

2012 ANNUAL MONITORING REPORT

MARTIN COUNTY ARTIFICIAL REEF PROGRAM

PREPARED FOR:

MARTIN COUNTY ENGINEERING DEPARTMENT
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(PHOTO OF THE RALPH EVINRUDE ARTIFICIAL REEF)

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1.0 INTRODUCTION

Martin County has one of the most active and well-developed artificial reef programs in the state of Florida. Since the early 1970's, private and not-for-profit groups have been deploying a wide variety of artificial substrate offshore to enhance local fishing and diving. More recently, the Martin County Coastal Engineering Division began administering a more innovative program that deploys artificial reef projects in cooperation with the Florida Fish and Wildlife Conservation Commission (FWC) and local citizens. Lessons learned from earlier efforts, including those of other groups and agencies, have refined the program significantly. Many materials that have historically been used to build artificial reefs are now known to be poor-quality reef substrate, leading to artificial reef construction limited almost exclusively to natural rock, concrete and steel materials. Figure 1 shows the location of the five Martin County permitted offshore reef sites.

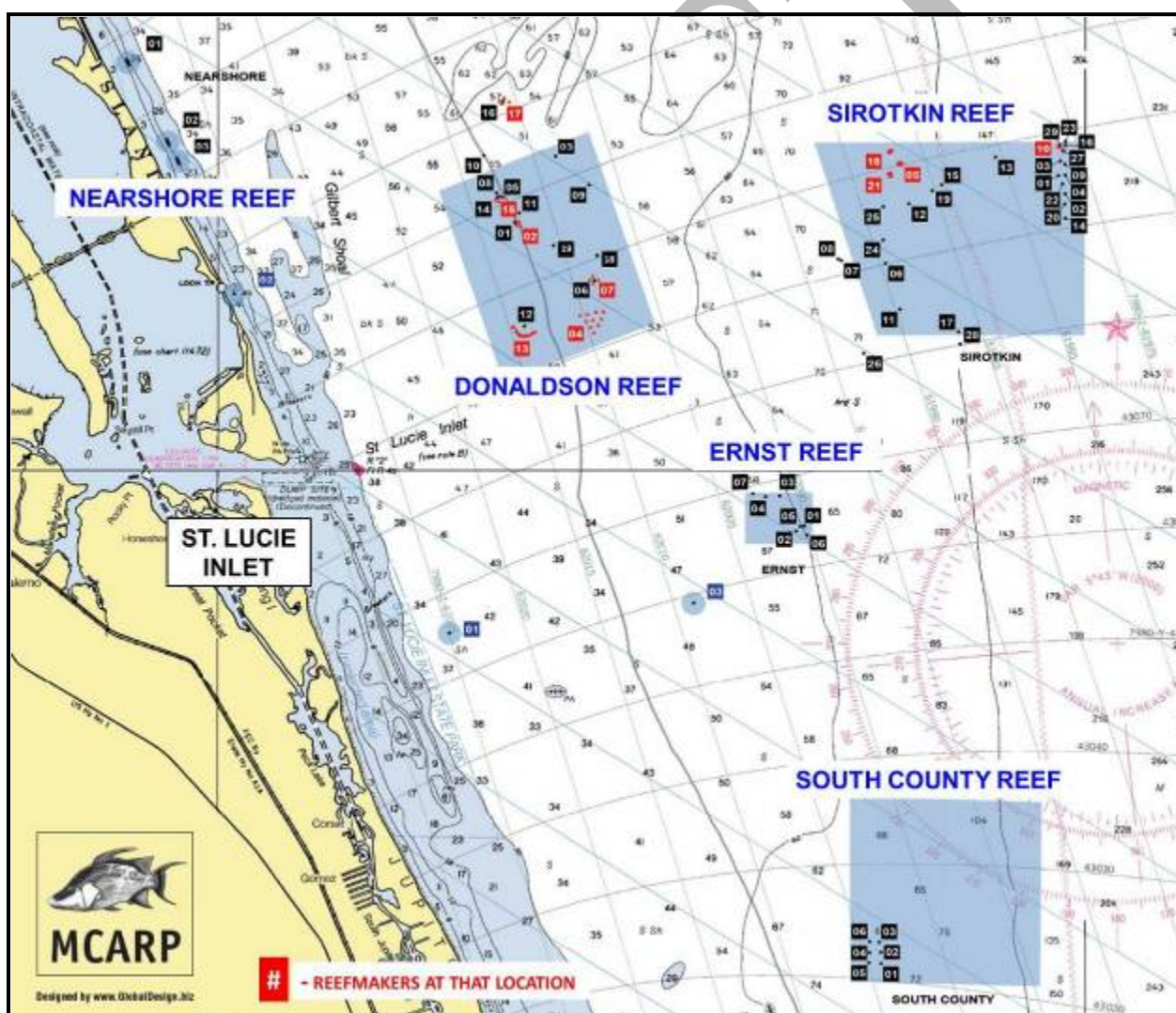


Figure 1. Location of Martin County's Permitted Offshore Reef Sites.

In 2012, Maxwell Marine Consulting Engineers, Inc. (MMCE) was authorized by Martin County to perform monitoring services for eleven reef sites, refer to Table 1.

Table 1. 2012 Monitoring Sites.

	Reefs to Monitor - 2012	Last Monitoring	Depth	Permit Area	Survey Type
1	Cement Barge (4 Reefmakers)	2007	60	Donaldson	in-water
2	Traffic Barge (4 Reefmakers)	2007	60	Donaldson	in-water
3	Upside-Down Barge (4 Reefmakers)	2007	60	Donaldson	in-water
4	Lee Harris Memorial Reef	N/A	60	Donaldson	in-water
5	Evinrude Reef	N/A	56	Donaldson	in-water
6	Kyle's Crossbar Reef	N/A	61	Donaldson	in-water
7	Clifton Perry Memorial	2009	65	Donaldson	in-water
8	Diamond Patch – Central (5 Reefmakers)	2007	105	Sirotkin	fathometer
9	Diamond Patch – South (5 Reefmakers)	2008	100	Sirotkin	fathometer
10	Glasrud Reef	2011	187	Sirotkin	fathometer
<i>Under a separate 5 year monitoring proposal, standalone report submitted in February 2012</i>					
11	Kyle Conrad Memorial Reef (tug)	N/A	150	Kyle Conrad	fathometer

2.0 BACKGROUND

Martin County has constructed in excess of 60 artificial reefs using discarded concrete and steel bridge components, steel-hulled derelict vessels and natural limestone rock. Within the last decade, dozens of purpose-built artificial reef modules have been deployed in varying arrays offshore to attract popular fish species. As the value and popularity of artificial reefs continue to grow, new strategies and reefing materials may be identified to further enhance local reef habitats. Annual artificial reef monitoring is required for two years following material placement. Refer to Table 2 for a list of all reefs deployed from 2000 to 2012, including the site location, materials and deployment date.

Table 2. Martin County artificial reefs deployed 2000 to 2012.

Reef Name	Materials	Site	Deployment Dates
Mitigation Site A	bridge pieces	Nearshore	Jul-Sep 2000
Mitigation Site B	bridge pieces	Nearshore	Jul-Sep 2000
Mitigation Site C	bridge pieces	Nearshore	Jul-Sep 2000
Evans Crary Bridge	bridge pieces	Ernst	Summer 2000
Tetrahedron Stack	concrete pyramids	Sirotkin	4,25 Apr 2001
Tetrahedron Patch-Yellow	concrete pyramids	Sirotkin	28 Mar 2002
Tetrahedron Patch-Pink	concrete pyramids	Sirotkin	28 Mar 2002
Tetrahedron Patch-Blue	concrete pyramids	Sirotkin	28 Mar 2002

Reef Name	Materials	Site	Deployment Dates
Tetrahedron Patch-White	concrete pyramids	Sirotkin	28 Jun 2002
Tetrahedron Patch-Black	concrete pyramids	Sirotkin	28 Jun 2002
Tree Barge	140' barge	Sirotkin	19 Apr 2002
Wickstrom	168' cargo ship	Sirotkin	21 Jan 2003
Railroad Tie Stack	concrete RR ties	Sirotkin	Mar-Jun 2003
High Queen and Zeppo	tug & 120' barge	Sirotkin	7 Aug 2003
Five Peaks Patch-Blue	concrete RR ties	Sirotkin	2 Jun 2004
Five Peaks Patch-Orange	concrete RR ties	Sirotkin	2 Jun 2004
Five Peaks Patch-Yellow	concrete RR ties	Sirotkin	28-29 Jun 2004
Five Peaks Patch-Pink	concrete RR ties	Sirotkin	28-29 Jun 2004
Five Peaks Patch-Black	concrete RR ties	Sirotkin	28-29 Jun 2004
Tension Barge	140' barge	Sirotkin	17 Jul 2004
Reefmaker Triangle	concrete & steel units	Donaldson	18 May 2005
Reefmaker Texas	concrete & steel units	Donaldson	20 May 2005
Reefmaker Cement Barge	concrete & steel units	Donaldson	20 May 2005
Reefmaker Traffic Barge	concrete & steel units	Donaldson	20 May 2005
Reefmaker Upside Down Barge	concrete & steel units	Donaldson	20 May 2005
Reefmaker Inlet Barge	concrete & steel units	Donaldson	20 May 2005
Reefmaker Patch N	concrete & steel units	Sirotkin	21 May 2005
Reefmaker Patch C	concrete & steel units	Sirotkin	21 May 2005
Reefmaker Patch S	concrete & steel units	Sirotkin	21 May 2005
Reefmaker Tree Barge	concrete & steel units	Sirotkin	21 May 2005
Clifton Perry Memorial	bridge pieces	Donaldson	Jan-May 2005
Frances Langford Memorial	bridge pieces	Sirotkin	Feb-Aug 2005
PCL Deep	bridge pieces	Sirotkin	Oct 2006
PCL Shallow	bridge pieces	Donaldson	Nov-Dec 2006
PCL River	bridge pieces	IR Lagoon	Nov 2006-Jan 2007
West 400	400 tons concrete	Ernst	15 Jun 2007
Mango	440 tons concrete	Ernst	15,26 Jun 2007
Grand Teton	728 tons concrete	Ernst	26,30 Jun 2007
KD Select	537 tons concrete	Sirotkin	9 Jul 2007
Ann Marie	260 tons concrete	S County	11 Jun 2008
Fogel Capital Management	245 tons concrete	S County	13 Jun 2008
The Heap	268 tons concrete	S County	20 Jun 2008
Jack MacDonald	272 tons concrete	S County	20 Jun 2008
Lentine	240 tons concrete	S County	13 Jun 2008
Shirley	249 tons concrete	S County	11 Jun 2008
American Custom Yachts Tower	Prefab steel tower	Sirotkin	27 Jun 2008
Bausch American Towers Tower	Prefab steel tower	Sirotkin	27 Jun 2008
Baratta Sight-See-Er Tower	Prefab steel tower	Sirotkin	27 Jun 2008
Deborah Schmidt Tower	Prefab steel tower	Sirotkin	27 Jun 2008
Pirate's Cove	500 tons concrete	Sirotkin	24 August 2009
Ballantrae Anglers	500 tons concrete	Sirotkin	24 August 2009
Corinthians Yacht Club	500 tons concrete	Sirotkin	24 August 2009
Glasrud	69 ft steel tugboat	Sirotkin	24 Feb 2010
Kyle Conrad Memorial (Tug)	70 ft steel tugboat	Sirotkin	17 Jan 2011

Reef Name	Materials	Site	Deployment Dates
Ralph Evinrude	concrete & steel pieces	Donaldson	12 April 2011
Lee Harris Memorial	concrete & steel pieces	Donaldson	15,19 April & 9,11 May 2011
Aaron Vaughn Memorial	concrete pile cut-offs	Donaldson	1, 6 July 2012
Kyle's Crossbar	concrete pile cut-offs	Donaldson	12, 17 July 2012

Table 3 presents the locations and water depths for the same artificial reef sites identified in Table 2.

Table 3. Locations of Martin County artificial reefs deployed between 2000 to 2012.

Reef Name	Latitude N	Longitude W	Water Depth (ft)	Reef Crest Depth (ft)
Mitigation Site A	27° 14.412'	80° 11.098'	10 to 20	7 to 20
Mitigation Site B	27° 13.553'	80° 10.647'	10 to 20	7 to 20
Mitigation Site C	27° 13.335'	80° 10.513'	10 to 20	7 to 20
Evans Crary Bridge	27° 09.346'	80° 03.368'	75	49
Tetrahedron Stack	27° 12.814'	80° 02.329'	100	91
Tetrahedron Patch (Yellow)	27° 12.486'	80° 02.369'	95	87
Tetrahedron Patch (Pink)	27° 12.465'	80° 02.341'	95	87
Tetrahedron Patch (Blue)	27° 12.479'	80° 02.350'	95	87
Tetrahedron Patch (White)	27° 12.462'	80° 02.323'	98	95
Tetrahedron Patch (Black)	27° 12.432'	80° 02.360'	95	87
Tree Barge	27° 13.419'	80° 00.280'	190	178
Wickstrom Ship	27° 13.492'	80° 00.318'	188	133
Railroad Tie Stack	27° 12.201'	80° 02.310'	93	73
High Queen and Zeppo	27° 13.489'	80° 00.257'	190	175
Five Peaks Patch (Blue)	27° 11.688'	80° 02.120'	99	90
Five Peaks Patch (Orange)	27° 11.670'	80° 02.131'	97	88
Five Peaks Patch (Yellow)	27° 11.701'	80° 02.140'	97	91
Five Peaks Patch (Pink)	27° 11.717'	80° 02.141'	95	86
Five Peaks Patch (Black)	27° 11.707'	80° 02.122'	98	92
Tension Barge	27° 13.527'	80° 00.261'	190	178
Reefmaker Triangle	27° 11.595'	80° 05.716'	50	40
Reefmaker Texas	27° 11.414'	80° 06.523'	50	40
Reefmaker Cement Barge	27° 12.627'	80° 06.597'	60	50
Reefmaker Traffic Barge	27° 12.912'	80° 06.821'	60	50
Reefmaker Upside-Down Barge	27° 13.953'	80° 06.732'	60	50
Reefmaker Inlet Barge	27° 12.022'	80° 05.709'	60	50
Reefmaker Diamond N	27° 13.410'	80° 02.280'	100	90
Reefmaker Diamond C	27° 13.276'	80° 02.165'	105	95
Reefmaker Diamond S	27° 13.166'	80° 02.284'	100	90
Reefmaker Tree Barge	27° 13.425'	80° 00.274'	185	175
Clifton Perry Memorial	27° 13.339'	80° 06.131'	66	40 to 50
Frances Langford Memorial	27° 13.353'	80° 01.046'	150	118
PCL Deep	27° 12.924'	80° 01.774'	122	104
PCL Shallow	27° 13.045'	80° 05.743'	60	41
PCL River	27° 12.771'	80° 11.190'	10 – 17	7 @ MLW

Reef Name	Latitude N	Longitude W	Water Depth (ft)	Reef Crest Depth (ft)
West 400	27° 09.735'	80° 03.856'	62	46
Mango	27° 09.702'	80° 03.702'	61	48
Grand Teton	27° 09.708'	80° 03.535'	62	34
KD Select	27° 11.476'	80° 01.474'	124	113
Ann Marie	27° 04.657'	80° 02.297'	67	59
Fogel Capital Management	27° 04.773'	80° 02.297'	67	60
The Heap	27° 04.888'	80° 02.430'	68	63
Jack MacDonald	27° 04.885'	80° 02.314'	68	59
Lentine	27° 04.769'	80° 02.423'	68	62
Shirley	27° 04.663'	80° 02.440'	66	61
American Custom Yachts Tower	27° 13.148'	80° 00.338'	190	155
Bausch American Towers Tower	27° 13.152'	80° 00.259'	189	154
Baratta Sight-See-Er Tower	27° 13.301'	80° 00.307'	187	172
Deborah Schmidt Tower	27° 13.277'	80° 00.266'	187	152
Pirate's Cove	27° 12.814'	80° 00.289'	187	174
Ballantrae Anglers	27° 12.936'	80° 00.280'	187	181
Corinthians Yacht Club	27° 13.040'	80° 00.306'	185	175
Glasrud	27° 12.698'	80° 00.259'	191	162
Ralph Evinrude	27° 12.211'	80° 05.696'	56	42
Lee Harris Memorial	27° 12.330'	80° 06.198'	61	45
Kyle Conrad Memorial (Tug)	27° 15.972'	80° 00.991'	150	119
Kyle's Crossbar	27° 12.720'	80° 05.610'	58, 57	41, 37
Aaron Vaughn Memorial	27° 12.780'	80° 05.610'	60, 53	45, 40

Note: The artificial reef sites in Table 2 and Table 3 required annual monitoring for the first two to five years following their deployment. The 2011/2012 annual monitoring was performed for eleven of the reefs created from 2000 to 2012.

Table 4 presents the dates of the deployments and annual monitoring performed from 2004 to 2012.

Table 4. Annual monitoring dates for Martin County artificial reefs.

Reef Name	2012	2011	2010	2009	2008	2007	2006	2005	2004
Mitigation Site A	-	no	no	no	No	8/18	5/21, 6/30, 12/27	no [1]	6/1
Mitigation Site B	-	no	no	no	No	8/18	5/22	no [1]	5/26 & 29
Mitigation Site C	-	no	no	no	no	7/11	5/21, 12/27	no [1]	5/26 & 30
Evans Crary Bridge	-	no	9/11	no	no	NA	NA	6/17	5/10,23,30
Tetrahedron Stack	-	no	9/13	no	no	NA	5/21	6/17	5/21, 6/11
Tetrahedron Patch-Yellow	-	no	9/13	no	no	7/18	4/26	6/7	5/24, 6/3
Tetrahedron Patch-Pink	-	no	no	no	no	7/18	4/26	6/7	5/24, 6/4
Tetrahedron Patch-Blue	-	no	9/13	no	no	7/18	4/26	6/7	5/24, 6/5
Tetrahedron Patch-White	-	no	no	no	no	7/18	4/26	6/7	5/24, 6/6
Tetrahedron Patch-Black	-	no	no	no	no	7/18	4/26	6/7	5/24, 6/7
Tree Barge	-	9/25	no	no	no	9/3	6/3	no [2]	no [2]
Wickstrom Ship	-	no	9/6	no	no	9/3	6/3	no [2]	8/18
Railroad Tie Stack	-	7/24	no	no	8/5	6/25	5/23	6/8	5/23 & 29
High Queen and Zeppo	-	9/29	no	no	no	9/15	no [2]	no [2]	8/27
Five Peaks Patch-Blue	-	no	no	10/2	6/25	7/10	5/27	6/8	deployed
Five Peaks Patch-Orange	-	no	no	10/2	6/25	7/10	5/27	6/8	deployed
Five Peaks Patch-Yellow	-	no	no	10/2	6/25	7/10	5/27	6/8	deployed
Five Peaks Patch-Pink	-	no	no	10/2	6/25	7/10	5/27	6/8	deployed
Five Peaks Patch-Black	-	no	no	10/2	6/25	7/10	5/27	6/8	deployed
Tension Barge	-	9/29		no	no	9/15	no [2]	no [2]	deployed
Reefmaker Triangle	-	no	12/17	no	no	6/24	5/23	deployed	NA
Reefmaker Texas	-	7/27	no	no	7/24	6/25	4/21, 6/30	deployed	NA
Texas Reef	-	8/23	-	-	-	-	-	-	-
Reefmaker Cement Barge	Yes	no	no	no	no	6/22	4/21	deployed	NA
Reefmaker Traffic Barge	Yes	no	no	no	no	6/21	4/3	deployed	NA
Reefmaker Upside-down Barge	Yes	no	no	no	no	6/19	no [3]	deployed	NA
Reefmaker Inlet Barge	-	no	12/17	no	no	6/21	no [3]	deployed	NA
Reefmaker Patch N	-	7/24	no	no	no	no [3]	3/6	deployed	NA
Reefmaker Patch C	Yes	no	no	no	no	7/10	no [3]	deployed	NA
Reefmaker Patch S	Yes	no	no	no	12/21	no [3]	3/6	deployed	NA

Reef Name	2012	2011	2010	2009	2008	2007	2006	2005	2004
Reefmaker Tree Barge	-	no	no	no	no	9/3	6/3	deployed	NA
Clifton Perry Memorial	Yes	no	no	9/28	7/24	6/24	4/3	deployed	NA
Frances Langford Memorial	-	no	no	10/8	12/21	8/8	6/2	deployed	NA
PCL Deep	-	no	no	10/2	12/20	10/29	deployed	NA	NA
PCL Shallow	-	no	no	9/28	6/25	9/20	deployed	NA	NA
PCL IRL	-	no	no	10/25		deployed	NA	NA	NA
West 400	-	no	no	8/26	6/27	deployed	NA	NA	NA
Mango	-	no	no	10/8	6/27	deployed	NA	NA	NA
Grand Teton	-	no	no	8/26	6/19	deployed	NA	NA	NA
KD Select	-	no	no	10/10	12/20	deployed	NA	NA	NA
Ann Marie	-	no	no	8/31	deployed	NA	NA	NA	NA
Fogel Capital Management	-	no	9/10	8/31	deployed	NA	NA	NA	NA
The Heap	-	no	9/10	10/8	deployed	NA	NA	NA	NA
Jack MacDonald	-	no	no	9/1	deployed	NA	NA	NA	NA
Lentine	-	no	no	9/1	deployed	NA	NA	NA	NA
Shirley	-	no	no	10/8	deployed	NA	NA	NA	NA
American Custom Yachts Tower	-	no	2/13/11	10/15	deployed	NA	NA	NA	NA
Bausch American Tower	-	no	no	no [3]	deployed	NA	NA	NA	NA
Baratta Sight-See-Er Tower	-	no	no	no [3]	deployed	NA	NA	NA	NA
Deborah Schmidt Tower	-	no	no	no [3]	deployed	NA	NA	NA	NA
Pirate's Cove	-	10/1	9/8	deployed	NA	NA	NA	NA	NA
Ballantrae Anglers	-	no	9/8	deployed	NA	NA	NA	NA	NA
Corinthian Yacht Club	-	no	no	deployed	NA	NA	NA	NA	NA
Glasrud Reef - "Big Al"	Yes	9/13	deployed	NA	NA	NA	NA	NA	NA
Ralph Evinrude	Yes	deployed	NA	NA	NA	NA	NA	NA	NA
Lee Harris Memorial	Yes	deployed	NA	NA	NA	NA	NA	NA	NA
Kyle Conrad Memorial (Tug)	Yes	deployed	NA	NA	NA	NA	NA	NA	NA
Kyle's Crossbar	Yes/deployed	NA	NA	NA	NA	NA	NA	NA	NA
Aaron Vaughn Memorial	deployed	NA	NA	NA	NA	NA	NA	NA	NA

Notes: (1) Mitigation reef monitoring not completed in 2005 due to poor visibility, (2) Annual in-water monitoring is not required for reef sites in water depths greater than 100 feet, (3) Not every Reefmaker unit is monitored every year.

