Delta Seven Inc.

General Environmental Consulting

Tampa Bay Epilithic Survey
Final Report

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Project Title: Tampa Bay Epilithic Habitat Survey

Reporting Period: Final Report

Project Narrative

Fishing records from prior to 1950 indicate that grouper and snapper were abundant in Tampa Bay waters. Concurrent with the development of the bay area, these populations declined dramatically and even recreational fishing has been generally unsuccessful. Ecological management initiatives including water quality improvements, and seagrass protection, has improved, but not resolved, the situation. An initiative which has also increased in popularity, and continues to grow, is the installation of artificial reefs to be used as a means of habitat improvement. Artificial reefs are man made hard bottom areas, which can vary in construction material. In the past these have included such materials as ships, planes, tanks and concrete debris. Artificial reefs, however, can also include native materials such as limestone and coquina rock.

Artificial reefs in Tampa Bay are often constructed as high relief structures and structures with cavities to support larger harvestable fish. Natural reef systems are often composed of low relief, patch reefs supporting medium and small fish. These bay reefs, both natural and artificial, provide habitat for fish maturing from juveniles to harvestable sized fish and is a critical, often missing, component in fishery and habitat management.

The project's overall purpose is to serve as an exploratory pilot program, which will compare and contrast the faunal inhabitants of artificial reefs to those of natural hardbottom in Tampa Bay. The results from the evaluation will be used to assist in the design of a large scale project for the restoration of hard bottom habitats.

The **objectives** of this project are to:

1) Compare the structure, function and faunal characteristics of two existing natural reefs to two existing artificial reefs. Comparisons will be made on the resident populations of selected fish, macro invertebrates and vegetation in each habitat;

2) Investigate substrate preferences of the exotic and invasive Asian green mussel (*Perna viridis*) within one project reef site (to be determined upon initial assessment);

3) Design a large scale restoration and rehabilitation project which will evaluate the efficacy of creating additional natural habitat structure in restoration efforts which will target associated fisheries for both non game and prey species.

Methods - Objective 1

Preliminary dives began in June of 2004. During these 11 preliminary field days, divers looked for suitable hard bottom throughout Tampa Bay to be used in this comparison study. Four (4) sites were chosen (Figure 1). The Hillsborough County reef (A.K.A. Egmont Key Reef) located east of Egmont Key (N 27.58302, W 82.74346); Rattlesnake key ledge (N 27.56420, W 82.62411); A Spoil Area south of Ft. DeSoto (N 27.35.940, W 82.43.011 WGS84); and the Reef Ball site located north of Anna Maria Island (N 27.55345, W 82.70613).

Figure 1: Location Map of Study Sites

Hillsborough Reef is a high relief (6-8 feet), man made reef structure composed of old concrete pipes and rubble, and has been in place since 1999. The reef is approximately 20 feet below the surface. The Rattlesnake Key Reef is characterized by broad expanses of smooth sand bottom interspersed with areas of low relief hard ground and rocky outcrops. At 15 feet below the surface, it is the shallowest of the four sample sites. The Spoil Site is 30 feet below the surface, and is an artificial hardbottom area composed of natural material from maintenance dredging of nearby

channels. The Reef Ball site is composed of approximately 30 low relief concrete balls at 15 feet below the surface. The specially designed, hollow, concrete balls have numerous holes and range in size from 1 foot to roughly 3 feet high and 3 feet across.

The Hillsborough Reef and the Reef Ball Reef both have similar relief. Both offer voids and offer surface area for organisms to hide behind or attached themselves to. The Spoil site and Rattlesnake Key have a much lower relief, limited to ledges and larger epilithic fauna. The Reef Ball site and the Hillsborough Reef site satisfy the artificial reef component of this study while the Spoil site and Rattlesnake Key site satisfy the natural reef component of the study.

Eleven preliminary dives were conducted in order to establish a baseline of species commonly present on the reefs and to test and evaluate the survey techniques. On August 8th and 9th, 2005 data collection dives took place on the selected hard bottom structures.

Table 1: Field Schedule

Date	Activity
June 7th, 2004	Search for areas of Hardbottom
June 22, 2004	Search for areas of Hardbottom
July 2, 2004	Hillsborough Reef - *preliminary dive*
August 17th, 2004	Rattle snake Reef - *mapping and preliminary dive*
August 17th, 2004	Hillsborough Reef - *preliminary dive*
February 23, 2005	Reef balls - *gear test, preliminary dive, and photo documentation*
April 21st, 2005	Spoil - *preliminary dive and photo documentation*
April 28th, 2005	Hillsborough Reef - *Install settlement collection substrates, install temperature logging device (HOBO) and preliminary reef dive, photo documentation*
June 7th, 2005	Hillsborough Reef - *Check status of settlement collection substrates, and reef photo documentation*
June 30th, 2005	Hillsborough Reef - *Check status of reef modules, and reef photo documentation*
July 5th, 2005	Hillsborough Reef - - *Check status of reef modules, and reef photo documentation*
July 22, 2005	Hillsborough Reef - *Replace lost settlement collection substrates, and reef photo documentation*
July 22, 2005	Reef balls - *preliminary dive and photo documentation*
August 8th, 2005	Rattlesnake - *Study transects and photo documentation*
August 8th, 2005	Reef Balls - *Study transects and photo documentation*
August 9th, 2005	Hillsborough Reef - *Study transects and photo documentation*
August 9th, 2005	Spoil - *Study transects and photo documentation*

Ichthyofauna

Ichthyofaunal data collection was limited to targeted species taken from existing monitoring information in order to focus the attention of the data collector. This helped to reduce missed records due to distractions by species of lesser interest. Species of interest were selected using the criteria of residency and recreational interest. Residents were selected, focusing on but not limited to, small territory size.

