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Submerged Prehistory

Edited by

Jonathan Benjamin
Clive Bonsall
Catriona Pickard
Anders Fischer

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Submerged Prehistory in the Americas

Michael K. Faught and Amy E. Gusick

In this chapter we outline what we know about submerged prehistory from the American perspective by revisiting places where researchers have actively searched for sites, places where sites underwater are known, and places that have great potentials for discovery. We describe our own works conducted on the East and West Coasts of North America: the eastern Gulf of Mexico, Apalachee Bay, Florida, and the western Gulf of California, Bahía Ballena, Baja California Sur. These two projects, located in different geological environments, with different culture-historical backgrounds, and situated in different marine settings, show some of the benefits of initiating research where submerged palaeolandscapes are easier to access because they are exposed or shallowly buried on the seabed.

Keywords: submerged prehistory, underwater archaeology, Americas

Introduction

If it can be said that scientific enquiries evolve as specific disciplines as their contributions grow, their theory, assumptions, and methods improve, and students seek out mentors to become proficient specialists, then this volume shows that submerged prehistoric site archaeology is becoming a discipline in its own right in Europe (Bailey and Flemming 2008). The same is not quite true in the Americas, but it is close. Of course anthropological questions about coastal adaptations and migration routes remain in America today, which can only be resolved with data from underwater settings on the continental shelf, as has become apparent to oceanographers and archaeologists alike since the 1960s (Emery and Edwards 1966; Kraft *et al.* 1983; Ruppe 1988; Stright 1990; Erlandson 2006; Ballard 2008).

Because it is expensive to go to sea, difficult to model what the seafloor looked like before submergence, and difficult to work under the sea, what drives this kind of research? There have to be motives for researchers to go to such lengths. Issues that motivate (or have funded) prehistoric underwater research in the Americas include fundamental questions about coastal adaptations; for example, when, why, and where did people begin to access coastal habitats (Erlandson and Fitzpatrick 2006)? Did people only go to the coast when other resources were stretched between 6000 and 5000 cal BC, at the same time as seas transgressed to near-modern levels, or did the majority of populations settle within a short distance of the coast, as is the case today, with evidence for them missing because sea-level rise covers those palaeocoastlines? Gusick's research described in brief below is motivated by this anthropological question, and evidence is accumulating that the latter is more likely.

Another motive for looking for submerged prehistoric sites is to identify migration pathways. While the Pacific Coast of North America is the logical place to look for migration routes into the Americas, alternative, data-based models are accumulating about different pathways of the initial peopling of the Americas that include East Coast pathways and ocean crossings (Dixon 2001; Bradley and Stanford 2004; Faught 2008). Recent projects in North America are focused on locating evidence to support a hypothesized Pleistocene coastal migration along the Pacific Coast of the Americas (Josenhans *et al.* 1997; Fedje and Josenhans 1999; Gusick and Davis 2007, 2009, 2010). Another project in the Gulf of Mexico is focused on finding 'pre-Clovis'

habitation sites in deep water settings that might be indicative of Iberian rather than Siberian origins for Clovis technology (Adovasio and Hemmings 2009, 2010).

Cultural resource management (CRM) projects offer other, not so theoretical, motives to conduct submerged prehistoric sites archaeology and, it will be shown, these kinds of projects have had important impacts on methodology and site discovery, and probably will continue to do so in the future. State and federal agencies have need for complete settlement pattern information, which logically includes bays, inlets, and continental shelf areas; projects often have funding levels of appropriate scale, and the archaeologist has the benefit of legislative compliance to compel attention to threatened resources.

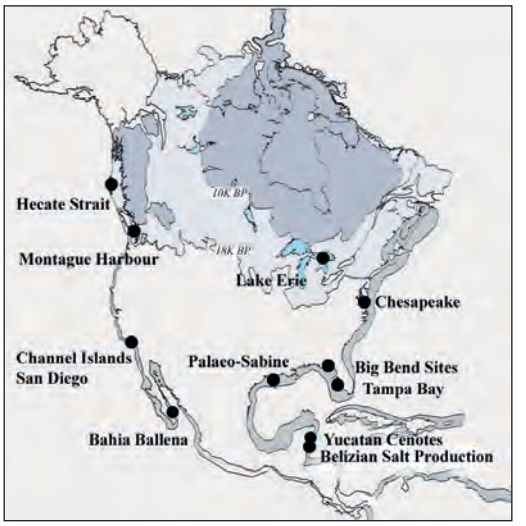

Figure 12.1: Locations of sites and areas discussed in the text, with generalized extent of the continental shelf and limits of Pleistocene glaciation at 18 ka BP (21.5 ka cal BP) and 10 ka BP (11.5 ka cal BP)

Where are the sites and who's looking in the Americas?

The diversity of locations with potential for the preservation of submerged prehistoric sites in the Americas is as remarkable as is its areal extent. Human presence is confirmed as early as *c*. 12,000 cal BC when sea levels are in the first meltwater pulse (MWP-1a) of the Late Pleistocene. Fluted points, the previous suspect for first people, expand later at *c*. 11,000 cal BC, at the beginning of the Younger Dryas in both North and South America. Human occupation is confirmed everywhere in North, Central, and South America by *c*. 9500 cal BC, in the Early Holocene (Faught 2008). It is more than probable that any palaeolandscapes exposed during those times were known to, and exploited by, people.

In general, the eastern coasts of North, Central and South America exhibit large areas of low slope continental shelf, with many estuarine bays and inlets, while the western coasts exhibit narrower continental shelves, active volcanism and tectonism, and high-energy marine conditions, with fewer situations favourable to preservation, except in bays, inlets, and island clusters. Submerged prehistoric sites are known from both coasts.

