

# 2007 Annual Monitoring

## Four Artificial Reef Sites Deployed in May 2006

### Offshore St. Lucie County, FL



*June 12, 2007 Photo of Snook, Porkfish, and Sheepshead on May 11, 2006 Deployment*

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## 1 Introduction

This report presents the first annual monitoring surveys of the four new artificial reefs deployed during May 2006 offshore St. Lucie County in Reef Site #2. This work was performed for St. Lucie County (SLC), with funding support from the Florida Fish and Wildlife Conservation Commission (FWC) and the 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 locations of the three artificial reef sites offshore of St. Lucie County. The four reefs deployed in May 2006 were all placed in 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 sand and 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.

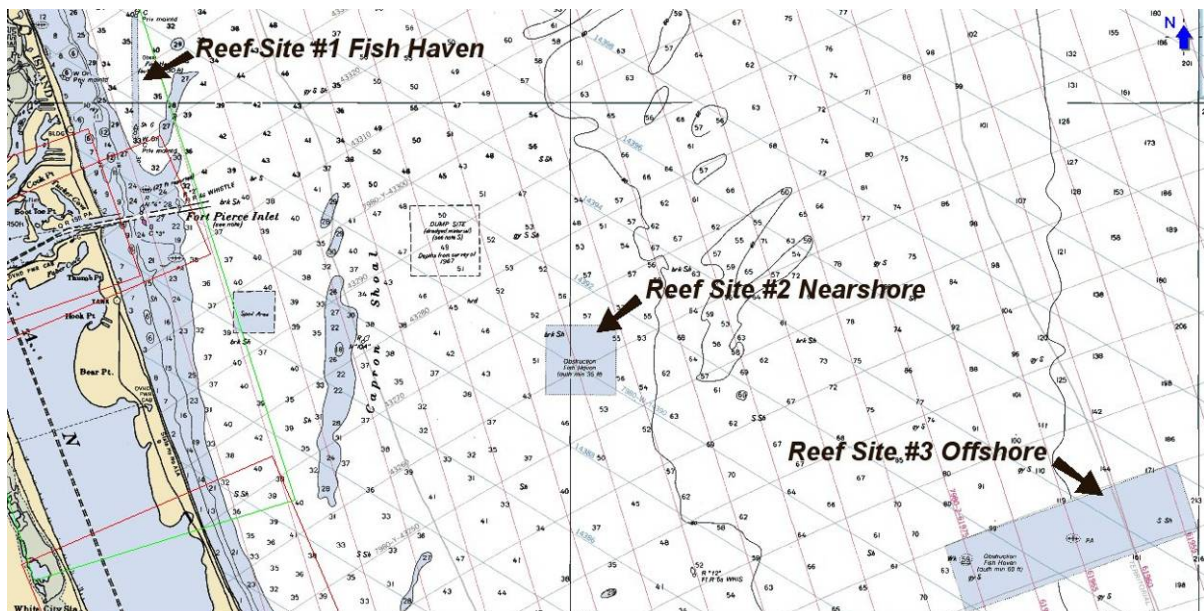


Figure 1. St. Lucie County Offshore Artificial Reef Sites

## 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. Distance measurements of the horizontal extent of the reefs were made using a tape measure. 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. 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 numbers observed, which can be described by 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.

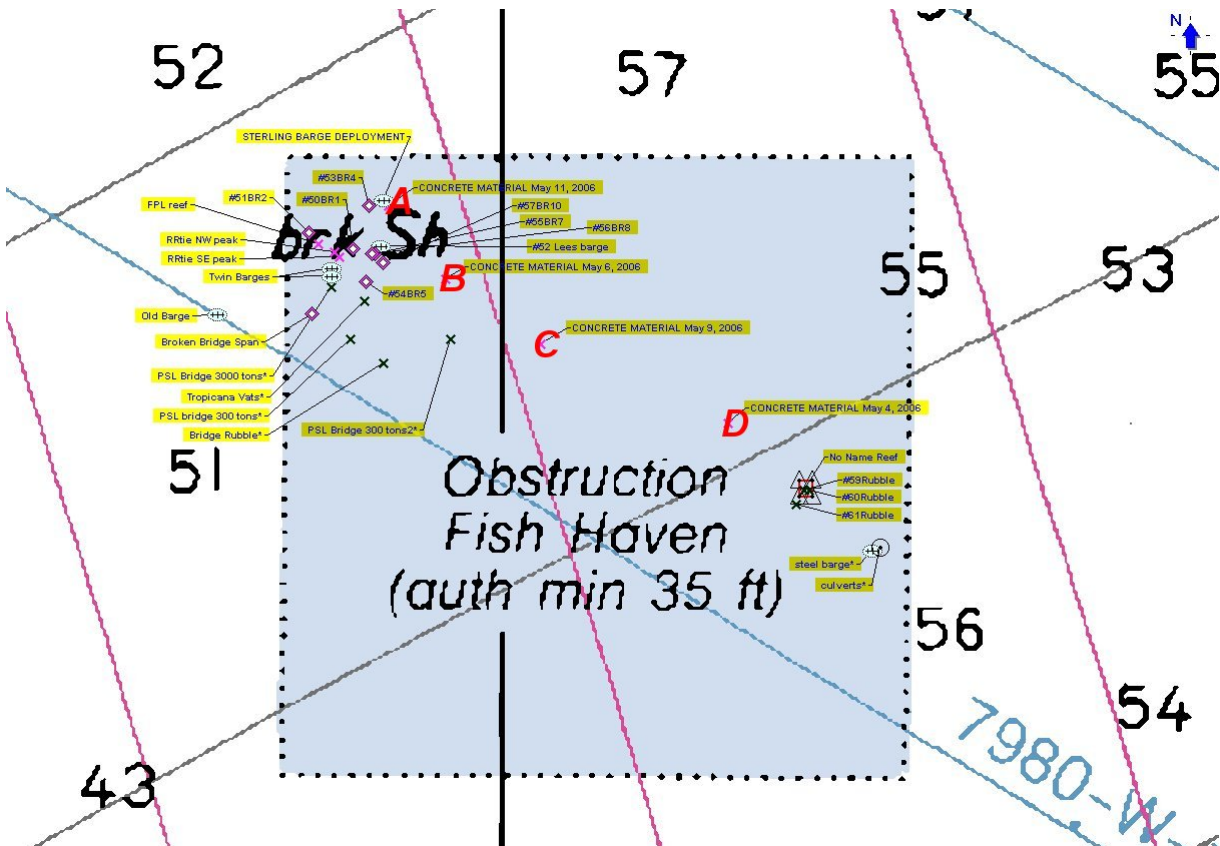
Backup photographic equipment was available during each diving day, so that additional equipment was available in the event of equipment failure. Post-deployment reports from prior years were reviewed prior to performing the field work, and slates were prepared in advance with sketches of the dive sites 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 four reefs are shown on the chart in Figure 2, indicated by letters A through D, numbered from NW to SE. These consist of (in chronological order of the deployments):

