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

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SUMMARY

The Sarasota Bay National Estuary Program's Comprehensive Conservation Management Plan stressed the importance of restoring and protecting juvenile fish habitats. The Sarasota Bay estuary has undergone considerable urbanization since the 1950's. An understanding of the distribution, abundance, and habitat use of nekton (fish and macroinvertebrate) within the Sarasota Bay estuary is critical to protecting and restoring estuarine habitats.

The Florida Fish and Wildlife Conservation Commission's (FWCC) Fisheries-Independent Monitoring (FIM) program has been monitoring nekton assemblages in Tampa Bay and Charlotte Harbor since 1989. The goal of the FIM program is to provide timely, accurate, and consistent fisheries-independent data and analysis to fisheries managers for the conservation and protection of Florida's fisheries. The sampling design and data collected are intended to not only assess fishery stocks, but to also describe habitat utilization, biodiversity, nekton communities, and to document changes within Florida's estuarine systems.

The general objectives of this study were to describe the nekton community and habitat utilization within the Sarasota Bay estuary. Specifically, this study was designed to: 1) provide a database of fish and selected invertebrate species that inhabit the Sarasota Bay estuary; 2) examine spatial differences in species composition and relative abundance within the Sarasota Bay estuary; 3) examine spatial differences in species composition and relative abundance between the polyhaline portions of four estuaries along Florida's Southwest Coast; and 4) develop baseline data on mercury

content in fish from the Sarasota Bay estuary and compare those data to adjacent estuaries.

The FIM program survey used a stratified-random sampling design to select sampling sites from the five Sarasota Bay embayments as defined by the Sarasota Bay estuary program. Samples were collected bi-monthly between June 2009 and April 2010 with 21.3-m seine, 183-m seine, and 6.1-m trawl. Water chemistry parameters (salinity, water temperature, dissolved oxygen and pH) and habitat assessments (bottom type, presence of submerged aquatic vegetation, shore habitat) were taken in association with each net deployment. A large body of descriptive habitat-use information was generated and is presented in the accompanying appendices.

Temperatures during winter/spring 2010, and the rainfall pattern throughout the study period were not typical of Southwest Florida. The weather pattern was defined by an El Nino event, which resulted in unseasonably high rain fall totals and cold temperatures during winter/spring 2010. The water temperatures and salinities observed during this study likely do not reflect the long-term expected condition and the nekton assemblage probably differs somewhat from that which would be expected from a longer-term sampling program that included typical weather patterns.

The nekton community in Sarasota Bay was typical of Florida estuaries. The majority of the animals (n=136,429) were collected with 21.3-m seines and two taxa (bay anchovy and pinfish) represented over 55% of the total catch in this gear. Pinfish were also particularly abundant in the other two gear types, comprising 59.4% and 21.1% of the total catch in the 183-m seine and 6.1-m trawl, respectively. Other estuarine dependent species such as spot, eucinostomus mojarra, silver jenny, silver perch, and scaled sardine were relatively abundant as well.

Community analyses of the five embayments of the Sarasota Bay estuary (*intra*bay) and between the polyhaline sections of four Southwest Florida estuaries (*inter*bay) provided similar results. The community structure in “small” estuaries was different than the community structure in “large” estuaries for 21.3-m seines (intrabay and interbay), 183-m seines (interbay), and 6.1-m trawls (interbay). The abundance for the discriminating taxa in the community analyses tended to be higher in “small” estuaries than in “large” estuaries (intra and interbay). Overall abundance tended to be higher in “small” than in “large” bays (intrabay). Differences in community structure and abundance could be related to water depth, salinity, ratio of land-water interface to open water, sediment type, quantity and type of submerged aquatic vegetation, or circulation patterns, residence times, and water quality.

Mercury is a toxic element that has been shown to bio-accumulate in tissues. Tissue samples for mercury content analysis were taken from 323 individuals representing 25 taxa. About 40% of the collected tissue samples have been analyzed. Sample sizes were not large enough to run linear regressions on any of the taxa collected from Sarasota Bay without combining with data from adjacent estuaries (Tampa Bay and Charlotte Harbor). The results of the mercury content analysis indicated that fish from Sarasota Bay do not contain any higher concentrations of mercury than those found in adjacent estuaries and suggest that accumulation rates for Sarasota Bay are similar to those found in Tampa Bay and Charlotte Harbor.

INTRODUCTION

The Sarasota Bay estuary is an urbanized coastal lagoon system located on the southwest coast of Florida. 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 (ICW) channel that hydrologically links all embayments. Intense development occurred throughout the system from the late 1950's to 1970 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 along with significant channelization of tidal creeks has altered historical patterns of surface water runoff to the bay and further exacerbated the problem of wetland habitat loss (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 the estuary and guide us in the protection of our estuarine-based fisheries and associated habitats (Paperno, et. al. 2001).

The Sarasota Bay National Estuary Program (SBNEP) Comprehensive Conservation Management Plan (CCMP) stressed the importance of restoring and protecting juvenile fish habitat as well as the need to maintain fish populations while restoration efforts are pursued (SBNEP 1995). The objectives of this study are to: 1) provide a database of fish and selected invertebrate species that inhabit the Sarasota Bay estuary; 2) examine spatial differences in species composition and relative abundance within the Sarasota Bay estuary; 3) examine spatial differences in species composition and relative abundance between the polyhaline portions of four estuaries along Florida's Southwest Coast; and 4) develop baseline data on mercury content in fish from the Sarasota Bay estuary and compare those data to adjacent estuaries.

METHODS

Study Area

Sarasota Bay is a coastal lagoon, located on the southwest coast of Florida, which stretches from Anna Maria Sound to the Venice Inlet. The bay is comprised of five embayments, Palma Sola Bay, Sarasota Bay, Roberts Bay, Little Sarasota Bay and Blackburn Bay, 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), 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 vegetative cover in Sarasota Bay and are widely distributed throughout the bay (Haddad 1989).

Sampling Design

The FIM program utilized a stratified-random sampling (SRS) design and a multi-gear approach to collect data on nekton (fish and select invertebrates) from a wide range of habitats and life history stages. This sampling design provides comprehensive data on size-specific, spatial and temporal patterns of abundance for the nekton community and for individual species. Specimens collected during this sampling are also used for various other assessments, such as fish health, mercury content, diet, age/growth, and reproduction. Three sampling gears (*Table 1*) were used: 1) 21.3-m seines; 2) 183-m seines; and 3) 6.1-m trawls. Generally speaking, the data from seine hauls document habitat use by shallow-water shoreline-associated organisms whereas the data from trawls document habitat use in deeper areas. The dominant catch for the 21.3-m seines and trawls is juvenile fishes, although the adults of smaller species are also commonly caught. The 183-m seine is used to catch larger sub-adult and adult fishes. The seines and trawls also regularly collect a few of the larger macroinvertebrate species from tidal rivers, notably blue crabs (*Callinectes sapidus*), and pink shrimp (*Farfantepenaeus duorarum*).

Sarasota Bay estuary was divided into five geographically-defined zones (Zone A - Palma Sola Bay, Zone B - Sarasota Bay, 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 used in each. The number of samples collected in each zone with each gear was approximately proportional to the number of grids in the zone that could be sampled with a particular gear. Sites for each sampling event were chosen by randomly selecting grids and then randomly selecting a sampling site within each grid. A single collection was made at each selected site. Thirty primary samples consisting of six 183-m seines, eight 6.1-m trawls and sixteen 21.3-m seines were collected during each sampling event. Nine to twelve additional 21.3-m seine samples were collected during each sampling event as time allowed.

Sampling events were scheduled with a bi-monthly periodicity in the Sarasota Bay estuary. Sampling began in June 2009 and is ongoing with sampling currently scheduled to end in April 2011. This report summarizes the data collected between June 2009 and April 2010.

Table 1. Description of sampling gears used during the Sarasota Bay stratified random sampling, June 2009 – April 2010. 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 seine	3.2	140	used in near-shore and shoreline areas ≤ 1.5 m
183-m seine	38.1	4,120	used along shorelines ≤ 2.5 m
6.1-m trawl	38.1 (3.2-mm bag liner)	1,400	used in areas from 1.8-m to 7.6-m deep

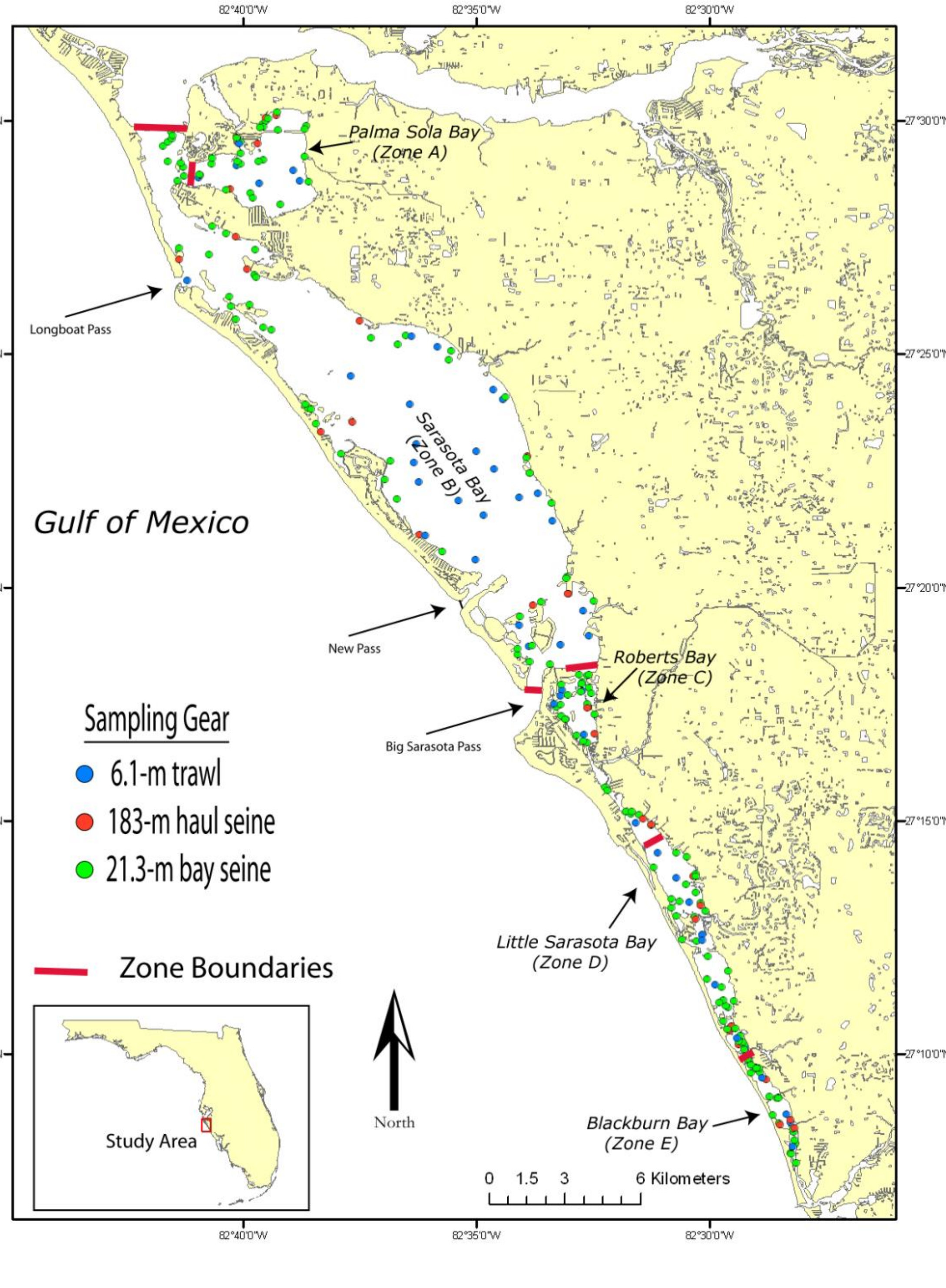

Figure 1.Sampling sites by gear, and zone boundaries for Sarasota Bay stratified random sampling, June 2009 – April 2010.

Gear Specifications and Deployment

The gear 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 mesh and leads spaced every 150 mm. The 21.3-m seine was pulled, with a crewmember on each wing, for a distance of 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 sample into the center bag. Each 21.3-m seine deployment sampled an estimated 140 m^2. Sampling sites for the 21.3-m seine were pre-stratified by the presence or absence of bottom vegetation or a shoreline.

The 183-m haul seine was used to target larger sub-adult and adult nekton associated with shallow, nearshore habitats. Deployment of this gear occurred from the net from the back of a boat in a standard rectangular shape along shorelines in relatively shallow waters (<2.5 m). Net wings were simultaneously hauled along the shoreline, keeping the lead lines close to the bottom, forcing the catch into the center bag portion of the gear. Each 183-m seine set enclosed an area of approximately 4,120 m^2. In Sarasota Bay proper, which had a relatively larger number of bi-monthly 183-m seine hauls, sites were pre-stratified by the presence or absence of overhanging shoreline vegetation. Sample sizes collected each month with 183-m seines in Palma Sola, Roberts, Little Sarasota, and Blackburn bays were too small to pre-stratify sampling sites, so sites were post-stratified by the presence or absence of overhanging shoreline vegetation.

Juvenile and adult nekton that inhabit relatively deeper waters (1.0 – 7.6-m) were collected with the 6.1-m otter trawl which had a 38-mm stretch mesh with a 3.2-mm mesh cod-end liner. The trawl was towed from the back of a boat in for ten minutes. Tow speeds averaged 0.6-m/s and 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 gear 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 daytime 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 2010).

Sample Processing

Sample work-up was similar for all samples, regardless of gear type or sampling regime. All fish and selected invertebrate species captured were identified to the lowest practical taxonomic level, generally species. Representative samples (three individuals of each species from the 21.3-m seines, and trawls on each sampling trip) were brought back to the FWC-FWRI laboratory to confirm field identification. Species 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, forty individuals were measured. Standard length (SL) was used for fish (total length [TL] for seahorses and 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 sub-sampled portions of the total catch split with a modified Motoda box splitter (Winner and McMichael 1997). Animals not chosen for further laboratory examination were returned to the river. Additional details concerning sample work-up are described in the FIM program's Procedure Manual (FWC-FWRI 2010).

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. We did not separate menhaden, *Brevoortia*, 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 so they are represented in this report as Menidia spp. (Duggins et al. 1986; Echelle and Echelle 1997; Chernoff, personal communication). 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 mojarras" is used for these small specimens. Species-level identification of gobies of the genus *Gobiosoma* (i.e., *G. robustum* and *G. bosc*) used in analyses was limited to individuals ≥ 20 mm SL for the same reason; smaller individuals are hereafter referred to as “gobiosoma gobies”. Similarly, needlefishes (*Strongylura* spp.) other than *S. notata* were only identified to species at lengths ≥ 100 mm SL.

The data for this report were summarized separately for each estuarine zone and for each gear type. Data were also summarized separately for all taxa and for taxa of recreational or commercial importance (‘Selected Taxa’; *Appendix A*). Abundance estimates for all gear types were calculated as the number of individuals/100 m^2 of area sampled.

Nekton Community Analysis

Nekton community structure was investigated using nonparametric multivariate analyses in PRIMER v6 software (PRIMER-E Ltd, UK) (Plymouth Routines in Multivariate Ecological Research; Clarke and Warwick 2001). Analyses were based on pooled samples averaged by each bi-monthly sampling event to investigate seasonality, or by geographic area to investigate spatial patterns. Data from each gear type (21.3-m seines, 183-m seines, and 6.1-m trawl) were treated separately. *Intra*bay analyses were conducted to compare nekton assemblages in each of Sarasota Bay’s smaller embayments. Broader-scale geographic analyses (*inter*bay analysis) were conducted to compare nekton assemblages in adjacent bay systems along the southwest coast of Florida (i.e., Lower Tampa Bay North, Lower Tampa Bay South, Sarasota Bay, Lemon Bay, Gasparilla Sound, Pine Island Sound) (*Figure 2*). All nekton taxa collected, including species complexes (e.g., *Eucinostomus* spp., *Menidia* spp.) and invertebrates were included in the community analyses.

Bray-Curtis similarity calculation

The basis of the multivariate analyses was an assessment of similarity in nekton community structure, calculated according to the method of Bray and Curtis (1957):

$$S_{jk} = 100\left\{1 - \frac{\sum_{i=1}^{p} \left| y_{ij} - y_{ik} \right|}{\sum_{i=1}^{p} \left(y_{ij} + y_{ik} \right)}\right\}$$

where S_{jk} is the Bray-Curtis similarity coefficient, y_{ij} is the abundance of the ith species in the jth sample and y_{jk} is the abundance of the same ith species in the kth sample. Abundance was standardized to number•haul^{-1} for both seine types, and to number•100m^{-2} to account for varying tow lengths. Abundance data were square root-transformed prior to analysis to reduce the influence of highly abundant taxa.

Non-metric multidimensional scaling (MDS) and Similarity Percentage Analysis (SIMPER)

In order to provide a visual depiction of differences in nekton community structure non-metric multidimensional scaling (MDS) of the initial Bray-Curtis similarity matrices was conducted. This technique generates two-dimensional plots of ‘distances’ between samples on the basis of their similarity in community structure (Clarke 1993). The MDS analysis uses an iterative procedure to attempt to map similarity of samples as closely as possible to the rank order of similarities from the input Bray-Curtis similarity matrix. The adequacy of this representation is judged by a ‘stress’ value, for which zero is perfect representation, and values below ~0.2 offer appropriate results for interpretation (Clarke and Warwick 2001). MDS-plot axes do not have units, so the important information in these plots is the distances between samples; samples close together on the plots are more similar in community structure than samples that are further apart. The MDS plots included ‘samples’ that were averages of all data collected by sampling event or by geographic area. Similarity percentage analysis (SIMPER; Clarke and Warwick 2001) was used to identify species representative of dissimilarities between groups determined from MDS.

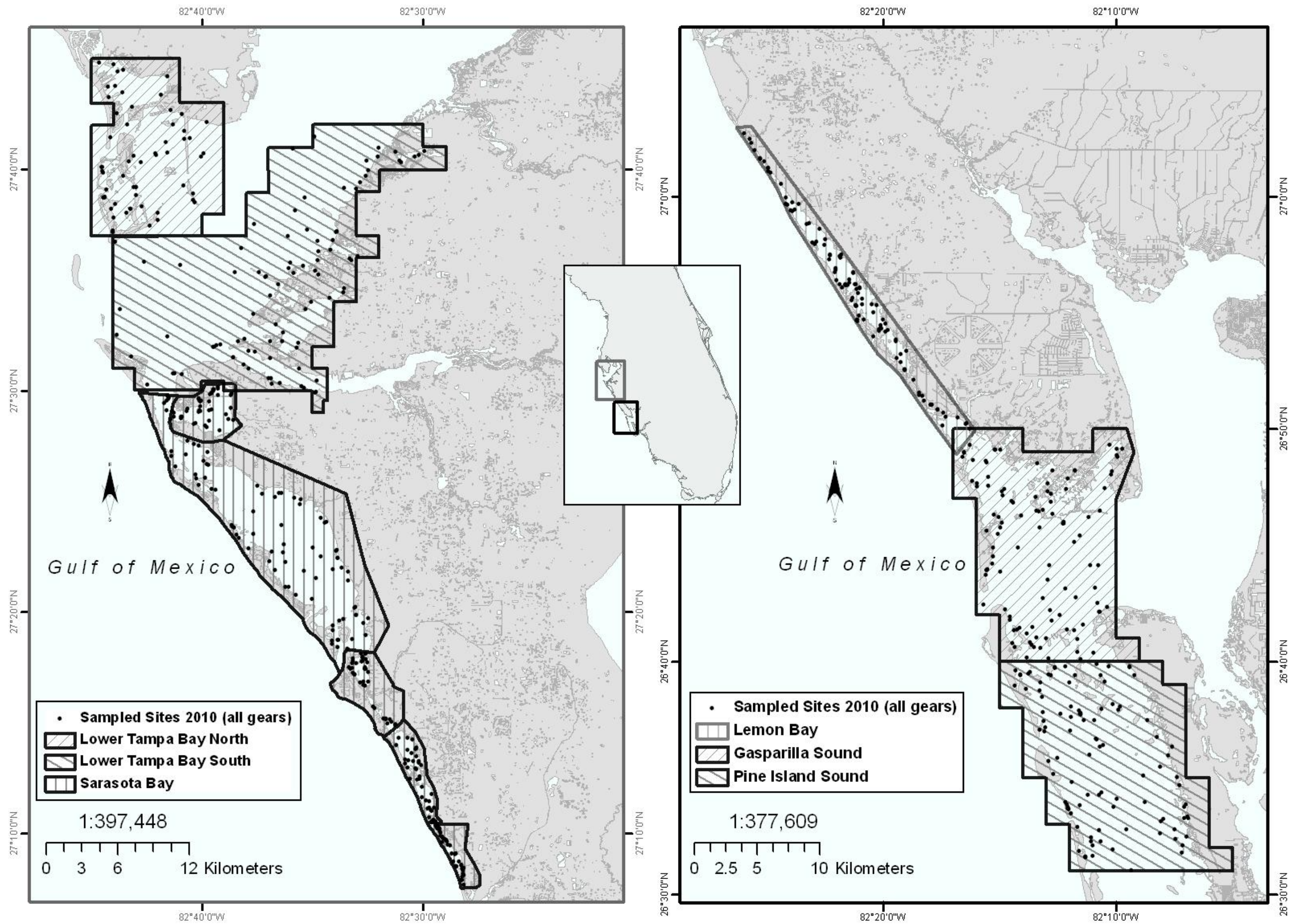

Figure 2.Sampling areas and sample sites along Florida's southwest coast, June 2009 – April 2010.

Mercury Content Analysis

Fish for mercury content analysis were placed directly on ice and returned to the laboratory, where standard length (SL) and sex were recorded. A clean stainless-steel knife was used to remove axial muscle tissue samples from the left dorsal area above the lateral line and anterior to the origin of the first dorsal fin for each fish. White muscle tissue taken from this region is representative of the portion of fish consumed by humans (Adams and McMichael 2001). Care was taken to assure that the sample did not contact the outer layer of the specimen, blood, scales, or other surrounding surfaces during the extraction process. Tissue samples were immediately placed in sterile polyethylene vials and frozen at -20° C until analyzed.

Total mercury concentration (THg) of each tissue sample was determined by EPA Method 7473 (*Direct Mercury Analysis by Thermal Decomposition, Amalgamation, and Atomic Absorption Spectrometry* [DMA], USEPA 2007). Frozen tissue samples were thawed until ice crystals were no longer present on or within the sample, and approximately 0.20 g of clean unexposed muscle tissue was then excised with sterilized stainless steel instruments from the interior portion of the sample. The tissue sample was placed directly into a clean quartz sampling vessel, weighed to 0.0001 g, and analyzed for total mercury by FWC-FWRI with a calibrated DMA-80 Direct Mercury Analyzer (Milestone Inc., Shelton, CT). Quality control included analysis of laboratory method blanks, duplicate or triplicate tissue samples, and certified fish-tissue reference material (CRM; TORT-2, DOLT-4, obtained from the National Research Council of Canada) for each group of 10 or fewer fish samples analyzed. Matrix spike samples were processed for every 40 samples analyzed in a group. If CRM results were not within 10% of their certified value, all samples run subsequent to the last acceptable CRM result were re-analyzed. All total mercury levels were measured and reported as milligrams per kilogram (mg/kg) wet weight, rounded to three decimal points (0.001).

Linear regressions were used to describe relationships between fish size and total mercury concentration. Sample sizes from Sarasota Bay were not large enough to be analyzed independently, so data collected from two adjacent estuaries (Tampa Bay and Charlotte Harbor) were also used in the regression analysis. Total mercury concentrations from Tampa Bay and Charlotte Harbor prior to 2006 were analyzed by EPA Method 245.6 (*Determination of Mercury in Tissues by Cold Vapor Atomic Absorption Spectrometry* [CVAAS]; USEPA 1991), which provides similar but not identical results to the DMA method. Therefore, THg values for all DMA-analyzed fish were converted into CVAAS values using equations developed by FWC from 1,566 split samples that were analyzed by both methods. Total mercury data were log transformed to approximate the normality and homoscedasticity requirements prior to regression analysis. Only species with at least 50 total animals collected, and at least 15 from Sarasota Bay, were analyzed using linear regression.

RESULTS and DISCUSSION

Physiochemical conditions

Temperature and rainfall patterns during the study period did not follow the long-term Southwest Florida trends (*Figure 3*). The period from May 2009 through April 2010 had slightly higher than average summer and fall air temperatures compared to the longer-term period (January 1990 to May 2010) (*Figure 3*); on average, temperatures were 0.5◦C warmer from June to December 2009 than during the longer-term period. Air temperatures during the winter and early spring of 2010 were colder than normal, with temperatures from January to March 2010 averaging almost 4˚C colder than the longer-term average. Differences from the longer-term climatic trend for rainfall were also apparent (*Figure 3*). Rainfall totals were higher than normal in May and July 2009, at the beginning of the study period. Total rainfall in June, August, September, and October 2009 were lower than normal, while the normally dry period between January and April 2010 had much higher than normal rainfall totals.

Mean water temperature in each of the embayments showed very similar trends with very little difference between the five embayments (*Figure 4*). Temperature followed the normal Florida pattern, being warmest during the summer months of June and August, decreasing during the fall and winter, and rising again in the spring. Although not obvious in the one-year study of Sarasota Bay, water temperatures in adjacent estuaries (Tampa Bay and Charlotte Harbor) with a longer time series of data, indicate that the January to March water temperatures were much colder in 2010 than during the historical period of record (*Figure 5*).

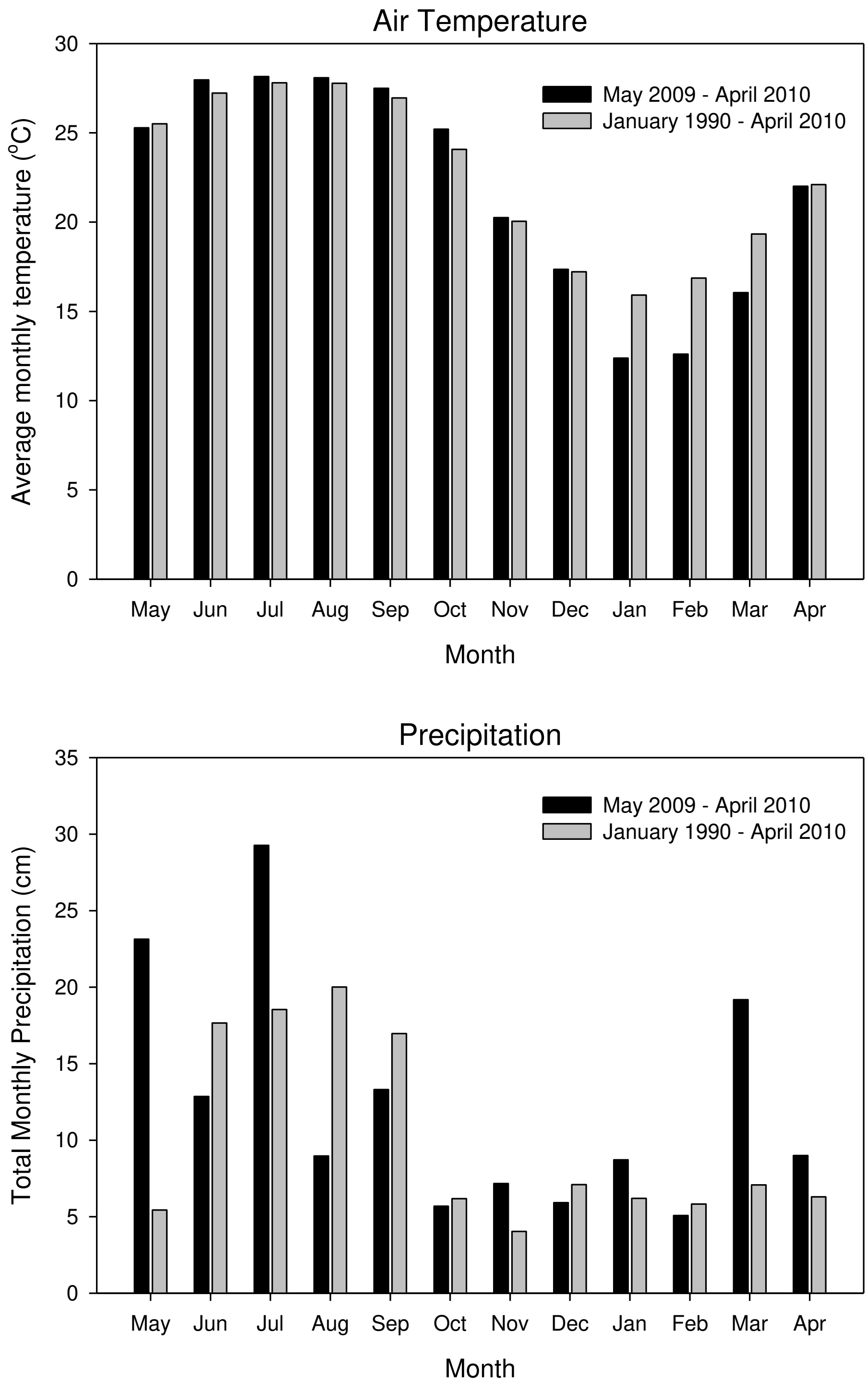

Figure 3. Temperature and total rainfall during the study period (May 2009 to April 2010) and during a longer-term reference period (January 1990 to April 2010). Data are from Tampa International Airport (Station 72211012842) and were downloaded from the National Climatic Data Center (http://gis.ncdc.noaa.gov/website/ims-cdo/gsod/viewer.htm).

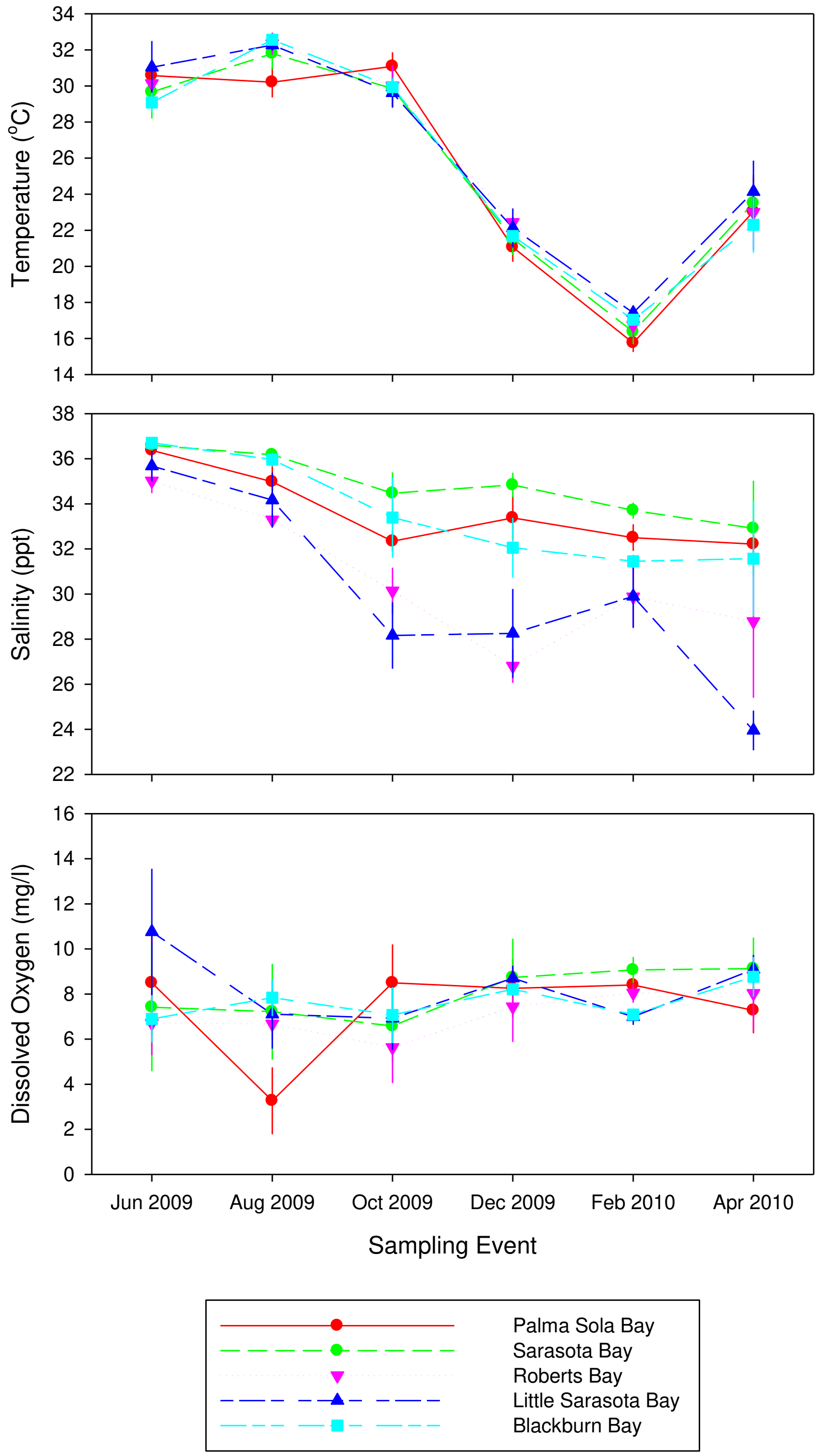

Figure 4. Mean (±standard deviation) water temperature, salinity, and dissolved oxygen (water column average) by embayment, from the Fisheries-Independent Monitoring collections in Sarasota Bay estuary during bi-monthly sampling (June 2009-April 2010).

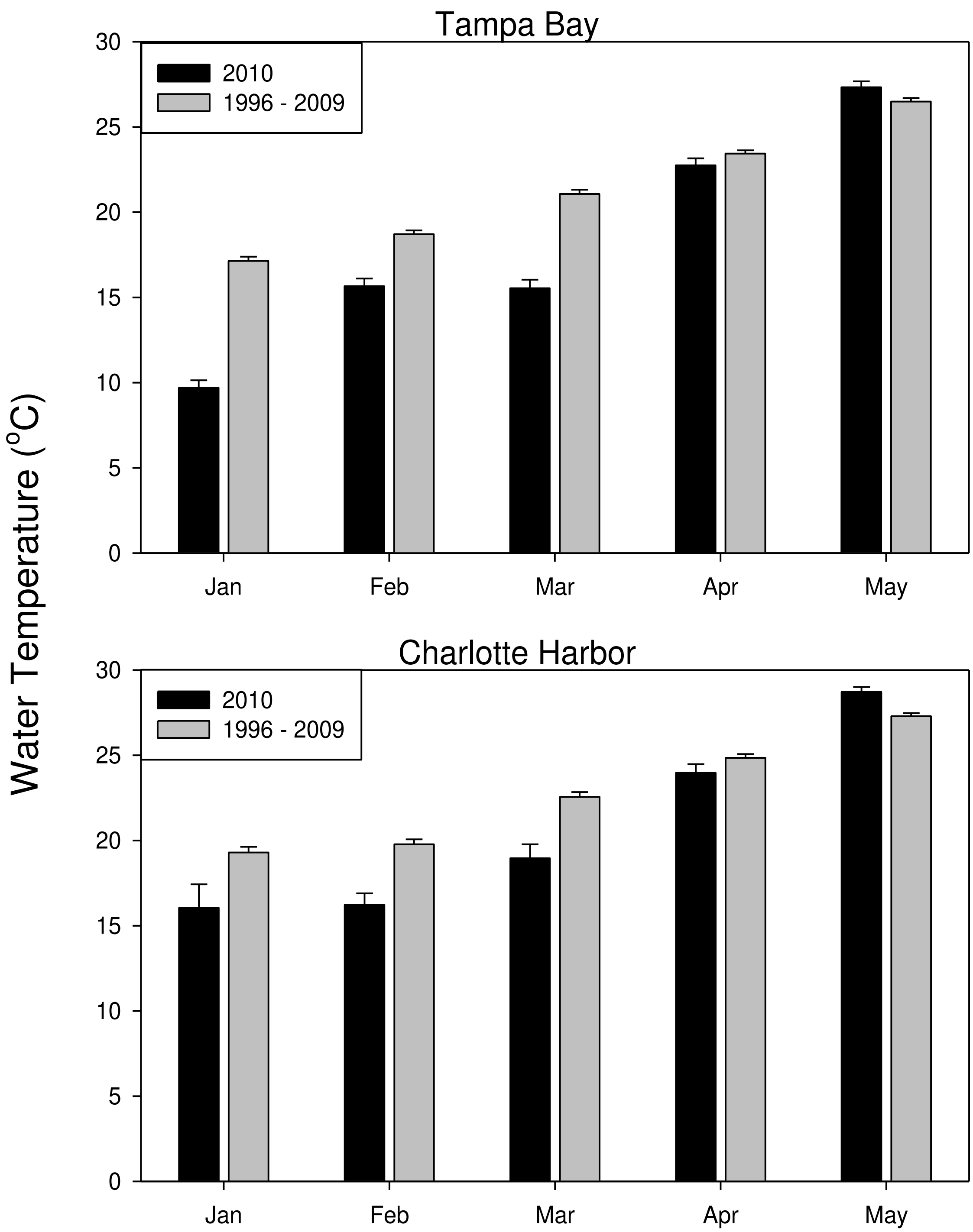

Figure 5. Mean monthly water temperature from the 183-m seine surveys conducted by the Fisheries-Independent Monitoring program in Tampa Bay and Charlotte Harbor. Gray and black fills represent the historical period (1996 – 2009) and 2010, respectively. Error bars represent the 95% confidence interval.

Each embayment had similar trends in salinity (*Figure 4*). Salinity maxima occurred in June 2006 in each of the embayments with values ranging from 35 to 37 ppt. Salinity was lowest in each embayment during April 2010, with two of the embayments (Roberts and Little Sarasota bays) having lower salinities (28.8 and 24.0 ppt, respectively) than the other three embayments (31 to 33 ppt). Although this pattern was experienced in many Florida estuaries between June 2009 and April 2010, Florida estuaries typically experience their highest salinities in spring (April and May) during which Florida typically receives its lowest rainfall totals.

Water column average dissolved oxygen was above 5 mg/l in each of the embayments during each sampling period (*Figure 4*), except for Palma Sola Bay in August 2009 (3.3 mg/l). The highest average dissolved oxygen occurred in Little Sarasota Bay during June 2009.

The climatic and physiochemical conditions experienced during this one-year study of Sarasota Bay were not typical compared to the longer-term average condition for Southwest Florida. January and February 2010 had unprecedented cold temperatures with fish kills reported throughout Florida. An El Nino rainfall pattern, with unseasonably heavy winter/spring precipitation, was experienced likely resulting in lower salinity in the study area than would normally be expected. It is very likely that the nekton community sampled during this period was impacted by these climatic and physiochemical conditions and may differ from the nekton community that would be sampled over a longer time period. The funding that was recently awarded for a second year of sampling, June 2010 to April 2011, will greatly improve the understanding of the nekton community in this estuary.

Composition of overall nekton community

A total of 159,271 fishes (103 taxa) and selected invertebrates (8 taxa) were collected from 245 samples (*Table 2*). Species lists with common and scientific names and number of animals collected are provided by sampling event, gear and habitat strata, and geographic strata in *Appendix B*, *C*, and *D*, respectively. About 17% of the total sampling effort, but over a quarter of the total number of animals collected (26.2%) were from Roberts Bay (*Table 2*). Sarasota Bay proper, in which just over 1/3 of the sets were made, accounted for only 28.7% of the total animals collected during the study period. The fewest number of animals (n=15,719, 9.9% of total catch) were collected in Palma Sola Bay.

Pinfish (*Lagodon rhomboides*, n=43,164) was the most numerous taxon collected, representing 27.1% of the total catch (*Appendix B*, *C*, and *D*). Bay anchovy (*Anchoa mitchilli,* n=40,349) was the second most abundant taxon collected, accounting for an additional 25.3% of the total catch. The twenty-one Selected Taxa (n=28,119 animals) that were collected comprised 17.7% of the total catch. Spot (*Leiostomus xanthurus,* n=23,577, 14.8% of total catch) and pink shrimp (*Farfantepenaeus duorarum,* n=1,497, 0.9% of total catch) were the two most abundant Selected Taxa collected.

Table 2. Summary of catch and effort data for Sarasota Bay stratified-random sampling, June 2009 to April 2010.

	21.3-m seine		183-m seine		6.1-m trawl		Totals	
Bay Segment (Zone)	Animals	Hauls	Animals	Hauls	Animals	Hauls	Animals	Hauls
Palma Sola Bay (A)	13,608	30	1,730	6	381	6	15,719	42
Sarasota Bay (B)	39,629	47	4,585	12	1,511	24	45,725	83
Roberts Bay (C)	34,272	29	560	6	6,945	6	41,777	41
Little Sarasota Bay (D)	29,652	29	622	6	5,199	6	35,473	41
Blackburn Bay (E)	19,268	26	785	6	524	6	20,577	38
Totals	136,429	161	8,282	36	14,560	48	159,271	245

Shallow water habitats sampled with 21.3-m seines

A total of 136,429 animals, representing over 85% of the overall catch, were collected from the Sarasota Bay estuary with 21.3-m seines (n=161 hauls; *Table 2*). Bay anchovy (*A. mitchilli*, n=39,964) was the most abundant taxon collected, accounting for 29.3% of the 21.3-m seine catch (*Table 3*). The taxa most frequently collected with 21.3-m seines were pinfish (*Lagodon rhomboides*, 84.5% occurrence) and eucinostomus mojarra (*Eucinostomus* spp., 57.8% occurrence). Animals collected with 21.3-m seines tended to be relatively small, ranging in length from 2 to 346 mm, with the mean length for each of the dominant taxa between 10 and 53 mm (*Table 3*).

A total of 18,086 animals from 15 Selected Taxa were collected, representing 13.3% of the entire 21.3-m seine catch (*Table 4*). Spot (*L. xanthurus*, n=14,808) was the most abundant Selected Taxon, accounting for 81.9% of the Selected Taxa collected by this gear. The Selected Taxon most frequently collected with 21.3-m seines was the pink shrimp (*F. duorarum*, 54.7% occurrence).

Nekton were previously sampled during 2002 in the Sarasota Bay estuary (SBNEP study) using a 21.3-m seine and protocols modeled after the Fisheries-Independent Monitoring program (SBNEP 2003). Ninety-three 21.3-m “standard” seine hauls were collected at 40 fixed stations during five-day sampling periods in both February and June. In this earlier study, fixed stations, selected to represent natural (n=22) and restored (n=18) habitats, were sampled. The SBNEP and FIM studies collected very similar numbers of total taxa (71 and 73, respectively). There were, however, many differences in the two species lists (*Table 5*), mostly because of 1) low salinity areas sampled by the SBNEP study were not sampled by the FIM study; 2) clupeids were identified to species (*Opisthonema oglinum* and *Sardinella aurita*) in the FIM study but not in the SBNEP study; 3) the FIM study’s stratified-random design sampled more diverse habitats than the SBENP study; and 4) the FIM study sampled six months, instead of the two sampled by the SBNEP study.

The rankings for species collected during both the SBNEP and FIM studies also differed. For instance *Farfantepenaeus duorarum* (pink shrimp) ranked tenth in the FIM study, but 20th in the SBNEP study and *Cyprinodon variegatus* (sheepshead minnow) ranked 10th in the SBNEP study but 38th in the FIM study. As with the differences in the overall species list, differences in ranking can be attributed to differences in the habitats and months that were sampled between the two studies.

Table 3. Catch statistics for 10 dominant taxa collected in 21.3-m seine samples during Sarasota Bay stratified-random sampling (n=161 hauls), June 2009 to April 2010. 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. Length is standard length for fish and post-orbital head length for shrimp. Taxa are ranked in order of decreasing mean catch-per-unit-effort.

	Number		%	Catch-per-unit-effort (animals/100m^2)				Length (mm)			
Scientific Name (Common Name)	No.	%	Occur	Mean	Stderr	CV	Max	Mean	Stderr	Min	Max
Anchoa mitchilli (bay anchovy)	39,964	29.3	32.9	177.30	70.91	507.49	9,792.14	30	0.03	15	56
Lagodon rhomboides (pinfish)	35,167	25.8	84.5	156.02	19.74	160.54	1,159.29	31	0.08	9	180
Eucinostomus spp. (eucinostomus mojarra)	17,073	12.5	57.8	75.75	21.55	360.92	3,285.71	25	0.05	8	39
Leiostomus xanthurus (spot)	14,808	10.9	36.6	65.70	14.14	273.04	965.00	23	0.07	11	118
Harengula jaguana (scaled sardine)	6,959	5.1	19.3	30.87	13.65	560.87	1,757.86	44	0.15	22	117
Lucania parva (rainwater killifish)	4,024	2.9	37.9	17.85	4.25	302.37	412.14	23	0.07	13	37
Menidia spp. (menidia silversides)	3,855	2.8	34.8	17.10	5.89	437.01	806.43	43	0.15	22	89
Anchoa cubana (cuban anchovy)	3,303	2.4	5.6	14.65	8.54	739.75	1,135.71	38	0.08	25	62
Eucinostomus gula (silver jenny)	2,193	1.6	49.1	9.73	2.65	346.16	377.14	53	0.20	40	91
Farfantepenaeus duorarum (pink shrimp)	1,429	1.0	54.7	6.34	1.22	245.04	97.86	10	0.10	2	39
Subtotal	128,775	94.3	.	.	.	.	.	.	.	2	180
Totals	136,429	100.0	.	605.28	88.62	185.77	10,460.71	.	.	2	346

Table 4. Catch statistics for Selected Taxa collected in 21.3-m seine samples during Sarasota Bay stratified-random sampling (n=161 hauls), June 2009 to April 2010. 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. Length is standard length for fish, post-orbital head length for shrimp, and carapace width for crabs. Taxa are ranked in order of decreasing mean catch-per-unit-effort.

	Number		%	Catch-per-unit-effort (animals/100m^2)				Length (mm)			
Scientific Name (Common Name)	No.	%	Occur	Mean	Stderr	CV	Max	Mean	Stderr	Min	Max
Leiostomus xanthurus (spot)	14,808	10.9	36.6	65.70	14.14	273.04	965.00	23	0.07	11	118
Farfantepenaeus duorarum (pink shrimp)	1,429	1.0	54.7	6.34	1.22	245.04	97.86	10	0.10	2	39
Mugil cephalus (striped mullet)	1,347	1.0	10.6	5.98	4.20	891.10	635.71	24	0.06	16	32
Cynoscion nebulosus (spotted seatrout)	128	0.1	19.3	0.57	0.13	286.87	10.71	40	1.57	18	101
Lutjanus griseus (gray snapper)	127	0.1	18.0	0.56	0.21	473.79	24.29	41	2.02	14	162
Lutjanus synagris (lane snapper)	87	0.1	12.4	0.39	0.14	468.16	17.14	38	1.51	20	108
Archosargus probatocephalus (sheepshead)	53	0.0	13.7	0.24	0.06	325.36	5.00	58	10.58	13	268
Sciaenops ocellatus (red drum)	36	0.0	5.0	0.16	0.09	680.04	12.86	69	5.50	12	136
Callinectes sapidus (blue crab)	29	0.0	9.3	0.13	0.04	382.06	3.57	38	5.67	7	134
Paralichthys albigutta (Gulf flounder)	22	0.0	8.1	0.10	0.03	413.14	3.57	49	9.62	15	242
Mugil gyrans (fantail mullet)	7	0.0	1.2	0.03	0.02	974.04	3.57	15	0.42	14	17
Centropomus undecimalis (common snook)	6	0.0	1.9	0.03	0.02	787.38	2.14	112	37.86	28	232
Trachinotus falcatus (permit)	4	0.0	1.2	0.02	0.01	894.41	1.43	42	9.09	21	57
Mycteroperca microlepis (gag)	2	0.0	1.2	0.01	0.01	894.41	0.71	135	40.50	94	175
Menippe spp. (stone crab)	1	0.0	0.6	0.00	0.00	1,268.86	0.71	41	.	41	41
Totals	18,086	13.3	83.9	80.24	15.26	241.34	996.43	.	.	2	268

Table 5. Listing of species that were not collected during both the SBNEP (2002) and the FIM (June 2009 to April 2010) studies. Rank refers to the species ranking based upon number collected – the larger the rank, the fewer animals that were collected.

SBNEP Study		***FIM Study***	
Species	***Rank***	***Species***	***Rank***
Aluterus schoepfi	55	*Acanthostracion quadricornis*	50
Anchoa cubana	23	*Adinia xenica*	65
Brevoortia spp.	15	*Anchoa spp.*	66
Clupeidae spp.	12	*Ariopsis felis*	67
Dasyatis say	64	*Astroscopus* spp.	55
Fundulus confluentus	50	*Blenniidae* spp.	56
Gambusia holbrooki	36	*Chasmodes saburrae*	48
Gobiosoma bosc	43	*Dasyatis sabina*	51
Haemulon parrai	65	*Haemulon plumierii*	44
Limulus polyphemus	51	*Hyporhamphus meeki*	35
Lophogobius cyprinoides	34	*Hyporhamphus unifasciatus*	61
Menticirrhus saxatilis	68	*Mugil gyrans*	28
Mycteroperca microlepis	46	*Nicholsina usta*	63
Pogonias cromis	70	*Ocyurus chrysurus*	45
Scomberomorus maculatus	22	*Opisthonema oglinum*	13
Selene vomer	71	*Ostraciidae* spp.	71
Sphyraena barracuda	60	*Paraclinus marmoratus*	64
Strongylura marina	48	*Prionotus scitulus*	52
Strongylura spp.	62	*Prionotus tribulus*	49
Trinectes maculatus	52	*Sardinella aurita*	72
		Symphurus plagiusa	54
		Urophycis floridana	43

Nearshore habitats sampled with 183-m seines

A total of 8,282 animals were collected with 183-m seines (n=36 hauls), representing 5.2% of the overall catch (*Table 2*). Pinfish (*L. rhomboides*, n=4,920) was the most abundant taxon collected with 183-m seines, accounting for 59.4% of the total catch (*Table 6*). Pinfish were also the most frequently collected taxon, occurring in every 183-m seine set. Animals collected with 183-m seines (*Table 6*) tended to be larger (mean size typically greater than 100 mm) than those collected with 21.3-m seines (*Table 3*) and 6.1-m trawls (*Table 8*).

A total of 814 animals from 18 Selected Taxa were collected, representing 9.8% of the entire 183-m seine catch (*Table 7*). *Archosargus probatocephalus* (n=160) was the most abundant Selected Taxon, accounting for 19.7% of the Selected Taxa collected by this gear. Sheepshead (58.3% occurrence) was also the most frequently collected Selected Taxa followed by common snook (*C. undecimalis*, 52.8% occurrence).

Table 6. Catch statistics for 10 dominant taxa collected in 183-m seine samples during Sarasota Bay stratified-random sampling (n=36 hauls), June 2009 to April 2010. 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. Length is standard length. Taxa are ranked in order of decreasing mean catch-per-unit-effort.

	Number		%	Catch-per-unit-effort (animals/haul)				Length (mm)			
Scientific Name (Common Name)	No.	%	Occur	Mean	Stderr	CV	Max	Mean	Stderr	Min	Max
Lagodon rhomboides (pinfish)	4,920	59.4	100.0	136.67	31.02	136.20	723.00	107	0.40	43	213
Bairdiella chrysoura (silver perch)	642	7.8	27.8	17.83	12.71	427.54	441.00	117	0.63	67	171
Harengula jaguana (scaled sardine)	611	7.4	25.0	16.97	11.64	411.53	406.00	100	0.48	60	140
Orthopristis chrysoptera (pigfish)	344	4.2	44.4	9.56	4.09	256.70	114.00	111	1.40	62	206
*Opisthonema oglinum (*Atlantic thread herring)	272	3.3	8.3	7.56	7.47	593.21	269.00	107	0.90	84	158
Ariopsis felis (hardhead catfish)	188	2.3	30.6	5.22	2.36	271.51	72.00	247	3.55	160	368
Eucinostomus gula (silver jenny)	177	2.1	52.8	4.92	1.25	153.08	28.00	81	1.08	41	133
Archosargus probatocephalus (sheepshead)	160	1.9	58.3	4.44	1.33	179.63	40.00	234	4.21	98	382
Centropomus undecimalis (common snook)	127	1.5	52.8	3.53	0.89	151.29	20.00	418	7.26	234	705
Lutjanus griseus (gray snapper)	110	1.3	38.9	3.06	1.09	213.38	29.00	179	4.02	66	285
Subtotal	7,551	91.2	.	.	.	.	.	.	.	41	705
Totals	8,282	100.0	.	230.06	50.81	132.51	1,351.00	.	.	31	716

Table 7. Catch statistics for Selected Taxa collected in 183-m seine samples during Sarasota Bay stratified-random sampling (n=36 hauls), June 2009 to April 2010. 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. Length is standard length for fish and carapace width for crabs. Taxa are ranked in order of decreasing mean catch-per-unit-effort.

