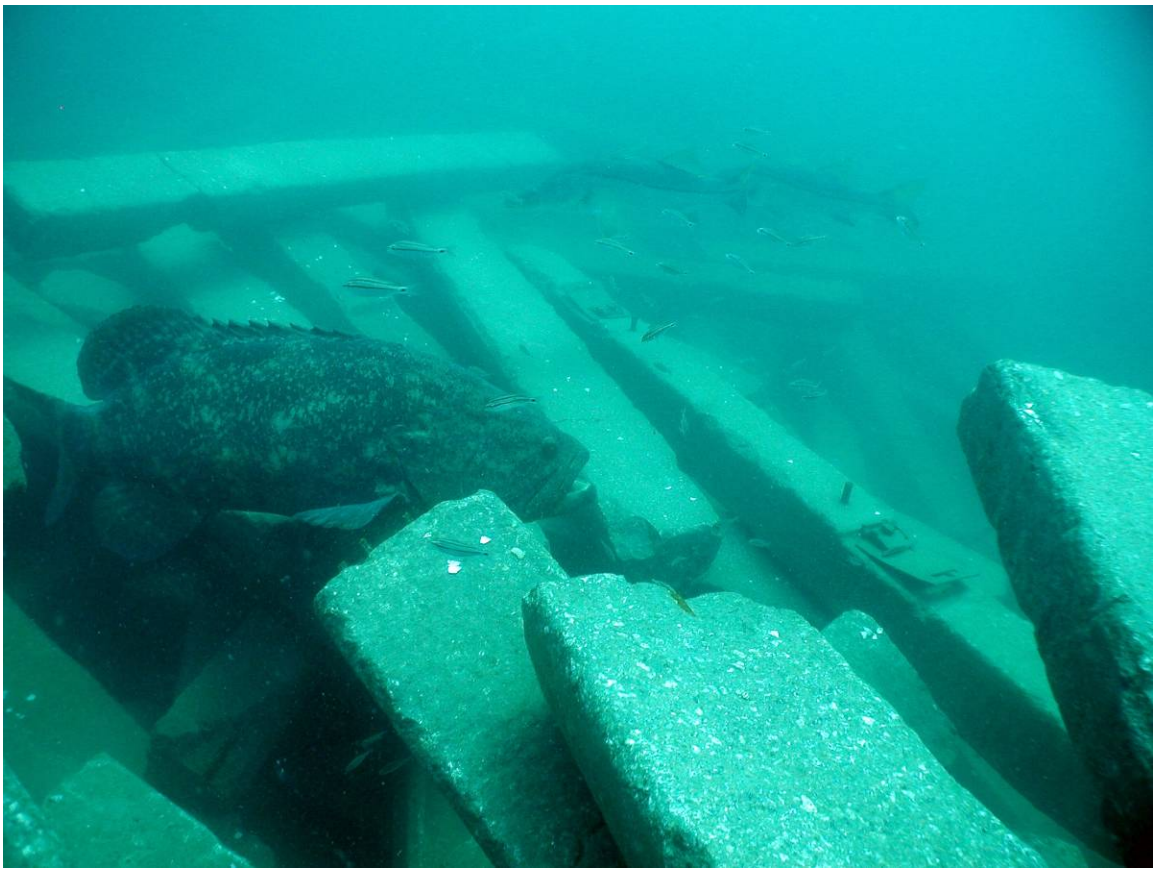
2006 Annual Monitoring for the 2005 Artificial Reef Deployments of the Concrete RRties and FPL Materials

St. Lucie County, FL



Goliath Grouper, Snook, and small fish on RRtie Reef

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1 Introduction

This report presents the first annual monitoring surveys of the two new artificial reefs deployed during the summer and fall of 2005 offshore St. Lucie County in Reef Site #2. This work was performed for St. Lucie County (SLC), with funding support from St. Lucie County Board of County Commissioners (SLCBOCC).

The primary objectives of this project were to:

- verify reef locations,
- document biological activity (benthic and pelagic communities,) and
- evaluate engineering performance (stability and condition of the reef materials, scour and settlement, etc.).

Figure 1 shows the location of Site #2, which is also known as the "Nearshore Site" and as the "Fishing Club" Site. This artificial reef area is a 1-mile square area located 6.3 miles SE of Ft. Pierce Inlet, with water depths ranging from 50 feet of water depth on the western boundary to 62 feet deep on the eastern boundary. The bottom is a mix of soft fine & coarse sand with shell fragments, and no natural reefs or hardbottom areas have been located in this area. Over the years the Fort Pierce Sportfishing Club, St. Lucie County, Florida FWC & DOT, and others have utilized this site to deploy artificial reef materials.

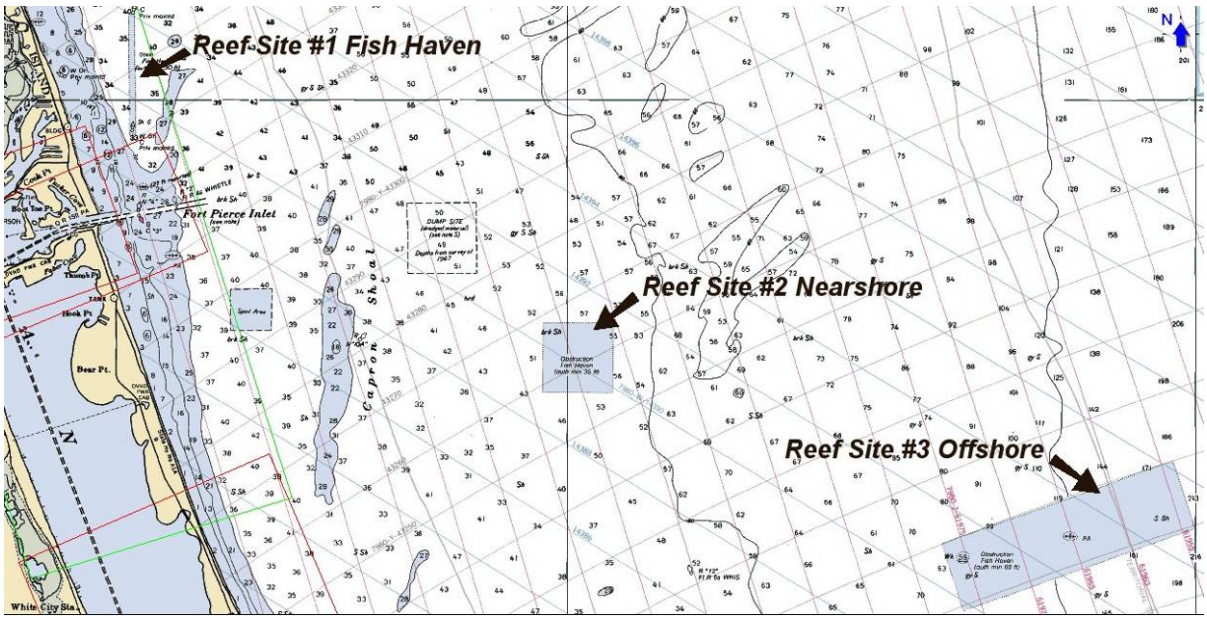

Figure 1. St. Lucie County Offshore Artificial Reef Sites

2 Methodology

The field work was performed by divers using visual techniques plus still and video underwater photography of the reef areas. Dr. Lee Harris and Kerry Dillon performed the field work and report writing for this report, with additional divers employed to assist with the field work. The field work is described as follows:

