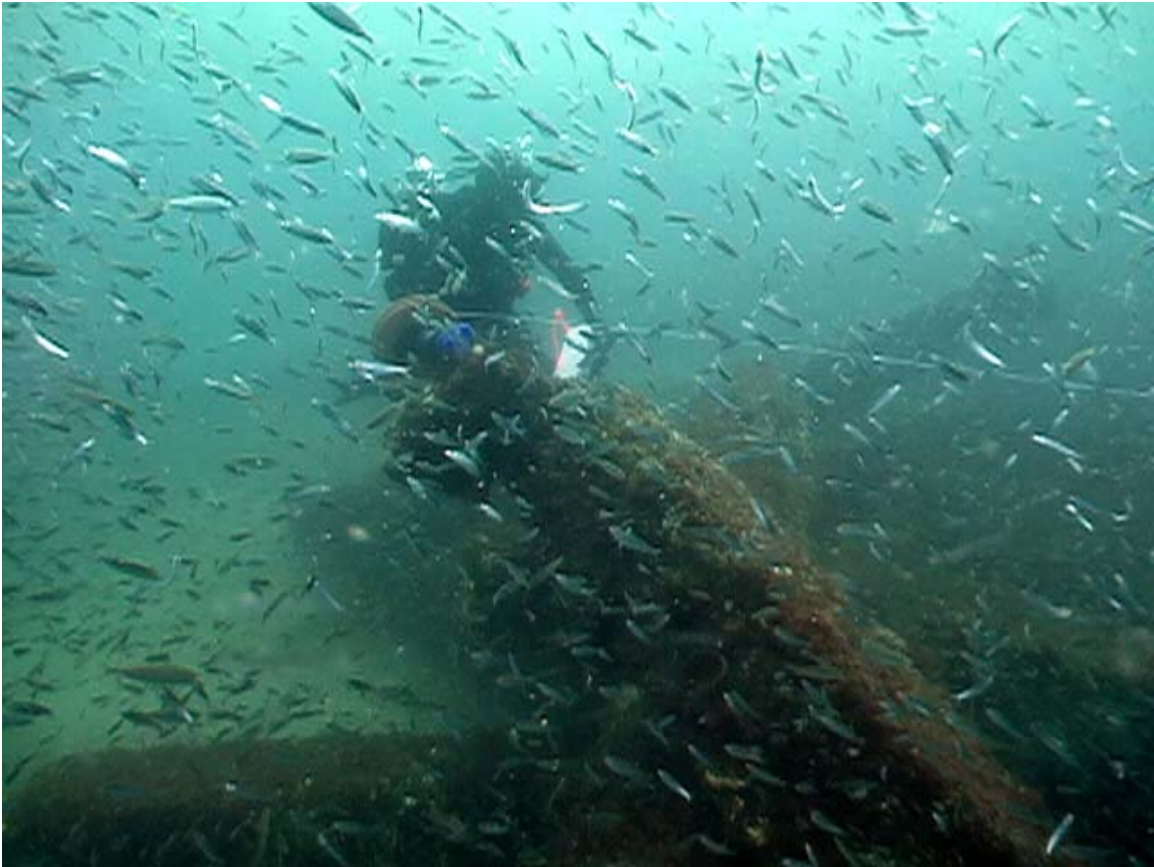


**2008 Second Annual Reef Monitoring of the
Four Artificial Reef Sites Deployed in May 2006
Nearshore Reef Site #2 in St. Lucie County, FL**



Prepared for:
St. Lucie County Public Works Department
2300 Virginia Avenue
Fort Pierce, FL 34982-5652

Prepared by:
Lee E. Harris, Ph.D., P.E. and Kerry L. Dillon

September 2008

Table of Contents

1 Introduction 4

2 Methodology 5

3 Reef Locations 6

4 History of the May 2006 Deployments 9

5 2007 First Annual Monitoring 10

6 2008 Second Annual Monitoring 11

6.1 Reef Site A – Deployed May 11, 2006 11

6.2 Reef Site B – Deployed May 6, 2006 16

6.3 Reef Site C – Deployed May 9, 2006 20

6.4 Reef Site D – Deployed May 4, 2006 25

7 Summary 29

List of Tables

Table 1. Materials and Locations of the Four Reefs Deployed May 2006 7

Table 2. Other Known Materials in St. Lucie County Artificial Reef Site #2 8

Table 3. 2007 Monitoring Dates and Data 10

Table 4. 2008 Monitoring Dates and Data 11

Table 5. Fish Census for Reef Site A 13

Table 6. Fish Census for Reef Site B 17

Table 7. Fish Census for Reef Site C 22

Table 8. Fish Census for Reef Site D 26

List of Figures

Figure 1. St. Lucie County Three Offshore Artificial Reef Sites 4

Figure 2. Chart of St. Lucie County Artificial Reef Site #2 6

Figure 3. Locations of the Four Artificial Reefs Deployed May 2006..... 7

Figure 4. May 4, 2006 Deployment – Reef Site D 9

Figure 5. May 6, 2006 Deployment – Reef Site B..... 9

Figure 6. May 9, 2006 Deployment – Reef Site C..... 10

Figure 7. May 11, 2006 Deployment – Reef Site A 10

Figure 8. Underwater Survey of Reef Site A (deployed May 11, 2006) 12

Figure 9. Underwater Photographs of Reef Site A taken May 23, 2008 14

Figure 10. Underwater Photographs of Reef Site A taken June 2008 15

Figure 11. Underwater Survey of Reef Site B (deployed May 6, 2006) 16

Figure 12. Underwater Photographs of Reef Site B taken July 2008 18

Figure 13. Underwater Photographs of Reef Site B taken July 2008 19

Figure 14. Underwater Photographs of Reef Site B taken July 2008 20

Figure 15. Underwater Survey of Reef Site C (deployed May 9, 2006) 21

Figure 16. Underwater Photographs of Reef Site C taken July 2008 23

Figure 17. Underwater Photographs of Reef Site C taken July 2008 24

Figure 16. Underwater Survey of Reef Site D (deployed May 4, 2006) 25

Figure 19. Underwater Photographs of Reef Site D taken July 2008..... 27

Figure 20. Underwater Photographs of Reef Site D taken July 2008..... 28

1 Introduction

This report presents the second 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 permitted 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 square measuring one mile on each side, and is 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 Three 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 one barge of approximately 500 tons of materials for each reef (in chronological order of the deployments):

