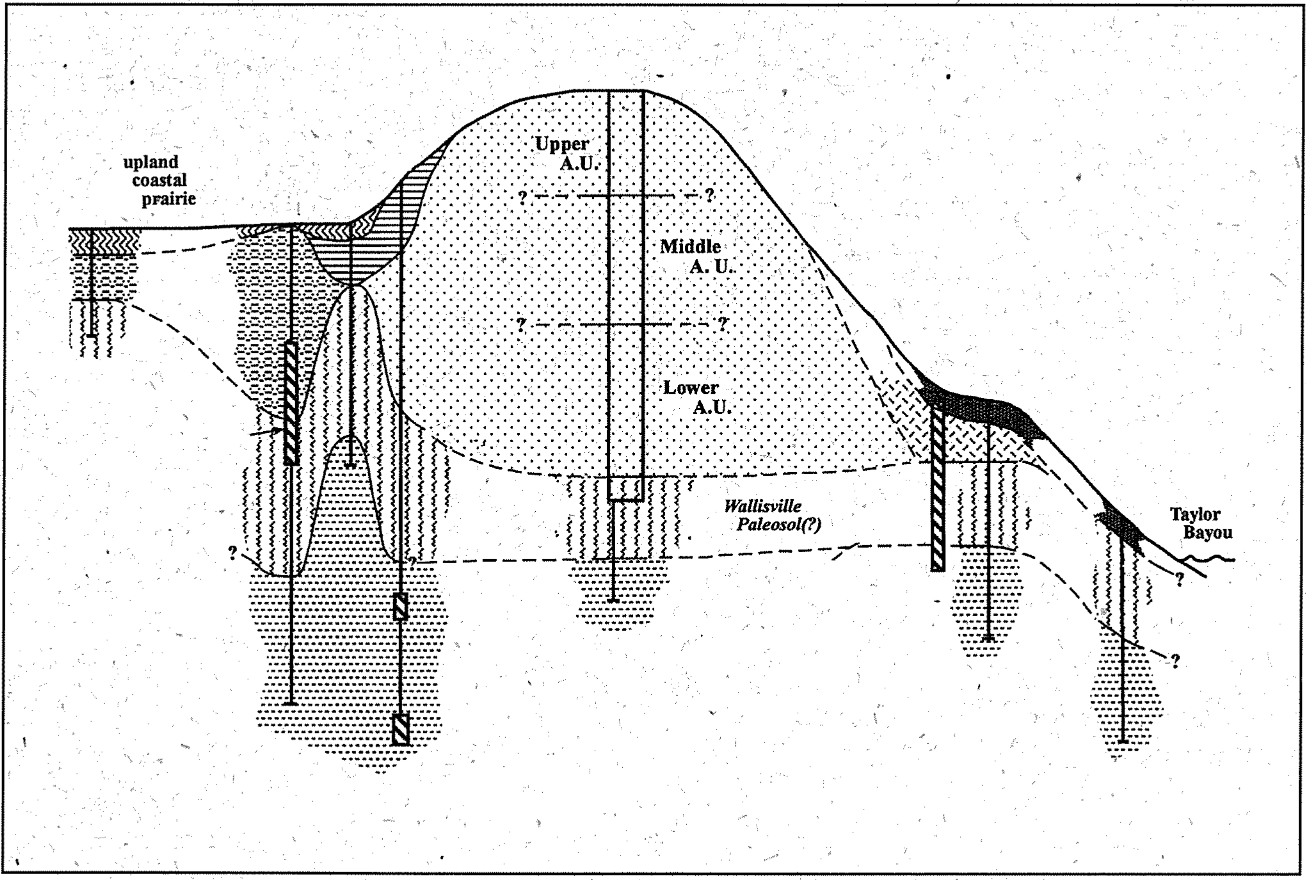
LATE HOLOCENE SETTLEMENT IN THE TAYLOR BAYOU DRAINAGE BASIN: TEST EXCAVATIONS AT THE GAULDING SITE (41JF27), JEFFERSON COUNTY, TEXAS

by
Lawrence E. Aten and Charles N. Bollich

with contributions by
Kenneth M. Brown and Richard W. Fullington



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ABSTRACT

The Gaulding site, 41JF27, was excavated in 1965 by the participants in the fourth summer field school of the Texas Archeological Society. Supplementary investigations were carried out in 1974 and 1995-96. A Late Archaic and Late Prehistoric shell-bearing site, Gaulding is located in extreme southeast Texas near Sabine Lake and the Gulf shore. In 1965, stratigraphic tests were placed in several areas of the site and numerous auger borings and profile trenches recorded its mass and stratigraphy. In 1974, additional testing was carried out in the ceramic deposits at the site. And in 1995-96, soil borings were placed around the site's periphery and one of the 1965 excavations was reopened. In the latter, the stratification was recorded in detail, bulk samples and radiocarbon samples were taken from all stratigraphic layers, and two cores collectively penetrating the entire thickness of the site were taken.

In the aggregate, this testing provides an understanding of the site's place in the landscape, its periods of use, and the potential for future investigation. The overall depositional structure of the site was identified and dated with a series of seven radiocarbon dates. The formation of the site's layers was examined as closely as possible with outcrop descriptions and particle analysis of the bulk samples. The ceramic technology was closely examined, a preliminary estimation of subsistence activity was identified, and a single human burial was described. A moderate-sized collection of terrestrial gastropods suggested a picture of evolving climate at the site and geological evidence permitted an initial description of the place of the site in the regional landscape of Taylor Bayou drainage basin.

The first of three periods of use and accumulation at the Gaulding site occurred between 4000 and 3700 calibrated radiocarbon years ago. After a hiatus the site was used again from around 2900 to 2700 calibrated radiocarbon years ago. Finally, after another hiatus, the site was used sporadically from around 2000 to about 600 calibrated radiocarbon years ago. Use of the site during the latter period was rare and accumulated much less refuse than during the earlier periods of site use.

An unexpected outcome after reviewing all of the landscape, geological, and archeological evidence of the Gaulding site and its environs, was that its history is most consistent with a model of Late Holocene small-scale sea level fluctuations that was initially proposed by W. F. Tanner (1991 and earlier papers). To the extent that relevant data are available, the Tanner model seems to account for the times of archeological deposition, the location, geometry and orientation of the shell deposits, and much of the material content of the archeological deposits.

Very few artifacts were found in deposits of the three periods of accumulation at Gaulding except for ceramics in the third and last period of site use. Although the ceramics collection is small, examination of the paste characteristics yielded new information about technological distinctions between several of the named pottery varieties. Most notable is that the sand temper sources for O'Neal Plain *variety Conway* appear to be similar to and probably taken from point bar deposits in either the lower Neches or the lower Sabine rivers.

Gaulding and the other sites in the Taylor Bayou drainage basin are important localities for further archeological and geoarcheological investigations. Although the basin has far fewer sites than the nearby Neches and Sabine river floodplains, it is less susceptible to overbank flooding, sedimentation, and erosion. Taylor Bayou is an environment in which preservation of subtle environmental perturbations – especially those due to sea level – may be more likely. Testing many of the preliminary environmental history suggestions developed in this study can be done through more detailed site survey in areas of the basin where settlement is implied by the Tanner model. The Gaulding site is interesting also for its extensive and relatively easy to distinguish deposits of late Middle Archaic or early Late Archaic age. This is a site that has substantial remaining information potential.

ACKNOWLEDGMENTS

This project benefited from the interest and assistance of many people, first and foremost of whom were the field school participants. Their numbers reached 50 at times and they are identified in Appendix A. Director of the field school was Dessamae Lorrain assisted by Burney McClurkan and Dorris Olds. Curtis Tunnell, Dave Dibble, E. Mott Davis, and Cecil Calhoun rendered other essential assistance. Charles N. Bollich and Lorraine Heartfield directed local arrangements. Permission to enter the land and to excavate was given by the late Fred Gaulding. Walter Ortego, who leased the property for agricultural purposes, showed continual interest in the work and was of great assistance pulling vehicles from the mud with his tractor and in backfilling the excavations. The authors also wish to thank James Burrell for permission to conduct the 1995-96 work at the site.

Our appreciation is further extended to R.M. Malina and Al B. Wesolowsky, then of the University of Texas at Austin, who examined the skeleton recovered from the site and provided essential information about the physical evidence. Dee Ann Story provided important advice on certain of the ceramics as well as assisted in the 1996 fieldwork at the site. Kenneth M. Brown, now staff archeologist at the Texas Archeological Research Laboratory but also a participant in the field school, analyzed the snails collected in 1965. Richard A. Fullington analyzed the second collection of terrestrial snails obtained in 1995 and provided important ecological insights. We are very grateful to Billy Max Davidson who identified the field school faunal remains in his usual thorough manner. Thomas R. Hester, former Director of TARL, made arrangements for artifact photography and for the identification of the Art Museum excavation's faunal material by Laura J. Froehlich. Darrell Creel, formerly Curator and now Director of TARL, and Laura Nightingale, TARL Curator, were always helpful in finding stored collections and in arranging loans.

We also thank Carolyn Murphy and Jan Stokes of the Galveston District, U.S. Army Corps of Engineers, for their assistance in searching for and making available Taylor Bayou engineering boring records. Ronnie Van Pelt of the Texas Department of Transportation provided boring logs taken at the State Highway 73 bridge crossing on Taylor Bayou. Kim A. Cox generously provided examples of oyster shells exhibiting the damage caused by various predators. Paul Goldberg, of Boston University, was extremely generous in assisting with both technical advice and assistance in collecting, hardening, and cutting the geoarcheological cores and for interpreting the thin-sections. Michael B. Collins, then President, and the officers of the Texas Archeological Society were most generous in providing funds for radiocarbon dates and for thin-section preparation. We are grateful for their patience, and particularly that of the late Bill Richmond, as the authors plodded along toward completion of this report. Finally, we are grateful to Dee Ann Story and Richard A. Weinstein for reviewing and providing detailed comments on the first draft of this manuscript.

Chapter 1

INTRODUCTION

The Sabine Lake area is home to much of the rich record of northern Gulf of Mexico coastal prehistory. Characteristic artifacts found in site surveys represent all the major culture-historical periods known for the coastal plain beginning with those from important Paleo-Indian localities. Continuing from an unknown time in prehistory to at least the early historic period, the Sabine Lake area was the western margin of the territory occupied by the western, or "sunset," bands of the Atakapa tribes (Aten 1983b:38-39; Kniffen et al. 1987:46; Newcomb 1961:315). The Western Atakapa was one of several tribal groups, possibly related by language, that formerly occupied the region roughly bounded east and west by the Calcasieu and Brazos rivers, and extending some 250 km inland to the southern margin of the Caddo homeland (Story 1990:256-258; cf. Aten 1983b:Figure 3.1).

These groups shared some technological characteristics of southeastern Woodland cultures, especially in ceramics (for discussion, see Story 1990:256 and citations). To avoid confusing these Texas and Louisiana cultures that were peripheral to the southeastern U.S. with the more typical use of the Woodland culture concept, Story proposed that the region incorporating Sabine Lake (Figure 1 insert) be known as the territory of the Mossy Grove tradition (Story 1990:256). Mossy Grove, a small community just south of the Trinity River in Walker County, Texas, is a name with no prior archeological usage. As such, it may be a useful term to distinguish these southwest Louisiana and southeast Texas cultures from other nearby, but also distinctive culture-geographic entities such as the Caddo area, the Lower Mississippi Valley, the Western Gulf tradition, and so on. The Mossy Grove tradition also provides a unifying concept for the archeology of an interstate region that helps avoid artificial distinctions driven by modern political subdivisions.

The territory of the Western Atakapa today is one of the least known sections of the Mossy Grove tradition. Even though numerous archeological sites had been discovered in the Sabine Lake area by the mid-1960s, little was known about them other than the presence of certain typologically distinctive lithic and ceramic artifacts. In an effort to realize some of the information potential of this poorly known region, the Texas Archeological Society (TAS) chose the Gaulding site, 41 JF 27, (Figure 1) as the venue for their Fourth Summer Field School. This was held from June 12-19, 1965 (Bollich 1965; Davis, 1965; Richmond et al. 1985). The field school program was conducted under the general supervision of Dessamae Lorrain who was assisted by Burney McClurkan and Dorris Olds. This TAS field school was the first professionally directed excavation in an upper Texas coast shell site since the 1930's.

In 1974, the Beaumont Art Museum (now the Art Museum of Southeast Texas) sponsored a very limited excavation at Gaulding under the supervision of C.N. Bollich as part of a program to orient young people to the nature and importance of archeological sites and their preservation. Finally, after agreeing to prepare a report on the Gaulding excavations, in 1995 and 1996 the present authors revisited Gaulding to obtain soil borings and to re-sample some of the strata for matrix and radiocarbon analyses.

The Gaulding site is located on Taylor Bayou, within the most important local drainage network immediately west of Sabine Lake. Today, as well as in prehistoric times, this drainage system collects the majority of runoff water for all of Jefferson County and funnels it into lower Sabine Lake. The natural and cultural environment of the Taylor Bayou drainage basin is the setting for the Gaulding site and will be the principal geographic context throughout this report. Insofar as retention of archeological sites is concerned, the middle to upper Taylor Bayou drainage basin appears to be relatively little modified. The primary developments have been flood control projects in which a number of channel meanders were straightened. With some exceptions, agriculture and oil and gas production have not occurred in such close proximity to the bayous and their floodplains as to endanger archeological sites. However, despite some infor-

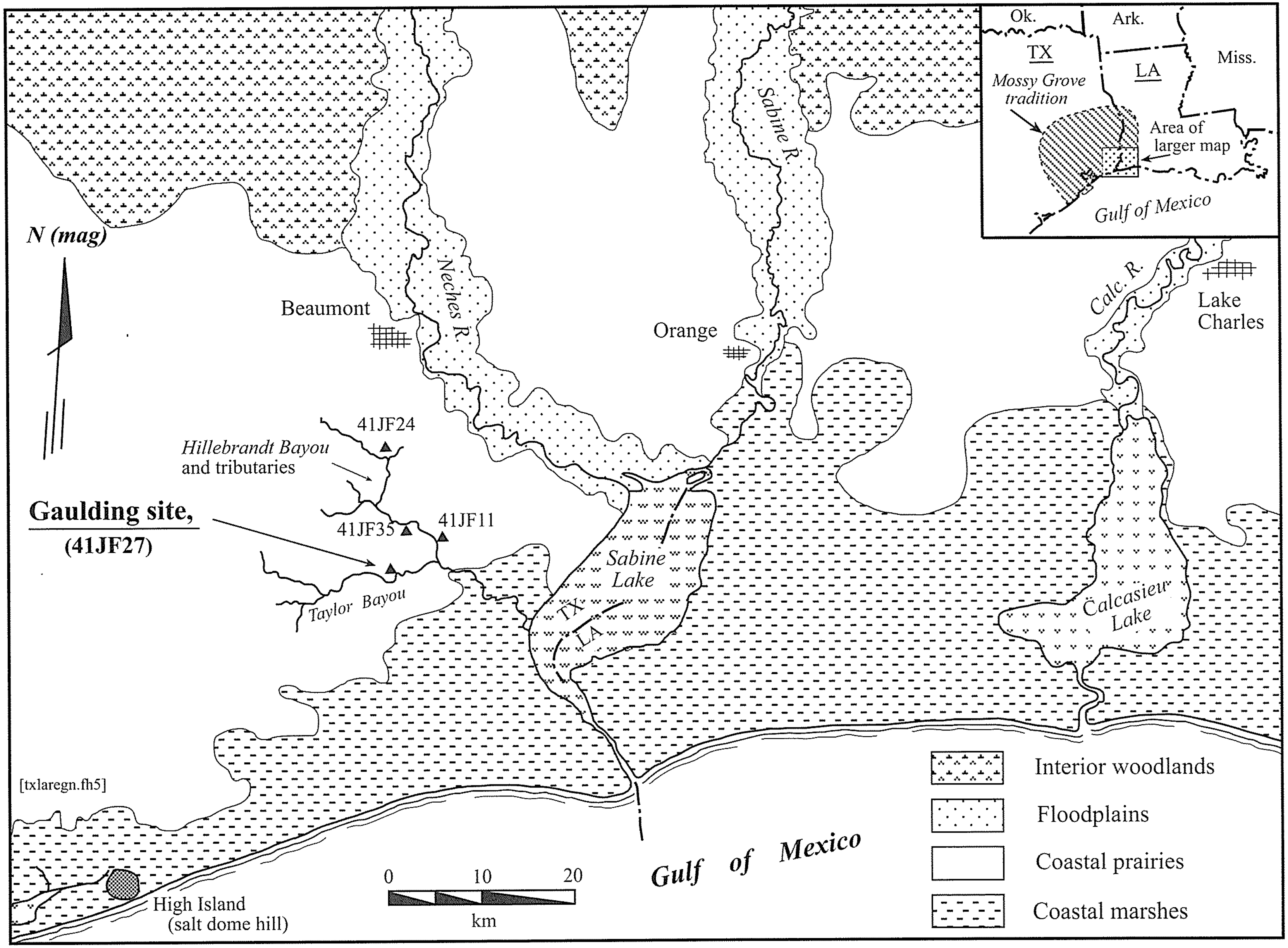

Figure 1. Southeast Texas-southwest Louisiana regional map, generalized vegetation zones, the Taylor Bayou drainage basin, and the principal sites discussed. The large map approximates the historic period territory of the Western Atakapa bands.

mal surveying there are no sites yet recorded from the lower Taylor Bayou basin, downstream from the Highway 73 bridge crossing. This is an area in which much industrial development, channel modifications, and marsh subsidence have occurred. It probably will never be known how many archeological sites were lost there but we would have expected at least a few shell sites originally to be present.

THE SABINE LAKE AREA LANDSCAPE

As described above, the region shown on Figure 1 approximates the territory currently understood to be that inhabited by the Western Atakapa bands in the early historic period and probably earlier (Aten 1983b). On the whole, this region's physiography is a flat to gently rolling surface. Indeed, when in remote parts of the prairie or marshes today, it often is reminiscent of being adrift on an ocean. The landscape of the Sabine Lake area is comprised of several habitats used by native peoples for food, material resources, and activities. These include the Gulf beaches and coastal marshes, Sabine Lake itself, the Sabine and Neches rivers and their floodplains, the interior woodlands that begin a few miles north of Beaumont, and the vast upland prairies (Figure 1). The Gulf of Mexico is not included in this landscape concept because there is no information at present to indicate systematic use of maritime resources by people here other than what appears to be occasional scavenging along beaches.

The first landscape zone behind the Gulf beaches includes the vast, flat, coastal marshes and lakes with mixed salt, brackish, and even freshwater habitats known as the Southern Cordgrass Prairie (Kuchler 1975). In 1861 a visitor here noted that:

"From the High Islands [*near Galveston Bay, see Figure 1*] to the Sabine all is prairie, in some places impassable marsh to a breadth of seven miles in the wet season, small bayous running through in various directions and entering the lake or ponds. Firm land at all seasons can not be found short of from six to nine miles from the coast, and in many places not short of fifteen or twenty miles. In very violent southerly winds nearly all the prairie for some distance back to the shore is covered by water from the Gulf" (Kennedy 1892:69).

In fact, the maximum recorded height of a storm surge at Sabine Pass is 2 m (White et al. 1987:12), an elevation that would flood the low coastal marshes all the way inland to Taylor Bayou. Nevertheless, the intensive use of this zone by native peoples is clearly indicated by the numerous shell and non-shell habitation sites that exist, or once existed, along the lakes and streams.

Inland from the marshes is the coastal prairie, a similarly vast expanse of flat to gently rolling prairie known to ecologists as the Bluestem-Sacahuista Prairies (Kuchler 1975). This coastal prairie was described by a traveler in the early 19th century as a "...generally barren prairie, destitute of trees, except on the margin of the water-courses" (Weniger 1984:24). The next zone inland is the interior woodland, a moderately dissected upland with mixed pine and hardwood forest interspersed with small prairies, and known as the Southern Mixed Forest and Oak-Hickory-Pine Forest (Kuchler 1975). As one proceeded northward these woodlands closed in until, as another traveler wrote, they were "...an almost continuous forest" (Weniger 1984:25). It seems very likely that the edge between the interior woodlands and the coastal prairies was regularly visited for its resources. However, there presently is no information about whether the coastal Indians also routinely penetrated the interior woodlands to any extent for their subsistence or activities other than traveling to villages of other native groups. There have not been any extensive surveys of the southern part of the interior woodlands, but the indication at present is that there may be fewer archeological sites here than in the other zones.

Crosscutting the three coast-parallel zones (i.e., coastal marsh, prairie, and woodlands) are the extensive lakes, streams, marshes, and swamps of the Neches, Sabine, and Calcasieu river floodplains. Upstream the floodplains contain mixed fluvial woodlands of the Southern Floodplain Forest (Kuchler 1975). A mid-19th century attempt to cross the Neches River and pass through its floodplain forests during a wet season was described as practically impossible (Olmsted 1978:376-378). A substantial part of the floodplain's downstream extent is fresh and brackish marshland with the latter containing many archeological shell sites. These rivers ultimately drain into Sabine and Calcasieu lakes. The potential estuarine characteristics of these lakes have been largely eliminated by the natural near-closure of their seaward ends by sedimentation causing them to be essentially freshwater environments. Early descriptions of Sabine and Calcasieu lakes indicate they were very shallow (approximately 1-2 m). A 19th century source described Sabine Lake as "fresh water" (Weniger 1984:161), a condition likely to have existed throughout recent millennia. In these respects, the coastal extremity of the Neches and Sabine rivers is more like south Louisiana than like most of the Texas coast.

The Sabine Lake area today is a very wet place, but to what extent this might have been the case in prehistory is not yet known. In Jefferson County, the Texas jurisdiction including the major cities of Beaumont and Port Arthur, the Taylor Bayou drainage basin, and the Gaulding site, average annual precipitation ranges from 44 to more than 56 inches (1.1-1.4 m) with many years exceeding this amount. Twice in the 20th century annual rainfall totals in the county approached 100 inches (2.5 m). Twice in recent years nearly 20 inches (.5 m) of rain fell in a single day (Bomar 1983). Because of the moderating influence of the Gulf of Mexico, the area averages only one day per year exceeding 100 degrees and 16 occurrences per year of freezing temperatures. The hottest and coldest temperatures ever recorded for the area were 107 and 11 degrees respectively (Bomar 1983).

Geologically, the coastal prairies originated as a Pleistocene deltaic plain, formed by the coalescence of several ancient river deltas during the Sangamon interglacial. These deposits are known as the Beaumont Formation in Texas and the Prairie Formation in Louisiana. Falling sea level at the onset of the last glacial period, the late Wisconsinan (Fisher et al. 1973), terminated deposition of this ancient deltaic plain. Taylor Bayou and its major tributary, Hillebrandt Bayou, occupy narrow valleys deeply incised into the Beaumont Formation (Kane 1959) and trace their origin to this glacial time of lower sea level. As the glaciers waned and Holocene sea level rose, sediments began filling the Taylor-Hillebrandt incised valley more or less continuously to the present day.

Today the resulting Taylor Bayou drainage basin can be divided readily into lower, middle and upper zones (cf. White et al. 1987: Plate V) on the basis of their fringing soils and biotic habitats. The lower basin extends from Taylor Bayou's outlet at lower Sabine Lake upstream to just below the Highway 73 bridge, a distance of about 16 km, and consists entirely of brackish-water marshes often with standing water. The middle basin continues upstream from the lower basin nearly to LaBelle, some 19 km along Taylor Bayou, and to Lovell Lake, some 14 km along Hillebrandt Bayou. The natural habitats here are a mosaic of freshwater marshes (with and without standing water), fluvial and poorly drained woodlands (but not swamps), and areas transitional between wetlands and upland prairies (Figure 2). The upper basin extends from the middle basin along Taylor and Hillebrandt bayous and their tributaries upstream to the headwaters of the drainage basin. The habitats in this section consist of fluvial and poorly drained woodlands, and swamps. The middle basin by far has the most ecologically diverse landscape and, as a result, probably had a greater plant and animal diversity than either the upper or lower basins (cf., Palmisano and Chabreck 1972:2, 38). In addition, or perhaps as a consequence, the middle basin contains nearly all the archeological sites known in the Taylor Bayou drainage basin. It is here that the Gaulding site is located, some 25 km upstream from the outlet at Sabine Lake.

Gaulding is situated on a slightly elevated tract of coastal prairie known as French Island that is largely surrounded by marsh and abuts Taylor Bayou at three points. About half the elevated "island" is heavily wooded, although other parts are developed with rice cultivation, pasture, oil wells and tanks, and buried pipelines. Despite this, the site has had only modest disturbance and remains in a relatively isolated location. The geomorphic surfaces surrounding the site location originated in several mostly deltaic late Pleistocene depositional environments; i.e., main river channels, distributaries, levees, and interdistributary basins. The lithofacies of these deposits differ in permeability, slope, and mineral composition leading to differences in the vegetative ground cover and understory that could be supported, and in the soils that were formed. Today the soil immediately upslope from the Gaulding site is the Morey Silt Loam, a sandy and silty soil largely derived from Beaumont Formation natural levee deposits. Nearby, at and below the elevation of the site, is the Beaumont Clay, largely derived from Beaumont Formation interdistributary deposits, and the Harris Clay, derived from the Holocene transgressive marsh deposits (Crout et al., 1965).

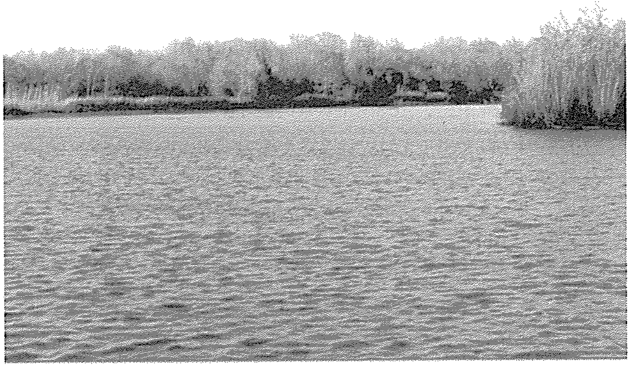

Figure 2. Landscape along middle Taylor Bayou near the Gaulding site, 41JF27; freshwater marsh in left center and fluvial woodlands in the background.

The natural habitats described above for the middle basin are, at least in general terms, probably the same that existed over the last two millennia of prehistoric times. However, French Island has been occupied and cultivated for nearly 150 years and much of the present vegetation also signifies these historic uses. In 1965 the site area was only partly wooded and had extensive clearings. The following plants were observed in the site's vicinity some of which suggest a domestic assemblage possibly associated with the now-vanished French family homestead: hackberry, water (?) elm, holly, yaupon, hawthorne, palmetto, wild white hibiscus, blue morning glory vine, passion flower vine, ageratum, gallardin, blackberry, honeysuckle, locust (?), and persimmon (D. Olds, field school notes).

Today, the site is overgrown with brush (Figure 3), a result of being overtaken by non-native Chinese tallow trees (*Sapium sebiferum*). The abundant flora on the site at this time includes hackberry, yaupon, and tallow tree accompanied in lesser amounts by sweet gum, palmetto, common morning glory, passion flower, honeysuckle, green briar, ironweed, dewberry, blackberry, aster, Virginia creeper, Spanish moss, locust, poison ivy and sumac, and cedar. Along the shoreline adjacent to the site are water hyacinth, bald cypress, and willow. This assemblage is similar to that observed in 1965 except for the substantial spreading of tallow trees (C. N. Bollich, 1995-96 field notes). Comparing the two vegetation lists to inventories of wetland plants in the middle Taylor Bayou basin habitats (White et al. 1987:Table 16) indicates that the plants on and near the Gaulding site are typical of the fluvial and poorly drained woodlands environment. However, they are accompanied by a number of non-native intrusive plants probably associated with historic and modern settle-

Figure 3. The Gaulding site, 41JF27, in 1995; note overgrown brush and tallow trees.

ment on French Island and throughout the region.

PREVIOUS ARCHEOLOGICAL WORK

The cumulation of archeological surveys in the Taylor Bayou basin is extensive and thorough, although the analysis to be presented later will suggest a possibility of undiscovered sites in locations previously not thought to be important for prehistoric settlement. The earliest reported archeological fieldwork in the drainage basin was a site survey conducted in 1940-41 by G. E. (Gus) Arnold of the University of Texas as part of his WPA-funded survey of 16 southeast Texas counties (Im 1975). Arnold reported four sites on French Island, including a shell midden approximately 300 feet (91 m) long and 50 feet (15 m) wide on a 6-7 foot (2 m) high bluff from which artifacts, bones and shells were eroding. It may be that he was describing the Gaulding site but, unfortunately, Arnold's map coordinates for these sites plot nearly three miles upstream near the small community of LaBelle. Subsequent examinations of the LaBelle locations by C. N. Bollich, as well as a separate survey by Thomas et al. (1977) have not revealed any indication of archeological sites there. Since both the LaBelle and French Island locations are relatively undisturbed by erosion or land uses, sites in either place should still be evident. Further, there are no other sites of such size known in the basin, so it seems likely that Arnold's map locations are wrong. In any event he may have initially visited and collected at the Gaulding site in 1940 and his description of a site recorded as 41JF10 seems most similar to, and likely to be, Gaulding. Nevertheless, the more recently assigned site number, 41JF27, is used here for the Gaulding site.

In the mid-1960's, archeological surveying by C. N. Bollich led to renewed awareness of the French Island sites and to selection of the Gaulding site for the 1965 field school. Subsequent to that time Harry Shafer, Vance Holliday, Paul Bollich, and Glen Fredlund conducted surveys of the upper parts of Taylor Bayou, Hillebrandt Bayou, and of several tributaries (Aten 1972). Additional surveys of selected locations were carried out by Pearson et al. (1982) and by Carolyn (Good) Murphy during a low water period in 1986 (TARL files). This work has covered, in some cases several times, both stream banks for approximately 60 km distance and has identified only 18 sites (excluding Arnold's probably misplotted sites).

Excavations with limited controls were carried out by local enthusiasts in the mid-1960's at 41JF24, the Black Hill Mound (Figure 1). Located in a remote upstream part of the basin near the merging of Hillebrandt and Willow Marsh bayous, this site was an earth midden containing some shell and several human burials (Heartfield n.d.). Then the majority of excavation at the Gaulding site reported here was carried out in 1965 with minor additional work in 1974. In 1981, test excavations were carried out at shell sites 41JF11 and 41JF35 (Figure 1), located on Hillebrandt Bayou. This work produced the first radiocarbon dating of archeological deposits in the Taylor Bayou basin (Raab and Smith 1983).

Elsewhere in the Sabine Lake area there has been survey (Beavers 1978; Gibson 1978; McGuff and Roberson 1974; McMichael and Bosarge 1979; Neuman 1977); a partial report on test excavations of pimple mound sites near Big Hill salt dome (Aten and Bollich 1981); a partial report of excavation at a ceramic period shell-bearing site (Eddleman and Akersten 1966); a study of site/chenier ridge relationships (McIntire 1958; McBride et al. 1997:50-61); salvage excavations at the Holly Beach site (Stopp 1976); reports on Paleo-Indian and Archaic lithic finds and geology at McFaddin Beach (Long 1977; Turner and Tanner 1994; Pearson and Weinstein 1983; Stright et al. 1999); and an effort to discover and evaluate Early and Middle Holocene shell sites submerged in offshore deposits of the Sabine River valley (Pearson et al. 1986). In addition, a preliminary ceramic chronology is available (Aten and Bollich 1969), as well as summaries integrating what is known of Sabine Lake culture history with that of the northern Gulf Coast region (Aten 1983b; Story 1990).

RESEARCH OBJECTIVES

The 1965 field school program at Gaulding was designed primarily to offer training in survey, excavation, and field laboratory methods to attending members of the Texas Archeological Society (Appendix A). The principal excavations focused on distinguishing stratigraphic layers and on determining how to correlate the separate excavation units (Davis 1965). The 1974 Beaumont Art Museum excavation had somewhat similar, if less technically intensive, objectives. In order to proceed now, decades later, with analysis of the excavation results, a more contemporary research focus is needed.

Area Overview

Chronology

The broad outlines of a local artifact chronology are evident even though much refinement is needed. Diagnostic Paleo-Indian and Archaic lithic materials are found in abundance at McFaddin Beach and Late Archaic material is found in numerous aceramic shell sites throughout the area. Early ceramic to protohistoric occupations are indicated in many sites by diagnostic decorated sherds representing Tchefuncte, Marksville, Coles Creek and Plaquemine ceramics typical of the lower Mississippi valley as well as those typical of the nearby Galveston Bay region. Small quantities of Caddoan ceramics also are found in late prehistoric contexts. There is little artifactual evidence of historic period Native Americans, although there is an ethnohistoric record of two Atakapa villages near Beaumont on the Neches River (Bolton 1970:334) and of another at Sabine Pass (Barroto 1987:178). Currently there are only 7 radiocarbon dates from area sites: One on a Pleistocene elephant tusk from McFaddin Beach (Long 1977); one on *Rangia* shells from a Tchefuncte pottery-bearing deposit (Valastro et al 1975:82); two *Rangia* shell dates (Eddleman and Akersten 1966) from a Tchefuncte ceramic deposit now being re-analyzed by the present authors; and three dates from Hillebrandt Bayou sites (Raab and Smith 1983). For various reasons, only the latter three dates are helpful at the Gaulding site. However, a series of 7 new dates is included here from Gaulding.

Site types/regional settlement pattern

Nearly all of the 145 prehistoric sites thus far recorded in the Sabine Lake area are shell-bearing sites. The only exceptions known are the apparent Paleo-Indian and Early Archaic sites being exhumed by the surf at McFaddin Beach; several pimple mound sites near Big Hill and Beaumont; a small number of upland stream margin middens in the timberlands and coastal prairies of the northern part of the region; and unidentified probable non-shell sites from along upper Spindletop Bayou where abundant ceramics were collected many years ago by a local trapper (TARL files). Prior to 1950 a great many of the reported shell sites were large stratified mounds, although few of these exist any longer. Several large prehistoric cemeteries as well as smaller burial aggregates existed at one time but never were documented; a single burial was documented at Gaulding in 1965, and Gus Arnold reported possible human bones eroding from what may have been the same site in 1940. Beavers (1978), reporting survey results from the lower Sabine River, suggested that there were clusters of sites on tributaries of larger streams that tended to have a large site with a wide range of faunal and artifact material, and numerous nearby small ones with much more limited artifacts and faunal remains. Superficially, at least, it appears a similar site distribution may exist in the Taylor Bayou basin also. Beavers thought this pattern might indicate functional site differentiation, with the small sites possibly being non-domestic, but this settlement concept has never been tested.

Bearing in mind that extensive surveying has taken place near Sabine Lake over the last six decades, inspection of the distribution of shell sites (TARL files) on the Texas side of Sabine Lake shows clusters in at least three locations probably reflecting shellfish resource availability. These locations are: 1) the lower Neches and Sabine rivers and the intervening Sabine Lake shoreline, with about 1.4 sites/stream km; 2) the lakes and streams of the coastal marshes largely south of the Gulf intracoastal waterway with about 1 site/stream km; and 3) the middle reaches of the Taylor Bayou/Hillebrandt Bayou system with 0.6 site/stream km. How or whether the intervening areas were used is unclear, although there are hints. The pimple mound middens at the coastal marsh/coastal prairie contact suggest how that ecotonal region was exploited (Aten and Bollich 1981). On Taylor Bayou, a largely east-west trending stream, sites tend to be on the more elevated north side (left bank) which has greater accessibility to the coastal prairie, possibly to facilitate retreating from storm surges or perhaps just a general logistical advantage. The large pottery collections from non-shell sites on upper Spindletop Bayou indicate significant upstream penetration into the coastal prairies of the interfluve between the Neches and Trinity rivers. And finally, several uninvestigated earth middens are known along Pine Island Bayou in northern Jefferson County, presumably reflecting use of the ecotone between the coastal prairies and the interior woodlands.

Geoarcheology/site formation

Many geological studies and soils surveys have been carried out in the Sabine Lake area and Louisiana – Texas coast yielding a general understanding of regional landscape development (cf. Fisher et al. 1973; Crout et al. 1965). At the archeological site level, however, little work has been done to define site formation processes and how these may correlate with the landscape history. An analysis was published partially analyzing pimple mound site formation (Aten and Bollich 1981) and a bulk sample data set was collected in 1995 from Gaulding to begin analyzing shell site formation there. In addition there are engineering boring records from the Taylor Bayou basin that can be used to document stream valley aggradation and its possible relation to the Gaulding site formation. Recent geoarcheological studies at sites on the lower Trinity River (e.g., Nordt and Jacob 1995; Nordt et al. 1997) have identified landscape development features that are relevant to the Sabine Lake area.

Paleoecology

Analysis of a late Pleistocene-Early Holocene vertebrate fauna being exhumed by the surf at McFaddin Beach (Russell 1975) revealed a mix of extinct and surviving animals. Pollen and foraminifera from Early to Middle Holocene deposits filling the offshore Sabine trench penetrated by borings indicate floodplain environments similar to those of today (Pearson et al. 1986) but not in the same location, of course. Several studies have been performed on the geometry, sedimentation, paleoenvironments, and modern aquatic habitats of Sabine Lake (Kane 1959 and 1960; Fisher et al.

1973; Anderson et al. 1991; White et al. 1987); and there has been some description of historic landscape changes in the region (Weniger 1984). In addition a terrestrial snail dataset spanning much of the Late Holocene now is available from the 1995 re-sampling of the Gaulding site.

Subsistence and seasonal movements

The principal method for seasonal site use determinations has been to evaluate *Rangia cuneata* growth (Aten 1981). Over time, however, various questions were raised about the accuracy of this method (e.g., Kibler et al. 1996:62-64). Recently an intensive re-evaluation of both the morphological and the microstructural techniques, as applied to *R. cuneata,* was conducted as well as testing several other approaches (Aten 1999). The new study indicated that none of the methods tested produced satisfactory results and so determining *Rangia* seasonality is not attempted on the Gaulding samples. Small quantities of oysters are found in some sites, including Gaulding, and may possibly be used for seasonality studies (Cox 1994). Beyond shells, there are the conventional seasonality data sources in faunal taxa presence/absence, otoliths, and other vertebrate elements that display growth cycles. At present the Gaulding and the Pipkin Ranch faunas are the best collections available for subsistence and seasonality analysis, although the former is not based on small screen mesh sampling and may be biased against small animals.

Territoriality

Several lines of evidence (Aten 1983b) suggest that western Jefferson County is a boundary region between the Atakapa Indians to the east, and the closely related Akokisa Indians to the west. This evidence includes differences in ceramic sequences and in distribution of certain non-ceramic technology; also there is ethnohistoric evidence that this was a tribal boundary during the historic period.

Technology

The only Sabine Lake area excavations for which the artifacts are described are the Hillebrandt Bayou testing (Raab and Smith 1983), the Holly Beach site (Stopp 1976), and the Paleo-Indian and Archaic lithics from McFaddin Beach (Stright et al. 1999). Beyond that there are studies of pottery typology (Aten and Bollich 1969; Aten 1983b) and of artifacts collected in numerous surveys (cited in the section on prior archeological work).

Mortuary practices

Although there is anecdotal information about the occurrence of cemeteries and individual burials from the area, the single Gaulding interment is the most completely described. In 1956 several burials were partially described while the site in which they were found, 41JF33, near the north shore of Sabine Lake was being quarried for shell (TARL files). In the 1960's, several burials were removed with only limited recording from the Black Hill mound in the headwaters of Hillebrandt Bayou (TARL files), and from 41OR9, a possible mortuary mound constructed on top of a shell mound on the lower Neches River (C. Bollich, field notes). As a result, while some skeletal material has been recovered, there is very little local context about mortuary ritual in which to place the Gaulding burial.

THE GAULDING SITE

While there were no *a priori* reasons for expecting anything radically different from, for instance, the emerging culture-historical picture in the Galveston Bay area, the research possibilities for the Gaulding site data were reviewed against this just-described area-wide background to see how they might best be used. The following observations stand out about Gaulding:

a. There are very few artifacts, with most confined to the upper 6 inches (15 cm) and these being mostly ceramics. Of the latter, a few were early (Tchefuncte and Mandeville Plain) but the majority appears to postdate Tchefuncte, including some Caddoan ware. A few examples of lithic, shell, and bone tools and manufacturing debris also were found.
b. A single human burial was documented which will be described, but with little other mortuary data from the Sabine Lake area for comparison, it is not possible to place this interment in the context of local burial ceremonialism.
c. A modest collection of vertebrate food remains was recovered, although it is biased toward large animals since small-mesh screening was not done. This sample will permit only a broad outline of the faunal subsistence during the site's occupations. Evaluation of the oyster shell growth as well as the faunal taxa that are present may enable an estimate of the season(s) of year the site was used.
d. The 1965 stratification records were detailed but not always consistent between excavation units. Likewise the layer descriptions, though representative of 1960's documentation standards, were not as focused as they would be today with the result that correlation of the site's physical structure from unit to unit is somewhat speculative and depends on continuity in certain gross features.
e. Inspection of the 1965 bulk samples curated at TARL also indicated that they were not consistently collected; some were from arbitrary excavation levels, others were from profile strata; some appeared to be complete or bulk samples of matrix material, while others were only washed shell; and some levels and strata were not sampled. Certain aspects of shell analysis (e.g., habitats, changes in demographics, predators, etc.) would be possible but a consistent analysis of physical structure and site formation would not be possible with the available samples.

f. Because of the uncertainty over where and how the 1965 shell samples were collected, this material was not reliable for radiocarbon dating.
g. There was available a significant amount of survey and some excavation data from elsewhere in the middle Taylor Bayou drainage basin that would provide some context for the Gaulding findings.

Taken all together, it was initially assumed that the preceramic deposits dated to earlier than 2,000 years ago, the Tchefuncte/Mandeville pottery indicated another period of settlement around 2000 years ago, and the other ceramics indicated settlement during various times ranging to perhaps about 600 years ago. But native use of the Gaulding site seems unlikely to have been continuous over such a time range; the site is too small and the artifact assemblage too limited for this to have been the case. Nevertheless, having such a span of occupations indicated that carefully collecting shells for radiocarbon dating could be an important addition to the area's culture history.

It would be possible, also, to do technological studies of ceramics and compare these with controlled collections from elsewhere in the Taylor Bayou basin, and to place documentation of the human burial in the published record. We believed it probably was possible to broadly correlate the several 1965 and 1974 excavations in terms of major site accretion episodes. It should then be possible to make culture-historical statements about the general focus of subsistence, possibly about the season(s) of settlement use, and about changes in artifacts all correlated with these depositional episodes.

There was one aspect of the site that particularly attracted attention. There was a small but persistent occurrence of oyster shell in the 1965 excavation at Gaulding. Oysters also have been reported from other shell sites on nearby Hillebrandt Bayou (Aten 1972; Raab and Smith 1983) and in several survey reports for sites on the northern end of Sabine Lake (TARL files). This is notable because the Sabine Lake and tributary drainages have, so far as is known, nearly always been very low salinity habitats. Studies of cores from the lake (Anderson et al. 1991; Kane 1961; White et al. 1987) suggest that oysters may always have been confined to the extreme southern end near the outlet to the Gulf through Sabine Pass. The one exception to this situation appears to have been a brief interval between 3500 and 4000 years ago when higher salinity faunas appear in the cores. Unless Indians were periodically transporting unopened oysters from a relatively great distance, finding oysters in the Gaulding samples suggests part of the site might be very old, circa 4000 years ago. Alternatively, or additionally, this might indicate the site contains archeological refuse documenting the onset and possibly the waning of the one currently known high salinity episode which appears to have occurred in the Sabine Lake estuarine system since 4000 years ago. It is possible that other episodes of higher salinity waters in the Sabine Lake system have occurred but thus far have escaped detection in cores.

In any event, the cause of such an episode is not clear. It may have been due to major reduction in freshwater outflow allowing Gulf waters more access to the Sabine Lake tributary drainages. On the other hand, it may represent a rapid small-scale rise in sea level temporarily giving marine waters greater access to the lake and its tributaries. Such sea level fluctuations are widely assumed to have occurred but are difficult to document (cf., Prewitt and Paine 1988). If such a rise and fall of sea level had occurred, it also would have affected other northern Gulf bays. But since the latter are higher salinity estuaries, any low magnitude (circa .5-1.5 m) sea level rise might not be as visible there in the form of invertebrate faunal changes.

We then considered what new data it might be feasible to collect to enhance the value of what had already been obtained without undertaking a major new excavation. Taking soil borings around the site's periphery, as well as reopening one of the 1965 test pits to re-document and resample some of the physical strata, would make it possible to place the site better in its landscape, verify the physical stratigraphy, collect bulk samples to begin examining site formation, and to obtain a series of radiocarbon samples. All of these analyses would contribute important new details about the local culture history to the original excavation data.

EXCAVATION PROCEDURES

The Gaulding site (Figure 4) is a shell ridge approximately 107 m long by 27 m in maximum width. It ranges in thickness from a thin lens of shell up to approximately 1.5 m. It consists primarily of numerous deposits of the brackish water clam *Rangia cuneata*. The composition was rounded out by small quantities of other shells, artifacts, vertebrate remains, organic detritus, and miscellaneous sedimentary materials. The procedures employed to test this site, in the three successive time periods of work, are described below. Because all primary measurements were made in the English system, these are retained here with the metric equivalent indicated in parentheses. New measurements made for this report, such as artifact descriptions or landscape distances are given only in the metric system. Records and specimens from all three periods of work at the Gaulding site are reported here and are curated at the Texas Archeological Research Laboratory (TARL) in Austin.

1965 Excavation

A control grid was established by driving a stake every 50 feet (15 m) on the long axis of the mound commencing at what was believed to be the southwestern extremity of the site. This southernmost stake was arbitrarily labeled N0/W100. All grid units were designated by the coordinates of their southeast corner. The line of stakes along the axis of the site was oriented 50 degrees east of north, and this direc-

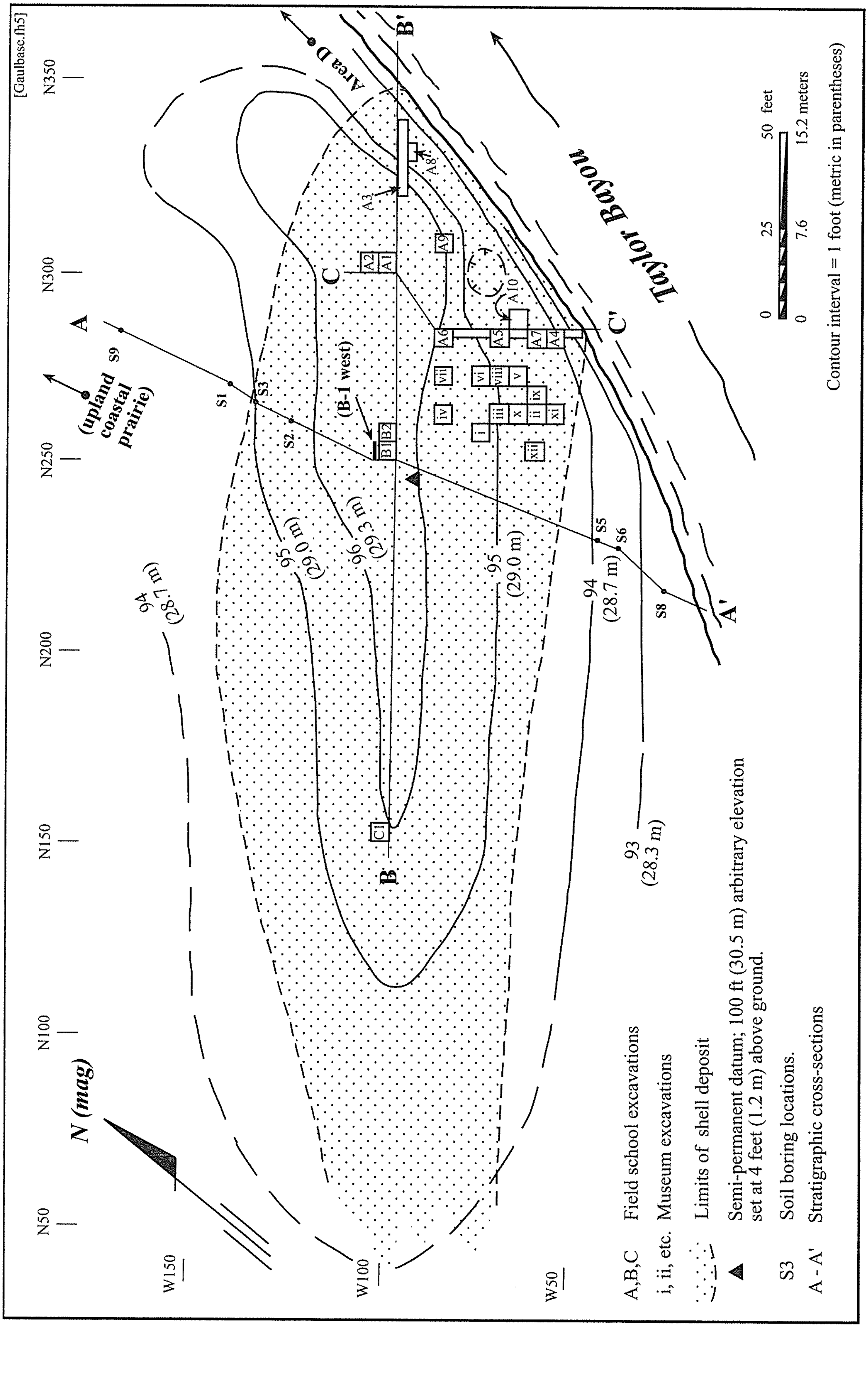

Figure 4. Gaulding site (41JF27) base map showing relief, excavations, cross-section locations, and extent of shell deposit.

tion was designated grid north. A nail driven into a tree about 4 feet (1.2 m) above ground level near N250/W100 was assigned an arbitrary elevation of 100 feet (30.5 m) and was designated as the primary datum. The site was then mapped with the use of a Brunton compass, hand level, tripod and tape. Elevations were taken every 10 feet (3 m) along the north-south line of stakes. In addition, elevations were taken at 10-foot (3 m) intervals from W50 to W150 along the lines N100, N150, N200, N250, and N300, as well as at selected other locations.

The initial excavations began with three 5-foot (1.5 m) grid units designated A-1, B-1, and C-1 in addition to their grid coordinates. These were at N300/W100, N250/W100, and N150/W100 respectively. Placing test excavations in widely separated areas was expected to reveal whether the nature of deposits was similar or different over the site's extent. These results were to be relied on to indicate where additional excavation might be fruitful. The initial test units were excavated in horizontal 6-inch (15-cm) levels and the excavated material was sifted through ¼ inch (6.3 mm) mesh screens.

All specimens were placed in general level bags labeled by site, grid unit, level, date and persons involved in the particular excavation. In addition, records were kept on the characteristics of the excavated matrix, unusual stratification, artifacts and other notable information for each grid level as work proceeded. Excavation of the shell deposit took longer and was more difficult than expected. As more people arrived at the field school, additional grid units were started before the initial three test excavations were completed. There appeared to be more artifacts found in the A-1 test then in either B-1 or C-1, and it was decided to concentrate excavations in the "A-1" area, or the northern third of the site. A total of eleven 5-foot (1.5 m) grid units were excavated down to sterile clay along with three exploratory trenches (Figure 4). The latter trenches were about 1.5 feet (.45 m) wide and were dug primarily to obtain longer profiles of the mound structure, although vertical control by levels was not generally used. In addition, numerous small holes were dug with a posthole digger to obtain information about the shell deposit's thickness and extent.

1974 Excavations

In 1974 the Beaumont Art Museum (now the Art Museum of Southeast Texas) sponsored a program to familiarize children with Native American history, archeology, and site preservation. To represent a tangible idea of what archeological sites were and how the material in them conveys information about the past, two outings were held (April 20 and July 7) during which 12 five-foot (1.5 m) squares were excavated to a depth of 6 inches (15 cm). The excavation units were identified by Roman numerals and coordinated with the original 1965 grid (Figure 4). All of this material was sifted through ½ inch (12.6 mm) mesh screen except Square "i" for which ¼ inch (6.3 mm) mesh was used.

