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SEDAR75-DW-01

29 April 2022



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Please cite this document as:

Flaherty-Walia, Kerry E., Amanda J. Tyler-Jedlund, and Theodore S. Switzer. 2022. Gray Snapper Abundance Indices from Inshore Surveys of Northeastern Gulf of Mexico estuaries (1996-2020). SEDAR75-DW-01. SEDAR, North Charleston, SC. 14 pp.

# Gray Snapper Abundance Indices from Inshore Surveys of Northeastern Gulf of Mexico estuaries (1996-2020)

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## Abstract

The Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute (FWRI), has conducted estuarine surveys since 1989 (seasonally) and since 1996 (monthly) in estuarine systems along the northern Gulf of Mexico. In SEDAR 51, monthly fisheries independent collections of Age 0 ( $\leq 100$  mm SL, 1998-2015) and Age 1 (101-250 mm SL, 1996-2015) Gray Snapper (*Lutjanus griseus*) were used to develop abundance indices that were included in the final stock assessment (SEDAR 2018). Appropriate estuarine systems and gears, as determined by abundance of defined size classes, were combined for each index by using a weighting factor that accounts for differences between the proportion of available area and the proportion of sets completed within each sampling universe. The analyses presented here use the same analytical methods employed in the previous working paper for SEDAR 51 (Flaherty-Walia et al. 2017).

## Survey Design

### FWRI long-term fishery-independent monitoring (FIM)

A stratified-random sampling design was employed to allocate sampling within each estuary. Sampling effort was allocated among spatial zones based on geographic and logistical criteria that defined areas of biological and hydrological homogeneity. Sampling sites were further stratified by habitat type depending on the estuary and gear type used. Sampling effort in each stratum for each estuary was proportional to the total number of potential sampling sites available. All sampling sites were selected randomly without replacement; this procedure was conducted monthly from 1996-2020. Estuaries sampled during long-term FWRI FIM surveys include Apalachicola Bay, Cedar Key, Tampa Bay, and Charlotte Harbor (Figure 1, Flaherty et al. 2014).

### *Gear:*

- 21.3-m  $\times$  1.8-m center-bag haul seine with 3.2-mm nylon mesh.
  - Bay deployments: Deployed in shallow ( $\leq 1.8$  m) shoreline (gr = 19) and offshore (gr = 20) bay habitats, the 21.3-m seine was pulled a distance of 9.1 m with a width of 15.5 m between the seine poles, sampling an area of approximately 140 m<sup>2</sup>. Seines were deployed along estuarine shorelines to sample areas with emergent

- vegetation, mangrove fringes, seawalls, and beaches. Seines were deployed offshore to sample flats at least 5 m from the shoreline; in all estuaries except Cedar Key, these deployments were stratified by the presence or absence of submerged aquatic vegetation (SAV; presence was defined as  $\geq 25\%$  SAV cover).
- River deployments: 21.3-m seines were deployed from the stern of a boat in a semi-elliptical pattern and retrieved onto shore, sampling an area of approximately 68 m<sup>2</sup>. Seines were deployed along river shorelines to sample areas with emergent vegetation, mangrove fringes, seawalls, and beaches.
  - 183-m  $\times$  2.5-m center-bag haul seine with 38-mm stretched nylon mesh: The seine was deployed by boat, set in a rectangular shape along the shoreline with a maximum depth of 2.5 m at the bag, and retrieved by hand. The dimensions of the area sampled by the net (approximately 40 m  $\times$  103 m = 4,120 m<sup>2</sup>) were standardized by marking 40 m from each end of the net to designate the corner locations of the rectangular set. In Tampa Bay and Charlotte Harbor, these deployments were stratified based on the presence or absence of overhanging vegetation (presence of overhanging vegetation was defined as  $\geq 10\%$  cover along the shoreline).

All Gray Snapper collected in each sample were identified and enumerated, and as many as 40 randomly selected individuals per sample were measured to the nearest mm standard length (SL). Location, date, time, and water depth at the bag of the net were recorded at each sampling site. Temperature ( $^{\circ}$  C) and salinity (psu) were recorded at the surface and at 1.0-m depth intervals and were averaged for each sample. Habitat variables (shore type and percentage cover of submerged aquatic vegetation [SAV]) were recorded at the time of sampling for each net set.

