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The Southern Texas Archaeological Association

The Southern Texas Archaeological Association brings together persons interested in the prehistory of south-central and southern Texas. The organization has several major objectives: To further communication among avocational and professional archaeologists working in the region; To develop a coordinated program of site survey and site documentation; To preserve the archaeological record of the region through a concerted effort to reach all persons interested in the prehistory of the region; To initiate problem-oriented research activities which will help us to better understand the prehistoric inhabitants of this area; To conduct emergency surveys or salvage archaeology where it is necessary because of imminent site destruction; To publish a journal (*La Tierra*), newsletters, and special publications to meet the needs of the membership; and to assist those desiring to learn proper archaeological field and laboratory techniques for southern Texas.

STAA Officers and Staff 2006

Information for Contributors

The co-editors of *La Tierra* 33 are Thomas R. Hester and Harry J. Shafer. Original manuscripts should be sent to Hester (Thomas R. Hester, P.O. Box 625, Utopia, TX 78884). Submissions by email should be sent to Hester (secocreek@swtexas.net) and copied to Shafer (hshafer@satx.rr.com). New authors, or authors with questions, can contact either Hester and Shafer for assistance in developing and submitting their papers. We welcome papers on the archeology of South Texas and surrounding areas, and we will also consider relevant papers from other parts of Texas.

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About the cover: View of Excavations in the Mission Indian Quarters at Mission San Bernardo, Guerrero, Coahuila.

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Notes on South Texas Archeology 2006: In Memoriam—Thomas Nolan Campbell, 1908-2003

Thomas R. Hester
with the assistance of Samuel Wilson and Mariah Wade

Thomas Nolan Campbell, Professor Emeritus of Anthropology, died on October 15, 2003 at the age of 95. He served on the faculty of The University of Texas at Austin from 1947 to 1978. However, he had also served as a teaching assistant in 1934-1936, as an Instructor from 1938-1941, and as an Assistant Professor on leave for military service, 1941-1946. Altogether, his record of service to The University spanned more than 40 years. Though he had been retired for 25 years, Dr. Campbell continued to do research and to work with, and encourage, graduate students until his final illness.In his prolific writing and in other scientific settings, he was known as "T. N. Campbell, " and to his friends and colleagues as "Tom." However, to the senior author having served as his undergraduate assistant in the 1960s, and working with him continually for the next four decades, it always seemed presumptuous to address him as "Tom." This was not because Tom Campbell was intimidating or severe, but rather that the anthropological community in Texas and beyond regarded him so highly. He was a gentleman in the truest sense and a scholar who was precise, inquisitive, and yet witty and self-effacing. In fact, he was a legend for his prodigious memory (which seemed to all of us to have "photographic" qualities), his devotion to puns, and his booming laughter.Born in Munday, Texas on July 3, 1908, Campbell was valedictorian at the local high school in 1925, attended McMurry College from 1925-1927, came to Austin and received a B.A. in 1930, an M.A. in 1936 (a second M.A. at Harvard University in 1940), and after service during World War II, a Ph.D. in 1947 from Harvard. During World War II, Lt. (later, Capt.) Campbell served in various capacities at the Army Air Force Pilot Ground School at Ellington Field (Houston) and at the AAF Training Command at Randolph Field, San Antonio.His full-time and continuous teaching career at The University began in 1947 as Associate Professor of Anthropology, promoted to Professor in 1952. The faculty in the Department of Anthropology in those years was very small, and so Dr. Campbell taught a wide range of courses in anthropology and archaeology. The senior author was generously awarded a "B" in "Introduction to Anthropology," but later managed an "A" in "The Archaeology of Texas and Adjacent Areas"! He taught courses on the Indians of Texas, the Southwest, and the Southeast, and archaeology courses focusing on Texas, North America, and the technology of material culture ("Primitive Arts and Crafts"). In my own teaching, I often taught a similar course called "Primitive Technology." I asked Dr. Campbell one time about borrowing his notes from his version of the course, as I knew I could extract some gems to use in my own lectures. He chuckled and said "I threw them all out when I retired!" His courses were exceedingly detailed and those details were certainly required to answer the essays that comprised his exams. Those of us who later went on to teach courses that were copiously illustrated with slides, and for some, Power Point, remember that Dr. Campbell would hold up a piece of yellow paper with a sketch of an artifact—which meant you had to go back to your assigned readings and focus on the illustrative material there. He was not one for theoretical dalliances or for stretching the interpretation of archaeological data. Indeed, as he told his classes: "Archaeologists always conclude their reports with a statement that 'with more research, these questions will be answered.' Yet if they were truthful, the statement would read "with more research, we will be even more confused!"His intellectual generosity is related by Prof. Mariah Wade.

She worked with Dr. Campbell for many years and relied heavily on him for her dissertation (and the book that followed through The University of Texas Press) on the Indians of the Edwards Plateau and their interactions with the Spanish and other native groups. I will always remember a view that I had of Mariah talking at top speed, with Tom sitting in his chair and backed into a corner, his eyes like a deer caught in the headlights, hashing out the fine points of Edwards Plateau ethnohistory. Professor Campbell would always ask "How does Mariah know so much?" Of course, Mariah would always counter that she had gotten the facts or the ideas from him! Dr. Wade was his last student and in many ways, his closest intellectual heir.

