2006 Final Report of the Sarasota and Tampa Bay Artificial Reef Evaluation of the Influence of Reef Number and Artificial Habitat on Fish Colonization

By:
Brett Ramey Blackburn, Ken Leber, and Sara Peatrowsky
Mote Marine Laboratory
1600 Ken Thompson Parkway
Sarasota, FL 34234

To:
Sarasota Bay Estuary Program

Date:
October 18, 2008

Mote Marine Laboratory
Technical Report # 1300

Table of Contents

List of Figures

Tables

List of Appendices

Project Summary

In March of 2006 a multiyear project was initiated to monitor the colonization of artificial reef habitats by finfish and invertebrate populations in Sarasota Bay and Tampa Bay. Five artificial reef systems located in southeastern Tampa Bay and central Sarasota Bay were used to evaluate the effect of artificial reef location and number on colonization. Seasonal surveys were conducted on each of the systems to assess temporal effects on colonization. The Bulkheads (BH) and Southeast Tampa Bay (SETB) reef systems are located in Tampa Bay, Whale Key (WK), Bayshore North (BSN), and Bayshore South (BSS) reef systems are located in Sarasota Bay.

Each of the reef systems had replicate reef sites containing two 4, 8, 16, and 32 reef sites. The replicate reef sites were evenly spaced throughout the system to minimize interactions between the replicate reef sites. This design allowed us to evaluate the effect of reef number on colonization and retention of finfish and invertebrate populations. Geographic location of the reef systems within 2 different bay systems allowed us to evaluate the influence of reef system on finfish and invertebrate populations. The ultimate goal of this project was to attempt to define the effect of artificial reef size and placement on species assemblages within Sarasota and Tampa Bays.

This report summarizes the results of 320 survey dives conducted from March 2006-March 2007. Surveys were severally restricted due to adverse weather patterns and reduced visibility across all of the reef systems. The advent of a extensive *Karenia brevis* bloom during 2005-2006 reduced the native finfish and invertebrate communities allowing us to begin assessment on relatively empty reef systems. Reductions of the native community structure across all reef systems reduced the effect of reef seasoning on organism abundance and distribution.

Artificial reef area appears to influence colonization and retention of both finfish and invertebrates across these reef systems. Reef size (# of balls/site) appeared to correlate with increased observation of both finfish and invertebrates. The larger reef sites tended to have higher overall organism and species abundance with lower organism densities. Organism density tended to declined as reef surface area increased across all of the reef systems and survey seasons.

Reef location influenced species colonization and distributions. Seasonal shifts in the dominant organisms on the reef systems tended to be system specific. Tampa Bay reef systems tended to be sub-adult- adult habitats, while the Sarasota Bay systems were generally juvenile finfish and invertebrate habitats. Reef system proximity to the Gulf of Mexico appears to strongly influence species distributions. Sarasota Bay reef systems tended to be dominated by larval – juvenile finfish species while the Tampa Bay reef systems had substantial populations of sub adult to adult finfish. Invertebrate distributions in Sarasota Bay were strongly influence by seasonal variation in the dominant crab species (*Calinectes sapidus* in spring and summer, *Menippe mercenaria* in fall and winter). Crab populations in Tampa Bay were generally lower than in Sarasota Bay and were dominated by *Menippe mercenaria*.

Finfish and invertebrate population compositions are defined seasonally. Winter and spring samples tended to be dominated by larval - juvenile finfish and macro invertebrates. Summer and fall sampling periods had lower species abundance but tended to have larger finfish across all of the reef systems. Fall observations were dominated by invertebrate species across all of the reef systems. Winter species assemblages tended to be dominated by larval – sub juvenile finfish at the Sarasota Bay systems and adult finfish at the Tampa Bay systems.

Preliminary investigations suggest that these reef systems are important seasonal habitats for both finfish and macro invertebrate habitats in Sarasota and Tampa Bays. Reef area and placement appear to strongly influence species colonization and development. Total reef area also appears to define the colonization of species assemblages. Even though the larger reef sites had greater surface area for settlement the overall organism density on the sites declined. This suggests that recruitment limitation may not be habitat dependant in these two systems. Future surveys will increase our understanding of these effects of these habitats within Sarasota and Tampa Bays.

Introduction:

Florida's economy relies on income derived from recreational and commercial fisheries targeting a number of finfish and invertebrate species. Greater demands on fishery resources, which are often threatened by the loss of habitat, have led to increased interest in the function and deployment of artificial reefs (Bohnsack et al., 1994). Artificial reefs have been proposed as mitigation tools to provide available habitat, which may enhance fish and invertebrate populations that may be otherwise habitat limited (Bortone et al., 1994; Fabi and Fiorentini, 1994; Butler and Herrnkind, 1997). For example, abundance of juvenile spiny lobster, Panulirus argus, was enhanced when a nursery area was supplemented with artificial habitat indicating that habitat limited recruitment (Butler and Herrnkind, 1997). In addition to greater habitat availability, artificial reefs could potentially provide increased food and shelter resources (Eggleston et al., 1990; Beets and Hixon, 1994). Adult Nassau grouper, Epinephelus striatus, abundance was greater on artificial reefs with appropriately sized crevices than natural reefs of similar size indicating shelter limitation may influence population densities in some areas (Beets and Hixon, 1994). The additive benefits of habitat availability, shelter, and increased food resources should lead to increased population persistence and production.

Specific reef characteristics, in addition to available habitat, influence colonization of artificial reefs. Reef size and number, habitat systemity, vertical relief, and patch distribution influence colonization of artificial reefs by many fish and invertebrate species (Bohnsack et al., 1994; Frazer and Lindberg, 1994; Potts and Hulbert, 1994; Rilov and Benayahu, 2000). Density of fish species and total number of species were greater on several small artificial reefs than one large artificial reef of equal area and where a greater number of reefs were present (Bohnsack et al., 1994). Smaller patches have larger perimeter to area ratios increasing the probability of smaller patches intercepting colonizers, which may explain greater observed abundances in smaller patches (Bohnsack, 1991; Eggleston et al., 1999). Fish abundance was greater on reefs with more structural volume and systemity, however if patches were close to one another, fish abundance was similar to abundances found in reefs with greater systemity (Potts and Hulbert, 1994). Also, higher species richness was observed at jetties with greater vertical relief and habitat systemity than at natural reefs (Rilov and Benayahu, 2000). A myriad of interacting factors is therefore expected to influence colonization of artificial reefs by fish and invertebrate species, and often causes optimal artificial reef design and deployment difficult. Considering the evidence that a wide range of species use artificial reefs for habitat, reef characteristics should be investigated further to develop optimal reef and deployment designs to ensure increased fish production.

Another issue surrounding artificial reefs is that their function and effectiveness remains unclear. One major debate surrounding the function of artificial reefs is the "Attraction-Production" debate (Bohnsack et al., 1994; Lindberg, 1997; Wilson et al., 2001). The Attraction Hypothesis predicts that fish and invertebrate species redistribute themselves to newly available habitats without changing production (Wilson et al., 2001). Conversely, the Production Hypothesis predicts that artificial habitats provide new habitat to an environment that would otherwise be saturated, thereby allowing for further recruitment into an area and increasing production (Wilson et al., 2001). Few studies have specifically evaluated this issue, however Bohnsack et al., (1994) determined that larval recruitment was lower at artificial reef sites than natural reef

sites, and older juveniles and adults colonized artificial reefs after settling elsewhere; therefore the attraction hypothesis was partially supported. Before proceeding with further artificial reef deployments, future comparisons of existing artificial and natural reefs should quantify densities of larval fish and invertebrates, as well as sub-adults and adults to evaluate this debate further.

Project Description

Goals and Objectives

The goals of this project are to evaluate and monitor the colonization of artificial reefs by fish and invertebrate species typically found in Sarasota Bay and Tampa Bay. To achieve this goal we will address the following objectives:

1. Determine whether colonization by fish and invertebrates is influenced by the amount of available habitat.

2. Determine whether colonization of artificial reefs is influenced by the location within Sarasota Bay and Tampa Bay.

3. Determine seasonal colonization and habitat use patterns by native finfish and invertebrate populations on artificial reef structures.

Methodology:

Site Selection

Five artificial reef systems located in southeastern Tampa Bay and central Sarasota Bay were used to evaluate the effect of artificial reef location and number on fish colonization. The following systems were used in this study: Bulkhead (BH) and Southeast Tampa Bay (SETB) reef systems located in southeast Tampa Bay, and Whale Key (WK), Bayshore North (BSN), and Bayshore South (BSS) reef systems in Sarasota Bay. Each of the reef systems was arranged in an approximate octagonal shape with 2 sets of alternating patch reef habitats containing 4, 8, 16, or 32 reef balls. The reef system design allowed us to evaluate the effect of reef number and location (site) on colonization of fish species (objectives 2 and 3).

Site Descriptions

Sarasota Bay reef systems were located in approximately the geographic center of Sarasota Bay in 3-4 m of water. Benthic substrate composition surrounding the eastern bay reef systems (Bayshore North and Bayshore South) was characterized by fine grained sand with relatively low silt content. Extensive sea grass meadows (*Thalassia testudinum*) border both of the reef systems which are within 2 km of the Bowlees Creek watershed outfall. Season upland drainage from the watershed strongly influences visibility and survey activities.

Whale Key is located adjacent to the Inter Coastal waterway (approx. 0.5 km west). Geographic location of the sites approximately 2 km from Long Boat key and 3-4 km from the eastern shore of the bay reduces the overall shore impact of the sites. The reef system is located in 3-3.5 m of water on a muddy sand bottom. Sea grass (*T. testudinum*) meadows surrounding the reef system are less dense than the area surrounding the Bayshore *reef system*. Survey attempts were hampered due extensive periods of suspended sediments over the reef area.

The Southeast Tampa Bay reef system was located approximately 3 km northwest of Emerson Point and the outfall of the Manatee River watershed in 5-6 m of seawater. Bottom composition at the reef system was primarily a mud/sand matrix. Sea grass meadows were absent from the immediate survey area surrounding the reef system. Survey attempts were restricted due pulses of dark water and suspended particulate matter from the Manatee River watershed.

The Bulkheads reef system was located 2-3 km northeast of Anna Maria Island approximately 5 km east of the Passage Key Inlet to the Gulf Mexico in 5-6 m of seawater. Bottom composition at the reef system was primarily composed of a fine grained sand and silt matrix. The presence of sea grass meadows were not recorded within 2 km of the system. Survey attempts were restricted due to seasonal weather fronts disturbing sediments along the inlet and beach side of Anna Maria Island and Egmont Key. **Figure 1** is a chart of the study area.

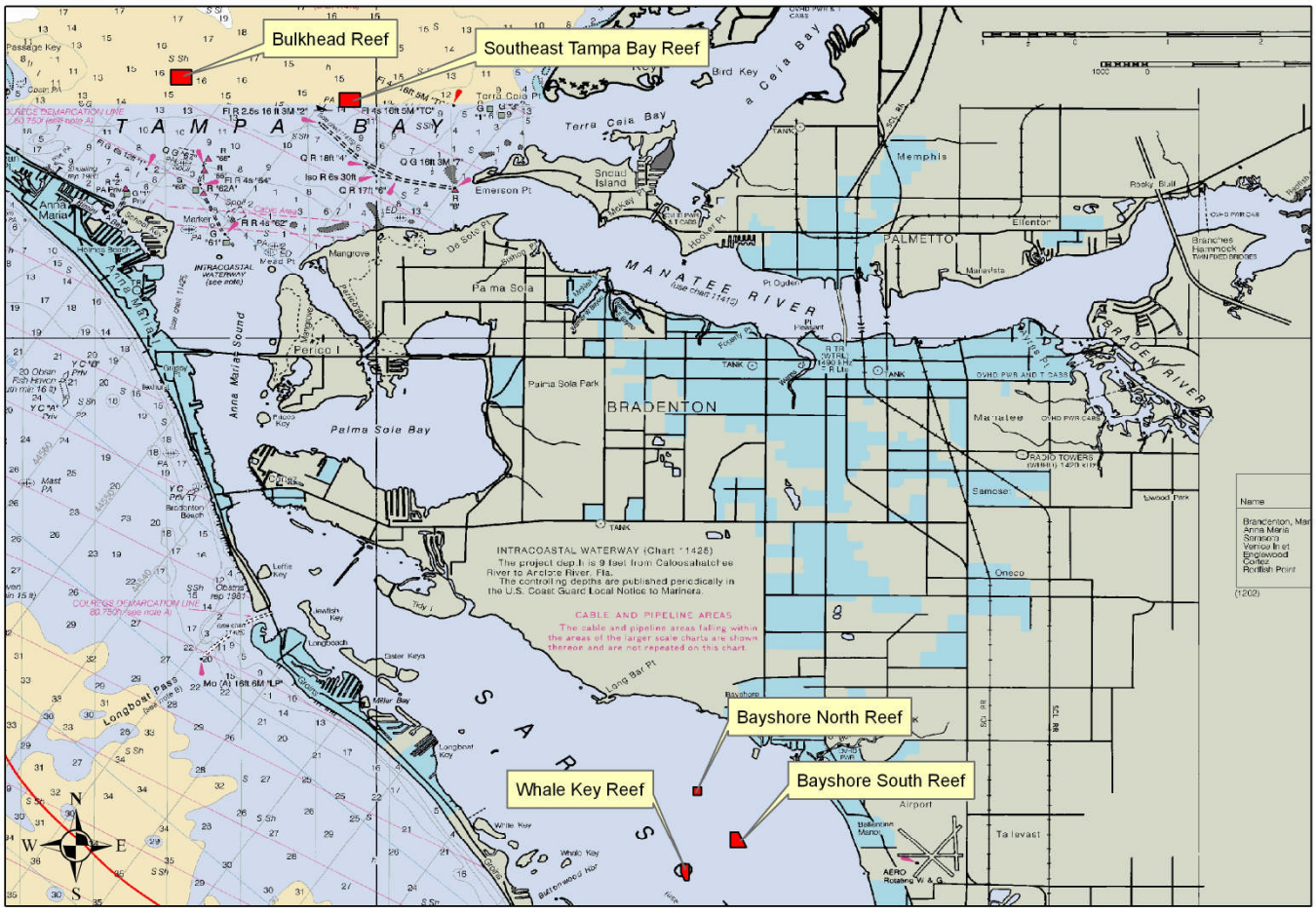

Figure 1. Map containing the Sarasota Bay Study area including nearby outlets to the Gulf of Mexico.

Data collection

Due to the extreme variability of visibility within Sarasota and Tampa Bay, the entire reef system was surveyed on each sampling date. Visibility constraints varied on a daily to weekly basis. Attempts to conduct the original survey plan resulted in losses in viable data collection, due to minimum visibility constraints of less than 1.5 m.. Surveys were conducted quarterly for one year to evaluate seasonal effects on colonization at our sites (27 sampling dates/year).

Sampling schedules were modified from the fall of 2005 until the spring of 2006, following the occurrence of a severe *Karenia brevis* bloom which covered most of Sarasota and Tampa Bays during the summer, fall, and early winter of 2006. The bloom directly impacted all of the reef systems within the study area. Anoxic conditions and diver visibility constraints slowed the completion of this project until the winter of 2007. Throughout the course of the year long evaluation, visibility constraints restricted seasonal survey efforts. Seasonal definition was further modified from a calendar year to a schedule based on water temperature, allowing the documentation of seasonal shifts in species use patterns and distributions on the *reef system*. Normal calendar time scales did not accurately depict the season variation in water temperature and weather patterns, which appear to influence the species assemblages on these systems.

During this sampling period, divers from Mote Marine Laboratory conducted 40 sampling dives within Sarasota and Tampa bay. Twelve other dives were conducted throughout the sampling area, but were called due to reduced visibility, in climate weather, or *Karenia brevis* bloom formation, which restricted sampling efforts. Dive cancellation further blurred the seasonal distinction between the calendar and seasonal scales. In some cases, conditions were reduced to levels below the sampling parameters for several weeks due to reduced visibility on one or more of the survey systems.

Sampling Schedule

Surveys were initiated in March of 2006 approximately 4 months following the subsidence of the *K. brevis* bloom of 2005. Visibility constraints between January and late March were less than 5 linear feet, with the exception of 2 occasions on the Bayshore North System. Divers observed no finfish or invertebrate species on these preliminary dives. The earliest surveys with recorded finfish and invertebrates in residence were on March 29, 2006. Summer surveys were conducted from August – October 2006. Fall Surveys were conducted during December of 2006. Winter surveys were conducted between March and April 2007. **Table 1** details dates of sampling efforts by reef site for the 2006-2007 sampling.

Table 1. Outlines sampling dates for each of the 4 seasonal sampling periods on the Whale Key, Bayshore South, Bayshore North in Sarasota Bay, and Southeast Tampa Bay, and The Bulkheads reef systems in Tampa Bay during the 2006 -2007 survey period.

Sampling Schedule 2006-2007

Spring 2006		**Summer 2006**	
Site	**Date**	**Site**	**Date**
Whale Key	3/29/06	Whale Key	10/7/06
Bayshore South	4/5/06	Bayshore South	10/6/06
Bayshore North	4/1/06	Bayshore North	9/26/07
Southeast Tampa Bay	5/2/06	Southeast Tampa Bay	10/26/07
The Bulkheads	5/22/06	The Bulkheads	10/19/07
Sampling Days Canceled	2 days	**Sampling Days Canceled**	2 days
Fall 2006		**Winter 2007**	
Site	**Date**	**Site**	**Date**
Whale Key	12/19/06	Whale Key	4/12/07
Bayshore South	12/13/06	Bayshore South	3/9/07
Bayshore North	12/12/06	Bayshore North	3/7/07
Southeast Tampa Bay	12/14/06	Southeast Tampa Bay	3/13/07
The Bulkheads	12/18/06	The Bulkheads	3/27/07
Sampling Days Canceled	2 days	**Sampling Days Canceled**	4 days

Dive Surveys

Two visual surveys over parallel line transects were conducted at the each patch reef sites (4, 8, 16, and 32 reef sites). Each patch reef sites, regardless of reef ball number, was comprised of two rows of equidistant reef balls. Line transect surveys were conducted along the two rows of reef balls. One diver was assigned to each transect line to eliminate diver interaction during the survey. Each diver identified all finfish and macro invertebrate species, the number of each species, and the approximate size of all fish observed along each transect. All species identifications were done to the species level. The ability of divers to visually survey these reef systems was related to the water clarity on each sampling date, with a minimum visibility standard of 1.5 m standard was used on all surveys. Visibility was quantified using a metric tape measure.

Visibility and transects observation strategies were employed to minimize the effect of diver disturbance on the *reef system*. Dive times were maintained to the shortest interval needed to survey the individual site to reduce sampling bias due to avoidance. Smaller number of reef sites would have a shorter exposure to sampling efforts than the larger sites, thereby reducing diver avoidance. Steady movement along the reef transect with observations taken directly in front of the diver to reduce the multiple organism counts reducing the impact of the divers presence (Bohnsack and Bannerot 1986, Bohnsack et.al., 1994, Tupper and Hunte 1998)

Water Quality

Surface and bottom water quality measurements were taken at each of the reef system on survey days. Water quality measures were taken using an YSI Model 600 Multi probe meter. Water temperature (°C), Dissolved oxygen (mg/l), pH, salinity (p.p.t.), and linear visibility (ft) were recorded at each reef system prior to survey start and following the final dive at the reef system. Water quality measurements were conducted to examine the relationships between parameters and fishery population dynamics across the reef system.

Data Analysis

The effect of reef number on mean abundance, species richness, and community similarity, and organism density were assessed by this study. Mean abundance was defined as the mean number of individuals observed over the total number of surveys. Species richness was defined as the mean number of species observed over the total number of surveys for each reef site type. Community similarities were assessed using percent contribution of the most common species by reef number and system. Organism densities were calculated by dividing the total observations on the reef site by the total reef surface area. Reef surface area was calculated by multiplying the total area of each reef unit by the number of reef units. Density measures were calculated as the total number of organisms per m^3 by reef site surface area.

Each reef system was designated as the entire reef system that contained two replicate sets of 4, 8, 16, and 32 reef unit sites. The mean number of organisms within the two sites was used for all comparisons within each site and between the reef systems.

This report outlines the work conducted by Mote Marine Laboratory staff during the 2006-2007 sampling season. The work reported contains the reef system and site descriptions of diver observations and analysis from Feb 2006 – March 2007. Seasonal evaluation schedules did not correspond to the normal calendar year but reflect a full 12 months of sampling effort. All data represented in this report follows the 2004 research proposal and scope of work approved by both the Sarasota Bay Estuary Program and Mote Marine Laboratory.

Results

Spring 2006

Site Abundance

Observations across all of the sites averaged 248.3 ± 59.1 Organism abundances increased across all of the reef systems with the total number of reef units at the reef systems (**Figure 2**, **Table 2**). Mean organism abundances increased by an average of 25.3 ± 2.7% across all of the reef systems. Organism abundance on the Sarasota Bay reef systems averaged 274.4 ± 65.3 organisms approximately 24% higher than observations at the Tampa Bay reef systems (209.1 ± 47.1 org.). Seasonal influence and chance occurrence of organisms on the reef systems were included to reflect the resident population at the reef site during the spring surveys.

Organism abundance at the four reef sites had the lowest number of observations across all of the reef system. The highest organism abundances were recorded at the 32 reef sites across all of the reef systems in Sarasota Bay. A similar pattern was noted at the Tampa Bay reef systems with the exception of the Southeast Tampa Bay System (SETB). Lower abundance totals at

Southeast Tampa Bay system were 50-75% lower than at the other 32 reef sites. Lower overall abundance observations at these sites were likely a result visibility constraints on the site at the time of the surveys (visibility = 1.5 m).

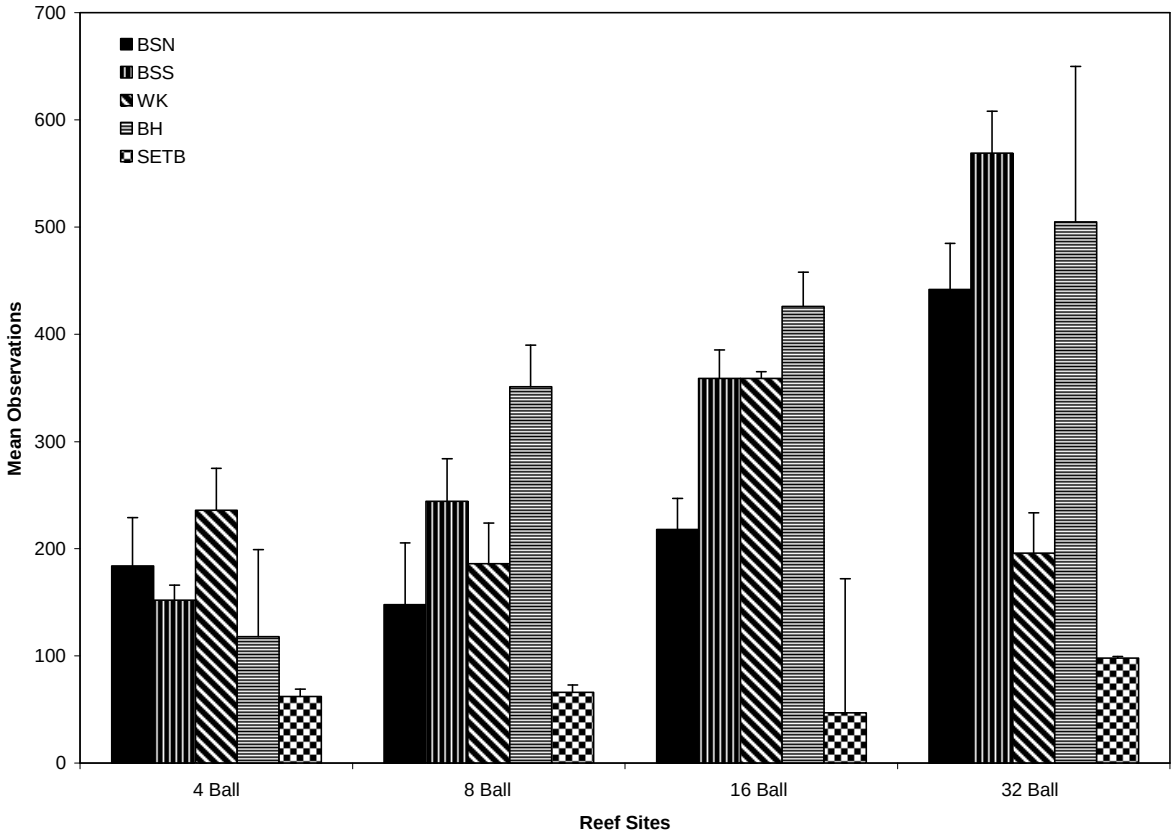

Figure 2. Mean number finfish and invertebrate observations at the Bayshore North (BSN), Bayshore South (BSS), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay reef system for spring 2006. Error bars equal to ±1 standard error.