1. Physical reef structure – diver inspections and measurements were made to determine changes in the reef structure, including scour, settlement, spreading out, and movement of reef components. This was accomplished by repeating survey measurements taken on past monitoring surveys. Reef structure depths were measured using dive computers for measurements of the bottom and both the highest and average depths of the reef materials. The natural bottom depths away from the reefs were compared to the maximum depths adjacent to the reefs to assess scour, and changes in the reef heights were used to assess settlement of the materials. Divers also released buoys on tight lines to the surface at key locations in order to get GPS coordinates with the boat.

2. Biological surveys – data collection methods included roaming diver fish counts to assess the relative fish species diversity and quantities. Benthic assessments were performed by identifying benthic growth on the reef materials. Fish census surveys were conducted using the Roving Diver underwater visual assessment method (Schmitt and Sullivan 1996). Data were recorded on waterproof slates during the reef assessments. Dive data such as date and time, bottom time, depth, and water temperature were recorded. The relative abundance for each species was recorded based on the following categories:
    - 'A' for abundant, (over 100 individuals);
    - 'M' for many (from 11 to 100) individuals;
    - 'F' for few, (from 2 to 10 individuals); and
    - 'S' for a single individual of that species.

3. Photo-documentation – underwater digital still and video cameras were used to document the reefs' condition and observations made during the dives. These were used to compare with still and video photographs taken in prior reef surveys. Representative photographs are included in this report, with a copy of all photographs and video submitted on CD.

Backup photographic equipment was available during each diving day, so that additional equipment was available in the event of equipment failure. Post-deployment reports from prior years were reviewed prior to performing the field work, and slates were prepared in advance with sketches of the dive sites and tables for recording measurements and observations. All data taken during each dive was thoroughly reviewed on the boat following each dive, and data was transferred into field books to assure that correct and complete data were recorded and saved. Data collected from the dive was compared to previous years' data to ensure reasonableness of the data.

3 Reef Locations

The locations for the two reefs are shown in Figure 2. These consist of:

1. one barge of concrete RRties deployed on August 17, 2005
2. one barge of steel and concrete materials deployed on September 30, 2005

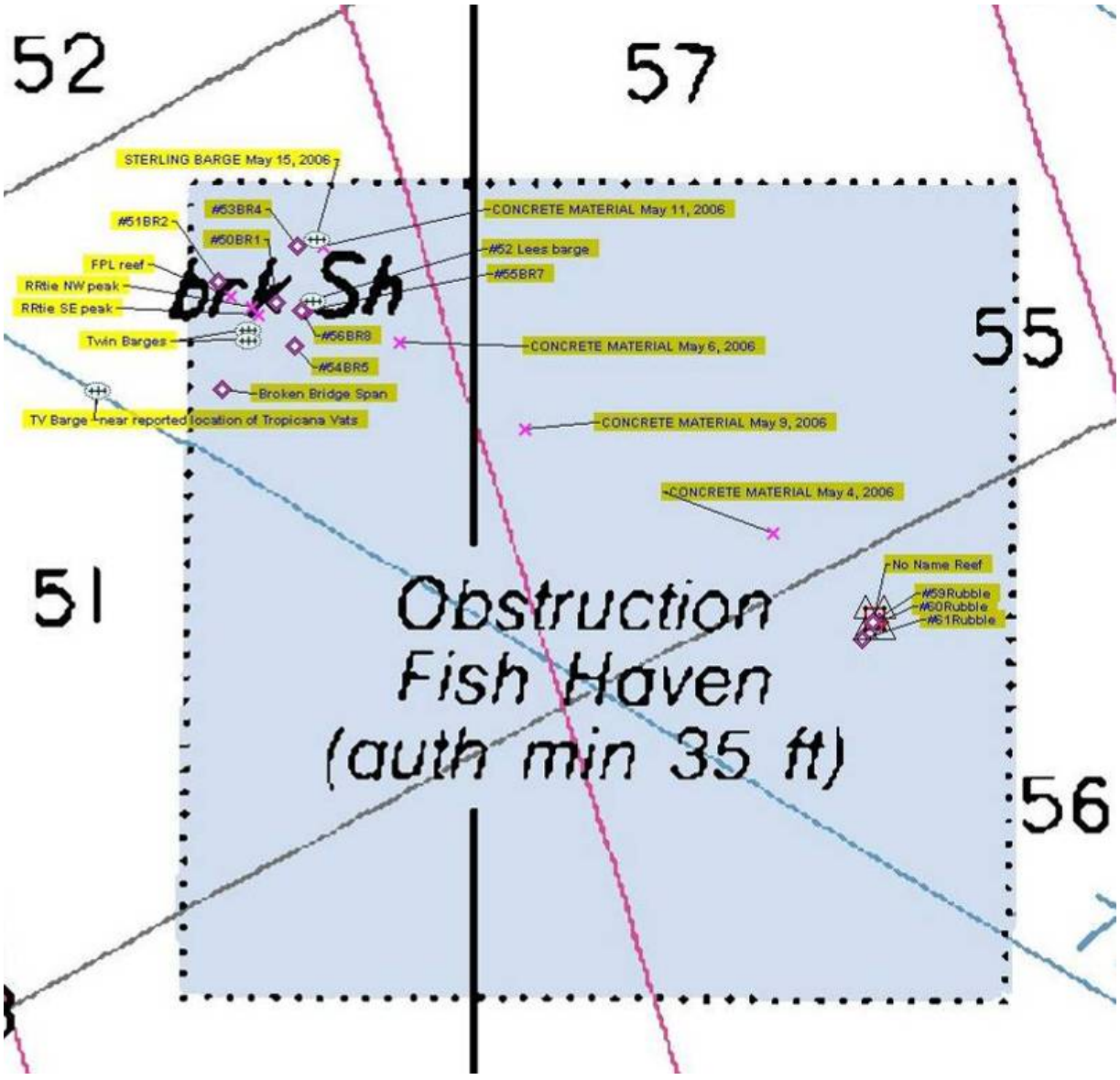

Figure 2. Chart of St. Lucie County Artificial Reef Site #2
2005 and 2006 deployments shown by red "x"; bridge spans by hollow red diamond; barges using traditional wreck symbol; and hollow black triangles for the No Name Reef.

