

PUERTO RICO ARTIFICIAL REEFS EVALUATION ON THE EAST COAST

FUNDING PROVIDED BY THE NOAA CORAL REEF CONSERVATION PROGRAM

GRANT NUMBER NA11NOS4820005

SEPTEMBER 23, 2013

**TO: DEPARTMENT OF NATURAL AND ENVIRONMENTAL RESOURCES OF PUERTO RICO,
MARINE RESOURCES DIVISION**

FROM: JOSE CABALLERO, MARINE CONTRACTOR

**RE: PROGRESS REPORT #1 - PUERTO RICO ARTIFICIAL REEFS EVALUATION ON
THE EAST COAST. CONTRACT # 2013-000096**

ARTIFICIAL REEFS EVALUATION ON THE EAST COAST OF PUERTO RICO

INTRODUCTION

Puerto Rico's east coast is where most of our recreational marine activities take place. In fact, nearly all boating events and the majority of the marinas, are in Fajardo - our eastern town. This study takes place within an area designated as a nature reserve called "Reserva de los Cayos de la Cordillera". Composed of a group of small islands located within eight nautical miles from town, marinas, hotels, condominiums and restaurants, among other establishments.

Hundreds of tourists and locals alike visit the nature reserve on a daily basis. In addition to tourism, 3 fishing villages and 7 marinas are within 5 miles of the reserve. This high volume of marine activity for the past 50 years has generated numerous nautical debris. Among these, sunken boats and abandoned derelict hulls from past hurricanes, are a very common find while diving the area. These wrecks provide shelter to juvenile fish of our local fishing industry.

Some of the goals of this project include the assessment of the amount of wrecks, documenting its location and size, seabed classification, conducting fish census in the area and categorizing the structures as 'useful' or 'not useful' for our marine industry. The term 'not useful' will be used to categorize the wrecks that will require preparation work in order to be "useful" and not become hazardous for divers or to other nearby habitats during severe weather.

The Puerto Rico Department of Natural and Environmental Resources may upgrade the structures found to "artificial reefs" after determining that these wrecks are safe and do not represent a hazard to other ecosystems, divers or to navigation.

Consequently, the study was conducted with the following objectives:

- A. Evaluate nautical charts and aerial pictures to determine which areas have the most concentration of boating activity during weekends.
- B. Identify sunken man-made structures that may work as artificial reefs by use of a Side Scan Sonar (SSS).
- C. Study targets using video from a remotely operated vehicle (ROV) unit.
- D. Evaluate videos of targets for fish census purposes and categorize as per the submerged structure's stability and safety.

METHODS AND EQUIPMENT

1. Imagenex Side Scan Sonar model 855
Frequency 330 kHz, 75' umbilical, 12 volts
2. Humminbird 997si Side Imaging Sonar - GPS Chartplotter Combo
Frequency 455kHz/800kHz, Gold Navionics Charts
3. Toshiba Satellite P755 Laptop Computer
4. Videoray PRO III GTO ROV, remotely operated vehicle equipped with high resolution video camera, adjustable halogen lighting, depth meter, three thrusters for forward/reverse/vertical propulsion, and 700 feet of umbilical cable.
5. Dusky 25' workboat with Honda 225BF Outboard.
6. Honda 2000i Generator
7. Coleman 800 watt auxiliary power supply inverter
8. Humminbird-PC Software
9. Diamond VC500 Software used to convert ROV -RCA signal to USB digital for recording and video editing purposes. Also used for taking still images.
10. Epiphany VGA2USB Hardware for converting SSS analog Images to digital.

METHODOLOGY

Marine charts and aerial photos of the Fajardo Islands were examined. Specifically, keys that are part of the Nature Reserve called Reserva Natural de Los Cayos de la Cordillera de Fajardo. The evaluation had as its main purpose to determine which of these islands had the higher concentration of boating activity during weekends. Once the high concentration areas were identified, they were selected for further analysis. Personally interviewing commercial underwater-fishermen of the area, was another approach used during this study to find submerged structures. These men provided valuable information of wrecks and other structures that work as artificial reefs.

The selected areas have been visited during the following time period: May 5, 2013 to Sept 2, 2013. A workboat equipped with side imaging bottom sounder and chartplotter GPS was used. A side scan sonar was also deployed from the boat to increase search pattern width as the boat proceeds over the selected areas.

The side scan sonar is a marine geophysical technique that is used to provide an image or "see" the ocean floor. The method uses sound pulses (sonar) shot sub-horizontally across the sea bottom from a towed transducer mounted on a "tow fish". The sound pulses reflect off objects that project above the bottom.

The strength and travel time of reflected pulses are recorded and processed into an image or picture of the seafloor.

When conducting side-scan survey operations a search "block" is set up. These blocks contain many lines and when searching in these blocks the boat will pass over one line then turn around and pass over another line in the opposite direction, much like someone "mowing the lawn". During this initial survey, the side-scan sonar towfish is towed behind the research vessel above the seabed.

During this study, the use of the side scan sonar was combined with a chartplotter GPS device in order to provide navigation while towing, therefore sweeping the study area. The chartplotter provided key data in order to resume search any other day at the exact position paused.

Targets that showed up in the side scan sonar monitor that had manmade characteristics, were saved in the chart plotter memory and given a target number. Their Lat /Long position and a snapshot of their shape was also recorded. Targets with obvious man made shape were swept with sonar various times and documented as such. Snapshots of these were saved on SD cards that the onboard electronics use. Please see attached SD Card Images #1, #2.

At this point in time, during Phase II of this project, side scan sonar has not been deployed in all of the studied areas due to technical problems powering the unit onboard combined with rough marine conditions. This Phase is scheduled to occur during October 2013.