### **Data Exclusions**

Data for the FWRI long-term FIM surveys were limited to monthly sampling (1996-2020) in estuarine systems in which the annual proportion positive sets were greater than 5% in most years. Data from the 21.3-m seines from 1996 and 1997 were omitted since shoreline seines were not incorporated and Apalachicola Bay and Cedar Key were not sampled (Flaherty-Walia et al. 2017). Age 0 indices only included data from the recruitment window of July-December (Flaherty et al. 2014). Only data from Tampa Bay and Charlotte Harbor were included in the Age 1 indices due to low numbers of this size class collected in the northern estuaries (Flaherty et al. 2014, Flaherty-Walia et al. 2015, 2017). Tables 1-4 summarize the subset of data included in each index including number of sets, proportion positive, and number of Gray Snapper collected by year, gear, and estuary.

### **Index Construction**

Based on previous research, monthly length-frequency distributions, gear type, and gear selectivity (Starck and Schroeder 1971; Manooch and Matheson 1981; Domeier et al. 1996, Flaherty et al. 2014, Flaherty-Walia et al. 2015, 2017), two age classes were defined by size class: Age 0 Gray Snapper ( $\leq 100$  mm SL) collected with 21.3-m seines during the recruitment window of July-December and Age 1 Gray Snapper (101–250 mm SL) collected with 183-m

seines over all months. Annual Indices of Abundance (IOA) of Gray Snapper combined over estuarine systems for each age class were constructed using generalized linear modeling analyses. Indices were calculated as individuals per haul using a weighting factor that represented a ratio of the proportion of total area sampleable that occurred within each estuarine sampling area to the proportion of total sampling effort that occurred within each area to account for non-proportional sampling across estuarine areas (weighting factor = (estuarine sampling area/total sampling area)/(sets per estuary/total sets)). Class variables included in the model included year, bay system, month, shore type (overhanging vegetation, emergent vegetation, terrestrial vegetation, manmade structure, none), SAV percentage (divided into bins of 10%), and quantiles of water depth, temperature, and salinity as calculated by the reduced dataset. For the Age 0 index, the area sampled (effort) over 100 m<sup>2</sup> was incorporated as a covariate to account for different deployment methods of the 21.3-m seine (shoreline, offshore, and river). The relative abundance of Gray Snapper represents count data, the distribution of which is bound by zero and therefore often highly nonnormal. Accordingly, generalized linear models based on the Poisson distribution and the negative binomial distribution were fit to the data, and residual diagnostics and goodness-of-fit statistics were examined to determine the most appropriate model. For both indices, the model based on the negative binomial distribution was the most appropriate. With the exception of year, bay system, and variables associated with significant interactions, variables that were not significant ( $\alpha = 0.05$ ) and did not improve model fit based on the AIC value were removed, and the analysis was repeated until the most parsimonious model remained. For each age class, annual least square means ( $\pm$  SE) and annual coefficients of variation (mean  $\pm$  SD) were calculated. Because standard deviations associated with annual least-square-means from GLM analyses are not directly available, we created a sampling distribution by repeatedly ( $n = 10,000$ ) calculating a random deviate from the standard normal distribution ( $\mu = 0$ ,  $\sigma^2 = 1$ ). These deviates were then multiplied by the standard error, and products were added to the least square mean to generate the sampling distribution from which standard deviations were calculated. All analyses were fit using the GLIMMIX procedure and SAS software (SAS Institute 2006).

## **Results**

The subset of FWRI long-term FIM data used during index construction included a total of 20,493 stations sampled from 1998-2020 using 21.3-m seines in Apalachicola Bay, Cedar Key, Tampa Bay, and Charlotte Harbor (Tables 1-3) and 10,894 stations sampled from 1996-2020 using 183-m seines in Tampa Bay and Charlotte Harbor (Table 4).

### ***Indices of Abundance***

For age 0 and age 1 Gray Snapper indices, year, bay, month, shore type, SAV percentage, salinity, depth, and the interaction between year and bay were significant and retained in the model (Tables 5-6). Temperature was also significant for age 0 Gray Snapper, but the difference in area sampled by 21.3-m seine deployments (effort) was not. Tables 5-6 summarize type III tests of fixed effects and the final set of variables used in each model and their significance. Annual abundance indices and boot-strapped coefficients of variation are presented in Tables 7-8 and Figure 2.