Compilation of submerged prehistoric sites known in the Americas begins with Nic Flemming's (1983) chapter of where sites are being found around the world, and why they are preserved. He pointed out that British Columbia, Southern California, Yucatan, and Florida had produced the majority of known sites in the Americas, and this remains the case today (Fig. 12.1) (Faught 2004; Fedje and Mathewes 2005; McKillop 2005; Masters 2010). Other early volumes focused on submerged prehistoric sites in the Americas include Bailey and Parkington (1988) and Johnson and Stright (1992).

Montague Harbour, in British Columbia, is an excellent example of a large Middle Holocene shell midden with deep stratigraphic extent that continued from land into the water. This midden was remotely sensed with sub-bottom profiler, and then cored and excavated underwater. This is surely one of the earliest examples of such combined methodology (Easton and Moore 1991; Easton 1992). More recently, important, sustained research terrestrially and underwater has been conducted in Haida Gwaii, in and around Hecate Strait by Parks Canada archaeologists. Their underwater research employs swath bathymetry, seismic profiling, and clam-bucket sampling to understand relative sea-level rise and isostatic rates. This methodology allows the researchers to reconstruct palaeolandscapes of different time frames, find early sites, and test Pacific Coast migration models (Josenhans *et al.* 1997; Fedje and Christensen 1999; Fedje and Mathewes 2005).

Terrestrially-based research conducted on the Channel Islands and the mainland of California has confirmed early coastal adaptations and implies earliest Holocene use of boats (Erlandson 1997; Erlandson *et al.* 2008). Although no submerged prehistoric sites are known from the islands, they are highly likely to exist on the slopes and canyons that surround the islands

underwater. On the other hand, Southern California has produced thousands of mortars and other ground and chipped stone artefacts from offshore contexts since 1915 (Masters 1983, 1985, 1998). Of the theories proposed to account for how these artefacts came to be deposited underwater, ceremonial deposition from a boat (ethnographically attested in local proto-historic accounts) and/or rising sea level inundating once-terrestrial sites are likely explanations, and, depending on the particular site and its assemblage, both are true (Masters 2010). Sites are known between Point Conception, California, and the United States–Mexico border, along the San Diego County coastline, and in the Santa Barbara Channel (Masters 1985: 28).

In the Gulf of Mexico, some of the most important work in assessing the potential for submerged prehistoric sites and the development of principles and methodologies for finding them, began with a CRM report for the Minerals Management Service (MMS) by Coastal Environments, Inc. (CEI 1977), which mapped probability areas for submerged historic and prehistoric sites in need of protection from oil and gas explorations. With focus on the prehistoric record, this document identified the culture history, geology, and sea-level characteristics of the Gulf, and especially the Big Bend, of Florida, as having very high potential for site presence and preservation. This conclusion was later demonstrated to be the case (Dunbar *et al*. 1992; Faught 1996). Currently, and with National Oceanic and Atmospheric Administration (NOAA) funding, Adovasio and Hemmings (2010) are in the third year of a multi-year project to remote sense and investigate by diving, sites in the Big Bend area. The Coastal Environments Inc. 1977 Survey is an excellent example of how geology, sea-level rise, and culture history need to be combined and synthesized in order to characterize potential, bottom and sub-bottom morphology, and thereby to know the palaeolandscape and places to test for sites.

Follow-up MMS projects conducted by Coastal Environments Inc. in the 1980s included development of terrestrial analogues and criteria for finding and recognizing archaeological sites in the western Gulf of Mexico (Gagliano *et al*. 1982), and sub-bottom profiling and vibracoring to test for sites offshore in the Palaeo-Sabine River (Pearson *et al*. 1986, 1989; Stright 1986). Two probable archaeological sites were identified on terrace surfaces near tributary channel margins of the Palaeo-Sabine, now located under more than 4.5 m of sediment, 12 m underwater, and almost 13 km offshore. The remains were observed in multiple cores. One exhibited significant amounts of organics, phosphates, fine lithic debris, and burnt bone (dating to *c*. 8000 BP/6900 cal BC), consistent with criteria developed for recognizing a site, and the other was a mound of shells considered by its reconstructed morphology to be a midden. Currently, MMS is funding research to test sub-bottom profiler targets that including probable shell middens and other kinds of features (Evans 2010). Federal protection of submerged prehistoric resources will come to our attention increasingly as more wind farms and other facilities are constructed offshore around the nation.

Surely Florida has produced more submerged prehistoric sites, and more evidence of prehistoric sites impacted by dredging, than any other state in the Union (Dunbar 1991; Dunbar *et al*. 1992; Watts *et al*. 2004). Tampa Bay, in particular, has produced frequent chipped stone artefacts in dredge spoil deposits dumped on land and found by local collectors (Goodyear and Warren 1972; Goodyear *et al.* 1983). These finds include diagnostic pieces indicating Late Pleistocene (Paleoindian), Early Holocene (Early Archaic), and Middle Holocene (Middle Archaic) activity; the Middle Archaic lithics are the most frequent of these finds.

Recent research projects in Tampa Bay by Eckerd College, University of South Florida, and the U.S. Geological Survey have resulted in a more detailed understanding of the depositional history of the bay, and a palaeo-freshwater lake has been discovered in the upper bay with pollen and radiocarbon determinations from *c*. 18,000 cal BC to 11,500 cal BC that show local environmental progression, as well as global climatic indicators (Suthard 2005; Willard *et al*. 2007). This lake would have been a prime location for human activities and settlement.

