5 Significance of Geomorphology to Cultural Resources

Introduction

Objectives

The last and most important objective of this study was to determine the archaeological significance of the geomorphic features, especially in terms of locating previously undiscovered sites. The major goals of this objective are as follows: identify and define the principal archaeological site/landform associations and classify the landforms according to their site potential; provide guidance for locating sites that are of specific ages or cultural components; and identify areas that have high potential for site destruction or preservation by natural geomorphic processes.

The approach that was used to define the relationships between known archaeological sites and geomorphic features involved identifying the known archaeological sites, evaluating the geomorphic site data from the recorded sites, and identifymg important characteristics that relate the archaeological sites to the geomorphic features. These characteristics were then evaluated to predict the locations of undiscovered sites according to their geomorphic context.

It is important to emphasize that the primary purpose of this analysis is to show general relationships between the various landforms that comprise the study area and the archaeological sites contained within this area. This study is not meant to be an archaeological analysis.

Procedure

Archaeological site data were obtained from the Environmental Resources Branch (PD-Q), CELMK. Site data consisted of published reports for Texas (Gibson 1969, Peter and Stiles-Hanson 1990, and Thurmond 1990) and the archaeological site records from the Louisiana Computerized Archaeological

Database (LA-CAD) for Caddo Parish in Louisiana. The Louisiana site data is part of the database maintained by the Division of Archaeology of the Louisiana Department of Culture, Recreation, and Tourism.

There are 92 known archaeological sites in the project area. Ten sites are historic sites and were not used for determining archaeological and landform relationships. For the remaining 82 sites, important archaeological and geomorphic characteristics were derived from the site descriptions and the geomorphic maps. Characteristics that were compiled from the geomorphic maps and site descriptions include site number and quadrangle map, river mile location, site drainage basin, site elevation, site type, kinds of artifacts (i.e. lithic scatter, ceramics, historic debris, etc.), cultural component(s), and landform type. The catalogue of all known sites is presented in Appendix F. Because of their sensitivity, the locations for the known archaeological sites are not individually identified in Appendix F or on the geomorphic maps.

The accuracy of the known site locations is often open to debate. Every effort was made in this study to use only sites that are judged to be located correctly. However, known sites were not field checked for their location. Site locations were plotted on base maps and compared to the site descriptions. If there was a doubt about the site location, then the site was not used in this study. The site catalogue is utilized with a full understanding that it may contain inaccurate site locations and site information. Ideally, a field verified archaeological site database is preferred and is recommended.

Archaeological site definition

An archaeological site is defined by Willey and Phillips (1958) as the smallest unit of space that marks the location of a single unit of settlement and is usually covered with artifacts or components indicating former occupation. The physical limits of a site may vary from a few square meters to many square kilometers. An archaeological site for purposes of this study is simply a location where artifacts have been found. The definition of a site as used in this study does not differentiate on whether settlement has occurred as in the definition by Willey and Phillips. There are no restrictions placed on the usage of the term “archaeological site” in this study. A site can be a location where settlement has occurred, or it can be a location that was occupied only once and artifacts were left.

The reason for adopting a nonrestrictive definition is due to the nature of the archaeological site data. The archaeological data from the project area consist of site reports that are more than 50 years old to recent reports. The site data vary from brief descriptions to detailed reports. Often times the site locations and other kinds of important information in the site descriptions are missing or the data are wrong. In addition, it is possible for a single large site to be represented in the record as multiple sites that were recorded at different times by different individuals or organizations.

The primary objective of using the archaeological site data is to show the general relationships between the prehistoric sites and the landforms It will be left to the archaeologists to interpret information about the site beyond its geomorphic characteristics, eliminate sites where duplicate listings occur, combine sites on the individual landforms that contain duplicate sites, or remove sites that are judged to be located inaccurately. It is important to emphasize that the site catalogue has not been field checked and it probably contains some erroneous data. Basic trends are defined about the landforms by the archaeological site data in this section of the report. Illustrations have been prepared from the catalogue in Appendix F, specifically about site-landform distributions.

Characteristics of an archaeological site

The artifacts that make up the archaeological site have by their distribution and position within the site certain temporal and spatial qualities. These qualities are defined by the geographic, stratigraphic, and the ethnographic characteristics of the artifacts (Gould 1987).

The stratigraphic and geographic characteristics describe physical qualities about the site itself. The geographic characteristics describe the spatial context between the artifacts and their relationships to other artifacts and their environment. The stratigraphic characteristics define the temporal or chronological order of the artifacts and relate these characteristics to the site occupation. Defining the geomorphic setting of the site is an important first step in evaluating the geographic and stratigraphic characteristics of the site.

This study describes mainly the geographic (environmental or geomorphic) characteristics of the known archaeological sites. The identification of the site geomorphology is important to understanding the overall site archaeology, since the different landforms are dominated by certain types of geomorphic processes. These different kinds of processes will affect or control the distribution of the archaeological sites and the associated artifacts.

Stratigraphic or chronological characteristics of individual archaeological sites are not fully addressed by this study. The geomorphic analysis provided by this investigation will provide a general stratigraphic or chronological framework to evaluate the individual sites. A more detailed evaluation of individual sites will require the acquisition and analysis of further soil borings on the landforms upon which the individual sites are located. These soil borings will identify important sedimentological and soil forming characteristics and may provide datable materials for further determining chronologic boundaries.

The last major criteria of an archaeological site are the ethnographic characteristics. These characteristics are determined by the archaeologist. The ethnographic characteristics of the artifacts and the site are concerned with the human qualities of the site. Ethnographic characteristics relate the human occupation to their associated activities and to the different types of cultures.

However, before the ethnographic characteristics can be fully understood, the geographic and stratigraphic characteristics must be fully defined and evaluated.

Distribution of Known Archhaeological Sites

Drainage basin

The known prehistoric archaeological sites (total of 82 sites) were evaluated according to drainage basin reach as shown by Figure 10. Sites are generally evenly distributed except for the Big Cypress Bayou reach of the study area. The distribution suggests that a detailed cultural resource survey has not been conducted for this reach. The Big Cypress Bayou reach accounts for approximately 25 percent of the land area contained in the study area. The largest concentration of sites are associated with and border Lake O' the Pines and Caddo Lake. This concentration is more a function of the number and quality of surveys performed in this area rather than a preference by the different cultural components.