1. one barge of concrete dock piles deployed on May 4, 2006 designated as Reef Site "D"
2. one barge of concrete dock piles deployed on May 6, 2006 designated as Reef Site "B"
3. one barge of mixed concrete materials deployed on May 9, 2006 designated as Reef Site "C"
4. one barge of mixed concrete materials deployed on May 11, 2006 designated as Reef Site "A" (located just SE of the Civic center Reef deployed in Jan-Feb 2007).

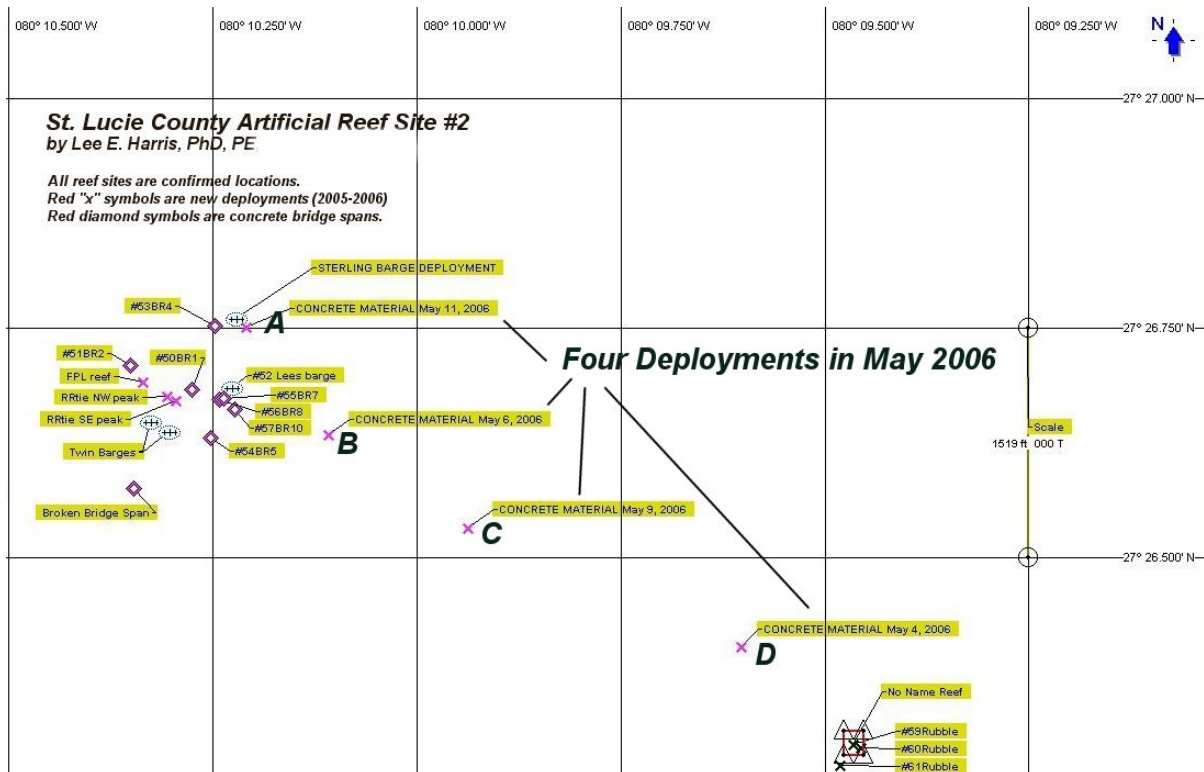


**Figure 2. Chart of St. Lucie County Artificial Reef Site #2**  
The four artificial reef sites deployed in May 2006 are numbered A-D.

Table 1 presents the deployment dates, quantities and types of materials, locations, water depth and depth of the crest of the reef measured immediately after deployment. This data is used to compare with the locations and measurements in the annual survey performed for this study.