	Number		%	Catch-per-unit-effort (animals/haul)				Length (mm)			
Scientific Name (Common Name)	No.	%	Occur	Mean	Stderr	CV	Max	Mean	Stderr	Min	Max
Archosargus probatocephalus (sheepshead)	160	1.9	58.3	4.44	1.33	179.63	40.00	234	4.21	98	382
Centropomus undecimalis (common snook)	127	1.5	52.8	3.53	0.89	151.29	20.00	418	7.26	234	705
Lutjanus griseus (gray snapper)	110	1.3	38.9	3.06	1.09	213.38	29.00	179	4.02	66	285
Elops saurus (ladyfish)	99	1.2	36.1	2.75	1.04	227.24	31.00	264	4.33	192	440
Leiostomus xanthurus (spot)	70	0.8	27.8	1.94	0.76	233.56	17.00	112	3.60	81	182
Mugil cephalus (striped mullet)	44	0.5	36.1	1.22	0.39	192.74	10.00	280	13.69	122	421
Mugil curema (fantail mullet)	41	0.5	25.0	1.14	0.47	246.71	12.00	221	9.10	112	298
Mycteroperca microlepis (gag)	41	0.5	16.7	1.14	0.60	314.25	18.00	219	8.73	98	331
Paralichthys albigutta (Gulf flounder)	25	0.3	30.6	0.69	0.22	194.17	6.00	175	11.24	77	265
Lutjanus synagris (lane snapper)	23	0.3	8.3	0.64	0.51	477.92	18.00	107	1.82	93	132
Cynoscion nebulosus (spotted seatrout)	19	0.2	27.8	0.53	0.15	172.39	3.00	224	20.65	52	379
Mugil gyrans (fantail mullet)	18	0.2	25.0	0.50	0.16	188.22	3.00	166	12.35	99	246
Sciaenops ocellatus (red drum)	15	0.2	19.4	0.42	0.18	252.53	5.00	306	56.10	75	625
Callinectes sapidus (blue crab)	8	0.1	16.7	0.22	0.09	243.19	2.00	106	14.93	48	158
Trachinotus falcatus (permit)	7	0.1	8.3	0.19	0.12	385.24	4.00	168	34.09	58	270
Scomberomorus maculatus (Spanish mackerel)	4	0.0	5.6	0.11	0.09	470.26	3.00	366	17.04	328	410
Pogonias cromis (black drum)	2	0.0	5.6	0.06	0.04	418.16	1.00	294	46.00	248	340
Menippe spp. (stone crab)	1	0.0	2.8	0.03	0.03	600.00	1.00	106	.	106	106
Totals	814	9.8	100.0	22.61	3.44	91.17	87.00	.	.	48	705

Deeper-water habitats sampled with 6.1-m trawls

A total of 14,560 animals were collected in 6.1-m trawls (n=48 hauls), representing 9.1% of the overall catch (*Table 2*). Spot (*L. xanthurus*, n=8,629, 59.2% of total catch) was the most abundant taxon collected with this gear (*Table 8*). The taxon most frequently collected with 6.1-m trawls was the pinfish (*L. rhomboides*), which occurred in over 80% of the trawl samples. Trawl collected animals tended to be similar in size to those collected with 21.3-m seines (*Table 3*) and smaller than those collected with 183-m seines (*Table 6*).

Fourteen Selected Taxa (9,219 animals, 63.3% of the entire trawl catch) were collected with 6.1-m trawls (*Table 9*). A single species (spot, *L. xanthurus,* n=8,629) accounted for 93.6% of the Selected Taxa collected with trawls. The Selected Taxon most frequently collected with 6.1-m trawls was the stone crab (*Menippe* spp.) which occurred in almost 50% of the trawl collections.

Table 8. Catch statistics for 11 dominant taxa collected in 6.1-m trawl samples during Sarasota Bay stratified-random sampling (n=48 hauls), June 2009 to April 2010. 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. Length is standard length for fish and carapace width for crabs. Taxa are ranked in order of decreasing mean catch-per-unit-effort.

	Number		%	Catch-per-unit-effort (animals/100m^2)				Length (mm)			
Scientific Name (Common Name)	No.	%	Occur	Mean	Stderr	CV	Max	Mean	Stderr	Min	Max
Leiostomus xanthurus (spot)	8,629	59.3	12.5	12.48	7.69	426.76	314.14	20	0.10	10	159
Lagodon rhomboides (pinfish)	3,077	21.1	81.3	4.44	1.70	265.54	65.84	35	0.59	11	154
Eucinostomus gula (silver jenny)	481	3.3	64.6	0.69	0.21	209.49	8.30	82	0.78	40	125
Anchoa mitchilli (bay anchovy)	385	2.6	8.3	0.55	0.47	592.40	22.13	29	0.23	20	52
Eucinostomus spp. (eucinostomus mojarra)	311	2.1	31.3	0.45	0.16	246.88	4.88	25	0.40	10	39
Orthopristis chrysoptera (pigfish)	270	1.9	54.2	0.40	0.14	249.92	6.45	116	2.08	46	209
Menippe spp. (stone crab)	255	1.8	45.8	0.36	0.13	247.19	5.46	28	1.25	4	113
Portunus spp. (swimming crab)	168	1.2	47.9	0.24	0.08	224.56	2.90	51	1.27	12	95
Callinectes sapidus (blue crab)	117	0.8	33.3	0.17	0.06	243.83	1.75	79	3.08	12	168
Archosargus probatocephalus (sheepshead)	74	0.5	16.7	0.12	0.07	437.38	3.41	171	8.04	13	360
Gobiosoma spp. (gobies)	81	0.6	16.7	0.12	0.07	418.71	3.24	16	0.23	10	19
Subtotal	13,848	95.2	.	.	.	.	.	.	.	4	360
Totals	14,560	100.0	.	21.01	9.22	304.11	359.37	.	.	4	590

Table 9. Catch statistics for Selected Taxa collected in 6.1-m trawl samples during Sarasota Bay stratified-random sampling (n=48 hauls), June 2009 to April 2010. 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. Length is standard length for fish, post-orbital head length for shrimp, and carapace width for crabs. Taxa are ranked in order of decreasing mean catch-per-unit-effort.

	Number		%	Catch-per-unit-effort (animals/100m^2)				Length (mm)			
Scientific Name (Common Name)	No.	%	Occur	Mean	Stderr	CV	Max	Mean	Stderr	Min	Max
Leiostomus xanthurus (spot)	8,629	59.3	12.5	12.48	7.69	426.76	314.14	20	0.10	10	159
Menippe spp. (stone crab)	255	1.8	45.8	0.36	0.13	247.19	5.46	28	1.25	4	113
Callinectes sapidus (blue crab)	117	0.8	33.3	0.17	0.06	243.83	1.75	79	3.08	12	168
Archosargus probatocephalus (sheepshead)	74	0.5	16.7	0.12	0.07	437.38	3.41	171	8.04	13	360
Farfantepenaeus duorarum (pink shrimp)	68	0.5	31.3	0.10	0.03	217.24	1.05	15	0.68	4	26
Lutjanus griseus (gray snapper)	23	0.2	10.4	0.03	0.02	407.18	0.71	149	10.90	50	228
Paralichthys albigutta (Gulf flounder)	21	0.1	25.0	0.03	0.01	201.81	0.22	178	20.78	16	301
Lutjanus synagris (lane snapper)	20	0.1	22.9	0.03	0.01	209.11	0.21	89	7.74	30	160
Menticirrhus americanus (southern kingfish)	4	0.0	8.3	0.01	0.00	335.40	0.07	209	59.27	36	287
Cynoscion arenarius (sand seatrout)	3	0.0	4.2	0.00	0.00	511.98	0.13	19	3.06	15	25
Cynoscion nebulosus (spotted seatrout)	2	0.0	4.2	0.00	0.00	484.82	0.07	124	104.50	19	228
Epinephelus morio (red grouper)	1	0.0	2.1	0.00	0.00	692.82	0.07	101	.	101	101
Mycteroperca microlepis (gag)	1	0.0	2.1	0.00	0.00	692.82	0.07	19	.	19	19
Sciaenops ocellatus (red drum)	1	0.0	2.1	0.00	0.00	692.82	0.07	590	.	590	590
Totals	9,219	63.3	81.3	13.33	7.69	399.81	314.43	.	.	4	590

Species Profiles

The following sections provide profiles on various abundant and frequently occurring species in terms of seasonal abundance, sizes collected, spatial distribution, and bottom habitat preference. Species included in these profiles are numerically dominant or economically important (i.e., recreationally or commercially fished species, such as spotted seatrout, common snook and pink shrimp). Appendices (*Appendix E*, *F*, and *G* for 21.3-m seines, 183-m seines, and 6.1-m trawls, respectively) contain summary graphs for all taxa that were identified to species, had at least a 15% occurrence, and for which at least 40 individuals were collected during bi-monthly sampling in the Sarasota Bay estuary between June 2009 and April 2010. The abundance and size distribution results presented here are based on a limited time series (one year of bi-monthly sampling) and relatively small sample size, so there tends to be considerable variability in the data.

Pink shrimp, *Farfantepenaeus duorarum*

Pink shrimp range from the Chesapeake Bay to the Yucatan Peninsula and are of great commercial importance, especially in the Gulf of Mexico (Carpenter 2002). Catches in Florida were valued at nearly $21M in 2005 (FWRI, unpublished data). They spawn offshore and enter estuaries as postlarvae (Allen et al. 1980). They probably use selective tidal stream transport to recruit to nursery grounds (i.e., they ascend into the water column on flood tides and descend to near the substrate on ebb tides [Hughes, 1969]). Different life stages of pink shrimp exhibit a broad range of salinity tolerance, although salinities from approximately 12 to 45 ppt seem to be preferred (Pattillo et al. 1997).

Pink shrimp were not collected with the 183-m seines (*Appendix C*) but were the tenth most abundant species collected with 21.3-m seines (*Table 3*) and were commonly collected with 6.1-m trawls (*Table 8*). Pink shrimp collected with 6.1-m trawls tended to be larger (median post-orbital head length of 14 mm; *Figure 7*) than those collected with 21.3-m seine (10 mm; *Figure 6*). Abundance in the shallow water habitats sampled with the 21.3-m seine was greater during October and December than in the other months (*Figure 6*). Pink shrimp were more abundant in Little Sarasota and Blackburn bays and over vegetated bottom habitats (*Figure 6*). Although mean abundance in the deeper waters sampled with 6.1-m trawls were higher in February and June and in Roberts and Little Sarasota Bay, the variability in the abundance estimates was too high to discern any real trends (*Figure 7*).

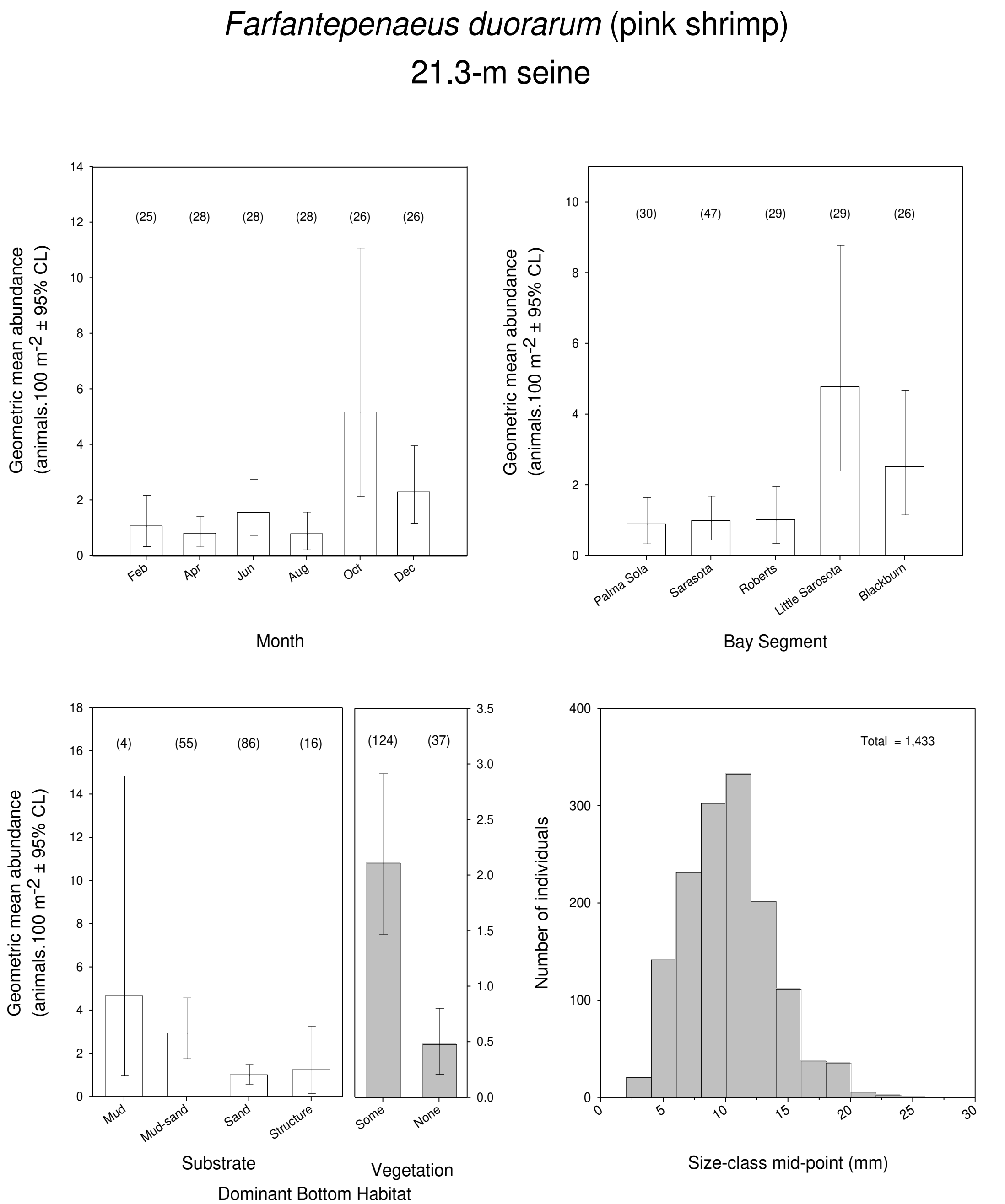

Figure 6. Relative abundance and length-frequency distribution of pink shrimp collected with 21.3-m seines in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Farfantepenaeus duorarum (pink shrimp)
6.1-m trawl

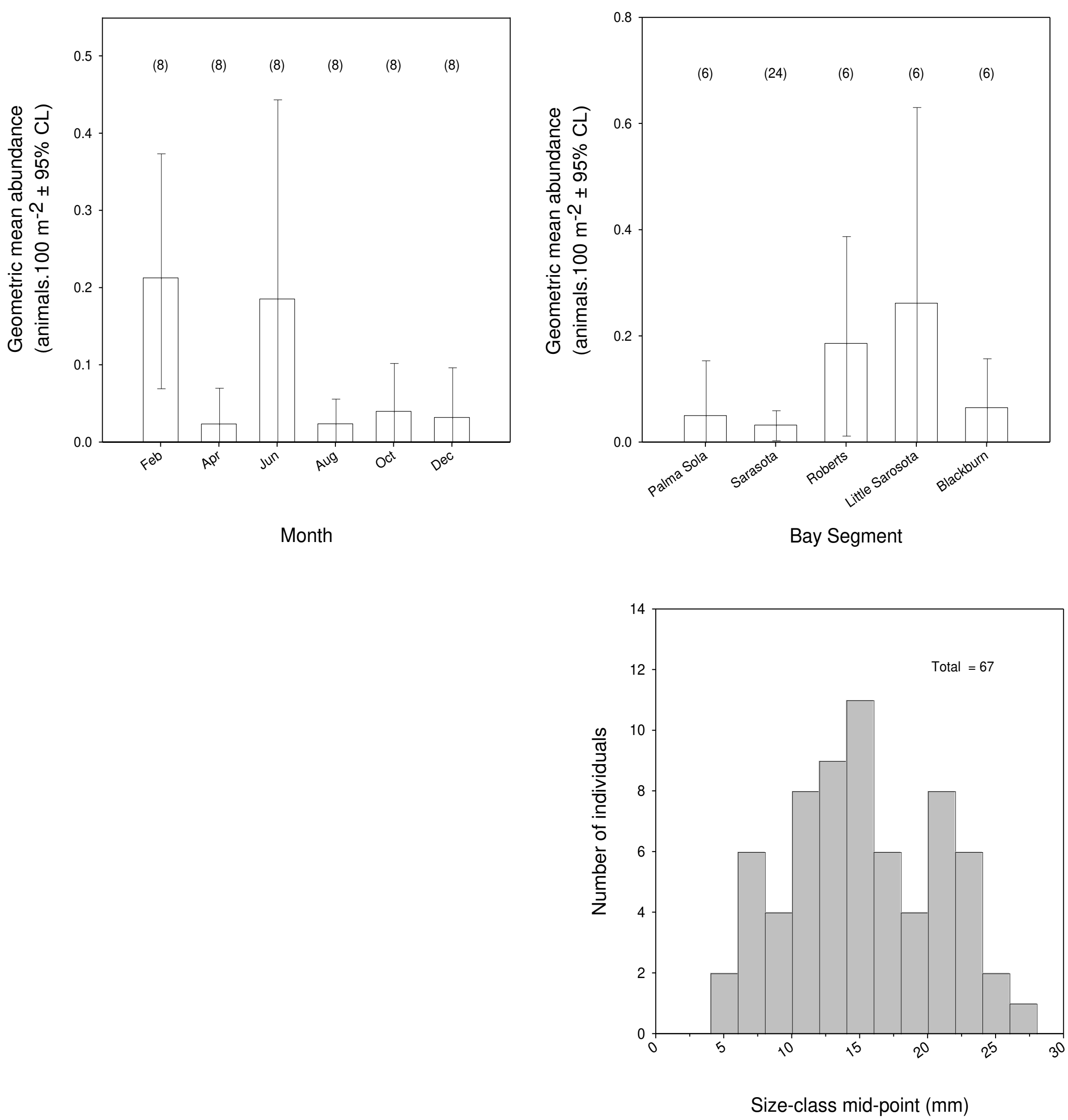

Figure 7. Relative abundance and length-frequency distribution of pink shrimp collected with 6.1-m trawl in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Blue crab, *Callinectes sapidus*

Blue crabs occur in the western Atlantic from Canada to Argentina, including Bermuda and the Antilles, and have been successfully introduced in Europe and Japan (Carpenter, 2002). This species supports large commercial fisheries in Florida, valued at nearly $12M in 2005 (FWRI, unpublished data), and is an important predator and prey species in inshore waters (Steele and Bert 1994). Blue crabs are transients in estuaries: spawning and larval development occur in marine waters, but juveniles and adults spend most of their time in estuaries (Steele and Bert 1994). Both larval blue crabs recruiting to the estuary and females leaving the estuary to spawn use selective tidal stream transport (Olmi 1994; Tankersley et al. 1998). Chemical cues emanating from estuarine and freshwater watersheds promote settlement by triggering metamorphosis in larvae (Wolcott and De Vries 1994; Forward et al. 1994 and 1997). Blue crabs tolerate salinities from freshwater to at least 50 ppt, but optimal salinities differ among life-history stages: 12–36 ppt for larvae, 2–21 ppt for juveniles, less than 10 ppt for adult males, and 23–33 ppt for egg-bearing females (Pattillo et al. 1997).

Blue crabs were collected with all three gear types deployed during this study (*Appendix C*), but were only common in the deeper-water habitats sampled with the 6.1-m trawl (*Table 9*). They were collected during all months sampled with no seasonal trend in abundance (*Figure 8*). Blue crabs were collected with 6.1-m trawls from each of the bays sampled, but were most abundant in Little Sarasota Bay and least abundant in Sarasota Bay. Sizes captured with 6.1-m trawls ranged from 12 mm to 168 mm carapace width (CW) with a bimodal distribution (modes at 50 and 90 mm CW).

Callinectes sapidus (blue crab)
6.1-m trawl

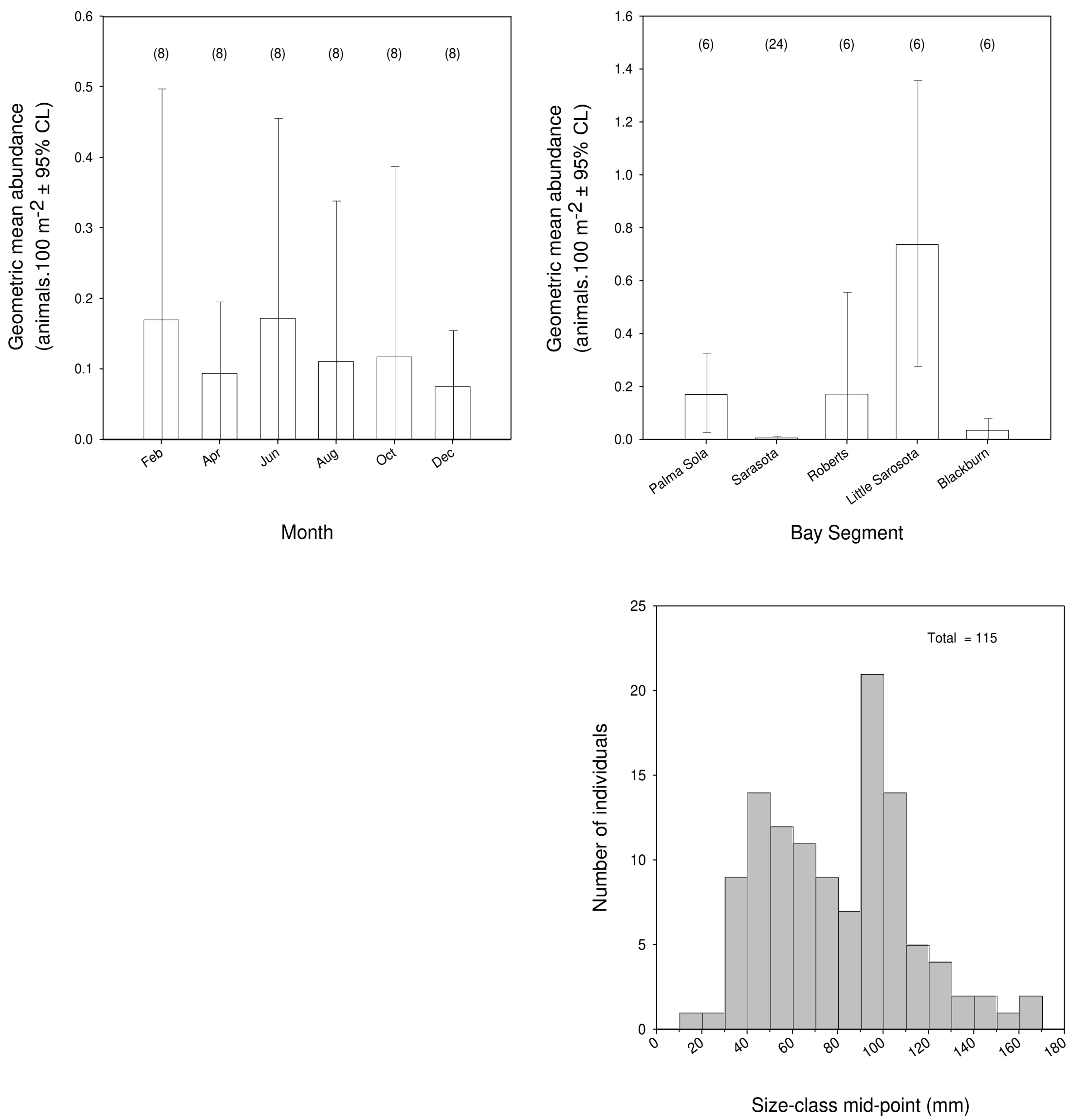

Figure 8. Relative abundance and length-frequency distribution of blue crab collected with 6.1-m trawl in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Ladyfish, *Elops saurus*

Ladyfish inhabit estuarine and nearshore waters throughout Florida. Larval and juvenile ladyfish can be found in a variety of nearshore habitats, including coastal beaches, canals, rivers, and mosquito impoundments (Gilmore et al. 1982 and McBride et al. 2001). Length-frequency analysis suggests that ladyfish grow to 200 mm to 300 mm standard length by age 1. Their diet consists mainly of fish with decapod crustaceans being of secondary importance (Darnell 1958 and Sekavec 1974). Florida landings were just over 1 million pounds in 2007 with over 75% being landed by the commercial fishery (FWRI-FWC 2008).

Ladyfish were only captured with the 183-m seine during this study (*Appendix C*); they comprised just over 1% of the catch in this gear and occurred in 36.1% of the hauls (*Table 7*). Although the largest ladyfish collected was 440 mm SL, the majority were between 200 and 300 mm SL (*Figure 9*). There appear to be both seasonal and distributional trends in abundance, but the variability was so high that discernment of real trends was not possible.

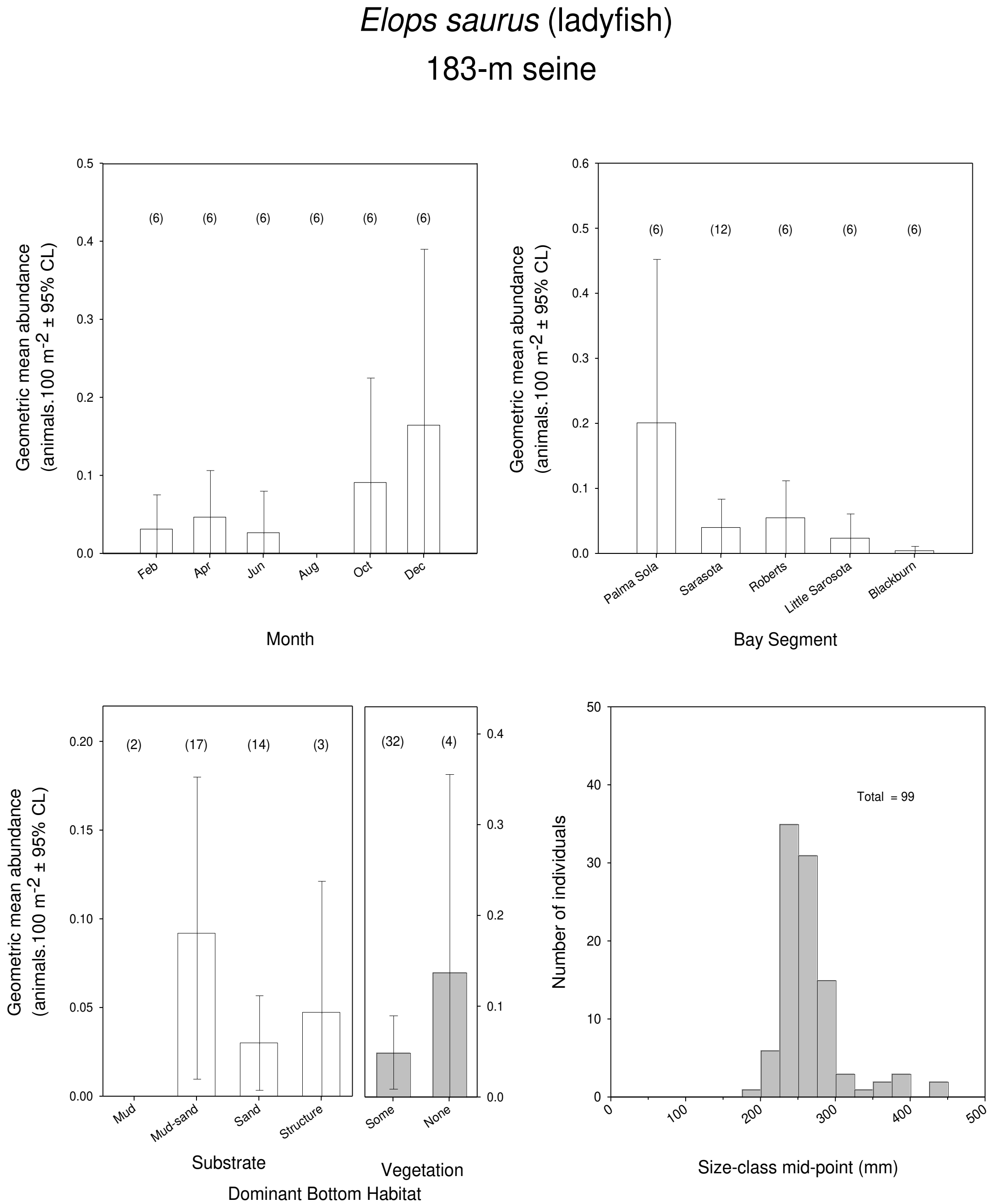

Figure 9. Relative abundance and length-frequency distribution of ladyfish collected with 183-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Bay anchovy, *Anchoa mitchilli*

Bay anchovies range from Maine to the Yucatan Peninsula and are of great importance in estuarine food chains due to their trophic position, small size, and extreme abundance (Pattillo et al. 1997; Carpenter 2002). They spawn in nearshore marine waters and estuaries (Peebles et al. 1996; Pattillo et al. 1997). Larvae use selective tidal stream transport to travel to upstream nursery areas (Schultz et al. 2003). Although each life stage of bay anchovy exhibits a broad range of salinity tolerance (Pattillo et al. 1997), each tends to distribute differently in relation to salinity: spawning adults, eggs, and newly hatched larvae are found at higher salinities than are later-stage larvae and juveniles (Peebles et al. 1991).

Bay anchovies were collected with 21.3-m seines (*Table 3*) and 6.1-m trawls (*Table 8*), but not with 183-m seine (*Appendix C*). They were only abundant (39,964 animals collected) and common (32.9% occurrence) enough in the 21.3-m seine collections for summary plots to be prepared. There were no obvious seasonal trends in abundance for bay anchovy (*Figure 10*) collected from the shallow waters sampled with 21.3-m seines; the low abundance in February may be indicative of the colder than average January/February water temperatures experienced during 2010. Bay anchovies were least abundant in Blackburn Bay and most abundant in Roberts and Little Sarasota Bay. They tended to have higher abundance in collections that sampled at least some seagrass. Bay anchovies collected with 21.3-m seines ranged in size from 15 mm to 56 mm SL.

Anchoa mitchilli (bay anchovy)
21.3-m seine

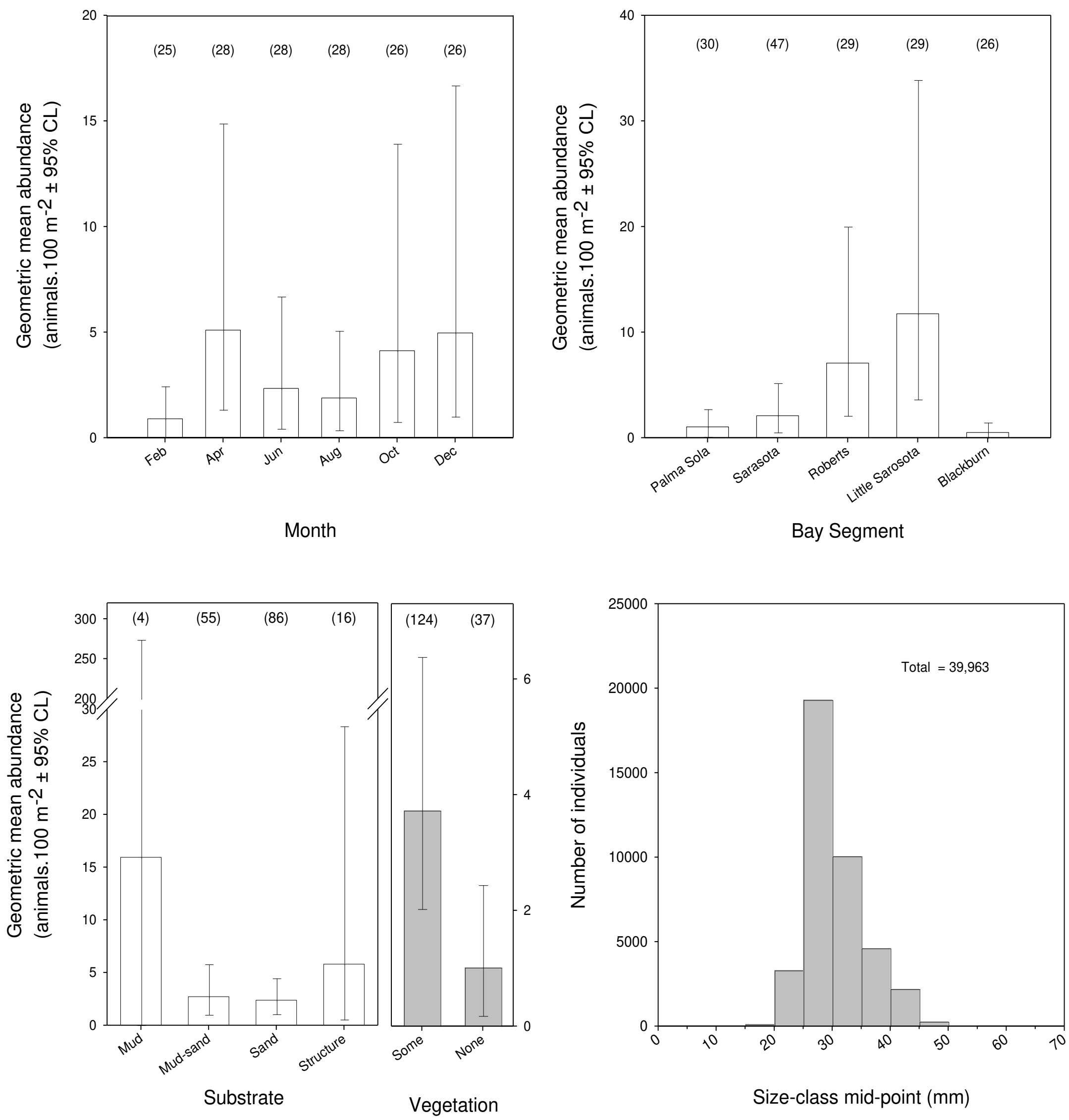

Figure 10. Relative abundance and length-frequency distribution of bay anchovy collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Common snook, *Centropomus undecimalis*

Common snook occur in tropical and subtropical estuarine systems of the western Atlantic (Rivas 1986). In Florida, they occur principally from Cape Canaveral on the Atlantic coast southward around the peninsula to Cedar Key on the Gulf of Mexico coast (Taylor et al. 2000). Common snook are popular sport fish that support a large recreational fishery throughout much of coastal south and central Florida (Muller and Taylor 2002). Spawning occurs primarily in ocean passes and secondary embayments (Taylor et al., 1998). Small juveniles are found in quiet shallow-water creeks, canals, and lagoons in both low-salinity (riverine) and high-salinity (mangrove and saltmarsh) environments (McMichael et al. 1989; Peters et al. 1998). As juvenile common snook grow to about 150 mm SL, marked changes in their tolerance of high temperature and low dissolved oxygen occur (Peterson and Gilmore 1991), and juveniles are no longer abundant at the sites described above. Larger juveniles and adult common snook are found in a wider variety of estuarine habitats.

Common snook were not collected with 6.1-m trawls (*Appendix C*), were rarely collected with 21.3-m seines (*Table 4*), but were encountered in over 50% of the 183-m seine sets (*Table 7*). There were no obvious seasonal trends in common snook abundance (*Figure 11*). Low abundance in February and August are likely due to the low sample size (6 hauls) collected during each sampling event, although the lower than average water temperatures during January/February 2010 likely also influenced the February catch. Common snook had much higher abundance in samples over seagrass, but the number of hauls that did not sample seagrass was very low. Common snook collected with 183-m seines ranged in size from 234 to 705 mm SL.

Centropomus undecimalis (common snook)
183-m seine

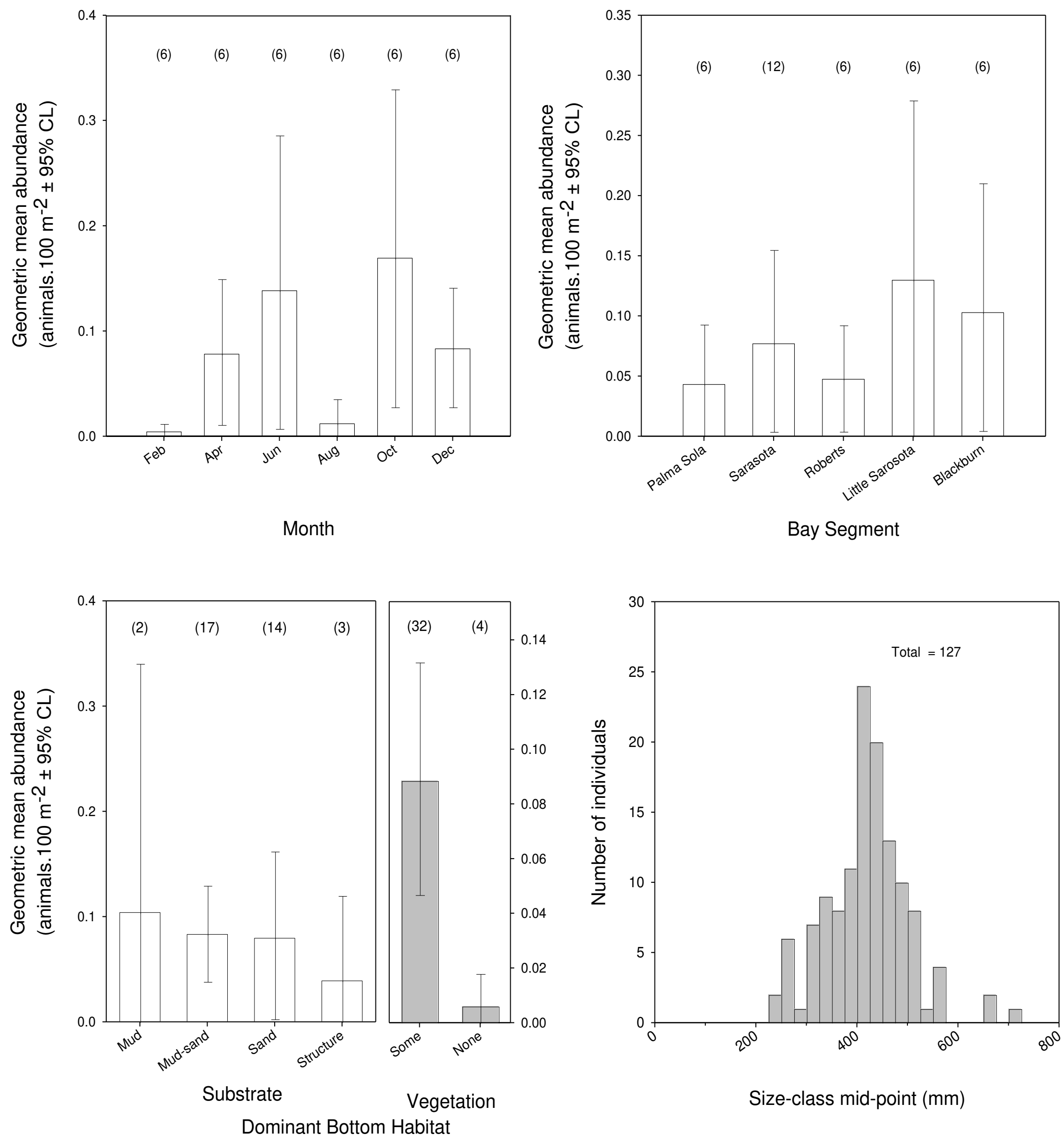

Figure 11. Relative abundance and length-frequency distribution of common snook collected with 183-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Gag, *Mycteroperca microlepis*

Gag is an economically important species of grouper found in the western Atlantic from Massachusetts southward to Florida, the Gulf of Mexico, and possibly to Brazil—excluding the West Indies (Bullock and Smith 1991). Juvenile gag inhabit estuarine seagrass areas (Keener et al. 1988; Ross and Moser 1995; Mullaney and Gale 1996; Koenig and Coleman 1998; Nagelkerken et al. 2000; Cocheret de la Moriniere et al. 2002; Casey et al. 2007; Whaley et al. 2007; Faunce and Serafy 2008) until approximately one year old and then move to deeper, offshore areas of reef and hard bottom. Almost 90% of the total gag catch in Florida during 2007 (4,246,561 pounds) was landed on Florida's Gulf coast (FWC-FWRI 2008).

Gag were collected with all three gear types (*Table 4*, *Table 7*, and *Table 9*) but only met the abundance and frequency of occurrence thresholds (≥40 animals and ≥15% occurrence) for the 183-m seine collections. Gag in 183-m seines were only collected when the net sampled at least some seagrass, were only present during June through August, and were not collected from Palma Sola or Roberts bays (*Figure 12*). Gag exhibited a bimodal length-frequency distribution with modes at 206 and 340 mm SL (*Figure 12*), possibly representing young-of-the-year and one-year old fish, respectively.

Mycteroperca microlepis (gag)
183-m seine

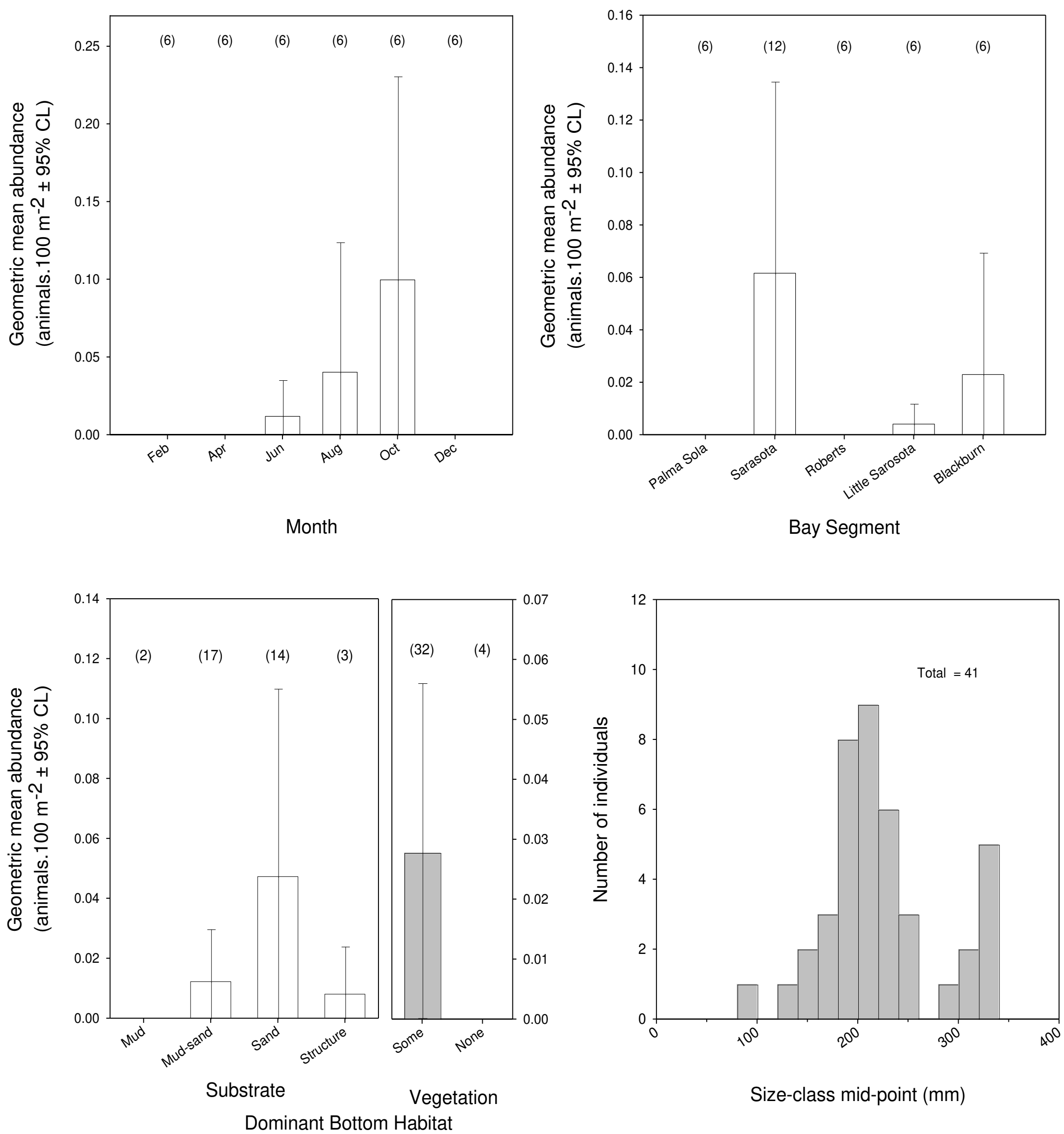

Figure 12. Relative abundance and length-frequency distribution of gag collected with 183-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Gray snapper, *Lutjanus griseus*

Gray snapper are a reef species that can be found along the western Atlantic from Massachusetts south to Rio de Janeiro, Brazil. Adults spawn during summer (June–September) near areas of bottom structure in offshore waters (Stark 1971; Domeier et al. 1997). Juvenile gray snapper recruit to estuarine areas including seagrass beds and mangrove shorelines (Nagelkerken et al. 2000; Cocheret de la Moriniere et al. 2002; Serafy et al. 2003; Whaley et al. 2007; Faunce and Serafy 2008) where they typically spend the first year or two of their lives. Juvenile gray snapper feed primarily on penaeid shrimp and crabs (Rutherford et al.1989) and adults feed on fish, shrimp, and crabs. (Harrigan et al. 1989; Hettler 1989). Gray snapper are an economically important species with Florida landings totaling 2,230,737 pounds in 2007 (FWC-FWRI 2008).

Gray snapper were collected in all three gear types deployed in the Sarasota Bay estuary, but were more frequently encountered with the 21.3-m (18.0%; *Table 4*) and 183-m (38.9%; *Table 7*) seines than with the 6.1-m trawl (10.4%; *Table 9*). The 21.3-m seine collected smaller gray snapper (mean of 41 mm SL) than did the 183-m seine (179 mm SL), but abundance trends between the two gears were similar (*Figure 13* and *Figure 14*, respectively). With both seines, gray snapper were absent from collections made in February and were most abundant in October, were least abundant or absent from Palma Sola Bay, and were more abundant in collections that sampled some bottom vegetation.

Lutjanus griseus (gray snapper)
21.3-m seine

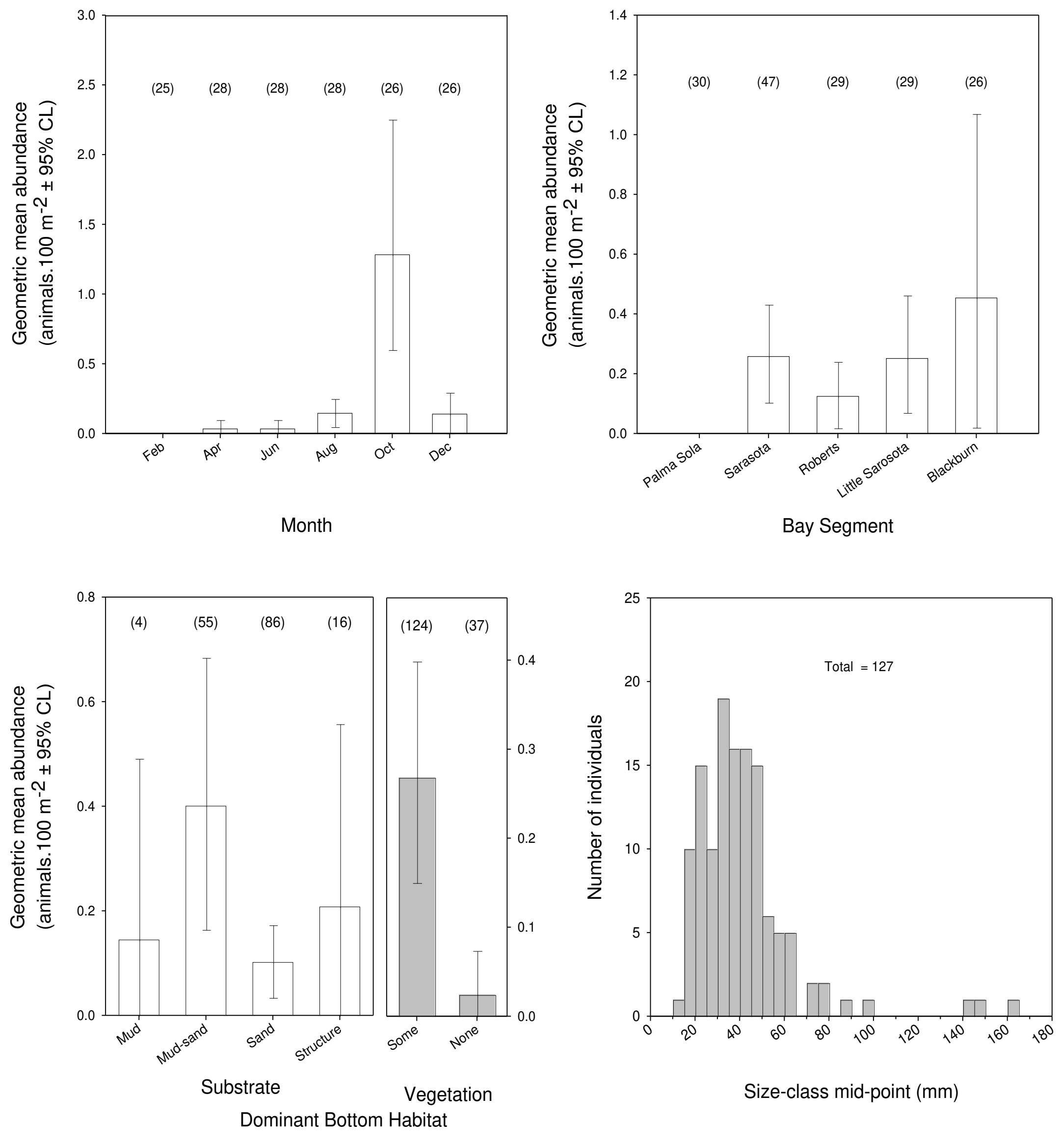

Figure 13. Relative abundance and length-frequency distribution of gray snapper collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Lutjanus griseus (gray snapper)
183-m seine

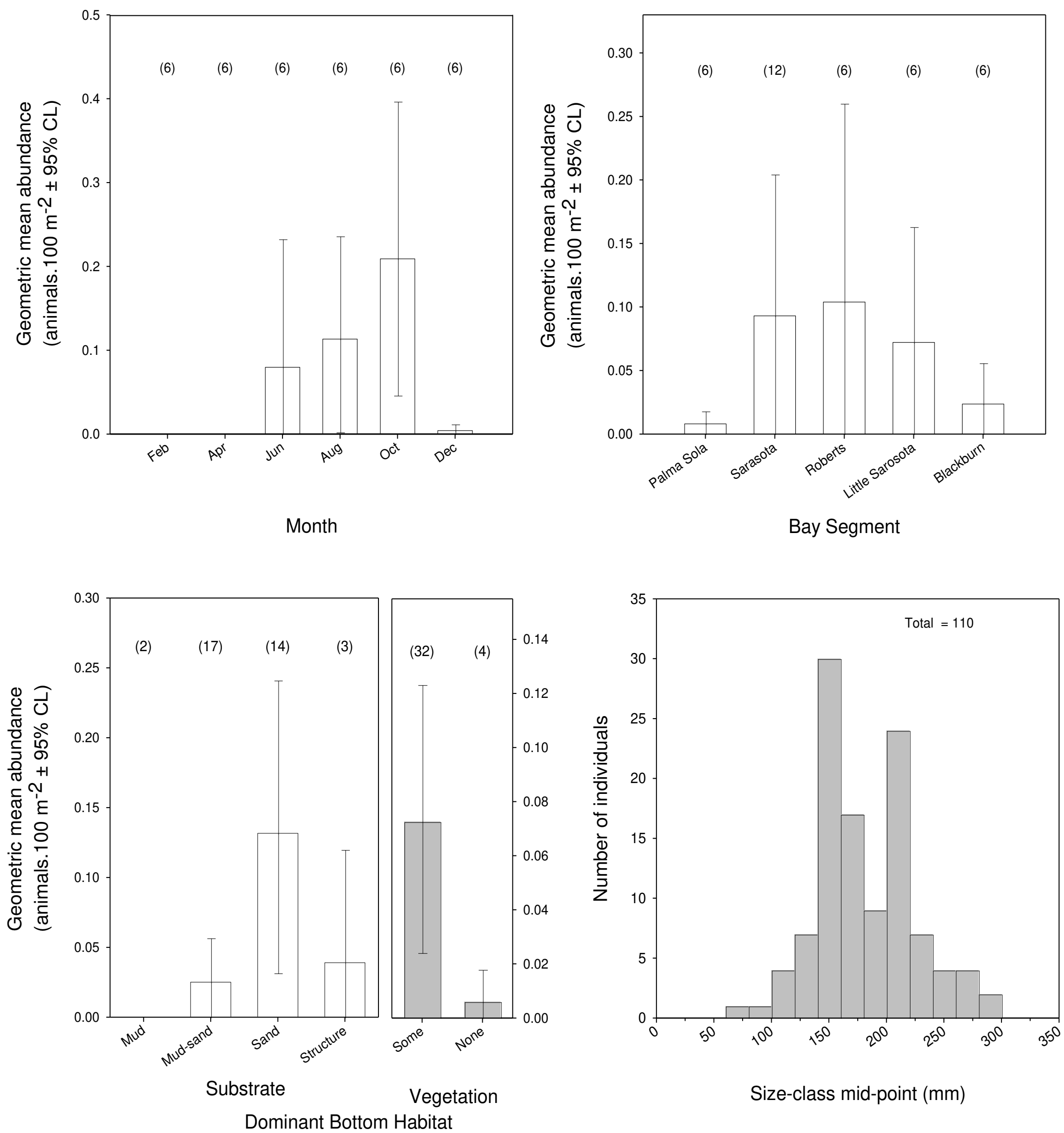

Figure 14. Relative abundance and length-frequency distribution of gray snapper collected with 183-m seines in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Pinfish, *Lagodon rhomboides*

Pinfish range from Cape Cod to the Yucatan Peninsula, including Bermuda and northern Cuba. They are most abundant from Cape Hatteras through the northern Gulf of Mexico (Pattillo et al. 1997; Carpenter, 2002). Florida's pinfish landings in 2007 were 2,022,492 pound with 96% of the total being landed by recreational fisherman and 83% coming from the gulf coast (FWRI-FWC 2008). Their great abundance in estuaries and their trophic habits have led some to suggest that they play an even more important role in structuring epibenthic communities (Pattillo et al. 1997) than they do in the fishery. Spawning occurs offshore, and larvae use selective tidal stream transport to travel to nursery areas (Pattillo et al. 1997; Forward et al. 1998). Pinfish have been recorded in salinities ranging from 0 to >40 ppt, but may avoid the lower end of this range (Pattillo et al. 1997).