Table 1 summarizes the two deployments that were made in 2005, with all of the other artificial reef sites in the northwest corner of Site #2 summarized in Table 3. These new deployments are filling in gaps between some of the older historical deployments, especially the concrete bridge spans, as shown in Figures 3 and 4.

Table 1. 2005 Deployments in Site #2

Name	*Latitude, N*	*Longitude, W*	*Depth (feet)*	*Top Depth (feet)*	*Deploy Date*	*Materials*
RRtie NW peak	27º 26.675'	080º 10.305'	50	37	17-Aug-05	RRties
RRtie SE peak	27º 26.670'	080º 10.295'	50	39	17-Aug-05	RRties
FPL reef materials	27º 26.689'	080º 10.339'	55	35	30-Sep-05	480 tons

Table 2. Materials in NW Corner of St. Lucie County Artificial Reef Site #2

Materials	***Latitude(N)***	***Longitude(W)***	***Water Depth***	***Top Depth***	***Deploy Date***	***Orientation***
Twin Barges – larger barge,	27º 26.651'	080º 10.312'	55’	49’	June 1995	steel barge, 100x40x8, lies E-W 100º
Twin Barges – smaller barge,	27º 26.638'	080º 10.310'	56’	49’	Jan. 1995	steel barge, 61x31x12, lies NW-SE 150º
#50BR1 - lies E-W	27º 26.682'	080º 10.274'	54’	50’	March 2001	concrete bridge span, lies E-W
#51BR2 -, top slopes down to W	27º 26.708'	080º 10.350'	54’	48’E, 50’W	March 2001	concrete bridge span, lies N-S
#52Lees barge – 90x34x8 lies N-S	27º 26.684'	080º 10.226'	56’	48’	unknown	steel barge lies N-S
#53BR4 northernmost span	27º 26.751'	080º 10.246'	53’	49’	Marc, 2001	concrete bridge span, lies SE-NW
#54BR5 - lies E-W	27º 26.629'	080º 10.251'	54’	50’	March 2001	concrete bridge span, lies E-W
#55BR7 - 2 PVC pipes inside	27º 26.672'	080º 10.235'	55’	50’	March 2001	concrete bridge span, lies E-W
#56BR8 - concrete slab inside	27º 26.671'	080º 10.241'	53’	47’	March 2001	concrete bridge span, lies N-S 190º
#57BR10, lies E-W (same as #55BR7)	27º 26.661'	080º 10.222'	55’	50’	March 2001	concrete bridge span, lies E-W
Broken Bridge Span, E end broken	27º 26.575'	080º 10.346'	54’	48’	March 2001	broken bridge span, lies E-W 80º
TV barge - steel barge remains (near reported site of Tropicana Vats)	27º 26.577'	080º 10.512'	53’	46’	unknown	steel barge remains 68’x44’, lies N-S, tilted down to W
Sterling barge bow	27º 26.743'	080º 10.214'	56’	46’	May 2006	140' steel barge
Sterling barge stern	27º 26.777'	080º 10.229'	56’	46’	May 2006	140' steel barge
Mixed materials	27º 26.750'	080º 10.208'	46’	52’	May 2006	523 tons mixed concrete and steel

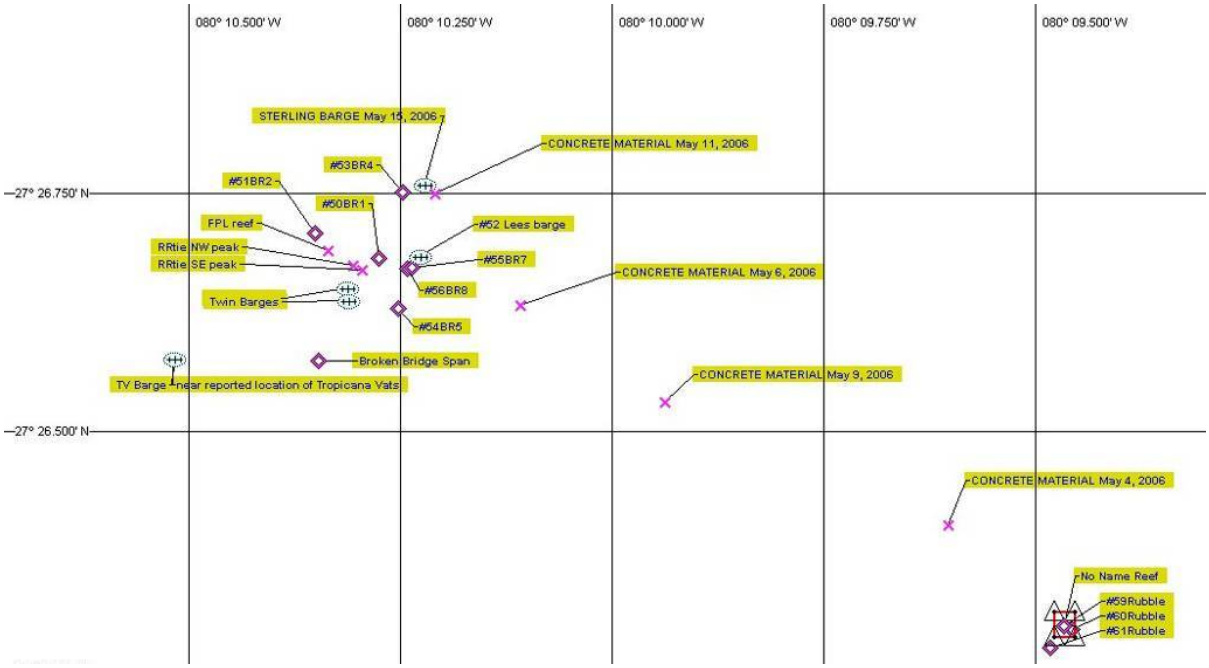

Figure 3. Locations of Historical and New Reef Deployments in Site #2
2005 and 2006 deployments shown by red "x"; bridge spans by hollow red diamond; barges using traditional wreck symbols; and hollow black triangles for the No Name Reef.