1995-96 Fieldwork

This field work, conducted by the authors over an aggregate 6-day-period, was focused on placing the site better in its landscape, improving documentation of the physical character of the archeological deposits, and to obtain new bulk and radiocarbon samples. From the original field notes and observation of the present site surface it was possible to identify the 1965 map datum tree and several of the original test excavations. After relocating the original baseline (W100), several soil boring locations beyond the edges of the site were surveyed with a transit in relation to the site datum. Soil borings were placed to make several transects: 1) approximately perpendicular to the W100 line extending in both east and west directions but intersecting the 1965 B-1 test excavation; 2) perpendicular to the W100 line intersecting the 1965 C-1 test excavation, but there was only enough time to dig these borings on the east side of the site; and 3) a line continuing from the north end of the site. Because of their general similarity, only the most complete profile, intersecting the B-1 excavation, is presented in this report. With these borings it was possible to create a stratigraphic profile showing the pre-archeological site setting and some of the modifications occurring since that time.

In addition to the soil borings, the fill was removed from part of the 1965 B-1 test pit thereby re-exposing one 5-foot (1.5 m) long face of the intact deposits that had been documented 30 years before. When this was completed and the face cleaned, the strata were identified on the basis of their visual and textural differences, and documented in detail at the outcrop. In addition, *Rangia cuneata* were collected from each stratum for radiocarbon dating purposes. Then, bulk samples were collected from each stratum for physical analysis. When the bottom of the site was reached an additional soil boring was made. To be certain that undisturbed deposits were being examined, the exposed profile along the west side of the original B-1 excavation was trimmed several centimeters westward and was identified in the records as profile B-1 (west).

Adjacent to the re-sampled profile and offset by about 3 feet (.9 m), a boring was made with a 4-inch (10-cm) bucket auger. Here a continuous set of samples was retained from each 2 to 3 inch (5–8 cm) depth interval that would fill the auger's bucket sample retainer. The purpose was to obtain a sample set with the bucket auger that someday can be compared in its physical characteristics with the excavated bulk samples to evaluate the auger's use as a shell site sampling tool. This analysis has only been partially performed and is not included here.

Finally, undisturbed core samples of the entire depositional sequence were obtained from adjacent to B-1 (west). Dr. Paul Goldberg (Boston University) impregnated these cores with epoxy as a permanent record of the site's stratification as well as for micromorphological analysis. Since measurements in the original excavations were in English units, this was continued in the 1995-96 fieldwork to simplify correlation of the profiles and borings. Despite this and other precautions, re-location of the original 100-foot (30.5 m) datum plane was not perfect, as there is a ±4 inch (10 cm) vertical misclosure between the original 1965 surface elevations and some of the same ground surface elevations re-measured in 1995-96.

CHAPTER 2

SITE FORMATION

A glance at any of the Gaulding site's stratigraphic cross-sections shows many layers. So how did the site form? At first the answer might seem obvious—people sitting about the fire, opening and eating clams and oysters, and tossing the shells nearby. Undoubtedly this is part of the answer, but which part? Were any of the layers formed in some other way? Were all the shellfish eaten when harvested, were they prepared for later consumption, or were they used as bait (cf., Claassen 1998:176-178)? Is there evidence of structured use and maintenance of campsite areas as is seen in some ethnographic examples (e.g., Meehan 1982). Why do the layers look different? To confuse matters further, the issue of whether these shell accumulations are exclusively man-made, a question that was often raised by 19th century natural scientists, continues to be heard a century later, even in the Taylor Bayou basin (Raab and Smith 1983:59). As much as we try to find certainty about shell-bearing sites, partial answers are all that come forth.

There are three classes of evidence available for examining the formation of the Gaulding site: *prehistoric setting* as expressed in external soil borings and excavations to examine the placement of the site in its local environment; *structure* as expressed in conventional physical and cultural stratigraphy and radiocarbon dates from the excavations; and *archeological sediments* as expressed in bulk samples, cores, and thin sections. Before proceeding, though, a word about terminology is needed.

The lithostratigraphic terminology used here generally is consistent with current geoarcheological practice (e.g., Stein 1990; Waters 1992). *Layer* is used for the sediments between interfaces when the units could be mapped across all or much of the excavation. They are based largely on continuity, geometry, superposition, and to some extent, lithologic similarity. *Layer* is approximately equivalent to the term "zone" as used in the 1965 documentation. Most, but not all, of these layers are traceable into the 1965 documentation of zones. Nevertheless, to avoid unnecessarily complicating the terminology, all of the 1995 units are referred to as *layers*. The term *deposit* is used for features and lithologic variations of more limited extent.

The bulk of the Gaulding site material is shell of the very low salinity clam, *Rangia cuneata*. Scattered through these were occasional oyster and other shells, ceramics and other artifacts, and vertebrate food remains. Sediment comprised mostly of fine sand, silt, and clay—along with small quantities of humus, ash and charcoal, small shell fragments, and small bone and artifact fragments—provided the "filler." When present, this filler is identified as *matrix*. Later, when discussing the analysis of bulk samples of archeological sediments, the definition of *matrix* will be refined to include all material passing through a 2-mm (-1ϕ) sieve (i.e., all very coarse sand and smaller grain sizes).

Finally, a *midden,* strictly speaking, is a specific kind of secondary deposition (cf., Schiffer 1987:58-61). The term "shell midden," as it is commonly used, refers to a site originating from assumed, but usually unconfirmed, domestic refuse accumulation processes. And so there is a growing view among coastal archeologists that the term "shell-bearing" site or some other combination of less prejudicial modifiers should be used instead of the blanket use of "shell midden" (cf., Widmer 1989; Claassen 1998:10-12). This concern underlies the general absence of the term "shell midden" in this report.

PREHISTORIC GEOMORPHIC SETTING

Like many local drainage systems on the coastal prairies during the last glacial period, Taylor Bayou entrenched a deep, narrow alluvial valley. Even today, when this valley is filled to the brim, the floodplain in the middle of the drainage basin on the average is not more than 1 km in width, with the present bayou channel only about 60 m wide. At many places in the alluvial valley, including at Gaulding, the Pleistocene uplands directly border one or both sides of the stream channel.

The original ground surface on which the site was established was the soil developed on the surface of the late Pleistocene Beaumont Formation (Figure 5; see Appendix B for lithologic descriptions). This paleosol at the top of the Beaumont and underlying the Gaulding site may be equivalent to the Wallisville Paleosol identified in field studies on the east side of the Trinity River valley some 57 km due west (Nordt and Jacob 1995:169-174). As is the case with the Trinity River location and others on upper Galveston Bay (Paine 1987), the Pleistocene surface at Gaulding was prominently gullied (Figures 5 and 6). Gaulding is situated on the edge of the late glacial incised Taylor Bayou valley that at one time (probably 15 to 18 thousand years ago) was entrenched to a depth of more than 30 m (Kane 1959:228). It seems virtually certain that valley margin gully erosion would have been underway from that time. The Gaulding stratigraphic profiles suggest that the paleosol's A-horizon, while not present everywhere, was present on the high parts of some of the irregular Pleistocene topography (cf. Figures 5 and 6). This indicates that gullying continued after soil formation, possibly during the Middle Holocene as suggested by Nordt and Jacob (1995:173-174).

Over time the archeological shell deposit accumulated to a thickness of more than a meter. By then the shell ridge had begun to act as a barrier to down-slope movement of sediment eroded from the slightly higher, nearby uplands of French Island; this accumulation on the land-side of the shell deposit also is seen in cross-section in Figure 5. Along the south, or bayou, side of the site, there is a colluvial deposit of rotted shell fragments and black clay. The geometry of the colluvium is only approximate but it suggests there may have been erosion directly against this face of the shell deposit at one time. A thin mantle of peat overlies the colluvial deposit. The black clay in both these deposits is similar and may have originated either from overbank flood deposits combined with decayed organic material, from marsh formation on the bayou side, or as an erosion product derived from the thick, black matrix of the uppermost layer of the archeological site. Although only shown here on the A-A' cross-section, a similar profile was documented in 1995 on a line south of Test Pit C-1 (Figure 4). There the colluvium was offlapped by a nearly 1 ft (30 cm) thick deposit of black clay. The peat shown at the south end of cross-section A-A' (i.e., grid east) covered both the clay and colluvium (Figure 5). Today the base of the archeological shell deposit is approximately at bayou water level.

It also may be asked whether there are other archeological remains that are embedded in the post-Pleistocene sediments beyond the periphery of the large shell mass. This possibility was raised on the upper Texas coast some 25 years ago (Hole 1974:8-9) but has rarely been pursued even though there are indications that such remains often occur. At the Fullen site, located near Clear Lake in Harris County, surface stripping around the main shell deposit identified small clusters of shell, artifacts, and possible structural remains (O'Brien 1974:49-50, Figure 7). The Lido Harbor site is the only other large-scale stripping done around the periphery of a concentrated shell deposit (Weinstein 1991). Some other investigators also have recovered evidence that low density archeological remains, with and without shell, can be found near shell-bearing sites (e.g., Aten et al 1976:7-10, 46-47; Aten 1983a:7-18). These may be little more than small hearth/refuse pile couplets formed during dry periods when either the superior drainage qualities of the shell mound or the superior heat retention qualities of previously deposited shell were not needed. Whatever they are, their nature is only slightly known. More of them need to be exposed and investigated to understand better the range of activities at Sabine Lake area shell-bearing sites.

In any event, in 1965 a small amount of *Rangia cuneata* shell and some sherds were seen scattered at the surface of a pimple mound a short distance downstream along the bayou from the Gaulding site shell mound. The notes do not record the specific location but it was approximately 30 to 50 m downstream. This location was designated Area D (Figure 4) and a profile 12-ft (3.6 m) long and 2-ft (.6 m) deep was cleared across the highest part of the pimple mound. The profile exposed a brown, fine sandy loam layer extending to 1.5 ft (.45 m) below the surface. A light tan very fine sandy loam underlay this to a depth of 22 inches (.56 m). This, in turn, was underlain by mottled reddish-yellow clay. *Rangia* shells were scattered through the brown loam section but mostly in the top 6 inches (.15 m); none were found in the tan loam and reddish-yellow clay subsoil. No excavation was undertaken to attempt to clear and describe any buried archeological features in Area D, but the limited information available resembles the sparse peripheral remains reported from other sites.

Finally, there is a peculiarity about the Gaulding site's setting that cannot be explained at this time; namely, the orientation of the site with respect to Taylor Bayou. Archeological shell deposits of the northern Gulf coast generally are oriented with their long axis parallel to their adjacent water-body or to the primary geomorphic feature on which they rest, such as bayfront, lakefront, stream channel, or beach ridge. The Gaulding site, however, is oriented about 35° from Taylor Bayou with only its eastern end impinging directly on the bayou. Aerial photographs of the bayou taken in 1938, prior to channel straightening in the 1950's, show a prominent lineation near to the stream-side of the site which might suggest an early channel position different from the present one. However, even this feature is 17° away from being parallel to the long axis of the site. The lineation can be located on the ground and marks a slightly lower surface elevation on the side towards the stream. A limited amount of probing across this linear feature with the soil augur indicated Beaumont Formation deposits continued on both sides; there was no indication of buried Holocene stream channel deposits that might explain the site's orientation.

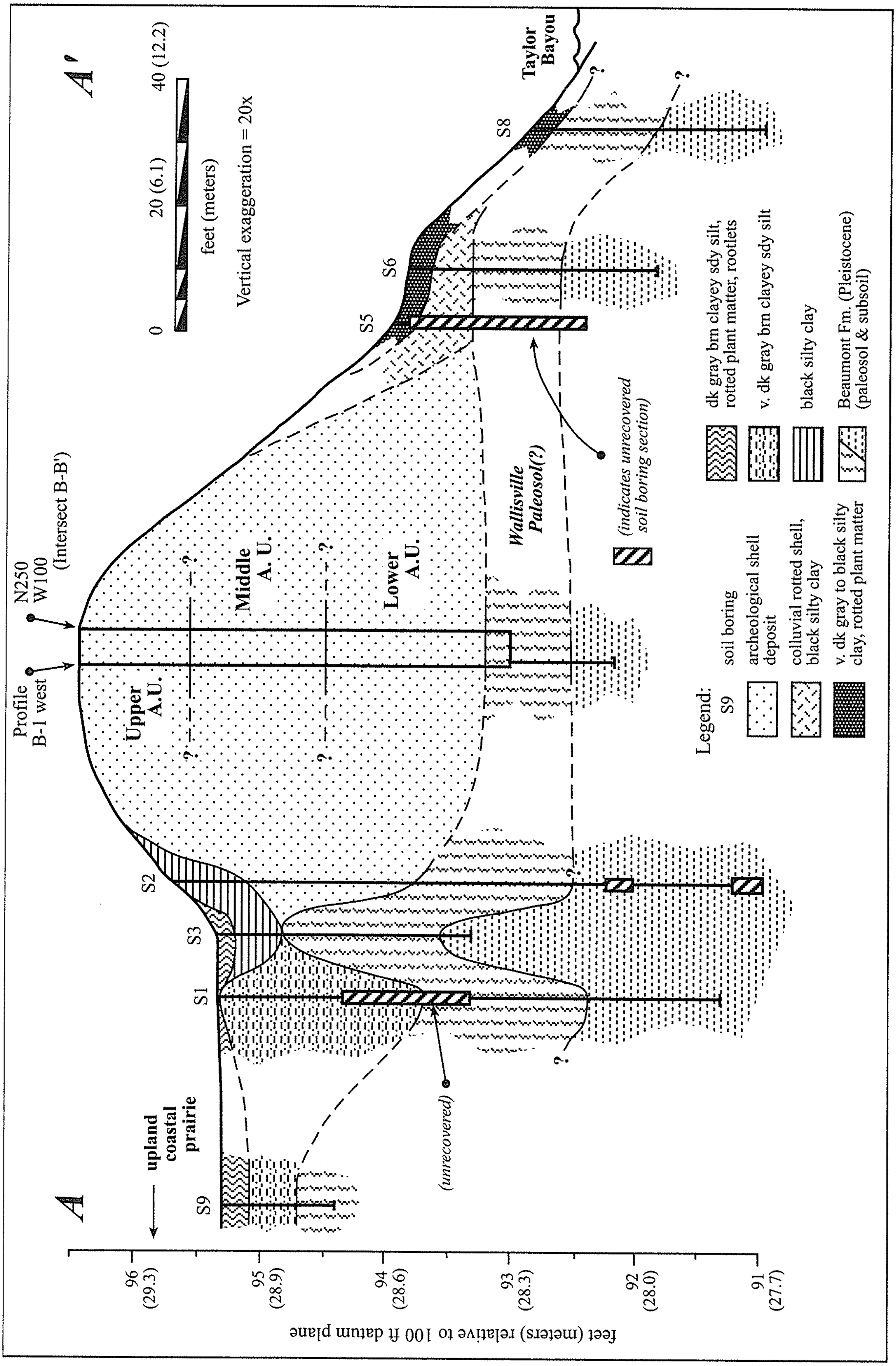

Figure 5. Stratigraphic cross-section A-A' (1995); see Figure 4 in Chapter 1 for locations; Gaulding site, 41JF27.

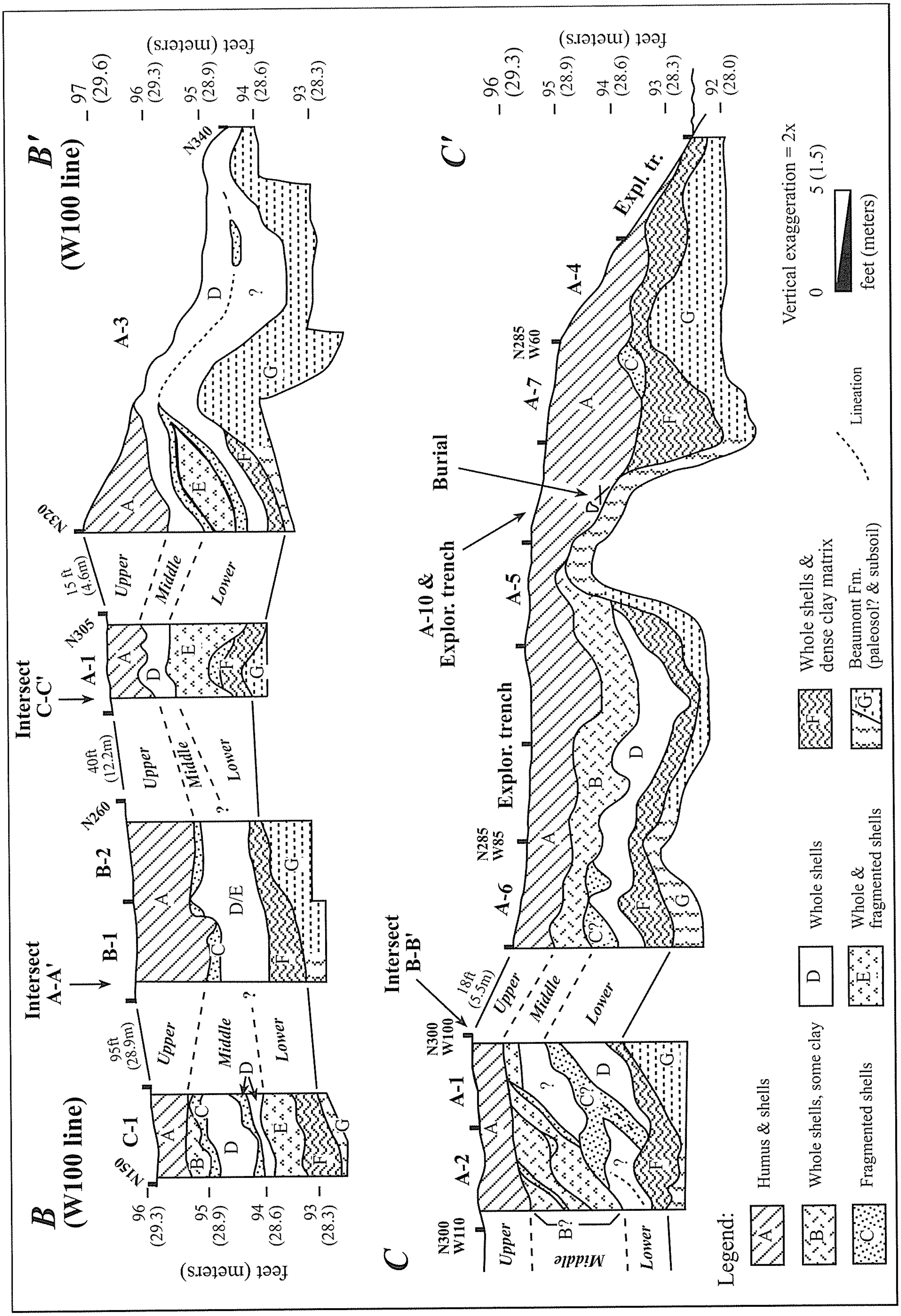

Figure 6. Stratigraphic cross-sections B-B' and C-C', Gaulding site, 41JF27. See Figure 4 in Chapter 1 for locations. Lettered strata are 1965 zone correlations. "Upper," "Middle," and "Lower" notations are analysis units employed in this study.

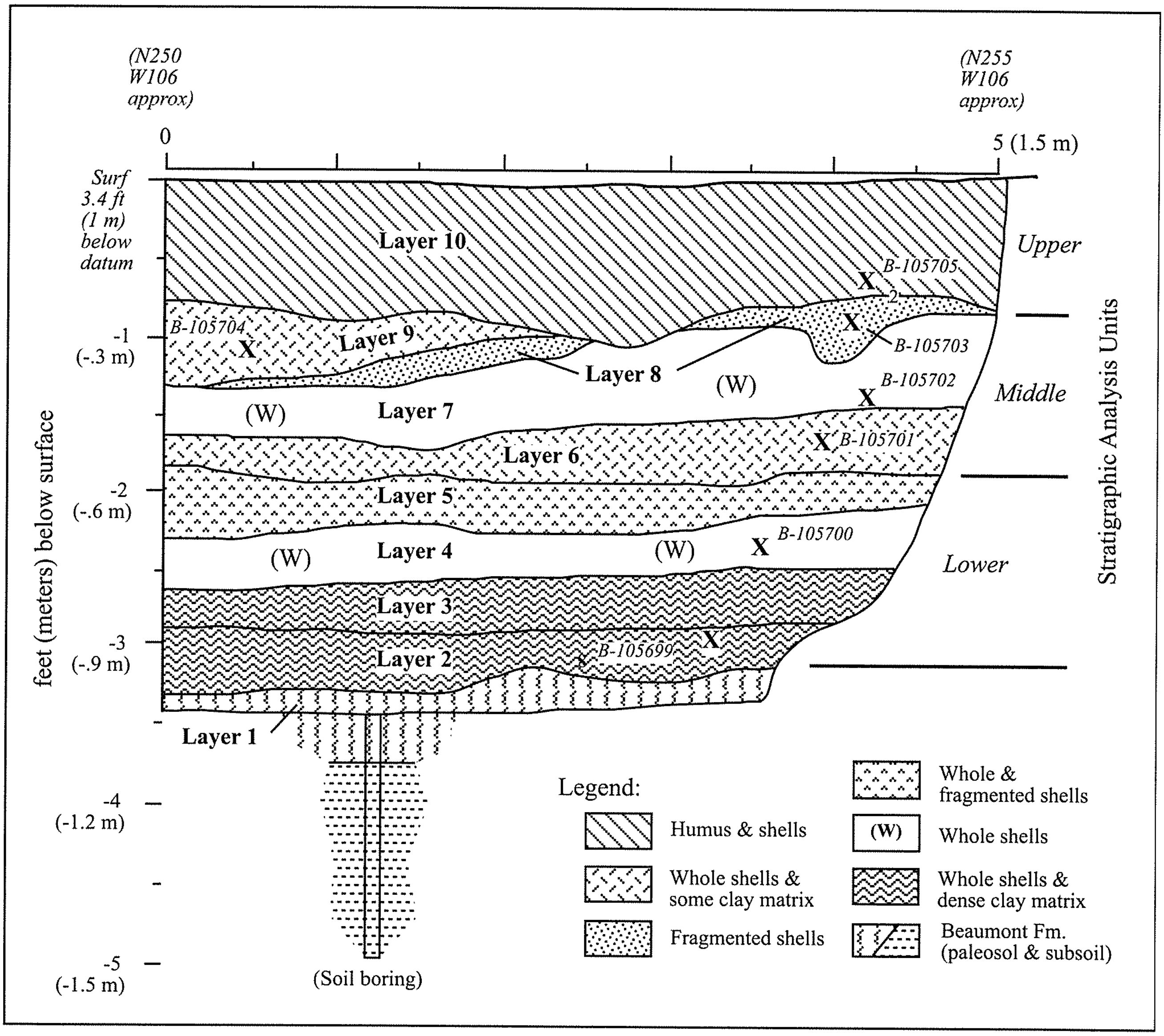

Figure 7. Stratigraphy and radiocarbon sample locations (X) in profile at B-1 (west), Gaulding site, 41JF27. See Table 1 for dating results.

SITE STRUCTURE

To display the internal structure of the shell site, the field profiles drawn at many of the exposed stratigraphic sections in the 1965 excavation units were combined into two more or less continuous cross-sections, B-B' and C-C' (Figure 6). To further examine some of the individual layers and deposits for diagnostic contents and possible formational signatures, a part of the Gaulding site was re-sampled in 1995. There were several reasons for doing this.

1. Since numerous individuals had participated in the 1965 stratigraphic profile evaluation and recording, the results, while broadly consistent, were not always identical in detail. For example, the N300/W100 intersection of walls in test A-1 (Figure 6) does not exactly match, and there are other minor inconsistencies. Because of this, it seemed desirable to re-examine a previously documented profile in the site.
2. Since most of the archeological site was preceramic, with deposits containing practically no diagnostic artifacts, obtaining samples suitable for radiocarbon dating was essential to documenting the site's formation.
3. Since investigating paleoenvironments and the site's formation was intended, collecting a uniform series of bulk samples from the stratigraphic layers would permit detailed analysis of archeological sediments.
4. As an experiment, undisturbed core samples of the archeological deposit were taken that were hardened with epoxy and kept as a permanent record of the site's stratification and to make thin sections also as part of the study of site formation.

As mentioned earlier, it was possible to relocate and re-open part of the original B-1 test pit (Figure 4), and perform the data and sample collecting just described. The re-documented stratification and the radiocarbon dating will be discussed here, while the bulk sample and core/thin-section analyses will be presented in the "Archeological Sediments" section.

Stratigraphy

The newly exposed and re-documented west wall of test pit B-1 (Figure 7) correlated well with the 1965 documentation. Although recorded in somewhat more detail, the strata recognized in 1995 could be matched easily with the earlier work which gave confidence that, on the whole, the 1965 profiles represented the internal structure of the Gaulding site. The consolidated descriptions of the 1965 "zones" are compared to the descriptions of the 1995 "layers" in Figure 8.

Unlike the present ground surface, the pre-site surface is quite irregular (Figure 6). The 1965 lithologic descriptions mainly distinguished the bedrock clay (Beaumont Formation) as blue or brown clay, and yellowish clay. These terms probably refer to the Wallisville Paleosol, and to its underlying subsoil, respectively; and so they are labeled this way on the cross-sections. The interrupted continuity of the Wallisville Paleosol may indicate that erosion continued up until the time that the site began to form.

The initial archeological layers, though mostly filling the low places of the apparently gullied Pleistocene surface, were horizontally extensive and more or less homogeneous sheets with abundant matrix binding the shells. Many layers and deposits of irregular geometry, particularly near the site margins, and containing very little matrix, succeeded the initial shell layers. Then, the entire site was blanketed with a thick layer of heavily matrix-bound shells, that filled in remaining topographic irregularities and culminated in a relatively smooth ground surface. Each of these three units is bounded by a significant depositional hiatus (Figure 8). This also may be true between individual layers and deposits but physical evidence for such hiatuses was not discovered.

A similar three-part aggradational structure has been observed at lowland shell mounds excavated in the Trinity River delta (Ambler 1973). It is a sequence of matrix-bound, horizontal layers at the top and the bottom of a site, intervened by a sequence of less continuous deposits, often without matrix, that dip steeply down the sides and ends of the mound. The middle of the sequence is the most complex and has many of the thin, fragmented shell deposits that grade into the thicker, whole shell deposits often on the side slopes of the mound. While these middle units might be accounted for by accumulation models developed by Aten (1983a:84-88) and Nodine (1987:19-26), the upper and lower units of horizontal layers remain to be explained.

Finally, the ground surface over the shell deposit today is a low, smooth ridge with a maximum of .6 m relief on the landward side and about 1¼ m on the bayou side (Figure 4). While the shell ridge is roughly elliptical and at one end impinges directly on the bayou, the surface contours describing the smooth, low ridge over the site bend downstream (to the north) paralleling the bayou without any corresponding change in the underlying shell deposit. This suggests that the surface sediment accumulation over the ridge is at least partly of non-cultural, hydrological origin.

Radiocarbon Dates

The relationship between physical stratigraphy and radiocarbon dates from the 1995 sampling at B-1 (west) make it possible to identify the age of deposition at Gaulding, at least in the excavations reported here. From this a scheme can be developed for grouping layers, levels, and zones into a common framework for analyzing the artifacts, faunal remains, and other data while minimizing confusion from miscorrelation of strata between excavation units. Although all ten archeological layers in B-1 (west) were sampled for radiocarbon purposes, only seven were measured. The locations of those seven radiocarbon samples are shown on the stratigraphic profile of the B-1 (west) excavation (Figure 7). The calibrated dates are listed in Table 1, and are plotted along with culture chronologies from nearby areas in Figure 9. An explanation of the calibration computations is given in Appendix C.

The seven radiocarbon and two diagnostic ceramic dates from Gaulding indicate three periods of habitation and accumulation of archeological deposits. The earliest group, whose average date is between roughly 3700 and 4000 cal B.P., dates Layers 2 and 4, and brackets Layer 3. Layer 5 is included with these also because bulk sample evidence to be described below shows a discontinuity in several attributes between Layers 5 and 6. The middle period of accumulation includes two groups of statistically identical samples whose average dates are very close and range between roughly 2700 and 3000 cal B.P. These samples directly date Layers 6, 7, 8, 9, and 10 (lower). While the intercepts of these dates are not always in chronological order, they are all close and their second standard deviation ranges all substantially overlap.

In addition, there are distinctive ceramics from the upper part of Layer 10 (Zone A in 1965 terminology) also shown on Figure 9. The uppermost arbitrary level in the 1965 and 1974 excavations included nearly all of the ceramics. Included in the collection were several sherds of Tchefuncte culture ceramics datable to the late 1st millennium B.C., along with several sherds from a single Caddoan vessel that would date to approximately A.D. 1300 (Dee Ann Story, personal communication, 1998).

These datable materials all describe a clear, three-part sequence for understanding the stratigraphy in the B-1 (west) profile. Layers 2 through 5 are sandwiched between depositional hiatuses, as are Layers 6 through 9. Layer 10 is the final accumulation at the site, much of it apparently non-

B-1 (west) Layers		Field lithologic classification: 1965	Field lithologic classification: 1995	Grain sizes -- 3-pole plot: Sedimentary "view"	Grain sizes -- 3-pole plot: Archeological "view"	Depositional character	Archeological Analysis Unit
Hiatus (soil formation)							
10	upper	Zone A: black loamy humus with large whole shells	Dark brown to black whole and fragmented shell with humus	Muddy shell	Whole shell with fragmented shell and sediment	Mixed geological and cultural	Upper (A)
	lower			Muddy sandy shell	Sediment with fragmented shell and whole shell		Upper (B)
Hiatus ??							
9		Zone B: tan soil with large whole shell	Whole shell and dark brown clay	Shell	Whole shell with fragmented shell	Cultural	Middle
8		Zone C: finely crushed shell	Fragmented shell		Whole shell with fragmented shell and sediment		
7		Zone D: loose, clean, generally whole shell	Whole shell with little dark grayish brown matrix		Whole shell with fragmented shell		
6			Whole and fragmented shell with very dark gray clay				
Hiatus (soil formation)							
5		Zone E: mixed small whole shells and crushed shell	Whole shell and lenses of fragmented shell with some dark grayish brown matrix	Shell	Fragmented shell with whole shell	Cultural	Lower
4			Whole shell with little matrix		Whole shell with fragmented shell		
3		Zone F: heavy plastic clay and whole shell	Whole and fragmented shell with dark gray clay	Muddy shell	Whole shell with fragmented shell and sediment	Mixed geological and cultural	
2			Whole shell and grayish brown clay				
Hiatus (soil formation)							
1		Zone G: sterile basal clay, sometimes yellow and sometimes blue-gray	Dark grayish brown silty clay	Mud	Sediment	Geological	Pre-archeological deposit

Figure 8. Comparison of different approaches to classifying stratigraphic units at the Gaulding site, 41JF27.

TABLE 1
Sabine Lake area radiocarbon dates

Laboratory number	Site and provenience	Data provided by radiocarbon laboratory			Calibrated ^{14}C date CALIB 4.0 (Stuiver and Reimer 1993)	Source
		Measured ^{14}C age (yrs B.P.) [1]	$^{13}C/^{12}C$ ratio, ‰	Conventional ^{14}C age (yrs B.P.)		
Late ceramic:						
TX-4507	41JF11/B (stratum B — upper shell zone)	420 ± 50	—	737 ± 64 [2]	(1s) 1240 (1270) 1290 cal A.D. (2s) 1200 (1270) 1360 cal A.D. *(1s) 710 (680) 660 cal B.P.* *(2s) 760 (680) 590 cal B.P.*	Raab and Smith 1983:24
Early ceramic:						
TX-1230	16CU108/1	2020 ± 110	—	2337 ± 117 [2]	(1s) 520 (400) 250 cal B.C. (2s) 780 (400) 130 cal B.C. *(1s) 2470 (2350) 2200 cal B.P.* *(2s) 2730 (2350) 2080 cal B.P.*	Valastro et al. 1975
(late) Late Archaic:						
B-105705	41JF27/10L (Layer 10 lower, B-1 west)	2380 ± 60	-5.5	2700 ± 60	(1s) 890 (840) 810 cal B.C. (2s) 960 (840) 790 cal B.C. *(1s) 2840 (2790) 2760 cal B.P.* *(2s) 2910 (2790) 2740 cal B.P.*	This report
B-105704	41JF27/9 (Layer 9, B-1 west)	2530 ± 60	-2.8	2900 ± 60	(1s) 1170 (1070) 990 cal B.C. (2s) 1280 (1070) 920 cal B.C. *(1s) 3120 (3020) 2940 cal B.P.* *(2s) 3230 (3020) 2870 cal B.P.*	This report
B-105703	41JF27/8 (Layer 8, B-1 west)	2420 ± 60	-2.7	2790 ± 60	(1s) 1000 (930) 870 cal B.C. (2s) 1090 (930) 830 cal B.C. *(1s) 2950 (2880) 2820 cal B.P.* *(2s) 3040 (2880) 2780 cal B.P.*	This report
B-105702	41JF27/7L (lower part of Layer 7, B-1 west)	2370 ± 60	-6.8	2670 ± 60	(1s) 870 (830) 800 cal B.C. (2s) 930 (830) 770 cal B.C. *(1s) 2820 (2780) 2750 cal B.P.* *(2s) 2880 (2780) 2720 cal B.P.*	This report
B-105701	41JF27/6 (Layer 6, B-1 west)	2520 ± 60	-6.3	2820 ± 60	(1s) 1040 (960) 890 cal B.C. (2s) 1150 (960) 840 cal B.C. *(1s) 2990 (2910) 2840 cal B.P.* *(2s) 3100 (2910) 2790 cal B.P.*	This report

TABLE 1 (continued)
Sabine Lake area radiocarbon dates

		Data provided by radiocarbon laboratory				
Laboratory number	**Site and provenience**	**Measured ^{14}C age (yrs B.P.)** [1]	**$^{13}C/^{12}C$ ratio, ‰**	**Conventional ^{14}C age (yrs B.P.)**	**Calibrated ^{14}C date CALIB 4.0 (Stuiver and Reimer 1993)**	**Source**
TX-4506	41JF11/D (stratum D – lower shell zone)	2490 ± 60	—	2807 ± 72 [2]	(1s) 1040 (950) 870 cal B.C. (2s) 1160 (950) 820 cal B.C. *(1s) 2990 (2900) 2820 cal B.P.* *(2s) 3110 (2900) 2770 cal B.P.*	Raab and Smith 1983:24
TX-4584	41JF35/B (stratum B)	2610 ± 60	—	2927 ± 72 [2]	(1s) 1250 (1120) 1010 cal B.C. (2s) 1350 (1120) 920 cal B.C. *(1s) 3200 (3070) 2960 cal B.P.* *(2s) 3300 (3070) 2870 cal B.P.*	Raab and Smith 1983:19
Average date for statistically identical samples B-105702 and 105705 (computed on CALIB 4.0)		—	—	2685 ± 43	(1s) 860 (840) 810 cal B.C. (2s) 900 (840) 790 cal B.C. *(1s) 2810 (2790) 2760 cal B.P.* *(2s) 2850 (2790) 2740 cal B.P.*	This report
Average date for statistically identical samples B-105701, 703, 705, TX-4506, and 4584 (computed on CALIB 4.0)		—	—	2846 ± 29	(1s) 1030 (1000) 960 cal B.C. (2s) 1080 (1000) 930 cal B.C. *(1s) 2980 (2950) 2900 cal B.P.* *(2s) 3030 (2950) 2880 cal B.P.*	This report
(late) Middle or (early) Late Archaic:						
B-105700	41JF27/4 (Layer 4, B-1 west)	3220 ± 70	-5.6	3540 ± 70	(1s) 1950 (1890) 1760 cal B.C. (2s) 2040 (1890) 1700 cal B.C. *(1s) 3900 (3830) 3710 cal B.P.* *(2s) 3990 (3830) 3650 cal B.P.*	This report
B-105699	41JF27/2U (upper part of Layer 2, B-1 west)	3290 ± 70	-7.5	3580 ± 70	(1s) 2000 (1920) 1850 cal B.C. (2s) 2110 (1920) 1730 cal B.C. *(1s) 3950 (3870) 3800 cal B.P.* *(2s) 4060 (3870) 3680 cal B.P.*	This report
Average date for statistically identical samples B-105699 and 105700 (computed on CALIB 4.0)		—	—	3560 ± 50	(1s) 1950 (1900) 1850 cal B.C. (2s) 2010 (1900) 1740 cal B.C. *(1s) 3900 (3850) 3800 cal B.P.* *(2s) 3960 (3850) 3690 cal B.P.*	This report

[1] All samples were *Rangia cuneata* shell.
[2] Samples without $^{13}C/^{12}C$ ratios were corrected using the mean of the 41JF27 samples (–5.3 ppm) as the best local estimate.
[3] Date is assumed to be conventional; calibration was computed without further carbon isotope ratio correction.

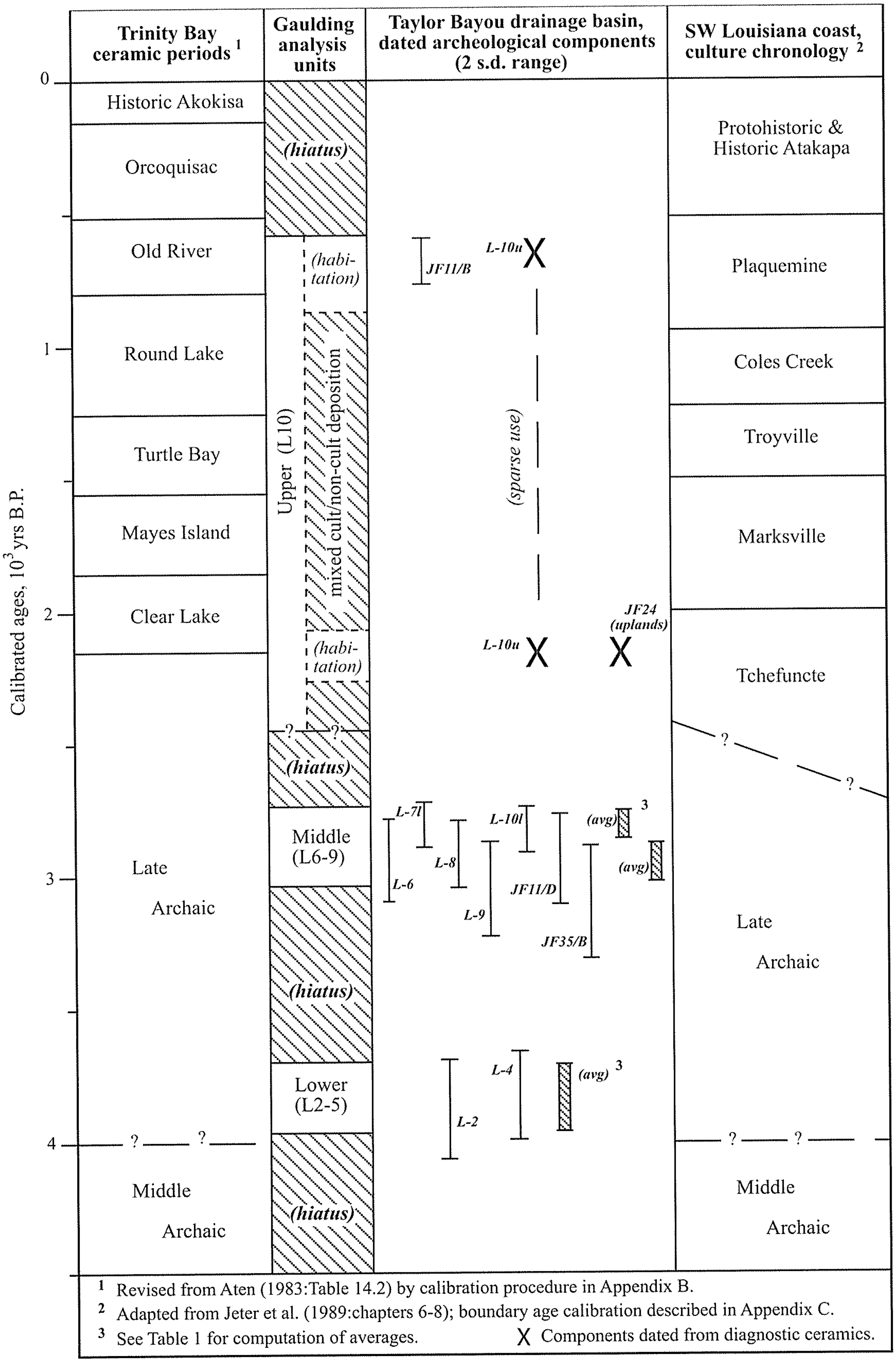

Figure 9. Culture chronologies bracketing the Sabine Lake area, and radiocarbon dates from sites in the Taylor Bayou drainage basin.

cultural. A question remains whether the Layer 10 (lower) radiocarbon sample actually dates the lower part of Layer 10, or whether the lower part of Layer 10 includes shells disrupted from the underlying shell mound surface of Layers 7, 8, and 9. Layer 10 is probably the most unmistakable stratum at Gaulding; it is thick, it blankets the entire site, and it is lithologically and visually distinctive. At this time, it looks as if Layer 10 represents very gradual depositional conditions and that the shells in the lower part of Layer 10 include some from the underlying mound surface.

Finally, as important as it is to recognize the periods of archeological accumulation, it is equally important to note that the hiatuses in the site represent at least three-fourths of the time elapsed since the earliest occupation circa 4,000 years ago.

Stratigraphic Analysis Units

Inspection of cross-sections B-B' and C-C' (Figure 6) shows that correlation of some strata is straightforward, while others are speculative. Nevertheless the correlation between the two datasets is fairly clear (Figure 8). The 1965 zonal terminology was correlated throughout the 1965 profiles (Figure 6) not long after the field school excavation by C. N. Bollich and it seems best to adopt that interpretation coming as it did while the excavation was still fresh in mind. Generally it is consistent and reasonable, although there are sections, as in the south wall of Test Pits A-1 and A-2, which cannot be clarified without re-opening the site.

Arbitrary levels at times, and depositional strata, or layers, at other times were used to control the 1965 excavation. Because there were relatively few specimens recovered, and because of the difficulty in correlating the different kinds of excavation units, a "lumping" rather than a "splitting" approach was taken. For culture-historical purposes, the site was chronologically subdivided into three parts, or *stratigraphic analysis units* – upper, middle, and lower – based on the three distinctive and well-dated periods of archeological accumulation described above. Rather than attempt to use individual layers and zones for site-wide analysis, this three-part scheme could be extrapolated through the 1965 excavation units with a minimum of confusion or debate, although there are places where an "educated guess" had to be made. The estimated correlation of analysis units with excavation units is shown in Appendix D. Lest there be any confusion due to the previously described three-part model of archeological sedimentation (i.e., matrix-bound top and bottom with complex middle section), and the three-part chronostratigraphy of the analysis units just described, these are two distinct and probably unrelated analytical devices.

Thickness and Depocenters

Because the 1965 field school excavations included numerous small test holes dug with shovels and post-hole diggers, it has been possible to reconstruct the limits and thickness of the shell deposit in some detail. With this information, lateral shifts in the centers of shell deposition can be noted, a feature not as evident on conventional stratigraphic cross-sections. The thickness map (Figure 10) shows several thick and thin irregularities in the overall deposit but with the greatest site mass generally in its center. In the same figure, a thickness cross-section along the W100 line is presented in which the thickness measurements are plotted downward from the ground surface. This direction was used, rather than making the bottom of the deposit the zero line because it is known the surface is relatively smooth and that the base is irregular.

The stratigraphic analysis units (A.U.'s) are identified on the thickness cross-section (Figure 10) and they give an indication of shifting depositional centers during the site's history. The lower shell deposits fill the original irregularities of the gullied Middle Holocene land surface from near N130/W100 eastward to N330/W100 near the bayou. The earliest deposits (i.e., the Lower A.U.) are midway along the length of the site primarily between excavation units B-1 and C-1. The principal accumulation during the Middle Analysis Unit shifted noticeably to the west and from N80/W100 to about N200/W100. The principal deposition of the Upper A.U. was at the eastern end of the site from N200/W100 to N330/W100, but extended westward well past the limit of the Lower and Middle analytical units. Later, evidence presented on the distribution of ceramics will confirm this eastern end as the focal area for cultural deposition in the Upper Analysis Unit. Nevertheless, the dark, loamy sediment of this layer may blanket the entire site and beyond, giving rise to the downstream bend in the topographic ridge on top of the site (Figure 4) and possibly extending even farther downstream to form the upper loam with incorporated *Rangia* shells at the pimple mound in Area D.

To conclude this section on site structure, there are several aspects of the geometry of the Gaulding site that seem unusual:

1. The prominent air photo lineation south of the shell mound to which the mound's overall elongate form appears to be oriented rather than to the present course of Taylor Bayou;
2. The evidence of a period of erosion directly against the south (i.e., grid east) side of the shell mound sometime after the formation of the Middle Analysis Unit; the black clay matrix of the colluvium suggests that the accumulating eroded shell fragments were washing down into marsh or lacustrine deposits and not into a flowing stream like Taylor Bayou. The overlapping of the colluvial shell by first a thick black clay and then a peat, both without shell, indicates that low energy marsh formation conditions continued for some time;
3. The principal depocenters for the Lower and Middle Analysis Units were in the center and western end of the shell ridge and not adjacent to Taylor Bayou. While the Upper Analysis Unit (Layer 10) covers the entire site and beyond, the archeological portion of the unit is

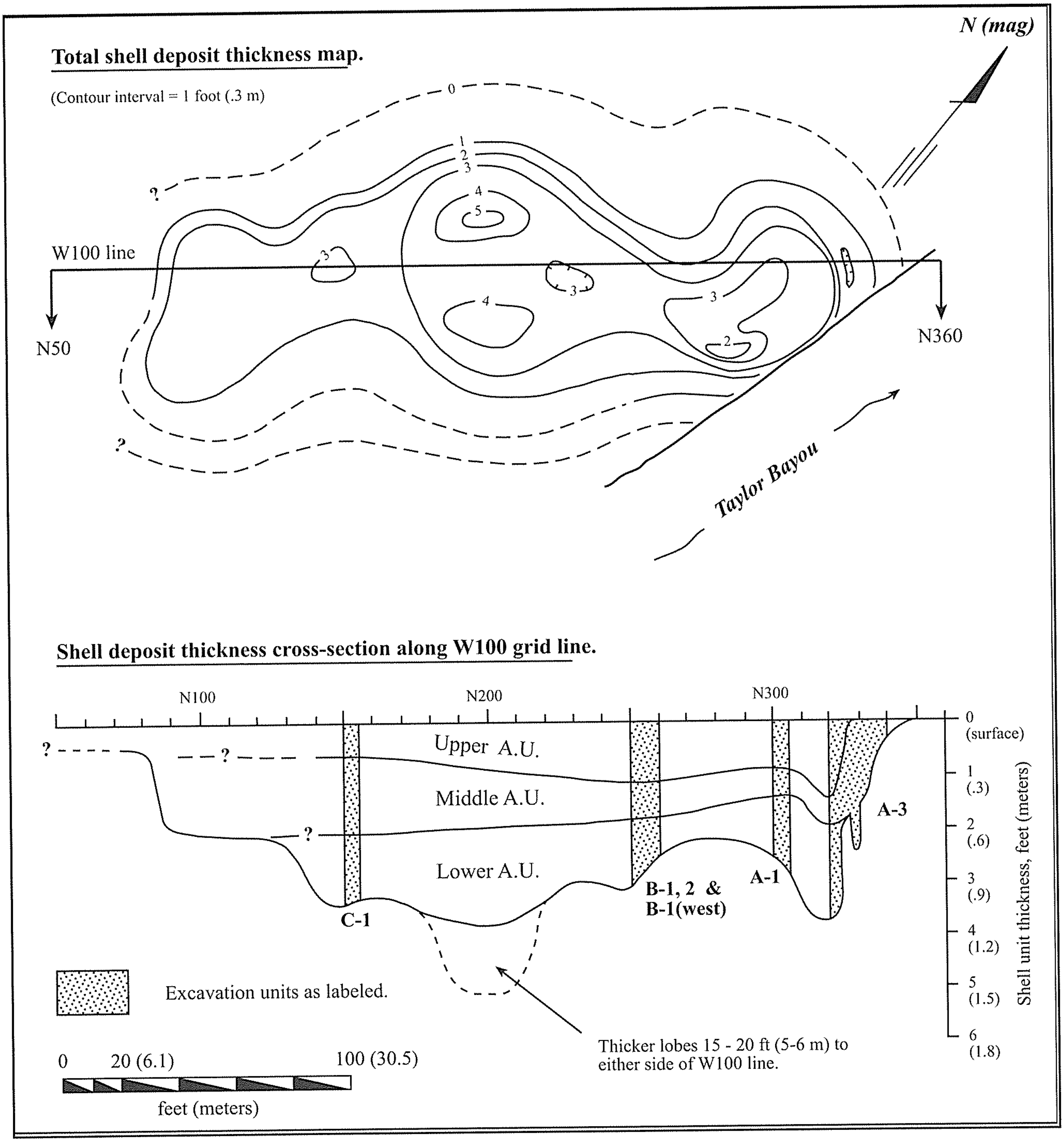

Figure 10. Isopach (thickness) contour map and thickness cross-section of Gaulding site, 41JF27, shell deposit.

confined primarily to the eastern end of the shell mound near the bayou.

4. At the same time, the hydrological impact of Taylor Bayou on the Upper Analysis Unit (Layer 10) is evident in the downstream trending surface contours seen on the site's topographic map. Because there is not a levee ridge all along the bayou, the downstream-deflected contours may not be deposits from overbank flooding. Rather, they may be Layer 10 (Upper A.U.) materials reworked and displaced downstream during bayou flood periods.

5. The Gaulding site stratigraphy apparently conforms to the three-part aggradational model of shell deposits containing little binding matrix sandwiched between horizontal, matrix-bound shell deposits above and below. While the formation of the middle deposits may

conform to models that have been proposed, the origin of the upper and lower layers is not clear.

ARCHEOLOGICAL SEDIMENTS

The previously described physical and chronological stratigraphies make it possible to recognize the succession of differently composed strata, and how the archeological shell mass correlates with the surrounding landscape. The visual distinctiveness of the Gaulding site strata is owed to variations in the composition of matrix and shells in each layer. To examine these differences more carefully, eleven bulk samples were taken in 1995 from the newly exposed B-1 (west) profile (Figure 11). The procedure used for analyzing the samples is described in Appendix B, part 4. While analyzing bulk samples gives a much more refined view of the contents of the stratigraphic layers and indicates specific successional differences, it must be admitted at the outset that only one sample from each layer provides no basis for evaluating the two-dimensional range of activities that created a layer. To study within-layer settlement patterns, an array of similar samples would be needed. But, that is a problem to address in a future investigation. Despite this limitation, the bulk samples yielded much interesting evidence.

As a complement to the bulk samples, two 24-inch (.6 m) cores were taken (Figure 11), for use as a permanent stratigraphic reference (see Appendix B, part 5). Since the cores were taken immediately adjacent to the B-1 (west) profile that was recorded in detail, the reference halves of the cores were correlated with the profile and then examined for features that would augment the lithologic descriptions (Appendix B, part 3). However, because of the similarity of the outcrop profile and cores, the latter were not independently described. Thin sections also were made from the other half of the split cores and were scanned under a petrographic microscope by Paul Goldberg (Boston University) for this project. While not a detailed study, those preliminary findings are included at appropriate places in the following discussion.

Grain size analysis

The first stage in analyzing the bulk samples was to divide them into size fractions to facilitate comparisons (Figure 12). Using Layer 1 (i.e., the Beaumont Formation) as a baseline for the sediment most likely to be incorporated into the archeological site from higher topographic surfaces nearby, it is apparent that all of the samples, perhaps excepting Layer 10 (lower), are similar except for the archeological shell they contain. That is, except for shell and other archeological materials mostly held in the 2ϕ and larger screens, very little geological sediment is larger than 3ϕ(.125 mm).

The next notable feature of the sieved samples is that grouped together in the middle of Figure 12 are the samples from Layers 2 and 10 (lower) followed a little higher up by the samples from Layers 3 and 10 (upper). These four samples comprise, at Gaulding, the manifestation of the lower and upper horizontal matrix-rich units that were described as part of the three-part aggradational model in the "Site Structure" section. The grain-size curves show that these bounding layers differ from the middle deposit in two respects: 1) they have a larger proportion of matrix; and 2) their mean grain sizes coarsen upwards. That is, Layer 2 has more matrix material than Layer 3, and likewise, Layer 10 (lower) has more matrix material than Layer 10 (upper). The grain-size curves also show that all other layers – those comprising the middle section of the B-1 (west) profile – clustered together at the top of the graph. This means these layers are all similar in their grain sizes, and that they have much less matrix than do Layers 2 to 3, and 10 (lower) to 10 (upper).