Landforms

The distribution of prehistoric sites as a function of the different landforms in the study area on which the sites are located is presented in Figure 11. Approximately 60 percent of the known prehistoric sites are located above the floodplain on terraces or valley slopes. The remaining 40 percent of the sites are associated with the floodplain of the various fluvial systems which form the study area. Three sites are located within or beneath Lake 0' the Pines and Caddo Lake.

The majority of floodplain sites are located upon the natural levees or point bars adjacent to abandoned channels and courses. Geomorphic mapping did not identify natural levee limits in the study area, since this environment is so widespread. Instead, the underlying fluvial environment was mapped as the principal landform type. Known prehistoric sites are primarily located upon point bars adjacent to the present channel or on the PB2 surface. The majority of floodplain sites are derived from Twelvemile Bayou and the Red River valley as shown by the site catalogue in Appendix F. As indicated by Figure 10, there are not many sites identified in the Big Cypress Bayou reach. Lack of sites on the PB2 surface in the river reach may be due, in part, to site burial by vertical accretion of sediment and/or the absence of detailed surveys in this area.

Lake shorelines

Sites associated with lake shorelines may provide additional evidence for the age of Caddo and Soda Lakes. Locations of the known Caddo

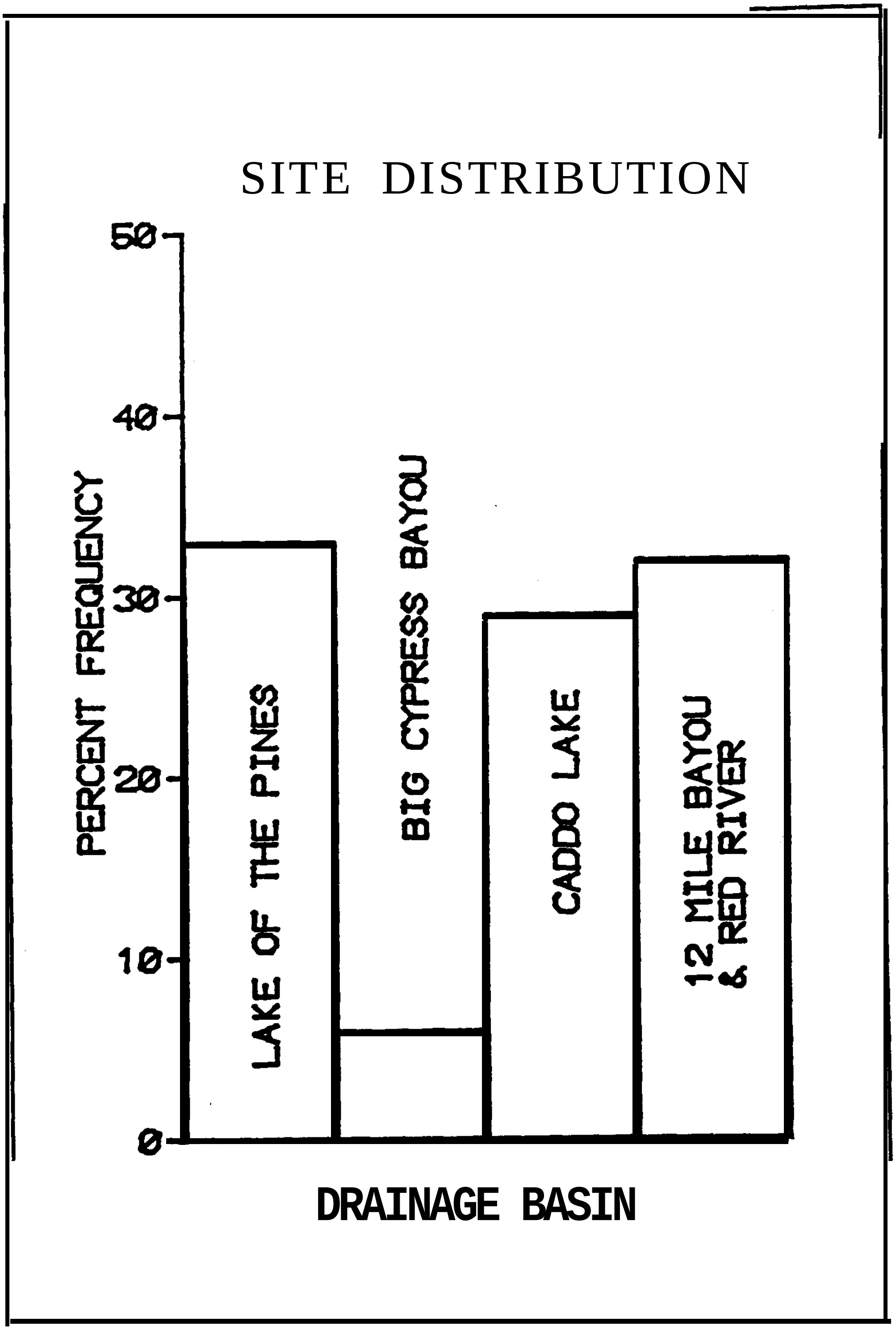


Figure 10. Distribution of archaeological sites based on drainage basin. Total number of reported prehistoric sites in study area is 82

archaeological sites are compared to the historic lake limits for Caddo and Soda Lakes in Figure 12. Only Caddo Indian sites were selected for the comparison, since the Caddo culture is within the time limits interpreted for the lake development. The Caddo culture ranges from approximately 200 BC

