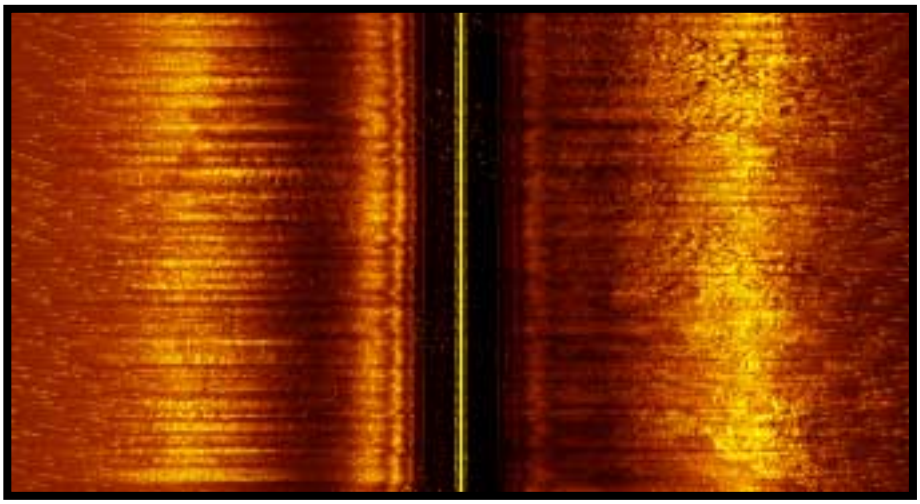
Side Scan Survey Offshore of the Big Bend: An Exercise in Ground-truthing March 14-17, 2002



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Program in Underwater Archaeology
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Research Reports # 18

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Between March 14, 2002 and March 17, 2002, the faculty and students of ANT4131: Techniques of Underwater Site Research conducted remote sensing and survey of a $1km^2$ area in order to perfect our knowledge, understanding, and interpretive ability of side scan sonar technology. The main aim of the project was 'ground-truthing'; in other words, what is it that we are seeing on the side scan record and are we correctly interpreting these features and anomalies? This report will outline the technology used, will discuss the images obtained from the remote sensing ops and the correspondent data gathered from the visual diver surveys of selected targets.

Previous Field Work

A significant portion of the work conducted by the Program in Underwater Archaeology has focused upon the identification and location of new sites, whether historic or prehistoric. Much of the work that has been conducted offshore has been part of the PaleoAucilla Prehistory Project. "The PaleoAucilla Prehistory Project is designed to discover and investigate prehistoric sites submerged by sea level rise on the continental shelf of northwestern Florida. The goal is to reconstruct human settlement patterns on the pre-submerged landscape. The PaleoAucilla Prehistory Project employs a long term sustained research methodology…..look[ing] for new sites farther offshore that can be targeted for assessment at a later date." (Faught, 2000)

PAPP's emphasis has been on the identification and location of prehistoric river channels. The most significant site worked on thus far is the J&J Hunt Site (8JE740), which is located 3.5 statute miles from the present-day mouth of the Aucilla River at a depth of 15 feet of sea water (Faught, 2000). Around 7,000 years ago this site would have been near the mouth of the PaleoAucilla River, since sea levels were significantly lower at that time. Previous research has ventured offshore in search of such Paleo portions of modern river channels. "The logic is to investigate locations progressively deeper and farther out, eventually as far out as the Clovis Shoreline[1], along the drainage system that includes the PaleoAucilla" (Faught, In Press). At this point, PAPP researchers have worked out to about 17 km (9 nautical miles) in 6 m (20 feet of sea water) (Faught, In Press).