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Table 1. Data included in the annual index for age-0 Gray Snapper collected during FWRI long-term FIM surveys using a 21.3-m seine along riverine shorelines (gear = 23). Annual sampling effort, proportion positive, and total number of age-0 Gray Snapper collected within Apalachicola Bay (AB), Cedar Key (CK), Tampa Bay (TB), and Charlotte Harbor (CH) are summarized.

Year	AB		CK		TB		CH	
	No. sets (proportion positive)	No. collected						
1998	.	.	54 (0.037)	3	130 (0.008)	1	48 (0)	0
1999	.	.	54 (0.111)	6	132 (0.023)	3	48 (0.042)	2
2000	30 (0.067)	4	54 (0.056)	3	124 (0.024)	3	48 (0)	0
2001	48 (0.083)	22	54 (0.111)	15	116 (0.103)	25	48 (0)	0
2002	48 (0.292)	21	69 (0.116)	12	114 (0.035)	4	48 (0)	0
2003	78 (0.026)	2	84 (0.071)	17	105 (0)	0	48 (0.021)	1
2004	78 (0.167)	21	84 (0.06)	9	116 (0.112)	17	48 (0.063)	7
2005	78 (0.026)	3	84 (0.071)	11	114 (0.018)	2	48 (0.021)	1
2006	78 (0.205)	36	84 (0.06)	9	121 (0.074)	10	48 (0)	0
2007	78 (0.077)	14	84 (0.107)	18	127 (0.071)	9	48 (0.083)	4
2008	78 (0.077)	7	84 (0.06)	9	138 (0.014)	2	48 (0.042)	2
2009	78 (0.077)	7	84 (0.19)	39	138 (0.029)	5	48 (0.083)	6
2010	78 (0.064)	5	84 (0.024)	3	120 (0.033)	5	48 (0.042)	3
2011	78 (0.064)	7	84 (0.06)	10	120 (0.025)	4	48 (0)	0
2012	78 (0.128)	13	84 (0.083)	8	120 (0.033)	5	48 (0.083)	7
2013	78 (0.013)	1	84 (0.012)	1	120 (0.025)	4	48 (0)	0
2014	78 (0.128)	19	84 (0.107)	13	144 (0.076)	15	48 (0.104)	5
2015	78 (0.013)	1	84 (0.071)	7	168 (0.012)	2	48 (0)	0
2016	78 (0.115)	13	84 (0.119)	19	153 (0.026)	13	48 (0.271)	28
2017	78 (0.026)	2	84 (0.06)	12	152 (0.02)	3	48 (0.063)	4
2018	78 (0.013)	1	84 (0.083)	9	151 (0.06)	9	48 (0.042)	2
2019	78 (0.013)	1	84 (0.083)	12	154 (0.026)	8	48 (0)	0
2020	42 (0.071)	3	84 (0.083)	13	151 (0.04)	8	48 (0.063)	5
	1,494		1,797		3,028		1,104	
Total	(0.083)	203	(0.08)	258	(0.04)	157	(0.073)	77

Table 2. Data included in the annual index for age-0 Gray Snapper collected during FWRI long-term FIM surveys using a 21.3-m seine deployed in offshore bay habitats (gear = 20). Annual sampling effort, proportion positive, and total number of age-0 Gray Snapper collected within Apalachicola Bay (AB), Cedar Key (CK), Tampa Bay (TB), and Charlotte Harbor (CH) are summarized.