During our next phase, a remotely operated vehicle (ROV) will be used to video the targets found in our previous search. A ROV, is a mobile robot used for sub aquatic work equipped with cameras, lights and thrusters for propulsion. Remote control is carried out by a tether or umbilical cord that connects the operator/pilot from a surface (boat) station. The control console provides the pilot with a monitor to see what the robot sees. Video and still images can be captured and saved to hard discs or other data storing devices. The ROV allows our project to evaluate further while maintaining low costs in lieu of the expenses when using divers.

After selecting a target on the chart plotter screen, a surface mark will be set in order to facilitate finding the underwater structures with the ROV. In other words, a small buoy or float with a sinker is deployed when the boat is directly on top of the chosen target. By doing this, the boat can be anchored as closed as possible to our mark. Once the boat anchor is set, we control the boat position with the amount of anchor line paid out. The ROV is launched after checking the pre-dive check list and connected via USB to a laptop pc for recording purposes.

The videos and still images captured are stored in the onboard PC hard disc for future evaluation. The ROV pilot will try to film the structure's surroundings as to portray what the structure is. Accessible compartments and holds must also be illuminated in order to appreciate overall condition of the hulk. The video will also concentrate in the marine life associated with the structure, since a mayor goal is to use the film for analyzing the extent of the wreck's fish diversity.

A survey of the surroundings is also required. The survey will determine if the wreck represents a threat to a neighboring coral reef or other valuable ecosystem. The ROV video will additionally reveal if the wreck should be anchored or secured to the seabed in the event of a tropical system. The information from the ROV is to be used in determining safety for divers (such as snag cables, sharp edges, openings, etc.) .

RESULTS - PROGRESS REPORT #1

PHASE I : EVALUATION OF MARINE CHARTS

After examining multiple marine charts of the Puerto Rico East Coast and various visits to the locations, with the objective of determining which areas had the most marine activity concentration within 8 nautical miles of the zone designated as a nature reserve called "Reserva Natural de los Cayos de la Cordillera de Fajardo", the following was found:

1. During the period from May 1, 2013 to August 31, 2013 the study determined that four of the islands within the reserve; Palomino, Palominito, Cayo Icacos and Cayo Lobos, had the highest concentration of boaters. See Aerial photos #1,2,3.

These four islands provide the recreational mariner with protected waters adequate for a beach day as well as diverse marine ecosystems. Among these; coral reef, sandy beaches, rocky shores, sea grass beds, and plenty vegetation to be enjoyed as shade from their evergreen coastal forests, especially in Cayo Icacos and Palomino. These resources also provide boaters with satisfactory sea bottom for anchoring, diving and water sports.

Another reason for the high concentration, is that the mentioned islands have available mooring buoys for the daily use of the local tourism vessels. Day charter catamarans, snorkeling tours, and dive schools use 100% of the existing mooring buoys in Icacos and Lobos.

Following is a brief description of the 4 islands within the reserve with the highest concentration of boaters:

A.PALOMINO

Located 3.5 nautical miles east from the Fajardo marinas. Palomino is the tallest of the islands in the Fajardo nature reserve. Very easy to see from 20 miles away because of her size, height and greenness. West side offers lee protected bay, with ample space for swing while at anchor or mooring ball. The bay is semicircular with a length of 0.5 nautical miles, from Punta Aguila demarcating its north end, and small patches of coral on its south boundary. Consists mainly of uniform seabed of mostly sea grass with a depth ranging from 12 to 30 feet. Palomino's bay has approximately 25 mooring balls.

B. PALOMINITO

Small island approximately 400 X 250 feet, 0.25 nautical miles from Palomino with abundant white sand beaches. The small island's northwest shore is the most used because of its calm and crystal clear waters. A coral reef surrounds the southern half of this island. Very few trees remain standing, all located in a small area in the center of the isle.

C. LOBOS

Located directly 1.5 nautical miles north from Palomino. This privately owned island offers protected waters on its western side. Because of private ownership, beach use is restricted. A manmade canal and small marina is found on the island's, north shore. A total of only 4 mooring balls were found, all being used by tourism vessels. The island's main attraction is the coral reef that borders the west shore and its schools of yellow tail snappers and blue tangs.

D. ICACOS

The largest in area of the four, 0.7 nm x 0.5nm. With approximately 0.7 nautical miles of sandy beach, has been the favorite for many families for a beach day. Boats concentrate in the south shore beaches. The island offers excellent anchor holding sandy bottom. Coral reefs are found in both ends of the island (north & south).

PHASE II. Use of SSS (side scan sonar) to Locate Underwater Structures

From May 2013 to Sept 2013, an Imagenex Side Scan Sonar model 855 was used in order to expand search width on the seabed of the selected areas. The seabed survey has not been totally completed during this phase. The study requires proper marine conditions (sea state 2 or less), due to onboard electronics, generator and other sensitive equipment. Nevertheless, some areas were studied during calm weather and some structures have been located so far. Please see Table #1.

Among the found targets, three objects similar to boats ranging from 25 to 40 feet in length resting on a sea grass bed in a depth of 34 feet near Punta Aguila in Palomino Island. These targets are within 200 feet of each other. During the next phase a ROV will be used to investigate and video the associated marine life on these structures.

A smaller target was marked off Icacos Island in approximate 50 feet depth. This object has a shape of a power boat and rests on a sandy bottom. Because of the proximity to Icacos's busy south shore, is very probable that the found structure is a small cabin cruiser.

An additional mark was saved on GPS off the southern shore of Lobos Island. The object on the screen appeared to be a medium size power vessel with a substantial amount of debris scattered in the vicinity. The debris can very well be parts of the hull, cabin top or aluminum pipes from a hard top.

