GEOPHYSICAL REMOTE SENSING AND UNDERWATER CULTURAL RESOURCE MANAGEMENT OF SUBMERGED PREHISTORIC SITES IN APALACHEE BAY: A DEEPWATER EXAMPLE, SITE PREDICTIVE MODELS, AND SITE DISCOVERIES

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ABSTRACT

This paper briefly describes progress made in finding and investigating prehistoric sites in open ocean settings over the continental shelf of Northwestern Florida. It presents an example of "deep" water survey near the proposed "Clovis Shoreline" (40 meter isobath) conducted in 2000 and 2001, as well as submerged prehistoric site archaeology practiced in shallower water in Apalachee Bay since 1986. A significant number of sites and artifacts have been located on Florida's western continental shelf as part of this programmatic research. These sites represent Paleoindian and Archaic occupations of the shelf when it was exposed by lowered sea levels during the last glacial maximum.

INTRODUCTION

This paper briefly describes progress made in finding and investigating prehistoric sites in open ocean settings over the continental shelf of Northwestern Florida. It describes beginning archaeological research in "deep" water near the proposed "Clovis Shoreline" (at the 40 meter isobath), as well as abundant work conducted in shallower water since 1986. In other areas of the Gulf of Mexico (GOM), the sites reported here would be in federal waters, but in this area they are in submerged lands that belong to the state of Florida to a distance of 9 nautical miles. It is my opinion that this work can be a useful analog for resource managers in Alabama, Mississippi, and Louisiana, even though the sediment loads there are more substantial.

Professional cultural resource managers are more and more in need of examples of procedures, protocols, and practical experience with marine submerged prehistoric sites because of increased offshore mining of sand to replenish beaches, and other infrastructure and resource procurement projects. There are prehistoric sites threatened by this dredging. It is a fact that state and federal laws protect these resources like any other cultural resources. There is a robust interest in and practice of finding and managing historic shipwrecks in the cultural resource management community. The failure to consider submerged prehistoric sites is due in part to the historic lack of a formal academic discipline of this kind of study and the lack of experienced researchers and consultants.

Because of modern remote sensing and excavation equipment, increased research funding, and continued forays offshore, faculty and students at Florida State University are having good success at finding and managing marine submerged prehistoric sites and understanding the physiographic and stratigraphic character of the submerged landscape within which they occur. A set of procedures for finding and managing marine submerged prehistoric sites has been developed from research conducted since 1986.

This paper provides background on principles of finding submerged prehistoric sites, details of local sea level rise that are relevant to knowing where to find sites of different ages, and a very short description of the ages of cultures available in the local prehistory. Deepwater research seeking the Clovis Shoreline in federal waters is described next. The paper concludes with a summary of our findings in more near-shore state waters.

Experience has shown that offshore sites are predicted by local models of terrestrial geology and archaeology, combined with a knowledge of local sea level rise and local bottom morphology. This information can be collected for areas with early occupation expressed terrestrially, and in some cases it may be possible to follow specific occupation patches offshore in specific drainages (such as the PaleoAucilla example presented here). Another part of the procedure is to conduct remote sensing, coring, and induction dredge operations to find, characterize, and study the paleo-topography and sedimentary sequences locally.

This methodological sequence has been a fruitful approach in our work with the PaleoAucilla drainage system in the Apalachee Bay (Figure 1C.33). By modeling the kinds of environments, sites, time periods of exposure, and culture groups that might be represented and finding sites on the continental shelf, we contribute information to incorporate into local site file inventories and cultural historical and processual reconstructions.

Figure 1C.33 shows the distribution of late Pleistocene and early Holocene archaeological sites in Florida, and the extent of the Floridian continental shelf and the bathymetric contours that represent paleo-shorelines at various stages of the transgression process. While there may be some subsidence due to accumulated sediment and water weight since submergence (Stright 1995), and some movement due to karstic solution uplift (Opdyke *et al.* 1984), the Florida continental shelf platform is considered “stable.”

Figure 1C.34 shows radiocarbon controlled sea level curves for the GOM, and Caribbean. Three curves come from the western GOM (Curray 1965; Frazier 1974; Nelson and Bray 1970) and one from Barbados (Fairbanks 1989). There is a short 8,000 to 6,000-rcybp sequence suggested by this research program for the northwestern continental shelf (Faught and Donoghue 1997). Some time between 5,000 and 4,000 rcybp sea levels were at today’s levels in the Big Bend.

The continental shelf of the Big Bend of Florida is a drowned karst landscape submerged by a relatively low energy open ocean (CEI (Coastal Environments) 1977; Rupert and Spencer 1988). The seafloor bottom is somewhat like a basin and range landscape. Limestone outcrops of various relief and scale are interspersed by plains of coarse shelly sand and beds of sea grass growing in fine-grained organic sediments. The general trend of the bottom is flat but there is relief over long distances, particularly in the vicinity of paleochannels. Rock out crops can be from a few centimeters to 80 cm in height, sandy plains can cover karst voids of various relief.