Year	AB		CK		TB		CH	
	No. sets (proportion positive)	No. collected						
1998	24 (0.125)	10	72 (0)	0	120 (0.025)	3	71 (0.028)	3
1999	24 (0.125)	7	72 (0.042)	3	120 (0.1)	36	72 (0.236)	38
2000	24 (0.167)	11	72 (0.042)	9	120 (0.05)	16	71 (0.099)	12
2001	67 (0.149)	29	72 (0.028)	6	119 (0.143)	52	72 (0.153)	69
2002	66 (0.106)	25	72 (0.028)	2	119 (0.084)	37	72 (0.139)	73
2003	66 (0.136)	60	72 (0.056)	6	114 (0.061)	24	74 (0.243)	78
2004	66 (0.182)	77	54(0)	2	118 (0.093)	45	78 (0.269)	94
2005	66 (0.076)	10	72 (0)	0	118 (0.042)	6	78 (0.077)	12
2006	66 (0.167)	55	72 (0.069)	27	116 (0.069)	19	78 (0.231)	47
2007	66 (0.061)	6	72 (0.028)	3	120 (0.033)	9	78 (0.167)	22
2008	66 (0.076)	11	72 (0)	0	120 (0.05)	12	78 (0.179)	26
2009	66 (0.03)	10	72 (0.042)	3	120 (0.083)	34	78 (0.179)	41
2010	66 (0.091)	105	71 (0.07)	9	118 (0.042)	26	78 (0.167)	24
2011	66 (0.076)	38	72 (0.028)	4	120 (0.033)	7	78 (0.038)	5
2012	66 (0.106)	29	72 (0.014)	1	120 (0.092)	20	78 (0.256)	131
2013	66 (0.121)	13	72 (0)	0	120 (0.058)	17	78 (0.09)	29
2014	66 (0.212)	30	72 (0.042)	3	119 (0.109)	51	78 (0.128)	43
2015	66 (0.045)	3	72 (0.014)	1	118 (0.068)	13	78 (0.115)	29
2016	66 (0.212)	28	72 (0)	0	110 (0.118)	44	78 (0.282)	69
2017	66 (0.045)	9	72 (0.056)	7	120 (0.05)	34	78 (0.205)	54
2018	66 (0.045)	9	72 (0.014)	1	120 (0.025)	9	78 (0.205)	77
2019	66 (0.106)	21	72 (0.014)	1	120 (0.05)	9	78 (0.244)	48
2020	66 (0.091)	13	72 (0.014)	1	120 (0.033)	5	78 (0.205)	43
Total	1,393	609	1,655	89	2,729	528	1,758	1,067
(Average)	(0.111)		(0.035)		(0.066)		(0.171)	

Table 3. Data included in the annual index for age-0 Gray Snapper collected during FWRI long-term FIM surveys using a 21.3-m seine deployed along bay shorelines (gear = 19). Annual sampling effort, proportion positive, and total number of age-0 Gray Snapper collected within Apalachicola Bay (AB), Cedar Key (CK), Tampa Bay (TB), and Charlotte Harbor (CH) are summarized.

Year	AB		CK		TB		CH	
	No. sets (proportion positive)	No. collected						
1998	24 (0.042)	5	.	.	30 (0.033)	1	72 (0.042)	3
1999	24 (0.083)	18	.	.	30 (0.167)	18	72 (0.125)	49
2000	24 (0.042)	1	.	.	30 (0.167)	7	73 (0.123)	36
2001	53 (0.094)	36	54 (0.037)	4	30 (0.2)	16	72 (0.25)	141
2002	54 (0.056)	15	54 (0.167)	40	30 (0.167)	16	72 (0.153)	24
2003	54 (0.13)	11	54 (0.037)	7	30 (0.1)	7	74 (0.216)	73
2004	54 (0.204)	31	54(0)	0	29 (0.138)	21	78 (0.167)	43
2005	54 (0.093)	9	54 (0.056)	3	84 (0.036)	3	78 (0.115)	24
2006	54 (0.056)	24	54 (0.074)	5	80 (0.075)	11	78 (0.192)	34
2007	54 (0.074)	17	54 (0.037)	3	83 (0.133)	25	78 (0.141)	17
2008	54 (0.037)	3	54 (0.019)	1	82 (0.085)	12	78 (0.103)	14
2009	54 (0.019)	5	54 (0.019)	1	81 (0.148)	40	78 (0.269)	45
2010	54 (0.167)	44	55 (0.055)	3	83 (0.096)	14	78 (0.077)	20
2011	54 (0.13)	29	54 (0.019)	4	84 (0.071)	25	78 (0.103)	15
2012	54 (0.148)	16	54 (0.056)	9	84 (0.119)	27	78 (0.282)	97
2013	54 (0.093)	10	54 (0.019)	1	84 (0.095)	15	78 (0.128)	46
2014	54 (0.204)	51	54 (0.093)	13	84 (0.131)	37	78 (0.231)	32
2015	54 (0.093)	24	54 (0.019)	1	84 (0.071)	10	78 (0.141)	39
2016	54 (0.204)	22	54 (0.037)	4	84 (0.143)	56	78 (0.282)	127
2017	54 (0.074)	9	54 (0.037)	2	84 (0.119)	41	78 (0.231)	64
2018	54 (0.148)	12	54 (0.074)	17	84 (0.167)	45	78 (0.192)	60
2019	54 (0.13)	34	54 (0.074)	6	84 (0.131)	21	78 (0.167)	28
2020	54 (0.111)	20	54 (0.019)	1	84 (0.083)	15	78 (0.282)	109
Total (Average)	1,151 (0.106)	446	1,081 (0.05)	125	1,542 (0.116)	483	1,761 (0.174)	1,140