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

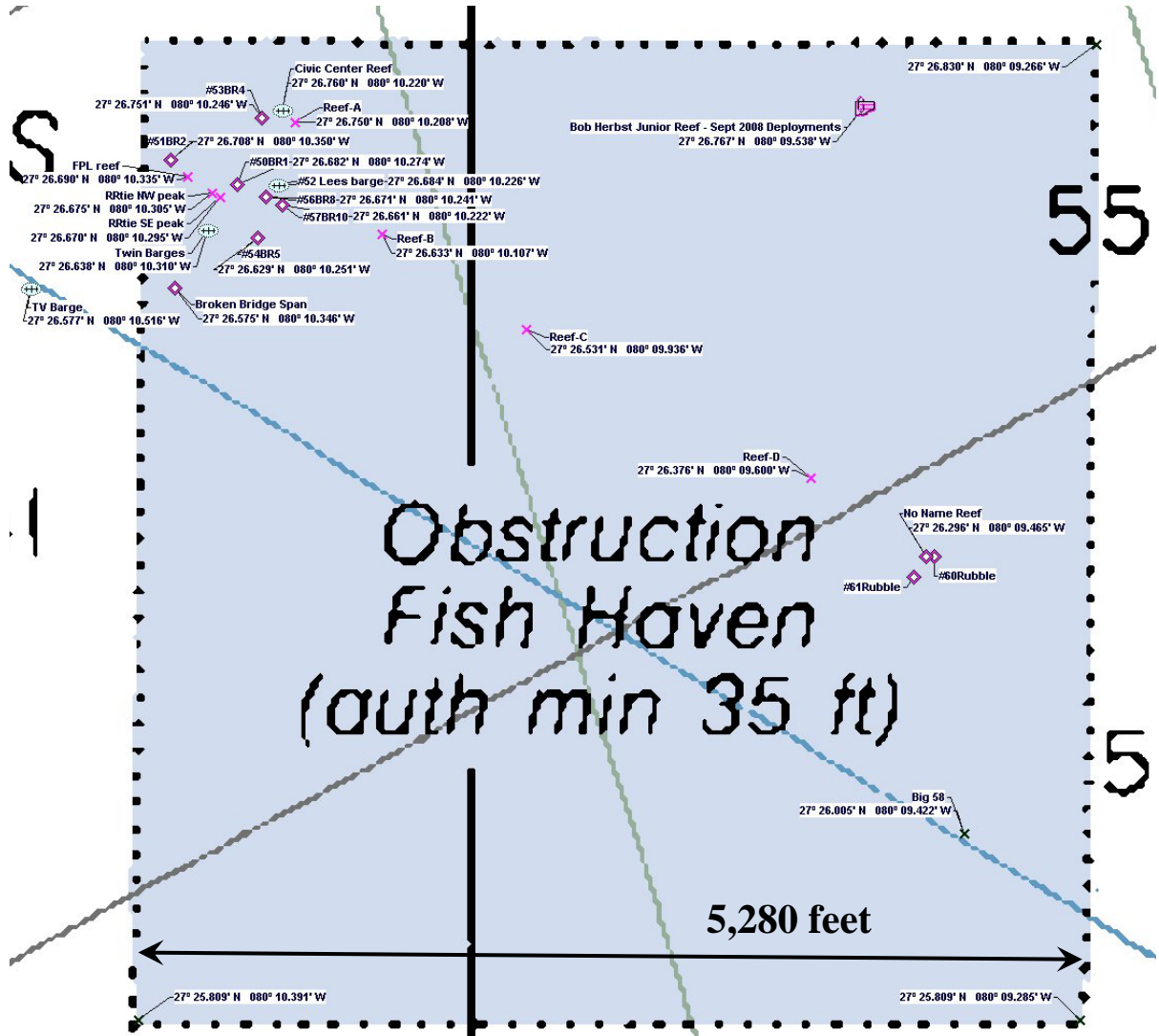


Figure 2. Chart of St. Lucie County Artificial Reef Site #2
The four artificial reef sites deployed in May 2006 are numbered A-D.

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. These data are used to compare with the locations and measurements performed for this study.

	<i>Deployment Date</i>	<i>Materials</i>	<i>Latitude, N</i>	<i>Longitude, W</i>	<i>Depth (feet)</i>	<i>Top Depth (feet)</i>	<i>Quantity</i>
A	11-May-06	Mixed	27° 26.750'	080° 10.208'	54	43	523 tons
B	6-May-06	Dock piles	27° 26.633'	080° 10.107'	55	44	572 tons
C	9-May-06	Mixed	27° 26.531'	080° 09.936'	53	43	515 tons
D	4-May-06	Dock piles	27° 26.402'	080° 09.601'	55	45	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 St. Lucie County Nearshore Reef Site #2. Figures 2 and 3 show that the four reefs constructed in May 2006 are located in a NW to SE line from the concentration of artificial reefs located in the NW corner of Site #2, to the reef sites located at the east side of the center of Site #2.

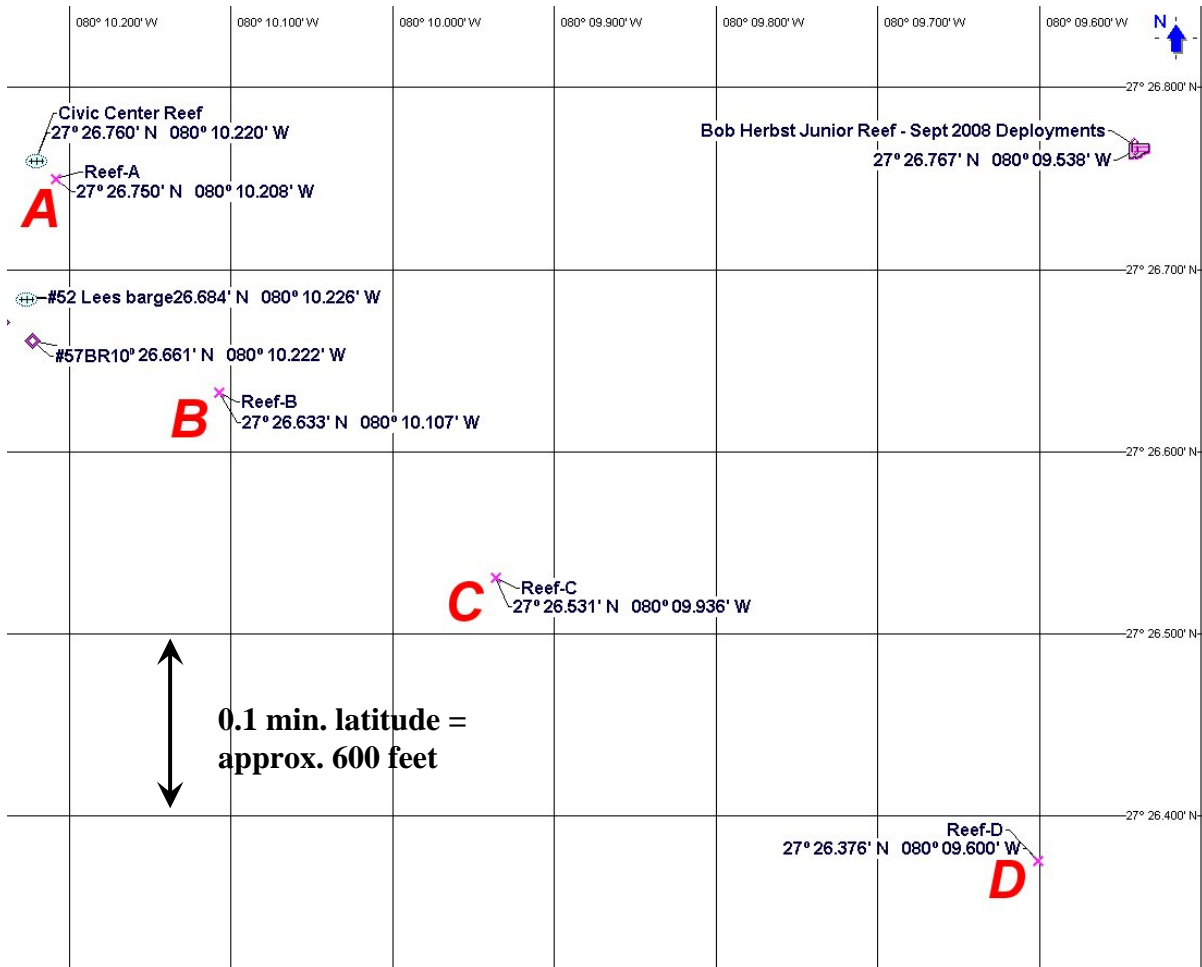


Figure 3. Locations of the Four Artificial Reefs Deployed May 2006
 The four artificial reef sites deployed in May 2006 are numbered A-D from NW to SE.

Table 2. Other Known Materials in St. Lucie County Artificial Reef Site #2						
<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
No Name Reef	27° 26.311'	080° 09.470'	58'	47'	mid 1990's	FPL plant mixed concrete and steel materials
RRtie NW peak	27° 26.675'	080° 10.305'	50	37	17-Aug-05	RRties
RRtie SE peak	27° 26.670'	080° 10.295'	50	39	17-Aug-05	RRties
FPL reef materials	27° 26.689'	080° 10.339'	55	35	30-Sep-05	480 tons
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
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
Bob Herbst Jr. Reef	27° 26.767'	080° 09.538'	55'	31'	Aug 2008	1,000 tons mixed concrete 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, locations of maximum reef height, water depth, top reef depth, and relief (water depth minus top depth) are summarized in Table 3. These and the deployment data are used to compare with the 2008 physical surveys. Fish census results from the 2007 surveys are shown in the tables with the 2008 fish census data for comparisons.

Table 3. 2007 Monitoring Dates and Data						
	Monitor Date	Highest Point Latitude, N	Highest Point Longitude, W	Depth (feet)	Top Depth (feet)	Relief (feet)
A	12-June-07	27° 26.746'	080° 10.228'	55	44	11
B	12-June-07	27° 26.626'	080° 10.111'	54	44	10
C	13-June-07	27° 26.536'	080° 09.937'	55	45	10
D	13-June-07	27° 26.400'	080° 09.600'	56	46	10

6 2008 Second Annual Monitoring

The annual monitoring of the four deployments was performed in summer 2008, 2 years following the deployments. The monitoring dates, locations of maximum reef height, water depth, top reef depth, and relief (water depth minus top depth) are summarized in Table 4. Using the roaming diver method, the fish census is summarized in Tables 5-8 for the four reef sites for both the 2008 and 2007 surveys.