Table 2. Mean site organism abundance totals by reef system and site including mean abundance totals by bay system and mean % increase for Bayshore South(BSS), Bayshore North (BSN), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay (SETB) reef system for spring 2006.

Reef #	BSN	BSS	WK	SB Mn	SB SE	BH	SETB	TB Mn	TB SE	Tot, Mn	Tot. SE	% Inc.
4 Ball	184.0	152.0	236.0	190.7	24.5	118.0	62.0	90.0	28.0	150.4	29.4	
8 Ball	148.0	244.0	186.0	192.7	27.9	351.0	66.0	208.5	142.5	199.0	47.7	24.4
16 Ball	218.0	359.0	359.0	312.0	47.0	426.0	47.0	236.5	189.5	281.8	67.8	29.4
32 Ball	442.0	569.0	196.0	403.0	109.0	505.0	98.0	301.5	203.5	362.0	91.4	22.2
Mean	248.0	331.0	244.3	274.6		350.0	68.3	209.1			**Mean**	25.3
SE	66.2	89.9	39.7	51.3		83.5	10.7	44.2			**SE**	2.1

Species Richness

The reef systems within Sarasota Bay and Tampa Bay had moderate numbers of resident species (**Figure 3**). Mean species number at the four reef sites was 9.0±1.5 species/site across all of the reef 4 sites, and 10.8 ± 1.5 species/site at the 8 reef sites. The highest species observations were recorded on the16 and 32 reef sites (12.8 species/site, and 13.2 species/site). Mean species abundance at the 16 and 32 reef sites had an average increase of 11.8±4.3% increase across all of reef systems. Species observations at the Tampa Bay systems were 38.3% higher than on the Sarasota Bay systems. Mean species observations ranged from 8.75 ±0.5 at the Bayshore North to 9.75±0.9 at Whale Key reef system in Sarasota Bay and 12.5±2.4 at the Bulkheads to 17.3±1.1 at Southeast Tampa Bay Reef system in Tampa Bay (Figure 3).

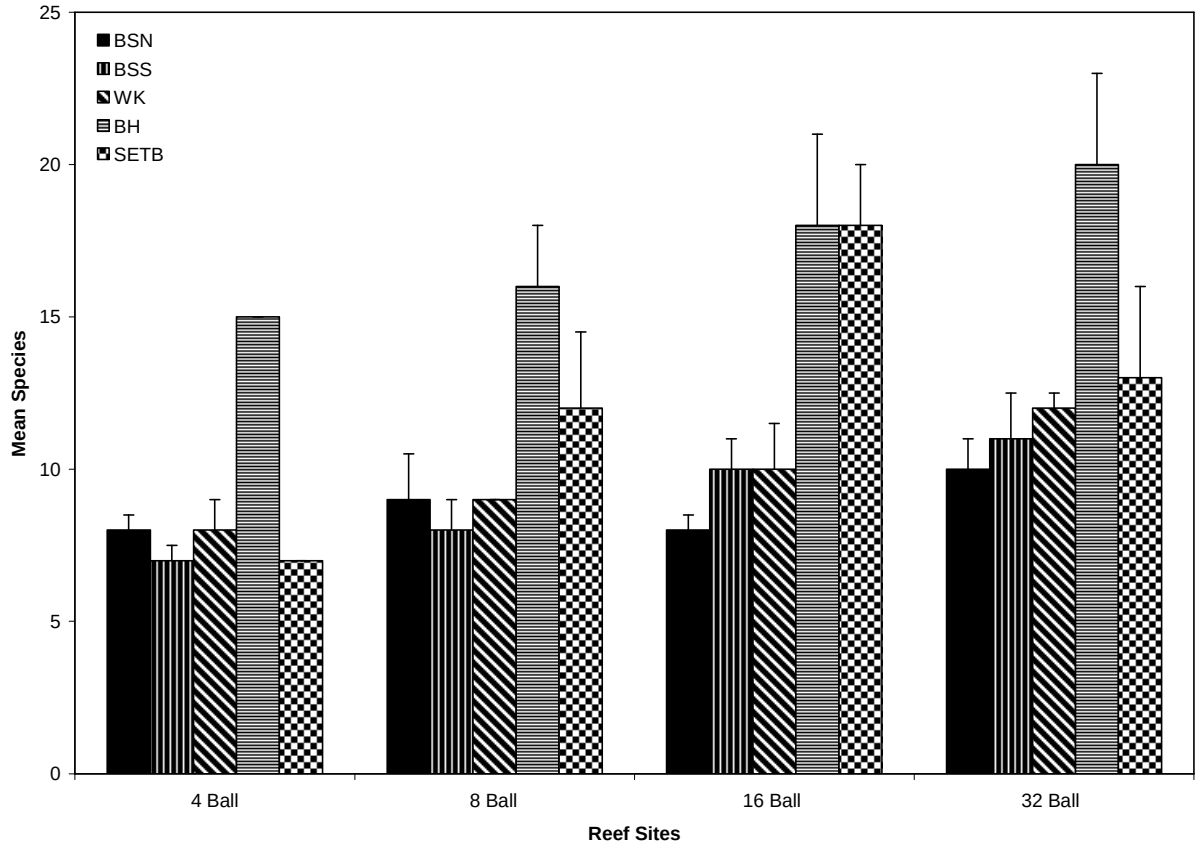

Figure 3 Species richness by reef site for Bayshore North (BSN), Bayshore South (BSS), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay reef system for spring 2006. Error bars equal to ±1 standard error.

Community Similarity

Community similarity comparisons were based on the commonly occurring species observed at teach of the systems and sites. Other commercially or recreationally important species include in the comparison (*Mycteroperca microlepis*, and *Lutjanus griseus*) even though the species were not common to all systems.

4 Reef Sites

Finfish and invertebrate community structure across the 4 reef sites were similar with 7 common species dominating (**Table 3**). Mean percent contribution by the common species accounted for 82.5±12.8% of the finfish and invertebrates observed at the 4 reef sites. *Lagadon rhomboides* dominated the sites in Sarasota Bay, accounting for 61.1±10.5% of the total observations. *Haemulon aurolinatum* accounted for 12.4±4.3% total observations at the Tampa Bay 4 reef sites. *Mycteroperca microlepis* were only observed at Bulkheads reef sites and contributed 7.4% of the total observations at the Bulkheads system in Tampa Bay. A large school *Harrengula jaguana* dominated the 4 reef sites within the Bulkheads system. The large schools were not considered in the comparisons due to their transient nature.

The invertebrate community was dominated by *Callinectes sapidus* and *Menippe mercenaria* (**Table 3**). *Callinectes sapidus* accounted for 2.5±1.0% of the total observations and *Menippe mercenaria* accounted for 9.1±1.9% of the observations. Crab species across all the reef systems accounted for 11.6.6% of the total observations. *Leptogorgia virgulata* colonies were observed across reef systems. All of the corals appeared to be in good health following the extensive *K. brevis* blooms of 2005-2006. A complete species list by reef number and system for the spring of 2006 is shown in **Appendix A**.

8 Reef Sites

Finfish and invertebrate community structures on the 8 reef sites had 7 species common to the survey sites totaling 79.9±6.20% of the observations (**Table 3**). *L. rhomboides* was the dominant species at the Sarasota Bay reef systems accounting for 73.3±3.1% of the total observations. *L rhomboides* observations at the Tampa Bay reef systems accounted for 2.3±0.2% total observations. *H. aurolinatum* was the dominant finfish at the Tampa Bay 8 reef sites accounting for 53.3±10.9% of the observations, within Sarasota Bay *H. aurolinatum* accounted for 5.0±1.2 of the observations.

The invertebrate community was dominated by *C. sapidus*, and *M. mercenaria* accounting for 9.5±3.3% of the observation across all of the systems (**Table 3**). *C. sapidus* accounted for 4.1±1.4% of the observations, while *M.* mercenaria accounted for 5.4±1.9% of the total observations. *L. virgulata* colonies were observed at all of the reef systems. All of the corals appeared to be in good health following the extensive *K. brevis* blooms of 2005-2006. A complete species list by reef number and system for the spring of 2006 is shown in **Appendix A**.

16 Reef Sites

Finfish and invertebrate community structures across the 16 reef sites had 7 common species accounting for 60.9±18.8% of the total observations across all of the reef sites. *L. rhomboides* was the dominant finfish on the Sarasota Bay systems accounting for 58±2.0% observations. *L rhomboides* accounted for 3.9±1.4% observations at Tampa Bay systems. *Haemulon aurolinatum* accounted for 5.9±1.6%of the total observations at the Tampa Bay 16 reef sites, and 8.1±10.4% of the Sarasota Bay observations. *H. aurolinatum* observations in Sarasota Bay were restricted to the Bayshore reef systems.

The invertebrate community was dominated by *C. sapidus,* and *M. mercenaria* accounting for 12.3± 5.4% of the total observations across all of the reef systems (**Table 3**). Crab observations in Sarasota Bay accounted for 4.4±2.0% of the observations at the Sarasota Bay systems and 0.2±0.01% of the Tampa Bay observations. *L. virgulata,* colorful seawhips, was observed at all of the reef systems. All of the corals appeared to be in good health following the extensive *K. brevis* blooms of 2005-2006. A complete species list by reef number and system for the spring of 2006 is shown in **Appendix A**.

32 Reef Sites

Finfish and invertebrate community structures across the 32 reef sites had 7 common species accounting for 86.1±5.3% of the finfish and invertebrate observations (**Table 3**). *L. rhomboides* was the dominant finfish on the Sarasota Bay systems accounting for 52.7.1±28.3% of the total observations. *L* rhomboides accounted for less than 1 % of the total observations on the Tampa Bay reef systems. *H. aurolinatum* was the dominant finfish on the Tampa Bay reef systems accounting for 42.4% ±20.0% of the total observations. *H. aurolinatum* accounted for 2.7±2.9% of the Sarasota Bay observations. *M. microlepis* observations accounted for 8.5±8.0% observations in Tampa Bay. Lower than expected observations of the species were noted on the Southeast Tampa Bay reef systems likely due to visibility constraints at the time of the surveys. *M microlepis* observations were not recorded on the Sarasota reef systems.

The invertebrate community was dominated by *C. sapidus* and *M. mercenaria,* across all of the reef systems accounting for 15.2±7.9% of the total observations across all of the systems. *C. sapidus* accounted for 3.2±1.3% of the total observations, while *M mercenaria* accounted for 12.0±6.6% of the total observations. *L. virgulata* colonies were observed at the reef systems. All of the corals appeared to be in good health following the extensive *K. brevis* blooms of 2005-2006. **Table 3** lists the individual percent contributions of commonly occurring organisms. A complete species list by reef number and system for the spring of 2006 is shown in **Appendix A**.

Community composition by size class summer 2006

Finfish observations on the Sarasota Bay reef systems were dominated by smaller finfish classes than at the Tampa Bay systems (**Tables 4a** and **4b**). *L rhomboides* observations ranged between 20-130mm TL on the Sarasota Bay and Tampa Bay reef systems between 40-110 mm TL. *M. microlepis* were not observed on the Sarasota Bay systems, while species was largely dominated by fish ranging from 180-450 mm TL. *M microlepis* observations on at the Tampa Bay reef systems were generally larger fish with majority of the observations ranging between 250-450 mm TL. *L.* griseus at the Sarasota Bay reef systems ranged from 60 -160 mm TL. *L griseus* observations on the Tampa Bay reef systems were restricted to the 32 reef unit sites and ranged between 200-300 mm TL. The species was observed on all of the Sarasota Bay reef systems except for the 4 and 8 reef sites at the Bayshore North reef system. *L. griseus* observations on the Sarasota Bay reef systems tended to be juvenile to sub adult fish while the fish observed on the Tampa Bay reef systems were largely adult fish.

Table 3. Species percent contribution estimates of the common game species observed at the 4, 8, 16, and 32 reef ball sites located within the Bayshore North (BSN), Bayshore South (BSS), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay (SETB) reef systems for spring 2006.

Species (4 Reef Sites)	**BSN**	**BSS**	**WK**	**BH**	**SETB**	**MN**	**SE**
Calinectes sapidus	3.98	3.03	5.39	0.27	0.00	2.53	1.05
Haemulon aurolineatum	13.11	11.11	39.59	16.84	8.11	17.75	5.64
Lagodon rhomboides	71.75	69.32	42.35	1.84	32.02	43.46	12.91
Menippe mercenaria	3.92	7.01	8.15	14.08	12.50	9.13	1.85
Mycteroperca microlepis	0.00	0.00	0.00	7.41	0.00	1.48	1.48
Synodus foetens	1.06	0.56	0.56	2.05	0.00	0.84	0.34
Site Total % Cont.	95.29	98.39	100.00	45.05	73.90	82.53	10.48
Species (8 Reef Sites)	**BSN**	**BSS**	**WK**	**BH**	**SETB**	**MN**	**SE**
Calinectes sapidus	8.58	3.66	5.49	0.13	2.56	4.09	1.42
Haemulon aurolineatum	3.38	5.80	5.88	64.10	42.46	24.33	12.31
Lagodon rhomboides	76.41	81.02	62.58	2.10	2.56	44.94	17.66
Lutjanus griseus	0.00	2.16	3.94	0.00	0.00	1.22	0.80
Menippe mercenaria	1.87	0.62	10.93	7.90	5.51	5.36	1.90
Mycteroperca microlepis	0.00	0.00	0.00	1.93	0.00	0.39	0.39
Site Total % Cont.	86.92	90.84	83.33	82.62	55.73	79.89	6.21
Species (16 Reef Sites)	**BSN**	**BSS**	**WK**	**BH**	**SETB**	**MN**	**SE**
Calinectes sapidus	10.72	5.91	5.20	0.17	0.16	4.43	1.98
Haemulon aurolineatum	22.67	1.49	0.00	7.42	4.30	7.17	4.08
Lagodon rhomboides	56.00	60.48	57.60	2.60	3.42	36.02	13.50
Lutjanus griseus	2.82	1.95	2.05	0.00	0.00	1.37	0.58
Menippe mercenaria	3.49	9.31	19.83	5.70	0.16	7.70	3.38
Mycteroperca microlepis	0.00	0.00	0.00	1.13	0.16	0.26	0.22
Site Total % Cont.	96.26	84.56	93.49	18.40	11.98	60.94	18.80
Species (32 Reef Sites)	**BSN**	**BSS**	**WK**	**BH**	**SETB**	**MN**	**SE**
Calinectes sapidus	3.96	2.38	7.59	2.20	0.00	3.23	1.26
Haemulon aurolineatum	6.74	0.42	0.86	62.46	22.46	18.59	11.67
Lagodon rhomboides	73.42	81.12	3.62	0.28	0.00	31.69	18.66
Lutjanus griseus	3.59	2.86	0.76	0.61	3.62	2.29	0.67
Menippe mercenaria	5.96	4.06	38.43	7.38	4.35	12.04	6.62
Mycteroperca microlepis	0.00	0.00	0.00	6.83	19.50	5.27	3.80
Site Total % Cont.	94.69	91.03	65.05	89.27	90.45	86.10	5.34

Table 4a. Species list with finfish total length estimates ranges by reef system for the 4 and 8 reef sites for the Spring 2006 surveys.

	4 Reef Sites				
Species	**BSN**	**BSS**	**WK**	**BH**	**SETB**
Archosargus probatocephalus	110-120				
Blenniidae sp.			20-30		
Chaetodipterus faber					*150-180*
Diplectrum formosum				200-210	
Haemulon aurolineatum	30-60	100-110		100-110	*100-110*
Harrengula jaguana				80-90	
Hippocampus erectus			110-120		
Lagodon rhomboides	40-80	20-60	30-80	80-90	80-90
Libinia emarginata	30-60				
Lutjanus synagris				140-150	
Mycteroperca microlepis				200-400	
Orthopristis chrysoptera				120-130	
Prionotus scitulus				220 -230	
Serranus subligarius				80-90	
Stephanolepis hispidus			60-70		
Synodus foetens		100-110		220-230	
Upeneus parvus					70-80
	8 Reef Sites				
Species	**BSN**	**BSS**	**WK**	**BH**	**SETB**
Centropristis striata					220-230
Chaetodipterus faber			140-150	180-200	80-90
Chaetodon ocellatus				20-30	
Diplectrum formosum				200-210	
Haemulon aurolineatum	40-50	60-80	40-50	20-60	80-140
Haemulon plumieri					130-140
Halichoeres bivittatus					100-110
Harrengula jaguana				80-90	
Hippocanthus erectus				100-110	
Lagodon rhomboides	30-120	30-80	40-120	60-110	60-80
Libinia emarginata	40-50				
Lutjanus griseus		60-100	60-70		
Lutjanus synagris	50-60				
Mycteroperca microlepis				200-240	230-240
Orthopristis chrysoptera					140-150
Prionotus scitulus				190-200	
Serranus subligarius				80-100	80-100
Stephanolepis hispidus			60-80		
Synodus foetens	130-140	100-120	130-160	100-300	230-240
Upeneus parvus					120-130

Table 4b. Species list with finfish total length estimates ranges by reef system for the 16 and 32 reef sites for the Spring 2006 surveys.

16 Reef Sites

Species	BSN	BSS	WK	BH	SETB
Archosargus probatocephalus				240-230	130-140
Chaetodipterus faber				180-200	80-100
Chaetodon ocellatus				20-40	
Diplectrum formosum		200-210			
Diplodus holbrookii				140-150	120-130
Epinephelus itajara			100-200		
Gobiosoma oceanops					70-80
Haemulon aurolineatum	40-60	40-50		60-190	60-160
Haemulon plumieri				200-290	80-100
Harrengula jaguana				90-100	80-90
Hyposblennius hentzi	40-60			60-70	
Lagodon rhomboides	40-130	20-90	40-70	100-110	40-100
Libinia emarginata	40-60				
Lutjanus griseus	60-120	80-110	70-140		
Lutjanus synagris			70-90		90-100
Mycteroperca microlepis				100-240	250-260
Oligoplites saurus				120-130	
Opsanus beta				220-230	
Orthopristis chrysoptera				100-110	
Pareques acumintus				20-30	
Serranus subligarius				90-100	80-90
Stephanolepis hispidus		110-120	40-90		80-90
Synodus foetens		100-110	100-150		
Upeneus parvus					80-120

32 Reef Sites

Species	BSN	BSS	WK	BH	SETB
Archosargus probatocephalus		200-250		200-375	
Blenniidae spp.			20-30		
Caranx hippos	200-210				
Centropristis striata				250-260	
Chaetodipterus faber				230-240	
Diplectrum formosum		200-210			
Gobiosoma oceanops					40-50
Haemulon aurolineatum	40-60	40-50	30-50	60-80	60-100
Haemulon plumieri				220-230	
Hippocampus erectus			140-150		
Lagodon rhomboides	60-80	30-110	40-100	40-50	60-80
Libinia emarginata	40-70	40-50	60-80		
Lutjanus griseus	60-90	80-160	80-110	200-250	290-300
Lutjanus synagris			70-90	200-210	
Mycteroperca microlepis					240-450
Mycteroperca phenax				180-260	140-150
Opsanus beta	150-160		180-190	140-150	
Orthopristis chrysoptera				100-120	
Pareques acumintus				30-40	
Serranus subligarius				80-90	80-90
Sphoeroides spengleri					140-160
Stephanolepis hispidus			40-90		
Synodus foetens	110-130		100-150	200-230	

Density by Reef Site and System

Reef number appears to influence the distribution of both finfish and invertebrate communities across the reef systems in Sarasota and Tampa Bays. Organism density by reef system and site is shown in **Figure 4**. The organism densities were recorded on the 4 reef sites with a steady decline as reef number increased. In general the highest organism densities were recorded on the Sarasota Bay reef systems with the exception of the Bulkheads 8 and 16 reef sites. Organism density on the 4 reef sites ranged from 2.2 - 10.5 org/m^3. Density measures on the 8 reef sites ranged from 1.5 - 5.5 org/m^3. The 16 reef sites densities ranged from 0.5 - 4.0org/m^3. The 32 reef sites had the lowest overall density range of all the reef sites from 0.6 - 3.2 org/m^3. The lowest density measures were recorded at the Southeast Tampa Bay Reef System.

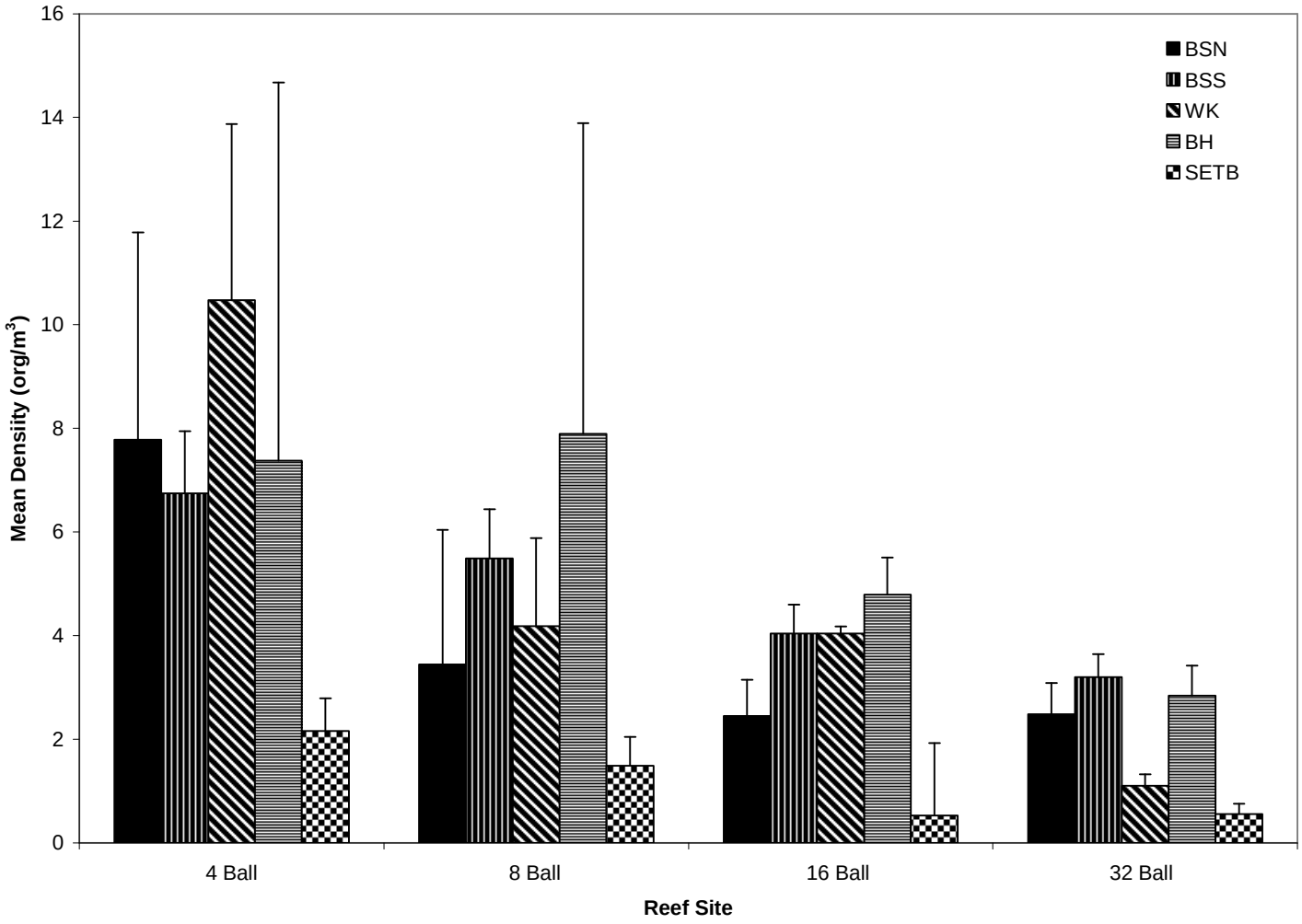

Figure 4. Mean density of macro invertebrate and finfish (org/m^3) observed at Bayshore North (BSN), Bayshore South (BSS), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay (SETB) reef Systems for spring 2006. Error bars equal to ±1 standard error.