Table 4. Data included in the annual index for age-1 Gray Snapper collected during FWRI long-term FIM surveys using 183-m shoreline seines (gear = 160). Annual sampling effort, proportion positive, and total number of age-1 Gray Snapper collected within Tampa Bay (TB) and Charlotte Harbor (CH) are summarized.

Year	TB		CH	
	No. sets (proportion positive)	No. collected	No. sets (proportion positive)	No. collected
1996	180 (0.044)	11	125 (0.112)	47
1997	240 (0.075)	25	204 (0.25)	137
1998	240 (0.042)	16	204 (0.191)	165
1999	240 (0.046)	31	204 (0.162)	160
2000	235 (0.106)	81	204 (0.172)	169
2001	240 (0.033)	14	204 (0.201)	194
2002	240 (0.113)	192	204 (0.294)	295
2003	239 (0.071)	42	204 (0.191)	186
2004	239 (0.075)	75	204 (0.147)	160
2005	234 (0.056)	21	204 (0.206)	198
2006	240 (0.033)	28	204 (0.132)	86
2007	240 (0.125)	423	204 (0.328)	1,124
2008	240 (0.163)	93	204 (0.25)	278
2009	240 (0.113)	81	204 (0.235)	235
2010	240 (0.050)	20	204 (0.211)	122
2011	240 (0.038)	12	204 (0.132)	219
2012	240 (0.154)	106	204 (0.216)	219
2013	240 (0.133)	133	204 (0.328)	628
2014	240 (0.163)	183	204 (0.265)	226
2015	240 (0.188)	255	204 (0.294)	712
2016	240 (0.167)	117	204 (0.343)	698
2017	240 (0.150)	204	204 (0.392)	1,411
2018	240 (0.175)	139	204 (0.304)	607
2019	240 (0.179)	293	204 (0.348)	770
2020	220 (0.186)	164	170 (0.459)	514
Total	5,907	2,759	4,987	9,559
(Average)	(0.107)		(0.247)	

Table 5. Type 3 tests of fixed effects for the negative binomial model for Age 0 Gray Snapper collected in FWRI long-term FIM surveys using 21.3-m seines from July-December, 1998-2020, within Apalachicola Bay, Cedar Key, Tampa Bay, and Charlotte Harbor.

<b>Type III Tests of Fixed Effects</b>				
Effect	Num DF	Den DF	F Value	Pr > F
Bay*Year	66	19739	3.73	<.0001
Year	22	19739	7.59	<.0001
Bay	3	19739	37.27	<.0001
Month	5	19739	101.25	<.0001
Shore type	5	19739	19.45	<.0001
SAV percentage	11	19739	94.77	<.0001
Temperature	3	19739	8.05	<.0001
Salinity	3	19739	3.95	0.0079
Depth	3	19739	17.06	<.0001

Table 6. Type 3 tests of fixed effects for the negative binomial model for Age 1 Gray Snapper collected during FWRI long-term FIM surveys using 183-m shoreline seines from January-December, 1996-2020 Tampa Bay and Charlotte Harbor.

<b>Type III Tests of Fixed Effects</b>				
Effect	Num DF	Den DF	F Value	Pr > F
Bay*Year	24	10505	5.45	<.0001
Year	24	10505	25.21	<.0001
Bay	1	10505	495.62	<.0001
Month	11	10505	94.22	<.0001
Shore type	5	10505	12.17	<.0001
SAV percentage	11	10505	13.28	<.0001
Salinity	3	10505	57.94	<.0001
Depth	3	10505	69.61	<.0001

Table 7. Index of abundance developed using the negative binomial model for Age 0 Gray Snapper collected in FWRI long-term FIM surveys using 21.3-m seines from July-December, 1998-2020, within Apalachicola Bay, Cedar Key, Tampa Bay, and Charlotte Harbor. The nominal frequency of occurrence, the number of samples (N), the least squares mean (Mean, number per set) and standard error (SE), the coefficient of variation on the mean (CV), lower and upper confidence limits (LCL and UCL), and the scaled mean are listed.