3.0 PROJECT OBJECTIVES

Artificial reefs are an increasingly valuable amenity for recreational fishing and diving. Florida registers more boats annually than any other state (USCG, 2007-2011 Recreational Boating Statistics) with many resident and visiting certified scuba divers, and marine anglers, that enjoy what the Florida waters have to offer. For several decades in Martin County, artificial reefs have been enhancing local fishing and diving while alleviating pressure on natural reef systems. While there is no scientific confirmation yet that artificial reefs enhance regional fish populations, or reduce human impacts to natural reef and hard-bottom communities, many fisheries biologists believe they do, and regular monitoring may eventually describe their full contribution to the nearshore marine environment.

Annual monitoring of each artificial reef structure is required by the US Army Corps of Engineers for a minimum of two years, which includes documenting associated flora and fauna. When permit requirements are satisfied, the reefs are monitored on a rotating basis, typically every 4-5 years. The primary objectives of the monitoring effort are to verify artificial reef locations, document biological activity (benthic flora and invertebrates, demersal and pelagic fish communities) and evaluate engineering performance (stability and condition of the reef materials, scour and settlement). Effective analysis of artificial reef monitoring data may result in a program that optimizes reef placement and engineering in ways that maximize both fisheries and recreational enhancement.

3.1 METHODOLOGY

The in-water monitoring techniques used to monitor Martin County's artificial reef sites in 2012 were identical to the methodology used by L. Harris and K. Dillon in previous annual monitoring efforts. Divers made direct measurements of the reefs, recorded visual observations and collected still photos and video footage to document vital statistics for each artificial reef. Fieldwork was performed by the authors and other qualified divers (engineers and scientists) to ensure that all pertinent engineering and biological data were observed and documented.

3.1.1 Physical Measurements

Divers inspected and measured each artificial reef unit to determine changes in the reef structure, including scour, settlement, and other movement of reef components by repeating survey measurements established during previous 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. Changes in reef heights were used to assess settlement of the materials. The natural bottom depths of 33 feet (10 meters) away from the reefs were compared to the maximum depths immediately adjacent to the reefs to assess scour. Measuring tapes and compass readings were used to measure horizontal distances on the reefs, as well as distances and bearings between the patch reefs, where applicable.

3.1.2 Biological Surveys

Data collection methods utilized the Roving Diver Technique (RDT) to perform fish counts to assess the diversity and density of demersal and pelagic fishes. Plant and invertebrate assessments were also performed by identifying benthic flora and fauna on and among the artificial reef substrate to the lowest practical taxa.

3.1.3 Photo/Video Documentation

Underwater still and video cameras were used to document observations during the dives. Photography was used to help confirm identification of flora and fauna and to compare with still and video photographs collected during previous monitoring. Due to varying conditions (especially visibility at the bottom), underwater photographs for some sites or some dates are not of sufficient quality to include in this report. Selected photographs taken in 2012 are included in this report. In addition to the report, copies of all photographs and videos shall be submitted on DVD.

Monitoring reports from previous years were reviewed prior to performing the fieldwork, and dive slates were prepared in advance with sketches of the dive sites and tables for recording measurements and observations. All data taken during monitoring dives were thoroughly reviewed on the boat immediately after each dive, and data was then transferred into field journals to assure that correct and complete data was recorded and saved.

3.1.4 Fathometer Surveys

Fathometer surveys were performed at reef sites exceeding depths of 100 ft using a Hummingbird 1197/c combination sidescan imaging and depth profiler with integrated GPS set to collect depth and position data at 4 second intervals. The objective of the surveys was to document and record the depths within artificial reef site and observe the reef via the depth profile / sidescan imaging. Fathometer data collected during the surveys is included in the Appendix.

4.0 ARTIFICIAL REEF LOCATIONS

A total of nine individual artificial reef sites were monitored in 2011, dispersed among two of the permitted offshore artificial reef sites. The specific artificial reef sites listed in Table 5 were monitored, with physical surveys of the reef site and biological inventories performed for each site.

Table 5. List of artificial reefs monitored in 2012.

Reefs to Monitor - 2012	2012 Monitoring	Last Monitoring	Depth	Permit Area	Survey Type
Cement Barge 4 Reefmakers	09/18/2012	2007	60	Donaldson	in-water
Traffic Barge - 4 Reefmakers	09/18/2012	2007	60	Donaldson	in-water
Upside-Down Barge - 4 Reefmakers	09/08/2012	2007	60	Donaldson	in-water
Lee Harris Memorial Reef	09/08/2012	N/A	60	Donaldson	in-water
Evinrude Reef	09/09/2012	N/A	56	Donaldson	in-water
Kyle's Crossbar Reef	09/09/2012	N/A	61	Donaldson	in-water
Clifton Perry Memorial	09/19/2012	2009	65	Donaldson	in-water
Diamond Patch – Central (5 Reefmakers)	09/05/2012	2007	105	Sirotkin	fathometer
Diamond Patch – South (5 Reefmakers)	09/05/2012	2008	100	Sirotkin	fathometer
Glasrud Reef	09/05/2012	2011	187	Sirotkin	fathometer
Kyle Conrad Memorial (Tug)*	09/05/2012	N/A	150	Kyle Conrad	fathometer
* This artificial reef site is under a separate 5 year monitoring proposal, a standalone report was submitted 2/2012					

The following sections provide a summary description of deployments on the Donaldson and Sirotkin permitted reef areas. The locations of the artificial reefs monitored for this report are shown on location charts along with other known artificial reef deployments. The permitted reef areas are located in water depths ranging from 50 to 190 feet and include artificial reefs constructed using a variety of man-made and natural materials. The size of the individual artificial reefs is also quite variable due to the type and quantity of materials used.

Figure 2 shows the distances from the St. Lucie Inlet sea buoy to the four primary offshore artificial reef areas, the Ernst, Donaldson, Sirotkin and South County Artificial Reef areas.

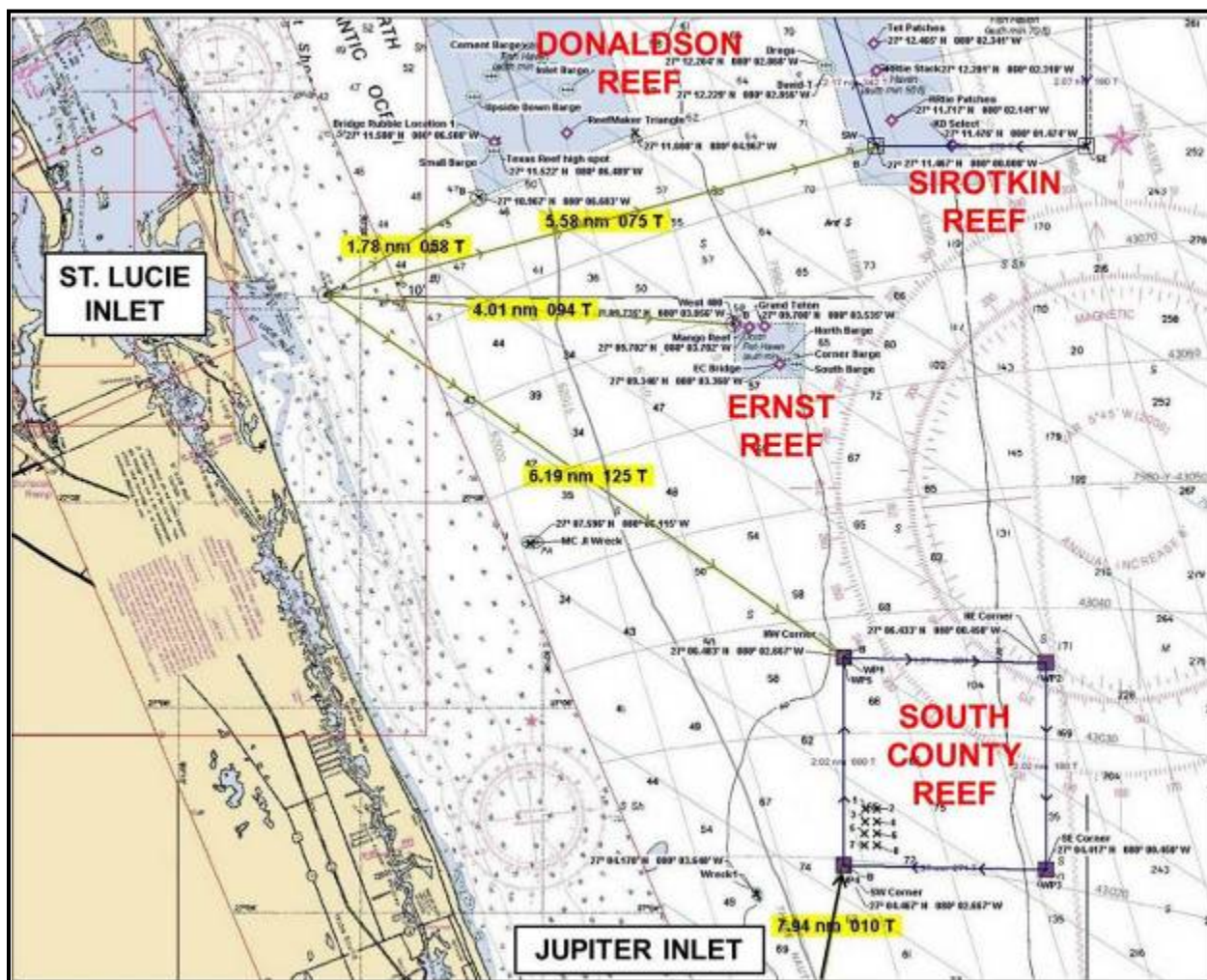


Figure 2. Bearing and distances from St. Lucie Inlet sea buoy to the offshore artificial reef sites.

4.1 DONALDSON ARTIFICIAL REEF SITE

The Donaldson Artificial Reef site is located about 2 nautical miles (nm) NE of the St. Lucie Inlet sea buoy as shown in Figure 2. Water depths vary from 50 to 68 feet within this area and it contains a variety of artificial reef structures, including several older barges, dredged limestone rubble, recycled bridge materials, concrete culverts, boxes and pilings and purpose-built artificial reef modules. Martin County received a grant from FWC to enhance existing artificial reef sites, and sixty pyramid shaped concrete with steel Reefmaker (RM) “Florida Special” artificial reef units were deployed in May 2005 adjacent to existing artificial reef materials within the Donaldson and Sirotkin Artificial Reefs Sites. Forty-one of these reef units were deployed in the Donaldson Artificial Reef Site, surrounding four existing barge sites (Upside Down, Traffic, Cement, and Donaldson Inlet) and as stand-alone artificial reef sites. Figure 3 shows the area of the permitted Donaldson Artificial Reef Site and the reef locations within the site.

The locations of the individual reef sites (by number) are shown in Figure 3 and are summarized in Table 6. The locations of the barge sites with Reefmaker units are shaded in red.

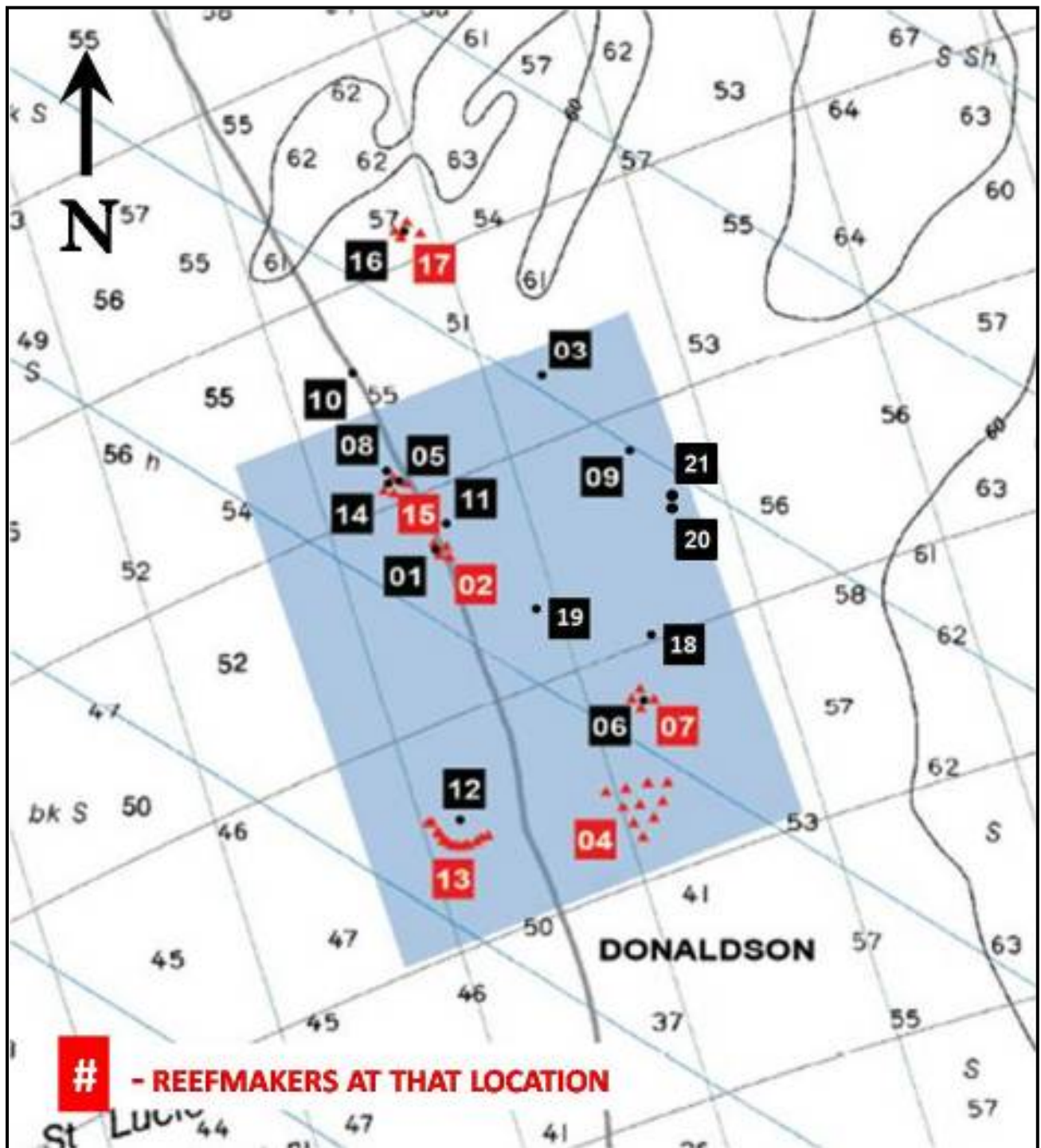


Figure 3. Chart of the Donaldson Artificial Reef site.

Table 6. Summary of Donaldson Artificial Reef sites.

NO.	REEF NAME
01	Cement Barge
02	Cement Barge – Reefmakers (4)
03	Clifton Perry Memorial Reef
04	Donaldson Triangle – Reefmaker
05	Guardian Reef
06	Inlet Barge
07	Inlet Barge – Reefmakers (4)
08	LC-6
09	PCL Shallow (Lyons Bridge)
10	Pipe Barge
11	The Owl
12	The Texas Reef
13	The Texas Reef – Reefmakers (15)
14	Traffic Barge
15	Traffic Barge – Reefmakers (4)
16	Upside-Down Barge
17	Upside-Down Barge – Reefmakers (4)
18	Ralph Evinrude
19	Lee Harris Memorial
20	Kyle’s Crossbar
21	Aaron Vaughn Memorial
Note: Reef names in bold were monitored in 2012.	

In 2012, two artificial reefs were deployed in the Donaldson area; the Kyle’s Crossbar Reef and the Aaron Vaughn Memorial Reef. The reefs are located approximately 600 ft apart, and were constructed using precast concrete pile-cutoffs of various lengths from the Veterans Memorial Bridge/Indian Street project. Each reef site received two - 500 ton barge loads of material.

Kyle Conrad was a local standout soccer player at Jensen Beach High School and Lynn University, was passionate about watersports, and spent much of his time fishing, diving and spearfishing the natural and artificial reefs in Treasure Coast waters. He lost his life in tragic accident in December 2010.

Aaron Vaughn spent his teen and young adult years in the Martin County community, graduating from Indian River State College and worked at the Jupiter Island Golf Course before enlisting in the Navy. Aaron Vaughn, a 30-year-old father of two, was among 30 Americans aboard a helicopter when it was shot down in Afghanistan in August 2011. On July 10, 2012, the Martin County Board of County Commissioners proclaimed that the new reef site be named after Navy SEAL Aaron Vaughn. The plaque’s engraving notes Aaron was a “loving husband, father and son.”

4.2 SIROTKIN ARTIFICIAL REEF SITE

The Sirotkin Artificial Reef site is the largest and deepest of the permitted artificial reef sites offshore of Martin County (Figure 4). Of the five permitted sites, Sirotkin contains the largest number of artificial reefs, a total of 30. The western side of the site has water depths in the 70 foot range, while the eastern border includes water depths of just over 200 feet. Although depths in excess of 130 feet are not recommended for recreational diving, technical divers and offshore sport fishermen utilize the deeper artificial reefs because of the dramatic underwater scenery and diversity of demersal and pelagic fish species encountered there. Through a grant Martin County received from the FWC to enhance existing artificial reef sites, sixty pyramid shaped concrete with steel Reefmaker (RM) “Florida Special” artificial reef units were deployed in May 2005 adjacent to existing artificial reef materials within the Donaldson and Sirotkin Artificial Reefs Sites. Nineteen of the sixty artificial reef units were deployed in the Sirotkin Artificial Reef Site to create three (3) patch reef clusters (North, Center, and South) and a corridor connecting the Tree Barge and the Wickstrom artificial reef sites.

The individual reefs within the Sirotkin Artificial Reef Site are identified and numbered in Figure 4; a summary of the reef names is located in Table 7. The locations of the sites with Reefmaker artificial reef units are shaded in red.

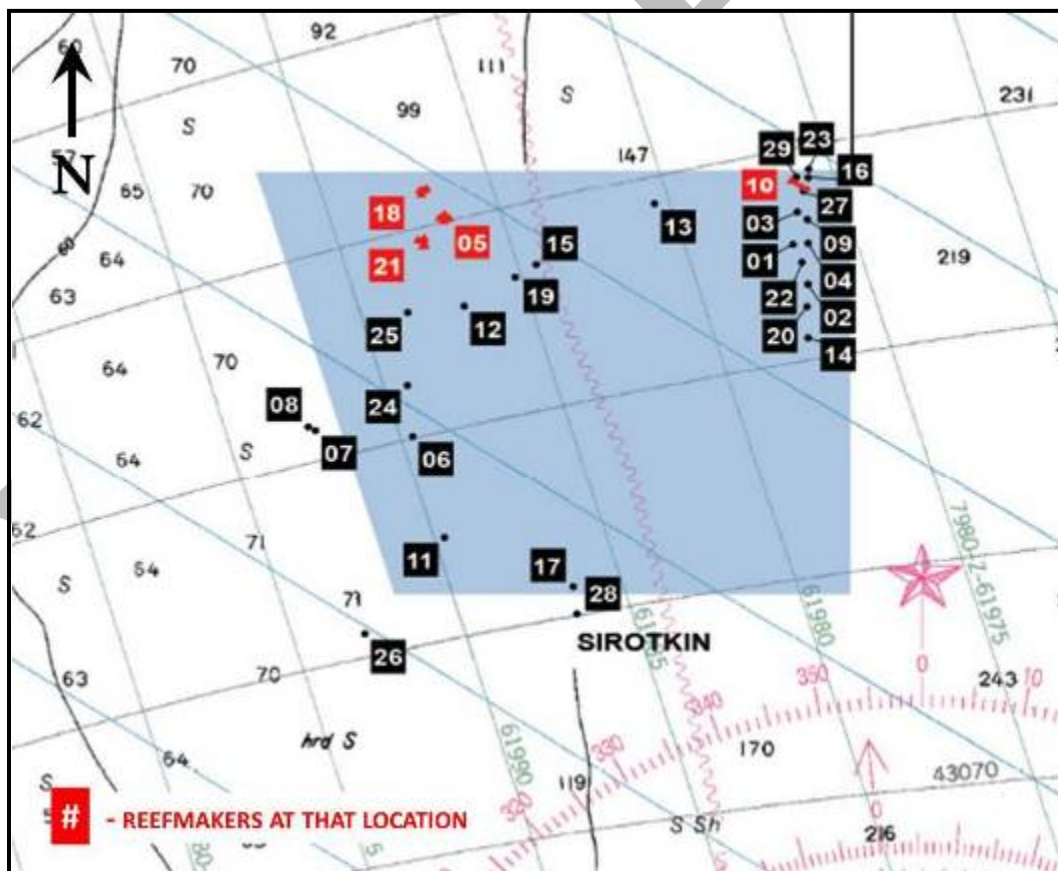


Figure 4. Chart of the Sirotkin Artificial Reef site.

Note – Reef Site No. 30, the Kyle Conrad Memorial Reef, was deployed just north of the permitted site and is not shown in the above figure.

Table 7. Summary of Sirotkin Artificial Reef sites.

NO.	REEF NAME
01	American Custom Yachts Tower
02	Ballantrae Anglers
03	Baratta Sight-Sea-Er Tower
04	Bausch American Towers Tower
05	Center Patch – Reefmakers (5)
06	Concrete RR Tie Stack
07	David-T
08	Draga-de-Arena
09	Debbie Schmidt Tower
10	Eastern Corridor – Reefmakers (4)
11	Five Peaks Reef
12	FPL Reef/Roosevelt Bridge
13	Frances Langford Memorial
14	Glasrud (BIG AL) Tug
15	Halloween Barge
16	High Queen & Zeppo
17	KD Select
18	North Patch – Reefmakers (5)
19	PCL Deep (Lyons Bridge)
20	Pirate's Cove
21	South Patch – Reefmakers (5)
22	Stuart Corinthian Y.C.
23	Tension Barge
24	Tetrahedron Patch
25	Tetrahedron Stack
26	Titan Tug
27	Tree Barge
28	USS Rankin Navy Ship
29	Wickstrom Ship
30	Kyle Conrad Memorial Reef (tug)
Note: Reef names in bold were monitored in 2012	

A variety of reefing materials have been deployed within the Sirotkin Artificial Reef site over the last several decades. The most recent addition to this deep reef site was made in January 2011 with the deployment of the Kyle Conrad Memorial Reef. Tuff-E-Nuff, originally known as Thomas Cunningham Sr., was a late 19th-century tugboat that had a remarkable 112-year commercial career. She was still operating as a working tugboat as recently as May 2007. After having been decommissioned, fish habitat creators with the MCAC Reef Fund decided to repurpose the 70-foot steel tugboat as an artificial reef memory of Kyle Conrad.