Pinfish were one of the two most abundant taxa collected in each of the three gear types, comprising 21%, 59%, and 21% of the total catch in 21.3-m seines, 183-m seines, and 6.1-m trawls, respectively (*Table 3*, *Table 6*, and *Table 8*, respectively). Pinfish were also one of the most commonly collected taxa, occurring in over 80% of the samples collected with 21.3-m seines and 6.1-m trawls and in 100% of the 183-m seine samples. Pinfish collected with 183-m seines tended to be larger (mean 107 mm SL, range 43 to 213 mm) than those collected with either the 21.3-m seine (mean 31 mm, range 9 to 180 mm) or the 6.1-m trawl (mean 35 mm, range 10 to 159 mm).

Pinfish were most abundant in the winter and spring (February to June) for both 21.3-m seines and 6.1-m trawl collections (*Figure 15* and *Figure 17*), but there were no obvious seasonal trends to the catches with the 183-m seine (*Figure 16*). Pinfish did not show any strong distributional trends among the five embayments with any of the gear types. Pinfish were more abundant in 21.3-m seine collections that sampled some seagrass (*Figure 15*), whereas pinfish collected with 183-m seines did not show an abundance trend related to bottom vegetation (*Figure 16*).

Lagodon rhomboides (pinfish)
21.3-m seine

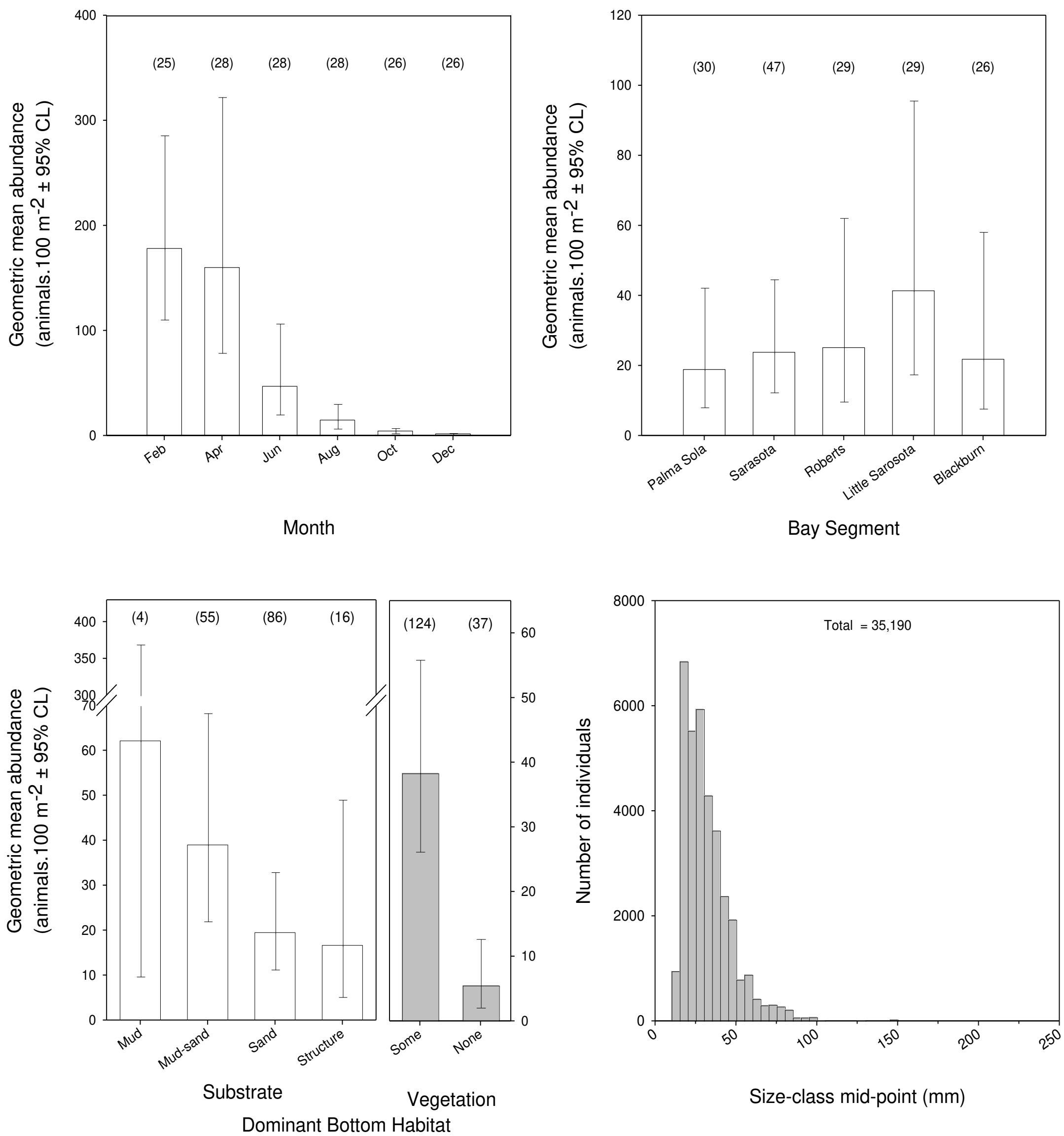

Figure 15. Relative abundance and length-frequency distribution of pinfish collected with 21.3-m seines in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Lagodon rhomboides (pinfish)
183-m seine

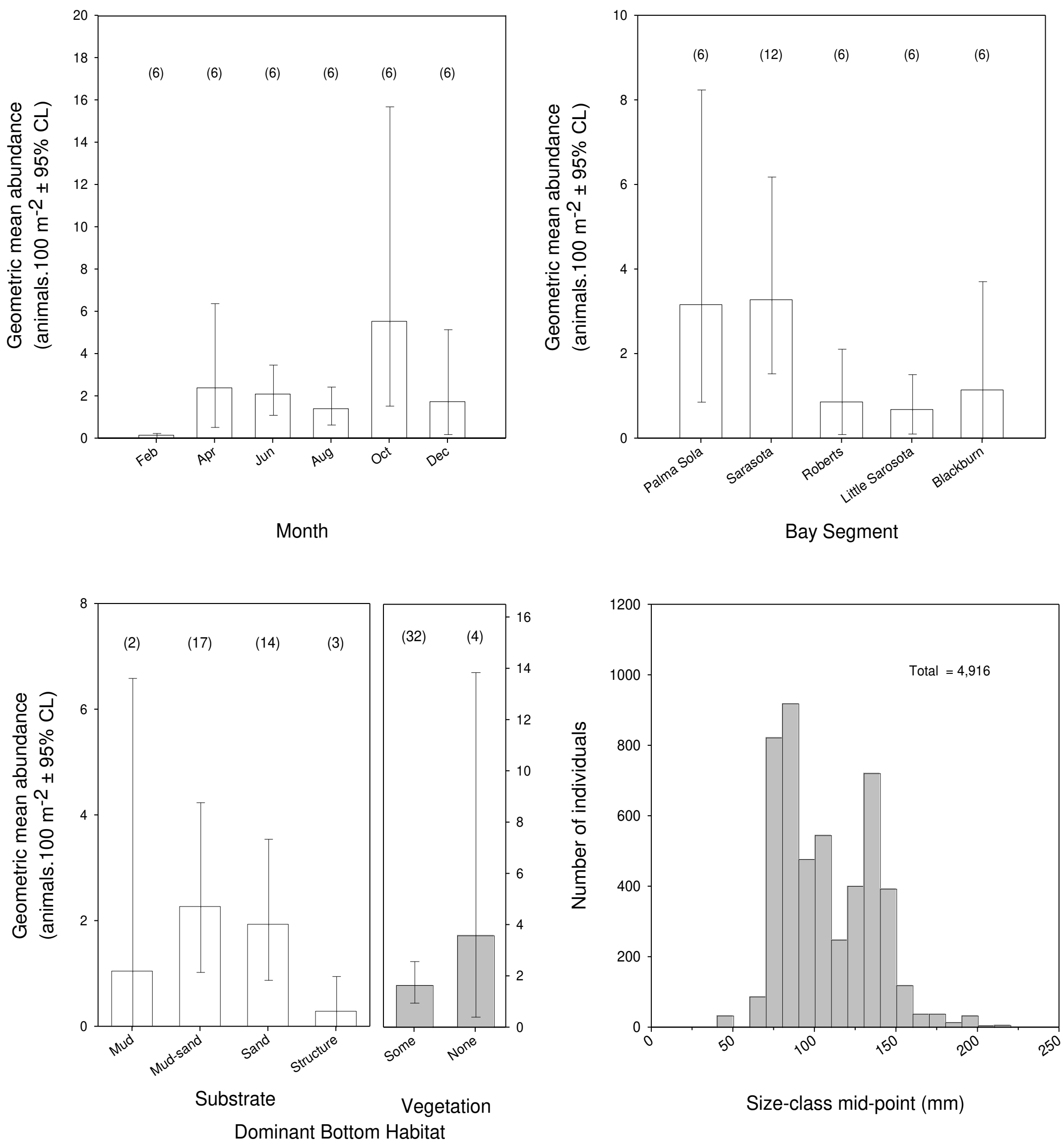

Figure 16. Relative abundance and length-frequency distribution of pinfish collected with 183-m seines in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Lagodon rhomboides (pinfish)
6.1-m trawl

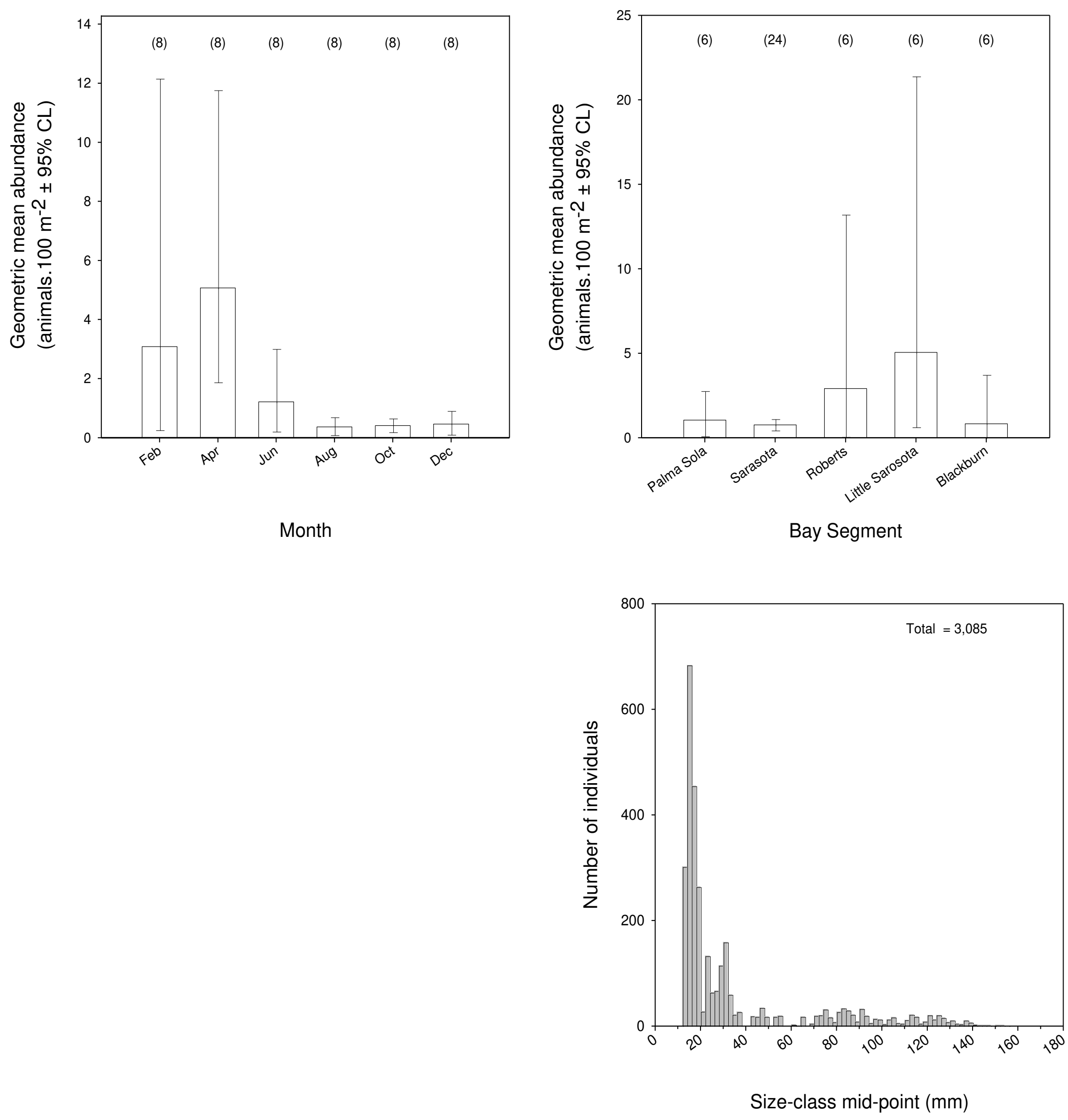

Figure 17. Relative abundance and length-frequency distribution of pinfish collected with 6.1-m trawls in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Sheepshead, *Archosargus probatocephalus*

Sheepshead, *Archosargus probatocephalus*, is common in coastal estuarine and inner- to mid-shelf waters from Cape Cod to Brazil (Jennings 1985). Larval sheepshead are pelagic and metamorphose into juveniles at about 8mm (Parsons and Peters 1989; Tucker and Alshuth 1997). Juvenile sheepshead are most abundant in grass flats and over mud bottoms (Springer and Woodburn 1960, Odum and Heald 1972, Jennings 1985). In late summer, juvenile sheepshead begin to congregate with adults around stone jetties, breakwaters, piers, wrecks, and bulkheads (Jennings 1985). Recreational and commercial fishermen commonly harvest sheepshead, with the recreational fishery accounting for almost 90% of the total pounds landed in recent years (Munyandorero et al. 2006).

Sheepshead were collected in more than 10% of the hauls made with each of the sampling gears (*Table 4*, *Table 7*, and *Table 9*). Sheepshead collected with the 21.3-m seine tended to be smaller (mean 58 mm SL, range 12 to 268) than sheepshead collected in the other two gear types. Abundance of sheepshead collected with 21.3-m seines was higher in April than any other month (*Figure 18*), corresponding to the time when young-of-the-year sheepshead typically recruit into Florida’s estuaries. There were no obvious seasonal trends for sheepshead collected with 183-m seines or 6.1-m trawls (*Figure 19* and *Figure 20*). Sheepshead collected with 21.3-m seines were least abundant in Sarasota Bay proper and did not show any trend with respect to bottom vegetation (*Figure 18*). Abundance of sheepshead collected with 183-m seines was highest in Little Sarasota Bay and from collections that sampled at least some bottom vegetation (*Figure 19*).

Archosargus probatocephalus (sheepshead)
21.3-m seine

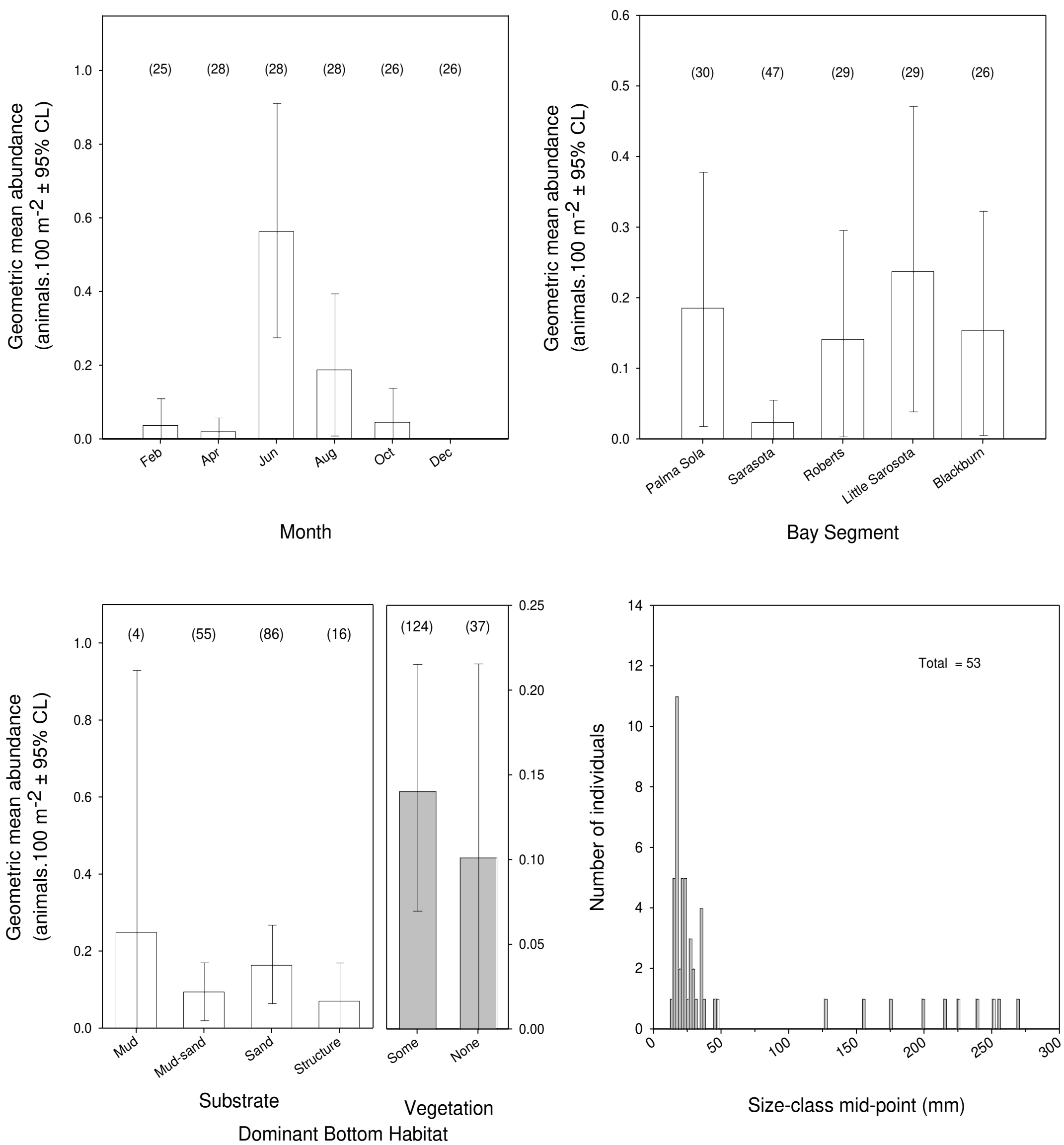

Figure 18. Relative abundance and length-frequency distribution of sheepshead collected with 21.3-m seines in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Archosargus probatocephalus (sheepshead)

183-m seine

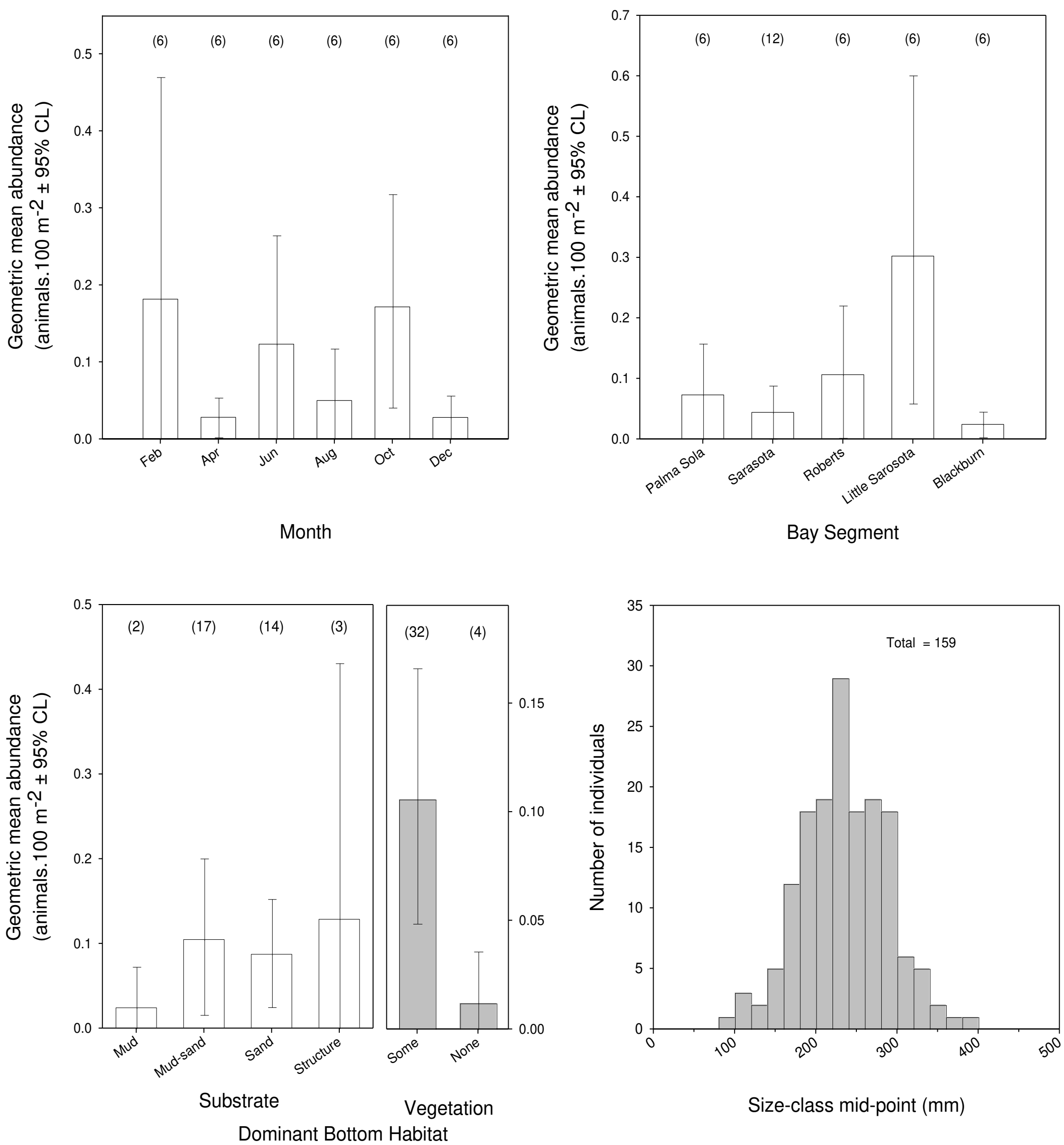

Figure 19. Relative abundance and length-frequency distribution of sheepshead collected with 183-m seines in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Archosargus probatocephalus (sheepshead)
6.1-m trawl

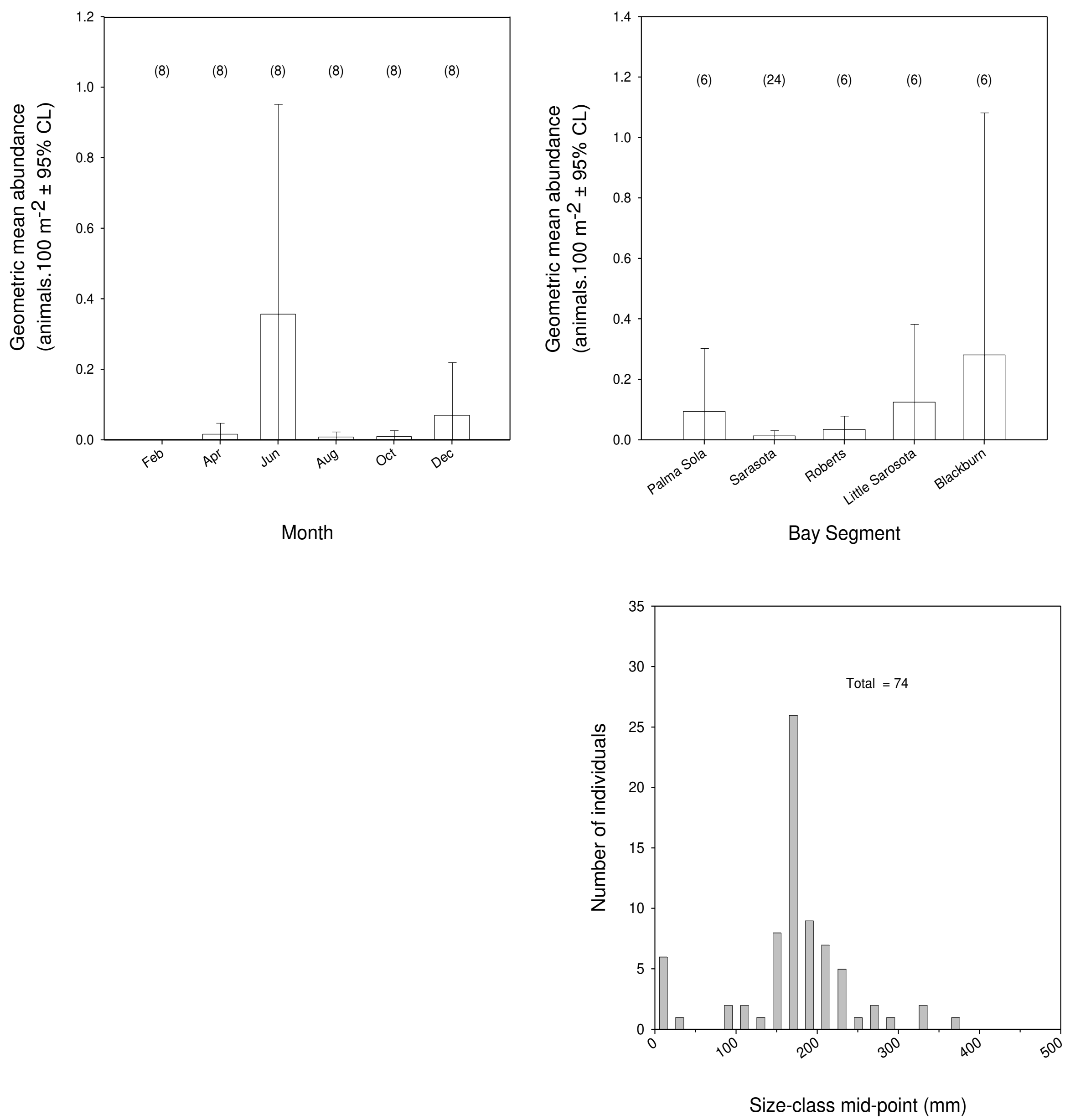

Figure 20. Relative abundance and length-frequency distribution of sheepshead collected with 6.1-m trawl in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Spotted Seatrout, *Cynoscion nebulosus*

Spotted seatrout occur along the U.S. and Mexican east coasts and in the Gulf of Mexico from New York to Laguna Madre (Carpenter 2002). Over much of its range, it is the target of important recreational and commercial fisheries (Bortone 2003). Spawning occurs within estuaries or near passes into estuaries (Brown-Peterson, 2003). Spotted seatrout have been collected at salinities ranging from 0 to 75 ppt, but juveniles may prefer 8-25 ppt, and 20-25 ppt may be the physiological optimum for larger juveniles and adults (Pattillo et al. 1997).

Spotted seatrout were collected with each of the gear types (*Table 4*, *Table 7*, and *Table 9*), but were only abundant (n=128) and frequently collected (19.3% of samples) in the 21.3-m seine hauls. The 21.3-m seine tended to collect relatively small spotted seatrout (≤101 mm SL) which represent young-of-the-year animals (*Table 4*). Abundance was higher during the summer and fall months (June, August, and October; *Figure 21*) than during other months (December, February, and April). They were most abundant in collections that sampled some bottom vegetation and had relatively similar abundance in each of the embayments, except Blackburn Bay.

Cynoscion nebulosus (spotted seatrout)
21.3-m seine

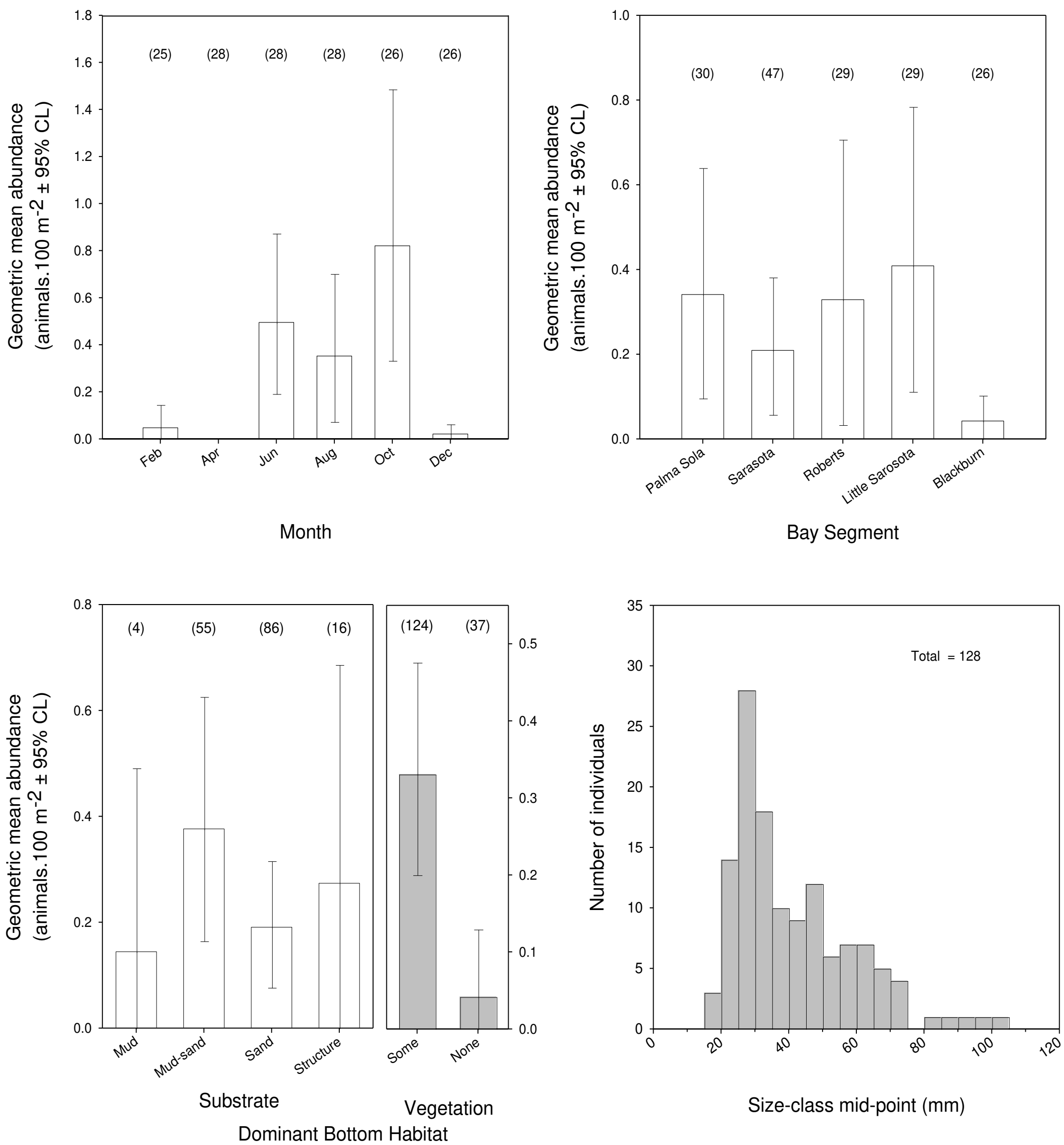

Figure 21. Relative abundance and length-frequency distribution of spotted seatrout collected with 21.3-m seines in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Striped mullet, *Mugil cephalus*

Striped mullet are cosmopolitan and range from Nova Scotia to Argentina in the Western Atlantic (Carpenter, 2002). This species supports large fisheries in many areas, including Florida; state landings were valued at over $5M in 2005, although this was less than half of the value in 1994 (FWRI, unpublished data), the year before the constitutional restriction on entangling nets was initiated. Striped mullet are a major prey item for many larger fishes and birds (Pattillo et al. 1997; Withers and Brooks 2004; Bacheler et al. 2005; Blewett et al. 2006). They spawn on the continental shelf and recruit to estuaries as slender, silvery pelagic juveniles (Pattillo et al. 1997; McDonough and Wenner 2003). Recruiting juveniles are strong swimmers capable of traversing long distances to locate nursery habitats, perhaps aided by olfactory cues (Etnier and Starnes 1993; Peters and Matheson, pers. obs.). Juvenile and adult striped mullet exhibit a broad range of salinity tolerance and can be extremely abundant in tidal rivers (Pattillo et al. 1997; Paperno and Brodie 2004; Idelberger and Greenwood 2005). Adults sometimes move hundreds of miles inland in major river systems such as the Mississippi, but juveniles are most common at salinities higher than freshwater (Etnier and Starnes 1993; Boschung and Mayden 2004).

Striped mullet were not collected with 6.1-m trawls (*Appendix C*), but were relatively abundant and frequently collected with 21.3-m seines (*Table 4*) and 183-m seines (*Table 7*). Striped mullet collected with 21.3-m seines represented young-of-the-year animals that had just recruited into the estuary (mean of 24 mm SL, range 16 to 32 mm; *Figure 22*). Peak abundance for striped mullet collected with 21.3-m seines occurred in February and April, months during which young-of-the-year striped mullet typically recruit into Florida's estuaries (*Figure 22*). There were no obvious abundance seasonal, geographical, or habitat trends for striped mullet collected with 183-m seines (*Figure 23*).

Mugil cephalus (striped mullet)
21.3-m seine

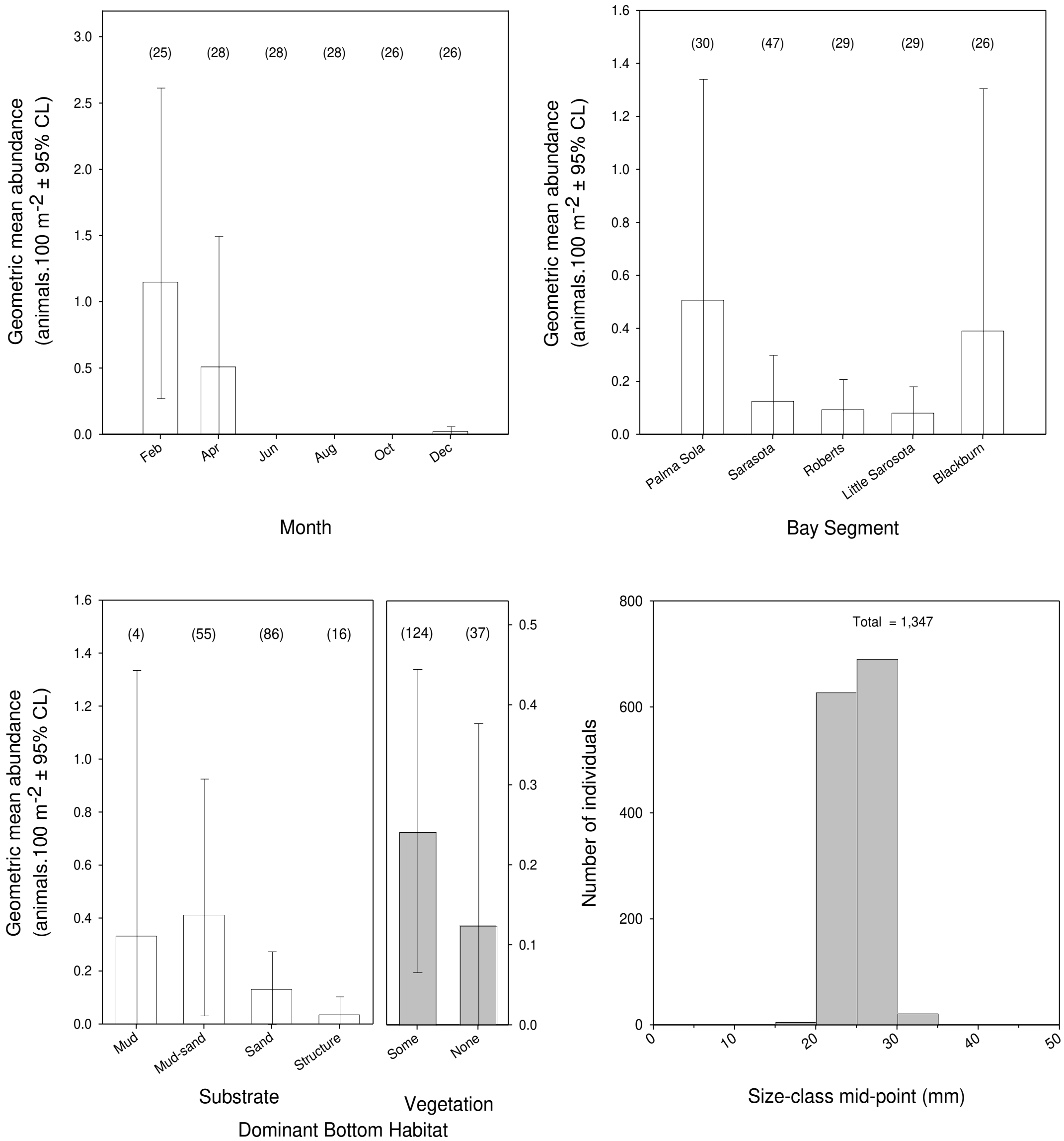

Figure 22. Relative abundance and length-frequency distribution of striped mullet collected with 21.3-m seines in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

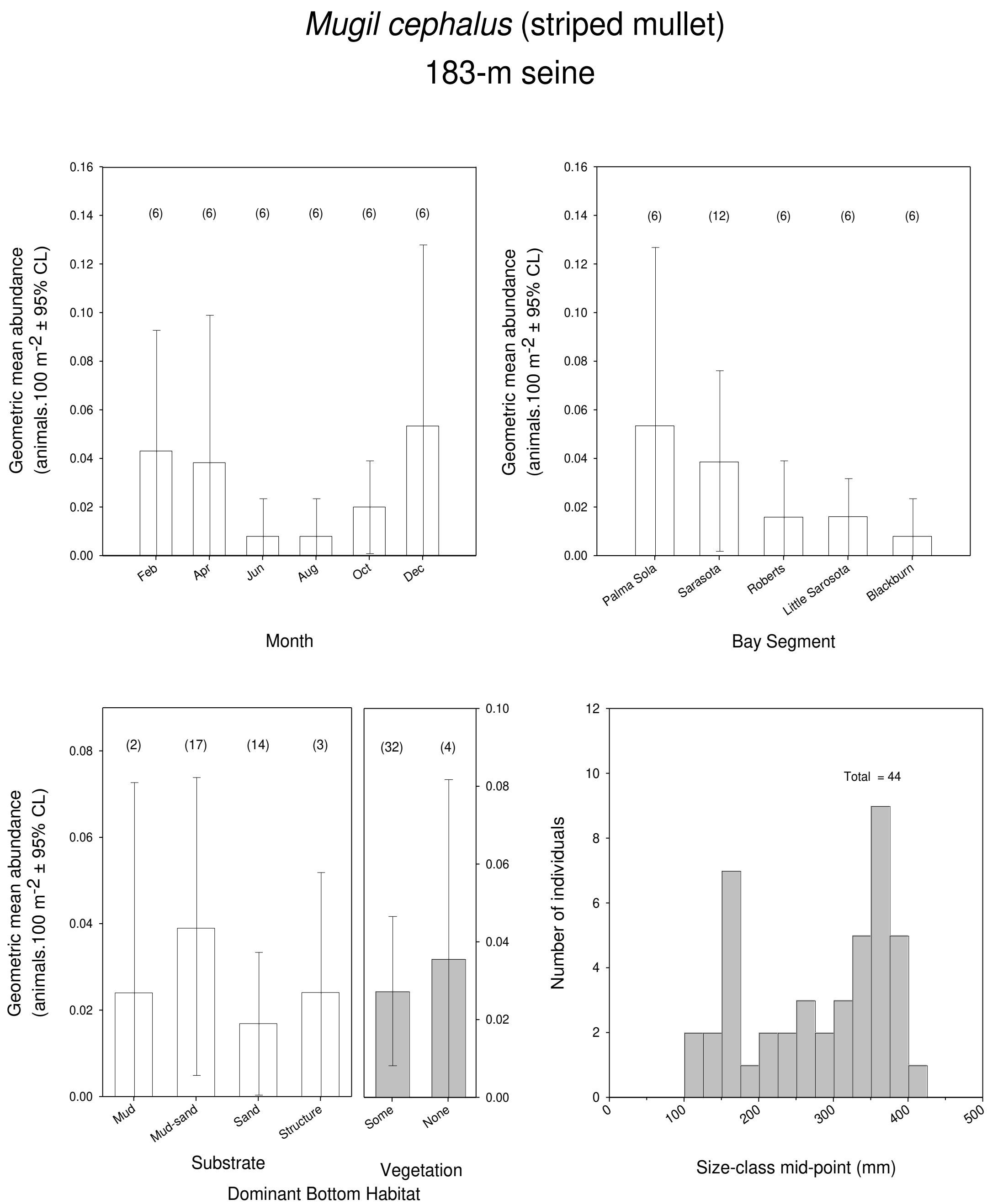

Figure 23. Relative abundance and length-frequency distribution of striped mullet collected with 183-m seines in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Nekton Community Structure

Intrabay Comparison

The non-metric multi-dimensional scaling (MDS) plots show no differences in nekton community structure between the five embayments that comprise the polyhaline portion of the Sarasota Bay estuary for the nekton assemblages sampled with the 183-m seine or 6.1-m trawl (*Figure 24*). Differences, however, were apparent between embayments for the nekton community sampled with the 21.3-m seine. Blackburn and Roberts bays, the two smallest embayments sampled, were similar to each other, but were different from the two larger embayments (Sarasota and Little Sarasota bays). The nekton community of Palma Sola Bay was distinct from the nekton assemblages of both the "small" and "large" embayments.

Similarity percentage analyses (SIMPER) indicated that mean abundance was greater in "small" relative to "large" embayments for six taxa (*Eucinostomus* spp., *Leiostomus xanthurus*, *Eucinostomus gula*, *Menidia* spp, *Harengulus jaguana*, and *Eucinostomus harengulus*; *Figure 25*). The remaining six taxa that distinguished "large" and "small" embayments either had similar abundance in both (*Lagodon rhomboides*), or greater abundance in the "large" bays (*Anchoa mitchilli*, *Orthopristis chrysoptera*, *Lucania parva*, and *Bairdiella chrysoura*). Ten of the top twelve taxa that distinguished "small" embayments from Palma Sola Bay had greater abundance in the "small" embayments (*Figure 25*). Eight of the twelve top taxa (*L. rhomboides*, *Eucinostomus* spp., *A. mitchilli*, *E. gula*, *F. duorarum*, *H. jaguana*, and *B. chrysoura*; *Figure 25*) that differentiated them "large" embayments from Palma Sola Bay were more abundant in the "large" embayments.

Palma Sola Bay has been identified by the Sarasota Bay Estuary Program and the Florida Department of Environmental Protection as not meeting Florida's standards for water quality due to high bacteria and chlorophyll concentrations (SBEP 2006). The multivariate community analyses separated Palma Sola Bay from the other embayments. Most taxa had lower abundance in Palma Sola Bay than in the other embayment groupings. Rainwater killifish, however, were 3.1 and 5.7 times more abundant in Palma Sola Bay than in the "small" and "large" bay groupings, respectively. Rainwater killifish have been described as pollution tolerant (Patrick and Palavage 1994) but are also a species that has highest abundance in aquatic vegetation regardless of salinity (Able and Fahay 1998). Any relationship between water quality standards and nekton community structure for Palma Sola Bay would require a more directed and coordinated collection of both water quality parameters and nekton.

There was considerable variability in the mean abundance of nekton sampled with each of the gear types (*Figure 26*). Significant differences in abundance (Analysis of Variance, Tukey post hoc test) were identified for nekton sampled with the 21.3-m seine ($P<0.01$, n=161, $df=4$, Model SS=42.995, Error SS=433.246) and the 6.1-m trawl ($P<0.01$, n=48, $df=4$, Model SS=21.848, Error SS=56.818). Nekton abundance for the 21.3-m seine was significantly higher in Little Sarasota Bay than in Palma Sola and Sarasota bays. For nekton collected with 6.1-m trawls, abundance was significantly higher in Roberts and Little Sarasota bays than in Sarasota Bay proper.

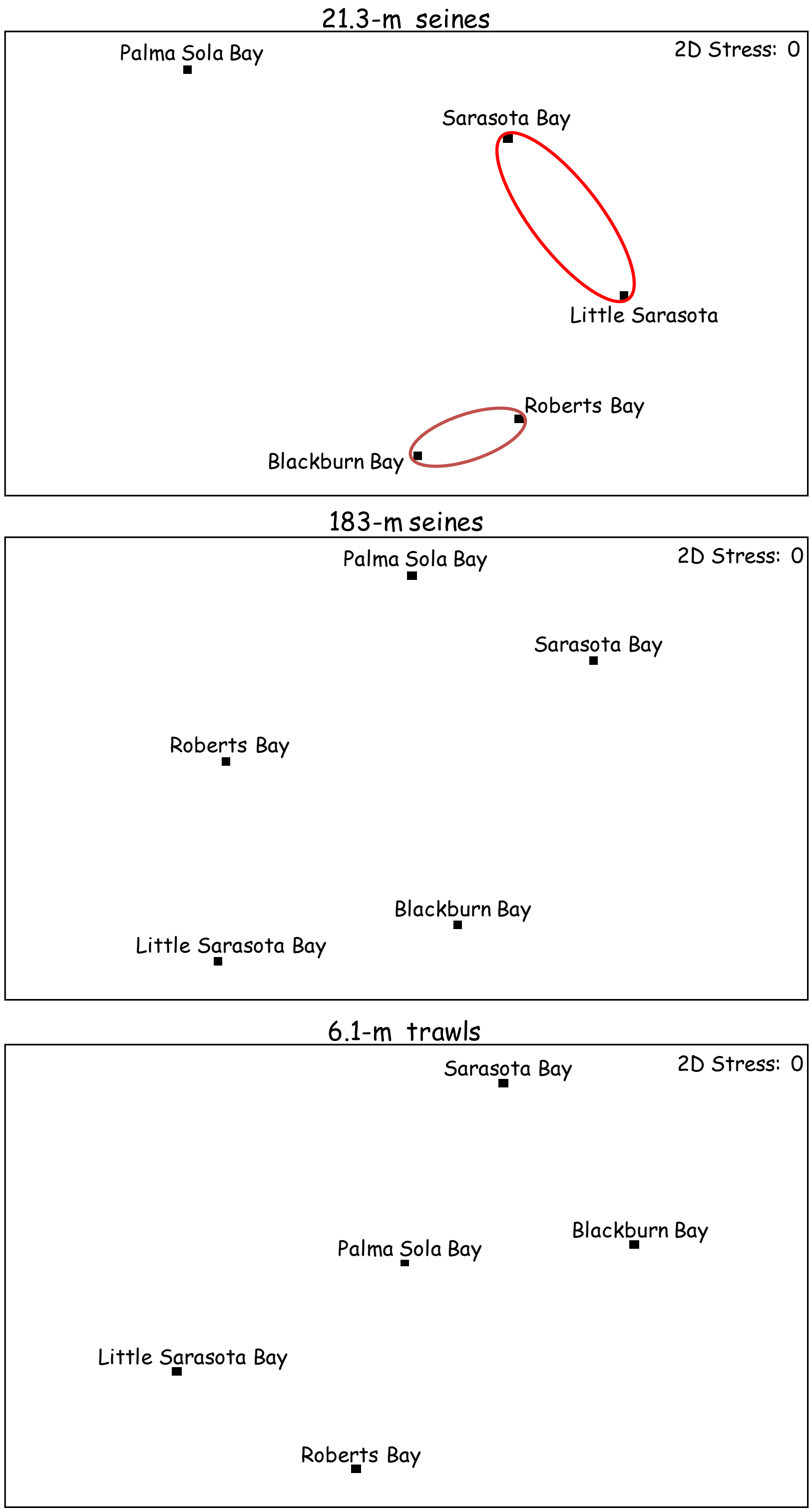

Figure 24. Non-metric Multidimensional Scaling (MDS) ordination plot of nekton community structure collected in five embayments within the Sarasota Bay estuary during bi-monthly Fisheries-Independent sampling (June 2009-April 2010). Ellipses in the 21.3.-m seine plot denote groups determined using Bray-Curtis similarity percentages of 75 from hierarchical agglomerative cluster analysis. No groupings could be discerned in the 183-m seine and 6.1-m trawl data.

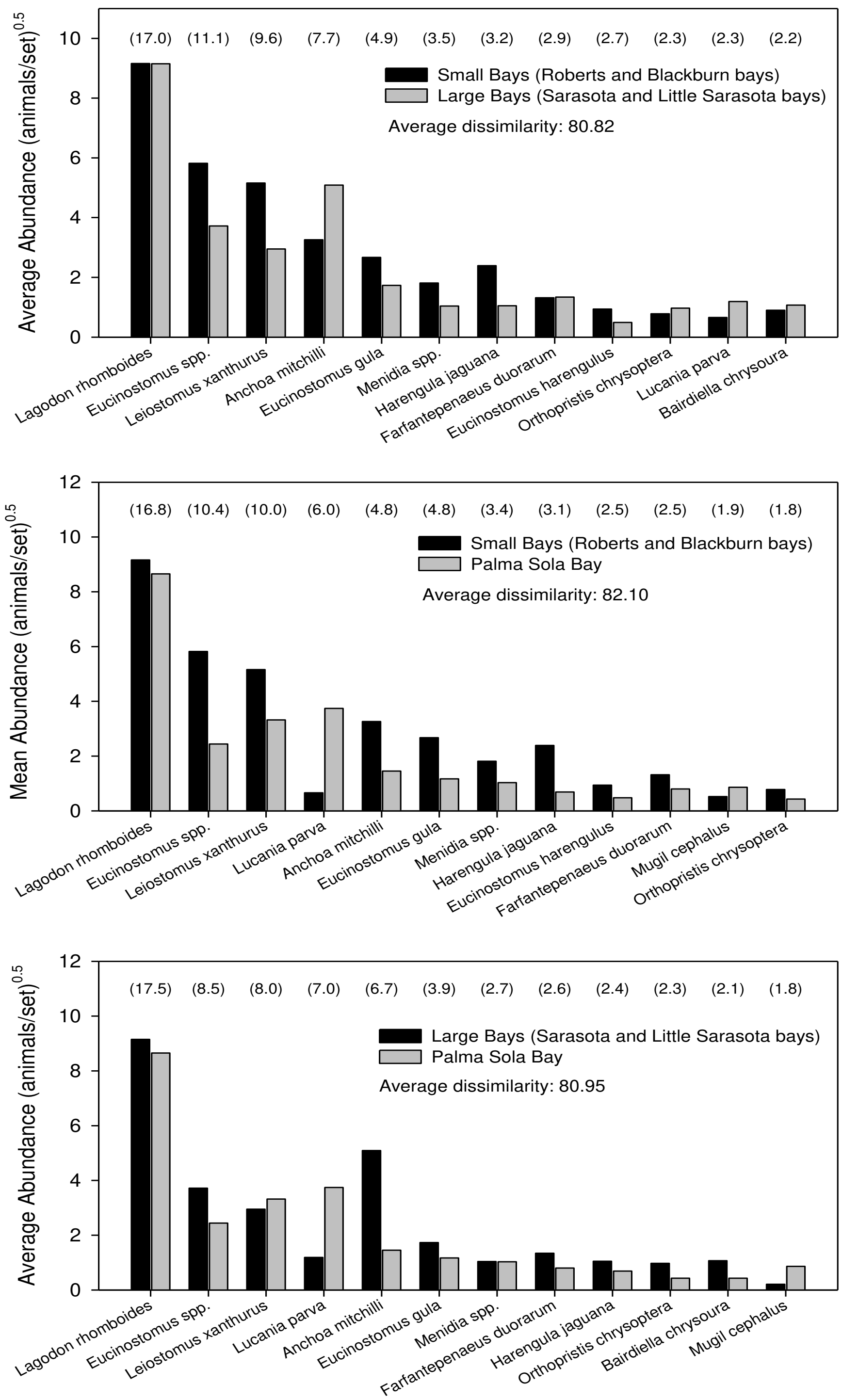

Figure 25. Similarity percentage (SIMIPER) analysis mean abundance for the top twelve taxa collected with 21.3-m seines that distinguished embayment groupings depicted in the MDS ordination. Average dissimilarity between groupings is listed in each plot. The percent contribution of each species to the total average dissimilarity is shown in parentheses above each species grouping.