Recent CRM projects in Florida have had some success in remote sensing, modelling site probabilities, and testing for sites or monitoring dredging activities. These CRM projects testing for submerged prehistoric sites, available from Florida's Master Site File and the senior author, were enabled because the Division of Historical Resources, Florida Department of State, is at the forefront of protecting submerged prehistoric

sites, just as they were at the forefront of protecting shipwrecks in the 1970s and 1980s. MMS has required sub-bottom profiling to assess for prehistoric sites since the 1980s, but Florida is the only state, so far, to require sub-bottom profiling in local underwater CRM projects.

That Florida is the only state that requires CRM attention to submerged prehistoric sites is disturbing, as virtually all states along the East Coast have exhibited evidence for submerged prehistoric sites. For instance, and for decades, fishermen, clammers, and shrimpers have recovered artefacts offshore or in Chesapeake Bay through dragging and dredging the seabed (Stright 1995; Blanton 1996). More recently, artefact discoveries from dredge spoil and beach replenishment have brought the presence and probability of offshore prehistoric sites to the attention of researchers (Crock 1993; Blanton 1996; Watts *et al.* 2004; Merwin 2006; Claesson *et al.* 2010). Geoarchaeological research by Leach and Belknap (2007) in Maine has compared the characteristics of submerged middens with submerged and buried oyster beds, and of benefit to the archaeologist is that substantial research has been conducted on the East Coast of North America by marine geologists and geophysicists, including sub-bottom profiling and multibeam reconstructing of palaeochannel systems, sand wave forms, and other sedimentary features (cf. Coleman and McBride 2008).

Not all the known submerged prehistoric sites are in marine waters. Sites include those in freshwater settings in Central America, such as lakes, and karst cenotes and cave systems. Some of the oldest examples of submerged prehistoric archaeology anywhere in the world were Thompson's brass helmet dives in Chichen Itza, on the Yucatan Peninsula (Andrews and Corletta 1995). In Central America there are cenotes and cave systems, as well as lakes, throughout the region with ceremonially deposited remains. Recent work in the karst caves of Yucatan, discovering human remains, and evidence for 9000 cal BC human remains has pushed the archaeological record back thousands of years in that region (Gonzalez *et al.* 2008).

McKillop (2005) has conducted very shallow water (<2 m) operations in Belize that have mapped and exposed massive salt production facilities with preservation that conforms to the potential of underwater conditions. She has documented numerous structures (indicated by postholes), wooden items, ceramics, and a wooden paddle. No boats, save small examples of dugouts from Mexico City, have ever been found in Meso-America, even though it is clear that the Maya and other culture groups had substantial maritime transit and trade at the time of Contact. Thus, the paddles found at K'ak' Naab', southern Belize, are very rare finds.

In Florida, the well-known Warm Mineral and Little Salt Springs karst cenotes are good examples of freshwater inundated prehistoric materials (Clausen *et al.* 1975, 1979). Page–Ladson, one of the oldest sites in the Americas, is an example of a sediment bank with terrestrially exposed and culturally altered levels preserved in the karst Aucilla River (Dunbar 1991, 2006; Latvis and Quitmeyer 2006). In addition, Page–Ladson is a repository of Late Pleistocene fauna in sealed beds and provides a record of pollen and macrofossils from Late Pleistocene to Late Holocene times (Webb 2006). Finally, a NOAA and NSF funded project in the Great Lakes has used multibeam bathymetry to reconstruct the bottom morphology, and known lake level fluctuations to show the configuration of the landscape in Paleoindian (Late Pleistocene) times. Diving explorations are planned (O'Shea and Meadows 2009; cf. Coleman 2008).

Two bays with underwater prehistoric sites: Apalachee and Ballena

Next, we talk about two projects that have had success at finding submerged prehistoric sites underwater, one in the Gulf of Mexico and one in the Gulf of California. They are located in different environments, with differing geologies and differing culture histories onshore, but with similar sea-level rise profiles and palaeolandscape settings. Both projects are conducted in exposed and shallowly buried submerged settings, which allow for simplified reconstruction of the palaeolandscape using bathymetry, as well as access to sites by SCUBA divers. We approached our projects with similar principles and ended up with some similar, and some different technical approaches. However, both projects focus on the benefits of finding and working in environments with archaeological and geoarchaeological potential in exposed and shallowly buried settings.

Apalachee Bay

One experience that seems to be shared by archaeologists looking for submerged archae-

ological sites is the realization of the immensity of the ocean, the transformation of a terrestrial exposed landscape to a dynamic seabed, and the smallness of the artefacts we are looking for in that medium. Finding a submerged prehistoric site underwater is, perhaps, more difficult than finding the 'needle in the haystack'.

In 1986, as a PhD dissertation project, Faught chose to find submerged prehistoric sites by identifying areas with 'overlapping potential' to increase the likelihood of discovery and to develop a sustained approach. This began with a literature survey to identify regions in North America with low-energy marine environments that enable preservation of submerged archaeological material, low sediment cover to allow for diver access to artefacts, and high numbers of early sites (i.e. artefacts) onshore, to increase the likelihood that remains could be found on the submerged landscape (cf. CEI 1977; Pearson *et al.* 1986; Stright 1995; Faught 1996: 270–94).

Florida's western continental shelf was known to have a low slope and relatively moderate- to low-energy marine environment and coastline, both factors that encourage relatively rapid transgression and potential for sedimentary preservation, particularly in karst 'voids' (CEI 1977; Faught 1996). Karst voids as used here describe sinkhole-like features of various sizes and shapes eroded in the basal limestone. The continental shelf off Florida is a stable platform, with recorded depths and environments of deposition indicative of sea-level rise (Ballard and Uchupi 1970; Faught and Donoghue 1997; Balsille and Donoghue 2004). However, even with these factors to guide the research, the continental shelf remained a vast, unknown submerged palaeolandscape.