Other more recent deployments consisted of various concrete rubble, dismantled bridge components, ships, barges and artificial reef modules. In February 2010, a 69 ft long, ocean-going, steel tugboat was placed upright on the seafloor and has an impressive profile of 42 ft, and named the Glasrud Reef. Other steel vessels have been deployed in the NE corner of the Sirotkin reef site such as the Wickstrom, Tree Barge, High Queen/Zepo, and the Tension Barge. Another recent addition (2008) is the Harbor Branch Towers formation, a group of four steel towers deployed upright in 190 feet of water. Each of the towers measures approximately 20 feet wide by 35 feet tall.

5.0 MONITORING RESULTS

The following sections summarize the monitoring results for the 2012 selected reefs. A brief history and description of each reef is followed by structural details and biological survey results, along with photographs.

5.1 CEMENT BARGE - 4 REEFMAKERS

- Location: Donaldson Reef
- Materials: Barge (Steel) & 4 concrete and steel Reefmaker units
- Maximum Depth: 62 feet
- Reef High Point: 52 feet
- Year Created: 1984, Reefmakers deployed in 2005
- Monitoring Date: 09/18/2012
- Total Cost: \$3,180 (FWC 89% & Martin County 11%)

5.1.1 History of the Cement Barge - 4 Reefmakers

The Cement Barge was deployed in January 1984 in the Donaldson Permitted Area, approximately 3.5 nm East Northeast of the St. Lucie Inlet, and sits upright in 60 feet of water. It is called the “Cement Barge” because it was deployed with several Rinker/Cement Mixer barrels on top of it that, during deployment, rolled off and settled on the Northeast side of the barge. Most of them remain in that same area to this day. In 2005, as part of an FWC grant, Martin County deployed four Reefmaker “Florida Special” artificial reef units around the Cement Barge site to enhance and diversify the existing reef site.

The Cement Barge site is one of four barge sites within Donaldson where four Reefmaker units were placed approximately 100 feet to the north, south, east and west of each barge. One colored zip tie was attached to each reef unit to mark the Reefmaker units deployed around the barges to assist divers with identifying and photo documenting the individual units during monitoring efforts. The following color code was used: blue - reef unit to north, red - reef unit to west, green - reef unit to east, yellow - reef unit to south.

Figure 5 shows a chart with the location of the Cement Barge and the Reefmaker units surrounding the barge. A chart showing the placement of the units around the Cement Barge location is shown in Figure 6.

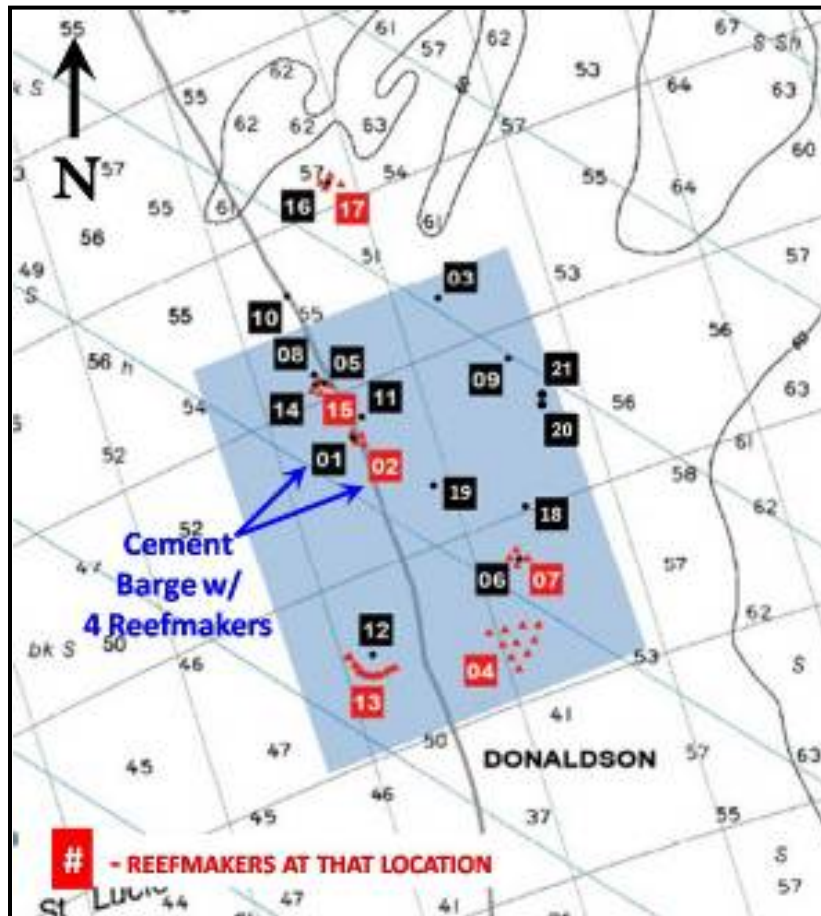


Figure 5. Chart of the Donaldson Reef site showing the Cement Barge and Reefmakers location.

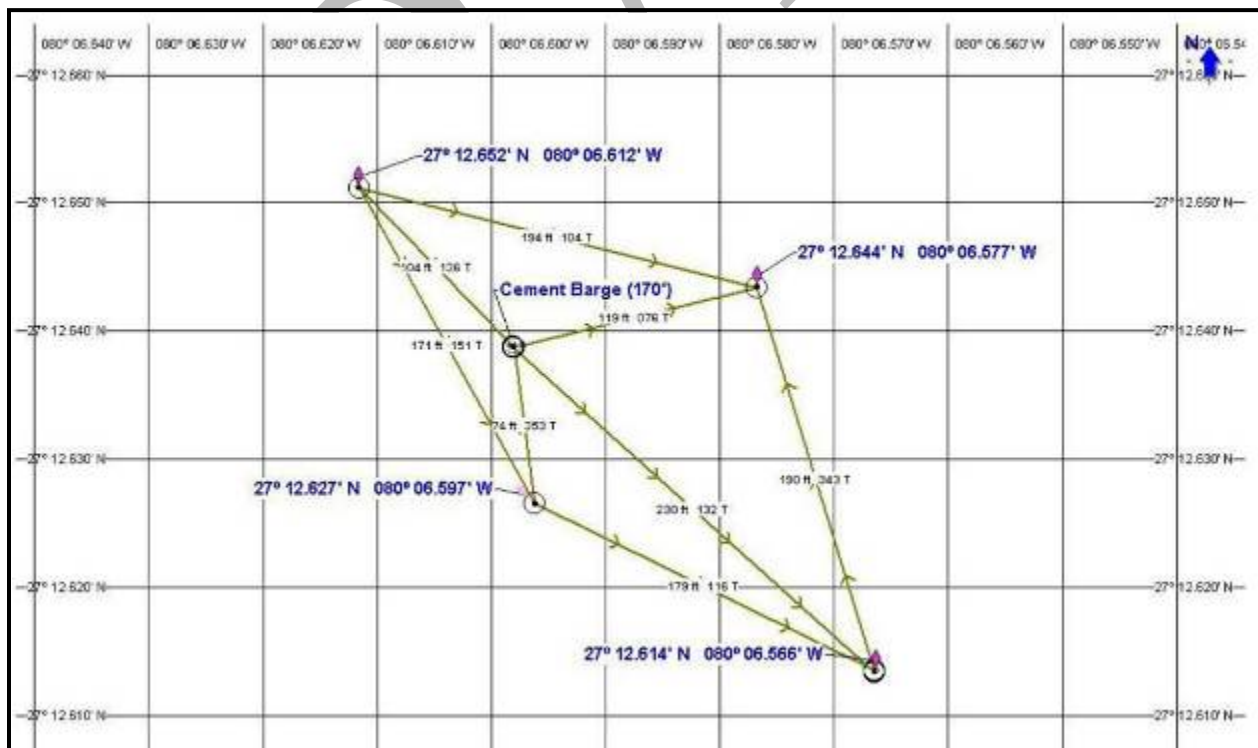


Figure 6. Chart view of the Cement Barge and 4 Reefmaker units.

5.1.2 Structural Summary

During the 2012 monitoring effort, divers checked for evidence of stability and settlement of the Reefmaker units surrounding the Cement Barge site. This was done by visually inspecting the steel and concrete, and by physically grasping the steel bars and tugging on them. In addition, measurements of seafloor depths were recorded immediately adjacent to the bases and offset 25 feet from the units. All of the exposed steel bars were assessed in overall good condition, except those portions closest to the seafloor (approximately within 18 inches). At those areas, corrosion and erosion damage is likely due to wave surge and shifting sands, which occurs almost continuously at shallow depths. In contrast, the Reefmaker units located in deeper sites (+100 ft) do not experience this level of erosive forces.

Because of shifting sediments in this area, some sides of the concrete bases were almost buried. In our opinion, this is a seasonal occurrence, and is not cause for concern when evaluating the overall effectiveness of the Reefmaker units. The photographs in Figure 7 show the general condition of the Reefmaker units surrounding the Cement Barge site.



Figure 7. Cement Barge – 4 Reefmakers 2012 photographs.

5.1.3 Biological Survey Results

Although the Cement Barge has been underwater since 1984 and is abundant with many fish species, at this time, monitoring was limited to the 4 Reefmaker sites, and 23 species were observed, identified and photographed. Of the 23 fish species, 5 are considered important recreational and food value species, as well as baitfish species. Unfortunately, a few Lionfish were observed on the Martin County Artificial Reefs. Table 8 lists the fish species census, including relative abundance and size class (adult, intermediate, and juvenile). Table 9 lists the benthic species that were present. Species identified in Figure 7, clockwise from the top left are (1) none, (2) atlantic spadefish, (3) none, and (4) atlantic spadefish.

Table 8. Cement Barge - 4 Reefmakers Fish Species Census.

Family/Common Name	Species	2012
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		Abundance	Size
Carangidae			
Blue runner	<i>Caranx crysos</i>	A	A
Permit	<i>Trachinotus falcatus</i>	S	A
Chaetodontidae			
Spotfin Butterflyfish	<i>Chaetodon ocellatus</i>	F	A
Clupeidae			
Fry	<i>Unidentified species</i>	A	J
Ephippidae			
Atlantic spadefish	<i>Chaetodipterus faber</i>	F	J
Haemulidae			
Tomtate	<i>Haemulon aurolineatum</i>	M	J & A
Porkfish	<i>Anisotremus virginicus</i>	M	J & A
Labridae			
Spanish hogfish	<i>Bodianus rufus</i>	S	A
Slippery dick	<i>Halichoeres bivittatus</i>	F	J & A
Labrisomidae			
Hairy blenny	<i>Labrisomus nuchipinnis</i>	F	J & A
Lutjanidae			
Gray snapper	<i>Lutjanus griseus</i>	F	A
Pomacanthidae			
Blue angelfish	<i>Holacanthus bermudensis</i>	S	A
Pomacentridae			
Beaugregory	<i>Pomacentrus leucostictus</i>	F	J
Sciaenidae			
High hat	<i>Equetus acuminatus</i>	F	J
Scorpaenidae			
Red Lionfish	<i>Pterois volitans</i>	F	J
Serranidae			
Belted sandfish	<i>Serranus subligarius</i>	F	J & A
Gag grouper	<i>Mycteroperca microlepis</i>	F	J
Goliath grouper	<i>Epinephelus itajara</i>	F(2)	A
Whitespotted soapfish	<i>Rypticus maculatus</i>	F	A
Sparidae			
Sheepshead	<i>Archosargus probatocephalus</i>	F	A
Sheepshead porgy	<i>Calamus penna</i>	F	A
Tetraodontidae			
Bandtail puffer	<i>Sphoeroides spengleri</i>	F	A
Sharppose puffer	<i>Canthigaster rostrata</i>	F	J
	Total	23	

Abundance Key: S=single, F=few (2-10), M=many (11-100), A=abundant (>100)

Size Key: A=adult, J=juvenile, A/J=intermediate

Table 9. Cement Barge - 4 Reefmakers Benthic Species Census.

	Common Name	Scientific Name
Echinoderms	Rock Boring Urchin	<i>Echinometra lucunter</i>
Cnidarians	Algae Hydroids	<i>Thyrosocyphus ramosus</i>
Crustaceans	Volcano Barnacle	<i>Tetraclita stalactifera</i>
Porifera	N/A	<i>Batzella spp.</i>

5.2 TRAFFIC BARGE - 4 REEFMAKERS

- Location: Donaldson Reef
- Materials: Barge (Steel), concrete jersey barriers & 4 Reefmaker units
- Maximum Depth: 62 feet
- Reef High Point: 51 feet
- Year Created: 1993, Reefmakers deployed in 2005
- Monitoring Date: 09/18/2012
- Total Cost: \$3,180 (FWC 89% & Martin County 11%)

5.2.1 History of the Traffic Barge - 4 Reefmakers

The Traffic Barge derived its name because there were several concrete traffic barriers (also known as “jersey barriers”), that were sitting on top of the barge when it was deployed in December 1993. It sits upright in 60 feet of water in the Donaldson permitted reef area.

In 2005, four Reefmaker “Florida Special” artificial reef units were deployed around the Traffic Barge site as part of a grant Martin County received from the FWC. The Traffic Barge site is one of four barge sites within the Donaldson Site where four Reefmaker units were placed approximately 100 feet to the north, south, east and west of each barge to enhance the existing artificial reef sites. One colored zip tie was attached to each reef unit to mark the Reefmaker units deployed around the barges to assist divers with locating units. The following color code was used: blue - reef unit to north, red - reef unit to west, green - reef unit to east, yellow - reef unit to south.

Figure 8 shows the location of the Traffic Barge and the Reefmaker units within the Donaldson site. A chart showing the placement of the units around the Traffic Barge location is shown in Figure 9.

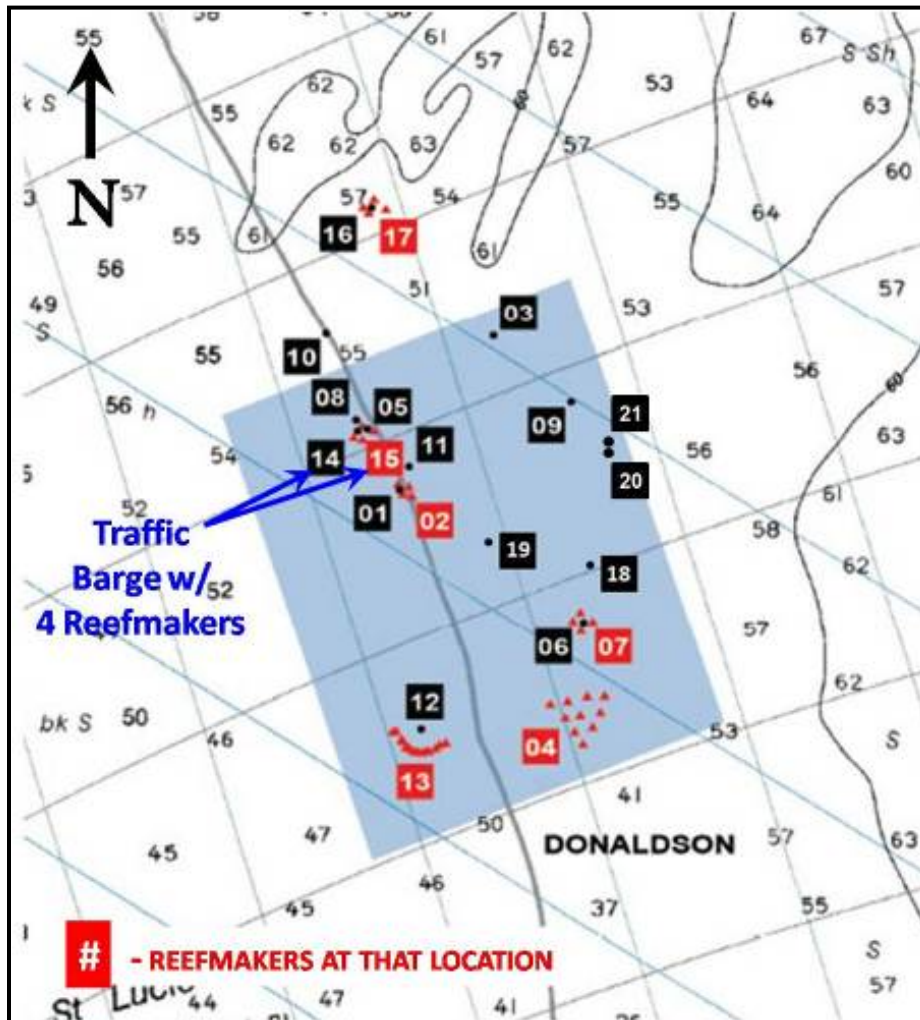


Figure 8. Chart of the Donaldson Reef site showing the Traffic Barge and Reefmakers location.

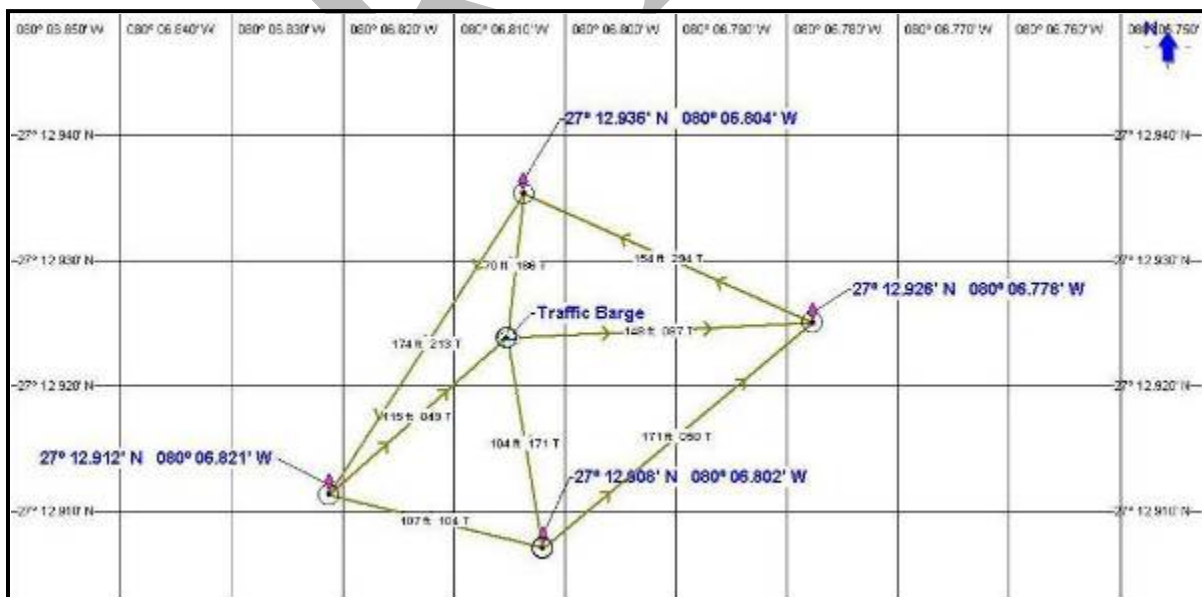


Figure 9. Chart view of the Traffic Barge and 4 Reefmaker units.

5.2.2 Structural Summary

The four Reefmaker units at this site are intact and overall, good condition. Because these units are situated in one of the more shallow locations, similar to Cement Barge, the units are experiencing levels of erosion, corrosion and degradation not observed on the deeper sites. The shallower artificial reef sites are closer to the shoreline; therefore much more sand transfer is experienced seasonally as well as during tropical storm events. This additional sediment movement has eroded the steel side sections considerably in the zone (within 24 inches) of the seafloor. Several steel bars were eroded, it is estimated that 25% of the original thickness is remaining, however; the concrete base and solid concrete framework is the main structural component of each Reefmaker unit. Over time, it is anticipated that much of the steel will be lost through corrosive and erosive forces, while the concrete framework will likely remain for many decades to come, providing an environment for good benthic habitat.

Based on past monitoring efforts, this particular site has demonstrated seasonal trends with sediment movement. During this 2012 monitoring survey, some of the units had substantial sediment buildup inside and around the concrete bases, partially covering them. Refer to Figure 10 for the general condition of some of the Traffic Barge Reefmaker “Florida Special” units and evidence of sand build up along the base.



Figure 10. Traffic Barge Reefmaker units 2012 photographs.

5.2.3 Biological Survey Results

Species identified in Figure 10, clockwise from the top left include (1) lionfish, (2) atlantic spadefish, (3) shortnose batfish, and (4) none. Of the 20 fish species identified during the 2012-monitoring event, four are noteworthy. Three sport fish species are sought after by fishing enthusiasts, including gag grouper, greater amberjack, and Spanish mackerel. Unfortunately, the fourth species, the red lionfish, was also observed. A total of three were documented, a small one can be seen in Figure 10. Table 10 lists the fish species census, including relative abundance and size class (adult, intermediate, and juvenile) observed during the monitoring dive. Table 11 lists the observed benthic species.

Table 10. Traffic Barge - 4 Reefmakers Fish Species Census.

Family/Common Name	Species	2012	
		Abundance	Size
Carangidae			
Greater amberjack	<i>Seriola dumerili</i>	F	J/A
Blue runner	<i>Caranx crysos</i>	M	A
Chaetodontidae			
Spotfin Butterflyfish	<i>Chaetodon ocellatus</i>	F	A
Dasyatidae			
Southern Stingray	<i>Dasyatis americana</i>	S	A
Ephippidae			
Atlantic spadefish	<i>Chaetodipterus faber</i>	F	A
Haemulidae			
Tomtate	<i>Haemulon aurolineatum</i>	A	J & J/A
Porkfish	<i>Anisotremus virginicus</i>	F	J & A
Labridae			
Spanish hogfish	<i>Bodianus rufus</i>	S	J/A
Slippery dick	<i>Halichoeres bivittatus</i>	M	J & A
Ogcocephalidae			
Shortnose batfish	<i>Ogcocephalus nasutus</i>	S	A
Pomacanthidae			
Blue angelfish	<i>Holacanthus bermudensis</i>	S	A
Pomacentridae			
Beaugregory	<i>Pomacentrus leucostictus</i>	F	J
Sergeant Major	<i>Abudefduf saxatilis</i>	F	J & A
Scombridae			
Spanish mackerel	<i>Scomberomorus maculatus</i>	S	A
Scorpaenidae			
Red Lionfish	<i>Pterois volitans</i>	F(3)	J
Serranidae			
Belted sandfish	<i>Serranus subligarius</i>	F	A & J
Gag grouper	<i>Mycteroperca microlepis</i>	S	J/A
Whitespotted soapfish	<i>Rypticus maculatus</i>	F	A
Sparidae			
Sheepshead porgy	<i>Calamus penna</i>	M	A
Tetraodontidae			
Sharpnose puffer	<i>Canthigaster rostrata</i>	F	A
	Total	20	

Abundance Key: S=single, F=few (2-10), M=many (11-100), A=abundant (>100)

Size Key: A=adult, J=juvenile, A/J=intermediate

Table 11. Traffic Barge - 4 Reefmakers Benthic Species Census.