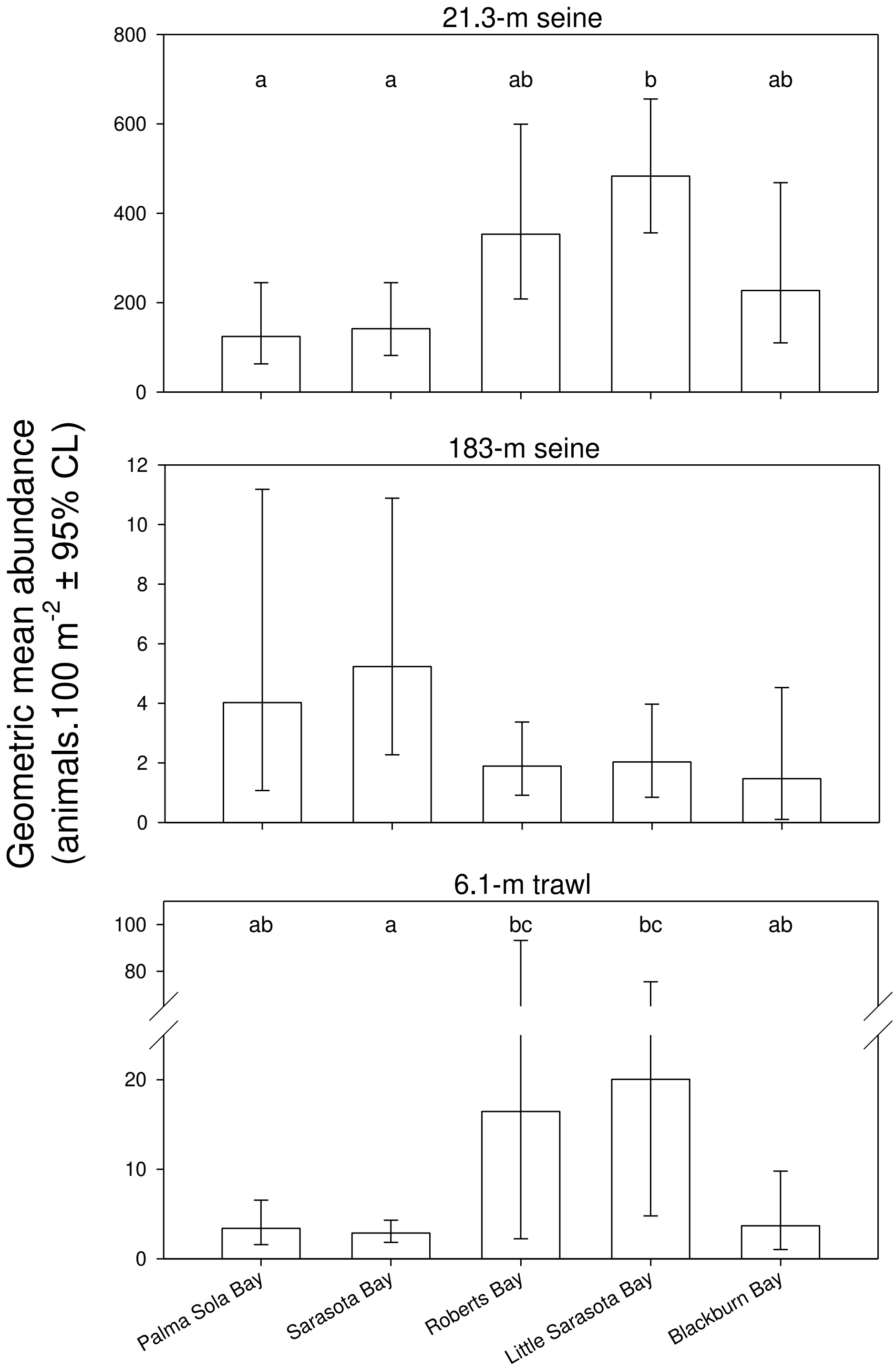

Figure 26. Mean abundance for nekton collected with 21.3-m seines for each of the five embayments of the Sarasota Bay estuary. Letters above bars in 21.3-m seine and 6.1-m trawl plot represent significant differences (ANOVA, *P*<0.001, Tukey post hoc test, c>b>a); significant differences (*P*<0.05) were not found for 183-m seines.

Bay morphology (“small” vs. “large”) appears to play a role in the nekton community structure that was sampled with 21.3-m seines (*Figure 24*), but other factors such as water quality, connectivity to the Gulf of Mexico, salinity, freshwater inflow and urbanization might also play a roll. Neither of the two “small” embayments (Roberts and Blackburn bays) has a direct connection to the Gulf of Mexico and, therefore, each depends on passes to the north and south for tidal flushing. Both of the “small” embayments have been identified as areas of concern due to chlorophyll concentrations (SBEP 2006). Unlike Palma Sola Bay, which did not meet water quality standards for bacteria and chlorophyll (SBEP 2006), nekton abundance in the “small” bay group was relatively high. Additional nekton data, inclusion of other environmental factors in the analysis, and comparison with adjacent estuaries (Tampa Bay, Lemon Bay, and Charlotte Harbor) should improve the understanding of the differences in community structure between “small” and “large” embayments.

Temporal differences in nekton community structure where not apparent, with the MDS plots showing a wide scatter of samples with no discernable pattern. The MDS plot for 21.3-m seines, the gear type with the largest number of collections, provided the best result but no obvious trends or groupings (*Figure 27*). The lack of patterns in these data is likely the result of small sample sizes within each embayment–month grouping, bi-monthly sampling, and an atypical weather pattern during the one year study period.

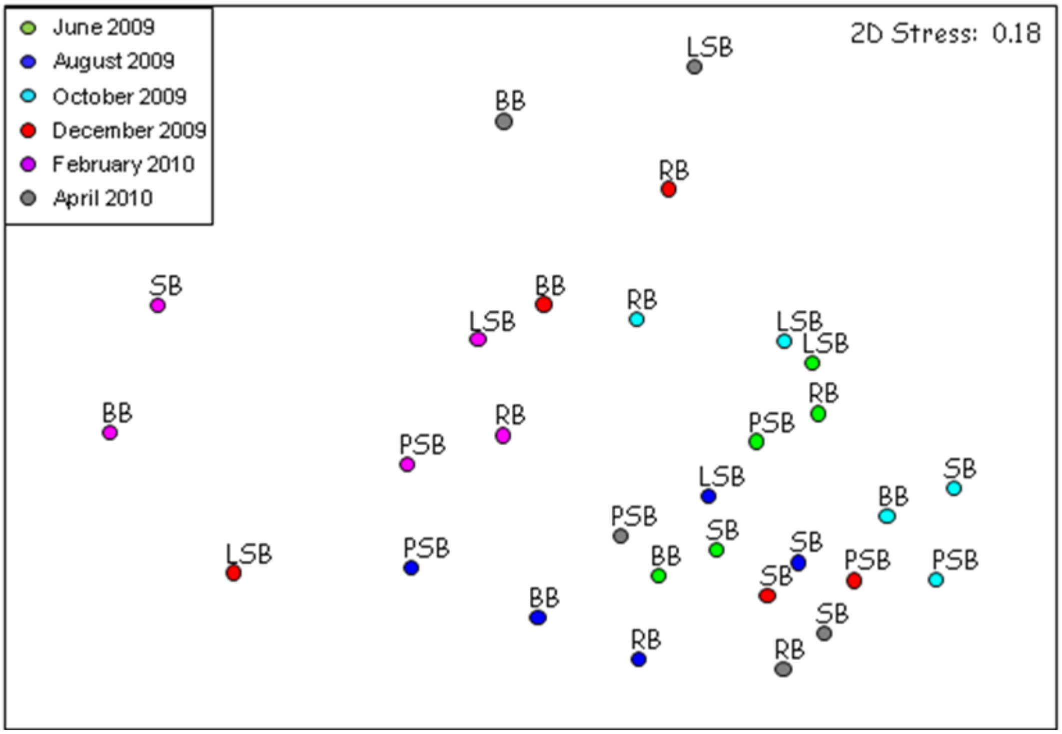

Figure 27. Non-metric Multidimensional Scaling (MDS) ordination plot of bi-monthly nekton community structure sampled with 21.3-m seines in five embayments within the Sarasota Bay estuary. PSB=Palma Sola Bay, SB=Sarasota Bay, RB=Roberts Bay, LSB=Little Sarasota bay, and BB=Blackburn Bay.

Interbay Comparison

Analysis of community structure in Tampa Bay, Sarasota Bay, Lemon Bay, and Charlotte Harbor initially included geographic strata that subdivided the polyhaline sections of Tampa Bay into lower North and lower South, and Charlotte Harbor into Gasparilla Sound and Pine Island Sound (*Figure 2*). The MDS plots from these analyses indicated that the Tampa Bay and Charlotte Harbor geographic strata were more like each other, plotting in the upper half of the MDS plot, and different from the smaller, Lemon and Sarasota bays (e.g., *Figure 28*). To better compare larger, open water estuaries with smaller, narrow estuaries, the geographic strata for Tampa Bay and Charlotte Harbor were dropped from subsequent analyses and these two systems were analyzed as Lower Tampa Bay and Lower Charlotte Harbor.

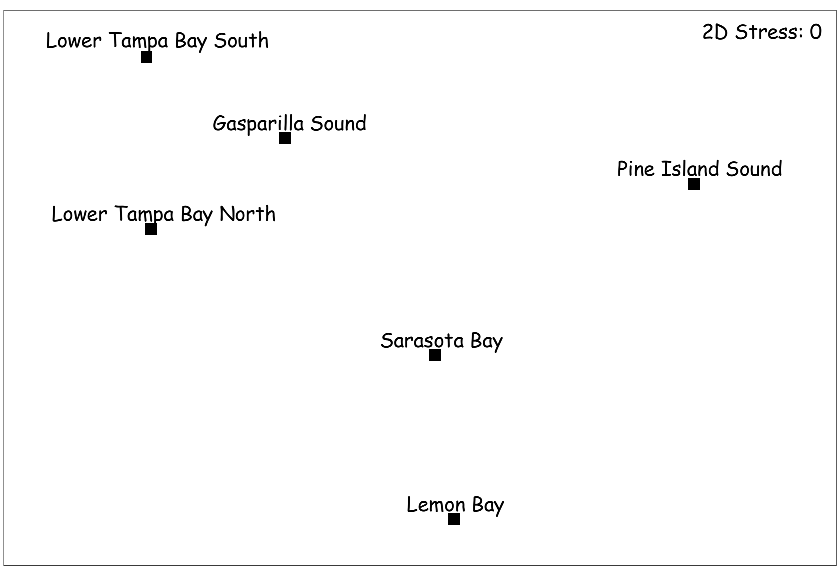

Figure 28. Non-metric Multidimensional Scaling (MDS) ordination plot of nekton community structure sampled with 21.3-m seines in the polyhaline portions of Sarasota Bay, Lemon Bay, Tampa Bay (Lower North and South) and Charlotte Harbor (Gasparilla and Pine Island sounds). Subsequent analyses combined Lower Tampa Bay North and South into Lower Tampa Bay and Gasparilla and Pine Island sounds into Lower Charlotte Harbor.

Physiochemical parameters were very similar between the four estuaries during each bi-monthly sampling event (*Figure 29*). The largest difference in water temperature between the four estuaries was in April 2010, during which Lemon Bay was about 3◦C cooler than the warmest estuary (Charlotte Harbor). Tampa Bay had a tendency to have slightly lower mean salinity (~3 ppt) during each bi-monthly sampling event, most likely because of the influence of the Manatee River which discharges directly into Lower Tampa Bay South. Each estuary, however, followed the same general trend with mean salinity highest in June 2009 and lowest in April 2010. Dissolved oxygen also followed the same general trend regardless of estuary; lowest values were recorded in August 2009 with higher values between December 2009 and April 2010.

Nekton community structure was very similar between the four estuarine systems analyzed; Bray-Curtis similarity percentages ranged from 67 to 76% for each of the gear types. There was, however, a tendency for the two small estuaries (Lemon and Sarasota bays) to group separately (79 to 85% Bray-Curtis similarity percentages) from the polyhaline portions of the two large estuaries (Tampa Bay and Charlotte Harbor; 78 to 79% Bray-Curtis similarities) (*Figure 30*) for each of the gear types.

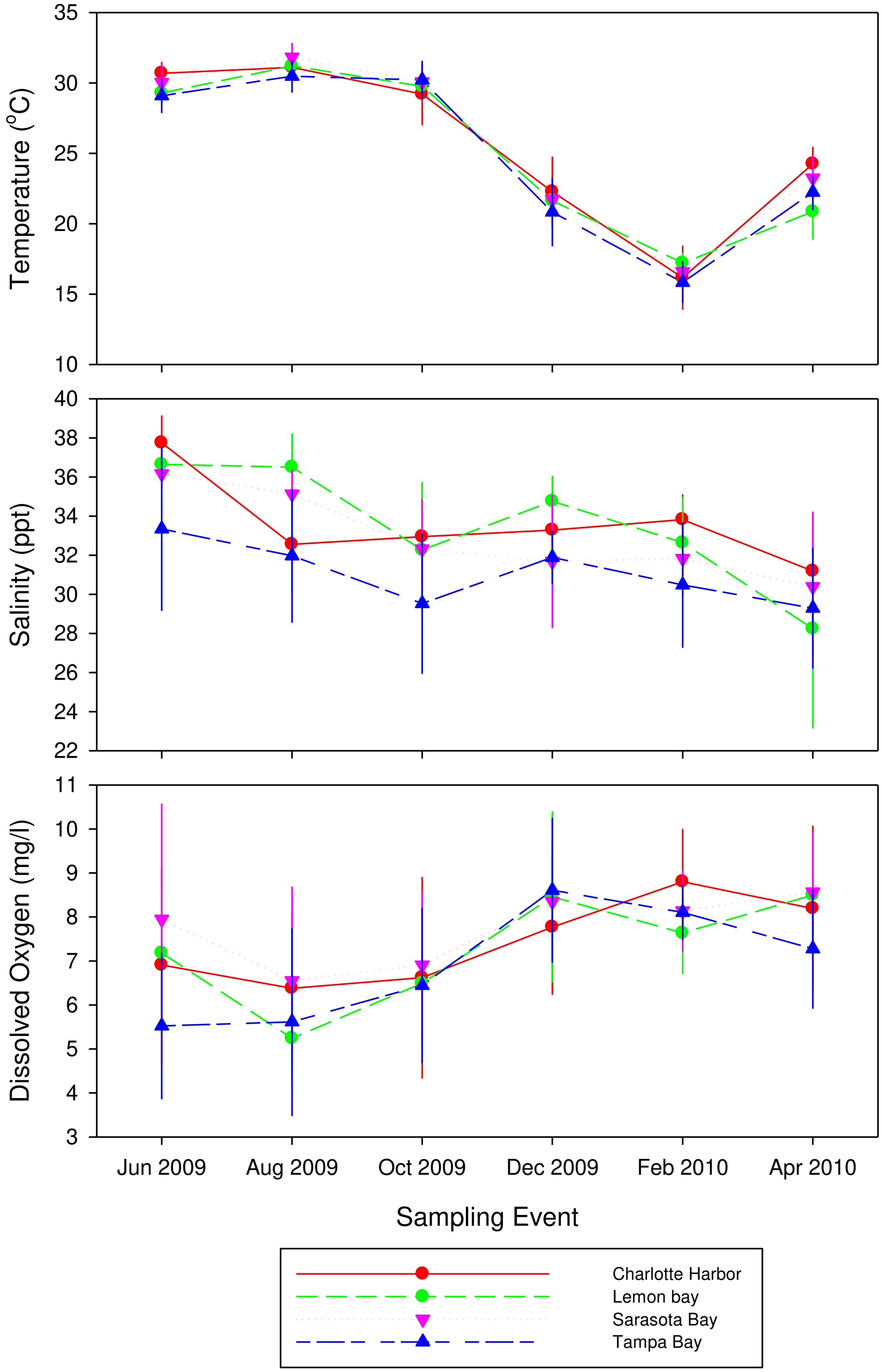

Figure 29. Mean (±standard deviation) water temperature, salinity, and dissolved oxygen (water column average) for the polyhaline portions of four estuaries along the southwest coast of Florida.

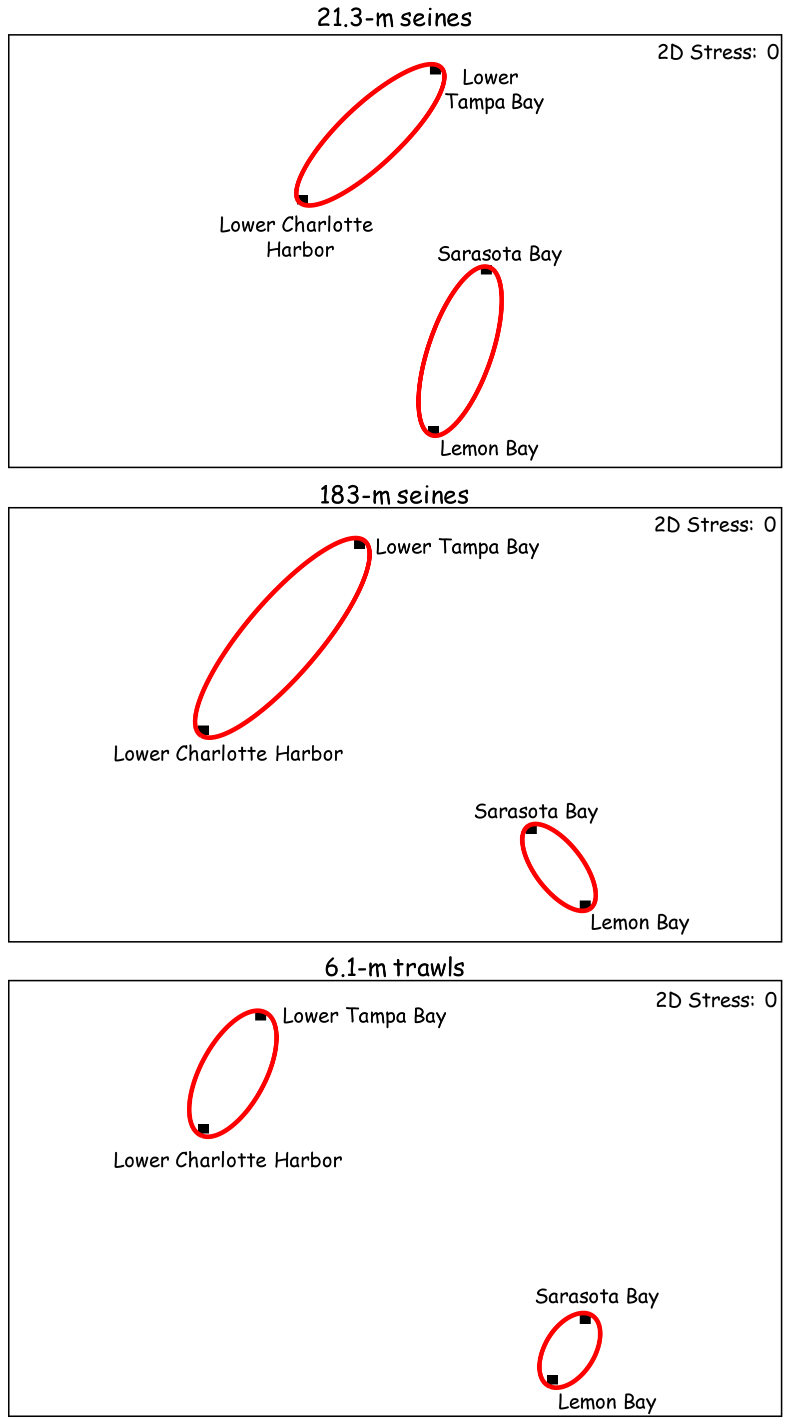

Figure 30. Non-metric Multidimensional Scaling (MDS) ordination plot of nekton community structure in the polyhaline portions of four estuaries located on Florida's southwest coast between Tampa Bay and Charlotte Harbor. Nekton sample in each estuary were collected by the Fisheries-Independent program using standardized procedures between June 2009 and – April 2010. Ellipses denote groups determined using Bray-Curtis similarity percentages of 68 to 75 from hierarchical agglomerative cluster analysis.

Similarity percentage analyses (SIMPER) showed that mean abundance was higher in “small” estuaries (Sarasota and Lemon bays) than in the polyhaline portions of the “large” estuaries (Tampa Bay and Charlotte Harbor) for most of the taxa that distinguished the two groups for each of the gear deployment methods (*Figure 31*). Eleven of the twelve distinguishing taxa for 21.3-m seines were more abundant in “small” estuaries than in “large”. The bay anchovy, which accounted for 6.9% of the dissimilarity between the two groupings in the 21.3-m seine, was over four times more abundant in “small” estuaries. In the deeper waters sampled by trawls, almost half of the top twelve distinguishing taxa were of recreational or commercial importance (*Menippe* spp., *L. xanthurus*, *C. sapidus*, *Lutjanus synagris*, and *F. duorarum*) (*Figure 31*). Seven of the top twelve distinguishing taxa collected in trawls were more abundant in “small” estuaries than in “large” (*L. rhomboides*, *E. gula*, *Menippe* spp., *Eucinostomus* spp., *L. xanthurus*, *C. sapidus*, and *F. duorarum*). Similarly, the majority of the distinguishing species collected with 183-m seines had higher abundance in “small” rather than “large” estuaries (*E. gula*, *B. chrysoura*, *O. chrysoptera*, *A. probatocephalus*, *C. undecimalis*, *A. felis*, *L. griseus*, and *E. saurus*)(*Figure 31*).

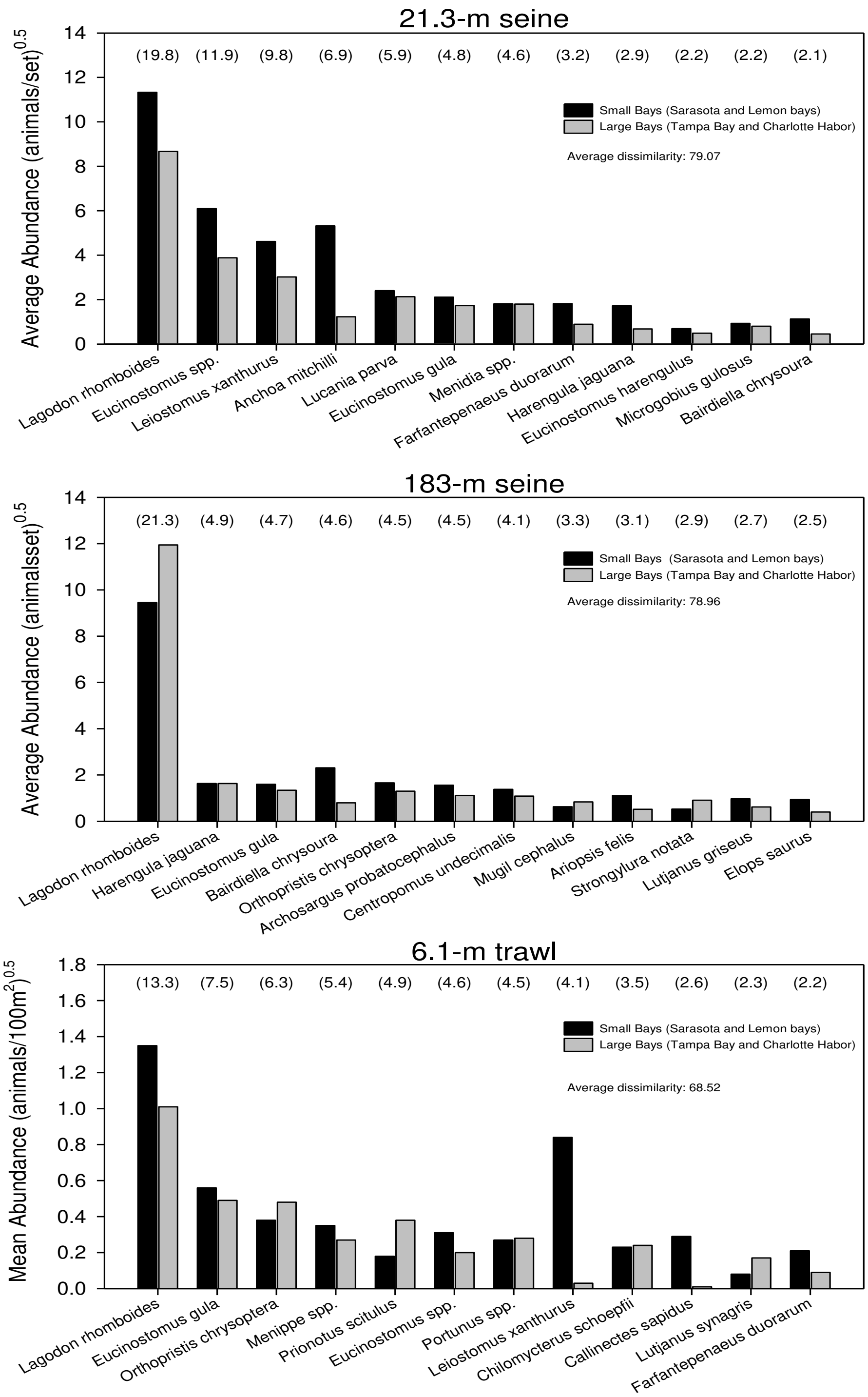

Figure 31, Similarity percentage (SIMIPER) analysis mean abundance for the top twelve taxa collected by gear deployment type that distinguished estuary groupings depicted in the MDS ordination (*Figure 30*). Average dissimilarity between groupings is listed in each plot. The percent contribution of each species to the total average dissimilarity is shown in parentheses above each species grouping.

The grouping of nekton communities by estuary morphology (“small” and “large”) in the interbay analysis is similar to the groupings identified in the analysis of the five Sarasota Bay embayments (intrabay). As with the intrabay comparison, overall mean abundance for the interbay comparisons showed considerable variability and overlap (*Figure 32*). Analysis of variance (ANOVA, Tukey post hoc test) identified significant difference in abundance between bays for the nekton community sampled with 21.3-m seines (P<0.001, n=389, df=3, Model SS=56.089, Error SS=1,161.39). The two “small” estuaries (Sarasota and Lemon bays) had higher abundance than the two “large” estuaries (Lower Tampa Bay and Charlotte Harbor) (*Figure 32*). Although the nekton abundance pattern for the 6.1-m trawl was similar to that of the 21.3-m seine (higher abundance in “small” estuaries), the differences between estuaries was not significant (ANOVA, P>0.05, n=168, df=3, Model SS=6.337, Error SS=198.261). There were no obvious abundance trends and no significant differences (ANOVA, P>0.05, n=156, df=3, Model SS=2.349, Error SS=138.210) between bays in the abundance of the larger bodied juvenile and adult nekton collected with 183-m seines.

The MDS plots and abundance trends indicate that the two narrow, polyhaline estuaries (Sarasota and Lemon bays) are more productive than wider, more open estuaries for smaller nekton (juveniles and adult’s with small body size) that predominate in 21.3-m seines and 6.1-m trawl collections. Similarly, the MDS plots for the larger bodied juvenile and adult nekton community sampled with 183-m seines showed that there were differences between “small” and “large” estuaries, but there was no trend in overall abundance. The mechanism behind these observations could be differences in water depths, more stable salinity in the “small” estuaries, ratio of land-water interface to open water, sediment type, quantity and type of submerged aquatic vegetation, or circulation patterns and residence times. Other metrics that could be assessed to determine if this abundance really relates to productivity would be differences in growth rates, mortality, reproduction, and condition. Additionally, comparisons that included the tributaries in each of these estuaries would likely prove informative.

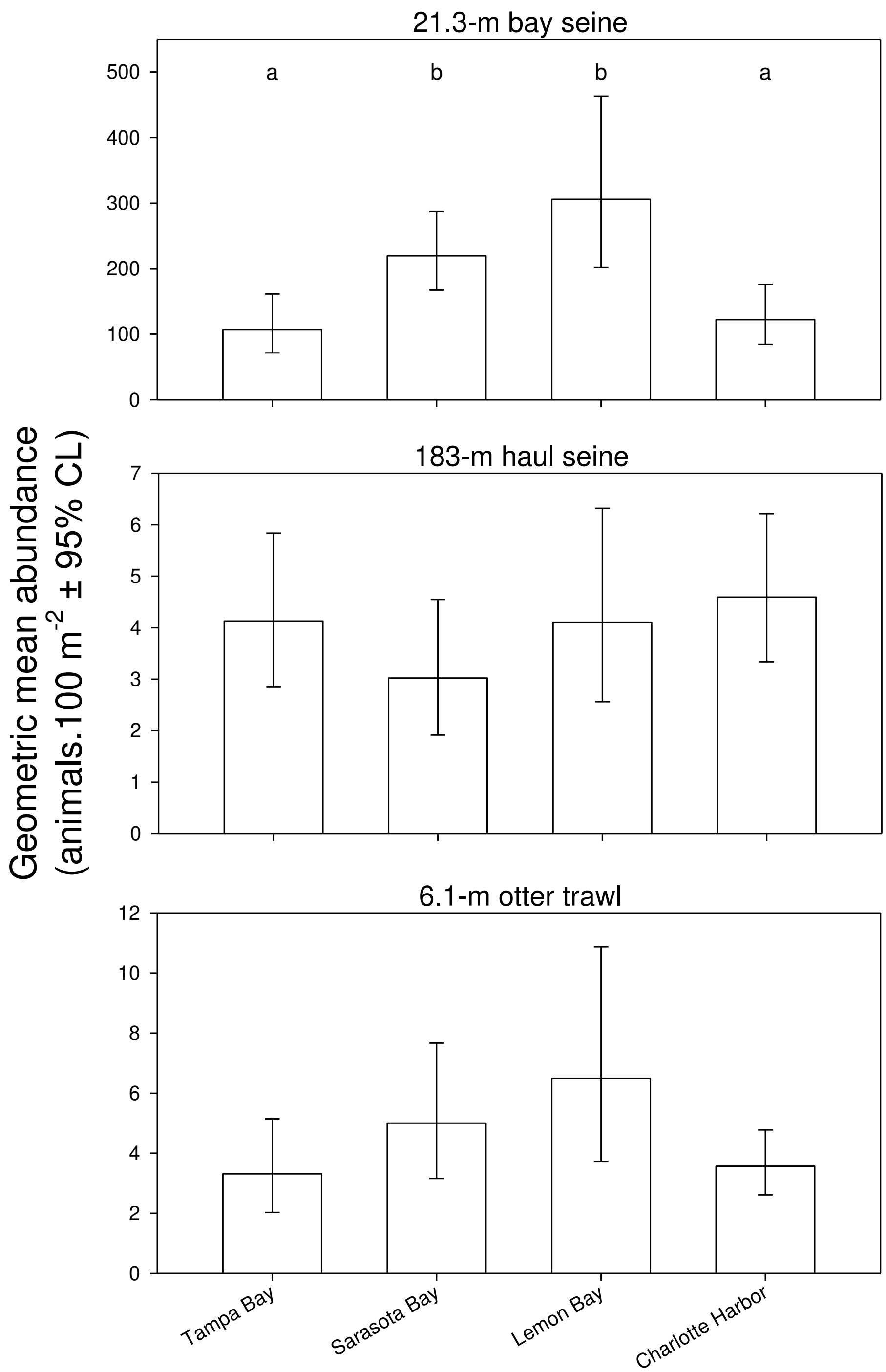

Figure 32. Geometric mean abundance for nekton collected from the polyhaline portions of four estuaries along the southwest coast of Florida. Letters above bars in 21.3-m seine plot represent significant differences (ANOVA, *P*<0.001, Tukey post hoc test, b>a); significant differences (*P*<0.05) were not found for 183-m seines or 6.1-m trawls.

Mercury Content Analysis

Tissue samples for mercury content analysis were taken from 323 individuals representing 25 taxa (*Table 10*). Animals collected for mercury analysis ranged in size from 49 to 658 mm SL. To date, just over 40% (n=133) of the tissue samples have been analyzed for mercury concentrations. Of the samples analyzed, 19 animals (10.0%), representing five taxa (*C. undecimalis*, common snook [n=12]; *Scomberomorus maculatus*, Spanish mackerel [n=3]; *Cynoscion nebulosus*, spotted seatrout [n=2]; *Elops saurus*, ladyfish [n=1]; and *Chaetodipterus faber*, spadefish [n=1]), had mercury concentrations above 0.3 mg/kg, a guidance level adopted by the U.S. EPA to protect public health (USEPA 2001). The highest mercury concentration level was 0.60 mg/kg (common snook, 524 mm SL, female).

Linear regression analyses were run on four taxa (ladyfish, *Elops saurus*; common snook, *Centropomus undecimalis*; sheepshead, *Archosargus probatocephalus*; and gray snapper, *Lutjanus griseus*) which had a large enough sample size in Sarasota Bay (≥15) and from the gulf coast of Florida between Tampa Bay and Charlotte Harbor (≥50).

Table 10. Summary of the number of animals, sizes, and mercury levels for fish tissue samples analyzed from the fisheries-independent sampling of Sarasota Bay, June 2009 through April 2010. Min = minimum, Max = maximum, Analyzed = number of fish that have been processed for mercury concentration, and Total = total number of fish collected for mercury content analysis. Species with at least 50 total animals collected and at least 15 from Sarasota Bay were analyzed using linear regression (* in Reg.).

	Sizes (mm)			*Hg Concentration (mg/kg)*			*Number*		
Species	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*	*Analyzed*	*Total*	Reg.
Ancylopsetta quadrocellata	153.5	149	158	0.06	0.05	0.06	2	2	
Archosargus probatocephalus	251.6	131	358	0.13	0.03	0.21	17	90	*
Caranx hippos	240.0	240	240	0.29	0.29	0.29	1	1	
Centropomus undecimalis	409.9	200	658	0.24	0.06	0.60	42	59	*
Chaetodipterus faber	278.5	252	312	0.20	0.11	0.34	4	4	
Cynoscion nebulosus	262.9	137	379	0.20	0.03	0.36	7	14	
Elops saurus	253.8	209	376	0.17	0.05	0.39	30	47	*
Epinephelus morio	101.0	101	101	0.03	0.03	0.03	1	1	
Eugerres plumieri	222.8	203	235	0.18	0.06	0.27	5	5	
Lagodon rhomboides	105.3	63	151	0.05	0.02	0.10	31	87	
Lutjanus griseus	185.8	115	240	0.08	0.03	0.17	26	26	*
Lutjanus synagris	89.5	49	133	0.06	0.05	0.07	3	12	
Menticirrhus americanus	285.0	285	285	0.24	0.24	0.24	1	1	
Mugil cephalus	262.5	135	379				0	20	
Mugil curema	125.7	112	135				0	3	
Mugil gyrans	125.7	112	135				0	3	
Mycteroperca microlepis	244.8	210	320	0.09	0.07	0.12	5	5	
Orthopristis chrysoptera	95.0	91	99				0	4	
Paralichthys albigutta	220.9	194	265	0.12	0.06	0.22	4	8	
Pogonias cromis	278.7	248	340	0.15	0.15	0.15	1	3	
Sciaenops ocellatus	526.0	494	590	0.13	0.08	0.19	4	5	
Scomberomorus maculatus	365.5	328	410	0.38	0.2	0.52	4	4	
Strongylura marina	414.0	324	480				0	6	
Synodus foetens	175.0	128	222				0	4	
Trachinotus falcatus	267.0	264	270	0.07	0.06	0.07	2	2	
Total	237.2	49	658	0.15	0.02	0.60	190	416	

Ladyfish, *Elops saurus*

Ladyfish that were collected in Sarasota Bay for mercury analysis ranged in size from 209 to 376 mm standard length (*Table 10*). Thirty of the 47 animals retained for mercury analysis from Sarasota Bay have been processed with a mean total mercury level of 0.17 mg/kg. The highest total mercury level recorded for ladyfish from Sarasota Bay was 0.39 mg/kg which was found in a fish measuring 271 mm SL.

There was a significant (P<0.0001), positive linear relationship between mercury concentration and standard length for ladyfish collected from the gulf coast between Tampa Bay and Charlotte Harbor (*Figure 33*), indicating a tendency for mercury concentrations to increase over time as ladyfish grow. Ladyfish collected for mercury analysis in Sarasota Bay were smaller (average 253 mm SL) than those collected in Tampa Bay and Charlotte Harbor (351 and 318 mm SL, respectively). A larger number of samples and a wider size range of ladyfish would be required to determine any estuary-specific difference in mercury concentrations at size.

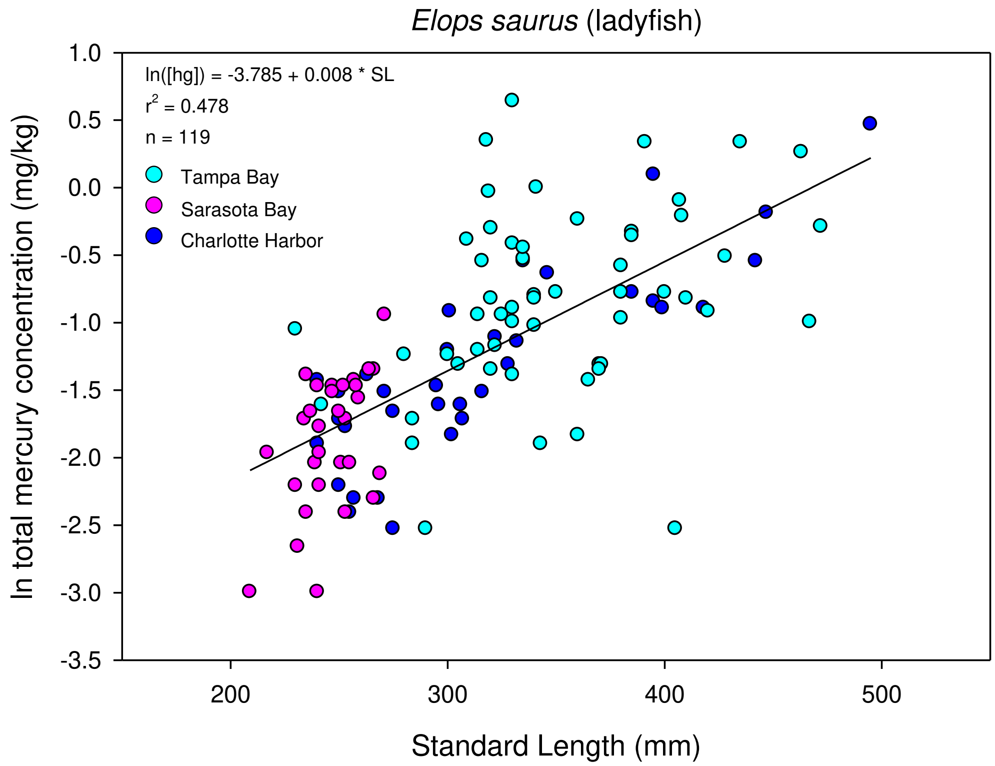

Figure 33.Relationship between ln total mercury concentration (mg/kg) and standard length (mm) for ladyfish collected in Tampa Bay, Sarasota Bay, and Charlotte Harbor.

Common Snook, *Centropomus undecimalis*

Forty-two of the 59 common snook collected for mercury analysis from Sarasota Bay have been processed (*Table 10*). The fish collected for mercury analysis range in size from 200 to 658 mm standard length (mean of 409.9 mm). The mean total mercury concentration for common snook in Sarasota Bay was 0.24 mg/kg. The highest concentration of mercury recorded for common snook in Sarasota Bay was from a 524 mm SL female (0.60 mg/kg); this was also the highest value recorded for any fish in the Sarasota Bay estuary analyzed to date.

Common snook from the gulf coast of Florida between Tampa Bay and Charlotte Harbor had a significant (P<0.0001) positive linear relationship with standard length (*Figure 34*). The common snook analyzed from Sarasota Bay (n=42) did not show any obvious differences in total mercury concentration or size distribution from the common snook analyzed from Charlotte Harbor (n=156) and Tampa Bay (n=1,032). More samples and a wider size range of common snook from Sarasota Bay would be necessary to determine any statistical difference in mercury concentrations between Sarasota Bay and Charlotte Harbor or Tampa Bay.

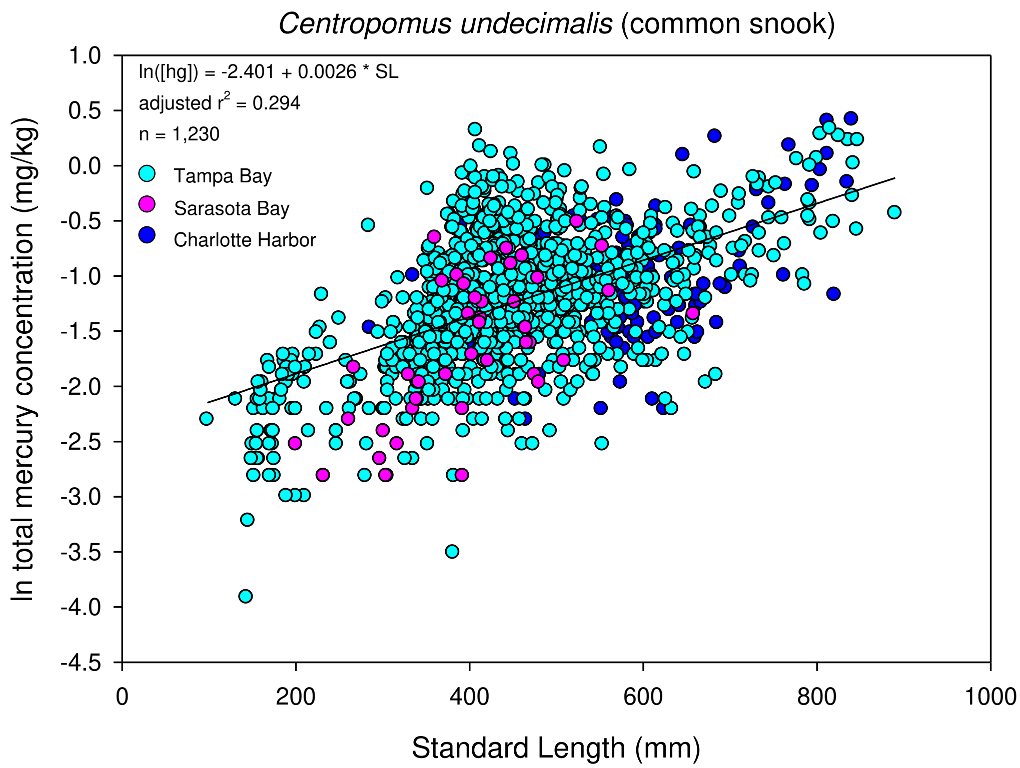

Figure 34. Relationship between ln total mercury level (mg/kg) and standard length (mm) for common snook collected in Tampa Bay, Sarasota Bay, and Charlotte Harbor.

Sheepshead, ***Archosargus probatocephalus***

Within Sarasota Bay, 90 sheepshead, ranging in size from 131 to 358 mm SL, were collected for mercury analysis between June 2009 and April 2010 (*Table 10*). The 17 fish processed for total mercury from Sarasota Bay had total mercury levels ranging from 0.03 to 0.21 mg/kg (mean of 0.13 mg/kg). Linear regression indicates that total mercury concentration had a significant (P<0.01) positive relationship with standard length for sheepshead collected between Tampa Bay and Charlotte Harbor (*Figure 35*). Total mercury concentrations for sheepshead were consistently low as compared to other estuarine species of recreational importance. There were no obvious differences in mercury concentration at size between the three estuaries; larger sample sizes of sheepshead from Tampa Bay, Sarasota Bay and Charlotte Harbor would be required to determine any statistical difference in mercury concentrations between the three estuaries.

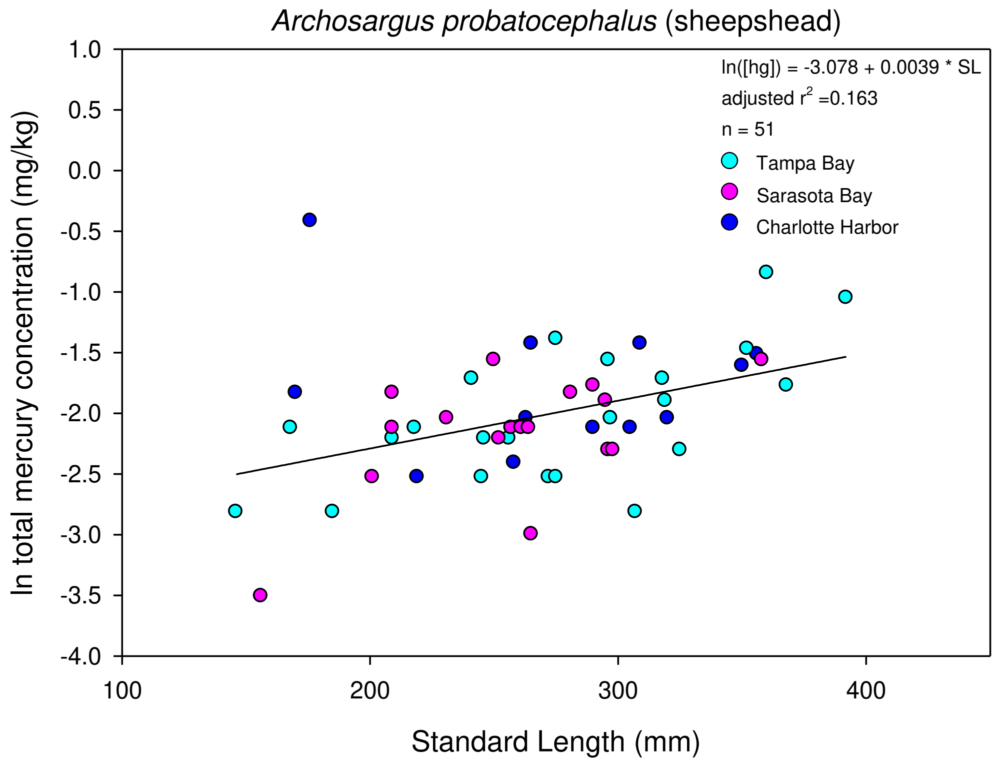

Figure 35. Relationship between ln total mercury level (mg/kg) and standard length (mm) for sheepshead collected in Tampa Bay, Sarasota Bay, and Charlotte Harbor.

Gray Snapper, *Lutjanus griseus*

All of the gray snapper collected for mercury analysis (n=26) from Sarasota Bay have been processed (*Table 10*). Gray snapper collected for mercury analysis ranged in size from 115 to 240 mm SL (mean of 185.8 mm). The mean total mercury level for gray snapper in Sarasota Bay was 0.08 mg/kg (range 0.03 to 0.17 mg/kg).

Gray snapper from estuarine waters along the gulf coast of Florida between Tampa Bay and Charlotte Harbor had a significant (P<0.0001) positive linear relationship with size, indicating that mercury concentrations increase as gray snapper grow and age (*Figure 36*). More samples of gray snapper from Sarasota Bay would be necessary to statistically determine any bay-specific differences, but no obvious differences in total mercury concentration at size were evident for gray snapper collected from Sarasota Bay, Charlotte Harbor (n=174) and Tampa Bay (n=204).

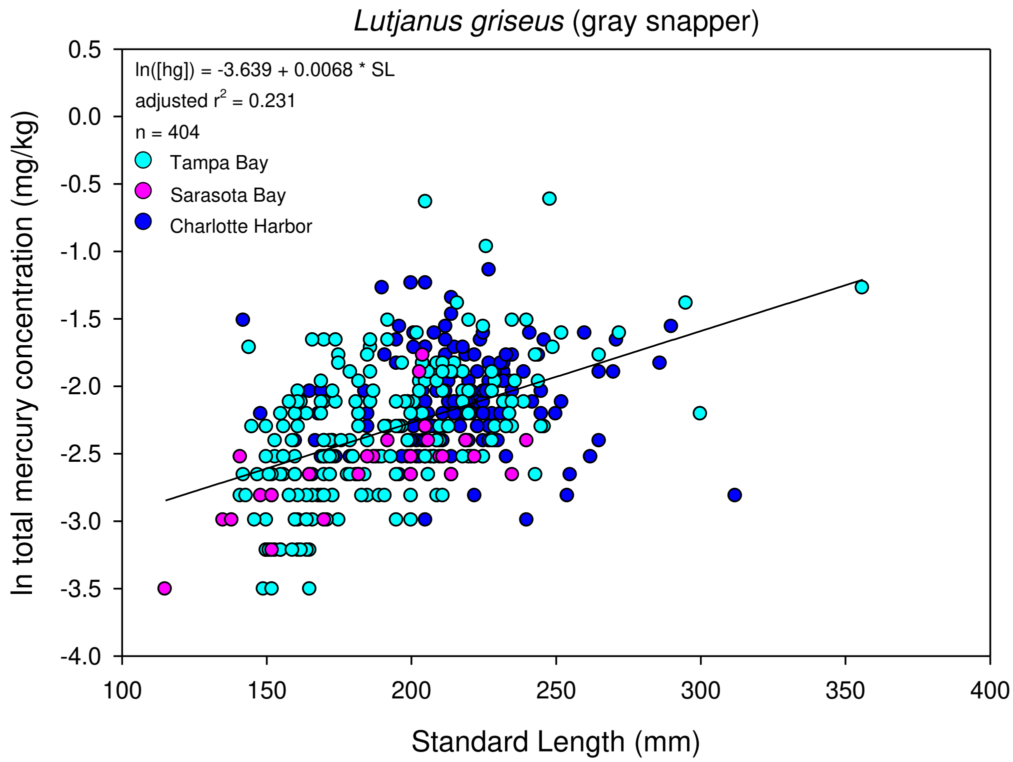

Figure 36. Relationship between ln total mercury level (mg/kg) and standard length (mm) for gray snapper collected in Tampa Bay, Sarasota Bay, and Charlotte Harbor.

CONCLUSION

Physiochemical conditions

The climatic conditions during this one-year sampling period were not typical of conditions in Southwest Florida, with below average temperatures in January and February and an unseasonably rainy winter/spring 2010. Undoubtedly these conditions influenced the physiochemical situation in Sarasota Bay during the study period. Water temperatures were colder for winter/spring 2010 in two estuaries adjacent to Sarasota Bay (Tampa Bay and Charlotte Harbor) as compared to the longer-time historical period. Salinity, during the normally dry period from January to April, was lower in Sarasota Bay and adjacent estuaries (Tampa Bay, Lemon Bay, and Charlotte Harbor) than normal. The climate and physiochemical conditions during this study period likely influenced the nekton community in Sarasota Bay such that some differences in community structure might be expected as compared to a longer-term sampling period.

Composition of overall nekton community

The nekton community in Sarasota Bay was generally quite typical of Florida estuaries. More than 80% of the total animals caught during the study came from just one of the gear types, 21.3-m seine. The bay anchovy, a small schooling fish, comprised almost 30% of the catch in this gear and 25% of the total catch during the study. Pinfish were also particularly abundant, representing one of the top two abundant taxa in each of the gear types and comprising over 27% of the total catch. Other estuarine dependent species such as spot, eucinostomus mojarra, silver jenny, silver perch, and scaled sardines were relatively dominant in overall abundance as well.

Nekton Community Structure

The intrabay comparison indicated that only the nekton community sampled with the 21.3-m seine showed differences between Sarasota Bay's five embayments. The two "small" embayments (Blackburn and Roberts bays), were similar to each other, but different from the two "large" embayments (Sarasota and Little Sarasota bays). The nekton community of Palma Sola Bay was distinct from the nekton assemblages of both the "small" and "large" embayments. Overall abundance and the abundance for most taxa collected with 21.3-m seines were higher in the "small" embayments than in either the "large" embayments or Palma Sola Bay.

The interbay comparison also indicated that "small" estuaries (Sarasota and Lemon bays) were different from polyhaline portions of the "large" estuaries (Tampa Bay and Charlotte Harbor) for the nekton communities sampled with 21.3-m seines, 183-m seines, and 6.1-m trawls. The majority of discriminating taxa in the community analysis had higher abundance in the small estuaries. Overall abundance was greater in the "small" estuaries for 21.3-m seine collections, which had much larger sample sizes than the other two gear deployment methods.

The intrabay and interbay community analyses provided similar results. The community structure in "small" estuaries was different than the community structure in "large" estuaries for 21.3-m seines (intrabay and interbay), 183-m seines (interbay), and 6.1-m trawls (interbay). The abundance for the discriminating taxa in the community analyses tended to be higher in "small" than in "large" estuaries (intra and interbay) and overall abundance tended to be higher in “small” than “large” bays (intrabay). These differences in community structure and abundance could be related to water depth, salinity, ratio of land-water interface to open water, sediment type, quantity and type of submerged aquatic vegetation, or circulation patterns, residence times, and water quality.

Mercury Content Analysis

Sample sizes were not large enough to run linear regressions on any of the taxa collected from Sarasota Bay without combining with data from adjacent estuaries (Tampa Bay and Charlotte Harbor). The results of the mercury content analysis provides no reason to suspect that fish from Sarasota Bay contain any higher concentrations of mercury than those found in adjacent estuaries and suggest that accumulation rates for Sarasota Bay are similar to those found in Tampa Bay and Charlotte Harbor.

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APPENDICES

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

Scientific Name	Common Name
Albula vulpes	*bonefish*
Archosargus probatocephalus	*sheepshead*
Callinectes sapidus	*blue crab*
Centropomus undecimalis	*common snook*
Cynoscion arenarius	*sand seatrout*
Cynoscion nebulosus	spotted seatrout
Cynoscion nothus	silver seatrout
Cynoscion regalis	weakfish
Cynoscion complex	seatrout
Elops saurus	ladyfish
Epinephelus adscensionis	rock hind
Epinephelus afer	mutton hamlet
Epinephelus cruentatus	graysby
Epinephelus drummondhayi	speckled hind
Epinephelus flavolimbatus	yellowedge grouper
Epinephelus fulvus	coney
Epinephelus guttatus	red hind
Epinephelus inermis	marbled grouper
Epinephelus itajara	goliath grouper
Epinephelus morio	red grouper
Epinephelus mystacinus	misty grouper
Epinephelus nigritus	Warsaw grouper
Epinephelus niveatus	snowy grouper
Epinephelus striatus	Nassau grouper
Farfantepenaeus aztecus	brown shrimp
Farfantepenaeus duorarum	pink shrimp
Farfantepenaeus brasiliensis	pinkspotted shrimp
Farfantepenaeus spp.	penaeid shrimps
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

Scientific Name	Common Name
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 saxatillis	northern kingfish
Micropogonias undulatus	Atlantic croaker
Mugil cephalus	striped mullet
Mugil curema	white mullet
Mugil gaimardianus	redeye mullet
Mugil gyrans	whirligig mullet
Mugil liza	liza
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	pompano
Trachinotus falcatus	permit
Trachinotus goodei	palometa

Appendix B. Summary of species collected, by sampling event (bi-monthly), during Sarasota Bay stratified-random sampling, June 2009 to April 2010. Effort, or total number of hauls, is labeled 'E'. Taxa are arranged alphabetically.

