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Data Summary Report:

Nekton of Sarasota Bay and a Comparison of Nekton Community Structure in Adjacent Southwest Florida Estuaries

for

Year Twelve
(January to December 2021)

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We thank all the Fisheries-Independent Monitoring program personnel, too numerous to mention, who were involved in collecting and processing the many samples that make up this study. We also thank the Sarasota Bay Estuary Program for funding the study, providing a unique opportunity to collect data from a coastal lagoonal type of system situated between Tampa Bay and Charlotte Harbor.

EXECUTIVE SUMMARY

The Florida Fish and Wildlife Conservation Commission's (FWC) Fisheries-Independent Monitoring (FIM) program began routine sampling of Florida estuaries to assess nekton populations in 1989. Since the Sarasota Bay Estuary Program's (SBEP) inception, it has recognized the importance of restoring and protecting juvenile fish habitat and the need to maintain fish populations while pursuing restoration efforts. With financial support from the SBEP, the FIM program initiated bimonthly stratified-random sampling in Sarasota Bay during June 2009 and will continue through at least August 2022. The objectives of this monitoring are to: 1) provide a database of fish and selected invertebrate species that inhabit Sarasota Bay; 2) examine spatial differences in species composition and relative abundance within the Sarasota Bay estuary; and 3) examine annual abundance trends for specific species between three estuaries along Florida's Southwest Coast.

The FIM program uses a stratified-random sampling (SRS) design and a multi-gear approach to collect nekton (fish and selected invertebrates) in the five embayments (Palma Sola, Sarasota, Roberts, Little Sarasota, and Blackburn bays) that fall within the SBEP watershed. Three gear types are deployed (21.3-m seines, 183-m seines, and 6.1-m otter trawls) to sample nekton populations in diverse habitats and at different stages in their life history. Water chemistry parameters (salinity, water temperature, dissolved oxygen, and pH measurements) and habitat assessments (bottom type, presence of submerged aquatic vegetation, shore habitat) are recorded in association with each gear deployment.

A total of 90,862 individuals, representing 103 fish and 10 selected invertebrate taxa, were collected from 252 stations during the twelfth year (January – December 2021) of this study.

Little Sarasota Bay accounted for the largest percentage of animals collected (41.6% of total catch). Sarasota Bay, the largest embayment with the most stations (n=84), had the second largest percentage of animals collected (21.4% of total catch). Robert's Bay accounted for the third highest catch (14.5% of total catch). Palma Sola Bay had the fourth largest percentage of animals collected (12.7% of total catch), while the fewest animals were collected in Blackburn Bay (9.7% of total catch).

Scaled Sardine (*Harengula jaguana*, 22.9% of the total catch), Pinfish (*Lagodon rhomboides*, 21.0%) and *Eucinostomus* Mojarra (*Eucinostomus* spp., 17.9%) accounted for 61.8% of the total catch of all three gear-types. There were 23 taxa of direct economic importance (Selected Taxa) collected during 2021 with Spot (*Leiostomus xanthurus*, 1.5% of total catch), Pink Shrimp (*Farfantepenaeus duorarum*, 1.3% of total catch) and Fantail Mullet (*Mugil trichodon*, 0.5% of total catch) being the most abundant Selected Taxa.

The 21.3-m seine captured 85.3% of the nekton (77,531) collected in 2021, while the 183-m haul seine (5.9%) and 6.1-m otter trawl (8.8%) accounted for the rest of the total catch. The 183-m haul seine (20 taxa) and 21.3-m seine (17 taxa) collected more species identified as Selected Taxa than were captured in the 6.1-m otter trawl (11 taxa).

Statistical (generalized linear) models were developed to compute annual relative indices of abundance (IOA) for five taxa of economic and/or ecological importance in three Southwest Florida estuaries (Tampa Bay, Sarasota Bay, and Charlotte Harbor). Indices of abundance were assessed for young-of-year (Red Drum, Spotted Seatrout, Sheepshead, and Pinfish) and subadult/adult (Red Drum, Spotted Seatrout, Common Snook, Sheepshead, and Pinfish) fish between June 2009 and December 2021.

The relative abundance for many species and life-history stages decreased from 2020 to 2021 to abundances comparable to or above the long-term averages in each of the southwest Florida estuaries. After a general trend of low abundance over the last few years, relative abundances of Red Drum in 183-m haul seines increased in 2021 to the highest levels seen in this twelve-year study for Tampa Bay and Charlotte Harbor. After a large increase in abundance in 2020, relative abundance in Sarasota Bay decreased to below the long-term average but remained higher than averages from 2014 to 2019. Relative abundance of Common Snook decreased in all three estuaries in 2021; abundance in Charlotte Harbor remained above average while abundances in Tampa Bay and Sarasota Bay decreased to below the long-term average. Spotted Seatrout in 183-m haul seines in Sarasota Bay decreased from 2020 to an abundance below the long-term average; relative abundance also decreased in 2021 in Charlotte Harbor but remained comparable to the long-term average. Tampa Bay abundance, however, increased above the long-term average for the first time since 2016. Legal-size Sheepshead in 183-m haul seines have more variable relative abundance than Red Drum, Spotted Seatrout, and Common Snook. Relative abundance in 2021 was comparable to the long-term average in all three estuaries; compared to 2020, relative abundance increased in Tampa Bay, decreased in Sarasota Bay, and did not change in Charlotte Harbor. Relative abundance trends for sub-adult and adult Pinfish collected in

183-m haul seines have been variable in Sarasota Bay and abundance continued to decline from 2020 to 2021. The 2021 abundance fell to levels comparable to the low averages of 2013 to 2015. Pinfish abundances in Tampa Bay and Charlotte Harbor also decreased from 2020 to 2021. Tampa Bay abundance fell to the lowest level seen in this study. Charlotte Harbor abundance deceased from 2020 but remained as the second highest abundance on record for this study.

INTRODUCTION

Sarasota Bay is an urbanized coastal lagoon system located on Florida's Southwest Coast. Since the early 1900s, dredge and fill activities have resulted in significant losses of ecologically important habitats, and historically semi-isolated tidal current regimes within embayments have been joined through the construction of an Intracoastal Waterway channel that hydrologically links the embayments. Intense development occurred throughout the system starting in the late 1950's resulting in much of the natural shoreline being replaced by seawalls to retain dredge-and-fill material for housing sites and other construction projects. Mosquito ditching and significant channelization of tidal creeks has altered historical patterns of surface water runoff to the bay and further exacerbated wetland habitat losses (*Sarasota Bay National Estuary Program 2003*). A thorough understanding of the ecology of local nekton assemblages is imperative if the consequences of further anthropogenic or environmental changes are to be determined (*Poulakis et al. 2004*). In addition, the development of a baseline database documenting habitat use, recruitment and biodiversity can provide a broader understanding of the status of fish populations found within an estuary and help to guide the protection of estuarine-based fisheries and associated habitats (*Paperno et al. 2001*).

The Sarasota Bay Estuary Program Comprehensive Conservation Management Plan stressed the importance of restoring and protecting juvenile fish habitat as well as the need to maintain fish populations while pursuing restoration efforts (*Sarasota Bay National Estuary Program 1995*). The objectives of this study are to: 1) provide a database of fish and selected invertebrate species that inhabit Sarasota Bay; 2) examine spatial differences in species composition and relative abundance within the Sarasota Bay estuary; and 3) examine annual abundance trends for specific species between three estuaries along Florida's Southwest Coast.

METHODS

Study Area

Sarasota Bay, located on the southwest coast of Florida, is a coastal lagoon that extends from Anna Maria Sound south to Venice Inlet. The bay comprises five embayments (Palma Sola, Sarasota, Roberts, Little Sarasota, and Blackburn bays) which were formed behind a barrier island complex. This system is connected to the Gulf of Mexico through five inlets: Anna Maria Sound, Longboat Pass, New Pass, Big Sarasota Pass, and Venice Inlet. Freshwater inflow enters the estuary through a series of creeks, bayous, and unnamed drainage ditches (*Roat and Alderson 1990*). The main tributaries and receiving water bodies are Bowlees Creek and Whitaker and Hudson bayous (Sarasota Bay proper), Phillippi Creek (Roberts Bay), Clower and Catfish creeks (Little Sarasota Bay), and South Creek (Blackburn Bay). Shoreline vegetation consists largely of mangroves and marsh grasses, and bottom substrates are typically characterized as sand, mud, oysters, or a combination thereof (*Flannery 1989*). Seagrass meadows are the dominant, submerged vegetative cover in Sarasota Bay and are widely distributed throughout the estuary (*Haddad 1989*).

Sampling Design

The FIM program used a stratified-random sampling (SRS) design and a multi-gear approach to collect nekton (fish and selected invertebrates) from a wide range of habitats and nekton life history stages. This sampling design provides comprehensive data on size-specific, spatial, and temporal patterns of abundance for individual species and for the entire nekton community. Specimens collected during this sampling are used for various assessments, such as fish health, mercury content, diet, age/growth, and reproduction. Three gear types (*Table 1*) were used: 1) 21.3-m bay seines (shoreline and offshore deployment methods); 2) 183-m haul seines; and 3) 6.1-m otter trawls. The data gathered from seine hauls document habitat use by shallow-water organisms (≤1.5 m deep for 21.3-m bay seine and ≤2.5 m deep for 183-m seine) whereas the data collected from trawls document habitat use in deeper areas (1.8 to 7.6 m deep). The 21.3 m seine is deployed using two different methods: 1) offshore set, where the net is at least 5 m from the shoreline and 2) shoreline set, where one seine wing is against shore. The dominant catch for the 21.3-m bay seine and 6.1-m otter trawl is juvenile nekton, although subadults and adults of smaller-bodied nekton species are also commonly collected. The 183-m haul seine typically catches larger sub-adult and adult nekton.

The FIM program sampling design divided the Sarasota Bay estuary into zones representing the five embayments designated by the Sarasota Bay Estuary Program (Zone A - Palma Sola Bay, Zone B - Sarasota Bay proper, Zone C - Roberts Bay, Zone D - Little Sarasota Bay, and Zone E - Blackburn Bay; *Figure 1*). Each zone was further subdivided into 1-nm^2 grids. Within each grid, habitat and depth strata were identified, thereby designating the gear types that could be deployed in each. The number of samples designated for collection in each zone with each gear type was proportional to the number of grids in the zone that could be sampled with a particular gear type. Randomly selected locations within randomly selected grids were designated as sampling sites to be visited during each sampling event. A single deployment with the designated gear type was made at each selected site. Thirty primary samples consisting of six 183-m haul seines, eight 6.1-m otter trawls, and sixteen 21.3-m bay seines were collected during each sampling event. Up to 12 additional 21.3-m bay seine samples were collected at randomly selected sites during each sampling event as time allowed.

Sampling in the Sarasota Bay estuary began in June 2009 and is conducted with a bimonthly periodicity. This report summarizes the data collected during 2021, the twelfth year of this study.

Table 1. Description of sampling gears used during the Sarasota Bay stratified random sampling. A more detailed description of each gear can be found in the FIM program's Procedure Manual.

Gear	Mesh Size (mm)	Area Sampled Estimate (m^2)	Description of use
21.3-m bay seine	3.2	140	used in areas ≤ 1.5-m deep
183-m haul seine	38.1	4,120	used along shorelines ≤ 2.5-m deep
6.1-m otter trawl	38.1 (3.2-mm bag liner)	~1,440	used in areas from 1.8-m to 7.6-m deep

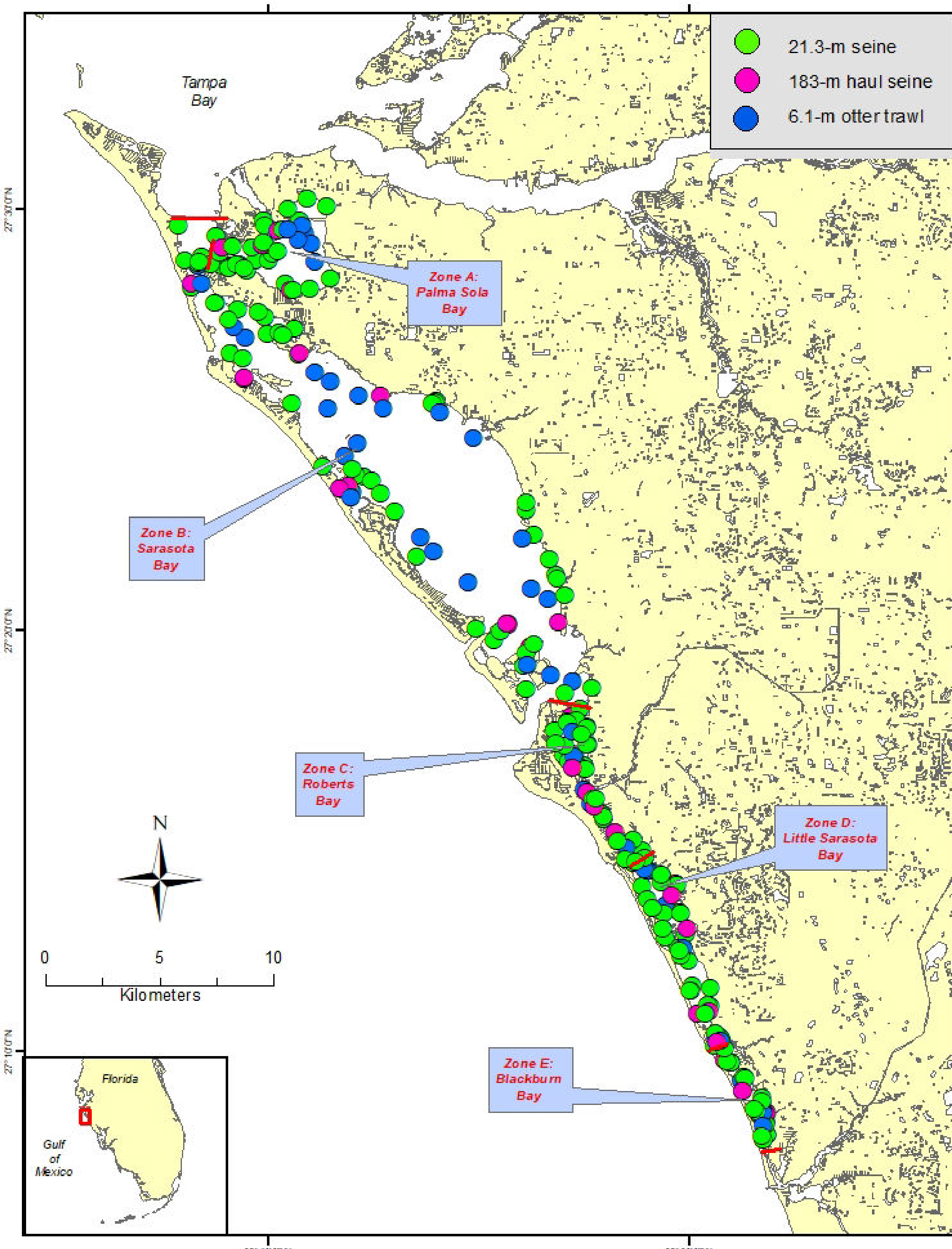

Figure 1. Stations sampled (filled circles) between February and December 2021 (Year 12), and geographic zones (solid red lines) in the Sarasota Bay estuary.

Gear Specifications and Deployment

The gear type used to collect smaller nekton associated with shorelines and on offshore flats (>5 m from shore) was a 21.3-m center-bag seine with 3.2-mm delta mesh and leads spaced every 150 mm. The 21.3-m bay seine was pulled, with a crewmember on each wing, for 9.1 m with the net wings separated by 15.5 m. The seine was deployed into the current and was landed by collapsing the seine around a pivot pole to close the wings and force the catch into the center bag. Each 21.3-m bay seine deployment sampled an estimated 140 m^2. Sampling sites for the 21.3-m bay seine were pre-stratified into one of three categories: 1) >5 m from the shore and bottom vegetation present, 2) >5 m from the shore and bottom vegetation absent, and 3) against a shoreline.

The 183-m haul seine (38.1-mm stretch mesh) targeted larger sub-adult and adult nekton associated with relatively shallow (≤2.5 m), nearshore habitats. Deployment of this gear type occurred from the back of a boat in a standardized rectangular shape. Both net wings were simultaneously hauled along the shoreline, keeping the lead lines close to the bottom, forcing the catch into the center bag portion. Each 183-m haul seine set enclosed an area of approximately 4,120 m^2. In Sarasota Bay proper, where two 183-m haul seine sets were collected during each sampling event, sites were pre-stratified by the presence or absence of overhanging shoreline vegetation (i.e., mangroves). The number of 183-m haul seine samples collected in Palma Sola, Roberts, Little Sarasota, and Blackburn bays during each sampling event were too small (n=1) to pre-stratify by the presence or absence of overhanging shoreline vegetation.

Juvenile and adult nekton that inhabit relatively deeper waters (1.8–7.6 m) were collected in the 6.1-m otter trawl, which had a 38.1-mm stretch mesh with a 3.2-mm delta mesh cod-end liner. The trawl was towed from the back of a boat for 10 minutes. Tow speeds averaged 0.6 m/s; start and end locations for each trawl were marked using a global positioning system (GPS) so that the distance fished could be estimated. Each trawl deployment sampled an area of approximately 1,440 m^2.

Salinity, temperature, pH, and dissolved oxygen were measured at the surface and at 1-m intervals to the bottom in association with each deployment. A variety of qualitative habitat assessments were also made, such as characteristics of the shoreline (e.g., vegetation type, inundation), substrate (e.g., sediment type, presence of submerged aquatic vegetation), and bycatch (i.e., total volume, type, and composition). All sampling was conducted during daylight hours (one hour after sunrise to one hour before sunset). Additional sampling details and habitat assessment procedures are described in the FIM program's Procedure Manual (*FWC-FWRI 2021*).