Table 4. 2008 Monitoring Dates and Data <i>Fish census dates in italics.</i>						
	Monitor Date	Highest Point Latitude, N	Highest Point Longitude, W	Depth (feet)	Top Depth (feet)	Relief (feet)
A	<i>23 May 08 & 12 June 08</i>	27° 26.746'	080° 10.228'	54	43	11
B	<i>1 July 08 & 28 Aug 08</i>	27° 26.626'	080° 10.111'	53	43	10
C	<i>1 July 08 & 16 July 08</i>	27° 26.536'	080° 09.937'	53	45	8
D	<i>1 July 08 & 27 Aug 08</i>	27° 26.400'	080° 09.600'	55	45	10

Comparison with the data in Tables 3 and 4 shows that virtually no changes have occurred in the overall reef heights in the last year. Reefs A, B, and D had the same reef relief, while Reef C decreased by 2 feet. These results are similar to the first year of monitoring, which showed no changes for the post-deployment measurements.

6.1 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 (approximately 1,100 tons total) 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 13, 2008 survey, and fish census data taken May 23, 2008 are shown in Table 5. The reef lies in a NE-SW orientation with the longest dimension of the reef approximately 225 feet, with a width of approximately 100 feet. Figure 8 shows the N-S extent of Reef Site A is approximately 150 feet and the E-W extent is approximately 200 feet.

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 (43' 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 (46' depth). These 2008 measurements are essentially the same as in 2007.

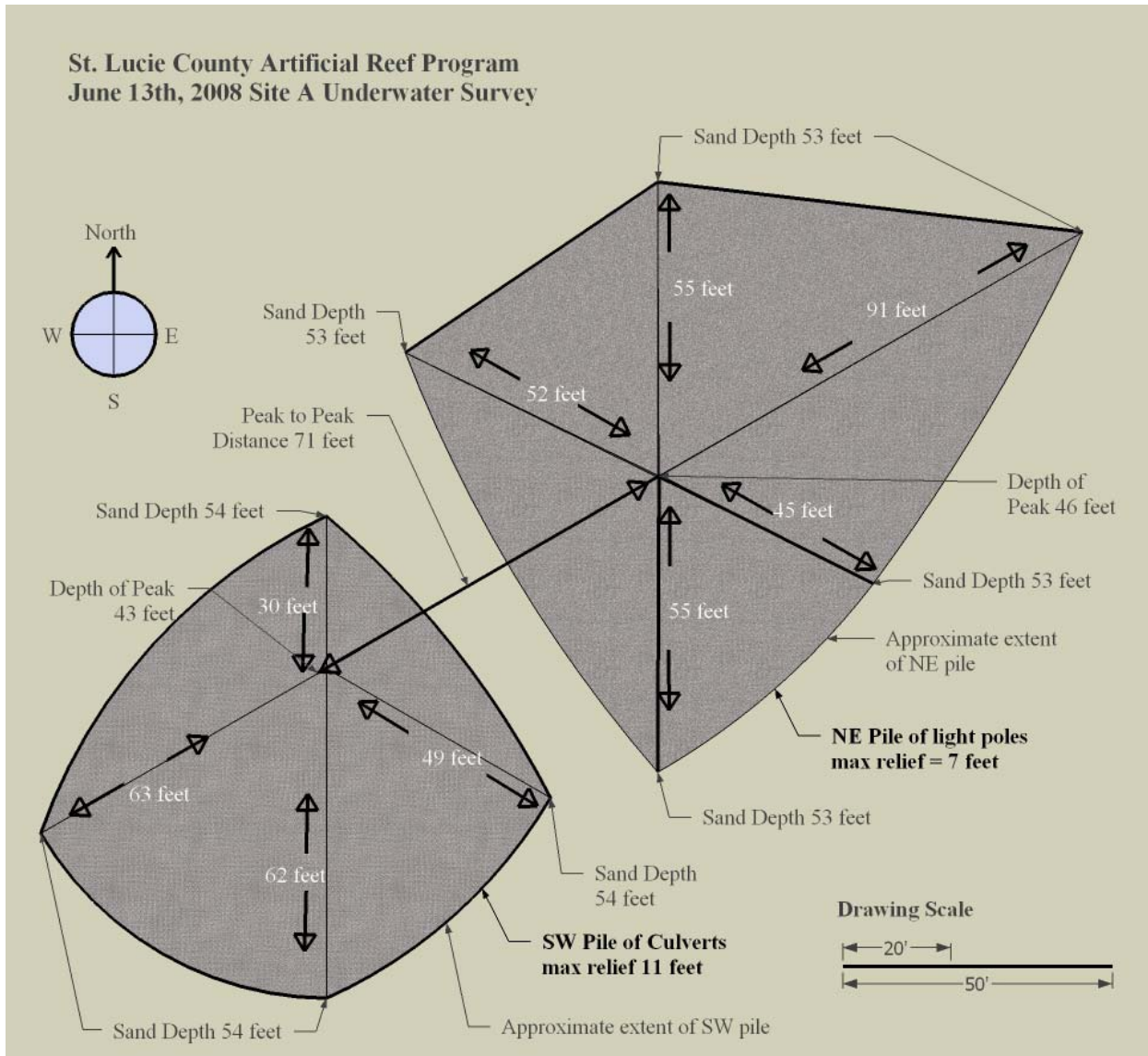


Figure 8. Underwater Survey of Reef Site A (deployed May 11, 2006)

The 2nd annual monitoring surveys of Reef A were performed on May 23 and June 13. Fish census data shown in Table 5 is from May 23, during which seas were calm, seawater temperatures were 76F at the surface and 73F at the bottom, horizontal visibility near the bottom was approximately 30 feet, and a current estimated at ¼ knot to the SE.

24 species were identified in the fish census for 2007, and 25 species were identified in the fish census for 2008. Several species that were seen in 2007 were not seen in 2008, and vice versa.

Table 5. Fish Census for Reef Site A

Site A deployed 5/11/2006		6/12/2007		5/23/2008	
Common	Scientific	Number	Adult or Juvenile	Number	Adult or Juvenile
Atlantic Spadefish	<i>Chaetodipterus faber</i>	F	A	M	A
Baitfish (2") Round scad	<i>Decapterus punctatus</i>	A	J		
Bandtail puffer	<i>Sphoeroides spengleri</i>	F	J		
Beaugregory	<i>Stegastes leucostictus</i>	M	J	M	J&A
Belted Sandfish	<i>Serranus subligarius</i>	M	J	M	A
Black grouper	<i>Mycteroperca bonaci</i>	S	J		
Black Margate	<i>Anisotremus surinamensis</i>	F	A	M	A
Black Seabass	<i>Centropristis striata</i>	M	J+A	M	A
Blue Runners	<i>Caranx crysos</i>			A	A
Cobia	<i>Rachycentron canadum</i>			S	A
Cubbyu	<i>Pareques umbrosus</i>	F	A	M	A&J
Doctorfish	<i>Acanthurus chirurgus</i>			F	A
Fry	<i>Jenkinsia lamprotaenia</i>			A	J
Goliath Grouper	<i>Epinephelus itajara</i>	F	A	F	A
Gray Snapper	<i>Lutjanus griseus</i>			M	A
Great barracuda	<i>Sphyrnaea barracuda</i>	F	A		
Hairy Blenny	<i>Labrisomus nuchipinnis</i>			F	A
Lane Snapper	<i>Lutjanus synagris</i>	F	A	F	A
Nurse Shark	<i>Ginglymostoma cirratum</i>			S	A
Pigfish	<i>Orthopristis chrysoptera</i>	A	J+A	M	A
Porkfish	<i>Anisotremus virginicus</i>	M	J+A	F	A
Puddingwife	<i>Halichoeres radiatus</i>			F	A
Queen angelfish	<i>Holocanthus ciliaris</i>	S	J		
Reef Butterflyfish	<i>Chaetodon sedentarius</i>			S	A
Sheepshead	<i>Archosargus probatocephalus</i>	M	A	F	A
Sheepshead porgy	<i>Calamus penna</i>	F	A		
Slippery Dick	<i>Halichoeres bivittatus</i>	F	A		
Snook	<i>Centropomus undecimalis</i>	M	A		
Southern Flounder	<i>Paralichthys lethostigma</i>			S	A
Southern Stingray	<i>Dasyatis americana</i>			F	A
Spiny Lobster	<i>Panuliris argus</i>	S	A		
Spotted eagle ray	<i>Aetobatus narinari</i>	F	A		
Spotted soapfish	<i>Rypticus subbifrenatus</i>	S	J		
Striped Croaker	<i>Bairdiella sanctaeluciae</i>	S	J	F	A
Tomtate	<i>Haemulon aurolineatum</i>	M	J+A	M	A
Two spot cardinalfish	<i>Apogon binotatus</i>			F	A

Representative underwater photographs of Reef Site A taken on May 23 and June 13, 2008 are shown in Figure 9 and 10 respectively. The visibility was better On May 23, so that the photographs more clearly show the overall reef structure. All photographs show the abundant benthic and pelagic marine life.