Average density of organism per m^3 of the reef systems for the combined reef sites are shown in **Figure 5**. Overall organism density at the 4 reef sites was 6.4 ±4.3 org/m^3 across the reef systems. Average organism density on the 8 reef sites was 4.5±3.0 org/m^3 approximately was 30% lower than the 4 reef systems. Sixteen reef density was 3.2±2.6 org/m^3 across the survey systems was 30% lower than at the 8 reef sites mean, and the 32 reef site organism density (2.0±1.5 org/m^3) was 35% lower than the 16 reef sites.

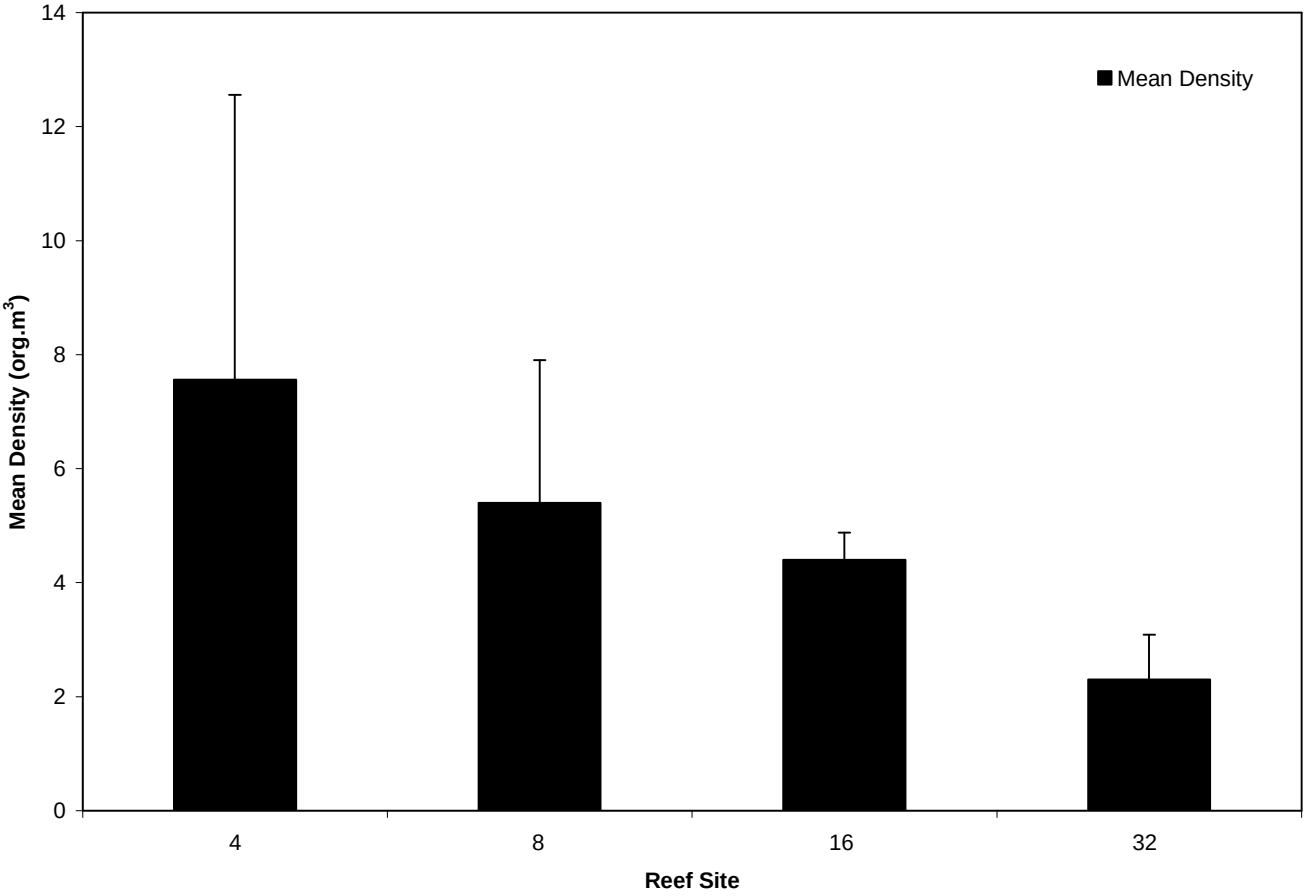

Figure 5. Mean density of organisms/m^3 by reef site across all reef sites for spring 2006. Error bars equal to ±1 standard error.

Spring 2006 Discussion

All of the surveyed reef systems appear to have recovered from the 2005-2006 *K. brevis* bloom and associated anoxic events. Juvenile finfish and invertebrate recruitment was observed across all of the reef system. Both finfish and invertebrate distributions reflect pre bloom concentrations suggesting that these sites have recovered. Extensive soft coral colonies observed across the survey area suggest that the anoxic condition associated with the bloom did not completely destroy the sessile invertebrate population.

Organism observations, species number and size of the observed finfish suggest that these bay reef systems provide juvenile finfish habitat during the late winter and early spring. Geographic location of the reef system appears to influence the total number of organisms, species and finfish size ranges. The distribution of lower numbers of larger fish at the Tampa Bay reef

systems could possibly be explained by the presence of an adjacent deepwater outlet to the Gulf of Mexico. Direct access to open gulf waters through the Tampa Bay may provide a seasonal migration corridor for adult finfish and invertebrates to the open gulf waters from inshore waters. These reef systems could provide a stepping stone pathway of structures between offshore and inshore habitats for sub adult to adult finfish in Tampa Bay. Sarasota Bay reef systems were dominated by juvenile to sub adult finfish suggesting that these habitats provide good recruitment area for finfish in Sarasota Bay. The reduced number of larger predator fish on these sites appears to correlate with ready access Gulf of Mexico. *M. mercenaria* and *C. sapidus* distribution on the reef systems further suggest that geographic location influences the species distributions on these reef systems.

Organism distribution and densities on the reef systems appears to relate to total reef area across all of the reef systems. Even though reef surface area was greater on the 32 reef sites the organism densities tended to decline by approximately 30 % with each increase level of surface area. The reduction in species density suggest that factors other habitat availability influence both species distributions and densities on these reef systems. It should be noted that the distribution of both *C. sapidus and M. mercenaria* are related to the total number of sediment level holes across all of the reef systems. Competition for these areas suggests that sediment level hole maybe a limiting habitat for both species on the reef systems.

Summer 2006

Site Abundance

Observation totals across all of the reef systems averaged 104.8±36.1 a 57.8% decline from the spring 2006 surveys. Organism abundance across the entire study area increased with reef site surface area (**Figure 6**, and **Table 5**). The larger reef sites had higher overall abundances than the smaller reef sites with an average increase of 43.1±4.5%. Organism abundance at the Tampa Bay reef systems tended to be higher than on the Sarasota Reef systems. Average organism abundance on the Tampa Bay reef systems was 119.2±37.0, and 95.2±35.5 at the Sarasota Bay reef systems. Organism abundance at the Sarasota Reef systems was approximately 20% lower than organism abundances on the Tampa Bay reef systems.

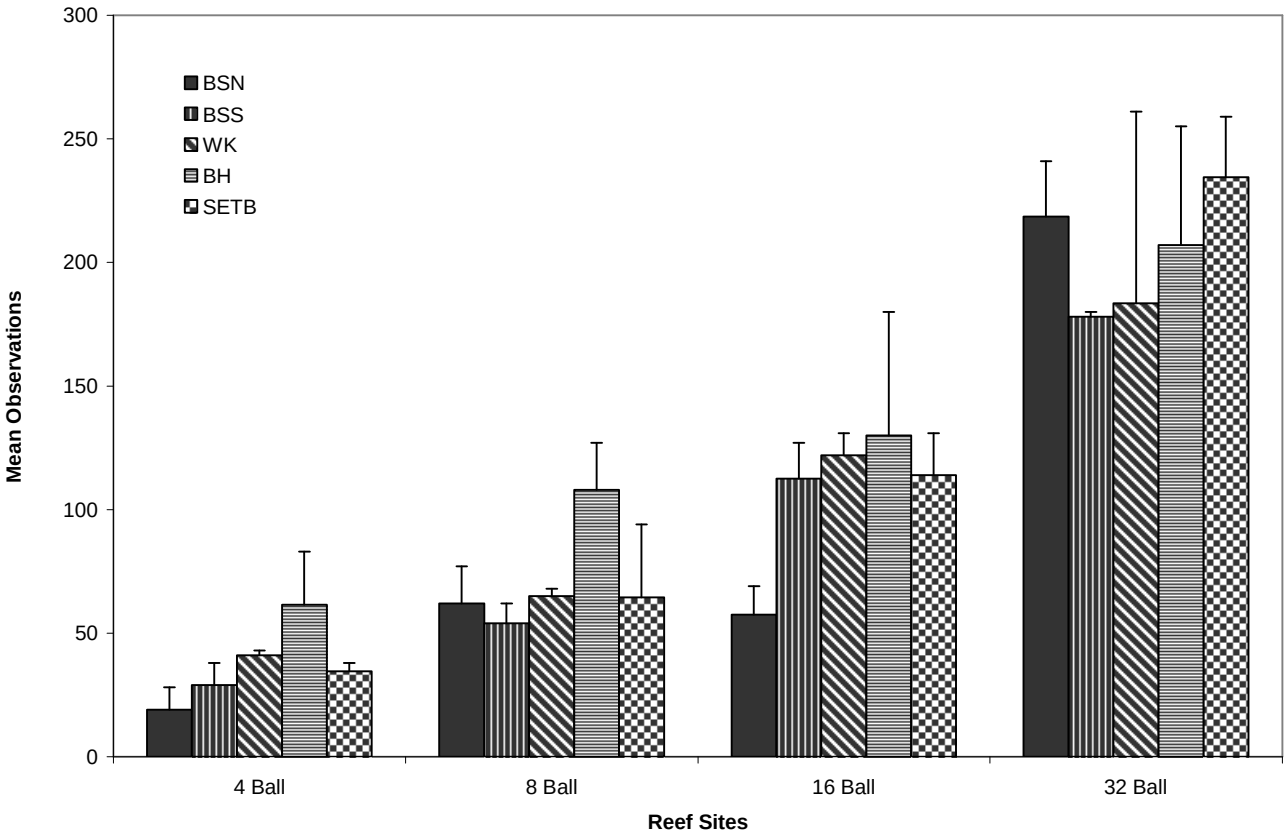

Figure 6. Mean number of finfish and invertebrates observed on the Bayshore North (BSN), Bayshore South (BSS), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay reef sites for summer 2006. Error bars equal to ±1 standard error.

Table 5. Mean site observation totals, and mean observation % increase by reef system and reef site for Bayshore South (BSS), Bayshore North (BSN), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay during the summer 2006 survey period.

Reef #	BSN	BSS	WK	SBMN	SBSE	BH	SETB	TBMN	TBSE	Tot. Mn	Tot. SE	% inc.
4 Ball	19.0	29.0	41.0	29.7	6.4	61.5	34.5	48.0	13.5	37.0	7.1	
8 Ball	62.0	54.0	65.0	60.3	3.3	108.0	64.5	86.3	21.8	70.7	9.5	47.7
16 Ball	57.5	112.5	122.0	97.3	20.1	130.0	114.0	122.0	8.0	107.2	12.8	34.1
32 Ball	218.5	178.0	183.5	193.3	12.7	207.0	234.0	220.5	13.5	204.2	10.5	47.5
Mn	89.3	93.4	102.9	95.2		126.6	111.8	119.2			**Mn % inc**	43.1
SE	129.3	84.6	80.6	35.5		81.0	122.3	37.0			**SE**	4.5

Species Richness

Total species number declined across all of the survey systems from the number of species observations recorded during the spring surveys. Mean species richness across all of the sites was 7.6 ±0.7 during the summer sampling period a 33.6% decline from spring surveys. Species totals ranged from 6.1±0.9 organisms at the four reef sites to 9.4±0.4 at the 32 reef sites. In general species observations total increased with total reef unit numbers and area. Species observation totals on the 4 reef sites had the smallest number of species than all of the other reef sites (**Figure 7**).

Total species observations across the Sarasota Bay reef systems was 7.4±0.7 species/ reef site, while species observation across the Tampa Bay reef systems had an average of 7.9±0.7 species/ reef site. Species observations were approximately 7% higher at the Tampa Bay reef systems than at the Sarasota Bay reef systems.

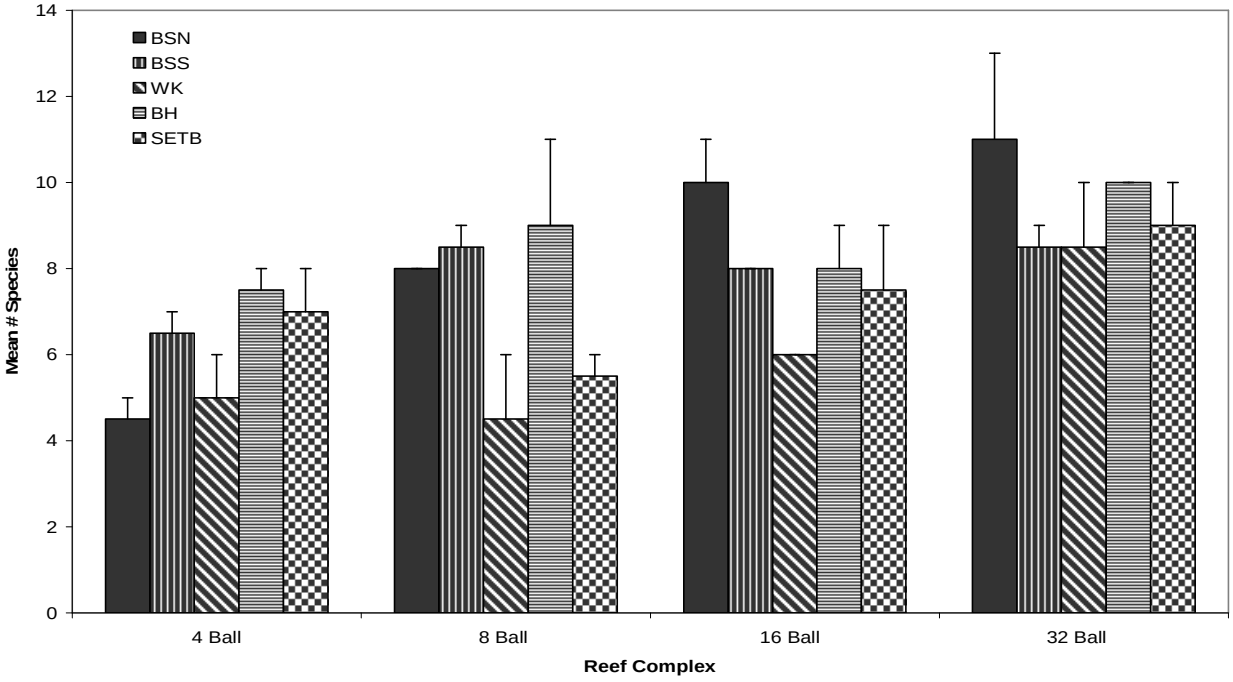

Figure 7. Species richness by reef site for Bayshore North (BSN), Bayshore South (BSS), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay reef systems for summer 2006. (Error bars equal to ±1 standard error.)

Community Similarity

4 Reef Sites

Finfish and invertebrate community structures across the four reef sites were relatively similar with 6 species common to all of the 4 reef sites **Table 6**. All of the common species were not observed across all of the 4 reef sites. Estimates were made using a general species list of all species common to the 4 reef sites during this sampling period. The common species accounted for 45.9±2.6% of the observed finfish and invertebrates observed at the 4 reef sites. *L. rhomboides* was the dominant finfish species across both the Sarasota Bay (9.9±4.9 %.) and Tampa Bay (10.7±2.6 %) 4 reef sites. The species accounted for 10.2±2.2% of the total observations. *L. rhomboides* % contributions were approximately 8 percent higher at the Tampa Bay sites than on the Sarasota Bay sites. *M. microlepis* contributed 4.9±5.3% of the Sarasota Bay 4 reef sites, and 6.8±6.2 of the Tampa Bay sites. *M. microlepis* percent contributions were approximately 28% higher on the Tampa Bay reef sites than on the Sarasota Bay reef sites. One juvenile *Epinephelus itajara* was observed at the Southeast Tampa Bay 4 reef sites.

The invertebrate community was dominated by *M. mercenaria* accounted for 21.3±1.3% of the individual observations at the Sarasota Bay four reef sites, and 10.4±6.0% of the Tampa Bay sites observations (**Table 6**). *M. mercenaria* were observed at all of the reef sites accounting for 16.9±4.0% of the observations. *M. mercenaria* observations at the Tampa Bay 4 reef sites were on approximately 51% lower than the Sarasota Bay contributions. *L. virgulata* colonies were observed at all of the reef sites. A complete species list by reef number and system for the summer of 2006 are shown in **Appendix B**.

8 Reef Sites

Finfish and invertebrate communities at 8 reef sites had 7 common species across all of the systems (**Table 6**). The common species accounted for 72.4±20.7% of the finfish and invertebrate communities. *L. rhomboides* accounted for 5.3±3.5% of the observations at the Sarasota Bay sites. *L. rhomboides* were not documented on the Tampa Bay reef sites. *H. aurolinatum* populations observed in the spring surveys were absent or reduced in number from the summer surveys. *L. griseus* accounted for 8.0±5.1% of the Sarasota Bay sites, and 0.23±0.23% of the Tampa Bay 8 reef sites. *L. griseus* percent contributions were approximately 98% higher on the Sarasota sites than at the Tampa Bay sites. *M. microlepis* accounted for 5.0±0.47% of the observations at the Sarasota Bay sites and 24.2±13.9% of the Tampa Bay sites. *M microlepis* contribution estimates were 79.2% higher at the Tampa Bay reef sites than on the Sarasota Bay reef sites. Three juvenile *E. itajara* were observed on the Sarasota Bay sites BSN 1 record, and BSS 2 records), accounting for 2.6% of the total observations).

The invertebrate community was dominated by *M. mercenaria* across all of the 8 reef sites accounting for 40.6±3.61% of the total observations. *M. mercenaria* contributed an average of 49.4±18.5% species observations across the Sarasota Bay sites, and 27.3±9.6% of the Tampa Bay observations. *M. mercenaria* percent contribution estimates across the Sarasota Bay reef sites were approximately 45 % higher than on the Tampa 8 reef sites. *L. virgulata* colonies were observed across all of the reef systems. A complete species list by reef number and system for the summer of 2006 are shown in **Appendix B**.

16 Reef Sites

Finfish and invertebrate community structures across the 16 reef sites had 7 common species accounting for 83.7±10.4% of the finfish and invertebrate communities. *L. rhomboides* was the dominant finfish observed on the Sarasota Bay reef sites accounting for 7.4±3.7% of the species observations. *L, rhomboides* were not recorded at any of the Tampa Bay 16 reef sites. *M. microlepis* contributions across the Tampa Bay sites accounted for 24.9±11.1% and 7.5±7.1% of the Sarasota Bay finfish observations. *M. mercenaria* observations were approximately 70.0% higher at the Tampa Bay sites than on the Sarasota Bay sites. *L. griseus* were observed at across all of the reef sites accounting for 12.7±6.8% of the total observations. L. griseus accounted for 18.0±9.2% of the total observation across the Sarasota Bay sites and 4.9±1.1% of the Tampa Bay observations. Observations on the Sarasota Bay reef sites were approximately 73% higher than on the Tampa Bay reef sites. Three juvenile *E. itajara* were observed om the 16 reef sites 2 observations were recorded at the Bayshore North reef system and 1 one the Southeast Tampa Bay reef system.

The invertebrate community was dominated by *M. mercenaria* accounting for 40.2±9.5% of the recorded observations. *M. mercenaria* accounted for 49.44 ±13.03% of the Sarasota Bay, and 26.3±4.4% of the Tampa Bay observations. Species observations on the Sarasota Bay reef sites were approximately 47% higher on the Sarasota sites than on the Tampa Bay sites. *L. virgulata* colonies were observed at all of the reef sites. A complete species list by reef number and system for the summer of 2006 are shown in **Appendix B**.

32 Reef Sites

Finfish and invertebrate populations at the 32 reef sites had 8 common species accounting for 91.8±3.13% of the total observations. *L. rhomboides* accounted for 6.8±3.9% of the Sarasota Bay observations, and 0.1±0.1 % of the total observations at the Tampa Bay reef sites. *L. rhomboides* observations were approximately 99% higher on the Sarasota reef sites than at the Tampa Bay reef sites. *M. microlepis* accounted for 7.6±3.8% of the observations within Sarasota, and 32.1±6.1% of the Tampa Bay 32 reef site species observations. *M. mercenaria* observations at the Tampa Bay reef sites were approximately 76% higher than species contributions on the Sarasota Bay reef sites. *L. griseus* observations accounted for 14.4±12.9% of the observations across all of the reef sites. Species observation at the Sarasota Bay reef sites accounted for 21.6±8.0% of the total observations, and 3.7±2.1% of the Tampa Bay reef site observations. *L. griseus* observations on the Sarasota Bay reef sites were approximately 83 % higher than on the Tampa Bay 32 reef sites. Juvenile *E. itajara* were observed at all of the reef sites except the Whale Key sites and accounted for 1.1±0.2 % of the total percent contribution estimates.

The invertebrate community was dominated by *M. mercenaria* accounting for 39.7±5.0% of the observations. *M. mercenaria* accounted for 48.8 ±15.58% of the Sarasota Bay observations, and 26.0±8.7% of the Tampa Bay observations. Species perncent contribution estimates at the Sarasota Bay 32 reef sites were approximately 47% higher than on the Tampa Bay reef sites. *L. virgulata* colonies were observed at all of the reef sites. A complete species list by reef number and system for the summer of 2006 are shown in **Appendix B**.