The grain-size curves confirm, up to a point, the visual impression of differences between layers seen and described at the B-1 (west) outcrop. They go beyond the outcrop descriptions in showing quantitatively that: 1) bottom and top layers are initially finer grained but lose matrix as they accumulate; and 2) that all the other layers are more or less similar to each other in their material sizes. From the standpoint of grain sizes alone, the only difference between any of the samples is in the addition of archeological materials, and in the degree of fineness of their size. In this way, the grain-size curves suggest that different activities or processes created the upper and lower layers versus creation of the middle layers. The middle layers all represent accumulation/reduction processes (i.e., habitation activities) that produce similar grain sizes, while the upper and lower zones may represent or be the result of something different.

Grain-size sieving of the bulk samples also makes it possible to look at the classification of archeological sediments in alternative but somewhat objective ways. Visual inspection of the fractions from all the samples with a binocular microscope at 10x and 20x indicates that materials larger than 3ϕ(.125 mm) are almost entirely related to the archeological use of the location, i.e., shell, bone, charcoal, etc. Moreover, materials retained in the –3.65ϕ (larger than 12.5 mm) are whole shells and very large shell fragments with only an occasional bone or artifact. The -2ϕ(4 mm) to 3ϕ(.125 mm) fractions are largely shell fragments, but include bone and a host of other materials related to the archeological occupation. Materials that are 4ϕ(.062 mm) or smaller (i.e., very fine-grained sand, silt, and clay) are almost exclusively clastic sediments derived from various nearby facies of the Beaumont Formation. The fine-grained (3ϕ or .125 mm) fraction in some bulk samples have substantial amounts of natural sediments, but in all cases a majority proportion is archeological. This latter size class is the pivot point between natural and cultural sediments in the layers.

Given these size-material relationships, it is possible to take a "cultural" view and a "sedimentary" view of the grain-size data and classify the layers in slightly different ways. The "cultural" view emphasizes the formative processes lead-

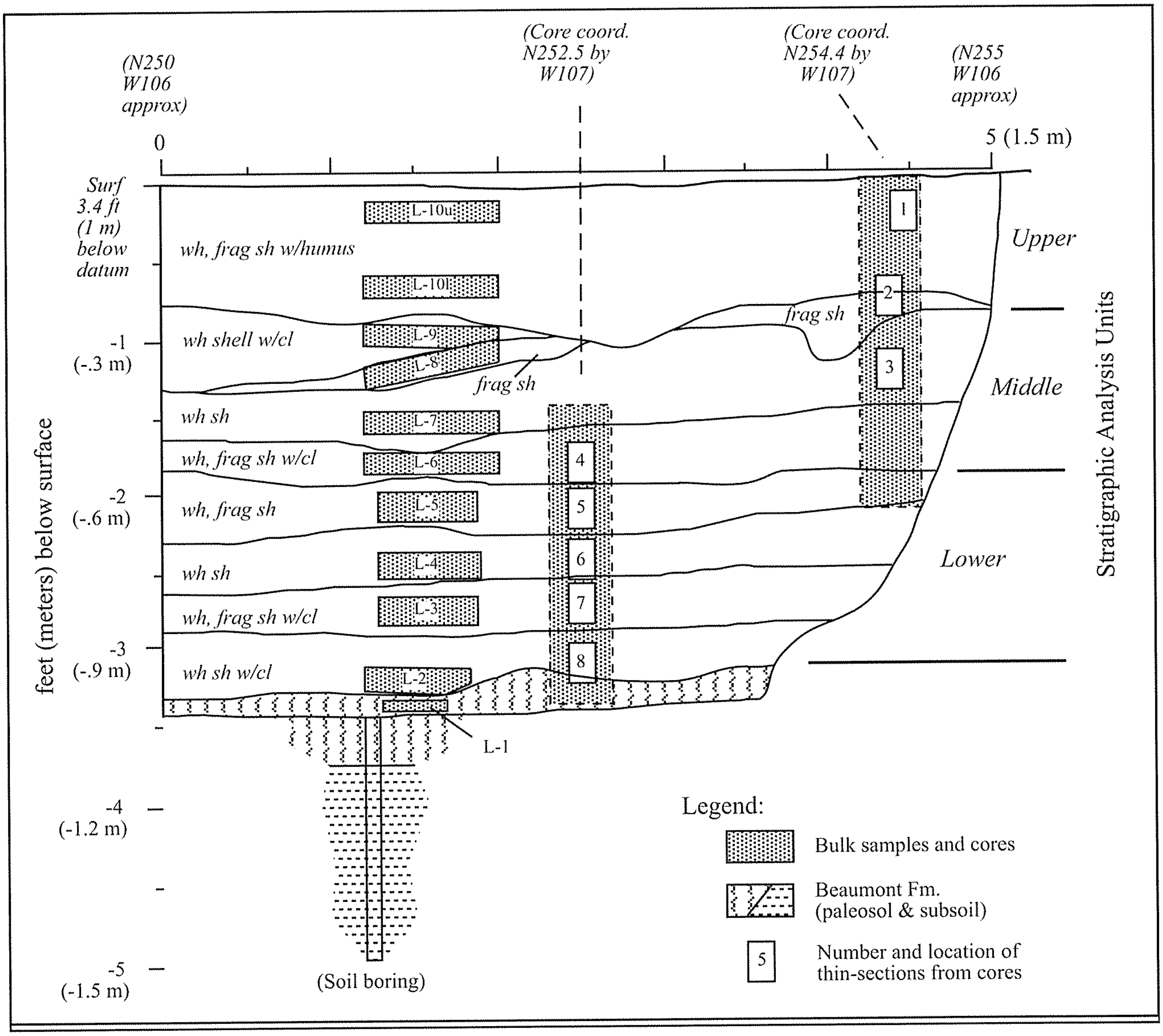

Figure 11. Locations of bulk samples, undisturbed cores, and thin-sections at the B-1 (west) profile, Gaulding site, 41JF27.

ing to hearth/refuse pile couplets (Aten 1983a) that may be what formed deposits in the middle layers at Gaulding. This approach visualizes deposits as a relationship between whole shell (and large fragments), fragmented shell (and other small archeological materials), and a natural sedimentary matrix. Plotting the weight percent values (Table 13) for each layer as a three-pole plot (Figure 13a) highlights more subtle differences between samples than is obvious in the cumulative grain size plots (Figure 12). For instance, none of the B-1 (west) bulk samples truly qualifies as "whole" or "fragmented" shell as is often used to label strata in field descriptions. At the same time, none of the samples truly qualifies as predominantly sedimentary, even those with the interstitial spaces filled with sediment. All of the Gaulding samples are significantly intermediate even though they are distinguishably different when viewed at the outcrop. In particular, and unlike the cumulative grain size plot, the three-pole plot identifies Layer 5 and possibly Layer 8 as different from the rest of the middle layers. The remainder of the groupings is similar to those in Figure 12.

The "sedimentary" view of the bulk samples looks at them in the often used "gravel-sand-mud" framework of sedimentation studies, although in this case the term "shell" is substituted for gravel (Figure 13b). Quantitative characterization of the three-part aggradation model (i.e., upper and lower matrix-rich zones encasing a middle, structurally complex, matrix-poor zone) is clearest in this plot. The coarsening upward pattern of the upper and lower zones is reasonably clear also. And overall, it is again clear that all of the archeological layers have proportionally little natural sediment. The respective descriptive classifications from all of these analyses are compared in Figure 8.

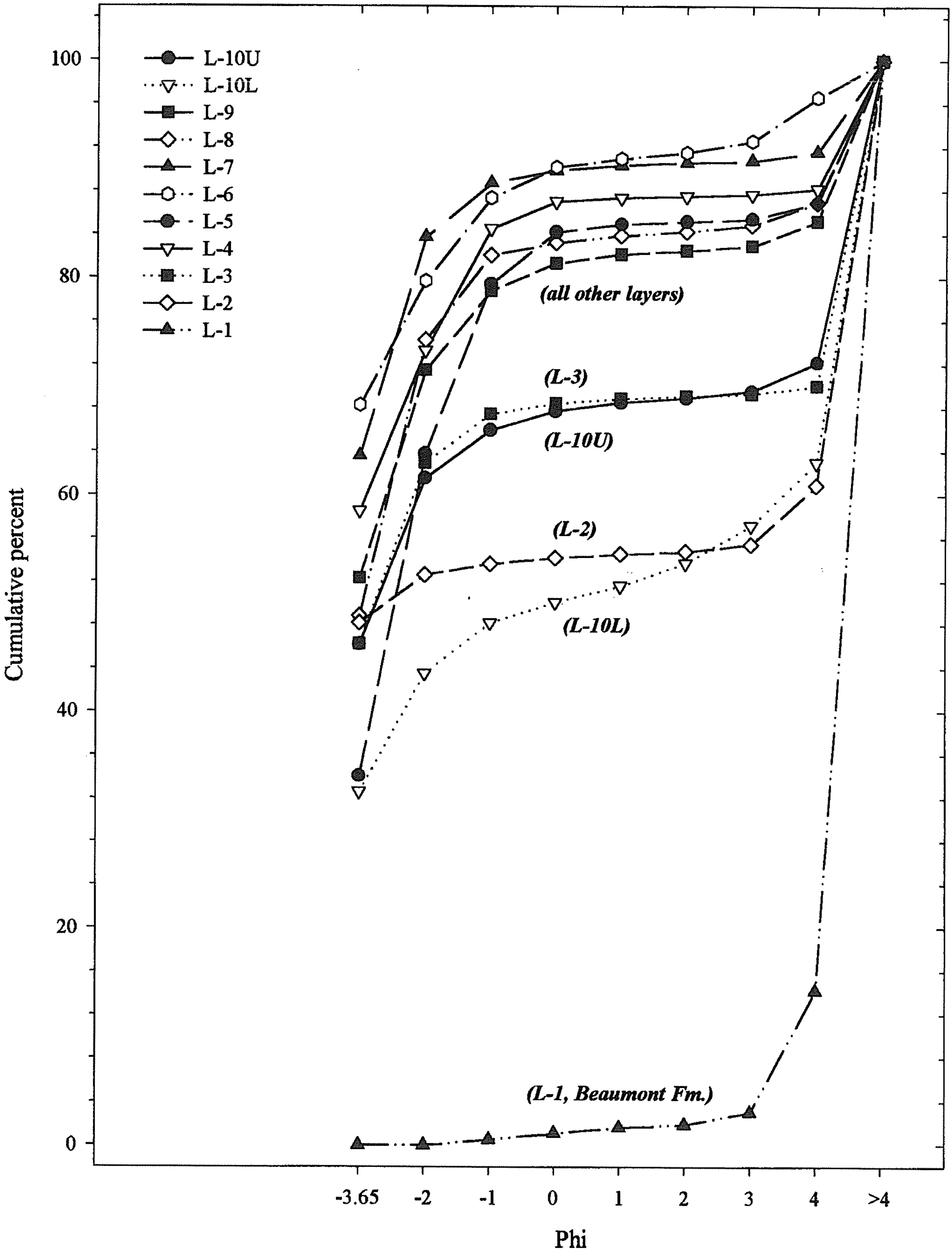

Figure 12. Cumulative grain size plots; profile B-1 (west) bulk samples, Gaulding site, 41JF27.

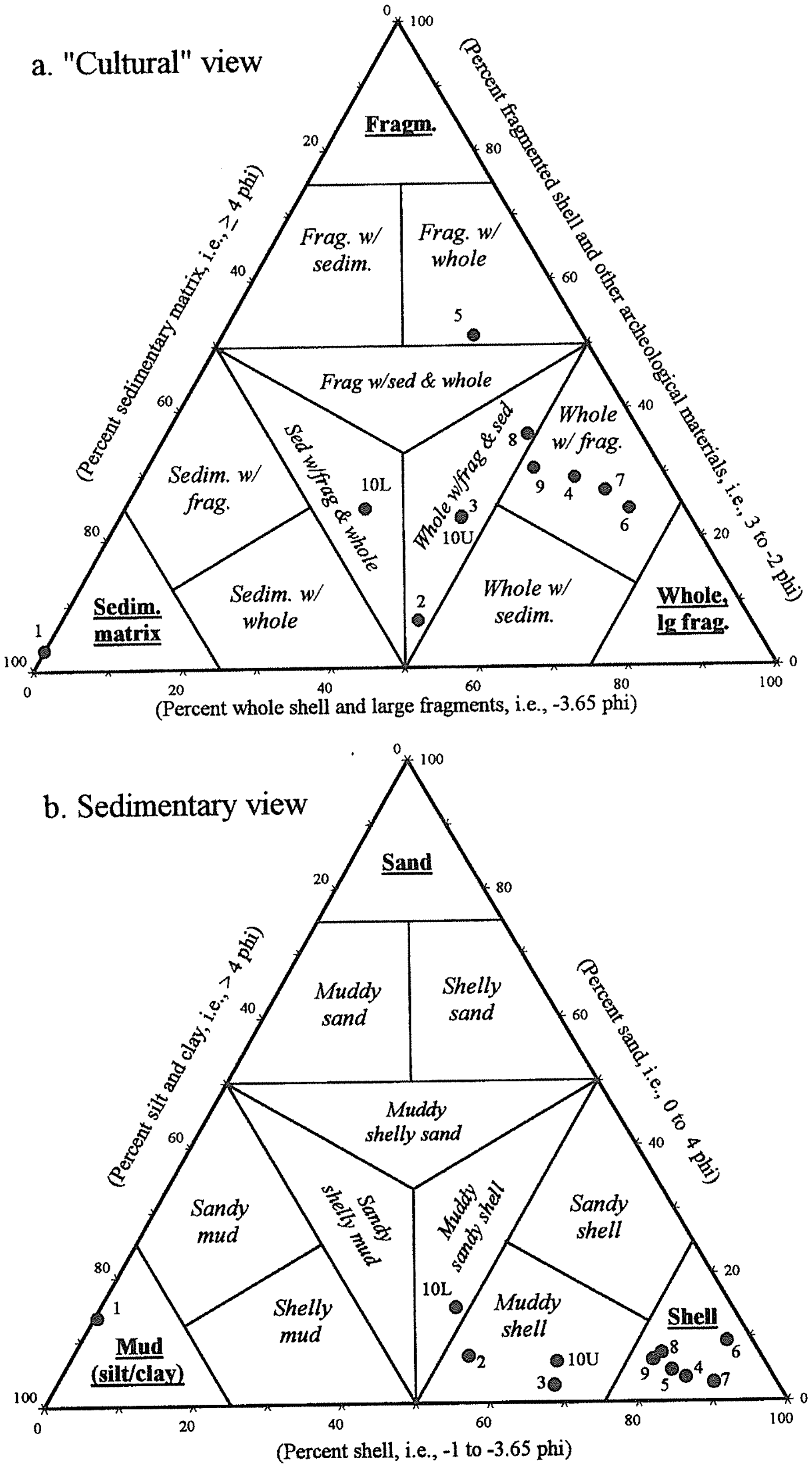

Figure 13. Additional perspectives on grain-size composition of bulk samples from the B-1 (west) profile, Gaulding site, 41JF27; a, the principal cultural and natural components; b, the sedimentology view. Samples identified by layer number. Classification for "b" adapted from McGowan and Morton (1979:Figure 3).

Composition

As previously noted, the Gaulding bulk samples consisted of large objects (nearly all *Rangia cuneata* shells) forming the structural framework of a layer, and small objects (consisting of both archeological and geological materials) that filled the interstitial spaces. The large objects reflect several manufacturing and use activities and may or may not have been found in their primary discard location. Data on the large materials was obtained from the -2ϕ(4 mm) and larger screen fractions, and included the number, size, and condition primarily of shells, bones, and some artifacts (Table 14). This material signifies either the locations of fire hearths, food preparation areas, and/or tool manufacture or maintenance. They also may indicate agglomerations of such materials that were cleared from living areas and placed in midden areas.

The small objects are equally complex and indicate various cultural activities, elements of the site environment, or post-deposition alteration of the site's materials. They are much too small to be gathered up and moved, and probably were found where they initially formed or were discarded. Conceivably, certain of these components may constitute an activity "signature." The 1ϕ(.5 mm) fraction was selected for point-counting because the particles were large enough to be identified and counted under a 10x to 20x binocular microscope, while probably being small enough to be unaffected by any site clean-up behavior. All of the point counts are recorded in Table 15. Those results also are divided in Table 16 into habitation-related and post-deposition material, with separately computed percentages for a different perspective on the data. Finally, in addition to the sieved and counted data, pH was measured on matrix before sieving, and terrestrial snails were floated from each bulk sample before it was water-sieved.

The ratio of whole shells to fragmented shells (Figure 14a) suggests the relative extent of layer formation attributable to use as hearth/living areas (i.e., relatively more fragmented shells) versus using them as disposal areas (i.e., relatively more whole shells). Layer 2 stands out strongly as containing whole shells with very little fragmentary material. Even Layers 4 and 7 that were given field names of "whole shell" (Figure 11) contained enough fragmentary shell to have a low whole-to-fragmented-shell ratio. The only prehistoric means to create an abundance of fragmented shell from sound, whole *Rangia* shells is through the application of heat, and apparently Layer 2 simply did not have any or many fire hearths, at least in this part of the site. This interpretation is further supported by the paucity of burned shell described below.

The ratio of shell to sand/silt/clay matrix may suggest the degree of overbank flooding, slope wash down into the site or, conceivably, extended submersion of the site. The plot of this ratio (Figure 14b) affirms the conclusions discussed earlier that there is a clear, quantitative difference between the bottom and top layers versus the middle layers. Matrix is scarce in the middle layers, at least relative to the amounts found in the upper and lower bounding layers. The question remains whether a relationship exists between the three-part aggradational model and the obviously cultural activities that reduced whole *Rangia* shells to a fragmentary state. To examine this, a scatter plot was prepared of the two indexes (i.e., shell: matrix and whole: fragmentary). This indicated no correlated changes or trends between them. The lack of any apparent relationship may indicate that the three-part aggradational model is due to natural rather than cultural causes.

The material comprising the layers is nearly all shell but the larger bone fragments were counted since they are moderately numerous in the -2ϕ and larger fractions (Table 14). Since counts rather than proportions were used, however, the data recorded in Table 14 were normalized to the bulk sample size of Layer 10 (upper). The amount of bone in all layers below the Upper Analysis Unit was small (Figure 14c) but the frequency increased significantly in Layer 5 and again in Layer 10. Comparing the large bone sample to that from point-counting the 1ϕ matrix fraction (Figure 14d), the bone proportion from the small fraction partially reflects that seen in the larger fraction by significantly increasing in Layer 10 but not in Layer 5. This may indicate either a different manner or kind of food preparation, or different refuse disposal in the two layers. Charcoal is consistently present in very small quantities throughout all layers except Layer 2 where it is absent. However, inspection of the sieve fractions smaller than 1ϕ reveals charcoal as much more abundant. Fire fuels in the coastal marshes are easily consumed materials like twigs, small shrubs, cane, and the like. Large charcoal fragments generally are not found and that is confirmed here again by the contents of the sieve fractions. Charcoal particles this small (<.5 mm) probably are easily wind-blown over a larger area than their source. It may not be a good activity signature unless it is found in large quantities, or is notable by its absence. At Gaulding, the absence of charcoal in the 1ϕ fraction of Layer 2 is another indicator that it differs from the other layers. Since smaller size fractions were not counted, some caution is in order, but the basic conclusion of no use of fire in this part of Layer 2 seems sound.

Burned and unburned *R. cuneata* shell fragments are plotted in Figure 14d also. Confirming the previous indication that formation of Layer 2 in the B-1 (west) area of the site did not include much use of fire hearths, the proportion of unburned shell is high and of burned shell is extremely low. In the succeeding Layers 3 through 9, burned and unburned shell fluctuates from layer to layer in generally similar percentages. However, when Layer 10 begins, the quantity of both kinds of shell is reduced below the proportion of bone fragments.

Usually it is the case that the number of right and left *Rangia cuneata* valves is about equal in samples from discrete contexts or of any moderate to large size (Aten 1983a:13;

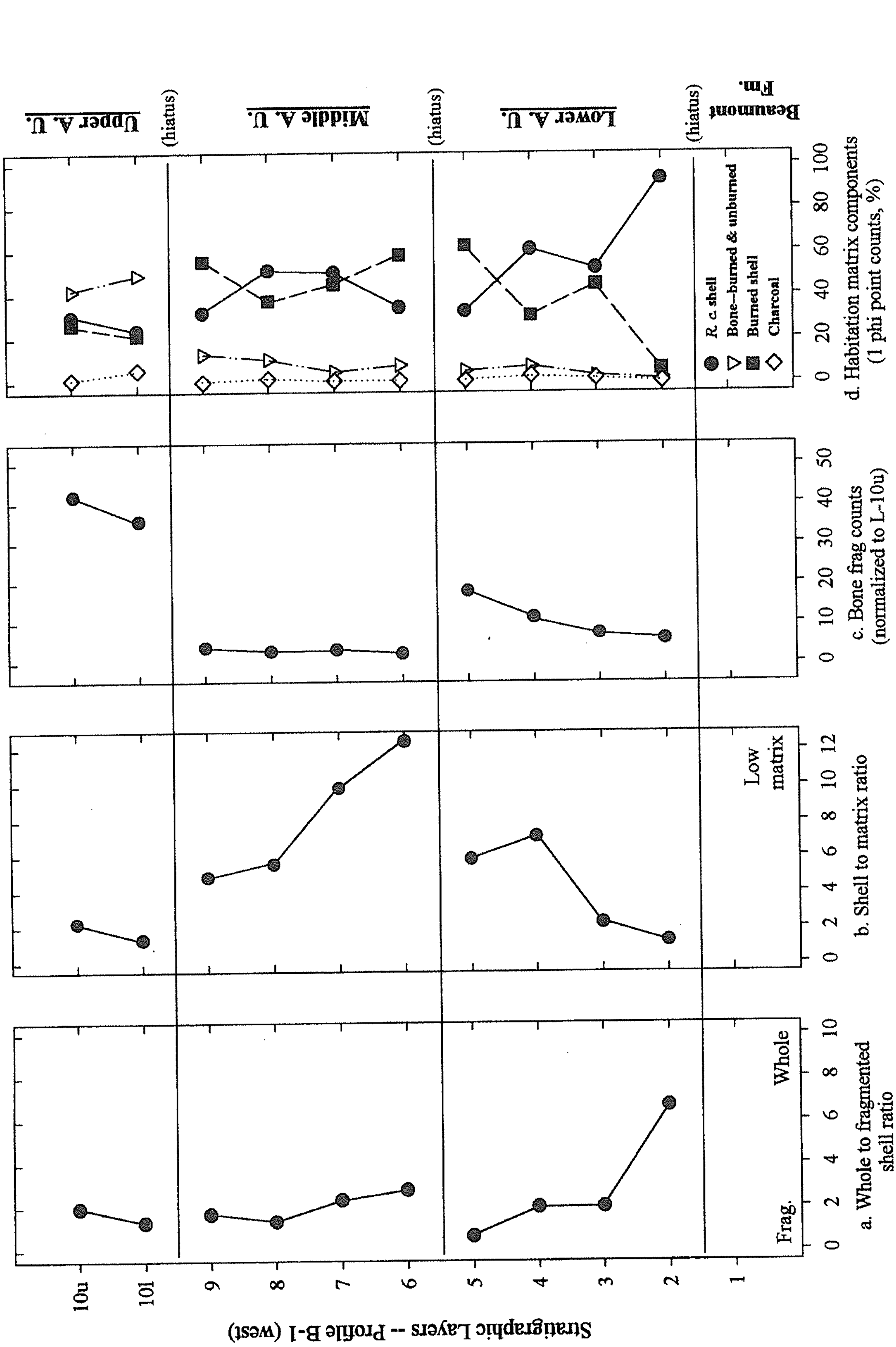

Figure 14. Stratigraphic layer composition. a) ratio of whole shell (and large fragments) to well-fragmented shell; b) ratio of shell to matrix; c) bone fragment counts (normalized to L-10u sample size); d) habitation-ralated characteristics expressed as percent of point counts (see Table 16). Data for a, b, and c are from the -3.65 and -2 phi fractions of bulk samples; d is from the 1 phi fraction of bulk samples taken from profile B-1 west, Gaulding site, 41JF27.

Weinstein 1991:173-175), although this may not be the case with *Rangia* in certain natural environments (Claassen 1998:74). In clam cooking experiments, it was observed that the right and left valves usually do not separate at the hinge unless heated excessively, in which event the shell is shattered and the meat is dried or charred (Aten, unpublished notes). So the expected situation in primary *Rangia* shell disposal contexts is approximately equal numbers of valves from both sides. For this reason, the ratio of right to left valves was compared for each layer (Figure 15a). Again, Layer 2 is distinguished from the other layers by having an abnormally large number of, in this case, left valves over rights. If Sabine Lake area prehistoric campsites that were inhabited for extended periods – say for weeks – were subject to periodic cleanup, this would result in secondary deposits, as are known from some contemporary shellfish gatherers (e.g., Meehan 1982). But whether such secondary deposits would be likely to have such a valve imbalance is unknown.

The maximum shell length was measured for all whole *R. cuneata* valves of whichever side had the largest number of specimens. From these data, both growth cohort histograms were plotted and shell length descriptive statistics were computed (Table 14). The growth histograms will be used later, but at this point the mean shell length is plotted as an indicator of the size of the clam population being exploited (Figure 15b). A distinct difference exists between the small clams harvested during the Lower Analysis Unit, and the larger ones harvested in the later units. This may have environmental implications and will be discussed again later. The question also arises whether the product of number of clams and the estimated meat weight represented by the mean shell length for each layer (Table 14) indicates a difference in amounts of shellfish meat harvested. These data were normalized to the bulk sample dry weight of the Layer 10 upper sample to facilitate comparison. The results indicate that most layers represent similar amounts of shellfish meat perhaps excepting Layer 7, which has a greater amount.

The habitation-related composition characteristics just described provide further refinements on the nature of the layers and their differences. They reaffirm the three-part aggradational model of matrix-rich upper and lower layers bounding the matrix-poor intermediate layers. But, while the upper and lower zones are superficially similar and matrix-rich, they are, nevertheless, quite different. Layer 2 is unlike any other layer in the site, with a large proportion of whole shells, abundant sedimentary matrix, an overall grain size distribution that is strongly bimodal, a striking paucity of evidence for using fire, and an unusual mismatch in the number of right and left clam valves. Layer 3 also is part of the lower zone but its only characteristic is the abundant fine matrix; otherwise it is similar to the contents of the middle layers. This may suggest that the reason for the excessive fine matrix is unrelated to the cause of all the other unusual, but habitation-related, features of Layer 2.

Layer 10, on the other hand, shares only the attribute of abundant sedimentary matrix with Layers 2 and 3. The greatest difference between Layer 10 and all the other layers is its much higher incidence of finely comminuted bone fragments and whole bones of very small animals. When subsistence evidence is discussed later, differences will be evident in the focus of subsistence between layers. Although the large fractions of the Layer 10 samples contained more bone fragments than earlier layers, there was no accumulation of fragmented large mammal bone as would be the case, say, where bone grease was being produced. Rather the small fractions are notable for the often whole bones of very small animals that must have been eaten essentially whole and the results of that consumption were being accumulated in the area of Layer 10 that was sampled.

The intermediate layers – 4 through 9 – and to some extent Layer 3 as well, have a substantial mixture of whole and fragmented shell, a fluctuating but substantial mix of burned and unburned shell, little fine matrix, very little bone or charcoal refuse, and more nearly matched right and left clam valves. It may be notable that in Layer 5 the bone fragments increased in the large fraction but did not increase in the matrix.

The indicators just described are primarily oriented to the cultural formation and use of the site's layers. The data set to be described next seems to relate to post-depositional modifications of the archeological sediments. At the outcrop it was noticed that *Rangia* valves that were horizontal and concave-upward often were encrusted on their interior surface with redeposited calcium carbonate. This was a sign of clam shells being actively leached at higher elevations and the mineral being precipitated again at lower elevations. The number of shells with carbonate crusts was recorded in the -2ϕ and larger samples (Table 14) and the percent of such shells was plotted (Figure 15c). In general the frequency of encrustation increases with depth but it is especially prominent in Layers 2 and 7, and especially deficient in Layer 10. The significant accumulation of carbonate crusts in Layer 2 likely is due to the ponding and evaporation of rain water at the top of the relatively impermeable Beaumont Formation. The more modest increase in Layer 7 may also reflect somewhat less permeability through the underlying Layer 6, which has some fine matrix. A similar pattern was obtained from the 1ϕ matrix sample that was point-counted (Tables 15 and 16).

Measurements of pH were made on matrix from all bulk samples (Table 14; Figure 15d). As would be expected, given the downward mobility of dissolved calcium carbonate, the pH steadily increases (i.e., becomes more alkaline) downward with an apparent stair-step pattern tied to the three stratigraphic analysis units. In this case, the pH pattern suggests that Layer 6 might be part of the lower stratigraphic analysis unit, despite other evidence to the contrary.

The matrix samples often contained small (circa 1 mm or less in diameter) iron concretions that are presumed to form under repeated wetting and drying conditions. These were

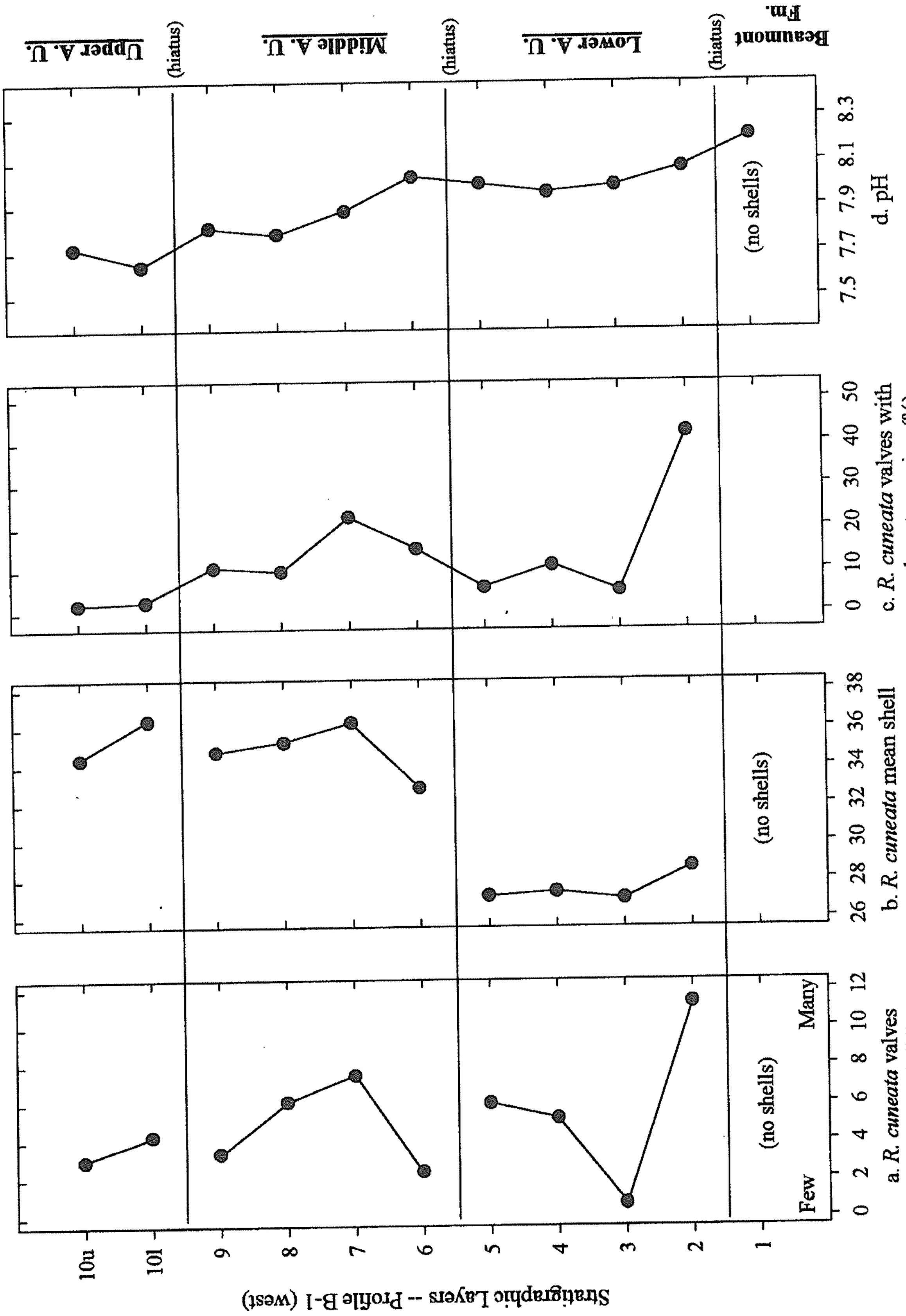

Figure 15. Stratigraphic layer composition continued. a) percent of under-represented right or left *R. cuneata* valves; b) mean *R. cuneata* valve length (mm); c) percent of *R. cuneata* with calcium carbonate precipitation crusts; d) average matrix pH. Data for a, b, and c are from the -3.65 and -2 phi fractions of bulk samples; d was measured on unsieved matrix from bulk samples taken from profile B-1 west, Gaulding site, 41JF27.

recorded as part of the point counting (Tables 15 and 16) and when plotted (Figure 16a) show a clear stair-step pattern closely following the interpreted stratigraphic analysis unit sequence. Presumably there are more such concretions in the lower and older deposits and particularly in Layer 2 because of its dense matrix. Although not point-counted, there also is an abundance of iron concretions in Layer 1 underlying the site.

The 1ϕ matrix samples often contained vegetal fragments, usually rootlets. Although the majority of vegetal materials were floated out of the sample before sieving, the remainder were point-counted just to see what would develop (Tables 15 and 16; Figure 16b). As it turns out, distinct peaks of vegetal fragments occurred in Layers 3, 8, and 10 (upper). These locations each are 10-20 cm below the former and the current ground surfaces at the site. Presumably the vegetal fragment plot also supports the three interpreted stratigraphic analysis units.

In the higher layers it was common in the point-counting to encounter small (ca. .5 mm), often cylindrical, indurated, dark gray clay and silt pellets that appear to be worm casts; these were abundant especially in the lower part of Layer 10 (Tables 15 and 16; Figure 16c). These pellets rapidly diminished with depth. Aside from confirming a sharp depositional break between Layers 9 and 10, they indicate that, unlike solutes, it was rare for even small particles to migrate downward through the deposit.

When the bulk samples were soaked before sieving, a sizable collection of terrestrial snails was floated to the surface (Table 14). A report on these samples is included (Appendix F) and their environmental implications are discussed later. However, the number of individuals recovered by layer is noted and plotted after being normalized to the size of the Layer 10 (upper) sample (Table 14; Figure 16d). Their paucity in Layers 2, 3, and 10 may be related to the matrix-rich character of these layers and perhaps indicates that when these layers were formed they were wet frequently, or perhaps even submerged, and were environments inimical to terrestrial snails. Clearly this was not the case during the middle stratigraphic analysis unit. Just what was the immediate site environment in the time of Layers 4 and 5 is not clear; perhaps it was like conditions during Layers 2 and 3, but not quite as extreme. In any event, the pattern of terrestrial snail occurrence also reinforces the interpretation of upper, middle and lower stratigraphic analysis units. In addition, fragments of broken snail shells were recorded in the point-counting of the 1ϕ matrix fraction (Tables 15 and 16) and these also yielded a frequency distribution that paralleled that of the floated samples.

Bulk samples from the 1965 excavations as well as the large and small fractions of the 1995 sieved samples also contained occasional fragments of unidentified oysters and mussels (Tables 14, 15, and 16). Based on recovery of more complete specimens from the excavated levels, these probably were *Crassostrea virginica* and its commensal mussel *Brachidontes spp.* Very likely the mussel was collected incidental to collecting the oyster. The provenience data are too imprecise to interpret whether these shellfish are confined to only certain layers. However, it is clear that both species were present in each of the three stratigraphic analysis units.

The presence of oysters in the site matrix has important paleoenvironmental significance. In the mid-20th century, single and clumped oysters were found scattered about the southern one-third of Sabine Lake (Kane 1961; White et al., 1987). Current geological investigations indicate this confinement to the lower lake appears to have characterized the past 4,000 years except for one brief time (Anderson et al. 1991) when they may have spread farther into the interior of this estuarine system. However, finding oysters during all three chronostratigraphic analysis units suggests that either there have been more marine water influxes that have gone unrecognized, or that Gaulding inhabitants traveled the 25 km downstream to harvest oysters from Sabine Lake. This and several other observations made about the estuarine shells (Table 9) will be discussed later in conjunction with the Taylor Bayou paleoenvironment.

Before concluding this section on the composition of the several layers at Gaulding, there are a few additional comments that can be made as a result of inspecting the thin-sections (P. Goldberg, personal communication, 1999), cores, and from the outcrop layer descriptions. On the basis of what has been described so far there is a temptation to see the matrix of Layer 2 as similar or identical to Layer 1 and that perhaps the shells were intruded into the top 10 cm or so of Layer 1. This may or may not be the case. From inspecting the thin-sections under reflected and transmitted light, it is clear that at the boundary between Layers 1 and 2 there is an abrupt reduction in the abundance of iron concretions in Layer 2, and an abrupt increase in relative proportion of silt in the matrix. And the gleyed condition of Layer 1 is not developed in Layer 2. Thus, despite the general similarity of color and appearance of the matrix, these two layers are texturally distinct. However, the pedological description of Layer 1, as the Morey Silt Loam, notes that the uppermost part of that soil's profile is generally a silt loam underlain by clay or silty clay loam (Crout 1965:12, 62). This may be what the Gaulding samples reflect.

Next, it is clear from both the thin-section and the core that Layer 6 has some brown to grayish brown, fine-grained clay matrix with some orientation developed indicating the occurrence of a degree of pedogenesis, as well as some reworking by earthworms. It may be that the former mound surface at the top of Layer 5 is actually a little higher than was observed at the outcrop in the field. A little ambiguity on this point is evident in some of the compositional characteristics described in the preceding pages, although on the whole, Layers 5 and 6 are distinct. The thin sections of Layer 10 indicate earthworm casts and that the dark brown matrix is biologically reworked, presumably by worms.

Finally, it may be significant that in the outcrop descrip-

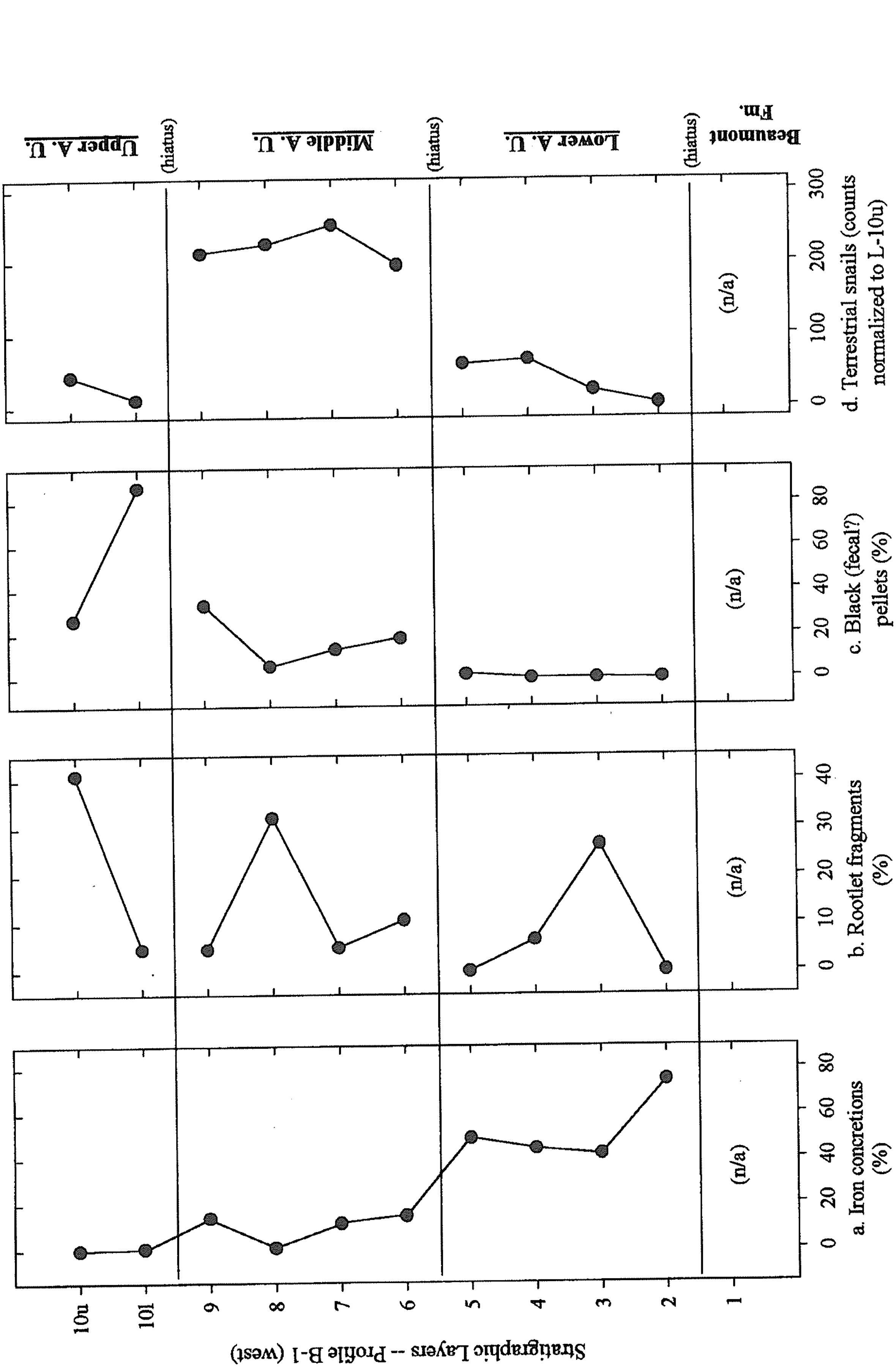

Figure 16. Stratigraphic layer composition continued. a) percent of iron concretions; b) percent of vegetal fragments, mostly rootlets; c) percent of fecal(?) pellets; and d) abundance of terrestrial snails, normalized to size of Layer 10 (upper) sample. Data for a, b, and c are from 1 phi fraction point counts (see post-depositional data, Table 16); d is from the pre-sieving float (Table 14). All bulk samples were taken from profile B-1 west, Gaulding site, 41JF27.

tions (Appendix B, part 3) it was noted that the clam shell orientations in Layers 2, 4, and 6 seemed random, as were a strong majority in Layer 3. But strong majorities of shells in all other layers were horizontal. Although there have been some taphonomic studies that included discard orientations of shell deposits (e.g., Claassen 1991:267), there have been none on *Rangia cuneata* and so it is difficult to interpret this observation. However, it is unmistakable that the manner of disposal in the Lower Analytical Unit is different from that in the Middle and Upper Analytical Units, further reinforcing the indications that dissimilar formation processes were responsible for the several stratigraphic layers at B-1 (west).

FORMATION PROCESSES

Whether Gulf coast shell sites actually are archeological, a common question about shell sites in past years, was raised locally as recently as 1983 in a report on test excavations on nearby Hillebrandt Bayou (Raab and Smith 1983). They brought up the issue in relation to two shell deposits dating approximately 2900 calibrated years ago and in which they observed no unequivocal cultural materials retained in the ¼ inch (6.5 mm) screens. The conclusion that shell mounds are not archeological usually takes the form that natural processes caused shell heaps to be established and that Indian peoples often made campsites on their surface (e.g., Pearce 1932). Numerous criteria have been put forward for determining whether a shell deposit is archeological or natural in origin, some dating back to the mid-19th century; recent examples are Anderson and McBride 1996, Bailey et al. 1994, Boyajian and Thayer 1995, McBride et al. 1997, and O'Conner and Sullivan 1994.

This is not a difficult question on the northern Gulf of Mexico coast. Natural shell deposit characteristics are either a function of species biology or of the energy environment that concentrated them into secondary deposits. Biological and low energy settings are not relevant to this issue because in such locations the shells remain in stream channel, lake, bay floor, or beach deposits. They are low density and bear no resemblance to archeological sites. In higher energy settings, such as the shore of lakes and bays – environments with a long fetch – substantial shell berms do form as secondary concentrations that in gross size are comparable to some archeological shell sites. The materials are derived either from the bay floor, or from shoreline archeological shell sites that are washed farther inland. The resulting berms are characterized by significant erosion of the shells, aquatic vegetation detritus, and sandy, non-organic matrix if there is any matrix at all. The high-energy wave environment usually removes most small clastic sediment and particles of habitation origin.

Clearly the Gaulding site is at least partly archeological because it contains artifacts interbedded with shell materials. However, the remaining evidence for a cultural origin of the shell accumulation is overwhelming. The site is located adjacent to a confined and very short fetch water body along which even major cyclonic storms could not create such a large, discrete, shell mass. There were repeated episodes of accumulation, centuries apart, but at precisely the same location. There is an absence of excessive wear and edge-rounding of the majority of the shells. The presence of burned shell, extensive preservation of very small bone fragments, and very lightweight materials such as charcoal, are not conclusive because, so the argument goes, natives camped on the shell surface, built fires, and so on.

Unfortunately, one of the sites at which Raab and Smith raised this issue no longer exists, but one remains and analysis of bulk samples there would be an appropriate means for seeking positive evidence of its origin. But there really are no locations, in the confines of the Taylor Bayou drainage basin, where natural processes could create shell deposits similar in mass to those recorded as archeological sites. There are, however, instances of shell deposits being created in historic times that might be confusing, such as now-abandoned shell-paved roads and ferry ramps near the bayou shoreline. Distinguishing these deposits from prehistoric ones might fruitfully entail examination of matrix if more obvious evidence was not found. In any event, there is no reason to think the Gaulding site is anything other than of entirely archeological origin, although natural processes have worked on and around the site over the centuries.

While it is certain that the Gaulding deposits are for the most part archeological, it is far from certain how they formed. Most archeologists working on the northern Gulf probably assume that diverse activities are responsible for formation of shell sites, but there has not been enough work yet directed at deciphering formation evidence (e.g., Aten 1983a; Gadus and Howard 1990; O'Brien 1974; Weinstein 1991). Generally it is assumed that the accumulated shell deposits at Gaulding and similar sites in the northern Gulf coast are food residues and living surfaces.

Nevertheless, perusal of ethnographic studies reminds us that there is a variety of other campsite habitation functions that can result in or modify shell deposits (cf., Claassen 1998:2-14). At a minimum there is the single meal period hearth/refuse pile couplet (Aten 1983a). Associated with selection of a location for habitation must be areas for voiding, which is significant because of the concentration of very small faunal remains that can result. If residency involves extended periods the campsite could additionally involve areas for small, temporary structures (O'Brien 1974: 49-51), as well as periodic cleanup of enlarged hearth/refuse pile(s) by collecting and dumping some of the latter in an area selected for the purpose (cf., Meehan 1982). Depending on the location, there may also be a need to dig a shallow well, an example of which may be responsible for Feature 1 at 41CH16 (Ambler 1973:52-53; Figure 10). Because water usually percolates rapidly through shell deposits, the deposit surface may have been favored for habitation during wet seasons, while during dry seasons it may not have mattered, thereby account-ing for many of the peripheral, low-density remains found in the vicinity of large shell sites. On other occasions when either a hot fire was needed (e.g., for pottery firing) or when fire fuels were scarce, it may have been necessary to make the fire on a shell surface to take advantage of the latter's excellent heat retention and radiation qualities (e.g., Aten 1983a:73).

Many campsite organizational patterns are possible. But the problem becomes much more complex when adding the element of accumulation through time. Addressing this question by simulating the repeated accumulation of hearths and refuse piles, Nodine (1987) used the organization of a well-known ethnographic shellfish gathering camp (Meehan 1982) as the starting point. The result showed rather convincingly that the outcome of a large number of repetitions of that particular pattern of hearth and refuse disposal would concentrate hearths in the central part of the shell deposit while primary and secondary refuse disposal would be more prominent on the periphery. Translating this into northern Gulf of Mexico terms, the accumulating site should have an abundance of fragmented shell deposits, many mixed fragmented and whole shell deposits, and some whole shell deposits in the central part of the site. Proportionally more whole shell deposits should be on the periphery of the shell pile. This idea cannot be rigorously tested with the data at hand, but inspection of the profiles suggests it might be consistent with the stratification of the middle portion of the three-part site aggradational model described earlier.

Another question that only recently is being scrutinized is whether it is reasonable to assume that all shell refuse is debris from human consumption (Claassen 1998:10). Is it reasonable to factor into subsistence and demographic projections that all these shells reflect a certain amount of clam meat, and a certain level of nutritional values? One alternative is for a prehistoric working party to harvest, open, and dry the clam meat for transport and consumption elsewhere by a demographically different group; there is no relationship between the group responsible for site formation and the amount of shellfish flesh harvested. Alternatively, some of the clam meat may have been used for bait to capture certain meat-eating fish or terrestrial-aquatic animals like alligators. The first use – storage and transport elsewhere – may be possible, but is totally speculative at this time. The second alternative – non-food production – may indeed be an important and reasonable factor to consider. At the present time, it is practically impossible to distinguish this use, but garfish, turtles, and alligators, among other terrestrial-aquatic animals were major elements of Gaulding faunal collections. While there is no ethnohistoric or archeological evidence suggesting these uses, on the other hand, they have never been sought, either. At the least, these possible alternative uses of clam meat can remind us to be cautious about demographic and nutritional predictions.

Given these site formation complexities, what can be said about the Gaulding site? As was noted earlier, but cannot be overemphasized, the Gaulding samples are very interesting from the perspective of changes through time. However, with only one sieved sample per layer it is not possible to examine lateral variations within layers which is at the core of investigating most of the kinds of formational issues described in the previous pages. Nevertheless, there is a substantial amount of information from the bulk samples relating to the formation of the site that can be grouped into two categories: 1) the effects of local environmental processes on the orientation, geometry, physical appearance and condition of the site; and 2) the activities that were the origin of the archeological sediments and deposits.

Environmental Processes

The orientation of northern Gulf shell sites paralleling the water body they border is as close to an immutable rule as can be found, and the Gaulding site appears to seriously violate it. The long axis of the Gaulding site must have faced on some presently unrecognized landscape feature. The shoreline of this feature was rotated some 35° from the present Taylor Bayou shoreline, but is roughly parallel to the longitudinal axis of the incised Taylor Bayou stream valley. The case for this changed orientation in the earlier Late Archaic is reinforced by evidence of the shifting depocenters from the Lower, to the Middle, to the Upper stratigraphic analysis units. The principal mass of archeological sediments from the Lower A.U. is roughly in the center of the linear shell deposit; that of the Middle A.U. is toward the west end of the deposit (grid south) farthest away from the present bayou shoreline; and the principal deposit of the Upper A.U. is at the east end of the site (grid north) immediately adjacent to the present bayou location. The surface topographic contours over the east end of the shell ridge are deflected downstream. This suggests that the principal form of the ridge, largely a clastic sediment blanket over the shell deposit but incorporating some archeological shell, was achieved in a different depositional environment than exists today, but that once the bayou was in its present position, overbank flood currents shaped the surface contours at the east end of the site. And there was erosion all along the south side of the shell ridge (grid east) creating a shoreface with colluvium at its base that is now buried under clay and peat deposits related to the present flood basin hydrologic regime.

Probably related to the evolution of the paleo-landscape is the three-part aggradational model mentioned often in the preceeding pages. This model describes upper and lower matrix-rich layers in the shell mound, and a middle that is matrix poor. As noted earlier, there appears to be no relationship between the shell to matrix ratio when plotted against the whole to fragmentary shell ratio, and so it seems likely at Gaulding that neither of the matrix-rich layers is related to the archeological deposition. The processes underlying these two characteristics must be independent. The sedimentary matrix in the lower layers at the site has abundant silt and fewer iron concretions but otherwise resembles the underlying Layer 1, the Morey Silt Loam developed on the Pleistocene Beaumont Formation. Since the upper 10-30 cm of the Morey typically is a silt loam underlain by a clay loam, it may be either that archeological shells discarded on this surface were intruded into the upper part of the Morey by trampling or by the weight of loading as the deposit thickened. Alternatively, the matrix in Layers 2 and 3 may be silty loam eroded from the adjacent slightly higher elevations on the Pleistocene surface that then were trapped in the shell interstices. In either event, the area may have been continuously or often wet or submerged given the paucity of terrestrial snails that were reported from Layers 2 and 3, the gleying of Layer 1, and the abundant iron concretions in Layers 1 and 2.