Table 1. Materials and Locations of the Four May 2006 Deployments							
	Deployment Date	Materials	Latitude, N	Longitude, W	Depth (feet)	Top Depth (feet)	Quantity
A	11-May-06	Mixed	27° 26.750'	080° 10.208'	52	46	523 tons
B	6-May-06	Dock piles	27° 26.633'	080° 10.107'	55	572 tons	
C	9-May-06	Mixed	27° 26.531'	080° 09.936'	57	50	515 tons
D	4-May-06	Dock piles	27° 26.402'	080° 09.601'	54	46	490 tons
						TOTAL =	2100 tons

Figure 3 shows a chart of the four artificial reef locations with the grids for latitude and longitude. Table 2 summarizes all of the known artificial reef sites in the St. Lucie County Nearshore Reef Site #2. Figures 1 and 3 shows that the four reefs constructed in May 2006 are located in a NW to SE line from the concentrated reefs located in the NW corner of Site #2 to the reef sites located at the east side of the center of Site #2.



**Figure 3. Chart of May 2006 St. Lucie County Artificial Reef Deployments**  
 The four artificial reef sites deployed in May 2006 are numbered A-D from NW to SE.

<b>Table 2. Materials in St. Lucie County Artificial Reef Site #2</b>						
<i>Name</i>	<i>Latitude(N)</i>	<i>Longitude(W)</i>	<i>Water Depth</i>	<i>Top Depth</i>	<i>Deploy Date</i>	<i>Materials and Orientation</i>
Twin Barges – larger barge,	27° 26.651'	080° 10.312'	55'	49'	June 1995	steel barge, 100x40x8, lies E-W 100°
Twin Barges – smaller barge,	27° 26.638'	080° 10.310'	56'	49'	Jan. 1995	steel barge, 61x31x12, lies NW-SE 150°
#50BR1 - lies E-W	27° 26.682'	080° 10.274'	54'	50'	March 2001	concrete bridge span, lies E-W
#51BR2 -, top slopes down to W	27° 26.708'	080° 10.350'	54'	48'E, 50'W	March 2001	concrete bridge span, lies N-S
#52Lees barge – 90x34x8 lies N-S	27° 26.684'	080° 10.226'	56'	48'	unknown	steel barge lies N-S
#53BR4 northernmost span	27° 26.751'	080° 10.246'	53'	49'	Marc, 2001	concrete bridge span, lies SE-NW
#54BR5 - lies E-W	27° 26.629'	080° 10.251'	54'	50'	March 2001	concrete bridge span, lies E-W
#55BR7 - 2 PVC pipes inside	27° 26.672'	080° 10.235'	55'	50'	March 2001	concrete bridge span, lies E-W
#56BR8 - concrete slab inside	27° 26.671'	080° 10.241'	53'	47'	March 2001	concrete bridge span, lies N-S 190°
#57BR10, lies E-W (same as #55BR7)	27° 26.661'	080° 10.222'	55'	50'	March 2001	concrete bridge span, lies E-W
Broken Bridge Span, E end broken	27° 26.575'	080° 10.346'	54'	48'	March 2001	broken bridge span, lies E-W 80°
TV barge - steel barge remains (near reported site of Tropicana Vats)	27° 26.577'	080° 10.512'	53'	46'	unknown	steel barge remains 68'x44', lies N-S, tilted down to W
Sterling barge bow	27° 26.743'	080° 10.214'	56'	46'	May 2006	140' steel barge
Sterling barge stern	27° 26.777'	080° 10.229'	56'	46'	May 2006	140' steel barge
No Name Reef	27° 26.311'	080° 09.470'	58'	47'	mid 1990's	FPL plant mixed concrete and steel materials
Civic Center Reef	27° 26.743'	080° 10.214'	56'	35'	Jan 2007	555 tons concrete Civic Center materials
Civic Center Reef	27° 26.777'	080° 10.229'	56'	31'	Feb 2007	539 tons concrete culverts and mixed materials



## 4 History of the May 2006 Deployments

Approximately 500 tons of concrete materials were deployed in each of the four reef sites. The first two deployments (May 4 and 6, Sites D and B) consisted of concrete pilings from the Fort Pierce City Marina, which had been removed due to damages by the 2004 hurricanes. Figure 4 shows the barge deploying the dock piles on May 4, 2006 and Figure 5 shows the May 6, 2006 deployment.



**Figure 4. May 4, 2006 Deployment – Reef Site D**



**Figure 5. May 6, 2006 Deployment – Reef Site B**

The third and fourth deployments consisted of mixed concrete materials, including pilings, slabs, culverts, and other construction debris. St. Lucie County has been collecting these clean concrete construction materials at its Harbour Point area, for deployment as artificial reefs. This provides enhancement of the marine environment, instead of burying the materials in land fills. Figures 6 and 7 show the barges being unloaded offshore during the May 9 and May 11 deployments.