Objectives

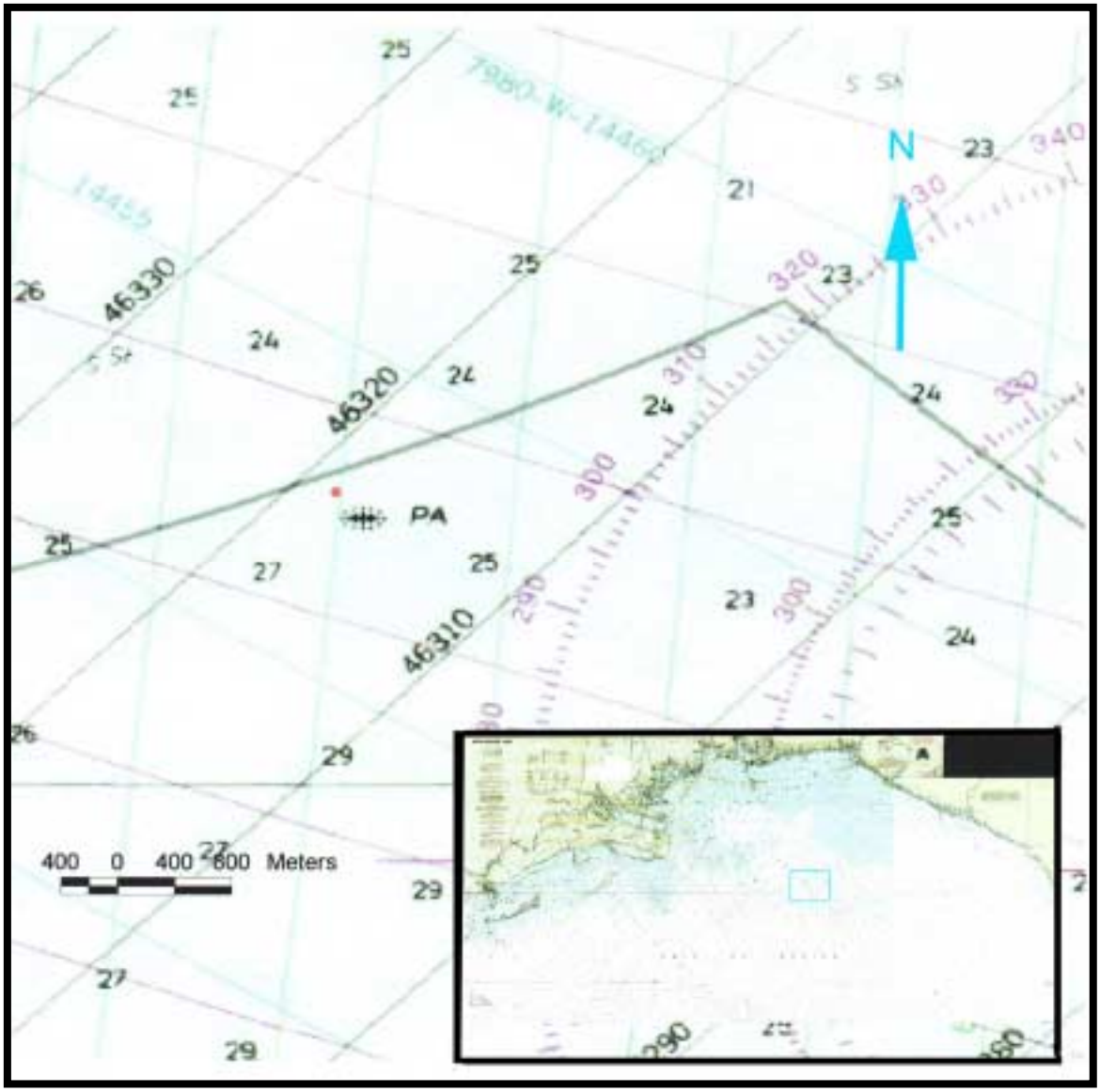
The main objective was to perform a side scan survey of a $1km^2$ area 15 miles offshore in 25 to 30 feet of water. This was done in order to locate targets with the possibility of holding cultural material. Through diver visual surveys, these targets could eventually be designated as sites for further investigation if it was found that they did possess artifacts.

[1] The "Clovis", or "Paleoindian" shoreline is most likely at 40m as proposed by (Frazier 1974) and (Faught and Donoghue 1997). Full glacial lowering at the peak of the last ice age would have been between 60 and 100 meters. (Faught, In Press)

Methodology

Before venturing out offshore, a location was chosen for the survey to take place. By comparing information on known wrecks from nautical charts with information provided by Steven D. Singer's Shipwrecks of Florida, the location of the *Ben* was chosen. This vessel was a barge of 369 tons built in Pensacola in 1903. It sank on December 18, 1921 and was still visible in 1983. The locational data provided by Singer's book was Lat.29-xx-xx, Long. 84-xx-xx. The figure below is a nautical chart of Apalachee Bay pinpointing the location of the vessel as provided by the makers of the chart. The red dot is the Lat/Long information provided by Singer and the vessel shaped icon below it is from the chart.

Location of the *Ben*



Survey began by remote sensing with Side Scan Sonar. A $1km^2$ grid was set up over the known location of the wreck and an initial series of nine tracklines were mapped out with GPS coordinates. These tracklines provide the vessel's captain with the route to follow when conducting the survey. While analyzing the side scan record in real time, the investigators highlighted structural anomalies or prominent features. Locational information for these targets was provided by the GPS information embedded in the record.

The side scan sonar unit used by the Program in Underwater Archaeology is a Marine Sonic Technology Sea Scan PC digital image sonar survey system with a 600 kHz towfish, a two-gigabyte hard drive, and a Pentium splash-proof CPU. Locational information is embedded in the digital record by a Lowrance GlobalNav 100 Global Positioning System, which has an accuracy of approximately 5 meters. (Tobón and Pendleton, 2002)

The sonar's towfish was deployed off the bow and was kept relatively close to the surface (75% of the swath above the seabed). A PVC tube was secured parallel to the vessel's deck on the very tip of the bow, along the shaft of the anchor that rests there, and through it was run the rope that secured the towfish to the vessel and the cable that transmits the data from the fish to the side scan computer. The height of the towfish was adjusted with the rope, which was then cleated to the bow and a person remained with the towfish at all times feeding out cable length as necessary and watching out for possible threats to the towfish. The vessel's speed during the survey was approximately 4 knots.

On the survey record, structural anomalies can represent the remains of a vessel whereas prominent bottom features in the form of rocky outcrops can represent deposits of prehistoric artifacts. This logic follows previous results where chert outcrops have produced debitage from quarrying activities (Faught, In Press).

The targets selected by the research team are ranked in order of preference. The next phase of survey involves diver survey of these targets so as to identify the extent and nature of the anomalies/features. Divers perform visual surveys of the area and look for possible cultural material. This material can be in the form of shipwreck material for historic remains or in the form of chert flakes or actual stone tools for prehistoric remains. If any such material is observed, a datum marker is placed on the site and more systematic surveys (such as transect or circle searches) can be conducted.