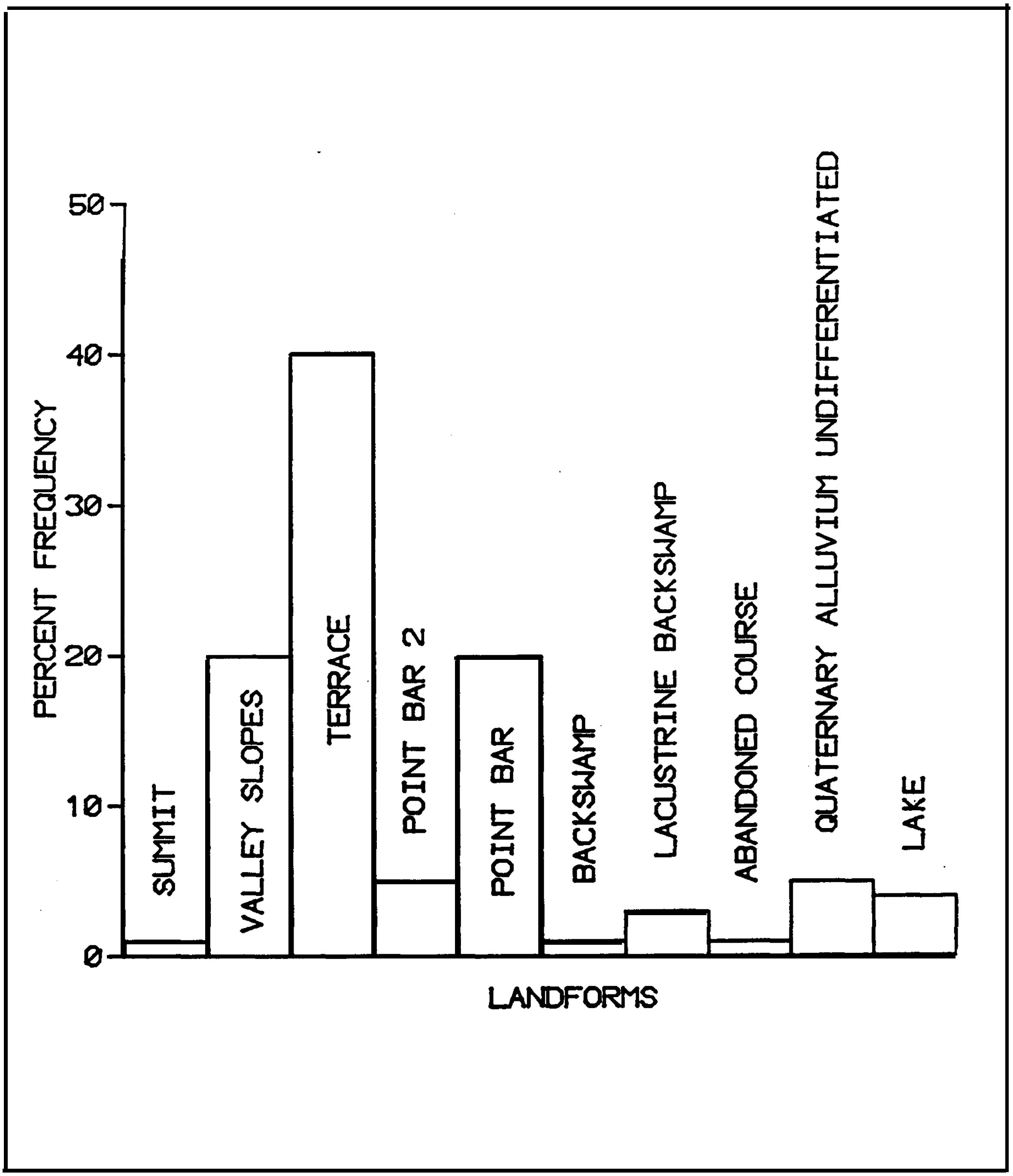


Figure **11. Distribution of all known archaeological sites based on landform**

to 1700 AD. Archaic sites were not used in the comparison, since these sites predate the earliest possible formation of the lake. Archaic sites in the southeastern United States generally range from approximately 10,000 years ago to 200 BC. Historic lake limits are based on the work by Kidder (1914) for Caddo Lake and the 1838-39 lake limits identified by Veatch (1906) in Figure 9a for Soda Lake. The site distribution identified by Figure 12 indicates that a correlation may exist between Caddo sites and the historic lake shorelines.