Figure 9. Underwater Photographs of Reef Site A taken May 23, 2008

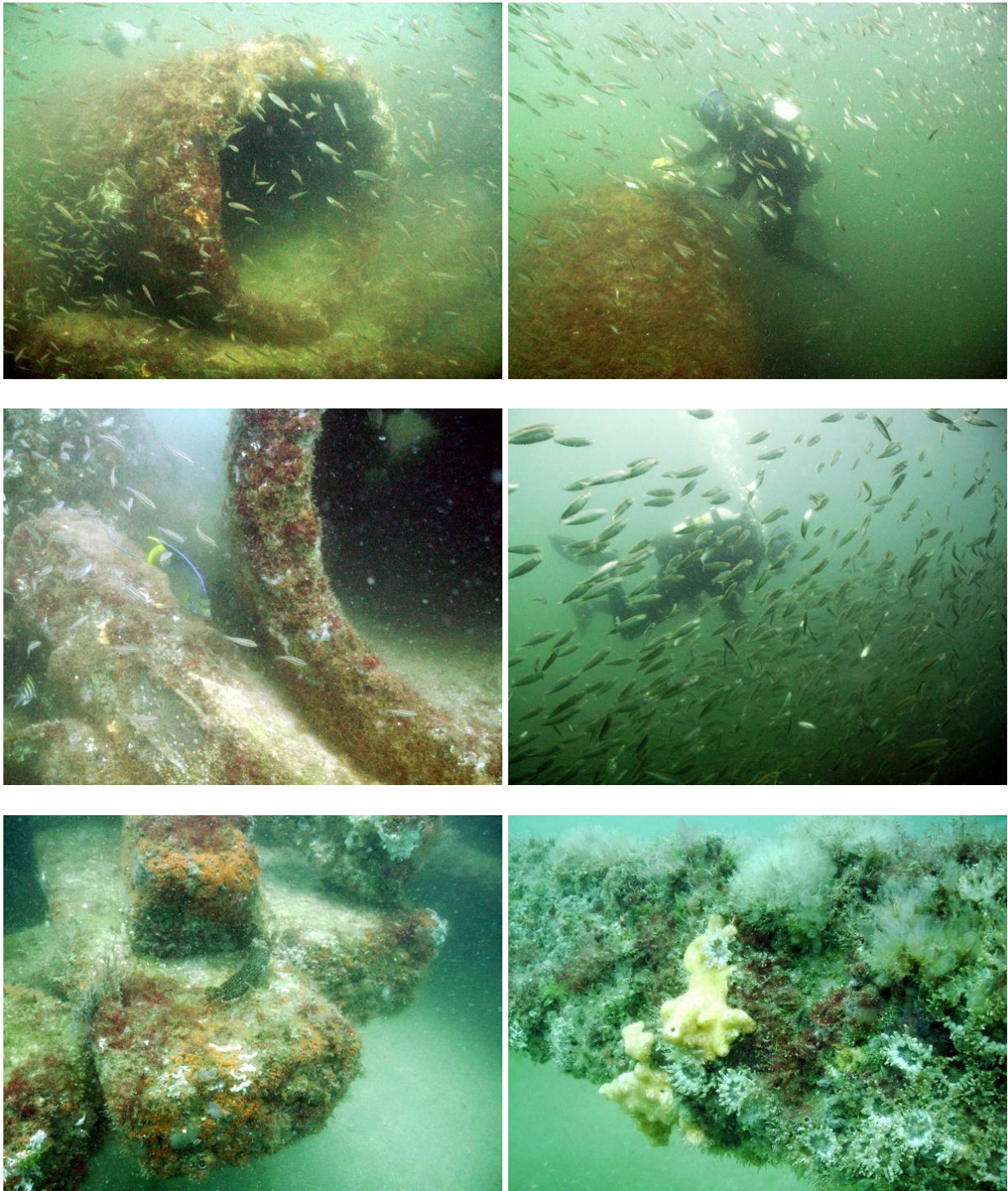


Figure 10. Underwater Photographs of Reef Site A taken June 2008

6.2 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 11 shows the measurements taken during the 2008 survey, and the fish census is in Table 6.

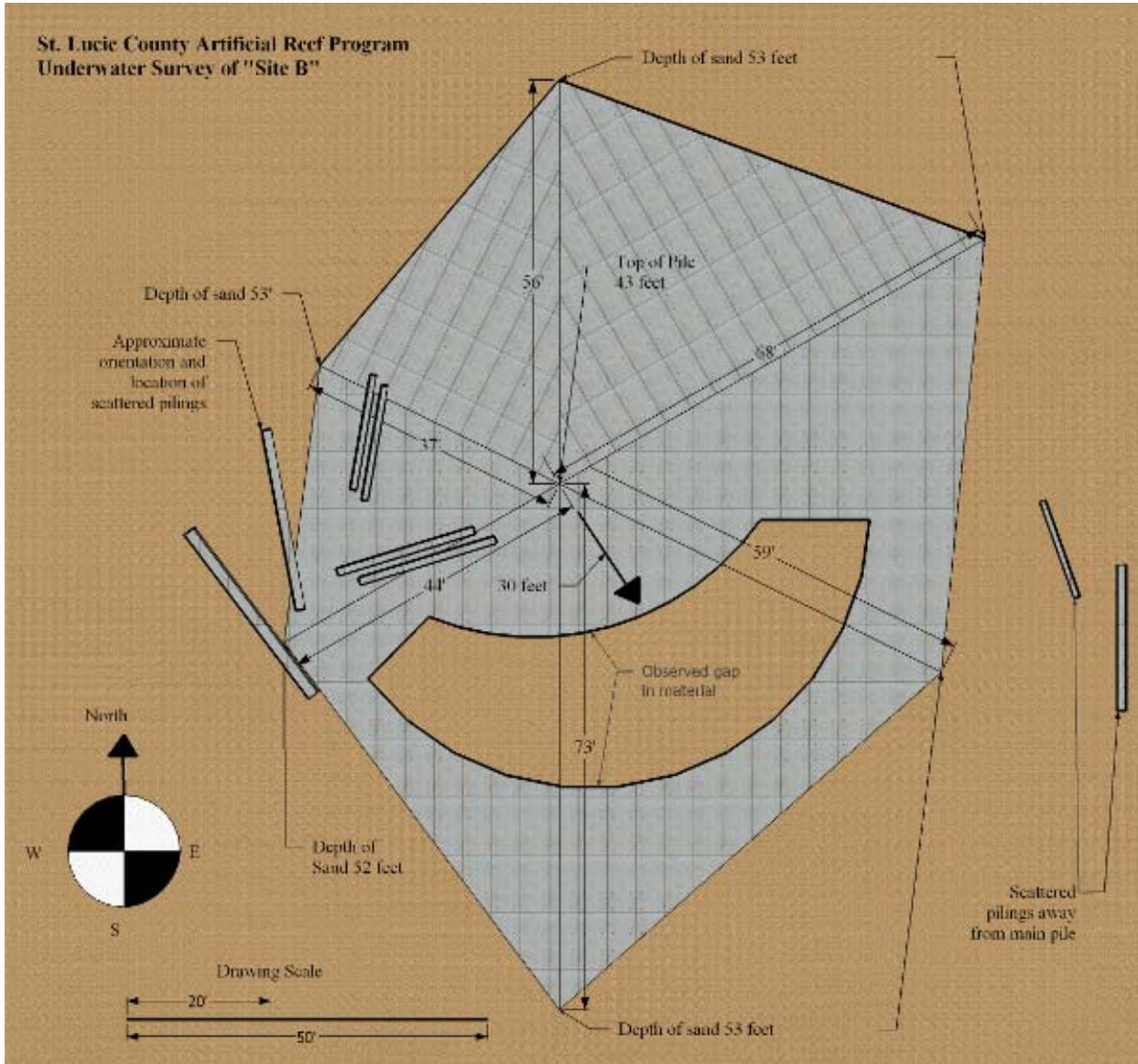


Figure 11. Underwater Survey of Reef Site B (deployed May 6, 2006)

The N-S extent of Reef Site B is approximately 130 feet and the E-W extent is approximately 100 feet. The highest point on the reef is at a depth of 43 feet in a water depth of 53 feet for an overall reef height (relief) of 10 feet (same as last year). Representative underwater photographs of Reef Site B are shown in Figures 12 through 14.

The 2nd annual monitoring surveys of Reef B were performed on July 1 and August 28. Fish census data shown in Table 6 is from August 28, during which seas were calm, seawater temperatures were 76F at the surface and 74F at the bottom, horizontal visibility near the bottom was approximately 25 feet, and a current estimated at 1/8 knot to the South.