Table 2: Ichthyofauna Species of Interest

Common Name	***Scientific Name***
Sheepshead	*Archosargus probatocephalus*
French grunt juv.	*Haemulon flavolineatum*
Blue stripe grunt juv.	*Haemulon sciurus*
Gray snapper	*Lutjanus griseus*
Red grouper	*Epinephelus morio*
Black grouper	*Mycteroperca bonaci*
Gag Grouper	*Mycteroperca microlepis*

Ichthyofaunal data were collected concurrent with the epilithic data collection, but by different divers. Data was collected using roving diver methods along the epilithic transects. Non target species present were also recorded.

Epilithos

Data on community structure of the epilithos were collected using gross visual characterization techniques, stationary point count methods and data collected from transects swum across each reef.

Video and extensive still photography was used in conjunction with diver notes.

Methods - Objective 2

Asian Green Mussel Study

Settlement collection substrates were constructed out of three types of material: concrete, limestone, and polyethylene buoy material (Figure 2).

Initial deployment of the settlement collection substrates took place on April 28th, 2005, during which time three samples of each module were deployed under the Hillsborough Reef buoy (Figure 3, 4 and 5). Strong currents and storms washed away 4 of the initial modules, which had to be reinstalled on July 22nd, 2005. Colonization of the modules was documented periodically and final collection of the modules took place in October 2005.

Figure 2: Example of the size of materials used for concrete and limestone settlement collection substrates.

Figure 3: Polyethylene settlement collection substrate deployed at Hillsborough Reef site

Figure 4: Concrete settlement collection substrates deployed at Hillsborough Reef site.

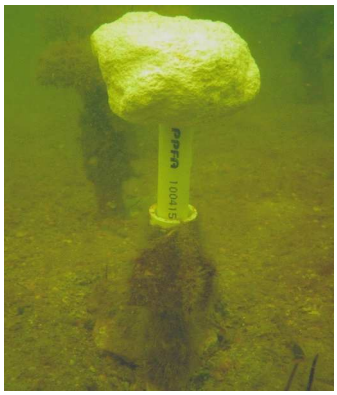

Figure 5: Limestone settlement collection substrates deployed at Hillsborough Reef site.

Results - Objective 1

During the first week of August 2005, the Florida Wildlife Research Institute (FWRI) received reports from diving and fishing charter businesses of mass mortalities of fish and other animals inhabiting reefs. The mortalities were attributed to an extreme red tide which spanned a geographical area extending from New Port Richey south to Sarasota and from approximately 3 to 23 miles offshore (Figure 6). It was estimated that bottom communities within an approximate area of 2,162 square miles were affected. Organisms affected included dead fish present on the bottom (ranging from baitfish to goliath grouper) as well as dead sponges, corals, worms, mollusks, crabs, sea urchins, starfish, and sea turtles. The results of the studies may therefore, not be representative of what is typical because of the effects of the red tide. Therefore, results of this report will be presented reef by reef and comparisons of Ichthyofauna will be made from observations made during preliminary dives beginning in 2004 (pre-red tide) to data collected during the actual study days in August of 2005 (post red tide). Non-target species were also added as observations noticed trends in the survivability of certain fishes following the red tide event. Other flora and fauna such as macro invertebrates and vegetation will be presented as a presence/absence survey without distinguishing between pre and post red tide.