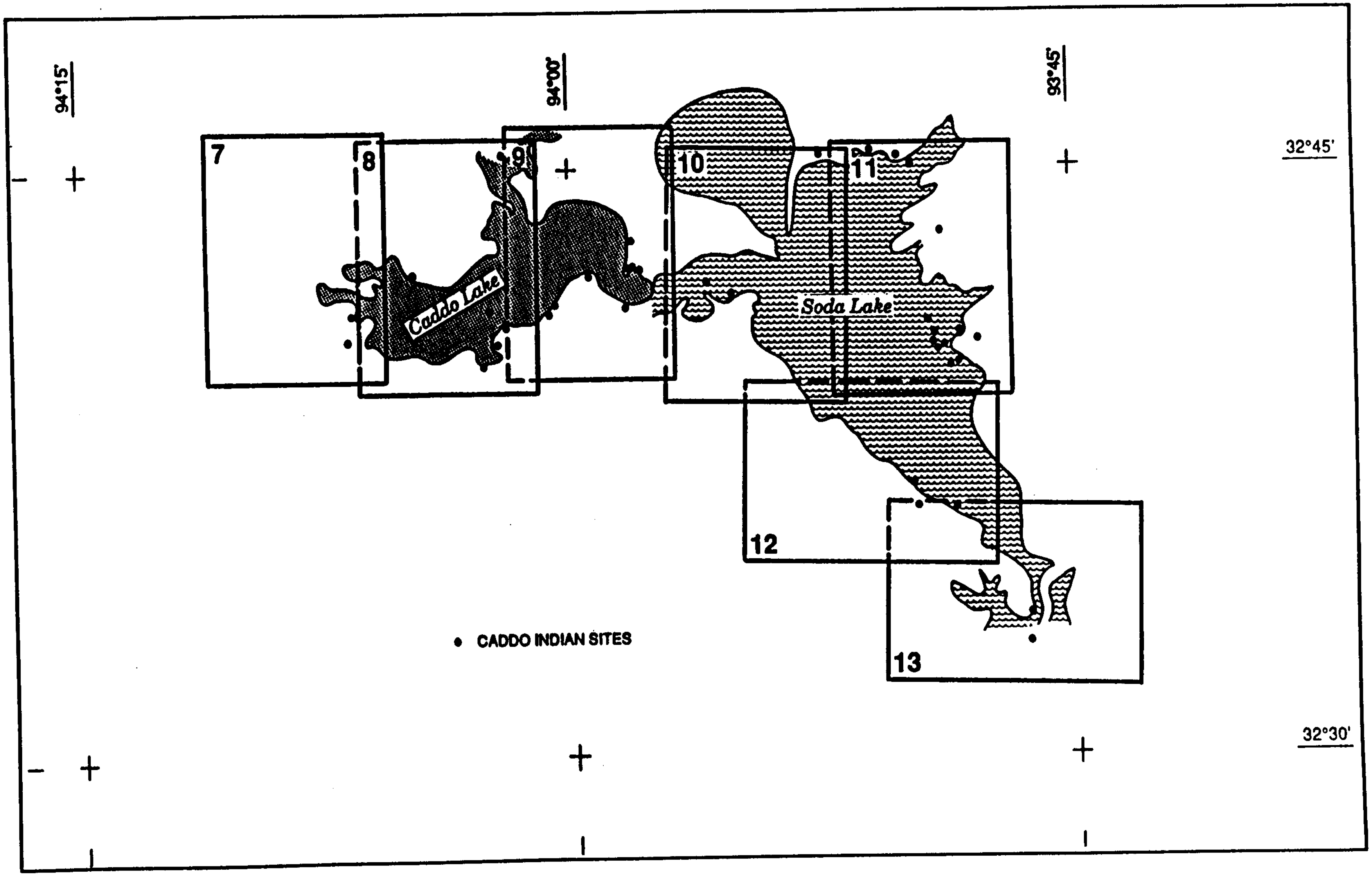


Figure 12. Distribution of Caddo archaeological sites along the historic shoreline of Caddo and Soda Lakes. Historic lake limits are from Kidder (1914) for Caddo Lake and from Veatch (1906) for Soda Lake (Figure 9a)

Lake limits for Soda Lake in Figure 12 were transferred to the geomorphic base maps and the archaeological sites located according to their position to the 1838-39 shoreline. Lake limits in Figures 9a and 12 are believed to be near their maximum at this time, since Captain H. M. Shreve, tasked with removing the raft, had only cleared to Shreveport by 1838 (Mills 1978). Sites in Soda Lake and adjacent to the Red River in Figure 12 (area of Plate 11) may not have been submerged, since these sites are associated with natural levees of an abandoned channel complex. This area would have been higher ground and may not have been flooded except possibly during seasonal flooding. The shoreline distribution of archaeological sites around Caddo Lake suggests that the lake complex was established during Caddo time.

An alternative explanation to the shoreline distribution is that the lake margin sites are not related to the lake complex but relate to the previous floodplain surface. Flooding inundated the study area because of the Red River Raft and drowned the existing prehistoric sites that were present. Lake margin sites are therefore not related to the lake complex but relate to the previous floodplain. The absence of sites in the lake is due to lacustrine sedimentation and burial of the existing floodplain and associated sites.

Closer examination of this latter explanation may, in fact, be partly true as early Caddo sites would have been inundated by the formation of the lake complex. Available data suggest that the lake complex is less than 500 years old. Consequently, sites associated with the Caddo culture between 200 BC and approximately 1200 to 1500 years AD, prior to lake formation, would have been flooded by the advent of the raft, providing there were sites at these locations. LMK has calculated that it would require 2.45 years to fill Caddo Lake to the present level, assuming total damming of the river, normal rainfall, and a dry lake bed (Cool 1992). Assuming similar conditions for the entire Caddo-Soda lake complex, it probably would have taken less than 10 years to form. This estimate is highly improbable, since a sudden complete blockage of river flow would have been unlikely. Rather, the blockage would have begun on the lower Red River and taken several decades to migrate upstream. The entire process may have taken 50 to 100 years to complete. The exact time required to form the lake complex may never be known, but the filling framework was short enough that prehistoric settlements were more than likely forced to move to higher ground and settlements began forming along the lake shoreline. It is highly probable that lake formation flooded prehistoric sites that were present beneath the historic limits of Caddo and Soda Lakes.

Elevation, flood frequency, and site location

The distribution of the known archaeological sites as a function of elevation, flood frequency, and their approximate river mile location above Shreveport is shown in Figure 13. Tributary sites distant from the central axis of the valley profile are not shown (i.e. Red River sites in the northern part of the study area). Only sites within the main valley of the study area are identified