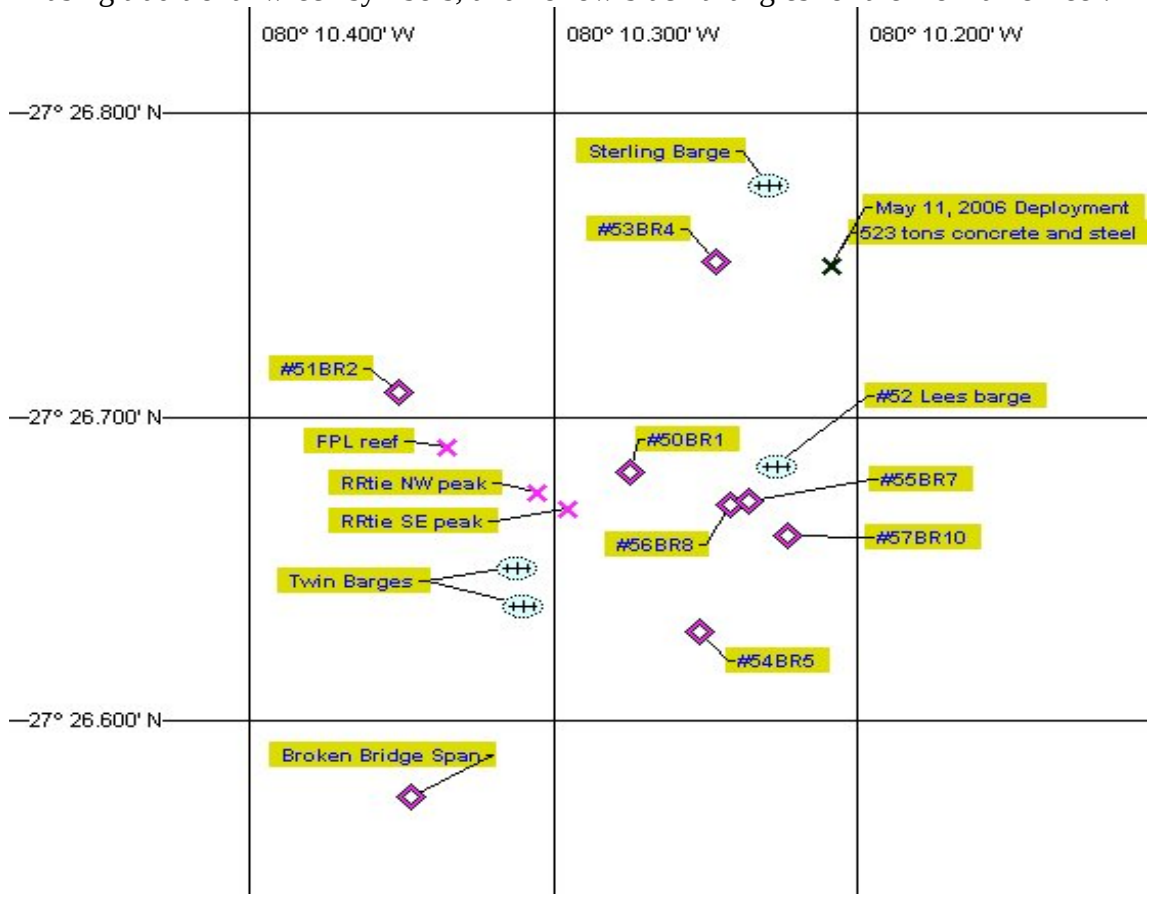

Figure 4. Reef Locations in the NW Corner of Site #2

4 RRtie Reef

4.1 History of the RRtie Reef

This is the first artificial reef to be built in St. Lucie County from donated concrete railroad ties. This reef was built on August 17, 2005 utilizing discarded concrete railroad ties donated by the Florida East Coast Railway Company. Each railroad tie is approximately 11' x 14" x 10" and weighs 600 to 700 lbs. each.

Approximately 500 tons of concrete railroad ties were placed in one deployment from an anchored barge in 50 feet of ocean water. As shown in the photographs in Figures 5 and 6, a front end loader was used to deploy the RR ties from the barge. Approximately half of the units were deployed from the same point on one side of the barge, and the other half from the same point on the other side of the barge, so that two distinct peaks were constructed.

The railroad ties that comprise this reef are interlocked with each other at numerous contact points. The reef structure is quite complex with many interstitial voids in which marine life can hide from predators. Even on bright sunny days with good visibility many dark recesses were observed which required use of a light just to peer into the areas. Underwater photographs of the RRtie Reef within several days of its deployment are shown in Figures 7 to 9, with the two peaks at depths of 37 and 39 feet.