CABEZA DE PERRO - WRECK

A steel hull commercial fishing vessel wreck was found between Cayo largo and Cabeza de Perro Island. The target is located approximately seven nautical miles south of the nature reserve.

After interviewing various fishermen and a few dozen hours of scanning the area, this wreck famous for lobster was finally located. The hull lies in 40' depth on a sea grass bottom. The wreck was verified with the use of scuba gear.

These five targets will be visited for further evaluation during the next phase :
ROV for close-up inspection and video recording.

PHASE II Results

Tabla #1

Reference	Pos Lat/Long	Type of structure	Aprox.LOA	Depth	Recommended use
Isla Palomino	18 21.146/65 34.624	Wreck - boat	25'	34.6'	TBD
Isla Palomino	18 21.996/65 34.598	Wreck - boat	30 '	35'	TBD
Isla Palomino	18 21.994/65 34.566	Wreck - boat	40 '	45'	TBD
Isla Icacos	18 23 /65 35	Wreck - boat	25 '	50'	TBD
Isla Lobos	18 22 /65 34	Wreck - boat	30 '	30'	TBD
Cabeza de Perro	18 15.882 /65 34.045	Wreck - Steel hull boat	60 '	43.2'	TBD

WORK SCHEDULE

- | | |
|---|--------------------|
| 1.Complete side scan scanner phase | Start October 2013 |
| 2.ROV use on targets selected from previous phase | Start January 2014 |
| 3.Evaluate ROV videos | Start March 2014 |

Aerial Photo #1
Palomino & Palominito



Aerial Photo #2
Cayo Lobos



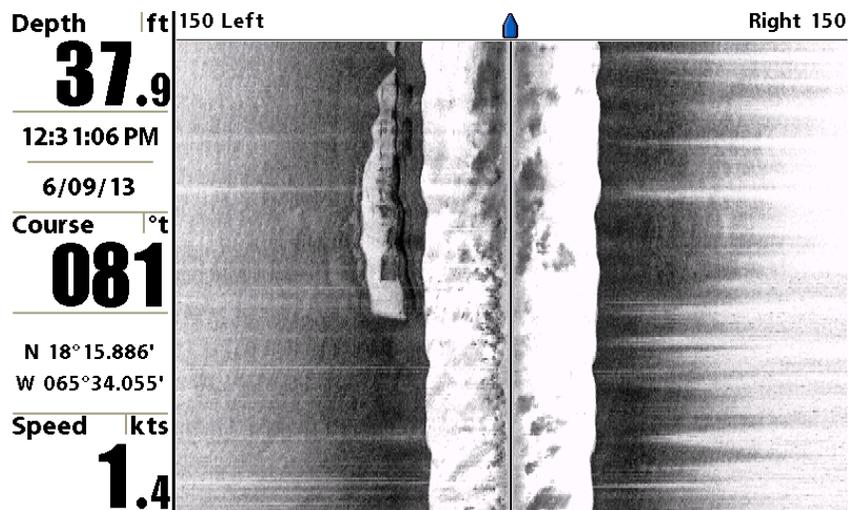
Aerial Photo #3

Icacos

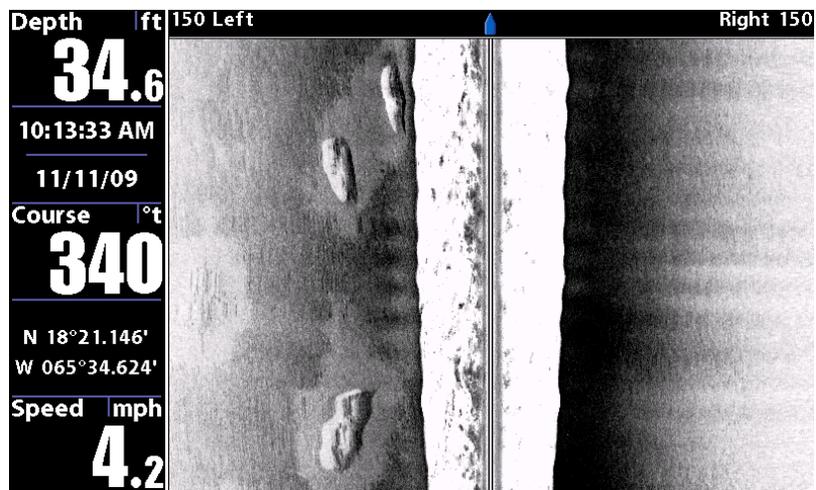


SD CARD IMAGE #1

Larger Wreck-Look alike structure



SD Card Image #2
Sunken Sailboats



July 21, 2014

Progress Report #2

PUERTO RICO ARTIFICIAL REEFS EVALUATION ON THE EAST COAST PR CONTRACT # 2013-000096

As part of our second phase of the study, an Imagenex Side Scan Sonar model 855, and a Humminbird Side Imaging system model 997si were used to sweep the seafloor in areas of high marine traffic in the east coast of Puerto Rico. Results up to this point are shown below under Table #1. The information on Table #1 was previously described in Progress Report#1 submitted on 9/23/13. The text shown in red indicates recently found targets.

