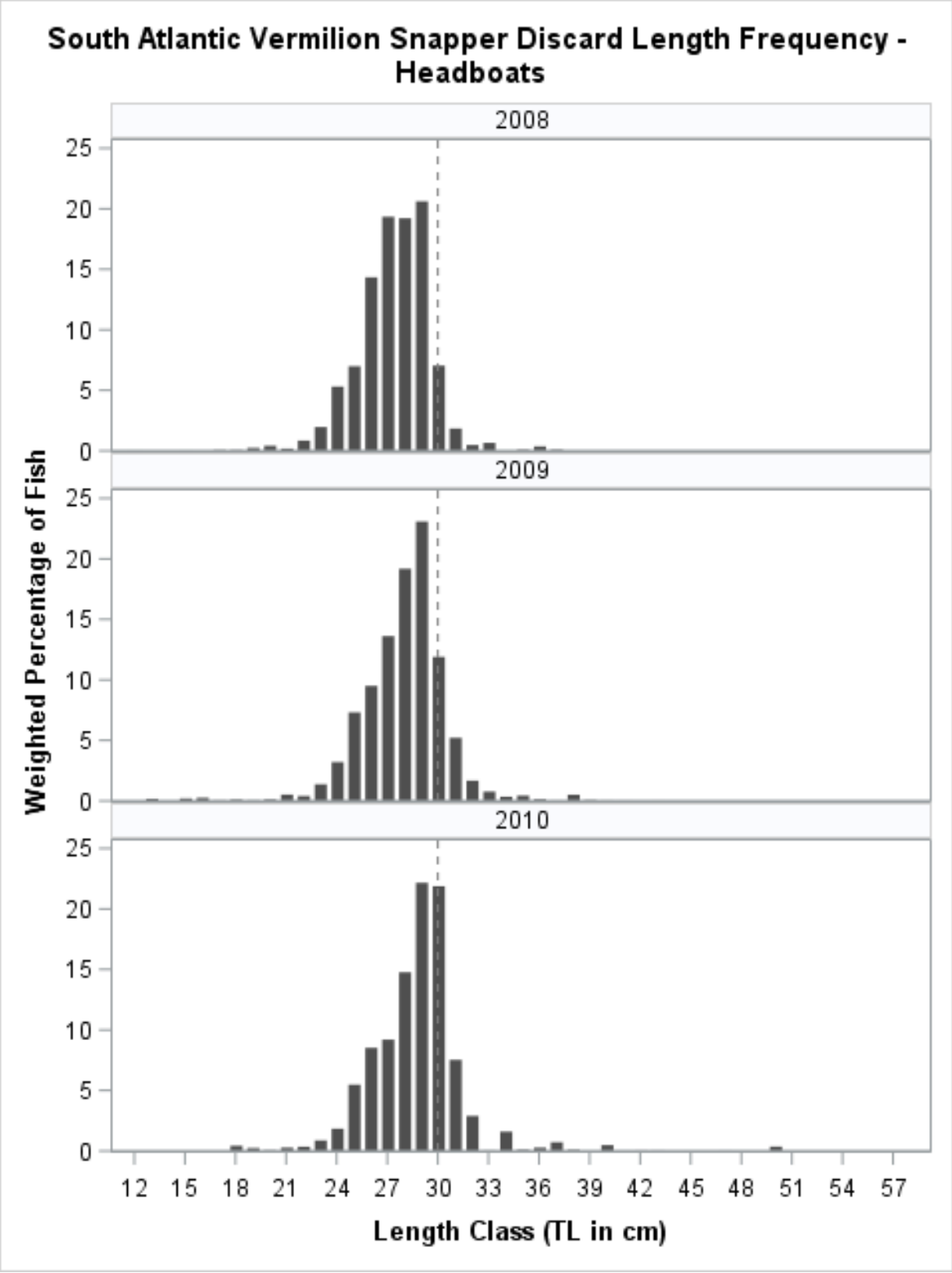
[2] Release percent – Total fish released alive / Total fish (released alive and killed)*100.