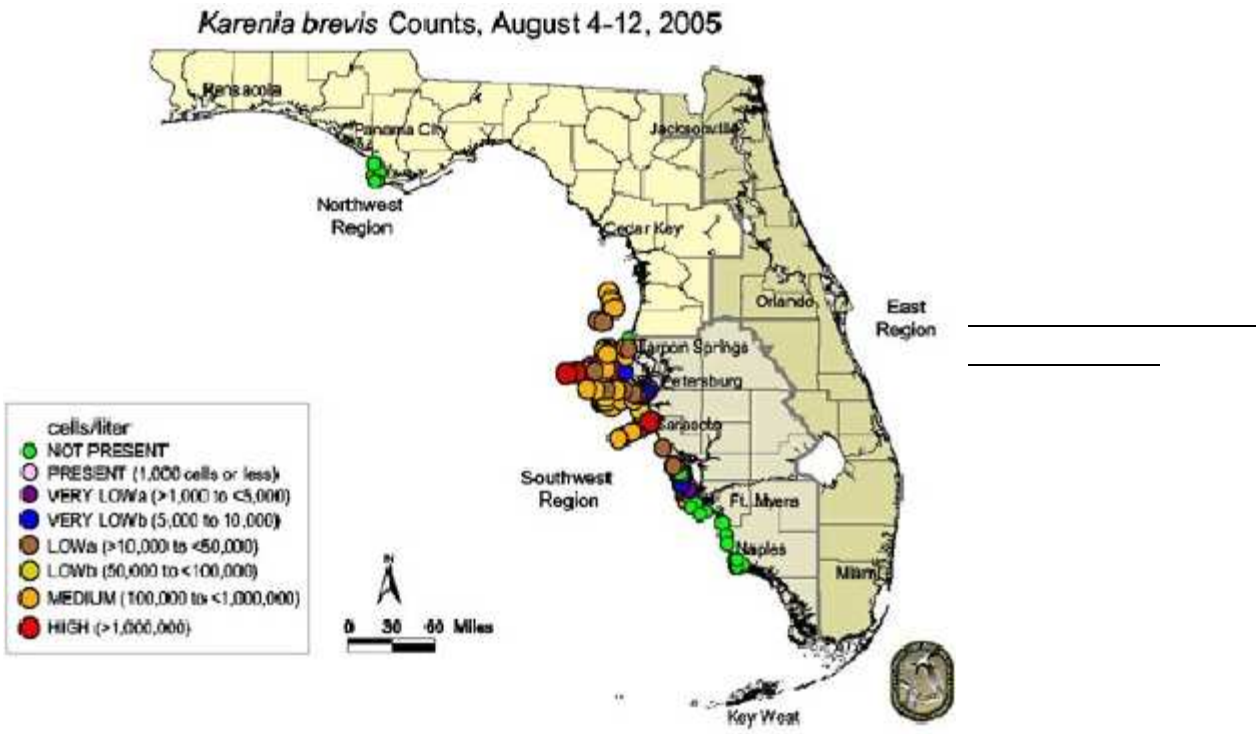

Figure 6: Karenia brevis Counts, August 4-12, 2005 (FWRI, 2005)

Ichthyofauna - Hillsborough Reef

The Hillsborough Reef, sitting at 20 feet beneath the surface, is a high relief structure composed of old concrete pipes and rubble, and has been in place since 1999. Observations during the study were made on pipes with a relief of 2-5 feet and include details on the ichthyofauna.

Table 3: Ichthyofauna on Hillsborough Reef (pre-red tide)

Species Present	Size Range(in)	Group Numbers	Orientation	Notable Behavior
Archosargus probatocephalus (Sheepshead)	8-16	1-3	not orienting to anything	Cruising; Grazing
Mycteroperca bonaci (Black Grouper)	18-24	1	inside pipes or outside near entrance to pipes	Cruising
Haemulon plumieri (White Grunt)	8-12	1	Swimming closely around structure	Cruising
Haemulon sciurus (Blue Stripped Grunt) Juvenile	2	10-15	superstructure	Loose schooling
Equetus umbrosus (Cubbyu) - Adult and Juvenile	2-4 - juvenile 5-8 - adult	3-4 - juvenile 2-6 - adult	underside of culvert; crevices and shadows	

Table 3: Cont.

Serranus subligarius (Belted sandfish)	2-3	1-2	on the top or base of faunal structure; tops or near or on culvert crevices	
Chaetodipterus faber (Spadefish)	8-14	4-8	above reef structure	Cruising
Sphoeroides spengleri (Bandtail puffer)	5-6	1	closely swimming above structure	Cruising
Hypleuochilus bermudensis (Barred Blenny)	2	1	top of culvert	
Brevoortia patronus (Gulf Menhaden)	3-4	500	above structure	large tight school

Table 4: Ichthyofauna on Hillsborough Reef (post-red tide)

Species Present	Size Range(in)	Group Numbers	Orientation	Notable Behavior
Archosargus probatocephalus (Sheepshead)	12	3	not orienting to anything	Cruising; Grazing
Mycteroperca bonaci (Black Grouper)	18-24	1	inside pipes or outside near entrance to pipes	Cruising
Lutjanus griseus (Grey Snapper)	10-12	1	Swimming closely around structure	Cruising

Presence of fish after the red tide was limited to adults. No small fish were reported.

Ichthyofauna - Spoil Site

The Spoil Site is an artificial hard bottom composed of natural material. The relief of the structure is limited to larger epilithic fauna (ie. sponges, small corals and gorgonians). Also, the current is notably strong.

Table 5: Ichthyofauna on the Spoil Site (pre-red tide)

Species Present	Size Range(in)	Group Numbers	Orientation	Notable Behavior
Haemulon sciurus (Blue Stripped Grunt) 1 Juvenile	<6	individual (Not in school)	superstructure	
Serranus subligarius (Belted sandfish)	2-3	1-2	on the top or base of rock or sponges	
Epinephelus morio (Red Grouper) 1 Juvenile 1 Adult	3 - juvenile 6 - adult	2 individuals	inside a hole - juvenile swimming around structures - adult	Cruising - adult

Table 6: Ichthyofauna on the Spoil Site (post-red tide)

Species Present	Size Range(in)	Group Numbers	Orientation	Notable Behavior
Serranus subligarius (Belted sandfish)	2-3	Several	On the top or base of rock or sponges	
Hypleuochilus bermudensis (Barred Blenny)	2	1	Top of sand on bottom	
Haemulon plumieri (White Grunt) Juvenile		1	Swimming closely around structure	Cruising
Prionotus ophryas (Bandtail Sea Robin)	5	1	On top of sandy bottom	
Lagodon rhomboides (Pinfish)	5-6	Several		Schooling

Presence of fish was limited to smaller fish. No large fish were reported after the red tide.

Ichthyofauna - Rattlesnake Key Reef

The Rattlesnake Key reef has a road expanse of smooth and sand bottom interspersed with areas of low relief hard ground and rocky outcrops. The rocky outcrops are found along a linear edge of the hard bottom structure.