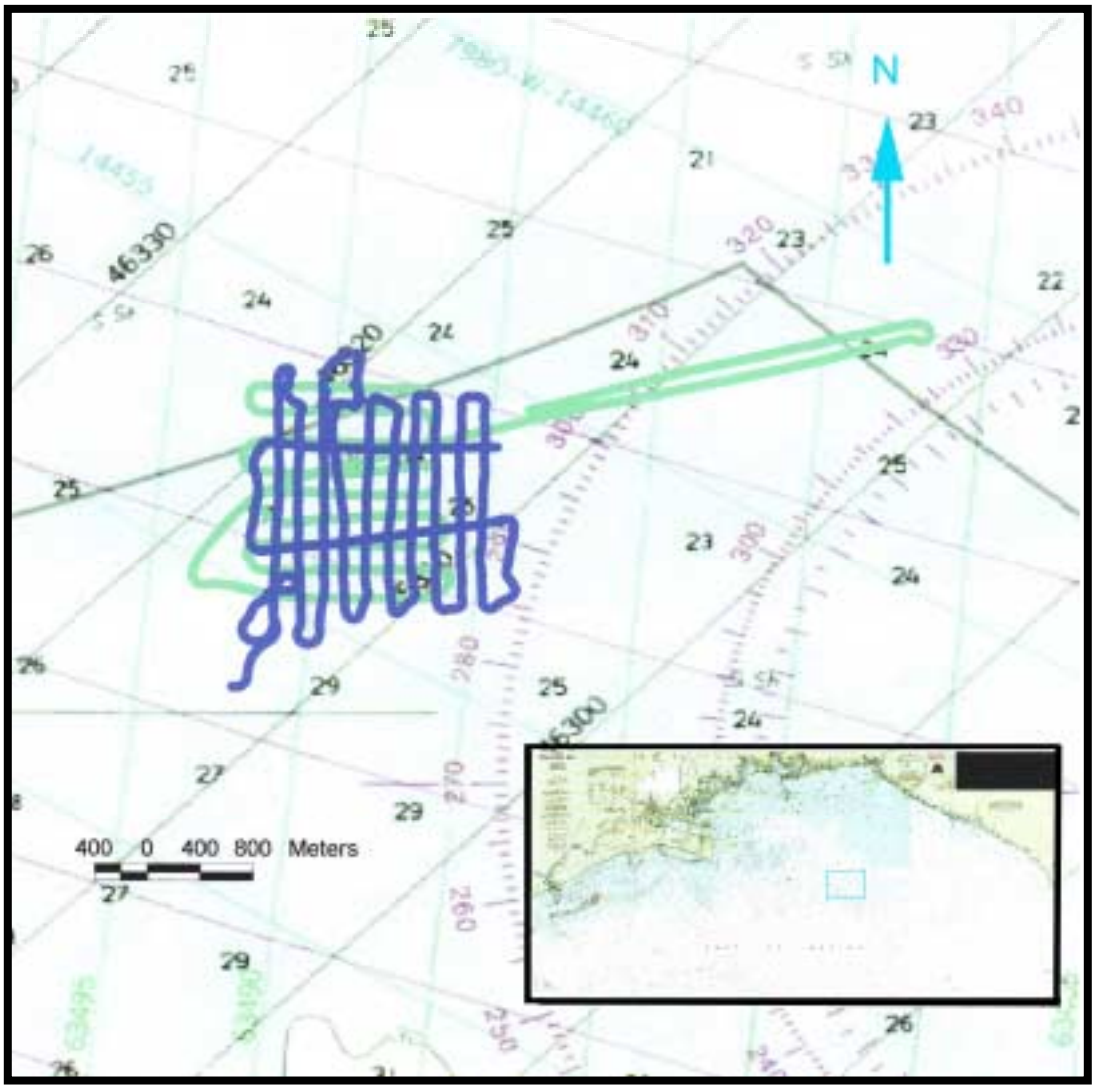
In a transect search, the divers begin at the datum, secure a tape measure to this point and begin to swim out in a line radiating in a cardinal direction from this main datum. The divers stop at pre-determined set intervals to scan the area and perhaps conduct handfan testing of the sediments in search of artifacts. In a circle search, the divers secure the tape measure to the datum and swim out a predetermined length. They stop, position themselves at intervals along this line, and proceed to swim in a circular fashion covering all 360 degrees of terrain within the search area. (Dean and Ferrari, 1992)

The main purpose of survey is to locate and identify new sites. The process by which a site gets designated as such requires that ten or more artifacts be found. Finding nine artifacts would constitute an 'encounter.' Once the requirements for a site are met the proper paperwork is filed with the Bureau of Archaeological Resources, Division of Historical Resources, at the Florida Department of State and the site is given a numerical designation for perpetuity. (Marks, 2002)

Field Work

On March 14, 2002, 9 tracklines were run in an East-West direction for remote sensing with the Side Scan Sonar. This survey was conducted at low frequency with a 200m swath and 25% overlap. After completing the pre-determined tracklines, the boat traveled to the coordinates provided by Singer's book and by nautical charts in order to run an additional trackline. The figure below shows these tracklines in green while the tracklines for the March 16th survey are in blue.