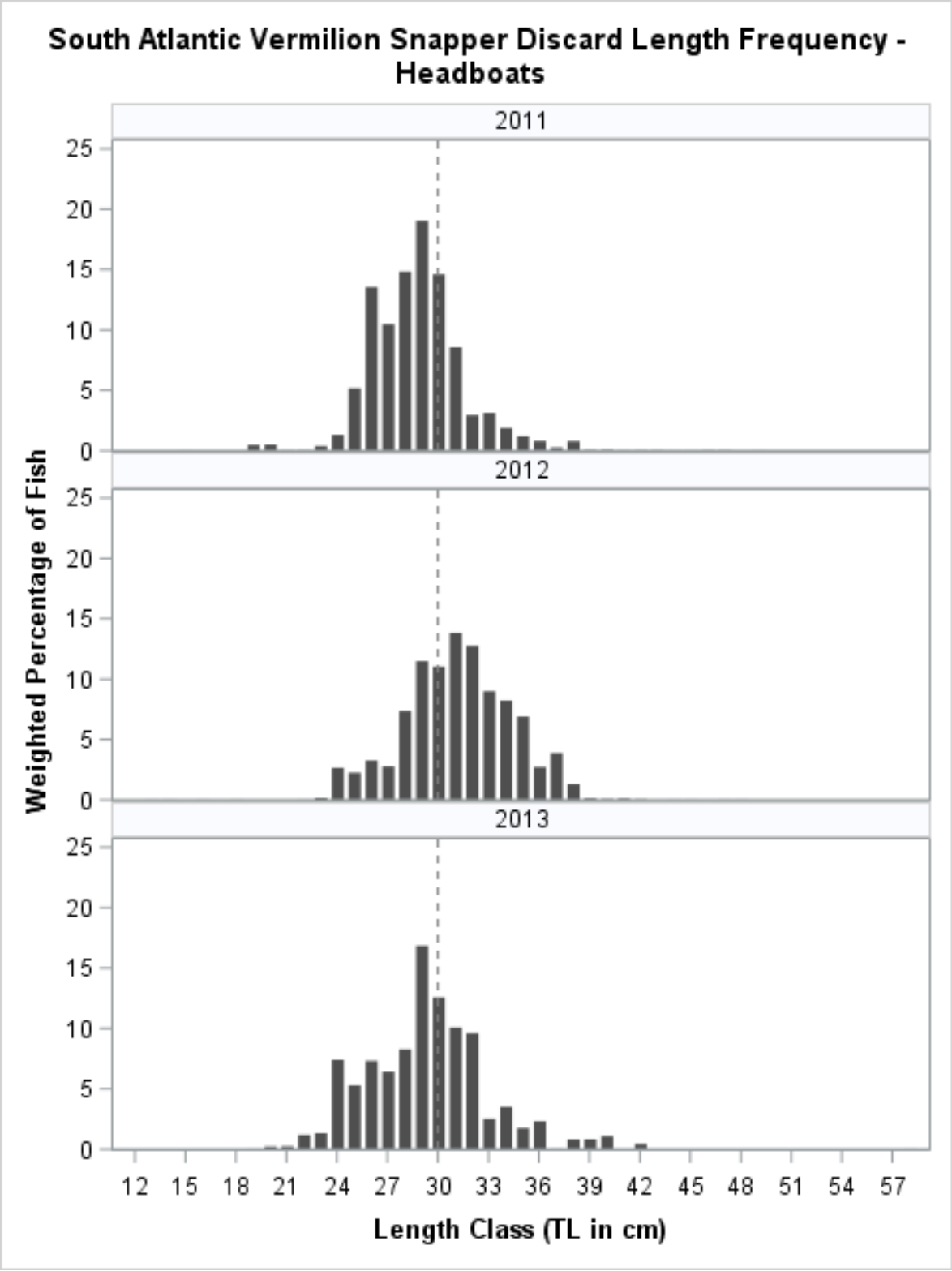
Table 5. Summary statistics for Atlantic coast vermilion snapper lengths (total lengths) in Florida's charter boat fishery . Harvest includes fish kept, used for bait, or discarded dead.

Year	**HARVESTED**				**RELEASED ALIVE**			
	Number Measured	*Minimum*	*Maximum*	*Mean*	*Number Measured*	*Minimum*	*Maximum*	*Mean*
2013	517	234	533	379	103	195	488	326
2014	810	183	588	361	103	195	488	326
2015	581	227	490	351	209	183	406	276

Figure 1. Weighted length frequencies of released vermilion snapper collected on headboats in the South Atlantic Ocean. The dotted lines in each pane correspond with the size limit for the species (12 inches~30.5 cm).