Work by Ballard and Uchupi (Ballard and Uchupi 1970) indicates several paleocoastal features (shore-face erosion ledges and drowned barrier islands) at certain depths on the western Floridian continental shelf (that is at 160, 60, 40, 32, and 20 meters; Figure 1C.33 and Figure 1C.34). Full glacial lowering of

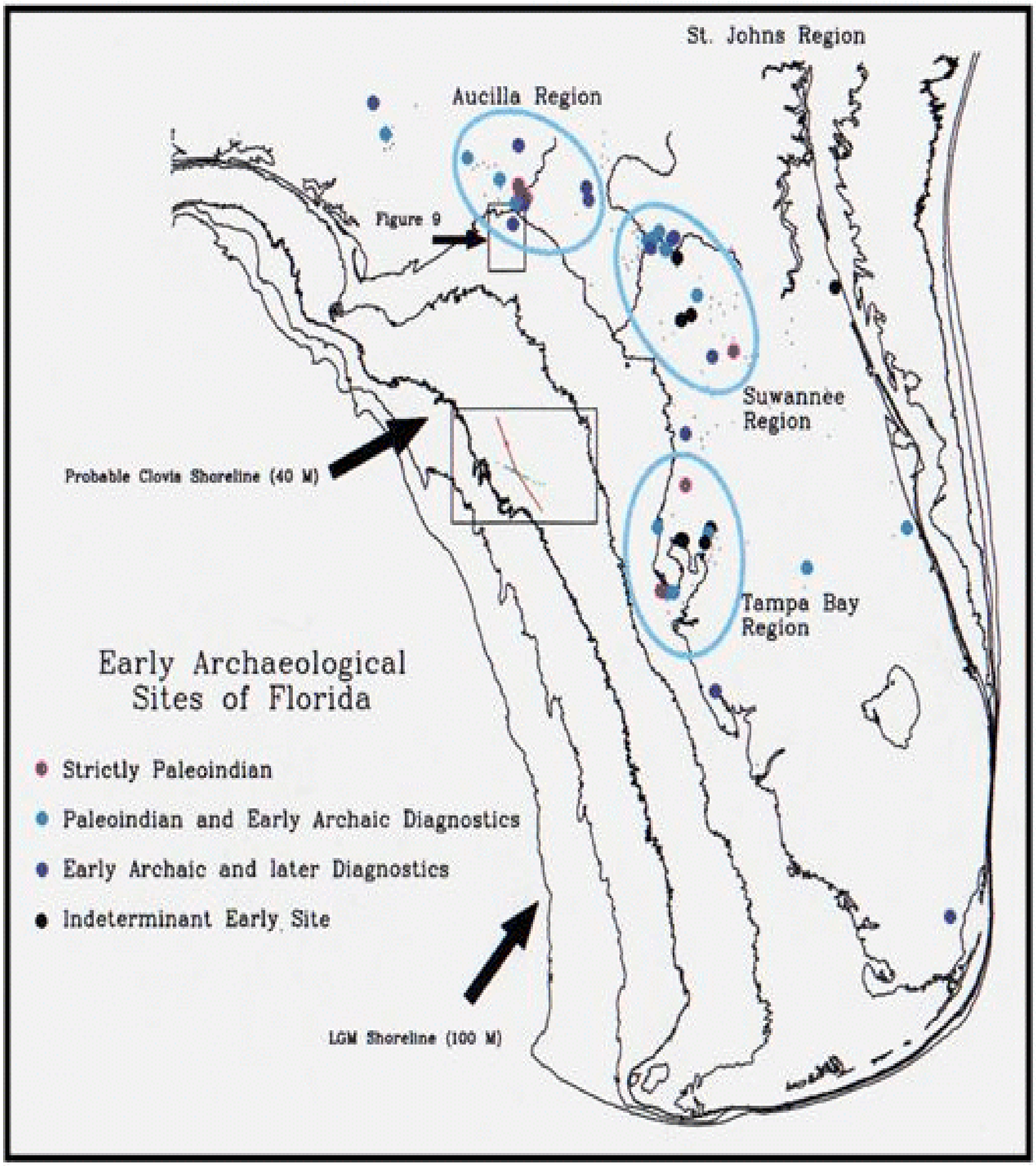

Figure 1C.33. Peninsular Florida, showing the distribution of find spots and excavated sites of Paleoindian and Early Archaic archaeological sites on land. Bathymetric contours at 20 meter intervals. The 40-meter contour is possibly the Clovis Shoreline (Dunbar *et al.* 1992; Faught and Donoghue 1997). Two research areas are shown: the southern area is that of Figure 1C.35, the northern of Figure 1C.36.