	Common Name	Scientific Name
Cnidarians	Algae Hydroids	<i>Thyroscyphus ramosus.</i>
Crustaceans	Volcano Barnacle	<i>Tetraclita stalactifera</i>
Porifera	N/A	<i>Batzella spp.</i>

5.3 UPSIDE-DOWN BARGE - 4 REEFMAKERS

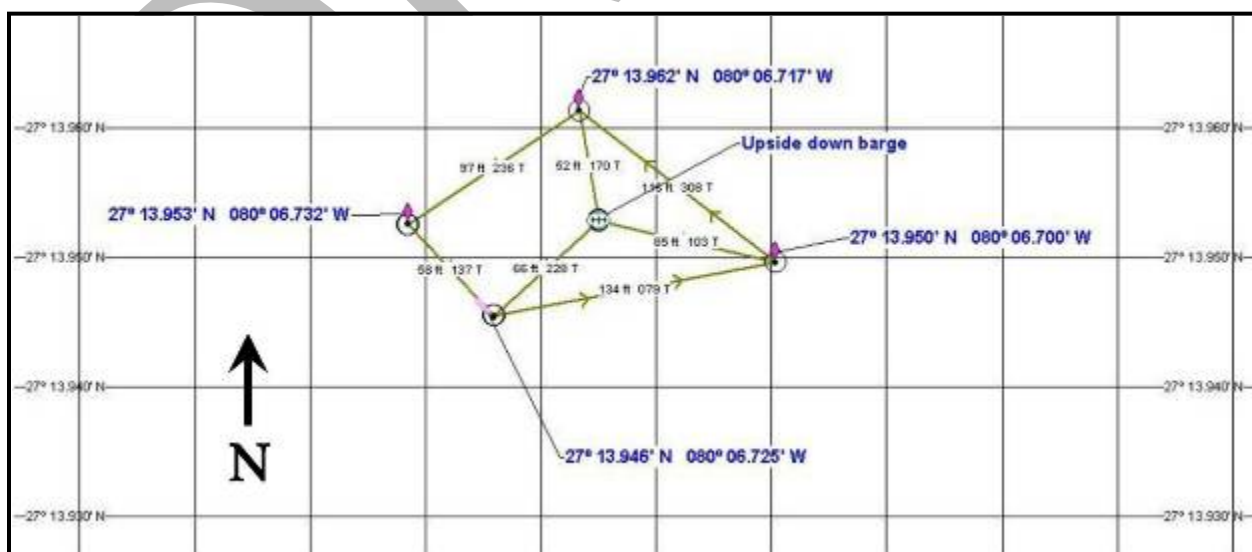
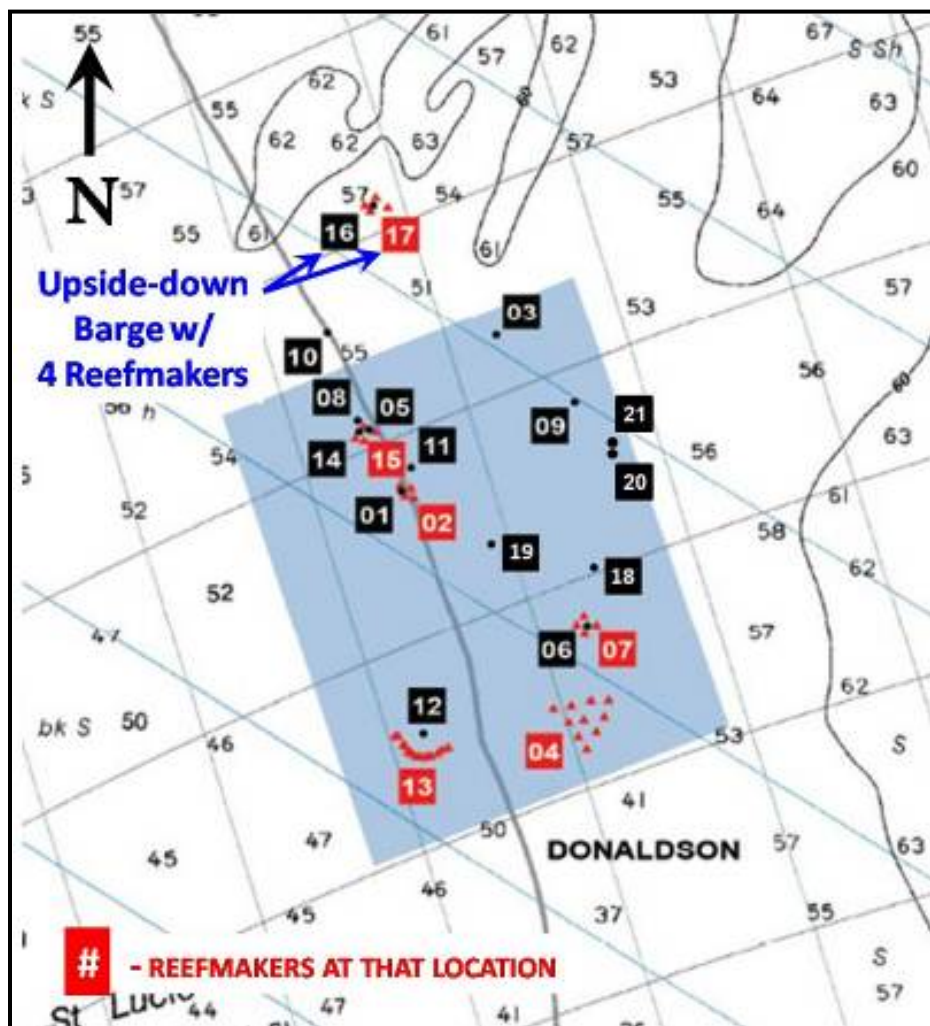
- Location: Donaldson Reef
- Materials: Barge (Steel) & 4 concrete and steel Reefmaker units
- Maximum Depth: 65 ft (barge), 67 ft (Reefmaker unit)
- Reef High Point: 62 ft (barge), 57 ft (Reefmaker unit)
- Year Created: Reefmaker units deployed in 2005
- Monitoring Date: 09/08/2012
- Total Cost: \$3,180 (FWC 89% & Martin County 11%)

5.3.1 History of the Upside-Down Barge - 4 Reefmakers

The “Upside-Down Barge” derived its name because it landed “upside-down” when it was deployed. Based on the Martin County archives it was established that the Upside-Down Barge was deployed as an Artificial Reef in the Donaldson Permitted Area sometime between 1980 and 1986. It remains upside-down in 65 feet of water, located in the most northern of the four Reefmaker barge sites within the Site, and approximately 1 nm north of the Traffic Barge site.

In 2005, the site was augmented when Martin County deployed four Reefmaker “Florida Special” artificial reef units north, south, east and west of the Upside-Down Barge site. Similar to the other barge/reef maker sites, colored zip ties were attached to the top of each reef unit to help with identifying and photo documenting the individual units during monitoring efforts. The following color code was used: blue - reef unit to north, red - reef unit to west, green - reef unit to east, yellow - reef unit to south.

A chart showing the location of the barge and the Reefmaker units surrounding the barge is shown in Figure 11. A chart showing the placement of the units around the Upside-Down Barge location is shown in Figure 12.



5.3.2 Structural Summary

Overall, the four-Reefmaker units at this site are intact and good condition. Similar to the Cement Barge and Traffic Barge, this site is considered shallow, with evidence of erosion and corrosion degradation not encountered at the deeper sites. Given the proximity to the shoreline, sediment transfer is expected, both seasonally and during significant storm events.

Although the impacts of sediment movement have resulted in erosion of the steel side sections closest to the seafloor, both the concrete base and solid concrete framework are the main structural components of each Reefmaker unit. Over time, it is likely that most, if not all, of the steel will be lost to corrosive and erosive forces, but the concrete framework of the Reefmaker will likely remain for many decades to come, providing good habitat for many benthic and fish species to thrive. The photographs in Figure 13 show the general condition of the Reefmaker units surrounding the Upside-Down Barge site observed during the monitoring dive. Some settling has occurred around the concrete base of the units, likely caused by seasonal occurrences prevalent with shifting sediments in the area.



Figure 13. Upside-Down Barge Reefmaker units 2012 photographs.

5.3.3 Biological Survey Results

Of the twenty seven (27) fish species identified during our survey, five (5) are noteworthy, including four common sport fish species; greater amberjack, lane snapper, gray snapper, and common snook. Unfortunately, five (5) Lionfish were also observed. Refer to Table 12 for the fish species census.

Table 12. Upside-Down Barge - 4 Reefmakers Fish Species Census.

Family/Common Name	Species	2012	
		Abundance	Size
Carangidae			
Atlantic bumper	<i>Chloroscombrus chrysurus</i>	A	A
Greater amberjack	<i>Seriola dumerili</i>	F	J/A & J
Round scad	<i>Decapterus punctatus</i>	A	J & A
Centropomidae			
Common snook	<i>Centropomus undecimalis</i>	F	J/A & A
Chaetodontidae			
Reef butterflyfish	<i>Chaetodon sedentarius</i>	F(3)	A
Spotfin butterflyfish	<i>Chaetodon ocellatus</i>	F	A
Clupeidae			
Fry	<i>Unidentified species</i>	A	J
Ephippidae			
Atlantic spadefish	<i>Chaetodipterus faber</i>	M	A
Haemulidae			
Tomtate	<i>Haemulon aurolineatum</i>	M	J & A
Porkfish	<i>Anisotremus virginicus</i>	M	J & A
Labridae			
Slippery dick	<i>Halichoeres bivittatus</i>	M	J
Labrisomidae			
Hairy blenny	<i>Labrisomus nuchipinnis</i>	F	A
Lutjanidae			
Gray snapper	<i>Lutjanus griseus</i>	F	J/A & A
Lane snapper	<i>Lutjanus synagris</i>	F	J/A
Ogcocephalidae			
Shorthose batfish	<i>Ogcocephalus nasutus</i>	S	A
Pomacentridae			
Yellowtail reeffish	<i>Chromis enchrysurus</i>	F	J
Beaugregory	<i>Pomacentrus leucostictus</i>	F	J
Sergeant Major	<i>Abudefduf saxatilis</i>	F	A
Sciaenidae			
Cubbyu	<i>Equetus umbrosus</i>	M	J & A
High hat	<i>Equetus acuminatus</i>	F	J
Scorpaenidae			
Red Lionfish	<i>Pterois volitans</i>	F(5)	J & A
Spotted scorpionfish	<i>Scorpaena plumeiri</i>	F	A
Serranidae			
Belted sandfish	<i>Serranus subligarius</i>	M	J & A
Black sea bass	<i>Centropristis striata</i>	F	J & A
Whitespotted soapfish	<i>Rypticus maculatus</i>	F	A
Sparidae			
Sheepshead porgy	<i>Calamus penna</i>	F	A
Tetraodontidae			
Bandtail puffer	<i>Sphoeroides spengleri</i>	F	J
	Total	27	

Abundance Key: S=single, F=few (2-10), M=many (11-100), A=abundant (>100)

Size Key: A=adult, J=juvenile, A/J=intermediate

As documented in Figure 13, benthic growth on the units is quite extensive. Most of the steel bars are covered with an assortment of benthic marine growth, including gorgonians, tunicates, bryozoans, crustaceans and others. At least fifteen (15) different benthic species were identified on the Reefmaker units. Since this reef is located in shallow waters, more sunlight reaches the units allowing for photosynthesis to occur, which results in a complex benthic community to survive on both the steel and concrete components. The deeper sites also support benthic marine growth, but in lesser diversity and concentrations. Figure 13 lists the benthic species identified.

Table 13. Upside-Down Barge - 4 Reefmakers Benthic Species Census.

	Common Name	Scientific Name
Echinoderms	Rock Boring Urchin	<i>Echinometra lucunter</i>
	3 Rowed Sea Cucumber	<i>Isostichopus badiotus</i>
Cnidarians	Sea Anemones	<i>Aptasia sp.</i>
	Algae Hydroids	<i>Thyroscyphus ramosus</i>
	Hydroids	Unidentified species
	N/A	<i>Pterogorgia citrina</i>
Ascidians	Overgrowing Tunicates	<i>Didemnidae</i>
	Giant Tunicates	<i>Polycarpa spongiabilis</i>
Crustaceans	Yellowline Arrow Crab	<i>Stenorhynchus seticornis</i>
Mollusca	Rock Snails	<i>Muricidae</i> (Unidentified species)
Ectoprocta	Encrusting Bryozoans	Unidentified Species
Porifera	Star Encrusting Sponge	<i>Halisarca sp.</i>
	N/A	<i>Verongula rigida</i>
	N/A	<i>Aiolocroia crassa</i>
	N/A	<i>Scopalina ruetzleri</i>

5.4 LEE HARRIS MEMORIAL REEF

- Location: Donaldson Reef
- Materials: concrete & steel components/debris (pilings, slabs, culverts)
- Maximum Depth: 60 feet
- Reef High Point: 46 feet
- Year Created: 2011
- Monitoring Date: 09/08/2012
- Total Cost: \$72,000 (FWC 75% & Martin County 25%)

5.4.1 History of the Lee Harris Memorial Reef

Lee Harris, PE, Ph.D., was a coastal engineer and scientist who spent decades of dedicated service to the design, construction, and monitoring of the artificial reefs of Martin County, Florida, and many Caribbean nations. Dr. Harris was known and highly respected worldwide as an expert in many aspects of the coastal engineering field, including artificial reefs, coastal structures, bathymetric surveying, Reef Ball™ breakwater designs, designed surfing reefs, and countless other ocean environment protection projects. He was an avid surfer and diver, overall advocate of everything ocean related and devoted his career to helping the ocean, teaching and mentoring others. Lee Harris received his PhD in ocean engineering from the Florida Atlantic University, and since 1980, began a long and successful career as a faculty member with the Florida Institute of Technology Ocean Engineering Department, initially at the Jensen Beach Campus and then the main campus in Melbourne, Florida. He authored more than thirty (30) publications and was engaged in at least eighty two (82) projects worldwide. He was a devoted husband and father, and teacher until his untimely passing in October of 2010. Dr. Harris was instrumental in his participation of the Martin County Artificial Reef Program. Figure 14 shows the location of the Lee Harris Memorial Reefs in the Donaldson Artificial Reef area.

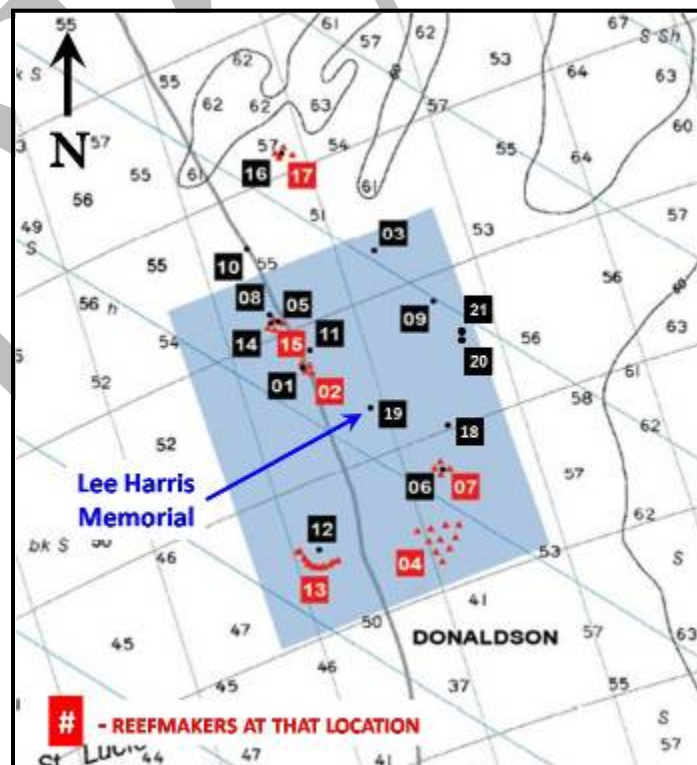


Figure 14. Chart of the Donaldson Reef site showing the Lee Harris Memorial Reef location.

The Lee Harris Reefs (Primary, South & East) are located in 59 – 62 ft. of water near the center of the Donaldson permitted area, comprised of three separate piles of concrete and steel, deployed from an anchored barge in close proximity to one another. In April 2011, four barge loads of material, approximately 400 tons each, were transported to the selected deployment site, where two barge loads of material were dropped in the same location, creating the “primary” center reef, and the remaining two barge loads (400 tons each) were deployed East and South of the center reef.

The deployment of such a large quantity (1,200 tons total), coupled with the diversity of the material, sizes and shapes have resulted in a unique and complex reef site. The new reefs have within their boundaries many types of “living spaces,” such as crevices, overhangs, caverns, scoured areas, upright protrusions; small cracks, lattice type areas, and well-shaded areas, with wide-open flat expanses. The footprints of the sites are considered oval shaped, and vary in size, ranging from 85 ft long by 52 ft wide, and up to 130 ft long by 87 ft wide. The maximum profile above seafloor is 16ft, with an average nominal of 13 ft. Although it was recently deployed, based on our monitoring surveys, it is evident many marine life species have already taken up residence in the new reefs.

5.4.2 Structural Summary

The center pile of the Lee Harris Memorial Reef was monitored during 2012, and consisted of many shapes and sizes of concrete, including pilings, culverts, catch basins, abutment wall sections, traffic light bases, roadway slabs, and other pieces of all shapes and sizes. These materials came from several sources including the demolition of several building and roadway sites in Martin County, as well as some classroom buildings from the closed Jensen Beach Campus of Florida Institute of Technology, where Dr. Harris taught during his tenure there in the late 1970’s thru 1986.

The 400 tons of concrete materials at the center pile form an elliptical shape on the seafloor that is a 98 ft long from north to south and 77 ft long east to west. The summit of the center reef has a profile of 16 ft. The use of so many various sizes and shapes of materials makes for a very stable artificial reef. The components are interlocked to create a matrix, providing a stable structural frame, which should likely withstand the powerful effect of tropical storms and hurricanes. There is ample historical data in Martin County to validate the durability and strength of this type of artificial reef structure following storm events.

During the survey, divers took measurements of the seafloor depths adjacent to and outside the perimeter of the reef footprint. Almost no settling or scouring has occurred around the reef structure (refer to Table 14). From a structural viewpoint, this reef appears very stable and is expected to provide many benefits to the marine environment for several decades.

Table 14. Summary of Depth measurements at the Lee Harris Memorial Reef.

Direction	Distance from reef high point to the perimeter (ft)	Perimeter Depth (ft)	Depth at 25 ft from perimeter (ft)
North	66	58	57
East	47	57	58
South	32	58	59
West	30	58	58

5.4.3 Biological Survey Results

Although the Lee Harris reef was 16 months old at the time of our first monitoring survey (September 2012), it has produced significant results. Thirty-three different finfish were noted, including an adult red grouper, a species rarely seen on artificial reefs in Florida, regardless of reef size, material, or depth. They are typically and readily found on natural reef ledges and hardbottom areas in Martin County.

Other important fish species observed during the monitoring include: yellowtail, mutton, and gray snapper, goliath grouper, black seabass, gulf flounder, and common snook. Large schools of silversides (baitfish), blue runners, and thousands of unidentified newly hatched fry (from 1/8" - 1/4" long), too small to positively identify without laboratory analysis were in abundance on the reef. Refer to Figure 15 for photographs of the Lee Harris Memorial Reef and some of the species observed during the monitoring dive.

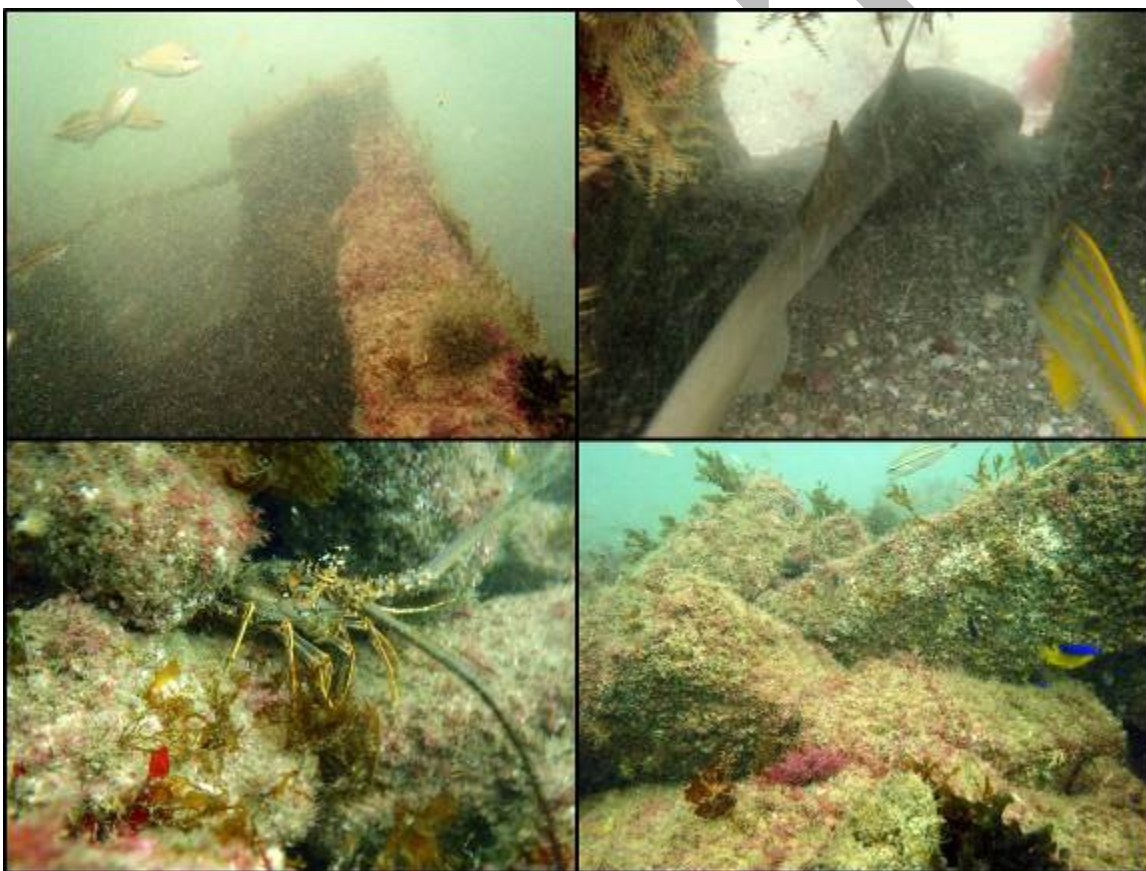


Figure 15. Lee Harris Memorial Artificial Reef Photographs from 2012.