Table 6. Fish Census for Reef Site B

Site B deployed 5/6/2006		6/12/2007		8/28/2008	
Common	Scientific	Number	Adult or Juvenile	Number	Adult or Juvenile
Atlantic Spadefish	<i>Chaetodipterus faber</i>			A	A
Barracuda	<i>Sphyraena barracuda</i>			F	A
Bank Seabass	<i>Centropristis ocyurus</i>			F	A
Bandtail Puffer	<i>Sphoeroides spengleri</i>			M	A & J
Beaugregory	<i>Stegastes leucostictus</i>			F	A & J
Belted Sandfish	<i>Serranus subligarius</i>	F	A	M	A
Bermuda Chub	<i>Kyphosus sectator</i>			F	A
Black Margate	<i>Anisotremus surinamensis</i>	F	A	F	A
Black Seabass	<i>Centropristis striata</i>	M	J+A	A	A & J
Cubby	<i>Pareques umbrosus</i>			M	A&J
Doctorfish	<i>Acanthurus chirurgus</i>			F	A
Goatfish	<i>Pseudupeneus maculatus</i>			F	A
Goliath Grouper	<i>Epinephelus itajara</i>			S	A
Gray Angelfish	<i>Pomacanthus arcuatus</i>			F	A
Gray Snapper	<i>Lutjanus griseus</i>	M	J+A	A	A & J
Great barracuda	<i>Sphyraena barracuda</i>	F	A		
Hairy Blenny	<i>Labrisomus nuchipinnis</i>			F	A
Lane Snapper	<i>Lutjanus synagris</i>	F	J+A	M	A & J
Mackerel Scad	<i>Decapterus macarellus</i>			A	A
Neon Goby	<i>Gobiosoma oceanops</i>			F	A
Octopus	<i>Octopus ???</i>			S	A
Pigfish	<i>Orthopristis chrysoptera</i>	A	J+A		
Porkfish	<i>Anisotremus virginicus</i>	M	J+A	M	A & J
Red snapper	<i>Lutjanus campechanus</i>	F	A		
Round scad	<i>Decapterus punctatus</i>	A	A		
Sailors Choice	<i>Haemulon parra</i>	F	A		
Sand Perch	<i>Diplectrum formosum</i>			F	A & J
Scamp	<i>Mycteroperca microlepis</i>			F	J/A
Sheepshead	<i>Archosargus probatocephalus</i>	M	A	M	A
Sheepshead Porgy	<i>Calamus penna</i>			F	A
Slippery Dick	<i>Halichoeres bivittatus</i>	M	A		
Snook	<i>Centropomus undecimalis</i>	M	A	A	A
Southern Stingray	<i>Dasyatis americana</i>			F	A
Tomtate	<i>Haemulon aurolineatum</i>	A	J+A	A	A & J
Two spot cardinalfish	<i>Apogon binotatus</i>			F	A
Yellowtail Reef fish	<i>Chromis enchrysurus</i>			F	A & J

15 species were identified in the fish census for 2007, and 30 species were identified in the fish census for 2008. Only five species that were seen in 2007 were not seen in 2008, and 20 species not seen in 2007 were observed in 2008. Representative underwater photographs of Reef Site B are shown in Figures 12 through 14.