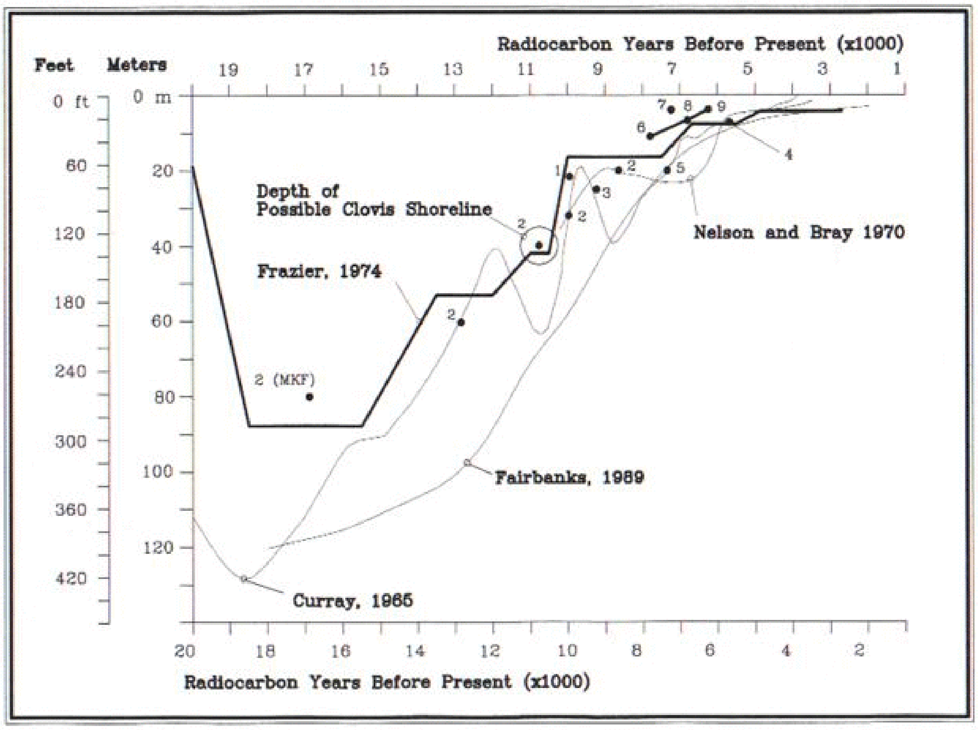

Figure 1C.34. Citations associated with curves are found in the references list. 1 = (Frazier 1974) 2 = (Ballard and Uchupi 1970) 3 – 9 = this research project.

this shelf was probably between 60 and 100-meter depths. The 160-meter isobath is anomalous, and may be a much earlier than the late Pleistocene. The Younger Dryas or Clovis Shoreline, may be at 40 m based on an overlap of western GOM data (Frazier 1974) and the paleocoastal features reported by Ballard and Uchupi at 40 meters (Faught and Donoghue 1997).

A simplified chronology of occupations in northwestern Florida is presented in Table 1C.1. The late Pleistocene-early Holocene cultural sequence in Florida is based on isolated artifacts and stratigraphic occurrences of diagnostic fluted Clovis points (or knives), lanceolate Suwannee points (or knives), and notched Bolen and Kirk projectile points (or knives) in that order. Sites are located on the karst landscape near sinkholes and river channels where there is much chert available. These represent adaptations showing social relationship with Clovis Paleoindians. Middle Archaic occupations are also represented in this portion of Florida, and they are marked by Archaic Stemmed Points. There may be a hiatus of occupation between the two cultural patches. The meaning of this is that sites found nearer to the modern shoreline have potential for occupation by both groups (Paleo / E. Archaic and Middle Archaic). Work farther offshore should restrict the discoveries to only the earlier group (Paleoindian and Early Archaic).

Table 1C.1. Sequence of culture history and sea level rise in northwestern Florida.

Projectile Point Type Name and Possible Depth Limit	
Lanceolate Clovis 11,000 rcybp	**Beginning Younger Dryas** 40 Meter Contour ??
Lanceolate Suwannee Greenbriar 10,500 rcybp estimate	**Younger Dryas** 40 Meter Contour
Side Notched Bolen Big Sandy Taylor 10,000 rcybp	**End of Younger Dryas** 40 Meter Contour
Corner Notched Palmer Bolen Kirk 9,500 rcybp	**Beginning Second Melt-water Pulse** 20 meters ??
Archaic Stemmed Several varieties 7,500 rcybp	**Last Phases of Submergence** 10 to 5 meters

DEEPWATER RESEARCH: SUSTAINABLE SEAS EXPEDITIONS 2000 AND 2001 TO THE FLORIDA MIDDLE GROUNDS

I was invited by Dr. Sylvia Earle of the National Geographic Society to accompany her on the Sustainable Seas Expedition (SSE) of 2000 to conduct work in and around Stu's Ridge at the 80-meter isobath, and the Florida Middle Grounds, between the 40-and 50-meter isobaths seeking paleohuman occupation sites. Stu's Ridge, a well-known grouper habitat, occurs around the 80-meter isobath and exhibits a wave cut notch, formed in a coquina. Wave cut notches are unequivocal evidence for sea level still stand, but we do not know the duration, or the age of the notch. It does have potential to mark the LGM (late glacial maximum) sea level stand.

The Florida Middle Grounds, on the other hand, is composed of high relief, flat topped, carbonate pinnacles with abundant algal growth, mollusks, and coral. The habitat of the Middle Grounds supports abundant marine life. This area is fished commercially and recreationally on a regular basis causing a depletion in marine fauna.

The Middle Grounds has been interpreted as a possible paleoreef feature, probably resulting from vertical reef growth with rising sea levels. An alternative interpretation, that it may be a pinnacle karst feature, is also possible. The tops of the Middle Grounds pinnacles are flat and occur at depths of approximately 30 meters. The eastern margins of the Middle Grounds are at the 40-meter contour, meaning that submerged prehistoric sites are more likely in shallower water, and east of this feature.

In the 2000 SSE cruise most of the research time was spent in the study of marine organisms by biological colleagues, and I spent time getting to know the DeepWorker submarines, studying the navigational maps, and making fathometer observations. One long transect (Figure 1C.35) was made with the fathometer aboard the NOAA Ship *Gordon Gunter*, while underway from Tampa Bay to the Middle Grounds (bearing 291 degrees) at about 10 knots on 12 August, 5:45 a.m. to 9:00 a.m. I observed and recorded positions of channels and rocky outcrops. Fathometers act as weak subbottom profilers, but there is no other record (digital or hard copy) other than bottom depth, latitude and longitude, and the perceptions of the observer.