The upper matrix-rich zone appears to extend over the general area and is not confined to the surface of the shell deposit, suggesting that this deposit is of a geological rather than cultural nature. Moreover, its deep, black sediment resembles desiccated marsh deposits that may have been thoroughly reworked by earthworms. This upper zone, like the lower one, also has few terrestrial snails again suggesting that the area was often wet or intermittently submerged. The grain size trends in both Layers 2 and 3 and Layers 10 (lower) and 10 (upper) coarsen upward further supporting this interpretation. That is to say, as deposition of the geological sediments tapered off, the relative proportion of shell materials would rise, resulting in a coarsening upward sequence. Taken together, all these indications point at there being little archeological significance to the matrix characteristics of the upper and lower zones. They may be due only to natural processes that intersect in space at the archeological site. At this point, the discussion cannot be taken much further, but the observation of the three-part aggradational model at certain other lowland shell mounds in the northern Gulf may indicate that regional geological processes are at work creating these conditions. The question of how this local geography of Gaulding relates to paleoenvironments will be addressed in a subsequent section of this report.

Archeological Processes

Whatever the orientation and local geography at the time the site began to accumulate, it nevertheless was founded on a gullied Pleistocene soil, possibly the Wallisville Paleosol, perched near the upland edge of the narrow but deep Taylor Bayou entrenched valley. The first layer of archeological sediment apparently is a secondary deposit. It includes only the kind of materials that could effectively be moved: whole shells and large fragments. In relation to other layers, there is little in the way of bone, charcoal, or small shell fragments. The inequity of right valves in favor of left valves also may suggest relocated masses of previously discarded shell.

There is a less obvious possibility, however. A number of archeological quahog deposits on the southwest Florida coast have been observed to consist primarily of left-handed valves (Luer 1986). While a variety of explanations were suggested, the short answer is that no explanation could be strongly supported. For example, it is tempting to think that human handedness had something to do with the situation. And, indeed, if a right-handed person meant to use a fresh clam shell as a scraper or cutting tool, a left-handed shell would be more feasible as a convenience tool. But this does not explain why the surplus of left-handed shells remains in the site. Nevertheless, the Florida evidence, combined with the material evidence for the contents of Layer 2, reinforce the notion that the differences in this layer are more than a random curiosity. A cultural explanation of some sort remains to be found. All we can say now is that whatever was the purpose for harvesting and opening *Rangia cuneata* clams and oysters in Layer 2 time, it would have entailed building fires and exposing shellfish to heat, thereby creating signature residues that are not present in the B-1 (west) area of this layer.

If the clastic sediment matrix in Layer 3 is disregarded, Layers 3 through 9 are very similar in their contents. Even though these layers formed at significantly different times, they are more or less alike in the mix they contain of burned shell, shell fragments, bone, charcoal, and similar numbers of right and left clam valves. All of this suggests that the bulk samples from these layers were in proximity to the locations of fire hearth, meat cooking, clam opening and shell disposal activities. No evidence of lithic artifact maintenance was found in the bulk samples and very little was found in the excavations.

Numerous well-defined deposits of fragmented or whole shell were seen in the stratigraphic reference cores from these layers. This further suggests they were primary deposits, although there is no reason for or against the possibility that some of the discarded whole shells were removed from this area and secondarily deposited elsewhere. Probably such deposits, if they exist, are on the periphery of the shell mound, wherever that was located at the time. For example, the steeply tilting deposits in cross-section C-C' (Figure 6) probably identify material discarded at the edge of the site. Although fragmented-shell lenses also are identified in the tilted deposits, one of the lessons from the grain size analyses and from the three-pole plots is that observing the texture of shell site sediments only at the outcrop easily can be misleading insofar as grain size is concerned. In this regard, it also is not certain what to make of the outcrop observation that shell orientation in nearly the entire Lower Analysis Unit appeared to be random while most in the Middle and Upper Analysis Units appeared horizontal. This may indicate that Layers 2, 3, 4, and 6 specifically were secondary deposits.

Finally, and disregarding the apparently natural sedimentation that forms much of Layer 10, with sparse archeological deposits perhaps being incorporated during intermittent drying out of this marsh-like surface, formation of the upper zone appears to be somewhat similar to Layers 3 through 9. There is, however, an important difference in the ratio of shellfish consumption to vertebrate animal consumption. The reduction in burned shell proportion might be related to having to heat fewer but larger shells; if this was the case, though, it should have been evident also in Layers 6 through 9. The limited amount of burned shell may instead be related to the ground surface being comprised more of clastic sediment and less of clam shells.

The major archeological difference in the contents of Layer 10 versus earlier deposits is the relatively great abundance of finely comminuted bone fragments and of very tiny but whole bones of small animals. Vertebrae, long bones, extremities, and crushed fragments of more massive bones all were seen in point-counting the 1ϕ fractions. These may suggest that very small animals were eaten whole and that the tiny bony remains were included in human stools voided at this location. While a significant change in subsistence may be indicated, this type of eating also may have occurred during the earlier layers, but the defecated remains were located elsewhere away from the clam and food preparation areas.

On the other hand, these bones may be the natural residues of small animals living and dying on this surface over several centuries. Layer 10 accumulated over a very long period of time probably during which it often was not suitable for habitation, perhaps because it was too wet. Again, without at least a two-dimensional picture of this kind of data, it is hard to be certain of its meaning.

In conclusion, the formation processes at the Gaulding site were complex. Both natural processes and cultural processes were active simultaneously. The cultural evidence may be demonstrating primary hearth area and associated refuse deposits, secondary refuse deposits, and latrine areas. Whether the *Rangia* clams were all prepared for food consumption on the spot, for use elsewhere, or as bait could not be determined. Given the prominence of such animals as alligators, garfish, and turtles in the faunal collection, the possibility of bait gathering is reasonable but whether this would account for a significant amount of shell refuse is hard to say. No other specialized technological activity areas were identified. But if an array of samples can be obtained in a future excavation at Gaulding, with a view toward resolving these questions in mind from the outset, it may be possible to identify some of the lateral arrangement of activities across the surface of individual layers. From this, it may be possible to begin to appreciate some of the organizational structure of such settlements.

CHAPTER 3

TECHNOLOGY

CERAMICS

Only a small collection of potsherds (739) was recovered from the excavations at Gaulding and their culture-historical usefulness is limited by the apparent absence of any stratigraphic separation; most of the excavated sherds were found in the 0-6 inch (0-15 cm) level. The pottery was examined with two objectives in mind: 1) recognizing the historical implications of typological distinctions; and 2) preliminary exploration of ceramic technology in the Sabine Lake area. Ceramic typology is generally well established in the northern Gulf region, even though refinements are ongoing. Investigations into ceramic technology, on the other hand, are just becoming a focus of research in the region (e.g., Ellis 1992 and others; Ensor 1997; Hood 1998; Kelley et al. 1994).

Typology

The system of pottery typology employed on this small collection generally follows Aten (1983b:221-245) along with more recent developments as reviewed in Ensor (1995:185-202). Although questions have been raised about the use of *variety unspecified* rather than a named established variety (Weinstein et al. 1988; 1989) as well as certain other classificatory issues, this report does not seem an appropriate place to debate them when so few sherds of any type are at issue. We have, however, incorporated Mandeville as a variety of the Tchefuncte type as recommended by Weinstein and Rivet (1978).

All sherds in the Gaulding collection were first examined on fresh breaks with a 10x binocular microscope. Then they were separated into type/variety groups or, if appropriate, into informal descriptive categories based on paste and design characteristics. Once the categorical separations were made, each group was closely examined for paste, form, and design attributes. There were few sherds illustrating form and even fewer illustrating design motifs. The principal opportunity for technological analysis in this collection was to observe paste and firing characteristics on body sherds.

Sherd frequencies are given in Table 2; no adjustments were made in the provenience table for vessel lots or reconstructed sherds, although comments on these are included sometimes in the type descriptions. For technological analysis, however, the attributes of obvious vessel lots were tallied only once, not cumulatively on multiple sherds from a single vessel. In the case of those varieties represented at Gaulding by a relatively large collection of sherds, attributes were documented on all of the rim and base sherds but only on a sample of the body sherds. For the latter, a minimum of 30 sherds was examined and their attributes recorded. This number was arrived at by comparing the means of quantitative grain size estimates in 10, 20, and 30 sherd samples; the differences between successively greater sample sizes were very small, usually less than 3 percent. The procedures for recording formal and technological attributes are described below.

Paste and firing criteria

Paste composition

It was expected that clays used for each ceramic taxon would be distinctive, reasonably uniform, and function as a unit in the manufacturing process. In order to convey the complexity of the ceramic pastes, all major components – temper, sand, matrix (i.e., clay/silt) – were identified and their proportional contribution to the whole was visually estimated. Standard charts for visually estimating proportions of constituents (e.g., Folk 1951) were used to record the abundance of sand sizes, and of grog, bone, or shell temper; the residual was assumed to be matrix (silt and clay). All sand grain sizes (e.g., coarse, medium, fine, etc.) are described in the Wentworth scale (Folk 1980:23).

The procedure used here was to draw the sample sherds without selection from the box of all sherds of a particular category and to line them up on a table in the order of their lot number. Each then was examined in sequence for one attribute at a time (e.g., surface treatment) until the entire sample had been recorded. Then they were all gone through for the next attribute, and so on. The benefit here was to keep the eye and mind trained on one element at a time. This was especially important when visually estimating the proportions of particular grain sizes. Visual estimates of constituents can be difficult to replicate unless great care is used. Here, the classification was done by frequently referring to a Wentworth grain size standard, doing only one size class (e.g., coarse grains) at a time for the entire sample of sherds, and periodically rechecking sherds that had been previously examined. For the purposes of verbally summarizing proportional estimates, the following ordinal groupings were sometimes used to simplify the data: common ($\geq$25%); moderate (10-20%); and rare (1-5%). Thus, a group of sherds averaging 1 percent coarse sand, 15 percent medium-grained sand, and 30 percent fine-grained sand would also be said to have rare coarse sand, moderate medium sand and common fine sand. This approach was used in the type descriptions.

Paste texture

This term was used to refer solely to the degree to which the paste had voids resulting from any of several causes, especially poor coil wedging, oxidation of organic material, and clay shrinkage. Sherds were impressionistically classed as compact (no voids), occasional, and abundant.

Iron concretions

Ferruginous concretions are commonly found in many of the younger Pleistocene and Holocene sediments of the upper coast region. The number of sherds in each sample with such inclusions in the paste was recorded and may distinguish certain ceramic groups.

Munsell color

Surface color was treated somewhat differently from customary approaches. As is well-known, vessels and sherds from the northern Gulf coast usually display a substantial variation in coloration depending on the clay used, temper, firing conditions, uses made of the vessel, and so on. However, the color variation on a sherd usually falls within an overall color range. For this reason, the full Munsell color classification (Anonymous 1994) of hue, value, and chroma was not attempted on sherds; this would have required either several determinations for each sherd, or a questionable judgment about which of the range of colors present was important to document. Neither approach would improve the reliability or utility of the color data. Instead, the range of colors in a sherd usually included values and chromas confined within a single Munsell color hue; this latter was recorded for each sherd in the paste sample. As a general matter, though, surface colors for a given hue tended to fall between 5 to 7 value and 2 to 4 chroma in the Munsell notation system.

Oxidation pattern

Firing characteristics are hard to analyze in the routine ceramic analyses of site reports. Therefore, in addition to simplifying the Munsell color data as described above, a different approach was devised for compiling quantitative evidence that would suggest the firing approach usually applied by the potters of a particular ceramic category. Recognizing the potential three zones of a fired ceramic (exterior surface, core, interior surface), a three-part number was recorded for each sherd beginning with the exterior coded first, core second, and interior last. Colors were coded as 1 for the lightest color, 2 for the next darker color, and 3 for the darkest color. If all three zones were the same color, the sherd was recorded as "111." If the interior was darker than the exterior and there was no core, it would be recorded as "102." A sherd of equal color on exterior and interior with a darker core would be recorded as "121;" a sherd with light exterior, darker interior, and even darker core would be recorded as "132;" and so on. Through this notation it was possible to compile quickly a data set describing the imprint of the firing process and subsequent use on the clay vessel through the relationships of oxidation to reduction. Summarizing these for each sample seems to record patterns of firing that are characteristic of some of the ceramic categories.

Surface treatment (interior/exterior)

With the aid of low power magnification, surface treatment was classed as scraped only (leaving coarse striations from dragging coarser grains); smoothed when wet or leather hard (matrix material spread and smoothed over surface irregularities, temper, or sand grains near the sherd surface); burnished (a light-reflecting sheen and possibly a floated layer); and eroded (final surface treatment removed by mechanical abrasion).

Vessel form characteristics

Rim/lip form

Where possible the rim diameter was estimated, although we required that any rim section used for measurement comprise at least 5 percent of the circumference. Three features of rims were recorded: rim form (everted, straight, and inverted); lip form (flat, ridged, and rounded); and lip modification (top notch perpendicular to rim; top notch diagonal to rim; inner edge notch; outer edge notch; and scalloped). Notations were made of whether the lip notches were narrow incised lines, V-shaped notches, or U-shaped notches.

Body

The only body sherd characteristic routinely documented was thickness. Thickened or thinned rims and thickened bases usually involve only a small area of the whole vessel, while body thickness is a predominant structural feature.

Base form

These included flat, round, and node shapes. Where possible, the angle between flat base and body wall was measured.

Vessel repair

Drilling holes on both sides of a crack and tying the break together occasionally repaired vessel walls. Alternatively, asphalt was smeared over a leak or small crack. To repair cracks developing during the air-drying phase, sometimes a clay patch was formed over the crack and then the vessel was fired. Although not for repair purposes, holes occasionally were drilled near the rim. Judging from the upward direction of abrasion near the hole, and considering that local prehistoric ceramics probably were not strong enough to bear the tensional forces on such a hole from the weight of a suspended vessel and its contents, such holes were more likely used to fasten a cover over the vessel mouth.

Design

Designs present in this collection were noted as incised, punctated, or brushed. Because of the small number of decorated sherds, design motifs were not classified, although they are described.

Grain size data for formal ceramic types and varieties are in Table 3; paste and firing attributes are in Table 4; and vessel form attributes are in Table 5. This information for the minor descriptive categories is included in their separate descriptions.

Pottery descriptions

Tchefuncte Plain, var. Tchefuncte

BACKGROUND

The established variety of Tchefuncte Plain is found widely in small numbers throughout the coastal zone of the northern Gulf and is locally abundant in the Sabine Lake area. In sherd form it is indistinguishable from Lower Mississippi Valley Tchefuncte Plain. There are so few vessel data that comparisons at that level are not yet possible. At a sherd level, however, there are no real differences between the original concept of Tchefuncte Plain and the sherds found across the northern Gulf into Texas. And so, the classification used in Weinstein and Rivet (1978) is adopted here.

41JF27 SAMPLE

5 sherds, Table 2.

PASTE

(Tables 3, 4) All sherds in this sample include iron concretions in the clay. Although typically fine textured to the touch, microscopic examination revealed that fine sand grains are present but in less than half of the sherds and in rare (i.e., 1-5%) proportions. Very fine sand occurs in all sherds; moderate (10-20%) amounts in 40 percent of the sherds, rare (1-5%) in the remainder. The overwhelming portion of the paste in these sherds is matrix (silt/clay) with small amounts of sand (Figure 17b).

CONSTRUCTION AND FIRING

(Table 4) These sherds erode easily making surface treatment difficult to document; scraping is the only technique observed. None of the sherds has a compact paste; all have either occasional or abundant voids. The color of most sherds is in the 7.5 and 10YR ranges; one sherd is in the 5YR range. The oxidation pattern of most sherds is light on both surfaces with darker core; the others are either uniform or have no core.

VESSEL FORM

(Table 5) No rims or bases were recovered. The body wall thickness of the sherds in the Gaulding sample, determined from a very small sample, averaged 7.7 mm, thicker than any of the other types.

Tchefuncte Plain var. Mandeville

BACKGROUND

The Mandeville variety likewise is found widely in small numbers in sites of the Sabine Lake area. It is known as very similar to Tchefuncte Plain in appearance and vessel forming technique but differs in having a distinctly coarser paste texture (Aten 1983b). Here, Mandeville is classified as a variety of Tchefuncte Plain according to the discussion in Weinstein and Rivet (1978:26-30).

41JF27 SAMPLE

8 sherds (7 if vessel associations are discounted), Table 2.

PASTE

(Tables 3, 4) Little more than half the Mandeville sherds contain iron concretions in the paste. Medium-grained sand was rare in one sherd; fine-grained sand was rare in most sherds and moderately abundant in one; and very fine-grained sand was present in all sherds about equally divided between common and moderate abundances. Mandeville paste composition stands out as similar to but distinct from *variety Tchefuncte* and probably occupies an intermediate position between the latter and Goose Creek pastes (Figure 17a).

CONSTRUCTION AND FIRING

(Table 4) These sherds erode easily making surface finish difficult to record; of the 3 observable sherds, two were finished by scraping and the other by smoothing while wet. One sherd has many probably accidental fingernail impressions on the interior. Almost 60 percent of the sherds have occasional paste voids with the remainder having abundant voids. Coils are not welded together very well with coil surfaces prominent in fractures. One sherd has colors in the 7.5YR range while all the others are in the 10YR range. The

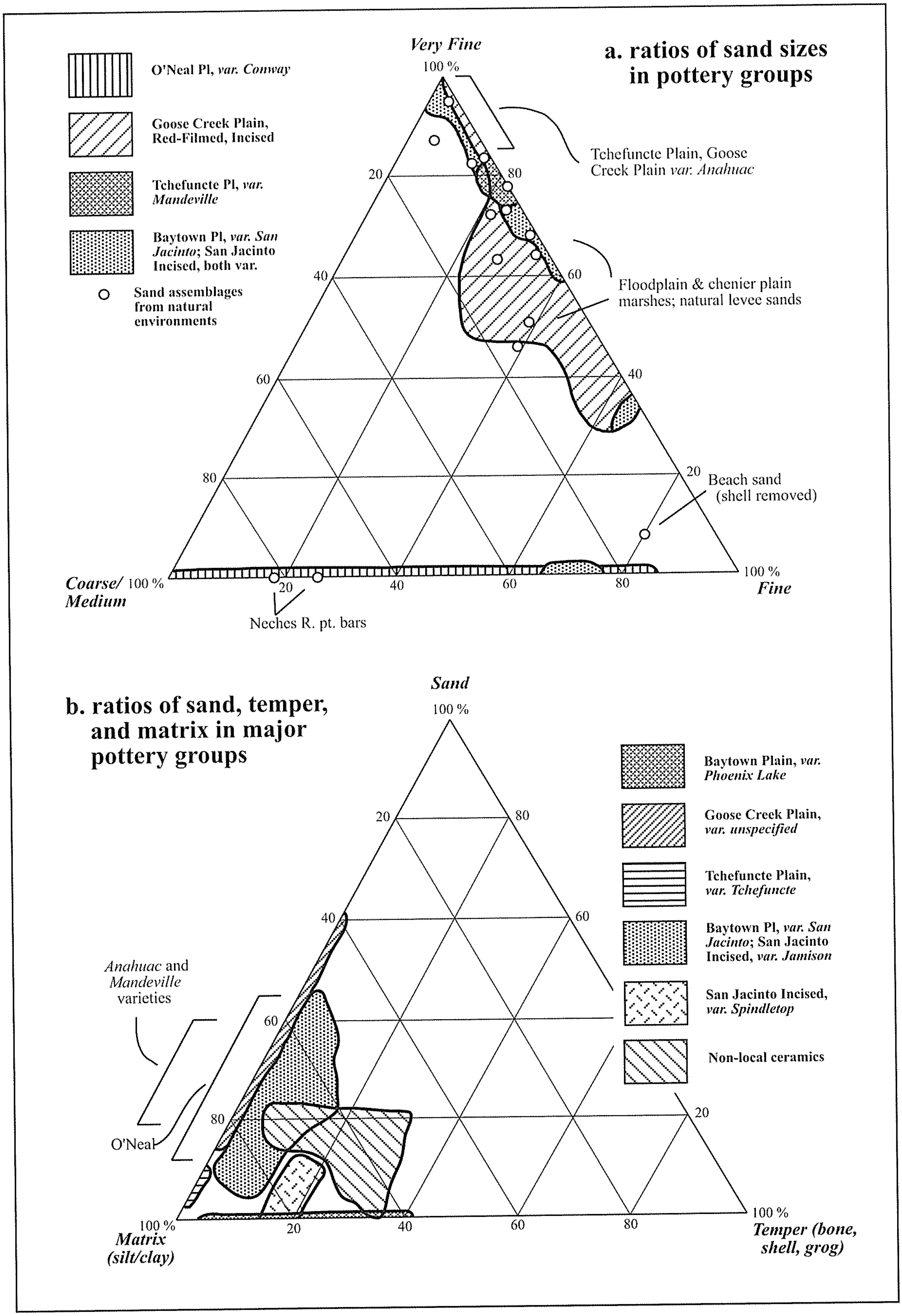

Figure 17. Three-pole graphs of clastic constituents in Gaulding site, 41JF27, ceramics.

TABLE 2
Ceramic category frequencies, Gaulding site, 41JF27

	Stratigraphic Analysis Units					
Ceramic categories	**Upper (A)**	**Upper (B)**	**Upper (undiff)**	**Middle**	**No prov.**	**Totals**
Tchefuncte Plain, *var. Tchefuncte*	2		1	1	1	5
Tchefuncte Plain, *var. Mandeville*	5				2	7
O'Neal Plain, *var. Conway*	25	1	14	4	9	53
Goose Creek Plain, *var. Anahuac*	1	3	1			5
Goose Creek Plain, *var. unspecified*	103	2	15	2	34	156
Goose Creek Incised, *var. unspecified*	1					1
Goose Creek Red-Filmed, *var. unspecified*	1					1
Baytown Plain, *var. San Jacinto*	206	1	27	1	43	278
Baytown Plain, *var. Phoenix Lake*	44	1	10	2	15	72
San Jacinto Incised, *var. Jamison*			1		1	2
San Jacinto Incised, *var. Spindletop*	9		4		4	17
Sand and grog-tempered plain			1			1
Grog and bone-tempered brushed (Caddo?)	18				1	19
Grog and shell-tempered plain	12					12
Bone-tempered brushed (?)					3	3
Sand and bone-tempered plain	16		1		11	28
Sherd crumbs	60	14	1	4	(n/a)	79
Totals	503	22	76	14	124	739

TABLE 3
Sand grain and temper abundance in ceramic types and varieties from the Gaulding site, 41JF27

		Sand size frequencies and (percents)				Grog temper counts and (percent)
Category and sample size	**Abundance class**	**Coarse**	**Medium**	**Fine**	**Very fine**	
Tchefuncte Plain *var. Tchefuncte* (attribute sample = 5)	Common (≥ 25%)					
	Moderate (10-20%)				2	
	Rare (1-5%)			2	3	
	Absent	5	5	3		5
Tchefuncte Plain *var. Mandeville* (attribute sample = 7)	Common (≥ 25%)				3	
	Moderate (10-20%)		1		4	
	Rare (1-5%)		1	6		
	Absent	7	6			7
O'Neal Plain *var. Conway* (attribute sample = 36)	Common (≥ 25%)		23 (63.9)	2 (5.6)		
	Moderate (10-20%)	5 (13.9)	12 (33.3)	11 (30.6)		
	Rare (1-5%)	27 (75.0)	1 (2.8)	1 (2.8)		
	Absent	4 (11.1)		22 (61.1)	36 (100.0)	36 (100.0)

TABLE 3 (continued)
Sand grain and temper abundance in ceramic types and varieties from the Gaulding site, 41JF27

Category and sample size	Abundance class	Sand size frequencies and (percents)				Grog temper counts and (percent)
		Coarse	Medium	Fine	Very fine	
Goose Creek Plain *var. Anahuac* (attribute sample = 3)	Common (≥ 25%)				2	
	Moderate (10-20%)				1	
	Rare (1-5%)			2		
	Absent	3	3	1		3
Goose Creek Plain *var. unspecified* (attribute sample = 30)	Common (≥ 25%)			3 (10.0)	17 (56.7)	
	Moderate (10-20%)			19 (63.3)	13 (43.3)	
	Rare (1-5%)	2 (6.7)	16 (53.3)	6 (20.0)		
	Absent	28 (93.3)	14 (46.7)	2 (6.7)		30 (100.0)
Goose Creek Red-Filmed Plain *var. unspecified* (attribute sample = 1)	Common (≥ 25%)				1	
	Moderate (10-20%)			1		
	Rare (1-5%)					
	Absent	1	1			1
Goose Creek Incised *var. unspecified* (attribute sample = 1)	Common (≥ 25%)				1	
	Moderate (10-20%)					
	Rare (1-5%)			1		
	Absent	1	1			1
Baytown Plain *var. San Jacinto* (attribute sample = 30)	Common (≥ 25%)				11 (36.7)	
	Moderate (10-20%)			4 (13.3)	14 (46.7)	12 (40.0)
	Rare (1-5%)		5 (16.7)	12 (40.0)	3 (10.0)	18 (60.0)
	Absent	30 (100.0)	25 (83.3)	14 (46.7)	2 (6.7)	
Baytown Plain *var. Phoenix Lake* (attribute sample = 30)	Common (≥ 25%)					13 (43.3)
	Moderate (10-20%)					16 (53.3)
	Rare (1-5%)					1 (3.3)
	Absent	30 (100.0)	30 (100.0)	30 (100.0)	30 (100.0)	
San Jacinto Incised *var. Jamison* (attribute sample = 2)	Common (≥ 25%)					
	Moderate (10-20%)			1	2	2
	Rare (1-5%)		1			
	Absent	2	1	1		

TABLE 3 (continued)
Sand grain and temper abundance in ceramic types and varieties from the Gaulding site, 41JF27

Category and sample size	Abundance class	Sand size frequencies and (percents) Coarse	Medium	Fine	Very fine	Grog temper counts and (percent)
San Jacinto Incised *var. Spindletop* (attribute sample = 6)	Common (≥ 25%)					
	Moderate (10-20%)				3	6
	Rare (1-5%)			1		
	Absent	6	6	5	3	

Note: Descriptive categories are not included. Percentages are not given for small samples.

oxidation pattern on all but one sherd is lightest on the exterior surface.

VESSEL FORM

(Table 5) Only one rim sherd was found; it is everted with a ridged lip and no lip modification. The few body sherds present have a relatively thick body wall averaging 7.3 mm.

O'Neal Plain, variety Conway

BACKGROUND

The paste of this variety is distinguished by its characteristic of incorporating large sand sizes in a silt/clay matrix. Because of this sorting gap between large and small grains this pottery has been assumed to be a silt/clay mix to which the sand was added as temper.

41JF27 SAMPLE

52 sherds, Table 2.

PASTE

(Table 3, 4) Nearly 40 percent of the sherds contain iron nodules in the clay, a relatively low proportion compared to other Gaulding site ceramics. Coarse sand is found in nearly 90% of all O'Neal Plain sherds but in small amounts (moderately abundant in 14% of sherds; rare in 75% of sherds; and absent in 11%). Because of the large size of these grains, small amounts are sufficient to give a strong impression of exceptional coarseness in the paste.

Medium-grained sand also is found in all O'Neal sherds in the 41JF27 sample (common in nearly two-thirds of all sherds; moderately abundant in one-third; and rare in only about 3% of the sherds). Fine-grained sand is found only in little more than a third of the O'Neal sherd sample (commonly in about 6%; moderately abundant in less than one-third; rarely in about 3%; and absent in 61% of the sherds). The triangular plot (Figure 17a) shows that these sand sizes and proportions combine in sherds in ways that are totally distinct from practically all other pottery types that contain sand.

CONSTRUCTION AND FIRING

(Table 4) A little over half of the sherd sample was either too small to determine final surface treatment or was too eroded. However, of the remaining half, approximately 90 percent of both interior and exterior surfaces had been smoothed while the clay was still wet with the remainder having been burnished.

The paste generally was well compacted; occasional voids from either shrinkage or combustion of organic inclusions were present in 83 percent of the sherds; the remainder was divided between sherds with abundant voids or none. Nearly 90 percent of the Conway sherds had colors encompassed by the 7.5YR and 10YR Munsell color cards; the few remaining sherds were of the redder 2.5YR and 5YR colors.

About 20 percent of the sherds had no core developed during firing. Some 90 percent of the sample had a light exterior and a dark core (or interior surface if no core); the remaining 10 percent were reversed with a dark exterior and lighter core or interior. This suggests that the principal firing procedure did not involve smothering the fire to create reducing conditions. The clay used was generally clean (few burned-out organic inclusions), coils were well-compacted, and firing was generally to an oxidized state. The coarse texture of the paste is an obvious feature of all sherds, although when newly made these pots seem to have had well-smoothed to burnished surfaces.

VESSEL FORM AND DESIGN

(Table 5) Of the rim sherds present, one each were everted or inverted, two were straight, and one was indeterminate. Of these rims, four had flat lips and one had a rounded lip form; in addition four lips had no further modification and one had incisions diagonal to the rim direction. There was one flat base with an estimated base/wall angle of 30 degrees. It was only possible to make one estimate of orifice diameter in this collection; that vessel was approximately 32.5 cm in diameter. The mean body sherd thickness was 6.2 mm. The Gaulding site sample of the Conway variety in-

TABLE 4
Additional ceramic vessel construction attributes, Gaulding site (41JF27)

Attributes		TPT	TPM	ONPC		GCPA	GCPU		GCIU	GCRF	BPPL		BPSJ		SJIJ	SJIS
		no.	no.	no.	(%)	no.	no.	(%)	no.	no.	no.	(%)	no.	(%) no.	no.	
Surface treatment, interior	SC	2	2								1	5	2	7		
	SL						1	6			1	5	3	10		2
	SW		1	15	94		15	94	1		11	58	19	66	1	2
	B			1	6						6	32	5	17		
Surface treatment, exterior	SC	1	2										1	4		
	SL						2	15					2	7		
	SW		1	14	87		11	85	1		11	65	21	78	1	2
	B			2	13						6	35	3	11		1
Paste texture	C			2	6		14	44		1	5	8	9	20	2	
	O	3	4	30	83	2	13	41	1		29	49	18	44		5
	A	2	3	4	11		5	15			25	42	18	44		
Munsell color card	2.5YR			1	3	1					7	12				
	5YR	1		3	8		3	9			2	3	2	4		1
	7.5YR	2	1	16	44	2	10	31		1	25	43	15	33	1	4
	10YR	2	6	16	44	1	19	60	1		24	41	28	62	1	1
No. with Fe nodules		5	4	14	39	1	24	75	0	1	33	56	23	51	1	4
Oxidation pattern	111	1	2	7	21	1	4	12			9	15	6	13		
	102	1	1	11	33		5	16			19	32	16	36		
	121	3	1	5	15	1	3	9		1	16	27	11	24	1	3
	123		1	2	6				1		4	7	2	4		
	132		1	4	12	1	5	16			8	13	8	18		2
	201			1	3		7	22			1	2			1	
	212			2	6		2	6			1	2	1	2		
	213			1	3											
	231						5	16			1	2	1	2		1
	312		1													
	321						1	3								

Abbreviations: TPT=Tchefuncte Plain, *var. Tchefuncte*; TPM=Tchefuncte Plain, *var. Mandeville*; GCPA=Goose Crk Plain, *var. Anahuac*; ONPC=O'Neal Plain, *var. Conway*; BPPL=Baytown Plain, *var. Phoenix Lake*; BPSJ=Baytown Plain, var. San Jacinto. Surface treatments: SC=scraped; SL=smoothed when leather hard; SW=smoothed wet; B=burnished. If all sherds are not tallied, the shortage means they were too eroded or small to evaluate. Paste texture: C=compact; O=occasional voids; A=abundant voids. Oxidation pattern: 1=lightest color; 2=intermediate; 3=darkest; 0=no core. Vessel exterior notation is on left, interior on right, core in center; e.g., 132=exterior is lightest, interior is next, and core is darkest color; 111=sherd is same color throughout.

Table 4 (continued)
Additional ceramic vessel construction attributes, Gaulding site (41JF27)

Attributes	TPT	TPM	ONPC		GCPA	GCPU		GCIU	GCRF	BPPL		BPSJ			SJIJ	SJIS
	no.	no.	no.	(%)	no.	no.	(%)	no.	no.	no.	(%)	no.	(%)	no.	no.	
Asphalt patch										2	3					
Drilled holes			1			1	3									
Sample size =	5	7	36		3	32		1	1	59		45			2	6

Abbreviations: TPT=Tchefuncte Plain, *var. Tchefuncte*; TPM=Tchefuncte Plain, *var. Mandeville*; GCPA=Goose Crk Plain, *var. Anahuac*; ONPC=O'Neal Plain, *var. Conway*; BPPL=Baytown Plain, *var. Phoenix Lake*; BPSJ=Baytown Plain, var. San Jacinto. Surface treatments: SC=scraped; SL=smoothed when leather hard; SW=smoothed wet; B=burnished. If all sherds are not tallied, the shortage means they were too eroded or small to evaluate. Paste texture: C=compact; O=occasional voids; A=abundant voids. Oxidation pattern: 1=lightest color; 2=intermediate; 3=darkest; 0=no core. Vessel exterior notation is on left, interior on right, core in center; e.g., 132=exterior is lightest, interior is next, and core is darkest color; 111=sherd is same color throughout.

Table 5
Ceramic vessel form and design attributes, Gaulding site (41JF27)

Attributes	TPM no.	ONPC no.	GCPA no.	GCPU no.	GCIU no.	BPPL no.	BPSJ no.	SJIJ no.	SJIS no.
Rims									
Everted	1	1				3	3	1	
Straight		2		2		1	1		1
Inverted		1		3			2		1
Unknown		1	1	2	1		3	1	4
Lip forms									
Flat		4		3	1	2	4		2
Ridged	1		1	1		1	3	1	
Rounded		1		3		1	2		
Unknown								1	4
Lip modification									
Top perp.								1	2
Top diag.		1							
Inner edge									
Outer edge									
Scalloped				1	1	1	2		
None	1	4	1	6		3	4		
Unknown							3	1	4
Bases									
Flat	1	1				1			
Round							1		
Node						1			
Rim diameter (cm)		32.5				10.0 35.0	18.7	13.7	17.5
Body thickness									
Mean (mm)		6.2		5.9		5.6	6.0		
St. dev.		1.2		0.8		1.0	1.1		
n =		35		32		58	42		

Abbreviations: TPM=Tchefuncte Plain, *var. Mandeville*; ONPC=O'Neal Plain, *var. Conway*; GCPA=Goose Creek Plain, *var. Anahuac*; GCPU=Goose Creek Plain, *var. unspecified*; GCIU=Goose Creek Incised, *var. unspecified*; BPPL=Baytown Plain, *var. Phoenix Lake*; BPSJ=Baytown Plain, *var. San Jacinto*; SJIJ=San Jacinto Incised, *var. Jamison*; SJIS=San Jacinto Incised, *var. Spindletop*; Tchefuncte Plain, *var. Tchefuncte* and Goose Creek Red-Filmed Plain are not included because there were no vessel form data except body wall thicknesses which were given in the text descriptions.

cludes, at least, simple jar forms with flat bases. One sherd has substantial traces of red film on the exterior surface.

Goose Creek Plain, var. Anahuac

BACKGROUND

This variety recognizes sherds transitional between Tchefuncte Plain *var. Mandeville* and Goose Creek Plain *var. unspecified* (Aten 1983b).

41JF27 SAMPLE

5 sherds (3 if vessel associations are discounted), Table 2.

PASTE

(Tables 3, 4) Only one sherd in this sample contains iron concretions in the paste. Fine-grained sand occurs rarely in two sherds; very fine-grained sand is common or moderately abundant in 3 sherds. These pastes are very fine and overlap Tchefuncte Plain *var. Tchefuncte* (Figure 17a).

CONSTRUCTION AND FIRING

(Table 4) The surfaces of these sherds erode easily making surface treatment impossible to record. Two sherds have occasional voids and one has abundant voids. Two sherds have colors in the 7.5YR range and one in the 10YR range.

The oxidation pattern is for highly oxidized exterior surfaces on all sherds.

VESSEL FORM

(Table 5) One rim sherd was found which was too small to use for estimating rim diameter or rim form, but the lip was ridged and not modified. There is a suggestion of the common Tchefuncte-Mandeville diagonal ridge and furrow surface molding. Coil wedging is highly variable on this pottery; some sherds are like Mandeville with the interior and exterior surfaces both smoothed upward. Others show the down on interior and up on exterior smoothing that is typical of Goose Creek wares. The average body thickness of the body sherds is 6.6 mm.

Goose Creek Plain, var. unspecified

BACKGROUND

This is one of the most common pottery varieties at all times from southwest Louisiana to the central Texas coast. It is thought to be made of naturally occurring sand/silt/clay assemblages rather than be artificially prepared pottery clay.

41JF27 SAMPLE

154 sherds (143 if vessel associations are discounted), Table 2.

PASTE

(Tables 3, 4) Three-fourths of the sherds in this sample include iron concretions in the paste. Coarse-grained sand is rarely present in 7 percent of the sample. Medium-grained sand is rarely present in a little more than half of the sample. Fine-grained sand is present in almost all sherds (rarely in 20 percent, moderately in over 63 percent, and commonly in about 10 percent). Very fine-grained sand is present in all sherds (moderately in over 40 percent of the sherds, and commonly in over 50 percent of the sherds). Compared to other ceramic varieties there is a fairly wide range of sand grain size combinations in Goose Creek Plain var. unspecified (Figure 17a).

CONSTRUCTION AND FIRING

(Table 4) All of the sherds that could be examined were smoothed most of the time when the clay was wet, although over half of the sherds in the sample were too eroded to evaluate. Nearly half of the sample had a very compact paste with the remainder in the occasional to abundant voids categories. Nearly 60 percent of the sherds had colors in the 10YR range, 31 percent had them in the 7.5YR range, and 9 percent were in the 5YR range. The interior and exterior vessel surfaces were oxidized with roughly similar frequency.

VESSEL FORM

(Table 5) Rim forms favored straight and inverted rims, with 2 sherds indeterminate. Lip forms included nearly 30 percent straight, 43 percent inverted, and the remainder indeterminate. Scalloped lip modification occurred on only one sherd, the remainder being unmodified. The average body sherd thickness of this sample was 5.9 mm.

Goose Creek Incised, variety unspecified

41JF27 SAMPLE

1 sherd, Table 2. This is a dubious specimen with a single "incised" line on a small sherd that may only be an artifact of surface smoothing.

PASTE

(Tables 3, 4) The sherd does not have iron concretions. The sand size proportions are similar to those described for Goose Creek Plain, variety unspecified.

CONSTRUCTION AND FIRING

(Table 4) Surfaces appear to have been smoothed while the clay was still wet. The paste has occasional voids; color was in the 10YR range; and the oxidation pattern is lightest on the exterior, darker in the core, and darkest in the interior.

VESSEL FORM

The sherd is a rim but is too small to orient; the lip is flat and scalloped (Table 5).

Goose Creek Red-Filmed Plain, variety unspecified

41JF27 SAMPLE

1 sherd, Table 2.

PASTE

(Tables 3, 4) This sherd has iron nodules in the paste. The sand size proportions are similar to those of Goose Creek Plain, variety unspecified.

CONSTRUCTION AND FIRING

(Table 4) Both surfaces are obscured by red paint and surface treatment cannot be determined. The sherd has a compact paste; color is in the 7.5YR range. The oxidation pattern is lightest on the exterior and interior and darker in the core.

VESSEL FORM

This specimen is a body sherd 4.7-mm thick (Table 5).

Baytown Plain, variety San Jacinto

BACKGROUND

Weinstein (1991:102-106) argued that this sparsely grog-tempered sandy paste ware be renamed to its own series (San Jacinto Series) with types for plain and incised wares. Patterson (1995) made a similar proposal largely as a matter of simplifying classification terminology. These proposals are not used at this time for reasons rooted in the discussion of southeastern U.S. pottery innovation presented elsewhere (Aten 1983b:297-299). Briefly, this view is that the development of grog-tempered technology is a major southeastern

US innovation, largely centered in the Lower Mississippi Valley, and was projected outward north, east, and west. We currently believe that considering these sandy paste grog-tempered ceramics as part of this regional technological diffusion phenomenon and related to Baytown helps maintain focus on the central cultural problem — diffusion of basic technologies. In any event, this is not a major practical problem because Weinstein's pottery categories are identical to ours; only the nomenclatural solution to the underlying cause differs. Eventually, though, these conceptual differences will have to be reconciled.

41JF27 SAMPLE

278 sherds (167 discounting sherds from same vessels), Table 2.

PASTE

(Tables 3, 4) Approximately half of the attribute sample contained iron nodules in the paste. Grog tempering was moderately present in less than half the sherds and was rare in a little more than half the sherds. The sand distribution in the paste generally resembles that in Goose Creek Plain *var. unspecified* pastes but is decidedly finer grained. This may suggest that the *var. San Jacinto* paste matrix is not as similar to Goose Creek as we have previously thought.

CONSTRUCTION AND FIRING

(Table 4) Two-thirds to three-fourths of the sherds were smoothed while wet with the remainder divided among all the other treatments. The sample pastes predominantly have occasional to abundant voids, presumably reflecting a greater use of clays containing organic matter. Most of the sherd colors are in the 10YR range. The oxidation pattern is predominantly lightest on the exterior and usually with a darker core than either surface.

VESSEL FORM

(Table 5) Rims are mostly everted or inverted, lips are flat, ridged, or rounded, and are occasionally scalloped. One round base was found. The mean thickness of a sample of body sherds was 6.0 mm and two vessel rim diameters were estimated at about 19 and 35 cm.

Baytown Plain, variety Phoenix Lake

41JF27 SAMPLE

72 sherds, Table 2.

PASTE

(Tables 3, 4) Like the *variety San Jacinto*, about half of the *variety Phoenix Lake* sherds contain iron nodules. However, it has no sand in the paste and a much higher proportion of grog particles.

CONSTRUCTION AND FIRING

(Table 4) Surface treatments are generally similar to those of *variety San Jacinto*, with a majority of sherds smoothed while wet. However, there is a stronger tendency for Phoenix Lake sherds to have burnished surfaces. Paste texture of the sample sherds is similar to *variety San Jacinto* with most sherds having occasional or abundant voids. Sherd colors cover a wider range, from 10YR to 2.5YR. The oxidation pattern is very similar to that of *variety San Jacinto*.

VESSEL FORM

(Table 5) Most of the rims are everted, with flat lips and rarely are scalloped. A flat and a noded base were found. The mean thickness of a sample of body sherds was 5.6 mm. The rim diameter of one small vessel was estimated at 10 cm.

San Jacinto Incised, variety Spindletop

41JF27 SAMPLE

17 sherds (6 if sherds from vessel lots are discounted), Table 2.

PASTE

(Tables 3, 4) Two-thirds of the small sample of pastes contained iron nodules. Grog particles were present in moderate abundance in all sherds while one sherd had rare fine sand and half the sherds had moderate amounts of very fine sand.

CONSTRUCTION AND FIRING

(Table 4) Surface treatments of this small sample are in the same range as the Baytown plainware. Most of the sherds have occasional voids and one is a compact paste. Sherd colors are predominantly in the 7.5YR range. The oxidation pattern is lighter on the exteriors and a darker core.

VESSEL FORM AND DESIGN

(Table 5) Rims are inverted or straight with flat lips and lip notching is perpendicular to the rim. One rim diameter could be estimated at 17.5 cm. Three incised design motifs are present: 1) simple horizontal lines; 2) simple bands around the rim, one with pendant triangles, and filled with parallel lines to create a zoned design; and 3) a fragment of a complex design including vertical zones of chevrons, horizontal lines, and possibly scalloped areas pendant from horizontal lines (Figure 18a-e). The first of these motifs is commonly found on several incised pottery types of the Texas and Louisiana coast. The second motif is particularly reminiscent of Mazique Incised from Louisiana (R. Weinstein, personal communication, 1999).

San Jacinto Incised, variety Jamison

41JF27 SAMPLE

2 sherds, Table 2.

PASTE

(Tables 3, 4) One of the sherds contains iron nodules. Grog particles are present in moderate amounts, and larger

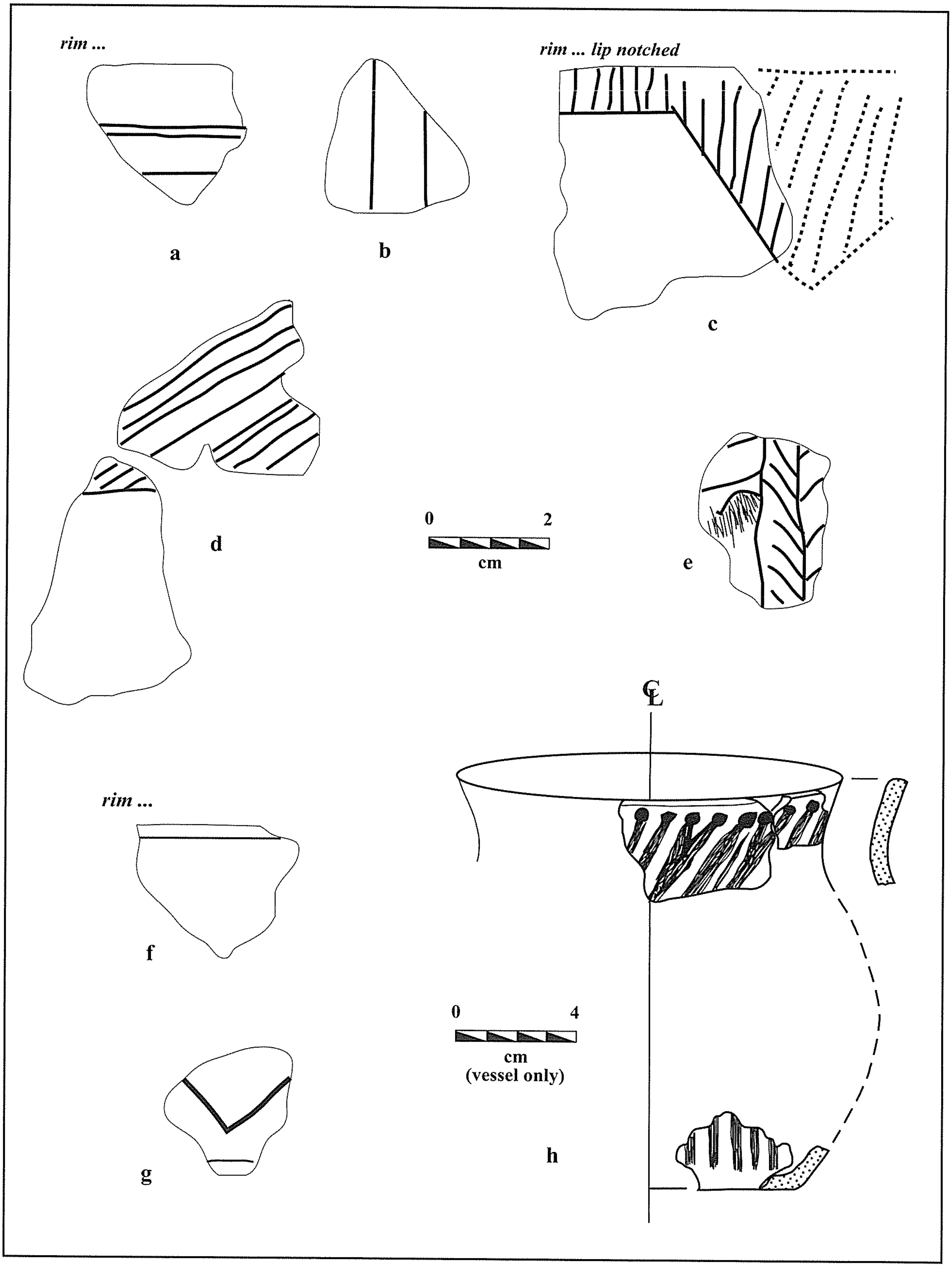

Figure 18. Incised design motif fragments; a-e) San Jacinto Incised, *var. Spindletop*; f-g) San Jacinto Incised, *var. Jamison*; H) unidentified brushed vessel (probably Caddoan), note scale change. All sherds are oriented vertically. Generally the incising was in the rim area but unless noted, vessel rims were not present.

proportions of medium, fine, and very fine sand are present in these sherds.

CONSTRUCTION AND FIRING

(Table 4) Surfaces were smoothed while wet. Both sherds have compact pastes. Their colors are in the 10YR and 7.5YR ranges. The oxidation patterns are in the ranges of the other grog-tempered wares.

VESSEL FORM

(Table 5) One of the rims is everted. The lip is ridged; lip modification cannot be determined. The rim diameter is nearly 14 cm. Two incised design motifs common to the Texas coastal region are represented: 1) a simple horizontal line around the rim just under the lip; and 2) a band probably around the rim bordered by a horizontal line and filled with a zigzag line (Figure 18f-g).

Miscellaneous ceramics

Several descriptive categories of ceramics were identified that did not conform to any currently recognized pottery types or varieties. All were present in small numbers but are interesting because of the external relationships they suggest.

GROG- AND BONE-TEMPERED BRUSHED

This is a single vessel represented by 19 sherds (Table 2). The paste includes common grog particles and moderate amounts of bone; the matrix is silty clay and contains no sand. Iron nodules occasionally are present. The paste is compact and the color is in the 10YR range. The interior surface was smoothed while wet. The vessel rim is everted, with a flat lip that is notched on the inner edge. The base is flat and the base/wall angle is 33 degrees. The rim diameter is 12.5 cm. Taken together, these characteristics suggest a small, restricted orifice, flat-based jar (Figure 18h). The exterior surface is covered with a brushed design, possibly using the broken end of a twig as a stylus. There are circular punctations immediately below the lip and descending from these are parallel and diagonal brushed lines. The body of the vessel has vertical, brushed lines. Taken together, these indicate that the rim area was brushed differently from the vessel body. This vessel is distinctively unlike indigenous northern Gulf coast pottery. The technique and style of brushing, including treating the rim differently from the body as well as the particular grog and bone tempering, suggest Caddo manufacture. Such brushed ware was common in Neches River Caddo sites from circa AD1300 to historic times (Dee Ann Story, personal communications, 1995 and 1999)

SAND- AND GROG-TEMPERED PLAIN

There is one sherd (Table 2) that has rare medium sand and moderate fine sand, but no very fine sand; grog particles are present in moderate proportion. The discontinuity between sand and the silt/clay matrix suggests this vessel was tempered with both sand and grog. The paste contained iron nodules, had abundant voids, and relatively more red colors of the 5YR range. The oxidation pattern was light on the exterior, darker on the interior, and there was no core. The body wall was relatively thin at 4.8 mm.

GROG- AND SHELL-TEMPERED PLAIN

There are 12 sherds, all from one vessel (Table 2), that have rare fine sand and moderate very fine sand along with moderate proportions of grog and shell particles. This indicates that the grog and shell were temper added to sandy clay. The shell particles appear to be from oysters or freshwater mussels as the fragments tend to break into flat platelets rather than the blocky fragments resulting from *Rangia cuneata* shell. The paste contains iron nodules, is compact, and its color is in the 5YR range. The oxidation pattern is lightest on the interior, darker on the exterior, and darkest in the core, the reverse of most local ceramics. The surface treatment on the vessel interior was smoothed probably during the leather hard state, while the exterior was burnished. The body wall thickness was 5.3 mm. These sherds do not appear to be of Caddo origin (D.A. Story, personal communication, 1995) and may be from a late Coles Creek or Plaquemine vessel of lower Mississippi valley origin (R. Weinstein, personal communication, 1999). A small campsite, radiocarbon dated to the late Coles Creek Period with appropriate ceramics was excavated west of Holly Beach, Louisiana (Stopp 1976; Wiseman et al. 1979:5-3). That site is only 45 km, as the crow flies, from Gaulding. Given other contemporaneous ceramics and radiocarbon dates from Gaulding, the presence of such a late Coles Creek or early Mississippi period grog and shell-tempered vessel is not implausible.