Table #1

Reference	Pos Lat/Long	Type of structure	Aprox.LOA	Depth	Recommended use
1.Isla Palomino	18 21.146/65 34.624	Wreck - boat	25'	34.6'	TBD
2.Isla Palomino	18 21.996/65 34.598	Wreck - boat	30'	35'	TBD
3.Isla Palomino	18 21.994/65 34.566	Wreck - boat	40'	45'	TBD
4.Isla Palomino NE	18 21.218/65 34.018	Possible Wreck	50'	54'	TBD
5.Isla Palomino N	18 21.546/65 34.526	Possible Wrecks	30'-40'	48'	TBD
6.Isla Palomino W	18 21.011/65 34.790	Possible Wreck	40'-50'	46'	TBD
7.Isla Icacos S	18 22.879 /65 35.721	Wreck - boat	25'	50'	TBD
8.Isla Lobos S	18 22.36 /65 34.38	Wreck - boat	30'	30'	TBD
9.Cabeza Perro NE	18 15.882 /65 34.045	Wreck - Steel hull boat	60'	43.2'	TBD
10.Cayo Largo NW	18 19.083 / 65 35.051	Possible wrecks	30'-50'	32'-38'	TBD
11.Cayo Largo NW	18 19.028 / 65 35.077	Possible wrecks	30'-40'	38'	TBD
12.Cayo Largo NW	18 19.071 / 65 35.019	Possible wrecks	30'-40'	32'	TBD

Items with reference numbers #4, 5, 6, 10, 11 and 12, represent newly found targets with high probability of these being man-made.

Item # 4, located close to the north east coast of the Palomino Island will require further study. Due to the proximity to the cliff on shore and windward conditions, this target will need proper sea state during next ROV/ visual inspection phase. The target resembles a near fifty feet length vessel.

Item #5, Was found off the north point of Palomino Island, outside the protected waters of "Punta Aguila" at a depth of approximate 50 feet. The possible wreck site appears to be formed by various structures or debris of man-made materials.

Item #6, A long and narrow structure resting in 46 feet deep with the shape of a medium size sailing vessel. The site will be explored with ROV or scuba in order to further study the type of structure.

Progress Report #2

Item #10, Located on the South West corner of an "open water" reef called Cayo Largo. Resembles a steel hull structure because of the strong return signal. Also because its proximity to the famous "Cayo Largo" reef, it is very probable to be some type of wreck. Please see SD Card image for details.

Item #11, Also located near Cayo Largo Reef, the target in 38 feet of water, resembles a medium size vessel.

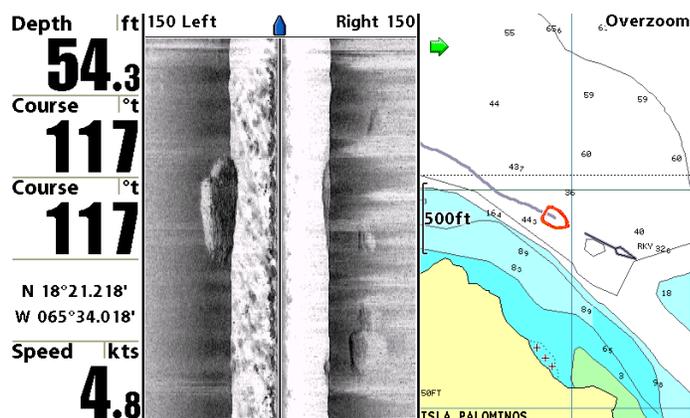
Item #12, Very close to Item #10. The apparent structure can very well be the same as Item#10. Appears to be a smaller target but due to proximity, is possible to be one and simply look different due to the angle of the boat passing over. The narrow point on the object seen on the SD Card image could be the bow of a small power or sailboat.

Due to technical malfunctions of the Imagenex 855 during the field trips on the month of February 2014, we were forced to use only the images taken from the smaller sonar Humminbird 997si. Our commercial grade Imagenex sonar lost synch between transducer and console causing intermittent sonar images.

SD Card Images

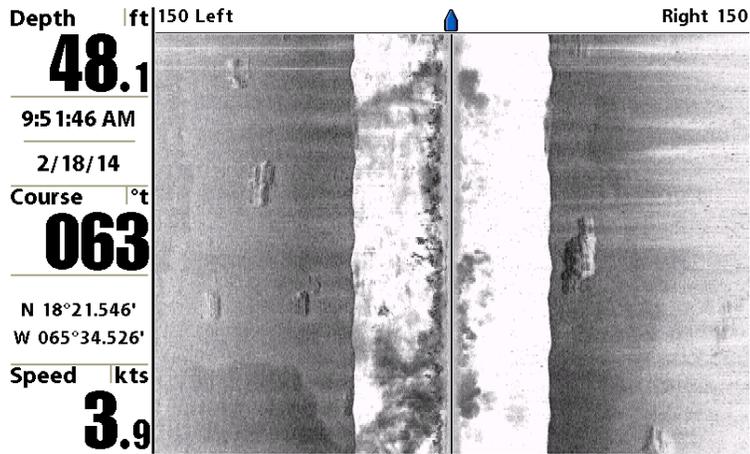
The following images were taken from an SD Card of our Humminbird 997si sonar system. In some of these, the monitor was split in order to simultaneously see the image of the seafloor and the track on the chart plotter GPS.