Table 7: Ichthyofauna on the Rattlesnake Key Reef (pre-red tide)

Species Present	Size Range(in)	Group Numbers	Orientation	Notable Behavior
Lutjanus griseus (Grey Snapper)	10-12	1	Swimming closely around structure	Cruising
Epinephelus morio (Red Grouper) - 3 Juvenile	5 - juvenile	3 individual	Underside of rocky ledge	In refuge

Table 8: Ichthyofauna on the Rattlesnake Key Reef (post-red tide)

Species Present	Size Range(in)	Group Numbers	Orientation	Notable Behavior
Mycteroperca microlepis (Gag Grouper) Juvenile	6-8	Several	Underside of rocky ledge and on top of ledges (Figure 7)	Periodic Foray: Not solitary
Archosargus probatocephalus (Sheepshead)	8-10	Several		Grazing ledge; moved in and out of school
Lutjanus griseus (Grey Snapper)	8-10	Several	Around, under and on top of ledges	Schooling and cruising ledge and over top of rocky outcroppings and sand

Table 8: Cont.

Haemulon plumieri (White Grunt)		1		Individual in w/grey snapper school
Lagodon rhomboides (Pinfish)	4-6	10-15	on top and among algae over sands NOT AT LEDGE	
Chaetodipterus faber (Spadefish)	6-8	50	Swimming over ledge	Tight School
Opsanus pardus (Leopard Toadfish)	7	1	Resting under ledge with only head protruding	

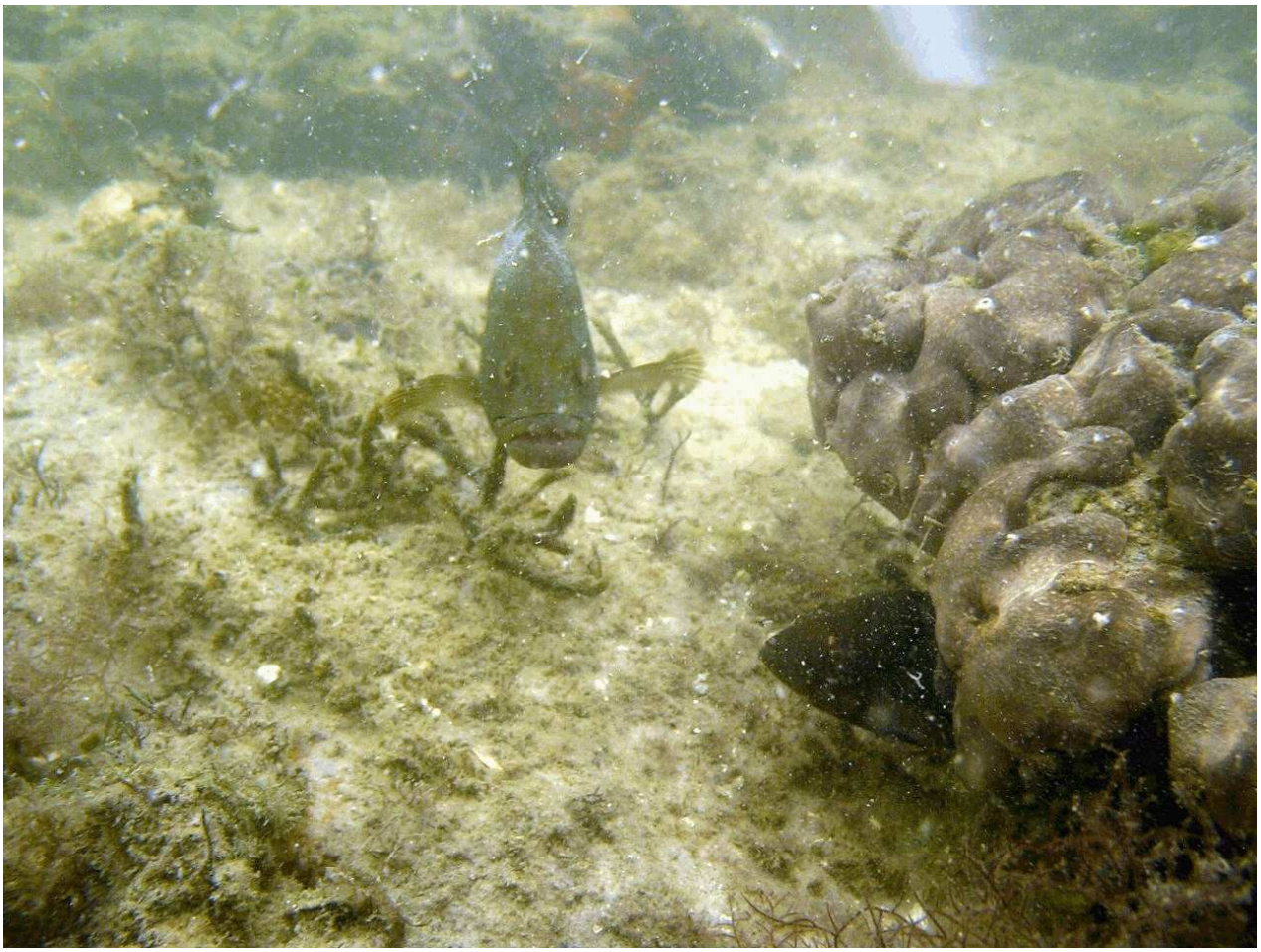

Figure 7: Photo from Rattlesnake Key *M. microlepis* using ledge as cover

Ichthyofauna - Reef Ball Site

The Reef Ball Site is an artificial hard bottom composed of concrete. The relief of the structure ranges is approximately 3 feet in height. The site consists of approximately 15 reef balls.