BONE-TEMPERED PLAIN

Three sherds, all possibly from the same vessel (Table 2), have common bone particles and rare fine sand. No grog was seen and the bone particles are more abundant than in the Caddoan grog- and bone-tempered vessel. The paste contains iron nodules, occasional voids, and is in the 10YR color range. The oxidation pattern is the same color on the interior and exterior and there is no core. Both interior and exterior surfaces were smoothed when wet. Body wall thickness is 5.6 mm. There are some indentations on the exterior surface that might be brushing, but this is uncertain.

SAND- AND BONE-TEMPERED PLAIN

One sherd (Table 2) was found with rare medium sand, moderate fine sand, but no very fine sand, and rare bone particles. The paste contains iron nodules, but is compact, and has colors in the 10YR range. The oxidation pattern is lightest on the interior, darker on the exterior, and has no core. Surface treatments cannot be evaluated because of erosion. Body wall thickness is 4.3 mm.

SHERD CRUMBS

Pottery fragments smaller than about 1 cm square were not classified or evaluated, but they were counted to help plot the occurrence of ceramics in the site.

Discussion

The Gaulding site pottery collection lacks high-resolution physical separation, so it cannot make a contribution insofar as ceramic chronostratigraphy is concerned. However, beyond using ceramic typology to map culture history and the intrasite spatial distribution of technological clusters, there is a need to continue defining the characteristics of southeast Texas and southwest Louisiana prehistoric ceramics as distinct technologies. Exploring the cultural aspects of pottery manufacture has begun in recent years in the nearby Galveston Bay area (Ellis 1992; Ennes and Flood 1997; Gadus and Howard 1990; Hood 1998; Kelley et al. 1994). Following that lead, several technological questions will be addressed to the extent that this relatively small data set will permit.

Ceramics within the site

All pottery was confined to the northern and probably largely the northeastern quadrant of the site (Figure 19). No pottery was found in test pit C-1 or in any of the postholes or pothole backdirt piles in the southern half of the site. Coincident with this area, the thickness map and cross-section (Figure 10) show the deposits (Layer 10) in the northern half of the site to be roughly 30 cm thicker than in the southern half probably due to the bulking effect of occasional shell-related habitation deposits. This thickened area, where the pottery was found, is the only part of Gaulding impinging directly on the shoreline of Taylor Bayou. The evidence of layer thickness and pottery distribution apparently outlines the area (approximately 400 square meters) of the late prehistoric occupations and distinguishes them from the preceramic occupations. Plots of sherds from the same vessels indicates that some were separated by as much as 6 m, but there is no other evidence now available with which to make better statements about the spatial organization of late prehistoric site use.

Ceramic dating

Nearly all ceramics came from the top 6-inch (15-cm) level. Tchefuncte Plain *varieties Tchefuncte* and *Mandeville*, and Goose Creek Plain *var. Anahuac* are all early ceramics probably dating in the Sabine to approximately 1900 to 2200 years ago. The bone- and shell-tempered vessel, and the Caddoan-like grog and bone-tempered brushed vessel represent a much later time period – only 600 to 800 years ago more or less. The other plainware types such as Goose Creek Plain *var. unspecified*, O'Neal Plain *var. Conway*, and the Baytown Plain varieties could be associated with either extreme or with any time between them. The San Jacinto Incised *var. Spindletop* design motifs call Mazique Incised to mind. On this information it appears that there were at least two brief episodes of ceramics-using occupations – early and late – and there may well have been others in the intervening time (cf., Figure 9).

Ceramic technology

Only four of the 16 pottery varieties found in the Gaulding excavations were present in numbers sufficient to analyze some of their technological characteristics statistically (Tables 3, 4, and 5). These were O'Neal Plain *var. Conway*, Goose Creek Plain *var. unspecified*, Baytown Plain *var. Phoenix Lake*, and Baytown Plain *var. San Jacinto*. In this analysis, Goose Creek Plain *var. unspecified* refers to all of the Goose Creek plainware except those separated out as *var. Anahuac*. When appropriate, other varieties will be mentioned.

Paste texture: Goose Creek Plain *var. unspecified* has the most compact paste of the four varieties being discussed; nearly half of those sherds have no voids and a similar proportion has voids only occasionally. The two Baytown Plain varieties are just the reverse, with nearly half having abundant voids and a similar proportion having occasional voids. O'Neal Plain *var. Conway* is squarely in the middle with an overwhelming majority of its sherds having only occasional voids. Whether these differences are due to vessel forming and drying technique or to firing consequences of their respective pottery clay mixtures is not yet known, but the differences at this site are distinctive.

Munsell color: All of the four varieties discussed here had more than 80 percent of their sample in the 7.5 and 10YR color ranges. Both O'Neal Plain *var. Conway* and Baytown Plain *var. Phoenix Lake* tended more toward the redder colors of the YR range. Goose Creek Plain *var. unspecified* and Baytown Plain *var. San Jacinto* were both similar in having nearly two-thirds of their sherds in the 10YR group and tended more strongly toward the yellow end of the range.

Iron concretions: Ferruginous concretions are found locally in many of the younger Pleistocene and Holocene fluvial sediments. O'Neal Plain *var. Conway* sherds had the fewest concretions (39 percent), the two Baytown Plain varieties had them in about half their sherds, and the Goose Creek Plain *var. unspecified* had iron concretions in 75 percent of its sherds. These differences may point to preferences for clay sources among potters of the several types. The O'Neal potters selected clay that intentionally or coincidentally also did not have many iron concretions. There was a 50:50 chance that the Baytown potters would select a clay containing concretions; and the Goose Creek Plain potters selected clays, possibly from the Pleistocene Beaumont Formation, that very often had concretions.

Oxidation pattern: O'Neal Plain *var. Conway* and both Baytown varieties share similar oxidation patterns with nearly all sherds being uniformly colored throughout, or lighter in color on their exterior surfaces and having a darker core. Goose Creek Plain *var. unspecified*, however, differs notably in having nearly half the sherds in the sample with a reverse pattern – dark exterior/light interior or lighter core than surfaces.

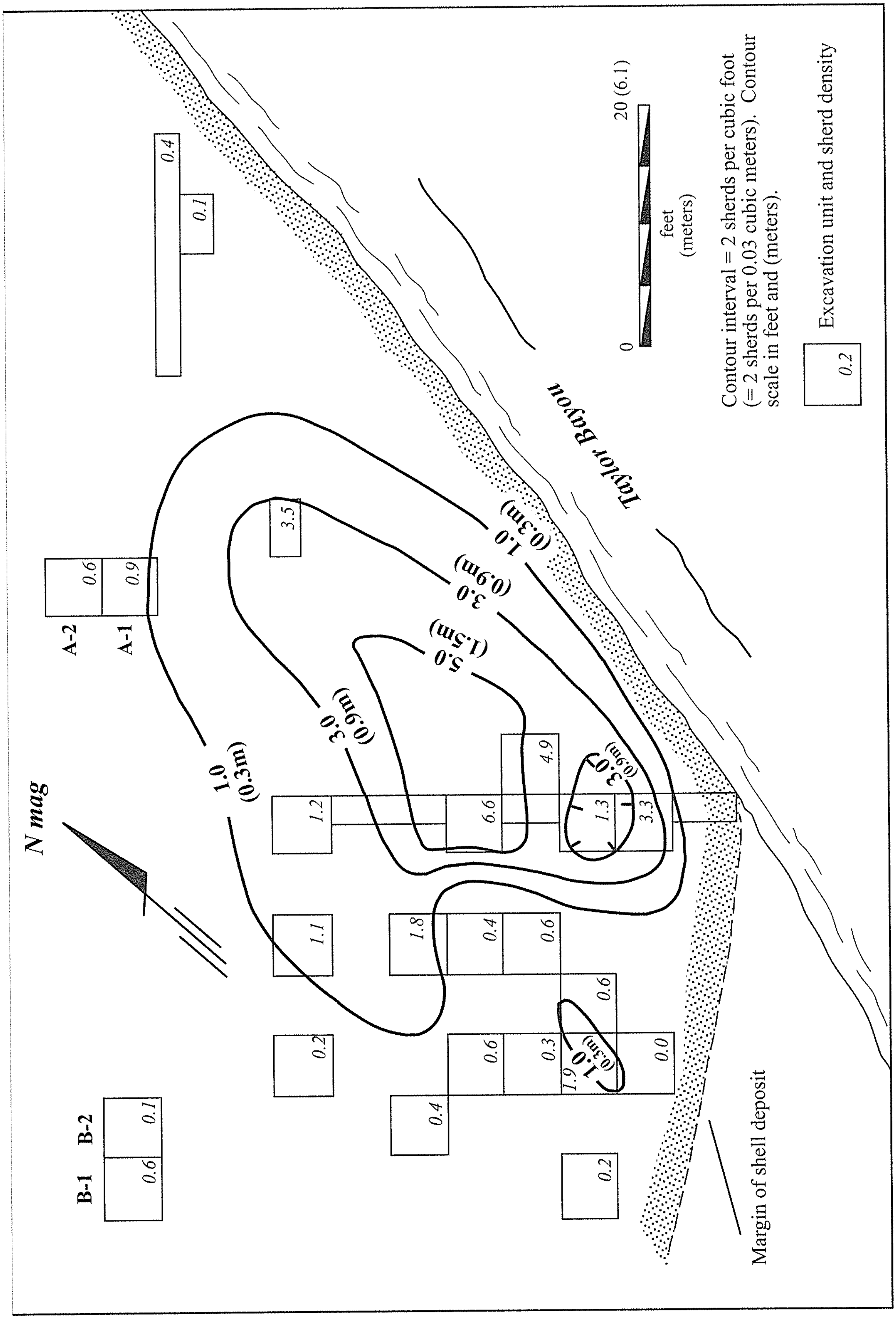

Figure 19. Sherd density at the Gaulding site (41JF27); see Figure 4 in Chapter 1 for identification of excavation units.

These results may suggest that most pots of the former varieties were fired while upside down possibly with additional fire fuel placed over the exterior. The pattern reversal for nearly half of the Goose Creek *var. unspecified* pottery suggests frequent use of a different arrangement of fire and/ or pots, possibly with orifice facing into the fire. Some of these latter vessels have cores lighter than surfaces suggesting that after extended firing that burned off all organics, the fire may have been smothered to cause reduction and darkening of the exterior surface.

Paste composition: While the ordinal scaling of paste constituents (Table 3) facilitated verbal descriptions of the pottery varieties, plotting the proportions of the constituents for a sample of specimens in each type or variety permits a more quantitative and pictorial representation of their differences. O'Neal Plain and the majority of Goose Creek Plain *var. unspecified* occupy very distinct positions in the triangular graphs (Figure 17). Both Tchefuncte Plain varieties, Goose Creek Plain *var. Anahuac*, Baytown Plain *var. San Jacinto* and the two San Jacinto Incised varieties all substantially overlap with the very fine sand range of Goose Creek Plain *var. unspecified* (Figure 17a). However, Baytown Plain *var. San Jacinto* shows overall a widely varying sand size content, which may also suggest that grain size was relatively unimportant in clay selection for that ceramic.

Figure 17b displays the ratios of silt and clay matrix, sand (natural or added), and bone, shell, and grog tempering agents. All ceramic categories are more than half composed of silt and clay matrix except for some Goose Creek Plain *var. unspecified* sherds. Baytown Plain *var. Phoenix Lake* is exclusively a matrix/grog temper mix; Tchefuncte, O'Neal and Goose Creek Plain (all varieties), are exclusively a matrix/ sand mix. Baytown Plain *var. San Jacinto*, both San Jacinto Incised varieties and the various rare bone, shell and grog categories are relatively distinct mixes of all three components—matrix, sand, and temper.

Pottery clay sources: It has been suggested that most pottery varieties on the upper Texas coast are made of natural sand/silt/clay assemblages modified sometimes by the addition of grog, bone, shell, or sand temper (Aten 1983b:206-245; but also see Ennes and Flood 1997:F-28). It was assumed, further, that O'Neal Plain *var. Conway* with discontinuously distributed sand sizes is not a natural assemblage but one in which coarse- and medium-grained sand has been added as temper to a finer silt/clay mixture. Some testing of this proposition has been carried out by analyzing sherd sediments in thin sections or through other means (Ennes and Flood 1997; Kelley et al. 1994). While these efforts have been informative they were limited by sample sizes of not more than 1 or 2 sherds per type or variety, thus giving little sense of variation in manufacture. In the following section, testing these proposals is continued with a different but complementary approach. Again, the burden falls on O'Neal Plain *var. Conway*, Goose Creek Plain *var. unspecified*, and the two Baytown Plain varieties because only they have sufficient sample sizes at the Gaulding site.

The discontinuity in grain sizes in O'Neal Plain *var. Conway* versus their relative continuity in Goose Creek Plain *var. unspecified* and Baytown Plain *var. San Jacinto* is clearly illustrated when plotting cumulative grain size curves for the three pottery samples (Figure 20). The question is whether any "natural" sediment deposits match the grain sizes observed in the sherd samples. While small amounts of larger sand sizes are found in various sediments around the area it is not in sufficient quantities to resemble the O'Neal paste. Minor amounts are found in the cheniers and modern beaches but these also include a large shell component in the sand fraction, something not seen in pottery (Stull 1965; Graf 1966; Byrne et al. 1959). The Cameron and Calcasieu Parishes soil surveys and the Jefferson County soil survey (Crout et al. 1965; Midkiff and Roy 1995; Roy and Midkiff 1988) all report a variety of soils derived from Pleistocene, Holocene, and modern floodplain, delta, and coastal marsh deposits but all have insufficient amounts of coarse sand to resemble O'Neal pottery clays. In his study of Sabine Lake, Kane (1959:229) reported that the most common bottom sediment is silt; very fine sand is found in limited areas and fine sand is rare. No coarser material was found. In cores from the buried Holocene Sabine River floodplain offshore, up to approximately 10 percent sand larger than fine sand was reported (Nelson and Bray 1970:58-59) but this too is an insufficient proportion to mimic O'Neal pastes.

Several samples were found in soil surveys and a variety of geological studies that could be quantitatively plotted on three-pole graphs in the same manner as the sherd data (Table 6). Plotting the sand fraction from the soil and geological samples (Figure 17a), the marsh and natural levee deposits overlap most of the ranges of the sandy paste ceramic types. The sand fraction of a modern beach plots away from any sherd group, and only Neches River point bar sediments plotted similarly to the O'Neal Plain *var. Conway* sherds (also see Figure 20).

From the perspective of grain-size, at least, it appears that the locally-made Gaulding pottery could have been manufactured from natural levee deposits and certain Beaumont Formation facies for the sandy paste wares; various marsh clays for the Tchefuncte, Baytown Plain *var. Phoenix Lake*, and San Jacinto Incised *var. Spindletop* wares; and a mix of local point bar sand with a sand-free clay/silt mixture for making O'Neal Plain *var. Conway*.

Surface treatment: Scraping both the interior and exterior surfaces seems to be proportionally more common on the early Tchefuncte and Mandeville varieties than on any other. All of the Goose Creek Plain *var. unspecified* is smoothed on interior and exterior while O'Neal Plain and both Baytown Plain varieties are predominantly smoothed but respectively show increasing proportions of burnishing. The two Baytown varieties also have definite minor proportions of interior scraping. This is broadly consistent with the findings on the lower Trinity River of burnishing

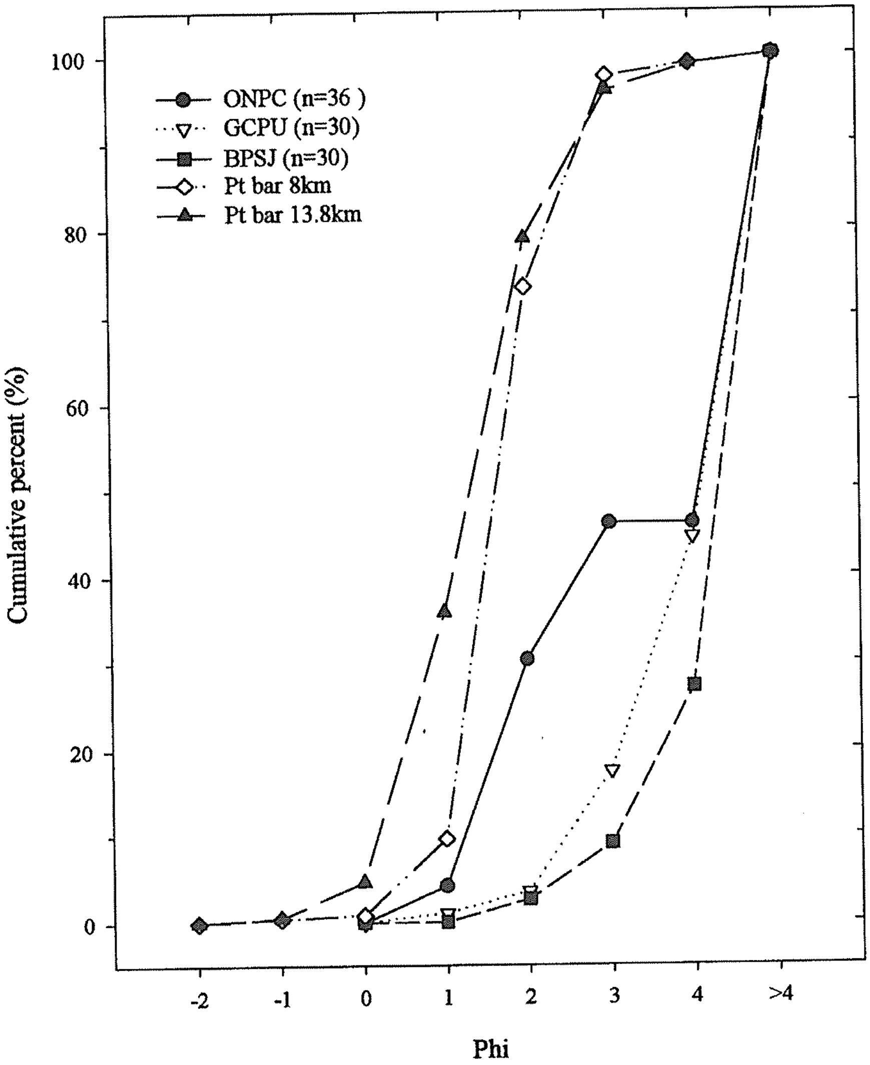

Figure 20. Grain size cumulative plots for the three major sand-bearing ceramic varieties in the Sabine Lake area, and for two Neches River point bar deposits near Beaumont: ONPC = O'Neal Plain *var. Conway*; GCPU = Goose Creek Plain *var. unspecified*; BPSJ = Baytown Plain *var. San Jacinto*; point bars identified by distance from river mouth.

becoming more common later in time (Ensor 1995:282-286).

Vessel form: Since there were few sherds found in the Gaulding excavations that provide clues to vessel form and size these limited data can mainly yield suggestions and hints. Body thickness measurements reported in the descriptions and on Table 5 suggest two broad groupings: a thinner-walled vessel group consisting of Goose Creek Plain *var. unspecified*, Goose Creek Red-Filmed Plain *var. unspecified*, Goose Creek Incised *var. unspecified*, O'Neal Plain *var. Conway*, and the two Baytown Plain varieties; and a slightly thicker-walled vessel group consisting of both Tchefuncte varieties, Goose Creek Plain *var. Anahuac*, and San Jacinto Incised *var. Spindletop*.

Similarly, rim diameter measurements (Table 5) suggest two groups of vessel sizes (10-19 cm. and 32.5-35 cm.), although the pottery taxa comprising these two groups are nearly all from the group of thinner-walled vessels. There is a tendency for the Goose Creek Plain *var. unspecified* group to have inverted rims, O'Neal Plain *var. Conway* to have straight rims, and for the grog-tempered varieties to have everted rims. All groups tend to use flat lips more than other lip forms. Most rims have no lip modification but the grog-tempered vessels tend to be more likely to have modification in the form of scalloping or perpendicular incised lines. There are not enough bases to indicate tendencies although flat bases are the most common in this collection as a whole.

Design motifs: The single Goose Creek Incised *var. unspecified* sherd may or may not be incised; the possible motif is a very sloppy pair of horizontal lines that might only be smoothing marks. San Jacinto Incised *var. Jamison* has two motifs: a single horizontal line, and a partially preserved motif consisting at least of a wide-stylus, horizontal, zigzag line bounded below by a single fine horizontal line, and whatever was above the wide zigzag has been lost (Figure 18g).

TABLE 6
Sedimentary grain size data for comparison to ceramics (see Figure 17a)

Sample material and locations	Sand sizes (percent) Coarse-Medium	Fine	Very fine	Source
1. Hackberry loamy fine sand	1.8	24.7	73.4	a
2. Kaplan silt loam	7.0	5.5	87.4	a
3. Peveto Beach - chenier	12.3	80.6	7.1	b
4. Acadia silt loam	5.5	22.1	72.4	c
5. Beaumont clay	1.0	4.8	95.2	c
6. Morey silt loam	2.8	14.0	83.2	c
7. Kinder silt loam	0.6	31.3	68.1	d
8. Leton silt loam	1.7	34.0	64.3	d
9. Una silty clay loam	7.7	29.0	63.3	d
10. Marsh clay/silt between cheniers	11.0	39.0	50.0	e
11. Marsh clay/silt between cheniers	15.0	38.0	46.0	e
12. Marsh clay/silt between cheniers	0.0	22.0	78.0	e
13. Marsh clay/silt between cheniers	0.0	17.0	83.0	e
14. Neches R. point-bar, 8 km upstream	74.0	24.6	1.4	f
15. Neches R. point-bar, 13.8 km upstream	79.7	17.2	3.1	f

Sources: a. Midkiff and Roy 1995
b. Stull 1965: 23
c. Crout et al. 1965
d. Roy and Midkiff 1988
e. Byrne et al. 1959
f. Aten and Bollich, unpublished notes

The most interesting motifs were found on San Jacinto Incised *var. Spindletop* (Figure 18a-e). In addition to one or more horizontal lines, one sherd has a band of pendant triangles filled with parallel vertical lines; another is incomplete but may be a band of diagonal parallel lines bounded on bottom by a single horizontal line. The most complex design also is fragmentary but consists of at least three panels: one may be filled with horizontal lines; another with a vertically oriented chevron or feather motif; and the third with a line comprised of a succession of arcs under which appears to be an excised area but this is not certain (Figure 18e).

Finally, the sherds from the imported Caddoan-like grog- and bone-tempered brushed vessel (Figure 18h) have a row of punctations around the rim and from this row is suspended diagonal brushing. Somewhere at or below the constricted neck of the vessel the brushing changes orientation to vertical brush strokes, as these are evident near the base. The stylus used appears to be the shredded end of a twig.

Vessel repairs and modifications: One Goose Creek Plain *var. unspecified* has a single hole drilled near the rim apparently to fasten a cover rather than to stabilize a crack. One O'Neal Plain *var. Conway* sherd has a hole drilled well below the rim and probably for crack repair. One Baytown Plain *var. Phoenix Lake* sherd is repaired with an asphalt patch over a poorly wedged coil join that presumably leaked. Another Baytown Plain *var. Phoenix Lake* vessel represented by three sherds was apparently covered with a thin layer of asphalt on the exterior. Presumably neither of the latter vessels was used near or over a fire or hot ashes because of the asphalt.

Conclusions

The pottery collection from the Gaulding test excavations clearly indicates limited use of the uppermost 15 to 30 cm of the north half or northeast quadrant of the site early in the ceramic period and again late in the ceramic period. Habitation probably occurred intermittently between these time periods as well, but there is relatively little volume to these deposits and so periodic use could not have occurred too often. Going beyond the chronological and distributional information from the pottery, the Gaulding data begins to suggest the manufacturing activity underlying the Sabine Lake area ceramic typology. From this collection, there appear to be at least 4 distinct modes of pottery manufacturing represented in the Tchefuncte/Mandeville varieties, Goose Creek Plain *var. unspecified*, O'Neal Plain *var. Conway*, and the local grog-tempered wares.

The Tchefuncte and Mandeville varieties maintain their thick-walled, irregular forming techniques, and distinctive clays.

Goose Creek Plain *var. unspecified* is distinguished by the frequent selection of fine sandy clays with iron nodules, a more compact paste texture than most other types, vessel surfaces usually smoothed while the clay is still wet, and firing techniques that are more variable in the resulting oxidation pattern than on other types.

O'Neal Plain *var. Conway* is distinctively tempered with

Table 7

Non-ceramic artifact frequencies by stratigraphic analysis units, Gaulding site (41JF27)

	Stratigraphic Analysis Units						
Non-ceramic artifacts	**Upper (A)**	**Upper (B)**	**Upper (undiff)**	**Middle**	**Lower**	**No prov.**	**Totals**
Projectile points							
Perdiz	1						1
Misc. arrow form	1						1
Gary	2						2
Misc. dart form 1	1				1		
Misc. dart form 2						1	1
Misc. dart form 3					1		1
Other lithic tools and debris							
Stemmed knife						1	1
Elongate biface tool				1			1
Small biface cutting tool	1						1
Indeterminate biface frag.		1			1	1	3
Used flake						1	1
Bipolar core (?)	1						1
Discarded core pebble						1	1
Debitage (flakes)	15	2	4	1	1	10	33
Primary cortex	*(1)*		*(1)*			*(1)*	
Secondary cortex	*(4)*		*(2)*		*(1)*	*(4)*	
Interior lipped-single facet	*(3)*	*(1)*				*(1)*	
Interior lipped-multiple facet	*(4)*	*(1)*		*(1)*		*(2)*	
Interior-not lipped	*(1)*						
Fragments	*(2)*		*(1)*			*(2)*	
Metate frag.			1				1
Pumice						1	1
Bone tools							
Socketed point				1		1	2
Deer ulna awl						1	1
Splinter awl	1					1	2
Antler flaker						1	1
Shell tools							
Columella bead-unfinished	1						1
Perforated *Rangia* valves	9	2	2		2		15
Totals	33	6	7	3	5	20	73

sands possibly from local point bar deposits. In addition, the matrix clay that was selected avoids iron nodules more than was done for other pottery types. Vessel surfaces were usually smoothed while wet and the variety's attributes show less variation than the other three groups indicating more adherence to a manufacturing procedure.

The Baytown Plain grog-tempered varieties are distinctive in their selection of matrix clay, have the least compact of all the paste textures possibly due to a higher organic content of the clays, and show much variation in smoothing techniques including much more use of burnishing. Their firing practices, however, may have less variation than other types, as there is less variety in the oxidation characteristics.

The only paste analysis dataset that can be compared in approximate terms to the Gaulding collection is the thin section grain-size analysis of 11 sherds from the Clear Lake Period component at Eagle's Ridge (Ennes and Flood 1997). Although grain sizes were recorded somewhat differently than in the present study (silt was separately identified and fine/very fine sands were combined), the results appear similar. The description of O'Neal Plain was practically identical in both studies. The other early varieties (Tchefuncte and Mandeville, Goose Creek Plain *var. Anahuac* and *var. unspecified*) often seemed a little finer-grained at Gaulding. These differences could be due either to difficulty in comparing the size classes that were used for analysis, or to the larger sample examined at Gaulding, which introduces more variability.

TABLE 8
Lithic artifact attributes, Gaulding site (41JF27)

Artifact	Dimensional attributes (mm) ML	MW	SL	SW	T	Color	Material
Projectile points							
Perdiz	24.0	18.0	6.8	5.8	3.5	10YR 4/2	chert
Misc. arrow form	22.3	16.0	2.5	6.0	3.5	"dk brown"	silicified wood
Gary (lot 43)	32.0	21.0	11.0	13.5	8.0	10YR 5/6, 10YR 3/1	silicified wood
Gary (lot 17)	?	21.0	13.0	14.5	9.0	7.5YR 4/2, 10YR 6/2	chert
Misc. dart form 1	27.0	21.0	8.5	12.5	7.3	10YR 6/2	silicified wood
Misc. dart form 2	31.5	17.0	10.2	12.4	8.5	10YR 5/6	chert
Misc. dart form 3	?	24.0	10.0	17.5	9.0	10YR 7/2 to 10YR 6/2	chert
Other lithic tools							
Stemmed knife	32.7	20.5	8.5	11.0	8.3	10YR 4/2	chert
Elongate biface tool	45.5	13.0	—	—	8.9	10YR 5/3	silicified wood
Small biface cutting tool	22.0	14.0	—	—	2.5	10YR 5/2	chert
Indet. bif. frag. (lot 41)	—	—	—	—	12.1	2.5YR 4/2	quartzite
Indet. bif. frag. (lot 60)	—	—	—	—	—	10YR 4/1	silicified wood
Indet. bif. frag. (lot 93)	—	—	21.2+	11.4	8.0	10YR 4/6	chert
Bipolar (?) core	30.0	15.0	—	—	15.0	5YR 4/3	chert
Discarded core pebble	25.0	25.0	—	—	10.0	2.5YR 4/4	chert

In any event, the Eagle's Ridge study is a positive step as is the Gaulding analysis. Each tells something different about the local ceramics, and together they reveal even more, indicating that the methods might fruitfully be merged. The Eagle's Ridge study uses petrography and mineralogy methods but because of its destructive and labor intensive nature can only be employed on a few specimens. The Gaulding study used low-power microscopic methods on larger samples but require great care in making visual estimates. The low power methods probably can be connected to the thin-section method at the grain-size estimation, but then go on to record other attributes and variability as well.

Presumably, each ceramic variety reflects the perceived cultural norm for a technological, functional, or stylistic solution to some need for a container. So, how would activity occur in the daily lives of Indians such that this archeological ceramic assemblage could be created? All potters in the same band (or whatever the face-to-face group was) could make the same kind of pottery, but different bands then each would have had to make different kinds of pottery, and an archeological assemblage could be the residue of different bands occupying a single archeological site. Or, each potter in the same band made a different ceramic variety and an archeological assemblage could be the residue of one or more single band occupations. Or, individual potters in the same band each made more than one kind of pottery, depending on the group's current needs, with an archeological assemblage being the residue of one or more band's occupation and their functional needs for pottery vessels at that time.

Whatever were the cultural requirements that brought an individual to manufacture a particular ceramic variety, through space and over time many other potters made the same kind or kinds of pottery. Their individual variations in technique, predilection, and location may be the key aspects of the variation that is documented in the ranges of attributes for each variety in Tables 3, 4, and 5 and in the descriptions. Interestingly, the several pottery varieties continue to form relatively distinctive clusters as their attributes are mapped in ever-greater detail. If native potters were making their primary manufacturing decisions on some attribute other than paste (such as design or vessel form), it is hard to see how such distinct paste clusters could continue to persist for long periods of time. These technologies should be mapped more widely with uniform methods addressing both the needs for detail as well as for sufficient sample sizes to reflect variation. With that information, time and space differences may emerge that begin to answer questions about the formation of such pottery assemblages as are found in Sabine Lake area shell-bearing sites.

LITHIC ARTIFACTS

Only 73 non-ceramic artifacts were recovered from the Gaulding site, most of which were lithics (Tables 7 and 8). Whenever feasible the artifact categories followed established usage. All specimens were examined with the aid of a 10x to 20x binocular microscope. Additional metric, color, and material data for lithic artifacts may be found in Table 8. As with ceramics, references to grain size are in terms of the Wentworth scale; color terminology is from the Munsell system.

Perdiz

(Figure 21a). The blade is triangular with prominent downturned barbs. The stem is contracting, with a rounded base, and comprises ¼ of the total length. Microscopic examination indicates some abrasion of prominences on the stem and blade; bifacially chipped.

Miscellaneous arrow form

(Figure 21b). A bifacially chipped artifact; blade is triangular with serrated, straight edges and prominent shoulders. The stem is slightly contracting to a flat base; the basal surface is the cortex surface of the resource cobble. This specimen was misplaced before final descriptions were made. Consequently, only a pencil sketch outline of the specimen and general color description, rather than Munsell color, is available.

Gary

(Figure 21c-d). Two examples of the Gary type were found, both associated with the upper half of the upper stratigraphic analysis unit. The first specimen (Figure 21c) has a slightly asymmetrical, triangular blade with slightly convex edges. The shoulders are prominent and project slightly upward toward the distal end. The stem is slightly asymmetrical and straight to slightly contracting with a strongly rounded base. The stem comprises one-third of the total length. Cortex is present on both faces of the specimen indicating the original resource pebble was not much larger than the final form of the tool.

The second specimen (Figure 21d) is missing much of the blade. However, the blade form probably was triangular with weakly developed shoulders. Cortex remains along one side of the specimen. The stem is contracting, asymmetrical, and has a rounded base.

Miscellaneous dart form 1

(Figure 21e). The blade is roughly triangular with convex edges; the shoulders are weakly developed. The stem is straight with a flat base and comprises about one-third the total artifact length. Cortex remains on both blade surfaces indicating the resource pebble had the same thickness as the finished projectile point, and was nearly the same width and length. This category resembles the Kent type, a group widely varying in its details of form that was in extensive use during the Late Archaic.

Miscellaneous dart form 2

(Figure 21f). The blade is asymmetrical but approximately triangular. One edge is nearly straight, the other is convex; shoulders are not pronounced. The stem appears to be slightly expanding, with a slight concavity in the base, and comprises about one-fourth of the total length of the artifact. Considerable cortex remains over one face of the specimen.

Miscellaneous dart form 3

(Figure 21g). The blade is roughly triangular, plano-convex in cross-section, and very asymmetrical. The distal blade tip is missing and an upward sweeping shoulder/barb is developed only on one side. The stem is roughly straight with a flat base. This form, too, resembles the Kent type.

Stemmed knife

(Figure 21h). The blade is roughly ovoid in outline and does not appear to have been reworked from a dart point. The stem is slightly expanded and the base is slightly convex. Cortex remains on both surfaces and on the distal end indicating the tool was made from a resource pebble not much larger than the final artifact form. There is wear and polish on both edges as indicated in Figure 21h.

Elongate biface tool

(Figure 21i) This is a roughly chipped tool exhibiting slight wear and polish on the distal end and slight wear on the lateral edges (indicated on Figure 21i). The presumed proximal end is flat and unmodified.

Small biface cutting tool

(Figure 21j). This is a small, leaf-shaped interior flake that has tiny use-retouch flaking or nibbling along the lateral edges (indicated on Figure 21j) and a small, graver-like point at the distal end. Examination at up to 43x indicates little wear of edges and no striations indicating patterned use; however, there is abrasion wear on prominent ridges between flake scars on the two faces. This tool was made on a thin flake with primarily unifacial edge trimming on alternate sides of the flake resembling beveling.

Indeterminate biface fragments

Three biface fragments could not be identified as to their original tool type, but add some information to the lithic technology used at Gaulding. From lot 41 (lower half of the upper stratigraphic analysis unit) was the small fragment of an ovoid or rounded biface that had broken either in manufacture or in use along a quartz vein that cuts across the material and obviously was a plane of weakness. From lot 60 (lower analysis unit) comes a fragment of which not enough remains to measure or to determine much about its form. Part of it includes an unmodified cortex surface, and the entire piece, including the break facet shows much abrasion and polish. From lot 93 (no stratigraphic provenience) was a piece that could be stem of a hafted tool. It has slightly contracting sides and a convex base.

Used flake

(Figure 21k). This convenience tool is an irregular secondary cortex chert flake that exhibits much wear around half of its circumference and polish within 2 mm of that edge.

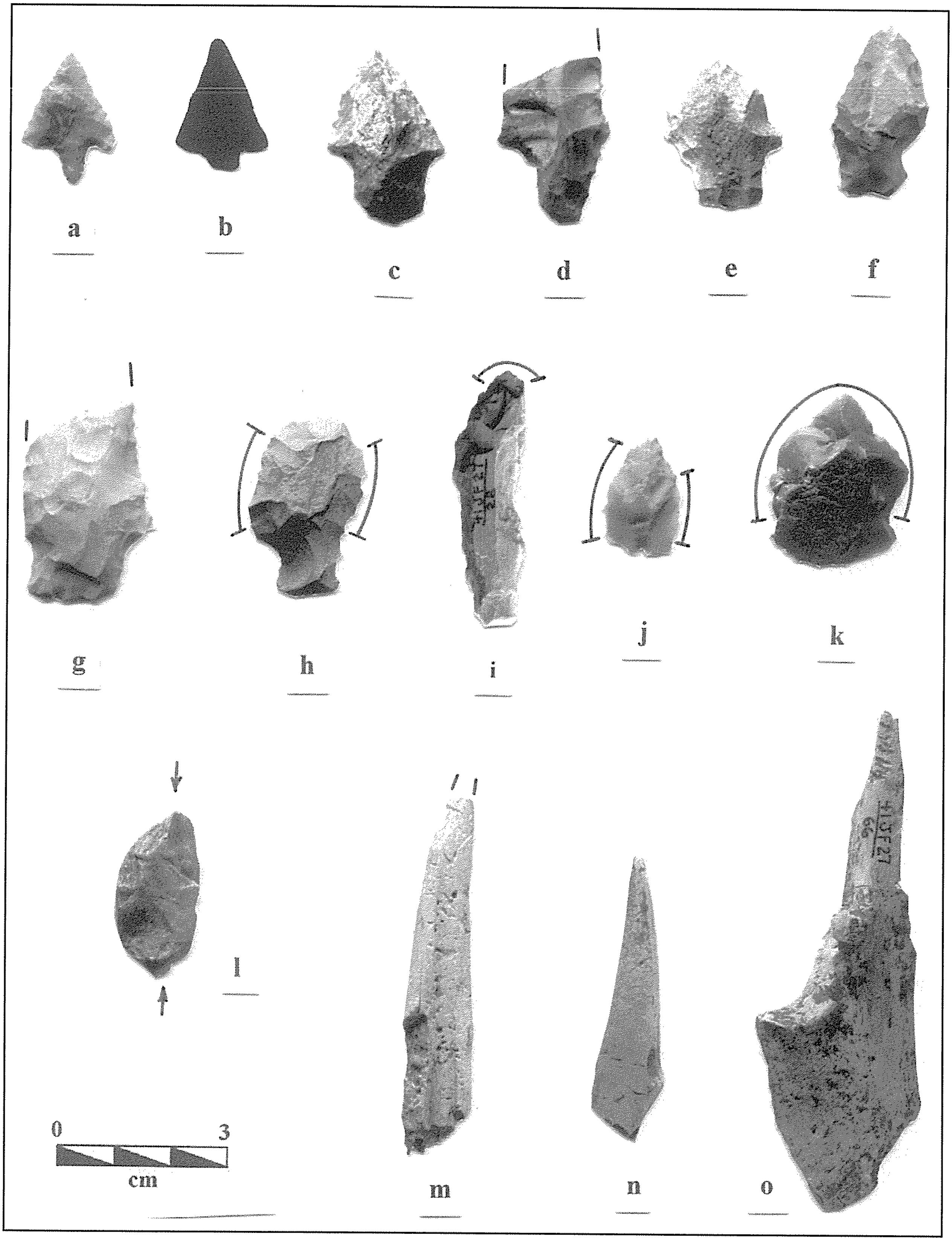

Figure 21. Non-ceramic artifacts: a) Perdiz; b) miscellaneous arrow form (silhouette only); c-d) Gary; e-g) miscellaneous dart forms 1, 2, and 3; h) stemmed knife; i) elongate biface tool; j) small biface cutting tool; k) used flake; l) bipolar(?) core; m-n) splinter awls; o) deer ulna awl. Marginal lines denote edge wear.

Also there is wear on the elevated areas of the dorsal and ventral surfaces.

Bipolar (?) core

(Figure 21l). This is the fragment of a pebble that shows percussion fractures on one end of the long side of the pebble and has what appear to be rebound fractures and flakes on the opposite end.

Discarded core pebble

This is a chert pebble on which much of the cortex remains but several flakes have been removed apparently in a failed attempt at making a core tool of some sort.

Debitage

From several sources (excavation, bulk samples, faunal samples) a small collection of 33 lithic flakes was assembled. They represent most of the flake types produced by manufacturing small biface tools except for small flakes produced during periodic resharpening. The evidence from the tools described above indicates that very often they were manufactured from small pebbles and cobbles that were barely larger than the finished implement. In this situation, it is not likely that a great many flakes would be produced, at least not many flakes large enough to have been recovered in the Gaulding excavations.

Metate fragment

(Figure 22f-f'). This is an unusual artifact with a complex history. It is a purplish brown (Munsell color was inadvertently not recorded) quartzitic sandstone that once was a large metate manufactured somewhere other than the Sabine Lake area. The metate had been broken and in its Gaulding incarnation was a piece that was roughly 100 by 64 by 32 mm and weighed 394 grams. The upper and lower surfaces, which can be seen in Figure 22, clearly show the original grinding facets, but its use at Gaulding was different. The piece has wear and rounding on all of the edges and breaks indicating it had been carried about or handled for quite some time after the metate was broken. Overlying the metate grinding facets along several of the edges are narrow grooves (Figure 22f). The latter are oriented perpendicularly to the edges. Some are V-shaped and relatively deep, considering this is a very hard rock. Others are U-shaped and are not so deep. The use(s) to which this ex-metate fragment was placed is/are speculative, but the grooves suggest it may have been tied to something perhaps as a weight, and/or used to rub or strop a cord or leather thong to improve its flexibility. Larry Banks examined the piece; he did not recognize the rock as to its source formation, but believed it was not Catahoula quartzite (L. Banks, personal communication, 1996). He also suggested as a possible function that the edge grooving might have resulted from edge preparation of stone bifaces before sharpening. Equally significant may be what this heavy piece of quartzite does not show; for example, it is not pitted as if used as an anvil in bipolar lithic technology. Neither is it battered as if it had been used as a hammerstone. Grinding slabs like this have been found in east Texas, from where the fragment may have been brought or traded into the coastal area.

Pumice

A small piece of apparently unmodified pumice, approximately 30 by 30 by 20 mm, was found in the surface collection.

Discussion

The majority of all provenienced lithic materials were from the upper half of the upper stratigraphic analysis unit, the location of nearly all the pottery as well. None of the chipped stone artifacts was very large; indeed, all are within the maximum dimension range previously suggested for small core tools made from alligator gastroliths (Aten 1983b:Appendix B). Perhaps further reinforcing this association is that the faunal collection from Gaulding site, to be described later, shows a major increase in alligator remains in the upper analysis unit, coincident with the major increase in lithic tools and debitage. The functional tool types are not remarkable, being typical of sites in the area. The most extensive analysis of projectile points conducted nearest to the Gaulding site was at the Eagle's Ridge site on the lower Trinity River (Ensor 1997). Generally, they found that Early and Middle Archaic forms were better made, employed higher quality lithic materials, and were obtained from greater distances than Late Archaic dart points, a pattern common in east Texas. The Late Archaic points tended to be made from local stream gravels (cherts, silicified wood, and quartzite), and usually were small in size. The resulting tools are often irregular and asymmetrical in form making typological analysis somewhat uncertain. While at Gaulding there is no early material for comparison, the Eagle's Ridge observations on Late Archaic dart points and associated stemmed tools are much like the situation at Gaulding.

Although not all of the Archaic stemmed tool forms are projectile points, it is interesting to note that all of the stems have similar widths and thicknesses (Table 8), possibly suggesting a standard technique and size for hafting and shafts during the Late Archaic. It also may be notable that in the upper analysis unit, when most artifacts and faunal remains were increasing in their abundance, only two arrow points were found.

The materials used in the Gaulding lithic technology, although few in number, are generally similar to the proportions previously described for the ceramic using time period in the Sabine Lake area (Aten 1983b:301); i.e., primarily cherts with small but persistent use of silicified wood and quartzite. So few specimens were recovered from the earlier Late Archaic layers it is hard to say much about them.

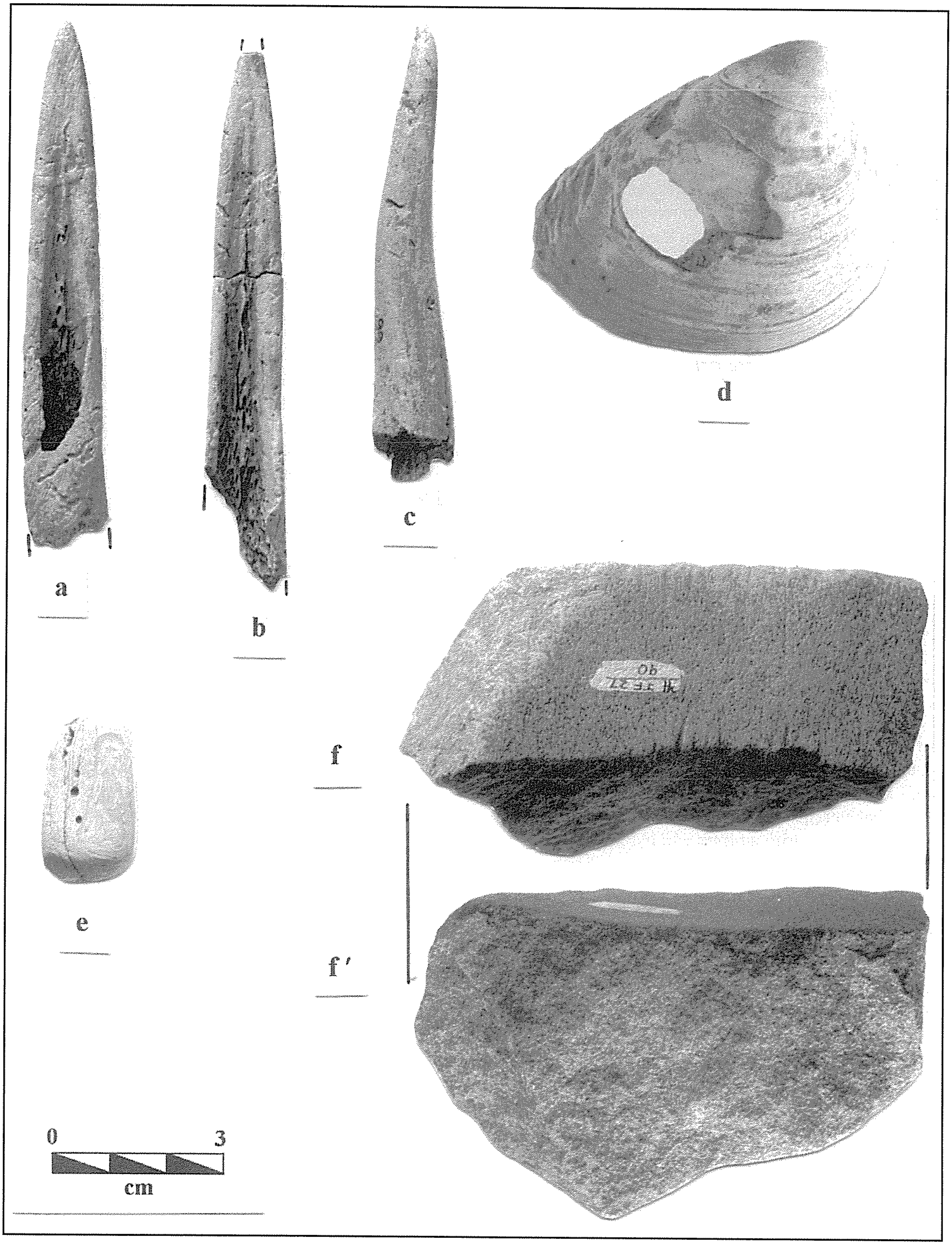

Figure 22. Non-ceramic artifacts: a-b) distal ends, socketed bone points (long form); c) antler tine; d) perforated *Rangia cuneata* shell; e) unfinished columella bead(?); f-f') quartzite metate fragment (f, grinding surface with numerous grooves along edges of fragment; f', side view of fragment and grinding surface).

BONE ARTIFACTS

Socketed bone points

(Figure 22a-b). These are two nearly identical socketed bone projectile points; one is from the middle analysis unit (lot 115, Figure 22a), and the other cannot be assigned to an analysis unit (lots 73 and 103, Figure 22b). Both are made from deer cannon bone and are of the long type. The specimen from lot 115 (Figure 22a) is 94.2 mm long and even though the base is broken, this probably is its original maximum length. The other specimen is 95.5 mm long but part of the base is missing which probably would have added another 5 mm at least to this specimen's maximum length. The distal tip from one is undamaged; the other is slightly broken but shows wear from continued use. Both have broken socket bases, which presumably is the reason for them to have been discarded.

Deer ulna awl

(Figure 21o). Although the distal tip of this specimen is broken, it was originally shaped, or developed through use, into a point rather than a spatula. The last 13 mm of the tip has about 7 sharp cuts in the bone (i.e., cut toward the distal tip) as if this bone was being used for an anvil for cutting something. In form, this specimen is the same as Type I from the Harris County Boys School (Aten et al. 1976: Figure 12E).

Splinter awl

(Figure 21m-n). These two specimens are splinters of long bones from large, deer-sized, mammals that have been shaped into a point and show polish around their distal tips. One specimen (lot 103; Figure 21m) is from the upper half of the upper analysis unit. A few mm of the distal tip is broken off, but when made, the tip had been cut or ground to a smaller diameter tip. The other specimen (lot 81; Figure 21n) is probably in its original form and is 51.5 mm long. The fractured bone edges were shaved and ground to make a working distal tip. This specimen cannot be correlated with the analysis units.

Antler tine

(Figure 22c). Also of unclear provenience, this antler tine has a highly polished distal tip, a condition that occurs naturally (D. A. Story, personal communication, 1996). Its presence in the site suggests some kind of use, but there is not much wear on the distal tip indicative of a flaking tool. In its present form, with a broken proximal end, the tine is 81.9 mm long.

SHELL ARTIFACTS

Unfinished columella bead (?)

(Figure 22e). This is a piece of a large conch columella ground around its circumference and on the ends. The piece is 29.5 mm long and roughly 13 mm in diameter. It has not been drilled, possibly because of its extremely ovoid cross-section, which might have made successful drilling difficult. Alternatively, this piece may have been used as is, for whatever purpose. It was associated with the upper half of the upper analysis unit.

Perforated Rangia cuneata valves

(Figure 22d). A number of *Rangia cuneata* valves were saved from the sorting screens because they had holes perforating the shells and were presumed to been tied together and used as weights (cf., Neyland and Worthington 1962). Inspection showed that many of them were perforated for other reasons: some had fresh breaks, some were holes drilled by natural predators, others were broken through weak areas as part of natural shell deterioration. But several shells remained that had old holes with worn edges that had been forced through from the interior. While the majority of these shells were associated with the upper analysis unit, two were found in the lower analysis unit also (Table 7).

Chapter 4

OTHER CULTURAL EVIDENCE

SUBSISTENCE

One of the drawbacks of the subsistence data from Gaulding is that the shellfish cannot be quantitatively integrated with the vertebrate data. That is to say, it cannot be determined how much shellfish meat per unit weight corresponds to a unit weight of vertebrate meat. Nevertheless, there are a number of things that can be said about each separately. Also, since there is no information on the plant component of Gaulding subsistence, the basic questions about the big picture of subsistence—plants versus vertebrates versus shellfish—and why, go unanswered at this time.

Shellfish

The Gaulding site shellfish were overwhelmingly, but not entirely, *Rangia cuneata,* a clam that reproduces in very low salinity upper estuarine conditions. As larvae, *R. cuneata* can be swept into fresh water or into high salinity water and survive, although these transported populations do not reproduce (Hopkins et al. 1973:17-21). Discussion was offered earlier about whether the *Rangia* was all harvested and opened as food for the moment, or were they used for some other purpose. It is assumed here that most of them were consumed on the spot but, for example, given the abundance of garfish and alligator bones in the site, it is not farfetched to assume that some quantity of the opened shellfish meat was used as bait.

Earlier, data also were presented from the bulk samples on the mean size of the clams in the various layers. Clams in Layers 2 through 5 were quite small, containing very little meat per individual, while those in the succeeding layers are a little larger. The shell samples available from the 1965 field school excavation also indicate the same relationship. Unfortunately, the bulk samples do not really tell how many clams were harvested in relation to vertebrates taken. One has to wonder why such small clams, containing only 1 to 2 grams of wet meat each, were worth the effort; but clearly they were.

It was speculated, in the field school field notes, about whether the small clams were dwarfed and, if so, why. However, after comparing their lengths to the annual growth interruptions on the shells and comparing these to modern known-age samples, it is evident that the small clams were just young individuals—usually in their second or third year – and of normal size (Aten 1999). Presumably they are all that was available to be collected. Alternatively, these layers may represent "hard times" subsistence. It is odd, however, that such small clams would have persisted as the available resource through the period of deposition of the four successive layers of the Lower Analysis Unit unless, hidden by the range of radiocarbon standard deviations, was a very rapid accumulation of cultural debris.