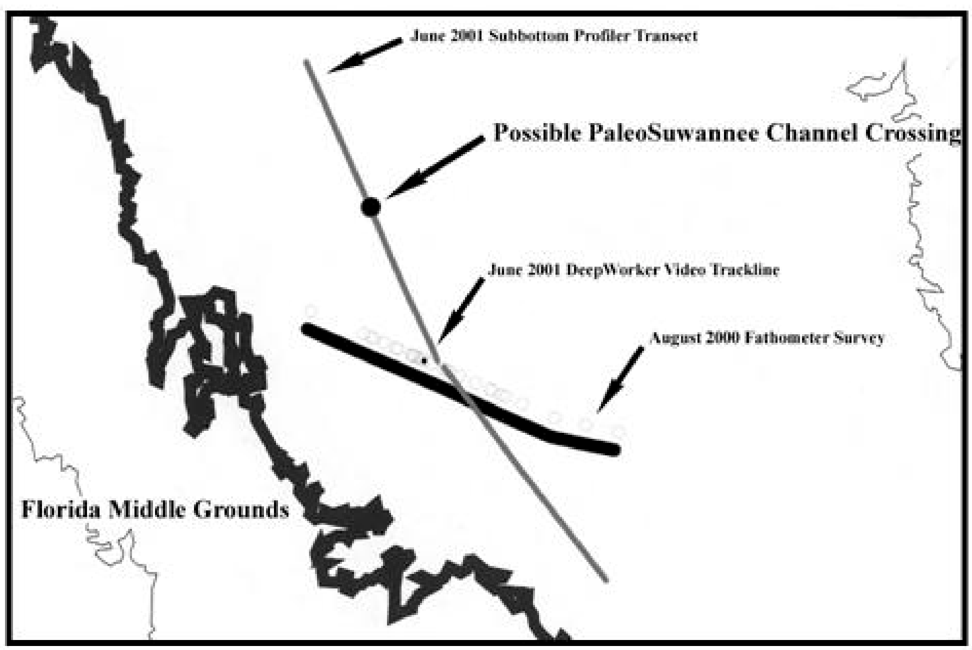

Figure 1C.35. Close-up of Middle Grounds research area and various tracklines outlined in Figure 1C.33. The heavy contour line is the 40-meter isobath. The 2000 fathometer survey and the 2001 subbottom tracklines are shown, as well as the 2001 DeepWorker video transect and the position of the subbottom profiler channel crossing.

Twelve anomalies were recorded as rocky rises, and eleven were channel or sediment filled depressions. Some of these latter features represent either side of a larger channel features. One location was targeted for further investigation. It is a rocky rise with nearby karst depression features analogous to features we are familiar with in our research nearer to the shoreline (summarized below). A topographic map was made from recorded fathometer data collected during nighttime tracklines shown in Figure 1C.36.

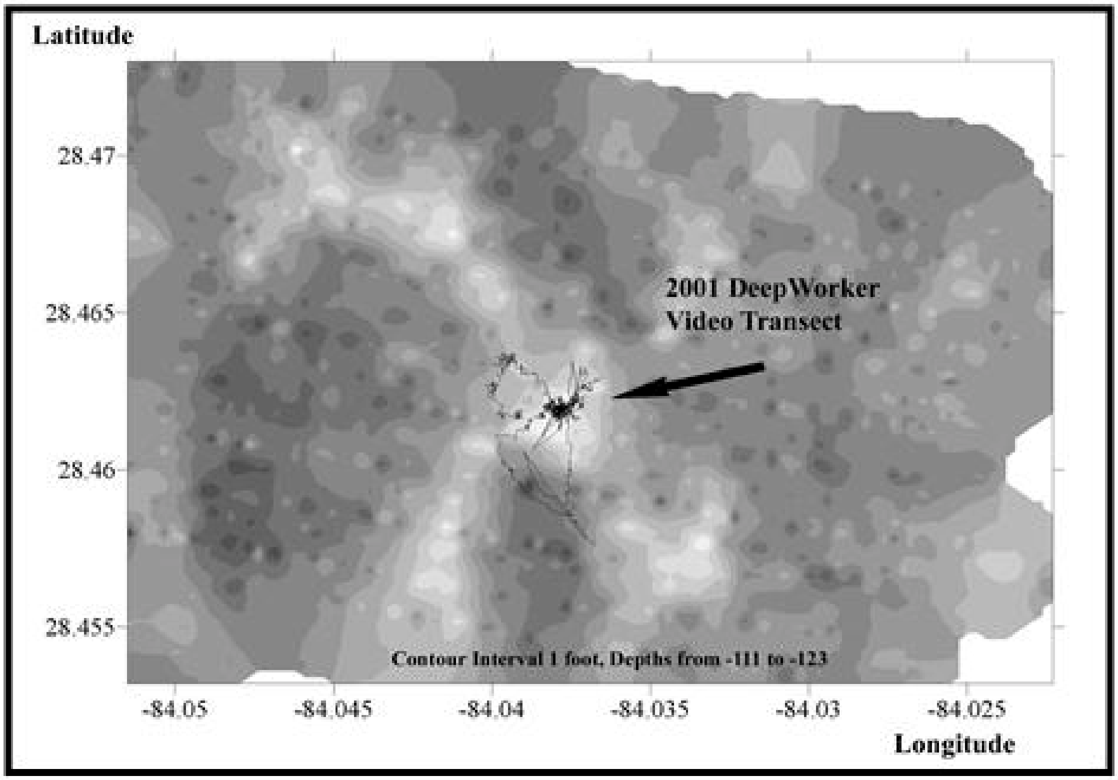

Figure 1C.36. Topographic map of the 2001 target area and submarine tracklines conducted there. Light areas are highs, darker colors lows. Range of topography is between -123 and -111. DeepWorker exploration of this location revealed bedrock exposures of limestone indicative of relict terrestrial conditions, but with significant sea floor life, and fish there now.