Ichthyofauna on the Reef Balls (pre-red tide)

Table 9: Ichthyofauna on the Reef Balls (pre-red tide)

Species Present	Size Range(in)	Group Numbers	Orientation	Notable Behavior
Epinephelus morio (Red Grouper)	18+		Within crevices and inside structure	
Archosargus probatocephalus (Sheepshead)	18-24		Around structure	Grazing

Table 10: Ichthyofauna on the Reef Balls (post-red tide)

Species Present	Size Range(in)	Group Numbers	Orientation	Notable Behavior
Epinephelus morio (Red Grouper) -	18+		Within crevices and inside structure	
Archosargus probatocephalus (Sheepshead)	24		Around and inside structure	Grazing

Figure 8: Photo taken at Reef Ball Site - *A. probatocephalus* resting in top opening of the reef ball

Invertebrate and Vegetation Results

The following tables have been included to provide a presence/absence survey of the invertebrates and algae located at the sites - Rattlesnake Key (RK), Hillsborough Reef (HR), Reef Ball site (RB) and Spoil Site (SS).

Table 11: Identified organisms and their locations

Group	Species Name	Common Name	RK	HR	RB	SS	Notes
Algae	*Codium isthmocladum*	Dead Man's Fingers	x				
	Caulerpa Sertularoides	Green feather algae			x		
		Red Turf Algae	x	x	x	x	
	Unknown Rhodophyta		x	x			Branching and covering ***L. virgulata*** (See Figure 16)
		Coralline algae	x	x	x	x	

Group	Species Name	Common Name	RK	HR	RB	SS	Notes
Polychaeta	Unknown Sabellidae		x	x	x		Banded and Shade of Violet
	Unknown Sabellidae		x				Bright Orange
	Unknown Sabellidae			x		x	Shade of white

Group	Species Name	Common Name	RK	HR	RB	SS	Notes
Arthropoda	*Balanus sp*	Barnacle		x	x		
	Paguristes sp	Hermit Crab	x			x	
	Stenorhynchus seticornis	Arrow Crab		x			
	Libinia dubia	Spider crab	x				Found hidden in the algal mat on the top of the ledge
	Menippe mercenaria	Stone Crab	x	x	x		

Group	Species Name	Common Name	RK	HR	RB	SS	Notes
Echinodermata	*Echinometra lucunter*	Rock-boring Urchin	x	x	x	x	
	Lytechinus variegatus	Variegated urchin		x		x	

Group	Species Name	Common Name	RK	HR	RB	SS	Notes
Octocorallia	*Leptogorgia spp*	Common Sea-whip		x	x	x	Colonies form long, straight, stiff, moderately branched, whip-like stalks. Color is bright yellow and purple
	Carijoa riisei	White Telesto		x	x	x	

Group	Species Name	Common Name	RK	HR	RB	SS	Notes
Mollusca	*Perna viridis*	Asian green mussel	x	x		x	
	Cerithium atratum	Florida Cerith	x	x			Tall-spired, pointed shell. Shell slender and elongate
	Pisania tincta	Tinted Cantharus	x	x			
	Pleuroplaca gigantea	Florida Horse Conch	x	x			
		Unknown Octopus		x			
		Unkown Murex			x		

Group	Species Name	Common Name	RK	HR	RB	SS	Notes
Actiniaria		Sponge Anenome		x			Bands around tentacles
	Unknown Actiniaria			x			Smooth tentacles w/out bands
	Aiptasia tagetes	Pale Anenome		x			
	Unknown Actiniaria			x			Speckled tentacles w/pale center disk
	Unknown Actiniaria				x		Deep red tentacles
	Unknown Actiniaria			x			White tentacles w/gray center

Group	Species Name	Common Name	RK	HR	RB	SS	Notes
Porifera	*Spheciospongia vesparium*	Loggerhead sponge	x			x	
	Aplysilla longispina	Yellow Sulfur Sponge		x			
	Unknown Spongidae		x	x	x	x	Appearance is very similar to commercial sponges
	Cliona spp		x	x	x	x	
		Unknown Orange Encrusting	x				
	Geodia gibberosa					x	
	Chondrilla spp		x				Encrusting around reef and *P. viridis*

Porifera Cont.

	Haliclona spp *Halichondria spp* *Lissodendoryx spp*		x	x		x	
	Monanchora sp.			x			
	Placospongia sp.		x	x	x	x	
		Unknown bright orange sponges		x		x	Lobate protrusions
	Plakrotis sp.			x	x		
	Axinyssa sp.			x	x		
	Ircinia spp.		x			x	

Group	Species Name	Common Name	RK	HR	RB	SS	Notes
Scleractinia	*Siderastrea siderea*	Massive Starlet	x				
	*Solenastrea bournoni***.**	Star Coral	x	x		x	
	Stephanocoenia michelinii	Blushing star coral	x				
	Phyllangia americana	Hidden Cup Coral		x		x	
	Astrangia poculata			x	x	x	
	Cladocora arbuscula	Tube Coral		x		x	

Group	Species Name	Common Name	RK	HR	RB	SS	Notes
Tunicates	*Styella plicata*	Striped Sea Squirt	x				
	Eudistoma spp	Strawberry Tunicate		x	x	x	
		Didemnid morph bright orange			x		
		Didemnid morph gray			x		
		Didemnid morph white		x	x		
		Didemnid morph purple			x		
		Didemnid morph peach			x		
		Didemnid morph orange/brown		x	x		

Tunicates Cont.