Table 6. Species percent contribution estimates of the common game species at the 4, 8, 16, and 32 reef sites located within Bayshore North (BSN), Bayshore South (BSS), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay (SETB) reef systems for summer 2006.

Species (4 Reef Sites)	**BSN**	**BSS**	**WK**	**BH**	**SETB**	**Mean**	**SE**
Archosargus probatocephalus	0.90	0.18	0.00	0.00	0.09	0.234	0.17
Epinephelus itajara	0.00	0.00	0.00	0.00	1.32	0.263	0.263
Lagodon rhomboides	0.00	15.79	13.95	13.25	8.06	10.21	2.15
Lutjanus griseus	0.00	2.63	1.28	1.20	3.23	1.67	1.56
Menippe mercenaria	20.00	13.16	30.77	7.83	12.90	16.93	4.03
Mycteroperca microlepis	10.00	3.95	0.00	0.60	12.90	5.49	7.41
Total	45.90	50.71	62.67	27.89	43.34	46.10	2.76
Species (8 Reef Sites)	**BSN**	**BSS**	**WK**	**BH**	**SETB**	**Mean**	**SE**
Archosargus probatocephalus	2.36	4.87	0.00	1.69	5.35	2.85	2.50
Epinephelus itajara	0.65	1.89	0.00	0.00	0.00	0.51	0.51
Lagodon rhomboides	1.95	11.40	2.94	0.00	0.00	3.26	3.26
Lutjanus griseus	11.04	7.82	5.22	0.56	0.00	4.93	4.93
Menippe mercenaria	67.93	42.74	37.50	17.71	36.96	40.57	3.61
Mycteroperca microlepis	4.55	10.52	0.00	10.28	38.12	12.69	25.42
Total	90.61	90.81	47.87	39.46	93.05	72.36	20.70
Species (16 Reef Sites)	**BSN**	**BSS**	**WK**	**BH**	**SETB**	**Mean**	**SE**
Archosargus probatocephalus	5.07	4.56	0.00	2.50	6.26	3.68	2.58
Epinephelus itajara	1.09	0.00	0.00	0.00	0.76	0.37	0.39
Lagodon rhomboides	9.42	1.69	11.05	0.00	0.00	4.43	4.43
Lutjanus griseus	17.03	34.35	2.67	3.75	5.99	12.76	6.77
Menippe mercenaria	39.86	36.41	72.02	21.88	30.68	40.17	9.49
Mycteroperca microlepis	7.61	14.46	0.44	13.82	35.96	14.46	21.50
Total	82.25	93.67	96.76	51.94	94.12	83.75	10.37
Species (32 Reef Sites)	**BSN**	**BSS**	**WK**	**BH**	**SETB**	**Mean**	**SE**
Archosargus probatocephalus	3.41	6.99	0.00	2.94	3.48	3.37	0.12
Epinephelus itajara	1.45	2.26	0.00	0.51	1.25	1.09	0.15
Lagodon rhomboides	3.01	6.70	10.82	0.00	0.24	4.15	3.92
Lutjanus griseus	34.62	23.07	7.07	5.81	1.58	14.43	12.86
Menippe mercenaria	39.79	42.18	64.36	17.31	34.68	39.67	4.99
Mycteroperca microlepis	11.41	9.52	1.80	38.24	26.03	17.40	8.63
Total	93.70	92.15	97.14	75.06	94.92	90.59	3.13

Table 7a. Species list with finfish total length estimates for 4 and 8 reef site surveys for the summer 2006 surveys.

	4 Reef Sites				
Species	**BSN**	**BSS**	**WK**	**BH**	**SETB**
Archosargus probatocephalus	110-120	140-150			180-190
Dasyatis americana					350-400
Epinephelus itajara					240-250
Haemulon plumieri				80-140	
Lagodon rhomboides		80-120	90-110	80-110	80-100
Lutjanus griseus		60-170	80-170	120-130	140-160
Lutjanus synagris	50-60			140-150	100-110
Mycteroperca microlepis	100-180	100-210		200-230	120-220
Opsanus beta		140-150		140-200	
Stephanolepis hispidus	80-90				
	8 Reef Sites				
Species	**BSN**	**BSS**	**WK**	**BH**	**SETB**
Archosargus probatocephalus	90-150	140-200		140-150	140-150
Calamus calamus	120-140				
Chaetodipterus faber				120 - 130	
Dasyatis americana				350 - 400	
Epinephelus itajara	220-230	190-250			
Haemulon plumieri				110-120	80-90
Lagodon rhomboides	90-110	90-110	60-120		
Lutjanus griseus	120-160	80-150	80-90	100-110	
Lutjanus synagris				60-80	
Mycteroperca microlepis	160-200	160-230		150-240	140-220
Opsanus beta	140-150			130-160	160-180
Pomacanthus paru	100-110				
Stephanolepis hispidus	80-90				

Community composition by size class summer 2006

The finfish community across all of the Sarasota Bay reef systems was largely composed smaller fish than community associated with the Tampa Bay reef systems (**Tables 7a** and **7b**). *L rhomboides* size ranges were between 60-120mm TL across the Sarasota Bay systems and between 80-110 mm TL at the Tampa Bay reef systems. L. rhomboides observations across the Sarasota Bay reef sites were generally on the lower end of the size rage with few observations larger than 90-100 mm TL. Observations across the Tampa Bay reef systems tended to be larger with the majority of the observations between 90-100 mm TL with few individual below 78-80mm TL. *M. microlepis* at the Sarasota Bay sites ranged from 110-260 mm TL, while the Tampa Bay populations ranged from 120-320 mm TL. *M microlepis* at the Tampa Bay reef systems were on the high end of the size range (200 -320 mm); while the Sarasota Bay populations were on the lower end of the size range (120-180 mm). *L. griseus* populations followed the same general pattern as the *M. microlepis* populations with 60-230 mm TL fish observed across the Sarasota Bay systems, and 100 -180 mm TL fish at the Tampa Bay reef systems.

Density by Reef Site and System

During the summer 2006 sampling period, organism density was similar across all of the study systems. (**Figure 8**). Overall the density measures ranged from 2.3 - 3.3 org/m^3 (**Figure 9**). Mean organism density on the Sarasota Bay and Tampa Bay reef systems was 2.4±0.2 org/m^3 and 3.3±0.4 org/m^3. Organism density at the Sarasota Bay reef systems was 26.5% higher than at the Tampa Bay systems. The highest overall organism densities were recorded on the 4 reef sites (3.3±0.2 org./m^3). Mean organism density at the 8 reef sites was 3.12±0.78 org/m^3 approximately 6.4% lower than on the 4 reef sites. The 16 reef site average density was 2.4±0.2 org/m^3 approximately 27% lower than the 4 reef, and 22% lower than at the 8 reef sites. The 32 reef sites had lowest mean organism density of 2.3±0.8 org/m^3 approximately 31% lower than the 4 reef, 26% lower than the 8 reef, and 5% lower than the 16 reef sites.

Table 7b. Species list with finfish total length estimates for 16 and 32 reef site surveys for summer 2006.

16 Reef Sites

Species	BSN	BSS	WK	BH	SETB
Archosargus probatocephalus	110-130	90-220		180-200	180-200
Calamus calamus	110-120				
Chaetodipterus faber				130-140	
Epinephelus itajara	260-270				230-240
Haemulon plumieri				90-100	
Lagodon rhomboides	80-130	90-120	90-110		
Lutjanus griseus	60-140	80-220	100-200	140-150	120-140
Lutjanus synagris	100-110			90-100	80-90
Mycteroperca microlepis	160-190	160-260	140-150	200-300	140-280
Opsanus beta	100-140	100-190	100-190	130-150	100-180
Synodus foetens	240-250				

32 Reef Sites

Species	BSN	BSS	WK	BH	SETB
Archosargus probatocephalus	90-180	100-230		120-220	130-210
Calamus calamus	110-160		180-190		
Chaetodipterus faber				80-100	
Dasyatis americana					500-600
Diplectrum formosum	130-140				
Diplodus holbrookii				110-200	
Epinephelus itajara	180-300	200-280		200-210	200-260
Haemulon plumieri				100-120	
Lagodon rhomboides	90-110	100-120	90-110		80-90
Lutjanus griseus	90-230	120-200	40-120	120-160	140-180
Lutjanus synagris	100-130			100-120	
Mycteroperca microlepis	140-220	160-250	160-230	140-260	160-320
Opsanus beta	130-140	140	100-120		140-150
Sphoeroides spengleri				80-90	80-90
Stephanolepis hispidus	80-120		90-100		
Synodus foetens	220-230				

.

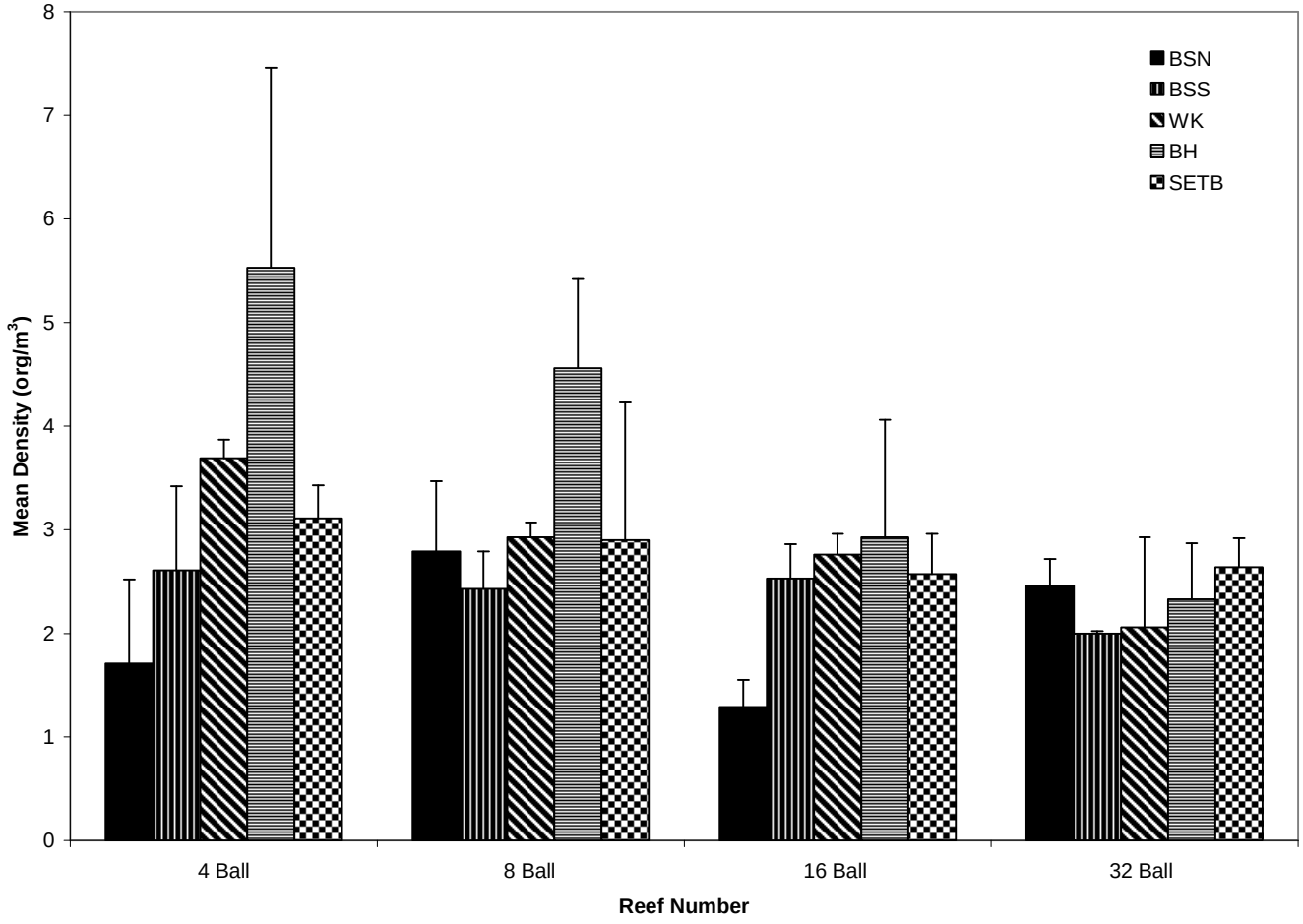

Figure 8. Mean density of macro invertebrate and finfish observed at Bayshore North (BSN), Bayshore South (BSS), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay (SETB) reef systems for summer 2006. (Error bars equal to ±1 standard error.)

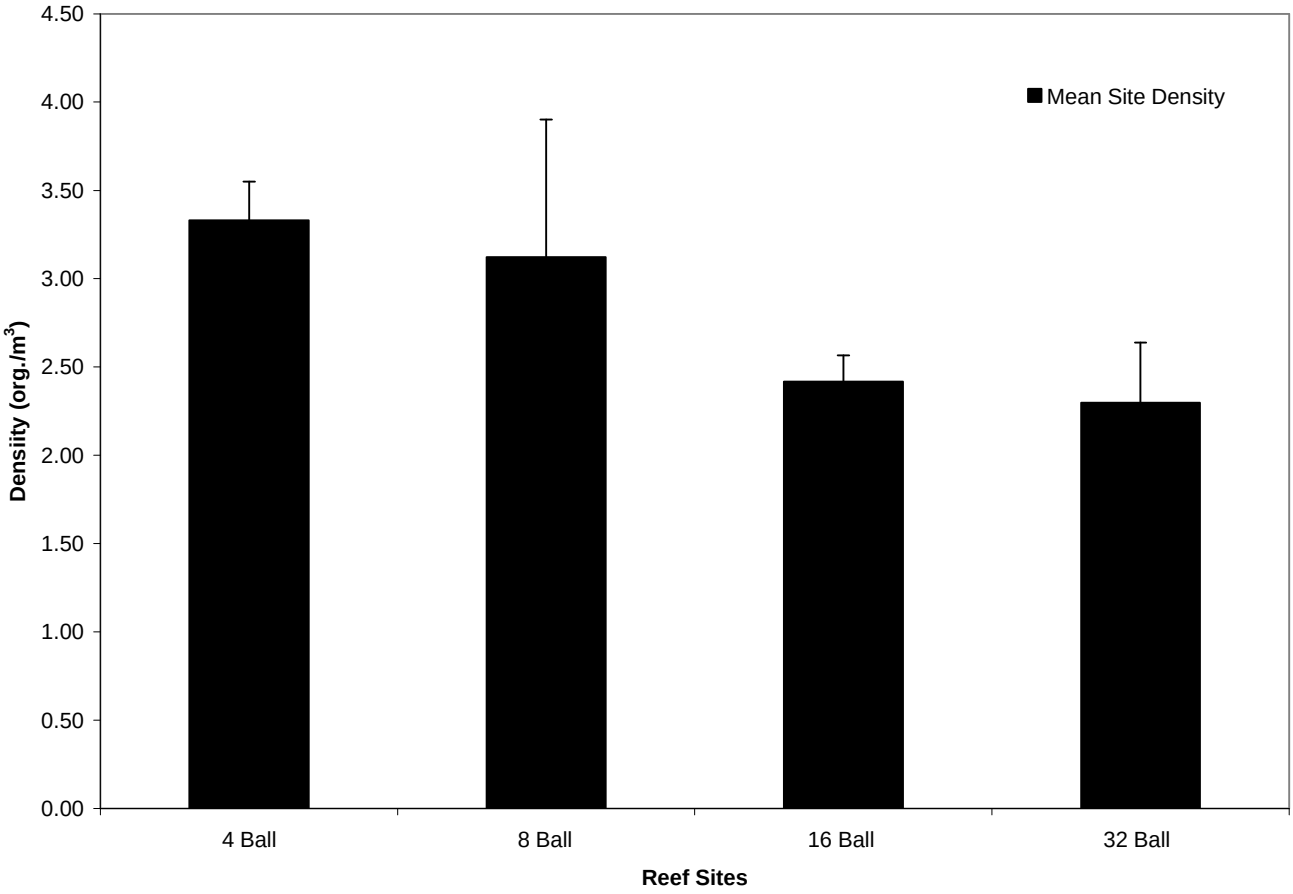

Figure 9 Mean density of organisms/m^3 by reef site for summer 2006. **(**Error bars equal to ±1 standard error.)

Summer 2006 Discussion

Organism abundances in the summer of 2006 were approximately 50% than spring 2006 survey totals. Divers noted that individual fish sizes increased across all of the systems with decreases in observations of baitfish and juvenile finfish. *L. rhomboides* concentrations were highest at the 4 reef sites and made up to 15% of the total observations. The 4 and 8 reef sites had fewer *M. microlepis* and *L. griseus* observations but had higher numbers of *L.* rhomboides especially evident at the Sarasota Bay reef systems. Juvenile *E. itajara* (less than 300 mm TL) were recorded at each of the reef systems and contributed between 3-5% of the total observations depending on the system. All of the *E. itajara* juveniles ranged between 200-300 mm TL. The strong presence of juvenile to sub adult finfish shows that these bay systems are likely important areas for finfish recruitment in Sarasota Bay. The Tampa Bay reef sites tended to be dominated by sub adult to adult fish suggests that these systems could be transition habitat zones from deeper water habitats to shallow bay habitats.

Finfish size classes at both the Sarasota Bay and Tampa Bay reef systems increased over the spring surveys. All of the survey sites and systems had defined size class shifts in both baitfish and game fish species. The Tampa Bay systems reef community tended to have larger fish than the Sarasota Bay systems. Sub adult to adult *M. microlepis* and *L. griseus* dominated the Tampa

Bay Finfish community sharply contrasted with the juvenile to sub adult dominated observations across the Sarasota Bay reef systems. Size class differences between reef systems suggest that the Tampa Bay reef systems are seasonal transition zones from deep water habitats to shallow water habitats while the Sarasota Bay systems are juvenile recruitment habitats.

Invertebrate populations across all of the reef sites were dominated by *M. mercenaria* accounting for between 20-70% of the total observations. During the summer survey period *M. mercenaria* population size appeared to be limited by substrate level holes on the reef units. All of the available substrate level holes were occupied suggesting space limitation. The relative amount of space available for the organisms resulted could have resulted in lower densities across all of the reef sites. *L. virgulata* observed across all of the reef systems increase in size and total over the spring surveys resulting in more the overall habitat complexity.

Reef site density followed the same general pattern observed during the spring sampling period within the highest organism density observed at the smaller reef sites. In general the 4 reef sites had the highest overall density of org/m^3. Summer density differences between the reef sites were lower due to the reduction in baitfish across all of the sites. Smaller reef sites tend to hold smaller numbers of organisms but higher densities. Increased surface area of the reef sites reduces the overall density.

Fall 2006

Site Abundance

Observation totals across all of the reef sites averaged 38.0±6.7org./system approximately 64% lower than summer 2006 surveys. Organism abundance across the entire study area increased with reef site surface area (**Figure 10**, and **Table 8**). The larger reef sites had higher overall abundances than the smaller reef sites with an average increase of 30.4±9.7% across all of the reef systems. Organism abundances across the Sarasota Bay reef systems averaged 27.6±8.3 org/reef system and 63.3±15.8 org/reef system at the Tampa Bay systems. Total organism abundances on the Tampa Bay reef systems were 56.3% higher than on the Sarasota Bay reef systems.

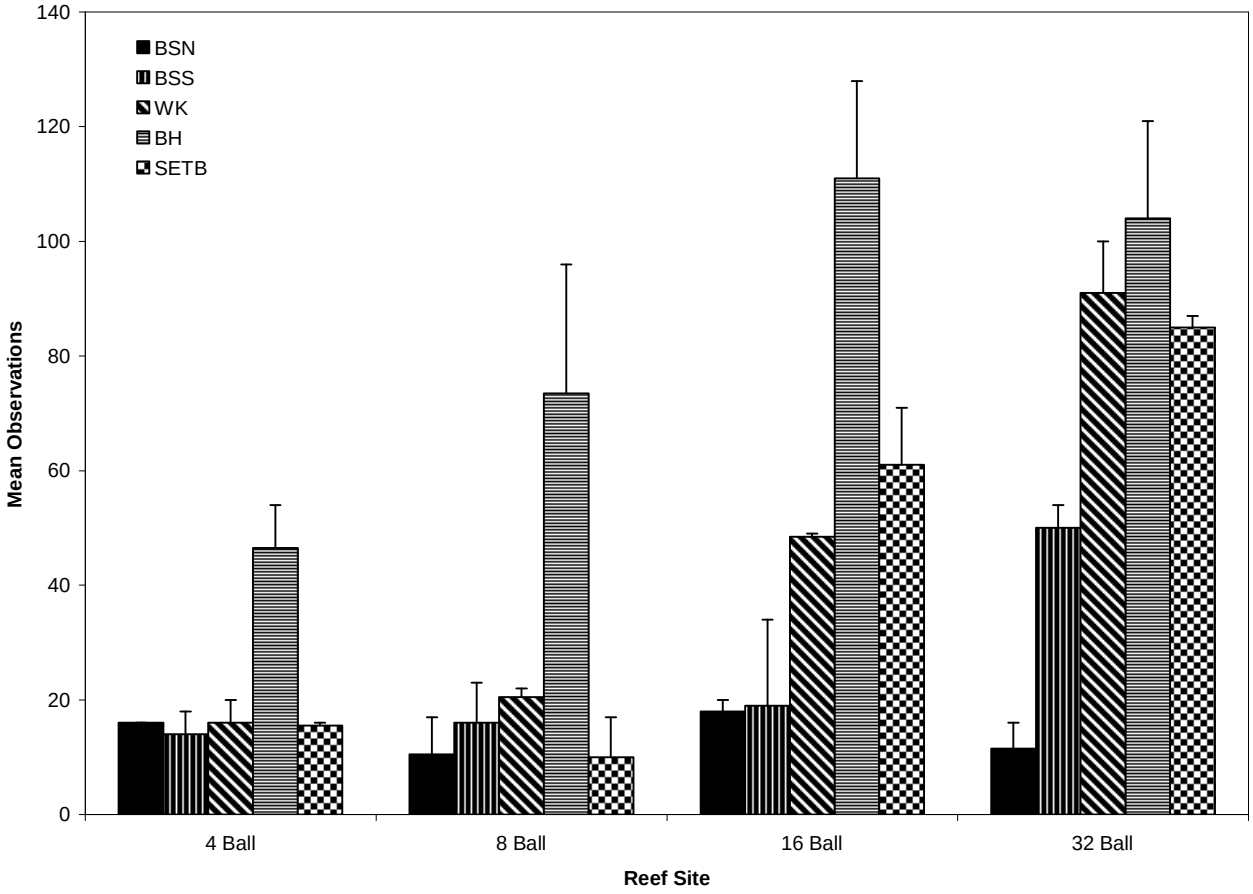

Figure 10. Mean number of finfish and invertebrate observed on the Bayshore North (BSN), Bayshore South (BSS), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay reef system for system and reef sites for fall 2006. (Error bars equal to ±1 standard error).

Table 8. Mean site organism abundance totals, and mean observation % increase y reef system and reef site for Bayshore South (BSS), Bayshore North (BSN), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay during the fall 2006 survey period.