We developed an understanding of the needs of an archaeologist while at sea and agreed to try again in 2001. I proposed that we conduct subbottom profiler remote sensing research to identify the mouths of any channels that debouched at 40 meters and to search for artifacts around a potential rock outcrop features identified in 2000 by the study of fathometer returns. In June of 2001, and with the help of the able-bodied crew and scientists aboard the NOAA Ship *Gordon Gunter*, I organized two operations that were focused on the discovery of relict channel features and Paleoindian occupation sites (Figures 1C.33 and 1C.35).

One operation consisted of two nighttime sessions of subbottom profiler remote sensing to discover the position of what was thought to be multiple relict river channel mouths east of the Florida Middle

Grounds. A transect of 41 nautical miles (about 76 kilometers) was completed. Florida State's Program in Underwater Archaeology has a dual frequency BENTHOS Chirp subbottom profiler (2-7 kHz and 10-20 kHz) that was towed at speeds of between three and four knots in two sessions. The Chirp system digitizes the analog sound data to a computer hard drive for later processing. BENTHOS has developed a Windows based software for real time data processing, image display, and manipulation. Signal classification algorithms are included. The track line data is embedded with NMEA-183 formatted data as supplied by a GPS receiver with an accuracy of between 4 and 6 meters.

The subbottom profiler transects were designed to encounter the mouths of rivers that might have come out into what might have been a bay-like feature inside of the Florida Middle Grounds. At the time, I thought there might be several of these crossings in the subbottom profiler pathway. However, only one channel feature was crossed in almost 40 nautical miles of remote sensing (Figure 1C.35). This feature was at the approximate latitude of the Suwannee River along today's coast. Surely, more remote sensing will be needed to confirm this finding or to show it to be the result of sampling bias.

A second research operation was conducted around the topographically reconstructed target from 2000 (described above) with a video transect by a DeepWorker submarine piloted by George P. Schmal of NOAA's Flower Gardens. There are two or three hours of video recording the trackline observations conducted over rocky areas and sandy sea floor bottom. There was no manipulator arm available for this transect, so no samples could be taken of the potential objects. One note of interest is that the biologist piloting the submarine was involved in aiming the camera at larger scale scenes, and scenes that focused on fish and fish behavior. In several frames of the video there are objects that very easily could be artifacts, as we are used to seeing in more shallow water, but until we can get some divers down to the target to look and collect, we will not know for sure. The DeepWorker proved its potentials, moreover, with certain upgrades and a pilot with archaeological experience it could be a great remote sensing tool (this is in no way a critic of the pilot of the sub, rather an interesting note about research attention and focus).

RESEARCH IN SHALLOWER WATER: DEVELOPING THE METHODS NEEDED FOR DEEPER WATER DATA RECOVERY

Since 1986, nine multi-week forays to open ocean localities on the Floridian continental shelf have been organized. Four were organized for doctoral dissertation field research in 1988, 1989, 1991, and 1992 (Dunbar *et al.* 1992; Faught 1988, 1992, 1996; Faught and Donoghue 1997). Another four field sessions have been organized since 1998 as a programmatic approach to submerged prehistoric sites archaeology. These latter four projects have been included in FSU's Field School in Underwater Archaeology. The current incarnation of the research is known as the *PaleoAucilla Prehistory Project* (www.adp.fsu.edu/paleoaucilla).

The intellectual intent of the *PaleoAucilla Prehistory Project* has been to work out from the modern coastline Aucilla River (*known*), to the offshore-*unknown* environment in search of relict portions of that river and sites within its channels and along its margins. The intellectual logic has been to investigate progressively deeper and farther out locations as boats, gear, funding, and staff permit. Most research time has been spent within about 17 km (9 nautical miles) of the modern coastline at depths varying from

12 to 20 feet. We are searching in areas containing channel features, rock outcrops, sea grass beds, and sandy, desert-like plains.

Underwater research has resulted in the retrieval of more than 4,000 chipped stone artifacts from 33 localities (sites) offshore since 1986, samples shown in Figure 1C.37. Of the chipped stone specimens, 1,158 have been found on survey, 1,632 have been retrieved from J&J Hunt, the remainder were collected from two other sites exhibiting hundreds of artifacts each (i.e. Econfina Channel and the Fitch Site in Figure 1C.38). The types and amounts of artifacts that are encountered range from a few isolated chunks of worked chert-quarry debris, to significant numbers of stone tools, biface thinning flakes, and other tool-making and edge-maintenance debris. These latter sites exhibit diagnostic projectile points as well. Based on the presence of diagnostic projectile points and certain unifacial tool types, three locations are late Pleistocene Paleoindian and early Holocene Archaic occupations. Four sites have produced evidence of the middle Holocene Archaic of Florida. Two of the locations indicate both groups: one of these is the J&J Hunt site reported in more detail here, the other is a site found in 2001 called “Ontolo” (Figure 1C.38).