		Month and Year						
		June 2009	August 2009	October 2009	December 2009	February 2010	April 2010	Totals
Scientific Name	Common Name	E=42	E=42	E=40	E=40	E=39	E=42	E=245
Acanthostracion quadricornis	scrawled cowfish	7	2	3	6	6	6	30
Achirus lineatus	lined sole	3	.	5	8	9	10	35
Anchoa cubana	cuban anchovy	.	792	2,358	2	.	152	3,304
Anchoa hepsetus	striped anchovy	.	200	.	1	.	.	201
Anchoa mitchilli	bay anchovy	4,547	1,778	11,258	17,671	555	4,540	40,349
Ancylopsetta quadrocellata	ocellated flounder	2	2	.	.	.	2	6
Archosargus probatocephalus	sheepshead	126	28	49	17	57	10	287
Argopecten spp.	bay scallops	6	2	1	.	.	.	9
Ariopsis felis	hardhead catfish	111	10	67	5	1	13	207
Astroscopus y-graecum	southern stargazer	.	.	.	.	.	1	1
Bairdiella chrysoura	silver perch	652	400	731	20	.	3	1,806
Brevoortia spp.	menhaden	.	19	5	2	.	.	26
Callinectes ornatus	shelligs	15	2	.	1	.	1	19
Callinectes sapidus	blue crab	28	26	25	13	36	26	154
Caranx hippos	crevalle jack	2	2	12	2	.	.	18
Caranx latus	horse-eye jack	.	.	1	.	.	.	1
Centropomus undecimalis	snook	37	7	47	21	1	20	133
Centropristis striata	black sea bass	2	.	5	.	.	.	7
Chaetodipterus faber	atlantic spadefish	1	10	5	.	.	.	16

Scientific Name	Common Name	Month and Year						Totals
		June 2009	August 2009	October 2009	December 2009	February 2010	April 2010	
		E=42	E=42	E=40	E=40	E=39	E=42	E=245
Chasmodes saburrae	florida blenny	1	3	16	2	.	1	23
Chilomycterus schoepfii	striped burrfish	17	4	13	11	19	6	70
Chloroscombrus chrysurus	atlantic bumper	.	.	1	.	.	.	1
Citharichthys macrops	spotted whiff	.	1	.	.	.	4	5
Ctenogobius boleosoma	darter goby	.	.	.	.	.	10	10
Cynoscion arenarius	sand seatrout	.	2	1	.	.	.	3
Cynoscion nebulosus	spotted seatrout	37	33	66	5	5	3	149
Cyprinodon variegatus	sheepshead minnow	.	181	6	.	.	17	204
Dasyatis americana	southern stingray	1	.	2	.	.	.	3
Dasyatis sabina	atlantic stingray	.	.	.	.	.	5	5
Dasyatis say	bluntnose stingray	.	.	.	.	.	1	1
Diplectrum formosum	sand perch	.	.	.	1	2	.	3
Diplodus holbrookii	spottail pinfish	7	36	4	.	.	.	47
Elops saurus	ladyfish	7	.	25	47	8	12	99
Epinephelus morio	red grouper	.	1	.	.	.	.	1
Etropus crossotus	fringed flounder	.	1	.	2	5	1	9
Eucinostomus gula	silver jenny	176	910	873	622	86	184	2,851
Eucinostomus harengulus	tidewater mojarra	323	194	170	28	.	12	727
Eucinostomus spp.	eucinostomus mojarra	1,832	6,840	4,889	3,816	5	2	17,384
Eugerres plumieri	striped mojarra	5	1	5	5	.	.	16
Farfantepenaeus duorarum	pink shrimp	173	96	766	219	168	75	1,497
Floridichthys carpio	goldspotted killifish	13	321	11	10	41	54	450
Fundulus grandis	gulf killifish	11	.	.	.	.	3	14
Fundulus similis	longnose killifish	14	22	.	.	48	.	84

Scientific Name	Common Name	Month and Year June 2009 E=42	August 2009 E=42	October 2009 E=40	December 2009 E=40	February 2010 E=39	April 2010 E=42	Totals E=245
Gobiesox strumosus	skilletfish	1	.	.	.	.	.	1
Gobiosoma longipala	twoscale goby	1	.	.	1	3	5	10
Gobiosoma robustum	code goby	35	8	8	50	106	159	366
Gobiosoma spp.	gobies	78	4	9	63	62	15	231
Gymnura micrura	smooth butterfly ray	.	.	1	.	.	2	3
Haemulon plumierii	white grunt	4	9	29	6	.	1	49
Harengula jaguana	scaled sardine	760	3,182	2,719	273	.	637	7,571
Hemicaranx amblyrhynchus	bluntnose jack	.	.	1	.	.	.	1
Hippocampus erectus	lined seahorse	3	1	.	.	1	6	11
Hippocampus zosterae	dwarf seahorse	4	2	1	10	5	1	23
Hypleurochilus caudovittatus	zebratail blenny	.	.	.	4	1	.	5
Hyporhamphus meeki	american halfbeak	1	11	7	.	.	.	19
Hyporhamphus spp.	halfbeaks	.	1	.	.	.	.	1
Hypsoblennius hentz	feather blenny	.	.	.	.	.	2	2
Lagodon rhomboides	pinfish	8,066	2,609	2,575	925	12,380	16,609	43,164
Leiostomus xanthurus	spot	29	23	25	9	19,389	4,032	23,507
Limulus polyphemus	horseshoe crab	1	.	1	2	.	2	6
Lucania parva	rainwater killifish	943	1,435	681	498	272	197	4,026
Lutjanus griseus	gray snapper	34	37	166	21	.	2	260
Lutjanus synagris	lane snapper	.	17	99	14	.	.	130
Membras martinica	rough silverside	38	.	.	1	.	.	39
Menidia spp.	menidia silversides	1,384	1,686	240	346	154	45	3,855
Menippe spp.	stone crab	3	33	99	29	90	3	257
Menticirrhus americanus	southern kingfish	.	2	.	1	.	1	4

Scientific Name	Common Name	Month and Year						Totals
		June 2009	August 2009	October 2009	December 2009	February 2010	April 2010	
		E=42	E=42	E=40	E=40	E=39	E=42	E=245
Microgobius gulosus	clown goby	72	14	83	126	64	189	548
Microgobius thalassinus	green goby	.	.	.	.	12	.	12
Monacanthus ciliatus	fringed filefish	.	.	.	7	.	2	9
Mugil cephalus	striped mullet	2	2	5	15	424	943	1,391
Mugil curema	white mullet	.	1	.	31	4	5	41
Mugil gyrans	fantail mullet	11	4	.	7	.	3	25
Mycteroperca microlepis	gag	4	11	28	.	.	1	44
Nicholsina usta	emerald parrotfish	10	2	.	4	.	2	18
Ogcocephalus cubifrons	batfish	1	.	7	1	2	6	17
Oligoplites saurus	leatherjacket	22	40	19	.	.	.	81
Opisthonema oglinum	atlantic thread herring	1	187	726	6	.	271	1,191
Opsanus beta	gulf toadfish	15	1	6	3	7	9	41
Orthopristis chrysoptera	pigfish	276	117	351	34	23	26	827
Ostraciidae spp.	boxfish, trunkfish and cowfish	.	.	.	1	.	.	1
Paralichthys albigutta	gulf flounder	14	3	13	8	6	24	68
Poecilia latipinna	sailfin molly	.	.	1	.	.	.	1
Pogonias cromis	black drum	.	.	1	.	1	.	2
Portunus spp.	swimming crabs	54	28	4	3	29	58	176
Prionotus scitulus	leopard searobin	10	10	7	5	13	12	57
Prionotus tribulus	bighead searobin	.	.	.	7	8	10	25
Rhinoptera bonasus	cownose ray	4	.	2	.	.	3	9
Sardinella aurita	spanish sardine	1	5	.	.	.	.	6
Sarotherodon melanotheron	blackchin tilapia	1	1	.	.	.	.	2
Sciaenops ocellatus	red drum	1	.	5	7	3	36	52

Scientific Name	Common Name	Month and Year June 2009 E=42	August 2009 E=42	October 2009 E=40	December 2009 E=40	February 2010 E=39	April 2010 E=42	Totals E=245
Scomberomorus maculatus	spanish mackerel	.	.	4	.	.	.	4
Scorpaena brasiliensis	barbfish	.	.	.	.	3	1	4
Selene vomer	lookdown	13	2	5	.	.	.	20
Serraniculus pumilio	pygmy sea bass	.	.	.	.	1	.	1
Serranus subligarius	belted sandfish	.	.	1	1	1	.	3
Sicyonia laevigata	hardback	.	.	.	1	.	4	5
Sphoeroides nephelus	southern puffer	10	.	12	17	9	6	54
Sphyraena barracuda	great barracuda	.	1	5	17	.	.	23
Sphyrna tiburo	bonnethead	.	.	2	2	.	.	4
Stephanolepis hispidus	planehead filefish	6	10	8	95	6	1	126
Strongylura marina	atlantic needlefish	16	.	.	7	.	.	23
Strongylura notata	redfin needlefish	18	27	41	21	1	4	112
Strongylura spp.	needlefish	4	.	.	.	.	.	4
Symphurus plagiusa	blackcheek tonguefish	.	.	1	2	6	14	23
Syngnathus floridae	dusky pipefish	1	1	4	3	1	1	11
Syngnathus louisianae	chain pipefish	6	1	1	7	2	4	21
Syngnathus scovelli	gulf pipefish	52	15	38	40	37	44	226
Synodus foetens	inshore lizardfish	17	16	10	31	18	30	122
Trachinotus falcatus	permit	.	.	5	6	.	.	11
Urophycis floridana	southern hake	.	.	.	.	23	1	24
Totals		20,183	21,485	29,476	25,305	34,219	28,603	159,271

Appendix C. Summary of species collected, by gear and stratum, during Sarasota Bay stratified-random sampling, June 2009 to April 2010. Effort, or the total number of hauls, is labeled 'E'. Taxa are arranged alphabetically.

		Gear and Strata						Totals
		21.3-m seine			183-m seine		6.1-m trawl	
		Veg	Unveg	Shore	Over	Nonover		
Scientific Name	Common Name	E=63	E=39	E=59	E=24	E=12	E=48	E=245
Acanthostracion quadricornis	scrawled cowfish	1	.	.	.	3	26	30
Achirus lineatus	lined sole	5	2	12	.	.	16	35
Anchoa cubana	cuban anchovy	918	3	2,382	.	.	1	3,304
Anchoa hepsetus	striped anchovy	.	.	200	.	.	1	201
Anchoa mitchilli	bay anchovy	18,973	1,755	19,236	.	.	385	40,349
Ancylopsetta quadrocellata	ocellated flounder	.	.	.	.	.	6	6
Archosargus probatocephalus	sheepshead	26	4	23	122	38	74	287
Argopecten spp.	bay scallops	3	1	1	2	.	2	9
Ariopsis felis	hardhead catfish	2	.	.	111	77	17	207
Astroscopus y-graecum	southern stargazer	1	.	.	.	.	.	1
Bairdiella chrysoura	silver perch	877	2	281	491	151	4	1,806
Brevoortia spp.	menhaden	.	.	16	8	2	.	26
Callinectes ornatus	shelligs	.	.	1	.	.	18	19
Callinectes sapidus	blue crab	14	1	14	6	2	117	154
Caranx hippos	crevalle jack	1	1	.	14	2	.	18
Caranx latus	horse-eye jack	.	.	1	.	.	.	1
Centropomus undecimalis	snook	.	.	6	97	30	.	133
Centropristis striata	black sea bass	2	.	4	1	.	.	7
Chaetodipterus faber	atlantic spadefish	.	.	1	13	2	.	16

Scientific Name	Common Name	Gear and Strata						Totals
		21.3-m seine			183-m seine		6.1-m trawl	
		Veg	Unveg	Shore	Over	Nonover		
		E=63	E=39	E=59	E=24	E=12	E=48	E=245
Chasmodes saburrae	florida blenny	16	2	3	.	.	2	23
Chilomycterus schoepfii	striped burrfish	8	1	.	1	9	51	70
Chloroscombrus chrysurus	atlantic bumper	.	.	.	.	.	1	1
Citharichthys macrops	spotted whiff	.	.	.	.	.	5	5
Ctenogobius boleosoma	darter goby	8	.	.	.	.	2	10
Cynoscion arenarius	sand seatrout	.	.	.	.	.	3	3
Cynoscion nebulosus	spotted seatrout	55	.	73	12	7	2	149
Cyprinodon variegatus	sheepshead minnow	.	.	203	1	.	.	204
Dasyatis americana	southern stingray	.	.	.	1	1	1	3
Dasyatis sabina	atlantic stingray	.	.	.	.	4	1	5
Dasyatis say	bluntnose stingray	.	.	.	.	.	1	1
Diplectrum formosum	sand perch	.	.	.	.	.	3	3
Diplodus holbrookii	spottail pinfish	9	.	.	3	33	2	47
Elops saurus	ladyfish	.	.	.	41	58	.	99
Epinephelus morio	red grouper	.	.	.	.	.	1	1
Etropus crossotus	fringed flounder	.	.	.	.	.	9	9
Eucinostomus gula	silver jenny	521	178	1,494	72	105	481	2,851
Eucinostomus harengulus	tidewater mojarra	11	296	330	25	9	56	727
Eucinostomus spp.	eucinostomus mojarra	4,919	2,341	9,813	.	.	311	17,384
Eugerres plumieri	striped mojarra	.	.	.	9	7	.	16
Farfantepenaeus duorarum	pink shrimp	598	36	795	.	.	68	1,497
Floridichthys carpio	goldspotted killifish	1	1	448	.	.	.	450
Fundulus grandis	gulf killifish	.	.	13	1	.	.	14
Fundulus similis	longnose killifish	.	.	83	.	1	.	84

Scientific Name	Common Name	Gear and Strata						Totals
		21.3-m seine			183-m seine		6.1-m trawl	
		Veg	Unveg	Shore	Over	Nonover		
		E=63	E=39	E=59	E=24	E=12	E=48	E=245
Gobiesox strumosus	skilletfish	.	.	.	.	.	1	1
Gobiosoma longipala	twoscale goby	.	1	.	.	.	9	10
Gobiosoma robustum	code goby	188	13	130	.	.	35	366
Gobiosoma spp.	gobies	74	34	42	.	.	81	231
Gymnura micrura	smooth butterfly ray	.	.	.	1	.	2	3
Haemulon plumierii	white grunt	4	.	29	3	5	8	49
Harengula jaguana	scaled sardine	1,474	2	5,483	6	605	1	7,571
Hemicaranx amblyrhynchus	bluntnose jack	.	.	.	1	.	.	1
Hippocampus erectus	lined seahorse	.	.	.	1	.	10	11
Hippocampus zosterae	dwarf seahorse	17	.	4	.	.	2	23
Hypleurochilus caudovittatus	zebratail blenny	.	.	.	.	.	5	5
Hyporhamphus meeki	american halfbeak	7	2	10	.	.	.	19
Hyporhamphus spp.	halfbeaks	.	1	.	.	.	.	1
Hypsoblennius hentz	feather blenny	2	.	.	.	.	.	2
Lagodon rhomboides	pinfish	19,540	2,729	12,898	3,104	1,816	3,077	43,164
Leiostomus xanthurus	spot	3,690	3,105	8,013	39	31	8,629	23,507
Limulus polyphemus	horseshoe crab	.	.	1	2	.	3	6
Lucania parva	rainwater killifish	1,719	22	2,283	.	.	2	4,026
Lutjanus griseus	gray snapper	65	2	60	38	72	23	260
Lutjanus synagris	lane snapper	51	1	35	22	1	20	130
Membras martinica	rough silverside	.	.	39	.	.	.	39
Menidia spp.	menidia silversides	800	21	3,034	.	.	.	3,855
Menippe spp.	stone crab	.	1	.	.	1	255	257
Menticirrhus americanus	southern kingfish	.	.	.	.	.	4	4

Scientific Name	Common Name	Gear and Strata						Totals
		21.3-m seine			183-m seine		6.1-m trawl	
		Veg	Unveg	Shore	Over	Nonover		
		E=63	E=39	E=59	E=24	E=12	E=48	E=245
Microgobius gulosus	clown goby	203	34	289	.	.	22	548
Microgobius thalassinus	green goby	.	.	.	.	.	12	12
Monacanthus ciliatus	fringed filefish	1	.	4	.	1	3	9
Mugil cephalus	striped mullet	14	.	1,333	26	18	.	1,391
Mugil curema	white mullet	.	.	.	10	31	.	41
Mugil gyrans	fantail mullet	2	.	5	8	10	.	25
Mycteroperca microlepis	gag	1	.	1	25	16	1	44
Nicholsina usta	emerald parrotfish	3	.	3	2	9	1	18
Ogcocephalus cubifrons	batfish	.	.	.	.	7	10	17
Oligoplites saurus	leatherjacket	18	12	44	5	2	.	81
Opisthonema oglinum	atlantic thread herring	171	2	744	.	272	2	1,191
Opsanus beta	gulf toadfish	3	.	7	2	1	28	41
Orthopristis chrysoptera	pigfish	153	.	60	275	69	270	827
Ostraciidae spp.	boxfish, trunkfish and cowfish	1	.	.	.	.	.	1
Paralichthys albigutta	gulf flounder	3	8	11	16	9	21	68
Poecilia latipinna	sailfin molly	.	.	1	.	.	.	1
Pogonias cromis	black drum	.	.	.	2	.	.	2
Portunus spp.	swimming crabs	1	1	4	1	1	168	176
Prionotus scitulus	leopard searobin	1	.	5	.	.	51	57
Prionotus tribulus	bighead searobin	1	1	5	1	.	17	25
Rhinoptera bonasus	cownose ray	.	.	.	2	7	.	9
Sardinella aurita	spanish sardine	5	.	1	.	.	.	6
Sarotherodon melanotheron	blackchin tilapia	.	.	.	2	.	.	2
Sciaenops ocellatus	red drum	.	3	33	13	2	1	52

Scientific Name	Common Name	Gear and Strata						Totals
		21.3-m seine			183-m seine		6.1-m trawl	
		Veg	Unveg	Shore	Over	Nonover		
		E=63	E=39	E=59	E=24	E=12	E=48	E=245
Scomberomorus maculatus	spanish mackerel	.	.	.	1	3	.	4
Scorpaena brasiliensis	barbfish	.	.	.	.	.	4	4
Selene vomer	lookdown	.	.	.	2	18	.	20
Serraniculus pumilio	pygmy sea bass	.	.	.	.	.	1	1
Serranus subligarius	belted sandfish	.	.	.	.	.	3	3
Sicyonia laevigata	hardback	1	.	2	.	.	2	5
Sphoeroides nephelus	southern puffer	11	7	13	4	14	5	54
Sphyraena barracuda	great barracuda	2	.	1	9	11	.	23
Sphyrna tiburo	bonnethead	.	.	.	.	4	.	4
Stephanolepis hispidus	planehead filefish	11	.	85	7	7	16	126
Strongylura marina	atlantic needlefish	1	1	14	.	7	.	23
Strongylura notata	redfin needlefish	12	10	72	5	13	.	112
Strongylura spp.	needlefish	1	.	3	.	.	.	4
Symphurus plagiusa	blackcheek tonguefish	1	5	2	.	.	15	23
Syngnathus floridae	dusky pipefish	4	.	7	.	.	.	11
Syngnathus louisianae	chain pipefish	3	4	6	.	.	8	21
Syngnathus scovelli	gulf pipefish	124	10	84	.	.	8	226
Synodus foetens	inshore lizardfish	15	28	36	.	5	38	122
Trachinotus falcatus	permit	.	.	4	1	6	.	11
Urophycis floridana	southern hake	4	1	.	.	.	19	24
Totals		55,371	10,685	70,373	4,667	3,615	14,560	159,271

Appendix D. Summary of species collected, by embayment, during Sarasota Bay stratified-random sampling, June 2009 to April 2010. Effort, or the total number of hauls, is labeled 'E'. Taxa are arranged alphabetically.

		Bay (Zone)					
		Palma Sola Bay (A)	Sarasota Bay (B)	Roberts Bay (C)	Little Sarasota Bay (D)	Blackburn Bay (E)	Totals
Scientific Name	Common Name	E=42	E=83	E=41	E=41	E=38	E=245
Acanthostracion quadricornis	scrawled cowfish	4	22	1	2	1	30
Achirus lineatus	lined sole	4	7	11	9	4	35
Anchoa cubana	cuban anchovy	.	101	3,147	2	54	3,304
Anchoa hepsetus	striped anchovy	.	.	200	.	1	201
Anchoa mitchilli	bay anchovy	1,000	20,727	6,405	11,639	578	40,349
Ancylopsetta quadrocellata	ocellated flounder	.	3	.	2	1	6
Archosargus probatocephalus	sheepshead	43	30	41	115	58	287
Argopecten spp.	bay scallops	1	.	1	5	2	9
Ariopsis felis	hardhead catfish	22	37	48	98	2	207
Astroscopus y-graecum	southern stargazer	.	1	.	.	.	1
Bairdiella chrysoura	silver perch	54	709	340	567	136	1,806
Brevoortia spp.	menhaden	7	.	18	.	1	26
Callinectes ornatus	shelligs	.	.	16	2	1	19
Callinectes sapidus	blue crab	20	15	28	87	4	154
Caranx hippos	crevalle jack	10	2	3	2	1	18
Caranx latus	horse-eye jack	.	.	1	.	.	1
Centropomus undecimalis	snook	12	42	15	37	27	133
Centropristis striata	black sea bass	.	1	3	.	3	7
Chaetodipterus faber	atlantic spadefish	4	.	8	4	.	16

Scientific Name	Common Name	Bay (Zone) Palma Sola Bay (A)	Sarasota Bay (B)	Roberts Bay (C)	Little Sarasota Bay (D)	Blackburn Bay (E)	Totals
		E=42	E=83	E=41	E=41	E=38	E=245
Chasmodes saburrae	florida blenny	2	18	1	1	1	23
Chilomycterus schoepfii	striped burrfish	10	41	10	1	8	70
Chloroscombrus chrysurus	atlantic bumper	.	1	.	.	.	1
Citharichthys macrops	spotted whiff	.	.	.	.	5	5
Ctenogobius boleosoma	darter goby	.	7	2	1	.	10
Cynoscion arenarius	sand seatrout	.	3	.	.	.	3
Cynoscion nebulosus	spotted seatrout	33	32	38	42	4	149
Cyprinodon variegatus	sheepshead minnow	188	16	.	.	.	204
Dasyatis americana	southern stingray	.	2	.	1	.	3
Dasyatis sabina	atlantic stingray	1	.	4	.	.	5
Dasyatis say	bluntnose stingray	1	.	.	.	.	1
Diplectrum formosum	sand perch	.	3	.	.	.	3
Diplodus holbrookii	spottail pinfish	.	38	6	.	3	47
Elops saurus	ladyfish	57	21	14	6	1	99
Epinephelus morio	red grouper	.	.	.	.	1	1
Etropus crossotus	fringed flounder	2	5	.	1	1	9
Eucinostomus gula	silver jenny	153	643	1,154	388	513	2,851
Eucinostomus harengulus	tidewater mojarra	63	149	314	80	121	727
Eucinostomus spp.	eucinostomus mojarra	1,236	3,542	6,872	2,594	3,140	17,384
Eugerres plumieri	striped mojarra	3	1	7	5	.	16
Farfantepenaeus duorarum	pink shrimp	110	300	166	603	318	1,497
Floridichthys carpio	goldspotted killifish	383	21	1	21	24	450
Fundulus grandis	gulf killifish	.	8	.	4	2	14
Fundulus similis	longnose killifish	24	29	.	31	.	84

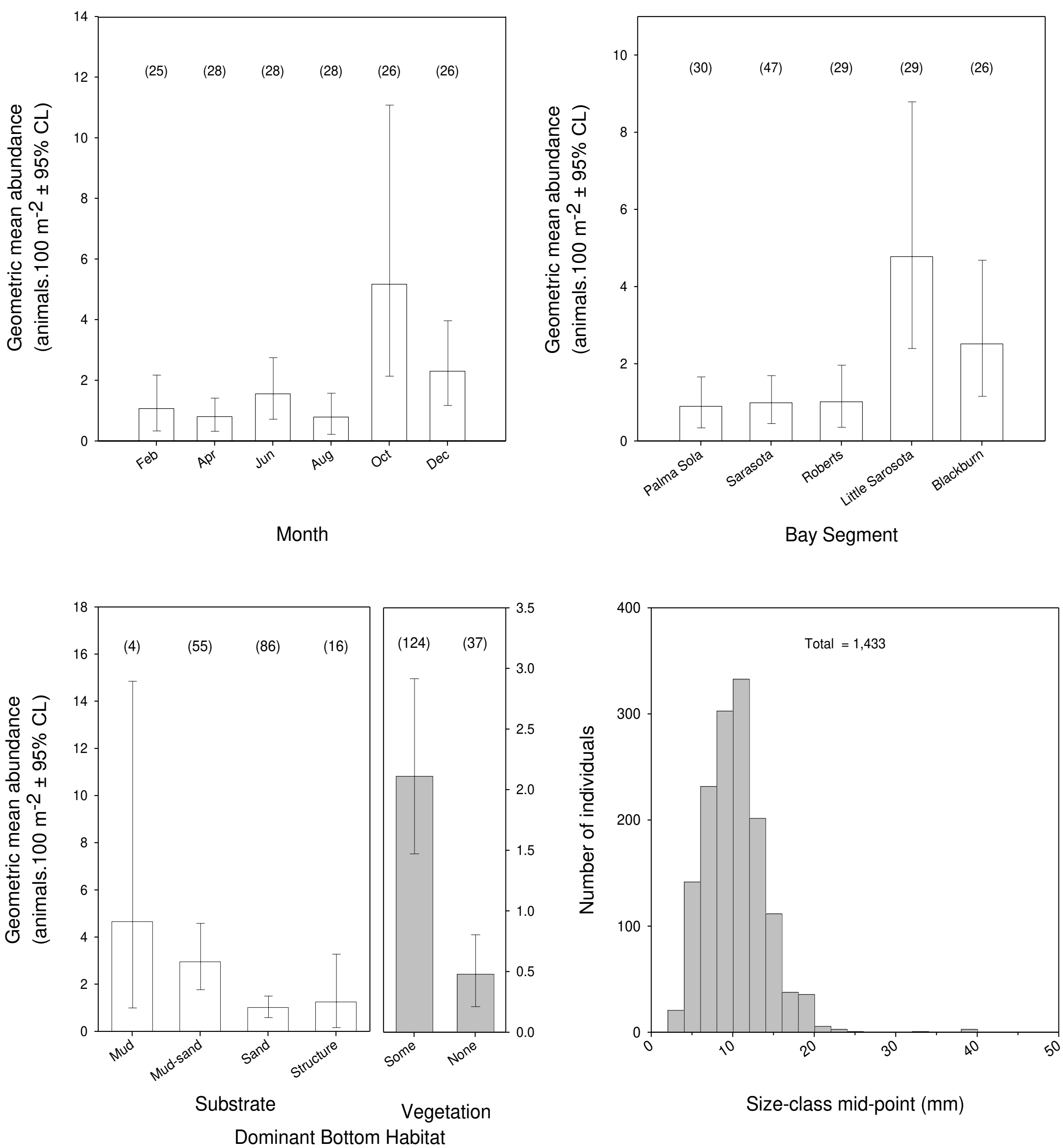
Scientific Name	Common Name	Bay (Zone) Palma Sola Bay (A) E=42	Sarasota Bay (B) E=83	Roberts Bay (C) E=41	Little Sarasota Bay (D) E=41	Blackburn Bay (E) E=38	Totals E=245
Gobiesox strumosus	skilletfish	.	.	.	.	1	1
Gobiosoma longipala	twoscale goby	1	3	3	.	3	10
Gobiosoma robustum	code goby	118	50	26	94	78	366
Gobiosoma spp.	gobies	16	35	69	88	23	231
Gymnura micrura	smooth butterfly ray	.	.	.	2	1	3
Haemulon plumierii	white grunt	.	14	25	4	6	49
Harengula jaguana	scaled sardine	205	1,155	4,341	550	1,320	7,571
Hemicaranx amblyrhynchus	bluntnose jack	.	.	.	1	.	1
Hippocampus erectus	lined seahorse	1	8	.	.	2	11
Hippocampus zosterae	dwarf seahorse	7	7	2	5	2	23
Hypleurochilus caudovittatus	zebratail blenny	.	4	.	1	.	5
Hyporhamphus meeki	american halfbeak	4	9	1	3	2	19
Hyporhamphus spp.	halfbeaks	1	.	.	.	.	1
Hypsoblennius hentz	feather blenny	.	2	.	.	.	2
Lagodon rhomboides	pinfish	6,612	12,210	7,394	9,790	7,158	43,164
Leiostomus xanthurus	spot	1,937	2,522	8,762	6,318	3,968	23,507
Limulus polyphemus	horseshoe crab	5	1	.	.	.	6
Lucania parva	rainwater killifish	2,084	1,225	349	249	119	4,026
Lutjanus griseus	gray snapper	3	86	36	54	81	260
Lutjanus synagris	lane snapper	4	73	26	4	23	130
Membras martinica	rough silverside	.	4	34	1	.	39
Menidia spp.	menidia silversides	357	276	561	1,131	1,530	3,855
Menippe spp.	stone crab	34	197	2	11	13	257
Menticirrhus americanus	southern kingfish	1	1	1	1	.	4

Scientific Name	Common Name	Bay (Zone) Palma Sola Bay (A) E=42	Sarasota Bay (B) E=83	Roberts Bay (C) E=41	Little Sarasota Bay (D) E=41	Blackburn Bay (E) E=38	Totals E=245
Microgobius gulosus	clown goby	161	20	90	257	20	548
Microgobius thalassinus	green goby	.	.	.	12	.	12
Monacanthus ciliatus	fringed filefish	.	7	.	.	2	9
Mugil cephalus	striped mullet	407	63	10	9	902	1,391
Mugil curema	white mullet	15	20	6	.	.	41
Mugil gyrans	fantail mullet	9	9	1	4	2	25
Mycteroperca microlepis	gag	.	34	.	1	9	44
Nicholsina usta	emerald parrotfish	2	14	.	1	1	18
Ogcocephalus cubifrons	batfish	.	15	2	.	.	17
Oligoplites saurus	leatherjacket	27	26	13	12	3	81
Opisthonema oglinum	atlantic thread herring	4	275	841	69	2	1,191
Opsanus beta	gulf toadfish	13	8	12	3	5	41
Orthopristis chrysoptera	pigfish	55	287	92	263	130	827
Ostraciidae spp.	boxfish, trunkfish and cowfish	1	.	.	.	.	1
Paralichthys albigutta	gulf flounder	9	21	18	9	11	68
Poecilia latipinna	sailfin molly	1	.	.	.	.	1
Pogonias cromis	black drum	.	.	1	1	.	2
Portunus spp.	swimming crabs	43	35	57	18	23	176
Prionotus scitulus	leopard searobin	6	33	8	2	8	57
Prionotus tribulus	bighead searobin	8	3	4	7	3	25
Rhinoptera bonasus	cownose ray	.	.	7	2	.	9
Sardinella aurita	spanish sardine	5	1	.	.	.	6
Sarotherodon melanotheron	blackchin tilapia	1	1	.	.	.	2
Sciaenops ocellatus	red drum	13	22	5	8	4	52

Scientific Name	Common Name	Bay (Zone) Palma Sola Bay (A)	Sarasota Bay (B)	Roberts Bay (C)	Little Sarasota Bay (D)	Blackburn Bay (E)	Totals
		E=42	E=83	E=41	E=41	E=38	E=245
Scomberomorus maculatus	spanish mackerel	1	3	.	.	.	4
Scorpaena brasiliensis	barbfish	.	3	1	.	.	4
Selene vomer	lookdown	.	19	1	.	.	20
Serraniculus pumilio	pygmy sea bass	.	1	.	.	.	1
Serranus subligarius	belted sandfish	.	3	.	.	.	3
Sicyonia laevigata	hardback	.	2	.	.	3	5
Sphoeroides nephelus	southern puffer	14	23	7	5	5	54
Sphyraena barracuda	great barracuda	.	15	.	5	3	23
Sphyrna tiburo	bonnethead	.	4	.	.	.	4
Stephanolepis hispidus	planehead filefish	8	103	4	6	5	126
Strongylura marina	atlantic needlefish	6	14	2	.	1	23
Strongylura notata	redfin needlefish	13	43	10	21	25	112
Strongylura spp.	needlefish	.	2	.	2	.	4
Symphurus plagiusa	blackcheek tonguefish	2	1	9	6	5	23
Syngnathus floridae	dusky pipefish	.	7	2	.	2	11
Syngnathus louisianae	chain pipefish	2	9	3	1	6	21
Syngnathus scovelli	gulf pipefish	50	67	21	62	26	226
Synodus foetens	inshore lizardfish	5	30	33	30	24	122
Trachinotus falcatus	permit	.	6	4	.	1	11
Urophycis floridana	southern hake	1	17	6	.	.	24
Totals		15,719	45,725	41,777	35,473	20,577	159,271

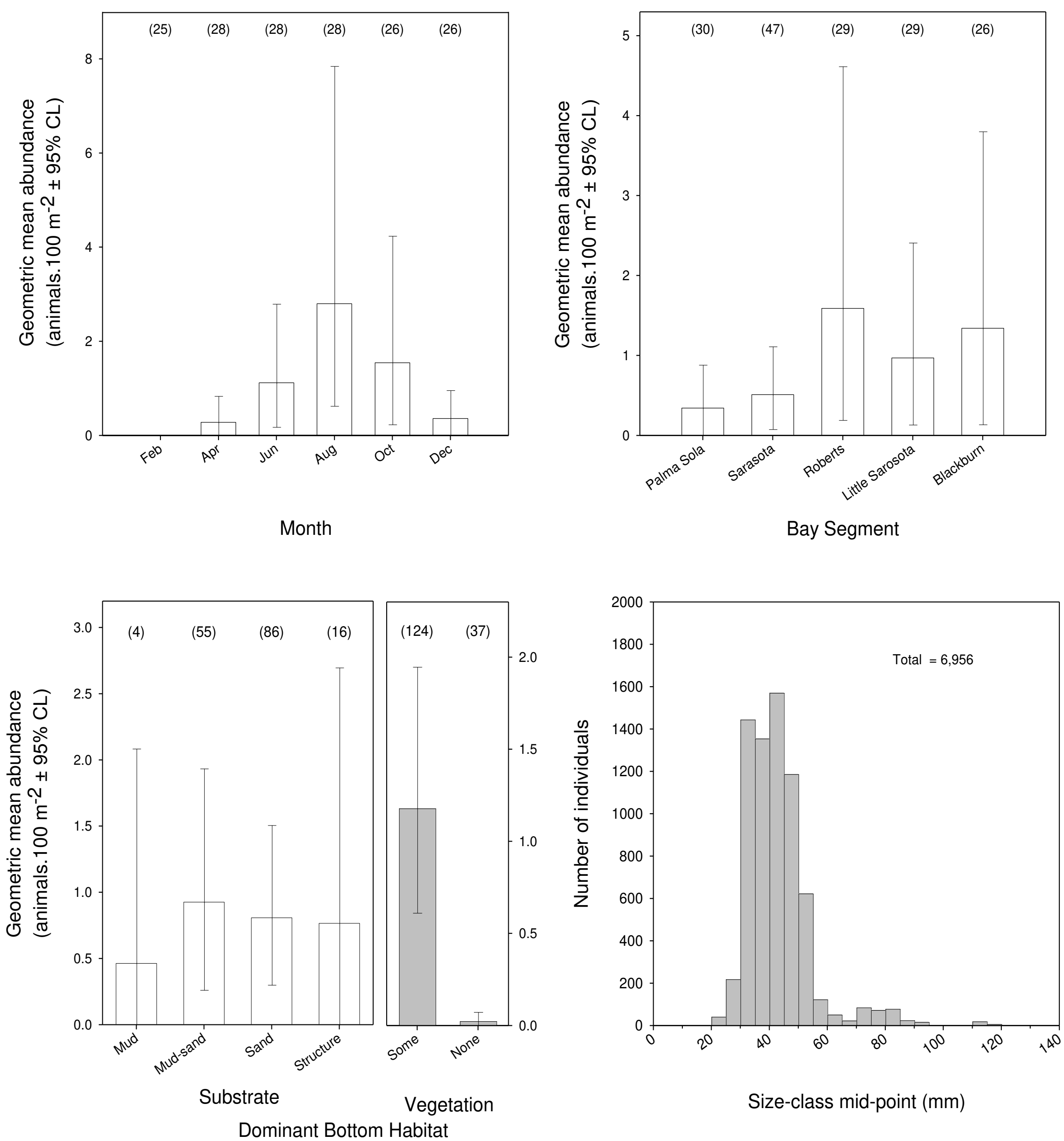
Appendix E. Catch overview plots for dominant taxa (≥40 animals collected and ≥10 occurrence in a gear type) collected with 21.3-m seines. Taxa are arranged phylogenetically.

Farfantepenaeus duorarum (pink shrimp)
21.3-m seine



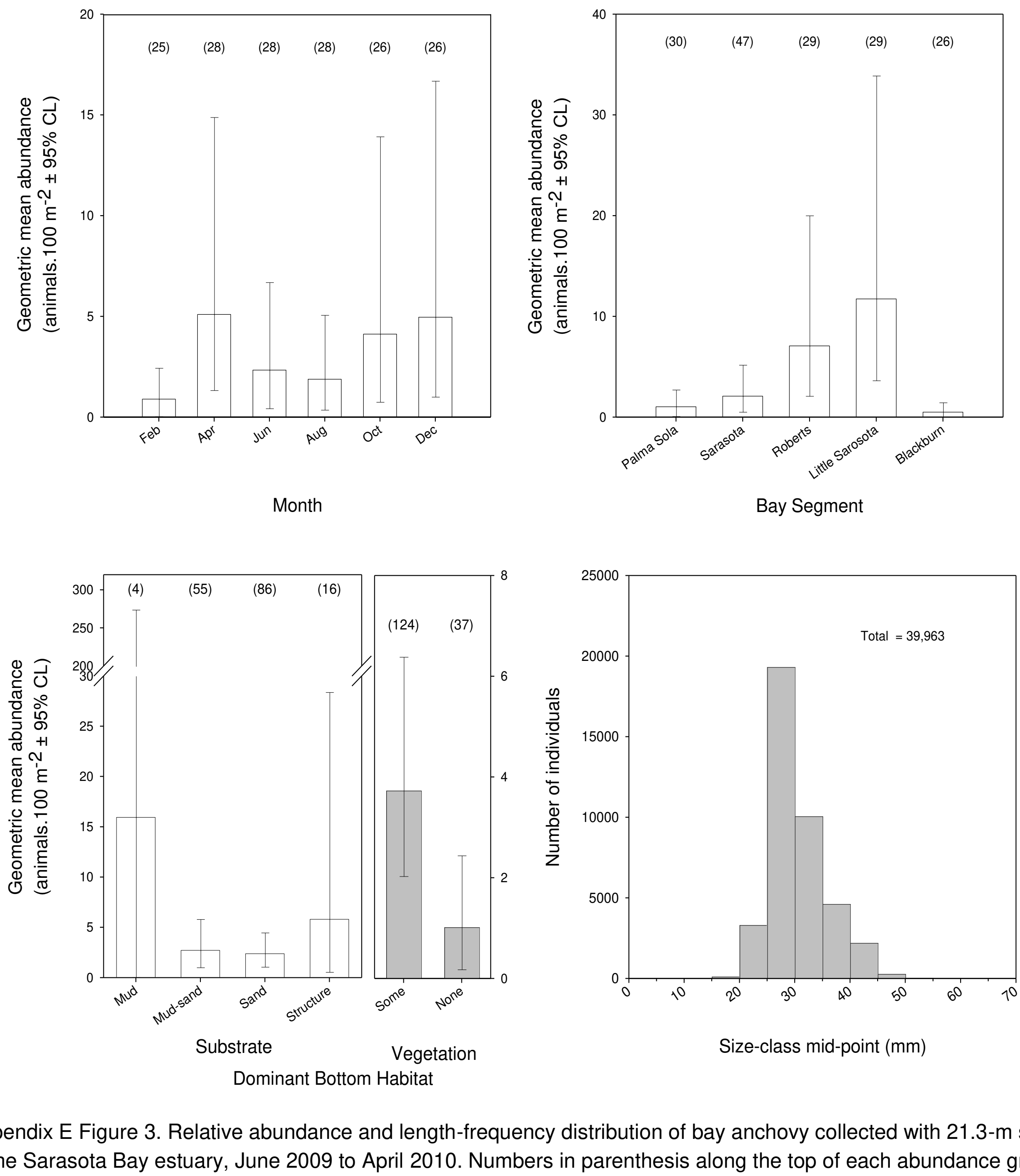
Appendix E Figure 1. Relative abundance and length-frequency distribution of pink shrimp collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Harengula jaguana (scaled sardine)
21.3-m seine



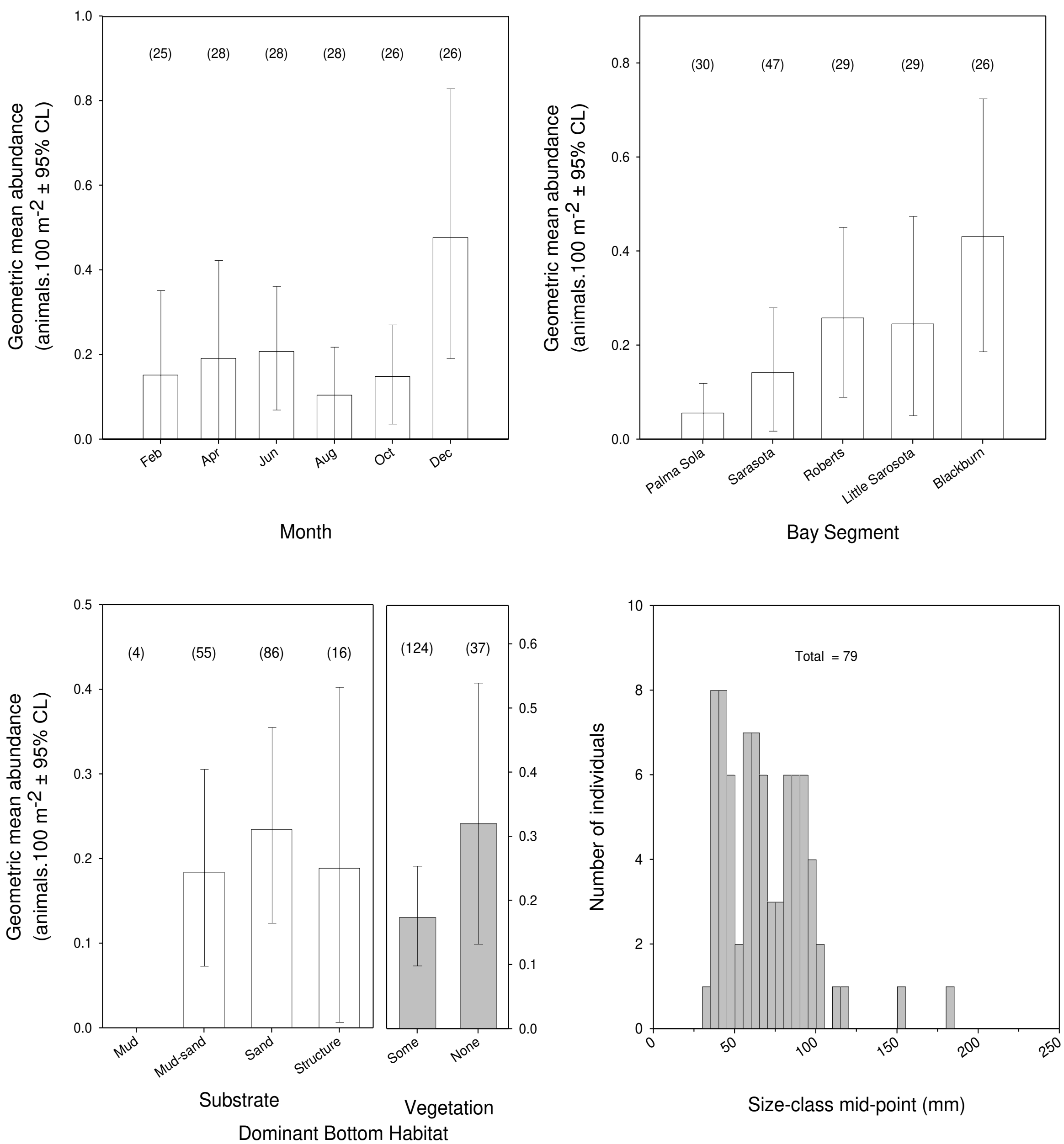
Appendix E Figure 2. Relative abundance and length-frequency distribution of scaled sardine collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Anchoa mitchilli (bay anchovy)
21.3-m seine



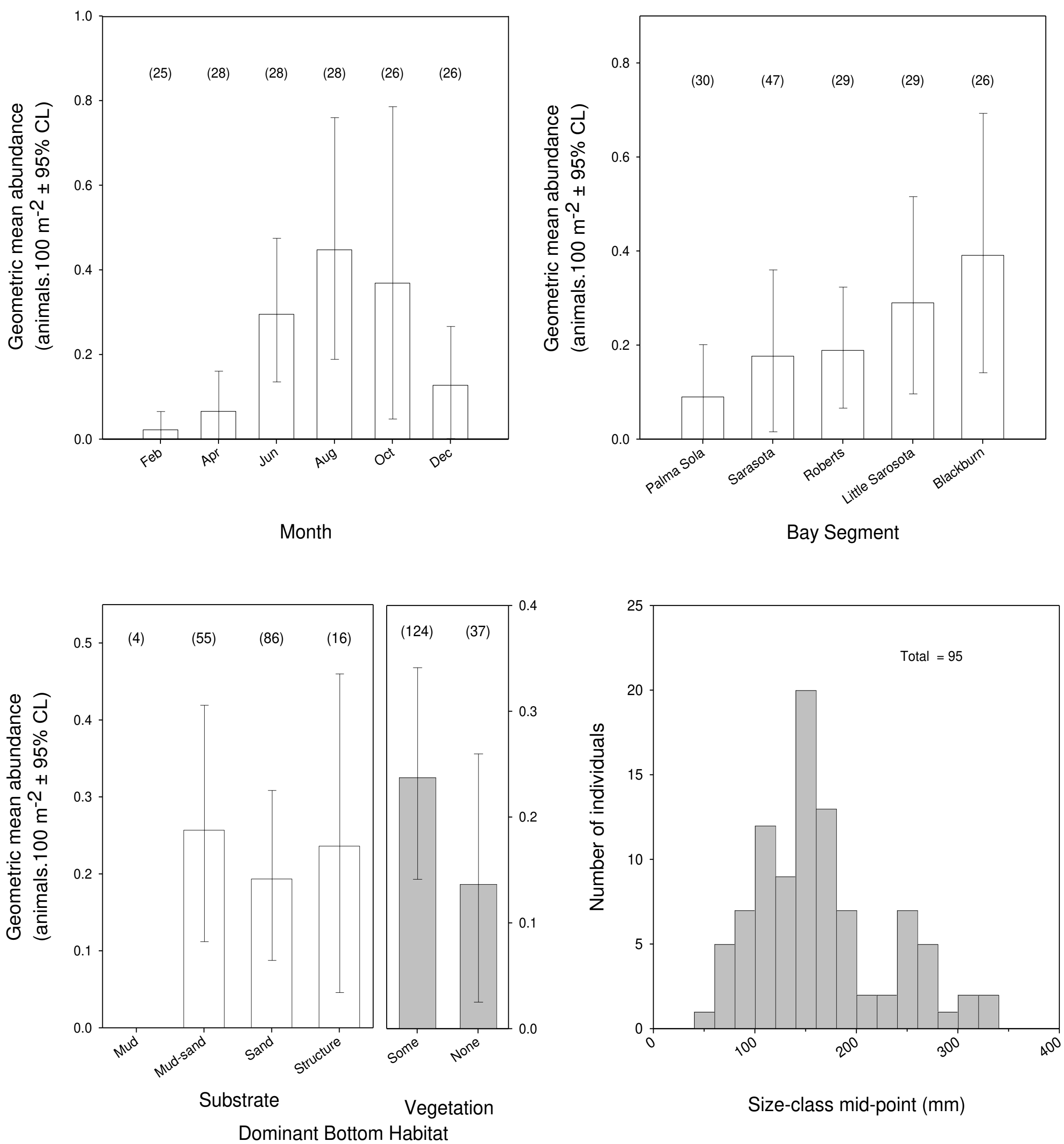
Appendix E Figure 3. Relative abundance and length-frequency distribution of bay anchovy collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Synodus foetens (inshore lizardfish)
21.3-m seine



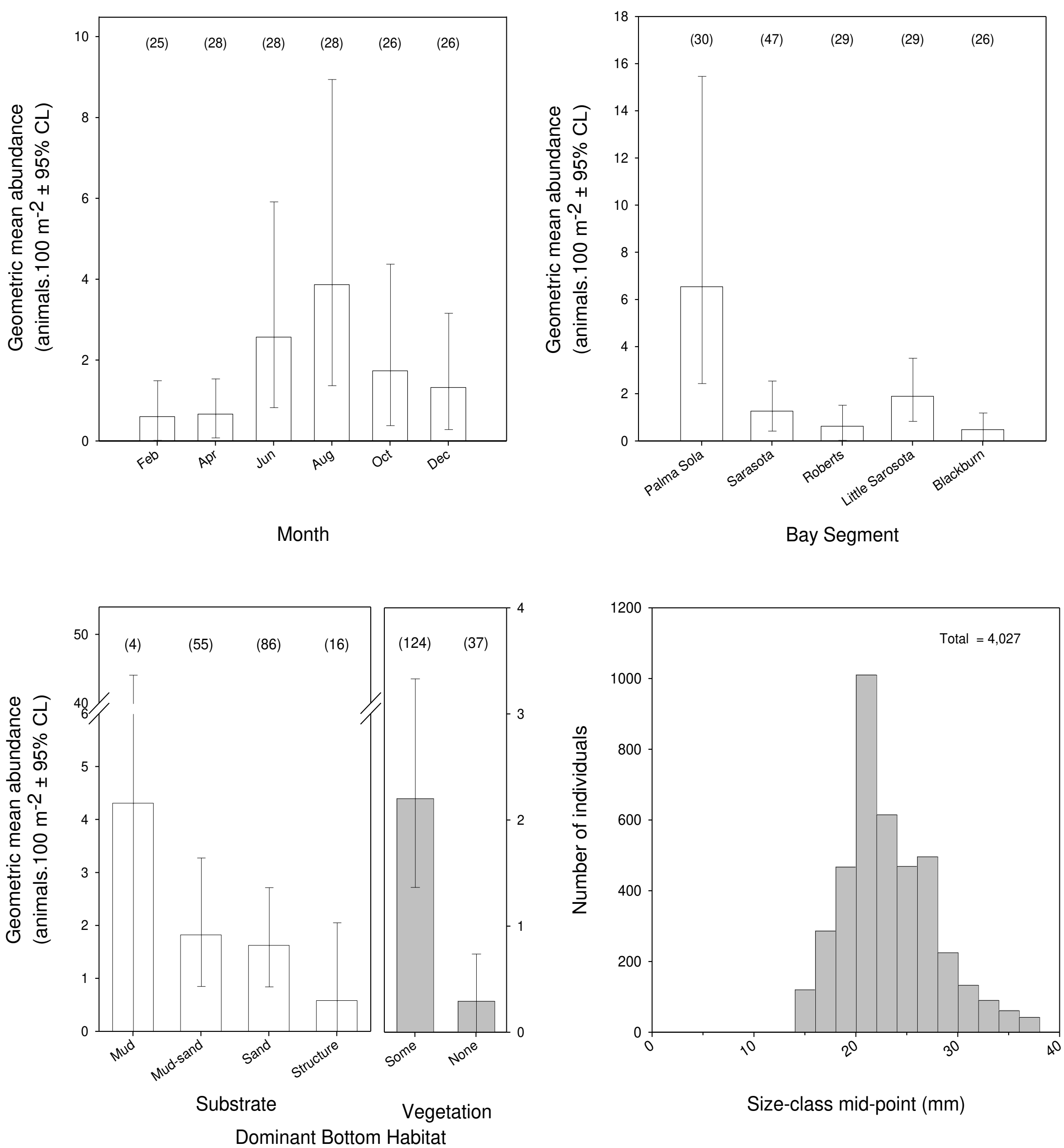
Appendix E Figure 4. Relative abundance and length-frequency distribution of inshore lizardfish collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Strongylura notata (redfin needlefish)
21.3-m seine