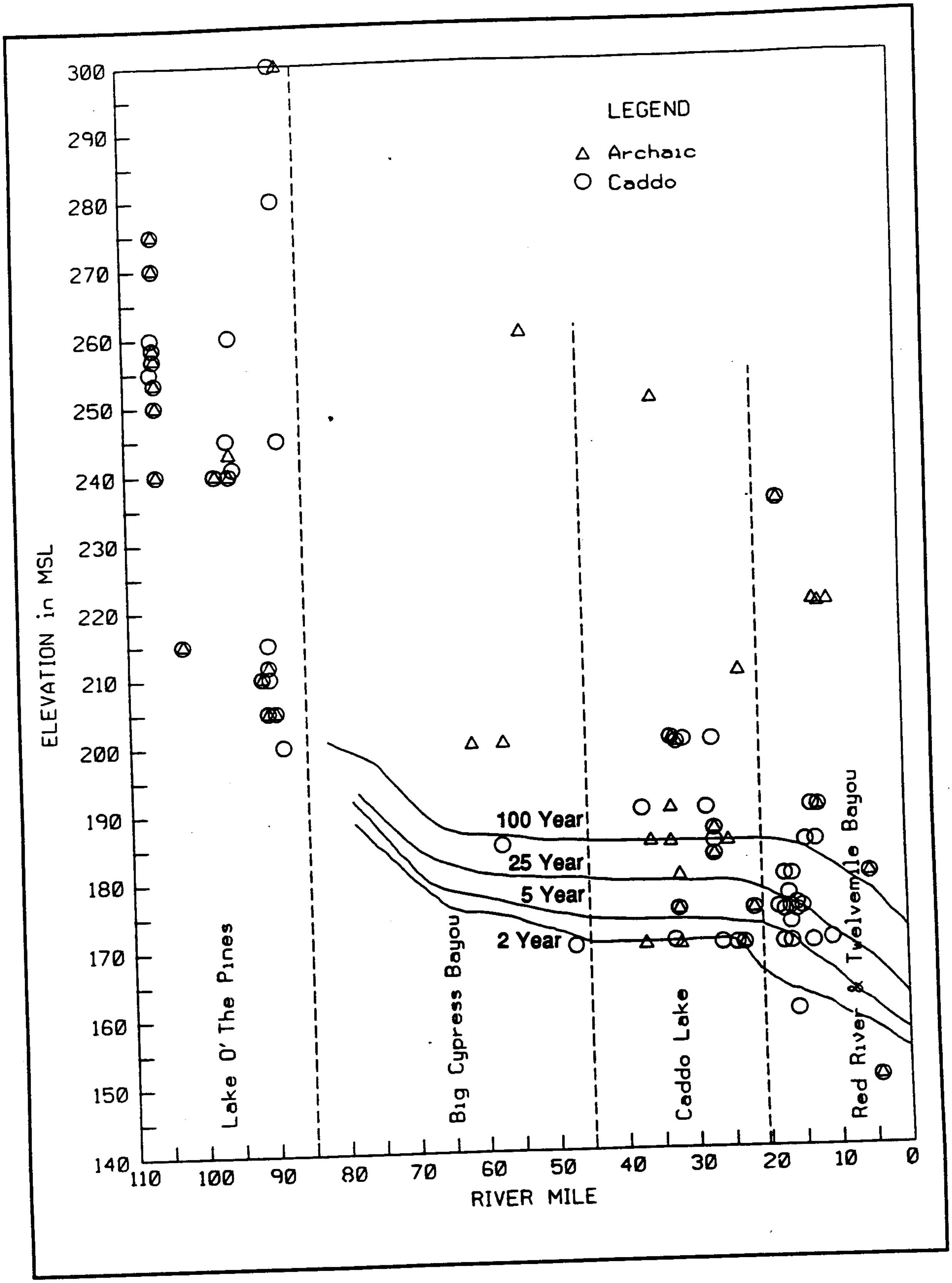


Figure 13. Distribution of archaeological sites in project area as a function of elevation, flood frequency, cultural component, and distance above Shreveport, LA

in Figure 13. The vast majority of sites are located above the minimum pool level or the 2-year flood frequency.

Archaeological sites are not uniformly distributed throughout the project ares as shown by Figure 13. There are fewer sites identified for the Big Cypress Bayou segment. Higher site concentrations along adjacent drainage segments are attributed to a higher intensity of cultural resource surveys in these areas.

Distribution of cultural components

Available archaeological site data for the purpose of this study were divided into three cultural component types: Archaic, Caddo, or Historic. Historic sites were not evaluated in this study since prehistoric sites are the primary focus of this investigation and because other factors may govern the distribution and occurrence of historic sites. Historic sites are best defined and evaluated by conducting a detailed historic assessment and inventory of the study area. A historic site assessment and inventory is beyond the scope of this study.

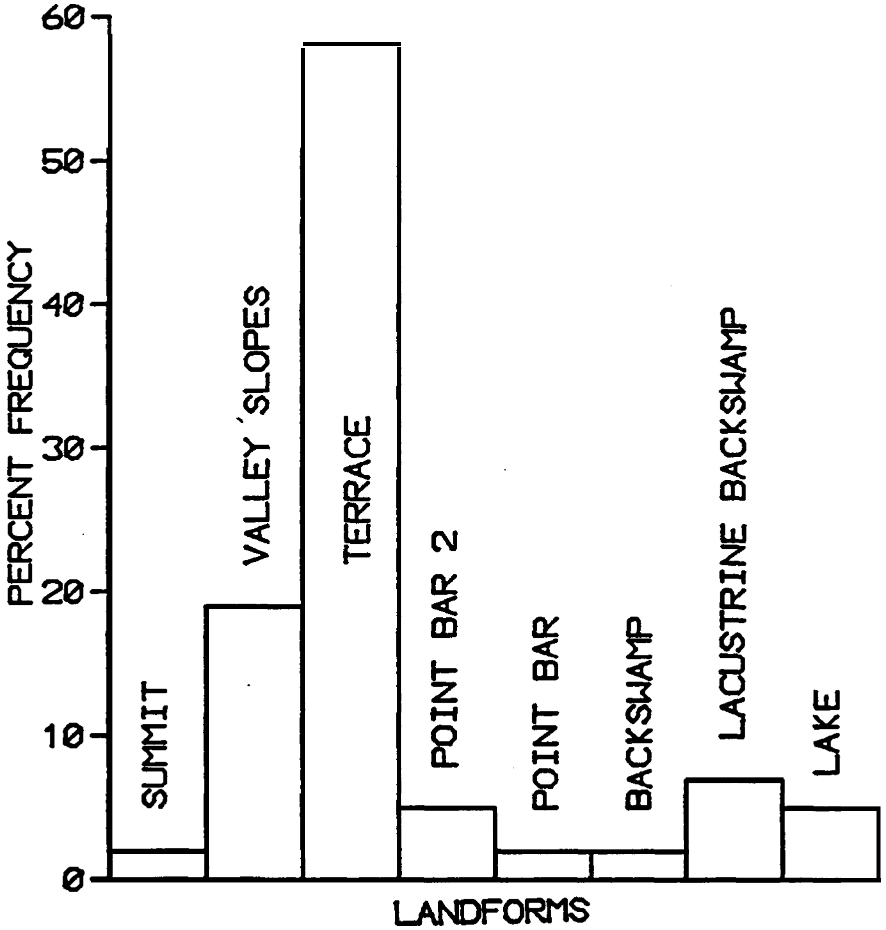
The distribution by cultural components in Figure 13 indicates that sites generally contain multiple occupations. Sites that identified multiple occupations were considered to be both an Archaic and a Caddo site.

Archaic sites are located primarily on terrace surfaces and valley slopes as shown by Figure 14a. Approximately 80 percent of the known Archaicsites are located upon these surfaces. The remaining sites are located primarily on the floodplain. Lack of sites upon the floodplain may be due in part to site burial by vertical accretion or because the landform age is to recent.

A positive correlation has already been determined to exist between historic Caddo and Soda Lake shorelines and Caddo sites. The distribution of Caddo sites according to other landforms is presented in Figure 14b. Caddo sites are concentrated primarily on valley slopes, terraces, and point bars adjacent to the present floodplain. These three landforms account for approximately 75 percent of the known Caddo sites.

Prediction of Site Occurrence

The distribution of the known archaeological sites as identified in the preceding illustrations indicates that sites are not random, but are clearly associated with specific landforms in the project area. Geomorphic relationships identified for the known sites can be used to locate and interpret previously undiscovered sites and guide the subsequent archaeological analysis of the individual sites and the entire study area. Geomorphic relationships identified by this study should help to improve the efficiency of later cultural resource investigations in the project area and maximize the results obtained.