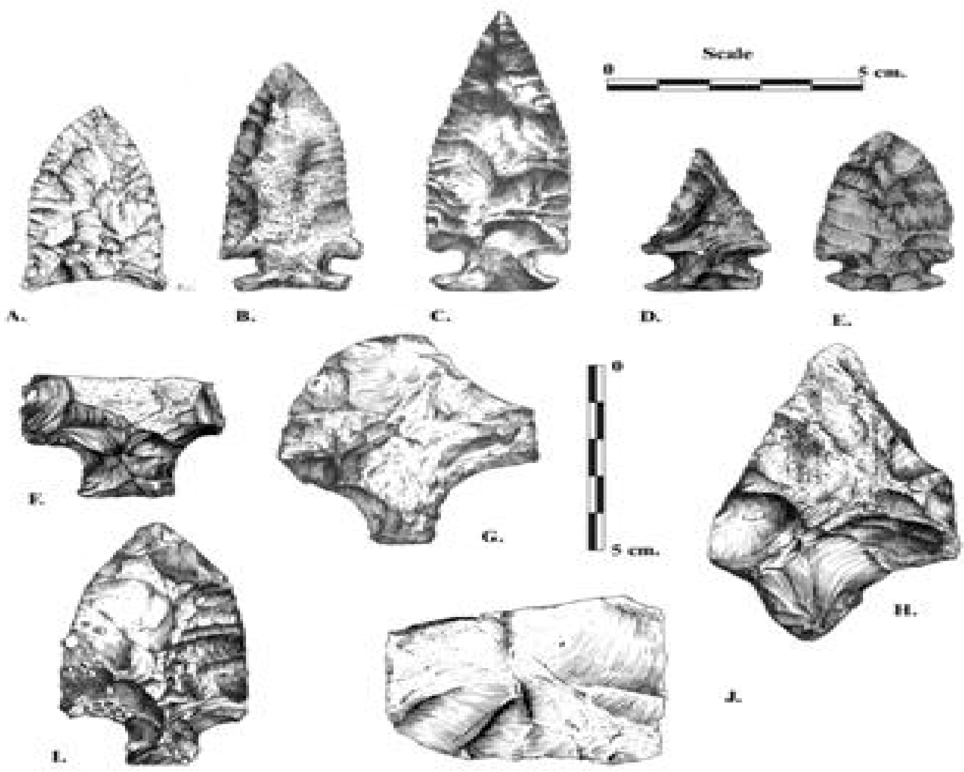

Figure 1C.37. A selection of projectile points found by offshore research. Paleoindian (A,J), Early Archaic(B-E), Middle Archaic(F-I) examples are shown (Drawings by Brian Worthington).