Reef #	BSN	BSS	WK	SBMN	SBSE	BH	SETB	TBMN	TBSE	Mn	SE	% Inc.
4 Ball	16.0	14.0	16.0	15.3	0.7	46.5	15.5	31.0	15.5	21.6	6.2	
8 Ball	10.5	16.0	20.5	15.7	2.9	73.5	10.0	41.8	31.8	26.1	12.0	17.2
16 Ball	18.0	19.0	48.5	28.5	10.0	111.0	61.0	86.0	25.0	51.5	17.1	49.3
32 Ball	11.5	50.0	91.0	50.8	23.0	104.0	85.0	94.5	9.5	68.3	16.8	24.6
Mean	**14.0**	**24.8**	**44.0**	**27.6**		**83.8**	**42.9**	**63.3**			**Mean**	**30.4**
SE	**1.8**	**8.5**	**17.2**	**8.3**		**14.8**	**18.1**	**15.8**			**SE**	**9.7**

Species Richness

Total species number declined across all of the survey systems from the number of species observations recorded during the summer surveys. Mean species richness across all of the sites was 4.6 ±0.5 species/reef site approximately 39% lower than from spring surveys. Species totals ranged from 3.8±0.9 species/reef system at the four reef sites to 5.6±1.4 species/reef site at the 16 reef sites. Species richness totals at the 32 reef sites were approximately 8 % lower than at the 16 reef sites. In general species observations totals increased with total reef unit numbers and area. Species observation totals on the 4 reef sites had the lowest species number across all of the reef systems (**Figure 11**). Total species observations across the Sarasota Bay reef systems was 3.2±0.3 species/reef system, while species totals across the Tampa Bay reef systems had an average of 6.6±0.8 species/ reef sites. Species observations were approximately 51.5% higher at the Tampa Bay reef systems than at the Sarasota Bay reef systems.

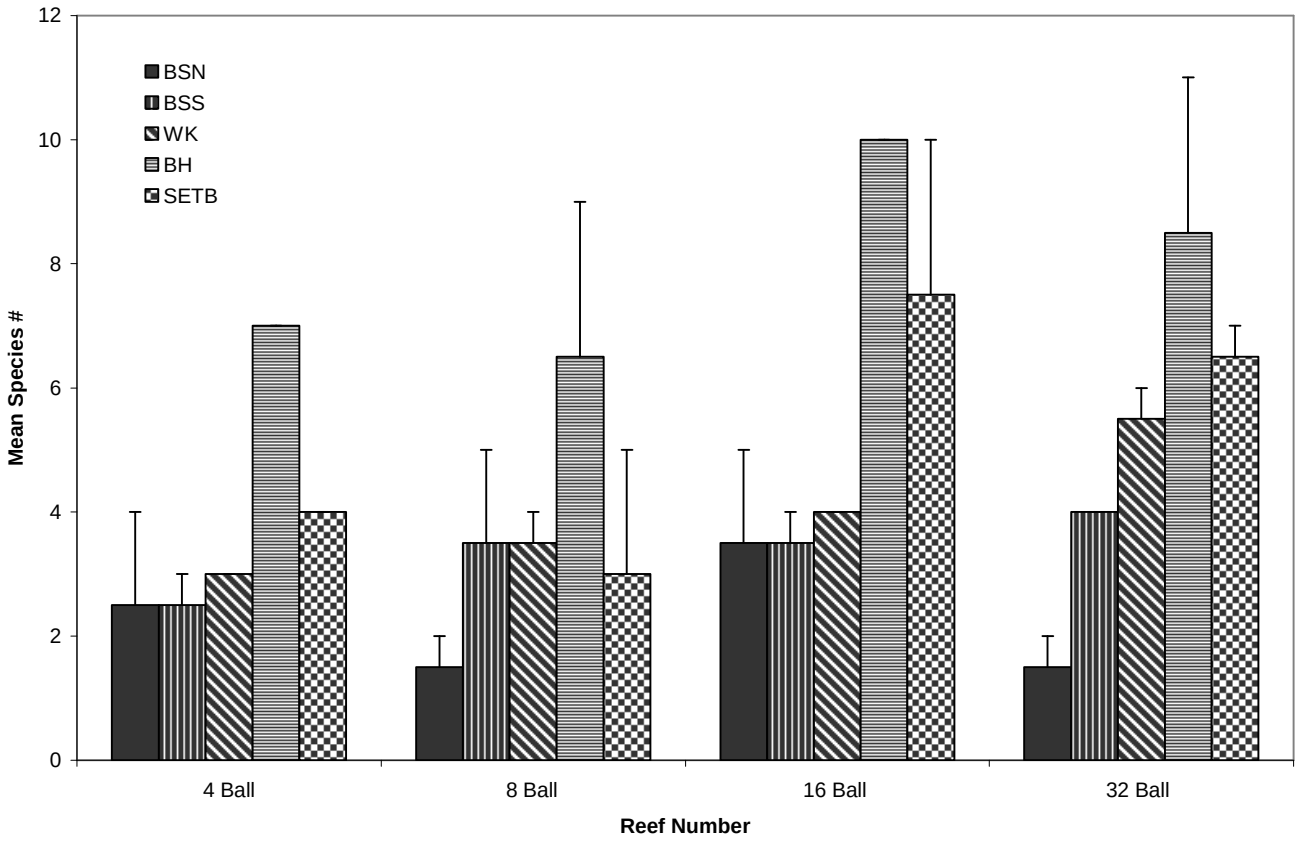

Figure 11. Species richness by reef site for Bayshore North (BSN), Bayshore South (BSS), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay reef systems for fall 2006. (Error bars equal to ±1 standard error.)

Community Similarity

4 Reef Sites

Finfish species accounted for 18.1±12.8% of the common observations across the 4 reef sites (**Table 9**). *L. griseus* was the dominant finfish at the Sarasota Bay reef sites accounting for 2.2±1.0% of the observations at the Sarasota Bay reef sites (no Tampa Bay observations). *D. formosum* was the dominant finfish at the Tampa Bay sites accounting for 15.9±11.8% of the individuals (no Sarasota Bay observations). A complete species observed at the 4 reef sites for fall 2006 are shown in **Appendix C**.

Invertebrates dominated the observations at the 4 reef sites across the Sarasota and Tampa Bay 4 reef sites accounting for 46.5±12.2% observations. (Table 10) *M. mercenaria* accounted for an average of 46.5±12.1% of the 4 reef site observations. *M. mercenaria* observations within Sarasota Bay accounted for 63.6±10.4% and at the Tampa Bay sites 20.9±8.0%. *M. mercenaria* observations in Sarasota Bay were 67% higher than at the Tampa Bay 4 reef sites.

8 Reef Sites

Finfish observations accounted for 7.0±2.4% of the individuals across the 8 reef sites. Finfish observations accounted for 4.2 ±1.8% of the individuals at the Sarasota Bay 8 reef sites and 21.7.±8.6% of the individuals across the Tampa Bay sites (**Table 9**). Finfish percent contributions within Sarasota Bay were restricted due to no common observations at the 8 reef sites. The dominant finfish at the Tampa Bay reef sites was sub adult to adult *M. microlepis* accounting for 28.7±27.2% of the individual finfish. *M. microlepis* observations in Sarasota Bay accounted for 0.72±0.72% of the individuals (1 individual on the Bayshore South reef site). A complete species list by reef number and system for fall 2006 are shown in Appendix 3.

Invertebrates dominated the observations at the 8 reef sites within Sarasota and Tampa Bay reef sites accounting for 33.6±10.0% of the individuals (Table 10). *M. mercenaria* accounted for an average of 43.5±14.7% of the 8 reef site observations. *M. mercenaria* observations within Sarasota Bay accounted for 67.2±3.9% and at the Tampa Bay sites 8.1±5.1%. *M. mercenaria* observations in Sarasota Bay were 87% higher than at the Tampa Bay. *L. virgulata* colonies accounted were recorded across all of the 8 reef sites.

16 Reef Sites

Finfish observations accounted for 4.0±2.3% of the individuals across the 16 reef sites (**Table 9**). Finfish within Sarasota Bay accounted for 5.6 ±3.4% of the individuals and 15.8±8.7% of the individuals within Tampa Bay. Finfish contributions at the Sarasota Bay 16 reef sites was approximately 65% lower than finfish observations in Tampa Bay. Juvenile *L. griseus* was the dominant finfish in Sarasota Bay accounting for 7.3±5.2% of the finfish observations (no observations at the Tampa Bay 16 reef sites). Sub adult and adult *M. microlepis* were the dominant finfish at the Tampa Bay reef sites accounting for 26.7±14.4% of the finfish (no observations at the Sarasota Bay reef sites). A complete species list by reef number and system for fall 2006 are shown in **Appendix C**.

Invertebrates dominated the observations at both the Sarasota and Tampa Bay 16 reef sites accounting for 33.9± 12.5% of the observations (**Table 9**). *M. mercenaria* were the dominant

invertebrate across the 32 reef sites accounting for 45.4±14.5% of the invertebrate observations. *M. mercenaria* observations within Sarasota Bay accounted for 65.5±14.0% and at the Tampa Bay sites 15.4±0.1%. *M mercenaria* contributions at the Sarasota Bay Reef sites were 77% higher than at the Tampa Bay reef sites. *L. virgulata* colonies were observed across all of the 16 reef sites.

32 Reef Sites

Finfish observations accounted for 4.4±2.4% of the individuals across the 32 reef sites (**Table 9**). Finfish within Sarasota Bay accounted for 8.1 ±4.3% of the individuals and 10.0.±5.8% of the individuals within Tampa Bay 32 reef sites. Finfish percent contributions within Sarasota Bay were restricted due to no common observations at the 32 reef sites. The dominant finfish at the Tampa Bay reef sites was sub adult to adult *M. microlepis* accounting for 32.4±1.2% of the individual finfish. *M. microlepis* observations in Sarasota Bay accounted for 0.3±0.3% of the individuals (1 individual on the Bayshore South reef site). A complete species list by reef number and system for fall 2006 are shown in **Appendix C**.

Invertebrates dominated observations at the Sarasota and Tampa Bay reef 32 reef sites accounted for 34.0±18.8% of the individuals **(Table 9)**. *M mercenaria* was the dominant invertebrate on all of the 32 reef sites accounting for 52.7±13.8% individuals. *M. mercenaria* observations within Sarasota Bay accounted for 74.8±4.4% and at the Tampa Bay sites 19.7±3.7.1%. Sarasota Bay 32 reef sites had 74% more stone crab observations than the Tampa Bay reef sites. *L. virgulata* colonies were observed across all of the 32 reef sites.

Community composition by size class fall 2006

Finfish at the Sarasota Bay reef systems tended to be dominated by smaller finfish than at the Tampa Bay reef sites (**Table 10**). Finfish observations at both Bayshore north and south reef systems were restricted to 5 species with few species common to the reef systems. *L griseus* observations ranged from 40 -100 mm TL. *L. griseus* observations were only recorded on the Bulkheads 4 reef sites and ranged from 80-90 mm TL (1 obs.). *M. microlepis* observations were recorded at the Bayshore South 32 reef sites and the Whale Key 8 reef sites (2 obs.). Sarasota Bay *M. microlepis* ranged from 140-200 mm TL. *M. microlepis* were observed at all of the Tampa Bay reef sites except the Bulkheads 4 reef sites. *M microlepis* in Tampa Bay ranged from 100 -350 mm TL. *M. microlepis* on the sites tended to be larger fish (200-350 mm TL). *E. itajara* were observed within each of the reef systems in Sarasota and Tampa Bays. *E. itajara* ranged from 190-240 mm TL at the Sarasota Bay reef sites to 240-250 mm TL at the Tampa Bay reef systems. *Opsanus beta* were observed at all of the reef systems and ranged from 110-150mm TL in Sarasota Bay and 120-160 mm TL at the Tampa Bay reef systems.

Density by Reef Site and System

During the summer 2006 sampling period organism density was similar across all of the study sites (**Figure 10**). Organism density across the reef systems ranged from 0.8 org/m^3 - 1.9 org/m^3 (**Figure 11**). Mean organism across the Sarasota Bay reef systems was 0.8±0.1 org/m^3 and 1.9±0.5 org/m^3 org across the Tampa Bay reef systems. Organism density at the Sarasota Bay reef systems was 57% lower than at the Tampa Bay systems. The highest overall organism densities were recorded on the 4 reef sites (1.9±0.6 org/m^3), with lowest average densities on the

32 reef sites (0.8±0.2 org/m^3). Organism density on the 8 reef sites was 1.2±0.5 org/m^3 approximately 37% lower than on the 4 reef sites. The 16 reef site average density was 1.1±0.4org/m^3approximately 57% lower than the 4 reef, and 8% lower than at the 8 reef sites. The 32 reef sites had lowest mean organism density approximately 60% lower than the 4 reef, 36% lower than the 8 reef, and 30% lower than the 16 reef sites.

Table 9. Species percent contribution estimates of the common species for 4, 8, 16, and 32 reef sites located at Bayshore North (BSN), Bayshore South (BSS), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay (SETB) reef systems for fall 2006.

			4 Reef				
Species	**BSN**	**BSS**	**WK**	**BH**	**SETB**	**Mean**	**SE**
Diplectrum formosum	0	0	0	60.97	18.75	15.94	11.8
Leptogorgia virgulata	6.25	45.00	36.67	11.40	23.33	24.5292	7.329433
Lutjanus griseus	3.13	2.78	5.00	0.00	0.00	2.180556	0.967149
Menippe mercenaria	84.38	52.22	54.17	12.89	28.96	46.52279	12.17222
Total	93.75	100.00	95.83	85.26	71.04		
			8 Reef				
Species	**BSN**	**BSS**	**WK**	**BH**	**SETB**	**Mean**	**SE**
Diplectrum formosum	0	0	0	20.59	14.71	7.058824	4.421558
Epinephelus itajara	0	0	2.63	0	0	0.526316	0.526316
Lagodon rhomboides	0	0	7.89	35.42	0	8.662281	6.861092
Leptogorgia virgulata	25.00	27.29	24.52	17.43	23.53	23.55565	1.650635
Menippe mercenaria	75.00	64.01	62.68	13.24	2.94	43.57311	14.73379
Mycteroperca microlepis	0	2.17	0.00	1.56	55.88	11.92375	10.99801
Total	100.00	93.48	97.73	88.24	97.06	95.30	39.19
			16 Reef				
Species	**BSN**	**BSS**	**WK**	**BH**	**SETB**	**Mean**	**SE**
Archosargus probatocephalus	0	0	0	7.45	2.11	1.911897	1.442942
Epinephelus itajara	2.38	0.00	0	0	0	0.47619	0.47619
Leptogorgia virgulata	2.38	21.32	20.60	21.53	35.65	20.29827	5.289006
Lutjanus griseus	0	12.50	2.04	0	0	2.908163	2.430307
Menippe mercenaria	84.97	38.24	73.21	15.43	15.29	45.4279	14.48379
Mycteroperca microlepis	0.00	0.00	0.00	12.31	41.19	10.69982	7.9866
Total	89.73	72.06	95.85	56.72	94.24		
			32 Reef				
Species	**BSN**	**BSS**	**WK**	**BH**	**SETB**	**Mean**	**SE**
Archosargus probatocephalus	18.75	0	0	1.24	2.41	4.479862	3.595552
Diplectrum formosum	0	1.09	0	0.41	0	0.300036	0.212382
Epinephelus itajara	0	0	1.00	0.41	0	0.282645	0.196381
Lagodon rhomboides	0	0	18.50	0.83	0	3.865289	3.662176
Leptogorgia virgulata	0	5.27	10.10	28.13	32.14	15.12688	6.362045
Menippe mercenaria	81.25	76.77	66.46	23.43	15.93	52.76858	13.77093
Mycteroperca microlepis	0	0.93	0.00	33.54	31.21	13.13422	7.864481
Total	100.00	84.06	96.06	87.98	81.69	89.96	35.66

Table 10. Species list with finfish total length estimates for 4, 8, 16 and 32 reef site surveys for fall 2006.

4 Reef Sites					
Species	**BSN**	**BSS**	**WK**	**BH**	**SETB**
Centropristis striata				80-90	80-120
Diplectrum formosum				80-120	80-130
Epinephelus itajara					240-250
Lutjanus griseus	90-100	90-100			80-90
Lutjanus synagris				80-90	
Mycteroperca microlepis					100-120
Opsanus beta				110-120	
Prionotus scitulus					120-130
Serranus subligarius				80-90	60-80
8 Reef Sites					
Species	**BSN**	**BSS**	**WK**	**BH**	**SETB**
Acanthostracion quadricomis					140-150
Centropristis striata			60-200		
Diplectrum formosum			80-90		120-150
Epinephelus itajara			190-200		
Hyposblennius hentzi					
Lagodon rhomboides			90-100		
Mycteroperca microlepis		140-150	180-200		
Opsanus beta			110-120		
16 Reef Sites					
Species	**BSN**	**BSS**	**WK**	**BH**	**SETB**
Acanthostracion quadricomis				130-160	
Archosargus probatocephalus				160-200	180-200
Chaetodipterus faber				120-140	
Epinephelus itajara	230-240				
Lagodon rhomboides				110-120	
Lutjanus griseus		60-70	40-60		
Mycteroperca microlepis				190-320	200-350
Opsanus beta	140-160			140-160	140-160
Paralichthys albigutta					270-280
Sphoeroides spengleri				80-100	
Synodus foetens			80-90		
32 Reef Sites					
Species	**BSN**	**BSS**	**WK**	**BH**	**SETB**
Acanthostracion quadricomis					140-150
Archosargus probatocephalus	160-200			140-160	240-280
Calamus calamus				210-230	
Diplectrum formosum		160-170			
Epinephelus itajara			140-150	240-250	
Harrengula jaguana			80-90		
Hyposblennius hentzi			40-60		
Lagodon rhomboides			100-110	100-110	
Lutjanus griseus			60-90		
Mycteroperca microlepis		180-190		180-240	180-350
Opsanus beta				120-160	120-130
Sphoeroides spengleri				70-100	

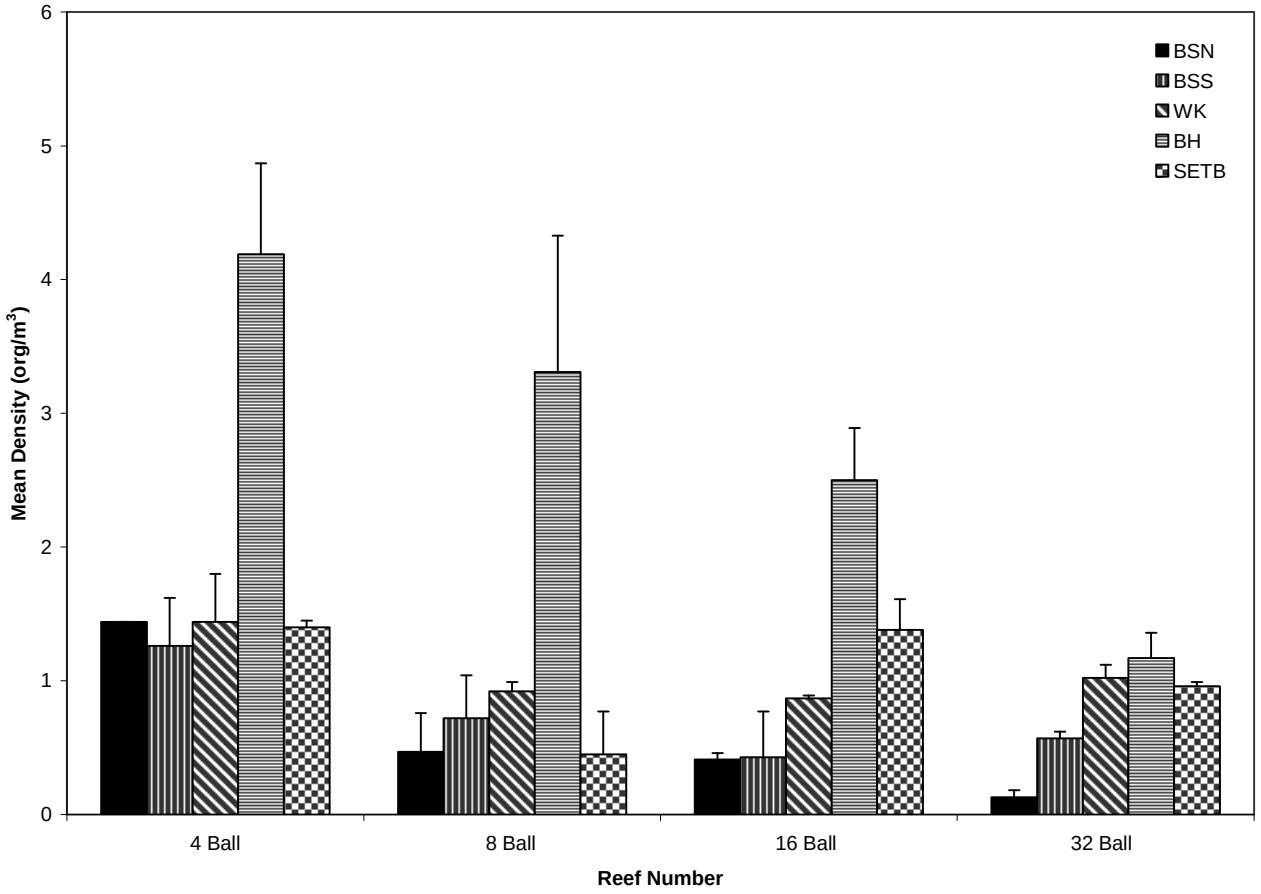

Figure 12. Mean density of macro invertebrates and finfish observed at Bayshore North (BSN), Bayshore South (BSS), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay (SETB) reef systems for fall 2006. (Error bars equal to ±1 standard error.)

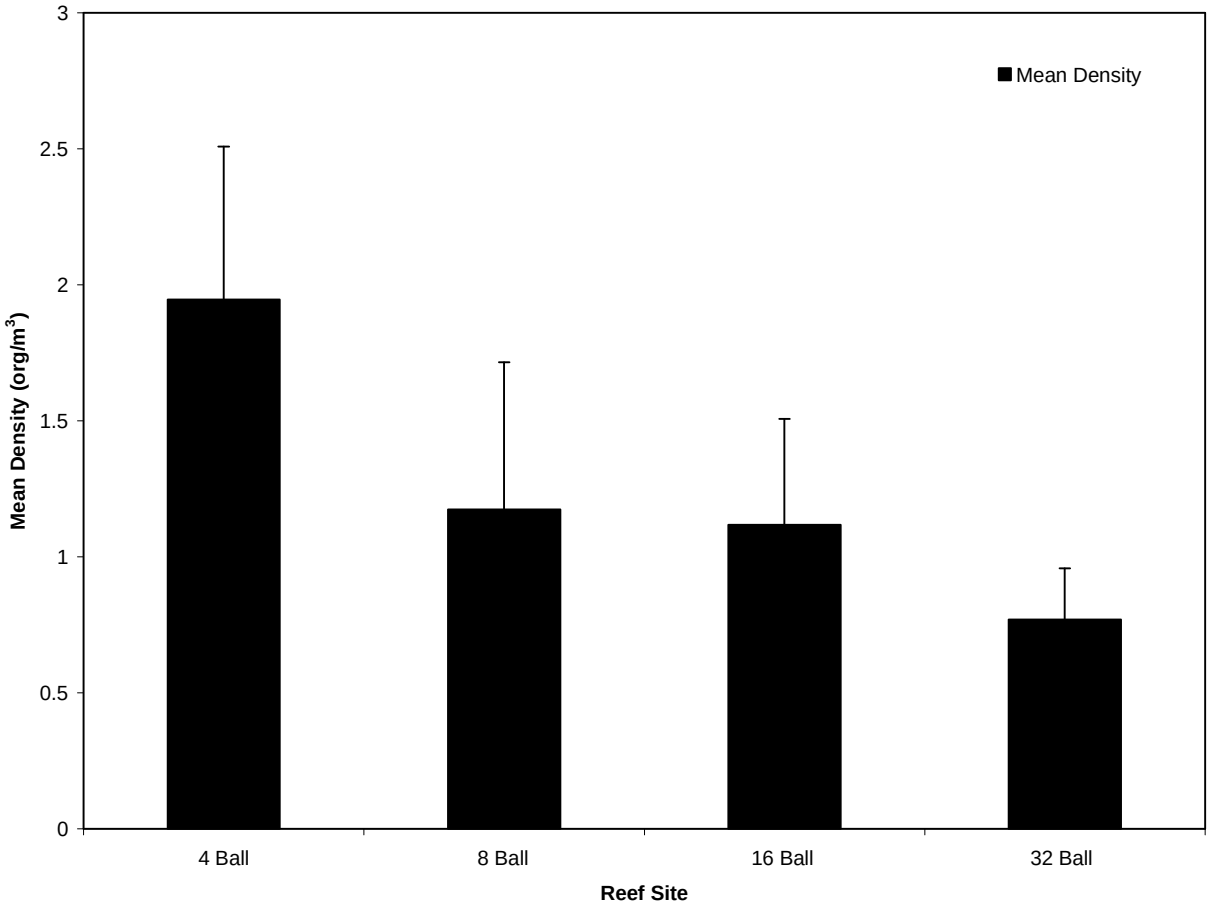

Figure 13. Mean density of organisms/m^3 by reef site for fall 2006. (Error bars equal to ±1 standard error.)