Species identified in Figure 15, clockwise from the upper-left photograph are (1) tomtates, (2) nurse shark and porkfish, (3) tomtate and juvenile beaugregory, and (4) spiny lobster. Table 15 lists the species/taxa, their relative abundance and size class (adult, intermediate, and juvenile) observed during the monitoring dive.

Because of its relatively shallow depth and clear water, sunlight easily penetrates and washes the reef with light energy. Many species of benthic marine plants and algae have attached to the materials. A listing can be found in Table 16 along with other benthic organisms.

Table 15. Lee Harris Memorial Artificial Reef Fish Species Census.

Family/Common Name	Species	2012	
		Abundance	Size
Acanthuridae			
Ocean Surgeonfish	<i>Acanthurus bahianus</i>	S	J
Atherinidae			
Silversides	<i>Atherinidae</i>	A	A
Bothidae			
Gulf flounder	<i>Paralichthys albigutta</i>	S	A
Carangidae			
Blue runner	<i>Caranx crysos</i>	A	A
Centropomidae			
Common snook	<i>Centropomus undecimalis</i>	M	J/A
Chaetodontidae			
Reef butterflyfish	<i>Chaetodon sedentarius</i>	F	J & A
Spotfin butterflyfish	<i>Chaetodon ocellatus</i>	S	A
Clupeidae			
Fry	<i>Jenkinsia lamprotaenia</i>	M	J
Dasyatidae			
Southern Stingray	<i>Dasyatis americana</i>	S	A
Ginglymostomatidae			
Nurse shark	<i>Ginglymostoma cirratum</i>	S	A
Haemulidae			
Tomtate	<i>Haemulon aurolineatum</i>	A	J & A
Black margate	<i>Anisotremus surinamensis</i>	F	A
Cottonwick	<i>Haemulon melanurum</i>	S	J
Porkfish	<i>Anisotremus virginicus</i>	M	J & A
Labridae			
Spanish hogfish	<i>Bodianus rufus</i>	F	J & A
Lutjanidae			
Gray snapper	<i>Lutjanus griseus</i>	M	J & A
Mutton snapper	<i>Lutjanus analis</i>	S	A
Yellowtail snapper	<i>Ocyurus chrysurus</i>	F(2)	J/A
Muraenidae			
Spotted moray eel	<i>Gymnothorax moringa</i>	F	A
Pomacanthidae			
French angelfish	<i>Pomacanthus paru</i>	S	A
Gray angelfish	<i>Pomacanthus arcuatus</i>	S	A
Pomacentridae			
Yellowtail reeffish	<i>Chromis enchrysurus</i>	F	J/A
Beaugregory	<i>Pomacentrus leucostictus</i>	F	J & A
Sergeant Major	<i>Abudefduf saxatilis</i>	M	J & A
Sciaenidae			
Cubbyu	<i>Equetus umbrosus</i>	M	J & A
Serranidae			
Belted sandfish	<i>Serranus subligarius</i>	M	J & A
Black sea bass	<i>Centropristis striata</i>	F	A
Goliath grouper	<i>Epinephelus itajara</i>	F(3)	A
Red grouper	<i>Epinephelus morio</i>	S	A
Whitespotted soapfish	<i>Rypticus maculatus</i>	F	A
Sparidae			
Sheepshead porgy	<i>Calamus penna</i>	F	A
Sheepshead	<i>Archosargus probatocephalus</i>	M	A
Tetraodontidae			
Bandtail puffer	<i>Sphoeroides spengleri</i>	F	A
Total		33	

Abundance Key: S=single, F=few (2-10), M=many (11-100), A=abundant (>100)

Size Key: A=adult, J=juvenile, A/J=intermediate

Table 16. Lee Harris Memorial Artificial Reef Benthic Species Census.

	Common Name	Scientific Name
Echinoderms	Common Arbacia Urchin	<i>Arbacia punctulata</i>
	Rock Boring Urchin	<i>Echinometra lucunter</i>
	3 Rowed Sea Cucumber	<i>Isostichopus badionotus</i>
	Variegated Urchin	<i>Lytechinus variegatus</i>
Cnidarians	Sea Anemones	<i>Aptasia sp.</i>
	Algae Hydroids	<i>Thyroscyphus ramosus</i>
	Hydroids	Unidentified species
	White telesto	<i>Carijoa riisei</i>
	N/A	<i>Pterogorgia citrina</i>
Crustaceans	Yellowline Arrow Crab	<i>Stenorhynchus seticornis</i>
	Spiny lobster	<i>Palnulirus argus</i>
Mollusca	Rock snails	<i>Muricidae</i> (Unidentified species)
	Wing Oyster	<i>Pteria colymbus</i>
	Black Sea Hare	<i>Aplysia morio</i>
Ectoprocta	Encrusting Bryozoans	Unidentified Species
Ascidians	Geometric Encrusting Tunicates	<i>Botryllus sp.</i>
	Bulb Tunicates	<i>Clavelina sp.</i>
	Giant Tunicates	<i>Polycarpa spongiabilis</i>
	Black Tunicate	<i>Phylusia nigra</i>
Porifera	White Lumpy Encrusting Sponge	<i>Ptilocaulus sp.</i>
	N/A	<i>Scopalina ruetzleri</i>
	Star Encrusting Sponge	<i>Halisarca sp.</i>

5.5 RALPH EVINRUDE REEF

- Location: Donaldson Reef
- Materials: Concrete (chunks, roof beams, roadway slabs, box culverts)
- Maximum Depth: 60 feet
- Reef High Point: 48 feet
- Year Created: 2011
- Monitoring Date: 09/09/2012
- Total Cost: \$72,000 (FWC 75% & Martin County 25%)

5.5.1 History of the Ralph Evinrude Reef

Ralph Evinrude was a respected resident of Martin County and supported many projects of the artificial reef program, including the USS Rankin Navy ship, which was scuttled in 1985 as the largest Artificial Reef to date in Martin County. He was the former CEO of the Evinrude Corporation, which introduced the world to outboard engines for motorboats in the 1920's. He and his famous actress wife, Frances Langford, moved to Jensen Beach in the 1950's. Over the decades, they provided major financial support to many civic organizations, including the Florida Oceanographic Society, Martin Memorial Hospital, and the former Jensen Beach Campus of Florida Institute of Technology. The materials utilized to build the Evinrude Reef were concrete and steel debris from the Ralph Evinrude Science Building on the former site of the Jensen Beach campus. A chart showing the location of the Ralph Evinrude Reef is shown in Figure 16.

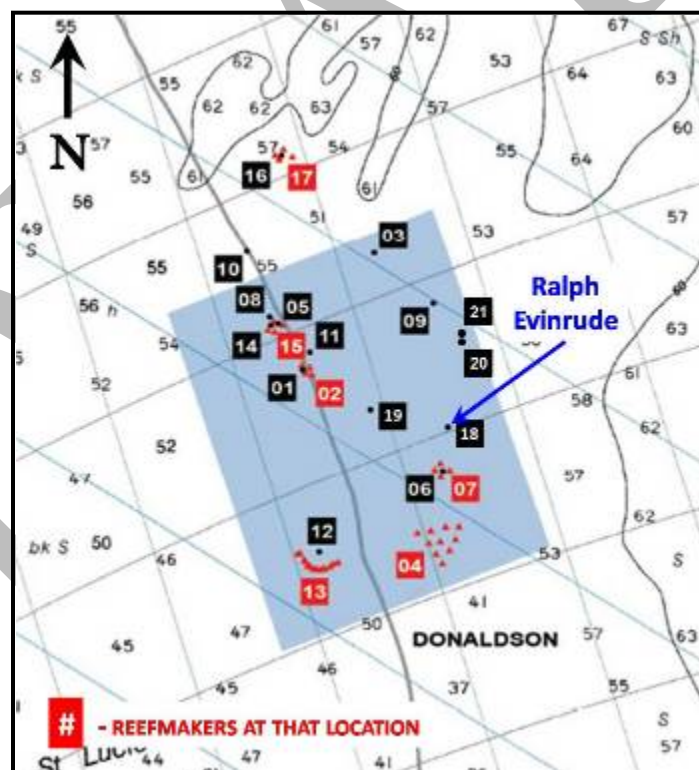


Figure 16. Chart of the Donaldson Reef site showing the Ralph Evinrude Reef location.

5.5.2 Structural Summary

This reef is comprised of many different sizes and shapes of concrete and steel components. When the contractor dismantled the Ralph Evinrude Science building, he demonstrated caution while removing the large roof concrete trusses without breaking them. These trusses are still mostly intact on the reef as documented in Figure 17, (upper left) which shows the end of one of the trusses covered in benthic growth while a school of tomtates take refuge beneath.

Similar to the Lee Harris reef configuration, the Evinrude reef appears very stable due of the interlocking and complex arrangement of mixed shapes and sizes of the materials used to create this reef. It is anticipated that the components will perform well resisting wave forces from significant storm events. On other artificial reefs at this depth range and with similar level of complexity, very little movement has occurred as documented from past monitoring efforts, even during the Category 2 and 3 hurricanes that passed through the Martin County waters in 2004 and 2005. Depth measurements taken during the monitoring dive show that minimal scouring has occurred at this artificial reef site (refer to Table 17).

Table 17. Summary of Depth measurements at the Ralph Evinrude Reef.

Direction	Distance from reef high point to the perimeter (ft)	Perimeter Depth (ft)	Depth at 25 ft from perimeter (ft)
North	30	58	59
East	28	58	58
South	23	58	58
West	50	60	60

5.5.3 Biological Survey Results

Similar to the Lee Harris reef, both in complexity, depth and age, the Ralph Evinrude Reef had many finfish species identified during this first annual monitoring effort. In our experience, it is rare to find greater than twenty (20) species after twelve months. We observed thirty three (33) fish species, and one species of marine reptile (loggerhead turtle). Of the 33 fish species, eleven (11) are considered important recreational and food value species, including three species of snapper and one grouper species. In addition, a large school of common snook (approximately 70 adults) were present on the reef. Hopefully, this is a positive indication and trend for future monitoring events. The photographs in Figure 17 show the general condition of the Ralph Evinrude Reef observed during the monitoring dive.



Figure 17. Ralph Evinrude Artificial Reef photos from 2012.

Species identified in the photographs shown above, clockwise from the upper-left photograph are (1) large school of tomtates, (2) tomtates, (3) loggerhead turtle, sheephead, porkfish, remora, and tomtates, and (4) sheephead, porkfish, and tomtates.

The benthic diversity for this newly deployed artificial reef was also impressive with sixteen (16) different species observed and attached to the concrete substrate, as well as inhabiting the many voids and crevices. Numerous sea cucumbers, urchins, and arrow crabs were seen foraging about the structure where tunicates, encrusting sponges, and anemones covered a majority of the exposed substrate. Table 18 lists the fish and marine reptile species/taxa, their relative abundance and size class (adult, intermediate, and juvenile) observed and Table 19 lists the benthic species observed during the monitoring dive.

Table 18. Ralph Evinrude Artificial Reef Fish Species Census.

Family/Common Name	Species	2012	
		Abundance	Size
Acanthuridae			
Ocean Surgeonfish	<i>Acanthurus bahianus</i>	F	J & J/A
Apogonidae			
Twospot cardinalfish	<i>Apogon pseudomaculatus</i>	F	A
Aulostomidae			
Trumpetfish	<i>Aulostomus maculatus</i>	S	A
Balistidae			
Gray Triggerfish	<i>Balistes capriscus</i>	F	A
Carangidae			
Greater amberjack	<i>Seriola dumerilli</i>	M	J/A
Centropomidae			
Common snook	<i>Centropomus undecimalis</i>	M(70)	A
Chaetodontidae			
Reef butterflyfish	<i>Chaetodon sedentarius</i>	F	J/A

Family/Common Name	Species	2012	
		Abundance	Size
Cheloniidae			
Loggerhead sea turtle	<i>Caretta caretta</i>	F(2)	A
Dasyatidae			
Southern Stingray	<i>Dasyatis americana</i>	F(4)	A
Echeneidae			
Common remora	<i>Remora remora</i>	F(2)	A
Ginglymostomatidae			
Nurse shark	<i>Ginglymostoma cirratum</i>	S	A
Haemulidae			
Tomtate	<i>Haemulon aurolineatum</i>	A	J & A
Cottonwick	<i>Haemulon melanurum</i>	F	J/A
Porkfish	<i>Anisotremus virginicus</i>	M	J & A
Labridae			
Spanish hogfish	<i>Bodianus rufus</i>	F	J & J/A
Lutjanidae			
Gray snapper	<i>Lutjanus griseus</i>	M	J & A
Lane snapper	<i>Lutjanus synagris</i>	M	J & A
Mutton snapper	<i>Lutjanus analis</i>	F(2)	A
Muraenidae			
Spotted moray eel	<i>Gymnothorax moringa</i>	S	A
Pomacanthidae			
Blue angelfish	<i>Holacanthus bermudensis</i>	S	A
Pomacentridae			
Cocoa damselfish	<i>Stegastes variabilis</i>	S	A
Yellowtail reeffish	<i>Chromis enchrysurus</i>	M	J & A
Beaugregory	<i>Pomacentrus leucostictus</i>	F	J & A
Sciaenidae			
Cubbyu	<i>Equetus umbrosus</i>	F	J
Rachycentridae			
Cobia	<i>Rachycentron canadum</i>	F(4)	A
Scombridae			
Spanish mackerel	<i>Scomberomorus maculatus</i>	S	A
Scorpaenidae			
Red Lionfish	<i>Pterois volitans</i>	S	J/A
Serranidae			
Belted sandfish	<i>Serranus subligarius</i>	M	J & A
Black sea bass	<i>Centropristis striata</i>	A	J & A
Scamp	<i>Mycteroperca phenax</i>	F	J/A
Sparidae			
Pigfish	<i>Orthopristis chrysoptera</i>	M	A
Sheepshead	<i>Archosargus probatocephalus</i>	M	J & A
Sphyraenidae			
Southern sennet	<i>Sphyraena picudilla</i>	A	A
Tetraodontidae			
Bandtail puffer	<i>Sphoeroides spengleri</i>	F	J & A
	Total	34	

Abundance Key: S=single, F=few (2-10), M=many (11-100), A=abundant (>100)

Size Key: A=adult, J=juvenile, A/J=intermediate

Table 19. Ralph Evinrude Artificial Reef Benthic Species Census.

	Common Name	Scientific Name
Echinoderms	Rock Boring Urchin	<i>Echinometra lucunter</i>
	3 Rowed Sea Cucumber	<i>Isostichopus badiotus</i>
Cnidarians	Sea Anemones	<i>Aptasia sp.</i>
	Hydroids	Unidentified species
	Algae Hydroids	<i>Thyroscyphus ramosus</i>
Ascidians	Overgrowing Mat Tunicates	<i>Trididemum solidum</i>
	Giant Tunicates	<i>Polycarpa spongiabilis</i>
	White Speck Tunicate	<i>Didemnum conchyliautum</i>
Crustaceans	Yellowline Arrow Crab	<i>Stenorhynchus seticornis</i>
	Giant Hermit Crab	<i>Petrochirus diogenes</i>
	Spiny lobster	<i>Palnulirus argus</i>
Mollusca	Rock Snails	<i>Muricidae</i> (Unidentified Species)
Ectoprocta	Encrusting Bryozoans	Unidentified Species
Polychaeta	N/A	<i>Spiroridae</i>
Porifera	Star Encrusting Sponge	<i>Halisarca sp.</i>
	N/A	<i>Clathria sp.</i>

5.6 KYLE'S CROSSBAR REEF

- Location: Donaldson Reef
- Materials: Indian Street 30" sq. concrete piling cut-offs (various lengths)
- Maximum Depth: 63 feet
- Reef High Point: 49 feet
- Year Created: 2012
- Monitoring Date: 09/09/2012
- Total Cost: \$80,860 for both reefs (67% FWC & 33% Martin County)

5.6.1 History of the Kyle's Crossbar Reef

In July 2012, this memorial artificial reef was deployed in the Donaldson Artificial Reef Site off the Coast of Martin County in remembrance of Kyle Conrad, 21, a local student athlete and water enthusiast who lost his life in tragic mishap in early December 2010. The artificial reef was built using precast concrete piling cut-offs from the Veterans Memorial Bridge Indian Street project. The reef site received two barge loads of pile cut-offs that varied in length from 3 ft to 31 ft and weighed approximately 904 tons. Figure 18 shows a chart with the location of the Kyle's Crossbar artificial reef.

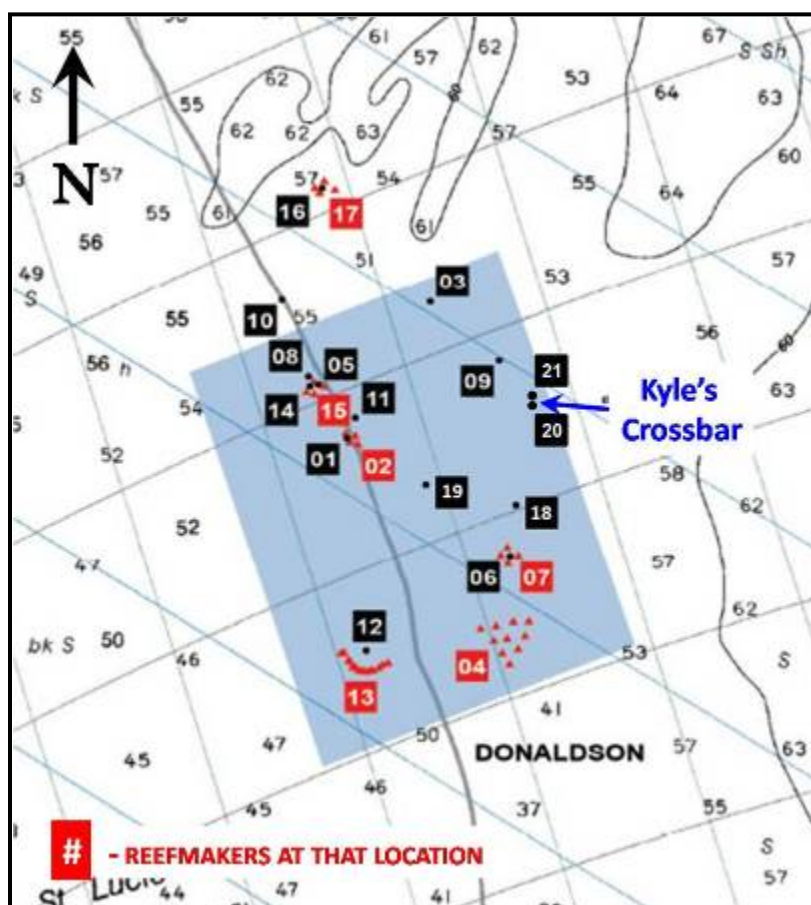


Figure 18. Chart of the Donaldson Reef site showing the Kyle's Crossbar Reef location.

5.6.2 Structural Summary

The Kyle's Crossbar Reef has a seafloor footprint of 111 ft (north/south) by 120 ft (east/west), almost a perfect circle. The entire reef was built from the same type of concrete components (piling cut-offs), so visually it appears as a very symmetrical, cone shaped reef with a profile height of 14 ft. The varying lengths of the piling cut-offs have yielded many overhangs, tunnels, and voids that formed during deployment which makes for an endless pattern of hiding places for fish and benthic creatures to inhabit. Given the configuration, it is anticipated that these heavy and dense components should remain during storm events and winter swells. Depth measurements taken at the perimeter of the reef, and depths 25 ft from the perimeter indicate that minimal scour has occurred at the newly deployed reef. Refer to Table 20.

Table 20. Summary of Kyle's Crossbar Depth measurements.

Direction	Distance from reef high point to the perimeter (ft)	Perimeter Depth (ft)	Depth at 25 ft from perimeter (ft)
North	88	63	63
East	73	62	63
South	23	63	63
West	47	63	63

5.6.3 Biological Survey Results

During this post-deployment monitoring survey in September 2012, twenty (21) fish species were identified and photographed, just seven (7) weeks post-deployment. Most notable sport/food fish species included: greater amberjack, gray, yellowtail, and lane snappers, goliath grouper, and two individuals of juvenile snowy grouper (rare at this shallow depth). Also notable were three species of baitfish, thousands of silversides, and hundreds of round scad and blue runners in schools swimming rapidly all around and above the reef. A large (10”) red lionfish was also observed hiding in the dark recesses of the overhanging concrete piling cut-off sections. The photographs in Figure 19 show the general condition of Kyle’s Crossbar Reef and some of the species observed during the monitoring dive.