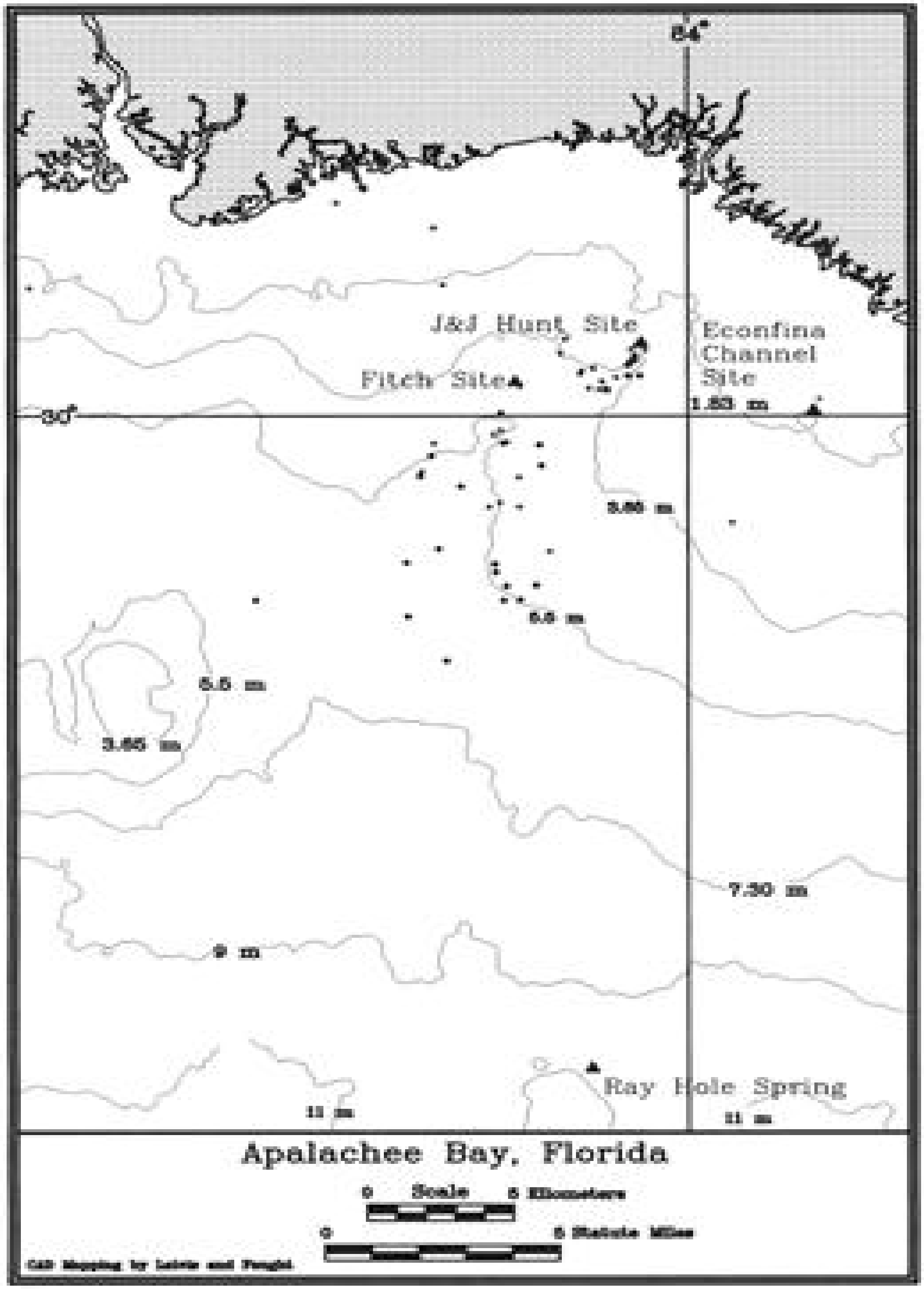

Figure 1C.38. Research area of the Paleo Aucilla Prehistory Project showing the locations of sites mentioned in the text, and sites located by survey operations.

Conducting open ocean operations is a logistical complexity controlled by the size and capabilities of the vessel, or platform to be used at sea. The difficulties with regard to boats (or other working platforms) revolve around adequacy of size, affordability, and availability. Boat sizes of 18 to 23 ft were used during the Ph.D dissertation research to work as far out as 3 nautical miles, but their capabilities in this environment were marginal. Crew sizes were restricted to three to five in each boat—including their dive gear and dredge equipment. There are only emergency overnight capabilities on vessels of these sizes, and no working in seas over about 2 feet.

Larger, more appropriately sized vessels, with galleys, heads, and comfortable sleeping quarters have been leased since 1998 because funds have permitted. We have chartered 50 ft (crew of five), 65 ft (crew of ten), and 72 ft (crew of ten) vessels from Florida State University, Panama City Marine Institute, and Florida Institute of Oceanography. We load the vessels at FSU's Marine Laboratory at Turkey Point, St. Teresa, Florida, and then run four to five hours to the survey areas reported here. The benefits of larger craft cannot be over-stated. Justifications for their procurement include the ability to stay at sea for as many as five days with adequate crew and equipment to run two or three operations simultaneously (remote sensing, diver survey, mapping, coring, or excavations). Crews are rested and better able to sustain safe and effective research activities on these larger vessels.

Just as a stratified random approach is desirable for terrestrial resource management inventory projects, increasing "site encountering success" rates are important factors in locating sites offshore. An initial study area was defined in 1986 that encompasses almost 1,500 square kilometers (585 square statute miles, shown in Figures 1C.33 and 1C.38).

One method of understanding the sea floor bottom with limited resources has been bathymetric enhancement conducted by digitizing the locations of known depth from the NOAA navigation map, recordation in spreadsheet format, gridding in Surfer, and study of depression trends, the likely paths of paleo channel features (Faught 1996). Figure 1C.39 is one such reconstruction of the topography of the seascape around J&J Hunt based on the depths recorded on the NOAA Navigational Map (Apalachee Bay), combined with subbottom profile fathometric data from 1991. The topography of the research area bottom has to be enhanced by a factor of 500 in Figure 1C.39 in order to bring out subtle differentiation.

Subbottom profiler remote sensing is another, better, but more expensive tool for accurately locating the paleo- drainage system offshore and understanding the character of the stratigraphic beds. All told, we have run 216 linear kilometers of subbottom profiler tracklines (111 in 1991 and 105 in 2001). This record crosses channels and other karstic depressions in several places. The equipment used in the 1991 field session included a GEOPULSE 3.5 kHz "Boomer" sounding device with an 2.4 meter hydrophone array, processed by a GEOPULSE 5210A receiver, and recorded on thermal paper. As described above, FSU's Program in Underwater Archaeology now has a dual frequency BENTHOS Chirp subbottom profiler.

Side scan sonar has proven to be another effective instrument for survey of large areas of the seafloor bottom for identifying features which might justify diving or other testing. At the time of this writing side scan sonar operations have accrued 250 kilometers of imagery (with swaths varying from 150 to 200 meters). The use of the side scan sonar for investigating the character of the seafloor bottom cannot be