An opportunity was presented to examine the long-term presence of the *Rangia cuneata* clam in the Taylor Bayou drainage basin. The Corps of Engineers Galveston District made a large number of engineering logs available from borings that had been drilled in the Hillebrandt and lower Taylor bayous not far from the Gaulding site. In addition to the geological and sedimentological data, they also contained notations about the presence of "shells." While some of these may not have been *Rangia*, it is assumed that the majority was. From the 56 boring logs taken in the middle basin, 171 shell occurrences were logged and their depth recorded (Figure 23). Shells were relatively infrequent in the deeper cores (up to 26 feet, or 8 m) and they gradually increased in abundance until a peak was reached around 10 to 12 feet (3-3.6 m) depth. After this the frequency declined rapidly to very few shells being recorded in the shallower core depths.

This plot becomes even more interesting when it is associated with radiocarbon dates that approximate rising sea level (Appendix C, Table C-4). These dates are from the Pleistocene-Holocene contact in Sabine Lake in the vicinity of the buried early channel of Taylor Bayou (Anderson et al. 1991). The calibrated dates were plotted on Figure 23 as well.

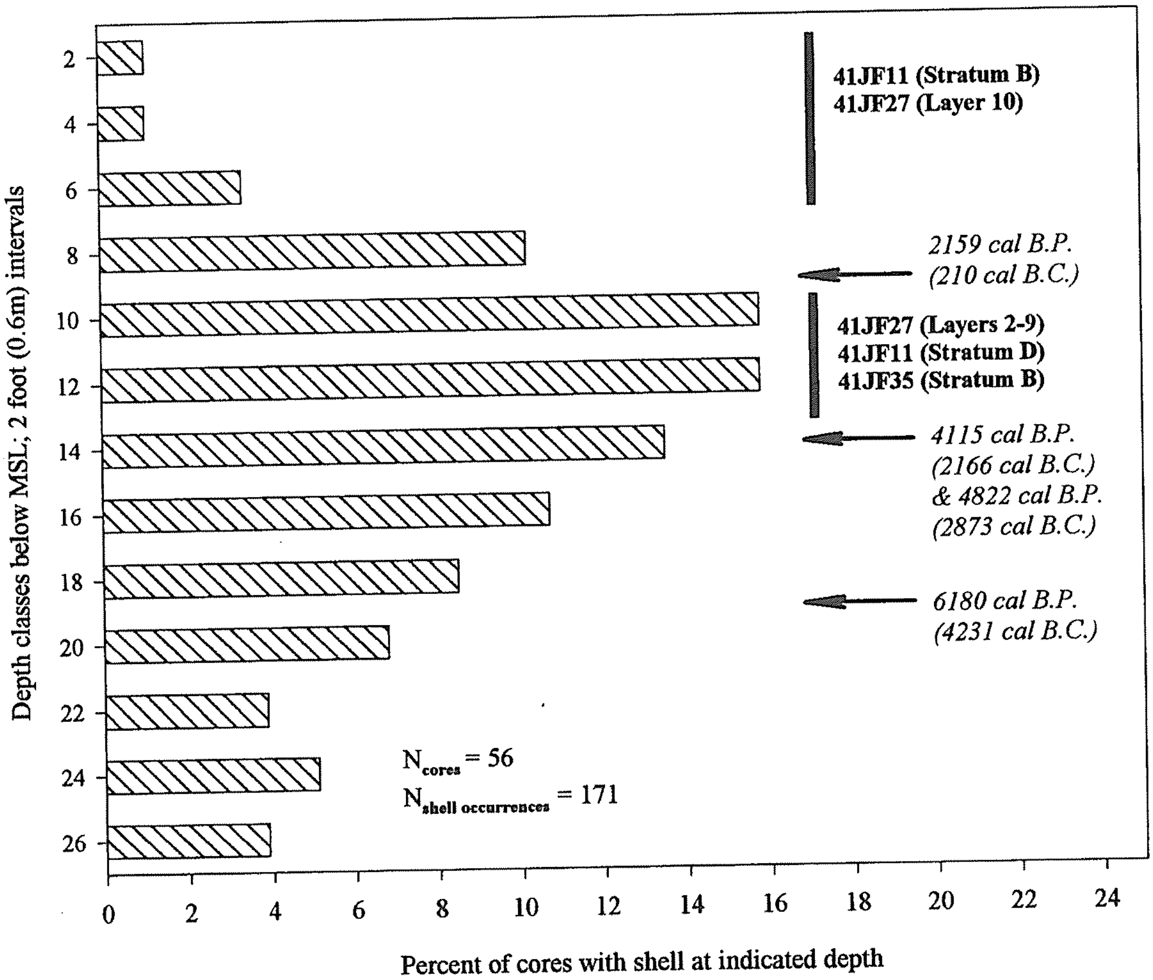

Figure 23. Relative abundance of shells (primarily *Rangia cuneata*) with depth below mean sea level in the middle reaches of Taylor and Hillebrandt Bayous. Radiocarbon dates are from Anderson et al. 1991 (see Appendix C, this report).

The period of maximum *Rangia cuneata* occurrence coincides with the Lower and Middle Analysis Units at Gaulding, as well as two other dated Late Archaic components nearby (cf. Figure 9). The Upper Analysis Unit at Gaulding and the dated upper component at 41JF11 (Raab and Smith 1983) coincide with the later period when *Rangia cuneata* was drastically reduced in abundance.

Taken together, these observations suggest that the period from roughly 2,000 to 4,000 years ago was the optimum period in the Taylor Bayou drainage basin for shellfish harvesting. This does not mean necessarily that clams were absolutely abundant at this time, but were as numerous as they ever were to be. Subsequent to 2,000 years ago, clams in Taylor/Hillebrandt Bayou were scarce on the whole and may not always have been available for harvest. Some of the dated archeological components from this latter time, though, are fairly substantial deposits. So the conditions in Taylor and Hillebrandt bayous must have been that periodically *Rangia cuneata* larvae were swept upstream from Sabine Lake or lower Taylor Bayou and they settled to form large but non-reproducing populations in the freshwater habitats of the middle Taylor Bayou drainage basin. These would persist until all had been harvested, or had died of natural causes – not longer than about 10 years in the northern Gulf coast (Aten 1999) – or were replenished by the next episode of drought or storm surge that would sweep a new supply of larvae upstream. Although a barrier was constructed early in this century on lower Taylor Bayou to prevent upstream intrusions of salt water, such intrusions were a rare event until construction of the Port Arthur Canal and heavy new demands for irrigation water from Taylor and Hillebrandt Bayous diminished the fresh water outflow (Alperin 1977:75).

The other shellfish species presumably used as a subsistence item at Gaulding was the eastern oyster, *Crassostrea virginica*. Although a number of oyster shells were recovered (Table 9), they still contributed an exceedingly small proportion of shellfish meat in relation to the *Rangia* and much of their value to this investigation is in terms of their information about shellfish source areas.

The greatest number of oyster shells that are in the collection came from the Lower Analysis Unit in the early Late Archaic. Their abundance seems to have declined slowly

TABLE 9
Excavated marine and estuarine shells and their characteristics, Gaulding site (41JF27)

	Analysis Units			
	Upper (A)	**Upper (B)**	**Middle**	**Lower**
Marine/estuarine shells:				
Brachidontes sp.	—	—	2	(*)
Busycon sp.	—	—	—	2
Dinocardium sp.	4	—	—	—
Crassostrea virginica, total	16	20	20	46
Left (lower) valves	(12)	(9)	(14)	(27)
Right (upper) valves	(4)	(11)	(6)	(19)
***C. virginica* characteristics:**				
Number set on *R. cuneata*	2	5	3	17
Number of ribbed *C. v.* valves	4	2	3	4
Right and left *C.v.* valves with *Polydora* worm burrows	16	16	20	45
C.v. left valve seasonality:				
Winter	4	2	1	10
Spring	3	5	10	7
Summer	—	—	—	1
Fall	2	1	—	2
Indeterminate	3	1	2	7
Distally broken valves	4	1	6	12

(*) Field notes only record "several" fragments from lower part of grid unit A-8.

from that time. Plots of the shell sizes indicate considerable variation in sizes collected with no clear trend (Figure 24). Lower Analysis Unit shells ranged widely from small to large. Middle Analysis Unit shells were consistently small. The lower half of the Upper Analysis Unit again ranged widely from small to large, while the upper half of the Upper Analysis Unit was consistently large shellfish. Roughly 20 to 25 percent of the valves had the distal ends broken off (Table 9) perhaps suggesting how at least some of the oysters were opened.

The frequency distribution of the height/width ratio of oyster shells as well as certain shell form features indicates the habitat in which the shellfish grew. The plot of oyster height/width ratios shows a strong peak in the 1.1 to 1.7 range indicating a predominance of rounded shells rather than elongate ones (Figure 25). Oysters with these forms typically grow either singly or in loose clusters on muddy sand substrates (Kent 1988:30). Moreover, some 10 to 25 percent of the oyster shells in this collection have developed radial ribs (Table 9), a feature typical of intertidal or shallow water growth. Nearly all of the oyster shells were infested with the *Polydora* mudworm (Table 9), a very low salinity animal that takes up symbiotic residence in the living oyster (Hofstetter 1967:19). There was no indication of higher salinity estuarine predators. There were, however, a fairly large number of lower oyster valves that had set on shells of *Rangia cuneata* molding their early shell formation to the shape of the clam shell and, in many cases, permanently incorporating the *Rangia* valve into the oyster shell.

In summary, the Gaulding site oysters had been growing in areas recently inhabited by *Rangia cuneata*, were infested with mudworms but not higher salinity predators, and grew in shallow water in small clumps or as individuals. Taken together, this information on oyster shells suggests that they were collected farther downstream from Gaulding, possibly in shallow marginal waters of lower Sabine Lake but did not originate in reefs or deeper parts of the estuary.

Vertebrates

Nearly 2,600 identifiable animal bones were recovered from the ½- and ¼-inch (15.2 and 7.6 mm) screens used during the 1965 and 1974 excavations. Billy M. Davidson analyzed the former collection and Laura J. Froehlich analyzed the latter. Because the sampling at the site was done without any 2-mm screening – hardly anyone did this in 1965 – we must assume there is an undefined degree of bias against small animals in the dataset. In addition, the faunal sample originates from several small, disconnected excavation units that often cannot be associated with specific layers. The only practical approach is to synthesize all excavation unit samples into the large-scale chronostratigraphic analysis units with which they are associated. These characteristics of the faunal data also make using estimated minimum numbers of individuals unrealistic. The number of identified specimens (NISP) approach is used instead. Although this approach introduces distortions of its own, it has the benefit of staying close to the data, and it produces a set of relationships between species that in some manner reflects cultural

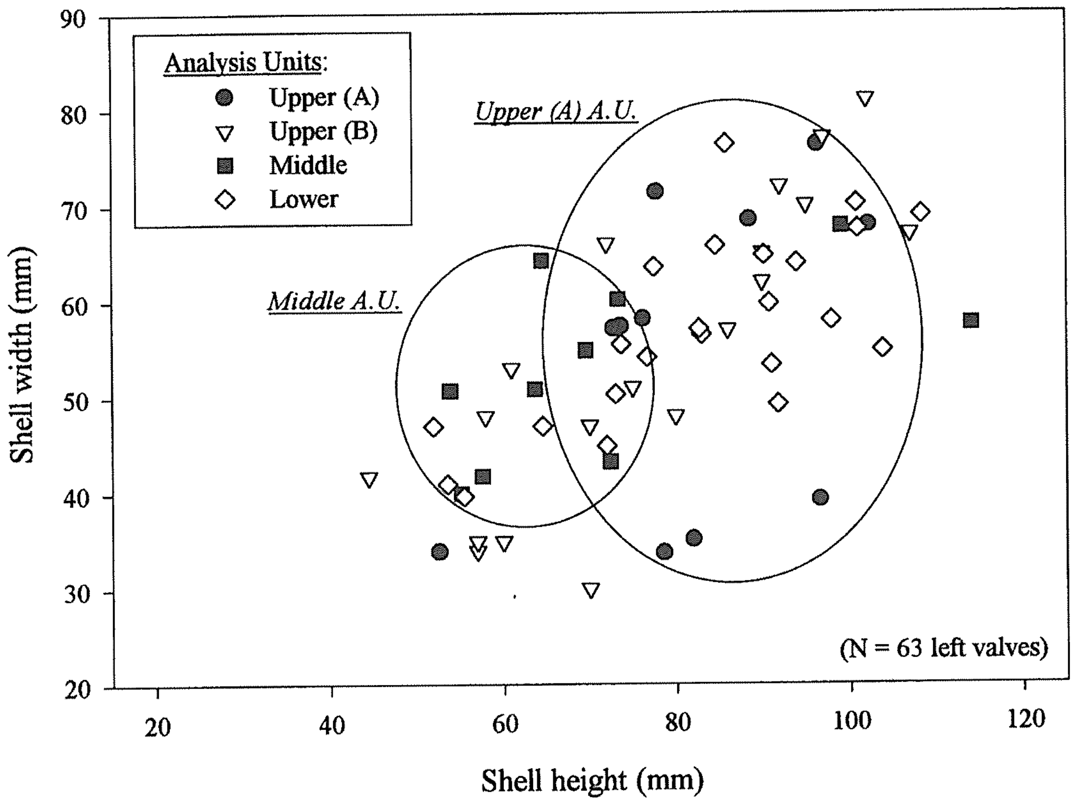

Figure 24. Oyster shell (lower valve) size in the archeological analysis units; Gaulding site, 41JF27.

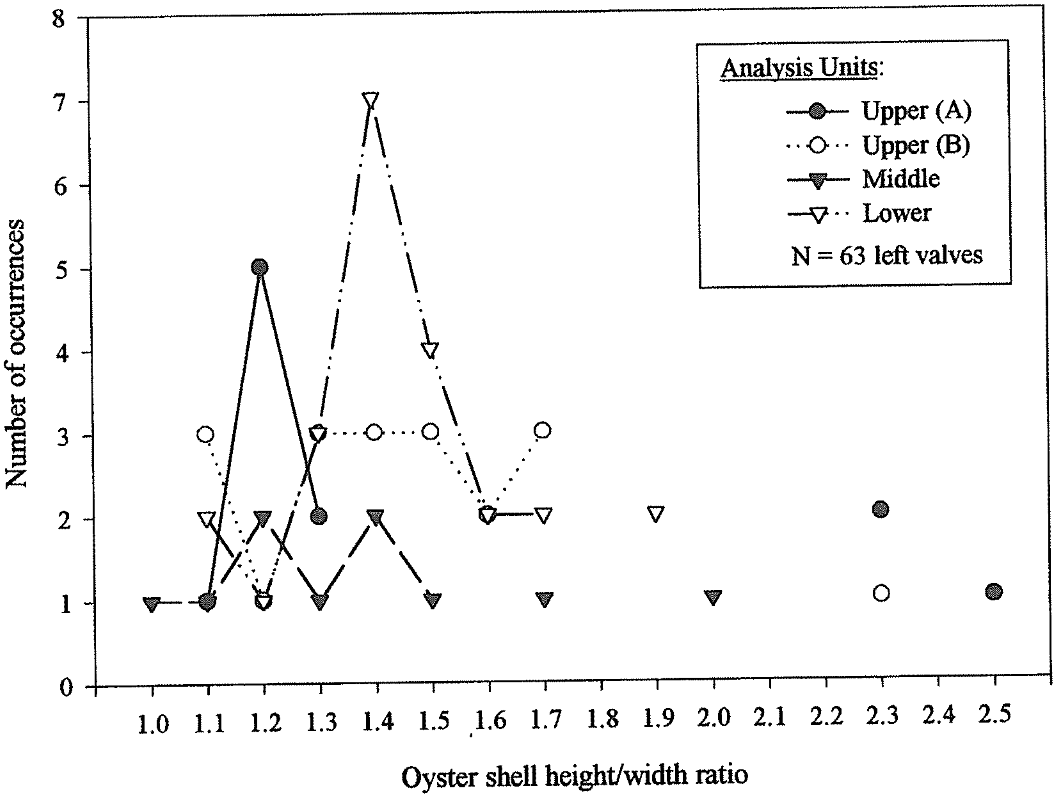

Figure 25. Frequency of oyster height/width ratios by archeological analysis units; Gaulding site, 41JF27.

differences in how food resources are taken from the landscape.

The condition of the bones in the faunal collection also should be noted. The bones and fragments usually are small (10-60 mm long), with most being in the small end of that range. These generally are unaltered except for having been broken. But a small proportion retains butchering evidence in the form of cutting and scraping marks. Another small group of bones are smoothed and polished, but are not shaped into a utilitarian or ornamental form. These seem likely candidates for having passed through the gastrointestinal tract of a larger animal, such as an alligator. Since alligator remains were found frequently in the site, this is a plausible explanation. It also indicates that faunal analysis of a better-defined collection than we have from Gaulding should look closely at bone condition and discount those that may only accidentally be in the site as residue from butchering other animals.

There are three key elements to the faunal analysis given here. The NISP and the stratigraphic analysis units have been introduced previously. The third element is the "animal class." This approach has been used for organizing still unpublished, as well as published, faunal data from the lower Trinity River (cf., Aten 1983a; Dillehay 1975). The original idea was obtained from Thomas (1969:392ff) who used animal classes to partition a faunal sample into groups of mammals of progressively larger body size to evaluate the effectiveness of certain archeological recovery techniques. In the adaptation of such an approach on the northern Gulf, animal classes are used to divide the entire archeological fauna into categories describing general body size and life style such as "aquatic," "small terrestrial," and so on. These groups of animals that are found by the Indian hunter or gatherer may have been subject to more or less similar acquisition techniques.

The species and number of identified specimens that were found in each stratigraphic analysis unit is given according to conventional taxonomic categories in Table 10; the same data organized according to animal classes is presented in Table 11. Because of the different volumes of excavated shell deposits assignable to each of the stratigraphic analysis units, the total number of identified bones per cubic foot (per .03 cubic meter) is given at the bottom of Table 11. Here it can be seen that the density of bones in the Lower and Middle Analysis Units (i.e., early and middle Late Archaic) is small compared to the Upper Analysis Unit. This does not appear to be a preservation problem since in northern Gulf shell-bearing sites, bone preservation usually is adequate and, as noted above, the Gaulding bones generally were in good condition except for breakage.

Discussion

As noted earlier the relationship between vertebrate and invertebrate fauna is significant here. Unfortunately, the data available only allow quantitatively considering shellfish and vertebrates separately. Despite the different sizes of *Rangia cuneata* clams in successive layers, and disregarding both the possibility that not all the harvested clams were used for human consumption and that these inferences are based on only one series of bulk samples, the estimated clam meat weight per unit of site volume was roughly the same for each layer. So even though it cannot be determined how much clam meat contributed to subsistence relative to the contribution of vertebrate animals, it appears that in the Late Archaic it was a declining proportion, as the vertebrate bone density in the site slowly increased (cf., Figure 14c and Table 14). Then, with the onset of the ceramics-using periods, a significant increase in use of vertebrate meat occurred, presumably causing the relative proportion of dietary contribution from harvested clam meat to decline further.

The proportional structure of faunal subsistence in each stratigraphic analysis unit (A.U.) can be seen in Figure 26. In the early Late Archaic (Lower A.U.) there tends to be relatively more avian and terrestrial animals and relatively fewer aquatic animals. In the Middle A.U., there is a proportional increase in fish apparently at the expense of the terrestrials that were more dominant in the Lower A.U. In the Upper (B) A.U., hunting large terrestrials and small terrestrial-aquatics continues to decline while the proportion of fish increases sharply. Finally, in the Upper (A) A.U., the proportion of large animal hunting continues to decline while the relative use of aquatic animals, especially alligators, continues to increase.

Despite the changes in relative proportions of the animal classes in the four analysis unit samples, the abundance of bones from each animal class (i.e., density per cubic foot, or per .03 cubic meter) tells a different story of how abundant the animals actually were (Figure 27). In the Lower and Middle A.U.'s, there is a very low density of bones from all animal classes, although several classes—especially the aquatic animals—show a tendency to increase in the Middle A.U. The two parts of the Upper A.U. are significantly different. Upper (B) shows major increases in quantity of large terrestrials (mainly deer) even though their relative proportion is declining. There are even larger increases in fish, with definite but smaller increases in large and small terrestrial-aquatics. Upper (A) A.U. again shows increases in large terrestrials with even greater increases in large terrestrial-aquatics and fish.

All in all, and assuming there is not a major undetected bone preservation problem, the faunal data show a major change in the focus of subsistence from the early Late Archaic to the Late Prehistoric ceramics-using periods. Within the context of the particular portion of the local settlement pattern represented by sites in the Taylor Bayou drainage basin, there is a progressive and proportional increase overall in the use of vertebrates versus shellfish. And within the vertebrates, there is a shift from predominantly using terrestrial and avian vertebrates to using aquatic and terrestrial-aquatic animals. Several investigators have described a similar phenomenon for the central Texas coast (e.g., Hall 1998:3-4).

Table 10
Archeological vertebrate fauna tabulated by taxonomic groups, Gaulding site (41JF27)

Taxon	Common name	Number of identified specimens (NISP)					
		Upper A	Upper B	Middle	Lower	No prov.	Area D
Fish:							
Amia calva	bowfin	2	1	0	0	1	0
Aplodinotus grunniens	freshwater drum	1	0	0	0	0	0
Archosargus spp.	sheepshead	1	0	0	0	0	0
Ictalurus spp.	freshwater catfish	1	0	0	0	0	0
Lepisosteus spp.	gar	700	162	36	6	266	0
Sciaenidae	drumfish	1	0	3	0	2	0
Unidentified fish	—	15	6	5	6	2	0
	Fish subtotal	**721**	**169**	**44**	**12**	**271**	**0**
	Fish %	**49.8**	**65.8**	**52.4**	**27.9**	**37.1**	**0.0**
Birds:							
cf. *Anas carolinensis*	green-wing teal	2	0	0	0	0	0
Anas spp.	unidentified teal	2	0	0	0	0	0
Unidentified duck	—	2	0	0	0	2	0
Ardea spp.	unidentified heron	1	1	0	0	0	0
Colinus virginianus	bobwhite quail	1	0	0	0	0	0
Meleagris gallopavo	turkey	1	0	0	0	0	0
Mimus polyglotus	mockingbird	0	1	0	0	0	0
Passeriformes	unidentified perching birds	1	0	0	0	0	0
Unidentified birds	—	1	1	0	1	1	0
	Birds subtotal	**11**	**3**	**0**	**1**	**3**	**0**
	Birds %	**0.8**	**1.2**	**0.0**	**2.3**	**0.4**	**0.0**
Reptiles:							
Agkistrodon spp.	cottonmouth/copperhead	2	0	0	0	0	0
Crotalus spp.	rattlesnake	1	0	0	1	0	0
Elapha spp.	rat snake	1	0	0	0	0	0
Chelonia mydas	green sea turtle	1	0	0	0	0	0
Chelonia spp.	sea turtle	41	0	0	0	0	0
Kinosternon spp.	mud turtles	1	0	0	0	0	0
Pseudemys spp.	slider	66	4	0	0	52	0
Trachemys scripta	freshwater painted turtle	1	0	0	0	0	0
Emydidae	freshwater turtles	7	0	0	0	0	0
Unidentified turtles	—	122	21	15	12	156	0
Rana spp.	frog	0	1	1	0	0	0
Unidentified frogs	—	1	0	0	0	0	0
Alligator mississippiensis	American alligator	252	13	2	0	73	1
Unidentified reptile	—	7	0	0	0	0	0
	Reptiles subtotal	**503**	**39**	**18**	**13**	**281**	**1**
	Reptiles %	**34.7**	**15.2**	**21.4**	**30.2**	**38.4**	**33.3**
Mammals:							
Lynx rufus	bobcat	0	0	0	0	0	1
Mustela vison	mink	0	0	0	1	0	0
Mustelidae	mink or skunk	1	0	0	0	0	0
Medium-sized carnivore	e.g., raccoon or fox	4	0	0	0	0	0
Bison spp.	bison	4	0	0	0	0	0
Odocoileus virginianus	white-tailed deer	151	41	21	16	153	1
Unidentified artiodactyla	probably deer	32	0	0	0	0	0
Geomys spp.	pocket gopher	1	2	0	0	0	0
Ondatra zibethicus	muskrat	21	0	1	0	21	0
Unidentified rodent	—	0	0	0	0	1	0
Sylvilagus aquaticus	swamp rabbit	0	3	0	0	0	0
Unidentified rabbit	—	0	0	0	0	1	0
	Mammals subtotal	**214**	**46**	**22**	**17**	**176**	**2**
	Mammals %	**14.8**	**17.9**	**26.2**	**39.5**	**24.1**	**66.7**
Grand total		**1449**	**257**	**84**	**43**	**731**	**3**

TABLE 11
Archeological vertebrate fauna by animal class and analysis unit; Gaulding site (41JF27)

Taxon	Common name	Number of identified specimens (NISP)					
		Upper A	Upper B	Middle	Lower	No prov.	Area D
Aquatic (AQ):							
Amia calva	bowfin	2	1	0	0	1	0
Aplodinotus grunniens	freshwater drum	1	0	0	0	0	0
Archosargus spp.	sheepshead	1	0	0	0	0	0
Ictalurus spp.	freshwater catfish	1	0	0	0	0	0
Lepisosteus spp.	gar	700	162	36	6	266	0
Sciaenidae	drumfish	1	0	3	0	2	0
Unidentified fish	—	15	6	5	6	2	0
	AQ subtotal	**721**	**169**	**44**	**12**	**271**	
	AQ %	**49.8**	**65.8**	**52.4**	**27.9**	**37.1**	**0.0**
Small terrestrial-aquatic (STA):							
Agkistrodon spp.	cottonmouth/copperhead	2	0	0	0	0	0
Chelonia mydas	green sea turtle	1	0	0	0	0	0
Chelonia spp.	sea turtle	41	0	0	0	0	0
Emydidae	freshwater turtles	7	0	0	0	0	0
Kinosternon spp.	mud turtles	1	0	0	0	0	0
Ondatra zibethicus	muskrat	21	0	1	0	21	0
Pseudemys spp.	slider	66	4	0	0	52	0
Rana spp.	frog	0	1	1	0	0	0
Trachemys scripta	freshwater painted turtle	1	0	0	0	0	0
Unidentified frogs	—	1	0	0	0	0	0
Unidentified turtles	—	122	21	15	12	156	0
	STA subtotal	**263**	**26**	**17**	**12**	**229**	**0**
	STA %	**18.2**	**10.1**	**20.2**	**27.9**	**31.3**	**0.0**
Large terrestrial-aquatic (LTA):							
Alligator mississippiensis	American alligator	252	13	2	0	73	1
	LTA %	**17.4**	**5.1**	**2.4**	**0.0**	**10.0**	**33.3**
Large terrestrial (LT):							
Bison spp.	bison	4	0	0	0	0	0
Lynx rufus	bobcat	0	0	0	0	0	1
Odocoileus virginianus	white-tailed deer	151	41	21	16	153	1
Unidentified artiodactyla	probably deer	32	0	0	0	0	0
	LT subtotal	**187**	**41**	**21**	**16**	**153**	**2**
	LT %	**12.9**	**16.0**	**25.0**	**37.2**	**20.9**	**66.7**
Small terrestrial (ST):							
Crotalus spp.	rattlesnake	1	0	0	1	0	0
Elapha spp.	rat snake	1	0	0	0	0	0
Geomys spp.	pocket gopher	1	2	0	0	0	0
Medium-sized carnivore	e.g., raccoon or fox	4	0	0	0	0	0
Mustela vison	mink	0	0	0	1	0	0
Mustelidae	mink or skunk	1	0	0	0	0	0
Sylvilagus aquaticus	swamp rabbit	0	3	0	0	0	0
Unidentified rabbit	—	0	0	0	0	1	0
	ST subtotal	**8**	**5**	**0**	**2**	**1**	**0**
	ST %	**0.6**	**1.9**	**0.0**	**4.7**	**0.1**	**0.0**
Birds (AV):							
Anas spp.	unidentified teal	2	0	0	0	0	0
Ardea spp.	unidentified heron	1	1	0	0	0	0
cf. Anas carolinensis	green-wing teal	2	0	0	0	0	0
Colinus virginianus	bobwhite quail	1	0	0	0	0	0
Meleagris gallopavo	turkey	1	0	0	0	0	0
Mimus polyglotus	mockingbird	0	1	0	0	0	0
Passeriformes	unidentified perching birds	1	0	0	0	0	0
Unidentified birds	—	1	1	0	1	1	0

TABLE 11
Archeological vertebrate fauna by animal class and analysis unit; Gaulding site (41JF27)

		Number of identified specimens (NISP)					
Taxon	**Common name**	**Upper A**	**Upper B**	**Middle**	**Lower**	**No prov.**	**Area D**
Unidentified duck	—	2	0	0	0	2	0
	AV subtotal	**11**	**3**	**0**	**1**	**3**	**0**
	AV %	**0.8**	**1.2**	**0.0**	**2.3**	**0.4**	**0.0**
Grand total		1449	257	84	43	731	3
Identified bones per cubic foot (per .03 cubic meter)		5.04	2.28	0.45	0.13	—	—

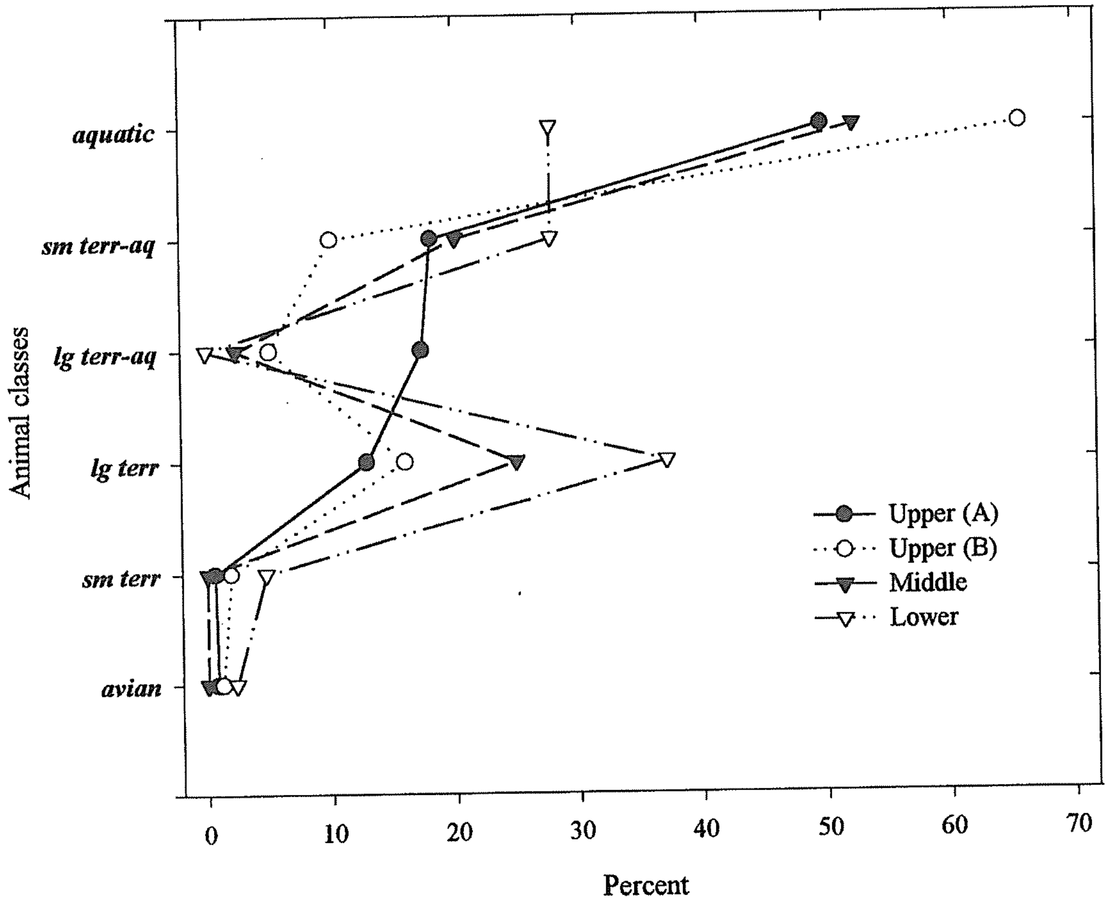

Figure 26. Archeological fauna plotted as animal classes in each analysis unit; Gaulding site, 41JF27.

Additional observations can be made about this faunal collection. Along with the increase through time in quantity of identified bones of the white-tailed deer, it appears that this increase was focused upon taking old deer rather than young or adult deer. The fish in this fauna are all freshwater or very low salinity species that presumably reflects the prevailing aquatic habitat in the middle Taylor Bayou drainage basin. And the most unusual of the animals present is the green sea turtle, *Chelonia mydas*, a marine species whose females only come ashore to lay eggs on the beach in spring. This is not an occurrence that can be rationalized for Taylor Bayou. In fact, there is a pattern of evidence (the sea turtle, oysters harvested from downstream, collection of *Busycon* and *Dinocardium* shells) suggesting that while people were living at Gaulding, watercraft were in use (cf., Barroto 1987:178-179, for description of Atakapa using canoes in 1686). On occasion these must have been used to make excursions downstream, sometimes as far as the Lake and even to the Gulf shores, nearly 50 km distant, returning with food items and resource materials.

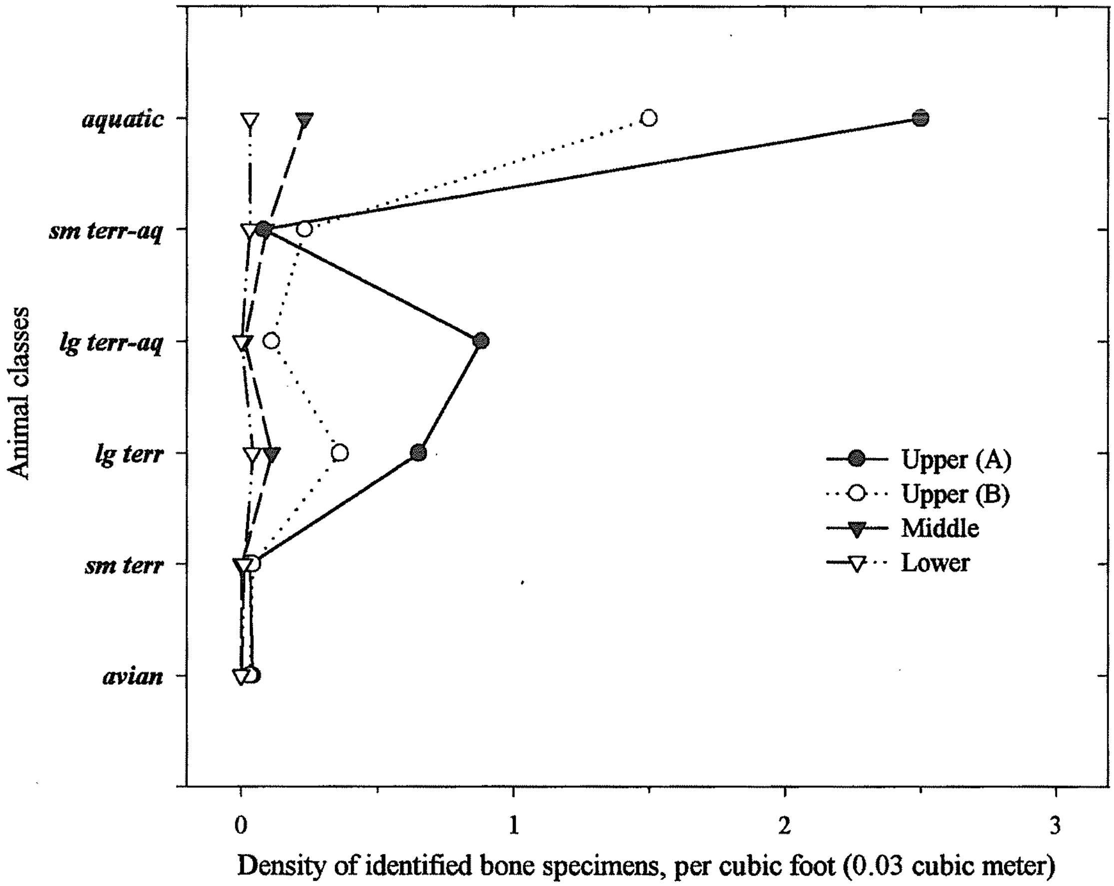

Figure 27. Archeological fauna plotted as density of identified bone specimen per analysis unit; Gaulding site, 41JF27.

THE GAULDING BURIAL

The interment of a single individual was discovered at the bottom of the shell deposit in the exploratory trench between excavation units A-5 and A-7, and extending into unit A-10 (Figure 4). Since the body was placed directly on the acidic silty clay of the Beaumont Formation and was surrounded by the relatively sparse shell deposit of Layer 10, the skeletal remains were fragile. R. M. Malina and Al B. Wesolowsky examined the remains and their notes were the basis for part of this section. Although photographs and drawings were made at the time of discovery, these are on file at TARL and are intentionally not included here.

Burial pit

As described earlier, the Beaumont Formation surface underlying the Gaulding site is gullied and irregular causing the shell deposit to be quite thin in places (see Figure 6). Apparently coincidentally, the burial pit was dug directly over a rise in the silty clay subsurface and the pit's maximum depth ranged from only about 8 inches to 15 inches (20 to 38 cm) below the present ground level; the pit was only slightly dug into the subsoil. Once the prehistoric people digging the original burial pit had reached the yellow clay they followed the slope of the clay surface for a short distance resulting in a steeply sloping bottom.

This mortuary excavation went entirely through the uppermost site stratum, Layer 10 (also called Zone A at the time of the field school excavation), and slightly into the underlying basal silty clay. Since Layer 10 consists of a dark matrix and only moderate amounts of *Rangia* clam shell, no pit fill was distinguished. Presumably the grave fill was the same material removed when digging the hole. Consequently it was not possible to determine from what elevation in Layer 10 the pit originated. However, because Layer 10 in this part of the site is the principal location of ceramics (Figure 19), the burial pit dates to sometime during, or later than, the ceramic occupation of the site.

Burial orientation

The burial was a primary inhumation of a single, articulated, human skeleton. The body was placed into the grave while lying on its back with the legs drawn up tightly flexed. The left arm was tightly flexed with the hand drawn up along the left side of the head; the right arm was loosely drawn-up with the hand in the individual's lap. Because of the pit's steeply sloping floor, the body was coincidentally in an inclined or semi-sitting position that probably should not be confused with an attempt at burial placement in a sitting position.

The body was oriented N61E (magnetic) with the head pointing to the easterly direction; it's head was rotated to face to the body's right side. No grave goods were found preserved with the body.

The individual

The skeleton was an adult female approximately 30-40 years of age at death, based on cranial suture closure and dental attrition. The teeth have moderate wear and one cavity. Several lambdoidal ossicles were observed. Lipping of the sacral alae (i.e., near the base of the spine) and slight lipping of the elbow joint also were reported that presumably are due to arthritis.

Comparisons

Many burials have been found by local collectors or have been seen when sites were being demolished. However, the only local comparative data on mortuary practices comes from notes on file at TARL that were made in 1956 by E. M. Davis on several burials partially documented at 41OR33 while that shell deposit was being removed. Remains of an estimated 13 individuals were recovered including all age groups and both male and female adults. As at Gaulding, these burials were relatively near the surface of the shell deposit and appear to have been confined to one general area. Where determinable, the bodies were oriented roughly east-west with their heads placed to the westerly direction. The four burials actually recorded while still partly in the ground were all flexed. Three were positioned in a row suggesting this may have been a cemetery rather than isolated occasional interments. A very late or protohistoric Caddoan bottle accompanied one of the burials.

In addition, the remains of several individuals—possibly as many as 14—were collected in 1963 from the Black Hill Mound (41JF24). This site was located not far from Gaulding on the upper reaches of Hillebrandt Bayou, a tributary of Taylor Bayou. There are no records of the mortuary practices, but there is some information available on the site. The site itself is an earth midden with some *Rangia cuneata* shell included. A collection of about 700 sherds has been examined and while a little more than one-third of the sherds are early ceramics—Tchefuncte and related varieties – the remainder could extend much later in time. The skeletal remains were highly fragmented by the time they were catalogued by TARL staff, and while the number of individuals is a bit uncertain, there could be as many as 14 represented. These included 2 infants, 3 subadults, and possibly 9 adults (TARL records).

There are several points that can be inferred about Sabine Lake area mortuary practices from Gaulding, Black Hill Mound, and 41OR33.

- All of the currently known burials are from relatively late in the area's prehistory and probably are more recent than the early ceramic occupations.
- Mortuary ritual apparently was not restricted to certain age groups or by adult sexes; all ages and sexes seem to be represented.
- No dramatic pathology was seen; only minor arthritic lipping, heavily worn teeth, and occasional cavities and bone abscesses.
- The majority of known individuals were oriented with heads to the west, although the Gaulding burial is oriented to the east. The 41OR33 graves may have been part of a cemetery. There is no information on orientation from the Black Hill Mound.
- Three apparent examples of artifacts placed in the grave with the body (two columella beads, a small ceramic vessel, and a turtle shell rattle) occurred at 41OR33; no artifacts, however, were found at the Gaulding site or were reported at Black Hill Mound.

SEASON OF OCCUPATION

There is little that can be said about seasonality with the data currently available. The method of evaluating *Rangia cuneata* shell morphology (Aten 1981) has been retested against new long-term samples and was found to be unsuccessful in estimating season of collection (Aten 1999); this method is no longer recommended for use. The only ethnohistoric information available places Atakapa Indians in a settlement containing a number of huts not far upstream from the mouth of Sabine Pass in mid-April 1686 (Barroto 1987:178-179). Archeologically, there are some indications of season from the small collection of oyster shells, but primarily it is necessary to fall back on the general indications of the vertebrate fauna. The best information is for the Upper Analysis Unit from which the greatest number of species was recognized (Table 10). Among the fish, most are present year round, although the sheepshead moves offshore once the estuarine waters become too cold. The birds are essentially all year round inhabitants (Peterson 1980). The reptiles, of which there are many, are generally scarce to absent in cold weather (Neill 1971:270-271). Their abundance in the archeological fauna is a strong indicator of habitation during warm seasons of the year. The sea turtle, however, is seasonally specific, with the females coming ashore to lay eggs only from April through June (Carr 1984:116). The majority of the mammals present are active year round (Davis, W. B. 1966).

A method for evaluating seasonality from the ligament groove of oyster shells has recently come into some use (Cox 1994; Kent 1988). Applying this to the oyster lower valves from Gaulding (Table 9) suggests the principal time of occupation in the Lower Analysis Unit was from the winter to spring. The Middle Analysis Unit oysters were collected mostly in the spring. The Upper Analysis Unit oysters were apparently collected in the winter and spring. Almost none of the shells indicated collection in the summer and few in the fall.

Taken together, there is an indication that during the time of all three Analysis Units, Gaulding was used at least during some or all of the winter through spring period. It may have been used at other parts of the year as well. Of course, the winters in the Sabine Lake area are not uniformly cold (cf., "Sabine Lake area landscape" earlier in this report) and alligators have been observed to be active in southwest Louisiana marshes in late January in recent years (Aten, field notes). So, while none of the vertebrates conclusively points to the cold seasons of year, the numerous species present that are active year round could mean that habitation occurred in the winter months as well as the spring.

REGIONAL SETTLEMENT PATTERNS

Gaulding's place in prehistoric use of this stream system may be illuminated by a review of what is known of adjacent settlements. Numerous reconnaissance surveys have been carried out in the Sabine Lake area, at least for shell-bearing sites. Thus far 145 have been found (TARL records) and, because of the extensive areas that have been covered, in most instances repeatedly, it seems certain that the large numbers of sites found in the Galveston Bay area, for example, will not be replicated in the Sabine.

In the Taylor Bayou drainage basin part of the Sabine, surveying has identified 18 sites, including Gaulding, located along some 41-stream km throughout the basin (Table 12; Aten 1972; TARL records). Most of these sites are modest in size but contain a minimum of 21 distinct culture-historical units, or components. All but one of the known Taylor Bayou basin sites and components are shell-bearing (Table 12). In the extreme upper reaches of Hillebrandt Bayou is the remnant of an earth midden with small amounts of shell included. It was an early ceramics-using habitation site subsequently used as a mortuary locality.

Most sites (18) in the basin are on or very near the Pleistocene uplands surfaces; only 3 were located in the marsh without higher ground nearby. In some cases, sites at the edge of the uplands face on or are overlapped to some extent by marsh, and their orientations suggest they are not associated with the present stream channel (e.g., Pearson et al. 1982:23-26). Seven sites or components have >30 cm of deposit; those remaining are thinner. Nine of the sites are partly or entirely below the present bayou water level. Most of the sites (14) have a substantial overburden of dark gray silty/clayey marsh deposits. Nine preceramic components are known or are probable and more could be present. Twelve sites have ceramic components—two-thirds of these are thin deposits (<30 cm) and at least one of the remaining ceramic components (i.e., Gaulding) is only a superficial layer at the top of thick preceramic shell deposits.

Of all these sites, Gaulding is the largest known in the Taylor Bayou drainage basin. Compared to shell sites elsewhere in the Sabine, though, it is only of modest size. And there are three other shell-bearing sites in the Taylor Bayou basin that may be comparable in size to Gaulding, although testing has not been done to confirm this. As best we can determine at this time, there is one, and perhaps four, modest-sized shell sites surrounded by 13 smaller sites. Recalling the "Sabine Lake area landscape" discussion at the beginning of this report, it was noted that the Taylor Bayou basin vegetation and geomorphology could be divided into three parts and that the shell-bearing sites were confined to the middle basin. This middle basin extends for about 22 stream-km and has a linear site density of .62 sites/km. Such a site density seems unusually low and, for comparison, similar statistics were compiled for elsewhere in the Sabine region.

The portion of the lower Neches River which contains shell sites has a minimum (because some sites were destroyed before surveys recorded their locations) linear density of 1.41 sites/km. The lower Sabine River has a linear density of 1.45 sites/km. And the densely occupied north shore of Sabine Lake—the section between the two river mouths—has a linear density of 1.47 sites/km. Even the coastal marsh behind the Gulf beaches, as typified by the Sea Rim Park area, has a linear or shoreline site density of 1 site/km. As shell site distributions go in the Sabine Lake area, that of the Taylor Bayou drainage basin is sparse. Although there are gaps in the testing data, the current indication is that prehistoric use of the Taylor Bayou basin was at its maximum in the Late Archaic or earlier Late Prehistoric. The ceramic-bearing shell sites or components are small and suggest the basin was used only intermittently then, and for brief occupations.

One process that went on concurrently with the decline in prehistoric use of the basin was the continuing slow rise of sea level to its contemporary elevation. Rising base level filled the incised stream valley and spilled out to create marshes in the lower and middle basin, and swamps in the upper basin, a phenomenon that is clearer on the 1915 Jefferson County soils map (Carter et al. 1915) than on more recent maps. Whether this landscape evolution impeded access or reduced habitats and resource availability is not clear, but the progressive watering of the basin seems more than coincidentally related to its progressive disuse by native shellfish collectors.

The role of the Taylor Bayou drainage basin in the regional activities of the Western Atakapa is an issue that remains to be shown. The upland prairies, into which the Taylor Bayou basin extends, are not noted for any abundance of archeological sites, although it is certain that the prairies and woodland margins were traversed and prairie resources exploited (Neyland 1970; Folmer 1940:218-220). Systematic surveys of floodplain and uplands were conducted along Cypress Creek, north of Houston, which indicated that 96 percent of the sites were along the floodplain and the remaining 4 percent were on the uplands (Moore 1995:141). Taken together, there is no evidence at this time contradicting the idea that, in the upper Texas coast area, most Indian life was carried out along the major streams with the interfluves only visited rather than occupied. It seems

Table 12
Attributes of prehistoric sites in the Taylor Bayou drainage basin

Site no.	*Rangia* shell deposit thickness	Assoc. with Pleistocene uplands?	Below present water level	Likely deposit age	Sediment overburden	Miscellaneous comments
Taylor Bayou (41JF—):						
74	thin	Y	Y?	P?/C	Y	
75	thin	Y	N	?	?	
76	thin	Y	N	?	?	
54	thick	Y	Y	P?/C	15	oysters found
27, Upper A.U.	thin	Y	N	C	Y	oysters found; mortuary site
27, Middle A.U.	thick	Y	N	P	30	oysters found
27, Lower A.U.	thick	Y	N	P	N	oysters found
53	thin	Y?	Y	P?	15	oysters found
73	thick	Y	Y	P?/C	?	
52	thin	Y	N	C	30	
60	thin	Y	N	P?	15	at 5 ft (1.5 m) contour
51	thin	Y	Y	C	30+	
6	thin	Y	N	C	?	
Hillebrandt Bayou (41JF—):						
33	thin	N	Y?	C	30	
64	thick	N	Y	C	15	
32	thin	N	N	C	30-35	
11, stratum B	thin	Y	Y?	C	10	
11, stratum D	thin	Y	Y	P	30-35	oysters found
34	thick	Y?	N?	?	10	
35	thin	Y	N	P	30	oysters found
24	thick	Y	N	C	?	earth midden with some *Rangia* shell; at 10 ft (3m) contour; mortuary site

Notes: Sites listed in order proceding upstream. *Rangia cuneata* shell deposit thickness (thin = <30 cm); site associated with Pleistocene uplands, yes/no; site below present water level, all or part = yes, otherwise no; likely site age (based on dates or artifacts in various collections), Preceramic or Ceramic; marsh overburden, yes/no or amount (cm) if known. Survey data from TARL files and from authors' unpublished data.

likely that what habitation there was in the Taylor Bayou basin was so meager as to not represent the comprehensive remains of any social group. Rather, these sites along with other peripheral areas such as Sabine Pass and the Gulf beaches most likely represent transient visitation by groups based elsewhere—probably on the Neches or Sabine River floodplains where historic era native villages were reported (Bolton 1970:334).

Chapter 5

PALEOENVIRONMENT

PALEOCLIMATE

Paleoclimate at the Gaulding site is inferred from the abundance and habitat associations of the terrestrial snail fauna given in Appendixes E and F (also see Figure 28). Layers 2, 3, and 4 (early Lower Analysis Unit) may represent a waning dry period (dry summers and cold winters). Layer 5 (late Lower Analysis Unit) represents the onset of a warmer, moister period with expanded riparian woodlands that continued into Layers 6 through 8 (the Middle Analysis Unit). There is a suggestion that during Layers 9 (the terminal Middle Analysis Unit) and 10 (lower) conditions were somewhat drier, with expanded grasslands but still with a relatively large snail population. By the time of the Layer 10 (upper) bulk sample (upper half of the Upper Analysis Unit), essentially modern climate was becoming established – a time of mild temperatures and increased annual rainfall.

These conditions and shifts are broadly consistent with regional climate patterns that have been reported for the Middle Holocene. Altithermal conditions have been widely documented in Texas (e.g., Nordt et al. 1994) and the Gaulding site Lower Analysis Unit may reflect the final phase of that episode and the shift to wetter conditions in the 3700 to 4000 B.P. (conventional age) period. These latter conditions persisted in central Texas until around 2900 B.P. (conventional age) when a somewhat drier regime may have occurred (cf., Nordt et al. 1994:Figure 4) that also may be reflected in Layers 9 and 10 (lower). However, by circa 2000 B.P. (conventional age), modern conditions of temperature and precipitation were being established as seen at Gaulding in the snail fauna of Layer 10 (upper).

PALEOGEOGRAPHY

As the long-term trend of sea level rose to its present elevation in the Sabine Lake estuary and its local tributaries, broad wetlands were created in the Taylor Bayou drainage basin and all or part of not quite half of the sites (Table 12) were drowned. But the landscape and archeology in the drainage basin has other features suggesting the paleogeographic story has not been fully uncovered.

For example, it seems as if there are too few archeological sites in the basin, as was noted earlier when discussing regional settlement patterns. The stream courses of Taylor Bayou and its major tributaries have been repeatedly examined and so insufficient survey does not seem the answer, unless it has not been looking in the right places. In this regard, it may be notable that one shell site (41JF60) was found rather coincidentally at the 5-foot (1.5 m) contour some 300 meters back from the bayou channel (Pearson et al. 1982:23-26). Another site, 41JF24, contains only small amounts of shell, and is at the 10-foot (3 m) contour in the upper drainage basin (Heartfield n.d.). These instances suggest that survey should be extended along the outside edge of the floodplain where Pleistocene uplands meet the floodplain marsh.