It was therefore important to consider the known archaeological patterning that existed onshore. In the Big Bend area, archaeological sites were known to occur by karstic river channels and their margins, and rock outcrops that were used as chert quarries (Dunbar 1991). As these karst features are known to retain much of their physiography when found in a submerged environment, rocky outcrops and karstic palaeochannel vestiges were targeted for diver survey. As there is little to no sediment yield from rivers in karst areas, the palaeolandscape near these rivers can be exposed or shallowly buried locally, and therefore accessible by divers. These favourable attributes that existed in the Big Bend area made it a logical locale to begin exploration (Fig. 12.2). To target the palaeochannel and rocky outcrop features, the bathymetry of the area was digitized and contoured from navigation maps. This allowed for identification of apparent channel 'thalwegs' (defined here as the line connecting the lowest points along the length of a channel) and their margins, based on deeper channel-like features (Fig. 12.3).

By narrowing the vast landscape down to this one region, and to specific features of the seascape, a predictive model of areas that were likely to contain archaeological material was developed and tested. Survey began with small

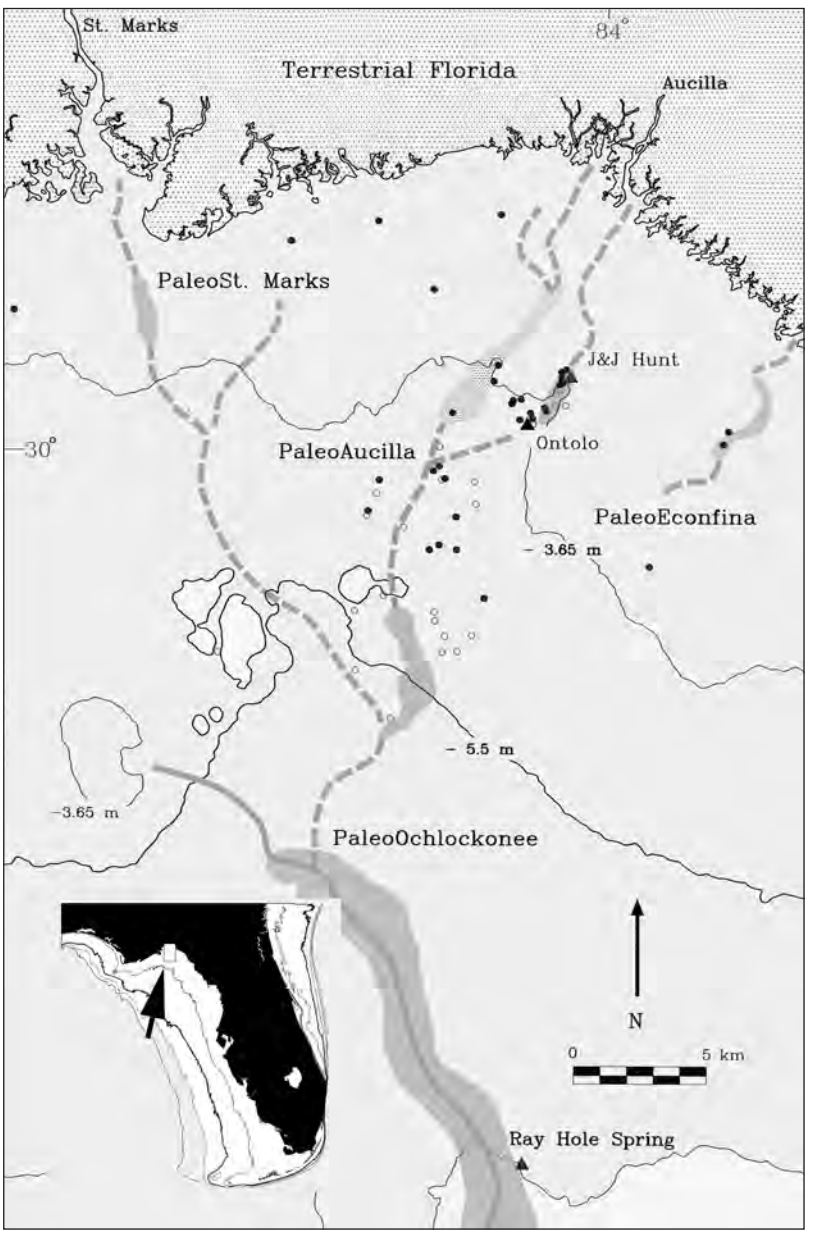

Figure 12.2: Study area for research in the Big Bend, showing the location in the Florida Peninsula (inset), as well as palaeolandscape features, locations of submerged sites (filled circles and triangles), and locations where sites were not found during survey (open circles)