Item #4

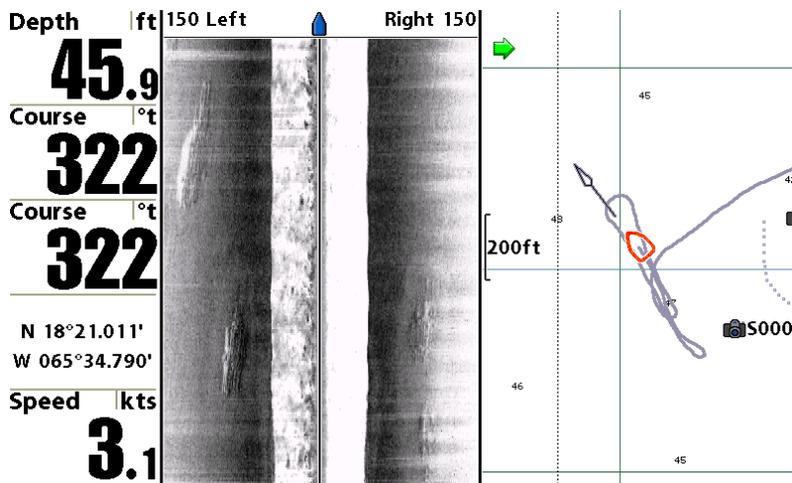


Progress Report #2

Item #5

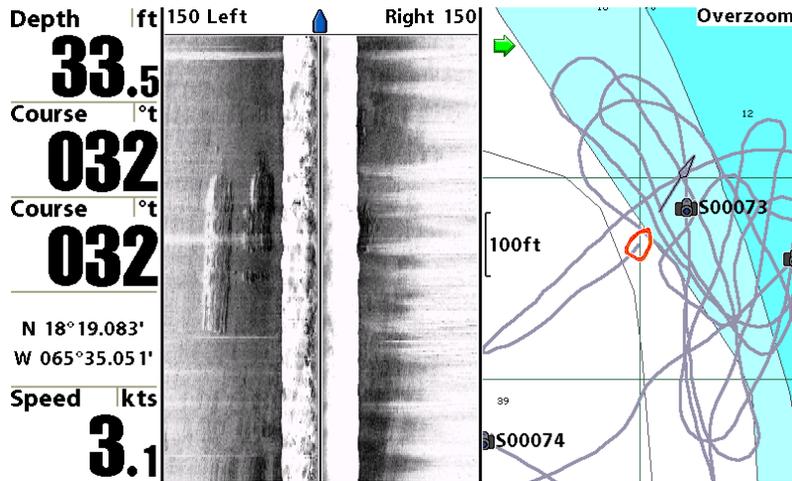


Item #6

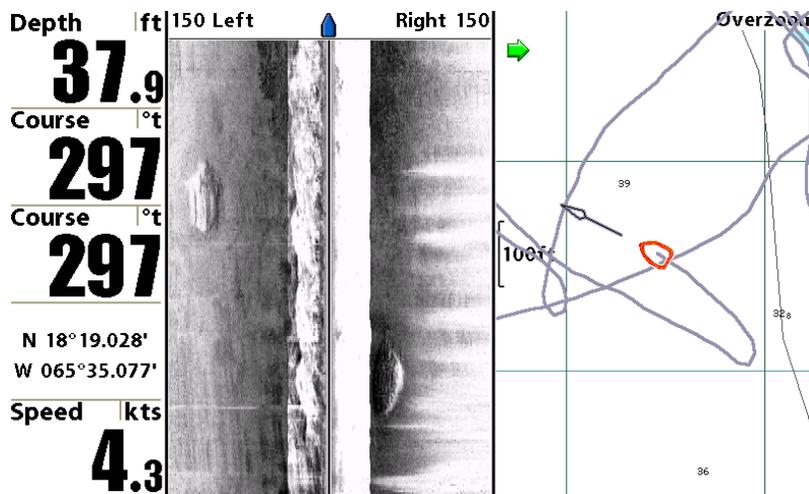


Progress Report #2

Item #10



Item #11



Progress Report #2

Item #12

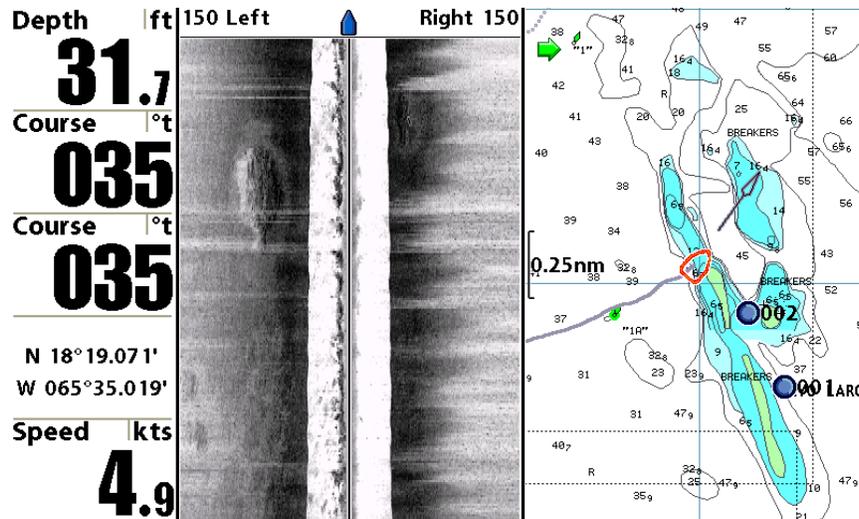


Table #1 and SD Card images from sonar will be updated periodically as the project continues to locate additional targets.

Sonar search phase (Phase #2) has been extended due to weather, sea state and technical problems with sonars. Our Imagenex Side Scan 855, lost sync between transducers and console, during the last search in the proximity of Palomino Island during a heavy squall. This unit will be replaced for future studies. Also, our Imagenex Sportscan Towfish was permanently damaged from a fracture in the lexan transducer housing, while searching the Palominito Island drop off.

The exposure of sensitive equipment to the marine environment onboard small craft has very limited capabilities. Fortunately, our Humminbird Side Imaging Sonar, which was kept as a backup resource, has worked very well. This underwater side imaging system has provided us with adequate images of targets, coordinates, depth and chart information during diverse weather conditions.

Local information from the area's fishermen and commercial divers, obtained from interviews, has provided the study with great advantage during the first and second phase, in terms of "man-hours". The local seamen assisted with precious intelligence regarding selection of areas within the study zones. For instance, large areas of seagrass, visited continuously for conch collection, were discarded from the search, as result of interviews, therefore saving valuable "sea time".