Sample Processing

Sample work-up was similar for all gear types. All captured fish and selected invertebrate species were identified to the lowest practical taxonomic level, generally species. During each sampling trip, representative samples (three individuals of each species from the 21.3-m bay seines and 6.1-m otter trawls) were brought back to the FWC-FWRI laboratory to confirm field identification. Individuals for which field identification was uncertain were also brought back to the laboratory. A maximum of 20 measurements (mm) were made per taxon, unless distinct cohorts were identifiable, in which case a maximum of 20 measurements were taken from each cohort; for certain economically valuable fish species (Selected Taxa, *Appendix A*), 40 individuals were measured. Standard length (SL) was recorded for teleost fish, total length (TL) for seahorses, precaudal length for sharks (PL), disk width (DW) for rays, post-orbital head length (POHL) for shrimp, and carapace width (CW) for crabs. Animals that were not measured were identified and counted. When large numbers of individuals (>1,000) were captured, the total number was estimated by fractional expansion of a sub-sampled portion of the total catch that had been split with a modified Motoda box splitter (*Winner and McMichael 1997*). Animals that did not require further laboratory examination were returned to the water. Additional details concerning sample work-up are described in the FIM program's Procedure Manual (*FWC-FWRI 2021*).

Due to frequent hybridization and/or extreme difficulty in the identification of smaller individuals, members of several abundant species complexes were not identified to species. Species of Menhaden (*Brevoortia* spp.) were not identified to species. *Brevoortia patronus* and *B. smithi* frequently hybridize and juveniles of the hybrids and the parent species are difficult to identify (*Dahlberg 1970*). Two abundant Silverside species (*Menidia beryllina* and *M. peninsulae*) tend to hybridize, form all-female clones, and occur in great abundance that renders identification to species impractical due to the nature of the diagnostic characters (*Duggins et al. 1986*; *Echelle and Echelle 1997*; Chernoff, personal communication). These two species of Silversides are presented in this report as *Menidia* spp. Species-level identification of Mojarras (genus *Eucinostomus*) was limited to individuals ≥40 mm SL due to great difficulty in separating *E. gula* and *E. harengulus* below this size (Matheson, personal observation). The term “Eucinostomus Mojarra” is used for these small specimens. Species-level identification of gobies of the genus *Gobiosoma* (i.e., *G. robustum* and *G. bosc*) was limited to individuals ≥20 mm SL for the same reason; smaller individuals are hereafter referred to as “Gobiosoma Goby”. Similarly, Needlefishes (*Strongylura* spp.), other than *Strongylura notata*, were only identified to species at lengths ≥100 mm SL.

Gear-specific data summary tables for the numerically dominant and economically important taxa (Selected Taxa, *Appendix A*) were prepared with data from the twelfth year of this study (January 2021 to December 2021). Summaries of all taxa collected by sampling event, gear type and habitat, and embayment (sampling zone) were also prepared using the twelfth year of the study period (*Appendices B*, *C*, and *D*, respectively).

RESULTS and DISCUSSION

Composition of overall nekton community

A total of 90,862 individuals, representing 103 fish and 10 selected invertebrate taxa, were collected from 252 samples during the twelfth year of this study (*Table 2*). Species lists with the number of animals collected during year twelve of this study are provided by sampling event, gear type and habitat strata, and embayment in *Appendices B*, *C*, and *D*, respectively. Little Sarasota Bay (Zone D), in which 16.7% (n=42) of the gear sets were made, accounted for 41.6% (n=37,805) of the total animals collected during 2021, the most total animals of all zones (*Table 2*). Sarasota Bay (Zone

B) had the greatest number of gear sets (n=84) and accounted for 21.4% of total catch (n=19,415). The remaining three zones all had the same amount of gear sets as Little Sarasota Bay (n=42, 16.7% of gear sets) but catches of total animals varied by bay. Robert's Bay (Zone C) accounted for 14.5% of the total catch (n=13,212). Palma Sola Bay had the second lowest total catch (n=11,577, 12.7% of total catch), while Blackburn Bay (n=8,853; 9.7% of total catch) had the fewest number of animals collected in any of the five bays.

Table 2. Summary of catch and effort data for Sarasota Bay stratified-random sampling, 2021.

Zone	21.3-m bay seine		183-m haul seine		6.1-m otter trawl		Totals	
	Animals	**Hauls**	**Animals**	**Hauls**	**Animals**	**Hauls**	**Animals**	**Hauls**
Palma Sola Bay (A)	8,948	30	1,399	6	1,230	6	11,577	42
Sarasota Bay (B)	14,233	48	1,752	12	3,430	24	19,415	84
Robert's Bay (C)	11,605	30	654	6	953	6	13,212	42
Little Sarasota Bay (D)	35,631	30	1,285	6	889	6	37,805	42
Blackburn Bay (E)	7,114	30	239	6	1,500	6	8,853	42
Totals	**77,531**	**168**	**5,329**	**36**	**8,002**	**48**	**90,862**	**252**

Scaled Sardine (*Harengula jaguana*, n=20,803) was the most numerous taxon collected, representing 22.9% of the total catch (*Appendices B*, *C*, and *D)*. Pinfish (*Lagodon rhomboides*, n=19,071) was the second most abundant taxon collected, representing 21.0% of the total catch. Eucinostomus Mojarra (*Eucinostomus* spp., n=16,241) was the third most abundant taxon collected, accounting for an additional 17.9% of the total catch. These three taxa accounted for 61.8% of the total catch in the

Sarasota Bay estuary. The 23 Selected Taxa (n=4,963 animals) that were collected comprised 5.5% of the total catch. Spot (*Leiostomus xanthurus*, n=1,360, 1.5% of total catch), Pink Shrimp, (*Farfantepenaeus duorarum,* n=1,170, 1.3% of total catch) and Fantail Mullet (*Mugil trichodon,* n=457, 0.5% of total catch) were the three most abundant Selected Taxa collected (*Appendices B*, *C*, and *D)*.

Shallow water habitats sampled with 21.3-m bay seines

In year twelve, 85.3% (n=77,531) of all nekton collected while sampling in the Sarasota Bay estuary were captured with 21.3-m bay seines (n=168 hauls; *Table 2*). Scaled Sardine (*Harengula jaguana,* n=20,094, 11.3% occurrence) was the most abundant taxon collected, accounting for 25.9% of the 21.3-m bay seine catch (*Table 3*). The next two most abundant taxa collected with 21.3-m bay seines were Pinfish (*Lagodon rhomboides*, n=14,617, 68.5% occurrence) and Eucinostomus Mojarra (*Eucinostomus* spp., n=14,018, 76.8% occurrence). Animals collected by 21.3-m bay seines tended to be relatively small, ranging in length from 3 mm to 602 mm, with the length for the 10 dominant taxa ranging from 10 mm to 168 mm.

A total of 3,445 animals from 17 Selected Taxa were collected with 21.3-m bay seines, representing 4.4% of the total 21.3-m bay seine catch (*Table 4*). Spot (*Leiostomus xanthurus,* n=1,330, 14.3% occurrence) was the Selected Taxon most collected (1.7% of total catch). Pink Shrimp (*Farfantepenaeus duorarum,* n=925, 45.8% occurrence) was the second most abundant Selected Taxon and the most frequently occurring taxon collected by this gear type (1.2% of total catch).

Table 3. Catch statistics for 10 dominant taxa collected in 168 21.3-m bay seine samples during Sarasota Bay stratified-random sampling, 2021. Percent (%) is the percent of the total catch represented by that taxon; percent occurrence (% Occur) is the percentage of samples in which that taxon was collected; CV is the coefficient of variation of the mean. Taxa are ranked in order of decreasing mean density.

Species	**Number**		**% Occur**	**Density Estimate (animals/100m^2)**				**Standard Length (mm)**			
	No.	**%**		**Mean**	**Stderr**	**CV**	**Max**	**Mean**	**Stderr**	**Min**	**Max**
Harengula jaguana	20,094	25.9	11.3	85.43	56.61	858.78	8,834.29	30	0.07	21	77
Lagodon rhomboides	14,617	18.9	68.5	62.15	9.13	190.44	660.71	37	0.17	10	168
Eucinostomus spp.	14,018	18.1	76.8	59.60	7.25	157.66	465.71	26	0.06	11	43
Anchoa mitchilli	11,896	15.3	17.9	50.58	20.97	537.39	2,325.71	36	0.07	18	56
Orthopristis chrysoptera	2,425	3.1	33.3	10.31	3.57	448.19	512.86	31	0.25	15	155
Lucania parva	2,227	2.9	19.6	9.47	3.21	439.93	367.86	22	0.08	12	35
Eucinostomus gula	1,836	2.4	50.6	7.81	1.65	273.55	183.57	51	0.18	40	94
Anchoa hepsetus	1,562	2.0	3.0	6.64	4.71	919.15	648.57	36	0.19	21	60
Menidia spp.	1,350	1.7	10.1	5.74	2.79	629.02	351.43	39	0.34	20	77
Leiostomus xanthurus	1,330	1.7	14.3	5.65	2.94	674.99	405.00	24	0.24	11	91
Subtotals	71,355	92.0	.	.	.	.	.	.	.	10	168
Totals	**77,531**	**100.0**	**.**	**329.64**	**78.13**	**307.22**	**11,457.86**	**.**	**.**	**3**	**602**

Table 4. Catch statistics for Selected Taxa collected in 168 21.3-m bay seine samples during Sarasota Bay stratified-random sampling, 2021. Percent (%) is the percent of the total catch represented by that taxon; percent occurrence (% Occur) is the percentage of samples in which that taxon was collected; CV is the coefficient of variation of the mean. Taxa are ranked in order of decreasing mean density.

Species	Number		% Occur	Density Estimate (animals/100m^2)				Standard Length (mm)			
	No.	%		Mean	Stderr	CV	Max	Mean	Stderr	Min	Max
Leiostomus xanthurus	1,330	1.7	14.3	5.65	2.94	674.99	405.00	24	0.24	11	91
Farfantepenaeus duorarum	925	1.2	45.8	3.93	0.93	307.37	82.14	11	0.15	3	27
Mugil trichodon	356	0.5	4.2	1.51	0.85	730.99	121.43	21	0.51	17	197
Archosargus probatocephalus	206	0.3	28.0	0.88	0.17	248.89	15.71	43	4.21	12	339
Cynoscion nebulosus	198	0.3	23.8	0.84	0.21	315.75	23.57	44	1.19	16	110
Mugil cephalus	141	0.2	6.5	0.60	0.44	949.92	72.14	33	4.87	18	411
Sciaenops ocellatus	93	0.1	6.5	0.40	0.19	615.62	26.43	32	3.45	12	322
Callinectes sapidus	78	0.1	19.0	0.33	0.09	368.10	12.86	37	4.41	6	176
Lutjanus griseus	55	0.1	16.7	0.23	0.05	284.62	4.29	80	7.82	14	243
Paralichthys albigutta	21	<0.1	7.7	0.09	0.03	430.57	3.57	50	8.05	13	139
Lutjanus synagris	14	<0.1	3.0	0.06	0.04	803.29	5.71	33	1.99	20	49
Centropomus undecimalis	12	<0.1	5.4	0.05	0.02	448.55	1.43	337	43.88	18	602
Trachinotus falcatus	11	<0.1	0.6	0.05	0.05	1,296.15	7.86	24	0.67	20	27
Mugil curema	2	<0.1	1.2	0.01	0.01	913.77	0.71	44	20.50	23	64
Epinephelus itajara	1	<0.1	0.6	<0.01	<0.01	1,296.15	0.71	36	.	36	36

Table 4. (Continued)

Species	Number		% Occur	Density Estimate (animals/100m²)				Standard Length (mm)			
	No.	%		Mean	Stderr	CV	Max	Mean	Stderr	Min	Max
Menticirrhus saxatilis	1	<0.1	0.6	<0.01	<0.01	1,296.15	0.71	8	.	8	8
Mycteroperca microlepis	1	<0.1	0.6	<0.01	<0.01	1,296.15	0.71	221	.	221	221
Totals	**3,445**	**4.5**	**.**	**14.65**	**3.89**	**344.62**	**555.71**	**.**	**.**	**3**	**602**

Nearshore habitats sampled with 183-m haul seines

A total of 5,329 animals were collected with 183-m haul seines (n=36 hauls), representing 5.9% of the overall catch (*Table 2*), during the twelfth year of sampling in the Sarasota Bay estuary. Pinfish (*Lagodon rhomboides*, n=2,829) was the most abundant taxon collected, accounting for 53.1% of the total catch, while Sheepshead (*Archosargus probatocephalus*, n=225) was the most frequently collected taxon, occurring in 72.2% of 183-m haul seine sets. (*Table 5*). Animals collected in 183-m haul seines tended to be larger (*Table 5*) than animals collected in either 21.3-m bay seines (*Table 3*) or 6.1-m otter trawls (*Table 7*). Animals collected ranged in length from 18 mm to 740 mm, with the length for each of the 10 dominant taxa ranging from 38 mm to 735 mm.

A total of 1,003 animals from 20 Selected Taxa were collected, representing 18.8% of the 183-m haul seine catch (*Table 6*). Sheepshead (*Archosargus probatocephalus,* n=225) was the most abundant Selected Taxon, accounting for 4.2% of the total catch collected by this gear and was the most frequently collected Selected Taxa (72.2%), followed by White Mullet (*Mugil curema*, n=215) and Common Snook (*Centropomus undecimalis*, n=157), which occurred in 16.7% and 52.8% of the hauls, respectively.

Table 5. Catch statistics for 10 dominant taxa collected in 36 183-m haul seine samples during Sarasota Bay stratified-random sampling, 2021. Percent (%) is the percent of the total catch represented by that taxon; percent occurrence (% Occur) is the percentage of samples in which that taxon was collected; CV is the coefficient of variation of the mean. Taxa are ranked in order of decreasing mean catch-per-unit-effort.

Species	Number		% Occur	Density Estimate (animals/set)				Standard Length (mm)			
	No.	%		Mean	Stderr	CV	Max	Mean	Stderr	Min	Max
Lagodon rhomboides	2,829	53.1	69.4	78.58	22.53	172.04	583	119	0.58	38	250
Eucinostomus gula	691	13.0	47.2	19.19	9.03	282.16	312	82	0.33	50	113
Harengula jaguana	226	4.2	8.3	6.28	5.86	559.76	211	101	0.50	80	134
Archosargus probatocephalus	225	4.2	72.2	6.25	1.25	119.94	28	250	3.01	60	365
Mugil curema	215	4.0	16.7	5.97	5.66	568.59	204	161	2.45	128	355
Centropomus undecimalis	157	2.9	52.8	4.36	1.36	187.58	33	422	6.34	261	735
Lutjanus griseus	112	2.1	36.1	3.11	1.04	200.77	29	185	4.39	86	312
Ariopsis felis	110	2.1	38.9	3.06	1.42	277.91	44	274	4.53	167	379
Mugil trichodon	101	1.9	22.2	2.81	1.90	406.83	68	152	4.80	105	282
Orthopristis chrysoptera	99	1.9	25.0	2.75	1.10	239.22	30	107	3.27	63	184
Subtotals	4,765	89.4	.	.	.	.	.	.	.	38	735
Totals	**5,329**	**100.0**	**.**	**148.03**	**29.38**	**119.10**	**679**	**.**	**.**	**18**	**740**

Table 6. Catch statistics for Selected Taxa collected in 36 183-m haul seine samples during Sarasota Bay stratified-random sampling, 2021. Percent (%) is the percent of the total catch represented by that taxon; percent occurrence (% Occur) is the percentage of samples in which that taxon was collected; CV is the coefficient of variation of the mean. Taxa are ranked in order of decreasing mean catch-per-unit-effort.

Species	Number		% Occur	Density Estimate (animals/set)				Standard Length (mm)			
	No.	%		Mean	Stderr	CV	Max	Mean	Stderr	Min	Max
Archosargus probatocephalus	225	4.2	72.2	6.25	1.25	119.94	28	250	3.01	60	365
Mugil curema	215	4.0	16.7	5.97	5.66	568.59	204	161	2.45	128	355
Centropomus undecimalis	157	2.9	52.8	4.36	1.36	187.58	33	422	6.34	261	735
Lutjanus griseus	112	2.1	36.1	3.11	1.04	200.77	29	185	4.39	86	312
Mugil trichodon	101	1.9	22.2	2.81	1.90	406.83	68	152	4.80	105	282
Mugil cephalus	57	1.1	38.9	1.58	0.60	226.15	16	304	10.29	122	454
Leiostomus xanthurus	30	0.6	13.9	0.83	0.50	363.41	17	160	7.04	90	198
Callinectes sapidus	21	0.4	27.8	0.58	0.18	189.46	4	122	7.84	44	168
Trachinotus falcatus	16	0.3	8.3	0.44	0.27	358.57	8	303	12.86	221	364
Elops saurus	13	0.2	5.6	0.36	0.33	554.45	12	268	12.12	222	403
Paralichthys albigutta	13	0.2	16.7	0.36	0.23	375.36	8	137	21.06	86	358
Sciaenops ocellatus	13	0.2	22.2	0.36	0.13	221.07	3	431	21.96	234	537
Cynoscion nebulosus	9	0.2	16.7	0.25	0.12	292.77	4	295	39.63	128	453
Lutjanus synagris	7	0.1	5.6	0.19	0.14	422.65	4	111	10.30	85	147
Menippe spp.	4	0.1	5.6	0.11	0.09	470.26	3	52	6.51	35	66
Farfantepenaeus duorarum	3	0.1	8.3	0.08	0.05	336.37	1	24	3.18	18	29

Table 6. (Continued)

Species	Number		% Occur	Density Estimate (animals/set)				Standard Length (mm)			
	No.	%		Mean	Stderr	CV	Max	Mean	Stderr	Min	Max
Pogonias cromis	3	0.1	5.6	0.08	0.06	442.07	2	440	42.00	397	524
Trachinotus carolinus	2	<0.1	5.6	0.06	0.04	418.16	1	378	9.50	368	387
Menticirrhus americanus	1	<0.1	2.8	0.03	0.03	600.00	1	266	.	266	266
Menticirrhus littoralis	1	<0.1	2.8	0.03	0.03	600.00	1	290	.	290	290
Totals	**1,003**	**18.8**	**.**	**27.86**	**8.39**	**180.74**	**304**	**.**	**.**	**18**	**735**

Deeper-water habitats sampled with 6.1-m otter trawls

During the twelfth year of sampling the Sarasota Bay estuary, 8,002 animals were collected in the 6.1-m otter trawls (n=48 hauls), representing 8.8% of the overall catch (*Table 2*). Eucinostomus Mojarra (*Eucinostomus* spp.*,* n=2,223, 27.8% of total catch) was the most abundant taxon collected (*Table 7*). Portunus Crabs (*Portunus spp.,* n=710) was the taxon most frequently collected with 6.1-m otter trawls*,* occurring in 72.9% of the trawl samples. Trawl-collected animals tended to be similar in size to those collected with 21.3-m bay seines (*Table 3*) and smaller than individuals collected with 183-m haul seines (*Table 5*). Animals collected ranged in length from 3 mm to 431 mm, with the length for the 10 dominant taxa ranging from 3 mm to 188 mm.