**Figure 6. May 9, 2006 Deployment – Reef Site C**



**Figure 7. May 11, 2006 Deployment – Reef Site A**

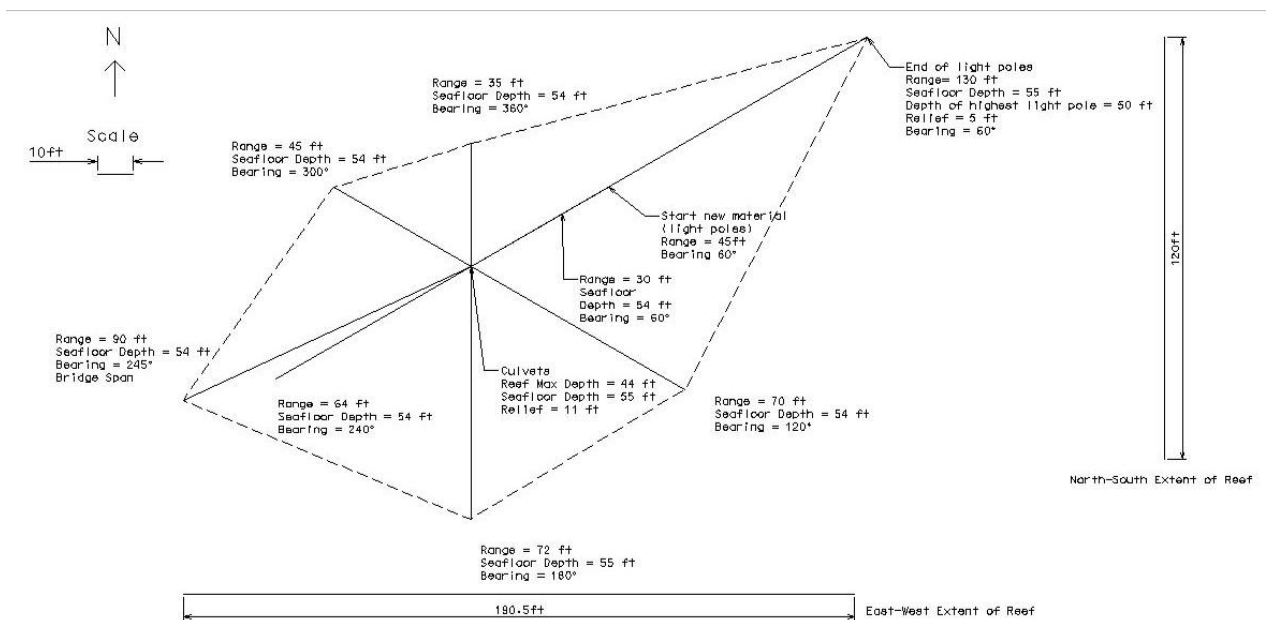
### 5 2007 First Annual Monitoring

The annual monitoring of the four deployments was performed in June 2007, 13 months following its deployment. The monitoring dates and times, locations of maximum reef height, water depth, top reef depth, and relief (water depth minus top depth) are summarized in Table 3. Using the roaming diver method, the fish census is summarized in the following Tables 4-7 for the four reef sites.

	Monitor Date	Monitor Time, EDT	Highest Point Latitude, N	Highest Point Longitude, W	Depth (feet)	Top Depth (feet)	Relief (feet)
A	12-June-07	1330-1530	27° 26.746'	080° 10.228'	55	44	11
B	12-June-07	1100-1300	27° 26.626'	080° 10.111'	54	44	10
C	13-June-07	1200-1300	27° 26.536'	080° 09.937'	55	45	10
D	13-June-07	0930-1100	27° 26.400'	080° 09.600'	56	46	10

#### 5.1 Reef Site A – Deployed May 11, 2006

This reef was constructed in close proximity to the Sterling Barge, which was also deployed in May 2006. In January and February 2007 two barge loads of concrete materials were placed on top of the Sterling Barge, and that reef site is now known as the Civic Center Reef. The Civic Center Reef is approximately 100 feet NW of Reef Site A. One of the concrete bridge spans is also located close to Reef Site A, located 90 feet at a bearing of 245 degrees SW of Reef Site A. Figure 8 shows the measurements taken during the June 12, 2007 survey, and fish census data are shown in Table 4.



**Figure 8. Underwater Survey of Reef Site A (deployed May 11, 2006)**

<b>Common name</b>	<b>Scientific name</b>	<b>Abundance</b>	<b>A(dult) or J(uvenile)</b>
1. Atlantic spadefish	<i>Chaetodipterus faber</i>	2	A
2. Baitfish (2") Round scad	<i>Decapterus punctatus</i>	100's	J
3. Bandtail puffer	<i>Sphoeroides spengleri</i>	2	J
4. Beaugregory	<i>Stegastes leucostictus</i>	10+	J
5. Belted sandfish	<i>Serranus subligarius</i>	10+	J
6. Black margate	<i>Anisotremus surinamensis</i>	4	A
7. Black seabass	<i>Centropristis striata</i>	10+	J+A
8. Cubbyu	<i>Equetus umbrosus</i>	4	A
9. Goliath grouper	<i>Epinephelus itajara</i>	3	A
10. Great barracuda	<i>Sphyraena barracuda</i>	7	A
11. Lane snapper	<i>Lutjanus synagris</i>	2	A
12. Black grouper	<i>Mycteroperca bonaci</i>	1	J
13. Pigfish	<i>Orthopristis chrysoptera</i>	100's	J+A
14. Porkfish	<i>Anisotremus virginicus</i>	10+	J+A
15. Queen angelfish	<i>Holocanthus ciliaris</i>	1	J
16. Sheepshead	<i>Archosargus probatocephalus</i>	10+	A
17. Sheepshead porgy	<i>Calamus penna</i>	5	A
18. Slippery dick	<i>Halichoeres bivittatus</i>	7	A
19. Snook	<i>Centropomus undecimalis</i>	10+	A (med size)
20. Spiny lobster	<i>Panulirus argus</i>	1	A
21. Spotted eagle ray	<i>Aetobatus narinari</i>	3	A
22. Spotted soapfish	<i>Rypticus subbifrenatus</i>	1	J
23. Striped croaker	<i>Bairdiella sanctaeluciae</i>	1	J
24. Tomtate	<i>Haemulon aurolineatum</i>	10's	J+A

As shown in Figure 8, the N-S extent of Reef Site A is 120 feet and the E-W extent is 190 feet. The longest dimension of the reef is 220 feet in a NE-SW orientation.