Progress Report #2

EXPECTED WORK SCHEDULE

1. Complete Sonar Phase	Start October 2013-Until July 2014
2. ROV/visual Inspections	Start July 2014-Until Aug 2014
3. Evaluate ROV videos	Start Aug 2014 –Until Sept 2014
4. Findings Report	Late Sept 2014

Sept. 05, 2014

Progress Report #3

PUERTO RICO ARTIFICIAL REEFS EVALUATION ON THE EAST COAST PR CONTRACT # 2013-000096

Underwater structures that resembled man-made shapes were marked on gps plotter SD card, during our side scan sonar exploration phase. An observation class ROV (remotely operated vehicle) was deployed to verify that the targets were in fact manufactured objects.

Targets located north of Palomino Island have not be verified using the ROV due to marine weather conditions. All others were verified and live video recorded. Table #2 details location, size, depth and status of target. Targets # 13 and # 14, were recently added to Table #2.

Appendix #1 on page 5 of this document shows snapshots of targets taken from ROV videos.

Table #2

TARGET	Pos Lat/Long	Type of structure	Aprox.LOA	Depth	Status
1.Isla Palomino	18 21.146 65 34.624	Wreck - sailboat	30'	34.6'	Verified
2.Isla Palomino	18 21.996 65 34.598	Wreck - sailboat	26'	35'	Verified
3.Isla Palomino	18 21.994 65 34.566	Wreck - sailboat	35'	45'	Verified
4.Isla Palomino NE	18 21.218 65 34.018	Possible Wreck	50'	54'	Not verified
5.Isla Palomino N.	18 21.546 65 34.526	Possible Wrecks	30'-40'	48'	Not verified
6.Isla Palomino W.	18 21.011 65 34.790	Possible Wreck	40'-50'	46'	Not verified
7. Icacos Island S.	18 22.879 65 35.721	Wreck - powerboat	28 '	53'	Verified
8. Lobos Island S.	18 22.360 65 34.380	Wreck - powerboat	34 '	46'	Verified
9. Cabeza de Perro NE	18 15.882 65 34.045	Wreck - shrimp boat	60 '	47'	Verified
10. Cayo Largo NW	18 19.083 65 35.051	Coral cluster	30'-50'	38'	Verified
11. Cayo Largo NW	18 19.028 65 35.077	Coral cluster	30'-40'	38'	Verified
12. Cayo Largo NW	18 19.071 65 35.019	Coral cluster	30'-40'	32'	Verified
13.Palominito Island	18 20.061 65 34.072	Wreck unidentified	40'	84'	Verified
14.Palominito Island	18 20.034 65 34.100	Wreck – deck only	30'	83'	Verified

ROV Observations of Targets / Brief Description of Findings

Target #1

Located on the leeward side of Palomino Island, this verified wreck is a production sailboat of approximately 30 feet in length. The wreck sits on a sandy bottom of 38' depth with a noticeable list to her port side. Amidships on the starboard hull, exists a large rectangular opening of about 8 feet long by three feet wide. The companionway hatch is fully opened providing easy access to interior. Cockpit is mostly free of debris with some missing hatch doors. Standing rigging cables should be removed from mast step area and sides. Auxiliary outboard engine still hanging from transom. Interior shows typical wreckage rubble and debris consisting of fragments of furniture, bunk cushions, and some electrical / plumbing hardware.

Target #2

Located less than 100 feet from Target#1, this is a classic Pearson 26' sailboat sloop. In general, the hull appears to have structural integrity. The wreck rests on an even keel on a sandy bottom as well. Most hatches are missing. Porthole side windows remain intact. Companion way hatch closed (but can be pushed back to open position). Many parts of rigging wires around cockpit and transom area. Interior shows typical rubble, cushions, wood fragments, electrical hardware.

Target #3

Also located in the vicinity of the previous wrecks, wreck #3 is a slightly larger sailboat of approximately 35 feet in length. The wreck lies on a sandy bottom. The boat's helm pedestal still standing with wheel. Rigging cables, fiberglass fragments and debris observed in cockpit area. The sailboat's inboard diesel engine very probably to remain inside. Most hatches missing, main hatch fully opened or missing. Typical interior with substantial amount of wreckage fragments.

Targets #4, #5 and #6

At this time have not been explored with ROV, due to weather conditions. These three targets located off the north shore of Palomino Island, are completely exposed to the Atlantic Ocean wave action and northeast tradewinds conditions. Therefore, these sites require special marine conditions for safety reasons to deploy ROV equipment. The ROV robot is controlled from the surface by command signals that are send via umbilical chord (aka tether). This tether can easily snag or tangle on a submerged structure's corners. On this specific location, because of the wave action, the vessel can drag anchor and risk losing this expensive underwater equipment. Consequently, we are waiting for calm conditions to survey these three targets.

Progress Report #2

Target #7

Wreck of a small powerboat located south of Icacos Island beach area. The vessel appears to be an approximately 28' feet twin inboard cruiser resting inverted on a sandy seabed. The depth is 52 feet deep. Except for the two engine lower drives, no other substantial hardware is present. Some smaller hull fragments and electric cables were observed in the vicinity. The hull positioned upside down provides decent shelter to reef fish species. Among these ; *Anisotremus* sp., *Holocentrus* sp., *Acanthurus* sp., etc.

Target #8

A medium size wreck of a powerboat of about 34 feet in length. The structure was found off the south shore of Lobos Island in 46 feet deep. The remaining of the vessel are scattered in a radius of approximately 100 feet. The hull appears to be complete, resting evenly on a sea grass bottom. The rest of the wreck consists of dismantled tops, marine hardware, and fiberglass pieces. The interior or cabin is not accessible due to abundant debris on deck. Substantial amount of reef fish can be seen at this location.