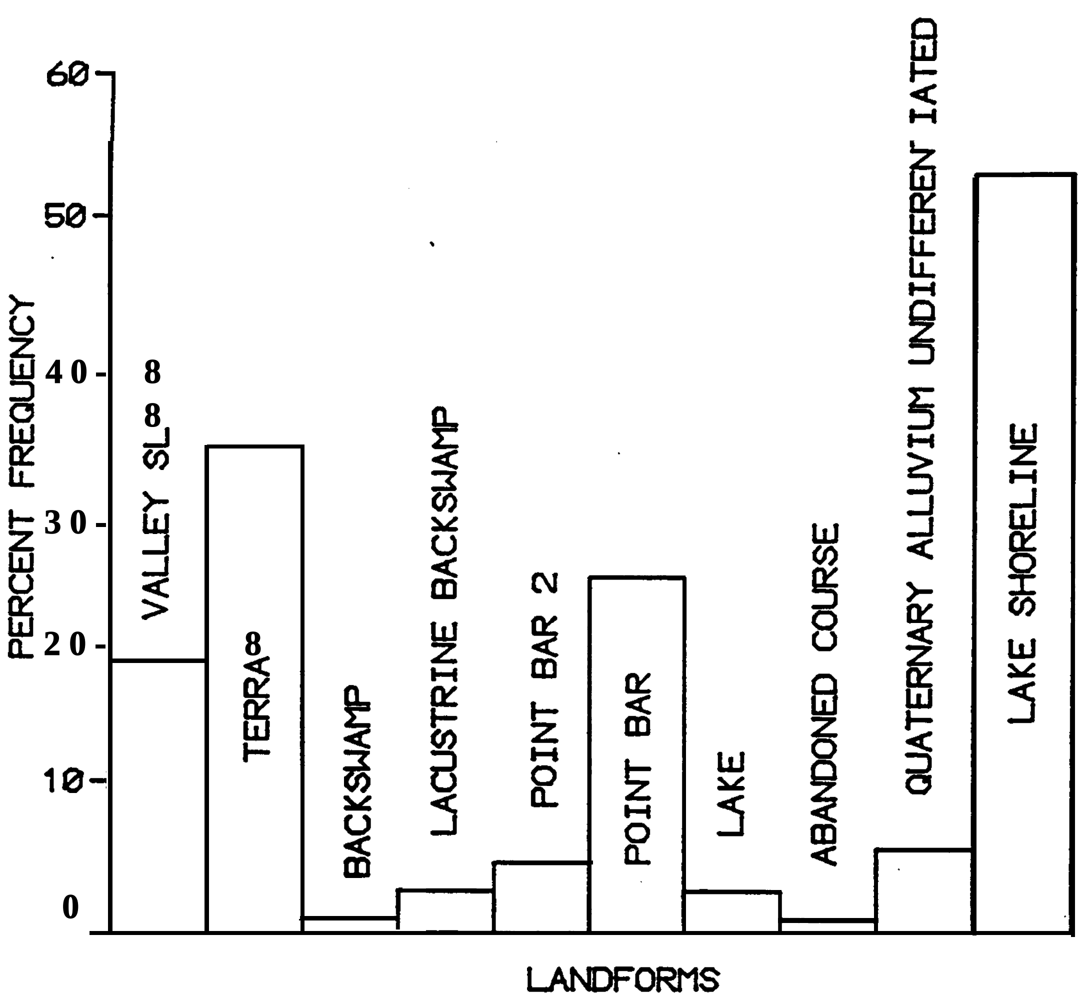
a. **Archaic sites**

Figure 14. Distribution of Archaic and Caddo archaeological sites by landform (Continued)

In addition to locating undiscovered sites, geomorphic relationships will aid the archaeologist in defining the ethnographic site characteristics.

Terraces have the highest site potential of all the landforms identified by this study. Forty percent of all the known Caddo and Archaic sites are located upon terraces (Figure 11). In addition to the terraces, Caddo sites are concentrated along the natural levees of point bars within the present floodplain and along the shorelines for historic Caddo and Soda Lakes.

Artifacts are most likely to be encountered on terraces and the natural levees of abandoned channels associated with the present floodplain course (i.e. PB surface). Artifacts may be located either on these landform surfaces or as part of the sediments that form these landforms.



). Caddo sites

Figure 14. (Concluded)

Lack of sites upon the older point bar (PB2) surface may be due to vertical accretion of sediment and/or the lack of adequate cultural resource investigation on this surface. The PB2 surface in the Big Cypress Bayou segment is probably the least surveyed part of the study area. Geomorphic data indicates that possibly some abandoned channels and courses comprising this surface may possibly have formed during the early Holocene or late Pleistocene. Archaeological site data may provide additional evidence to the age of the various floodplain components.

Site Preservation and Destruction

Introduction

In the Shreveport to Daingetfield project area, a number of processes are or have been at work either preserving or destroying the evidence of prehistoric groups. Most evident of these processes are the result of historic man, such as cultivation of the soil, timbering, construction of roads, buildings, and dams, and removal of the Red River Raft. However, natural processes have also played a key role in the preservation or destruction of the archeological record. Some geomorphic processes, such as lacustrine sedimentation or fluvial sedimentation, may serve to preserve the record through burial. Erosional processes may destroy sites by redistribution or destruction of the surfaces where sites occur. In the following paragraphs, the archeological significance of several processes are discussed, including fluvial sedimentation, chemical weathering, fluvial scouring, and wave attack from fluctuating lake levels.

Fluvial sedimentation and site preservation

An understanding of fluvial sedimentation rates is important in evaluating artifact decay and preservation characteristics. Knowledge about sedimentation rates is also important in understanding the stratigraphic or chronological significance of the archaeological record. Rapid sedimentation will promote the preservation and superposition of artifacts and features that result from serial occupation of sites (Figure 15 (Ferring 1986)). In contrast, slow sedimentation rates will result in the accumulation of archaeological debris as mixed assemblages and increase the potential for artifact decay by chemical and physical causes.