Figure 5. August 17, 2005 Deployment

Figure 6. 2005 Photograph of Deploying RRties from Barge

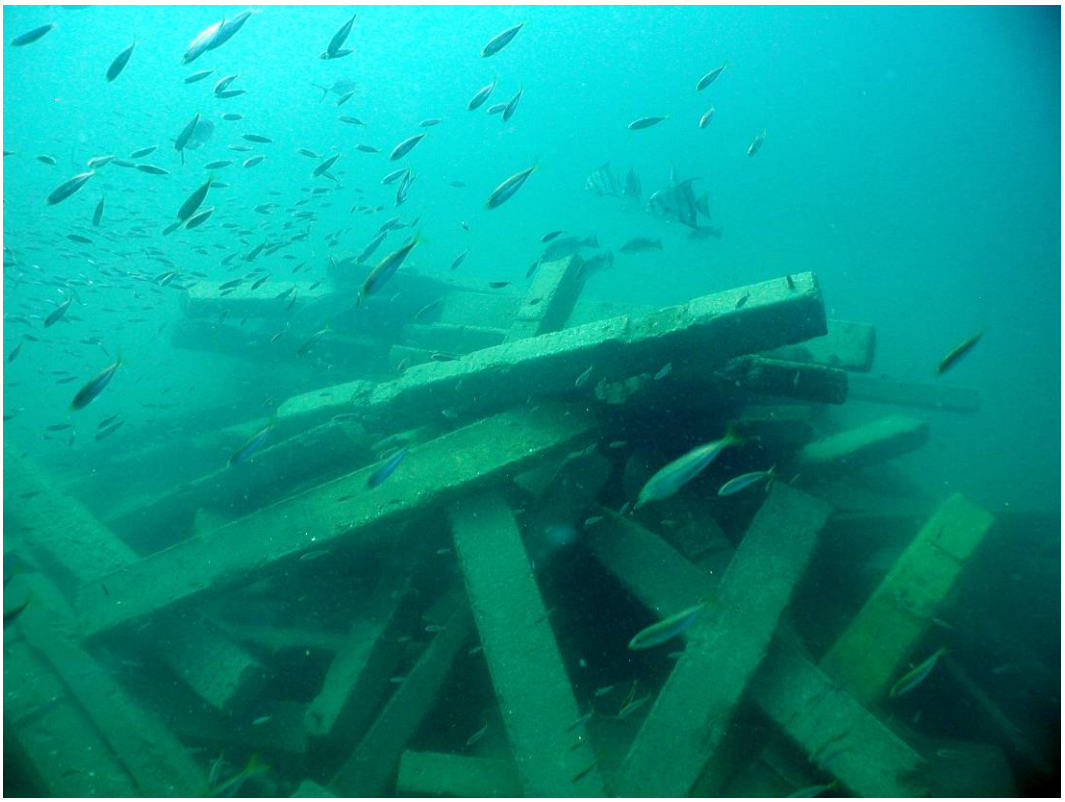

Figure 7. 2005 Photograph of RRties Underwater

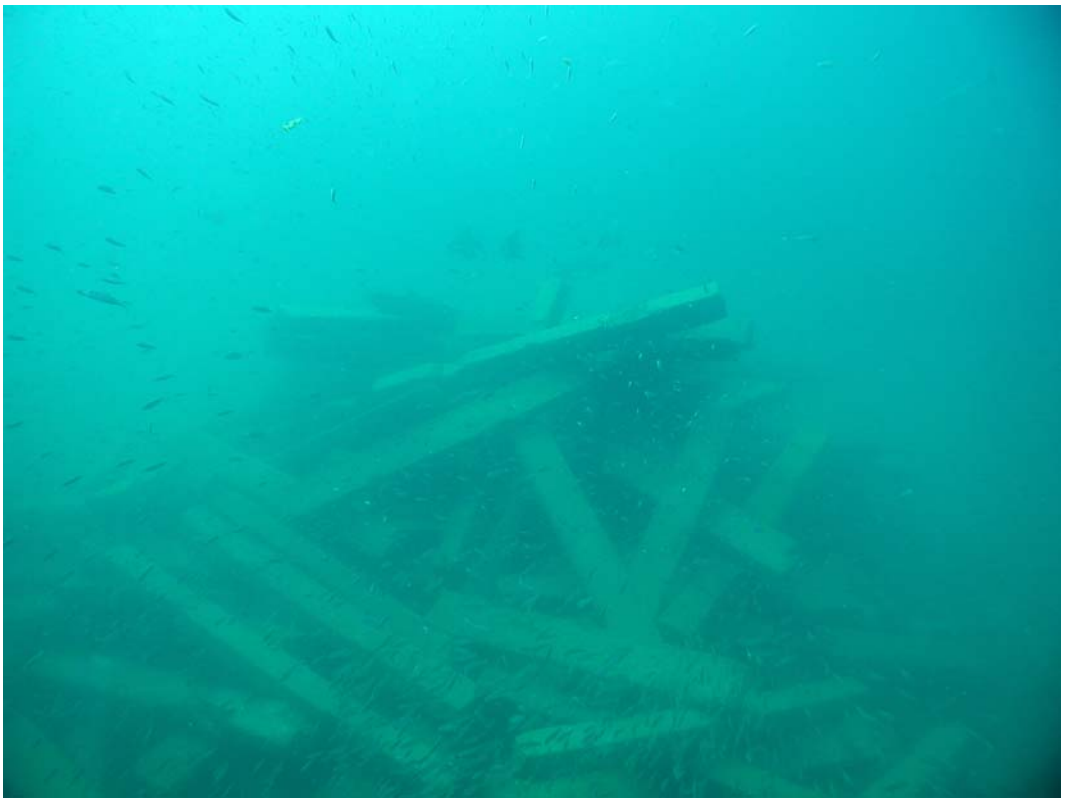

Figure 8. 2005 Photograph of RRtie Pile and fish

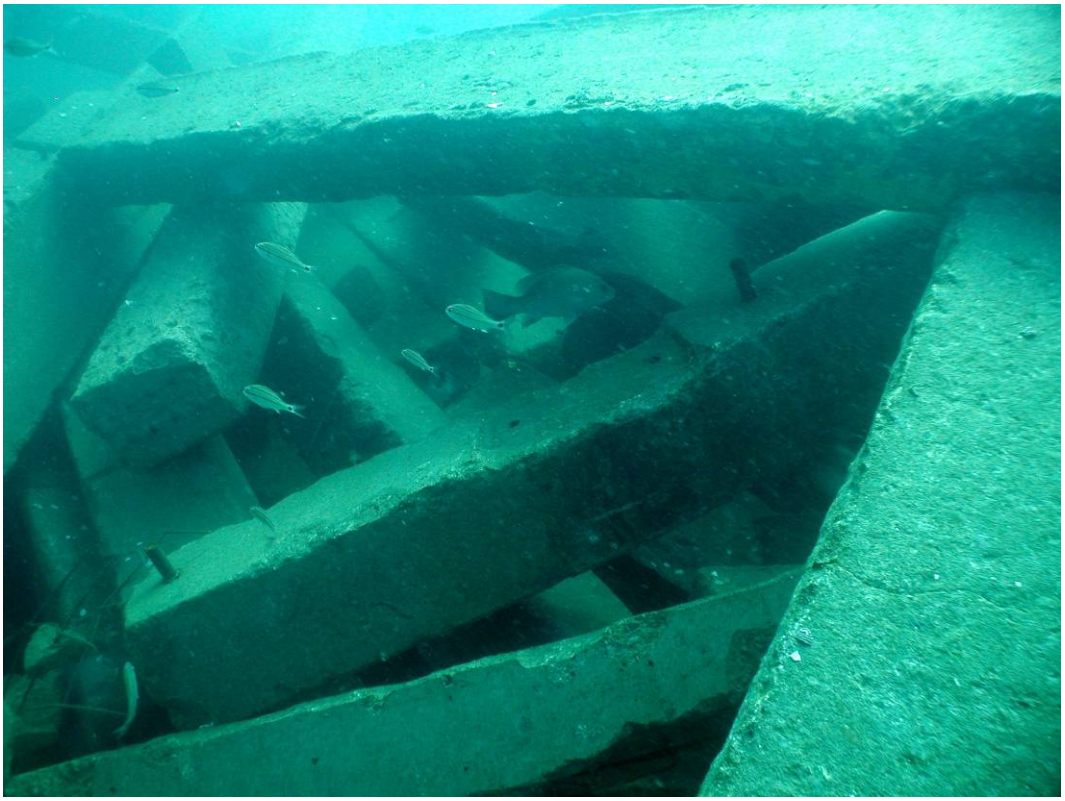

Figure 9. 2005 Photograph of Snapper and Tomtates within RRtie interstices

4.2 2006 Monitoring of the RRtie Reef

The annual monitoring of the RRtie Reef was performed in the fall of 2006, just over one year following its deployment. Using the roaming diver method, the fish census is summarized in Table 3 below for the RRtie Reef. In addition to the fish observed on the RRtie Reef, a porpoise swam into this area and was observed by divers next to the RRtie Reef.