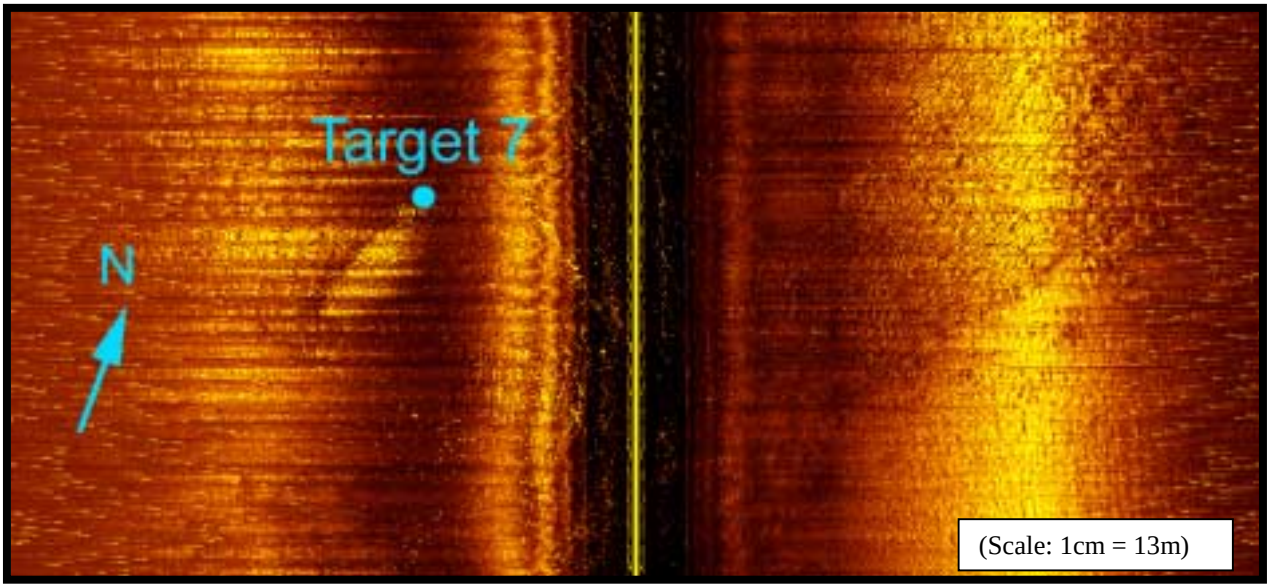
Tracklines of the *Ben* Side Scan Survey, 2002



After completing the survey, the information was transferred to a desktop computer for processing. Using SonarWeb, the side scan records were mosaicked in groups of ten instead of all together; this allowed the size of the files to remain more manageable and allowed the researchers to quickly study the data in its entirety. For this particular survey (March 14), 22 possible sites for diver survey were targeted. Of those, four were investigated. And of those four, two were in close proximity – within 100 meters.

The data will be presented in the following manner: images of the side scan record will be followed by 1) a description of the anomaly that triggered the designation as a target and 2) a description of what was actually encountered by the divers.

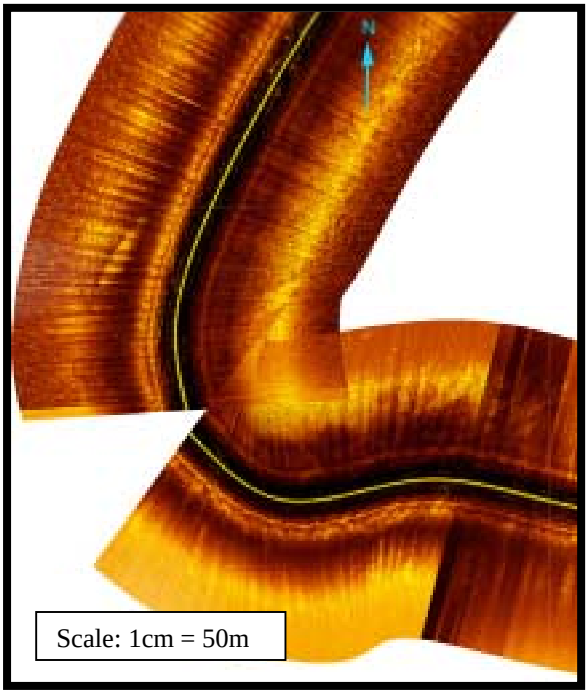
March 14, 2002 Target #7



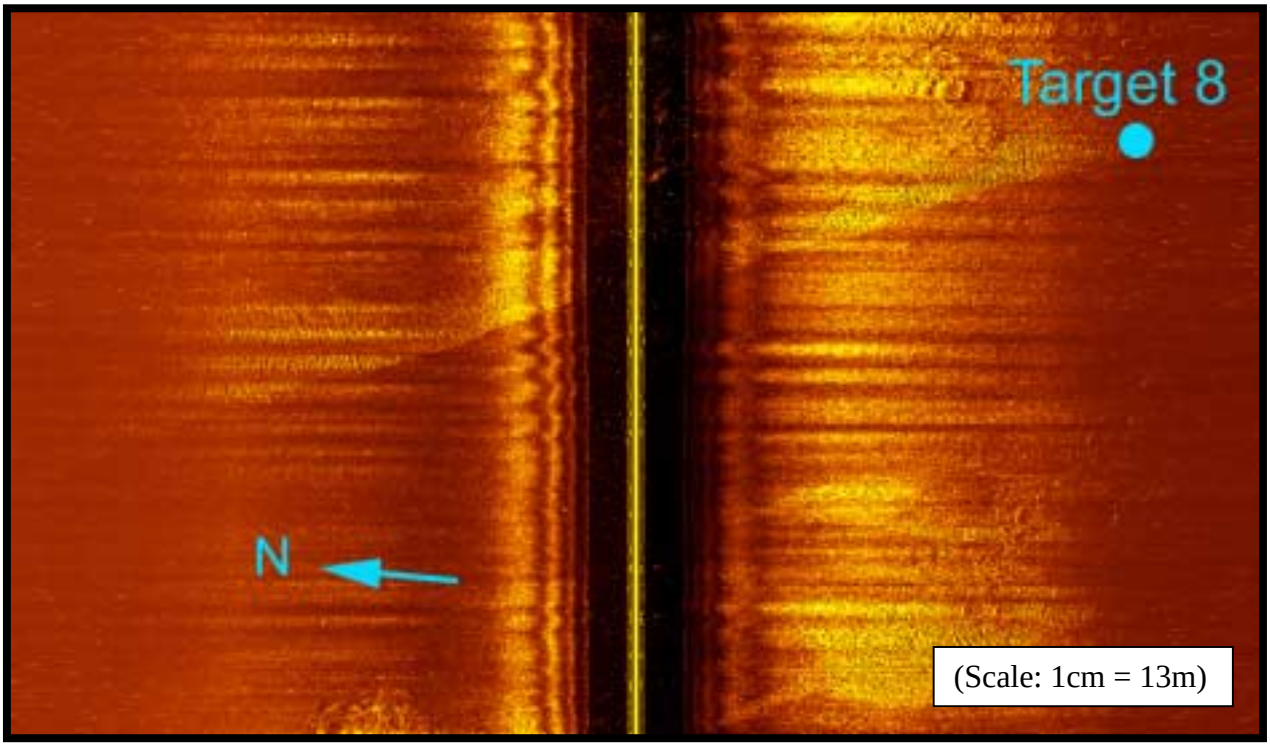
This target is marked at the northernmost point of the anomaly, which was identified as a 37m long structure. It could have been indicative of a ship's structure, for example. The visual inspection, however, did not locate any such structures after conducting circle searches in a one-hour dive. The divers encountered sandy bottom with scattered rocks about 3 feet high.