		Didemnid morph black/white		x	x		
	Clavelina spp			x	x	x	
		Unknown Bright Yellow Encrusting		x			Encrusting the *P. viridis*

Invertebrate and Vegetation Results - Spoil Site - Pre Red Tide

The physical structure is augmented by biological structure. Additional relief comes from the physical structure provided by sessile fauna. The structure is primarily composed of sponges, gorgonians and telestos. Abundance and diversity of the sponges was the greatest at the spoil site.

Figure 9: Photo taken at Spoil Site demonstrating diversity of sponges

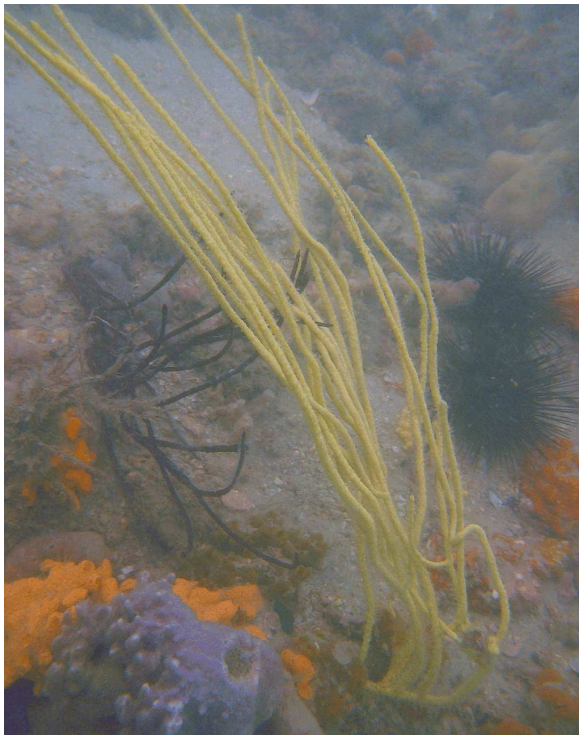

Figure 10: Photo taken at Spoil Site demonstrating relief from sponges and gorgonians

Invertebrate and Vegetation Results - Spoil Site - Post Red Tide

The tunicates and telestos demonstrated an observable decline while the sponges survived. Coral bleaching was widespread and no algae was observed.

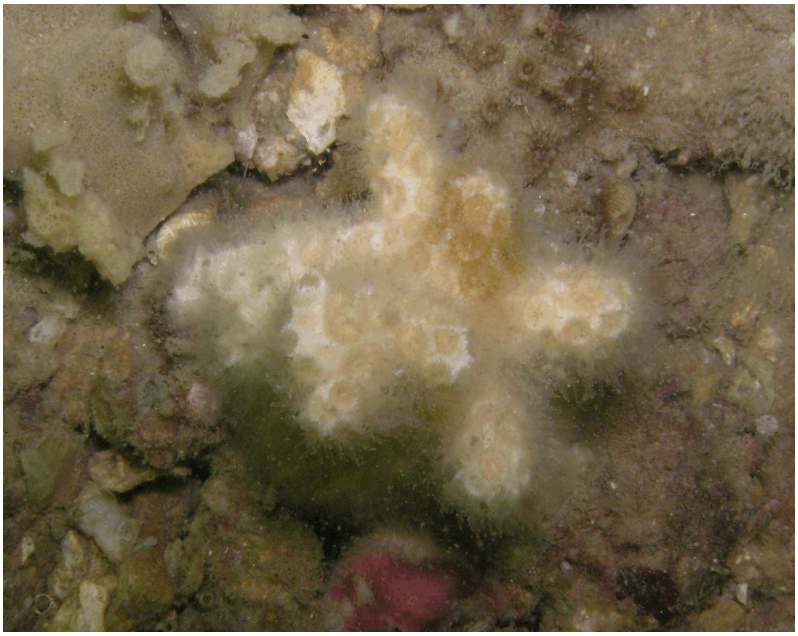

Figure 11: Photo from the Spoil Site with a bleached *A. poculata* after the Red Tide

Invertebrate and Vegetation Results - Rattlesnake - Pre Red Tide

The largest sponges were observed at this site, specifically *S. vesparium* and *C. celata.* Coral species, *S. siderea* and *S. bournoni,* also very common along the ledge platform. No corals were observed on the ledge itself. *C. nucula* and *I. felix* occupied the majority of available space along the ledge and along the platform.