Another peculiarity is that there is no evidence of habitation in the drainage basin after roughly 1300 A.D. and most of the ceramic period components that are present prior to that time seem to be sparse accumulations. Likewise it is odd that the orientation of the Gaulding site shell ridge does not conform to the present bayou channel. This is true also at 41JF34 and 41JF54. Then there was the colluvial erosion that occurred all along the "front," or bayou side, of the Gaulding shell ridge and at a higher elevation than the present bayou. Also, the apparent centers of shell accumulation at Gaulding are away from the present bayou during the Lower and Middle Analysis Units while cultural accumulation during the Upper Analysis Unit does face the bayou.

And it is especially odd that nearly all of the sites have a thick layer of sediment overburden (Table 12). This not only includes sites that are near or below today's bayou level, but sites having elevations up to 5 feet (1.5 m) or more such as Gaulding (41JF27), 41JF54, 41JF60, 41JF34, and 41JF35. There is no information available on how high the Taylor Bayou basin floods during contemporary storm surges

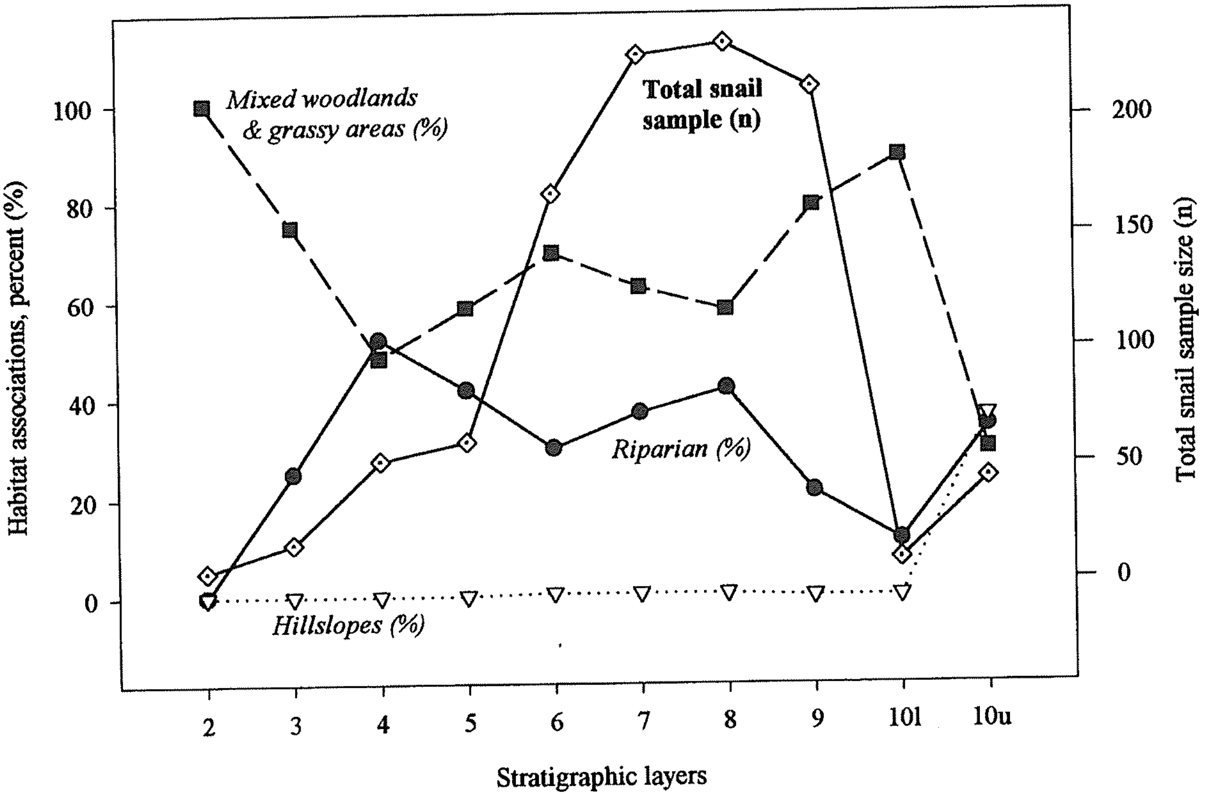

Figure 28. Sample sizes and habitat associations of terrestrial snails from the B-1 (west) bulk samples, Gaulding site, 41JF27. Data are from Appendix F.

or excessive rainfall, but normal floodplain aggradation does not seem an adequate explanation for this apparent blanket of sediment at higher elevations. The Taylor Bayou drainage system is not a major river drawing from a large interior basin that during floods adds much sediment to its floodplain and sustains peak flow for extended periods.

Before agriculture began on the nearby uplands, the Taylor Bayou sedimentation model probably included sediment derived from up-basin headward erosion, and sediment eroded from the peripheral Pleistocene uplands some of which can be seen accumulated behind the Gaulding shell ridge (Figure 5). The latter sediment, in particular, ordinarily would become trapped in the fringing marshes and in the ponded or slow moving water. This contributes to expansion of the marshes and development of the organic character of the overburden deposits, as well as filling the entrenched stream channel. This process is slow and probably means that organic sediment now stranded at higher elevations, including that blanketing elevated archeological sites, may be attributable to extended periods of time during which sea level, and the normal level of the bayou, was at a higher elevation than at present. Furthermore, all of the other "peculiar" conditions mentioned above could be a consequence of higher sea level as well. This is an unexpected inference to have arrived at. Nevertheless, if there is a possibility of recording short-term, low amplitude sea level changes in relation to the archeological record, this should be examined because of the importance of aligning the scales of cultural-historical and environmental-historical information.

Most eustatic sea level curves in use for the northern Gulf of Mexico are linear or curvilinear trends leading directly to the present level of the sea (Pirazzoli 1991:182-184). However, recent investigations are identifying periods of rapid sea level rise punctuated with stillstands or periods of slow rise, leading to refinement of smooth sea level curves into "step-wise" models; for a recent review of sea level concepts pertaining to the northern Gulf of Mexico, see Ricklis and Blum (1997). Of course, low amplitude (1-3 m) fluctuations in Middle and Late Holocene sea level have long been predicted or reported, perhaps most notably by Fairbridge (1992, and in several preceding papers). However, their limited elevations make them difficult to identify amongst the signatures of other coastal processes that operate over a similar or greater range of elevation. Moreover, while higher-than-present Late Holocene sea level geomorphology has been found in many places, the key question to resolve has been whether these high level features are due to eustatic, isostatic, or other causes (Kidson 1986:52-54). Eustasy versus other mechanisms is not an issue here; the concern is relative sea level and how this impacted human settlement in the Taylor Bayou basin.

Thus far, the principal field inquiries into higher-than-present sea levels in the northern Gulf have been carried out on the central Texas coast (Paine 1991:71-139). There, stranded estuarine fringing marshes, tidal flats, and dunes were correlated with habitation at an archeological site. In addition, Paine noted possible emerged tidal deltas, barrier packets, and a shoreline berm all as potential higher-than-present Holocene sea level features around East Bay, part of the next estuary to the west from Sabine Lake. These are all features at a similar spatial scale and chronological range to those found in the Taylor Bayou drainage basin. Before focusing on higher sea level, though, the depositional sequence in Taylor Bayou will be examined and compared to sea level evidence previously reported for the northern Gulf coast west of the Mississippi River delta down-warped area.

There is nothing on Taylor Bayou geology in the literature except mapping of the incised stream valley (Kane 1959). However, a series of deep cores that were taken at the State Highway 73 bridge crossing of Taylor Bayou 8.2 km downstream from the Gaulding site was made available by the Texas Department of Transportation. Because of the paucity of such information in the Sabine Lake area, this cross-section is included here (Figure 29). The stratigraphy in the Highway 73 cross-section apparently consists of two "fining-upward" sequences indicating distinct, successive regimes of fluvial responses to a rising base (sea) level. The greatest depth of entrenchment into the Pleistocene Beaumont Formation at this location was 24 m; from that depth a succession of clayey silt/silty clay grades upward to gray clays. At a depth of about 10 m the second sequence begins with a gray clayey silt and quickly changes over to dark gray organic clay. The calibrated Pleistocene-Holocene contact dates from near the mouth of Taylor Bayou at Sabine Lake (Anderson et al. 1991), described earlier for use in Figure 23, are also plotted at the appropriate depth on the Highway 73 cross-section (Figure 29). These are seen to be included entirely within the upper organic clay section and indicate that the upper sequence began sometime prior to 6180 cal B.P. (cf. Appendix C).

The Taylor Bayou fill sequence is similar to sequences identified elsewhere on the Texas coast. A two-phase rising and stillstand sequence was identified in the San Jacinto River drowned valley submerged in Galveston Bay (Kibler et al. 1996:24-45). A similar two-part sequence was documented on the Central Texas coast, although it has been dated somewhat earlier (Ricklis and Blum 1997). And a higher than present phase was reported for Copano Bay at approximately the same time as the second stillstand phase in Galveston Bay (Prewitt and Paine 1987). The "big picture" of rising base level and sedimentation in the entrenched Taylor Bayou appears to be consistent with the emerging stepwise sea level model for the northern Gulf coast. The two-phase bayou filling sequence, the progressive watering of the basin as seen in the soils maps, and even the increase and decrease in shells in the gray organic clay of the upper filling sequence are all consequences of the overall trend of rising sea level. But this does not account for the apparent high level marsh-like deposits in the basin probably because there is insufficient resolution in these indicators.

Although Paine (1991) identified some geomorphic features originating in a higher-than-present sea level period, there is only one detailed Late Holocene sea level model available for the Gulf of Mexico. For several years a body of sea level measurements has been collected from locations around the Gulf of Mexico from southwest Florida to Yucatan (Mitchell-Tapping et al. 1996; Stapor et al. 1991; Tanner 1991, 1992). Most sea level methods are based on dating the relative elevation differences between sea level-related geomorphic features (such as strandlines and deltas) and present sea level, and produce relatively few dated reference points. The method applied by Tanner (1992) measures textural characteristics of sediments from numerous beach ridges within distinct beach ridge packets. In numerous technical papers, Tanner shows that kurtosis is a sensitive reflection of changes in sea level, although not of their amplitude. This method produces a much larger number of measurements and, consequently, more detailed curves for given periods of time. Since most beach ridges around the Gulf of Mexico are less than 4000 years old, the resulting sea level model applies only to the Late Holocene. The "Tanner curve" has been applied and refined in studies in southwest Florida (Mitchell-Tapping et al. 1996; Stapor et al. 1991), but has not been studied much west of the Mississippi River. In any event, the only approach available using literature sources in the Gaulding and the Taylor Bayou basin case is to compare the consistency between the regional sea-level concept of the Tanner curve and datable geomorphic and archeological features from the southeast Texas and southwest Louisiana coast.

There are numerous papers applying or refining the Tanner Late Holocene sea level model that often differ to some degree. The general pattern of sea level rise and fall used here (Figure 30) is synthesized from Tanner (1991, 1992, 1993) and Stapor et al. (1991) with some archeological confirmation from Marquardt (1996:27). To estimate the ages of the change periods of rise or fall, Gunn's replot (1997:Figure 5) of Tanner's data was used as well as the extensive radiocarbon dating by Stapor et al. (1991); see Appendix C for calibration details. The informal time-stratigraphic terminology of the Caloosahatchie Bay version of the model (Stapor et al. 1991) was used to label the individual events back to about 2500 years ago (Figure 30). Earlier events are not named, and for the present we have just labeled them "Tanner A," "Tanner B," and so on. The estimated amplitude of each event was derived from Gunn (1997) and Stapor et al. (1991). These should not be taken too seriously just yet, although it does seem clear that the Wulfert event was when sea level reached its highest level in the Late Holocene according to this model.

The model as used here (Figure 30) is plotted on a trend line of long-term sea level rise approximated from the same four Sabine Lake Pleistocene-Holocene boundary dates (Anderson et al. 1991) that were described above. Because

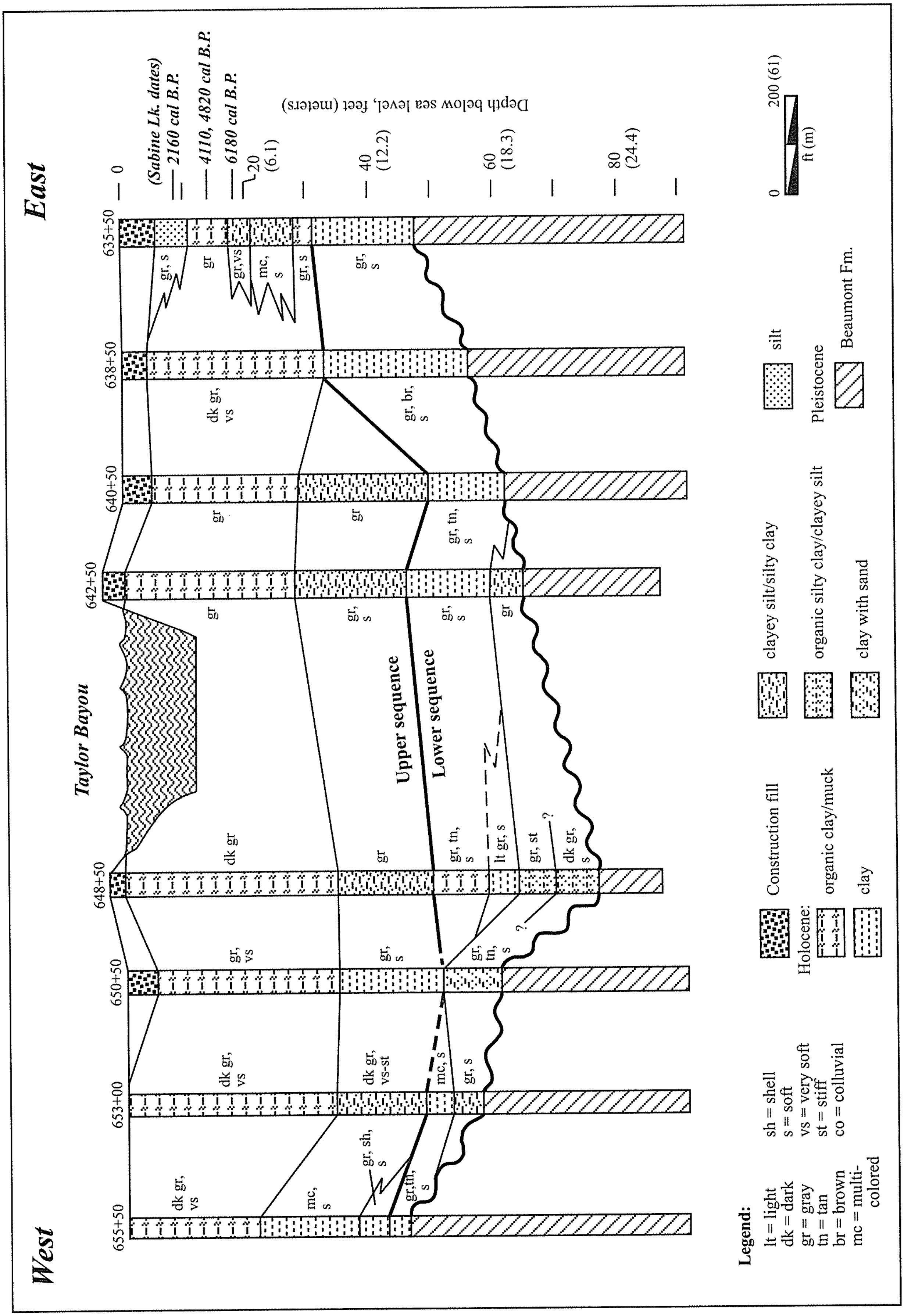

Figure 29. Geologic cross-section of the Taylor Bayou entrenched valley at the State Highway 73 bridge crossing. Boring logs are from the Texas Department of Transportation. Radiocarbon dates are calibrated from Anderson et al. (1991). See Appendix C for calibration details.

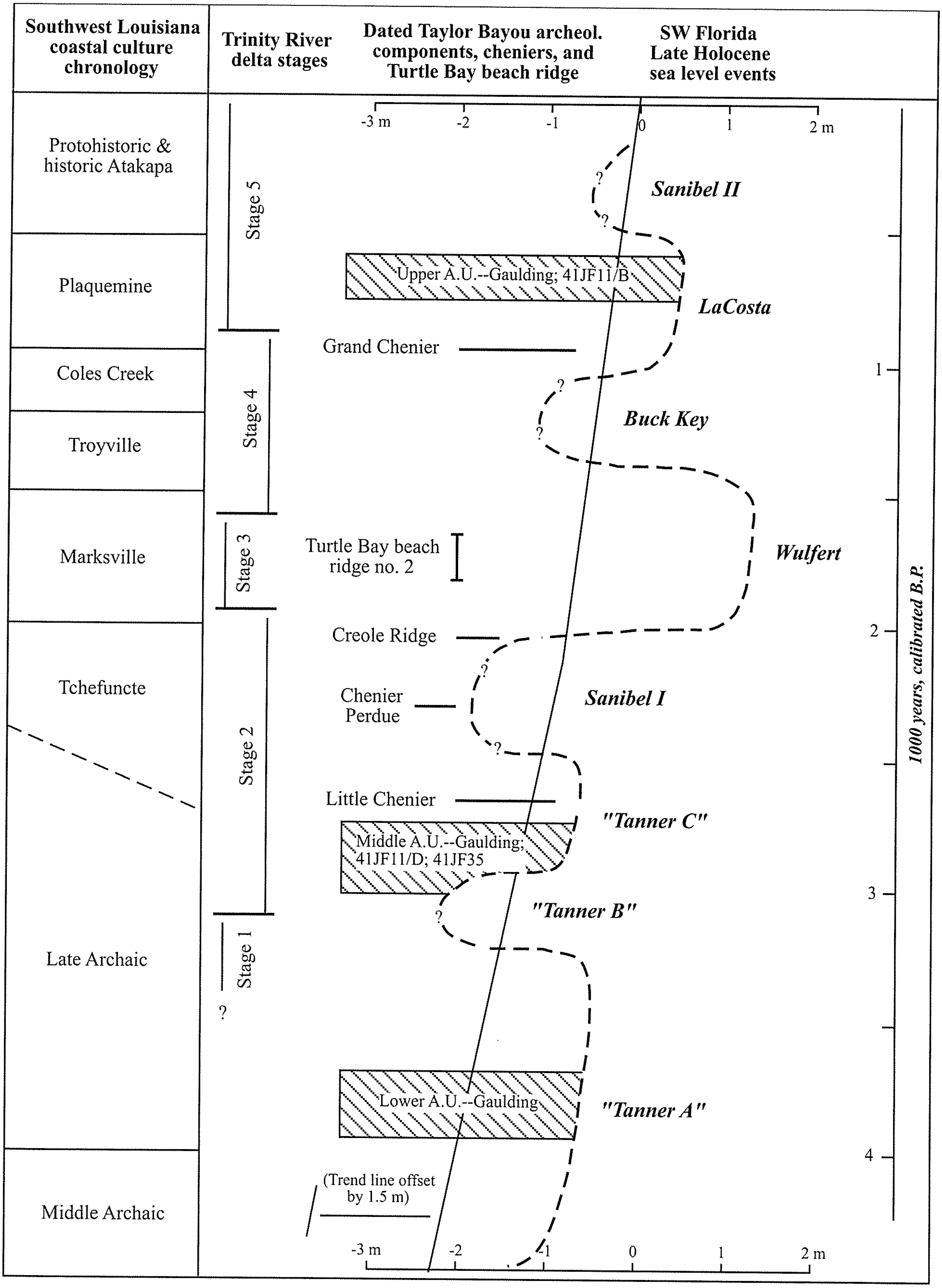

Figure 30. Tanner Gulf of Mexico Late Holocene sea level curve in relation to archeological and geological features from Taylor Bayou, Galveston Bay, and southwest Louisiana.

the latter dates presumably represent submerged features (natural shellfish beds) and were run on the shallow water mollusc *Rangia cuneata*, the estimated long-term trend line of the Holocene submergence is offset 1.5 m higher so that the model curve elevations will better approximate the local sea surface.

There are several dated northern Gulf coast geomorphological features that can be compared with the Tanner Late Holocene sea level curve. If they are consistent, this might be taken as a degree of verification and encourage a search for further evidence. Beginning with the radiocarbon-dated archeological components in the Taylor Bayou basin, they entirely or largely coincide with postulated high sea level events (Figure 30). The age of the early Upper Analysis Unit at Gaulding and of 41JF24, both estimated from the presence of Tchefuncte and related pottery, is not plotted because the time range over which these potentially could date is anywhere from the middle "Tanner C" event to the early Wulfert event. This range is too broad to be useful in this test of the Tanner model.

In the next estuary to the west, Galveston and Trinity Bays, the Late Holocene delta sequence of the Trinity River has been mapped and approximately dated (Aten 1983b:125-127). The estimated boundary age of each channel stage was calibrated and plotted (Figure 30; Appendix C). Except for Stage 3, each channel stage begins with the onset of a rising sea level event and continues on through the subsequent falling sea level event after which time it is succeeded by the next channel/delta stage. The data for Stage 3 obviously should be re-examined. It was the least well documented of the channel stages and it is possible that Stage 3 and Stage 4 are really one and the same.

Just east of the Trinity River delta is a progradational beach ridge complex developed on the northwest side of Lake Anahuac when it was still a part of Trinity Bay. These ridges are of interest in part because some of them were locations of a number of archeological shell sites. Many years ago it was possible to excavate a pit through the bottom of a destroyed archeological site (41CH9) that was located on the second ridge and to collect several *Rangia cuneata* shells that predated formation of the ridge (Aten 1983b:278-279; also see Appendix C, this report). In addition, a small test excavation was dug in site 41CH137, also located on the same ridge (Aten 1983b:187-190). The basal layers of 41CH137 had ceramics typical of the middle Mayes Island Period. The radiocarbon date from under the beach ridge and the lower boundary age for the middle Mayes Island Period were calibrated and used to bracket the likely age of Turtle Bay beach ridge number 2 (Figure 30). The resulting estimated age of this ridge plotted well within the range of a high sea level event.

Finally, the cheniers of southwestern Louisiana invite comparison to the sea level curve. Numerous radiocarbon dates have been run on various cheniers over the years but there are many problems with them as recently discussed by McBride et al. (1997:41). After selecting the best understood dates, they estimated the most likely age for four prominent ridges. These were calibrated (Appendix C) and plotted (Figure 30). Three of the ridges plotted within or at the beginning of a high sea level event, an association with sea level that seems appropriate for a transgressive feature. One ridge, Chenier Perdue, plotted in the middle of a low sea level event, a miscorrelation that cannot be explained with any certainty here.

The majority (10 out of 12) of the datable events and features in and near Taylor Bayou relate in an expectable way to the possibility of a Late Holocene sea level curve like that proposed by Tanner. Assuming, for the moment, that the variable sea level curve (Figure 30) is a correct hypothesis, would its implications for the human settlement of the Taylor Bayou drainage basin facilitate explaining any of the unusual archeological site circumstances described earlier?

- The two rising sea level periods prior to about 2000 years ago would have increased the likelihood of *Rangia cuneata* larvae being swept up into the lower and middle basin where they could establish populations and have been harvested. The contemporaneity of the Lower and Middle Analysis Units at Gaulding as well as several other relatively large shell sites with "Tanner A" and "Tanner C" events is consistent with this hypothesis. Similarly, the absence of cultural deposits coincides with the times of the low sea level events when shellfish larval intrusion would be more difficult. One would think the presence of shell-bearing sites would be even more the case during the Wulfert and LaCosta events, but it was not so. An explanation for this is only speculative, but it seems plausible that the progressive shoaling of the Taylor Bayou channel, narrowing of Sabine Pass subsequent to 2100 years ago (Gould and McFarlan 1959), and the onset of modern precipitation conditions would have made the Taylor Bayou basin the consistently freshwater environment that was described in the 19th century. This would account for the diminished frequency with which shellfish populations were established in the basin after about 2000 years ago (Figure 23).
- Assuming the amplitudes for the "Tanner A" and "Tanner C" events are more or less right, the water level at these times would not have spilled out of the entrenched valley, at least in the middle and upper basin. So the Lower and Middle Analysis Units and any other contemporaneous components at other sites would not be expected to have any culturally sterile sediment either incorporated within the shell deposits or as overburden unless they continued to be exposed during the time of the later high sea level events. This is at least partially consistent with evidence at the Gaulding site. There is a modest soil zone that began to develop in among the shells of the top 10 cm or so of the site after deposition of the Lower Analysis Unit. This was then covered,

after several hundred years, by archeological shell refuse of the Middle Analysis Unit. Except for Layers 2 and 3, neither the Lower nor the Middle Analysis Units have much sediment in the shell deposit. This is also the case for the contemporaneous (stratum D) which, although below present water level, had very little sediment in its shell deposit.

- The Wulfert high sea level event is generally documented as the highest of the high (e.g., Stapor et al. 1991). In the Taylor Bayou basin, this would be the period when the middle basin would have been flooded nearly to the 5 foot (1.5 m) contour creating the extensive blanket of marsh sediment that covers sites at higher elevations as well as lower. This would have been the time when what use of the basin there was, was probably relocated back from the bayou channel to positions like that occupied by 41JF60, near the 5 foot (1.5 m) contour. This also may be part of the explanation for too few sites in the basin described earlier; perhaps more sites will be found at this elevation.
- The Wulfert or the subsequent LaCosta high sea level event may be the time that the front of the Gaulding shell ridge was being eroded at the water's edge with displaced shell accumulating at the base of the erosional face (cf., Figure 5). These two events also may have included periods of even more subtle vertical water level fluctuations which would leave the marsh blanket overlying Gaulding and other sites periodically exposed and dry, thus inviting the sparse shell deposits that are found within the Upper Analysis Unit at the Taylor Bayou end of the Gaulding shell ridge. The thick mantle blanketing 41JF54, another nearby site that nearly reaches 5 foot (1.5 m) elevations in places, also has sparse, thin shell layers in the mantle similar to Gaulding (authors' field notes).
- The fluctuating sea level model also may explain the problems with the site orientations described earlier. There is no evidence that either Taylor or Hillebrandt bayous actively meander to any significant degree, even though their courses wind through the basin. It may be that the streams originally were in a different alignment at the time of pre-Wulfert sea level events, alignments to which the original formation and footprint of the older shell-bearing sites conformed. The basin then was flooded during the Wulfert event; the prior stream channels were no longer in use and may even have filled with sediment. When the basin subsequently was dewatered, the two bayous may then have established new alignments similar to those of today.
- Subsequent to the LaCosta high sea level event, the basin was essentially a freshwater environment with shellfish only rarely encountered. It may be that there is an unrecognized population of non-shell sites in the basin especially from this final period of prehistory. However, it will require different surveying techniques to test this possibility.

It should be feasible to test the Tanner sea level model to determine its applicability to the upper Texas and southwest Louisiana coast. For example, the small beach ridge complex on the northwest shore of Turtle Bay/Lake Anahuac could easily be investigated for age, elevation, and perhaps even sedimentological characteristics. More difficult, but nevertheless possible, would be obtaining more radiocarbon samples from the initial levels of early archeological sites on each of the Trinity River channel stages to refine estimates of the latter's termination dates. Field studies possibly could be carried out to re-evaluate the evidence for the termination of Trinity River channel stage 3.

Also, there are two broad lines of investigation that could be carried out in the Taylor Bayou drainage basin. First is a program of mapping and stratigraphic testing at several key shell sites in the basin. This would expand information about site orientations, record the basal and surface elevations of archeological sites and any interbedded or capping geological deposits, identify sub-site landforms, and provide samples for radiocarbon dating. The other line of investigation would be to extend archeological site surveying in two directions: 1) following the marsh-uplands contact, or approximately the 5-foot (1.5 m) contour, looking for additional shell sites; and 2) a pilot project of shovel testing to search for non-shell habitation sites. If the results from these projects were consistent with the Tanner sea level model this would provide further confirmation of a useful environmental model that may explain geomorphology and prehistoric settlement at a time scale similar to that of the archeological components. If the results were not consistent, then the field investigations would still be important because a new environmental model for the basin would be needed to explain all the unusual site characteristics described earlier.

Chapter 6

SUMMARY AND LATE HOLOCENE CULTURE HISTORY

It is no exaggeration to say that the 1965 Texas Archeological Society field school at the Gaulding site has, in the reflected light of other work carried out over the past 35 years, given new insights into the archeology of the northern Gulf coast. Indeed, with practically no points of comparison available in 1965, it might even be said that much about the Gaulding site could not have been understood until recent years. After briefly reviewing the current status of archeological understanding in the Sabine Lake area at the beginning of this report, it seemed that formation of the site in a larger sense should be examined in addition to analyzing the basic stratigraphy, artifacts, and faunal remains. When did this site form; through what activities; and how did these activities relate to the evolving environment of the Taylor Bayou drainage basin?

At this time we can only stress that applying the Tanner Late Holocene sea level model as a framework for prehistoric settlement of the southeast Texas coast is just a preliminary concept. But, working through several lines of circumstantial evidence that are available, it seems to be a viable working hypothesis. The hypothesis is interesting because of its apparent consistency in explaining much of the physical evidence seen at the Gaulding site, and at linking both the culture history and the landscape history of the Taylor Bayou drainage basin. Fortunately, there are opportunities available for further testing the model's implications. Given these encouraging signs, much of the following summary is organized around the information in Figure 30.

SUMMARY OF THE CULTURE HISTORY

The earliest visible archeology in the Taylor Bayou basin is the initial shell deposit at the Gaulding site, dating to nearly 4000 calibrated years ago, at the onset of the Late Holocene and Late Archaic. There is every reason to believe that prior to this time prehistoric peoples often visited the basin; Taylor Bayou undoubtedly was a perennial stream and must have had suitable habitat for many desirable plants and animals. During the warm, dry, Middle Holocene Altithermal event Taylor Bayou would have been an especially attractive environment at least for intermittent habitation. But any archeology from that time or earlier will be difficult to locate. It either is submerged, now that the entrenched stream valley is filled to overflowing, or is buried under the extensive marsh deposits that blanket most of the basin.

At circa 4000 years ago, however, the bayou was still entrenched in its narrow stream valley. Sea level controlled the level of water in the bayou, and was trending ever higher. But pulses of sea level, rising and falling over periods of hundreds of years, finally had reached high enough elevations (Tanner "A") to enable larvae of the brackish-water clam *Rangia cuneata* to be flushed upstream into the middle reaches of the basin and there to establish populations. *Rangia cuneata* is a shellfish that is physiologically adapted to live in fresh or salt water, although it can only reproduce in low salinity habitats. At this time, Indian peoples began harvesting and processing the clams at new settlement locations on the rugged, gullied, upland edge overlooking the entrenched stream valley. Judging from the land snail assemblages found at Gaulding, the initial climate at this time was still experiencing cold winters and warm, dry summers, but was ameliorating from the extreme temperatures and dryness of the Altithermal. By circa 3700 calibrated years ago, the area was noticeably more moist and warm with expanding riparian woodlands along the bayou and its tributaries.

During the time of this early shell-accumulating occupation at Gaulding, the peoples living there must have used tools and other equipment that were largely made from perishable materials; very little technology from that time was preserved in the site. The presence of oysters that probably were collected many kilometers downstream suggests that watercraft were in use at this early date. Nothing is known of the plant foods they may have gathered and used but in addition to the clams, they killed or scavenged relatively few vertebrate animals. Assuming the evidence is not biased by preservation problems, these included birds, small animals such as turtles and a moderate amount of fish. The largest animals taken were occasional deer. Fishing may have been done with nets as the technology included some perforated clam shells that are believed to be net weights. Little is known of the manner in which the habitation site was organized during the early occupation, but the several layers formed during this time signify different origins. The earliest layer penetrated by the excavation may have been a refuse dump (midden), although it still has some unexplained peculiarities. The contents of the succeeding levels suggest they formed as domestic activity areas.

Around 3700 calibrated years ago use of this campsite halted. From this time onward only a very little sediment accumulated at the top of the old shell deposit. In this sediment, soil-forming processes began and continued for about seven centuries. During part of this time interval, a lower than normal sea level period occurred (Tanner "B") that must have ensured that the hydrology of Taylor Bayou was exclusively fresh water. No brackish water clam populations could become established and no archeological shell sites formed. People may have continued using the basin though, exploiting the nearby prairies and the freshwater riparian environments, but leaving archeological residues that are extremely difficult to detect.

Circa 2900 calibrated years ago, another high sea level pulse (Tanner "C") may have occurred, raising the level of Taylor Bayou again for three or four hundred years. As before, this must have enabled larvae of the brackish-water clam, *Rangia cuneata,* to be flushed upstream establishing new populations because Indian peoples again began to harvest them. Ultimately they formed a substantial new accumulation of clam shells precisely on top of the old campsite's shell debris that had been abandoned three-quarters of a millennium before. Even though sea level was higher than normal at this time, there are no indications that water overtopped the upper edges of the entrenched stream valley, at least not in the middle basin, as there is no sediment accumulation mixed into the campsite shell debris at Gaulding.

The climate at this time was largely a continuation of the relatively warm and moist conditions that were beginning to set in near the end of the earlier shell site's use. This second use of the campsite continued intermittently over a span of perhaps two centuries or so. By the end of that time, the climate was changing to somewhat drier conditions with grasslands again expanding on the upland prairies surrounding Taylor Bayou.

During the time of this middle period of occupation at Gaulding, the people living there seemed to have changed their tools very little from those used nearly a thousand years before. Oysters continued to be collected from downstream near the lake, probably indicating continued watercraft use. Bone tools and chipped stone tools continued to be extremely rare, and the mix of vertebrate animals they obtained was not greatly different from that preserved from the previous campsite dating hundreds of years earlier. Again, little can be said about the organization of their campsites since there is only a single data location from each of the stratigraphic layers accumulated at that time. However, what is seen seems to be all debris formed in domestic activity areas.

Around 2700 calibrated years ago, shell harvesting and accumulation at this second campsite halted once again. This may or may not have been related to the onset of the next falling sea level period (Sanibel I), but the latter almost certainly eliminated any possibility of periodically replenishing the *Rangia* clam beds. Although use of the basin may have continued, it did not involve shellfish harvesting and there is no known archeological evidence until several centuries later. Sometime during the period of 2000 to 2500 calibrated years ago, an apparently brief use of the surface of the Gaulding site shell ridge occurred by people who left a few sherds of Tchefuncte culture pottery. This was during the previously mentioned low sea level period and although there are some shells in the deposit it cannot be said whether they were in association with the pottery. One advantage of pottery-using cultures is that there is a lot more artifact debris that can leave a habitation signature. This small amount of Tchefuncte pottery may be an indication of some non-shellfishing use of the Taylor Bayou basin. In addition, there was another site of significant size with Tchefuncte culture pottery located at a much higher elevation in the far upper reaches of the drainage basin. Although this site, too, contained small amounts of *Rangia* clam shell, it may have been largely associated with using the basin during the low sea level, fresh water period.

At around 2000 calibrated years ago, the highest sea level pulse (Wulfert) began, lasting for about five centuries. The water level evidently spilled out of the entrenched stream valley and rose up at times to a level about 1.5 meters above today's sea level. This event drowned the entire lower and middle drainage basin. It relocated the shoreline landward for substantial distances in some areas, displacing possible locations for habitation sites to above the 5-foot (1.5 m) contour line. Marsh deposits formed throughout the middle and lower basin, and the entire ponded area began to be filled with sediment blanketing drowned archeological sites and geomorphic features. Although some shell-bearing archeological sites attributable to this period have been found at the higher elevation (e.g., 41JF60), they have not been investigated. Along with small quantities of *Rangia* shell, indicating some occasional habitation, the upper deposits at Gaulding include potsherds that could easily be attributed to the time period between the respective ages of Tchefuncte sherds and Caddoan sherds found in the same deposits.

The climate from this time onward was approximately the moist precipitation and moderate seasonal temperatures that characterize the present. However, the abundance of clam beds declined sharply from this time on and archeological shell sites, while they are not unknown, also are not numerous. This reduction, but not elimination, of clam populations during a time of higher sea level may have been a combined function of shoaling of the bayou channel and increased freshwater flow resulting from the moist climate.

This highest sea level event came to an end around 1500 calibrated years ago with the onset of another low sea level period (Buck Key) that, in turn, ended with the final, more modest, high sea level period (LaCosta) from 500 to 1000 calibrated years ago. One consequence of the 1500 to 2000 years ago high sea level period may have been that it lifted the bayous out of their long-time channel which then may have become filled with sediment. When sea level again fell (Sanibel II), the bayou channels apparently became established in slightly different locations, because the orientations of numerous sites no longer conform to the bayou channels of the present. Although large *Rangia cuneata* beds were no longer being established, small ones occurred from time to time, possibly during the 500 to 1000 year ago sea level rise.

There was a final use of the Gaulding shell ridge around 600 to 700 years ago. Small quantities of shellfish were harvested and processed here, although another contemporaneous site (the upper zone of 41JF11) located not far away had a more substantial shell accumulation. The climate at this time continued more or less like that of the present. The technology preserved at the site from this time is somewhat elaborated over that used by the Late Archaic peoples of more than a thousand years earlier. By this time the toolkit, though still limited, included some different projectile points and other chipped stone tools, bone awls, shell ornaments, and perforated clam shell net weights. The quantities of vertebrate animals had increased significantly and had begun to proportionally displace shellfish (assuming that most of the harvested shellfish were eaten). By the time of this final use of the site, it was apparently being visited during the spring months, and possibly during the winter as well. Deer, alligator, and fish had become the major components of the vertebrate animal diet. The presence of green sea turtle bones in the site tells a clear story of canoeing downstream as far as the Gulf beaches to collect oysters, shells from the beaches, and, in that one case, a sea turtle. It still is not possible to tell much about the organization of the campsite at this time, but the contents of the sediment suggest that the particular location that was bulk-sampled may have been a midden and latrine area. During or after this time, a middle-aged adult woman visiting this area died and was interred on the Gaulding shell ridge.

GENERAL OBSERVATIONS FOR FUTURE INVESTIGATIONS

It is fortunate in the Taylor Bayou drainage basin that apparent evidence of the high and low sea level episodes is preserved. Unlike the major floodplains of the Neches and Sabine Rivers, there generally are not the large-scale hydrologic processes to flood, erode, or aggrade thereby hiding or erasing much of the evidence of low amplitude sea level fluctuations. There is a remarkable consistency between certain dated landscape features in Taylor Bayou and nearby northern Gulf locations, and the Tanner sea level model that we are hard-pressed to explain in other ways. In order to make this information come together, though, it was important to calibrate the dating to align the scales of environmental and cultural models.

This study also points to some important additional research needs in the Taylor Bayou area. Additional site surveying and mapping are needed to test whether some of the expected consequences of this model are in fact the case. Fortunately, a number of bits of geological and archeological evidence that were collected for other purposes also turned out to be relevant to the limited testing of the sea level model that was done here. But testing the sea level hypothesis can be expanded in the Taylor Bayou basin, and in certain other areas of the northern Gulf coast as described earlier.

Another lesson from Gaulding came in the benefits of detailed analysis of bulk samples, cores, and thin sections. By providing several lines of evidence bearing on the formation processes at the site, a more robust analysis was achieved. The detailed analysis of archeological sediments seems to indicate at least some formation activity signatures. If bulk samples were taken from several locations in a single stratigraphic layer, it might be possible to begin a two-dimensional reconstruction of the layout of camp activity organization. In addition, a reasonably convincing argument was developed that the three-part aggradational model (matrix rich top and bottom layers with a complex, matrix-free middle), rather than being entirely a result of cultural activities forming the site, seems instead to be natural processes (top and bottom) imprinted on the cultural processes of archeological accumulation. That is to say, the cultural activities and regional geological processes were occurring simultaneously and intersected at the archeological site. This conclusion, though, still needs more investigation because whatever was going on during the formation of Layers 2 and 3 at Gaulding still is not clear. Also, verification is needed that this conclusion is valid at certain sites in other areas, such as the Trinity River delta, where the three-part pattern likewise is seen.

Finally, and apart from the geoarcheological emphasis of the previous discussion, continuing the sediment analysis of the ceramic pastes could lead to mapping distributions of more detailed cultural patterns of pottery manufacture. These may then be used, possibly, to identify such things as the multiple layers of social boundaries that are hypothesized by Moore (1995) and which might constitute the basic social structure of the tribal groups whose residues are recognized as the Mossy Grove tradition.

APPENDIX A: FIELD SCHOOL PARTICIPANTS

FIELD SCHOOL PARTICIPANTS (Davis 1965)

William Birmingham
M/M J. C. Blaine
Charles N. Bollich (and Andrew)
Frank J. Brezik, Jr.
Maxey Brooke
Kenneth M. Brown
Randall Brown
M/M Cecil A. Calhoun (and children)
M/M William P. Caskey
Mrs. Anna E. Childers (and Lauren)
Dr. E. Mott Davis
Hugh Davis
Jonathan Davis
David S. Dibble
Mrs. Harmon Drew
M/M Alan R. Duke (and Bruce and Gary)
Mrs. Henry L. Fox
Dan Fox
M/M William L. Fullen (and Jean and John)
Kathleen Gilmore
Mrs. G. K. Hannaford
C. E. Heartfield
L. D. Heartfield
Lorraine Heartfield
W. A. Henderson
Mrs. M. B. Hoffrichter
M/M R. A. Jircik (and Mark and Stanley)
M/M Griffin W. King
Mrs. Prescott Krouse
Skip Lacy
Dan Lipscomb
Dessamae and Paul Lorrain (and Diana)
Burney McClurkan
C. C. Harsh
Mrs. Dorris Olds
Brig. Gen. T. S. Olds (retired)
A. D. Riggs, Jr.
E. H. Schmiedlin
M/M D. J. Smelley, Jr. (and son)
C. A. Smith, Jr.
Francis C. Stickney
Raymond W. Summers
Curtis Tunnell
W. C. Urwin
W. M. Whitehead
L. Jack Whitmeyer, Jr.
Jerry Whitten
M/M F. W. Zoeller

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APPENDIX B: LITHOLOGIC DESCRIPTIONS AND BULK SAMPLE DATA

CROSS-SECTION A-A' (FIGURE 5)

The following are brief field descriptions of sediment samples from the 1 inch (2.5 cm) diameter soil borings in the order the borings appear from north to south along cross-section A-A'.

Soil boring 9 (S9)

Holocene

0-.2 ft (0-6 cm): very dark grayish brown (10YR 3/2) very fine sandy clayey silt with rootlets and identifiable plant matter.

.2-.6 ft (6-18 cm): very dark grayish brown (10YR 3/2) clayey, very fine sandy silt; numerous reddish yellow (7.5YR 6/8) poorly-formed .5 mm diameter ferruginous concretions; some rootlets.

Late Pleistocene

.6-.95 ft + (18-29+ cm; bottom not reached): brown (10YR 4/3) silty clay; abundant well-formed 1 mm diameter reddish yellow (7.5YR 6/8) ferruginous concretions; paleosol on surface of Beaumont Fm.

Soil boring 1 (S1)

Holocene

0-1+ ft (0-30+ cm; bottom not recovered): dark gray clay, homogeneous; iron nodules (same as S9: 6-18 cm).

1-2ft (30-61cm): core lost from sampler. (Losses usually were from suction in the boring; lost cores were generally cleaned out of the hole with the coring tool or the auger attachment and coring then continued.)

Late Pleistocene

2-3 ft (61-91 cm): brownish gray clay with iron nodules; paleosol on surface of Beaumont Fm.

3-4+ ft (91-122+ cm; bottom not reached): yellowish-brown clay; Beaumont Fm.

Soil boring 3 (S3)

Holocene

0-.1 ft (0-3 cm): black clay; humus and rootlets; some shell fragments (same as S9: 0-6 cm).

.1-.5 ft (3-15 cm): black (7.5YR 2.5/1) silty clay; occasional .5 mm diameter reddish yellow (7.5YR 6/8) ferruginous concretions; occasional rootlets.

Late Pleistocene

.5-1.1 ft (15-32 cm): very dark gray (10YR 3/2) mottled with brown (10YR 5/3) silty clay; 1.5 mm diameter well-formed reddish yellow (7.5YR 6/8) ferruginous concretions; rootlets; paleosol on surface of Beaumont Fm.

1.1-1.7 ft (32-52 cm): very dark grayish brown (10YR 3/2) mottled with olive brown (2.5Y 4/3) silty clay; 1-2 mm diameter well-formed reddish yellow (7.5YR 6/8) ferruginous concretions; some carbonized fragments of plant tissue; base of paleosol on Beaumont Fm.

1.7-2+ ft (52-61+ cm; bottom not reached): light olive brown (2.5Y 5/3) clay, homogeneous; 1-2 mm diameter well-formed reddish yellow (7.5YR6/8) ferruginous concretions; rare fragments of carbonized plant tissue; Beaumont Fm.

Soil boring 2 (S2)

Holocene

0-.6 ft (0-18 cm): black clay (same as S3: 3-15 cm).

.6-2 ft (18-61 cm): archeological shell deposit.

Late Pleistocene

2-3 ft (61-91 cm): dark gray (10YR 4/1) silty clay; occasional well-formed, ≤ 1 mm diameter ferruginous concretions; small (< 1 mm) diffuse yellow (10YR 7/6) mottles.

3-3.5+ ft (91-106+ cm; bottom not recovered): dark gray (2.5Y 4/1) silty clay; abundant well-formed 1-1.5 mm. diameter ferruginous concretions; paleosol on surface of Beaumont Fm.

3.5-3.7 ft (106-111 cm): core lost from sampler.

3.7-4.6 ft (111-139 cm): dark gray (10YR 4/ 1) silty clay (same as 91-106 cm above).

4.6-4.8 ft (139-144 cm): core lost from sampler.

Soil boring

At bottom of archeological shell deposit in profile B-1 west started at depth 3.35ft (102 cm) below surface.

Late Pleistocene

3.35-3.8 ft (102-116 cm): gray (10YR 511) silty clay; abundant brownish yellow (10YR 6/8) mottles and ferruginous concretions (.5 mm diameter); no acid reaction; paleosol on surface of Beaumont Fm.

3.8-5.1+ ft (116-155 cm; bottom not reached): yellowish brown (10YR 5/6), with some gray (10YR 6/1) mottles, silty clay; occasional well-formed 1 mm diameter ferruginous concretions; occasional calcium carbonate nodules up to 18 mm diameter; Beaumont Fm.

Soil boring 5 (S5)

Holocene

0-.2+ ft (0-6+ cm; bottom not recovered): black clay; rotted plant material (same as S6: 0-6 cm). (Remainder of boring not usable because of excessive compaction.)

Soil boring 6 (S6)

Holocene

0-.2 ft (0-6 cm): very dark gray (10YR 3/1) fine and very fine sandy and silty clay; abundant rotted plant matter.

.2-.5 ft (6-15 cm): black (7.5YR 2.5/1) very fine sandy and silty clay; rotted shell fragments washed from archeological shell deposit; few identifiable plant fragments; few rootlets; colluvium.

Late Pleistocene

.5-1.2 ft (15-35 cm): dark gray (10YR 4/1) very fine sandy silty clay; well-formed 1 mm diameter ferruginous concretions; paleosol on surface of Beaumont Fm.

1.2-2+ ft (35-61+ cm; bottom not reached): yellowish brown (10YR 5/4) very fine sandy silty clay; abundant poorly formed ± 1 mm diameter strong brown (7.5YR 5/8) ferruginous concretions; occasional ±3 mm diameter calcium carbonate nodules; Beaumont Fm.

Soil boring 8 (S8)

Holocene

0-.2 ft (0-6 cm): primarily rotted organic material and a small amount of black clay (similar to S6: 0-6 cm).

Late Pleistocene

.2-1.05 ft (6-32 cm): dark gray clay; ±.5 mm diameter ferruginous concretions; ±.5 mm diameter calcium carbonate nodules; paleosol on surface of Beaumont Fm.

1.05-1.2 ft (32-37 cm): grayish brown clay, transition to layer below.

1.2-1.9+ ft (37-58+ cm; bottom not reached): brownish gray clay with yellowish-brown mottles; 1-2 mm diameter iron nodules; >10 mm diameter calcium carbonate nodules; Beaumont Fm.

1965 CONSOLIDATED FIELD DESCRIPTIONS OF STRATIGRAPHIC "ZONES" (FIGURES 6, 8)

The standard for describing archeological sediment at the time of the field school was much different than the geoarcheological standards employed today. Each observably distinct stratum was given a descriptive label that reflected the principal distinguishing visual characteristics. There were a multitude of minor differences in terminology employed by the various recorders that may have been due to intrasite variation in the deposits or to inconsistencies among the descriptions. All of the profile descriptions were reviewed and the terminology was consolidated as given below.

Zone A; <u>black loamy humus with generally large, whole shell</u>
Self explanatory.

Zone B; <u>generally tan soil with large, whole shell</u>
Loose generally whole shell with some matrix soil; lighter in color than Zone A.

Zone C; <u>finely crushed shell</u>
Burned shell fragments are readily noted in shell samples from this zone; it generally is thinner than other zones, often shows lensing, and is intermittent.

Zone D; <u>loose, clean, generally whole shell</u>
Self explanatory.

Zone E; <u>mixed whole and crushed shell</u>
Burned shell is readily noted in this zone, and the clam shells are markedly smaller than in higher zones.

Zone F; <u>mixed heavy plastic clay and whole shell</u>
Identical to Zone G except that Zone F contains some shell and bones.

Zone G; <u>sterile basal clay</u>
Sometimes yellow, sometimes blue-gray in color; this is the original soil and underlying sediment on which the site was established; appears similar to Zone F.

FIELD DESCRIPTIONS (1995) OF STRATIGRAPHIC LAYERS IN PROFILE B-1(WEST),

Section Coordinates: N250-255/W106 (Figures 7, 8)

The descriptions given below were made in 1995 and are based entirely on the observations made of the appearance of the layers in the exposed vertical profile. Most attributes are self explanatory, although the following clarifications are provided: percentages were visually estimated; thickness of the chalky rind on the *R. cuneata* shells was determined by scratching with a knife blade and the scale is relative to those examined in this profile; acid reaction was determined with 5% HCl; pocket penetrometer readings were only possible when there was a dense sediment matrix and was performed on fresh damp surfaces; Munsell colors also were determined on fresh surfaces.

Layer 10; <u>whole and fragmented shell with humus</u>

[Geometry] .8-1.0 ft (24.4-30.5 cm) thickness; lower contact abrupt and irregular; massive bedding.

[Shells] *R. cuneata*; 60 percent are approximately horizontal (a little more than half are concave side up), 40 percent are in some vertical orientation; predominantly whole shells and large fragments; moderately thick chalky rind; no calcium carbonate precipitation.

[Matrix] Shell interstices are all filled with matrix sediment of very dark brown (10YR2/2) very fine sandy silt and unidentified dark organic material; includes comminuted bone fragments, and entire layer is penetrated with small roots and many rootlets; crumbly structure; very slight to no acid reaction; pocket penetrometer reading =.75.

Layer 9; <u>whole shell and dark brown clay</u>

[Geometry] 0-.4 ft (0-12.2 cm) thickness; wedge shaped deposit found only in south half of profile; lower contact abrupt and irregular; massive bedding.

[Shells] *R. cuneata*; 90 percent horizontal (three-fourths with concave side up, one-fourth with concave down), 10 percent random orientations; 90 percent whole, 10 percent large fragments; moderately thick chalky rind; no carbonate precipitation; a fine film of clay matrix adheres to shells.

[Matrix] Shell interstices are 100 percent filled with very dark grayish brown (10YR3/2) sandy silt; includes ±1 mm diameter gastropod shells, abundant rootlets and small roots, possible fecal pellets, charcoal fragments; crumbly and granular structure; slight acid reaction (probably tiny shell fragments, not the mineral matrix).

Layer 8; fragmented shell

[Geometry] 0-.3 ft (0-9.1 cm) thickness; discontinuous across profile; lower contact abrupt and wavy; massive bedding; layer volume is approximately 90 percent well-compacted shell fragments and 10 percent mostly inorganic matrix.

[Shells] *R. cuneata* only; about 15 percent of the layer is whole shells oriented generally horizontal and roughly evenly divided between concave side up versus concave down; 85 percent of layer consists mostly of small shell fragments with about 40 percent displaying gray color from burning; thin chalky rind; no calcium carbonate precipitation.