This structure was identified while investigating the side scan records individually, because at the time that the targets were being located the mosaicking program was malfunctioning. However, once the program was back in working order and the records were mosaicked in pieces of ten, the true nature of the anomaly was discerned. That is, this record was part of a turn made by the vessel when beginning a new trackline and the 'structure' was a result of the turn. The following image is a section of the mosaic showing the vessel's turn and the anomaly caused by it.

Mosaic for Target #6

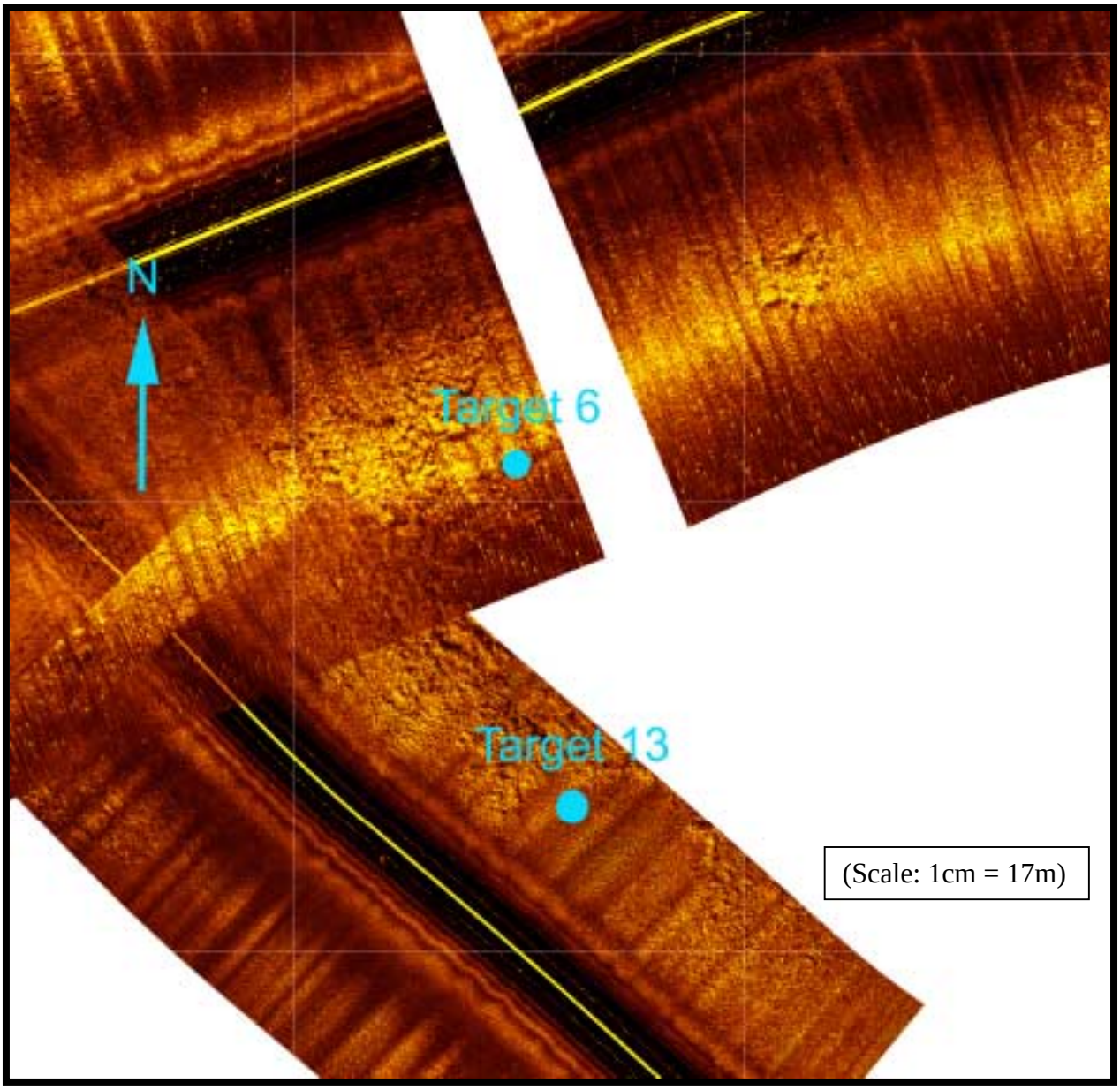


March 14, 2002 Target #8



This target was identified as a rectilinear anomaly that extends from one side of the side scan record to the other. During the diver survey, no feature as prominent as this was encountered by the investigators. It was concluded that this anomaly was indicating something dense on the seafloor that was not clearly visible to the divers. One possibility is that this record represents a relict channel feature, which would be filled in by sediments with different densities.