Eleven Selected Taxa (515 animals, 6.4% of the trawl catch) were collected with 6.1-m otter trawls (*Table 8*). The most abundant Selected Taxon was Pink Shrimp (*Farfantepenaeus duorarum*, n=242); it was also the Selected Taxon most frequently collected, occurring in 43.8% of the trawl collections.

Table 7. Catch statistics for 10 dominant taxa collected in 48 6.1-m otter trawl samples during Sarasota Bay stratified-random sampling, 2021. Percent (%) is the percent of the total catch represented by that taxon; percent occurrence (% Occur) is the percentage of samples in which that taxon was collected; CV is the coefficient of variation of the mean. Taxa are ranked in order of decreasing mean density.

Species	Number		% Occur	Density Estimate (animals/100m^2)				Standard Length (mm)			
	No.	%		Mean	Stderr	CV	Max	Mean	Stderr	Min	Max
Eucinostomus spp.	2,223	27.8	35.4	3.20	1.43	308.90	50.46	23	0.14	11	39
Lagodon rhomboides	1,625	20.3	58.3	2.56	1.05	284.47	36.22	49	0.91	11	148
Portunus spp.	710	8.9	72.9	1.27	0.45	244.83	15.97	50	0.52	10	82
Eucinostomus gula	734	9.2	50.0	1.07	0.33	215.59	9.87	74	0.68	41	117
Harengula jaguana	483	6.0	4.2	0.71	0.71	691.43	34.23	25	0.21	21	114
Orthopristis chrysoptera	433	5.4	39.6	0.62	0.31	342.01	14.30	62	2.27	15	188
Gobiosoma robustum	258	3.2	37.5	0.47	0.17	242.74	6.02	24	0.18	14	33
Gobiosoma spp.	257	3.2	35.4	0.46	0.22	325.55	9.96	17	0.13	11	24
Farfantepenaeus duorarum	242	3.0	43.8	0.38	0.15	277.17	6.25	13	0.25	3	29
Opsanus beta	153	1.9	45.8	0.30	0.19	435.38	9.13	49	1.94	15	134
Subtotals	7,118	88.9	.	.	.	.	.	.	.	3	188
Totals	**8,002**	**100.0**	**.**	**12.42**	**2.22**	**123.98**	**58.37**	**.**	**.**	**3**	**431**

Table 8. Catch statistics for Selected Taxa collected in 48 6.1-m otter trawl samples during Sarasota Bay stratified-random sampling, 2021. Percent (%) is the percent of the total catch represented by that taxon; percent occurrence (% Occur) is the percentage of samples in which that taxon was collected; CV is the coefficient of variation of the mean. Taxa are ranked in order of decreasing mean density.

Species	Number		% Occur	Density Estimate (animals/100m^2)				Standard Length (mm)			
	No.	%		Mean	Stderr	CV	Max	Mean	Stderr	Min	Max
Farfantepenaeus duorarum	242	3.0	43.8	0.38	0.15	277.17	6.25	13	0.25	3	29
Callinectes sapidus	110	1.4	39.6	0.18	0.07	249.14	2.47	87	3.47	25	182
Menippe spp.	75	0.9	41.7	0.13	0.04	230.22	1.49	36	2.43	6	98
Paralichthys albigutta	39	0.5	31.2	0.06	0.02	221.61	0.71	155	8.68	25	298
Archosargus probatocephalus	13	0.2	14.6	0.02	0.01	343.69	0.40	53	22.80	14	253
Lutjanus griseus	10	0.1	14.6	0.02	0.01	310.60	0.28	129	18.96	35	227
Menticirrhus americanus	8	0.1	10.4	0.01	0.01	312.22	0.14	246	8.63	194	271
Cynoscion nebulosus	7	0.1	8.3	0.01	0.01	419.82	0.27	95	37.97	30	277
Lutjanus synagris	6	0.1	4.2	0.01	0.01	484.66	0.21	71	10.26	36	105
Sciaenops ocellatus	4	<0.1	4.2	0.01	0.01	485.36	0.22	14	0.96	13	17
Mycteroperca microlepis	1	<0.1	2.1	<0.01	<0.01	692.82	0.07	236	.	236	236
Totals	**515**	**6.4**	**.**	**0.83**	**0.18**	**148.39**	**6.96**	**.**	**.**	**3**	**298**

Species Profiles

An important use of FIM program data is to track relative abundance of fish stocks and provide information for species management plans, including information on the abundance of juvenile fish. Juvenile indices of abundance (IOAs) assess the relative abundance of newly-recruited or young-of-the-year (YOY) fish and may be used to describe recruitment processes and forecast population trends. Adult IOAs assess the relative abundance of larger, older fish and may be used to describe the sexually mature portion of a population and help forecast future YOY recruitment trends. When combined, these two pieces of information can provide a comprehensive picture of the relative condition of a population. This section provides profiles of species that are routinely collected in FIM program sampling and are of economic importance in Florida.

Statistical models were used to develop recruitment indices for each species examined (Red Drum, Common Snook, Spotted Seatrout, Sheepshead, and Pinfish), hereafter referred to as “target species”. Data from stratified-random sampling (SRS) were used to create IOAs for YOY and adults of target species in three adjacent estuaries (Tampa Bay, Sarasota Bay, and Charlotte Harbor) in the southeastern Gulf of Mexico. The specific time periods and sizes of specimens included in the analyses varied among species based upon their individual patterns of recruitment and growth. Length-frequency histograms were examined to determine the time period and size at which the target species fully recruited to the sampling gears. In general, only months of peak abundance were included in the analyses. Larger sizes of fish considered to be sub-adult or adult were typically analyzed separately from YOY life-history stages.

The annual IOAs representing either juvenile recruitment (YOY IOAs) or the sub-adult and adult portion of the population (Adult IOAs) were computed using generalized linear models. The FIM program's SRS design generates count data, the distribution of which is bounded by zero. Often, the frequency distribution of these counts is highly non-normal; therefore, a Poisson or negative binomial distribution was used to create IOAs. This report represents a data summary and not an in-depth analysis of factors affecting abundance; therefore, year was the only factor retained in the model runs for the Species Profiles. All IOAs were completed using the GLIMMIX procedure (*SAS Institute Inc. 2006*).

Relative abundance was calculated as the median annual number of fish per set. Median values were determined from the least-squares adjusted means by multiplying the standard error by a random normal deviate (μ=0, σ=1) and adding it to the least-squares mean. These data were then back-transformed (e^x). The process was repeated 500 times for each year to create a sampling distribution of back-transformed values. Summary statistics (25th and 75th percentiles) were then calculated and plotted with the median to view annual trends in IOAs (*Sokal and Rohlf 1981*).

Red Drum, *Sciaenops ocellatus*

The Red Drum, *Sciaenops ocellatus*, is an estuarine-dependent species inhabiting coastal waters from Massachusetts to northern Mexico (*Yokel 1966*; *Reagan 1985*). This species supports important recreational fisheries throughout the U.S. south Atlantic and Gulf of Mexico coasts. In Florida, dramatic stock reductions in the mid-1980s resulted in a 1986 moratorium on commercial and recreational Red Drum fisheries. In 1989, the fishery was reopened with strict size and bag limits, as well as a no-sale provision that effectively eliminated the commercial Red Drum fishery in Florida. Since that time, Red Drum stocks have recovered significantly. The most recent model predictions for age-specific indices of Red Drum indicated that populations in Florida exceeded the Florida Fish and Wildlife Conservation Commission's management target of at least a 40% escapement rate (geometric mean of the last three years, 2017–2019) in three (NW, SW, NE) of the four statewide assessment regions *(Addis 2020*). In these three regions, Red Drum are not considered overfished nor undergoing overfishing. The SE region of Florida exceeded the escapement rate management target in 2019, the terminal year of the assessment (55%), but did not meet the escapement rate management target over the three-year time period. Current escapement rates for 2017-2019 were 48% in the NW, 72% in the SW, 61% in the NE, and 35% in the SE region *(Addis 2020*). In addition, continued improvement of escapement rates within the northeast management region of the state led to an increase of the daily bag limit from one to two fish in early 2012 and a renewed interest in opening coastal Red Drum to harvest in the Gulf. However, bag limits within the southern and northwest management areas of the state are at one fish per person per day.

In Florida, adult Red Drum spawn from mid-August through late November (*Yokel 1966*). Spawning occurs primarily near bay mouths, inlets, or over nearshore continental shelf waters (*Mercer 1984*; *Murphy and Taylor 1990*), and in some locations inside estuaries (*Murphy and Taylor 1990*; *Johnson and Funicelli 1991*). In Florida estuaries, recruitment of juveniles begins in September and continues through February, with peaks occurring in October and November (*Reagan 1985*; *Peters and McMichael 1987*; *Daniel 1988*). Settlement of young-of-the-year (YOY) Red Drum typically occurs in the middle to upper reaches of estuaries, away from ocean inlets or passes, and can be strongly influenced by the availability of low to moderate salinity habitats (*FDEP-FMRI 1997*). On both coasts, large juvenile Red Drum enter the fishery at approximately 15–18 months of age and are fully recruited at the beginning of their third year (age-2) (*Chagaris et al. 2015*). The legal recreational slot limit (457 to 686 mm TL; 18 to 27-TL) includes predominantly age-1 and age-2 fish. Red drum greater than 700 mm SL are uncommon in the FIM program samples from west Florida estuaries but are occasionally collected on the east coast in the Indian River Lagoon (IRL) (*FWC-FWRI 2021*).

To monitor year-class strength and improve the ability to predict future abundance of legal-size Red Drum, the FIM program developed IOAs of YOY recruitment into selected Florida estuaries. Abundance data for YOY Red Drum ≤40 mm SL that were collected in stratified-random 21.3-m bay seine samples were examined to assess recruitment into three Florida estuaries (in order of sampling inception): Tampa Bay, Charlotte Harbor, and Sarasota Bay. Young-of-the-year Red Drum recruited to habitats sampled with our 21.3-m bay seines primarily from September through

February; therefore, these months were used to define the respective recruitment seasons for each estuary in subsequent analyses (2009–2020). Annual IOAs were also developed for legal-size Red Drum that fall within the permitted recreational harvest size range (457–686 mm TL; 374–565 mm SL; *Murphy and Taylor 1990*) in each estuary. These IOAs included all legal-size Red Drum collected in stratified-random 183-m haul seines during each calendar year (January 2010–December 2021).

Annual IOAs for YOY Red Drum indicated similar recruitment patterns in Tampa Bay, Sarasota Bay, and Charlotte Harbor (*Figure 2*) with each estuary having relatively stable recruitment over the time series and strong recruitment in 2013 (all three estuaries), 2015 (Tampa and Sarasota bays), and 2016–2017 (Tampa Bay). Red Drum abundance in 2018 fell below the average of the previous five years in Tampa Bay, 2013–2017, with levels similar to abundance in 2010. Red drum abundance in Tampa Bay increased in 2019, nearing the average, before abundance fell slightly again in 2020. In Sarasota Bay, Red Drum abundance from 2017–2019 remained the lowest on record before an increase in 2020 to the long-term average, similar to 2010–2011 and 2016 abundances. In Charlotte Harbor, 2019 Red Drum abundance decreased to the lowest on record in the twelve-year time series. Abundance levels rose slightly above the long-term average in 2020 for the first time since 2014. The similarity in patterns of YOY Red Drum abundance observed over the past seven years in Florida's Gulf of Mexico estuarine systems suggests that Red Drum recruitment along Florida's west coast may be influenced by factors operating over regional scales.

Annual IOAs for legal-size fish in Tampa Bay, Sarasota Bay, and Charlotte Harbor increased beginning in 2011 and peaked in 2013 (*Figure 3*). After 2013, abundance of legal-size Red Drum in Sarasota Bay declined to levels below 2010, with the lowest abundance in 2016, followed by an increase in abundance in 2017 and 2019. In 2020, after six years of below-average relative abundance, Red Drum abundance in Sarasota Bay increased to a level above the average and similar to the recorded peak in 2013. In 2021, abundance decreased to below the long-term average but remained higher than averages from 2014–2019. In Tampa Bay and Charlotte Harbor, abundance initially declined after the 2013 peak but then remained relatively stable from 2014–2016. Following 2016, abundance in Tampa Bay declined in 2017 to levels similar to 2010. Abundance increased in 2018 to equal the long-term average and was followed with a decrease in 2019. In 2020, abundance of Red Drum in Tampa Bay rose above the long-term average for the first time since 2016 before abundance continued to increase in 2021 to the highest level seen in this study for the estuary. Charlotte Harbor levels continued to decline from 2016–2018 and then increased marginally in 2019. Red Drum abundance in Charlotte Harbor rose sharply in 2020 and continued to increase in 2021 to reach the estuary's highest abundance in the twelve-year time series.

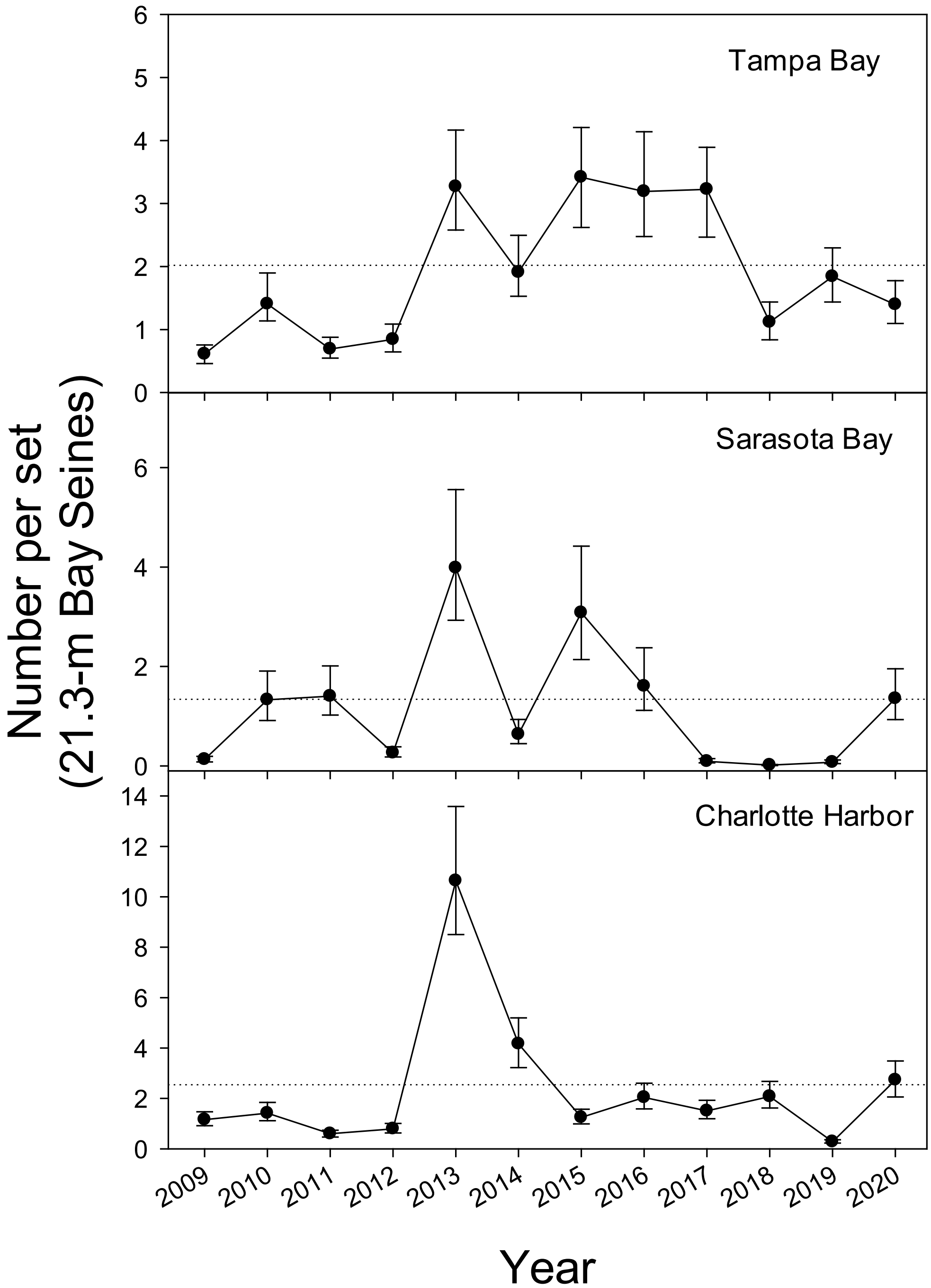

Figure 2. Relative abundance of young-of-the-year Red Drum (≤40 mm SL) collected in 21.3-m bay seines between 2009 and 2020 during stratified-random sampling in three southwest Florida estuarine systems. Not all data for the 2021 recruitment year (October 2021–February 2022) were available yet so 2021 was not included. Points represent the median estimate, the vertical bars represent the 25th–75th percentiles, and the dotted horizontal line represents the median value during the reporting period. Note different scales of relative abundance among plots.