Fall 2006 Discussion

Observed organism abundance during the fall sampling period reflected the same general pattern observed during spring and summer sampling within increased overall abundances on the larger reef sites. Larger reef areas resulted in net increases in species number, with declines in organism abundance and species number to approximately half of the observed summer totals. Density measures during this sampling period reflected the findings of both spring and summer sampling periods. Organism densities declined as reed area increased across all of the reef systems. Density declines were not as dramatic as spring and summer but the general trend suggests that organism density is a product of total available reef area.

Finfish observations primarily consisted of sub adult to adult finfish with few juvenile or baitfish observations. Finfish observations across all of the systems were largely replaced by invertebrate assemblages except at the 16 and 32 reef sites within Tampa Bay. Aggregation of *M. microlepis* at the Tampa Bay 16 and 32 reef sites constituted a larger proportion of the total finfish on these sites. Increased numbers of larger piscivorous finfish on the sites could explain the overall reduction in other finfish species on the sites. Juvenile *E. itajara* were observed in residence on the internal reef ball structure across all of the reef systems. Orientation to the internal reef habitats suggests recruitment to these sites maybe size dependant

Reef systems finfish populations were generally oriented to the physical reef structure of the reef systems. All of the finfish with the exception of *O. beta* and *E. itajara* were oriented to the open paces in and immediately adjacent to the individual reef units. Seasonal reduction of bait fish species across all of the systems lowered the overall density of the sites. Organism density decreases could be a result of seasonal migration and lifecycle patterns of the species observed on the reef systems. The seasonal shift from juvenile fish to sub adult to adult finfish suggest that these reef systems are likely transition habitats from the inshore juvenile habitats to offshore sub-adult to adult habitats in both Sarasota and Tampa Bays.

Invertebrate species across all of the reef systems were dominated by *M. mercenaria*. *M. mercenaria* occupied all of the available internal reef unit habitat and most of the external reef habitats across the reef systems. *M. mercenaria* observations at the Sarasota Bay reef systems were 50-75 higher than at the Tampa Bay reef systems. This could possibly be explained by the presence of nearby sea grass meadows and reduced commercial and recreational fishing pressure at the sites. Both Tampa Bay reef system had adjacent crab trap sets and are relatively well known to commercial and recreational fishermen. *L. virgulata* colonies on all of the reef sites contributed to the overall complexity of these systems. Colonization of the reef sites by these species increase the overall surface area of the reef sites allowing for increased finfish and invertebrate settlement and retention on the sites.

Invertebrate dominance across all of the reef sites and a reduced finfish population suggests reef density was largely dependant on the community structure. Settlement habitat on the site appears to be a retention limiting factor within these reef sites. Invertebrate immigration to the site is limited to space availability. All of the sediment level holes in the reef units were occupied by *M. mercenaria.* Occupation of these areas by *M. mercenaria* could explain the overall reduction of demersal finfish like *O. beta*. *O. beta individuals* were observed at all of the reef sites but their presence appeared to be limited to available substrate level holes. Occupation of these holes by *M. mercenaria* suggests some level competitive interaction between these species.

Finfish size classes at both the Sarasota Bay and Tampa Bay reef systems increased over the spring surveys. All of the survey sites and systems had defined size class shifts in both baitfish and game fish species. The Tampa Bay systems reef community tended to have larger fish than the Sarasota Bay systems. Sub adult to adult *M. microlepis* and *L. griseus* dominated the Tampa Bay Finfish community sharply contrasted with the juvenile to sub adult dominated observations across the Sarasota Bay reef systems. Size class differences between reef systems suggest that the Tampa Bay reef systems are seasonal transition zones from deep water habitats to shallow water habitats while the Sarasota Bay systems are juvenile recruitment habitats.

Geographic location of the site appears to drive the species assemblage on the reef systems in Sarasota and Tampa Bay. Deepwater access and size of the Tampa Bay water shed possibly allows direct access to these habitats as finfish and invertebrate species transition from the Gulf of Mexico to the inshore habitats. The seasonal reduction in species observations and size classes of finfish further suggest that the reef systems in Sarasota Bay are nursery habitat areas for finfish and wintering areas for motile invertebrate populations. While the Tampa bay sites tend to be largely sub-adult seasonal transition zones for larger finfish species.

Winter 2007

Site Abundance

Observation totals across all of the reef systems averaged 130.0±32.9 approximately 68% higher than fall 2006 surveys. Organism abundance across the entire study area increased with reef site surface area (**Figure 14**, and **Table 11**). Observation totals on the Sarasota Bay reef systems averaged 177.1±56.4 org./reef system and 37.1±6.8 org/reef system at the Tampa Bay systems. Total organism abundances on the Sarasota Bay reef systems were 68% higher than observation to totals recorded at the Tampa Bay reef systems.

Organism abundance during the winter sampling period was dominated by larval finfish. Organism observations during the winter sampling period increased over the fall and summer 2006 survey periods. Motile invertebrate abundances declined while finfish observations increased across all of the reef systems. Organism abundance across the entire study area increased with reef site surface area (**Figure 14)**. The larger reef sites had higher overall abundances than the smaller reef sites with an average increase of 45.4±5.0% across all of the reef systems.

Species Richness

Total species number increased over from fall survey periods to 5.4±0.4 species/reef systems approximately 15% higher than fall species totals. Species totals ranged from 4.8±0.8 species to 6.2±0.60 ± at the 16 reef sites. Species numbers at the 32 reef sites were on average 6.1±0.84 species slightly lower than the 16 reef sites. The lowest numbers of species observations were recorded on the 4 reef sites across all of the reef systems. Mean species observations across the Sarasota Bay reef systems was 6.6±0.4 org./reef system, while species totals across the Tampa Bay reef systems had an average of 4.5±0.6 species/ reef sites. Species observations were approximately 31.8% higher at the Sarasota Bay reef systems than at the Tampa Bay reef systems. Individual reef site and system species observation total are shown in **Figure 15**.

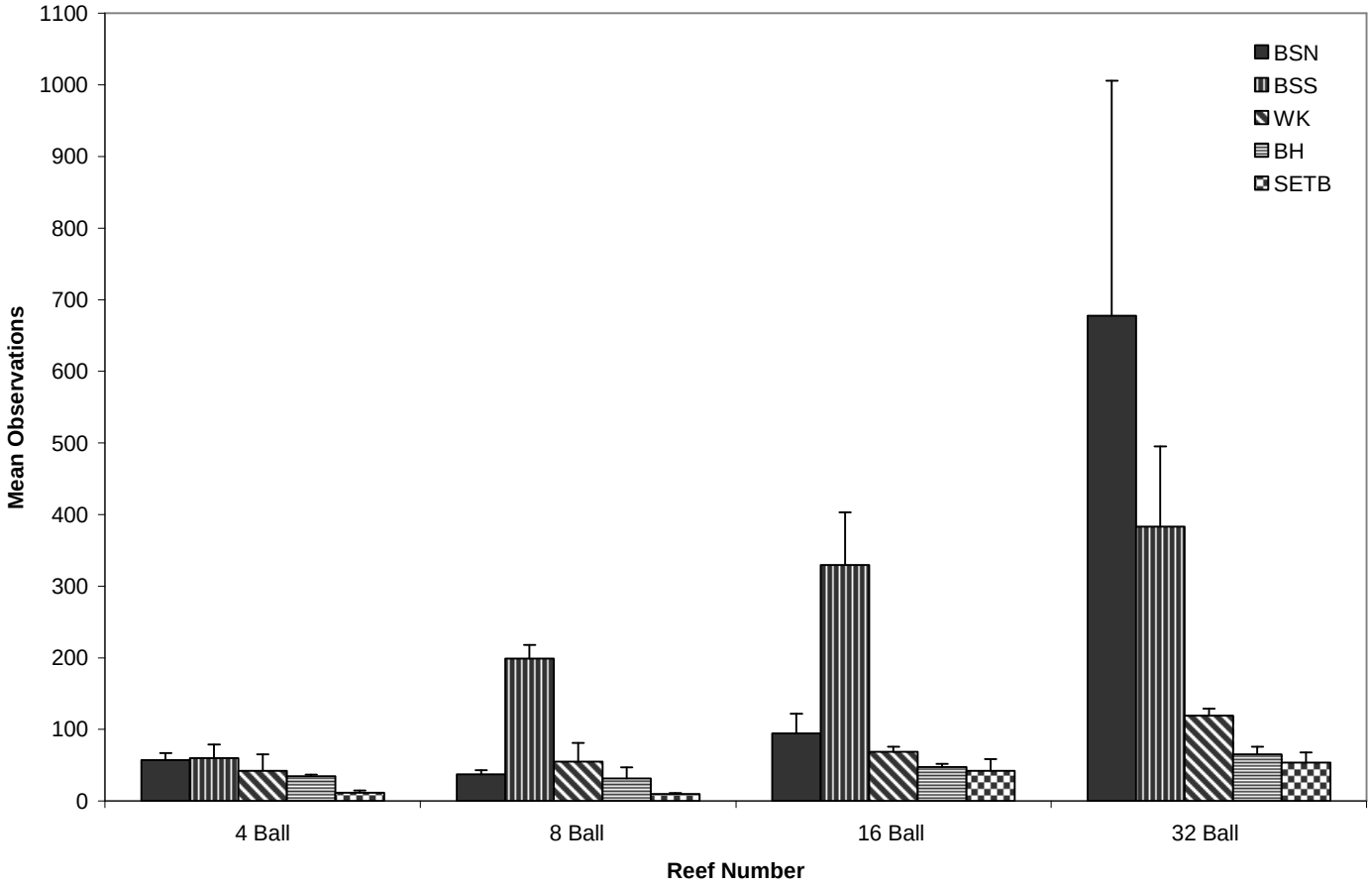

Figure 14. Mean number of finfish and invertebrates by reef site at Bayshore North (BSN), Bayshore South (BSS), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay reef systems for winter 2007. (Error bars equal ±1 standard error.)

Table 11. Mean site organism abundance totals, and mean observation % increase reef system and reef site for Bayshore South (BSS), Bayshore North (BSN), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay during winter 2006 survey period.

Reef #	BSN	BSS	WK	SBMN	SBSE	BH	SETB	TBMN	TBSE	Tot.MN	Tot.SE	% Inc.
4 Ball	57.5	60.0	42.0	53.2	5.6	34.2	12.0	23.1	11.1	41.1	8.7	
8 Ball	37.5	199.0	55.0	97.2	51.2	31.5	10.0	20.8	10.8	66.6	33.9	38.2
16 Ball	94.5	330.0	69.0	164.5	83.1	47.5	42.5	45.0	2.5	116.7	54.1	42.9
32 Ball	678.0	383.5	119.5	393.7	161.3	65.0	54.0	59.5	5.5	260.0	120.5	55.1
Mean	**216.9**	**243.1**	**71.4**	**177.1**		**44.5**	**29.6**	**37.1**			**Mean**	**45.4**
SE	**154.2**	**72.3**	**16.9**	**56.4**		**7.6**	**11.0**	**6.8**			**SE**	**5.0**

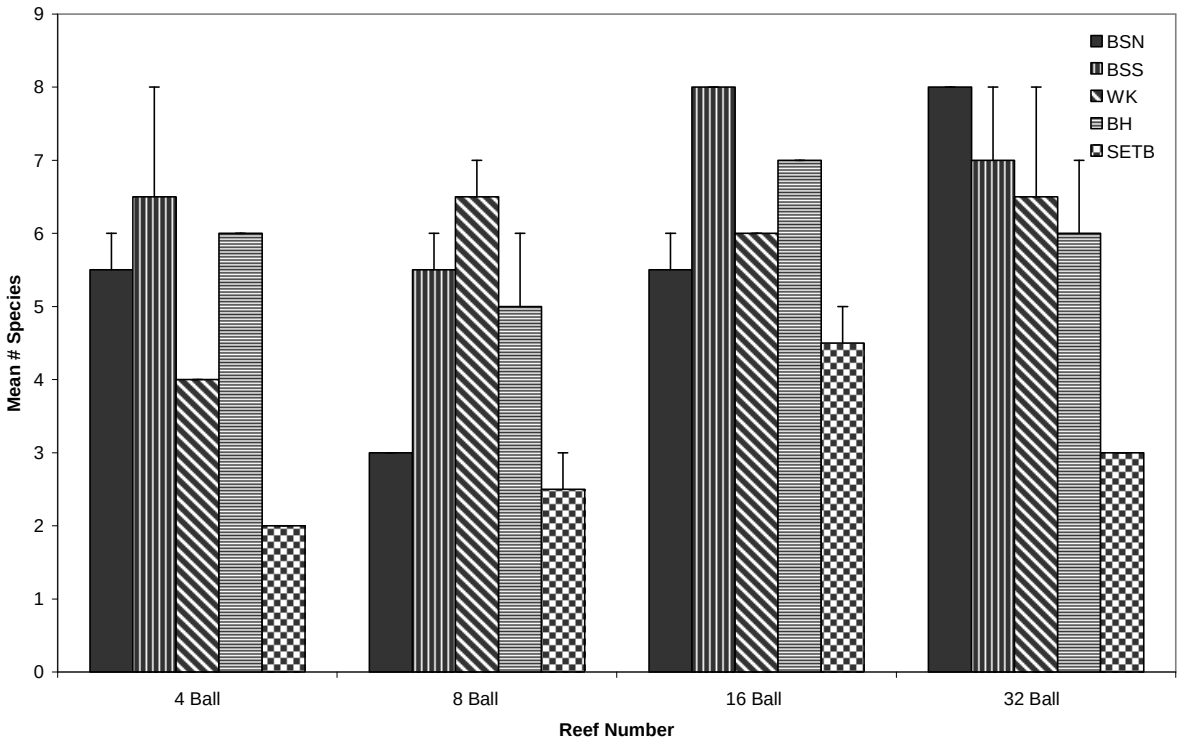

Figure 15. Species richness by reef site for Bayshore North (BSN), Bayshore South (BSS), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay reef systems for spring 2006. (Error bars equal to ±1 standard error.)

Table 12. Mean species totals by reef site for Bayshore North (BSN), Bayshore South (BSS) , Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay (SETB) reef sites for winter 2007.

Reef #	BSN	BSS	WK	BH	SETB	Mean	SE
4 Ball	5.50	6.50	4.00	6.00	2.00	4.80	0.82
8 Ball	3.00	5.50	6.50	5.00	2.50	4.50	0.76
16 Ball	5.50	8.00	6.00	7.00	4.50	6.20	0.60
32 Ball	8.00	7.00	6.50	6.00	3.00	6.10	0.84
Mean	5.5	6.8	5.8	6.0	3.0	5.4	
SE	1.0	0.5	0.6	0.4	0.5	0.4	

Community Similarity

4 Reef Sites

Finfish observations accounted for 46.3±21.0% of the species observations across the 4 reef sites in both Sarasota and Tampa bay. Sub-juvenile *L. rhomboides* were the dominant finfish species across the 4 reef sites accounting for 42.1±17.1% of the individual observations (**Table 13**). *L. rhomboides* observations at Sarasota Bay reef sites accounted for 69.6±5.2% individuals, and 0.7±0.7% of the Tampa bay observations. *L. rhomboides* observations at the Sarasota Bay sites were 99% higher than the Tampa Bay reef sites (1 observation). *L griseus* accounted for 1.0±0.6% of the finfish at the 4 reef sites. *L griseus* observations in Sarasota Bay accounted for 1.7±0.9% of the observations. *L griseus* were not observed at the Tampa Bay 4 reef sites.

Invertebrate observations at the 4 reef sites accounted for 22.3±16.79% of the individuals across the 4 reef sites (**Table 13**). *M. mercenaria* was the dominant motile invertebrate at the 4 reef sites accounting for 6.2±2.3% of the 4 reef observations. *M. mercenaria* observations within Sarasota Bay accounted for 9.8±0.9% and at the Tampa Bay sites 0.7±0.7%. *M. mercenaria* observations in Sarasota Bay were 92.8% higher than at the Tampa Bay 4 reef sites. *C. sapidus* observations accounted for 5.1±1.5% of the Sarasota Bay observations. *C. sapidus* were not observed at the Tampa Bay reef sites. *L. virgulata* were observed at all of the 4 reef sites in Sarasota and Tampa Bays accounting for the largest percent contributions of any species on the sites. A complete species list for the winter 2007 sampling period is shown in **Appendix D**.

8 Reef Sites

Finfish observations accounted for 56.0±25.1% of the individuals across the 8 reef sites. Juvenile *L rhomboides* were the dominant finfish species at the Sarasota Bay reef sites accounting for 37.4.4±16.7% of the observations. *L rhomboides* were not observed at the Tampa Bay reef sites (**Table 13**). *M. microlepis* was the dominant finfish at the Tampa Bay reef sites accounting for18.9 ± 18.9% of the observations. *M microlepis* observations were accounted for 0.23% of the Sarasota Bay observations (1 observation at Bayshore South).

Invertebrates species accounted for 30.9±17.6% of the observations at the 8 reef sites at the Sarasota and Tampa Bay reef sites (**Table 13**). *M. mercenaria* was the dominant motile invertebrate at the 8 reef sites accounting for 9.0±6.6 of the observations. *M. mercenaria* observations within Sarasota Bay accounted for 12.9±11.1% and at the Tampa Bay sites 3.1±3.1%. *M. mercenaria* observations in Sarasota Bay were 76% higher than at the Tampa Bay 8 reef sites. *C. sapidus* accounted for 4.8±4.6% of the invertebrate observations at the Sarasota Bay reef sites. *C. sapidus* were not recorded at the Tampa reef sites. *L. virgulata* were observed at all of the 8 reef sites in Sarasota and Tampa Bays accounting for the largest percent contributions of any species on the sites. A complete species list of all observations for the winter 2007 sampling period is shown in **Appendix D**.

16 Reef Sites

Finfish observations accounted for 52.9±23.6% of the individuals across the 16 reef sites. Juvenile *L rhomboides* were the dominant finfish species at the Sarasota Bay reef sites accounting for 71.6±4.93% of the finfish observations (**Table 13**). *L rhomboides* accounted for 1.8±1.8% of the Tampa Bay finfish (3 observations at the Bulkheads reef sites). *M. microlepis*

was the dominant finfish at the Tampa Bay reef sites accounting for 20.3± 8.8% of the observations. *M microlepis* observations accounted for 0.1% of the Sarasota Bay obs. (1 observation at Bayshore South

Invertebrates species accounted for 30.0±16.4% of the observations at the 16 reef sites in Sarasota and Tampa Bays (**Table 13**). *M. mercenaria* was the dominant invertebrate at the 16 reef sites accounting for 6.3±2.7 of the observations. *M. mercenaria* observations within Sarasota Bay accounted for 9.4±3.4% and 1.5±0.4% at the Tampa Bay reef sites. *M. mercenaria* observations in Sarasota Bay were 84% higher than at the Tampa Bay 8 reef sites. *C. sapidus* accounted for 3.7±3.4% of the invertebrate observations across all of the reef sites. *C. sapidus* were not observed at the Tampa Bay reef sites. *L. virgulata* were observed at all of the16 reef sites in Sarasota and Tampa Bays accounting for the largest percent contributions of any species on the sites. A complete species list of all observations for the winter 2007 sampling period is shown in **Appendix D**.

32 Reef Sites

Finfish observations accounted for 62.2±26.9% of the observations across the 32 reef sites. Juvenile *L rhomboides* were the dominant finfish species at the sites accounting for 48.36±18.2% of the finfish observations. *L rhomboides* accounted for 71.6±4.9% of the finfish observations at the Sarasota Bay sites and 1.8±1.8% of the Tampa Bay finfish. L rhomboides observations at the Sarasota Bay reef sites were 97% higher than the Tampa Bay observations. *M. microlepis* was the dominant finfish at the Tampa Bay reef sites accounting for 31.1± 0.3% of the observations. *M microlepis* observations were accounted for 0.2±0.2% of the Sarasota Bay observations (1 observation at Bayshore South).

Invertebrates species accounted for 31.6±19.2% of the observations at the 32 reef sites (**Table 13**). *M. mercenaria* observations at the 32 reef sites accounted for 2.7±1.4% of the invertebrate observations. *M. mercenaria* accounted for 4.0±2.1%of the Sarasota Bay and 0.7±0.7 of the Tampa Bay observations. *M. mercenaria* observations in Sarasota Bay were 83% higher than at the Tampa Bay 32 reef sites. *C. sapidus* was the dominant motile invertebrate across the reef sites accounting for 4.9±4.7% of the invertebrate observations. *C sapidus* accounted for 8.1±7.8% of the Sarasota Bay observation. *C sapidus* were not observed at the Tampa Bay reef sites. *L. virgulata* were observed at all of the 32 reef sites in Sarasota and Tampa Bays accounting for the largest percent contributions of any species on the sites. A complete species list of all observations for the winter 2007 sampling period is shown in **Appendix D**.

Community composition by size class winter 2007

The finfish population at the Sarasota Bay reef systems was largely dominated by larval to sub juvenile *L. rhomboides and H aurolinatum.* Observations on all of the sites ranged between 20 – 60mm for both *L rhomboides* and *H. aurolinatum. L. rhomboides* observations in Tampa Bay were adult fish (100-120 mm TL) and were only recorded at the 16 and 32 reef sites of the Bulkheads system. Juvenile *L. griseus* observations were recorded at the Sarasota Bay reef systems with size ranges between 40-100 mm TL, no observations were recorded at the Tampa Bay reef systems. *M. microlepis* observations at the Sarasota Bay reef systems were restricted to the Bayshore South Reef system (8, 16, and 32 reef sites). All *M. microlepis* observations were

juvenile to sub adults ranging between 140-180 mm TL. *M. microlepis* observations were recorded at both the Southeast Tampa Bay and Bulkheads reef systems. The largest numbers of observations were recorded at the Southeast Tampa Bay Reef System (4, 8, 16, and 32 reef sites). *M. microlepis* observations on The Bulkheads reef system were restricted to the 16 and 32 reef sites. All *M. microlepis* observations were sub adults to adults ranging from 140-340 mm TL with the majority of the observations on the upper end of the range (260-340 mm TL). Size class observations by reef system and reef site are shown in **Table 14**.

Table 13. Species percent contribution estimates of the common species for 4, 8, 16, and 32 reef sites located at Bayshore North (BSN), Bayshore South (BSS), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay (SETB) reef sites for winter 2007.