Figure 12: Photo from Rattlesnake Key - *S. vesparium*

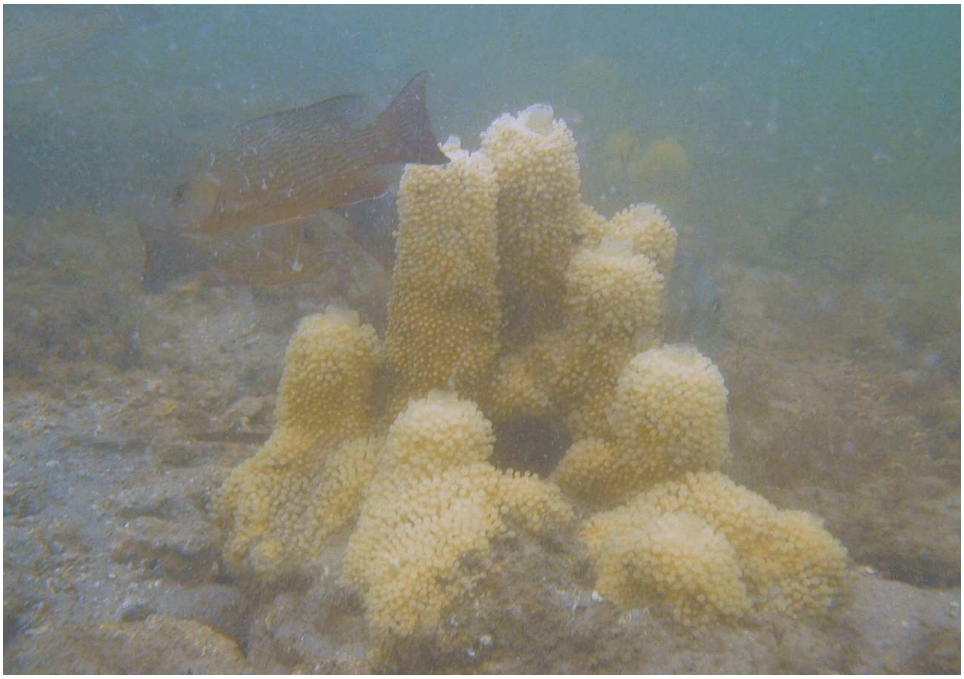

Figure 13: Photo from Rattlesnake Key - *C. celata*

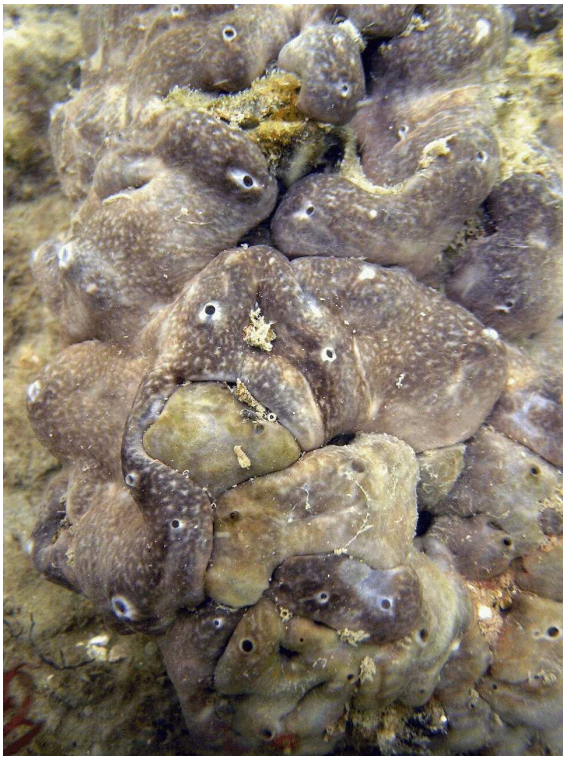

Figure 14: Photo from Rattlesnake Key - *C. nucula*

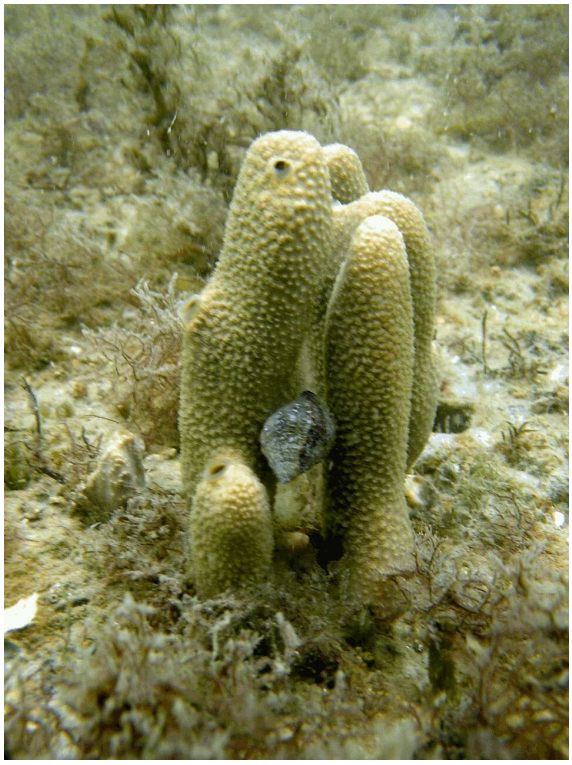

Figure 15: Photo from Rattlesnake Key - *I. felix*

Invertebrate and Vegetation Results - Rattlesnake - Post Red Tide

Observations are inconclusive as to whether the site actually was effected by the red tide. Bleaching was observed on *S. siderea.* However, no changes were observed that could be directly linked to the event.

Invertebrate and Vegetation Results - Reef Balls - Pre Red Tide

The reef balls were heavily populated with *Balanus sp.* and had a diverse population of smaller sponges and tunicates attached to them. *Leptogorgia sp.* and *C. riisei* were abundant, growing along the inner lips of the reef balls where the hydroids were growing.

Invertebrate and Vegetation Results - Reef Balls - Post Red Tide

The populations of *C. riisei***,** sponges and tunicates demonstrated an observable decline following the red tide event. However, the abundance of *Balanus sp.* Hydroids and *Leptogorgia sp.* remained unchanged.

Invertebrate and Vegetation Results - Hillsborough Reef- Pre Red Tide

The Hillsborough reef demonstrated the largest diversity of sessile invertebrates and algae. *Leptogorgia sp.* were notable abundant. The *Leptogorgia sp.* was found on top of the submerged culvert pipes and were oriented to the current which was fairly strong compared to the other sites. Similar to the reef ball site, the *C. riisei* were found along the inside of the culvert pipes growing along side the Hydroids. Corals were also notable in abundance, yet small in size and were the size of small recruits. Encrusting sponges were observed, large sponges were not.