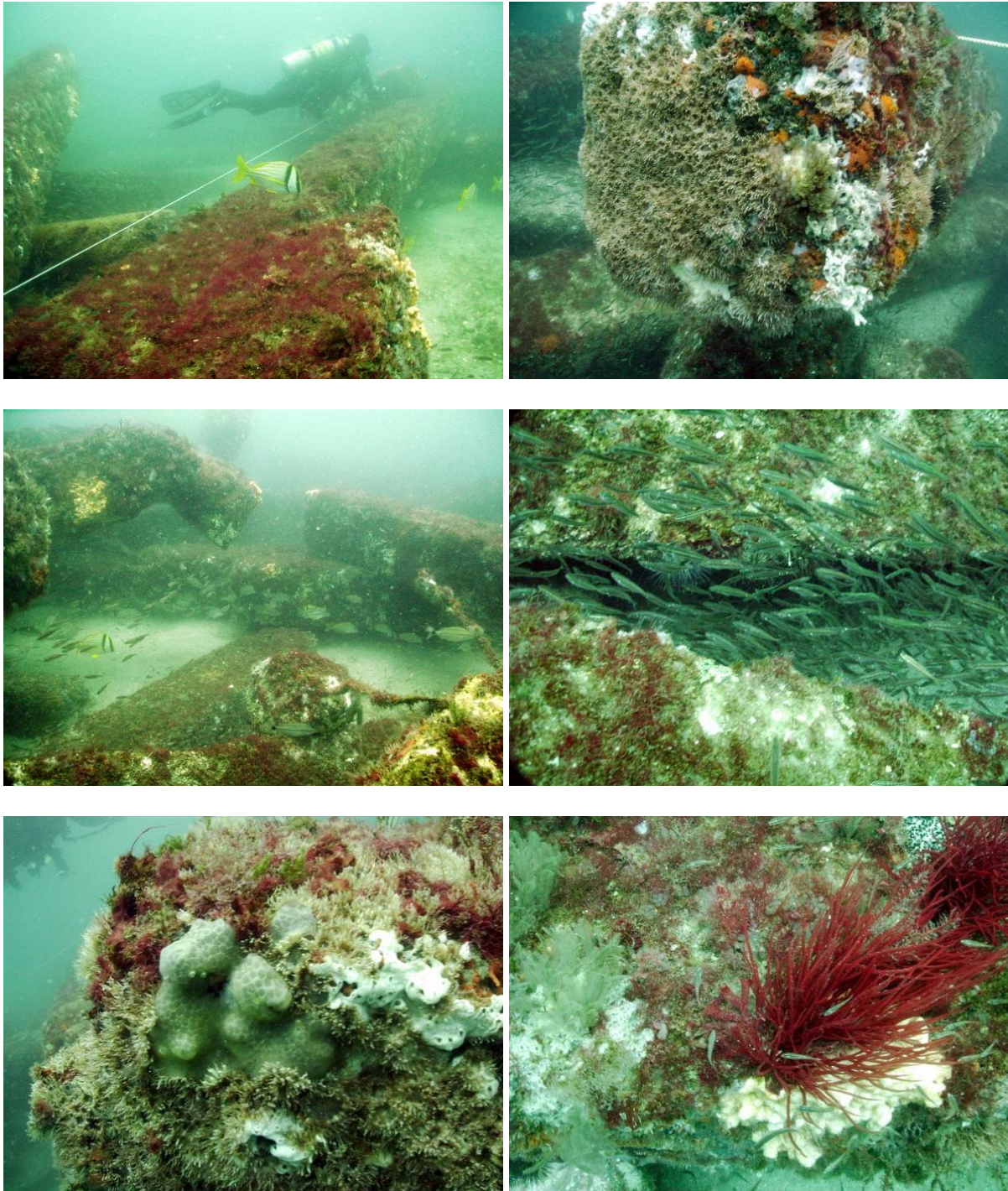


Figure 12. Underwater Photographs of Reef Site B taken July 2008

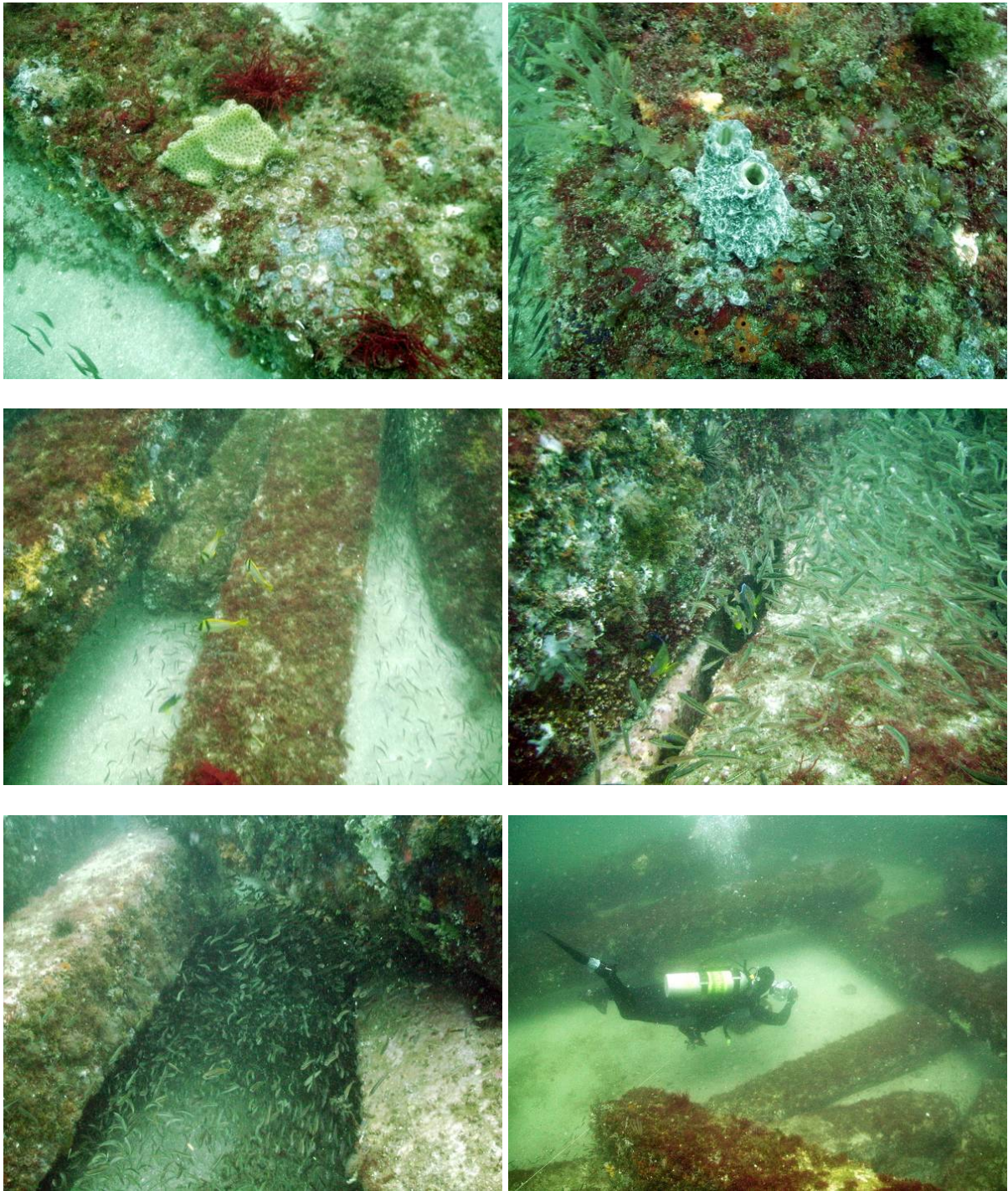


Figure 13. Underwater Photographs of Reef Site B taken July 2008

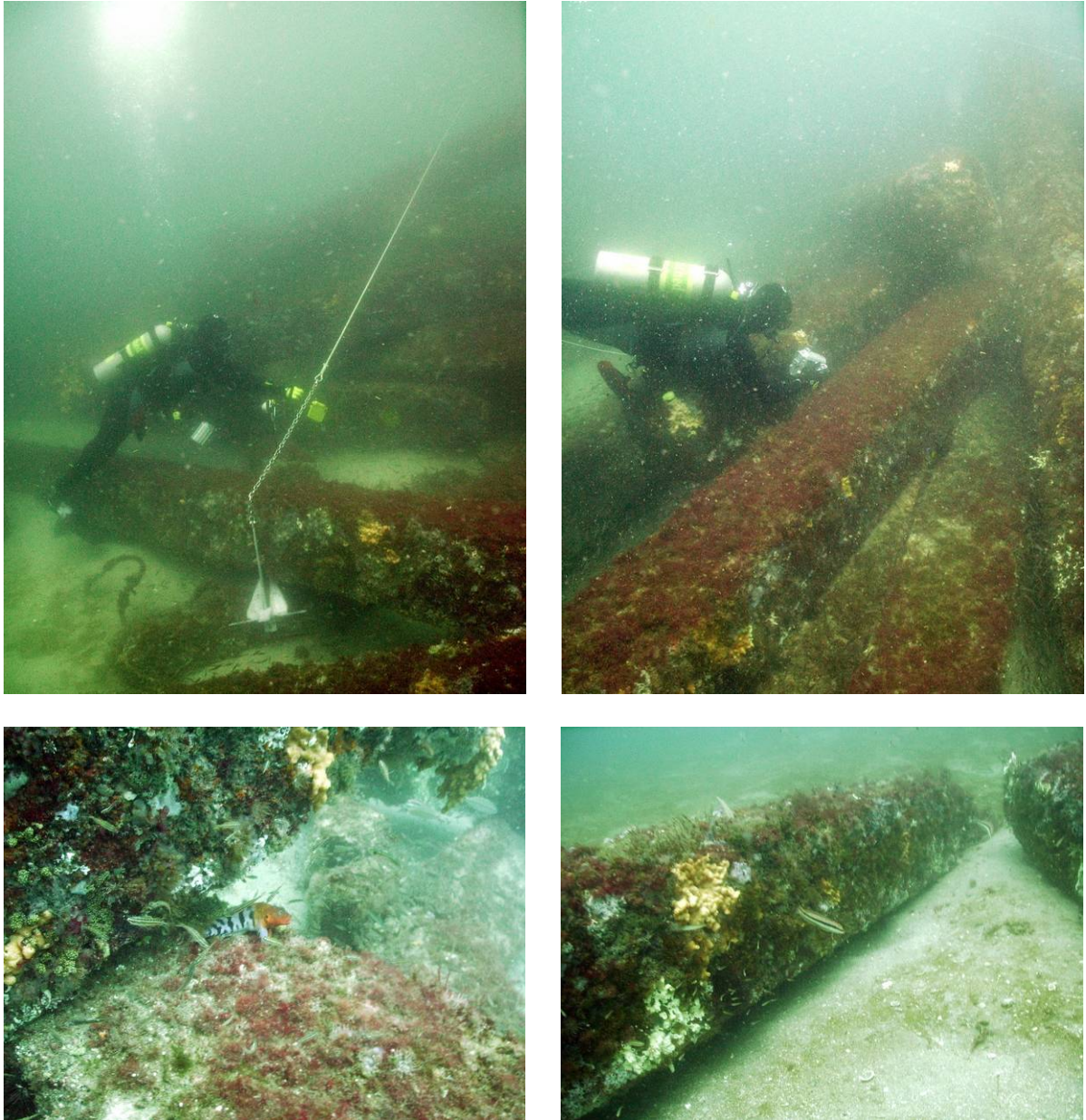


Figure 14. Underwater Photographs of Reef Site B taken July 2008

6.3 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 15 shows the measurements taken during the 2008 survey, and the fish census data is in Table 7.