	4 Reef						
Species	**BSN**	**BSS**	**WK**	**BH**	**SETB**	**Mean**	**SE**
Lagodon rhomboides	75.7	59.2	73.8	1.4	0.0	42.0	17.1
Lutjanus grieseus	2.5	0.0	2.6	0.0	0.0	1.0	0.6
Mycteroperca microlepis	0.0	0.0	0.0	0.0	16.7	3.3	3.3
Callinectes sapidus	5.2	2.5	7.7	0.0	0.0	3.1	1.5
Leptogorgia virgulata	2.1	14.1	3.1	17.9	43.3	16.1	7.5
Menippe mercenaria	8.1	11.2	10.2	1.4	0.0	6.2	2.3
Total	93.6	87.0	97.4	20.6	60.0	71.4	14.4
	8 Reef						
Species	**BSN**	**BSS**	**WK**	**BH**	**SETB**	**Mean**	**SE**
Haemulon aurolineatum	0.0	3.9	1.7	0.0	0.0	1.1	0.8
Lagodon rhomboides	57.2	85.4	44.5	0.0	0.0	37.4	16.7
Mycteroperca microlepis	0.0	0.2	0.0	0.0	37.9	7.6	7.6
Callinectes sapidus	0.0	0.6	23.3	0.0	0.0	4.8	4.6
Leptogorgia virgulata	7.8	3.9	8.9	28.4	36.4	17.1	6.4
Menippe mercenaria	35.0	3.6	0.0	6.3	0.0	9.0	6.6
Total	100.0	97.7	78.4	34.6	74.2	77.0	11.7
	16 Reef						
Species	**BSN**	**BSS**	**WK**	**BH**	**SETB**	**Mean**	**SE**
Lagodon rhomboides	73.7	78.7	62.3	3.5	0.0	43.6	17.3
Lutjanus grieseus	1.6	0.8	3.3	0.0	0.0	1.1	0.6
Mycteroperca microlepis	0.0	0.1	0.0	11.6	29.1	8.2	5.7
Callinectes sapidus	0.7	0.6	17.3	0.0	0.0	3.7	3.4
Leptogorgia virgulata	1.2	1.0	9.4	35.6	52.6	20.0	10.3
Menippe mercenaria	14.9	10.3	3.1	1.2	1.9	6.3	2.7
Total	92.2	91.6	95.5	51.8	83.7	83.0	8.0
	32 Reef						
Species	**BSN**	**BSS**	**WK**	**BH**	**SETB**	**Mean**	**SE**
Lagodon rhomboides	94.9	76.8	56.4	13.2	0.0	48.3	18.2
Mycteroperca microlepis	0.0	0.6	0.0	31.2	31.8	12.7	7.7
Synodus foetens	0.1	0.6	1.4	0.0	0.0	0.4	0.3
Lutjanus grieseus	0.1	0.2	3.8	0.0	0.0	0.8	0.7
Leptogorgia virgulata	0.0	0.8	9.1	46.4	63.7	24.0	13.1
Callinectes sapidus	0.3	0.3	23.7	0.0	0.0	4.9	4.7
Menippe mercenaria	1.8	8.3	2.0	1.3	0.0	2.7	1.4
Total	97.3	87.5	96.4	92.1	95.5	93.8	1.8

Table 14. Species list with finfish total length estimates for 4, and 8, reef sites for Winter 2007.

4 Reef Sites					
Species	**BSN**	**BSS**	**WK**	**BH**	**SETB**
Centropristis striata				140-150	
Diplectrum formosum				100-160	140-200
Haemulon aurolineatum		40-60			
Haemulon plumieri				100-120	
Lagodon rhomboides	20-40	20-40	40-60	80-90	
Lutjanus griseus	60-70		60-70		
Mycteroperca microlepis					200-250
Opsanus beta		160-170			
Serranus subligarius				60-80	
Synodus foetens	120-130	100-110			
8 Reef Sites					
Species	**BSN**	**BSS**	**WK**	**BH**	**SETB**
Archosargus probatocephalus					180-200
Centropristis striata				140-160	
Diplectrum formosum				80-140	100-140
Haemulon aurolineatum		40-60	20-30		
Haemulon plumieri				120-130	
Lagodon rhomboides	20-40	20-40	20-60		
Lutjanus griseus		80-90			
Mycteroperca microlepis		140-150			140-270
Serranus subligarius				60-70	
Stephanolepis hispidus			100-110		
Synodus foetens			120-130		
16 Reef Sites					
Species	**BSN**	**BSS**	**WK**	**BH**	**SETB**
Acanthostracion quadricomis				200-210	
Archosargus probatocephalus				180-240	180-220
Calamus calamus				160-200	
Diplodus holbrookii		180-190			
Haemulon aurolineatum	40-60	40-60			
Lagodon rhomboides	20-40	20-40	20-60	100-120	
Lutjanus griseus	60-80	80-90	60-70		
Mycteroperca microlepis		160-170		140-200	120-340
Scartella cristata		30-40	120-130		
Opsanus beta	200-210				
Synodus foetens	100-120				
32 Reef Sites					
Species	**BSN**	**BSS**	**WK**	**BH**	**SETB**
Acanthostracion quadricomis				200-210	
Archosargus probatocephalus	180-200			140-160	
Calamus calamus				160-170	
Diplectrum formosum				200-210	
Epinephelus morio					160-170
Haemulon aurolineatum	20-30	20-60			
Lagodon rhomboides	20-40	20-80	20-100	100-120	
Lutjanus griseus	90-100	80-90	40-80		
Mycteroperca microlepis		160-180		120-240	160-250
Opsanus beta	140-170				
Scartella cristata	70-80				
Synodus foetens	120-140	100-140	100-140		
Lutjanus synagris	80-90				

Density by Reef Site and System

Observed density followed the same general pattern as the previous surveys with higher average densities recorded at the smaller reef sites (**Figure 16**). Organism density declined across all of the reef systems with increased reef number and surface area. Mean organism density on the 4 reef site density (3.7±0.8 org/m^3) was approximately 20% higher than at the 8 reef sites (3.0±1.5 org/m^3). Density at the 8 reef sites was 12.4 % higher than the 16 reef sites (2.6±1.2 org/m^3). Organism density at the 16 reef sites was 10.4% lower than at the 32 reef sites (2.92±1.35 org/m^3). **Figure 17** shows the mean organism density by reef number across the reef systems.

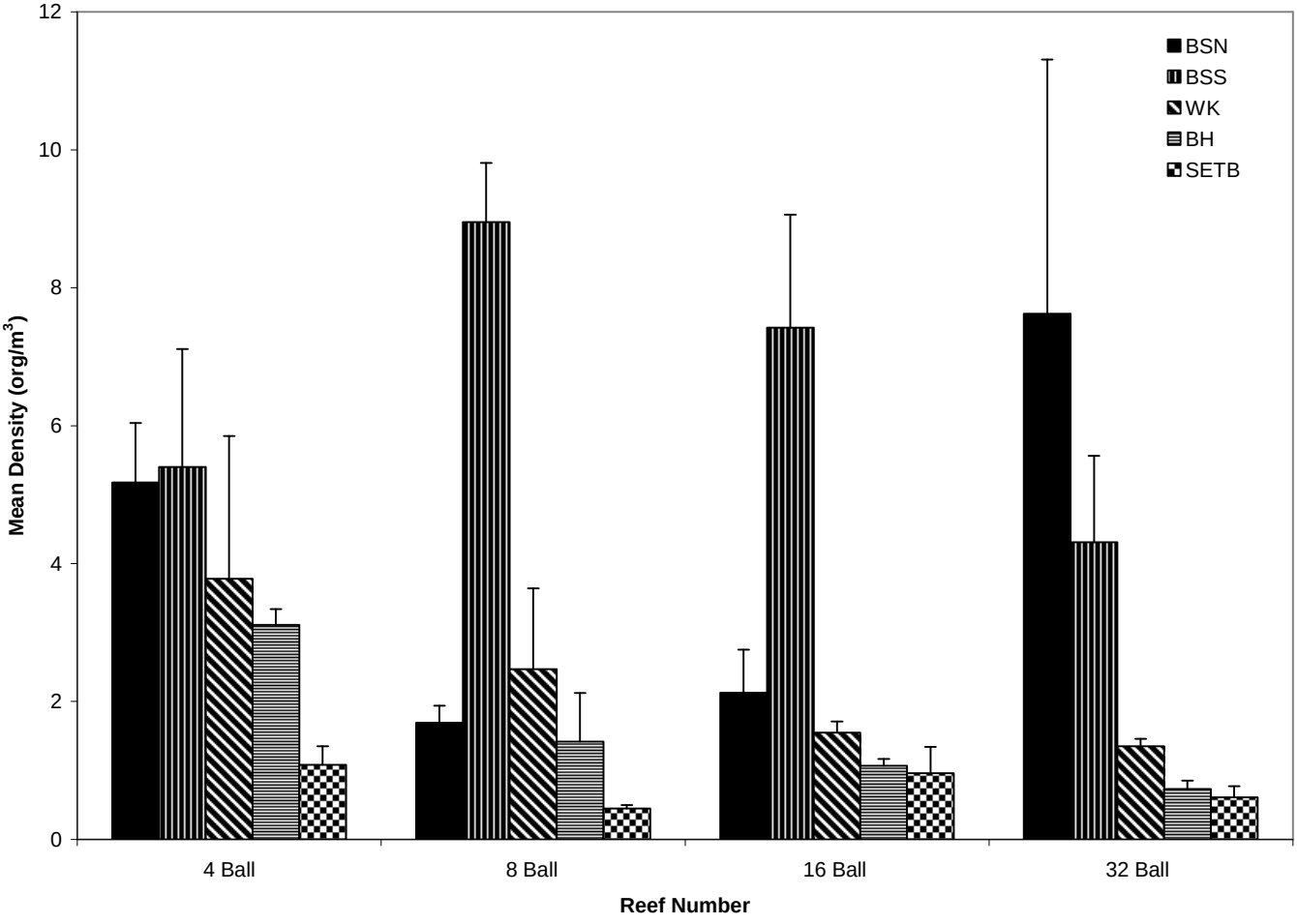

Figure 16. Mean density of macro invertebrate and finfish observations at Bayshore North (BSN), Bayshore South (BSS), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay (SETB) reef systems, winter 2007.

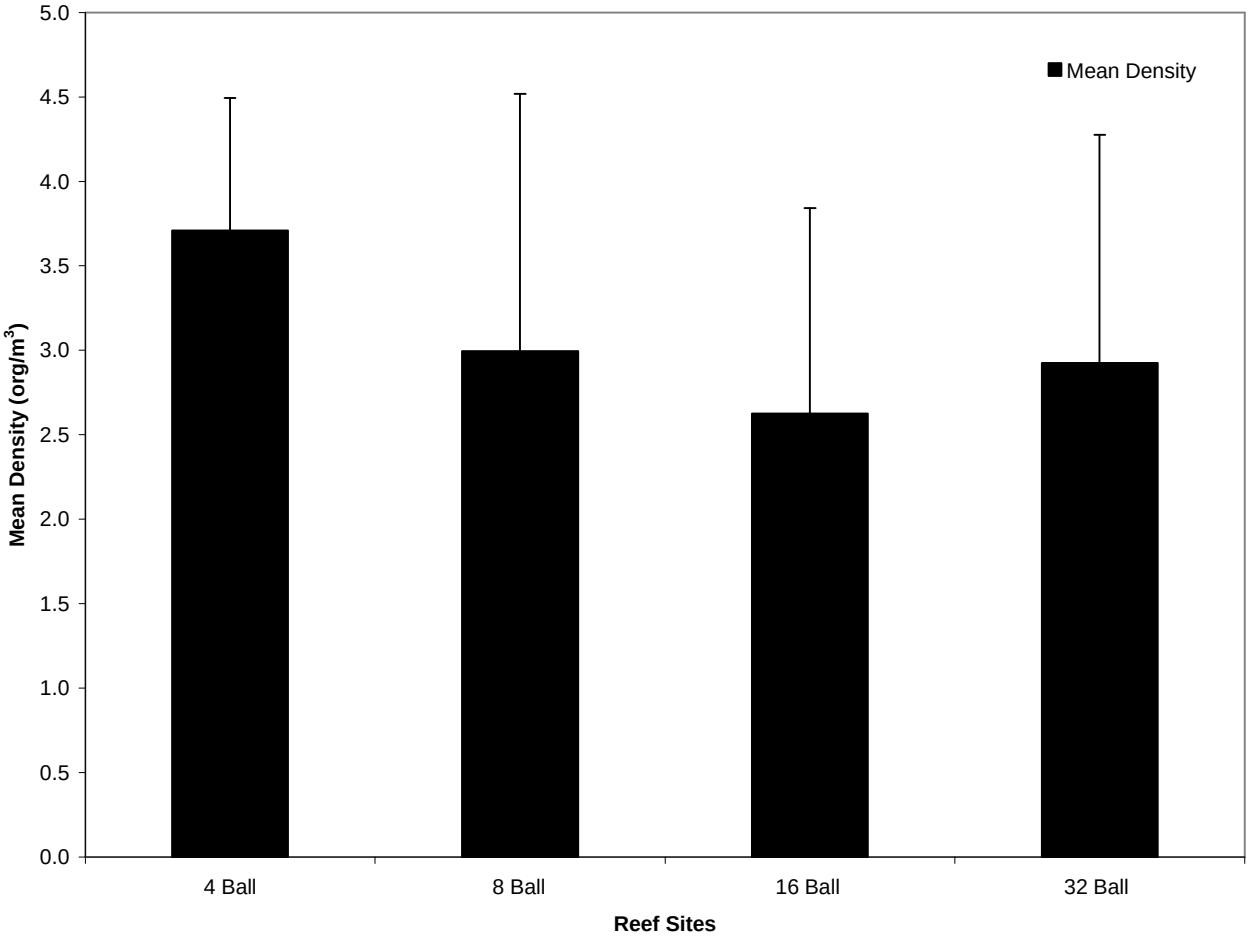

Figure 17. Mean density of organisms/m^3 by reef site for winter 2007.

Winter 2007 Discussion

Winter 2007 surveys showed a defined increase in organism abundance and species assemblage over the fall sampling period across all of the reef systems. Finfish abundance across all of the reef systems was greater than during the invertebrate dominated fall survey period. Juvenile finfish dominated the Sarasota Bay systems, while the Tampa Bay systems were dominated by sub adult to adult finfish. The size class and distribution of finfish on these sites suggests that Sarasota Bay reef systems are largely juvenile to sub adult habitats, while the Tampa bay sites are larger sub adult to adult finfish assemblages

Invertebrate densities including soft coral and sponge colonies were lower than during the fall surveys at the Sarasota Bay systems. Soft coral reductions are likely due to lower water temperatures and increased disturbance following seasonal weather patterns. Soft coral and sponge colony observations within Tampa Bay were higher than in Sarasota Bay with continued growth following the fall surveys. *M mercenaria* observations were lower during the winter survey period than the fall surveys. *M. mercenaria* declines were greater at the Tampa Bay reef systems than at the Sarasota Bay systems. *M. mercenaria* abundance declines at the Tampa Bay reef systems were likely due to recreational and commercial crabbing activity. Recreational and commercial stone crab gear and fishing were noted on both the Bulkheads and Southeast Tampa

Bay systems during the survey period. Crabbing gear and recreational activity was not noted on the Sarasota Bay reef systems.

Increased *C. sapidus* observations during this survey period appear to correspond with lower M. mercenaria observations. Sediment level holes in the reef balls were either occupied by *M. mercenaria* or *C. sapidus* at the Sarasota Bay reef systems. Sediment level holes on the reef units appear to be a limiting factor in adult crab retention across all of the sites within Sarasota Bay. Sediment level holes were either occupied by *C. sapidus* or *M mercenaria* suggesting that there may spatial restraints resulting in lower observations of one species when the other is in residence. *C. sapidus* observations were generally in spawning pairs. The presence spawning pairs suggests that these areas could provide aggregation and spawning sites for *C. sapidus* in Sarasota Bay.

Species richness increased during the winter 2007 survey period compared to fall surveys. Species observations during this survey period were similar to the spring 2006 observations. Species observations increased as the size of the reef increased. Species observations and organism abundance decreased at the Southeast Tampa Bay reef system. Total specie abundances were replaced by higher concentrations of individual species (adult *M. microlepis*). Lower species number and organism abundances were also likely due to visibility constraints and dark water intrusions from the Manatee River watershed.

Seasonal shifts in the total number of organisms and the distribution of the observations suggest that Sarasota Bay reef systems are largely juvenile –sub adult habitats during spring and summer. Winter observations showed an apparent recolonization of the finfish population following seasonal species movements. Large groups of larval finfish were observed across of the Sarasota Bay reef systems. These fish were less than 10-20 mm TL, and could not be identified. The fish were likely pinfish or some other baitfish noted in the spring 2006 survey periods. All of the larval fish were associated with extensive drift algae mats.

Drift algae mats were noted on all of the reef systems during winter 2007 survey period. Algal coverage was noted at all of the survey systems within Sarasota Bay. Algal coverage on the Tampa Bay reef systems was lower than at the Sarasota Bay systems. Algal coverage accounted for 80-90% interior and exterior reef structures increasing the overall habitat complexity and surface area of the Sarasota systems. Tampa bay reef systems had approximately 50-60 % algal coverage. Seasonal increases in the surface area of the reef systems could provide increased protection of larval fish on the reef systems resulting in higher observed larval-juvenile finfish.

The density of organisms on the Sarasota Bay sites follows the same general patterns as noted in the previous seasons. In general, the smaller reef sites had a higher overall density of organisms when compared to the larger reef sites. Density increases on the Sarasota Bay sites further support the influence of these systems on juvenile recruitment within Sarasota Bay. Absence of these populations at the Tampa bay sites, and the dominance of the adult *M. microlepis* populations not observed at the Sarasota Bay sites, also that geographic location of the reef systems contributes to organism density and community make up of the species assemblage. Increased surface area allows for more species and higher organism abundances due to surface area on the reef. Increased abundances could result in more competitive interaction at the

individual reef sites. Even though the reef site increases the surface area the same amount of food resources are available in the habitats surrounding the reef systems. Resource availability of the habitats surrounding the reef site appears to be the limiting factor and not area of the reef.

2006-2007 Summary

The goals of this project were to determine the overall effect of artificial reef habitats on the local finfish and invertebrate communities in Sarasota and Tampa Bays. The 2005-2006 *K. brevis* bloom helped this project by allowing us to begin assessment on relatively barren reef systems, which allowed us to document the recovery of these systems the event. During the 2006 sampling we were able to document a steady succession of species across all of the reef systems. Seasonal organism shifts from finfish dominated communities to invertebrate dominated communities. Seasonal shifts in species dominance and size changes suggest that these systems appear to be beneficial for recruitment and retention of finfish and invertebrate communities in both the Sarasota and Tampa Bays. Seasonal movement patterns of adult finfish at the Tampa Bay reef systems suggest that these sites provide a stepping stone habitat corridor between offshore habitats and inshore habitats.

Reef size appears to influence of colonization species colonization and retention on the habitats. Increased habitat area resulted in larger numbers of organisms, and showed in net increases in the species numbers across all four seasons. In general reef sites with smaller surface areas tended to have the highest overall density of organisms. Organism densities on the larger reef sites had the lowest organism density but had increase species numbers. Smaller reef sites tended to have reduced abundances of organisms and species. Organism densities followed the same general pattern across all four survey seasons. Organism density on the sites appears to be dependant upon resource availability and not just habitat area. Lower organism densities on the larger reef sites suggest that resource availability on the area surrounding the reef systems define overall organism densities and abundances.

Size classes of fish also appeared to follow seasonal shifts. Winter and spring surveys in Sarasota Bay were dominated by larval to juvenile finfish at of the reef systems. Seasonal algal concentration on these sites appears to help drive the recruitment of juvenile finfish to the Sarasota Bay reef systems. Summer surveys showed lower finfish observations but size organism size increased. Algal coverage on the sites was lower during this period accounting for 10-20% of the total reef surface area. Reductions in reef coverage could account for the reduced numbers of smaller (TL > 20 mm) finfish across all of the reef systems. Reductions in available shelter could have force the smaller fish away from the sites due to predation and loss of protective habitats.

Finfish observations were lowest during the fall survey periods across all of the reef systems. Juvenile finfish observations from the summer sampling period were replaced by sub adult to adult finfish at the Sarasota Bay reef systems. Juvenile fish (40-60 mm TL) observed during the spring and summer samplings were replaced with 60-100 mm TL fish during the fall survey periods within Sarasota Bay. Seasonal species movement and the steady growth resident species on the reef systems suggest that these sites are important recruitment habitats for larval and juvenile finfish in Sarasota Bay.

Finfish observations at the Tampa Bay reef systems tended to be larger than at the Sarasota Bay reef systems. *M. microlepis* and *L. griseus* observations within the Tampa Bay Reef systems tended to be dominated by sub adult to adults. *L rhomboides* and other baitfish observations on within the reef systems tended to be dominated by larger fish throughout the all of the survey periods. Juvenile fish were observed at the reef systems but tended to be dominated by large predator fish. Algal coverage on the Tampa Bay reef systems were noted but the large concentrations of juvenile finfish observed on the Sarasota Bay reef systems were not recorded. Increased algal concentrations at the Tampa Bay reef systems resulted in lower overall densities of finfish observations. Algal coverage on and in the reef units appears to reduce habitat availability for larger finfish colonization.

Geographic location of the reef systems appears to influence colonization rates and species distributions. Seasonal shifts in organism dominance on the reef systems tended to be system and bay specific. The Tampa Bay reef systems tended to be dominated by sub-adult to adult finfish where as the Sarasota Bay systems tended to be dominated by juvenile finfish. Water movement from adjacent watersheds likely influences distributions of both finfish and invertebrate populations. Southeast Tampa Bay sites appeared to be influenced by the flow patterns of the Manatee River. The Southeast Tampa Bay system finfish and invertebrate populations tended to diverged from the other reef systems. The reef systems within the system tended to be dominated by sub-adult – adult gag grouper habitats. Accessibility to deeper waters of the Gulf of Mexico and the higher flow across these systems may be the dominant force driving the colonization the Tampa Bay reef systems by adult populations.

The protected shallow water areas surrounding the Sarasota Bay reef systems appears to drive the recruitment of juvenile finfish and invertebrate populations to these systems. The shallow water areas and relative protection from weather fronts could also explain the occurrence of the large algal mats observed in the winter sampling period. Seasonal surface area additions to the sites could be a significant factor promoting larval finfish settlement and retention on within the systems.

Finfish and invertebrate populations showed defined seasonal shifts. Spring 2006 and winter 2007 samples tended to be dominated by larval - juvenile finfish assemblages. Summer and fall finfish observations were dominated by sub adult to adult finfish with reduced juvenile finfish assemblages across all of the reef systems. Sub-adult finfish dominated all of the Sarasota bay sites showing definitive shifts from the juvenile baitfish communities during the spring. Observations at the Tampa Bay reef systems were dominated by sub adult to adult finfish populations. Increased abundances of larger *M. microlepis* and *L griseus* on all of the reef systems suggest that these habitats could be important habitats for these species as they move between inshore and offshore habitats.

Fall sampling showed a defined dominance shift in invertebrates across all of the reef systems. *M. mercenaria* and *L. virgulata* soft coral colonies dominated all of the systems. *M. mercenaria* abundances increased summer and fall sampling period resulting in lower overall abundance of *C. sapidus* populations. The reduced presence of the *C. sapidus* at the Sarasota Reef systems is likely a result of seasonal species shifts within the bay. Reduced *C. sapidus* populations across the reef systems correspond to seasonal movement patterns of both *C. sapidus* and *M.*

mercenaria between spring and fall habitats. Spring and winter concentrations of *C. sapidus* suggest that the Sarasota Bay systems are important seasonal habitats for blue crab reproduction and deeper water refuges for *M mercenaria* following seasonal migrations from inshore to offshore habitats.