Target # 9

A larger size structure consisting of a steel hull wreck. The vessel resembles a commercial fishing boat sunk in 47 feet of water north east of Cabeza de Perro Island. The hulk sits on a sea grass bottom with large sand patches. The wreckage rests on its starboard side. Port side hull not visible under seabed. The classic fishing vessel has a flat aft deck and forward wheel house with hardtop and round portholes. Aft towards stern, a few large openings are visible on the structure. The larger is possible a cargo hold with missing hatch cover. Others seem as fractures on the steel plating. The cargo hold can be easily accessed. Great amounts of various fish species live in this void. Forward towards the wheel house, no doors are found and very few obstructions, although typical amount of debris present. On the seabed vicinity, some large and medium size metal fragments can be seen. The overall marine growth coverage on this wreck indicates at least 30 years sunk. The amount of fish (mostly *Lutjanos griseus*) swimming on this wreck is stunning.

Target #10, #11 and #12

Targets marked as possible structures of interest because of its shape, however, ROV showed only coral formation mounts on these area. These three targets are located on the leeward side of an offshore reef known as Cayo Largo. The reef is a narrow three nautical mile long shallow area made of mostly live coral, located between Palomino Island, Fajardo and Ceiba, approximately 2.5 nautical miles from shore.

Target # 13

Located off the south shore of Palominito Island at 84' feet of depth, the structure resembles an older hull of a powerboat approximately 40 feet. A classic rounded stern is noticeable. Substantial marine growth on hull surface reflects at least 20 years of this structure on seabed. The wreckage lacks sunlight

and visibility is less than 12 feet. The structure provides shelter, however is not as integral as the other wrecks found. Seems that the deck was separated from the hull.

Suspended organic material in water column impedes the ID of associated fish species. A large grouper was sighted, although the species identification was not possible due to lack of visibility. Other fish genera, such as Haemulon, Stegastes and Lutjanos, among others were seen in several numbers but also not sufficient light to properly identify.

Target #14

Located off the south shore of Palominito Island at 83' feet depth. The only part visible of this sailboat is the top deck. The rest may be in the sub bottom or simply not in the same location. The deck resembles a 35+ feet length overall sailboat. All hatches are missing, exterior hardware, rigging and windows. The deck platform lies flat on seabed. The color and texture of the marine growth on the structure resembles the actual seabed, giving the wreckage a camouflaged feature.

EXPECTED WORK SCHEDULE

- 1. Evaluate ROV videos**
- 4. Findings Report**

Start Aug 2014 –Until Sept 2014
Late Sept 2014

Progress Report #2

Appendix #1 : Verified Wrecks Snapshots from ROV Video

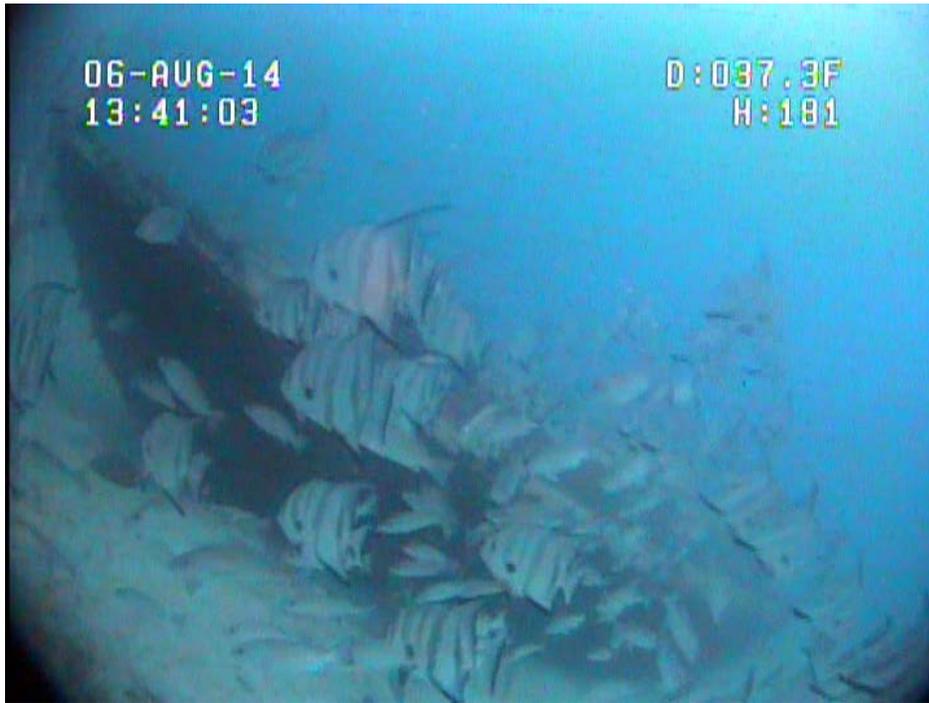
Target #1



Target #2



Target #3



Target #7



Progress Report #2

Target #8



Target #9



Target #13



Target #14



February 25, 2015

Progress Report #4

PUERTO RICO ARTIFICIAL REEFS EVALUATION ON THE EAST COAST PR
CONTRACT # 2013-000096

RESULTS

The study consisted on the exploration and search of submerged man made structures in areas of high boating activity concentration on the east coast of Puerto Rico. The search was focused in that area due to the concentrated marine activity. The “Reserva de los Cayos de la Cordillera” nature reserve was part of the search area due to the same reasons.

The main goal of the study has been satisfied, provided that eight (8) confirmed new wrecks for the area are now listed. The wrecks vary in size, depth and structure condition.

The submerged structures found during our initial side scan sonar exploration phase that were verified and confirmed as sunken boats, are shown below on Table #1. These wrecks were successfully recorded on video by means of a remotely operated vehicle (ROV) during our phase #3. The used, ROV technology allows to record fish census for future analysis and reference.