March 14, 2002 Targets #6 and #13



This is a mosaic of the side scan records of and around targets 6 and 13. Since both targets were identified as being close together from their GPS points, the dive team sent in to perform the visual survey made this mosaic in order to plan their dive. Target 6 was identified because it represented hard sonar returns as evidenced by the bright yellow clusters. Rock outcrops most frequently cause hard returns. Target 13 was highlighted because it represented a circular depression surrounded by rock outcrops. The point on the record for this target is at the northwestern part of the depression.

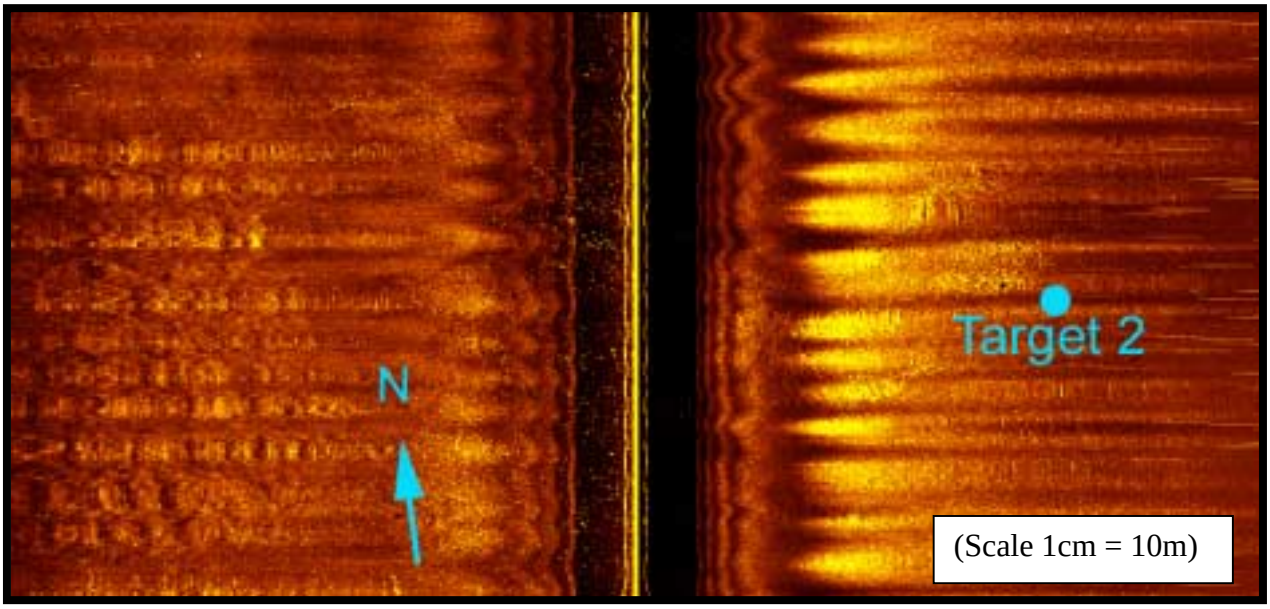
The dive team inspecting these targets began at Target 13 and ran transect searches. From the record, a transect run directly to the South would yield no rock, just sand. A transect SE would put the divers in the circular depression. A transect East would cover rocky bottom. A Western transect would yield nothing and a Northern transect would lead to target #6, rocky outcrops. The visual survey did see these expected results. As seen on the side scan record, the depression was the rock-sand interface in a circular formation. To the North the divers encountered coral and live bottom. Handfanned units were placed in 10m increments and hard coral bottom was hit after approximately six inches.

The search yielded a stone artifact shaped like a projectile point encrusted with coral. This artifact was brought to the surface and bathed in vinegar to remove the concretion. Once this was successfully accomplished, the artifact, which was indeed shaped like a projectile point, was cut in half in order to determine its nature. It turned out to be limestone. Although this was not a chipped stone artifact, it did demonstrate the visual acuity necessary to identify possible artifacts this far out into the continental shelf, where the sea level would have risen at an earlier date and marine processes would have been at work for much longer.

After several visual inspections of this relatively large area, no additional artifacts were found. The hard returns represented by the side scan sonar were representations of coral/live bottom and were not indicative of source for raw materials or tool manufacturing spot. The sediments were dark gray sand above the hard coral bottom. The sand on the surface alternated between coarse and fine grained and most of the coral formations were small and patchy. Some shell samples were collected, none of which were indicative of brackish or fresh water sediments.

On Saturday, March 16, the side scan sonar was again operated but this time the survey was run in a North-South direction. This new survey allowed full saturation of the 1km^2 area (as seen on Figure 2) in addition to providing a new perspective on the seabed and its features. The survey was set up to have a swath of 150m and no overlap.