[Matrix] Shell interstices are about 80 percent filled with very dark grayish brown (10YR3/2) sandy silt. The layer looks lighter in profile because of the abundance of shell; includes a few small roots (most root growth ended in Layer 9 or 10); crumbly, granular structure; could not separate enough inorganic matrix from shell to test for acid reaction.

Layer 7; whole shell with little matrix

[Geometry] .2-.5 ft (6.1-15.2cm) thickness; continuous across profile; lower contact abrupt and irregular; massive bedding; layer volume is almost entirely shell and interstitial spaces.

[Shells] *R. cuneata;* 70 percent of shells are horizontal (80 percent are concave side up), the remainder are randomly oriented; 90 percent of shells are whole, remainder are large and small fragments; very thick chalky rind on shells; calcium carbonate precipitation on upper shell surfaces.

[Matrix] Relatively little inorganic matrix filling about 30 percent of shell interstices with very dark grayish brown (10YR3/2) sandy silt and clay; includes many small snails and rootlets, also rounded masses of possible fecal pellets or worm casts; crumbly and angular structure; slight acid reaction of inorganic sediment.

Layer 6; whole and fragmented shell with very dark gray clay

[Geometry] .15-.4 ft (4.6-12.2 cm) thickness; continuous across profile; lower contact abrupt and irregular; massive bedding structure.

[Shells] *R. cuneata;* shell orientations are largely random; 60 percent whole; 20 percent each large and small fragments; some noticeable gray (burned) fragments; moderately thick chalky rind; shells break easily, surface features are dissolved on some shells (surface is smoother than usual); no calcium carbonate precipitation observed.

[Matrix] Interstices are completely filled with very dark gray (10YR3/1) sandy silt and clay; includes abundant Fe concretions (10YR6/8-brownish yellow), small snail shells (<1 mm), and unidentified black fragments-possibly charcoal, numerous rootlets and small roots (less than above); crumbly and sub-angular structure; no acid reaction.

Layer 5; whole shell, lenses of fragmented shell, with some matrix

[Geometry] .2-.4 ft (6.1-12.2 cm) thickness; continuous across profile; lower contact abrupt and irregular; massive bedding structure except for thin (about 1 in or 2.5 cm) lenses of fragmented shell.

[Shells] *R. cuneata;* about 75 percent of shells were horizontal (with some 60 percent oriented concave side down), and the remainder were oriented randomly; about 50 percent of shells were whole, 10 percent large shell fragments, and 40 percent small shell fragments; about one-third of small fragments were gray (burned); thin chalky rind on whole shells; no calcium carbonate precipitation.

[Matrix] About 90 percent of shell interstices were filled with dark grayish brown (10YR4/2) sandy silt and clay; includes unidentified black fragments (charcoal?), occasional rootlets, occasional 1 mm diameter possible fecal pellets or worm casts; crumbly and subangular structure; slight acid reaction.

Layer 4; whole shell with little matrix

[Geometry] .3-.5 ft (9.1-15.2 cm) thickness; continuous across profile; lower contact abrupt and irregular; massive bedding structure.

[Shells] *R. cuneata;* about 90 percent or more whole shell largely oriented randomly; thin chalky rind; no calcium carbonate precipitation; shells often have dark gray clay film adhering to them.

[Matrix] Shell interstices are about half empty; the other half is filled with very dark gray (10YR3/1) clay; includes possible charcoal fragments or decayed root fragments, small (1-2 mm) snail shells, occasional roots, small masses of rounded fecal(?) pellets or worm casts protected in the concave area of whole shells; crumbly; slight acid reaction.

Layer 3; whole and fragmented shell with dark gray clay

[Geometry] .2-.35 ft (6.1-10.7 cm) thickness; continuous across profile; lower contact gradual and wavy; massive bedding except for small pockets of fragmented shells.

[Shells] *R. cuneata;* about one-fourth are horizontal generally with concave side up; the remaining 75 percent are randomly oriented; about half of the shells are whole and the remainder are small fragments; very thick chalky rind; no calcium carbonate precipitation.

[Matrix] About 90 percent of interstices are filled with dark gray (10YR4/1) clay; the remaining 10 percent are voids; includes only a few rootlets; massive to crumbly structure;

strong acid reaction; pocket penetrometer reading is .6; small grooves in matrix clay adhering to concave interior of shells may be worm burrows (.5-1 mm diameter).

Layer 2; whole shell and grayish brown clay

[Geometry] .35-.5 ft (10.7-15.2 cm) thickness; continuous across profile; lower contact abrupt and smooth; massive bedding.

[Shells] *R. cuneata;* shells seem randomly oriented; nearly all shells are whole or in large fragments; very thick chalky rind; shells are intact and fresh looking when removed from clay matrix but are soft and crumble easily under pressure; no calcium carbonate precipitation.

[Matrix] All shell interstices are filled with grayish brown (10YR5/2) silty clay; includes Fe stains (10YR6/8-brownish yellow); massive structure; very slight acid reaction; pocket penetrometer reading is 1.2.

Layer 1; dark grayish brown silty clay

[Geometry] Basal clay (probably the Morey silt loam soil zone on top of Beaumont Fm.); continuous across profile; bottom contact not observed

[Shells] None.

[Matrix] Dark grayish brown (10YR4/2) silty clay; gleyed; includes brownish yellow (10YR6/8) Fe and small calcium carbonate concretions; massive structure, slickensides; no acid reaction to clay, slight reaction to concretions; pocket penetrometer reading is 1.2.

BULK SAMPLE DATA FROM B-1 (WEST),

Section Coordinates N250-255/W106 (Figures 14, 15, 16)

Eleven bulk column samples were taken from the layers exposed in the B-1 (west) profile for analysis of their composition. The sample locations are shown on Figure 11; their volumes were roughly 2000 cc and they were each processed as follows:

1. The entire sample was air dried thoroughly;
2. Ten gm of matrix was removed from the sample and diluted with 25 ml of distilled water for pH determinations using an Oakton pHTestr3 meter (three separate readings were averaged for the result reported here);
3. The wet pH sample sediment was re-dried and returned to the main sample;
4. The complete dry sample was weighed and then placed in a 5 gallon bucket with 2-3 gallons of distilled water to soak for at least 24 hours;
5. Floating debris and terrestrial gastropod shells were removed with an aquarium net and the submerged sediment agitated until no more vegetal material or snail shells floated to the surface;
6. The entire sample was then water-washed through 8 nested sieves retaining all but the silt/clay fraction;
7. Each sieve fraction was air dried and weighed (Table 13);
8. The retained material in the two largest screens (-3.65 and –2 phi, or all material larger than 4 mm) was sorted for identifiable constituents, which were nearly all *R. cuneata* shells; the number of right and left umbos were counted to determine the degree of pairing; shell lengths were measured from whichever side had the largest number of measurable valves; and whole valves were examined under low power magnification for precipitated calcium carbonate crusts (Table 14);
9. The 1 phi fraction (.5 to 1.0 mm) was point-counted as a proxy for the composition of matrix (Table 15). For point counting in soils and sediment work, 1500 grains is recommended as an adequate compromise between statistical assessment of variability and the time costs of conducting the counting (Brewer 1964:50). A study of archeological sediments on the northern Gulf of Mexico, after comparing results of point-counting samples up to 2000 grains, determined that little fluctuation in percentage estimates occurred above a sample size of 500 grains (Gagliano et al. 1982:99). Two of the Gaulding samples were counted up to roughly 1500 grains and the results were similar to those reported by Gagliano et al. However, since it was intended during analysis of results, to subdivide the point-counts into depositional and post-depositional components, the target of 800-900 grains was used.
10. The compositional elements were divided into those relating to the cultural activities forming the site – for example, burned shell – and into others related to post-depositional natural processes, such as iron concretions. Table 16 was prepared in which the two categories were divided and proportions separately calculated.

UNDISTURBED CORES AND THIN-SECTIONS FROM B-1 (WEST)

Section Coordinates N250-255/W106 (Figure 11)

Two .6 m long and 12.5-cm diameter PVC pipes were beveled on one end and driven with a sledgehammer into undisturbed shell deposit. The upper core was driven in from the ground surface while the lower core was driven from the pedestal left after an abortive attempt to secure a plaster-jacketed undisturbed sample of the deposit. Once profile sampling was completed, the cores were removed and sealed on each end for transport. Numerous quarter-inch (7.6 mm) holes then were drilled through the casing and the sample was left to air dry for several months. Once dry, the cores were impregnated with epoxy and cut in half lengthwise by Paul Goldberg (Boston University). One half of each core was polished and used as a permanent stratigraphic reference. The other half was used for preparation of eight thin-sections. Although only a brief petrographic examination of the thin sections was possible in time to include with this study, both the polished cores and the thin sections were examined in detail with a binocular microscope at 10x and 20x magnification to clarify descriptions from the out-

TABLE 13
Grain size sieving results for bulk samples from profile B-1 (west), Gaulding site, 41JF27

	Sieving results, dry weight, gms									
Layers	Small Pebble >12.5 mm (-3.65 phi)	Small Pebble 4 mm (-2 phi)	Granule 2 mm (-1 phi)	Very coarse sand 1 mm (0 phi)	Coarse sand 0.5 mm (1 phi)	Medium sand 0.25 mm (2 phi)	Fine sand 0.125 mm (3 phi)	Very fine sand 0.062 mm (4 phi)	Silt/clay <0.062 mm (>4 phi)	Total dry sample weight (gms)
10U	1851.49	612.39	177.57	70.42	31.59	17.43	24.76	107.69	1111.97	4005.31
wt. %	*46.23*	*15.29*	*4.43*	*1.76*	*0.79*	*0.44*	*0.62*	*2.69*	*27.76*	
10L	1021.64	342.92	147.84	59.45	46.10	64.45	108.81	182.35	1160.24	3133.80
wt. %	*32.60*	*10.94*	*4.72*	*1.90*	*1.47*	*2.06*	*3.47*	*5.82*	*37.02*	
9	2102.29	768.51	293.57	103.02	32.50	15.02	17.17	90.80	593.74	4016.62
wt. %	*52.34*	*19.13*	*7.31*	*2.56*	*0.81*	*0.37*	*0.43*	*2.26*	*14.78*	
8	2012.16	1044.92	322.83	47.96	25.83	16.09	24.35	106.61	537.80	4138.55
wt. %	*48.86*	*25.38*	*7.84*	*1.16*	*0.63*	*0.39*	*0.59*	*2.09*	*13.06*	
7	2298.21	726.74	180.27	41.61	18.19	8.10	6.77	29.05	303.72	3612.66
wt. %	*63.62*	*20.12*	*4.99*	*1.15*	*0.50*	*0.22*	*0.19*	*0.80*	*8.41*	
6	2337.78	392.00	261.74	96.43	27.11	19.81	36.07	137.47	116.67	3425.08
wt. %	*68.25*	*11.44*	*7.64*	*2.82*	*0.79*	*0.58*	*1.05*	*4.01*	*3.41*	
5	1366.24	1189.89	627.16	192.25	28.61	10.31	9.82	59.99	524.06	4008.33
wt. %	*34.09*	*29.69*	*15.65*	*4.80*	*0.71*	*0.26*	*0.24*	*1.50*	*13.07*	
4	1861.12	469.88	357.60	79.76	10.77	5.11	5.15	17.14	374.87	3181.40
wt. %	*58.50*	*14.77*	*11.24*	*2.51*	*0.34*	*0.16*	*0.16*	*0.54*	*11.78*	
3	1274.85	459.50	123.10	27.49	12.31	6.26	5.83	20.30	825.59	2755.23
wt. %	*46.27*	*16.68*	*4.47*	*1.00*	*0.45*	*0.23*	*0.21*	*0.74*	*29.96*	
2	1648.86	149.08	35.92	19.09	11.38	7.92	23.24	186.30	1336.64	3418.43
wt. %	*48.23*	*4.36*	*1.05*	*0.56*	*0.33*	*0.23*	*0.68*	*5.45*	*39.10*	
1	0.00	0.00	0.49	0.56	0.53	0.26	1.09	10.81	82.90	96.64
wt. %			0.51	0.58	0.55	0.27	1.13	11.19	85.78	

crop and the sieving analysis.

BULK SAMPLES FROM THE 1965 FIELD SCHOOL EXCAVATION

The bulk samples from the original excavation represented a variety of collecting methods, sizes, and composition. Consequently, they were not sieved but they were examined for evidence about the shells: species, size, and condition. Broadly the species may be divided into three groups: 1) a small collection of terrestrial snails which were studied by Kenneth M. Brown and whose report is included here as Appendix E; 2) a few marine shells probably collected from the beach and a larger collection of estuarine species some of which are presumed to be food resources (Table 17); and 3) many *Rangia cuneata* which were measured for shell length. The *Rangia* data were not included here because they were similar to the measurements derived from the 1995 bulk samples, and because the uncertainty about correlation of some of the layers between excavation units.

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TABLE 14
Additional results from bulk samples from profile B-1 (west), Gaulding site, 41JF27

Layers	pH (avg. of 3 meas.)	No. of terre-strial snails in float	Max. no. of right or left *R. cuneata* valves	% of right or left *R. cuneata* valves unmatched	R. cuneata valve length: Mean shell length (mm)	Shell length std. dev.	Shell length sample size	Est. wet meat weight (gms) for mean shell length*	% of *R. cuneata* valves with $CaCo_3$ precipitate	Estuarine (M)ussel; o(Y)ster frags	Sherd	Bone fragments	Siltstone (prob. baked sediment)
10U	7.72	44	200	3.0	34.41	4.77	51	1.40	2.0		1	42	2
10L	7.64	9	92	4.3	36.42	4.45	38	1.75	2.6	1M		28	3
9	7.81	213	174	3.4	34.77	4.91	113	1.45	10.6			4	7
8	7.78	232	163	6.1	35.26	4.58	94	1.50	9.7	2M		3	9
7	7.88	227	186	7.5	36.29	5.48	102	1.70	22.5			3	5
6	8.03	167	163	2.4	32.85	7.84	93	1.20	14.9			2	7
5	8.00	60	298	6.0	27.17	3.79	139	0.70	5.8			18	34
4	7.96	52	325	5.2	27.38	3.40	194	0.75	10.9			9	13
3	7.99	16	230	0.7	27.01	3.79	144	0.70	5.0			5	8
2	8.07	4	274	11.3	28.68	4.42	148	0.80	42.2	1Y		5	0
1	8.21	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

* Correlation of *Rangia cuneata* shell length with wet meat weight is from unpublished data held by L. Aten.

TABLE 15
Point-count results from 1 phi fractions of bulk samples, profile B-1 (west), Gaulding site, 41JF27

Layers	*Rangia* fragments (not discolored)	*Rangia* fragments (burned)	Mussels, oysters frags	Bone fragments (burned and unburned)	Charcoal	Terrestrial snail fragments	Siltstone (prob. baked sediment)	Iron oxidation-reduction nodules	Calcium carbonate precipitation crusts	Rootlet fragments	Worm cast pellets	Chert/ quartz grains	Count totals
10 upper	184	164	2	260	7	46	69	0	0	60	39	1	832
%	*22.1*	*19.7*	*0.2*	*31.3*	*0.8*	*5.5*	*8.3*	*0.0*	*0.0*	*7.2*	*4.7*	*0.1*	
10 lower	126	113	0	260	29	21	24	2	0	14	252	1	842
%	*15.0*	*13.4*	*0.0*	*30.9*	*3.4*	*2.5*	*2.9*	*0.2*	*0.0*	*1.7*	*29.9*	*0.1*	
9	249	431	0	99	0	19	4	6	1	2	14	0	825
%	*30.2*	*52.2*	*0.0*	*12.0*	*0.0*	*2.3*	*0.5*	*0.7*	*0.1*	*0.2*	*1.7*	*0.0*	
8	346	260	13	72	9	116	18	2	2	62	11	0	911
%	*38.0*	*28.5*	*1.4*	*7.9*	*1.0*	*12.7*	*2.0*	*0.2*	*0.2*	*6.8*	*1.2*	*0.0*	
7	377	336	0	33	4	37	12	7	5	3	8	0	822
%	*45.9*	*40.9*	*0.0*	*4.0*	*0.5*	*4.5*	*1.5*	*0.9*	*0.6*	*0.4*	*1.0*	*0*	
6	239	406	0	51	3	62	19	18	6	13	22	0	839
%	*28.5*	*48.4*	*0.0*	*6.1*	*0.4*	*7.4*	*2.3*	*2.1*	*0.7*	*1.5*	*2.6*	*0*	
5	240	484	12	37	3	27	2	29	1	0	1	1	837
%	*28.7*	*57.8*	*1.4*	*4.4*	*0.4*	*3.2*	*0.2*	*3.5*	*0.1*	*0.0*	*0.1*	*0.1*	
4	449	227	7	50	19	39	2	48	14	7	0	0	862
%	*52.1*	*26.3*	*0.8*	*5.8*	*2.2*	*4.5*	*0.2*	*5.6*	*1.6*	*0.8*	*0.0*	*0.0*	
3	444	377	0	18	11	11	3	16	1	10	0	0	891
%	*49.8*	*42.3*	*0.0*	*2.0*	*1.2*	*1.2*	*0.3*	*1.8*	*0.1*	*1.1*	*0.0*	*0.0*	
2	467	28	0	7	0	1	0	283	95	0	0	0	881
%	*53.0*	*3.2*	*0.0*	*0.8*	*0.0*	*0.1*	*0.0*	*32.1*	*10.8*	*0.0*	*0.0*	*0.0*	

TABLE 16

Point-count results divided into habitation and post-depositional elements; from 1 phi fractions of bulk samples, profile B-1 (west), Gaulding site, 41JF27

	Habitation elements							Post-deposition elements						
Layers	*Rangia* fragments (not discolored)	*Rangia* fragments (burned)	Mussels, oysters frags	Bone fragments (burned and unburned)	Char-coal	Siltstone (prob. baked sediment)	Count totals	Terrestrial snail fragments	Iron oxidation-reduction nodules	Calcium carbonate precipitation crusts	Rootlet fragments	Worm cast pellets	Chert/ quartz grains	Count totals
10 upper	184	164	2	260	7	69	686	46	0	0	60	39	1	146
%	*26.8*	*23.9*	*0.3*	*37.9*	*1.0*	*10.1*		*31.5*	*0.0*	*0.0*	*41.1*	*26.7*	*0.7*	
10 lower	126	113	0	260	29	24	552	21	2	0	14	252	1	290
%	*22.8*	*20.5*	*0.0*	*47.1*	*5.3*	*4.3*		*7.2*	*0.7*	*0.0*	*4.8*	*86.9*	*0.3*	
9	249	431	0	99	0	4	783	19	6	1	2	14	0	42
%	*31.8*	*55.0*	*0.0*	*12.6*	*0.0*	*0.5*		*45.2*	*14.3*	*2.4*	*4.8*	*33.3*	*0.0*	
8	346	260	13	72	9	18	718	116	2	2	62	11	0	193
%	*48.2*	*36.2*	*1.8*	*10.0*	*1.3*	*2.5*		*60.1*	*1.0*	*1.0*	*32.1*	*5.7*	*0.0*	
7	377	336	0	33	4	12	762	37	7	5	3	8	0	60
%	*49.5*	*44.1*	*0.0*	*4.3*	*0.5*	*1.6*		*61.7*	*11.7*	*8.3*	*5.0*	*13.3*	*0*	
6	239	406	0	51	3	19	718	62	18	6	13	22	0	121
%	*33.3*	*56.5*	*0.0*	*7.1*	*0.4*	*2.6*		*51.2*	*14.9*	*5.0*	*10.7*	*18.2*	*0*	
5	240	484	12	37	3	2	778	27	29	1	0	1	1	59
%	*30.8*	*62.2*	*1.5*	*4.8*	*0.4*	*0.3*		*45.8*	*49.2*	*1.7*	*0.0*	*1.7*	*1.7*	
4	449	227	7	50	19	2	754	39	48	14	7	0	0	108
%	*59.5*	*30.1*	*0.9*	*6.6*	*2.5*	*0.3*		*36.1*	*44.4*	*13.0*	*6.5*	*0.0*	*0.0*	
3	444	377	0	18	11	3	853	11	16	1	10	0	0	38
%	*52.1*	*44.2*	*0.0*	*2.1*	*1.3*	*0.4*		*28.9*	*42.1*	*2.6*	*26.3*	*0.0*	*0.0*	
2	467	28	0	7	0	0	502	1	283	95	0	0	0	379
%	*93.0*	*5.6*	*0.0*	*1.4*	*0.0*	*0.0*		*0.3*	*74.7*	*25.1*	*0.0*	*0.0*	*0.0*	

APPENDIX C: RADIOCARBON DATE CALIBRATIONS

The radiocarbon-based absolute age estimates used in this study originated from a multitude of sources, procedures and sample materials. Most of the dates used were run before $\delta^{13}C$ measurements were available to correct for isotope fractionation and before reservoir correction problems were understood. A number of the dates being used are the boundary ages an investigator has interpreted from a group of radiocarbon dates. Aligning all of these "dates" through calibration is the only means available to normalize these diverse results, but it entails assumptions and procedures that might not be obvious, so they are described in this appendix. The terminology used here, particularly *measured age, conventional age,* and *calibrated date* is as defined by Stuiver and Reimer (1993). The procedures that were used for calibrating radiocarbon dates are as follows:

1. Calibrate with the University of Washington Quaternary Research Center's CALIB computer program; as of January 1999, this software is in version 4.0.
2. For samples with a "conventional" age (i.e., corrected for $\delta^{13}C$) reported by the radiocarbon laboratory, use that value rather than start with the laboratory's "measured" age and recalculate the $\delta^{13}C$ normalization using CALIB. The differences between CALIB and laboratory conventional dates, which may be based on different calibration software, seem to be slight and using the lab-reported "conventional" ages is one way to minimize having slightly different numbers in circulation for the same sample. For samples with no lab-reported conventional age or $\delta^{13}C$ value, estimate the conventional age using an average $\delta^{13}C$ value from the same kind of sample material and preferably from the same general area. If this is not available, use an approximation of $\delta^{13}C$ from Stuiver and Reimer (1998:Table 1).
3. For calibration of charcoal and *Rangia cuneata,* use the CALIB 4.0 atmospheric dataset 1 (filename INTCAL98.14C) which is a decadal atmospheric dataset. It is not yet clear which dataset is most suitable for the oyster, *Crassostrea virginica*. Older versions of CALIB had both decadal and bidecadal datasets available, but since archeological *Rangia cuneata* typically only lived for 3-6 years, the decadal dataset was still a better approximation for short-lived samples than the bidecadal dataset. For true marine shells, use data set 3 (filename MARINE98.14C). While the appropriate dataset is clear for most organic materials, there has been confusion about which one to use with *Rangia cuneata*, a species that survives in habitats ranging from freshwater to full estuarine salinity. While it might seem that the marine dataset should be used with such shell samples, the CALIB 4.0 manual advises that lacustrine samples be "... calibrated with the atmospheric dataset due to comparable rapid exchange rates" (Stuiver and Reimer 1998:5). In the sense that shallow waters with rapid mixing also are typical of northern Gulf estuaries, bayhead river deltas, floodplain lakes and their tributary and distributary streams, this suggests that it is better to use the atmospheric dataset for calibration purposes involving *Rangia cuneata* as the sample material. This is done also for the shallow water oysters occasionally used for dating. This dataset conclusion is reinforced by comparing $\delta^{13}C$ measurements of marine species (Stuiver and Reimer 1998:Table 1) to those of *Rangia cuneata*; while they sometimes overlap, generally the two are distinctly different.
4. Reservoir correction for dilution of ^{14}C is not necessary in the Sabine Lake area (Aten 1983:Appendix A). However, a local correction is needed in the lower Trinity River and possibly in the Brazos and other major streams to the west, although this need has not yet been clearly documented. Unfortunately, the 1983 study did not clearly distinguish between the main streams draining large interior basins, and the local tributaries. When the -225 years reservoir correction for *Rangia* shells from the Trinity deltaic plain is used, this should be subtracted from the *measured* age before computing the *conventional* age and calibrating. Shells harvested from tributaries with local drainage basins, such as Clear Lake or Buffalo Bayou, around the Galveston Bay estuary should not be corrected other than for $\delta^{13}C$ unless there is a specific reason to do so.
5. Calibrate with CALIB's Method A (curve intercepts) rather than using the probability approach (Method B) only because the former method of presentation is customarily used in the northern Gulf region.
6. Set other CALIB options to: a) laboratory error multipliers at 1; b) curve smoothing with 10 points (i.e., a 100-year running average) to minimize noise and unnecessary intercepts; and c) round all calibration results to the nearest decade.

CALIBRATION LOG

Taylor Bayou Drainage Basin

Description

Seven new dates were obtained in 1997 for samples from B-1 (west) at the Gaulding site (41JF27). In addition, there are three dates from other sites in the drainage basin and a fourth from a Tchefuncte component at a site on Conway Bayou immediately east of the Sabine River. These were discussed in the report and the results were given in Table 1.

Material

Rangia cuneata.

Calibration Procedure

For the 41JF27 samples, the conventional age provided by the radiocarbon laboratory was calibrated with the INTCAL98.14C dataset. Samples from 41JF11, 41JF35, and 16CU108 were only available as measured ages. The average $\delta^{13}C$ value from the 41 JF 27 samples (-5.3 ppm) was used to calculate estimated conventional ages at these other sites. These samples also were calibrated with the INTCAL98.14C dataset. No local reservoir correction was applied.

Results

See Table 1, main text.

Galveston Bay Area Ceramic Periods

Description

The culture-historical framework for the Galveston Bay area is based on ceramic stratigraphy, seriation, and radiocarbon dating principally from sites in the Trinity River delta (Aten 1983:217-290).

Material

Nearly all the radiocarbon samples that support boundary dates for the ceramic periods were obtained from samples of the mollusc *Rangia cuneata* to which a local reservoir correction of -225 years had been applied to accommodate an excess of "dead" carbon in the surface waters from the interior Trinity River drainage basin.

Calibration Procedure

The calibrations were run on the ceramic period boundary dates from Aten (1983:Table 14.2). To simplify the calibration of the sequence of ceramic periods, the boundary dates were treated as if they were measured dates on *Rangia cuneata.* They were given an arbitrary standard deviation of ±80 years and retained the previously incorporated local reservoir correction (-225 years). Based on many recent shell dates from the lower Trinity River area, a $\delta^{13}C$ value of –6 ppm was used to correct the measured dates to conventional dates. The latter then were calibrated using the INTCAL98.14C dataset. For results, see Table 17.

Coastal Louisiana Culture-Historical Periods

Description

The culture-historical framework for south Louisiana is based on ceramic typology and radiocarbon dating from sites widespread throughout Louisiana (Jeter et al. 1989).

Material

This chronology relies heavily on wood charcoal radiocarbon samples that generally are not calibrated.

Calibration Procedure

Calibration was performed on the culture period boundary dates given in Jeter et al. (1989:94-220). The boundary dates were treated as measured dates on wood charcoal and were given an arbitrary standard deviation of ±80 years. The CALIB4.0 default $\delta^{13}C$ value of -25 ppm was used to correct the measured dates to conventional dates. The latter were calibrated using the INTCAL98.14C dataset. For results see Table 18.

Trinity River Channel/Delta Stages

Description

The main channel and delta of the Trinity River has relocated several times (Aten 1983:125-128). In the 1960s it was important to interpret and to date this sequence because the initial ceramics associated with the archeological sites that followed the abandonment of each channel stage was expected to—and did—provide some of the first clues to the structure of the ceramic technology changes and to a culture-historical framework for the Galveston Bay area. Subsequently, the channel stage sequence was used as the environmental framework for human activities in the Trinity floodplain.

Material

The channel stage chronology relies heavily on *Rangia cuneata* radiocarbon samples in the same manner as the Trinity River ceramic periods.

Calibration Procedure

The boundary dates for the Trinity channel stages were

TABLE 17
Calibration of Galveston Bay area ceramic period boundary ages

Ceramic Period	Measured age, B.P. (terminal dates)	Calibrated age (2 sd), B.P. (terminal dates)
Old River	150±80	630 (510) 310
Round Lake	600±80	980 (790) 680
Turtle Bayou	1000±80	1360 (1260) 1020
Mayes Island	1350±80	1770 (1540) 1350
Clear Lake	1600±80	2040 (1850) 1620
Late Archaic	1850±80	2350 (2130) 1910

TABLE 18
Calibration of coastal Louisiana culture-historical period boundary ages

Culture Period	Measured age, B.P. (terminal dates)	Calibrated age (2 sd), B.P. (terminal dates)
Plaquemine	450±80	590 (510) 320
Coles Creek	950±80	1010 (910) 700
Troyville	1250±80	1310 (1190) 980
Marksville	1550±80	1600 (1420) 1300
Tchefuncte	2050±80	2260 (2010) 1840
Late Archaic	2400±80	2730 (2380) 2200

taken from Aten (1983:Figure 8.8). The calibration procedure was the same as described above for Trinity River ceramic periods. For results see Table 19.

Turtle Bay Beach Ridge No. 2

Description

Immediately east of the Trinity River deltaic plain and northwest of Lake Anahuac is a beach ridge complex of uncertain age. It has been mapped (Aten, field records) but only limited information has been published (Aten 1983:187-188, Figure 11.19, Table 14.1). Several of the ridges have numerous archeological shell sites on them, although they have scarcely been investigated. Ridge number 2 was penetrated with a shovel test and *Rangia cuneata* shells in bay-bottom deposits from under the ridge sediments were collected and dated. In addition, a small stratigraphic test excavated in one of the shell sites on top of the ridge yielded ceramics in the early levels that date to middle or late Mayes Island Period. The age of beach ridge number 2 is bracketed on Figure 30 between the calibrated ages of the shell sample under the ridge and the middle Mayes Island Period archeology on top of the ridge.

Material

The sample from under the beach ridge was *Rangia cuneata.*

Calibration Procedure

The underlying shell sample (TX-1050, 41CH9/1) was dated and calibrated in the same manner as described above for the Trinity River archeological shell samples. The measured age less the -225 year local reservoir correction was 1417±103, and the 2 standard deviation calibrated age is 1840 (1640) 1450 B.P. The age of the middle Mayes Island Period is approximately 1690 cal B.P. thereby dating Beach Ridge No. 2 to the interval from 1650 to 1700 cal B.P.

Sabine Lake Pleistocene-Holocene Boundary

Description

Anderson et al. (1991) published four dates on shells from cores that documented the beginning of Holocene deposition at different elevations below sea level taken from near the drowned Taylor Bayou channel in Sabine Lake: B-43807, core SL-4, -2.5 m depth; B-35417, core SL-7, A, -4.2 m depth; B-35418, core SL-7, B, -4.2 m depth; B-43808, core SL-12, -5.4 m depth.

Material

Rangia cuneata.

Calibration Procedure

The dates were published as measured ages. They were corrected to conventional ages using the average d^{13}C value from 41JF27 (-5.3 ppm) and were calibrated using the INTCAL98.14C dataset. No local reservoir correction was applied. For results see Table 20.

Southwest Louisiana Cheniers

Description

McBride et al. (1997:41) reviewed dates obtained some 4 decades ago by Gould and McFarlan (1959) and recommended new upper boundary age estimates for four prominent chenier trends, as listed below, based generally on the youngest dates for each trend (also see Taylor et al. 1996).

Material

Marine shells, generally *Mulinia.*

Calibration Procedure

Because the original samples were dated so long ago, the chenier trend upper boundary ages would have been based on measured ages uncorrected for δ^{13}C. Since no measured standard deviations were provided, this was estimated at ±80 for all four ages. The MARINE98.14C calibration dataset was used and δ^{13}C values were estimated at -5 ppm. No local reservoir correction was used. For results see Table 21.

TABLE 19
Calibration of Trinity River channel and delta stages boundary ages

Channel Period	Measured age, B.P. (terminal dates)	Calibrated age (2 sd), B.P. (terminal dates)
Stage 5	ongoing	—
Stage 4	650±80	1030 (910) 700
Stage 3	1400±80	1830 (1590) 1390
Stage 2	1700±80	2160 (1950) 1760
Stage 1	2650±80	3350 (3110) 2860

TABLE 20
Calibration of Sabine Lake Pleistocene-Holocene boundary dates.

Lab sample no.	Measured age, B.P.	Calibrated age (2 sd), B.P.
B-43807	1870±100	2380 (2160) 1910
B-35417	3440±140	4530 (4110) 3700
B-35418	3890±120	5050 (4820) 4420
B-43808	5050±80	6320 (6180) 5940

TABLE 21
Calibration of southwest Louisiana chenier ages

Chenier ridge	Est. measured age, B.P.	Calibrated age (2 sd), B.P.
Grand Chenier	1100±80	1160 (960) 770
Creole Ridge	2100±80	2290 (2050) 1840
Chenier Perdue	2275±80	2480 (2290) 2050
Little Chenier	2520±80	2780 (2650) 2330

Tanner Late Holocene Sea Level Episodes

Description

The boundary dates calibrated here are from two sources: the early three episodes are from Gunn (1997:Figure 5) and, while not so labeled in the source, are for convenience here called "Tanner A" (high), "Tanner B" (low), and "Tanner C" (high). The boundary dates of the subsequent episodes are taken from extensive mapping and radiocarbon dating done in the Charlotte Harbor-Caloosahatchee River area of southwest Florida (Stapor et al. 1991)

Material

The calibrations here were run on episode boundary ages.

Calibration Procedure

The early episode estimated boundary ages were calibrated as if they were conventional dates run on wood with a standard deviation of ±80 years using the INTCAL98.14C dataset. The remainder from southwest Florida was more complex. These boundary estimates were based on numerous radiocarbon measured ages on marine shells. The standard deviation of ±150 years was estimated from the actual sample data (Stapor et al., 1987:Appendix). The $\delta^{13}C$ value of +390 years and the local reservoir correction (R=5±20) are from Marquardt (1992:12). The calibration was run using the MARINE98.14C dataset. For results see Table 22.

TABLE 22
Calibration of Tanner Late Holocene sea level estimated boundary ages

Sea level episodes	Est. measured age, B.P. (terminal date)	Calibrated age (2 sd), B.P. (terminal date)
Sanibel II (low)	540±150	490 (170) 0
LaCosta (high)	890±150	710 (500) 250
Buck Key (low)	1490±150	1320 (1020) 710
Wulfert (high)	1890±150	1780 (1420) 1280
Sanibel I (low)	2390±150	2350 (2010) 1650
"Tanner C" (high)	2450±80	2750 (2460) 2330
"Tanner B" (low)	2830±80	3190 (2920) 2780
"Tanner A" (high)	3030±80	3400 (3240) 2970

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APPENDIX D: CORRELATION OF STRATIGRAPHIC ANALYSIS UNITS AND EXCAVATION UNITS, GAULDING SITE, 41JF27

The primary definition of stratigraphic analysis units (A.U.) was based on features of the B-1 (west) profile and then those groups of strata were correlated throughout the other excavations units in the site. The linkages are approximate and try to resolve sloping strata and non-equivalent lithologic descriptions. Principally the A.U.s are needed for analyzing the faunal remains, as nearly all ceramics are in the uppermost 6-inch (15-cm) level in all excavations, and because there are very few artifacts of any other kind. They are important also to support the isopach map and cross-section (Figure 10). The following Table 23 lists the estimated correlation of excavation and sampling units from the 1965, 1974, and 1995-96 periods of investigation at the Gaulding site.

Lower A.U.

Based on similar radiocarbon dates from Layers 2 and 4, and similar bulk sample characteristics from Layers 3 through 5, this A.U. includes all layers and deposits equivalent to Layers 2 through 5 in profile B-1 (west).

Middle A.U.

This unit is based on similar radiocarbon dates and similar bulk sample characteristics from Layers 6, 7, 8, and 9 in profile B-1 (west).

Upper A.U.

This unit corresponds to Layer 10, the most visually distinctive layer throughout the site. The layer was generally thick enough to require two and sometimes three arbitrary levels to excavate through it. Since nearly all ceramics were in the first level and the levels below were nearly always devoid of artifacts, although faunal remains were generally present, Layer 10 was divided into an "A" (or upper) and a "B" (or lower) part, "A" always being equivalent to the uppermost level, and "B" equivalent to whatever remained.

TABLE 23
Correlation of excavation units and analysis units, Gaulding site, 41JF27.

Excavation Units (depths in inches)	Analysis Units			
	Upper (A)	Upper (B)	Middle	Lower
A-1	0-6	—	6-12 12-18	18-24 24-30 30-36 36-42
A-2	0-6	6-12	12-18 18-24	24-30 30-36 36-42
A-3	[6-inch (15-cm) levels above 24 inches (61 cm) are too mixed with "upper" and "middle" layers to use.]			24-30 30-36 36-42
A-4	0-6	6-12	—	12-18
A-5	0-6 (Stratum 1)	—	6-12	18-24 24-30
A-6	Zone A	Zone A	Zone B	Zone C Zone D Zone E
A-7	0-6 6-12 (Zone A)	12-18	—	18-24 24-30 30-36 Zone C Zone E
A-8	[Probably too mixed to use]			
A-9	0-6 6-12 Zone A	12-18	18-24 24-30 "crushed shell"	30-36 36-42 "clean shell"

Table 23 (continued)
Correlation of excavation units and analysis units, Gaulding site, 41JF27.

Excavation Units (depths in inches)	**Analysis Units**			
	Upper (A)	**Upper (B)**	**Middle**	**Lower**
A-10 **0-4** **6-12** —	4-6		—	
N285 trench (from W75-85)	Zone A	Zone B	Zone D	Zone E
B-1	0-6	6-12	12-18 18-24	24-30 30-36 36-42
B-2	0-6	6-12	12-18 18-24	24-30 30-36
C-1	—	0-6	6-12 12-18 18-24	24-30 30-36 36-42
Museum excav., all grid units	0-6	—	—	—
D-1	All probably corresponds to Upper (A)			

APPENDIX E: TERRESTRIAL GASTROPODS FROM THE 1965 EXCAVATION AT THE GAULDING SITE, 41JF27

by Kenneth M. Brown

A small collection of 57 land snails was studied, using Cheatum and Fullington (1971), Fullington and Pratt (1974), and Burch (1962) as the principal identification guides. No comparative collection for the Gaulding site area was available, although a small reference collection identified by Raymond Neck from Berger Bluff in Goliad County was available for comparison.

The Gaulding site collection appears to be unsystematic and heavily size-biased, and presumably consists of snails collected from the ¼ and ½ inch (6.3 to 12.6 mm) screen. Measurements were made with vernier calipers after Cheatum and Fullington (1971:Figure 1b); the notation N/M indicates a measurement was not possible. No specimens smaller than about 7 mm in diameter were recovered. Bulk sediment samples sieved through very fine mesh and floated ought to yield two or three dozen taxa of terrestrial and aquatic snails from this area, in contrast to the five or six large species that are represented here.

Recovery rates from similar habitats in nearby Chambers County show the kind of assemblage representation that might be expected when wet screening through medium-sized mesh is used. At least 14 taxa of land or freshwater snails were recovered from 41 CH 56 (Weinstein and Whelan 1987:Table 4-13), where only about 2% of the snails were recovered from the quarter-inch screen, the rest coming from eighth-inch or sixteenth-inch mesh (Weinstein and Whelan 1987:Table 4-14). Perhaps a dozen or so snail taxa were recovered from 41 CH 63 (Weinstein et al. 1989:Table 6-7), where the same mesh sizes were used.

DESCRIPTIONS

A-1 (0-6"), lot 1, N=1. Very small fragments of what appears to be a single *Oligyra orbiculata*.

A-2 (0-6"), lot 5, N=2. One *Polygyra cf. P. texasiana*, diameter 9.42 mm, height 5.00 mm, unbleached (modern?). One *Rabdotus dealbatus* adult, diameter 12.98 mm, height 21.18 mm.

A-5 (0-6"), lot 81, N=1. *Polygyra cf. P. texasiana*, diameter 9.52 mm, height 5.44 mm.

A-6 (0-6"), lot 16, N=4. One unidentified fragment. Three *Polygyra cf. P. mooreana*(?).

diameter (mm)	height (mm)
8.62	4.58 unbleached
8.10	4.30 unbleached
7.46	4.12

A-7 (0-6"), lot 12, N=1. *Mesodon sp.*, possibly *M. thyroidus*, but too incomplete for identification; fragments of a single specimen.

A-8 (no lot number, has notation "with oyster shell; Whitmeyer"), N=9. Four specimens of *Polygyra cf. P. texasiana*:

diameter (mm)	height (mm)
11.10	6.00
10.90	6.38
9.84	N/M
N/M	N/M

A minimum number of 5 *Mesodon thyroidus* (only 3 have intact apertures):

diameter (mm)	height (mm)
22.24	13.76
19.66	N/M

(remaining 3 are not measurable)

A-10 (0-6"), lot 98, N=1. One *Polygyra cf. P. texasiana*, diameter 9.94 mm, height 5.20 mm.

B-1 (0-6"), lot 106, N=2. One complete *Mesodon thyroidus*, diameter 20.88 mm, height 12.76 mm, and one fragmentary *Mesodon* that may be the same species but is too fragmentary for identification.

B-1 (0-6"), lot 112, N=1. One *Stenotrema leai aliciae*, diameter 7.06 mm, height 5.10 mm.

B-1 (0-6"), lot 113, N=1. One *Mesodon thyroidus*, diameter 19.88 mm, height 12.04 mm.

B-1 (6-12"), lot 21, N=6. Three taxa, including one *Rabdotus sp.* small adult, aperture fragment too incomplete for identification; two *Stenotrema leai aliciae* specimens:

diameter (mm)	height (mm)
7.26	4.60
6.92	4.82

and three *Mesodon thyroidus* specimens:

diameter (mm)	height (mm)
20.32	N/M
20.12	N/M
18.06	N/M

B-1 (6-12"), no lot number, N=3. One *Rabdotus dealbatus*, diameter 13.08 mm, height 22.08 mm. Fragments of at least two *Mesodon sp.* individuals, too incomplete for identification, but compatible with *M. thyroidus*.

B-1 (12-18"), lot 110, N=1. One fragmentary *Rabdotus cf. R. dealbatus*, diameter 13.58 mm, height N/M.

B-2 (0-6"), lot 43, N=14. Three taxa, including one *Mesodon thyroidus* specimen, diameter 18.44 mm, height 12.20 mm; eleven *Stenotrema leai aliciae* specimens:

diameter (mm)	height (mm)
7.42	4.98
7.42	4.78
7.40	5.00
7.32	4.88

7.26	5.02
7.18	4.86
7.14	5.00
7.10	4.76
6.98	5.12
6.90	4.42
7.36	N/M

and two *Polygyra cf. P. texasiana* specimens:

diameter (mm)	height (mm)
9.68	5.56
9.52	4.98

B-2 (6-12"), lot 2, N=1. *Mesodon cf. M. thyroidus*, fragmentary, not measurable.

C-1 (0-6"), lot 41, N=1. One *Polygyra cf. P. mooreana*(?), diameter 8.56 mm, height 5.38 mm.

C-1 (6-12"), lot 37, N=3. One *Mesodon sp.* individual, too fragmentary for identification. Two *Oligyra orbiculata*; these have minimally thickened lips (see Hubricht 1985:3).

COMMENTS

There appear to be six taxa present in this small collection. Although neither Hubricht (1985:Map 389) nor Cheatum and Fullington (1971:Figure 4) list *Polygyra mooreana* as occurring in Jefferson County, both list it as present in Galveston County. I have tentatively identified a few specimens as possibly *Polygyra mooreana*, based on smaller size, the shape and placement of the peristomal teeth, and in at least one case an umbilical furrow. If this identification is wrong, then the specimens are probably small examples of *Polygyra texasiana*, and there are instead five taxa present. Cheatum and Fullington (1971:17) and Pilsbry (1940:623, 624) describe an interior tubercle on the columella of *P. mooreana*, but I have seen no examples on these specimens. Hubricht (1985:37) remarks that in the eastern part of its range, the peristomal teeth of *P. texasiana* are spaced farther apart, as in *P. triodontoides* (see Pilsbry 1940:Figure 393), and that is certainly true of the Gaulding site specimens. Incidentally, neither Hubricht nor Fullington and Pratt show any species of *Rabdotus* as known from Jefferson County.

A few of the snails examined from the first six-inch excavation level (lots 5, 16) have dark, unbleached shells and do not appear to be very old.

It is surprising that no aquatic snails were recovered, even given the unsystematic recovery methods. The Chambers County sites mentioned earlier also produced relatively few aquatic taxa, despite the fact that water for wet screening was drawn from a shell-mining borrow pit and from Lake Charlotte. No filtration system for the water pump is mentioned. In my experience, unless the pump intake is carefully filtered, wet screen samples are often heavily contaminated with modern aquatic biota that survive the journey through the pump impeller intact. [The Chambers County wet-screening referred to was conducted with 1/16-inch (1.6 mm) mesh screen over the end of the intake hose (R. A. Weinstein, personal communication to L. Aten and C. Bolllich, 1999)]. Even so, few aquatic snails were recovered from those sites.

Hubricht lists *Oligyra orbiculata* and *Rabdotus dealbatus* as calciphile species, although in fact many of the species in the other genera are also characterized as "calciphile." Exactly what this means is unclear, since all snails need at least some calcium for shell construction. Possibly many of the snails in this collection were attracted to the *Rangia* shell midden as a ready source of calcium.

Polygyra texasiana, *Oligyra orbiculata*, and *Rabdotus dealbatus* are somewhat cosmopolitan snails and are fairly widespread in the eastern and southern parts of Texas. All three can range from prairie to woodland habitats. *Oligyra orbiculata* is often seen in weedy or grassy disturbed (disclimax) habitats. *Polygyra mooreana* prefers wooded areas. *Mesodon thyroidus* prefers deciduous floodplain woodlands but can live in meadows or marshes; it is widespread in the eastern United States. *Stenotrema leai* is perhaps the most mesic-adapted of these taxa, "a snail of damp places near the water" (Pilsbry 1940:678) in leaf litter or under logs, or in meadows. It is widespread in eastern North America; La Rocque (1970:Figure 420) shows it extending as far as New England. These latter three taxa would be especially compatible with the heavy closed-canopy forest present along Taylor Bayou.

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APPENDIX F: TERRESTRIAL GASTROPODS FROM THE 1995 BULK SAMPLING AT THE GAULDING SITE, 41JF27

by Richard W. Fullington

This appendix reports the identification and interpretation of the approximately 1,000 gastropod specimens recovered from 10 bulk samples. Aten and Bollich took these bulk samples in 1995 from profile B-1 (west). The sampling and the layer identification numbers are described in the main body of this report. All of the bulk samples were approximately the same volume (roughly 2,000 to 2,500 cc). Prior to their screening by Aten, each bulk sample was soaked for several hours in distilled water. During this soaking process, small gastropod shells floated to the surface and were skimmed off with an aquarium net. The soaking samples were repeatedly agitated until no additional gastropod shells could be recovered and the resulting snail samples were forwarded to me for analysis.

All of the specimens were terrestrial snail shells representing 6 taxonomic families. As assemblages, these taxa represent three habitat preferences (Table 24).

Riparian woodlands

Dense woodlands (usually mature trees) with moderate to thick leaf litter floor adjacent to streams or rivers; the soil generally is moist.

Hillslope woodlands

Heavy or sparse woods on sloping hillsides that usually are vertical extensions of riparian woodlands; however, there is usually less leaf litter and the underlying soil is dry during much of the year.

Mixed woodlands/open grassy areas

Open, grassy areas partially surrounded by trees and/or brush; may be sloping or flat; inhabited by more xeric tolerant molluscan species. Tabulation of species found in each Layer sample and any accompanying comments are given in Table 25.

DISCUSSION

Layers 10 (upper) and 10 (lower)

These uppermost layers contain the largest number of species (8) although the number of individuals per species is quite low when compared to the total number of individuals per species found in Layers 7, 8, and 9. The diversity of species suggests a very suitable climate (mild temperatures and increased annual rainfall). Dense and moist woodlands were adjacent to the site during this time period. The low number of individuals suggests that the site was actively occupied by humans and the snails were kept from coming in to the organic debris (trash heaps).

Layers 6, 7, 8, and 9

The relatively small number of species found through these layers suggests that the climate was more xeric than the climate through the overlying layers. However, the climate apparently was not greatly different because the same species are dominant in Layers 7 through 10 (upper). The large number of individuals suggests that humans, particularly on any long-term basis did not actively occupy the site. The snails had time to move into the site area. There is no evidence that these specimens were flood deposited (there would be a larger number of species and would most likely include bivalves). Layer 6 has only four species present while the numbers of individuals is similar to layers 7, 8, and 9.

Layers 4 and 5

The number of individuals significantly drops in Layers 4 and 5 although the number of species in Layer 5 is similar to the number of species in Layer 10. The number of species and individuals in Layer 4 is quite low. Layer 5 may have experienced a climatic change from relatively dry summers (xeric) and colder winter to a warmer and moister period.

Layers 2 and 3

The very low numbers of species and individuals found through these layers suggests a severe drying trend that ended in Layer 4. Increased acidification of the soil could also be a contributing factor. Shells in these layers were more decalcified (white, thin and chalky) than the shells found in the overlying layers (except Layer 4). However, shell dissolution does not account for the paucity of species.

TABLE 24
Gastropod taxa found at the Gaulding site (41JF27) and their preferred habitat

Taxa	Riparian woodlands	Hillslope woodlands	Mixed woodlands/ open grassy areas
Family Polygyridae			
Stenotrema leai alicia (Pilsbry)	XXX		
Family Helicinidae			
Helicina orbiculata tropica (Say)		XXX	
Family Zonitidae			
Zonitoides arboreus (Say)	XXX		
Hawaiia minuscula (Binney)			XXX
Glyphyalinia indentata paucilirata (Say)	XXX		
Family Pupillidae			
Gastrocopta contracta (Say)		XXX	
Gastrocopta pellucida hordeacella (Pilsbry)			XXX
Gastrocopta pentodon (Say)	XXX		
Pupoides albilabris			XXX
Family Strobilopsidae			
Strobilops texasiana (Pilsbry and Ferriss)	XXX		
Family Endodontidae			
Helicodiscus parallelus (Say)	XXX		

TABLE 25
Gastropod species, frequency, and comments by stratigraphic layer at the Gaulding site, 41JF2

Layer	Species	Frequency	Comments
10 (upper)	*Stenotrema leai aliciae*	7	adults
	Helicina orbiculata tropica	7	adults
	Glyphyalinia indentata paucilirata	1	adult
	Hawaiia minuscula	5	most are immature
	Zonitoides arboreus	3	adults
	Gastrocopta pellucida hordeacella	8	adults
	Gastrocopta contracta	9	adults
	Strobilops texasiana	4	sub-adults
	Sub-total	44	
10 (lower)	*Stenotrema leai aliciae*	1	adult
	Hawaiia minuscula	8	most are immature
	Sub-total	9	
9	*Zonitoides arboreus*	29	most are immature
	Hawaiia minuscula	168	most are immature
	Helicodiscus parallelus	16	most are immature
	Sub-total	213	
8	*Helicina orbiculata tropica*	1	sub-adult
	Zonitoides arboreus	59	most are immature
	Hawaiia minuscula	134	most are immature
	Helicodiscus parallelus	38	most are immature
	Sub-total	232	
7	*Zonitoides arboreus*	19	most are immature
	Hawaiia minuscula	142	most are immature
	Helicodiscus parallelus	65	most are immature
	Gastrocopta contracta	1	adult
	Sub-total	227	

Table 25 (continued)
Gastropod species, frequency, and comments by stratigraphic layer at the Gaulding site, 41JF2

Layer	Species	Frequency	Comments
6	*Helicina orbiculata tropica*	1	sub-adult
	Zonitoides arboreus	27	most are immature
	Hawaiia minuscula	116	most are immature
	Helicodiscus parallelus	23	most are immature
	Sub-total	167	
5	*Zonitoides arboreus*	5	sub-adults
	Hawaiia minuscula	28	most are immature
	Helicodiscus parallelus	14	most are immature
	Pupoides albilabris	3	adults
	Gastrocopta pellucida hordeacella	4	adults
	Gastrocopta pentodon	6	adults
	Sub-total	60	
4	*Zonitoides arboreus*	19	most are immature
	Hawaiia minuscula	25	most are immature
	Helicodiscus parallelus	8	most are immature
	Sub-total	52	
3	*Zonitoides arboreus*	3	sub-adults
	Hawaiia minuscula	12	most are immature
	Strobilops texasiana	1	sub-adult
	Sub-total	16	
2	*Hawaiia minuscula*	4	sub-adults
	Sub-total	4	
	Site total	**1024**	

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