Reef Site A was constructed of mixed concrete materials, as shown on the barge photograph in Figure 7. The reef materials include large concrete culverts, long light poles, shorter pilings and other concrete materials. The concrete culverts stacked well, forming the highest part of the reef at 11 feet above the bottom (45' depth). Many of the longer poles and pilings are located about 45 to 130 feet NE of the culverts, with a maximum height of 7 feet (47' depth).

Representative underwater photographs of Reef Site A taken on 12 June 2007 are shown in Figure 9. The visibility was unusually good, so that the photographs clearly show the reef structure with benthic and pelagic marine life.





**Figure 9. June 2007 Underwater Photographs of Reef Site A**

### **5.2 Reef Site B – Deployed May 6, 2006**

This reef was constructed SE of Reef Site A. It was constructed of concrete dock piles, as shown on the barge photograph in Figure 5. Figure 10 shows the measurements taken during the June 12, 2007 survey, and the fish census is in Table 5.



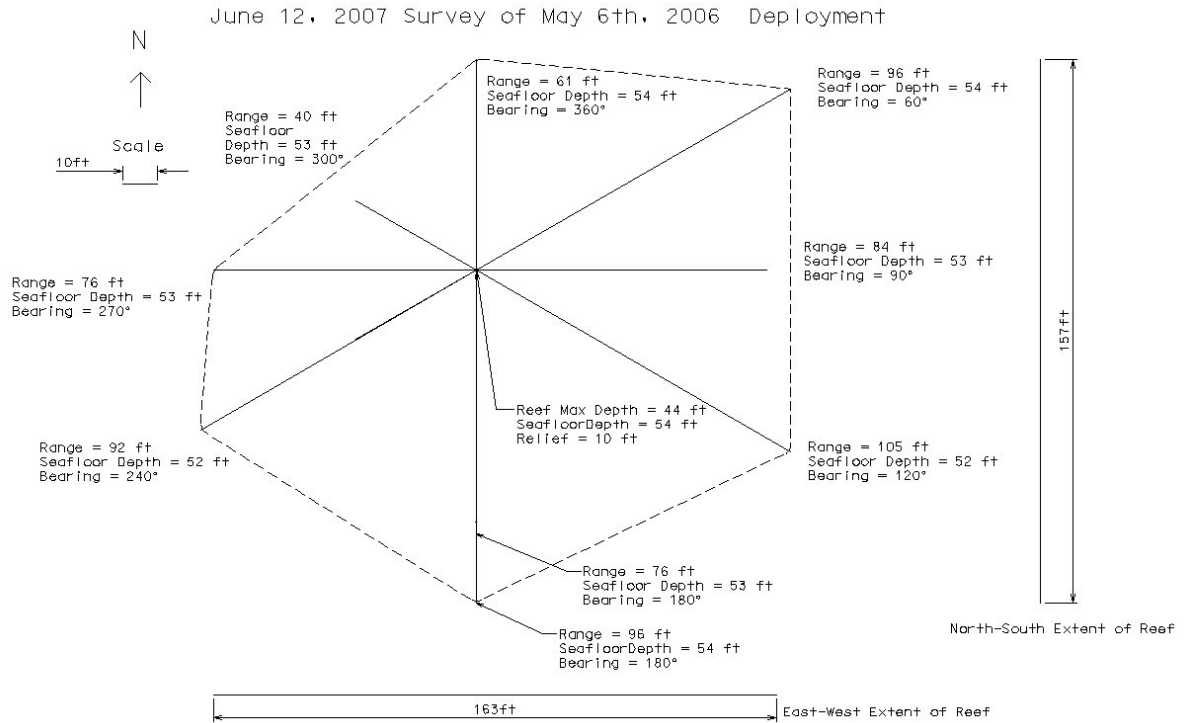


Figure 10. Underwater Survey of Reef Site B (deployed May 6, 2006)

**Table 5. 2007 June 12 Fish Census for Reef Site B**

<b>Common name</b>	<b>Scientific name</b>	<b>Abundance</b>	<b>A(dult) or J(uvenile)</b>
1. Atlantic spadefish	<i>Chaetodipterus faber</i>	2	A
2. Baitfish Round scad	<i>Decapterus punctatus</i>	100's	A- 3" Long
3. Bandtail puffer	<i>Sphoeroides spengleri</i>	3	J
4. Beaugregory	<i>Stegastes leucostictus</i>	5	J
5. Belted sandfish	<i>Serranus subligarius</i>	5	J
6. Black margate	<i>Anisotremus surinamensis</i>	4	A
7. Black seabass	<i>Centropristis striata</i>	10	A+J
8. Blue runner	<i>Caranx crysos</i>	7	A
9. Cubbyu	<i>Equetus umbrosus</i>	3	A+J
10. Goliath grouper	<i>Epinephelus itajara</i>	2	A
11. Gray snapper	<i>Lutjanus griseus</i>	7	A
12. Great barracuda	<i>Sphyraena barracuda</i>	3	A
13. Lane snapper	<i>Lutjanus synagris</i>	5	A
14. Pigfish	<i>Orthopristis chrysoptera</i>	100's	A+J
15. Porkfish	<i>Anisotremus virginicus</i>	10+	A
16. Queen angelfish	<i>Holocanthus ciliaris</i>	1	A
17. Sheepshead	<i>Archosargus probatocephalus</i>	7	A
18. Sheepshead porgy	<i>Calamus penna</i>	3	A
19. Slippery dick	<i>Halichoeres bivittatus</i>	7	J (3"to5")
20. Snook	<i>Centropomus undecimalis</i>	30	A (Big)