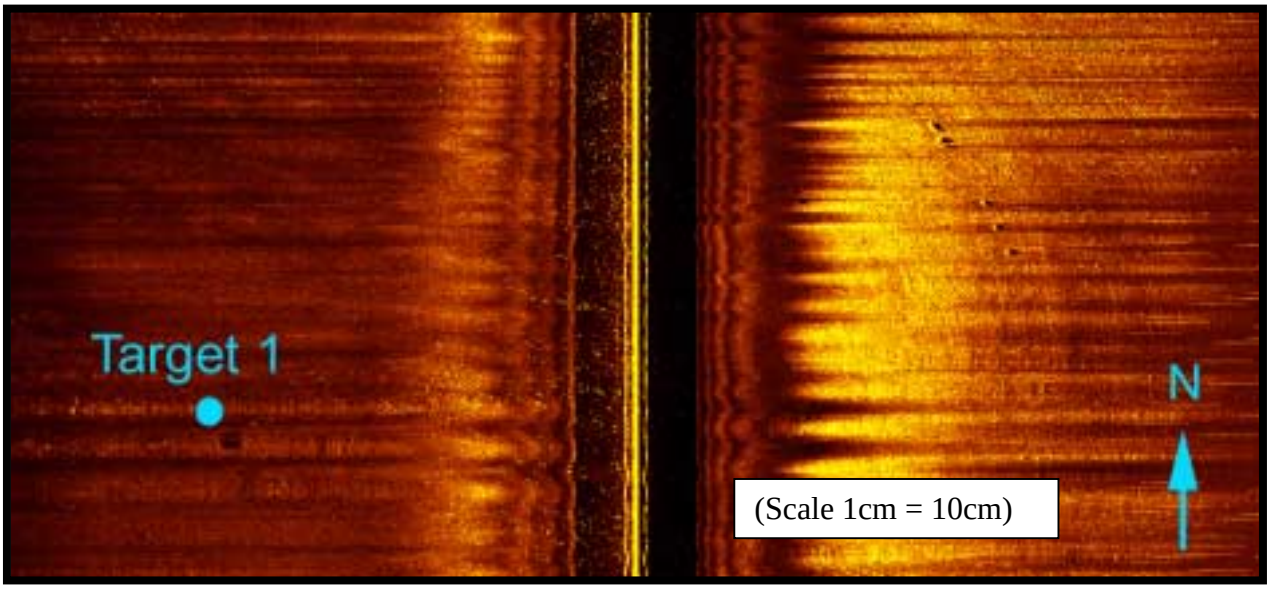
March 16, 2002 Target #2



This target was identified because it seemed to be a structure. The marker is on the southeast corner of the anomaly, which represents hard returns and a shadow. The dark shadow could represent relief from an object standing perpendicular to the seabed.

The divers touched down on a coralline formation and found a sliver of wood, however, there was no indication of a wreck structure. Therefore, the hard returns represented a natural and not a man-made structure on the seabed.

March 16, 2002 Target #5



Target 1 looks like a hole in the seabed. There were several such anomalies on both the side scan surveys and their exact composition was unknown. The largest of these 'holes' was selected as a target for diver survey.

The visual survey encountered no 'holes' in the seabed. However, they did come upon a large sponge about 2.5 feet high and about 1.5 feet wide. What looked like a hole in the record could have been the shadow cast by the sponge or it could have been a representation of a very soft return caused by absorption of the sound wave by the sponge matter.

On the right of the side scan record there is a formation of five structures protruding from the seabed. The divers swam over to this area to investigate further and came upon a line of large sponges and coral.

Conclusions

This exercise in ground truthing was designed as a way to gain familiarity with the side scan sonar equipment and to gain experience in reading the data output by the machine. The students of ANT 4131 took turns operating the side scan computer and managing the towfish.

Neither the *Ben*, nor any similar wreck structure was located. The possibility for this was high considering that the location given by the waypoints from Singer's book did not correspond with the position as indicated by the nautical chart (see Location of the *Ben* on page 3). This discrepancy is the result of the evolution of position fixing at sea, which in the early to mid 20th century involved a system of radio beacons called Loran. Loran is an acronym for Long Range Navigation. This system relies on triangulating the signal from land-based radio transmitters to pinpoint locations at sea[2]. (Cunliffe, 1982). This then progressed to the Global Positioning System, which has only taken over in the last 3-4 years (Faught 2002). This system is based on position fixing using satellites. When looking for sites at sea that are not in GPS coordinates there is a website that translates such locations to GPS Lat/Long information: http://anchor.ncd.noaa.gov/awois/search.cfm.

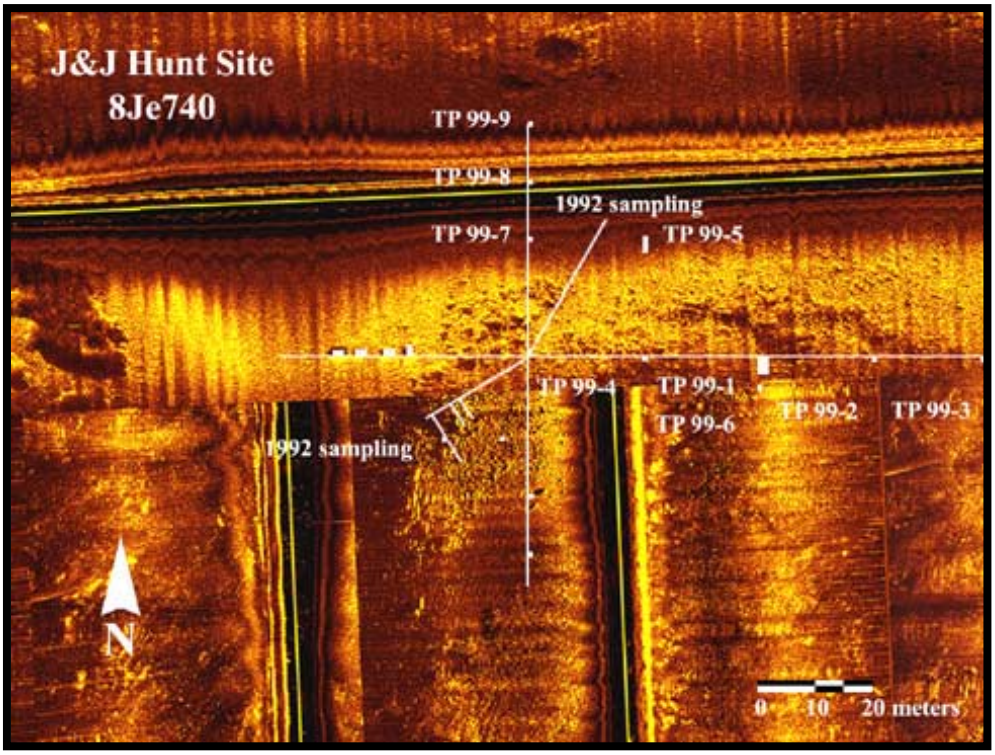
It was concluded that the *Ben* was not in this particular 1km^2 area, since it was saturated with remote sensing and no obvious wreck structures were found. However, there were additional interesting targets identified by the researchers that could answer questions on ground-truthing side scan sonar surveys and on the fate of the *Ben*. It is therefore recommended to continue investigating targets in the 1km2 area with diver visual surveys.