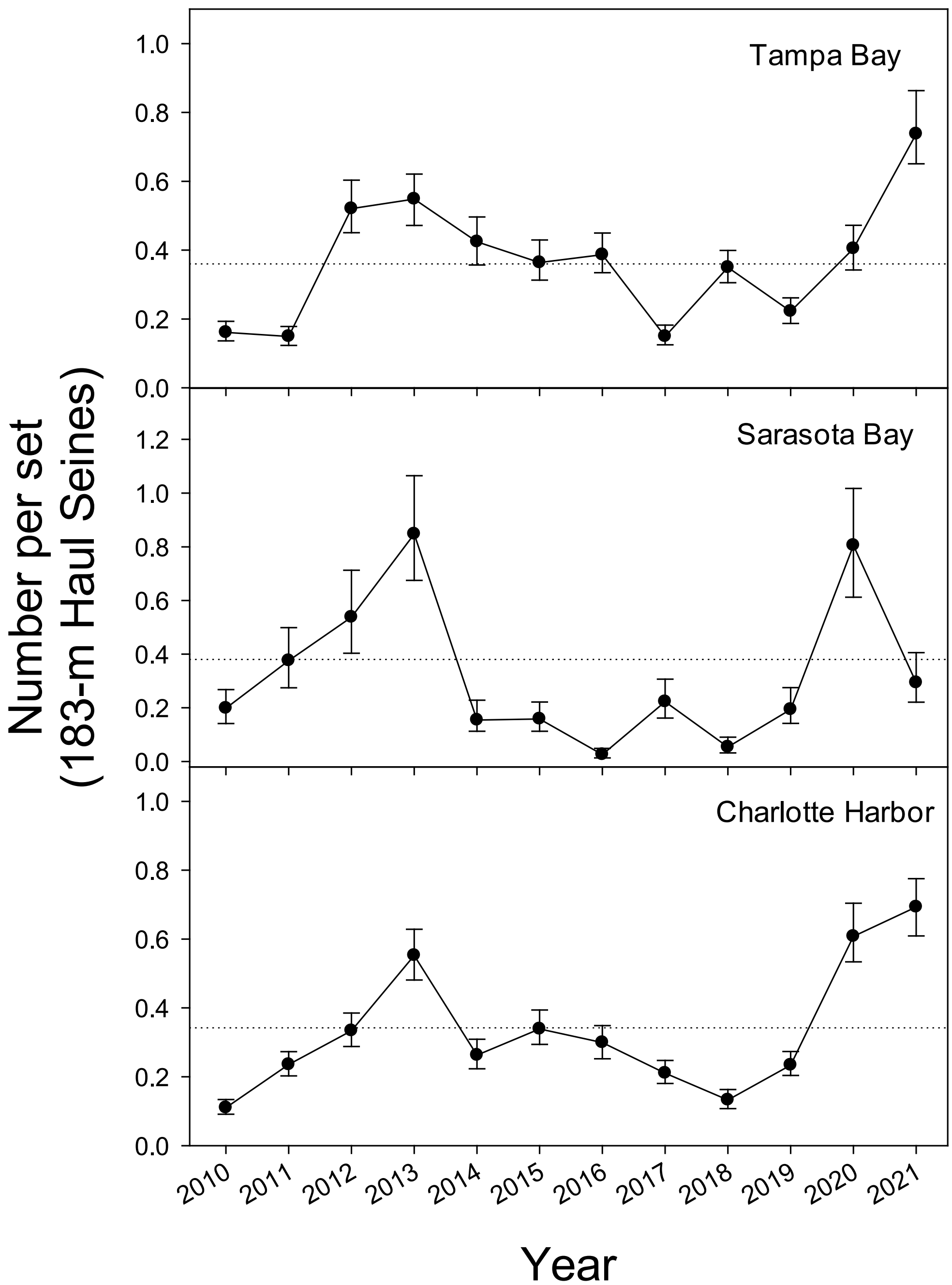

Figure 3. Relative abundance of legal-sized Red Drum (374–565 mm SL) collected in 183-m haul seines between 2010 and 2021 during stratified-random sampling in three southwest Florida estuarine systems. Points represent the median estimate, the vertical bars represent the 25th–75th percentiles, and the dotted horizontal line represents the median value during the reporting period. Note different scales of relative abundance among plots.

Common Snook, *Centropomus undecimalis*

Common Snook, *Centropomus undecimalis*, are found in estuaries, adjacent rivers, and in nearshore waters of the tropical and subtropical western Atlantic and Gulf of Mexico (*Gilmore et al. 1983*; *Rivas 1986*; *Winner et al. 2010*). This species supports an important recreational fishery in Florida and is one of the most popular gamefish in state waters. There has been no legal commercial harvest of Common Snook in Florida since the State Legislature declared it a gamefish in 1957 and prohibited its sale. Recreational fishing effort targeting Common Snook has increased consistently over the past 30 years on both coasts, but more so on Florida's Gulf coast (*Munyandorero et al. 2020*). While the overall harvest of Common Snook has declined since the mid-1990s, the numbers of Common Snook caught and released have remained consistently high over the past 25 years *(Munyandorero et al. 2020*). Gulf and Atlantic coast Common Snook stocks are currently meeting Florida Fish and Wildlife Conservation Commission management objectives by exceeding the 40% transitional spawning potential ratio target *(Munyandorero et al. 2020*). In response to cold-weather fish kills that occurred statewide during 2010, the FWC issued executive orders that prohibited the harvest of Common Snook through August 31, 2010, and subsequent executive orders extended the closure through August 31, 2011 (State of Florida Executive Order No. E0 10-45). At the June 2011 Florida Fish and Wildlife Conservation Commission Meeting, Commissioners concluded that the Atlantic coast stock was less severely impacted by cold weather than the Gulf coast. Based on this information, the Commissioners ruled to reopen Common Snook harvest on September 1, 2011, in Atlantic waters, but Gulf coast waters remained closed through August 31, 2013.

In Florida, Common Snook populations from the Atlantic and Gulf coasts have been genetically identified as separate stocks and are managed separately (*Taylor et al. 1993*; *Tringali and Bert 1996*). Histological evidence shows that Common Snook are protandric hermaphrodites, meaning they begin life as males, and some become females after maturation (*Taylor et al. 2000*). Males typically become sexually mature at ~200 mm SL and females at ~680 mm SL. The reproductive season for Common Snook extends at least six months: April through September on the Gulf coast and April through October on the Atlantic coast (*Taylor et al. 1998*).

In Tampa Bay, Sarasota Bay, and Charlotte Harbor, the FIM program monitored the relative abundances of large juvenile and adult Common Snook. Individuals between 200 mm and 609 mm SL were included in the IOA since they are assumed to be reproductively mature males and serve as a “pre-recruitment” indicator to the fishery. The upper limit of 609 mm SL used in this IOA corresponds to the lower regulatory minimum size of 711 mm total length (TL). Data from stratified-random 183-m haul seines were used to develop IOAs that included all Common Snook between 200 and 609 mm SL collected between January and December from 2010 to 2021.

Annual IOAs of pre-fishery adult Common Snook (200–609 mm SL) on Florida’s west coast varied through time within each estuary (*Figure 4*). Regardless of estuary, the lowest abundance on record occurred in 2010, following a cold kill event in early 2010. Since 2010, there has been an increasing trend in abundance for all three estuaries, with the highest abundance on record occurring in 2016 in Sarasota Bay, 2018 in Tampa Bay, and 2020 in Charlotte Harbor. Common Snook abundance for all three estuaries decreased in 2019, possibly in response to a long-term red tide event between October 2017 and February 2019. In Sarasota Bay, abundance fell below the long-term average in 2019 for the first time since 2015. In 2021, Common Snook abundance decreased in all three estuaries. The largest decrease in abundance occurred in Tampa Bay, with smaller declines in Sarasota Bay and Charlotte Harbor. Tampa Bay abundance fell below the long-term average for the first time since 2014 while Charlotte Harbor abundance decreased to slightly above the long-term average. In Sarasota Bay, Common Snook abundance remained below the long-term average with a slight decrease in abundance in 2021 to averages comparable to 2014 and 2019.

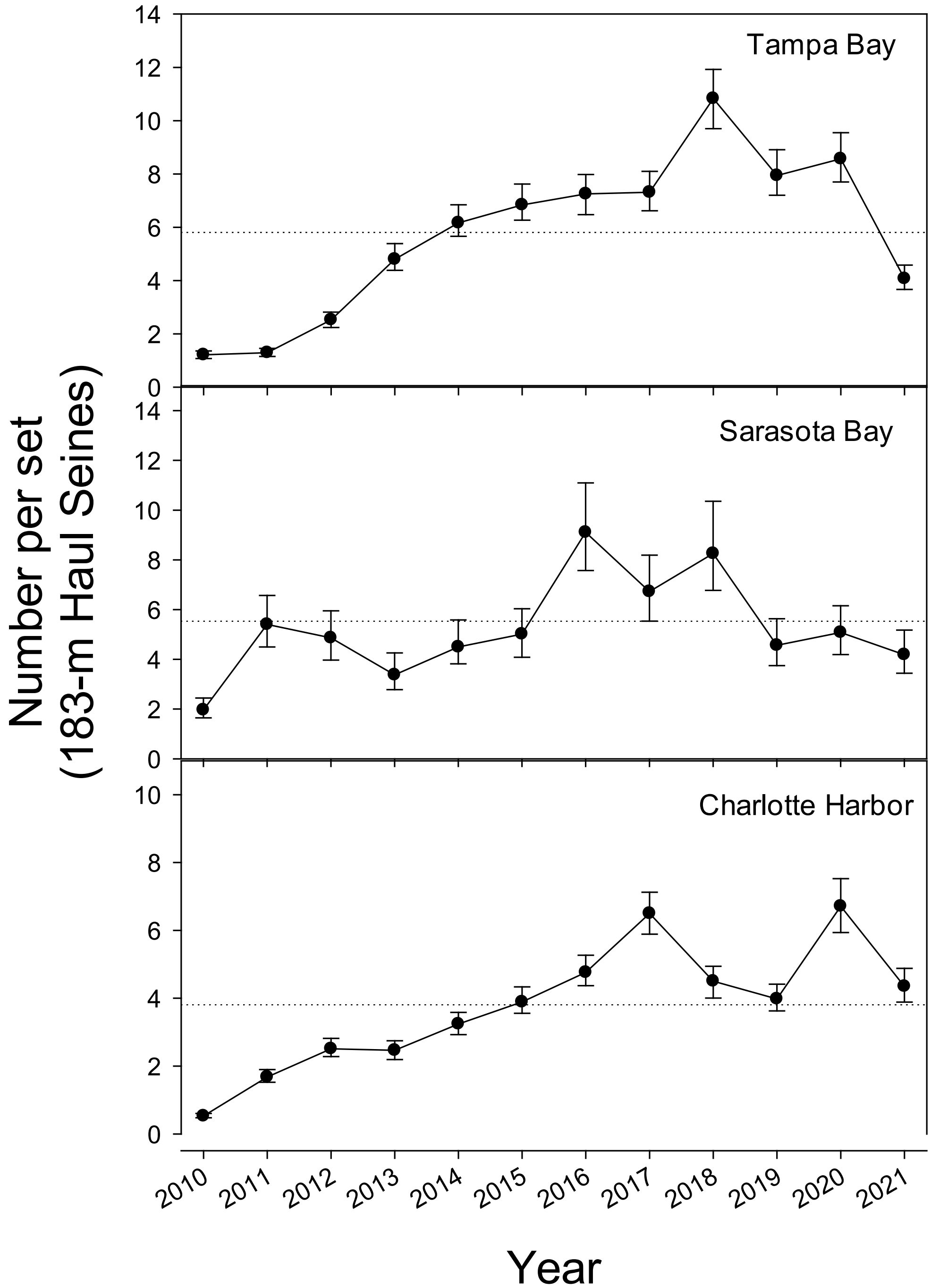

Figure 4. Relative abundance of pre-fishery Common Snook (200–609 mm SL) collected in 183-m haul seines between 2010 and 2021 during stratified-random sampling in three southwest Florida estuarine systems. Points represent the median estimate, the vertical bars represent the 25th–75th percentiles, and the dotted horizontal line represents the median value during the reporting period. Note different scales of relative abundance among plots.

Spotted Seatrout, *Cynoscion nebulosus*

Spotted Seatrout, *Cynoscion nebulosus*, occur in temperate to tropical estuarine and coastal waters on the Atlantic and Gulf coasts of the United States (*Bortone 2003*). In Florida, Spotted Seatrout have historically supported economically important recreational and commercial fisheries. Overall, annual commercial landings of Spotted Seatrout in Florida declined slowly during the period from 1950 through the 1970s. During the 1980s, the decline accelerated, especially in the Southwest region (*Murphy et al. 2011*). Statewide commercial landings never exceeded much more than 500,000 fish during the early 1990s and dropped drastically to fewer than 50,000 fish after implementation of the constitutional amendment banning the use of entangling gear in 1995 and the establishment of a 3-month open season in 1996 (*Murphy et al. 2011*). Declines in the number of commercial trips from the mid-1980s to more recent years were over 90% on the Atlantic coast and nearly 99% on the Gulf coast (*Murphy et al. 2011*). Commercial effort continues to be significantly less than the recreational sector (*Murphy et al. 2011*). Since the mid-1990s various commercial and recreational fishing regulations have been adopted to support the rebuilding of Spotted Seatrout stocks (*Murphy et al. 1999*). With these regulatory changes, the Spotted Seatrout fishery has moved from a mixed–sector fishery, with about 20% of the landings made by commercial fishers, to an almost exclusive recreational fishery (*Chagaris et al. 2008*). Total estimated landings for this species in Florida during 2009 were 1,589,030 fish, with 98% of this total from the recreational fishery (*Murphy et al. 2011*).

Adult Spotted Seatrout begin to spawn in March or April in southwest and west-central Florida estuaries (i.e., Tampa Bay and Charlotte Harbor; *McMichael and Peters*

1989). Spotted Seatrout are generally reproductively mature at age-2 (males >200 mm SL; females >235 mm SL; *Murphy et al. 2006*). Protracted spawning of Spotted Seatrout continues through the summer and into late September or October, depending upon location (*Murphy et al. 1999*). Spawning generally occurs during the evening hours in deep channels and depressions near grass flats in estuarine areas with water temperatures >21°C (*Tabb 1966*; *Helser et al. 1993*). Estuarine water temperatures below 20°C may reduce hatching success for Spotted Seatrout (*Gray et al. 1991*).

To assess year-class strength and to improve the ability to predict future adult Spotted Seatrout abundances, relative IOAs were developed for YOY Spotted Seatrout recruitment into Tampa Bay, Sarasota Bay, and Charlotte Harbor. Abundance data for YOY Spotted Seatrout (≤100 mm SL) collected from stratified-random 21.3-m bay seine samples were examined to assess recruitment. Young-of-the-year Spotted Seatrout recruited to habitats sampled with 21.3-m bay seines primarily from April through October in Tampa Bay, Sarasota Bay, and Charlotte Harbor. These recruitment periods coincide with published recruitment and spawning periods of Spotted Seatrout throughout Florida (*Moody 1950; Nelson and Leffler 2001*; *Devries et al. 2002*; *Walters et al. 2007*). Therefore, these months were used to define the recruitment seasons for each estuary in subsequent analyses of 21.3-m bay seine data. Data for the 2009 recruitment year (April 2009–October 2009) were included in analysis from 2009 to 2021, despite no sampling data for April 2009. April typically has very low recruitment abundance and the lack of April data would not adversly affect indices of abundance for the year. Data from stratified-random 183-m haul seines collected within these same Florida estuarine systems were used to develop IOAs for adult Spotted Seatrout (≥200 mm SL). These IOAs were derived by including all Spotted Seatrout ≥200 mm SL collected between January and December from 2010 to 2021.

Trends in relative abundance of YOY and adult Spotted Seatrout varied within and among the three estuaries during this reporting period (*Figures 5* and *6*). In each estuary, YOY abundance has been relatively stable since 2010 (*Figure 5*) with estuarine-specific abundance peaks occurring in 2015 (Tampa Bay), 2020 (Sarasota Bay), and 2011 and 2013 (Charlotte Harbor). Tampa Bay maintained a stable trend from 2016–2018, with abundances above the long-term average. In 2019, abundance in Tampa Bay decreased to the second lowest level recorded in this study then increased to the long-term average in 2020. In 2021, Tampa Bay Spotted Seatrout abundance decreased to the lowest level in the twelve-year study period. Relative abundance has generally declined in Sarasota Bay since 2015, with 2017–2019 having the three lowest abundances on record. In 2020, Spotted Seatrout abundance in Sarasota Bay surpassed the long-term average and reached the highest level on record in this study before abundance declined again in 2021 to an average comparable to 2015. Abundance has also declined in Charlotte Harbor since 2015, with 2018 having the lowest abundance on record. Relative abundance then increased in 2019 and again in 2020 to be comparable to the long-term average. Charlotte Harbor abundance then declined to a level below the long-term average in 2021.

Adult Spotted Seatrout abundance has been variable but relatively stable during the reporting period (*Figure 6*) with higher abundances in 2011 for Tampa Bay and Sarasota Bay and 2014 in Charlotte Harbor. Lower than average abundance was evident in Tampa Bay in 2015, 2017, and 2019–2020; in Sarasota Bay in 2017–2019, and 2021; and in Charlotte Harbor in 2012–2013 and 2015–2019. In 2021, Tampa Bay adult Spotted Seatrout abundance increased above the long-term average while Sarasota Bay abundance decreased to one of the lowest levels on record during this study. In 2021, Charlotte Harbor abundance decreased to a level comparable to the long-term average. The estuarine-specific abundance trends for both YOY and adult Spotted Seatrout likely indicate that local processes control recruitment success.