The N-S extent of Reef Site B is 160 feet and the E-W extent is 160 feet. The highest point on the reef is at a depth of 44 feet in a water depth of 54 feet for an overall reef height (relief) of 10 feet. Representative underwater photographs of Reef Site B taken on 12 June 2007 are shown in Figure 11.



**Figure 11. June 2007 Underwater Photographs of Reef Site B**

### 5.3 Reef Site C – Deployed May 9, 2006

This reef was constructed SE of Reef Site B of mixed concrete materials, as shown on the barge photograph in Figure 6. The reef materials include long light poles, shorter pilings and other concrete materials. Figure 12 shows the measurements taken during the June 12, 2007 survey, and the fish census data is in Table 6.

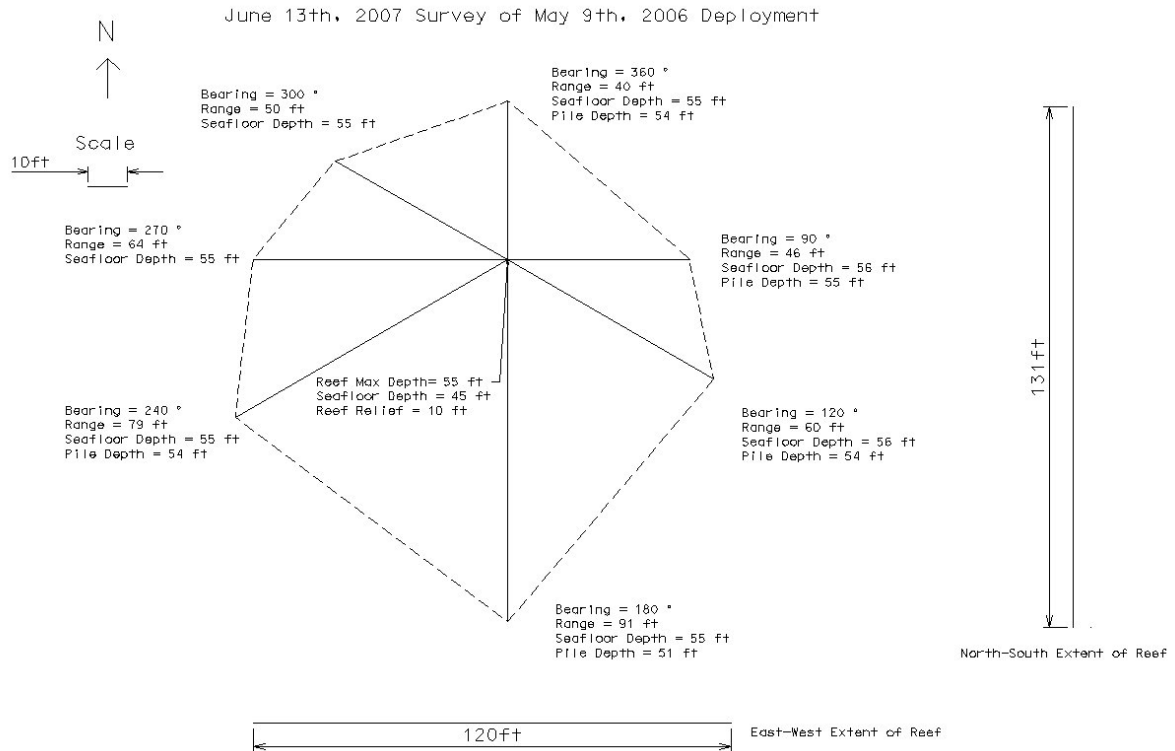


Figure 12. Underwater Survey of Reef Site C (deployed May 9, 2006)

Table 6. 2007 June 13 Fish Census for Reef Site C			
Common name	Scientific name	Abundance	A(dult) or J(uvenile)
1. Belted sandfish	<i>Serranus subligarius</i>	7	A
2. Black margate	<i>Anisotremus surinamensis</i>	5	A
3. Black seabass	<i>Centropristis striata</i>	10's	J+A
4. Gray snapper	<i>Lutjanus griseus</i>	10's	J+A
5. Great barracuda	<i>Sphyraena barracuda</i>	5	A
6. Lane snapper	<i>Lutjanus synagris</i>	4	J to A
7. Pigfish	<i>Orthopristis chrysoptera</i>	100's	J to A
8. Porkfish	<i>Anisotremus virginicus</i>	10's	J+A
9. Red snapper	<i>Lutjanus campechanus</i>	2	A
10. Round scad	<i>Decapterus punctatus</i>	100's	A
11. Sailor's choice	<i>Haemulon parrae</i>	3	A
12. Sheepshead	<i>Archosargus probatocephalus</i>	10's	A
13. Slippery dick	<i>Halichoeres bivittatus</i>	20+	A
14. Snook	<i>Centropomus undecimalis</i>	10's	A
15. Tomtate	<i>Haemulon aurolineatum</i>	100's	J+A

The N-S extent of Reef Site C is 130 feet and the E-W extent is 120 feet. The highest point on the reef is at a depth of 45 feet in a water depth of 55 feet for an overall reef height (relief) of 10 feet. Representative underwater photographs of Reef Site C taken on 13 June 2007 are shown in Figure 13.