The rock outcrop anomalies identified during this survey were found to be unlike those encountered at J&J Hunt. One must consider that this survey was conducted further out on the continental shelf than the work conducted by the *PaleoAucilla Prehistory Project*. The rock formations in this particular area were large sand-covered formations with patchy coral on the seabed. The lack of brackish shell or sediment samples indicates that this area was not associated with fresh water deposits (which are generally in the form of rivers and sinkholes). Human presence is most often associated with fresh water sources and the lack of artifactual evidence suggests that humans did not occupy this particular area offshore.

The following figures offer a comparison of what the artifact rich outcrops at J&J Hunt look like on the sonar record and what was encountered on this survey. The top image is of the J&J Hunt site. The main rock outcrop lies above the horizontal axis and is clustered around the main datum. This site lies near a fresh water feature, which is the mouth of the PaleoAucilla River. The bottom image is the side scan record of Target #6, a rock outcrop of morphology as described in the previous paragraph (rock covered by 6-12 inches of sand with patchy coral on the seabed). The bottom record is of less hard returns than those seen on the J&J Hunt side scan and they are not as clustered, but rather seem more dispersed and less dense.

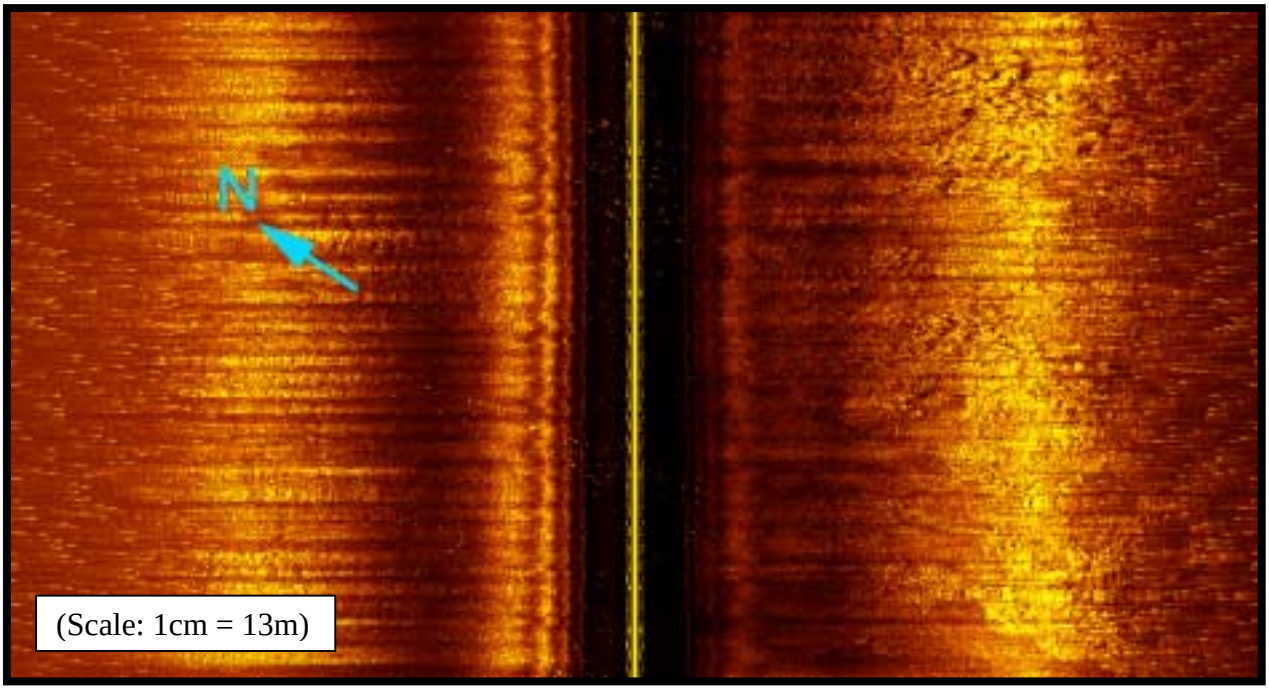
[2] Loran A was in use before WWII and Loran C, the most current method, was developed in the post war years.

Side Scan Mosaic of the J&J Hunt Site



This image was taken from http://www.adp.fsu.edu/fs2000/Short_Summaries/shortsummary_2000.html.

March 14, 2002 Side Scan Record #22



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