It is therefore important to understand, at least in general terms, local sedimentation rates to address the potential for site preservation and the types of sites that will be preserved. Sedimentation rates in the project area were interpreted from geomorphic evidence and are based on field observations and laboratory analysis of the available data.

Geomorphic Evidence and Archaeological Significance of Sedimentation Rates

Geomorphic evidence and sedimentation model

Geomorphic mapping and laboratory data were the principal means of determining sedimentation rates in the study area. The various types of evidence used to determine sedimentation rates are presented in Figure 16

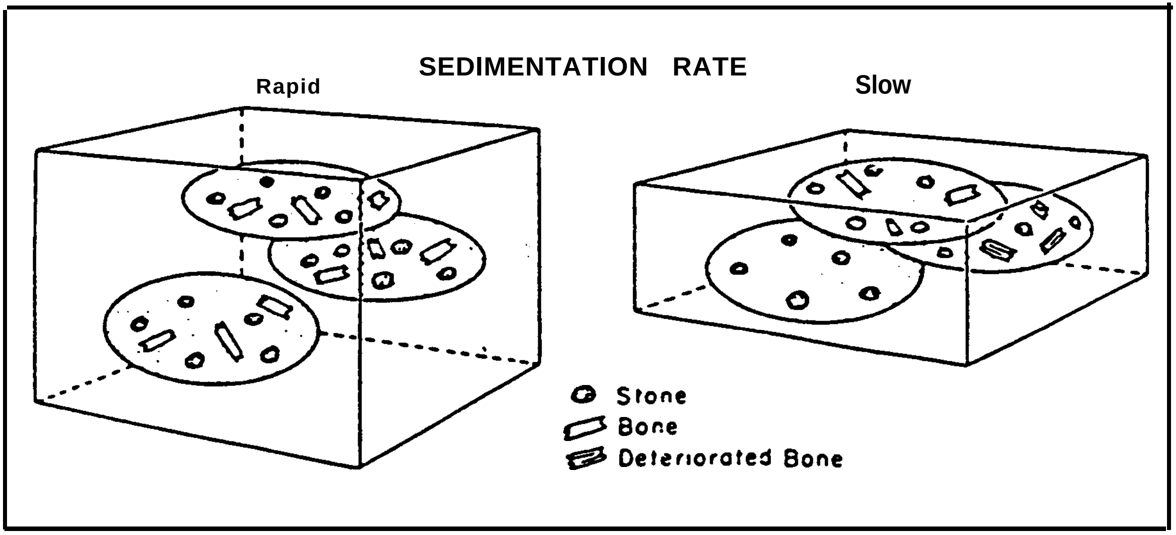


Figure 15. Sedimentation model contrasted between settings with rapid and slow accumulation rates. With rapid sedimentation rates, note better preservation and superposition of artifacts (from Ferring 1986)

(Ferring 1986). Types of evidence include sedimentary structure, soil profile development, bioturbation, and fossil preservation. The types of evidence shown by Figure 16 and a general knowledge of the different processes operating within each landform make it possible to estimate sedimentation rates for the landforms identified in Table 2.

Sedimentation rates in the study area must be considered in terms of the present day and when Caddo Lake was formed. Erosion and sediment transport are occurring throughout the project area. Sediment deposition is judged to be high in the lake and headwaters area of Caddo Lake and Lake 0' the Pines. Sedimentation rates on the Red River floodplain are also considered to be high, estimated at approximately 3 ft (1 m) per 1,000 years (Smith 1982). In addition, sedimentation rates are higher here because the Red River Raft accelerated the aggrading of the Red River floodplain by adding 3 to 4 ft (0.91 to 1.22 m) of lacustrine sediment during the past 500 years. In contrast, the lowest sedimentation rates occur on the terraces and areas removed from semiannual flooding. Valley slopes and summits are mainly locations of weathering and erosional processes. Sedimentation rates on terraces are intermediate between rates on summits and hill slopes and the higher rates on the floodplain.

The site preservation and destruction characteristics of the different iandforms, as a function of sedimentation, are evaluated for different types of archaeological artifacts in Table 2. The artifacts examined in Table 2 are animal bones, shell, charcoal, ceramics, crystalline lithics, and granular lithics. The different landforms were evaluated according to their ability to enhance preservation or accelerate decay. The interpretations made in Table 2 are based on the deterioration of archaeological sites primarily by chemical weathering in a humid environment with the main preservation influence by burial from fluvial sedimentation as indicated by the model in Figure 14.