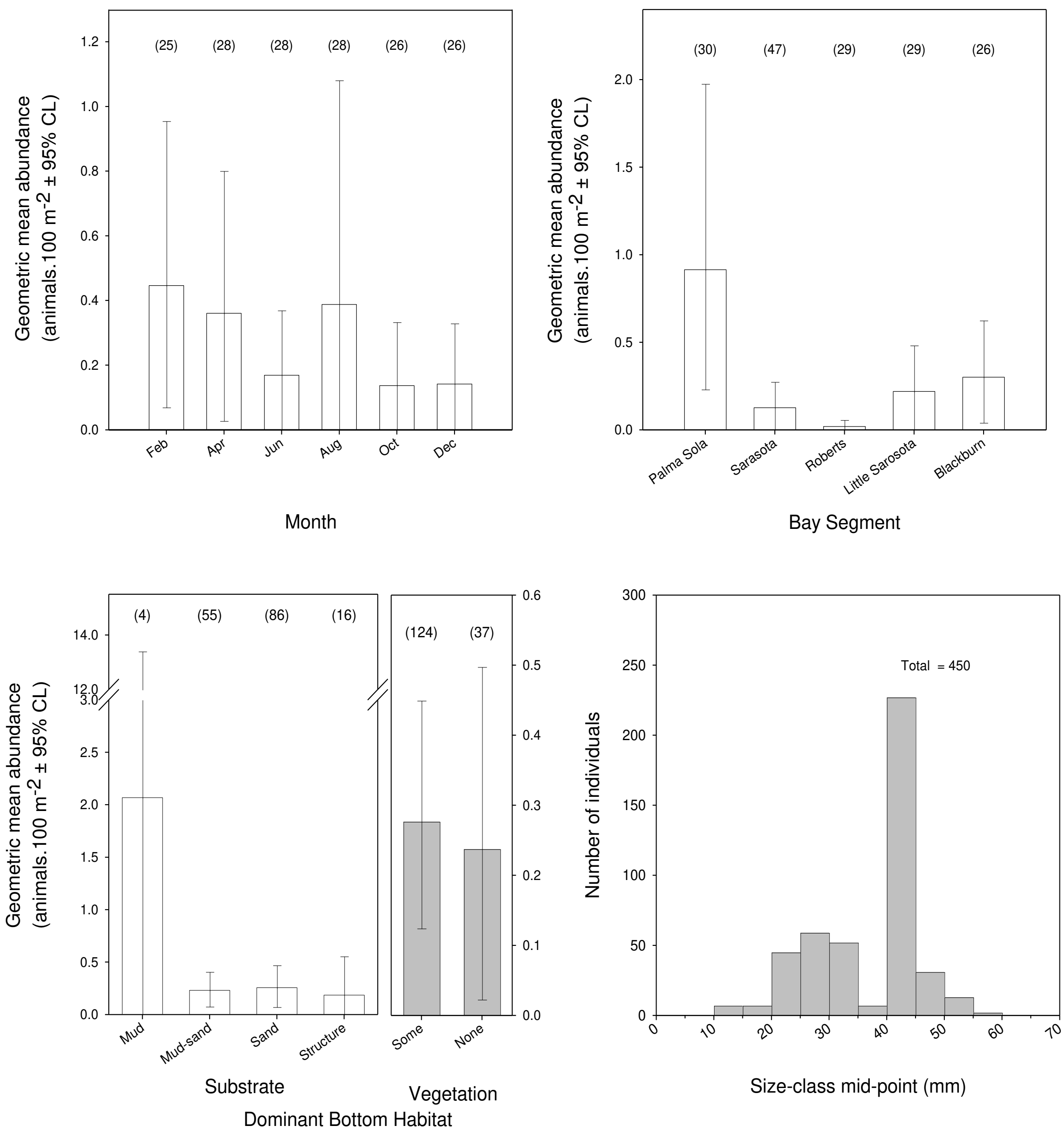
Appendix E Figure 5. Relative abundance and length-frequency distribution of redfin needlefish collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Lucania parva (rainwater killifish)
21.3-m seine

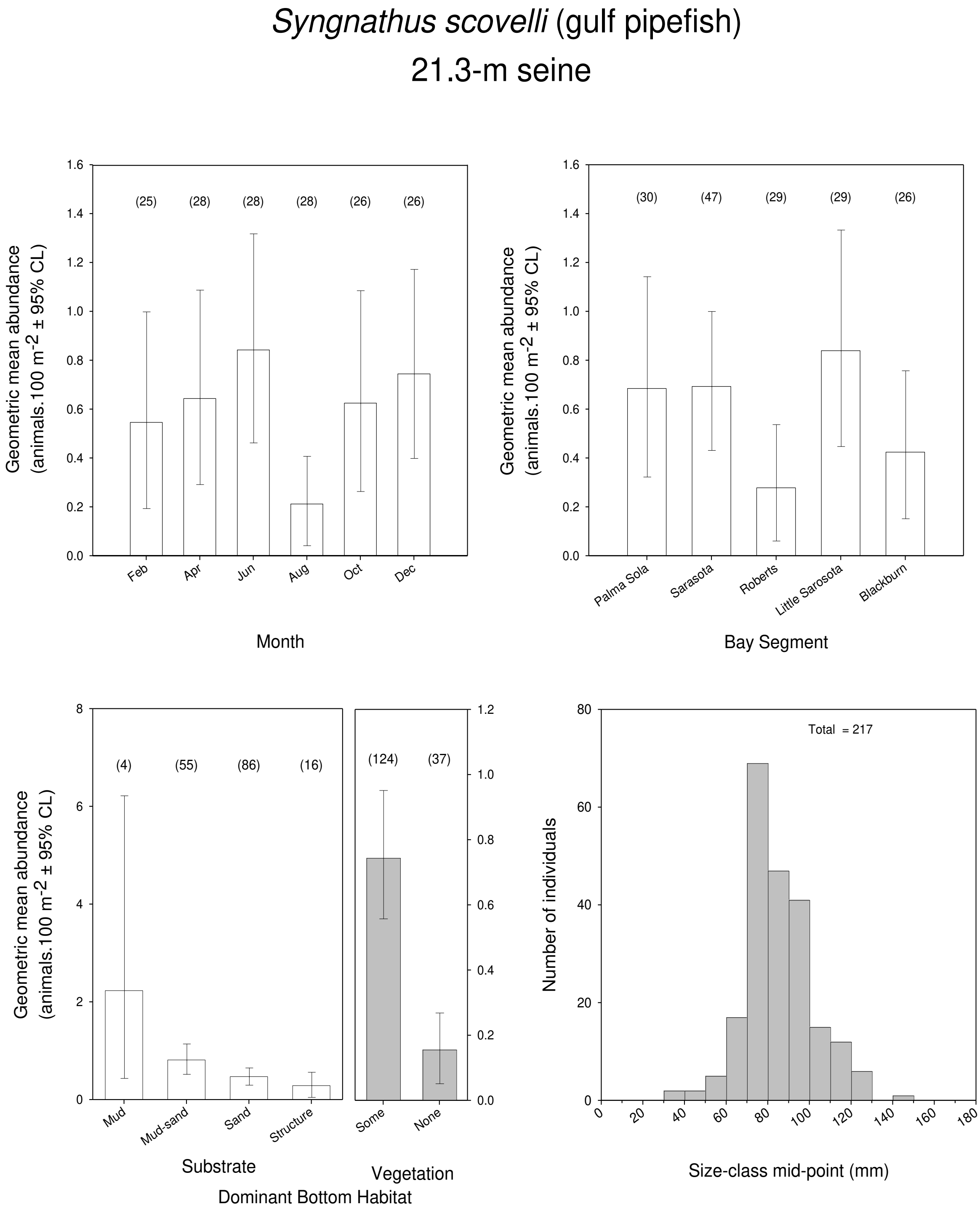


Appendix E Figure 6. Relative abundance and length-frequency distribution of rainwater killifish collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Floridichthys carpio (goldspotted killifish)
21.3-m seine

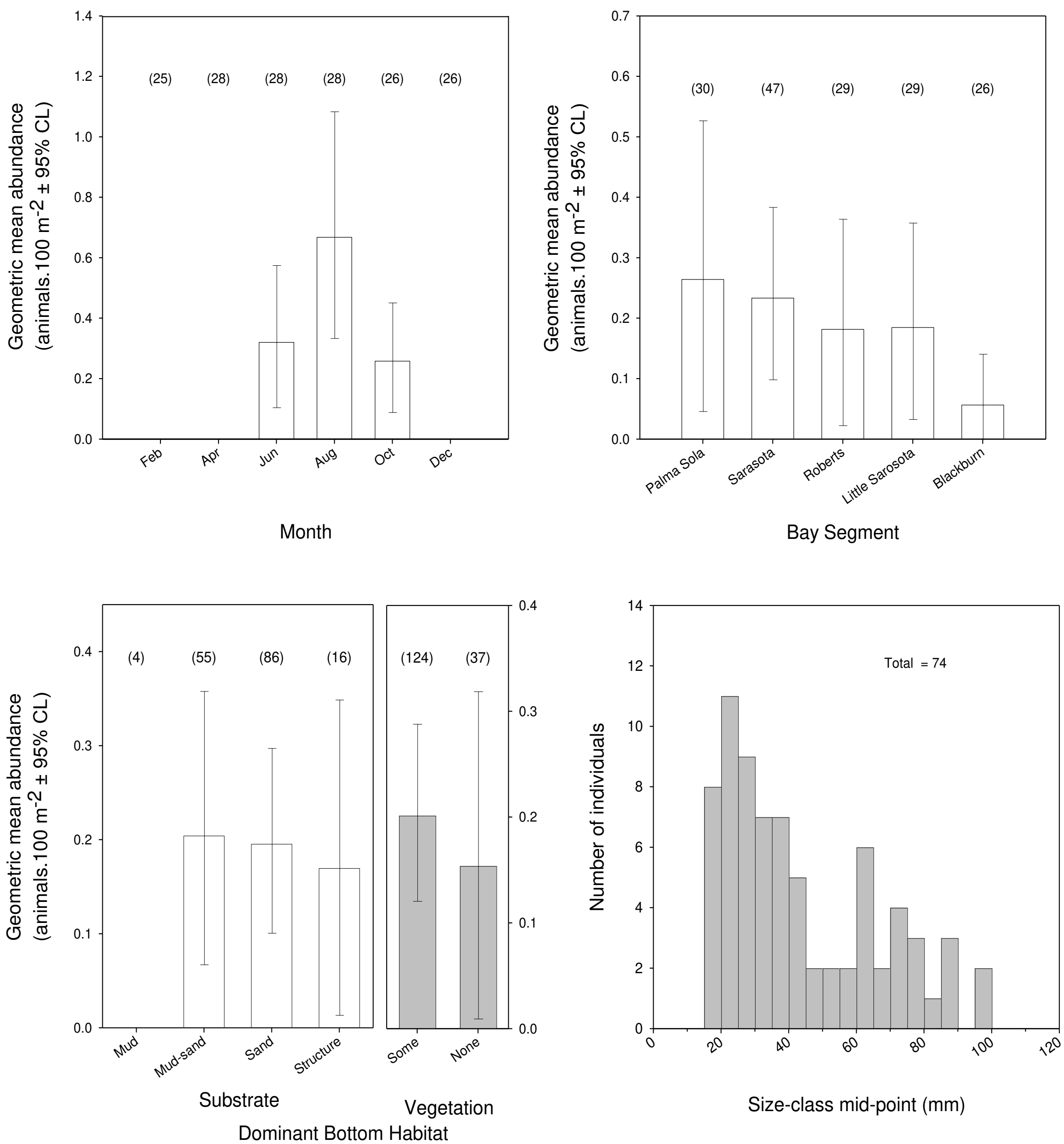


Appendix E Figure 7. Relative abundance and length-frequency distribution of goldspotted killifish collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.



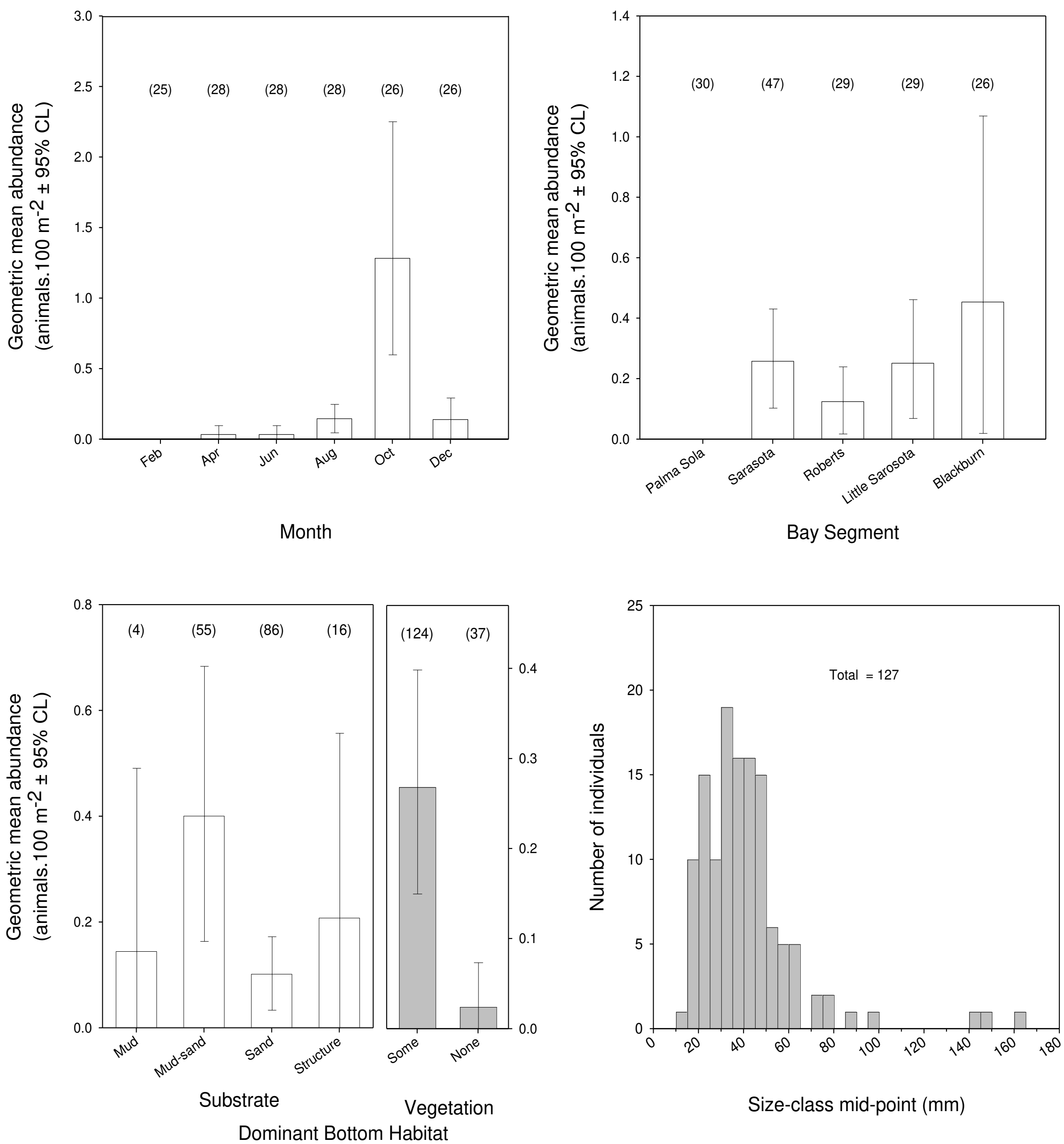
Appendix E Figure 8. Relative abundance and length-frequency distribution of gulf pipefish collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Oligoplites saurus (leatherjack)
21.3-m seine

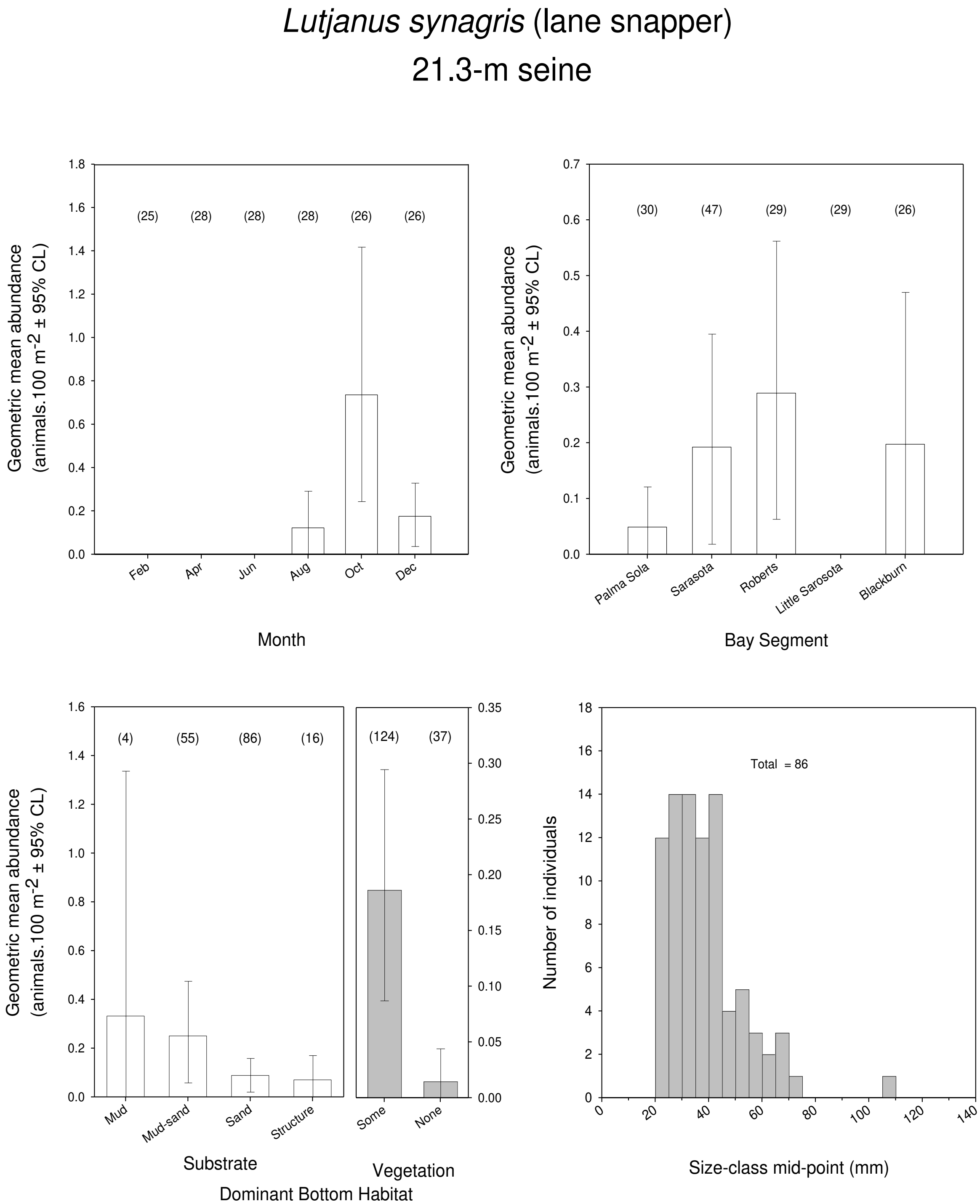


Appendix E Figure 9. Relative abundance and length-frequency distribution of leatherjack collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Lutjanus griseus (gray snapper)
21.3-m seine

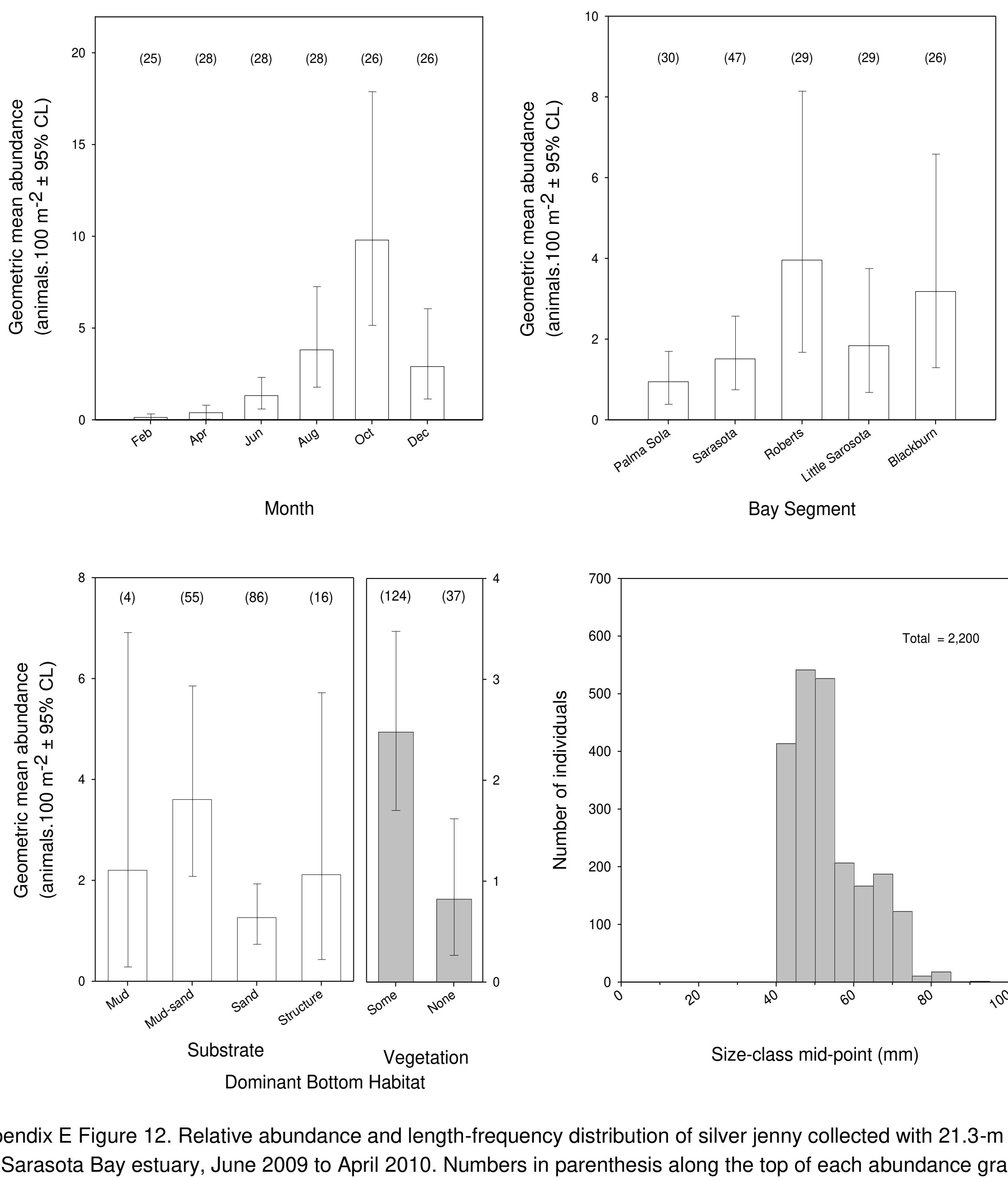


Appendix E Figure 10. Relative abundance and length-frequency distribution of gray snapper collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.



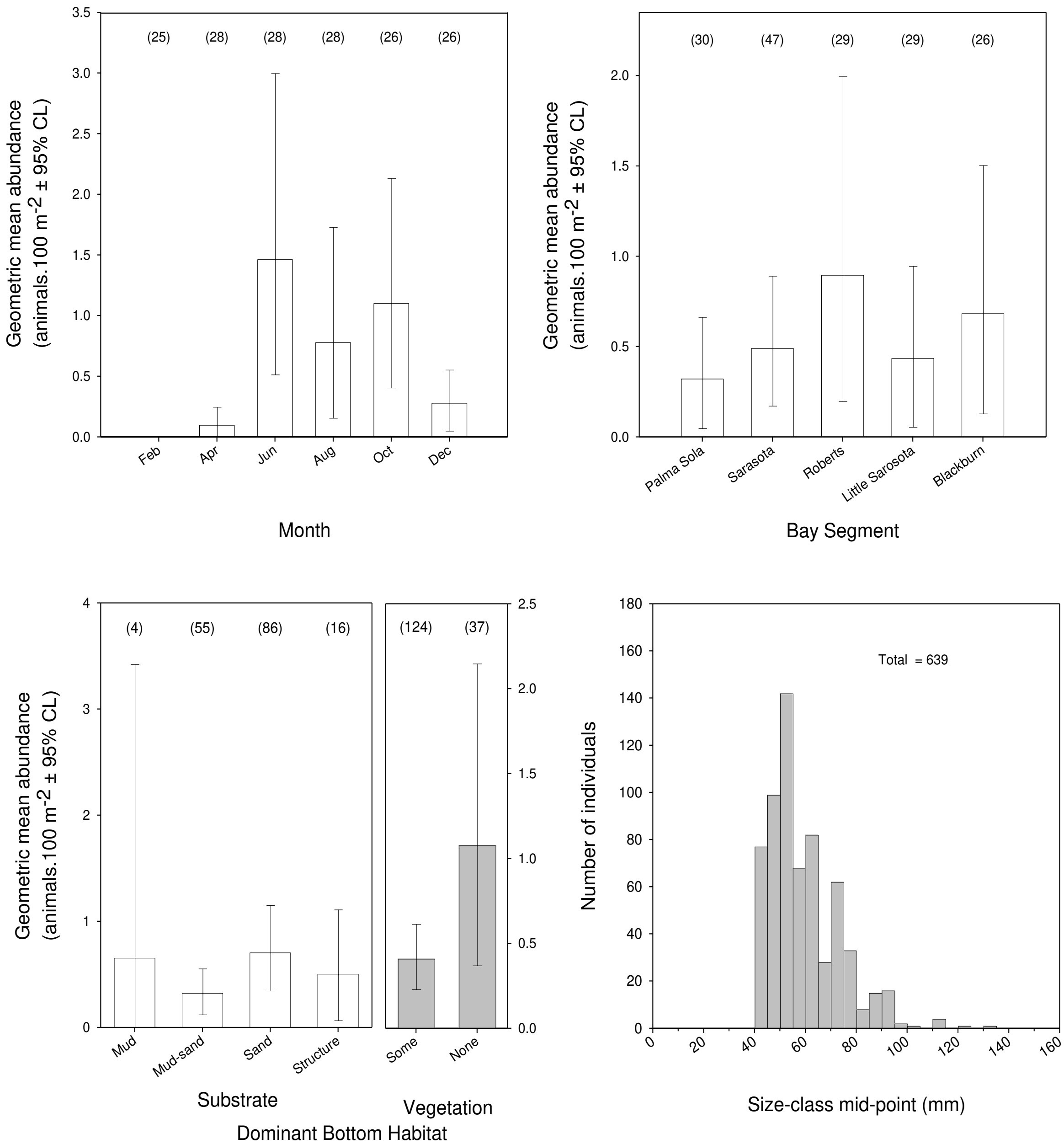
Appendix E Figure 11. Relative abundance and length-frequency distribution of lane snapper collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Eucinostomus gula (silver jenny)
21.3-m seine



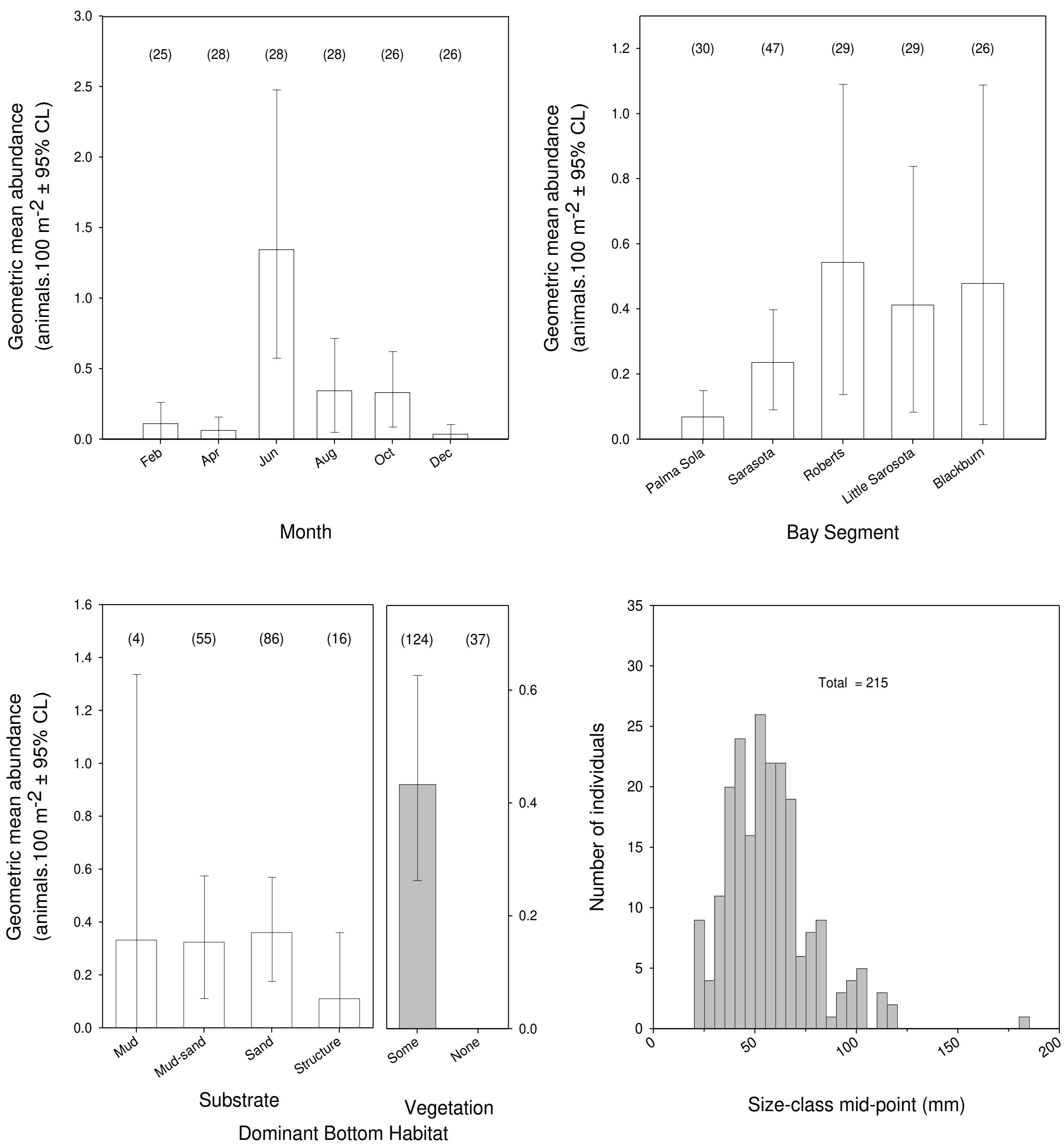
Appendix E Figure 12. Relative abundance and length-frequency distribution of silver jenny collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Eucinostomus harengulus (tidewater mojarra)
21.3-m seine



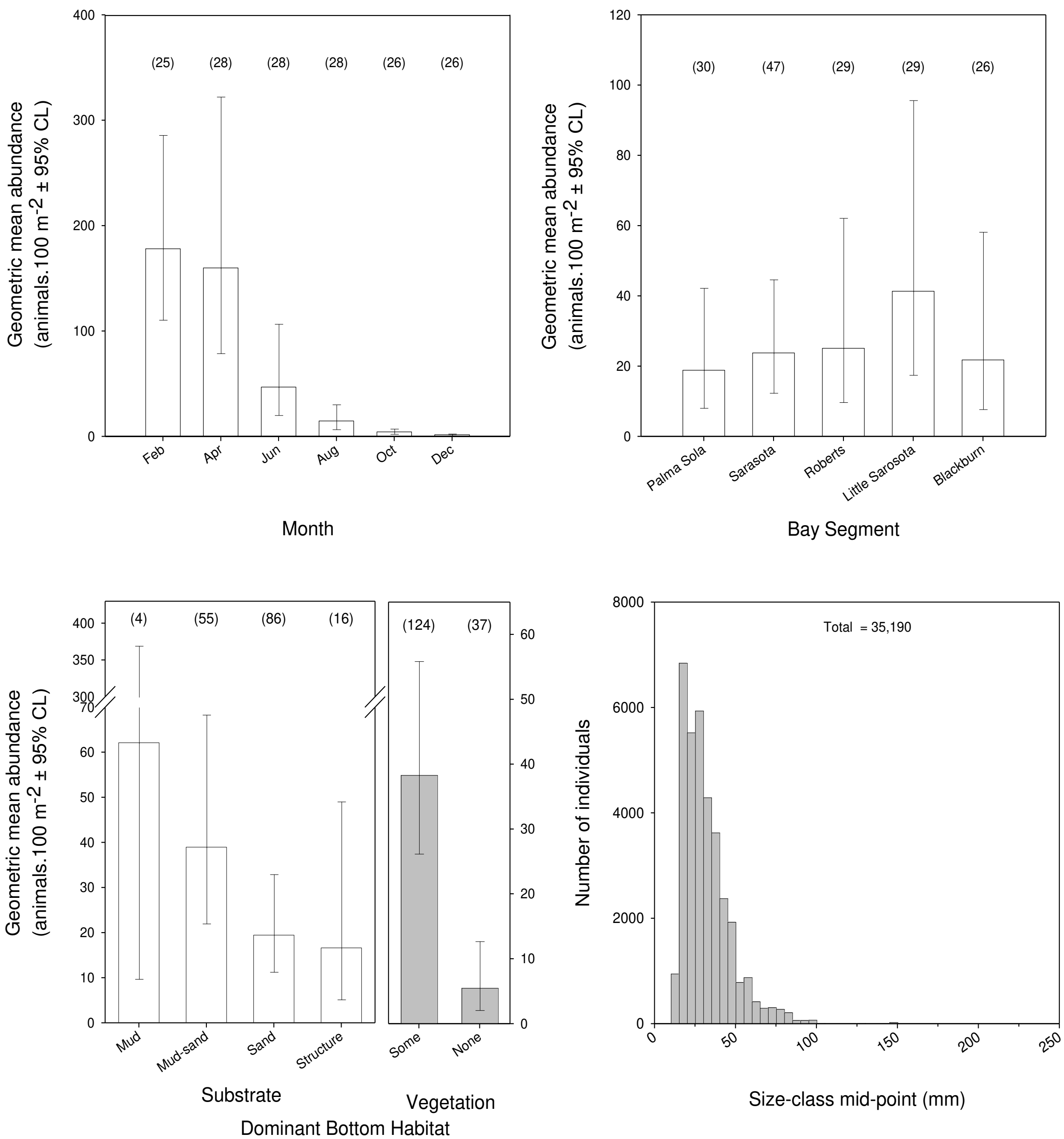
Appendix E Figure 13. Relative abundance and length-frequency distribution of tidewater mojarra collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Orthopristis chrysoptera (pigfish)
21.3-m seine



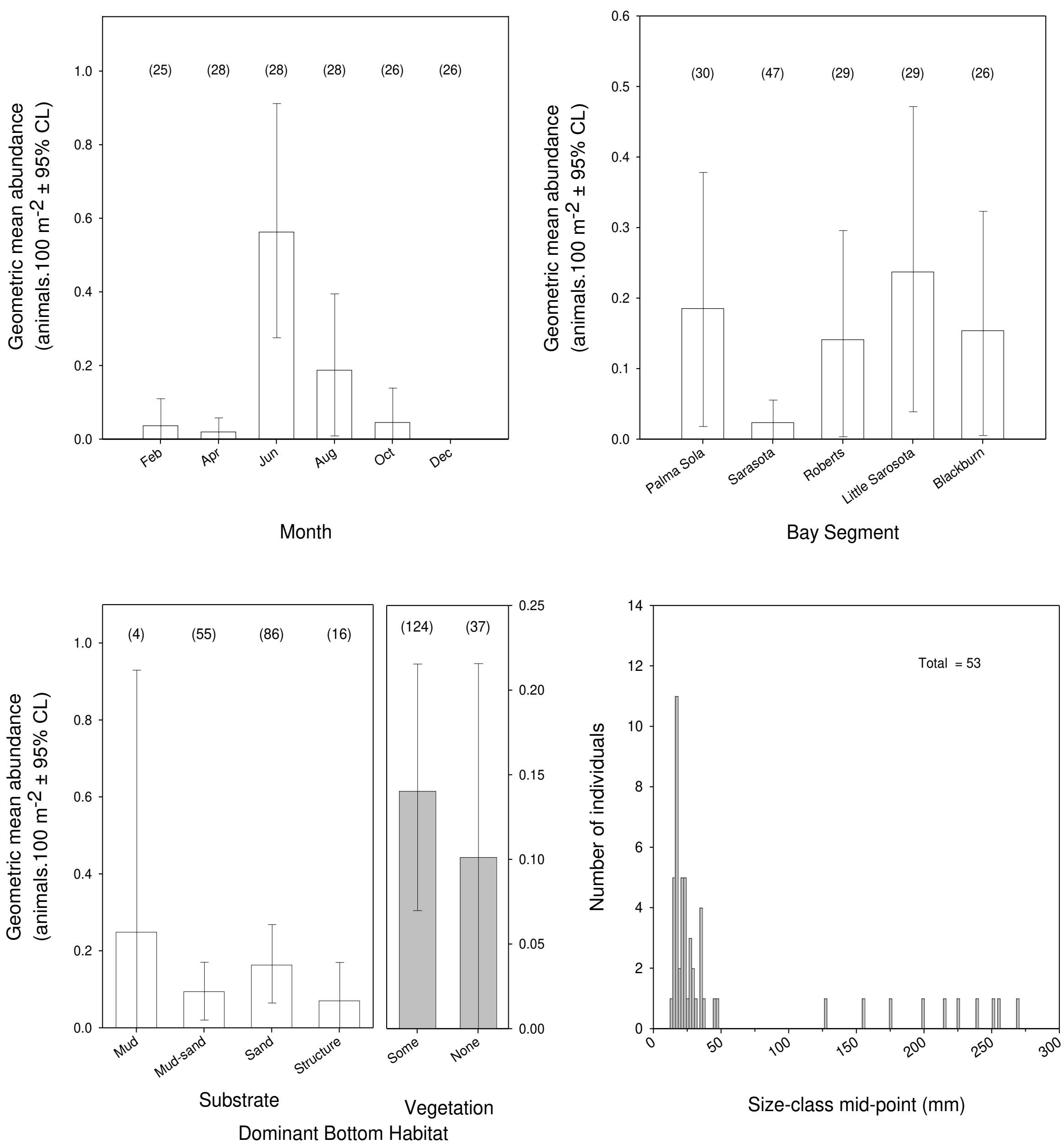
Appendix E Figure 14. Relative abundance and length-frequency distribution of pigfish collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Lagodon rhomboides (pinfish)
21.3-m seine



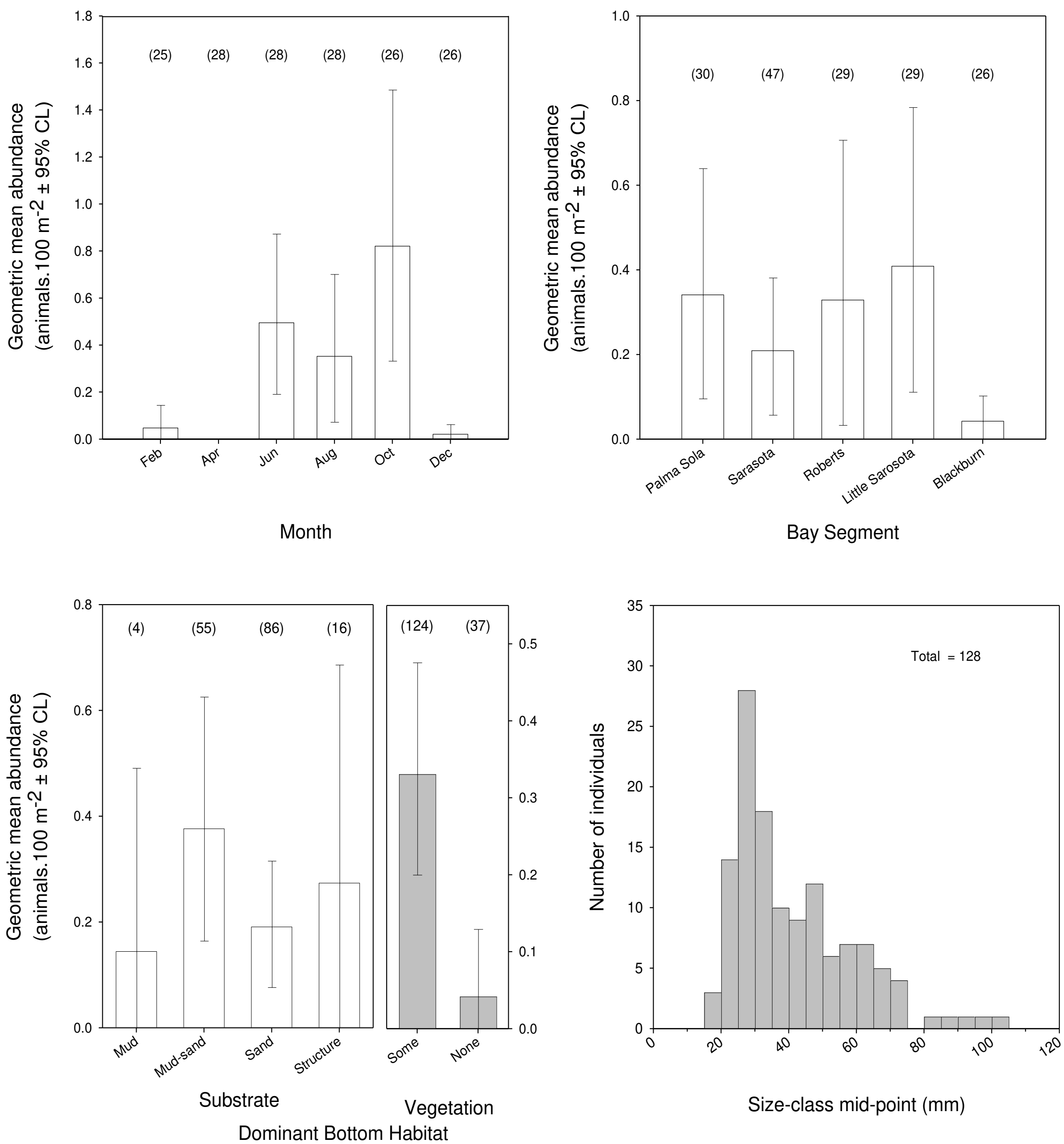
Appendix E Figure 15. Relative abundance and length-frequency distribution of pinfish collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Archosargus probatocephalus (sheepshead)
21.3-m seine



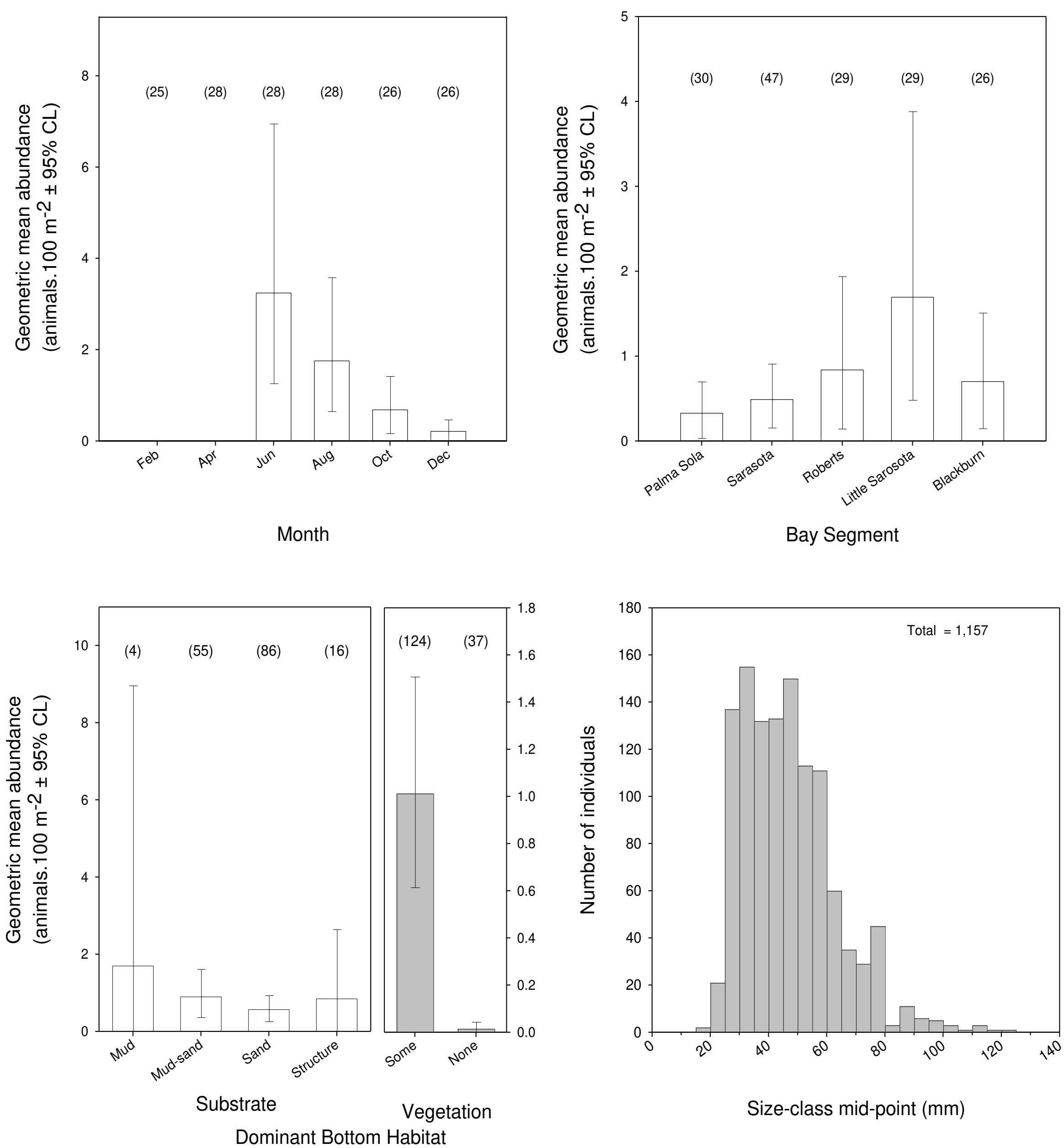
Appendix E Figure 16. Relative abundance and length-frequency distribution of sheepshead collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Cynoscion nebulosus (spotted seatrout)
21.3-m seine



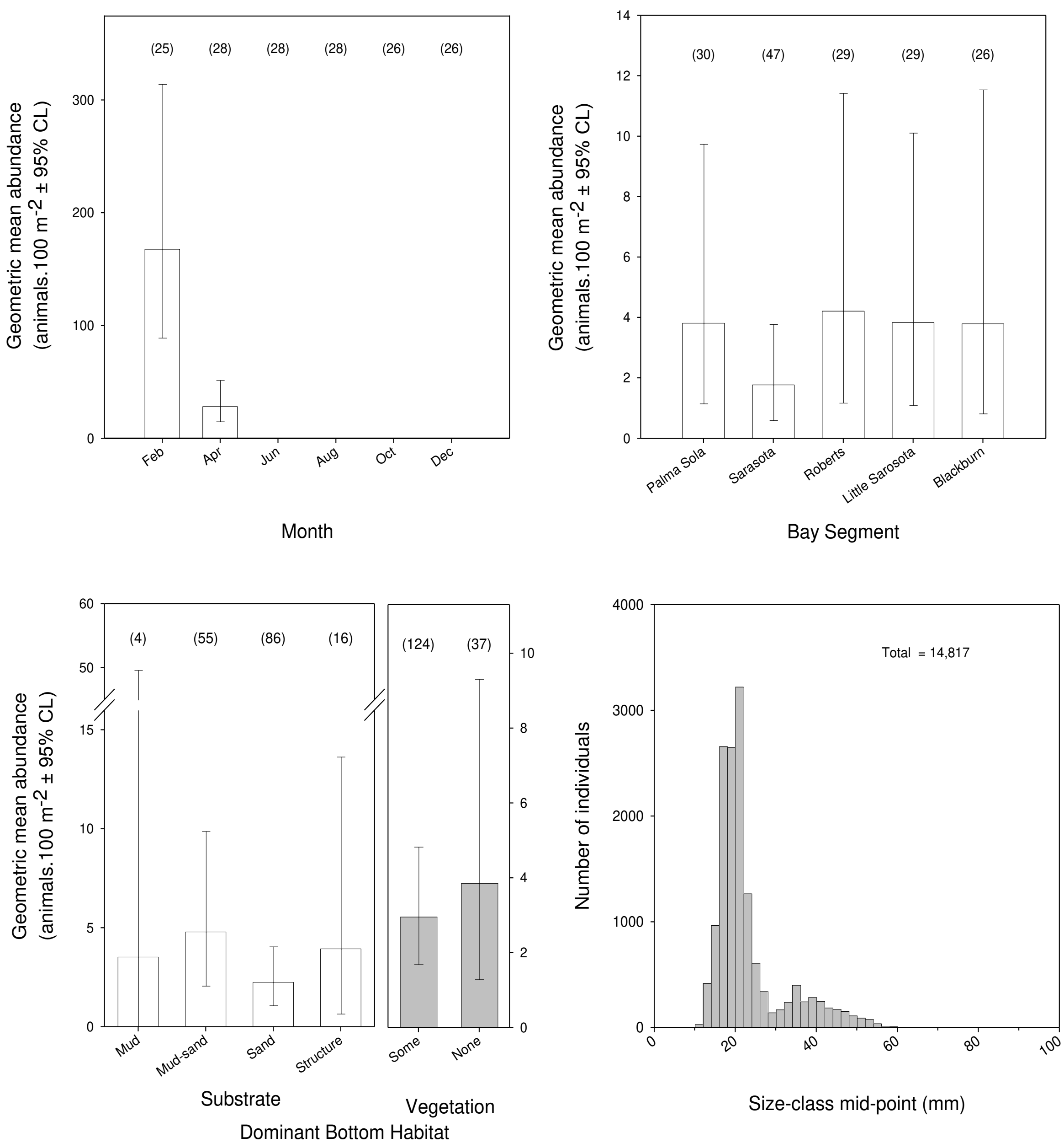
Appendix E Figure 17. Relative abundance and length-frequency distribution of spotted seatrout collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Bairdiella chrysoura (silver perch)
21.3-m seine



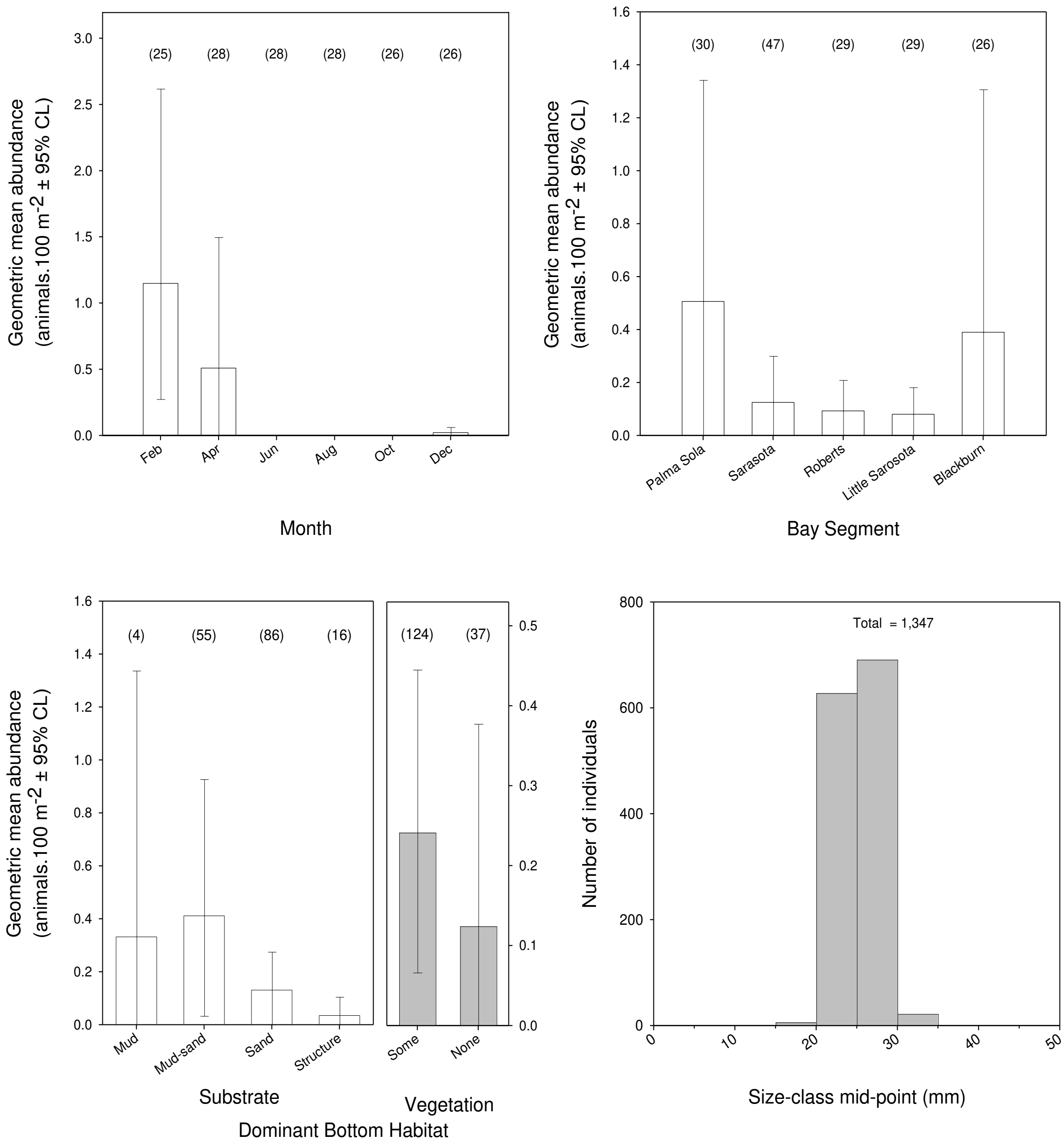
Appendix E Figure 18. Relative abundance and length-frequency distribution of silver perch collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Leiostomus xanthurus (spot)
21.3-m seine