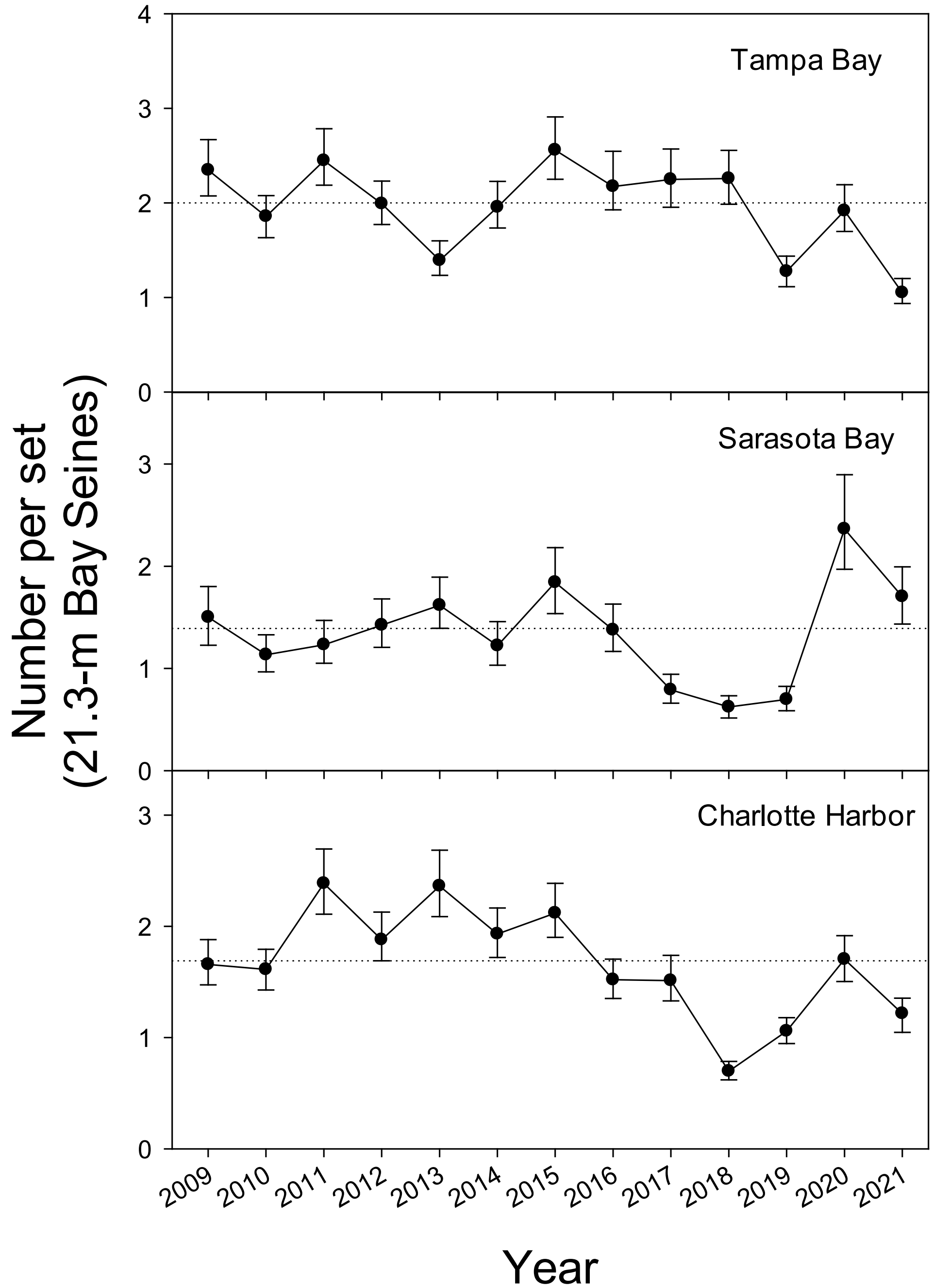

Figure 5. Relative abundance of young-of-the-year Spotted Seatrout (≤100 mm SL) collected in 21.3-m bay seines between 2009 and 2021 during stratified-random sampling in three southwest Florida estuarine systems. Data for the 2009 recruitment year (April 2009–October 2009) were included in analysis despite no sampling data for April 2009. April typically has very low recruitment abundance and the lack of April data would not adversely affect indices of abundance for the year. Points represent the median estimate, the vertical bars represent the 25th–75th percentiles, and the dotted horizontal line represents the median value during the reporting period. Note different scales of relative abundance among plots.

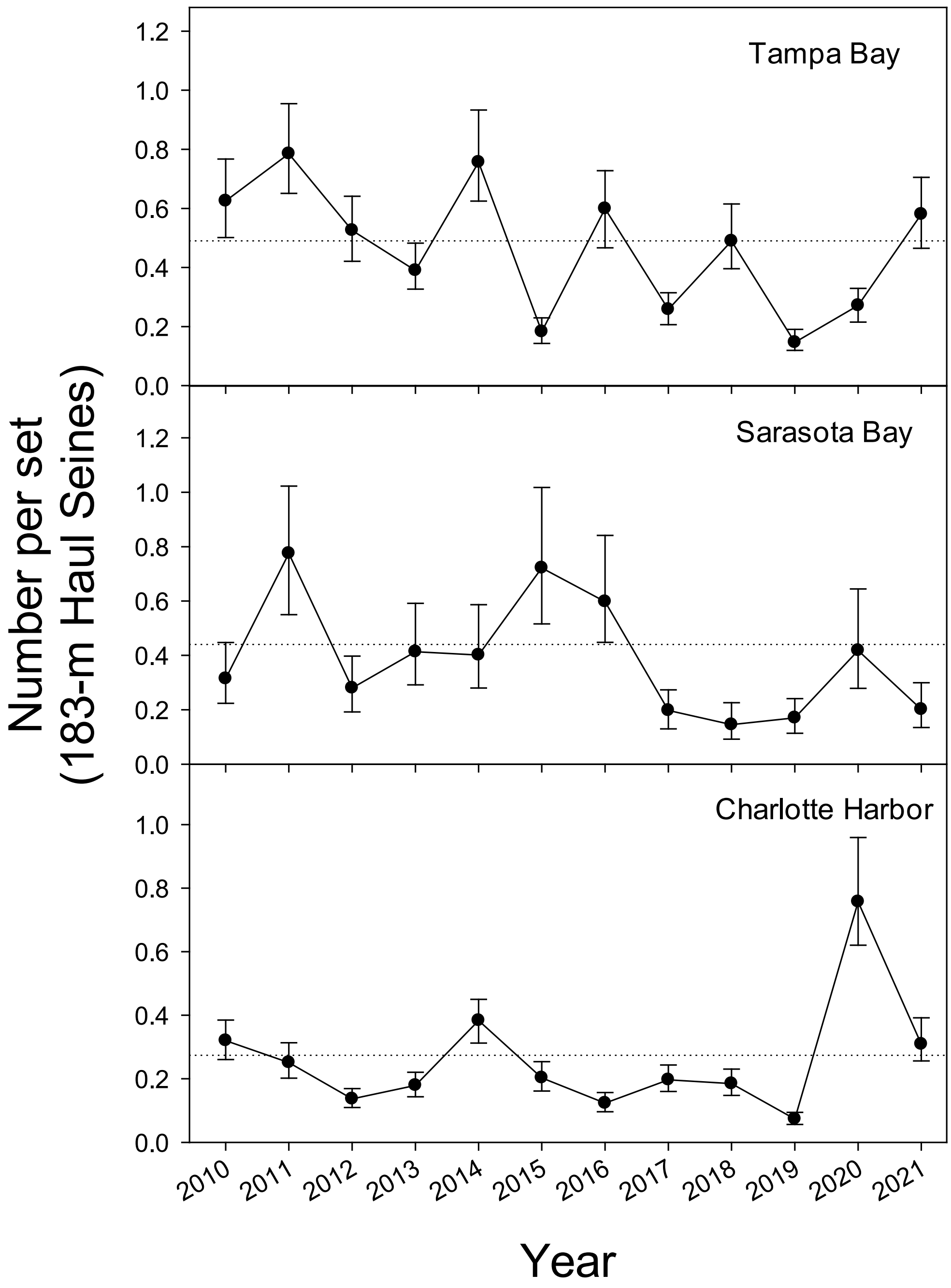

Figure 6. Relative abundance of adult Spotted Seatrout (>200 mm SL) collected in 183-m haul seines between 2010 and 2021 during stratified-random sampling in three southwest Florida estuarine systems. Points represent the median estimate, the vertical bars represent the 25th–75th percentiles, and the dotted horizontal line represents the median value during the reporting period. Note different scales of relative abundance among plots.

Sheepshead, *Archosargus probatocephalus*

The Sheepshead (*Archosargus probatocephalus*) occurs from Nova Scotia (*Gilhen et al. 1976*) to Brazil (*Caldwell 1965*) and is common in United States coastal waters from Chesapeake Bay to Texas (*Bigelow and Schroeder 1953*). The combined recreational and commercial landings of Sheepshead from Florida's Gulf coast between 1990 and 2009 made up 19–44% of the total annual Sheepshead landings for all U.S. Gulf states (*NMFS 2014*). Historically, recreational landings have comprised 82–99% of the combined recreational/commercial annual landings (2000–2015) along Florida's Gulf coast (*Munyandorero et al. 2017*). Sheepshead in Florida waters are currently regulated by a minimum size (305 mm TL) and a bag limit (15 fish/day). The most recent stock assessment for Sheepshead (2017) used FIM program data to derive IOAs during different life history stages to guide coast-specific, catch-at-age models (*Munyandorero et al. 2017*). This stock assessment determined that Sheepshead stocks on the Gulf and Atlantic coasts appeared abundant enough to supply adequate numbers of new recruits while maintaining current harvest rates.

In Florida waters, the reproductive season for adult Sheepshead is February to April and newly recruited YOY are most abundant in shallow estuarine areas between April and June. Regression analyses conducted by FIM for YOY Sheepshead show they reach 40 mm SL at approximately 90 days and 130 mm SL at one year of age. Sheepshead in Florida waters enter the fishery at 242 mm SL, which typically corresponds to an age of 3 to 6 years (Dutka-Gianelli and Murie 2001; Winner et al. 2017).

To assess year-class strength and to improve the ability to predict future adult

Sheepshead abundance, relative IOAs were developed to estimate YOY Sheepshead recruitment into selected Florida estuaries. Abundance data for YOY Sheepshead (≤40 mm SL) that were collected in stratified-random 21.3-m bay seines were examined to assess recruitment in three Florida estuaries: Tampa Bay, Sarasota Bay, and Charlotte Harbor. Young-of-the-year Sheepshead recruited to habitats sampled with 21.3-m bay seines primarily from April through June. These months were used to define the respective recruitment seasons for each estuary in subsequent analyses. Annual IOAs were also calculated for Sheepshead fully recruited to the fishery (≥242 mm SL) for the same three Florida estuaries. Data from stratified-random 183-m haul seines were used to develop IOAs for fully-recruited Sheepshead from January through December of each year.

Annual trends in YOY Sheepshead IOAs were variable in the three southwest Florida estuaries, but a cycle of one year of relatively high abundance followed by a year of lower recruitment has been consistent in Tampa and Sarasota bays since 2013 (*Figure 7*). In Tampa Bay, abundances were highest in 2014, 2016, and 2021. In Sarasota Bay, YOY Sheepshead IOAs have fluctuated with peak abundances in 2012, 2018, 2020 and 2021. In Tampa and Sarasota bays in 2021, abundance increased above the long-term average to the highest levels on record in this study for these two estuaries. In Charlotte Harbor, YOY Sheepshead abundance increased considerably between 2010 and 2014, before decreasing in 2015, increasing again in 2016, declining through 2019 to the lowest recorded level in all three estuaries, followed by an increase in 2020 to a level above the long-term average and another decline in 2021 to a level just below the long-term average.

Adult Sheepshead abundance has been relatively stable during the reporting period (*Figure 8*). The lowest adult sheepshead abundances occurred in 2011 (Tampa Bay and Sarasota Bay) and 2012 (Charlotte Harbor). In Tampa Bay, adult Sheepshead abundance has increased since 2011, with a peak in 2016. In Sarasota Bay, adult Sheepshead abundance peaked in 2015 and has been variable but stable since. Abundance peaked in 2018 in Charlotte Harbor. In 2021, adult Sheepshead abundance in all three estuaries was comparable to the long-term average with a slight increase in abundance from 2020 in Tampa Bay, a decrease in abundance from 2020 in Sarasota Bay and no change in abundance compared to 2020 in Charlotte Harbor.

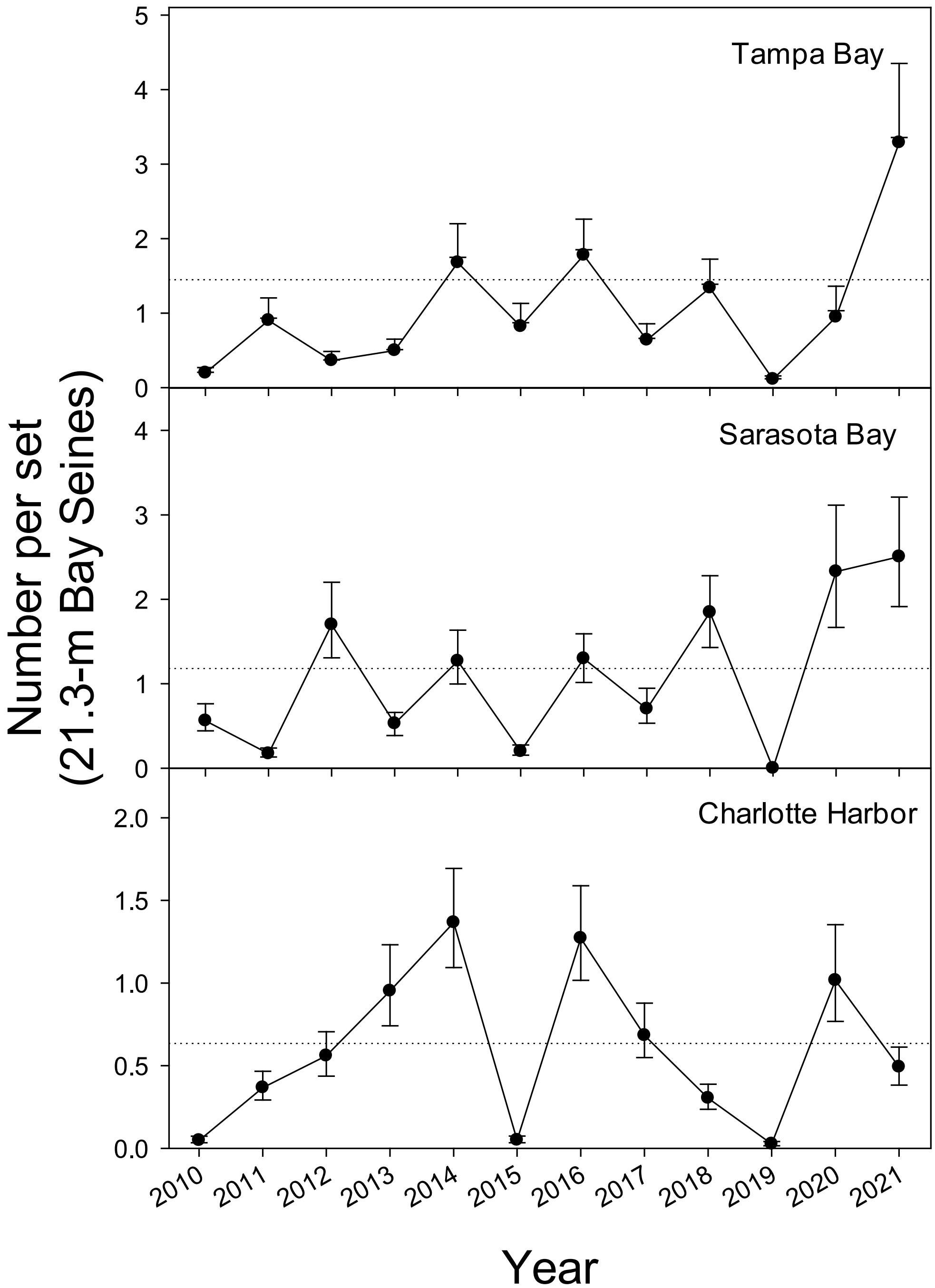

Figure 7. Relative abundance of young-of-the-year Sheepshead (≤40 mm SL) collected in 21.3-m bay seines between 2010 and 2021 during stratified-random sampling in three southwest Florida estuarine systems. Points represent the median estimate, the vertical bars represent the 25th–75th percentiles, and the dotted horizontal line represents the median value during the reporting period. Note different scales of relative abundance among plots.

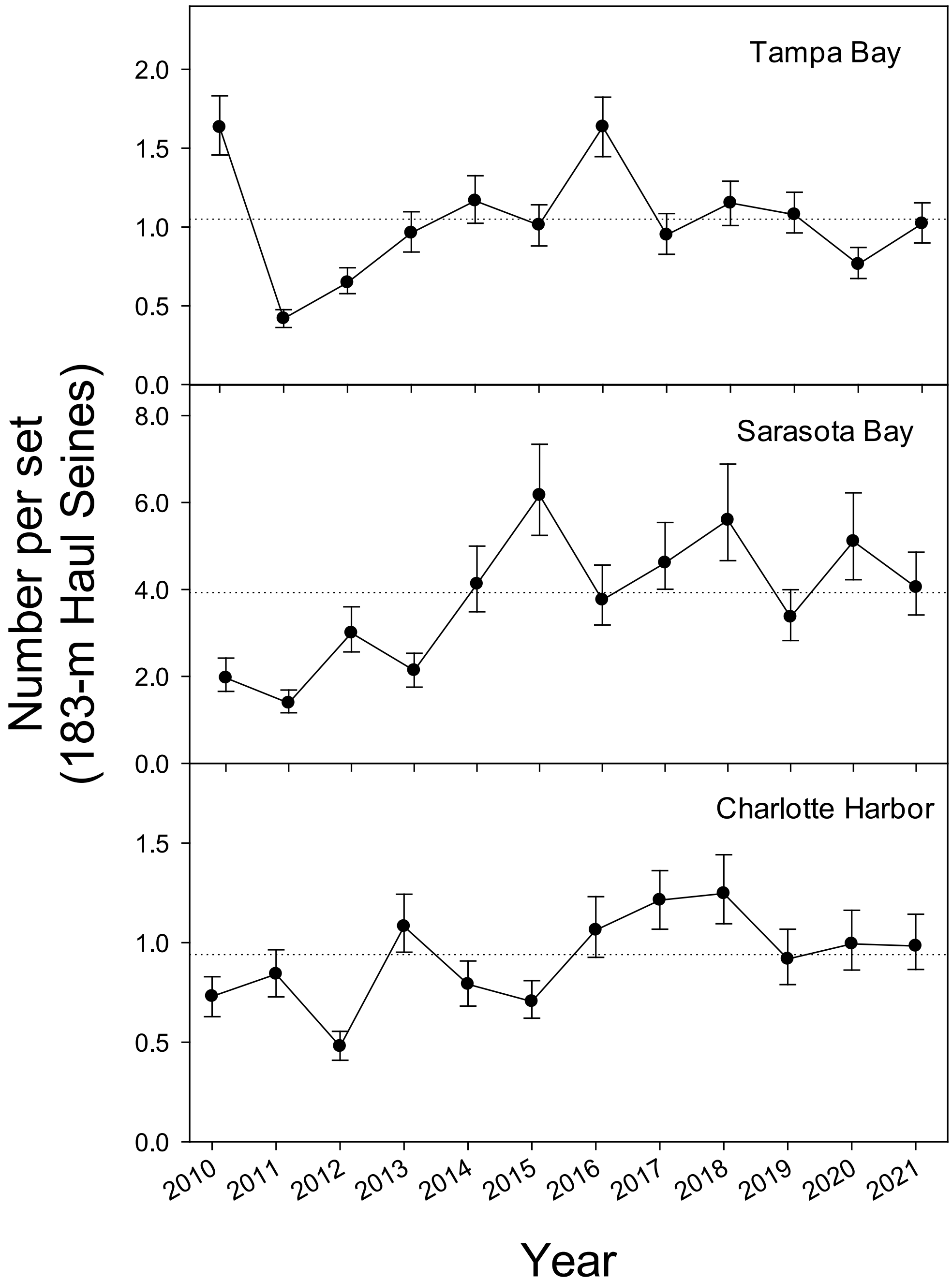

Figure 8. Relative abundance of legal-sized Sheepshead (≥242 mm SL) collected in 183-m haul seines between 2010 and 2021 during stratified-random sampling in three southwest Florida estuarine systems. Points represent the median estimate, the vertical bars represent the 25th–75th percentiles, and the dotted horizontal line represents the median value during the reporting period. Note different scales of relative abundance among plots.