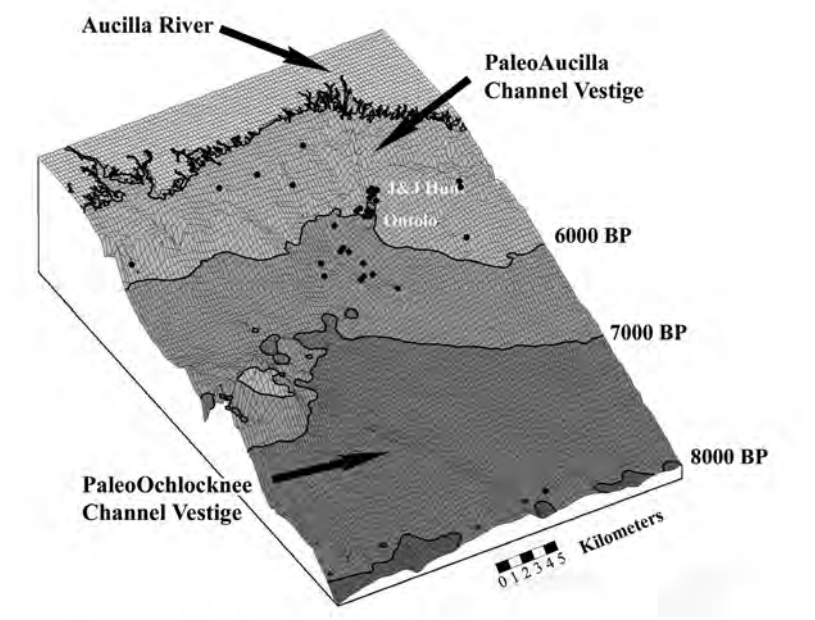

Figure 12.3: Initial reconstruction of the local bathymetry enhanced by 500 per cent vertical and displayed as a mesh diagram showing palaeochannels and other features of the palaeolandscape. Dates in radiocarbon years.

boat forays of SCUBA diving and snorkelling, from both the Econfina and Aucilla rivers, utilizing a variety of methods (study of navigation map features, towing divers, and hand fanning potential sites). These initial forays resulted in recovery of chipped stone artefacts, some characteristic of the Middle Holocene, associated with rocky outcrops along channel margins. As the Aucilla River was known as the prime collecting location in Florida for early fluted (Clovis) points, and because the J&J Hunt site was discovered along its margins, the Palaeo-Aucilla River was targeted for sustained research (Faught 1988, 1996; Dunbar *et al.* 1992).

Once the Apalachee Bay was known to contain preserved, diagnostic cultural materials, more funding could be obtained by grant writing. This research culminated with a field school in underwater archaeology funded by the Florida Department of State, Division of Historical Resources. This field school collected remotely sensed data using side-scan sonar (able to identify rocky outcrops and channel margins when exposed) and a sub-bottom profiler (allowing reconstruction of bottom bathymetry, buried palaeochannels, and identification of various sediment beds). In addition, multiple excavation and mapping crews operated from 15–18 m vessels for extended periods of time offshore. Remote sensing surveys logged more than 500 linear km of survey lines, and diver investigations were conducted at 52 locations targeted by the initial research. Thirty-six of these locations were positive for preserved cultural material. Of these, five sites were sampled using 10 and 15 cm induction dredges (Fig. 12.4), with most sampling occurring at the J&J Hunt and Ontolo sites (Marks and Faught 2003; Faught 2004).

Figure 12.4: Diver excavating the margins of the Palaeo-Aucilla River with a 15 cm induction dredge the slurry from which was screened from a floating screen deck

The resulting sample from survey, collection, and testing operations of the *PaleoAucilla Prehistory Project* is well over 4500 pieces of chipped stone, including diagnostic projectile points of Late Pleistocene to Middle Holocene age (Fig. 12.5), formal chipped stone tools, and abundant debitage, as well as a rough reconstruction of site types for the segment of the Palaeo-Aucilla River studied (Faught 2004). In addition, a significant amount of animal bone, including both extinct and extant species, has been found at these sites – particularly at J&J Hunt – and unaltered wood, mollusc, and sediment samples complete the collections. A final report is forthcoming, but there are three summary publications (Faught 1996, 2002, 2004), a Master's thesis (Arbuthnot 2002), and a PhD dissertation (Marks 2006), as well as several interim reports (http://www.flheritage.com/archaeology/underwater/fsu_pua/).

Bahía Ballena

As mentioned above, it is integral to underwater research to locate an area with high preservation potential. Along the Pacific Coast, numerous areas in the Gulf of California exhibit characteristics that are ideal for submerged archaeological research. One such area is the submerged landscape off of Isla Espíritu Santo, Bahía Ballena, in the southern Gulf of California (Fig. 12.6). The geographical, geological, environmental, and cultural characteristics of this region combine to present an area with significant archaeological potential.

Culturally, this area has a known, prolonged, occupational history that extends from the Late