Survey year	Frequency	N	Mean	SE	CV	LCL	UCL	Scaled Mean
1998	0.0424	645	0.0284	0.0087	0.3124	0.0156	0.0517	0.1682
1999	0.1053	648	0.1565	0.0363	0.2358	0.0993	0.2466	0.9269
2000	0.0835	670	0.1114	0.0232	0.2111	0.0741	0.1676	0.6598
2001	0.1229	805	0.2268	0.0423	0.1898	0.1574	0.3270	1.3433
2002	0.1219	818	0.2738	0.0439	0.1603	0.2000	0.3748	1.6217
2003	0.0998	853	0.1881	0.0299	0.1570	0.1377	0.2568	1.1141
2004	0.1346	875	0.2913	0.0459	0.1596	0.2139	0.3967	1.7253
2005	0.0572	928	0.0753	0.0150	0.2020	0.0509	0.1114	0.4462
2006	0.1156	929	0.2198	0.0328	0.1479	0.1640	0.2945	1.3018
2007	0.0843	942	0.1638	0.0269	0.1664	0.1187	0.2261	0.9701
2008	0.0674	952	0.0793	0.0151	0.1920	0.0545	0.1153	0.4696
2009	0.0974	951	0.2229	0.0335	0.1505	0.1660	0.2993	1.3202
2010	0.0773	933	0.1463	0.0238	0.1640	0.1063	0.2013	0.8665
2011	0.0587	936	0.0896	0.0162	0.1830	0.0629	0.1276	0.5307
2012	0.1168	936	0.2356	0.0405	0.1741	0.1683	0.3298	1.3954
2013	0.0654	936	0.0606	0.0185	0.3076	0.0333	0.1101	0.3589
2014	0.1304	959	0.2380	0.0385	0.1625	0.1733	0.3267	1.4096
2015	0.0602	982	0.1038	0.0197	0.1919	0.0716	0.1504	0.6148
2016	0.1645	959	0.2767	0.0411	0.1494	0.2069	0.3701	1.6388
2017	0.0820	968	0.1479	0.0249	0.1697	0.1064	0.2056	0.8760
2018	0.0890	967	0.1635	0.0279	0.1694	0.1170	0.2285	0.9684
2019	0.0943	970	0.1766	0.0290	0.1649	0.1279	0.2437	1.0460
2020	0.0913	931	0.2073	0.0349	0.1679	0.1489	0.2884	1.2278

Table 8. Index of abundance developed using the negative binomial model for Age 1 Gray Snapper collected in FWRI long-term FIM surveys using 183-m shoreline seines from January-December, 1996-2020, within Tampa Bay and Charlotte Harbor. The nominal frequency of occurrence, number of samples (N), the least squares mean (Mean, number per set) and standard error (SE), the coefficient of variation on the mean (CV), lower and upper confidence limits (LCL and UCL), and scaled mean are listed.