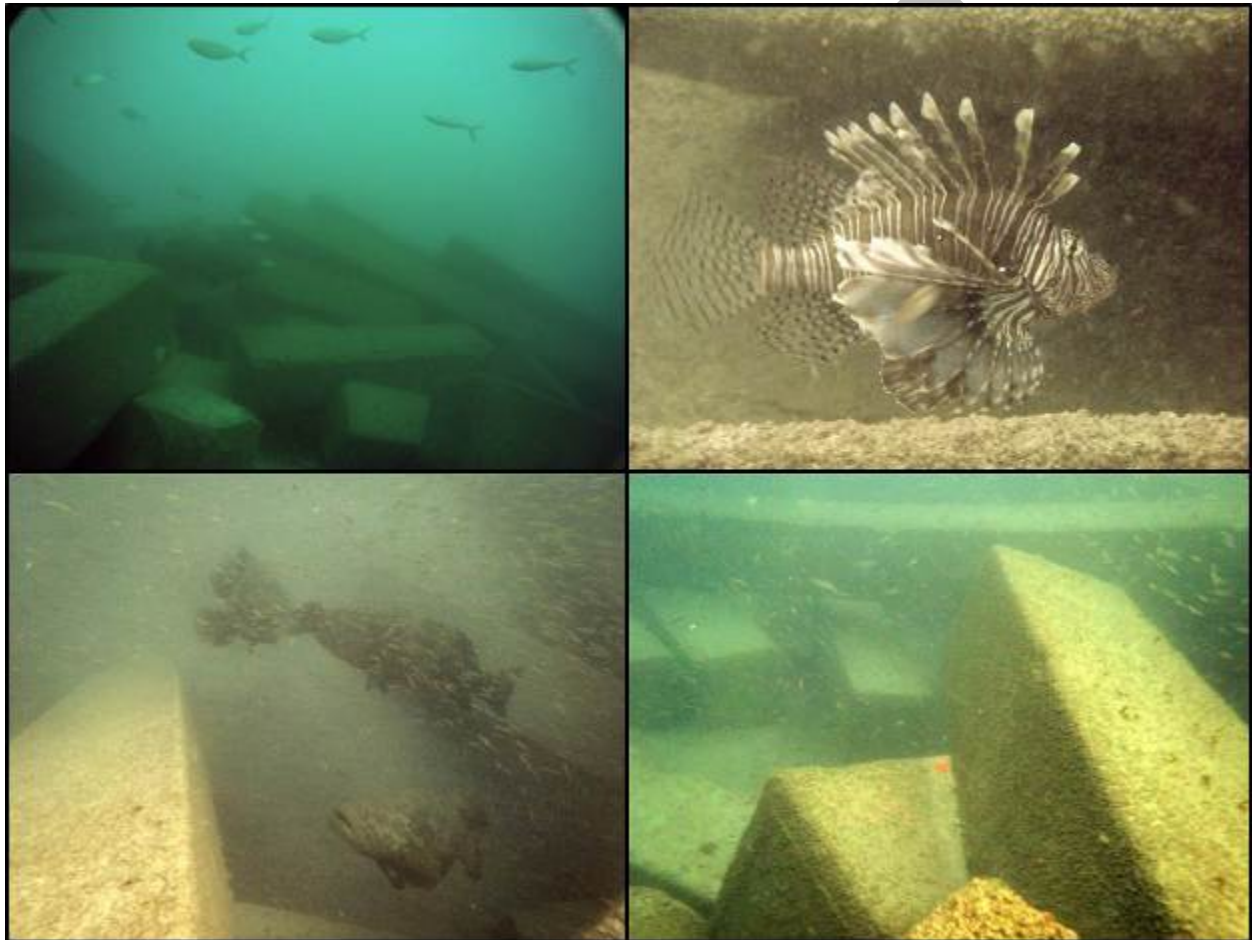


Figure 19. Kyle’s Crossbar Artificial Reef photos from 2012.

Species identified in the photographs shown above, clockwise from the upper-left photograph are (1) round scad and blue runners, (2) lionfish, (3) silversides, and (4) goliath grouper and silversides.

The most notable attached benthic organisms consisted of slight algae slime and small barnacles that seemed to cover every exposed surface. These findings are the early beginnings of the food chain. Table 21 lists the fish species census, including the relative abundance, and size class (adult, intermediate, and juvenile) while Table 22 lists the benthic species observed during the monitoring dive.

Table 21. Kyle's Crossbar Artificial Reef Fish Species Census.

Family/Common Name	Species	2012		
		Abundance	Size	Comments
Apogonidae				
Twospot cardinalfish	<i>Apogon pseudomaculatus</i>	M	J & A	
Atherinidae				
Silversides	<i>Atherinidae</i>	A	A (1,000's)	
Carangidae				
Greater amberjack	<i>Seriola dumerili</i>	A	J & A	
Round scad	<i>Decapterus punctatus</i>	A	A	
Blue runner	<i>Caranx crysos</i>	A	A	
Dasyatidae				
Roughtail stingray	<i>Dasyatis centroura</i>	S	A	
Southern stingray	<i>Dasyatis americana</i>	S	A	
Echeneidae				
Common remora	<i>Remora remora</i>	F	A	
Ginglymostomatidae				
Nurse shark	<i>Ginglymostoma cirratum</i>	F(2)	A	
Labridae				
Pearly razorfish	<i>Xyrichtys novacula</i>	F	J & A	
Lutjanidae				
Gray snapper	<i>Lutjanus griseus</i>	M	J & A	
Lane snapper	<i>Lutjanus synagris</i>	M	J & A	
Yellowtail snapper	<i>Ocyurus chrysurus</i>	F	J & A	
Pomacentridae				
Sergeant Major	<i>Abudefduf saxatilis</i>	F	A	
Scorpaenidae				
Red Lionfish	<i>Pterois volitans</i>	S	A	10" in length
Serranidae				
Goliath grouper	<i>Epinephelus itajara</i>	F(8)	A	
Sand perch	<i>Diplectrum formosum</i>	F	A	
Snowy grouper	<i>Epinephelus niveatus</i>	F(2)	J	2 ½" & 3 1/2 " in length
Sphyraenidae				
Southern sennet	<i>Sphyraena picudilla</i>	A	A	
Tetraodontidae				
Bandtail puffer	<i>Sphoeroides spengleri</i>	F	A	
Sharpnose puffer	<i>Canthigaster rostrata</i>	F	A	
Total		21		

Abundance Key: S=single, F=few (2-10), M=many (11-100), A=abundant (>100)

Size Key: A=adult, J=juvenile, A/J=intermediate

Table 22. Kyle' Crossbar Reef Benthic Species Census.

	Common Name	Scientific Name
Cnidarians	Sea Anemones	<i>Aptasia sp.</i>
Crustaceans	Caribbean Spiny Lobster	<i>Panulirus argus</i>
Mollusca	Rock snails	<i>Muricidae (Unidentified species)</i>
	Octopus - Caribbean Reef	<i>Octopus briareus</i>
Porifera	Encrusting Sponge	<i>Halisarca sp.</i>
Polychaeta	N/A	<i>Spirorbidae</i>

5.7 SIROTKIN DIAMOND PATCH - CENTRAL

- Location: Sirotkin Reef
- Materials: 5 Reefmaker "Florida Special" units (steel and concrete)
- Maximum Depth: 105 feet
- Reef High Point: 95 feet
- Year Created: 2005
- Monitoring Date: 09/05/2012
- Total Cost: \$3,975 (FWC 89% & Martin County 11%)

5.7.1 History of the Sirotkin Diamond Patch - Central

As part of a FWC grant Martin County received in 2005, sixty (60) Reefmaker "Florida Special" pyramid shaped artificial reef units made of concrete and steel were deployed around existing artificial sites, in addition to being placed as stand-alone reef sites. Fifteen (15) of the artificial reef units were deployed in three (3) groups of five (5) units each (North, Central, and South) within the Sirotkin Reef site on May 21, 2005. Charts showing the artificial reef's location within the Sirotkin site, and the placement of the units at the reef location for the Diamond Patch are shown in Figure 20 and Figure 21.

The placement pattern shown in Figure 21 is roughly diamond-shaped with one central unit surrounded by the remaining four, spaced approximately 100 feet apart. Color coded zip ties were attached to the top of each unit during deployment to simplify identification of individual units during monitoring.

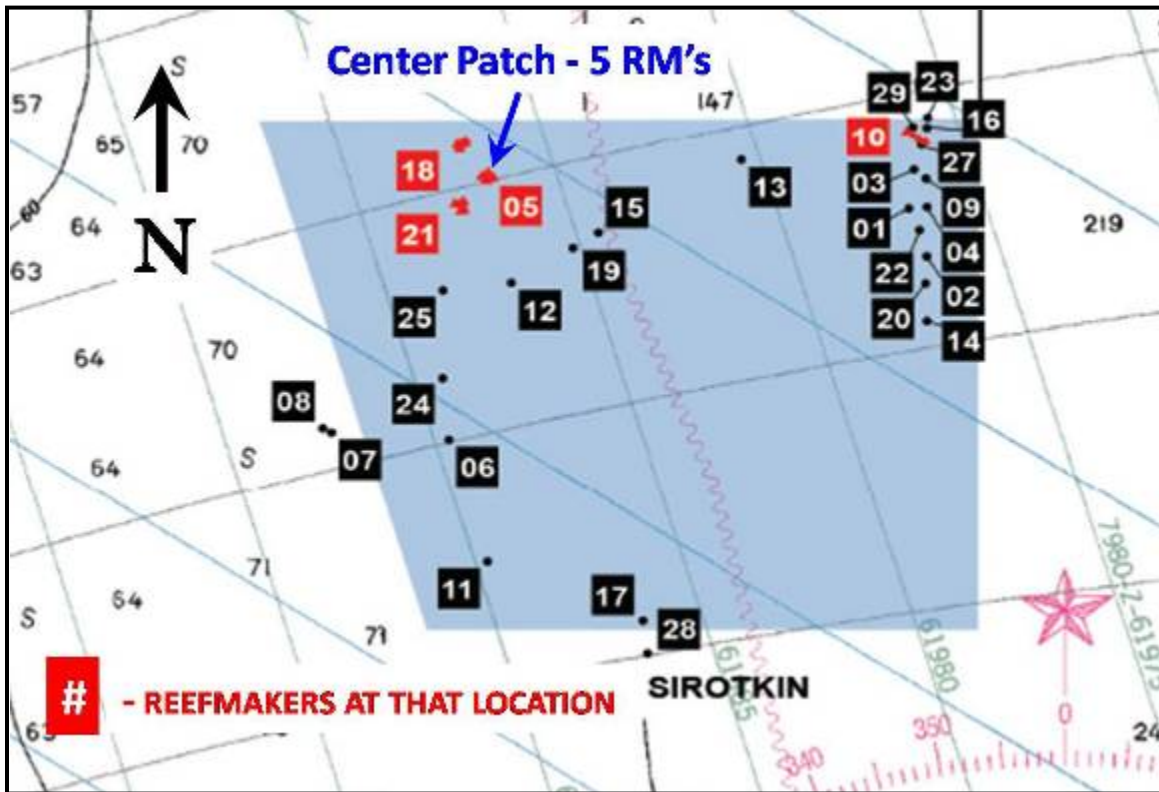


Figure 20. Chart of the Sirotkin site showing the Diamond Patch – Central location.

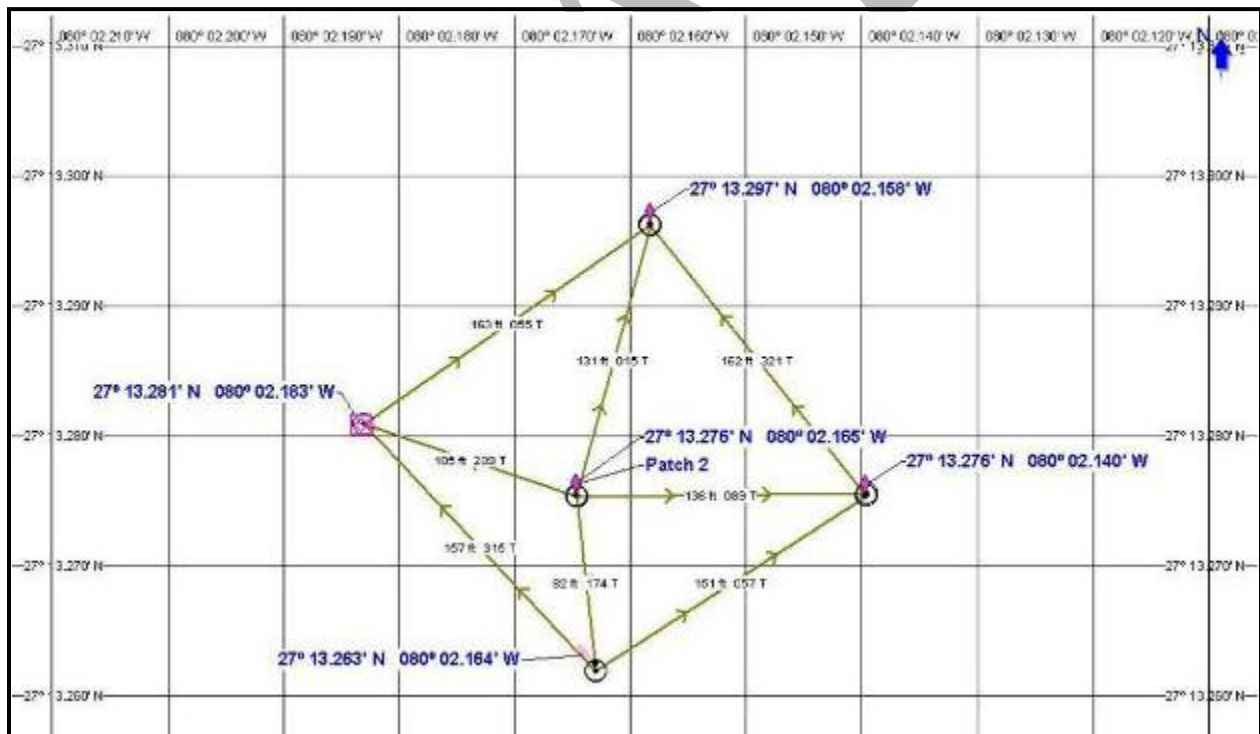


Figure 21. Chart view of the Sirotkin Diamond Patch - Central unit locations.

5.7.2 Fathometer Survey Summary

A fathometer survey of the Sirotkin Diamond Patch – Central site location was conducted to obtain depth information in the vicinity of the reef site, and a depth profile image of the individual Reefmaker units. The map in Figure 22 shows the relative location of the Reefmaker units at the Sirotkin Diamond Patch – Central reef site, which is identified by the blue dots and the dive flag symbol. The path of the survey vessel during the fathometer readings is represented by the yellow line. The survey track had an average depth of 101.5 ft, a minimum depth of 97.3 ft, and a maximum depth of 107 ft. During the course of the survey, attempts were made to locate each Reefmaker unit within the patch using the Hummingbird depth profiler, however, the individual Reefmaker units have a small profile in comparison to the larger debris piles or sunken vessel artificial reef sites, and were difficult to locate given their size and the water depth.

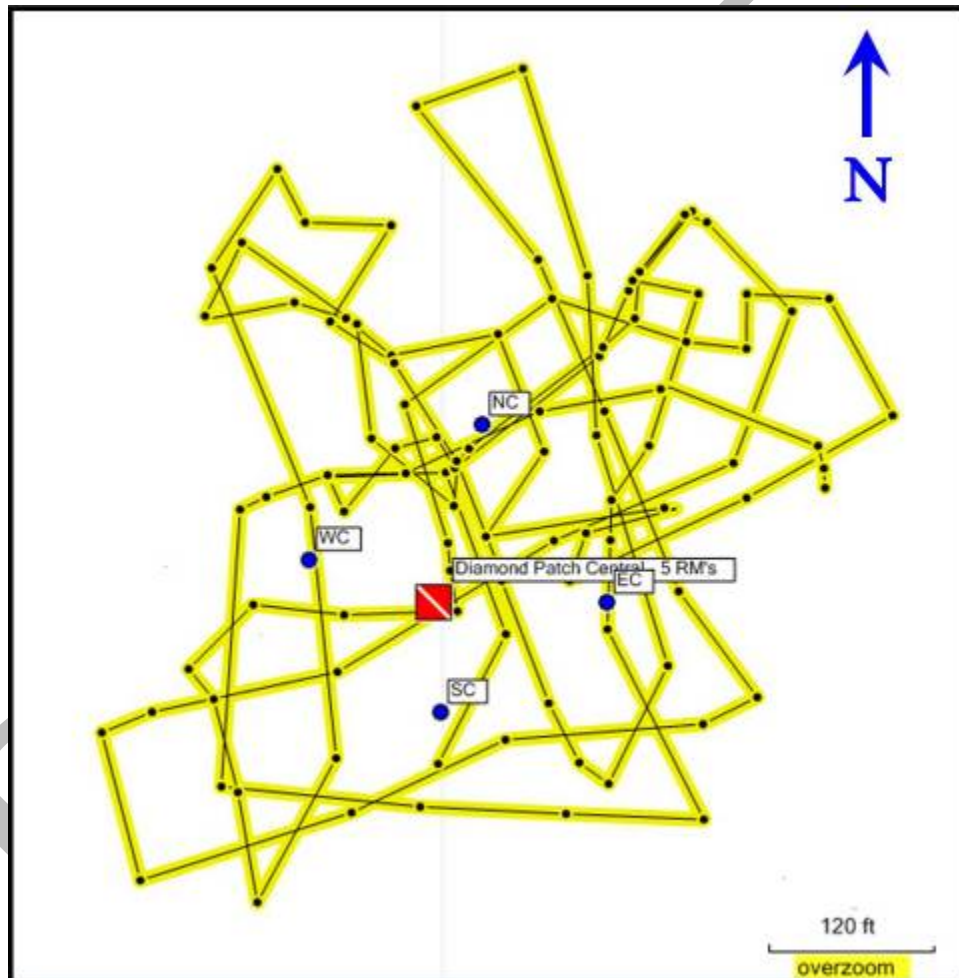


Figure 22. Garmin GPS track of the Sirotkin Diamond Patch - Central Fathometer Survey.

The survey boat maneuvered within the artificial reef site to pass over each Reefmaker unit and obtain the depth at each unit location. All units were observed on the screen during the course of the survey. The screen-shot images in Figure 23 were captured during the survey as the Reefmaker units appeared on the depth profile. Due to the triangular profile of the units, the wide bases have a greater target signature and are more distinguishable in the depth profile. The depth profile images show the individual units on the bottom with associated latitude/longitude, time, course over ground, temperature and depth information.

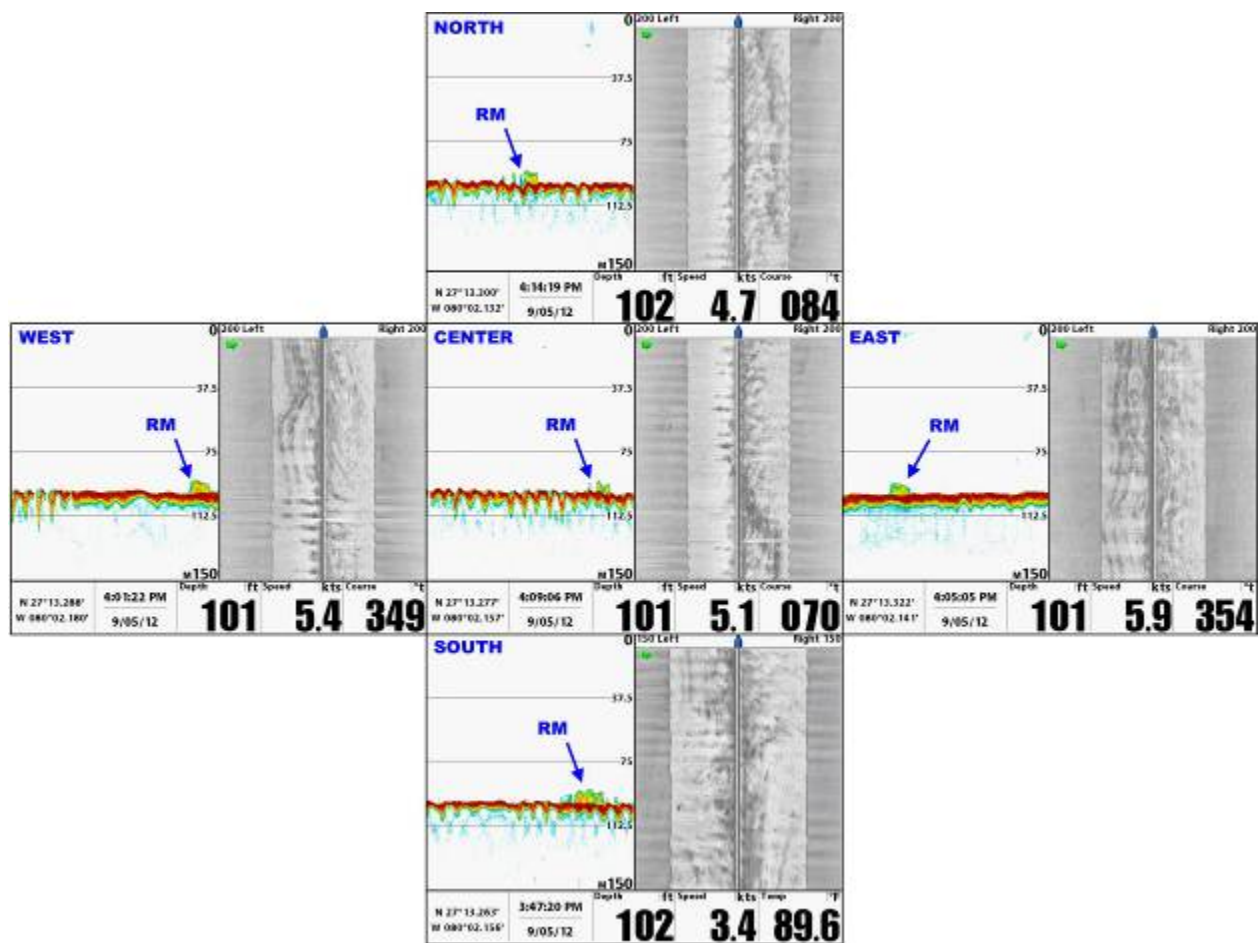


Figure 23. Hummingbird depth profile/sidescan images of the Sirotkin Diamond Patch - Central.

The timestamp for each screen-shot image was used as a point of reference to display the Hummingbird data for each Reefmaker unit as the survey vessel passed over the units, and they became visible on the depth profile. The results from the fathometer survey in Table 23 show the data within the timeframe each unit was observed. Depth data obtained during the fathometer survey of the Sirotkin Diamond Patch - Central reef are included in the Appendix.

Table 23. Sirotkin Diamond Patch - Central Artificial Reef Fathometer Survey Results.