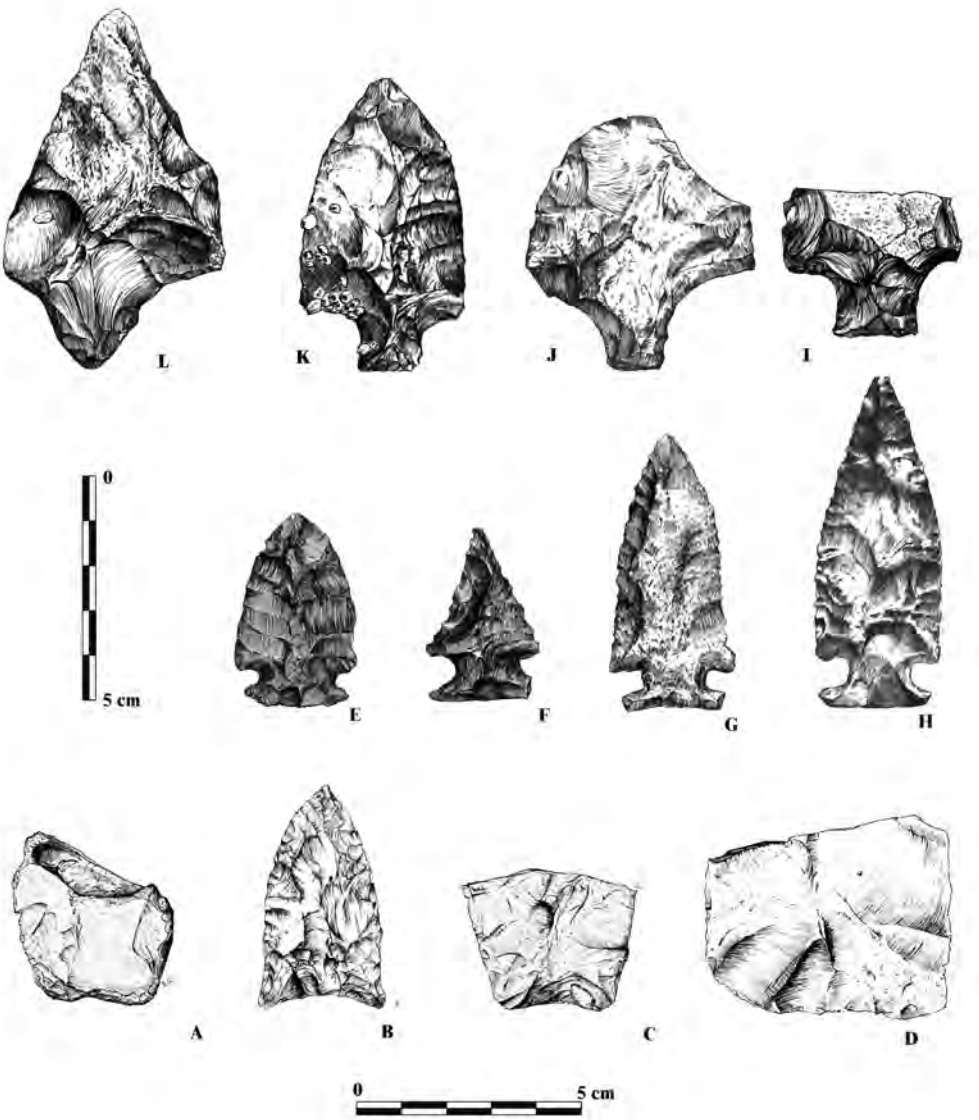

Figure 12.5: Diagnostic artefacts from the Palaeo-Aucilla River research, most from J&J Hunt. A–D Paleoindian diagnostics (including probable fluted point, A), E–H Early Archaic diagnostics, and the remainder Middle Archaic points characteristic of Middle Holocene cultures in Florida

Pleistocene through to the Historic Period. Throughout this entire occupation span, the groups that inhabited this region made extensive use of the abundant rockshelters present in the soft volcanoclastic rock that forms much of the geological make-up of Isla Espíritu Santo. When considering where to conduct underwater work, an area with archaeologically identified rockshelter use can be considered extremely favourable. In a submerged environment, the area inside a rockshelter can provide an enclave in which any cultural material present may be protected from tidal and wave action and, therefore, have a higher probability of preservation than open-air archaeological material exposed to shoreface erosion.

Environmentally, the coast of Baja California is generally rich in marine resources, an important consideration for groups migrating along a coastal route. Although marine productivity in Baja California was 'drastically lower during past cool stadials and the Last Glacial Maximum than it was during the Holocene and past warm episodes' (Ortiz *et al.* 2004: 523), the littoral and nearshore environments of Isla Espíritu Santo could have supported the small groups thought to comprise the New World Pleistocene palaeocoastal population. Identifying evidence of these smaller groups on the now submerged palaeolandscape is facilitated by the geographical characteristics of the island and surrounding waters. Isla Espíritu Santo dips to the west and