Figure 16: Photo from Rattlesnake Key demonstrating *Leptogorgia sp.* and algal cover

Figure 17: Photo from Rattlesnake Key - *C. riisei*

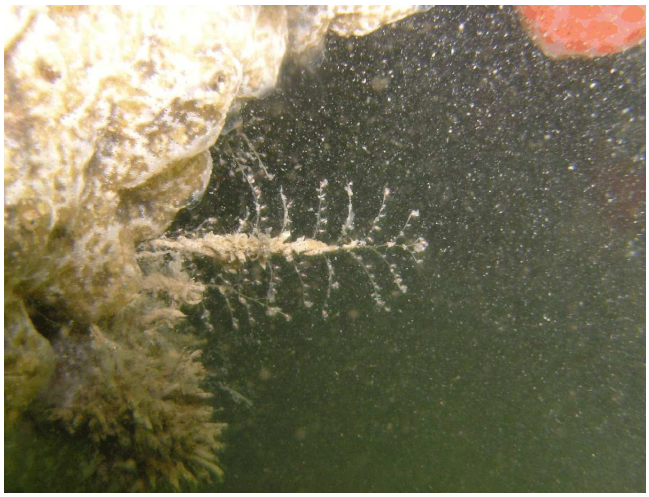

Figure 18: Photo from Rattlesnake Key - Unknown Hydroida

Invertebrate and Vegetation Results - Hillsborough Reef- Post Red Tide

The Hillsborough reef exhibited the most dramatic effects of the red tide event. The hyroids and gorgonians remained while the abundance of tunicates and *Carijoa riisei* decreased. The coral remained, however it had bleached.

Results - Objective 2

Asian Green Mussel Study

Table 12: Field Schedule

Date	Activity
April 28th, 2005	Deployment of "Mushrooms"
June 7th, 2005	Check progress
June 30th, 2005	Check progress
July 5th, 2005	Check progress
July 22nd, 2005	Check progress, replace lost
August 9th, 2005	Check progress
October 14th, 2005	Check progress and collect "Mushrooms"

There was no *P. viridis* settlement on any of the substrates after almost 6 months of deployment. *P. viridis* was found on three of the four sites in our study. The Spoil site had 1 large and 1 small *P. viridis.*

Figure 19: Photo from the Spoil Site - *P .viridis*

The Hillsborough Reef contained several *P. viridis*. Each was growing individually and signs of predation were also noted. Possibly the result of the nearby *M. mercenaria*.

Figure 20: Photo from the Hillsborough Reef - *P. viridis* cluster

Figure 21: Photo from the Hillsborough Reef - *P. viridis* individual

Rattlesnake Key had the largest population of *P. viridis*. A large colony was found on the top of the ledge surrounded and encrusted by *I. felix.* and *C. nucula.*

Figure 22: Photo from Rattlesnake Key - *P. viridis* colony

Figure 23: Photo from Rattlesnake Key - *P. viridis* individual

Discussion

Ichthyofauna

The results of the studies may not be representative of what is typical because of the effects of the red tide. However, simple observations indicate that structure size, complexity and type of material play a critical role in site selection for fishes, more specifically sub-adult fishes. Observations also suggest a correlation between the size and complexity of the structure and the size of the fish using the habitat.

Commercially and recreationally targeted fish were seen on all of the sites in this study - both the artificial reefs and the natural hard bottom structures. Structure was not limited to the limestone ledges, or concrete rubble and reef balls; Nearby fauna (ie sponges and gorgonians) played an important role in providing the necessary cover for local fish species. Sometimes the fauna offered the only vertical relief in the area (ie. The Spoil Site). The importance of nearby fauna must therefore not be underestimated, and a better understanding of what fauna is available to the sub adult fish must be taken into consideration when making management decisions regarding habitat protection and artificial reef creation.

Fauna

Faunal characteristics of each site were variable. The invertebrate populations were abundant and may be selected for, and variable, based on current, depth and substrate material. No conclusions have been made and more observations will be necessary.

Because the results of the studies may not be representative of what is typical due to the effects of the red tide, the numbers recorded from stationary point count methods and data collected from transects swum across each reef were not used. They will be kept and used if sampling can be done again to see how the fauna has recovered from the red tide.

More data is needed in order to examine whether the creation or enhancement of habitats for the sub adult fishes in Tampa Bay will restore the historically available low relief hard bottom habitats that sub adults require between post larval and reproducing adult stages.

Artificial reefs in Tampa Bay are often constructed into high relief structures and structures with cavities to support larger harvestable fish. Natural reef systems are often composed of low relief, patch reefs supporting medium and small fish. These bay reefs, both natural and artificial, provide habitat for fish maturing from juveniles to harvestable sized fish and is a critical, often missing, component in fishery and habitat management.

Future work will be needed and will have to include a map of suggested sites for low relief reef installations specific to (juvenile and sub adult) fish, typical design sections, and recommended management and regulatory improvements.

Knowledge gained on the relative benefits of the reef configurations studied will then assist Tampa Bay resource managers in the design and installation of more functional artificial reefs, and whether the reef is used for restorative or recreational purposes; Thereby providing more effective and focused improvements in the future. The knowledge can then be applied to other areas of Florida.