Table 3. 2006 Fish Census for RRtie Reef

Common name	***Scientific name***	***Abundance***	***A(dult) or J(uvenile)***
tomtate grunt	*Haemulon aurolineatum*	A	A
silver porgy	*Diplodus argenteus*	F	A
belted sandfish	*Serranus subligarius*	M	A
sheepshead	*Archosargus probatocephalus*	F	A
porkfish	*Anisotremus virginicus*	M	A & J
beaugregory	*Stegastes leucostictus*	F	A
black sea bass	*Centropristis striata*	M	A & J
pigfish	*Orthopristis chrysoptera*	F	A
cubbyu	*Equetus umbrosus*	F	A & J
great barracuda	*Sphyraena barracuda*	F	A
gray snapper	*Lutjanus griseus*	M	A
sergeant major	*Abudefduf saxatilis*	F	A
bandtail puffer	*Sphoeroides spengleri*	F	A
blue runner	*Caranx crysos*	M	A
southern sennet	*Sphyraena picudilla*	F	A
bottlenose dolphin	*Tursiops truncatus*	S	A
Atlantic tripletail	*Lobotes surinamensis*	S	A
striped croaker	*Bairdiella sanctaeluciae*	M	A

Representative underwater photographs of the RRtie Reef taken in the fall of 2006 are shown in Figure 10. The visibility was not as good during the fall of 2006 as it was during the post-deployment dives in 2005, so that the photographs from 2006 are not as clear as in 2005. However, the benthic growth and fish inhabiting the RRtie Reef in 2006 was very impressive, as shown in Table 3 above and the following photographs.

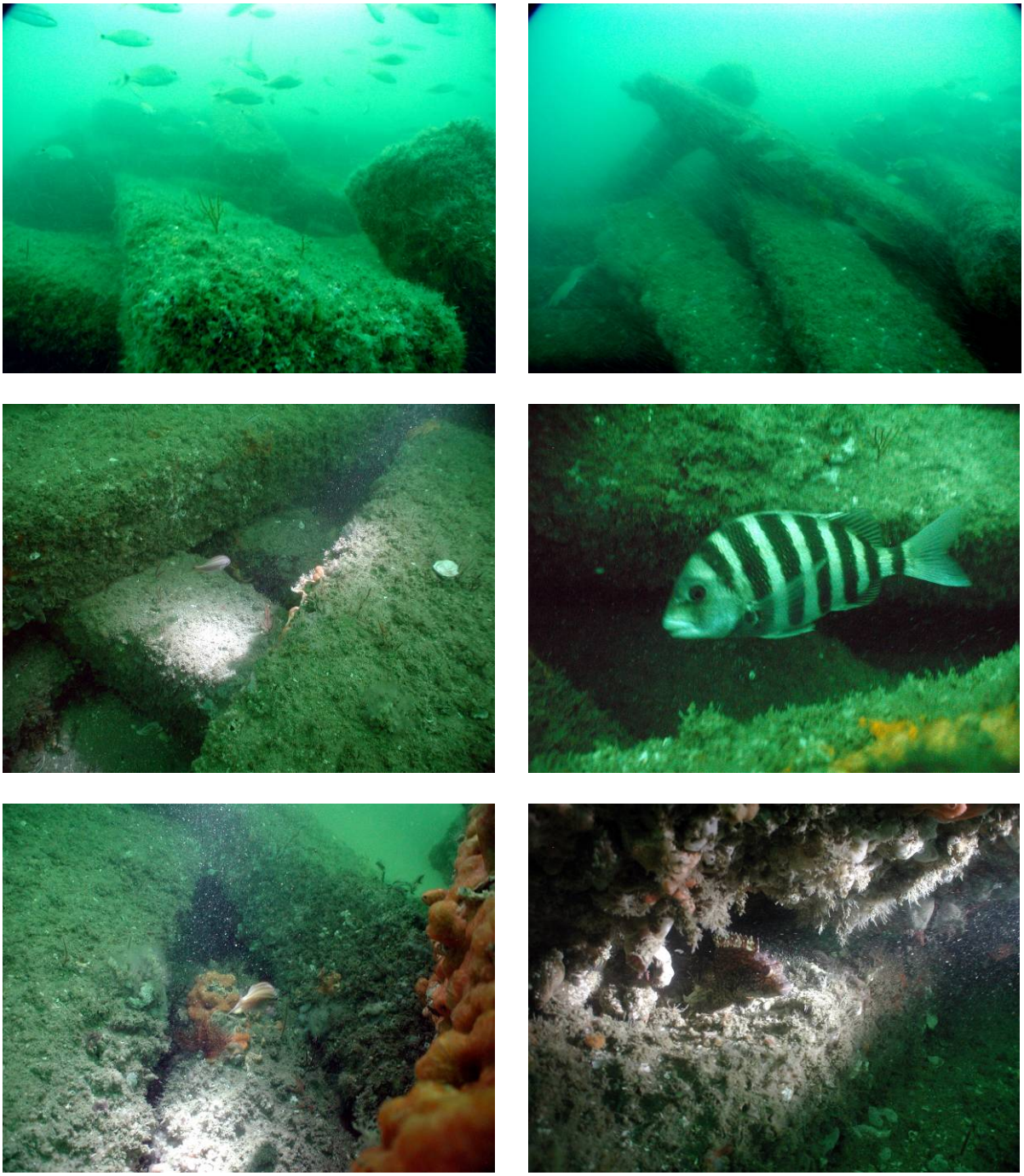

Figure 10. 2006 Photographs of RRtie Reef

The RRtie materials lie in a SE to NW orientation, with two distinct peaks of stacked RRties separated by a valley with some scattered ties. During the monitoring dives in the fall 2006, the maximum bottom depth at the RRtie Reef Site was measured as 50 feet, with the minimum depth at the reef crest measured as 37 feet, for a maximum reef height above the bottom of 13 feet. Little scouring or settlement of the reef was observed, and the materials were observed to be stable and covered with benthic growth, as shown in the photographs above.

5 FPL Reef

5.1 History of the FPL Reef

This reef was constructed on September 30, 2005 utilizing discarded steel and concrete pieces donated by the Florida Power and Light Company. These materials were of various sizes and shapes. Approximately 480 tons of materials were placed in one deployment from an anchored barge in 55 feet of ocean water.

The materials that comprise this reef are interlocked with each other at numerous contact points. The reef structure is quite complex with many interstitial voids in which marine life can hide from predators. Even on bright sunny days with good visibility many dark recesses were observed which required use of a light just to peer into the areas.

5.2 2006 Monitoring of the FPL Reef

The annual monitoring of the FPL Reef was performed in the fall of 2006, one year following its deployment. Using the roaming diver method, the fish census is summarized in Table 4 below for the RRtie Reef.