Pinfish, *Lagodon rhomboides*

Pinfish, *Lagodon rhomboides*, is an ecologically and economically important sparid found in marine and estuarine waters from Massachusetts to Texas (*Bigelow and Schroeder 1953*; *Caldwell 1957*). It is one of the most abundant resident species in estuaries of the northeastern Gulf of Mexico (*Hoese and Jones 1963*; *Hansen 1970*; *Ogren and Brusher 1977*). Densities of Pinfish have been found to be positively correlated to seagrass and drift algae cover (*Rydene and Matheson 2003*). Studies have shown that predation by Pinfish plays a role in the organization of seagrass macrobenthic faunal assemblages (*Young et al. 1976*; *Young and Young 1977*). Pinfish are also a major link between primary and secondary production as individuals >60 mm SL consume and digest seagrasses and encrusting epiphytes (*Stoner 1980*; *Weinstein et al. 1982*; *Montgomery and Targett 1992*). Pinfish of all sizes are commonly targeted by anglers for use as bait when fishing for recreationally important species such as Sailfish (*Istiophorus platypterus*), Red Drum (*Sciaenops ocellatus*), Spotted Seatrout (*Cynoscion nebulosus*), Southern Flounder (*Paralichthys lethostigma*), Common Snook (*Centropomus undecimalis*) and Gag (*Mycteroperca microlepis*).

To assess year-class strength and to improve the ability to predict future adult Pinfish abundances, relative IOAs were developed for YOY Pinfish recruitment into selected Florida estuaries. Abundance data for YOY Pinfish (≤80 mm SL) that were collected in stratified-random 21.3-m bay seine samples were examined to assess recruitment into three Florida estuaries: Tampa Bay, Sarasota Bay, and Charlotte Harbor. Young-of-the-year Pinfish recruited to habitats sampled with 21.3-m bay seines primarily from January through June and IOAs were calculated using catch data from only these months. This period coincides with the published recruitment period for this species (*Nelson 1998*). The maximum size that individuals of YOY cohorts attain by June is 80 mm SL (*Nelson 1998*). The FIM program also monitored the abundance of larger Pinfish within these same Florida estuarine systems. Data from stratified-random 183-m haul seines were used to develop IOAs for sub-adult and adult fish (≥100 mm SL) collected between January and December.

Annual IOAs of YOY Pinfish in Tampa Bay, Sarasota Bay, and Charlotte Harbor generally had similar trends, although relative abundance was higher in Sarasota Bay (*Figure 9*). The abundance of YOY Pinfish in all three estuaries peaked in 2010 and overall, has declined through 2021. In Tampa Bay and Charlotte Harbor, abundance has remained relatively stable since 2017, with a slight increase in 2021 to the long-term average. In Sarasota Bay a slight increase above the long-term average occurred in 2018–2019 before declining in 2020 to one of the lowest abundances on record for Sarasota Bay in this study, followed by a slight increase in abundance in 2021.

The annual IOAs of sub-adult and adult Pinfish showed similar trends in all three estuaries and relative abundance was higher in Sarasota Bay than in Tampa Bay and Charlotte Harbor. In general, three modes can be detected in the time series for each of the three bays (*Figure 10*). The first peak was in 2012; the second was in 2015–2017 for Charlotte Harbor and 2016 for Tampa Bay and Sarasota Bay. The third peak was in 2019 for Sarasota Bay and in 2020 for Tampa Bay and Charlotte Harbor (highest abundance on record). In 2021, abundance decreased to the lowest abundance on record for this study in Tampa Bay and to a level comparable to the lowest abundances on record in Sarasota Bay. In Charlotte Harbor, adult Pinfish abundance in 2021 declined from the highest level in 2020; however, the 2021 abundance was still the second highest level in Charlotte Harbor in this twelve-year study with an abundance slightly above the long-term average.

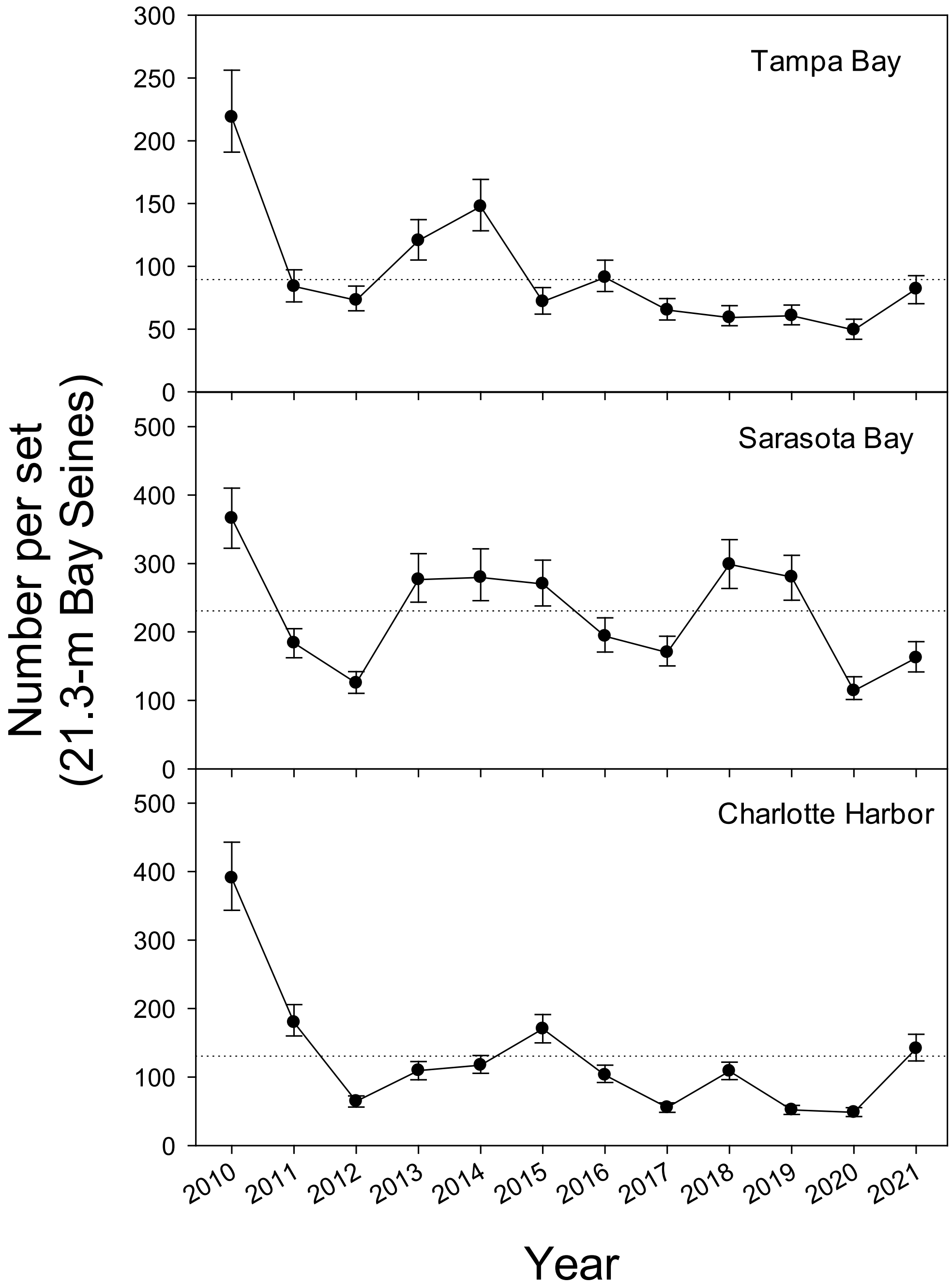

Figure 9. Relative abundance of young-of-the-year Pinfish (≤80 mm SL) collected in 21.3-m bay seines between 2010 and 2021 during stratified-random sampling in three southwest Florida estuarine systems. Points represent the median estimate, the vertical bars represent the 25th–75th percentiles, and the dotted horizontal line represents the median value during the reporting period. Note different scales of relative abundance among plots.

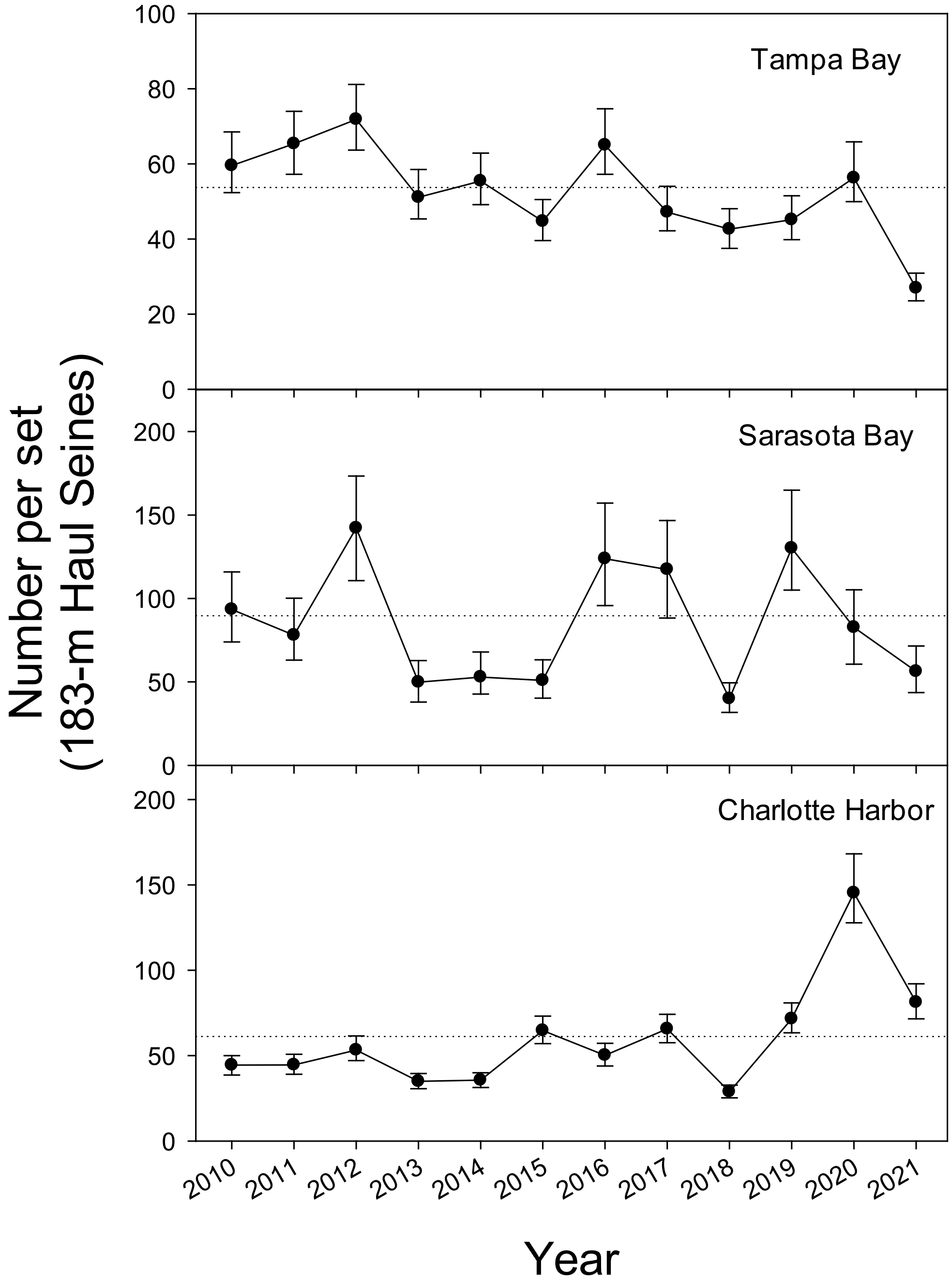

Figure 10. Relative abundance of sub-adult and adult Pinfish (>100 mm SL) collected in 183-m haul seines between 2010 and 2021 during stratified-random sampling in three southwest Florida estuarine systems. Points represent the median estimate, the vertical bars represent the 25th–75th percentiles, and the dotted horizontal line represents the median value during the reporting period. Note different scales of relative abundance among plots.

LITERATURE CITED

Addis, D. 2020. The 2020 stock assessment of Red Drum, *Sciaenops ocellatus*, in Florida. Florida Fish and Wildlife Conservation Commission Fish and Wildlife Research Institute, IHR 2020-002, St. Petersburg, FL. *https://myfwc.com/media/26851/drum-assessment-2020.pdf*.

Bigelow, H. B., and W. C. Schroeder. 1953. Fishes of the Gulf of Maine. Fishery Bulletin 53:1–577.

Bortone, S.A. 2003. Introduction. pp. 1-3 *In*: S.A. Bortone (ed.). Biology of the spotted seatrout. CRC Press, Boca Raton, Florida.

Caldwell, D.K. 1957. The biology and systematics of the pinfish, *Lagodon rhomboides* (Linnaeus). Bulletin of the Florida State Museum, Biological Sciences 2:77-173.

Caldwell, D. K. 1965. Systematics and variation in the sparid fish *Archosargus probatocephalus*. Bulletin of Southern California Academy of Science 64:89–100.

Chagaris, D., B. Mahmoudi, R.G. Muller, J. Munyandorero, Murphy, M.D., J. O'Hop, M.F.D. Greenwood, and T.S. Switzer. 2008. Florida's inshore and nearshore species: 2007 Status and Trends Report. Florida Fish and Wildlife Conservation Commission Fish and Wildlife Research Institute.

Chagaris, D., B. Mahmoudi, and M. Murphy. 2015. The 2015 stock assessment of Red Drum, *Sciaenops ocellatus*, in Florida. Fish and Wildlife Research Institute Report.

Dahlberg, M.D.1970. Atlantic and Gulf of Mexico menhadens, Genus *Brevoortia* (Pisces: Clupeidae). Bulletin of the Florida Museum of Natural History 15(3):91-162.

Daniel, L.B. 1988. Aspects of the biology of juvenile Red Drum, *Sciaenops ocellatus*, and spotted seatrout, *Cynoscion nebulosus* (Pisces: Sciaenidae) in South Carolina. M.S. Thesis, College of Charleston. 58 p.

Devries, D.A., C.D. Bedee, C.L. Palmer, and S.A. Bortone. 2002. The demographics and reproductive biology of spotted seatrout, *Cynoscion nebulosus*, in six northwest Florida estuaries. In: Biology of the Spotted Seatrout (Bortone, S.A., ed.). CRC Press, Boca Raton, pp 79-98.

Duggins, C.F. Jr., A.A. Karlin, K. Relyea, and R.W. Yerger. 1986. Systematics of the key silverside, *Menidia conchorum*, with comments on other *Menidia* species (Pisces: Atherinidae). Tulane Studies in Zoology and Botany 25:133-150.

Dutka-Gianelli, J. and D.J. Murie. 2001. Age and growth of the Sheepshead, *Archosargus probatocephalus* (Pisces: Sparidae), from the Northwest Coast of Florida. Bulletin of Marine Science 68(1):69–83.

Echelle, A.A. and A.F. Echelle. 1997. Patterns of abundance and distribution among members of a unisexual-bisexual complex of fishes (Atherinidae: *Menidia*). Copeia 1997(2):249-259.

FDEP-FMRI. 1997. Fisheries-Independent Monitoring Program 1996 Annual Data Summary Report. Florida Marine Research Institute. St. Petersburg, Florida.

Flannery, M. 1989. Tampa and Sarasota Bays: Watersheds and Tributaries. Pp 18-48 In: E.D. Estevez, (ed.), Tampa and Sarasota Bays: Issues, Resources, Status, and Management. U.S. Department of Commerce. Washington, D.C.

FWC-FWRI. 2021. Fisheries-Independent Monitoring Program Procedure Manual. Florida Fish and Wildlife Research Institute. St. Petersburg, Florida.

Gilhen, J. C., G. Grunchy, and D. E. McAllister. 1976. The Sheepshead, *Archosargus probatocephalus*, and the feather blenny, *Hypsoblennius hentzi*, two additions to the Canadian Atlantic ichthyofauna. Canadian Field-Naturalist 90:42-46.

Gilmore, R.G., C.J. Donahoe, and D.W. Cooke. 1983. Observations on the distribution and biology of the Common Snook, *Centropomus undecimalis* (Bloch). Florida Scientist 46:313-336.

Gray, J.D., T.L. King, and R.L. Colura. 1991. Effects of temperature and hypersalinity on hatching success of spotted seatrout eggs. Progressive Fish Culturist 53:81-84.

Haddad, K. 1989. Habitat Trends and Fisheries in Tampa and Sarasota Bays. Pp 113-128 In: E.D. Estevez, (ed.), Tampa and Sarasota Bays: Issues, Resources, Status, and Management. U.S. Department of Commerce. Washington, D.C.