Year	Frequency	N	Mean	SE	CV	LCL	UCL	Scaled Mean
1996	0.0782	305	0.0372	0.0107	0.2940	0.0212	0.0654	0.1492
1997	0.1625	444	0.0730	0.0167	0.2315	0.0467	0.1142	0.2929
1998	0.1164	444	0.0849	0.0215	0.2591	0.0517	0.1394	0.3404
1999	0.1038	444	0.0698	0.0162	0.2333	0.0443	0.1099	0.2800
2000	0.1390	439	0.0618	0.0133	0.2170	0.0406	0.0942	0.2479
2001	0.1172	444	0.0564	0.0138	0.2528	0.0348	0.0912	0.2261
2002	0.2033	444	0.2020	0.0388	0.1963	0.1386	0.2944	0.8103
2003	0.1312	443	0.1747	0.0384	0.2218	0.1136	0.2686	0.7008
2004	0.1112	443	0.1785	0.0373	0.2138	0.1185	0.2689	0.7160
2005	0.1307	438	0.1334	0.0313	0.2401	0.0842	0.2112	0.5351
2006	0.0828	444	0.0550	0.0131	0.2428	0.0345	0.0877	0.2206
2007	0.2267	444	0.4728	0.0905	0.1925	0.3248	0.6881	1.8966
2008	0.2063	444	0.2381	0.0481	0.2028	0.1602	0.3538	0.9551
2009	0.1739	444	0.1861	0.0382	0.2053	0.1244	0.2784	0.7465
2010	0.1304	444	0.0684	0.0160	0.2370	0.0433	0.1082	0.2744
2011	0.0849	444	0.0428	0.0117	0.2812	0.0251	0.0730	0.1716
2012	0.1849	444	0.1276	0.0231	0.1835	0.0895	0.1820	0.5118
2013	0.2309	444	0.3640	0.0684	0.1889	0.2518	0.5261	1.4601
2014	0.2136	444	0.2122	0.0404	0.1935	0.1461	0.3082	0.8512
2015	0.2408	444	0.5278	0.0951	0.1810	0.3707	0.7514	2.1172
2016	0.2549	444	0.5534	0.1046	0.1900	0.3821	0.8016	2.2199
2017	0.2711	444	0.8392	0.1554	0.1861	0.5837	1.2064	3.3663
2018	0.2395	444	0.5784	0.1127	0.1984	0.3948	0.8473	2.3202
2019	0.2636	444	0.4856	0.08893	0.1838	0.3391	0.6953	1.9479
2020	0.3226	390	0.4093	0.08081	0.1986	0.278	0.6027	1.6418

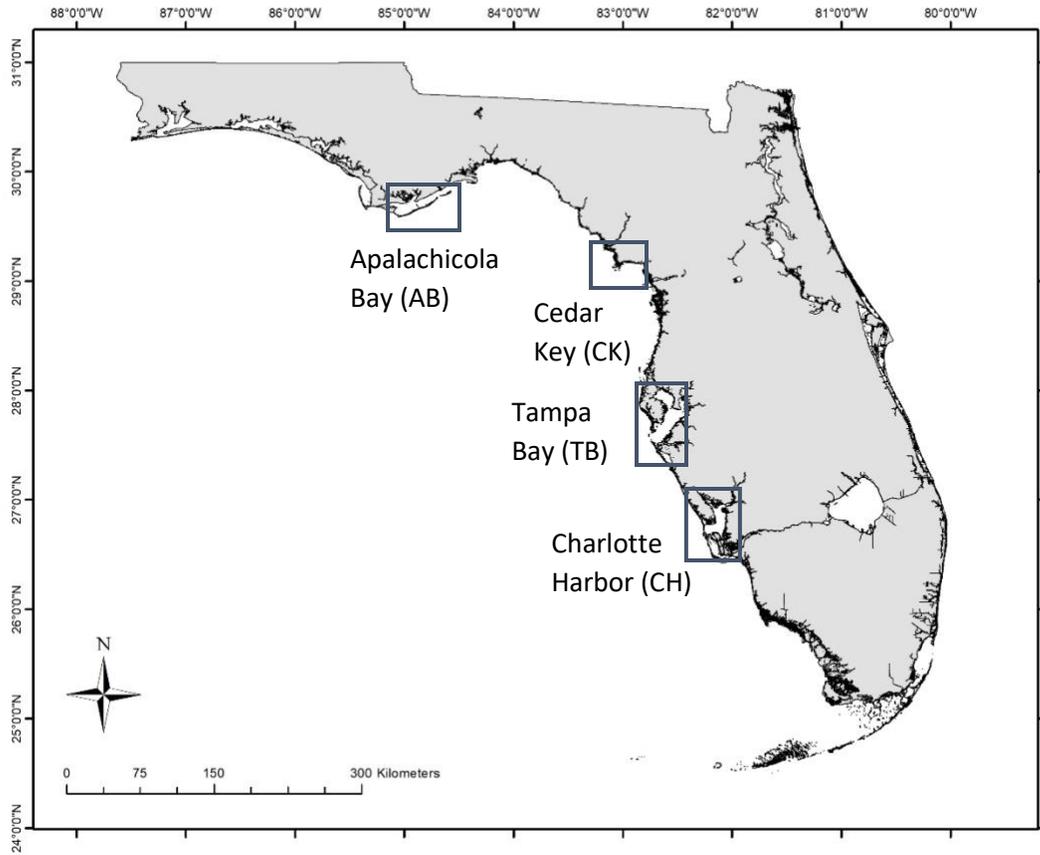


Figure 1. Map of estuaries within which FWRI seine surveys were conducted.