Table 4. 2006 Fish Census for RRtie Reef

Common name	***Scientific name***	***Abundance***	***A(dult) or J(uvenile)***
tomtate grunt	*Haemulon aurolineatum*	A	A
silver porgy	*Diplodus argenteus*	F	A
blue runner	*Caranx crysos*	M	A
gray snapper	*Lutjanus griseus*	M	A
porkfish	*Anisotremus virginicus*	M	A & J
beaugregory	*Stegastes leucostictus*	F	A
black sea bass	*Centropristis striata*	M	A & J
belted sandfish	*Serranus subligarius*	M	A
cubbyu	*Equetus umbrosus*	M	A & J
great barracuda	*Sphyraena barracuda*	F	A
sheepshead	*Archosargus probatocephalus*	M	A
bank sea bass	*Centropristis ocyurus*	F	A
bandtail puffer	*Sphoeroides spengleri*	F	A
goliath grouper	*Epinephelus itajara*	F	A
baitfish (3 types)	difficult to tell, N/A	A	A

Representative underwater photographs of the FPL Reef taken in the fall of 2006 are shown in Figure 11. The visibility was not as good during the fall of 2006 as it was during the post-deployment dives in 2005, so that the photographs from 2006 do not look as clear as in 2005. However, the benthic growth and fish inhabiting the FPL Reef in 2006 was very impressive, as shown in Table 4 above and the following photographs.

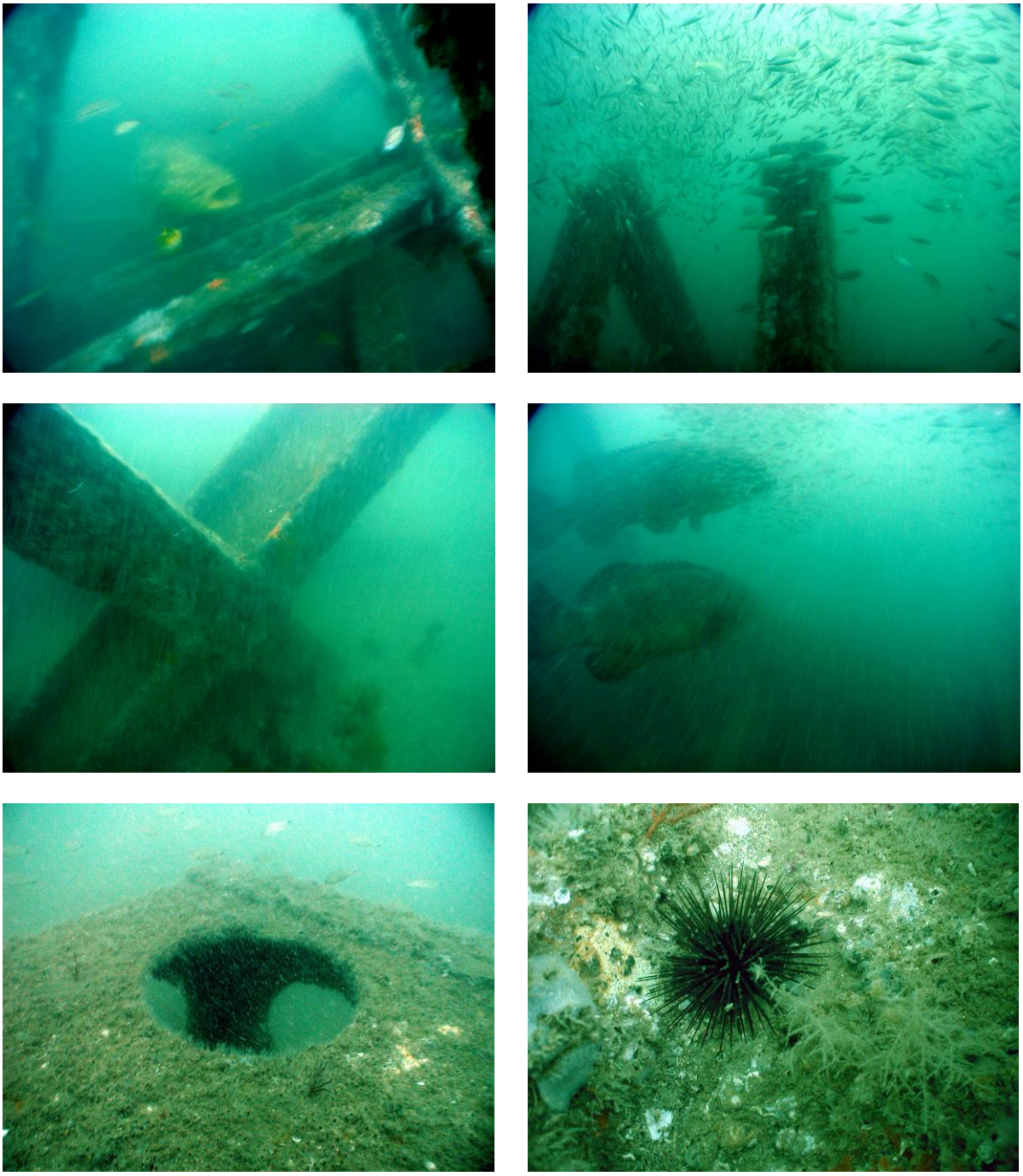

Figure 11. 2006 Photographs of FPL Reef

The FPL materials lie in a roughly SE to NW orientation, with clusters of stacked materials and some scattered pieces. During the monitoring dives in the fall 2006, the maximum bottom depth at the FPL Reef Site was measured as 57 feet, with the minimum depth at the reef crest measured as 39 feet, for a maximum reef height above the bottom of 18 feet. Little scouring or settlement of the reef was observed, and the materials were observed to be stable and covered with benthic growth, as shown in the photographs above.

6 Summary

The RRtie reef, FPL reef, and the nearby barges, bridge spans, and other reef s in the NW corner of the Nearshore Reef Site #2 are functioning as very healthy reefs, with abundant habitat for benthic and pelagic species. Benthic plants and animals include algae, sponges, anemones, crustaceans, gastropods, bryozoans, urchins, mollusks, tunicates, hydroids, etc. Tropical and important sport fishes including snook, groupers, snappers, sheepshead, etc. are abundant on these reefs. This area is very popular for fishing and diving, as well as the environmental enhancement that the reefs provide.

Although these two reefs were constructed during August and September of 2005 after the two major hurricanes in September 2004 (Frances and Jeanne), Hurricane Wilma affected this area during October 2005, shortly after these two new reefs were constructed. Wave data from the wave gage offshore Sebastian Inlet for the past 10 years is shown in Figure 12, which indicates that these three hurricanes produced the largest waves experienced by the central east coast of Florida during that time period. Wind and current speeds and directions measured offshore Sebastian Inlet during Hurricane Wilma are shown in Figure 13.