**Figure 13. June 2007 Underwater Photographs of Reef Site C**



### 5.4 Reef Site D – Deployed May 4, 2006

This reef was constructed SE of Reef Site C of concrete dock piles, as shown on the barge photograph in Figure 4. Figure 14 shows the measurements taken during the June 13, 2007 survey, and the fish census data is in Table 7.

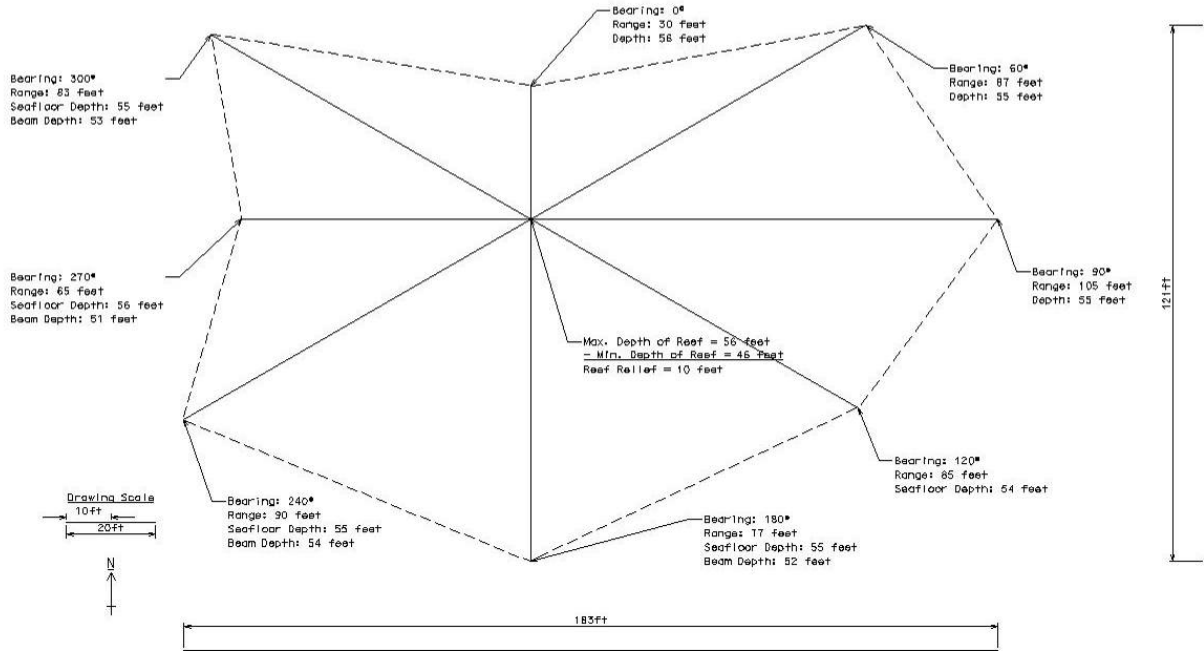
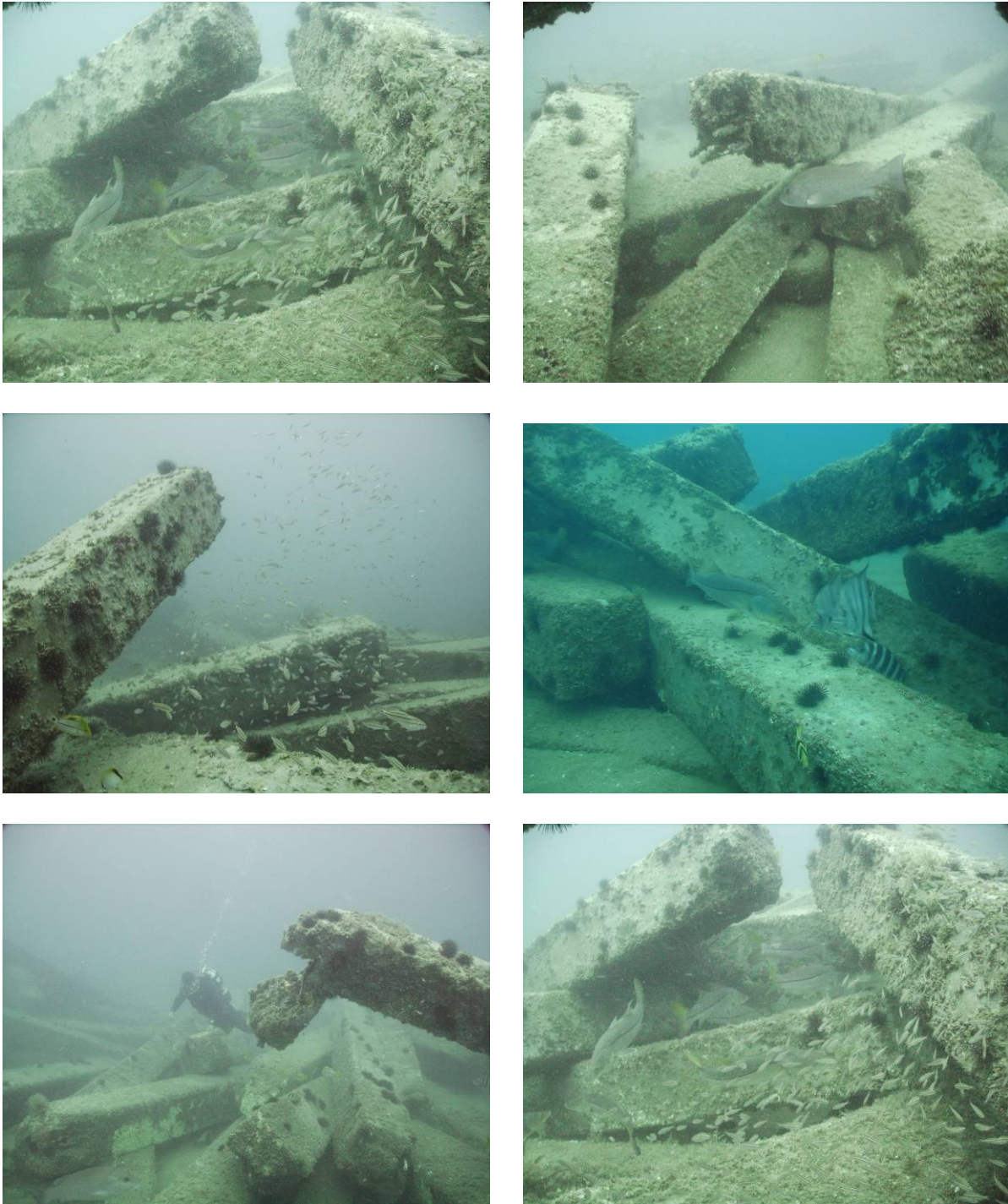