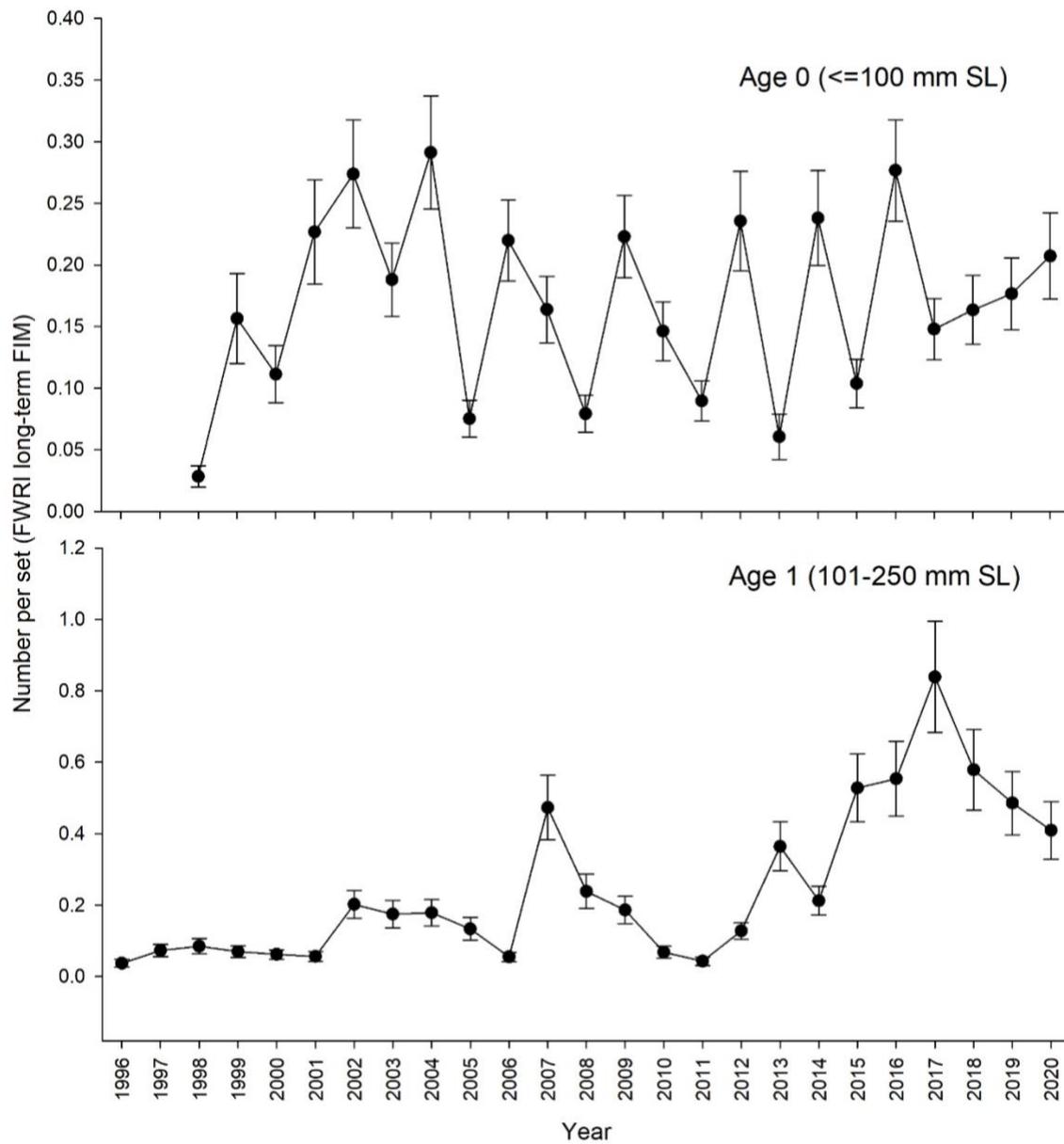


Figure 2. Indices of abundance (least square means  $\pm$  SE) for Age 0 (top panel) and Age 1 (bottom panel) Gray Snapper collected during FWRI seine surveys in northeastern Gulf of Mexico estuaries.