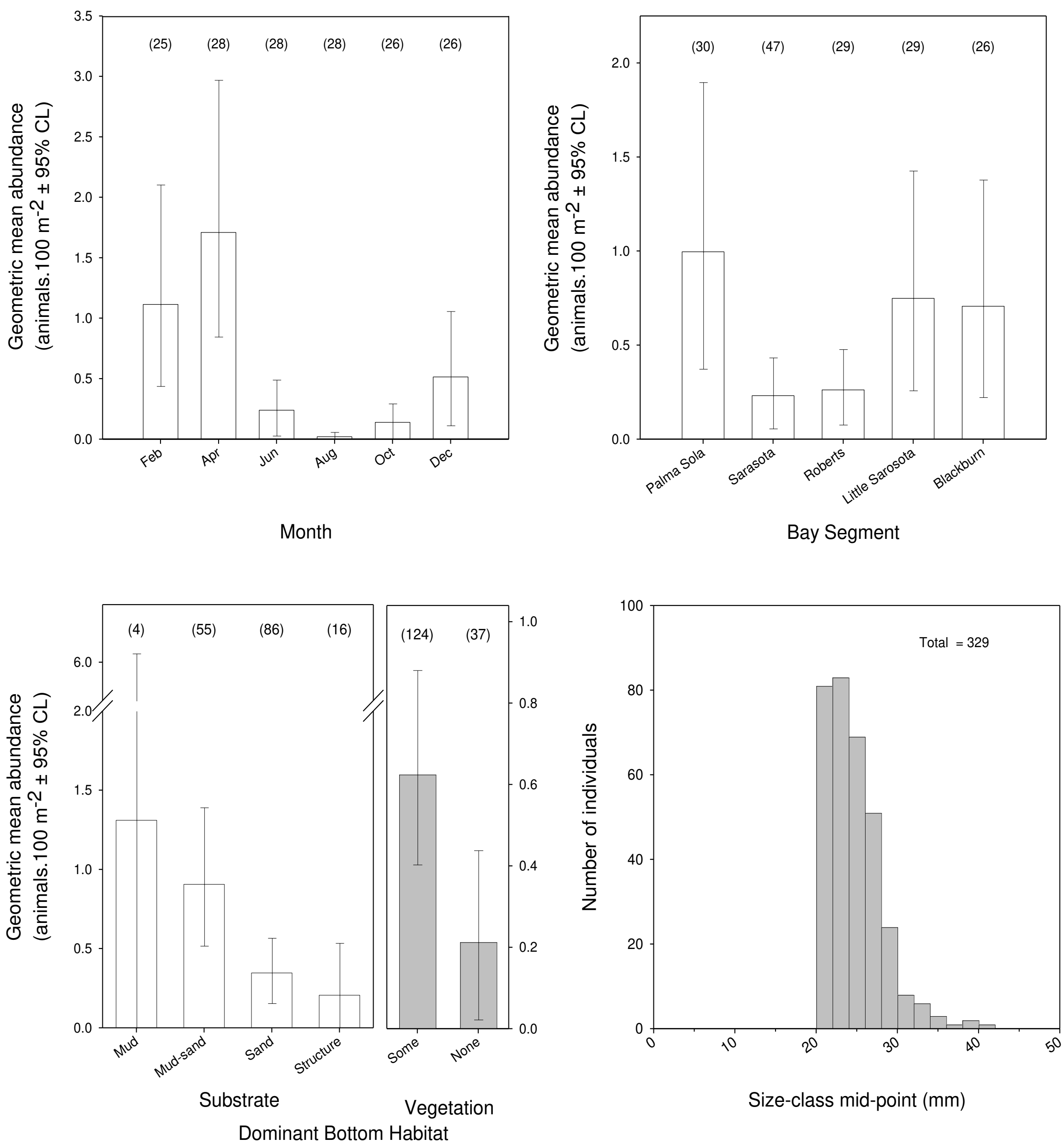
Appendix E Figure 19. Relative abundance and length-frequency distribution of spot collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Mugil cephalus (striped mullet)
21.3-m seine



Appendix E Figure 20. Relative abundance and length-frequency distribution of striped mullet collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

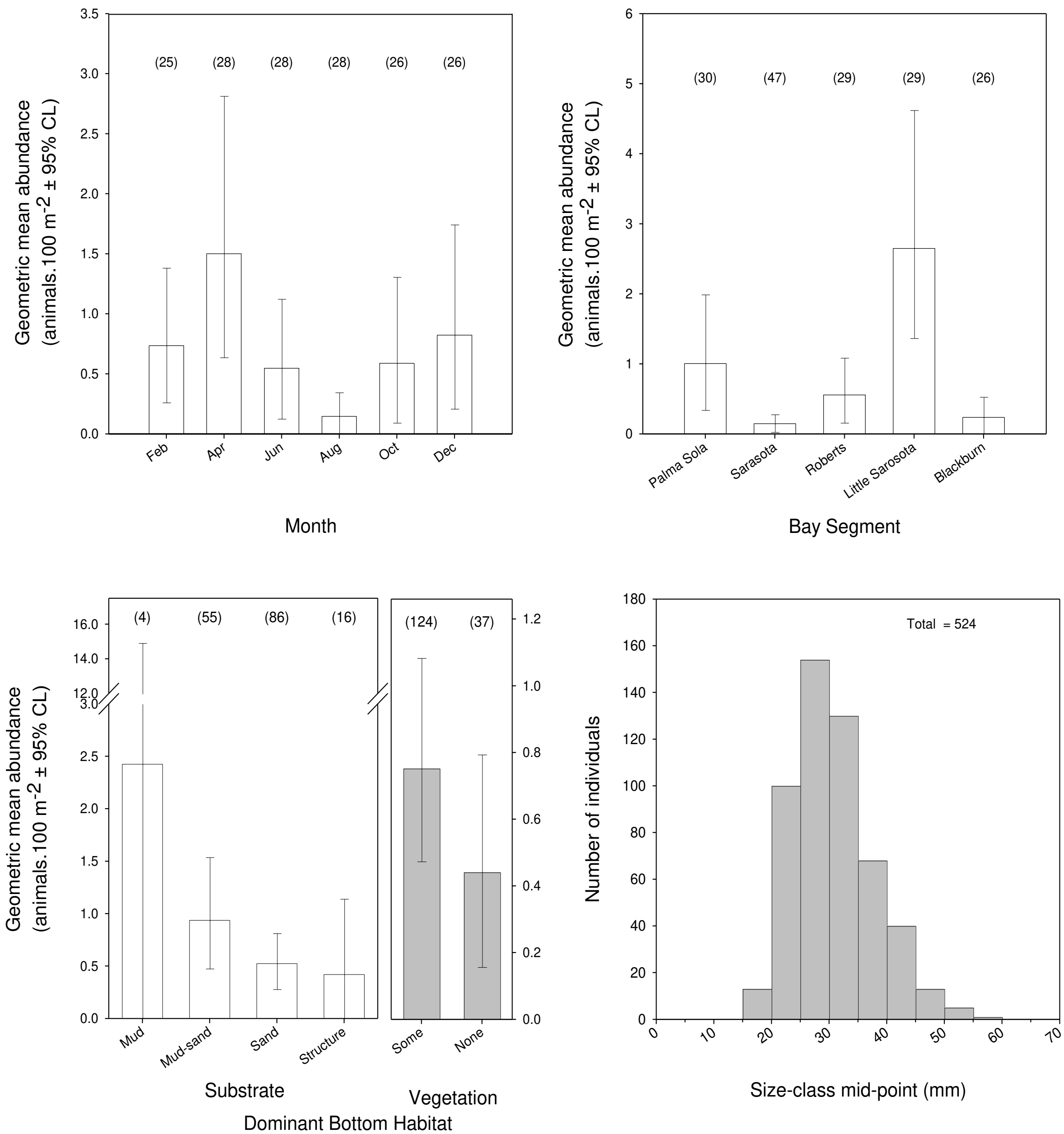
Gobiosoma robustum (code goby)
21.3-m seine



Appendix E Figure 21. Relative abundance and length-frequency distribution of code goby collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Microgobius gulosus (clown goby)

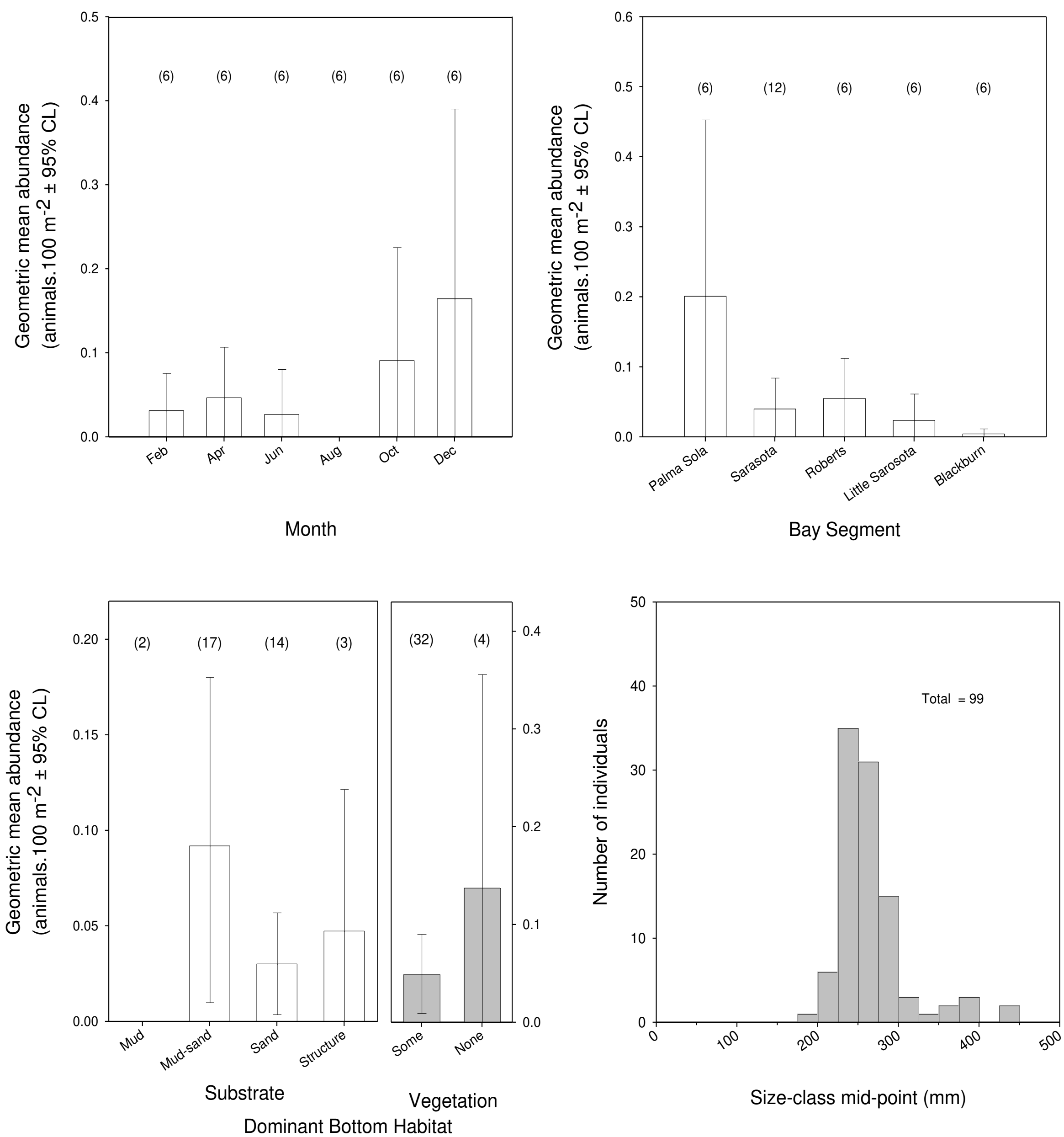
21.3-m seine



Appendix E Figure 22. Relative abundance and length-frequency distribution of clown goby collected with 21.3-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Appendix F. Species overview plots for dominant taxa (≥40 animals collected and ≥10 occurrence in a gear type) collected with183-m seines. Taxa are arranged phylogenetically.

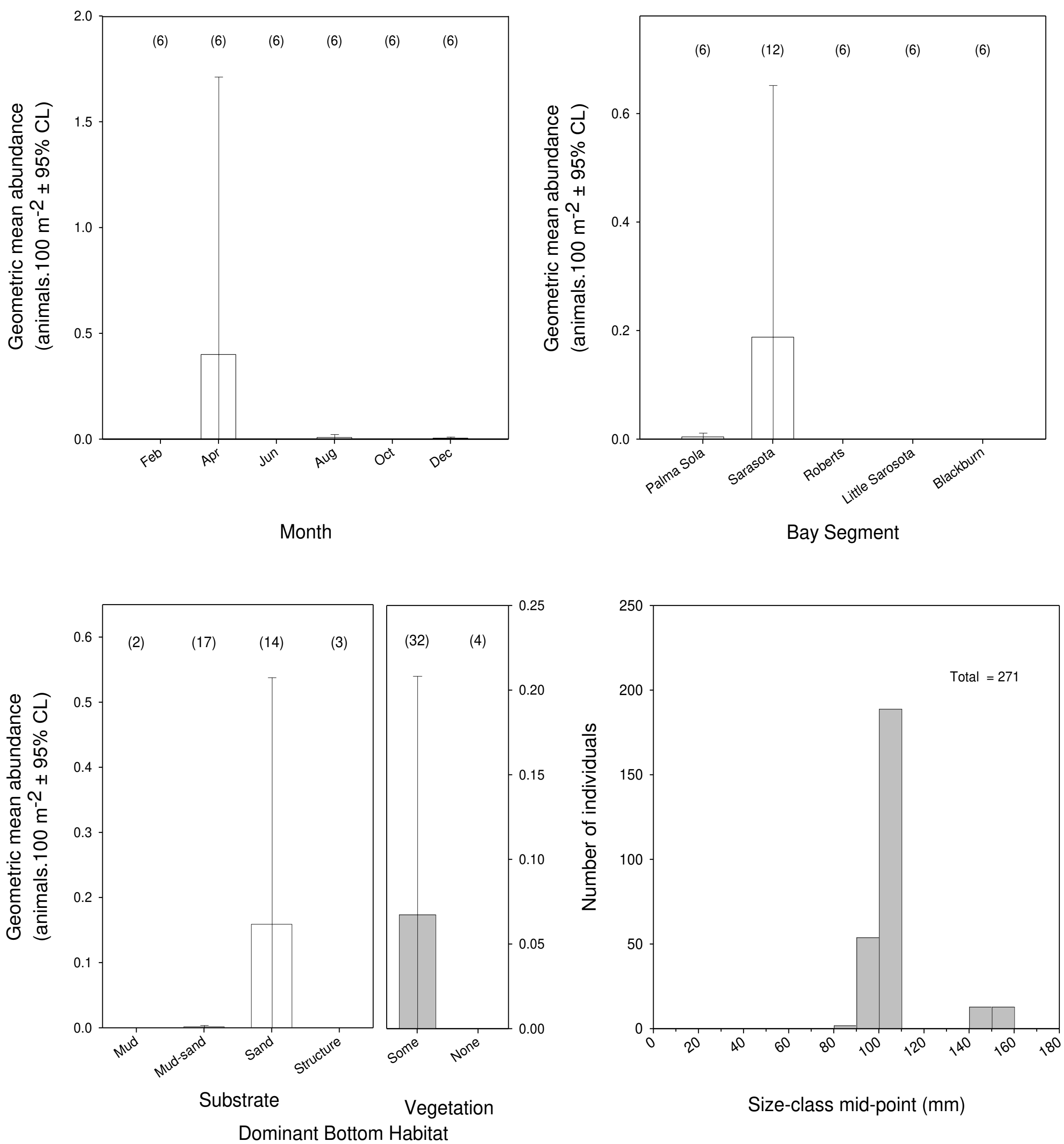
Elops saurus (ladyfish)
183-m seine



Appendix F Figure 1. Relative abundance and length-frequency distribution of ladyfish collected with 183-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

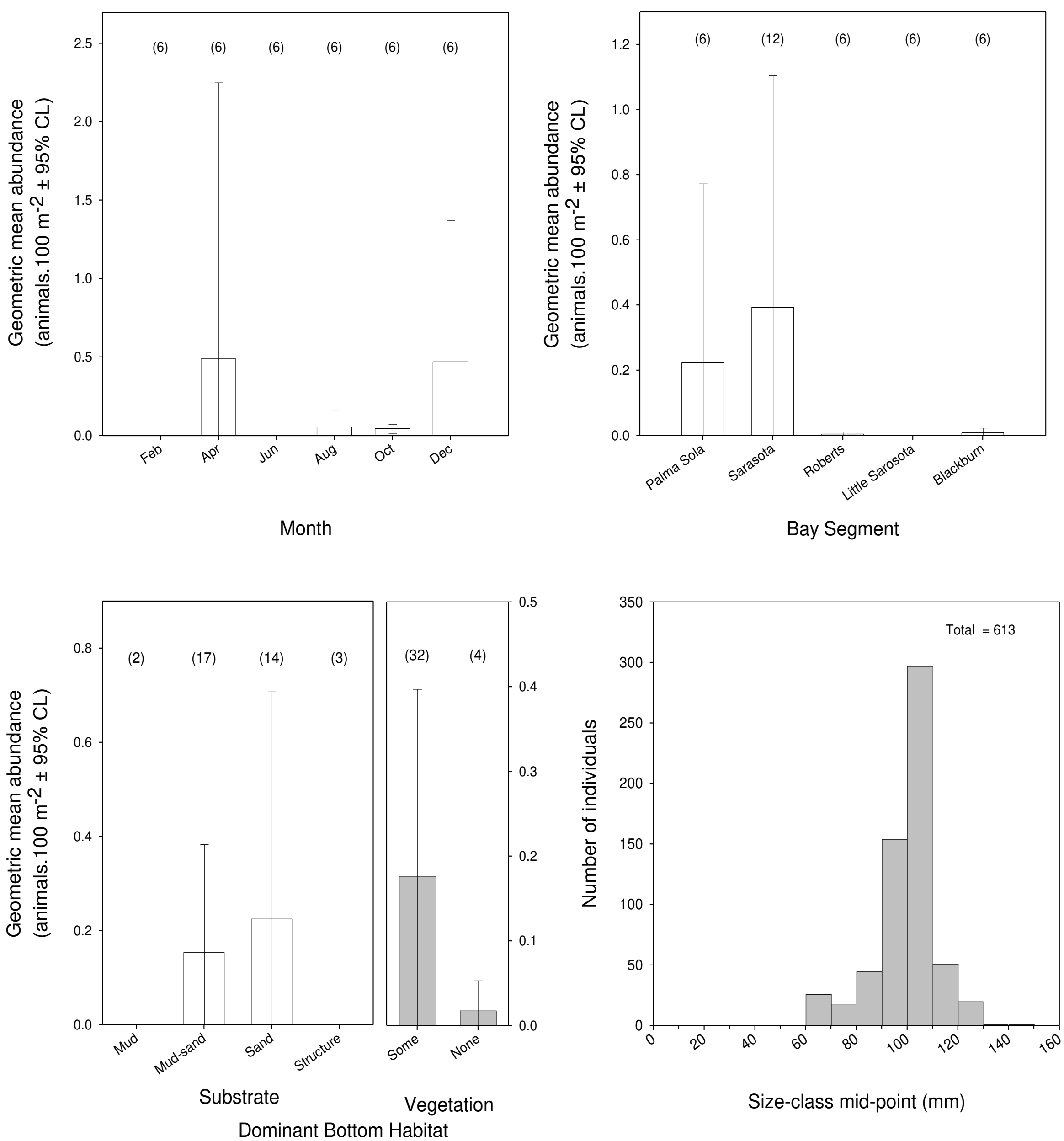
Opisthonema oglinum (atlantic thread herring)

183-m seine



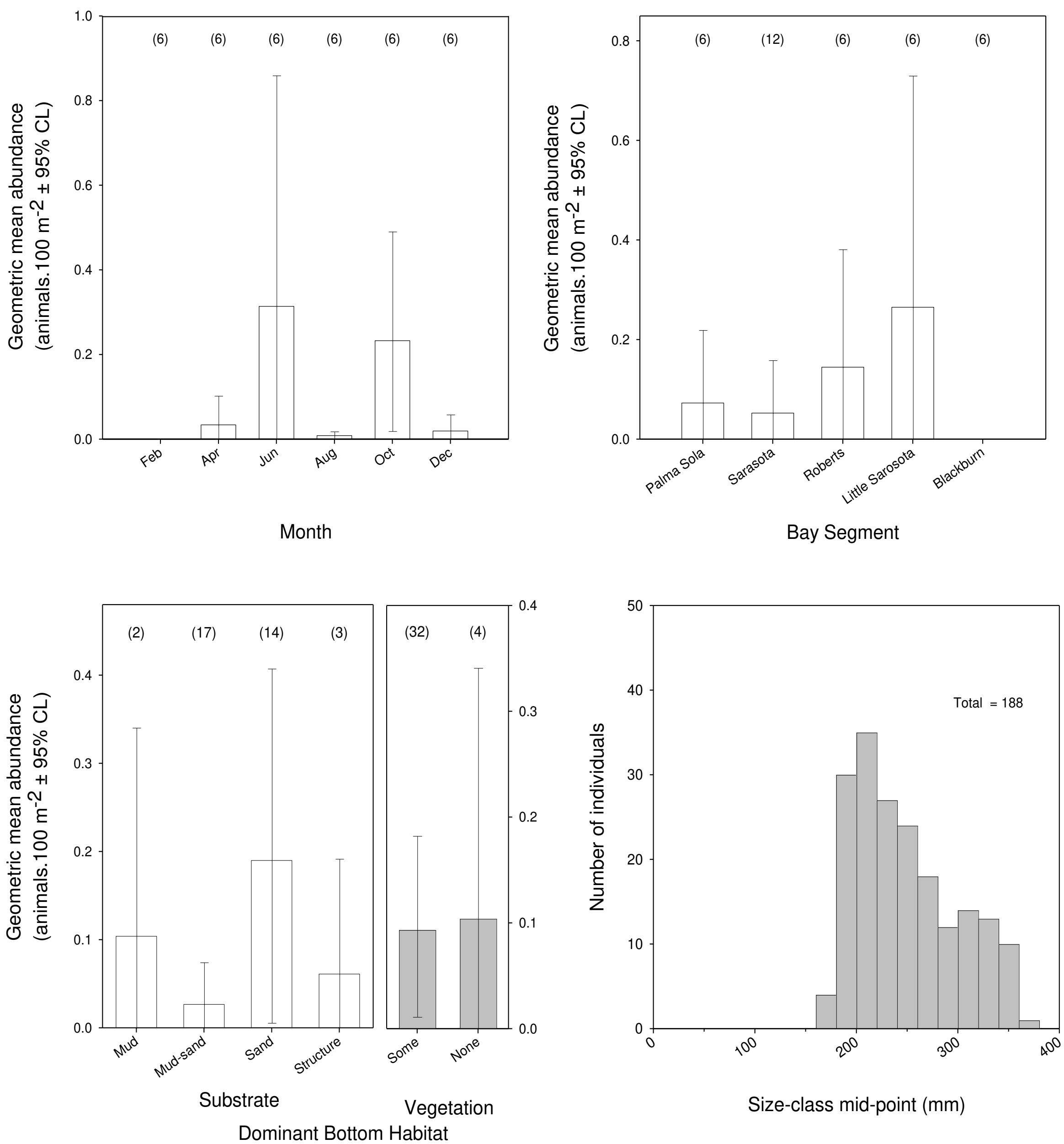
Appendix F Figure 2. Relative abundance and length-frequency distribution of atlantic thread herring collected with 183-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Harengula jaguana (scaled sardine)
183-m seine



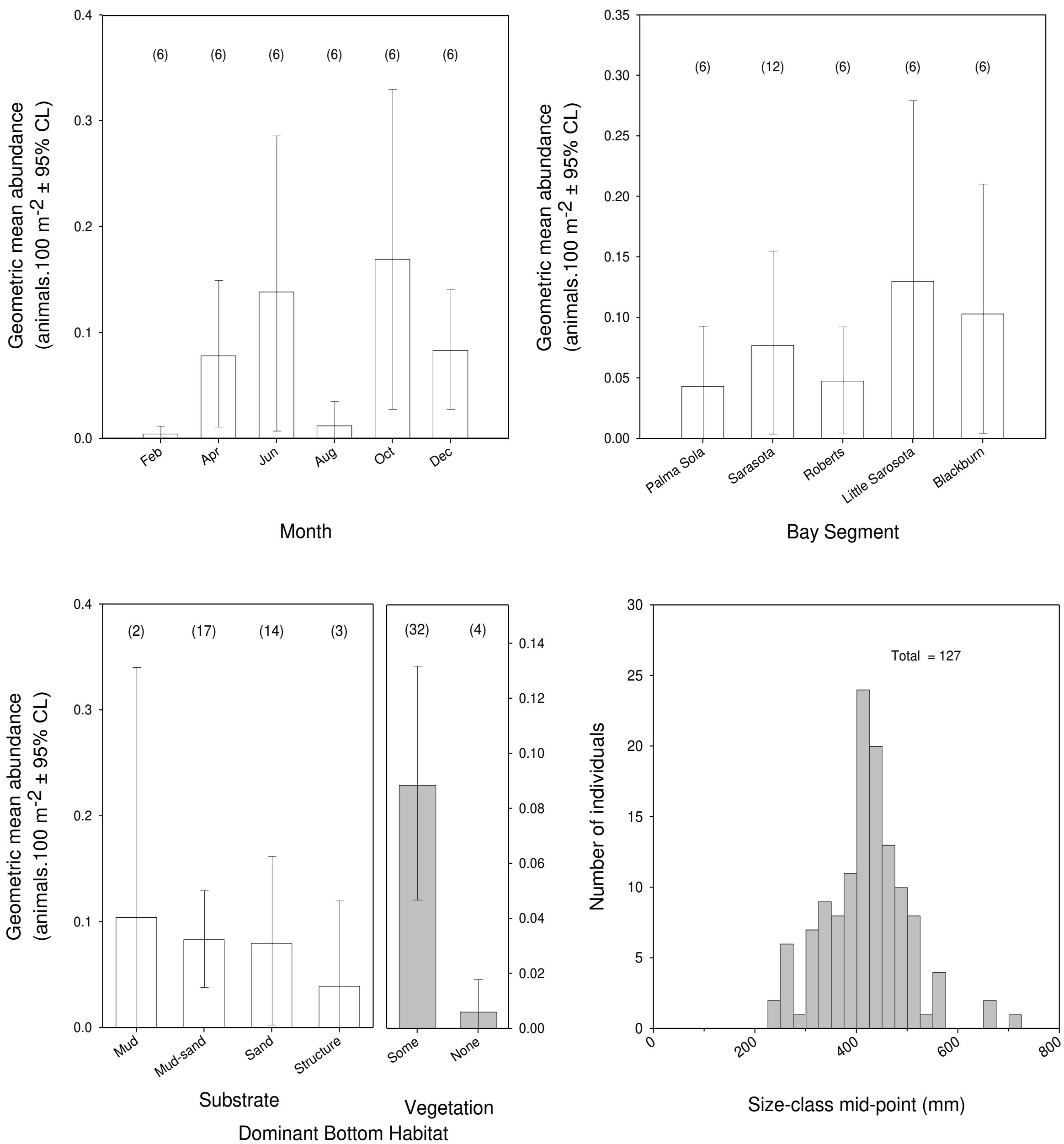
Appendix F Figure 3. Relative abundance and length-frequency distribution of scaled sardine collected with 183-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Ariopsis felis (hardhead catfish)
183-m seine



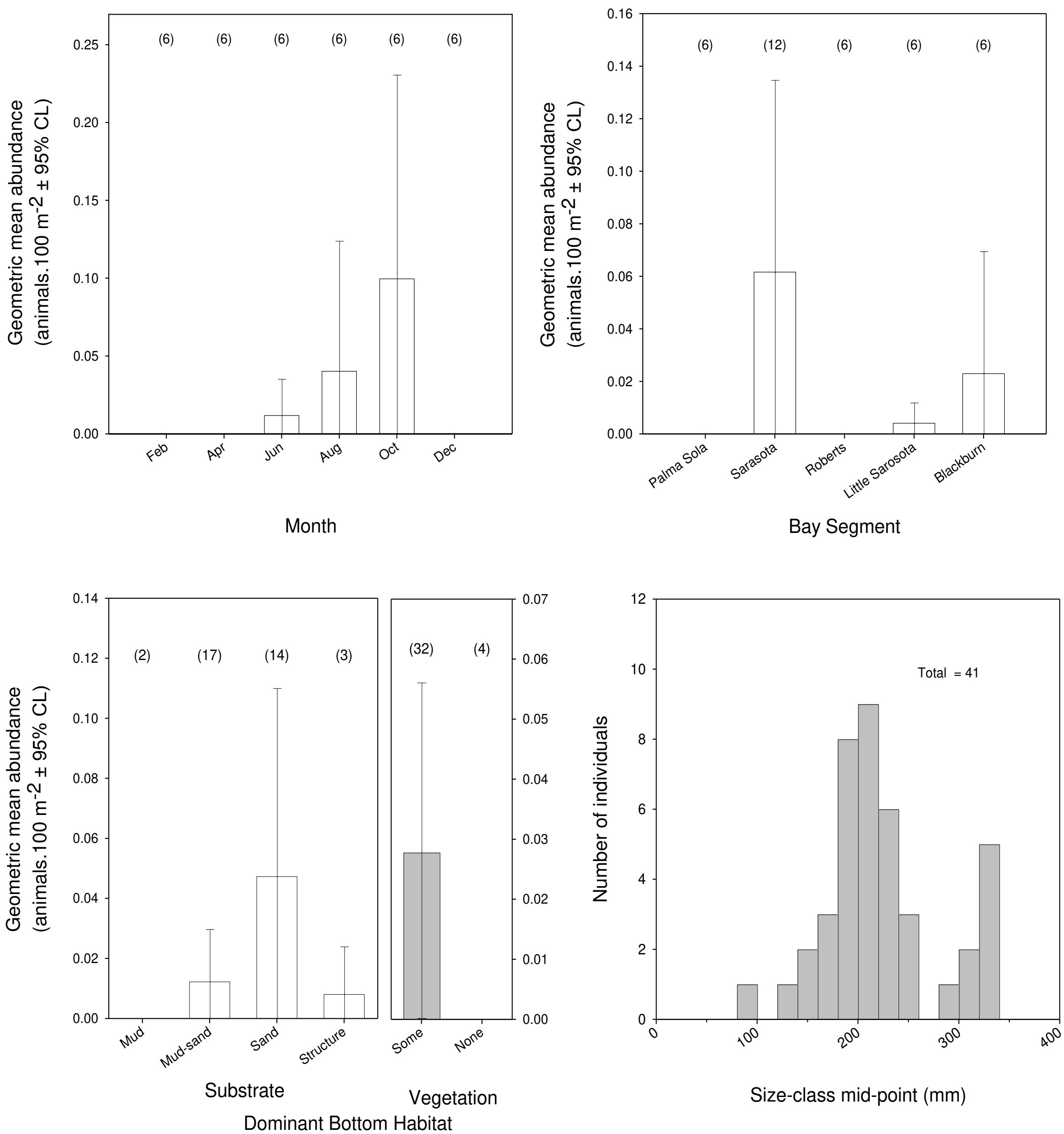
Appendix F Figure 4. Relative abundance and length-frequency distribution of hardhead catfish collected with 183-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Centropomus undecimalis (common snook)
183-m seine



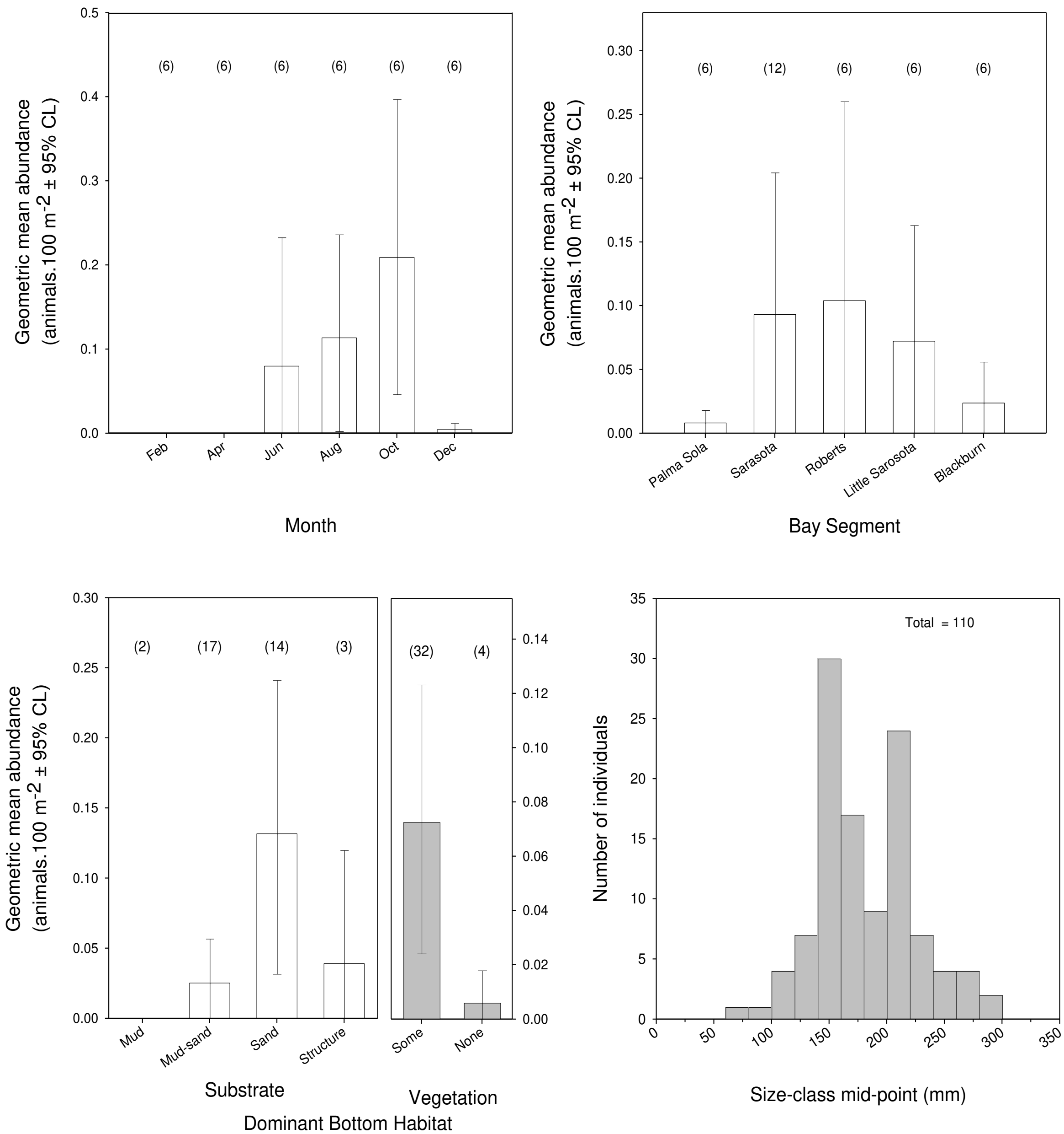
Appendix F Figure 5. Relative abundance and length-frequency distribution of common snook collected with 183-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Mycteroperca microlepis (gag)
183-m seine



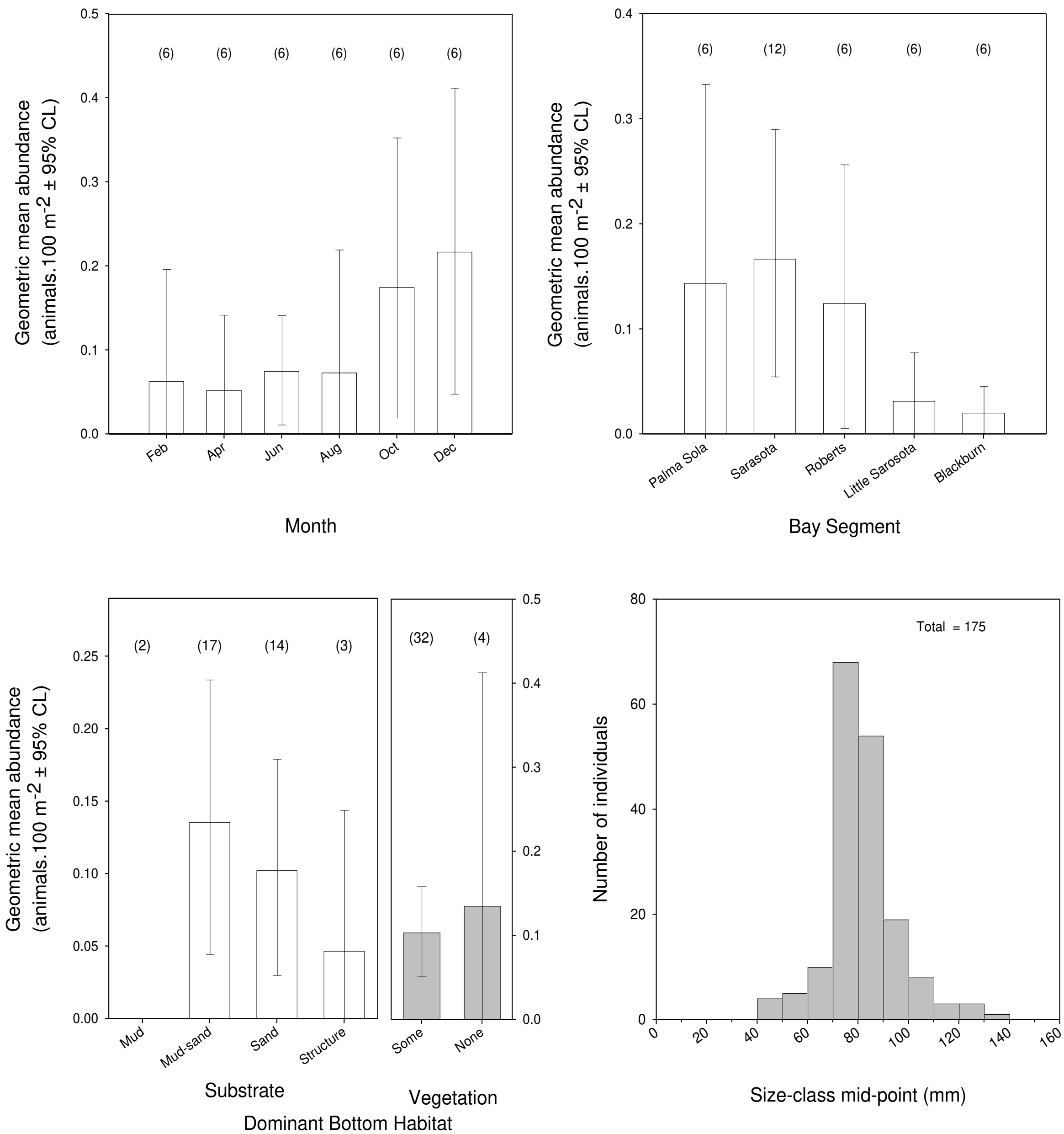
Appendix F Figure 6. Relative abundance and length-frequency distribution of gag collected with 183-m seine in th Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Lutjanus griseus (gray snapper)
183-m seine



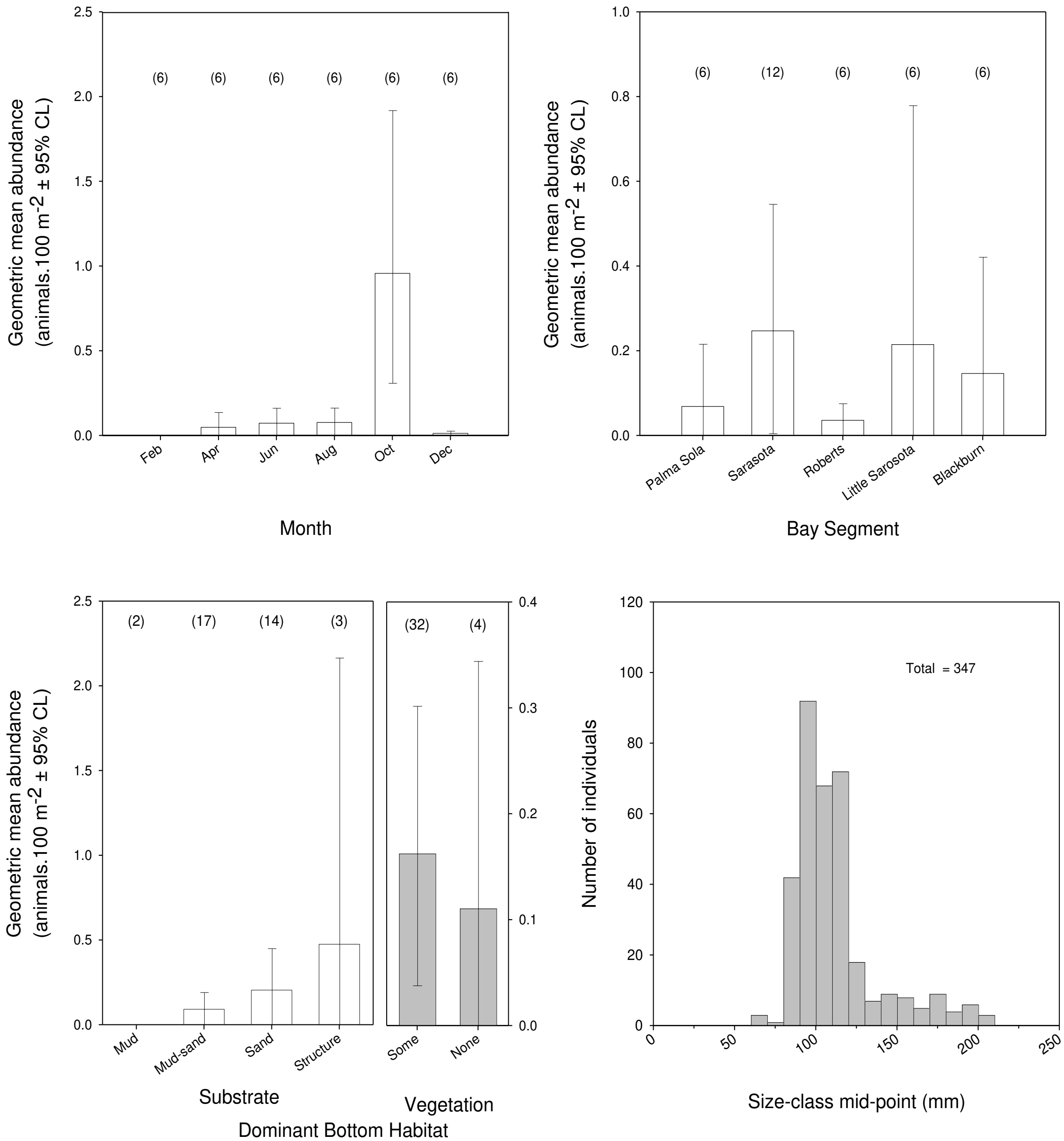
Appendix F Figure 7. Relative abundance and length-frequency distribution of gray snapper collected with 183-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Eucinostomus gula (silver jenny)
183-m seine



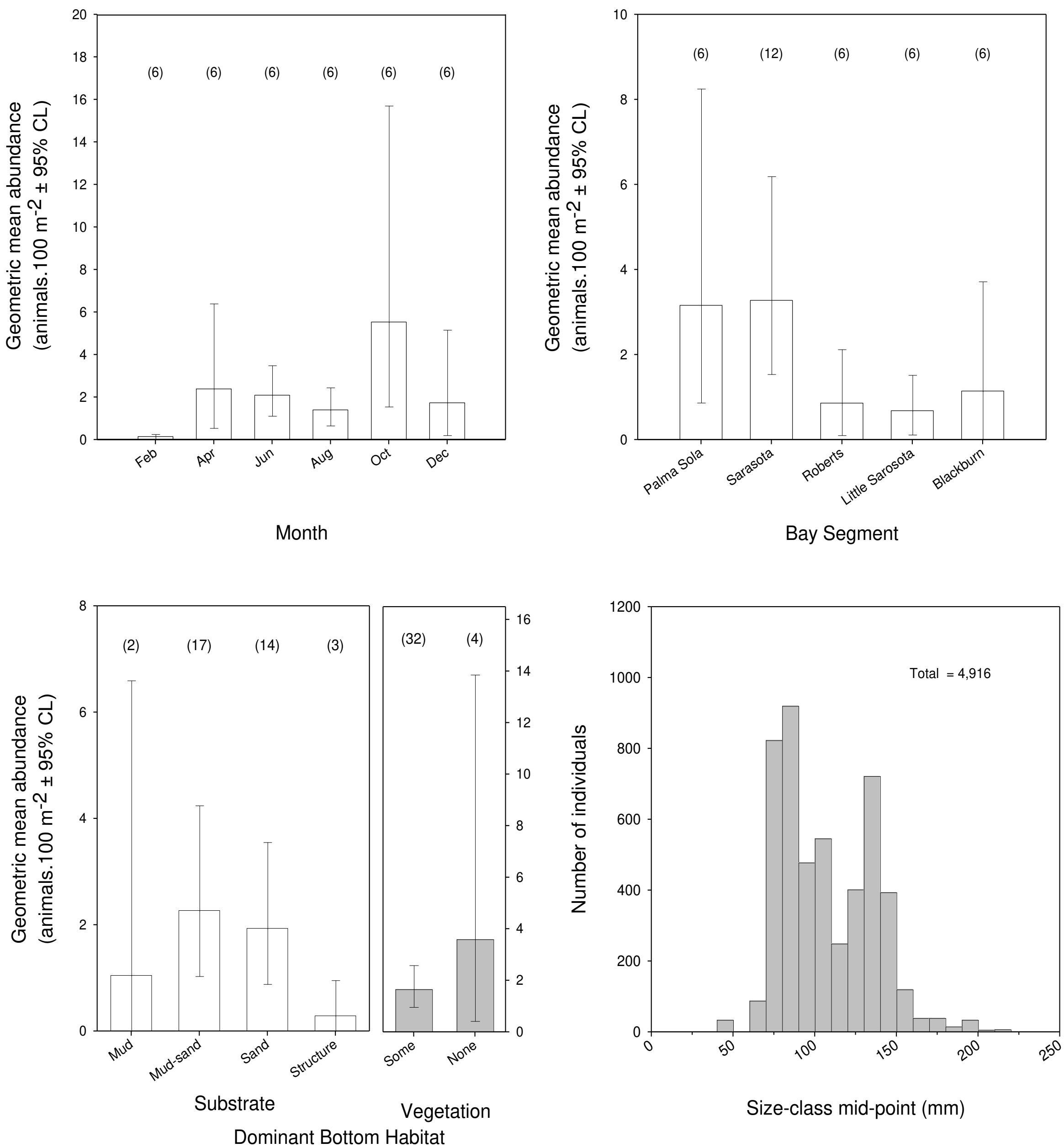
Appendix F Figure 8. Relative abundance and length-frequency distribution of silver jenny collected with 183-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Orthopristis chrysoptera (pigfish)
183-m seine



Appendix F Figure 9. Relative abundance and length-frequency distribution of pigfish collected with 183-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

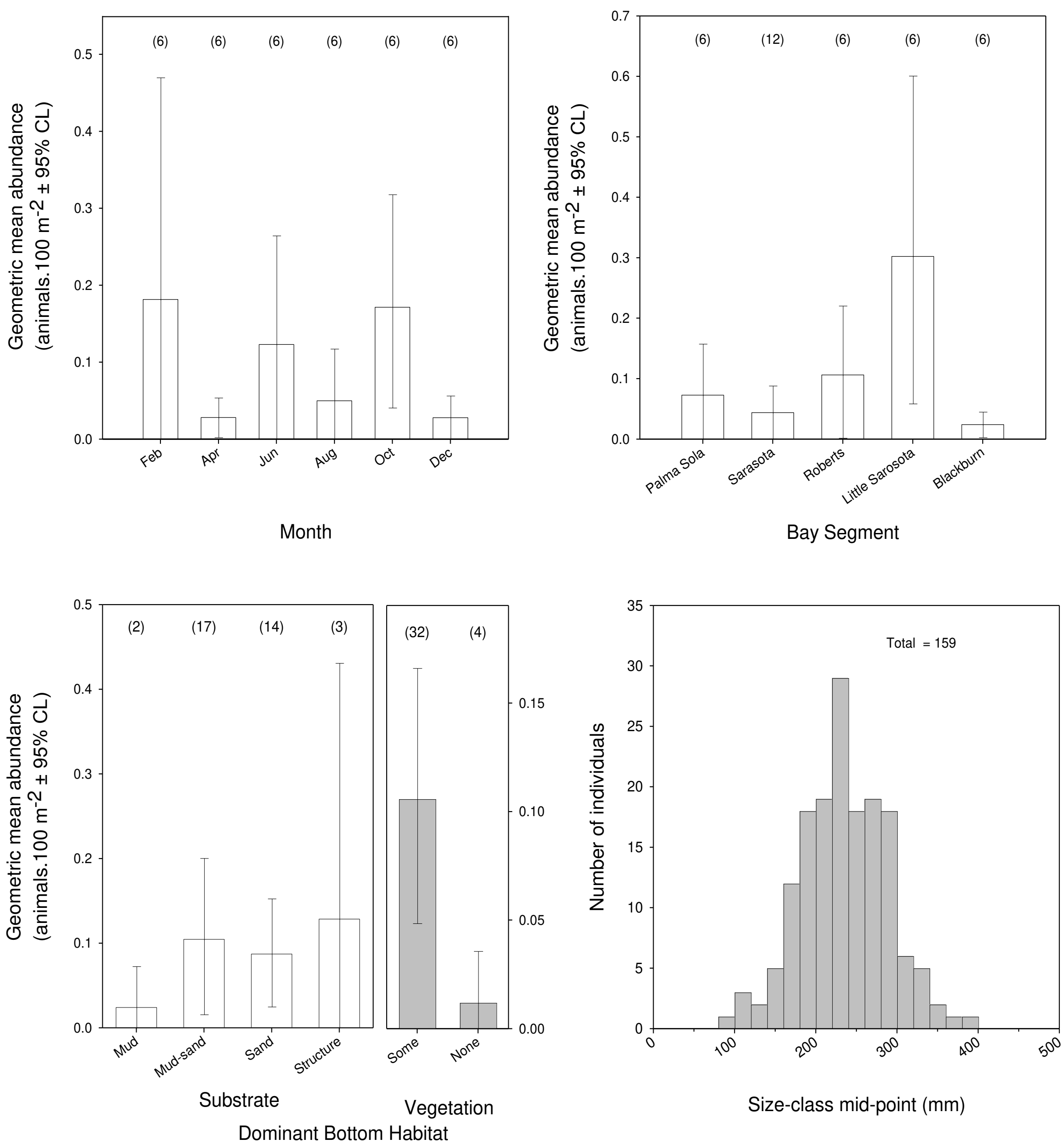
Lagodon rhomboides (pinfish)
183-m seine



Appendix F Figure 10. Relative abundance and length-frequency distribution of pinfish collected with 183-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

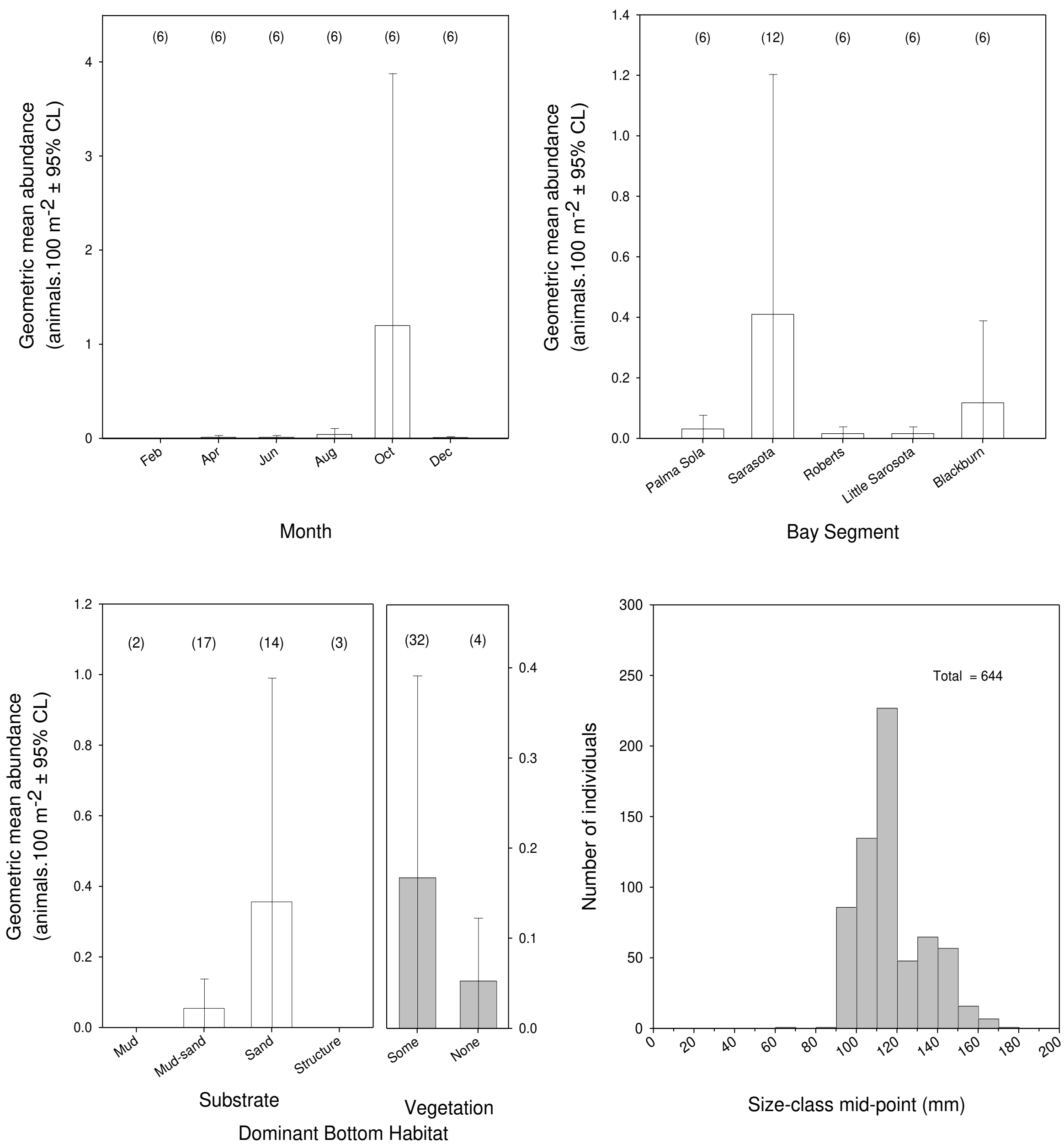
Archosargus probatocephalus (sheepshead)