Preliminary investigations show that these reef systems are important parts of the bay ecosystems. Reef area and placement appear to strongly influence species colonization and development. Total reef area also appears to define the colonization of species assemblages. Even though the larger reef systems had greater surface area for settlement the overall organism density on the sites declined, suggesting that recruitment limitation may not be habitat dependant in these two systems. Future surveys will increase our understanding of these effects of these habitats within Sarasota and Tampa Bays.

References

Beets, J., Hixon, M.A. 1994. Distribution, persistence, and growth of groupers (Pisces: Serranidae) on artificial and natural patch reefs in the Virgin Islands. Bulletin of Marine Science 55 (2-3) 470-483.

Bulter IV, M.J., Herrnkind, W.F. 1997. A test of recruitment limitation and the potential for artificial enhancement of spiny lobster (Paulirus argus) populations in Florida. Canadian Journal of Fisheries and Aquatic Science 54:452-463.

Bohnsack, J.A., Bannerot S. P. 1986. A stationary visual census technique for quantitatively assessing community structure of coral reef fishes. NOAA Technical Report NMFS 41:1-15.

Bohnsack, J.A., Harper, D.E., McClellan, D.B., Hulsbeck, M. 1994. Effects of reef size on colonization and assemblages of fishes at artificial reefs off southeastern Florida, USA. Bulletin of Marine Science 55 (2-3): 796-823.

Danner, E.M., Wilson, T.C., Schlotterbeck, R.E. 1994. Comparison of rockfish recruitment of nearshore artificial and natural reefs off the coast of central California. Bulleting of Marine Science 55 (2-3): 333-343.

Eggleston, D.B., Lipcius, R., Miller, D., Coba-Centina, L. 1990. Shelter scaling regulates survival of juvenile spiny lobster, *Panlirus argus*. Marine Ecology Progress Series 62: 79-88.

Eggleston, D.B., Elis, W.E., Etherington, L.L., Dahlgren, C.P., Posey, M.H. 1999. Organism response to habitat fragmentation and diversity: Habitat colonization by estuarine macrofauna. Journal of Experimental Marine Biology and Ecology 236: 107-132.

Fabi, G., Fiorentini, L. 1994. Comparison between an artificial reef and a control site in the Adriatic Sea: Analysis of four years of monitoring. Bulletin of Marine Science 55(2-3): 538-558.

Frazer, T.K., Lindberg, W.J. 1994. Refuge spacing similarly affects reef-associated species from three phyla. Bulletin of Marine Science 55 (2-3): 388-400.

Lindberg, W.J. 1997. Can science resolve the attraction-production issue? Fisheries 22: 10-13.

Potts, T. A., Hulbert, A.W. 1994. Structural influences of artificial and natural habitats on fish aggregations in Onslow Bay, North Carolina. Bulletin of Marine Science 55 (2-3): 609-622.

Rilov, G., Benayahu, Y. 2000. Fish assemblage on natural versus vertical artificial reefs: the rehabilitation perspective. Marine Biology 136: 931-942.

Tupper, M., Hunte, W. 1998. Predictability of fish assemblages on artificial and natural reefs in Barbados. Bulletin of Marine Science 62 (3): 919-935.

Wilson, J., Osenberg, C.W., St. Mary, C.M., Watson, C.A., Lindberg, W.J. 2001. Artificial reefs, the attraction-production issue, and density dependence in marine ornamental fishes. Aquarium Sciences and Conservation 3: 95-105.

Appendix A

Complete list of observed species by reef site (4, 8, 16, 32 units) and reef system Bayshore North (BSN), Bayshore South (BSS), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay (SETB) for the Spring of 2006 sampling period.

4 Reef Sites

Species	Common Name	BSN	BSS	WK	BH	SETB
Archosargus probatocephalus	Sheepshead					x
Blenniidae sp.	Blenny			x		
Callinectes sapidus	Blue Crab	x	x	x		
Chaetodipterus faber	Atlantic Spadefish					x
Chaetodon ocellatus	Spotfin Butterflyfish					
Cliona sp.	Boring Sponge	x	x			
Diadema antillarum	Long Spine Sea Urchin					
Diplectrum formosum	Sand Perch					
Haemulon aurolineatum	Tomtate	x	x	x	x	x
Harrengula jaguana	Scaled Sardine				x	
Hippocampus erectus	Seahorse					
Lagodon rhomboides	Pinfish	x	x	x	x	x
Leptogorgia virgulata	Colorful Sea Whip	x	x	x	x	x
Libinia emarginata	Feather Blenny	x	x	x		
Lutjanus synagris	Lane Snapper					
Menippe mercenaria	Stone Crab	x	x	x	x	x
Mycteroperca microlepis	Gag Grouper				x	
Orthopristis chrysoptera	Pigfish				x	
Prionotus scitulus	Leopard Searobin				x	
Serranus subligarius	Belted Sandfish				x	
Stephanolepis hispidus	Planehead Filefish					
Synodus foetens	Inshore Lizardfish				x	
Upeneus parvus	Dwarf Goatfish	x	x			x

8 Reef Sites

Species	Common Name	BSN	BSS	WK	BH	SETB
Archosargus probatocephalus	Sheepshead					
Blenniidae sp.	Blenny					
Calinectes sapidus	Blue Crab	x	x	x	x	x
Centropristis striata	Black Sea Bass					x
Chaetodipterus faber	Atlantic Spadefish			x	x	x
Chaetodon ocellatus	Spotfin Butterflyfish				x	
Cliona sp.	Boring Sponge	x	x		x	
Diadema antillarum	Long Spine Urchin				x	
Diplectrum formosum	Sand Perch				x	
Haemulon aurolineatum	Tomtate	x	x	x	x	x
Haemulon plumieri	White Grunt					x
Halichoeres bivittatus	Slippery Dick					x
Harrengula jaguana	Scaled Sardine				x	
Hippocanthus erectus	Lined Seahorse				x	
Lagodon rhomboides	Pinfish	x	x	x	x	x
Leptogorgia virgulata	Colorful Sea Whip	x	x		x	x
Libinia emarginata	Feather Blenny	x				x
Lutjanus synagris	Lane Snapper	x		x		
Lutjanus griseus	Gray Snapper		x	x		
Menippe mercenaria	Stone Crab	x	x	x	x	x
Mycteroperca microlepis	Gag Grouper				x	x
Orthopristis chrysoptera	Pigfish					x
Pleuroplaca gigantea	Florida Horse Conch				x	x
Prionotus scitulus	Leopard Sea Robin				x	
Serranus subligarius	Belted Sandfish				x	x
Stephanolepis hispidus	Planehead Filefish			x		
Synodus foetens	Inshore Lizardfish	x	x	x	x	x
Upeneus pavus	Dwarf Goatfish					x

16 Reef Sites

Species	Common Name	BSN	BSS	WK	BH	SETB
Archosargus probatocephalus	Sheepshead				x	x
Calinectes sapidus	Blue Crab		x	x	x	x
Chaetodipterus faber	Atlantic Spadefish				x	
Chaetodon ocellatus	Spotfin Butterflyfish				x	
Cliona sp.	Boring Sponge	x	x	x	x	x
Diplectrum formosum	Sand Perch		x			
Diplodus holbrooki	Spottail Pinfish				x	x
Epinephelus itajara	Goliath Grouper			x		
Gobiosoma oceanops	Neon Goby					x
Haemulon aurolineatum	Tomtate	x	x		x	x
Haemulon plumieri	White Grunt				x	x
Harrengula jaguana	Scaled Sardine				x	
Hyposblennius hentzi	Feather Blenny				x	
Lagodon rhomboides	Pinfish	x	x	x	x	x
Leptogorgia virgulata	Colorful Sea Whip	x		x	x	x
Libinia emarginata	Feather Blenny	x				
Lutjanus griseus	Gray Snapper	x	x	x		
Lutjanus synagris	Lane Snapper			x		x
Menippe mercenaria	Stone Crab	x	x	x	x	x
Mycteroperca microlepis	Gag Grouper				x	x
Oligoplites saurus	Leatherjacket					x
Opsanus beta	Gulf Toadfish				x	
Orthopristis chrysoptera	Pigfish				x	
Pareques acumintus	Highhat				x	
Serranus subligarius	Belted Sandfish				x	x
Stephanolepis hispidus	Planehead Filefish		x	x		x
Synodus foetens	Inshore Lizardfish		x	x		
Upeneus parvus	Dwarf Goatfish					x

32 Reef Sites

Species	Common Name	BSN	BSS	WK	BH	SETB
Archosargus probatocephalus	Sheepshead		x		x	
Blenniidae sp.	Blenny			x		
Callinectes sapidus	Blue Crab	x	x	x	x	
Caranx hippos	Crevalle Jack	x				
Centropristis striata	Black Sea Bass				x	
Chaetodipterus faber	Atlantic Spadefish				x	
Cliona sp.	Boring Sponge	x	x		x	x
Diadema antillarum	Long Spine Sea Urchin				x	x
Diplectrum formosum	Sand Perch		x			
Gobiosoma oceanops	Neon Goby					x
Haemulon aurolineatum	Tomtate	x	x	x	x	x
Haemulon plumieri	White Grunt				x	
Hippocanthus erectus	Lined Seahorse			x		
Lagodon rhomboides	Pinfish	x	x	x	x	x
Leptogorgia virgulata	Colorful Sea Whip		x	x	x	x
Libinia emarginata	Feather Blenny	x	x			
Lutjanus griseus	Gray Snapper	x	x	x	x	x
Lutjanus synagris	Lane Snapper			x	x	
Menippe mercenaria	Stone Crab	x	x	x	x	x
Mycteroperca microlepis	Gag Grouper				x	x
Mycteroperca phenax	Scamp					x
Opsanus beta	Gulf Toadfish	x	x	x	x	
Orthopristis chrysoptera	Pigfish				x	
Panulirus argus	Spiny Lobster					x
Pareques acumintus	Highhat				x	
Pleuroplaca gigantea	Florida Horse Conch			x		
Serranus subligarius	Belted Sandfish				x	x
Sphoeroides spengleri	Bandtail Puffer		x			x
Stephanolepis hispidus	Planehead Filefish			x		
Synodus foetens	Inshore Lizardfish	x		x	x	
Upeneus parvus	Dwarf Goatfish					

Appendix B

Complete list of observed species by reef site (4, 8, 16, 32 units) and reef system Bayshore North (BSN), Bayshore South (BSS), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay (SETB) for the summer of 2006 sampling period.

4 Reef Sites

Species	Common Name	BSN	BSS	WK	BH	SETB
Archosargus probatocephalus	Sheepshead	x	x			x
Callinectes sapidus	Blue Crab			x		
Cliona sp.	Sponge	x	x	x	x	x
Dasyatis americana	Southern Stingray					x
Diadema antillarum	Long Spine Urchin				x	
Epinephelus itajara	Goliath Grouper					x
Haemulon plumieri	White Grunt				x	
Lagodon rhomboides	Pinfish		x			
Leptogorgia virgulata	Colorful Sea Whip	x	x	x	x	x
Lutjanus griseus	Gray Snapper		x	x	x	x
Lutjanus synagris	Lane Snapper	x			x	x
Menippe mercenaria	Stone Crab	x	x	x	x	x
Mycteroperca microlepis	Gag Grouper	x	x		x	x
Opsanus beta	Gulf Toadfish		x		x	
Stephanolepis hispidus	Planehead Filefish	x				

8 Reef Sites

Species	Common Name	BSN	BSS	WK	BH	SETB
Alcyonacea	Soft Coral			x		
Archosargus probatocephalus	Sheepshead	x	x		x	x
Calamus calamus	Saucereye Porgy	x				
Callinectes sapidus	Blue Crab		x	x		
Chaetodipterus faber	Atlantic Spadefish				x	
Cliona sp.	Sponge	x	x	x	x	x
Dasyatis americana	Southern Stingray				x	
Diadema antillarum	Long Spine Urchin				x	
Epinephelus itajara	Goliath Grouper	x	x			
Haemulon plumieri	White Grunt				x	x
Lagodon rhomboides	Pinfish	x	x	x		
Leptogorgia virgulata	Colorful Sea Whip	x	x	x	x	x
Lutjanus griseus	Gray Snapper	x	x	x	x	
Lutjanus synagris	Lane Snapper				x	
Menippe mercenaria	Stone Crab	x	x	x	x	x
Mycteroperca microlepis	Gag Grouper	x	x		x	
Opsanus beta	Gulf Toadfish	x			x	x
Pomacanthus paru	French Angelfish	x				
Stephanolepis hispidus	Planehead Filefish	x				

16 Reef Sites

Species	Common Name	BSN	BSS	WK	BH	SETB
Archosargus probatocephalus	Sheepshead	x	x		x	x
Calamus calamus	Saucereye Porgy	x				
Callinectes sapidus	Blue Crab	x		x		
Chaetodipterus faber	Atlantic Spadefish				x	
Cliona sp.	Sponge	x	x	x	x	x
Diadema antillarum	Long Spine Urchin				x	
Epinephelus itajara	Goliath Grouper	x				x
Haemulon plumieri	White Grunt				x	
Lagodon rhomboides	Pinfish	x	x	x		
Leptogorgia virgulata	Colorful Sea Whip	x	x	x	x	x
Lutjanus griseus	Gray Snapper	x	x	x	x	x
Lutjanus synagris	Lane Snapper	x			x	x
Menippe mercenaria	Stone Crab	x	x	x	x	x
Mycteroperca microlepis	Gag Grouper	x	x	x	x	x
Opsanus beta	Gulf Toadfish	x	x	x	x	x
Synodus foetens	Inshore Lizardfish	x				

32 Reef Sites

Species	Common Name	BSN	BSS	WK	BH	SETB
Archosargus probatocephalus	Sheepshead	x	x		x	x
Calamus calamus	Saucereye Porgy	x		x		
Callinectes sapidus	Blue Crab	x	x	x		
Chaetodipterus faber	Atlantic Spadefish				x	
Cliona sp.	Sponge	x	x	x	x	x
Dasyatis americana	Southern Stingray					x
Diplectrum formosum	Sand Perch	x				
Diplodus holbrookii	Spottail Pinfish				x	
Epinephelus itajara	Goliath Grouper	x	x		x	x
Haemulon plumieri	White Grunt				x	
Lagodon rhomboides	Pinfish	x	x	x		x
Leptogorgia virgulata	Colorful Sea Whip	x		x	x	x
Libinia emarginata	Spider Crab			x		
Lutjanus griseus	Gray Snapper	x	x	x	x	x
Lutjanus synagris	Lane Snapper	x			x	
Menippe mercenaria	Stone Crab	x	x	x	x	x
Mycteroperca microlepis	Gag Grouper	x	x	x	x	x
Opsanus beta	Gulf Toadfish	x	x	x		x
Sphoeroides spengleri	Bandtail Puffer				x	x
Stephanolepis hispidus	Planehead Filefish			x		
Synodus foetens	Inshore Lizardfish	x				

Appendix C

Complete list of observed species by reef site (4, 8, 16, 32 units) and reef system Bayshore North (BSN), Bayshore South (BSS), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay (SETB) for the fall of 2006 sampling period.

4 Reef Sites

Species	Common Name	BSN	BSS	WK	BH	SETB
Centropristis striata	Black Sea Bass				x	x
Cliona sp.	Sponge	x		x		
Diadema antillarum	Long Spine Urchin				x	
Diplectrum formosum	Sand Perch				x	x
Epinephelus itajara	Goliath Grouper					x
Leptogorgia virgulata	Colorful Sea Whip	x	x	x	x	x
Lutjanus griseus	Gray Snapper	x	x			
Lutjanus synagris	Lane Snapper				x	
Menippe mercenaria	Stone Crab	x	x	x	x	x
Mycteroperca microlepis	Gag Grouper					x
Opsanus beta	Gulf Toadfish				x	
Prionotus scitulus	Leopard Searobin					x
Serranus subligarius	Belted Sandfish				x	

8 Reef Sites

Species	Common Name	BSN	BSS	WK	BH	SETB
Acanthostracion quadricomis	Scrawled Cowfish					x
Bispira variegata	Variegated Feather Duster				x	
Callinectes sapidus	Blue Crab		x			
Centropristis striata	Black Sea Bass				x	
Cliona sp.	Sponge		x		x	
Diadema antillarum	Long Spine Urchin				x	
Diplectrum formosum	Sand Perch				x	x
Epinephelus itajara	Goliath Grouper			x		
Hyposblennius hentzi	Feather Blenny			x		
Lagodon rhomboides	Pinfish			x	x	
Leptogorgia virgulata	Colorful Sea Whip	x	x	x	x	x
Menippe mercenaria	Stone Crab	x	x	x	x	x
Mycteroperca microlepis	Gag Grouper		x		x	x
Opsanus beta	Gulf Toadfish				x	
Pleuroplaca gigantea	Florida Horse Conch				x	

16 Reef Sites

Species	Common Name	BSN	BSS	WK	BH	SETB
Acanthostracion quadricomis	Scrawled Cowfish				x	
Archosargus probatocephalus	Sheepshead				x	x
Bispira variegata	Variegated Feather Duster		x		x	
Callinectes sapidus	Blue Crab	x				
Chaetodipterus faber	Atlantic Spadefish				x	
Cliona sp.	Sponge		x	x	x	x
Diadema antillarum	Long Spine Urchin				x	
Epinephelus itajara	Goliath Grouper	x				
Lagodon rhomboides	Pinfish				x	
Leptogorgia virgulata	Colorful Sea Whip	x	x	x	x	x
Lutjanus griseus	Gray Snapper		x	x		
Lytechinus variegatus	Variegated Urchin				x	
Menippe mercenaria	Stone Crab	x	x	x	x	x
Mycteroperca microlepis	Gag Grouper				x	x
Opsanus beta	Gulf Toadfish					x
Paralichthys albigutta	Gulf Flounder					x
Sphoeroides spengleri	Bandtail Puffer				x	
Synodus foetens	Inshore Lizardfish			x		

32 Reef Sites

Species	Common Name	BSN	BSS	WK	BH	SETB
Acanthostracion quadricomis	Scrawled Cowfish					x
Archosargus probatocephalus	Sheepshead	x			x	
Bispira variegata	Variegated Feather Duster				x	x
Calamus calamus	Saucereye Porgy				x	
Cliona sp.	Sponge		x	x	x	x
Diadema antillarum	Long Spine Urchin					x
Diplectrum formosum	Sand Perch		x		x	
Epinephelus itajara	Goliath Grouper			x	x	
Harrengula jaguana	Scaled Sardines			x		
Hyposblennius hentzi	Feather Blenny			x		
Lagodon rhomboides	Pinfish			x	x	
Leptogorgia virgulata	Colorful Sea Whip		x	x	x	x
Lutjanus griseus	Gray Snapper			x		
Menippe mercenaria	Stone Crab	x	x	x	x	x
Mycteroperca microlepis	Gag Grouper		x		x	x
Opsanus beta	Gulf Toadfish				x	x
Sphoeroides spengleri	Bandtail Puffer				x	

Appendix D

Complete list of observed species by reef site (4, 8, 16, 32 units) and reef system Bayshore North (BSN), Bayshore South (BSS), Whale Key (WK), Bulkheads (BH), and Southeast Tampa Bay (SETB) for the winter of 2007 sampling period.

4 Reef Sites

Species	Common Name	BSN	BSS	WK	BH	SETB
Bispira variegata	Variegated Feather Duster		x		x	
Callinectes sapidus	Blue Crab	x	x	x		
Centropristis striata	Black Sea Bass				x	
Cliona sp.	Sponge	x	x	x		
Diadema antillarum	Long Spine Urchin				x	
Diplectrum formosum	Sand Perch				x	x
Haemulon aurolineatum	Tomtate		x			
Haemulon plumieri	White Grunt				x	
Lagodon rhomboides	Pinfish	x	x	x	x	
Leptogorgia virgulata	Colorful Sea Whip	x	x	x	x	x
Lutjanus griseus	Gray Snapper	x		x		
Menippe mercenaria	Stone Crab	x	x	x	x	
Mycteroperca microlepis	Gag Grouper					x
Opsanus beta	Gulf Toadfish		x			
Serranus subligarius	Belted Sandfish				x	
Synodus foetens	Inshore Lizardfish	x	x			

8 Reef Sites

Species	Common Name	BSN	BSS	WK	BH	SETB
Archosargus probatocephalus	Sheepshead					x
Callinectes sapidus	Blue Crab		x	x		
Centropristis striata	Black Sea Bass				x	
Cliona sp.	Sponge	x	x	x		
Diadema antillarum	Long Spine Urchin				x	
Diplectrum formosum	Sand Perch				x	x
Haemulon aurolineatum	Tomtate		x	x		
Haemulon plumieri	White Grunt				x	
Hippocampus erectus	Seahorse			x		
Lagodon rhomboides	Pinfish	x	x	x		
Leptogorgia virgulata	Colorful Sea Whip	x	x	x	x	x
Lutjanus griseus	Gray Snapper		x			
Menippe mercenaria	Stone Crab	x	x		x	
Mycteroperca microlepis	Gag Grouper		x			x
Serranus subligarius	Belted Sandfish				x	
Stephanolepis hispidus	Planehead Filefish			x		
Synodus foetens	Inshore Lizardfish			x		

16 Reef Sites

Species	Common Name	BSN	BSS	WK	BH	SETB
Acanthostracion quadricomis	Scrawled Cowfish				x	
Archosargus probatocephalus	Sheepshead				x	x
Bispira variegata	Variegated Feather Duster				x	
Calamus calamus	Saucereye Porgy				x	
Callinectes sapidus	Blue Crab	x	x	x		
Cliona sp.	Sponge	x	x	x	x	x
Diadema antillarum	Long Spine Urchin				x	x
Diplodus holbrookii	Spottail Pinfish		x			
Haemulon aurolineatum	Tomtate	x	x			
Lagodon rhomboides	Pinfish	x	x	x	x	
Leptogorgia virgulata	Colorful Sea Whip	x	x	x	x	x
Lutjanus griseus	Gray Snapper	x	x	x		
Lytechinus variegatus	Variegated Urchin				x	
Menippe mercenaria	Stone Crab	x	x	x	x	x
Mycteroperca microlepis	Gag Grouper		x		x	x
Opsanus beta	Gulf Toadfish	x				
Scartella cristata	Molly Miller		x			
Synodus foetens	Inshore Lizardfish	x		x		

32 Reef Sites

Species	Common Name	BSN	BSS	WK	BH	SETB
Acanthostracion quadricomis	Scrawled Cowfish				x	
Archosargus probatocephalus	Sheepshead	x			x	
Calamus calamus	Saucereye Porgy				x	
Callinectes sapidus	Blue Crab	x	x	x		
Cliona sp.	Sponge	x	x	x	x	x
Diplectrum formosum	Sand Perch				x	
Epinephelus morio	Red Grouper					x
Haemulon aurolineatum	Tomtate	x	x			
Lagodon rhomboides	Pinfish	x	x	x	x	
Leptogorgia virgulata	Colorful Sea Whip		x	x	x	x
Libinia emarginata	Spider Crab			x		
Lutjanus griseus	Gray Snapper	x	x	x		
Lutjanus synagris	Lane Snapper	x				
Menippe mercenaria	Stone Crab	x	x	x	x	
Mycteroperca microlepis	Gag Grouper		x		x	x
Opsanus beta	Gulf Toadfish	x				
Scartella cristata	Molly Miller	x				
Synodus foetens	Inshore Lizardfish	x	x	x		