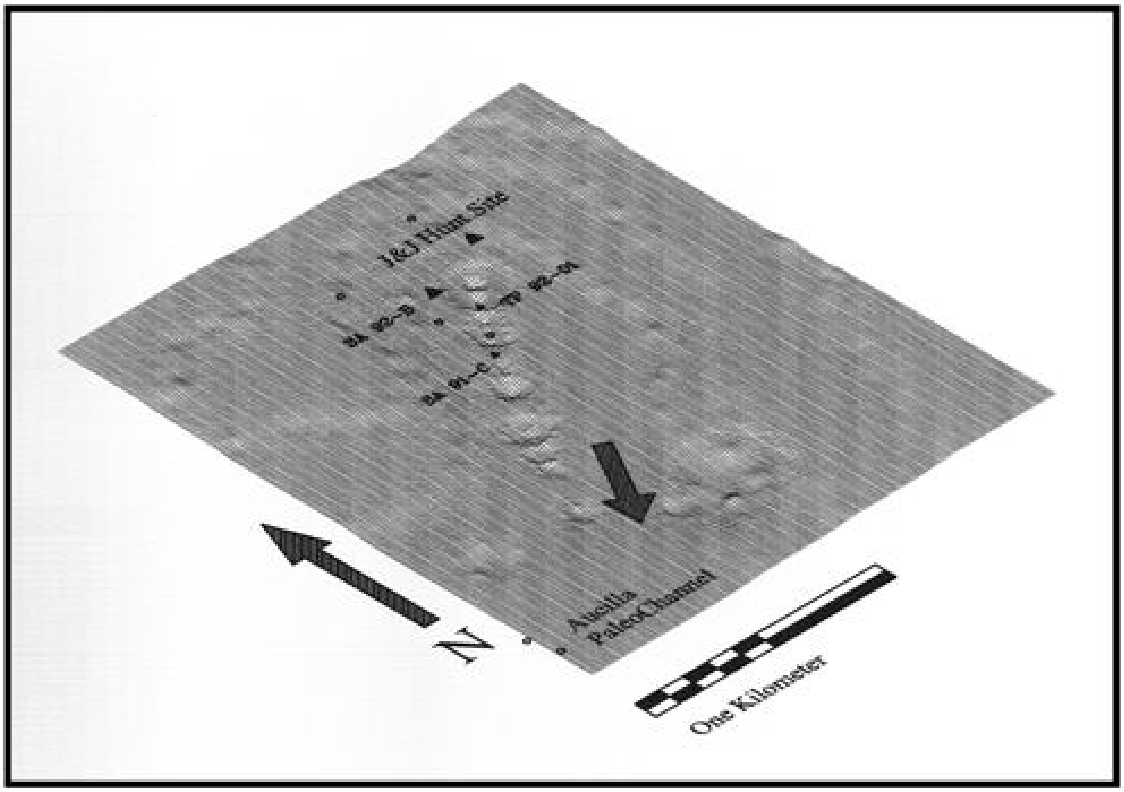

Figure 1C.39. Bathymetric reconstruction of a segment of the PaleoAucilla, showing the location of the J&J Hunt Site and other artifact locations discovered offshore.

understated. Especially when used in conjunction with the use of a third party mosaicking program. The side-scan sonar unit being used by FSU is a Marine Sonic Technology Sea Scan PC “Splash-proof” digital image sonar survey system with a 600 kHz tow fish, a two-gigabyte hard drive, and a Pentium splash-proof CPU. The track line GPS data is embedded in the digital record and is supplied by any GPS system with data output (NMEA-183 type) with an accuracy of between 4 and 6 meters. The swath of the side scan coverage can be set from 100 to 200 meters with the speed of the vessel running between three and four knots.

Before 1998 site locations and remote sensing tracklines were recorded with Loran-C navigational signals, manually plotted on the NOAA Apalachee Bay navigation map, and then digitized onto the CAD map using a State Plane (Florida North Zone) coordinate base (Figure 1C.38). Since 1998 our locations have been recorded in latitude and longitude using DGPS technology, plotted in both GIS and CAD formats by translating the global coordinates into either state plane and UTM coordinates. The differential signals that reach the Big Bend are weak, and therefore most of our GPS data has been without differential control since selective availability was turned off in May of 2000.

Since 1986 this research project has dived at 52 locations and encountered artifacts at 35, a discovery rate of about 67% overall (Faught 1996; Pendleton and Tobon 2002) (Figure 1C.38). In 2001 our rate was six encounters for seven targets dived for a success rate of 85%. Of these artifact encounters, 15 are registered with the Florida State Master Site File because those were encounters of ten or more artifacts (a protocol of the research program). The numbers of artifacts recovered has already been described above.

Initially, all sites are sampled randomly. Controlled hand fanned sampling is employed if artifacts are produced and if time and conditions allow. More intensive excavations, coring, and mapping have been conducted at J&J Hunt, and two other locations (Econfina Channel (Faught 1988), The Dorothy C. Fitch Site (Faught 1996)).

CONCLUSIONS

This paper has briefly described progress made in finding and investigating prehistoric sites in open ocean conditions over the continental shelf of Northwestern Florida. It described initial research in "deep" water near the proposed "Clovis Shoreline" (40 meter), and gave a short overview of abundant research conducted in shallower conditions. I believe that this work can be a useful analog for resource managers in Alabama, Mississippi, and Louisiana, even though the sediment loads there are more substantial. In other areas of the Gulf, many of these sites would be in federal waters, but in this example they are in state of Florida waters to a distance of nine nautical miles. More submerged cultural resource management projects need to consider these kinds of resources, more prehistoric archaeologists need to be able to manage them because of the specialized nature of site prediction, recognition, and analysis, and obviously more sites need to be discovered.

Sustained research in the Florida Big Bend has resulted in practice with several conceptual and methodological techniques found useful in the investigation of marine submerged prehistoric sites. In general, offshore site prediction is best conducted by developing local predictive models; models based on the local terrestrial record of prehistoric sites, local sea level rise history, and local bottom type and past drainage systems. One site prediction model in Florida postulates that artifacts and Pleistocene fauna can be found in river sinkhole features as at the Page Ladson Site, in the Aucilla River. Another site prediction model suggests that sites can be found by taking perpendicular (lateral) transects from the channel margins.

The amount of work that can be accomplished offshore is dependent on sufficient funding, procurement of appropriate boat (or boats), adequate levels of technical support, and the vagaries of inclement weather and crew availability. We have found that use of remote sensing (subbottom profiler and side scan sonar devices) and coring operations are helpful to find paleotopographic features, sediment packages and sites. Induction dredge testing operations have also been effective to investigate sites. One of the more successful approaches is simply having divers in the water seeking artifacts to define sites by hand fanning.

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