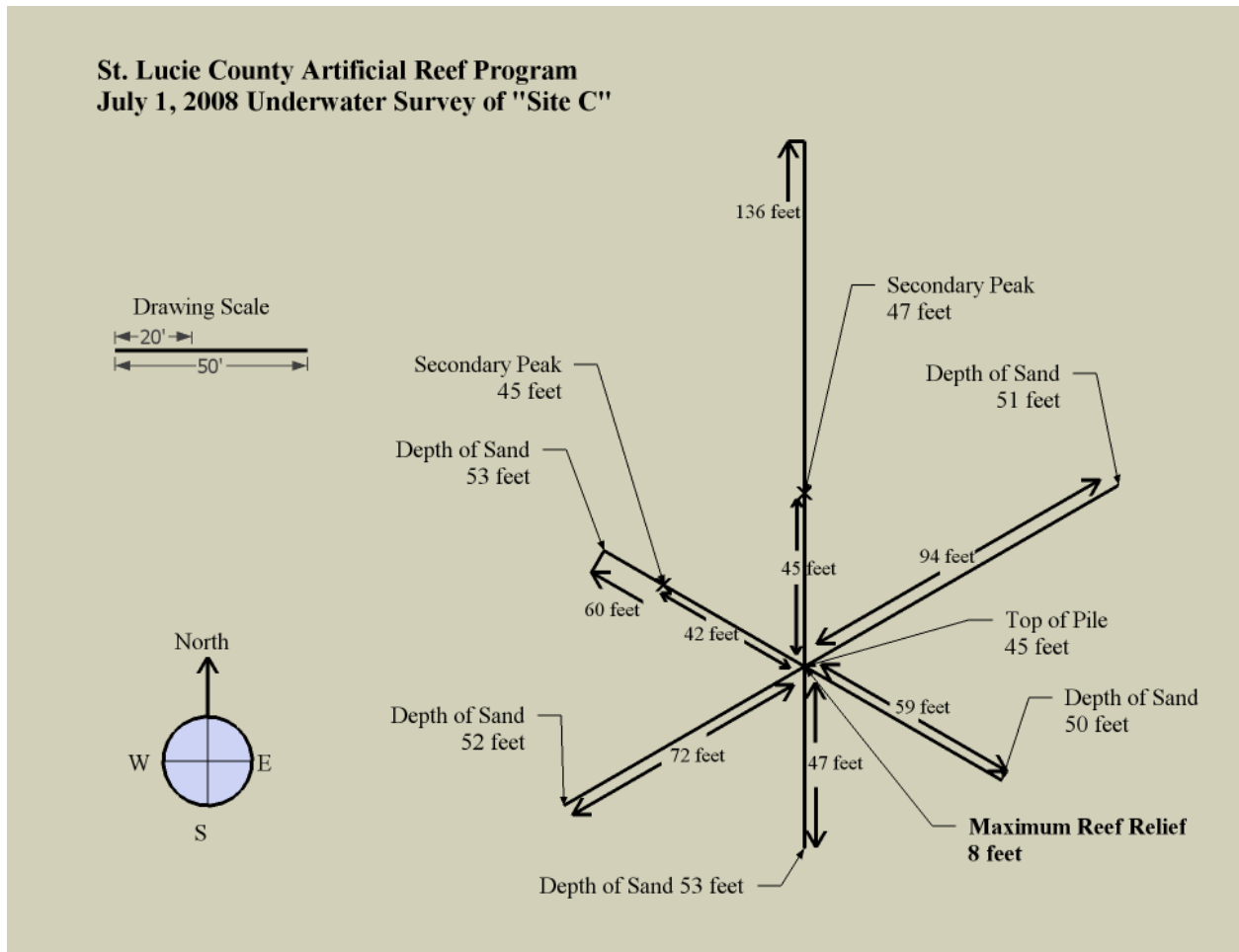


Figure 15. Underwater Survey of Reef Site C (deployed May 9, 2006)

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 53 feet for an overall reef height (relief) of 8 feet. These 2008 measurements show a two foot reduction in reef height compared to the original deployment and data from 2007.

The 2nd annual monitoring surveys of Reef C were performed on July 1 and July 16. Fish census data shown in Table 6 is from July 16, during which seas were calm, seawater temperatures were 80F at the surface and 78F at the bottom, horizontal visibility near the bottom was approximately 30 feet, and a negligible current.

15 species were identified in the fish census for 2007, and 24 species were identified in the fish census for 2008. Only four species that were seen in 2007 were not seen in 2008, and 13 species not seen in 2007 were observed in 2008. Representative underwater photographs of Reef Site B are shown in Figures 16 and 17.

Table 7. Fish Census for Reef Site C

Site C deployed 5/9/2006		6/13/2007		7/16/2008	
Common Name	Scientific Name	Number	Adult or Juvenile	Number	Adult or Juvenile
Atlantic Spadefish	<i>Chaetodipterus faber</i>			F	A
Baracuda	<i>Sphyraena barracuda</i>			F	A
Beaugregory	<i>Stegastes leucostictus</i>			F	A & J
Belted Sandfish	<i>Serranus subligarius</i>	F	A	M	A
Black Margate	<i>Anisotremus surinamensis</i>	F	A	F	A
Black Seabass	<i>Centropristis striata</i>	M	J+A	A	A
Cubbyu	<i>Pareques umbrosus</i>			M	A & J
Doctorfish	<i>Acanthurus chirurgus</i>			F	A
Goliath Grouper	<i>Epinephelus itajara</i>			F	A
Gray Snapper	<i>Lutjanus griseus</i>	M	J+A	F	A
Great barracuda	<i>Sphyraena barracuda</i>	F	A		
Hairy Blenny	<i>Labrisomus nuchipinnis</i>			M	A
Lane Snapper	<i>Lutjanus synagris</i>	F	J+A	M	A
Pigfish	<i>Orthopristis chrysoptera</i>	A	J+A	A	A
Porkfish	<i>Anisotremus virginicus</i>	M	J+A	M	A & J
Red Snapper	<i>Lutjanus campechanus</i>	F	A		
Reef Butterflyflyfish	<i>Chaetodon sedentarius</i>			S	A
Round scad	<i>Decapterus punctatus</i>	A	A		
Sailor's choice	<i>Haemulon parrae</i>	F	A		
Scamp	<i>Mycteroperca phenax</i>			S	J/A
Sheepshead	<i>Archosargus probatocephalus</i>	M	A	M	A
Sheepshead Porgy	<i>Calamus penna</i>			F	A
Slippery Dick	<i>Halichoeres bivittatus</i>	M	A	F	A
Snook	<i>Centropomus undecimalis</i>	M	A	M	A
Spottail Pinfish	<i>Diplodus holbrookii</i>			F	A
Tomtate	<i>Haemulon aurolineatum</i>	A	J+A	A	A
Two spot cardinalfish	<i>Apogon binotatus</i>			F	A
Whitespotted soapfish	<i>Rypticus maculatus</i>			F	A



Figure 16. Underwater Photographs of Reef Site C taken July 2008



Figure 17. Underwater Photographs of Reef Site C taken July 2008

6.4 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 16 shows the measurements taken during the 2008 survey, and the fish census data is in Table 8.

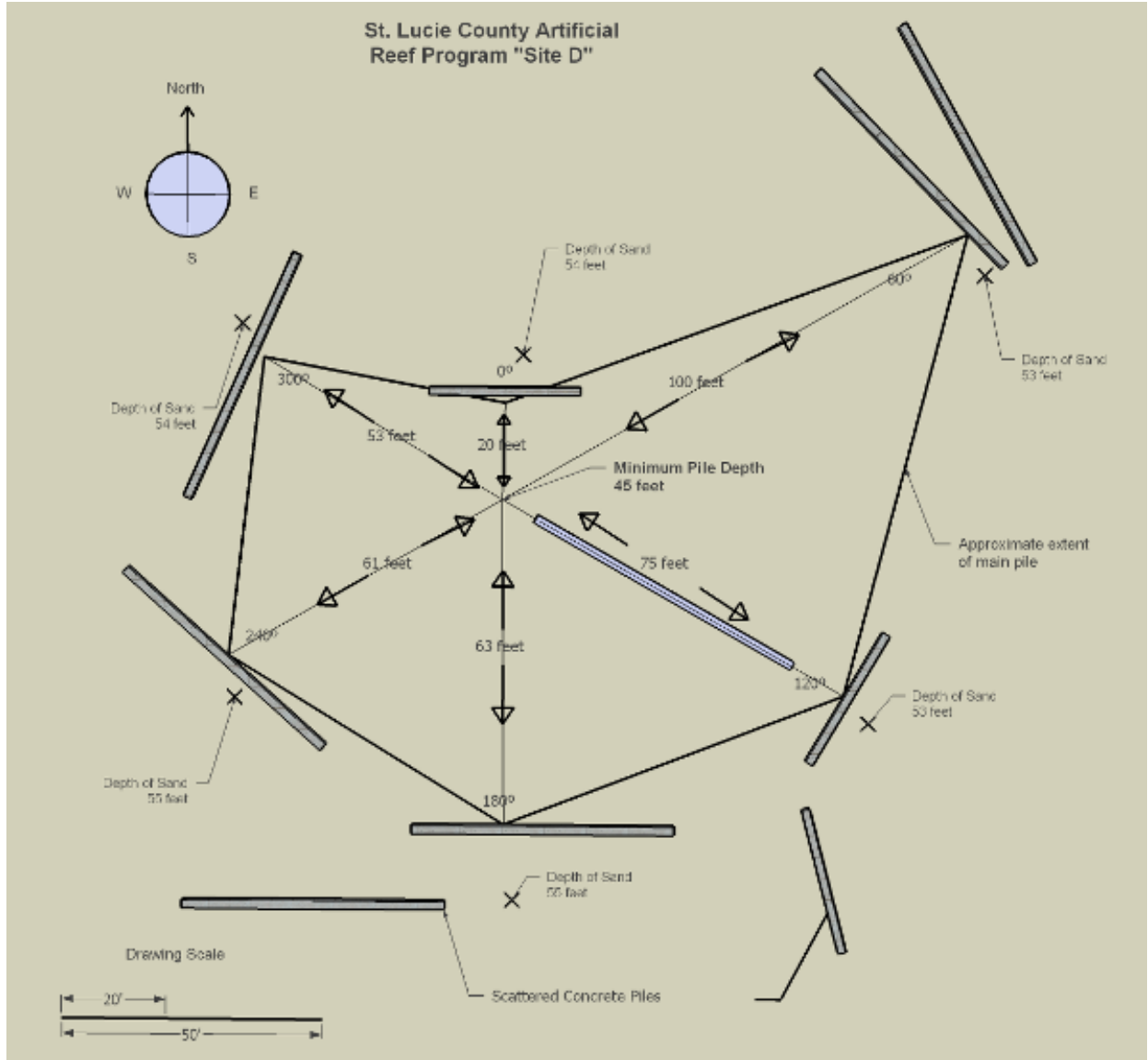


Figure 18. Underwater Survey of Reef Site D (deployed May 4, 2006)

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 45 feet in a water depth of 55 feet for an overall reef height (relief) of 10 feet. These 2008 measurements are essentially the same as in 2007.