Time	Latitude (DD)	Longitude (DD)	Depth (ft)	Water Temp (°C)
NORTH REEFMAKER UNIT				
16:13:30	27.222	80.037	98.9	32.7
16:13:34	27.222	80.036	100.3	32.7
16:13:38	27.222	80.036	99.3	32.8
16:13:42	27.222	80.036	100.3	33
16:13:46	27.222	80.036	98.6	33.1
16:13:50	27.222	80.036	100.9	33.1
16:13:54	27.222	80.036	99.6	33.1
16:13:58	27.222	80.036	100.9	33
16:14:02	27.222	80.036	100.6	33
16:14:07	27.222	80.036	102.6	33
16:14:11	27.222	80.036	101.2	32.8

16:14:15	27.222	80.036	100.9	33
16:14:18	27.222	80.036	102.9	33
16:14:23	27.222	80.035	101.6	32.8
16:14:25	27.222	80.035	100.9	32.8
EAST REEFMAKER UNIT				
16:03:00	27.222	80.036	99.3	32.8
16:03:04	27.222	80.036	99.6	33
16:03:08	27.222	80.036	100.6	33
16:03:12	27.222	80.036	101.2	33
16:03:16	27.222	80.036	99.9	33.1
16:03:20	27.222	80.036	99.9	33
16:03:24	27.222	80.036	101.2	33.1
16:03:28	27.222	80.036	100.6	33
16:03:32	27.221	80.036	103.2	33
16:03:36	27.221	80.036	102.6	33
16:03:40	27.221	80.036	101.2	33.1
16:03:44	27.221	80.036	104.9	33.1
16:03:48	27.221	80.036	102.2	33.1
16:03:52	27.221	80.036	102.9	33.1
16:03:56	27.221	80.036	101.9	33.2
SOUTH REEFMAKER UNIT				
15:47:00	27.221	80.036	102.2	31.9
15:47:04	27.221	80.036	99.9	31.9
15:47:08	27.221	80.036	100.9	32
15:47:12	27.221	80.036	103.2	31.8
15:47:16	27.221	80.036	102.2	32
15:47:20	27.221	80.036	101.2	32.1
15:47:24	27.221	80.036	101.6	32.2
15:47:28	27.221	80.036	101.2	32.8
15:47:32	27.221	80.036	101.2	32.7
15:47:36	27.221	80.036	100.9	32.6
15:47:40	27.221	80.036	101.2	32.4
15:47:44	27.221	80.036	100.6	32.4
15:47:48	27.222	80.036	103.9	32.6
15:47:52	27.222	80.036	100.9	32.4
15:47:56	27.222	80.036	101.2	32.3
WEST REEFMAKER UNIT				
16:00:29	27.221	80.036	100.3	31.8
16:00:33	27.221	80.037	99.3	32.1
16:00:37	27.221	80.037	99.9	32
16:00:41	27.221	80.036	99.6	32.1
16:00:45	27.221	80.036	100.9	32.3
16:00:49	27.221	80.036	103.2	32.3
16:00:53	27.221	80.036	100.6	32.6
16:00:56	27.221	80.036	99.9	33.1
16:01:00	27.221	80.036	101.6	33

16:01:08	27.221	80.036	99.9	32.7
16:01:08	27.221	80.036	99.3	32.5
16:01:12	27.221	80.036	100.3	32.2
16:01:16	27.221	80.036	101.9	32.1
16:01:20	27.221	80.036	102.2	32.2
16:01:25	27.222	80.036	99.6	32.2
CENTER REEFMAKER UNIT				
16:08:12	27.221	80.037	98.6	33.2
16:08:16	27.221	80.037	98.3	33
16:08:20	27.221	80.037	97.3	33
16:08:24	27.221	80.037	100.6	33
16:08:28	27.221	80.037	100.9	33
16:08:32	27.221	80.037	101.2	32.8
16:08:36	27.221	80.037	105.8	32.8
16:08:40	27.221	80.037	99.6	33
16:08:44	27.221	80.037	100.6	33.2
16:08:48	27.221	80.036	101.2	33.3
16:08:52	27.221	80.036	105.8	33.1
16:08:56	27.221	80.036	102.9	33.1
16:09:00	27.221	80.036	100.9	33.1
16:09:04	27.221	80.036	103.2	33.2
16:09:08	27.221	80.036	102.6	33.1
Note: All information obtained using a Hummingbird 1197c/997c, depths are relative to NAD83 Horizontal Datum				

5.8 SIROTKIN DIAMOND PATCH - SOUTH

- Location: Sirotkin Reef
- Materials: 5 Reefmaker “Florida Special” units (steel and concrete)
- Maximum Depth: 100 feet
- Reef High Point: 90 feet
- Year Created: 2005
- Monitoring Date: 09/05/2012
- Total Cost: \$3,975 (FWC 89% & Martin County 11%)

5.8.1 History of the Sirotkin Diamond Patch - South

Through a grant from the FWC, Martin County deployed five (5) Reefmaker “Florida Special” artificial reef units adjacent to existing reef materials in the Donaldson and Sirotkin reef sites, as well as four (4) stand-alone sites. Fifteen (15) of these units were deployed within the Sirotkin Reef site on May 21, 2005 in three groups of five units (North, Central, and South). Charts showing the location of the South Reefmaker Diamond Patch within the Sirotkin site and the placement of the individual units at the reef location are shown in Figure 24 and Figure 25, respectively.

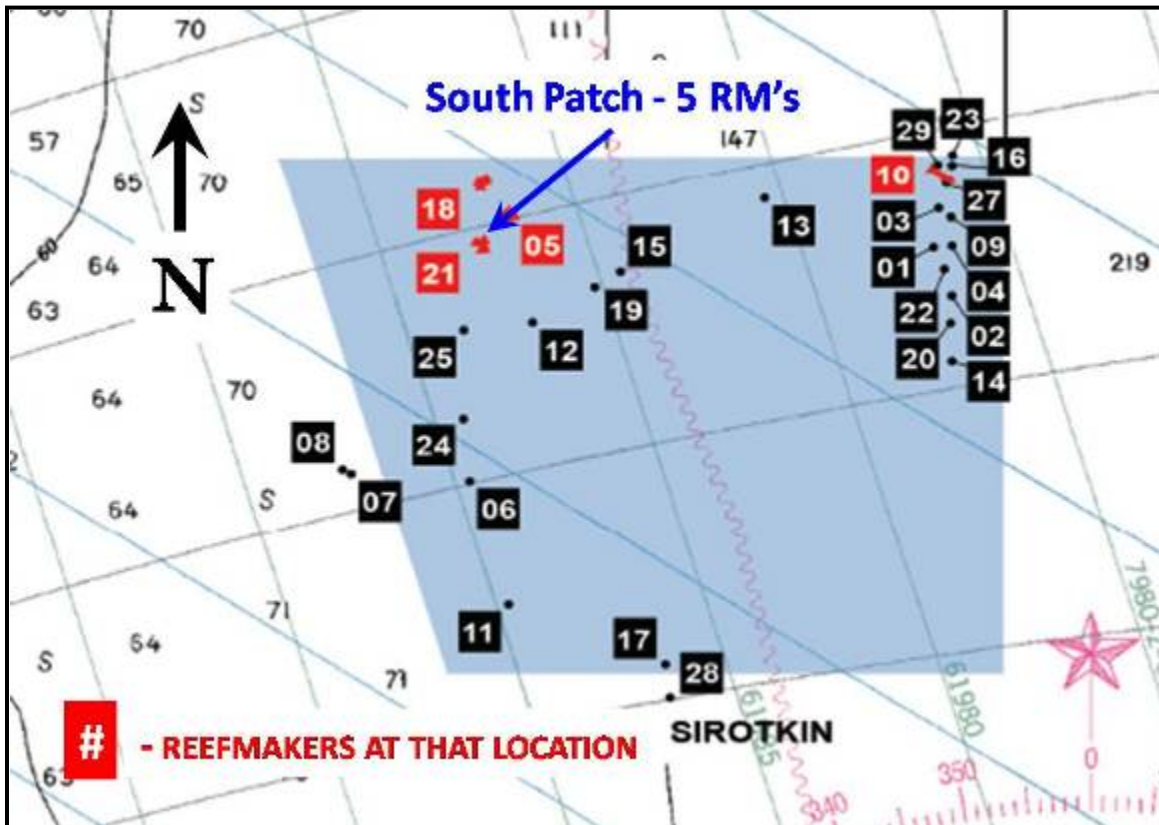


Figure 24. Chart of the Sirotkin site showing the Diamond Patch – South location.

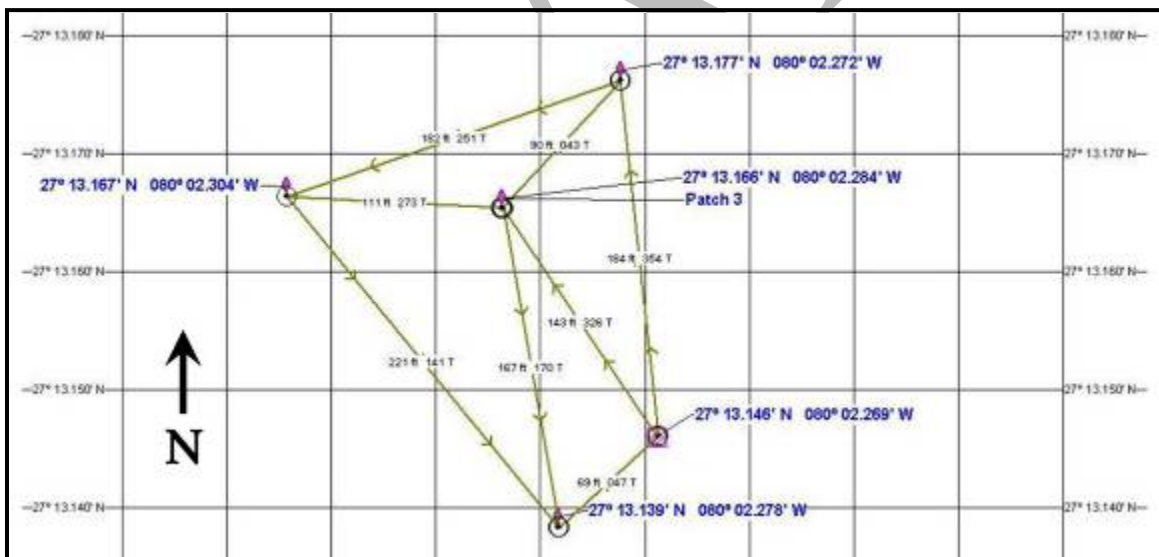


Figure 25. Chart view of the Sirotkin Diamond Patch - South unit locations.

The placement pattern shown in Figure 25 is roughly diamond-shaped, with one central unit surrounded by the remaining four, spaced approximately 100 feet apart. Color coded zip ties were attached to the top of each unit during deployment to simplify identification of individual units during monitoring.

5.8.2 Fathometer Survey Summary

A fathometer survey of the Sirotkin Diamond Patch – South artificial reef site was conducted to obtain depth information in the vicinity of the reef site and a depth profile image of the individual Reefmaker units. The map in Figure 26 shows the relative location of the Reefmaker units at the Sirotkin Diamond Patch – South reef site, which is identified by the blue dots and the dive flag symbol, and the path of the survey vessel (yellow line). The area had an average depth of 94.5 ft, minimum depth of 90 ft and a maximum depth of 102 ft. During the course of the survey, attempts were made to locate each Reefmaker unit within the patch using the Hummingbird depth profiler, however, the individual Reefmaker units have a small profile in comparison to the larger debris piles or sunken vessel artificial reef sites, and were difficult to locate given their size and the water depth.

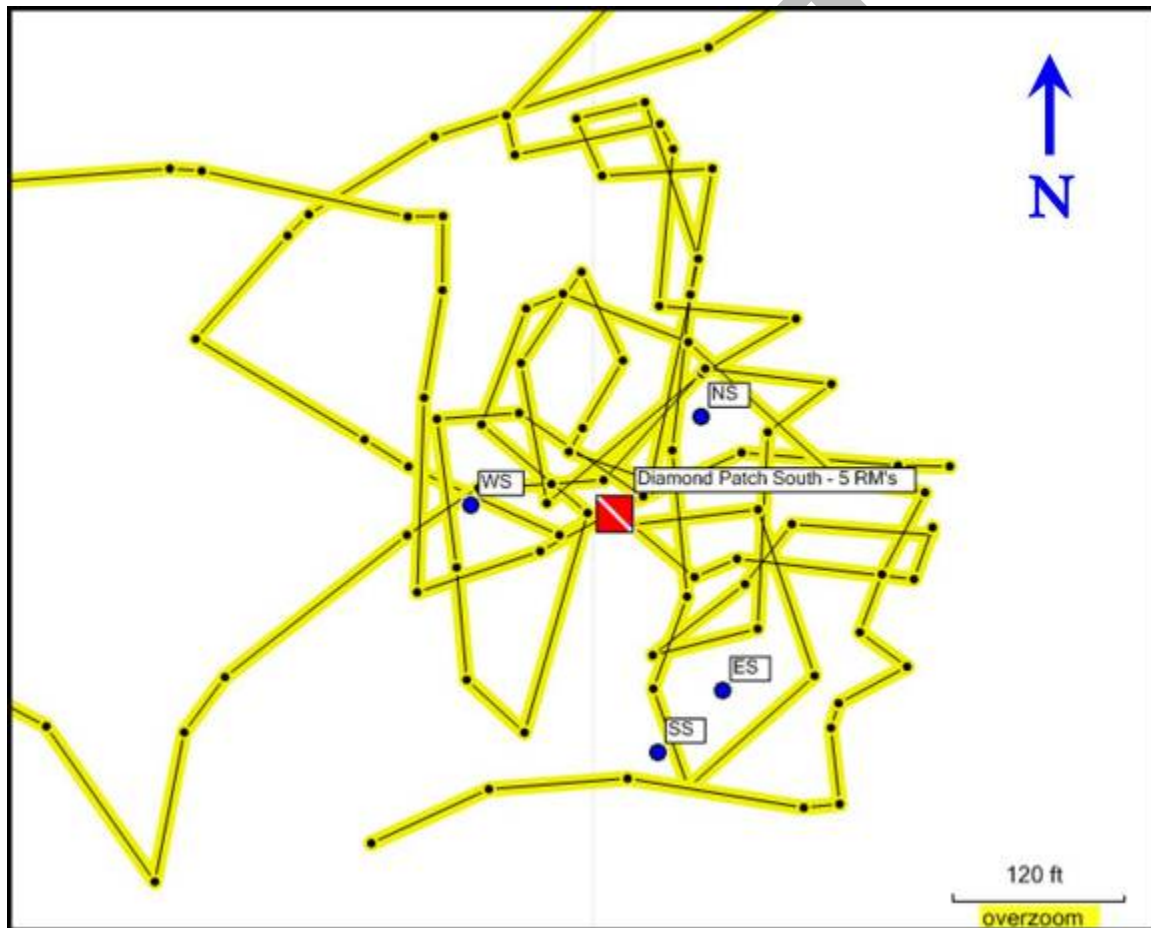


Figure 26. Garmin GPS track of the Sirotkin Diamond Patch - South Fathometer Survey.

All units, with the exception of the center Reefmaker unit, were documented on the screen during the survey; however, rough sea conditions and strong currents hindered the survey efforts. Due to the triangular profile of the units, the wide bases have a greater target signature and are more distinguishable in the depth profile. The screen-shot images in Figure 27 were captured during the survey as the Reefmaker units appeared on the depth profile. The depth profile images show the individual units on the bottom with associated latitude/longitude, time, course over ground, temperature and depth information.

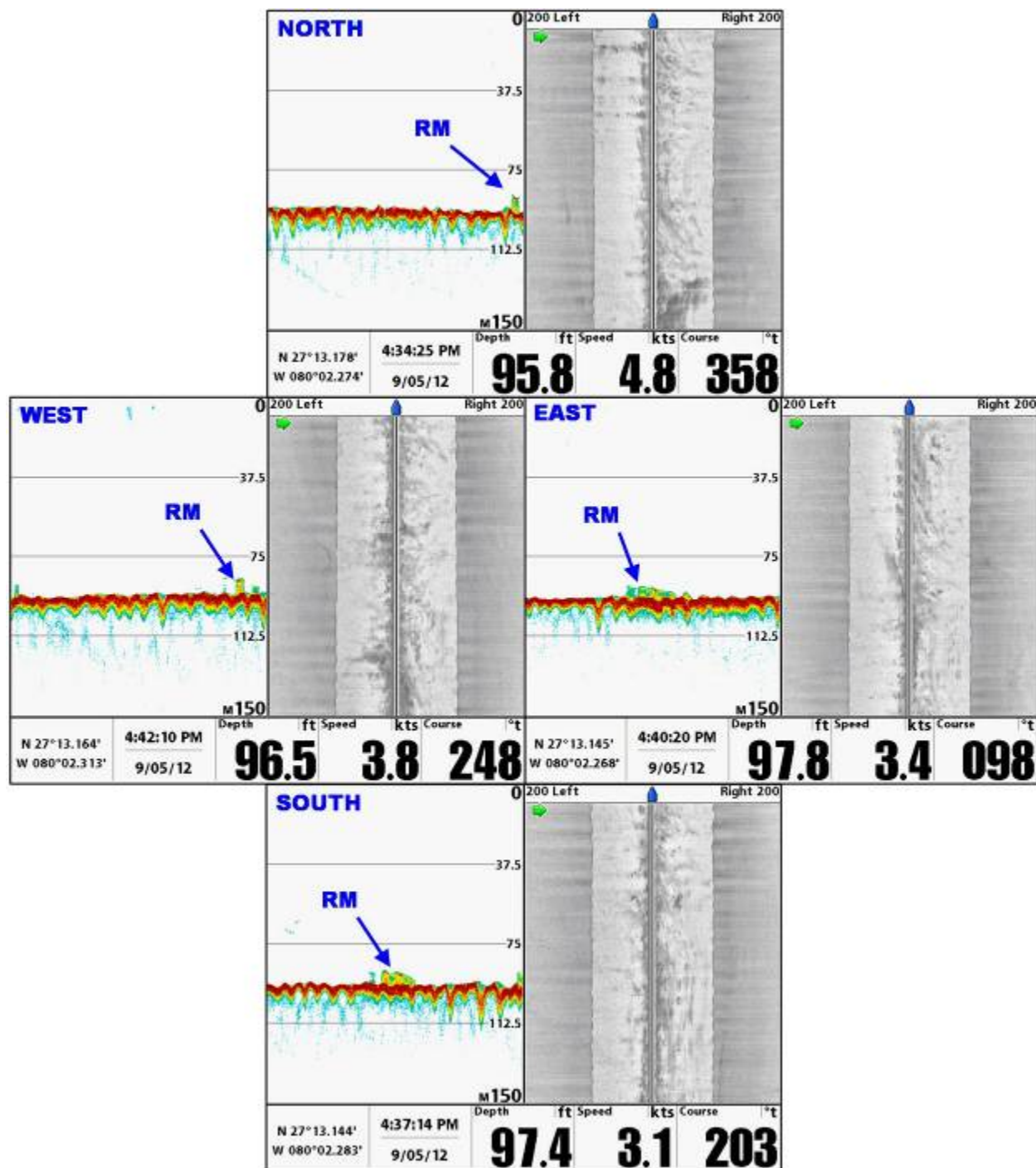


Figure 27. Hummingbird depth profile/sidescan images of the Sirotkin Diamond Patch - South.

The timestamp for each image was used as a point of reference to display the Hummingbird data for each Reefmaker unit as the survey vessel passed over the units and they appeared on the depth profile. Results from the fathometer survey (when each unit was observed) are shown below in Table 24. All depth data obtained during the fathometer survey of the Sirotkin Diamond Patch – South is included in the Appendix.

Table 24. Sirotkin Diamond Patch - South Artificial Reef Fathometer Survey Results.

Time	Latitude	Longitude	Depth	Water Temp
	(DD)	(DD)	(ft)	(°C)
NORTH REEMAKER UNIT				
16:34:01	27.22	80.038	95.0	33.1
16:34:06	27.22	80.038	95.0	33
16:34:10	27.219	80.038	96.0	33.1
16:34:14	27.219	80.038	96.0	33.2
16:34:18	27.22	80.038	97.3	33
16:34:22	27.22	80.038	99.9	33.1
16:34:26	27.22	80.038	95.7	33.2
16:34:30	27.22	80.038	95.7	33
16:34:34	27.22	80.038	95.7	32.8
16:34:38	27.22	80.038	95.7	33.2
16:34:42	27.22	80.038	96.6	33.2
16:34:46	27.22	80.038	96.6	33
16:34:50	27.22	80.038	97.0	33
16:34:54	27.22	80.038	94.7	33
16:34:58	27.22	80.038	96.3	33
EAST REEFMAKER UNIT				
16:39:30	27.219	80.037	98.0	33
16: 39:33	27.219	80.038	98.0	33
16: 39:37	27.219	80.038	96.6	33
16: 39:41	27.219	80.038	96.0	33
16: 39:45	27.219	80.038	95.7	32.8
16: 39:49	27.219	80.038	96.3	32.6
16: 39:53	27.219	80.038	97.6	32.6
16: 39:57	27.219	80.038	96.3	32.8
16:40:01	27.219	80.038	97.6	33
16:40:06	27.219	80.038	96.3	32.8
16:40:10	27.219	80.038	96.0	33
16:40:14	27.219	80.038	97.6	32.8
16:40:18	27.219	80.038	95.0	32.8
16:40:22	27.219	80.038	97.6	33
16:40:26	27.219	80.038	96.3	33.3
SOUTH REEFMAKER UNIT				
16:36:21	27.22	80.038	95.7	32.6
16:36:25	27.22	80.038	96.6	32.6
16:36:29	27.22	80.038	95.7	33
16:36:33	27.219	80.038	96.3	32.8
16:36:37	27.219	80.038	97.0	32.7
16:36:41	27.219	80.038	98.0	32.6
16:36:45	27.219	80.038	97.3	32.5
16:36:49	27.219	80.038	97.3	32.5
16:36:53	27.219	80.038	97.0	32.4

16:36:57	27.219	80.038	96.6	32.5
16:37:01	27.219	80.038	98.3	32.4
16:37:05	27.219	80.038	97.3	32.8
16:37:09	27.219	80.038	95.7	33
16:37:13	27.219	80.038	98.0	33.2
16:37:18	27.219	80.038	96.6	33
WEST REEFMAKER UNIT				
16:41:38	27.22	80.038	95.7	32.5
16:41:42	27.22	80.038	96.3	32.5
16:41:46	27.22	80.038	95.7	32.6
16:41:50	27.22	80.038	95.7	32.6
16:41:54	27.219	80.038	93.7	32.6
16:41:58	27.219	80.038	94.7	32.7
16:42:02	27.219	80.038	95.3	32.6
16:42:06	27.219	80.038	94.4	32.6
16:42:10	27.219	80.039	93.7	32.7
16:42:14	27.219	80.039	93.4	32.7
16:42:18	27.219	80.039	91.7	32.5
16:42:22	27.219	80.039	94.4	32.7
16:42:26	27.219	80.039	95.3	32.6
16:42:30	27.219	80.039	91.7	32.7
16:42:34	27.219	80.039	92.7	32.6
Note: All information obtained using a Hummingbird 1197c/997c, depths are relative to NAD83 Horizontal Datum				

5.9 GLASRUD - “BIG AL” REEF

- Location: Sirotkin Reef
- Materials: “Big Al” Tugboat (Steel)
- Maximum Depth: 191 feet
- Reef High Point: 162 feet
- Year Created: 2010
- Monitoring Date: 9/05/2012
- Total Cost: \$40,000 (MCAC)

5.9.1 History of the Glasrud Artificial Reef

On Wednesday February 24th 2010, the 69-foot steel tug boat “Big Al” was deployed offshore as an estimated 100 spectators aboard 20 boats watched, photographed and took video of the sinking. The tug sank quickly after it was properly positioned in line with other artificial reefs created. During the deployment the crews on the support vessels had to contend with current, wind and the edge of the severe midday squall. The tug reached bottom in 187 feet of water near the Wickstrom, a 168 foot long steel freighter deployed in January 2003. Figure 28 shows a chart with the location of the Glasrud Reef.