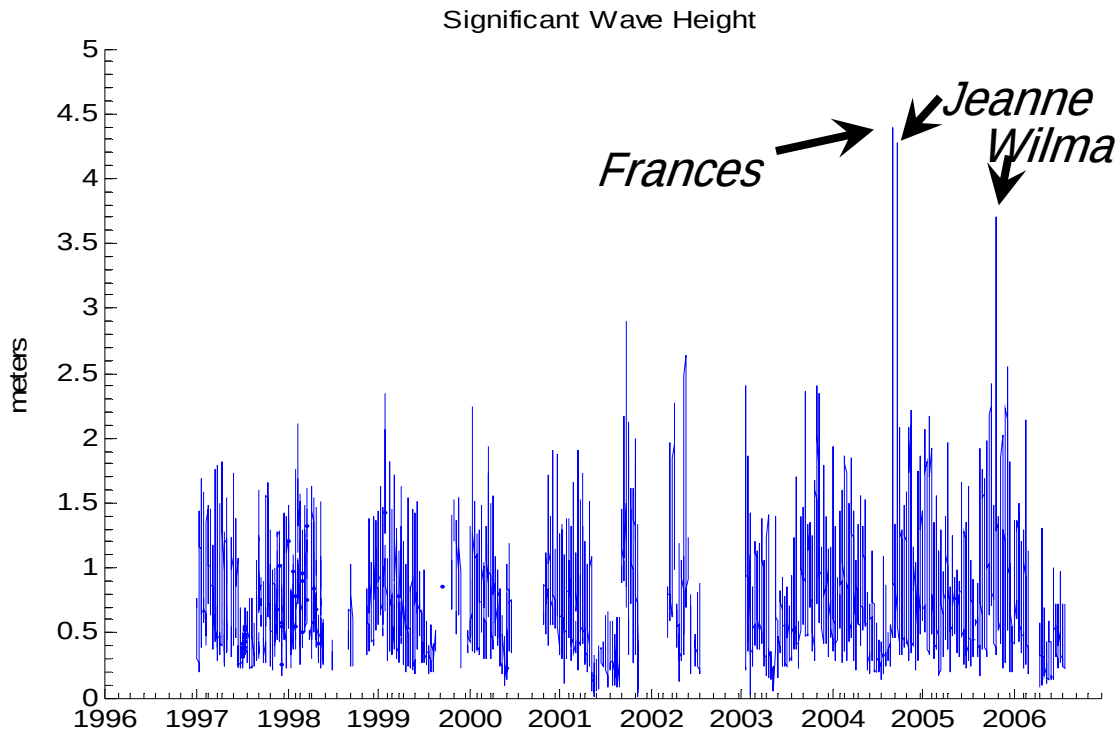

Figure 12. Significant Wave Heights Offshore Sebastian Inlet
(Harris and Flanary, 2007)

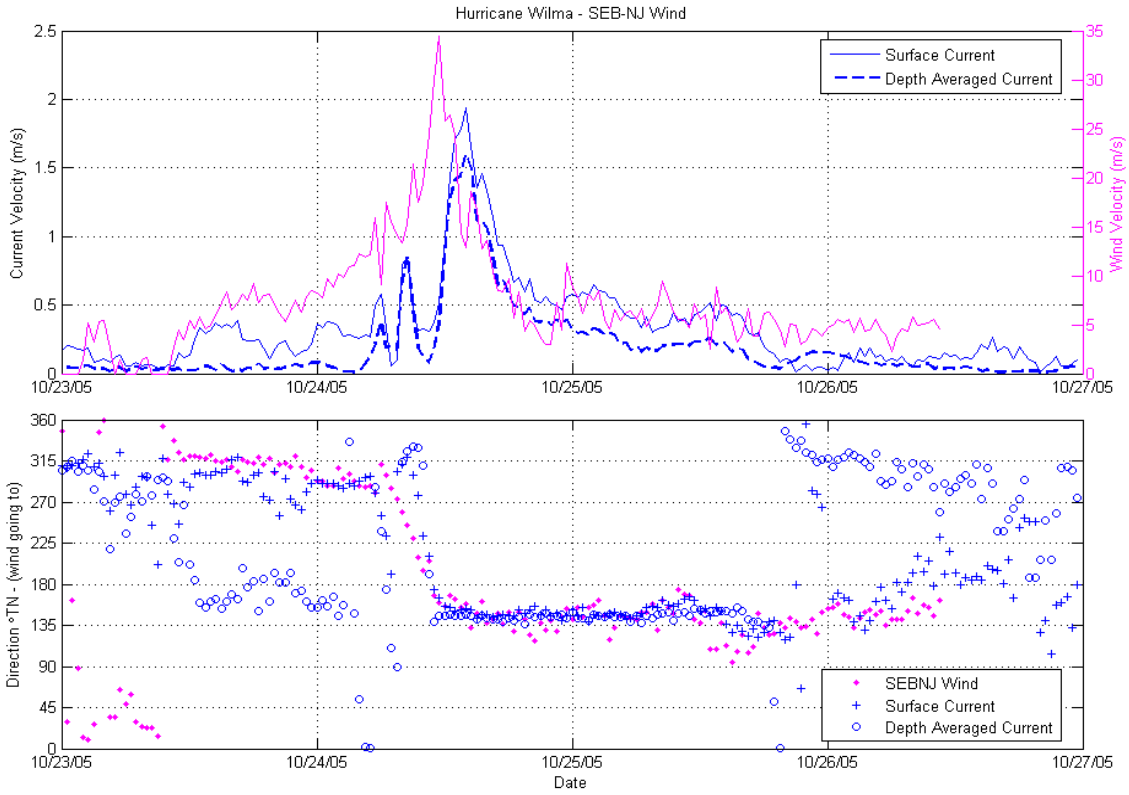

Figure 13. Wind (shown in pink) and Current (shown in blue) Speeds and Directions Offshore Sebastian Inlet during Hurricane Wilma
(Harris and Flanary, 2007)

The 2006 annual monitoring performed in the fall of 2006 showed that these reefs remained stable, even after Hurricane Wilma. Some spreading out and settlement of the reef materials was observed, but no significant changes in the overall reef structures were observed, other than slight settlement and increases in the water depths above the reef crests, as summarized in Table 5.

Table 5. RRtie and FPL Reef Changes
(All measurements in feet using dive computers).

Reef	*Original Depth*	*Original Top Depth*	*Original Reef Height*	*Fall 2006 Depth*	*Fall 2006 Top Depth*	*Fall 2006 Reef Height*	*Change in Reef Height*
RRtie NW peak	50	37	13	50	40	10	-3
RRtie SE peak	50	39	11	51	42	9	-2
FPL reef	55	35	20	57	39	18	-2