Table 8. Fish Census for Reef Site D

Reef Site D deployed 5/4/2006		6/13/2007		8/27/2008	
Common	Scientific	Number	Adult or Juvenile	Number	Adult or Juvenile
Atlantic Spadefish	<i>Chaetodipterus faber</i>			F	A
Bandtail Puffer	<i>Sphoeroides spengleri</i>			F	A & J
Beaugregory	<i>Stegastes leucostictus</i>	S	J	M	J
Belted Sandfish	<i>Serranus subligarius</i>	F	J	F	A
Black Margate	<i>Anisotremus surinamensis</i>	F	J+A	F	A
Black Seabass	<i>Centropristis striata</i>	M	J+A	A	A & J
Blue Runners	<i>Caranx crysos</i>	S	A	M	A
Cubbyu	<i>Pareques umbrosus</i>			A	A & J
Doctorfish	<i>Acanthurus chirurgus</i>			M	A
Goliath Grouper	<i>Epinephelus itajara</i>			S	A
Gray Angelfish	<i>Pomacanthus arcuatus</i>			F	A
Gray Snapper	<i>Lutjanus griseus</i>	M	J+A	A	A & J
Great barracuda	<i>Sphyræna barracuda</i>	F	A	S	A
Greater Amberjack	<i>Seriola dumerili</i>			M	J (10")
Hairy Blenny	<i>Labrisomus nuchipinnis</i>			M	A
Lane Snapper	<i>Lutjanus synagris</i>	F	J+A	F	A & J
Permit	<i>Trachinotus falcatus</i>			S	A
Pigfish	<i>Orthopristis chrysoptera</i>	A	J+A	F	A
Porkfish	<i>Anisotremus virginicus</i>	M	J+A	M	A
Sand Diver	<i>Synodus intermedius</i>			F	J
Scamp	<i>Mycteroperca microlepis</i>			S	J
Sergeant Major	<i>Abudefduf saxatilis</i>			F	A
Sharpsnosed buffer	<i>Canthigaster rostrata</i>			F	A
Sheepshead	<i>Archosargus probatocephalus</i>	M	A	F	A
Sheepshead Porgy	<i>Calamus penna</i>	F	A	F	A
Slippery Dick	<i>Halichoeres bivittatus</i>	M	J+A		
Snook	<i>Centropomus undecimalis</i>	M	J+A	M	J (15 - 24")
Spiny Lobster	<i>Panulirus argus</i>			S	A
Spotted Goatfish	<i>Pseudupeneus maculatus</i>			F	A
Tomtate	<i>Haemulon aurolineatum</i>	A	J	A	A & J
Two spot cardinalfish	<i>Apogon binotatus</i>			F	A
Yellowtail Reef fish	<i>Chromis enchrysurus</i>			F	J
Baitfish (3")		A	J		
Loggerhead Turtle	<i>Caretta caretta</i>			S	A

The 2nd annual monitoring surveys of Reef D were performed on July 1 and August 27. Fish census data shown in Table 6 is from August 27, during which seas were calm, seawater temperatures were 78F at the surface and 74F at the bottom, horizontal visibility near the bottom was approximately 25 feet, and an estimated current of 1/8 knot to the South.

16 species were identified in the fish census for 2007, and 32 species were identified in the fish census for 2008. Only two species that were seen in 2007 were not seen in 2008, and 18 species not seen in 2007 were observed in 2008. Representative underwater photographs of Reef Site B are shown in Figures 19 and 20.



Figure 19. Underwater Photographs of Reef Site D taken July 2008

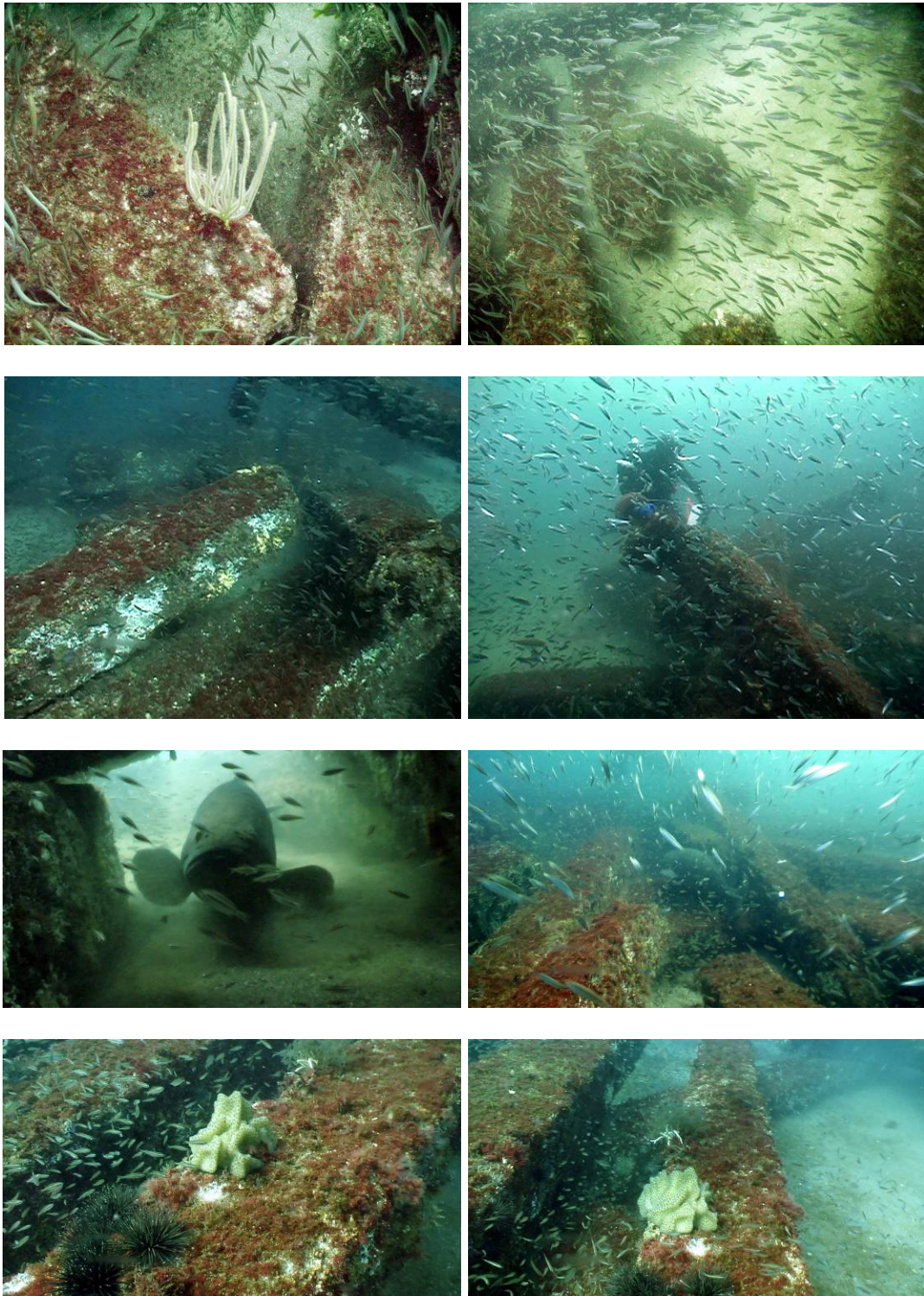


Figure 20. Underwater Photographs of Reef Site D taken July 2008

7 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, furnishing 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 two years 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.

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. Negligible changes in the reef structures and dimensions were measured during the 2008 surveys. All four reef sites showed excellent stability, with little to no scour and settlement.

The numbers of fish species observed on Reef Sites A-D in June 2007 were 24, 15, 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 the reduction in species diversity from NW to SE.

The numbers of fish species observed on Reef Sites A-D in 2008 were 25, 30, 24, and 32, respectively. All four sites showed increases in the number of species observed from 2007 to 2008 (from 4% to 100% increases). Due to weather and other constraints, fish census dates varied more than in 2007, with dates for the fish census work being May 23 for Reef A, August 28 for Reef B, July 16 for Reef C, and August 27 for Reef D. Therefore comparisons of species diversity between the four sites in 2008 are not possible. Seasonal variations may play a dominant role in the variations in fish species between the four reef sites, as well as in comparisons with 2007 data. However, the number of fish species and the overall fish populations did increase at each of the four reef sites from the first annual monitoring in the summer of 2007 to the second annual monitoring in the summer of 2008.