The same generosity and humility carried over into his prodigous scholarship. To be sure, he was keenly curious from an intellectual standpoint, and rigorous intellectually in his research. But, he saw the end product as a building block in the study of human culture, and he could not have cared less about the outlet in which it was published. Scholarly research for Professor Campbell was integral to the pursuit of knowledge and it was fun—not driven by academic ambition. His scholarship ranged from pioneering fieldwork in the Big Bend, to ethnohistoric studies of Southeastern Indians, and the preparation of archaeological excavation reports on the Texas coast. A lot of the fieldwork done on the coast, and in other parts of Texas, by the WPA in the 1930s had languished unpublished, and Tom set about organizing the data from these sites and getting it into print. He was a skillful editor and on the national scene, he was editor of *American Antiquity* in the 1960s. He edited the *Bulletin of the Texas Archeological Society* from 1958-1961 (two issues of that journal were dedicated to him, in 1985 and 2005) and the *Texas Journal of Science* (1953-1956).

His "true love" from a scholarly standpoint, were his inquiries into the myriad hunting and gathering Indian groups of south Texas and northeastern Mexico. Campbell's research was marked by tenacity in ferreting out the details of the lifeways and locations of hundreds of these groups (his contributions to the *Handbook of Texas* and the *New Handbook of Texas* [558 entries] far outdistance other contributors). He heavily utilized original sources, which for the Texas Indians largely meant 17th and 18th century Spanish documents. He mined the materials for every tidbit of information, searched for snippets on daily activities and material culture, and worked diligently to get these Indians in their right geographic locations! This was very difficult since early in the Spanish era, Native American groups from northeastern Mexico had already been pushed into south Texas, even into central Texas—and it was hard to sort out the local peoples from those caught up in the Spanish whirlwind. His studies of the Indians in south Texas, which also included a meticulous account of the route of Alvar Nunez Cabeza de Vaca, syntheses of the groups at the Spanish missions of San Antonio, and later, the groups at the Guerrero missions in Coahuila, contain so much information that one can hardly conceive it was done by one scholar, and with very limited research funds. He gave much of the credit to his daughter, T.J., saying that "she can read the archaic Spanish. . . and "she does the real work. . ." They were a remarkable team. In recognition of his ethnohistoric work, and to honor his 80th birthday, the Texas Archeological Research Laboratory (in association with other university entities) published a volume entitled *The Indians of Southern Texas and Northeastern Mexico, Selected Writings of Thomas Nolan Campbell* (Austin, 1988).

When we worked on some joint south Texas-northeast Mexico projects, Tom always had insights on archaeology and ethnohistory, and would rattle off the accounts of expeditions, Indian groups encountered, the day the encounter took place, all the while looking at you as if were already fully aware of these details. All you could do was nod knowingly, afraid your gaze would somehow expose your abject ignorance of these new facts! My favorite memory includes the many times when he was asked a question, he would jump up and pull a book from his library shelves, saying that "I think this is all covered on page 378," and flipping to the page as if he needed verification of that remarkable memory!

Tom grew old gracefully, though not without aches and pains, and he devoted much of his time to caring for his beloved wife, Lorene, who passed away in 1994. In some of his letters, he did express some wistful thoughts of being younger again. When he was in his seventies, and I was in my early thirties, he would write "oh, to be 50 again." Now I know what he meant!

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NOTE

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The Pacuache Indians of Southern Texas

T. N. Campbell

ABSTRACT

The Pacuache Indians of southern Texas are often mentioned in the Spanish Colonial literature. Additionally, they were the dominant Native American group at Mission San Bernardo, near present-day Guerrero, Coahuila. Ethnohistoric data obtained by the author is presented in this paper, including such topics as Pacuache language, territory, population, subsistence and trade.

The Pacuache homeland was in the area of what are now Dimmit and Zavala Counties in south Texas. Archaeological research in that area has revealed some Late Prehistoric and Protohistoric sites that likely reflect Pacuache occupations.

INTRODUCTION

[Thomas R. Hester]

This paper presents ethnohistoric research carried out by the late Professor Thomas N. Campbell of The University of Texas at Austin. It is part of a broad array of studies undertaken by Campbell, often with the aid of his daughter, Tommy Jo, into the Native American cultures of early historic southern Texas and northeastern Mexico (Campbell 1988). The manuscript was completed in the late 1970s, and over the years, Prof. Campbell made minor changes, and Hester added some archaeological data relevant to the Pacuache homeland.

The editorial changes to the original manuscript have been few. However, the manner in which references are listed at the end of the paper varies a bit from *La Tierra* style. In order to shorten the manuscript, Prof. Campbell used abbreviations, defined at the beginning of the **References Cited**, for those archives and other sources that are repeatedly used in his bibliography.