Figure 14. Underwater Survey of Reef Site D (deployed May 4, 2006)

Table 7. 2007 June 13 Fish Census for Reef Site D			
Common name	Scientific name	Abundance	A(dult) or J(venile)
1. Baitfish (3")		100's	J
2. Beaugregory	<i>Stegastes leucostictus</i>	1	J
3. Belted sandfish	<i>Serranus subligarius</i>	2	J
4. Black margate	<i>Anisotremus surinamensis</i>	5	A+ one J
5. Black seabass	<i>Centropristis striata</i>	10's	J+A
6. Blue runner	<i>Caranx crysos</i>	1	A
7. Gray snapper	<i>Lutjanus griseus</i>	10's	J+A
8. Great barracuda	<i>Sphyraena barracuda</i>	2	A
9. Lane snapper	<i>Lutjanus synagris</i>	7	J+A
10. Pigfish	<i>Orthopristis chrysoptera</i>	100+	J to A
11. Porkfish	<i>Anisotremus virginicus</i>	20's	J+A
12. Sheepshead	<i>Archosargus probatocephalus</i>	10's	A
13. Sheepshead porgy	<i>Calamus penna</i>	2	A
14. Slippery dick	<i>Halichoeres bivittatus</i>	10's	J+A
15. Snook	<i>Centropomus undecimalis</i>	25	J+A
16. Tomtate	<i>Haemulon aurolineatum</i>	100's	J



The N-S extent of Reef Site D is 120 feet and the E-W extent is 190 feet. The highest point on the reef is at a depth of 46 feet in a water depth of 56 feet for an overall reef height (relief) of 10 feet. Representative underwater photographs of Reef Site D taken on 13 June 2007 are shown in Figure 15.



**Figure 15. June 2007 Underwater Photographs of Reef Site D**

## 6 Summary

The four May 2006 deployments and the nearby barges, bridge spans, and other reefs in the Nearshore Reef Site #2 are functioning similar to natural 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, sea bass, etc. are abundant on these reefs. Both the benthic growth and fish inhabiting these four reef sites was very impressive, especially considering that these reefs are only one year old. This area in reef Site #2 is very popular for fishing and diving, and these four new reefs provide additional resources to the existing artificial reefs in this area.

Table 8 shows the changes in depths and reef heights based on this study measurements one year after deployment, compared to the measurements taken immediately after deployment of the reefs. This table shows that the reefs have been very stable over the first year, with 0 to 1 foot of settlement. No significant scour, settlement or burial of reef units was observed. No tropical storms or hurricanes have impacted this area since the original deployments in May 2006.

<i>Reef</i>	<i>Original Depth</i>	<i>Original Top Depth</i>	<i>Original Reef Height</i>	<i>June 2007 Depth</i>	<i>June 2007 Top Depth</i>	<i>June 2007 Reef Height</i>	<i>Change in Reef Height</i>
A	55	44	11	55	44	11	0
B	55	44	11	54	44	10	-1
C	57	47	10	55	45	10	0
D	56	46	10	56	46	10	0

Reef Sites B and D were constructed of dock piles, while Reef Sites A and C were constructed of mixed materials. Both materials provide complex reef mounds approximately 10 feet high, with lateral extents of 120 to 220 feet. In addition to the primary reef mound, there are some outlying scattered materials at greater distances from the reef centers.

The numbers of fish species observed on Reef Sites A-D in June 2007 were 24, 20, 15, and 16, respectively. Since there were already a considerable number of existing artificial reefs in the NW corner of Site #2, and since Reef Site A is the closest one to that area, this could be one reason for this variation.