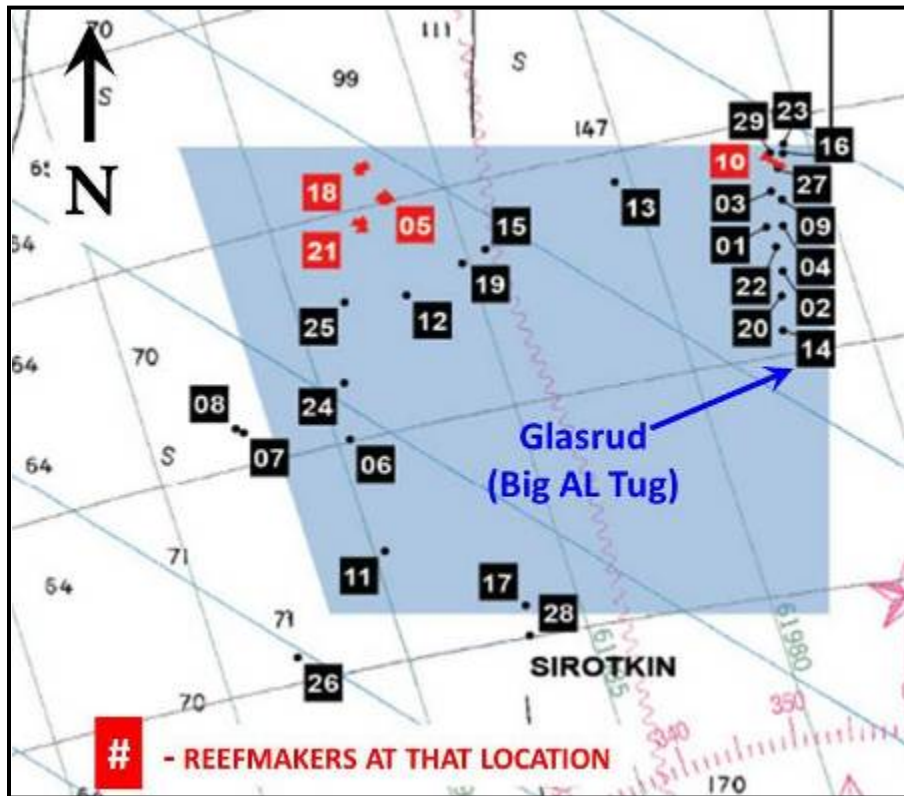


Figure 28. Chart of the Sirotkin Site showing Glasrud Reef location.

5.9.2 Fathometer Survey Summary

A fathometer survey of the Glasrud artificial reef site was conducted to obtain depth information in the vicinity of the reef site and a depth profile image of the reef. The map in Figure 29 shows the path of the survey vessel (yellow line), where the survey tracks recorded had an average depth of 188 ft, a minimum depth of 182 ft and a maximum depth of 201 ft.

The screen-shot image in Figure 30 was captured as the Glasrud appeared on the depth profile. The survey boat maneuvered above the artificial reef site and obtained an approximate top of reef depth of 161 ft. The depth profile image shows the Glasrud on the bottom with associated latitude/longitude, time, date, temperature, and depth information.

The timestamp from the Hummingbird image was used as a point of reference to display the depth data for the Glasrud Reef as the survey boat passed over. Results from the fathometer survey are shown below in Table 25. All depth data obtained during the fathometer survey of the Glasrud Reef is included in the Appendix.

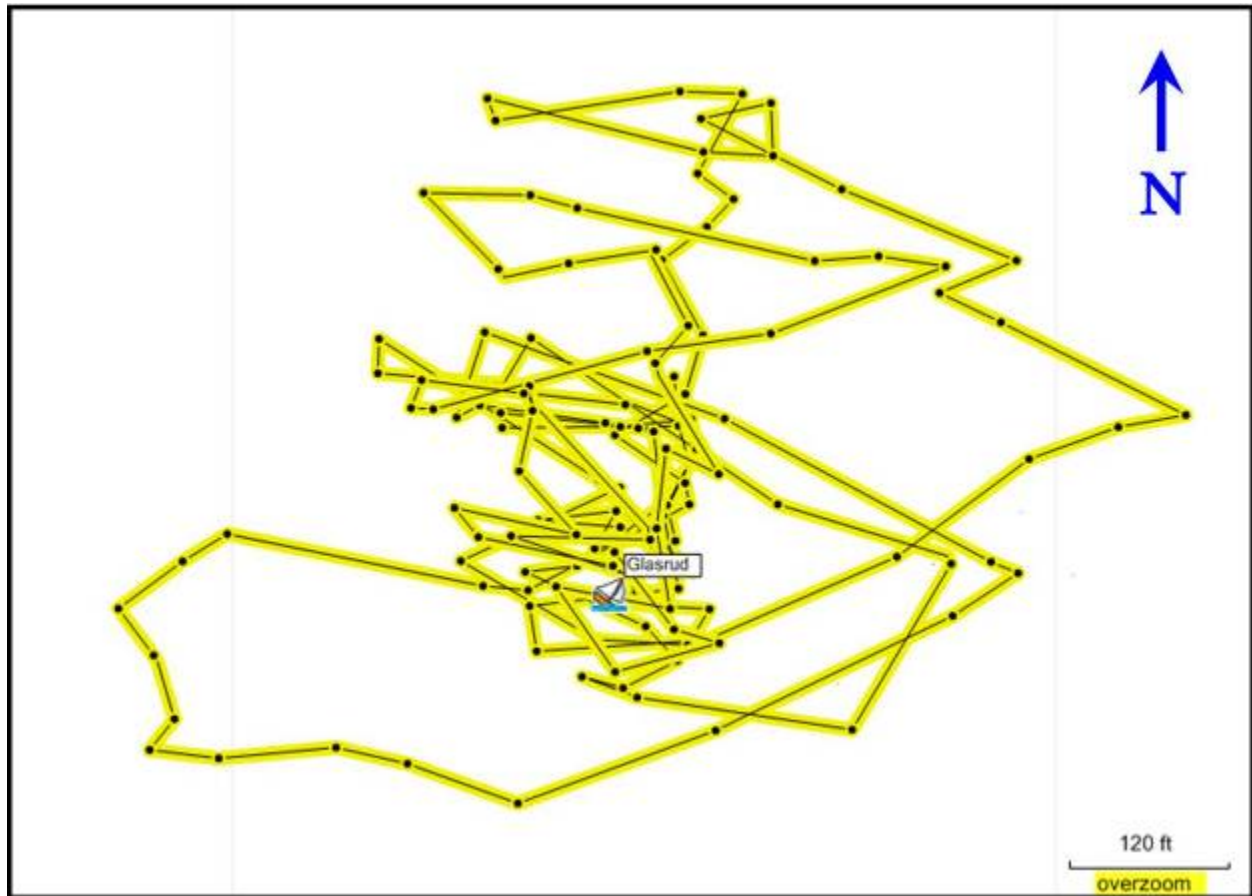


Figure 29. Garmin GPS track of the Glasrud Fathometer Survey.

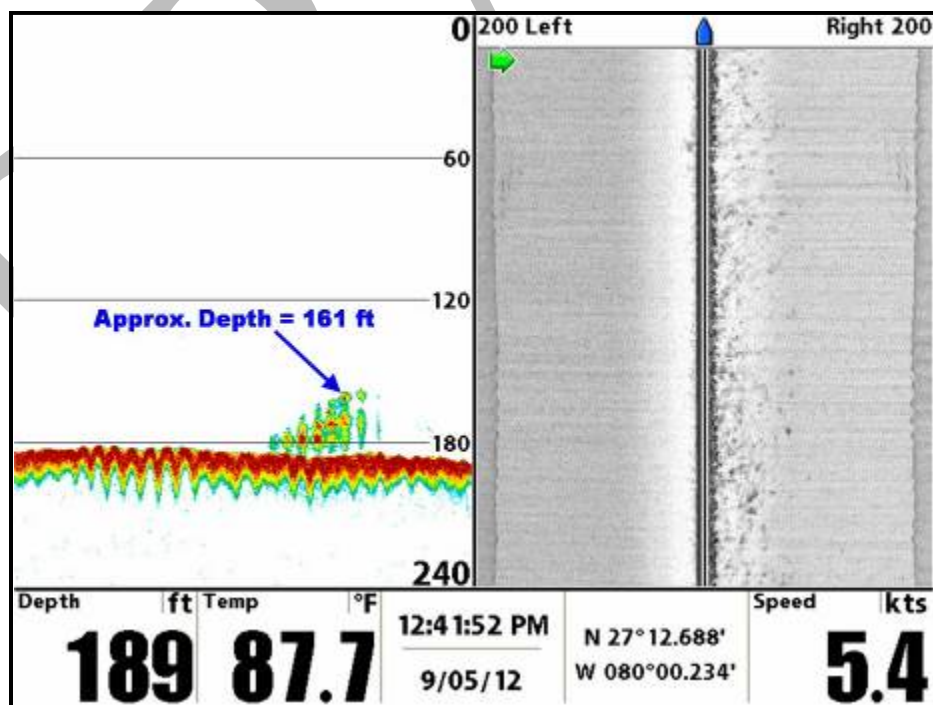


Figure 30. Hummingbird depth profile/sidescan images of the Glasrud Artificial Reef.

Table 25. Glasrud Artificial Reef Fathometer Survey Results.

Time	Latitude	Longitude	Depth	Water Temp
	(DD)	(DD)	(ft)	(°C)
12:41:00	27.211	80.005	186.9	30.9
12:41:04	27.211	80.005	184.6	30.8
12:41:08	27.211	80.005	184.9	30.8
12:41:12	27.211	80.005	187.9	30.8
12:41:16	27.211	80.005	186.9	30.9
12:41:20	27.211	80.005	186.2	31
12:41:24	27.211	80.005	189.5	30.8
12:41:28	27.211	80.005	188.8	30.9
12:41:32	27.211	80.004	192.1	30.8
12:41:36	27.211	80.004	186.9	30.9
12:41:40	27.211	80.004	186.5	30.8
12:41:44	27.211	80.004	189.8	30.9
12:41:48	27.211	80.004	189.8	30.8
12:41:52	27.211	80.004	190.2	30.9
12:41:56	27.212	80.004	192.8	30.9
Note: All information obtained using a Hummingbird 1197c/997c, depths are relative to NAD83 Horizontal Datum				

5.10 CLIFTON S. PERRY MEMORIAL ARTIFICIAL REEF

- Location: Donaldson Reef
- Materials: Concrete slabs, pilings, roadway sections, pile caps, sidewalk sections, steel I beams, braces, piping, plating, rods, guardrails, grating, and Z sheetpiling
- Maximum Depth: 64 feet
- Reef High Point: 49 feet
- Year Created: 2005
- Monitoring Date: 09/19/2012
- Total Cost: \$6,832 (Martin County and FDOT)

5.10.1 History of the Clifton Perry Memorial Reef

Nine barge loads of concrete and steel materials were deployed at the Clifton Perry Memorial Reef site in the winter and spring of 2005. The reef materials came from the demolished Jensen Beach Causeway/Frank Wacha draw bridge that spanned the Indian River Lagoon at Jensen Beach. The new reef was named in honor of one of the Florida Oceanographic Society's (FOS) original founders. FOS was the first non-profit environmental advocacy group in the area and Mr. Perry's early efforts in the organization helped establish the original artificial reef deployments offshore of Martin County. This reef is located in the northeastern corner of the Donaldson Artificial Reef Site. Figure 31 shows a chart with the location of the Perry reef within the permitted artificial reef area.

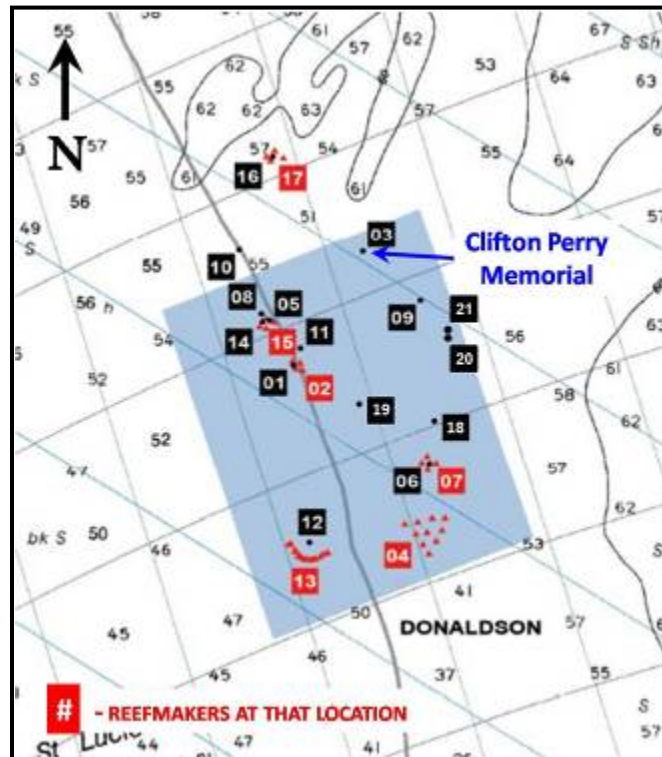


Figure 31. Chart of the Donaldson Reef site showing the Clifton Perry Memorial Reef location.

5.10.2 Structural Summary

The reef lies in an elliptical array on an east-southeast to west-northwest axis. The overall footprint gathered from GPS data is 330 feet by 280 feet, or approximately 2 acres. The average profile at this reef site was determined from eight (8) profile measurements taken along the ridge of the reef's highest peaks, and is currently 12 ft above the seafloor. The measurements ranged from a low of 9 feet to a high of 16 feet. There has obviously been settlement of the reef over time. It has been determined that most of this settlement occurred during hurricane Wilma in October 2005, which caused significant damage to resources on land and the below sea-level terrain of the natural and artificial reefs. The Clifton Perry Reef was finished just months before the hurricane struck; therefore, many concrete and steel components had not yet settled into locking position.

Depth measurements taken at along the reefs perimeter and in the surrounding seafloor indicate a scour depth of at least two feet around the reef. This is likely due to the shifting sediments, as well as past storm events. The photographs in Figure 32 show the general condition of the Clifton Perry Reef and some of the species observed during the monitoring dive.

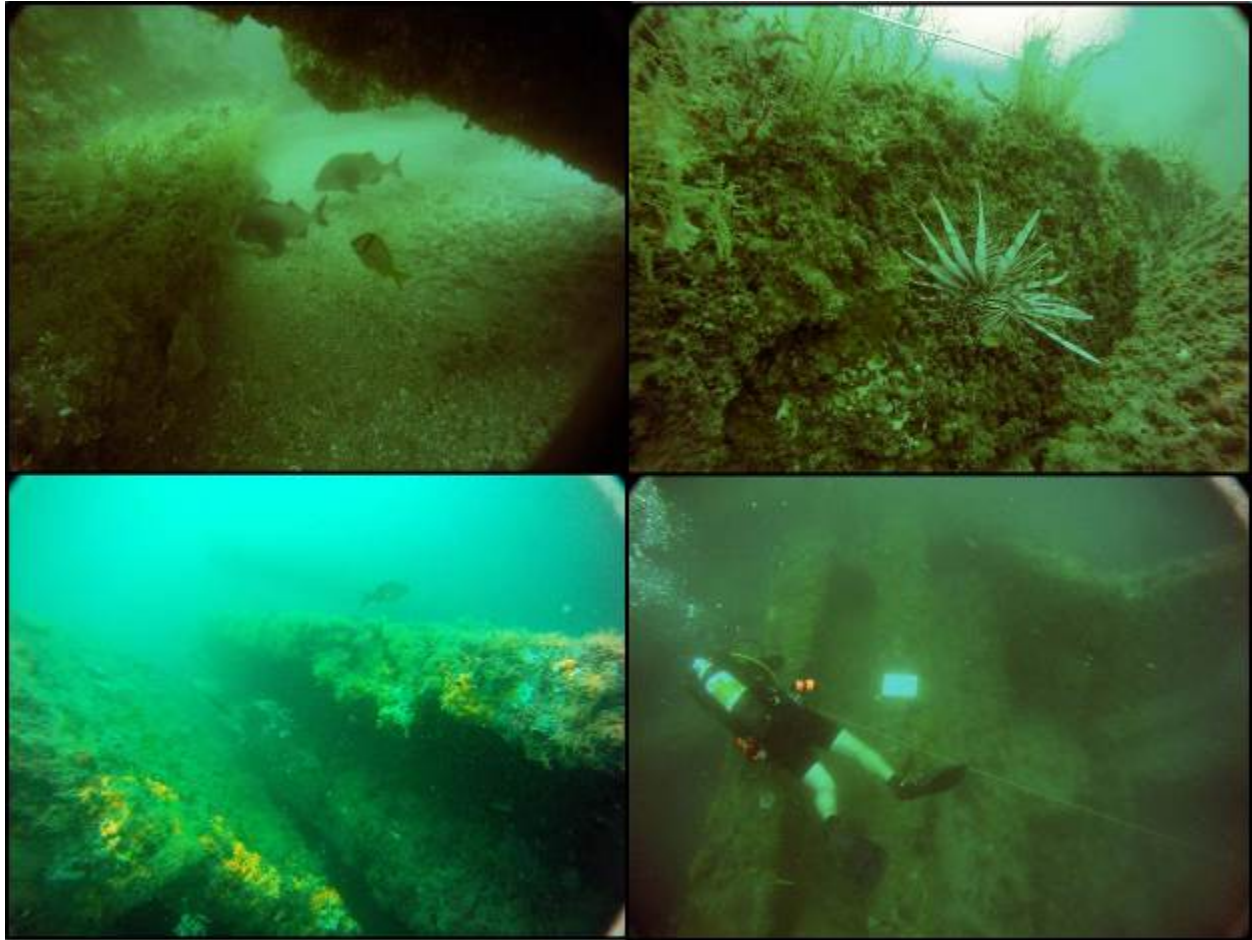


Figure 32. Clifton Perry Memorial Reef 2012 photographs.

Identification of species in the photographs shown above, clockwise from the upper-left photograph are (1) black margate and porkfish, (2) lionfish, (3) none, and (4) scamp.

5.10.3 Biological Survey Results

Following the 2012 fish census and in reviewing past monitoring efforts, we noticed an increasing trend in both species diversity and total biomass on the Clifton Perry Memorial Reef since its construction in 2005. The most notable recreational sport/food fish identified on the reef were: common snook, gag grouper, snapper (lane, yellowtail and gray), scamp, and great barracuda. Unfortunately, two venomous fish species were also observed: the spotted scorpion fish (native) and the invasive exotic red lionfish (native to the Pacific Ocean). Lionfish have become a large problem in the western Atlantic and Caribbean Sea waters in recent years, and based on monitoring efforts, are more common in the waters of Martin County, especially over the last 3 years.

Several adult cottonwick were also documented. Although native to Florida, they are seldom found on artificial reefs and prefer the shallow natural reefs close to shore. Overall, the Perry reef supports a uniformly dense assemblage of sessile invertebrates, marine plants, algae and other benthic marine organisms. The fish and invertebrate species observed during the monitoring dive are listed below in Table 26 and Table 27.

Table 26. Clifton Perry Memorial Artificial Reef Fish Species Census.

Family/Common Name	Species	2012	
		Abundance	Size
Carangidae			
Blue runner	<i>Caranx crysos</i>	A	A
Centropomidae			
Common snook	<i>Centropomus undecimalis</i>	M	J/A & A
Chaetodontidae			
Reef butterflyfish	<i>Chaetodon sedentarius</i>	M	A
Spotfin butterflyfish	<i>Chaetodon ocellatus</i>	F	A
Dasyatidae			
Southern Stingray	<i>Dasyatis americana</i>	S	A
Diodontidae			
Striped burrfish	<i>Chilomycterus schoepfi</i>	S	A
Haemulidae			
Tomtate	<i>Haemulon aurolineatum</i>	A	J & A
Black margate	<i>Anisotremus surinamensis</i>	F	A
Cottonwick	<i>Haemulon melanurum</i>	F	A
Porkfish	<i>Anisotremus virginicus</i>	M	J & A
Labridae			
Slippery dick	<i>Halichoeres bivittatus</i>	A	J & A
Spanish hogfish	<i>Bodianus rufus</i>	M	J & A
Lutjanidae			
Gray snapper	<i>Lutjanus griseus</i>	M	A
Lane snapper	<i>Lutjanus synagris</i>	M	J & A
Yellowtail snapper	<i>Ocyurus chrysurus</i>	M	J & A
Mullidae			
Spotted goatfish	<i>Pseudupeneus maculatus</i>	S	A
Muraenidae			
Spotted moray eel	<i>Gymnothorax moringa</i>	S	A
Ogcocephalidae			
Shortnose batfish	<i>Ogcocephalus nasutus</i>	S	A
Pomacanthidae			
Blue angelfish	<i>Holacanthus bermudensis</i>	F	A
Pomacentridae			
Yellowtail reeffish	<i>Chromis enchrysurus</i>	M	J & A
Beaugregory	<i>Pomacentrus leucostictus</i>	M	J & A
Sciaenidae			
High hat	<i>Equetus acuminatus</i>	M	J & A
Scorpaenidae			
Red Lionfish	<i>Pterois volitans</i>	F	J
Spotted scorpionfish	<i>Scorpaena plumeiri</i>	S	A
Serranidae			
Belted sandfish	<i>Serranus subligarius</i>	M	J & A
Gag grouper	<i>Mycteroperca microlepis</i>	F	J
Scamp	<i>Mycteroperca phenax</i>	M	J & A
Whitespotted soapfish	<i>Rypticus maculatus</i>	M	J & A
Sparidae			
Sheepshead	<i>Archosargus probatocephalus</i>	F	A
Sheepshead porgy	<i>Calamus penna</i>	M	A

Family/Common Name	Species	2012	
		Abundance	Size
Sphyraenidae			
Great barracuda	<i>Sphyraena barracuda</i>	S	A
Tetraodontidae			
Bandtail puffer	<i>Sphoeroides spengleri</i>	F	J & A
Sharpnose puffer	<i>Canthigaster rostrata</i>	F	J & A
	Total	33	

Abundance Key: S=single, F=few (2-10), M=many (11-100), A=abundant (>100)

Size Key: A=adult, J=juvenile, A/J=intermediate

Table 27. Clifton Perry Memorial Artificial Reef Benthic Species Census.

	Common Name	Scientific Name
Cnidarians	Algae Hydroids	<i>Thyroscyphus ramosus</i>
Crustaceans	Volcano Barnacle	<i>Tetraclita stalactifera</i>
Porifera	N/A	<i>Batzella spp.</i>