South Atlantic Vermilion Snapper Discard Length Frequency - Headboats
2008
2009
2010
Weighted Percentage of Fish
0
5
10
15
20
25
12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57
Length Class (TL in cm)


South Atlantic Vermilion Snapper Discard Length Frequency - Headboats
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0
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12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57
Length Class (TL in cm)

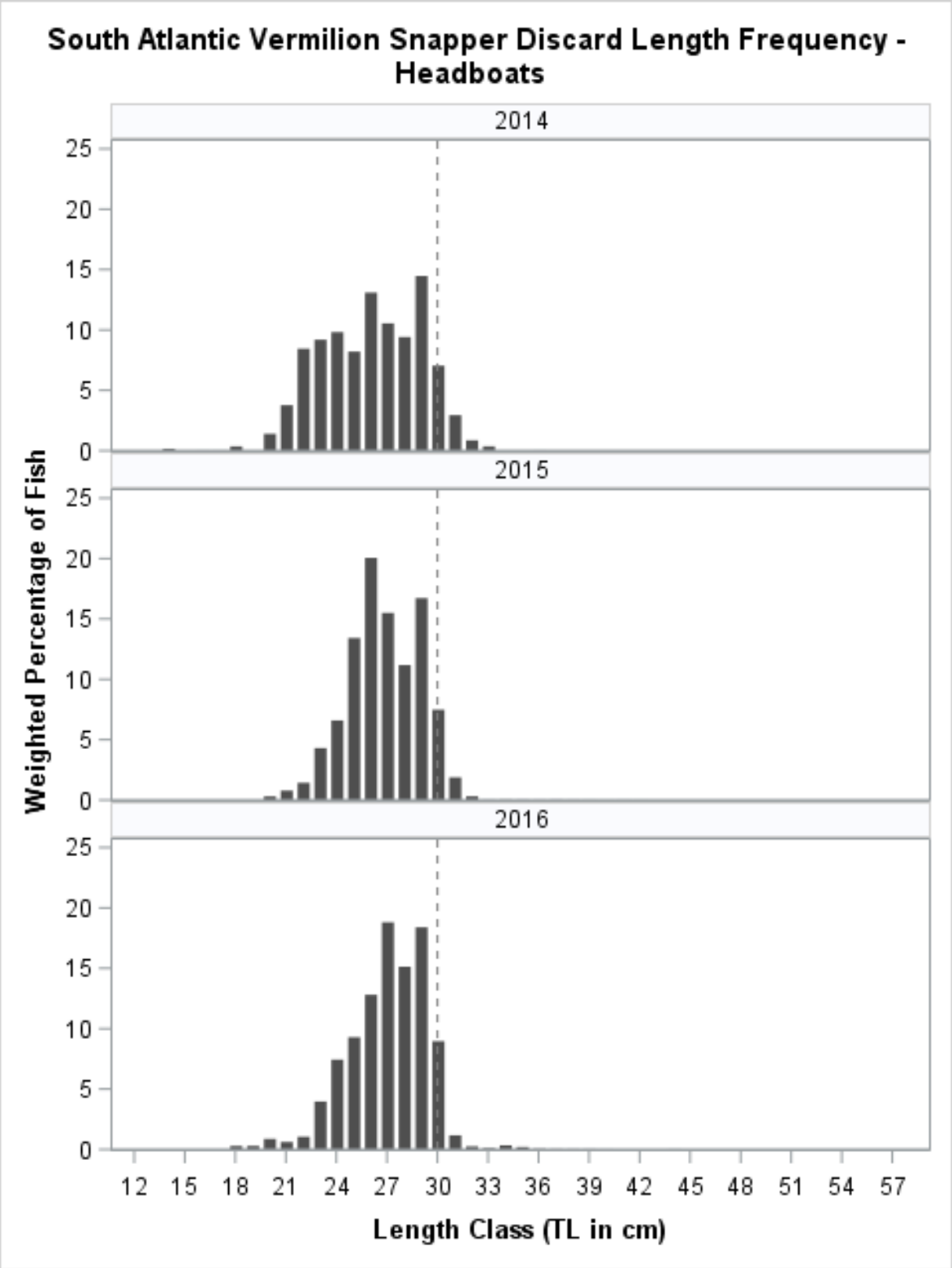
South Atlantic Vermilion Snapper Discard Length Frequency - Headboats
2014
2015
2016
Weighted Percentage of Fish
0
5
10
15
20
25
12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57
Length Class (TL in cm)

Figure 2. Length frequencies (unweighted) of harvested and released vermilion snapper collected on Florida charter vessels. The dotted lines in each pane correspond with the size limit for the species (12 inches~30.5 cm).