183-m seine



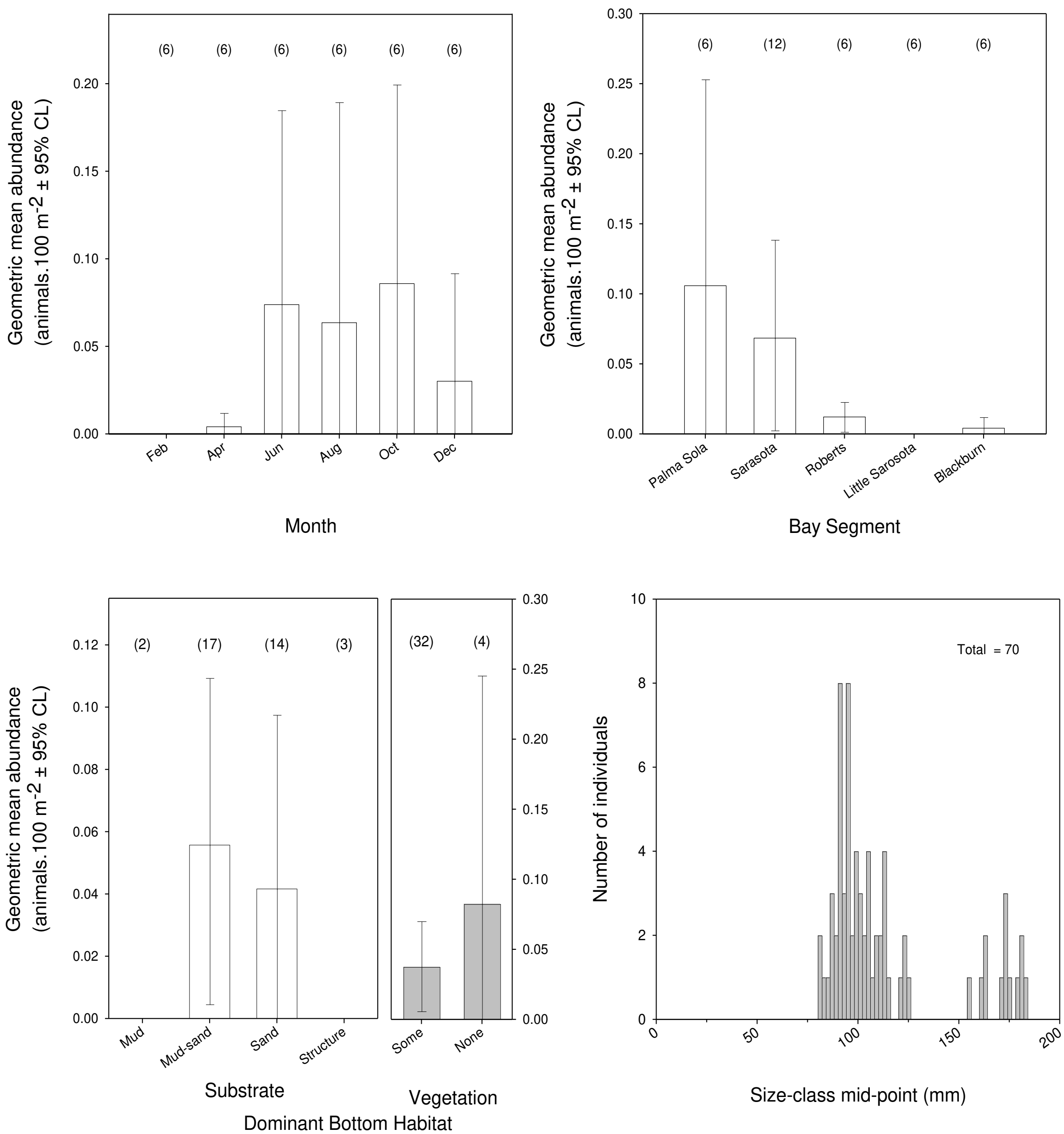
Appendix F Figure 11. Relative abundance and length-frequency distribution of sheepshead collected with 183-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Bairdiella chrysoura (silver perch)
183-m seine



Appendix F Figure 12. Relative abundance and length-frequency distribution of silver perch collected with 183-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

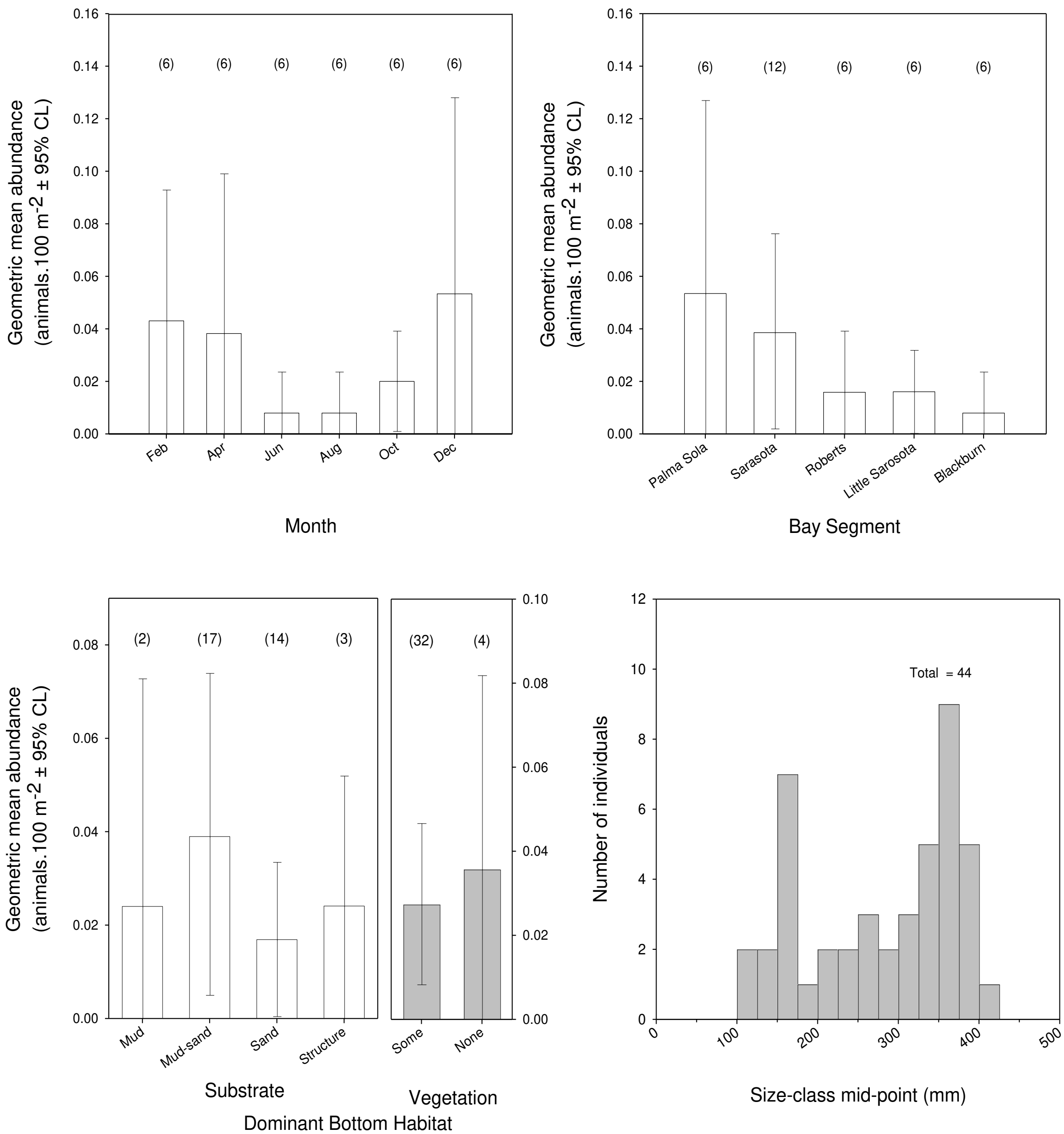
Leiostomus xanthurus (spot)
183-m seine



Appendix F Figure 13. Relative abundance and length-frequency distribution of spot collected with 183-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

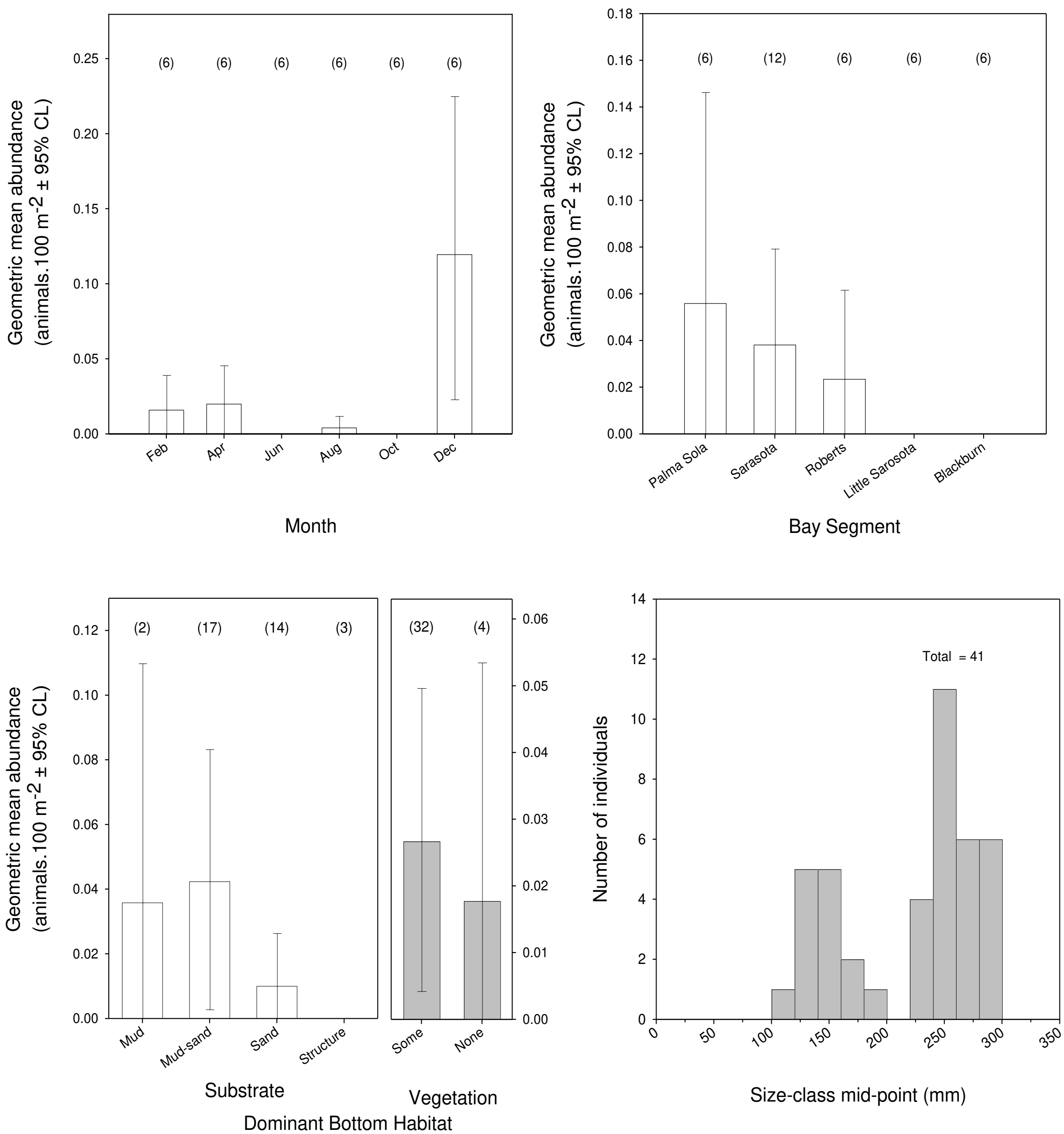
Mugil cephalus (striped mullet)

183-m seine



Appendix F Figure 14. Relative abundance and length-frequency distribution of striped mullet collected with 183-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

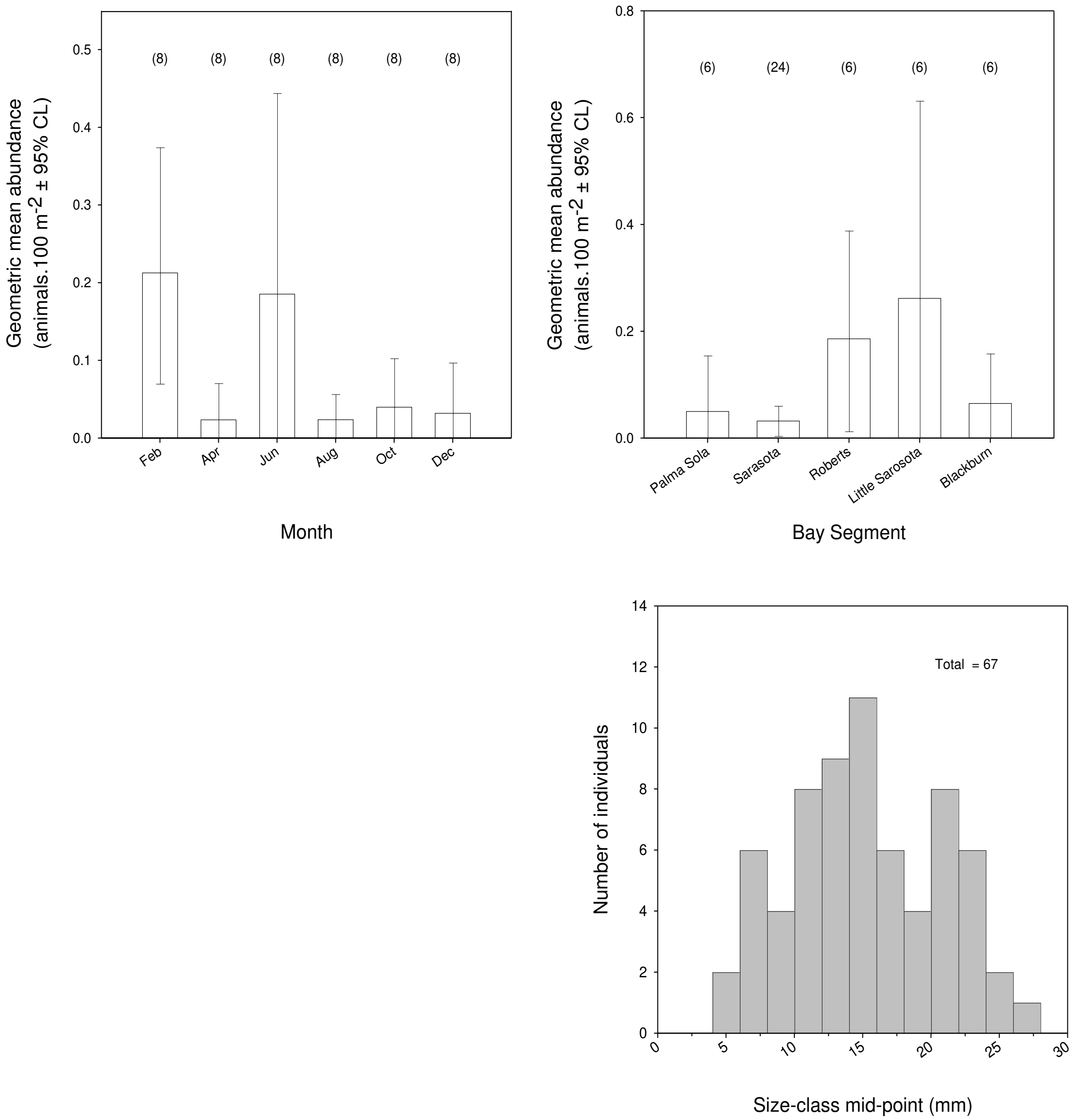
Mugil curema (white mullet)
183-m seine



Appendix F Figure 15. Relative abundance and length-frequency distribution of white mullet collected with 183-m seine in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

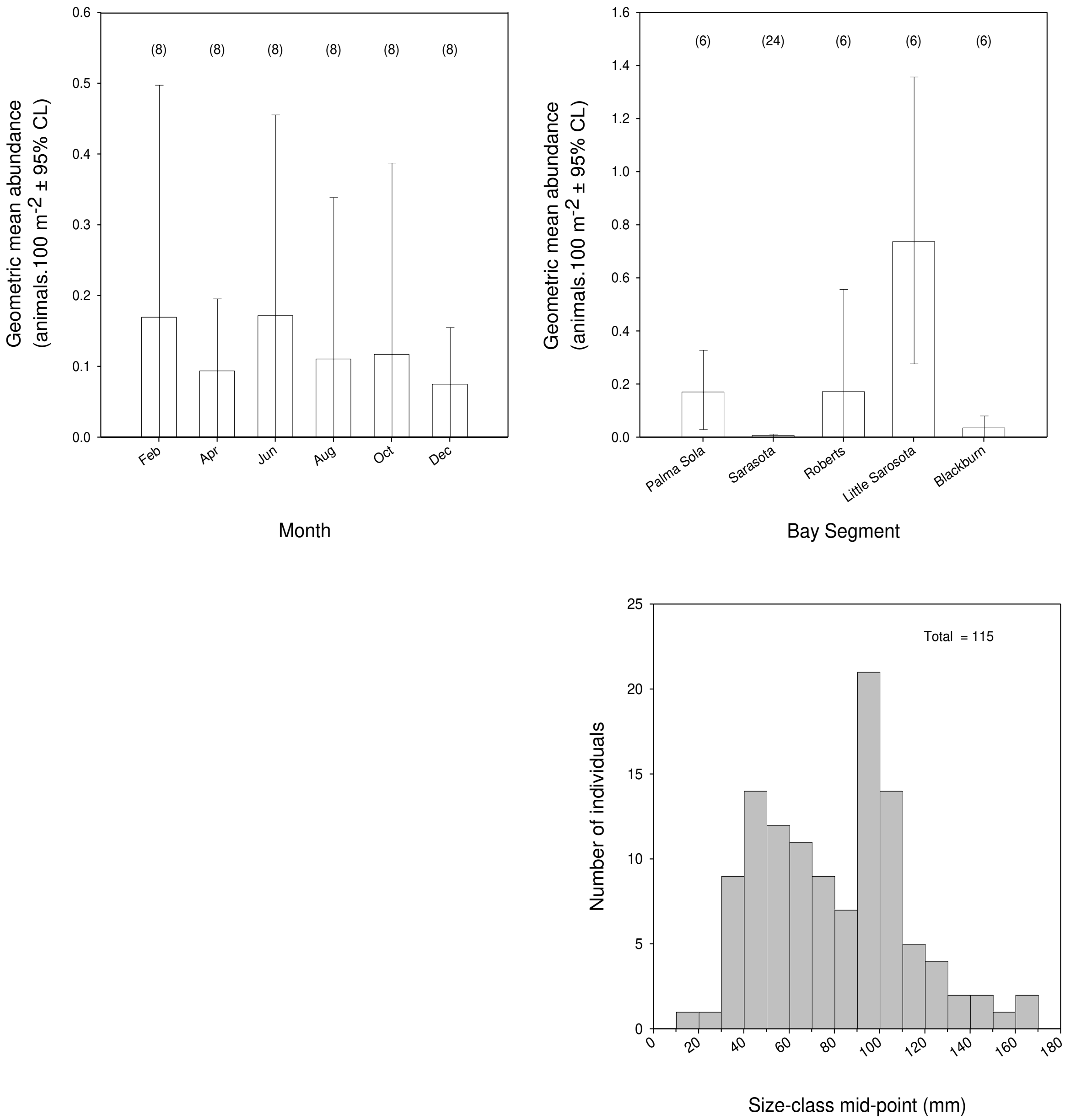
Appendix G. Species overview plots for dominant taxa (≥40 animals collected and ≥10 occurrence in a gear type) collected with 6.1-m trawls. Taxa are arranged phylogenetically.

Farfantepenaeus duorarum (pink shrimp)
6.1-m trawl



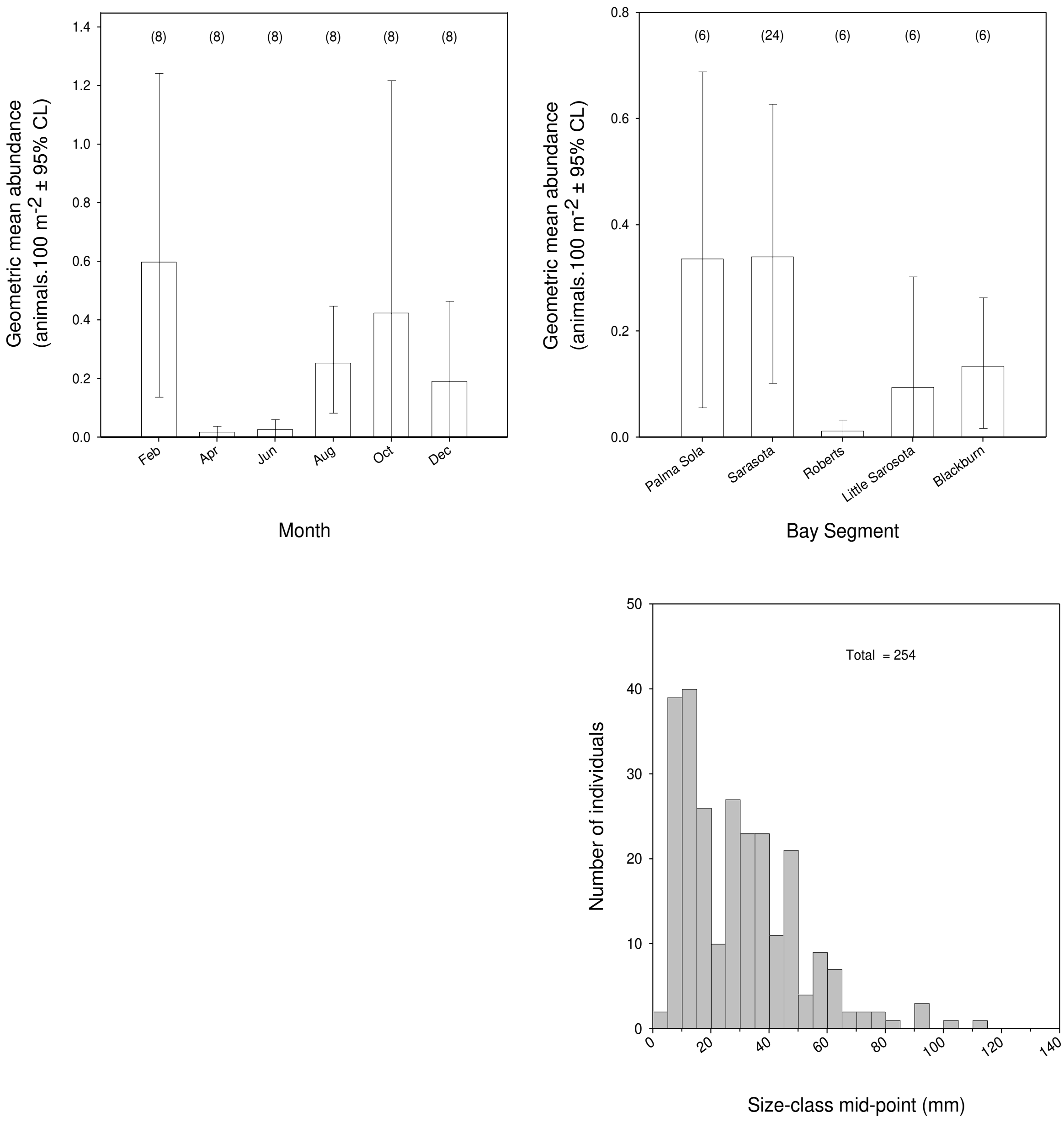
Appendix G Figure 1. Relative abundance and length-frequency distribution of pink shrimp collected with 6.1-m trawl in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Callinectes sapidus (blue crab)
6.1-m trawl



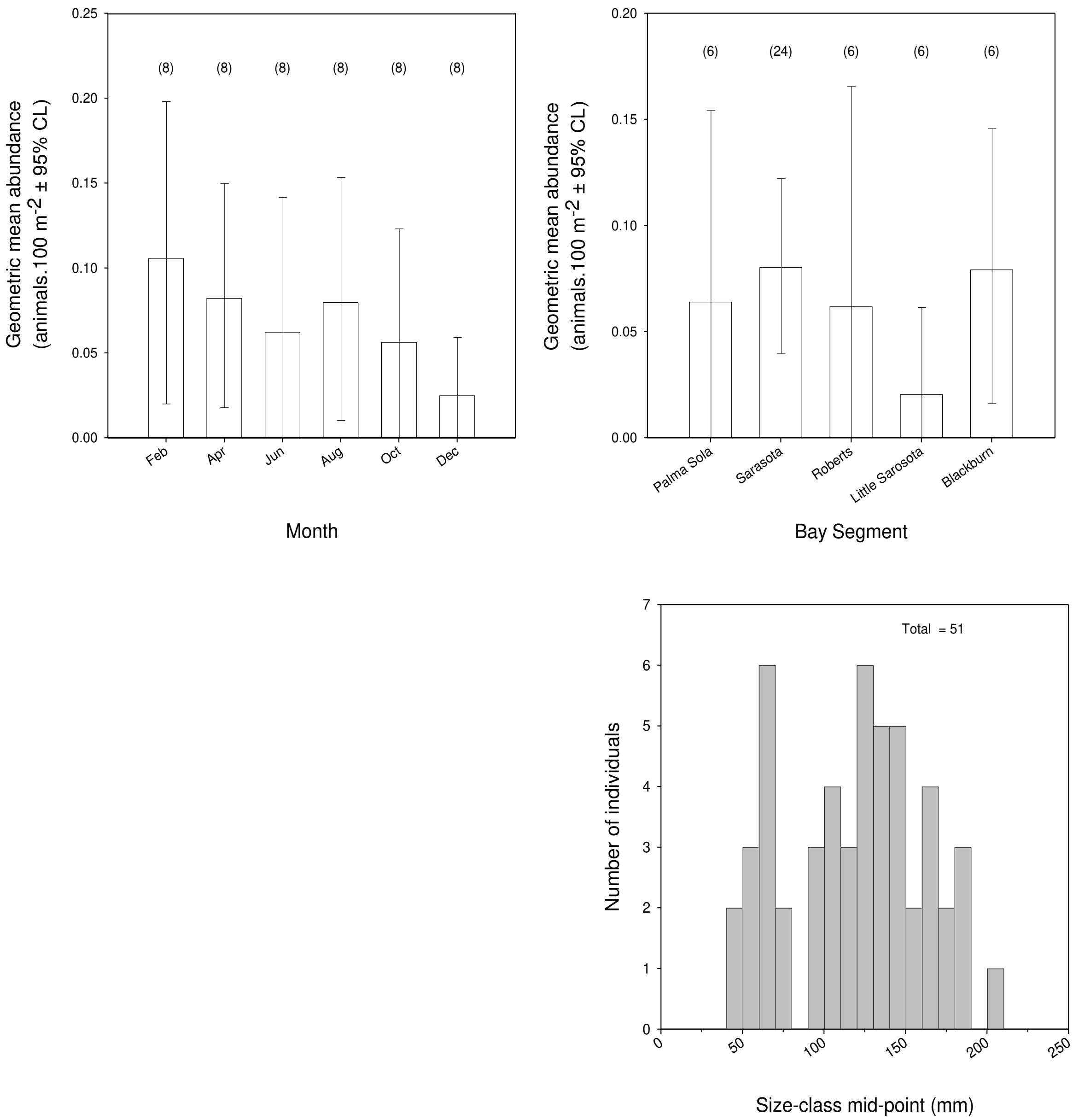
Appendix G Figure 2. Relative abundance and length-frequency distribution of blue crab collected with 6.1-m trawl in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Menippe spp. (stone crabs)
6.1-m trawl



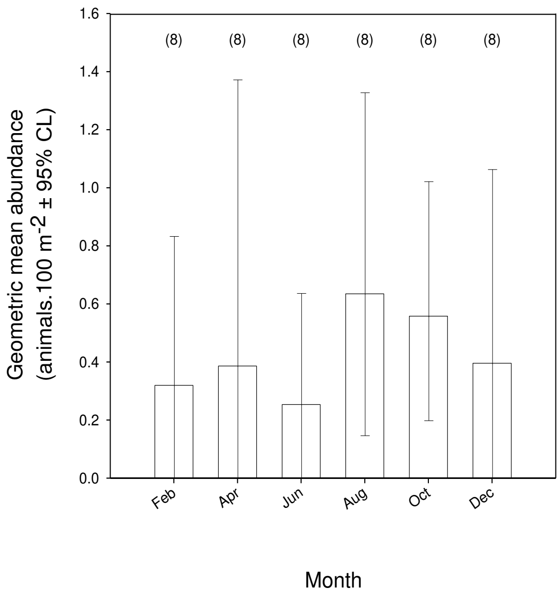
Appendix G Figure 3. Relative abundance and length-frequency distribution of stone crabs collected with 6.1-m trawl in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

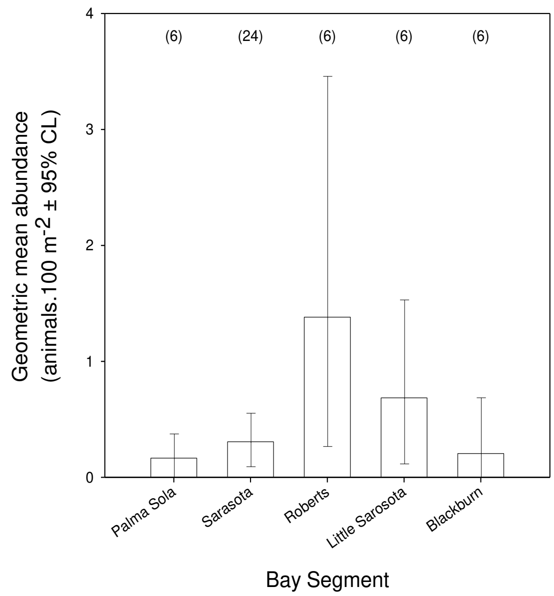
Prionotus scitulus (leopard searobin)
6.1-m trawl

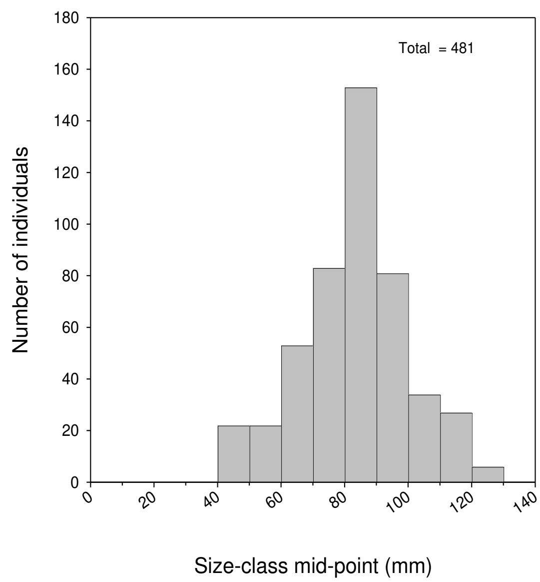


Appendix G Figure 4. Relative abundance and length-frequency distribution of leopard searobin collected with 6.1-m trawl in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Eucinostomus gula (silver jenny)
6.1-m trawl

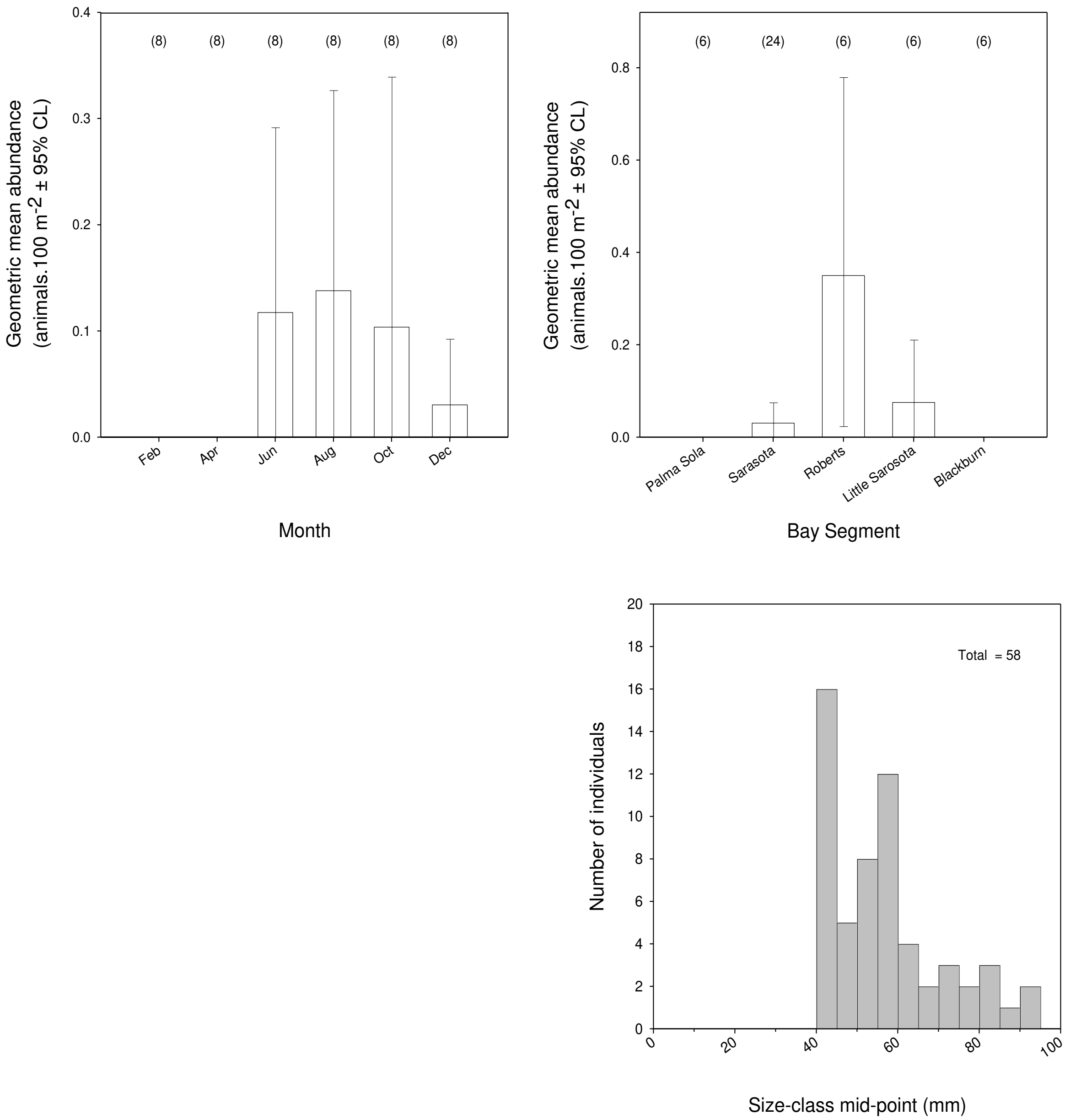






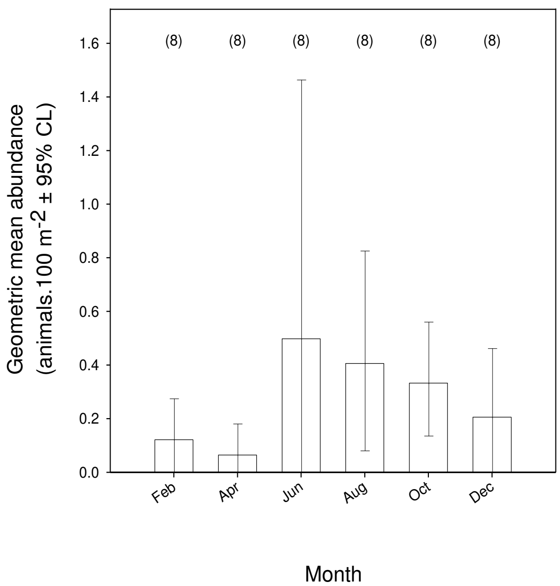
Appendix G Figure 5. Relative abundance and length-frequency distribution of silver jenny collected with 6.1-m trawl in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

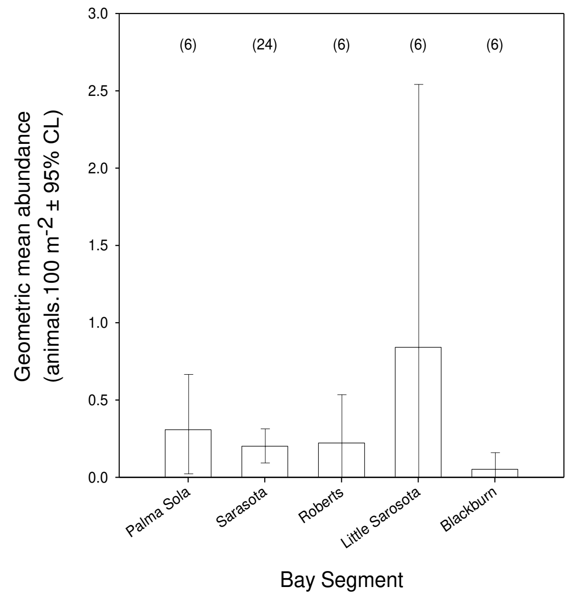
Eucinostomus harengulus (tidewater mojarra)
6.1-m trawl

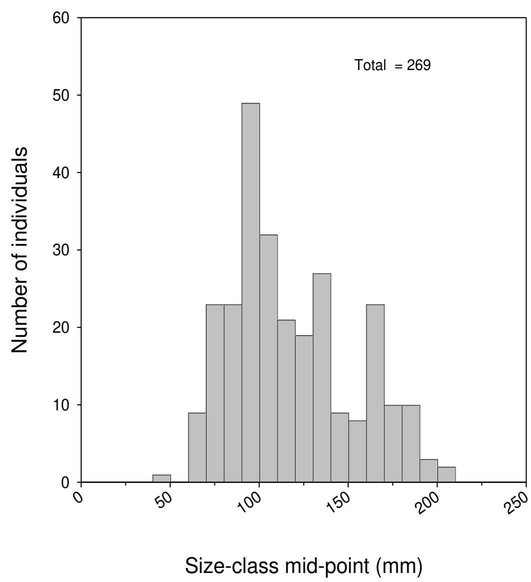


Appendix G Figure 6. Relative abundance and length-frequency distribution of tidewater mojarra collected with 6.1-m trawl in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Orthopristis chrysoptera (pigfish)
6.1-m trawl

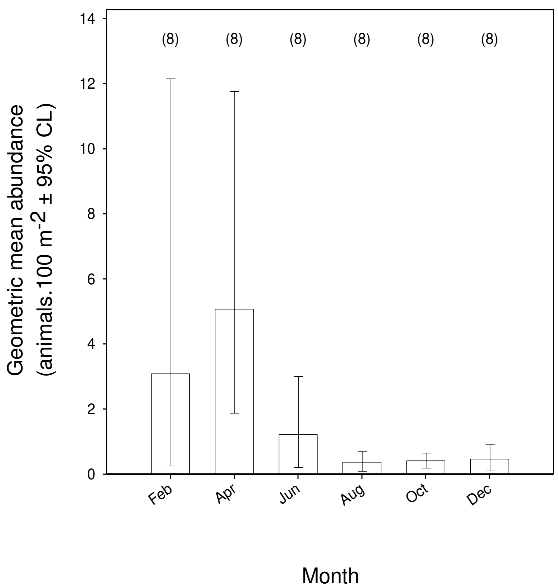


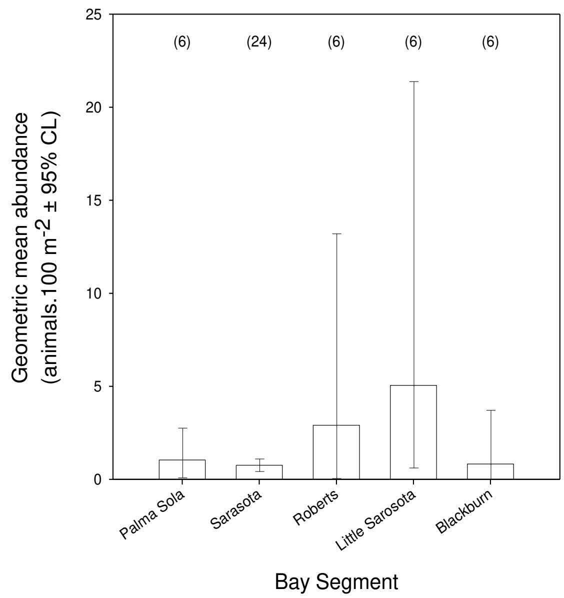


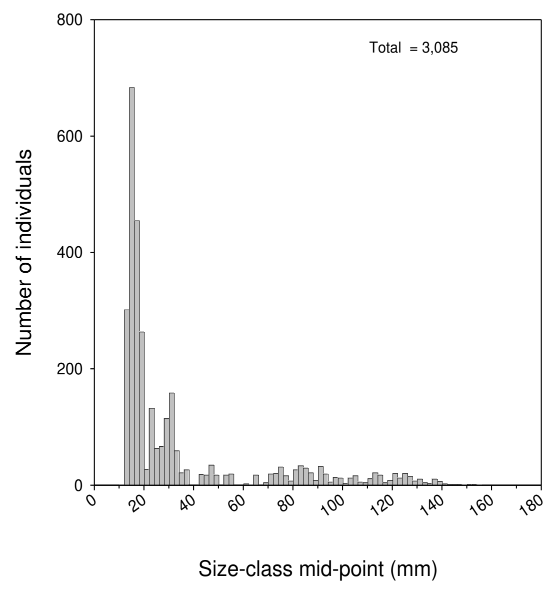


Appendix G Figure 7. Relative abundance and length-frequency distribution of pigfish collected with 6.1-m trawl in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Lagodon rhomboides (pinfish)
6.1-m trawl



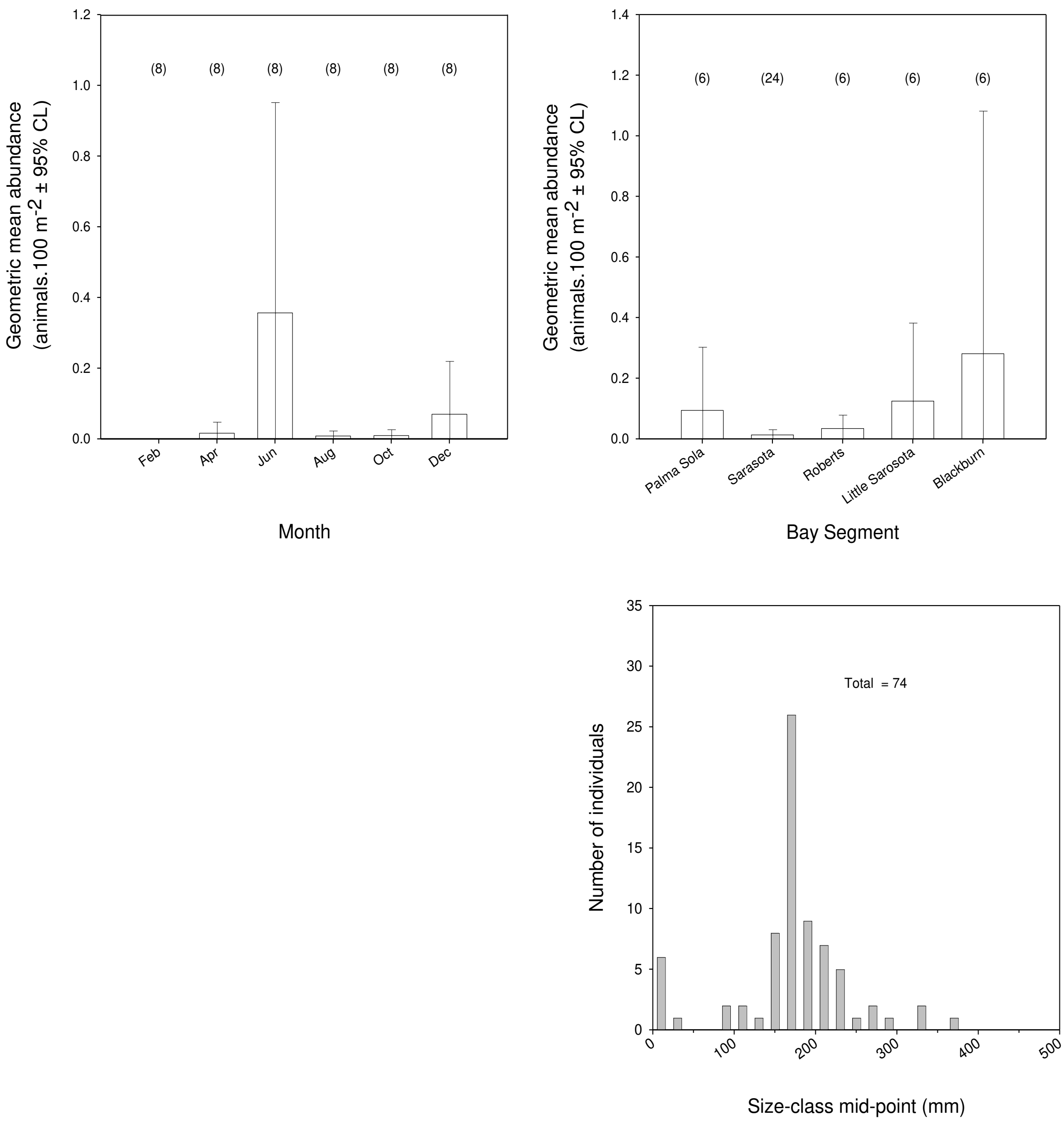




Appendix G Figure 8. Relative abundance and length-frequency distribution of pinfish collected with 6.1-m trawl in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

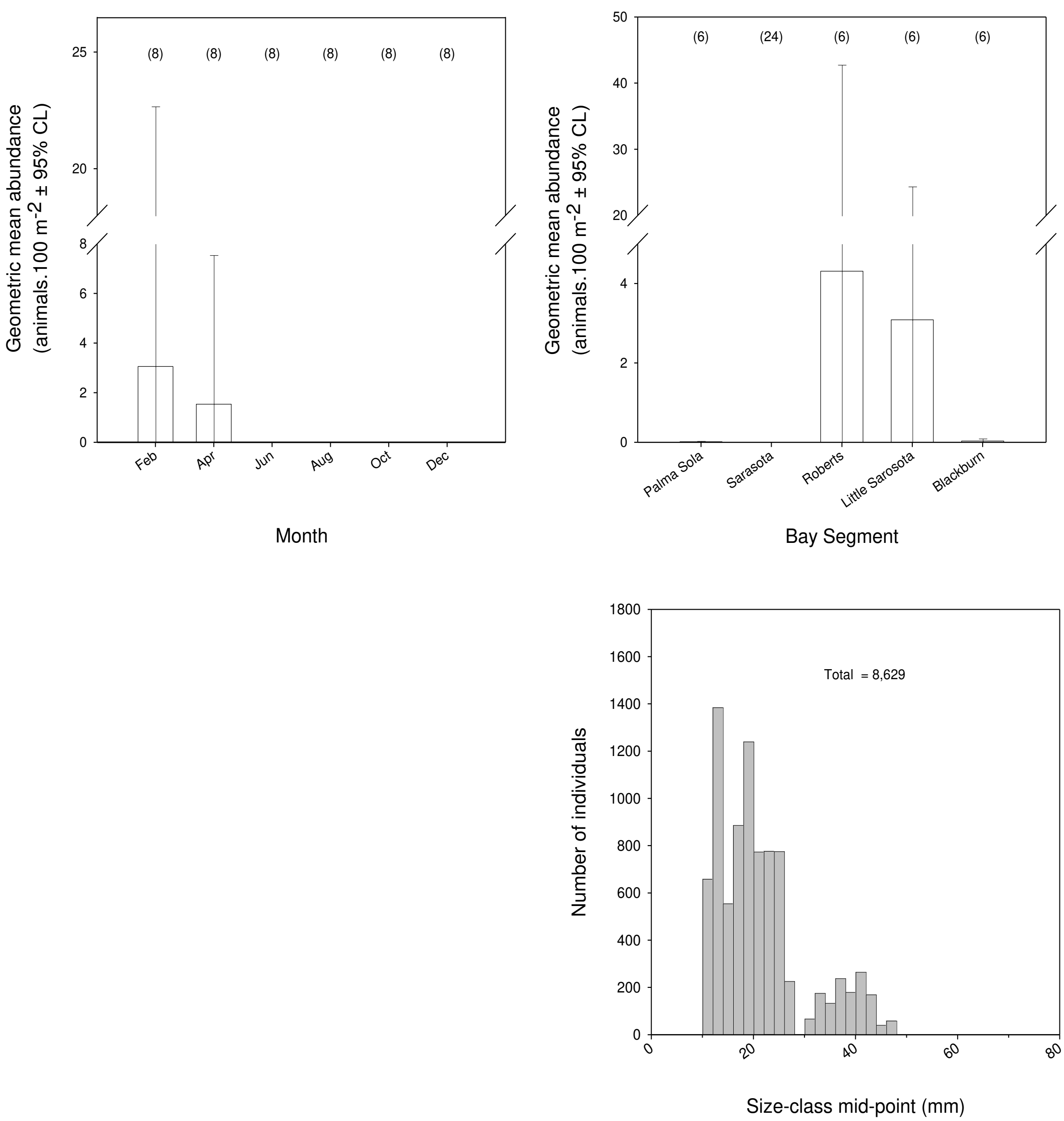
Archosargus probatocephalus (sheepshead)

6.1-m trawl



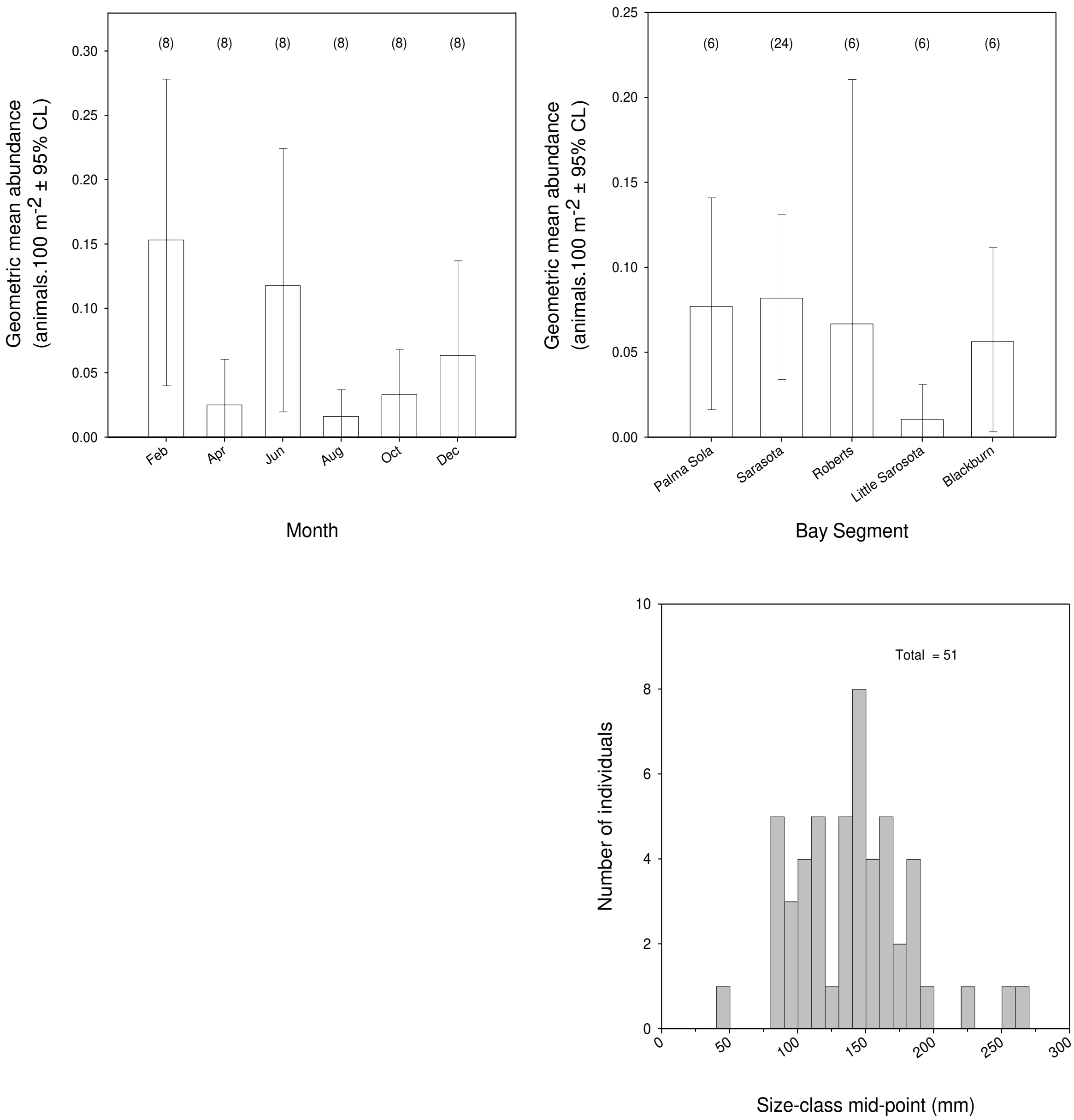
Appendix G Figure 9. Relative abundance and length-frequency distribution of sheepshead collected with 6.1-m trawl in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Leiostomus xanthurus (spot)
6.1-m trawl



Appendix G Figure 10. Relative abundance and length-frequency distribution of spot collected with 6.1-m trawl in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.

Chilomycterus schoepfii (striped burrfish)
6.1-m trawl



Appendix G Figure 11. Relative abundance and length-frequency distribution of striped burrfish collected with 6.1-m trawl in the Sarasota Bay estuary, June 2009 to April 2010. Numbers in parenthesis along the top of each abundance graph represent the number of samples collected within each category.