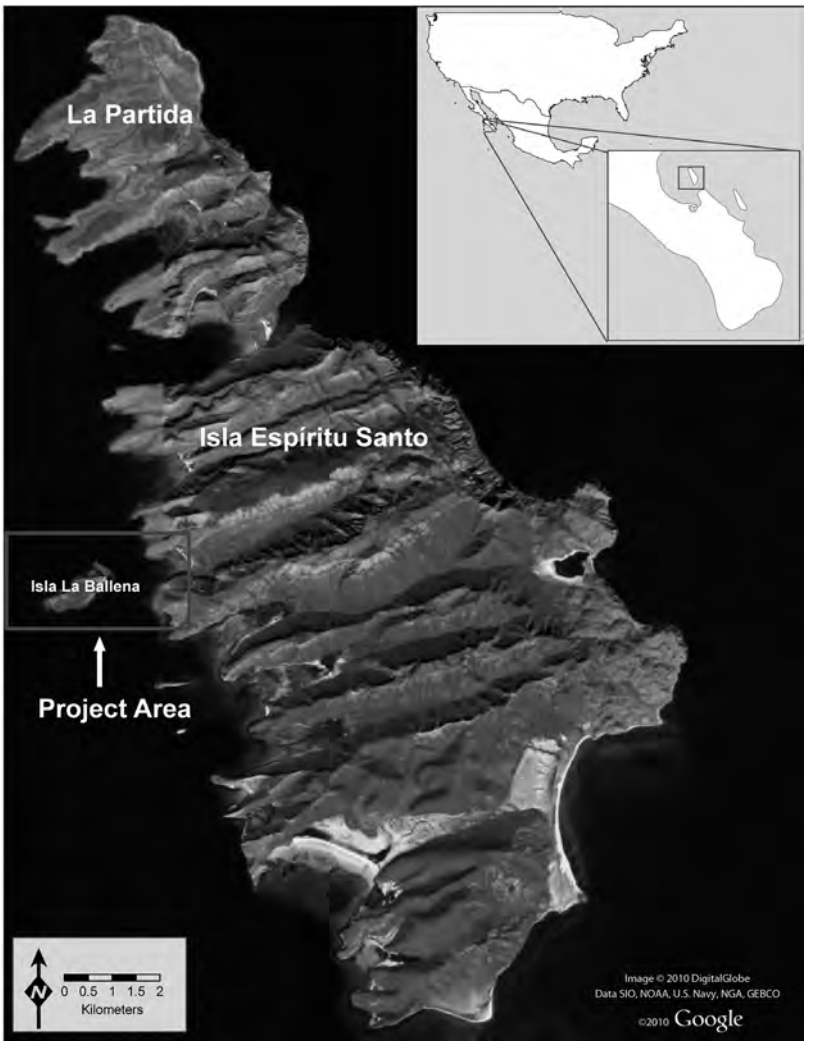

Figure 12.6: Location map of Isla Espíritu Santo and Isla La Ballena

the resulting structural context is one of shallows bays with gently sloping nearshore bathymetry. This bathymetry promotes preservation of inundated archaeological deposits in nearshore open-air contexts as site disturbance can be mitigated by the rapid sedimentation that can occur on a slope during sea-level rise.

The unique oceanographic and geological conditions that exist in this locale allowed for a simplified method of bathymetric data collection and creation of a palaeolandscape model. Over a period of two weeks, a team of researchers logged a total of *c*. 35 hours on a bathymetric survey of 30 km^2. The survey was conducted in a small boat (*c*. 6 m in length) that slowly traversed back and forth across the entirety of the one of the shallow bays off Isla Espíritu Santo and the waters directly outside the bay. Once beyond the points of the bay, the survey continued to -80 m in a north–south trajectory and to -140 m to the east beyond La Ballena Island.

To collect the bathymetric data a Garmin GPS 76 unit was used to record horizontal position, and a consumer fathometer, also called a 'fishfinder', was used to measure depth to the seafloor. A total of 2145 depth readings with corresponding UTM coordinates were logged in a notebook each time the depth reading changed by approximately 1.5 m, or in areas of rapid seafloor descent or ascent. Although this method for obtaining seafloor morphology is not as precise as a swath bathymetric system, it provided a highly cost-effective means of identifying larger geomorphic features that might be associated with submerged sites, including rock outcrops, terraces, and palaeochannels.

In order to utilize the bathymetric data to create a palaeolandscape model, the data were imported into ArcGIS 9 and integrated with temporal sea-level elevation data. This allowed the creation of a digital elevation model (DEM) of the submerged landscape by using an interpolation technique called Inverse Distance Weighting (IDW). This method is a lattice-based algorithm that calculates the unknown Z-value for each cell missing elevation data by assigning a weighted average based on a minimum number (typically n=12) of surrounding Z-values (Hageman and Bennett 2000: 116) (Fig. 12.7).

Much of the additional data required for modelling efforts within GIS is accessible through government agencies via the Internet. For the research area, satellite imagery of Isla Espíritu Santo was acquired from the freeware software program, Google Earth, and topographic data for Isla Espíritu Santo were acquired from the Shuttle Radar Topography Mission (SRTM). The Google Earth image was georeferenced using latitude and longitude lines, and the SRTM image was already embedded with spatial information upon receipt. By merging the SRTM of the terrestrial landscape and the DEM of the submerged landscape, the ArcGIS software could consider them one seamless surface and create a visual representation of the palaeolandscape at 12,000 cal BP (Fig. 12.7).

Using existing knowledge of archaeological site distribution from surveys of the modern terrestrial landscape (Fujita and Poyatos de Paz 1998), we made predictions about the distribution of palaeoenvironmental features that might have attracted early hunter-gatherers, and

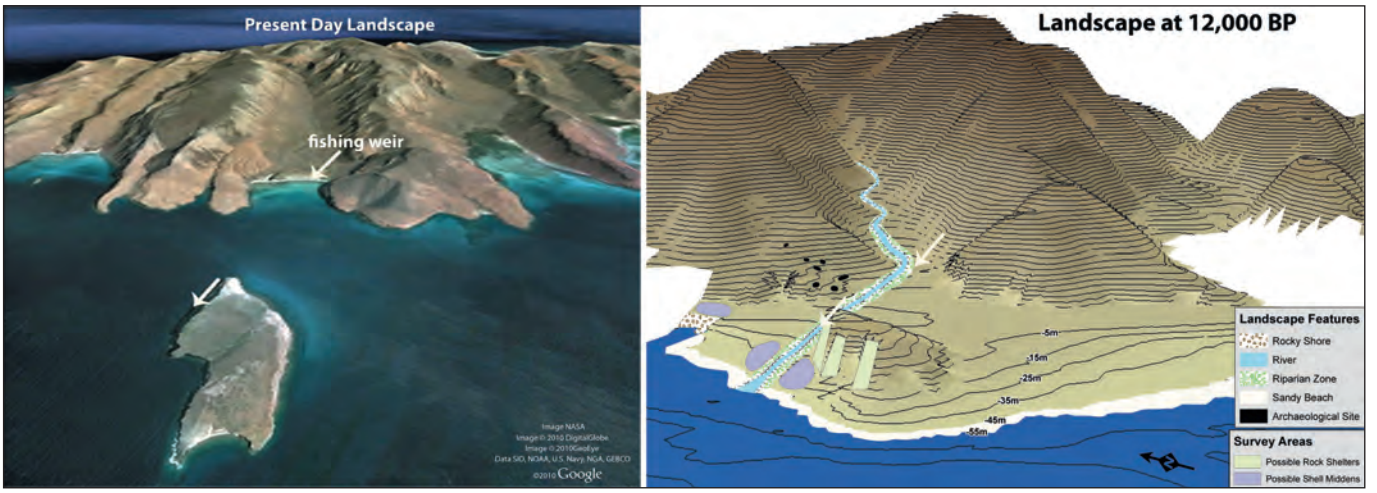

Figure 12.7: Palaeolandscape model of topographic and environmental features, and locations of known archaeological sites. Left – present landscape off the western margin of Isla Espíritu Santo; arrow on shore indicates location of prehistoric fishing weir; arrow by smaller island indicates location of caves investigated. Right – configuration at 12,000 cal BP, showing currently submerged palaeolandscape and palaeoenvironmental features, as well as areas targeted for survey. These survey areas were targeted owing to the possibility that rockshelters and/or shell middens would be present