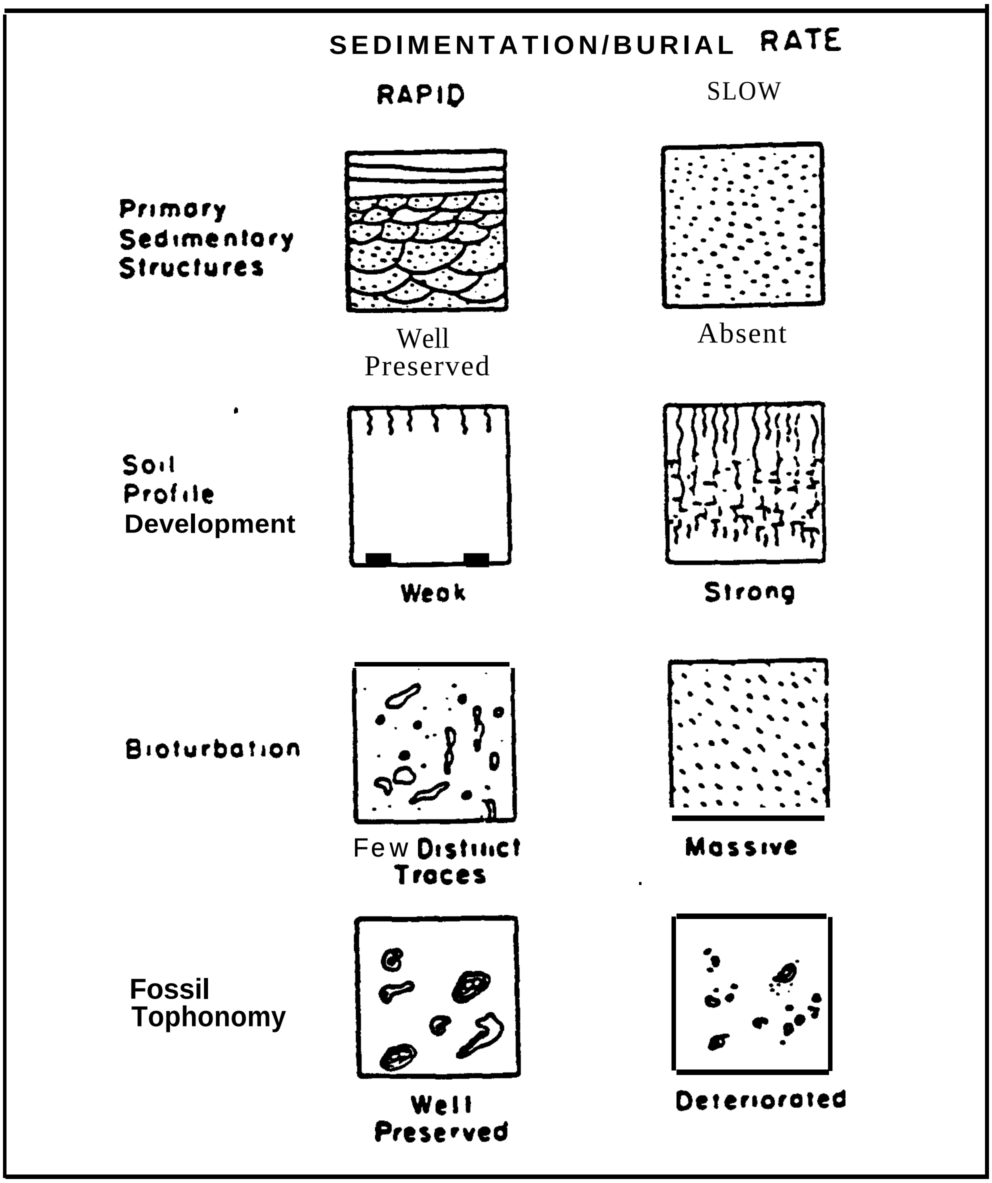


Figure 16. Geomorphic evidence of sedimentation rates (from Ferring 1986)

Discussion

Preservation and destruction qualities of landforms are site dependent and are based on a number of interdependent variables. These variables include soil pH, soil moisture, wet aerobic or anaerobic environments, types of micro-organisms and macro-organisms present, sediment movement, and soil loading. The relationships between these variables are very complex. They can vary slightly and result in different decay properties for the different artifact types. Hamilton (1987), Steele (1987), and Vaughn (1987) describe the effects that each of these variables has on artifact deterioration in archaeological sites. The majority of artifacts identified in the archaeological site

Table 2
Geomorphology of the Big Cypress Drainage Basin Project Area

Surface	Landform - Formation	Age[1]	Geomorphic Process[2]	Rate[3]	Archaeological Artifacts[4]					
					AB	SH	CH	CE	CL	GL
Floodplain	Point bar (PB)	H	LA	M-R	B	B	B	B	N	N
	Point bar (PB2)	H-P	LA-VA-BT-SF	M	B	B	B	B	N	B
	Lacustrine delta (LD)	H	LA-VA	M-R	E	E	A	E	N	N
	Abandoned course (ACO)	H-P	VA-LA	M	E	E	A	E	N	N
	Abandoned channel (AC)	H	VA-LA	M	E	E	A	E	N	N
	Tributary alluvium (QAL)	H	VA-LA	M-R	A	A	A	A	N	N
	Lake shoreline	H	E-WW	none	A	A	A	A	A	A
Terrace	Abandoned floodplain (QTD and QTU)	H-P	SF	L	A	A	A	A	N	N
Valley slopes	Tertiary geology Clairborne, Wilcox, and Midway groups	T	E-SF	L	A	A	A	A	N	N

[1] Age: H = Holocene, P = Pleistocene, T = Tertiary.
[2] Geomorphic process: VA = Vertical accretion, LA = Lateral accretion, SF = Soil forming processes (Pedogenesis), BT = Bioturbation (organic mixing by vegetation an organisms), E = Erosion, WW = Wave wash.
[3] Rate of deposition: Low, M = Medium, R = Rapid.
• Archaeological artifact: AB = animal bones, SH = shell, CH = charcoal, CE = ceramics, CL = crystalline lithics, GL = granular lithics, A = accelerates decay, E = enhancer preservation, B = both; may accelerate decay or enhance preservation, N = neutral or no effect.

descriptions (Appendix F) are lithics. These artifacts are least affected by chemical and physical weathering as shown by Table 2.

Chemical weathering promotes the decay of bone, shell, charcoal, and pottery. Stone artifacts are not affected. With increasing sedimentation and burial, artifact preservation is greatly enhanced as burial reduces the rate at which chemical weathering occurs. Archaeological sites are most threatened on the summits and on the side slopes where sedimentation rates are very low or where erosion is the dominant process.

Archaeological sites are more likely to be protected adjacent to or near the main channel where maximum sedimentation and burial occurs. Sites that are in close proximity to the main channel and not in the direct path of lateral migration by the river are buried by vertical accretion. Vertical accretion is presently an important mechanism for sedimentation in the lakes and headwaters portion of the project area. In the headwaters area, the former floodplain has been buried by lacustrine and lacustrine delta sedimentation.

Other factors to be considered in a discussion of artifact preservation and decay for geomorphic systems include flooding effects, groundwater movements, fluvial scouring, and wave wash. Lake or reservoir flooding can accelerate artifact decay by altering the chemical and physical processes normally operating. Artifacts may be affected by groundwater movements and associated chemical reactions between the groundwater. Terraces are especially affected by groundwater movements as they are composed primarily of unconsolidated sediments and are hydraulically connected to the main channel. The consequences of lake and reservoir flooding have been to increase the probability of fluvial scouring to areas above the normal floodplain and to increase the frequency and magnitude of changes to the groundwater levels in terrace soils. Other indirect and potentially adverse effects of reservoir flooding on archaeological sites include wave wash (wind and boat traffic) and riverbank caving following a rapid pool drawdown.

There are no strict rules governing archaeological site preservation or destruction as a function of the respective landforms and associated geomorphic processes. Various trends or generalizations have been identified above which can be used as guidelines in evaluating the archaeological significance of the different landforms Specific areas or individual archaeological sites should be examined and evaluated on the merits of each site.