Hansen, D.J. 1970. Food, growth, migration, reproduction and abundance of pinfish, *Lagodon rhomboides*, and Atlantic croaker, *Micropogonias undulatus*, near Pensacola, Florida, 1963-65. Fishery Bulletin 68:135-146.

Helser, T.E., R.E. Condrey, and J.P. Geaghan. 1993. Spotted seatrout distribution in four coastal Louisiana estuaries. Transactions of the American Fisheries Society 122:99-111.

Hoese, H.D. and R.S. Jones. 1963. Seasonality of larger animals in a Texas turtle grass community. Publications of the Institute of Marine Science, University of Texas 9: 37-47.

Johnson, D.R. and N.A. Funicelli. 1991. Spawning of Red Drum in Mosquito Lagoon, east-central Florida. Estuaries 14:74-79.

McMichael, R.H. Jr., and K.M. Peters. 1989. Early life history of the spotted seatrout, *Cynoscion nebulosus*, Pisces: Sciaenidae, in Tampa Bay, Florida. Estuaries 122:98-110.

Mercer, L.P. 1984. A biological and fisheries profile of Red Drum, *Sciaenops ocellatus*. Special Scientific Report 41, NC Department of Natural Resources Community Development Division of Marine Fisheries, Raleigh, 89 p.

Montgomery, J.L.M. and T.E. Targett. 1992. The nutritional role of seagrass in the diet of the omnivorous pinfish, *Lagodon rhomboides* (L.). Journal of Experimental Marine Biology and Ecology 158:37-57.

Moody, W.D. 1950. A study of the natural history of the spotted trout, *Cynoscion nebulosus*, in the Cedar Key, Florida area. Quarterly Journal of the Florida Academy of Sciences 12:147-172.

Munyandorero, J., A. A. Trotter, P.W. Stevens, and R. G. Muller. 2020. The 2020 Stock Assessment of Common Snook, *Centropomus undecimalis*. Florida Fish and Wildlife Conservation Commission Fish and Wildlife Research Institute, IHR 2020-004, St. Petersburg, FL. *https://myfwc.com/media/26711/snook-assessment-2020.pdf*

Munyandorero, J., M. Masi, and S. D. Allen. 2017. An assessment of the status of Sheepshead in Florida waters through 2015. Report from the Florida Fish and Wildlife Research Institute to the Florida Marine Fisheries Commission. St. Petersburg, FL., IHR 2017-002, 202 p.

Murphy, M.D., and R.G. Taylor. 1990. Reproduction, growth, and mortality of Red Drum, *Sciaenops ocellatus*, in Florida. Fishery Bulletin 88:531-542.

Murphy, M.D., G.A. Nelson, and R.G. Muller. 1999. An update of the stock assessment of the spotted seatrout, *Cynoscion nebulosus*. Florida Marine Research Institute Report to the Florida Fish and Wildlife Conservation Commission. 122 pp.

Murphy, M.D., C.B. Guenther, and B. Mahmoudi. 2006. An assessment of the status of spotted seatrout in Florida waters through 2005. Florida Fish and Wildlife Conservation Commission Fish and Wildlife Research Institute In-House Report IHR2006-017.

Murphy, M.D., D. Chagaris, and D. Addis. 2011. An assessment of the status of spotted seatrout in Florida waters through 2009. Florida Fish and Wildlife Conservation Commission Fish and Wildlife Research Institute In-House Report IHR2011-002.

Nelson, G.A. 1998. Abundance, growth, and mortality of young-of-the-year pinfish, *Lagodon rhomboides*, in three estuaries along the gulf coast of Florida. Fishery Bulletin 96:315-328.

Nelson, G.A. and D.L. Leffler. 2001. Abundance, spatial distribution, and mortality of young-of-the-year spotted seatrout (*Cynoscion nebulosus*) along the Gulf Coast of Florida. Gulf of Mexico Science 19:30-42.

NMFS (National Marine Fisheries Service). 2014. Fisheries Statistics and Economics Division. Website: www.nmfs.noaa.gov.

Ogren, L.H. and H.A. Brusher. 1977. The distribution and abundance of fishes caught with a trawl in the St. Andrew Bay system. Northeast Gulf Science. 1(2):83-105.

Paperno, R., K. J. Mille, and E. Kadison. 2001. Patterns in Species Composition of Fish and Selected Invertebrate Assemblages in Estuarine Subregions near Ponce de Leon Inlet, Florida. Estuarine and Coastal Shelf Science 52:117-130.

Peters, K.M. and R.H. McMichael. 1987. Early life history of the Red Drum, *Sciaenops ocellatus* (Pisces: Sciaenidae), in Tampa Bay, Florida. Estuaries 10:92-107.

Poulakis, G. R., R. E. Matheson Jr., M. E. Mitchell, D. A. Blewett, and C. F. Idelberger. 2004. Fishes of the Charlotte Harbor Estuarine System, Florida. Gulf of Mexico Science 2:117-150.

Reagan, R.E. 1985. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Gulf of Mexico). Red Drum. FWS/OBS Biological Report 82(11.36 TR EL-82-4):1-16.

Rivas, L.R. 1986. Systematic review of the perciform fishes of the genus *Centropomus*. Copeia 1986:579-611.

Roat, P., and M. Alderson. 1990. State of the Bay Report. National Estuary Program, Sarasota Bay Project. Sarasota, Florida.

Rydene, D.A. and R.E. Matheson. 2003. Diurnal fish density in relation to seagrass and drift algae cover in Tampa Bay, Florida. Gulf of Mexico Science 1:35-58.

SAS Institute, Inc. 2006. The GLIMMIX Procedure. SAS/STAT® 9.2 User's Guide. SAS Institute Inc., Cary, North Carolina.

Sarasota Bay National Estuary Program. 1995. The Comprehensive Conservation and Management Plan for Sarasota Bay, Volume 1. 255 pp.

Sarasota Bay National Estuary Program. 2003. Sarasota Bay Juvenile Fisheries Habitat Assessment. Sarasota Bay National Estuary Program. Sarasota, Florida.

Sokal, R.R. and F.J. Rohlf. 1981. *Biometry*. Freeman, New York. 859 pp.

Stoner, A.W. 1980. Feeding ecology of *Lagodon rhomboides* (Pisces: Sparidae): variation and functional responses. Fishery Bulletin 78:337-352.

Tabb, D.C. 1966. The estuary as a habitat for spotted seatrout, *Cynoscion nebulosus*. American Fisheries Society Special Publication 3:58-67.

Taylor, R.G., J.A. Whittington, and H.J. Grier. 1993. Biology of Common Snook from the east and west coasts of Florida. Study 3, Sect. 1. In: Investigations into nearshore and estuarine gamefish distributions and abundance, ecology, life history, and population genetics in Florida (R.E. Crabtree, T.M. Bert, and R.G. Taylor, eds.) FDNR/FMRI Rep. No. F0165-F0296-88-93-C. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. pp 1-51.

Taylor, R.G., H.J. Grier, and J.A. Whittington. 1998. Spawning rhythms of common snook in Florida. Journal of Fish Biology 53:502-520.

Taylor, R.G., J.A. Whittington, H.J. Grier, and R.E. Crabtree. 2000. Age, growth, maturation, and protandric sex reversal in common snook, *Centropomus undecimalis*, from the east and west coasts of South Florida. Fishery Bulletin 98:612-624.

Tringali, M.D. and T.M. Bert. 1996. The genetic stock structure of Common Snook, *Centropomus undecimalis*. Canadian Journal of Fisheries and Aquatic Sciences 53:974-984.

Walters, S., S. Lowerre-Barbieri, J. Bickford, L. Crabtree, and D. Mann. 2007. Preliminary results on seasonal and diel periodicities of a resident *Cynoscion nebulosus* spawning aggregation in Tampa Bay, Florida. Proceedings of the Gulf and Caribbean Fisheries Institute, v.58, p. 295-296.

Weinstein, M.P., K.L. Heck, Jr., P.E. Giebel, and J.E. Gates. 1982. The role of herbivory in pinfish (*Lagodon rhomboides*): a preliminary investigation. Bulletin of Marine Science 32(3):791-795.

Winner, B.L. and R.H. McMichael, Jr. 1997. Evaluation of a new type of box splitter designed for subsampling estuarine ichthyofauna. Transactions of the American Fisheries Society 126:1041-1047.

Winner, B.L., D.A. Blewett, R.H. McMichael, Jr., and C.B. Guenther. 2010. Relative abundance and distribution of Common Snook along shoreline habitats of Florida estuaries. Transactions of the American Fisheries Society 139:62-79.

Winner, B.L., T.C. MacDonald, and K.B. Amendola. 2017. Age and growth of sheepshead (*Archosargus probatocephalus*) in Tampa Bay, Florida. Fishery Bulletin 115:155–166.

Yokel, B.J. 1966. A contribution to the biology and distribution of Red Drum, *Sciaenops ocellata.* Master’s Thesis. University of Miami, Miami, FL. 160 p.

Young, D.K., M.A. Buzas, and M.W. Young. 1976. Species densities of macrobenthos associated with seagrass: a field experimental study of predation. Journal of Marine Research 34:577-592.

Young, D.K. and M.W. Young. 1977. Community structure of the macrobenthos associated with seagrass of the Indian River estuary, Florida. pp. 359-381. *In*: B. C. Coull (ed.), Ecology of marine benthos. Belle W. Baruch Library in Marine Science 6. University of South Carolina Press, Columbia.

APPENDICES

Appendix A. Animals designated as Selected Taxa because of their commercial or recreational importance.

Scientific Name	Common Name
Albula vulpes	Bonefish
Alphestes afer	Mutton hamlet
Archosargus probatocephalus	Sheepshead
Callinectes sapidus	Blue crab
Centropomus undecimalis	Snook
Cephalopholis cruentata	Graysby
Cephalopholis fulva	Coney
Cynoscion arenarius	Sand seatrout
Cynoscion nebulosus	Spotted seatrout
Cynoscion nothus	Silver seatrout
Cynoscion regalis	Atlantic weakfish
Cynoscion Complex	Seatrout
Dermatolepis inermis	Marbled grouper
Elops saurus	Ladyfish
Epinephelus adscensionis	Rock hind
Epinephelus drummondhayi	Speckled hind
Epinephelus guttatus	Red hind
Epinephelus itajara	Goliath grouper
Epinephelus morio	Red grouper
Epinephelus striatus	Nassau grouper
Farfantepenaeus aztecus	Brown shrimp
Farfantepenaeus brasiliensis	Pinkspotted shrimp
Farfantepenaeus duorarum	Pink shrimp
Farfantepenaeus spp.	Penaeid shrimps
Hyporthodus flavolimbatus	Yellowedge grouper
Hyporthodus mystacinus	Misty grouper
Hyporthodus nigritus	Warsaw grouper
Hyporthodus niveatus	Snowy grouper
Leiostomus xanthurus	Spot
Litopenaeus setiferus	White shrimp
Lutjanus analis	Mutton snapper
Lutjanus apodus	Schoolmaster
Lutjanus buccanella	Blackfin snapper
Lutjanus campechanus	Red snapper
Lutjanus cyanopterus	Cubera snapper
Lutjanus griseus	Gray snapper
Lutjanus jocu	Dog snapper
Lutjanus mahogoni	Mahogany snapper
Lutjanus synagris	Lane snapper
Lutjanus vivanus	Silk snapper
Megalops atlanticus	Tarpon
Menippe spp.	Stone crab
Menticirrhus americanus	Southern kingfish
Menticirrhus littoralis	Gulf kingfish
Menticirrhus saxatilis	Northern kingfish
Micropogonias undulatus	Atlantic croaker
Mugil cephalus	Striped mullet
Mugil curema	White mullet
Mugil liza	Liza
Mugil rubrioculus	Redeye mullet
Mugil trichodon	Fantail mullet
Mycteroperca bonaci	Black grouper
Mycteroperca microlepis	Gag
Mycteroperca phenax	Scamp
Mycteroperca tigris	Tiger grouper
Mycteroperca venenosa	Yellowfin grouper
Panulirus argus	Spiny lobster
Paralichthys albigutta	Gulf flounder
Paralichthys dentatus	Summer flounder
Paralichthys lethostigma	Southern flounder
Paralichthys oblongus	Fourspot flounder
Paralichthys squamilentus	Broad flounder
Penaeidae spp.	Shrimps
Pogonias cromis	Black drum
Pomatomus saltatrix	Bluefish
Rachycentron canadum	Cobia
Sciaenops ocellatus	Red drum
Scomberomorus cavalla	King mackerel
Scomberomorus maculatus	Spanish mackerel
Scomberomorus regalis	Cero
Trachinotus carolinus	Florida pompano
Trachinotus falcatus	Permit
Trachinotus goodei	Palometa

Appendix B. Monthly summary of species collected during Sarasota Bay stratified-random sampling, 2021. Effort, or total number of hauls, is labeled 'E'. Taxa are arranged alphabetically. Species of commercial or recreational importance (Selected Taxa) are denoted with an asterisk (*) after the species name.

Species	Month						Totals
	Feb	Apr	Jun	Aug	Oct	Dec	
	E=42	E=42	E=42	E=42	E=42	E=42	E=252
Acanthostracion quadricornis	1	8	8	6	.	3	26
Achirus lineatus	1	8	12	3	4	3	31
Aluterus schoepfii	.	.	1	.	.	.	1
Anchoa cubana	.	.	.	.	1	.	1
Anchoa hepsetus	8	10	8	1	641	908	1,576
Anchoa mitchilli	2	28	6,770	128	2,066	2,902	11,896
Ancylopsetta quadrocellata	1	5	.	.	.	.	6
*Archosargus probatocephalus**	28	91	169	65	69	22	444
Argopecten irradians	.	3	2	.	.	.	5
Ariopsis felis	47	89	7	31	11	1	186
Bagre marinus	.	2	.	.	.	.	2
Bairdiella chrysoura	1	144	311	43	46	3	548
Bathygobius soporator	1	.	.	.	.	.	1
Calamus spp.	6	1	.	.	.	11	18
Callinectes ornatus	2	5	3	2	.	1	13
*Callinectes sapidus**	56	53	10	15	34	41	209
Caranx hippos	.	8	2	.	.	16	26
*Centropomus undecimalis**	1	44	24	71	22	7	169
Centropristis striata	3	4	.	1	.	.	8
Chaetodipterus faber	.	4	2	27	4	2	39
Charybdis hellerii	.	1	2	7	.	.	10
Chasmodes saburrae	.	2	7	.	3	1	13
Chilomycterus schoepfii	16	25	15	10	13	10	89
Chloroscombrus chrysurus	.	.	.	1	.	.	1

Appendix B

Species	Month						Totals
	Feb	Apr	Jun	Aug	Oct	Dec	
	E=42	E=42	E=42	E=42	E=42	E=42	E=252
Citharichthys macrops	5	2	2	.	.	.	9
Ctenogobius boleosoma	1	7	.	2	.	.	10
Ctenogobius smaragdus	.	1	.	.	.	.	1
*Cynoscion nebulosus**	3	18	32	19	135	7	214
Cyprinodon variegatus	1	.	.	.	.	.	1
Dasyatis americana	.	1	.	1	.	.	2
Dasyatis sabina	.	5	5	.	2	.	12
Dasyatis say	.	10	.	3	.	.	13
Diapterus auratus	1	2	4	39	1	.	47
Diplodus holbrookii	.	1	1	5	.	.	7
Echeneis neucratoides	.	.	1	.	.	.	1
*Elops saurus**	.	.	.	.	13	.	13
*Epinephelus itajara**	.	.	.	.	.	1	1
Etropus crossotus	3	.	.	.	1	1	5
Eucinostomus gula	277	225	85	1,408	548	718	3,261
Eucinostomus harengulus	45	173	219	23	21	67	548
Eucinostomus spp.	270	280	4,961	4,423	4,144	2,163	16,241
Eugerres plumieri	.	17	38	5	1	.	61
*Farfantepenaeus duorarum**	27	26	99	438	382	198	1,170
Floridichthys carpio	18	.	9	7	15	46	95
Fundulus grandis	4	.	.	4	.	2	10
Gerres cinereus	.	1	.	.	.	.	1
Gobiosoma longipala	5	.	.	3	.	2	10
Gobiosoma robustum	20	18	39	150	69	405	701
Gobiosoma spp.	2	2	51	150	91	168	464
Gymnura micrura	1	.	1	.	3	.	5
Haemulon plumierii	.	3	1	15	.	.	19
Harengula jaguana	6	1	19,920	128	226	522	20,803

Appendix B

Species	Month						Totals
	Feb	Apr	Jun	Aug	Oct	Dec	
	E=42	E=42	E=42	E=42	E=42	E=42	E=252
Hippocampus erectus	2	5	1	4	2	1	15
Hippocampus zosterae	7	2	2	1	1	3	16
Hypleurochilus caudovittatus	.	.	2	.	.	.	2
Hypsoblennius hentz	.	.	1	.	.	1	2
Lagodon rhomboides	4,091	7,621	4,328	2,360	412	259	19,071
*Leiostomus xanthurus**	1,320	32	7	1	.	.	1,360
Limulus polyphemus	.	.	.	1	2	.	3
Lucania parva	3	142	843	564	235	440	2,227
*Lutjanus griseus**	3	16	64	59	23	12	177
*Lutjanus synagris**	.	3	4	1	3	16	27
Membras martinica	.	.	108	.	.	.	108
Menidia spp.	6	146	603	186	406	3	1,350
Menippe spp.*	9	7	7	35	16	5	79
*Menticirrhus americanus**	6	2	.	.	.	1	9
*Menticirrhus littoralis**	.	1	.	.	.	.	1
*Menticirrhus saxatilis**	.	.	.	.	.	1	1
Microgobius gulosus	8	63	138	132	585	214	1,140
*Mugil cephalus**	154	20	3	6	6	9	198
*Mugil curema**	204	5	.	.	5	3	217
*Mugil trichodon**	150	4	1	1	.	301	457
Mullus auratus	.	2	.	.	.	.	2
*Mycteroperca microlepis**	.	1	.	.	1	.	2
Myrophis punctatus	.	.	.	2	.	.	2
Nicholsina usta	2	23	11	.	.	1	37
Ogcocephalus cubifrons	1	3	2	.	.	.	6
Oligoplites saurus	.	.	19	4	15	.	38
Opisthonema oglinum	.	12	.	.	19	5	36
Opsanus beta	4	8	14	114	12	15	167