subsequently retained archaeological evidence of occupation. Any survey plan developed from this approach must take into account the methods that will be used for further landscape exploration. Our research was focused on nearshore, relatively shallow locales that could be adequately explored using conventional SCUBA equipment.

Development of a survey plan based on the palaeolandscape model narrowed search areas to those most likely to have preserved evidence of past cultural use. By targeting locales with features that might include rockshelters, rock outcrops, and palaeochannels, we were able to create project goals that were achievable in the time designated for underwater survey. Areas with strong current or no prominent topographic features were immediately taken out of consideration for survey in order to focus time and resources on those areas considered favourable for preservation.

The underwater investigation began with a number of reconnaissance dives intended to collect data, such as sediment type, features present, and feasible dive times for the areas highlighted with the palaeolandscape model. This allowed for further culling of any area that did not meet our criteria for a locale with high archaeological and preservation potential. At the end of the reconnaissance phase, survey areas were limited to four submerged rockshelters, the areas outside the mouths of each of the rockshelters, an area with extensive rock outcrops, and one steep slope (Fig. 12.7). These areas were highlighted as features that might contain evidence of past human use, specifically shell middens or lithic scatters.

Although, originally, survey efforts were focused on the interior of the rockshelters, it was quickly determined that all lithic material located inside and directly outside the submerged rockshelters was abraded owing to tidal action. This made identification of culturally flaked material impossible, and we therefore shifted our survey focus to the rock outcrop locales, and to determining the amount of sediment cover that had accumulated over the terrestrial landscape. The area chosen for this work was 18–20 m in depth, downslope from a rockshelter, and next to a modelled palaeochannel. By hand fanning test pits that extended approximately 80 cm below the seafloor, we were able to identify numerous depositional episodes within each test unit, a shell deposit within one test unit, and lithic material that is currently being analyzed for evidence of cultural modification.

The issue of identifying artefacts from geofacts within the Baja California Sur region is difficult and in need of disciplined criteria developed for determination. Likewise, in many submerged situations, immediate recognition of an archaeological site that has been altered by transgression and submergence is not always forthcoming and criteria for determination of a site are needed for local situations (Gagliano *et al*. 1982). This Baja California research is making strides to understand the processes that have occurred in the region over the last 13,000 years, and how these affect material identified in a submerged setting. While this will be an ongoing process, the immediate contribution of the present research is methodological. The fact that a paleolandscape model was developed using simplified and inexpensive methods, and this

model was accurate enough to reconstruct the locations of rockshelters, a palaeostream channel and possible shell midden locales, contributes to the methodological development of prehistoric underwater archaeology in the Americas (Gusick and Davis 2007).

Conclusions

Our experiences have shown that exposed and shallow-buried palaeolandscapes enable the discovery of submerged prehistoric sites, as well as information about where to go in more deeply buried and possibly better-preserved situations. The principles that provided the framework for our projects described above include knowing culture histories, understanding regional sea-level histories, identifying geoarchaeological preservation potential, developing predictive models based on the synthesis of these factors, and, most importantly, diving and digging to test them (Gusick and Faught, in press).

These examples also demonstrate that low-tech, lower-cost operations are often useful to lay the groundwork for obtaining additional and sustainable resources, but that higher-cost methods are by far preferable to assess and investigate offshore settings, and will be so for buried and truncated palaeolandscape settings. In particular, sub-bottom profiling to reconstruct channel configurations, and coring or excavating to test sediments deemed probable for sites, have proven effective methodologies at Hecate Strait, British Columbia, and at the Palaeo-Sabine River, in the Gulf of Mexico (Stright 1986; Easton and Moore 1991; Josenhans *et al.* 1997). The research in Apalachee Bay reported here has benefited substantially from channel configuration mapping with sub-bottom profiling (Faught 1996; Faught and Donoghue 1997) and the next phase of research in Baja California has been funded by NOAA's *Ocean Exploration program* and will include remote sensing operations with sub-bottom profiler and side-scan sonar devices. In fact, it is developments in underwater technologies, such as GPS locational control, sound underwater imagery, and seismic remote sensing that will enable underwater prehistoric archaeological research to come into its own in the 21st century in the Americas.

Today, the need for American researchers to have expanded settlement pattern data and procedures for remote sensing and testing in different coastal situations is increasing. Recent NOAA and MMS funding for research specific to palaeolandscape exploration and testing targets identified with remote sensing has enabled several important exploration and research projects to be undertaken, which will bear fruit in future publications. Furthermore, in areas with large expanses of continental shelf such as the Eastern Seaboard or the Gulf of Mexico, cultural resource managers charged with protecting submerged prehistoric sites are becoming more aware that there are settlement systems preserved offshore. Although protected by law, these are in danger of destruction by the increasing number of industrial and developmental projects conducted in near- and offshore settings. Threats can be addressed by cooperative projects with industries capable of large-scale, high-precision manipulation of remote sensing gear and bottom sediment excavation and processing (Faught and Flemming 2008).

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