Additional data included in Table #1 are, target general area, gps position (latitude/ longitude), depth, size, seabed type, and wreck classification category.

Table #1

TARGET	Pos Lat/Long	Type of structure	Aprox.LOA	Depth	Seabed	Category
1. Palomino Island	18 21.146 65 34.624	Wreck - sailboat	30'	34.6'	Seagrass/sand	II
2. Palomino Island	18 21.996 65 34.598	Wreck - sailboat	26'	35'	Seagrass/sand	II
3. Palomino Island	18 21.994 65 34.566	Wreck - sailboat	35'	45'	Seagrass/sand	II
4. Icacos Island S.	18 22.879 65 35.721	Wreck - powerboat	28'	53'	sand	I
5. Lobos Island S.	18 22.360 65 34.380	Wreck - powerboat	34'	46'	seagrass	II
6. Cabeza de Perro	18 15.882 65 34.045	Wreck – steel hull “shrimpboat”	60'	47'	Seagrass/sand	I
7. Palominito Island	18 20.061 65 34.072	Wreck unidentified	40'	84'	sand	I
8. Palominito Island	18 20.034 65 34.100	Wreck – deck only	30'	83'	sand	I

In addition, wrecks found on this study have been classified in three categories: I,II, OR III.

Categories:

- I. Useful as fish shelter and recreational diving
- II. Useful as fish shelter & diving but requires preparation:
 - a) Anchoring or securing to seabed to prevent movement during severe weather
 - b) Preparations to provide a safer dive; removal of debris, cables, batteries, hardware
 - c) Closing of openings; hatches, small hazardous hull openings, missing windows
- III. Wreck Removal Recommended – Due to location, danger and perils for divers or nearby marine sensitive ecosystems.

A total of 44 fish species have been recorded on video, living in these sunken boats. Many of them, juvenile species of high fisheries value to the local industry. These submerged man-made structures acting as artificial reefs can provide an alternative to the local diving schools and tourism “snorkel trips”. By offering this alternative we could decrease the excessive visits to the stressed natural coral reef areas of the east coast.

As a result of this study, the following is available;

- Associated Fish species list for marine studies available
- Underwater videos of the found wrecks
- Wrecks as consistent dive school locations
- Tourism growth potential for local dive and charter companies
- Stress reduction to natural coral reefs
- Seabed important information for marine studies and navigation
- Safety data for correct anchoring
- Promotes artificial reef concept

April 26, 2015

Final Report

PREPARATION AND CLEANUP OF THREE SUNKEN SAILBOATS ACTING AS "ARTIFICIAL REEFS" OFF THE EAST COAST PR.

Three (3) production sailboats of composite material hulls, were found resting at 40 feet depth in the vicinity of Palomino Island, Fajardo, Puerto Rico. The hulls are located off the leeward side of the mentioned island on a sandy bottom. The coordinates are 18 21.146 North / 65 34.626 West. The wrecks were found using side scan sonar and later explored and photographed with the help of a remotely operated vehicle (ROV). The site composed of three hulls positioned less than 200 feet from each other, provides a very attractive dive site for scuba enthusiast and dive schools.

These structures required preparation, cleanup and removal of wreckage debris in order to suit safely visiting scuba enthusiasts. The scope of work of this job consisted particularly in the extraction of marine hardware from the underwater structures. Fragments of rigging, lines, plumbing, wiring harness, cushions fabrics and sails, among other parts, were removed and raised to the surface support vessel by means of marine salvage lift bags.

Most of the stainless steel standing rigging and interior wiring harnesses had to be cut off due to marine corrosion. Corroded fasteners, bolts and rigging pins required the use of heavy duty wire cutters in order to move ahead promptly with the cleanup. Piles of the extracted materials were stacked next to the hulls. The mounds were then divided and tied in smaller bundles. These "bales" were rigged to lift bags that will raise the loads to our support vessel.

Marine crew on the support boat took the challenge of getting aboard, the 25 year old parts of the wreckages. Bedding mattresses and cushions weighting over 300 pounds each had to be split in smaller sizes for handling and disposal. These pieces were drained carefully while getting aboard so as to carefully release smaller crustaceans. Hundreds of pounds (800 – 1000 lbs.) of the aged hardware was properly disposed at a solid waste designated dumpster.

The three structures consisting of fiberglass production sailboats from the 1970's, range in sizes from 26' to 35' feet length overall. The three are conveniently positioned less than 200 feet apart. The site is approximately a quarter of a mile from the Palomino Island lee shore, and depth averages 40 feet. Two of these sailboats lay upright, while the third rests on its port side with a 45-degree incline. The later is larger than the rest. The hull has a large opening on the vessel's starboard beam. The approximately 8'X4' hole provides an excellent marine life observation landscape. Schools of fish are constantly gliding in and out of the structure.

The other two wrecks seem relatively undamaged. Except for the missing hatches and windows. One of these, still keeps the helm station binnacle and wheel. Similar to the first described hull, substantial amount of fish soar these structures constantly. Mostly Lutjanus species have been observed during our cleanup visits. Atlantic spadefish schools are also seen on a regular basis at the structures.

During our ten-day cleanup and removal operations, local divers or fisherman were never seen near the wrecks. The amount of sea life observed surrounding the structures may indicate that the site is not visited or fished habitually.

Installation of commercial mooring buoy systems to hold and prevent commercial dive boats from dropping anchors on the submerged structures, is highly recommended for this site. An additional recommendation will be to promote the spot to a non-fishing dive site.

Underwater images and videos of the site, including the stacks of extracted debris and the position of the hulls on the sandy bottom are available upon request.



Jose Caballero
Marine Contractor