Appendix B

Species	Month						Totals
	Feb	Apr	Jun	Aug	Oct	Dec	
	E=42	E=42	E=42	E=42	E=42	E=42	E=252
Orthopristis chrysoptera	1,313	1,181	387	37	28	11	2,957
*Paralichthys albigutta**	14	20	15	12	8	4	73
Poecilia latipinna	2	.	.	.	.	.	2
*Pogonias cromis**	.	.	.	3	.	.	3
Portunus spp.	23	95	35	246	98	234	731
Prionotus scitulus	12	14	26	11	15	10	88
Prionotus tribulus	9	1	4	1	1	1	17
Rimapenaeus spp.	2	.	.	.	1	.	3
Sardinella aurita	.	1	.	.	.	.	1
Sarotherodon melanotheron	.	.	.	.	.	8	8
Sciaenidae sp.	1	.	.	.	.	.	1
*Sciaenops ocellatus**	43	5	4	4	17	37	110
Scorpaena brasiliensis	.	1	1	.	.	.	2
Selene vomer	.	9	1	.	3	.	13
Sicyonia laevigata	.	.	.	1	.	.	1
Sphoeroides nephelus	7	39	10	2	1	62	121
Sphoeroides spengleri	.	.	2	.	.	.	2
Sphyraena barracuda	2	2	4	2	4	1	15
Sphyraena borealis	.	2	5	.	.	.	7
Sphyrna tiburo	.	.	.	1	.	.	1
Stephanolepis hispidus	7	19	41	.	2	16	85
Strongylura marina	.	2	1	1	.	.	4
Strongylura notata	13	6	38	26	28	14	125
Strongylura spp.	.	2	4	.	.	.	6
Symphurus plagiusa	.	1	4	2	.	.	7
Syngnathus floridae	1	6	8	.	.	2	17
Syngnathus louisianae	9	8	11	2	2	14	46
Syngnathus scovelli	50	97	55	20	28	124	374

Appendix B

Species	*Month*						*Totals*
	Feb	*Apr*	*Jun*	*Aug*	*Oct*	*Dec*	
	E=42	*E=42*	*E=42*	*E=42*	*E=42*	*E=42*	*E=252*
Syngnathus sp.	1	.	.	.	.	.	1
Synodus foetens	40	36	21	8	39	74	218
*Trachinotus carolinus**	.	.	.	.	1	1	2
*Trachinotus falcatus**	.	.	8	4	4	11	27
Urophycis floridana	1	.	.	.	.	.	1
Totals	***8,383***	***10,993***	***39,664***	***11,088***	***10,589***	***10,145***	***90,862***

Appendix C. Summary by gear and stratum of species collected during Sarasota Bay stratified-random sampling, 2021. Effort, or the total number of hauls, is labeled 'E'. Taxa are arranged alphabetically. Species of commercial or recreational importance (Selected Taxa) are denoted with an asterisk (*) after the species name.

Species	Gear and Strata						Totals
	21.3-m bay seine			183-m haul seine		6.1-m otter trawl	
	Veg	Unveg	Shore	Over	Nonover		
	E=71	E=37	E=60	E=25	E=11	E=48	E=252
Acanthostracion quadricornis	.	.	.	3	6	17	26
Achirus lineatus	1	1	5	.	.	24	31
Aluterus schoepfii	1	.	.	.	.	.	1
Anchoa cubana	.	1	.	.	.	.	1
Anchoa hepsetus	1,561	1	.	.	.	14	1,576
Anchoa mitchilli	8,101	230	3,565	.	.	.	11,896
Ancylopsetta quadrocellata	.	.	.	.	1	5	6
*Archosargus probatocephalus**	92	.	114	190	35	13	444
Argopecten irradians	.	.	.	.	1	4	5
Ariopsis felis	11	.	8	40	70	57	186
Bagre marinus	.	.	.	.	2	.	2
Bairdiella chrysoura	292	7	219	5	6	19	548
Bathygobius soporator	.	.	1	.	.	.	1
Calamus spp.	7	5	1	.	.	5	18
Callinectes ornatus	.	.	1	.	4	8	13
*Callinectes sapidus**	35	27	16	10	11	110	209
Caranx hippos	.	.	.	25	1	.	26
*Centropomus undecimalis**	5	.	7	129	28	.	169
Centropristis striata	.	.	.	.	.	8	8
Chaetodipterus faber	1	.	2	5	24	7	39
Charybdis hellerii	.	.	.	.	.	10	10
Chasmodes saburrae	7	.	2	.	.	4	13
Chilomycterus schoepfii	10	1	.	13	3	62	89
Chloroscombrus chrysurus	1	.	.	.	.	.	1
Citharichthys macrops	.	.	.	.	1	8	9
Ctenogobius boleosoma	2	.	8	.	.	.	10
Ctenogobius smaragdus	.	.	1	.	.	.	1
*Cynoscion nebulosus**	126	.	72	9	.	7	214
Cyprinodon variegatus	.	.	1	.	.	.	1

Species	Gear and Strata						Totals
	21.3-m bay seine			183-m haul seine		6.1-m otter trawl	
	Veg	Unveg	Shore	Over	Nonover		
	E=71	E=37	E=60	E=25	E=11	E=48	E=252
Dasyatis americana	.	.	.	.	2	.	2
Dasyatis sabina	.	1	1	9	.	1	12
Dasyatis say	.	.	.	11	2	.	13
Diapterus auratus	1	.	.	41	5	.	47
Diplodus holbrookii	1	.	.	5	1	.	7
Echeneis neucratoides	.	.	.	.	.	1	1
*Elops saurus**	.	.	.	1	12	.	13
*Epinephelus itajara**	.	.	1	.	.	.	1
Etropus crossotus	.	.	.	.	.	5	5
Eucinostomus gula	1,010	132	694	505	186	734	3,261
Eucinostomus harengulus	88	40	355	24	30	11	548
Eucinostomus spp.	7,086	1,073	5,859	.	.	2,223	16,241
Eugerres plumieri	.	.	33	28	.	.	61
*Farfantepenaeus duorarum**	572	25	328	2	1	242	1,170
Floridichthys carpio	9	.	86	.	.	.	95
Fundulus grandis	.	.	10	.	.	.	10
Gerres cinereus	1	.	.	.	.	.	1
Gobiosoma longipala	.	.	.	.	.	10	10
Gobiosoma robustum	373	11	59	.	.	258	701
Gobiosoma spp.	150	14	43	.	.	257	464
Gymnura micrura	.	.	.	3	.	2	5
Haemulon plumierii	7	.	4	.	1	7	19
Harengula jaguana	17,575	.	2,519	.	226	483	20,803
Hippocampus erectus	.	1	.	.	2	12	15
Hippocampus zosterae	6	3	5	.	.	2	16
Hypleurochilus caudovittatus	.	.	.	.	.	2	2
Hypsoblennius hentz	1	.	.	.	.	1	2
Lagodon rhomboides	9,139	198	5,280	2,206	623	1,625	19,071
*Leiostomus xanthurus**	225	354	751	7	23	.	1,360
Limulus polyphemus	.	.	.	.	2	1	3
Lucania parva	1,055	8	1,164	.	.	.	2,227
*Lutjanus griseus**	39	.	16	87	25	10	177
*Lutjanus synagris**	10	.	4	.	7	6	27

Appendix C

Species	Gear and Strata						Totals
	21.3-m bay seine			183-m haul seine		6.1-m otter trawl	
	Veg	Unveg	Shore	Over	Nonover		
	E=71	E=37	E=60	E=25	E=11	E=48	E=252
Membras martinica	.	.	108	.	.	.	108
Menidia spp.	155	2	1,193	.	.	.	1,350
Menippe spp.*	.	.	.	.	4	75	79
*Menticirrhus americanus**	.	.	.	1	.	8	9
*Menticirrhus littoralis**	.	.	.	1	.	.	1
*Menticirrhus saxatilis**	.	1	.	.	.	.	1
Microgobius gulosus	282	26	822	.	.	10	1,140
*Mugil cephalus**	27	4	110	55	2	.	198
*Mugil curema**	.	.	2	212	3	.	217
*Mugil trichodon**	.	1	355	85	16	.	457
Mullus auratus	.	.	.	.	.	2	2
*Mycteroperca microlepis**	1	.	.	.	.	1	2
Myrophis punctatus	.	.	.	.	.	2	2
Nicholsina usta	6	1	2	.	10	18	37
Ogcocephalus cubifrons	.	.	.	.	1	5	6
Oligoplites saurus	14	.	22	.	2	.	38
Opisthonema oglinum	7	.	18	9	1	1	36
Opsanus beta	9	.	1	2	2	153	167
Orthopristis chrysoptera	1,649	118	658	73	26	433	2,957
*Paralichthys albigutta**	6	9	6	11	2	39	73
Poecilia latipinna	.	.	2	.	.	.	2
*Pogonias cromis**	.	.	.	2	1	.	3
Portunus spp.	9	3	4	1	4	710	731
Prionotus scitulus	.	5	.	.	.	83	88
Prionotus tribulus	.	2	2	1	.	12	17
Rimapenaeus spp.	.	.	.	.	.	3	3
Sardinella aurita	.	.	.	.	.	1	1
Sarotherodon melanotheron	.	.	.	8	.	.	8
Sciaenidae sp.	.	.	.	.	.	1	1
*Sciaenops ocellatus**	29	.	64	12	1	4	110
Scorpaena brasiliensis	.	.	.	.	.	2	2
Selene vomer	.	.	.	4	9	.	13
Sicyonia laevigata	.	.	.	.	.	1	1

Appendix C

Species	Gear and Strata						Totals
	21.3-m bay seine			183-m haul seine		6.1-m otter trawl	
	Veg	Unveg	Shore	Over	Nonover		
	E=71	E=37	E=60	E=25	E=11	E=48	E=252
Sphoeroides nephelus	51	9	44	2	5	10	121
Sphoeroides spengleri	.	.	1	.	.	1	2
Sphyraena barracuda	1	.	1	11	2	.	15
Sphyraena borealis	5	.	2	.	.	.	7
Sphyrna tiburo	.	.	.	.	1	.	1
Stephanolepis hispidus	35	2	20	1	1	26	85
Strongylura marina	1	1	2	.	.	.	4
Strongylura notata	7	10	90	10	8	.	125
Strongylura spp.	.	.	6	.	.	.	6
Symphurus plagiusa	.	1	.	.	.	6	7
Syngnathus floridae	11	1	2	.	.	3	17
Syngnathus louisianae	19	3	11	.	.	13	46
Syngnathus scovelli	180	9	125	.	.	60	374
Syngnathus sp.	.	.	.	.	.	1	1
Synodus foetens	80	47	38	10	.	43	218
*Trachinotus carolinus**	.	.	.	1	1	.	2
*Trachinotus falcatus**	.	.	11	12	4	.	27
Urophycis floridana	1	.	.	.	.	.	1
Totals	**50,186**	**2,388**	**24,957**	**3,882**	**1,447**	**8,002**	**90,862**

Appendix D. Summary by zone of species collected during Sarasota Bay stratified-random sampling, 2021. Effort, or the total number of hauls, is labeled 'E'. Taxa are arranged alphabetically. Species of commercial or recreational importance (Selected Taxa) are denoted with an asterisk (*) after the species name.

Species	Zone					Totals
	A	B	C	D	E	
	E=42	E=84	E=42	E=42	E=42	E=252
Acanthostracion quadricornis	7	18	1	.	.	26
Achirus lineatus	9	12	1	9	.	31
Aluterus schoepfii	.	.	1	.	.	1
Anchoa cubana	.	.	.	1	.	1
Anchoa hepsetus	5	909	648	14	.	1,576
Anchoa mitchilli	322	955	542	9,767	310	11,896
Ancylopsetta quadrocellata	.	5	.	.	1	6
*Archosargus probatocephalus**	72	72	120	82	98	444
Argopecten irradians	.	5	.	.	.	5
Ariopsis felis	29	70	15	69	3	186
Bagre marinus	.	2	.	.	.	2
Bairdiella chrysoura	81	94	144	125	104	548
Bathygobius soporator	.	.	1	.	.	1
Calamus spp.	1	2	11	2	2	18
Callinectes ornatus	1	7	.	.	5	13
*Callinectes sapidus**	26	33	51	73	26	209
Caranx hippos	2	2	15	5	2	26
*Centropomus undecimalis**	45	28	35	48	13	169
Centropristis striata	1	6	.	.	1	8
Chaetodipterus faber	27	7	.	3	2	39
Charybdis hellerii	.	.	.	.	10	10
Chasmodes saburrae	2	7	3	1	.	13
Chilomycterus schoepfii	22	28	9	22	8	89
Chloroscombrus chrysurus	.	.	1	.	.	1
Citharichthys macrops	.	8	.	.	1	9
Ctenogobius boleosoma	.	1	1	.	8	10
Ctenogobius smaragdus	.	.	.	.	1	1
*Cynoscion nebulosus**	37	39	13	43	82	214
Cyprinodon variegatus	.	1	.	.	.	1
Dasyatis americana	1	1	.	.	.	2

Appendix D

Species	Zone					Totals
	A	B	C	D	E	
	E=42	E=84	E=42	E=42	E=42	E=252
Dasyatis sabina	6	.	3	2	1	12
Dasyatis say	8	2	.	3	.	13
Diapterus auratus	4	1	.	25	17	47
Diplodus holbrookii	.	2	5	.	.	7
Echeneis neucratoides	.	.	.	1	.	1
*Elops saurus**	.	12	1	.	.	13
*Epinephelus itajara**	.	.	.	.	1	1
Etropus crossotus	1	3	.	.	1	5
Eucinostomus gula	687	873	876	480	345	3,261
Eucinostomus harengulus	70	89	188	137	64	548
Eucinostomus spp.	2,058	4,106	3,532	2,928	3,617	16,241
Eugerres plumieri	21	.	20	15	5	61
*Farfantepenaeus duorarum**	63	341	260	61	445	1,170
Floridichthys carpio	65	6	5	17	2	95
Fundulus grandis	2	4	.	.	4	10
Gerres cinereus	1	.	.	.	.	1
Gobiosoma longipala	.	9	.	.	1	10
Gobiosoma robustum	29	247	331	47	47	701
Gobiosoma spp.	20	258	122	60	4	464
Gymnura micrura	.	.	1	4	.	5
Haemulon plumierii	.	5	.	.	14	19
Harengula jaguana	2,029	976	195	17,120	483	20,803
Hippocampus erectus	.	9	2	.	4	15
Hippocampus zosterae	3	6	5	2	.	16
Hypleurochilus caudovittatus	.	2	.	.	.	2
Hypsoblennius hentz	.	1	1	.	.	2
Lagodon rhomboides	3,020	6,210	3,678	4,319	1,844	19,071
*Leiostomus xanthurus**	13	634	534	123	56	1,360
Limulus polyphemus	.	3	.	.	.	3
Lucania parva	1,645	219	78	176	109	2,227
*Lutjanus griseus**	6	29	37	37	68	177
*Lutjanus synagris**	.	14	8	.	5	27
Membras martinica	108	.	.	.	.	108
Menidia spp.	331	398	4	65	552	1,350

Appendix D

Species	Zone					Totals
	A	B	C	D	E	
	E=42	E=84	E=42	E=42	E=42	E=252
Menippe spp. *	2	60	2	.	15	79
*Menticirrhus americanus**	1	4	.	1	3	9
*Menticirrhus littoralis**	1	.	.	.	.	1
*Menticirrhus saxatilis**	.	1	.	.	.	1
Microgobius gulosus	137	179	513	287	24	1,140
*Mugil cephalus**	5	117	26	38	12	198
*Mugil curema**	.	4	.	211	2	217
*Mugil trichodon**	1	254	52	149	1	457
Mullus auratus	.	2	.	.	.	2
*Mycteroperca microlepis**	.	2	.	.	.	2
Myrophis punctatus	.	2	.	.	.	2
Nicholsina usta	1	34	1	.	1	37
Ogcocephalus cubifrons	.	4	.	.	2	6
Oligoplites saurus	16	6	10	6	.	38
Opisthonema oglinum	9	22	2	3	.	36
Opsanus beta	4	149	10	1	3	167
Orthopristis chrysoptera	231	717	847	990	172	2,957
*Paralichthys albigutta**	26	19	15	3	10	73
Poecilia latipinna	.	2	.	.	.	2
*Pogonias cromis**	1	.	.	2	.	3
Portunus spp.	60	536	29	12	94	731
Prionotus scitulus	26	50	5	2	5	88
Prionotus tribulus	6	4	.	3	4	17
Rimapenaeus spp.	.	2	.	.	1	3
Sardinella aurita	.	1	.	.	.	1
Sarotherodon melanotheron	.	8	.	.	.	8
Sciaenidae sp.	1	.	.	.	.	1
*Sciaenops ocellatus**	5	48	9	19	29	110
Scorpaena brasiliensis	.	2	.	.	.	2
Selene vomer	4	8	.	1	.	13
Sicyonia laevigata	.	.	.	.	1	1
Sphoeroides nephelus	27	55	20	11	8	121
Sphoeroides spengleri	.	.	.	.	2	2
Sphyraena barracuda	.	3	5	.	7	15

Appendix D

Species	Zone					Totals
	A	B	C	D	E	
	E=42	E=84	E=42	E=42	E=42	E=252
Sphyraena borealis	.	1	2	4	.	7
Sphyrna tiburo	1	.	.	.	.	1
Stephanolepis hispidus	4	66	6	.	9	85
Strongylura marina	.	3	1	.	.	4
Strongylura notata	6	43	11	50	15	125
Strongylura spp.	4	2	.	.	.	6
Symphurus plagiusa	4	1	.	1	1	7
Syngnathus floridae	3	10	4	.	.	17
Syngnathus louisianae	5	25	4	8	4	46
Syngnathus scovelli	65	119	98	84	8	374
Syngnathus sp.	1	.	.	.	.	1
Synodus foetens	36	67	36	33	46	218
*Trachinotus carolinus**	.	1	1	.	.	2
*Trachinotus falcatus**	4	11	4	.	8	27
Urophycis floridana	.	.	1	.	.	1
Totals	**11,577**	**19,415**	**13,212**	**37,805**	**8,853**	**90,862**