BASIC PACUACHE SOURCES

Since the Pacuache as a recognizable ethnic group can no longer be identified (and thus appear to be "extinct") sources of information about them consist of documents written by Europeans who observed them before their ethnic identity was lost, supplemented by such identifiable material residues of their former life as may be recovered through investigations by archaeologists. Such information on the Pacuache Indians as is presented here has been gleaned, usually in small increments, from a variety of civil, military, and ecclesiastical records, as well as from a few early maps, all of which pertain to Spanish colonial expansion into the frontier region now embraced by northern Coahuila and the adjoining part of southern Texas. The best information has come from accounts of early travel, from presidio records (garrison inspection reports and descriptions of Indian hostilities), and from mission records (official mission foundation documents, progress reports, administrative inspection records, occasional Indian censuses, and the routinely kept baptismal, marriage and burial registers). The few books compiled by early church historians, particularly those who themselves had served in the area as missionaries or as mission inspectors, have provided confirmatory detail. In the various dated records the name Pacuache first appears in documents for the year 1684 and disappears from documents written after the year 1775, a time span of approximately 90 years. Except for one mission Indian census of 1772, the most informative primary sources of data are documents that were written between the years 1690 and 1730.

For purposes of analysis, the European documents which contain information about the Pacuache were sorted into two groups: 1) those which say something about the Pacuache in their native and presumably aboriginal habitat, and 2) those which say something about the Pacuache at the various Spanish missions which they began to enter in 1700. Chronologically, these two sets of documents overlap because at the times the Pacuache in missions returned to their native haunts when food supplies in missions were low and also, apparently, when some of them became fed up with the restraints of mission life and felt compelled to get away for awhile. Eventually, nearly all of the Pacuache ended up in missions, largely because their home territory came to be dominated by hostile Athapaskan-speaking Apaches. The initial phase of Athapaskan expansion into central and southern Texas has been briefly discussed in a recent study of the Payaya Indians (Campbell 1975:1-2, 23-24).

Documents referring to Pacuache Indians in Spanish missions are relatively abundant, but recorded observations of Pacuache outside of missions are not. The latter consist of some 15 sources, of which only nine are firsthand accounts of actual encounters with Pacuache individuals, small groups of individuals, or entire encampments. All 15 sources refer to a period that begins in 1684 and ends in 1729, a span of some 45 years.

Of the 15 sources, only five refer to Pacuache encampments, four of which the Pacuache were sharing with other named Indian groups, the number of these groups ranging from one to 12. However, four sources refer to encounters with Pacuache individuals or very small groups who were engaged in special activities, such as hunting or stealing Spanish horses, with the implication that they were from Pacuache encampments nearby. Thus, it is possible to say that nine sources throw at least some light on Pacuache settlements away from missions. The remaining six sources contain general statements pertinent to the territorial range of the Pacuache, a topic that is summarized later in this paper. Their territory included the present-day counties of Dimmit and Zavala, as well as peripheral portions of adjacent and nearby counties, e.g., Maverick, Uvalde, LaSalle (see Figure 1). There has been limited archaeological fieldwork within this area, but it is fortunate that a number of Late Prehistoric and Protohistoric sites have been published, providing some limited perspective on the way of life of what were Pacuache or ancestral groups. Major sites include Tortuga Flat (41ZV155; Inman et al. 1998), Mariposa (41ZV83; Montgomery 1978) and other sites on Chaparrosa Ranch, and in the upper components at the Holdsworth site, (Hester and Hill 1972) and the Jonsson site (Inman et al. 1995) also in Zavala County. At the latter, a radiocarbon date of ca. 1400 A.D. came from a level with an Ensor point . The date is in line with the late 14C dates from Chaparrosa Ranch, suggesting that small dart points (especially Zavala, but also Ensor-like) and a mixture of arrow points are present in very late campsites. Site 41ZV226, near the Zavala-Maverick Counties border also yielded Late Prehistoric materials, with intact hearth features dating to Late Prehistoric and Protohistoric times. Artifacts included arrow points, Ensor and Frio "dart" points, as well as the Zavala type (inexplicably mis-classified as "Figueroa" in Mauldin et al. 2004:51).

PACUACHE NAME VARIANTS

The *Handbook of American Indians North of Mexico* (Hodge 1910, II: 183) has a brief entry for "Pacuaches," author not designated, and another brief entry for "Pacuachiam," written by H. E. Bolton. This seems to indicate clearly enough that each name was believed to represent a separate and distinct Coahuiltecan Indian group. Yet elsewhere in the *Handbook* the two names are used interchangeably. For example, in the entry for "Pitahay," written by Bolton, "Pacuache" is used to refer to the same people, and with the same cited source, as designated in the entry for "Pacuachiam." It seems evident that Bolton regarded the two names as synonymous and that the *Handbook* discrepancies are the result of editorial confusion. This confusion is understandable but also unfortunate, since later writers have accepted the *Handbook's* judgment without challenge. Swanton (1940:134; 1952:310) listed "Paquache" and "Pacuachiam" as two separate Coahuiltecan groups, and Ruecking (1954:5-6,19; 1955:332,335) followed suit. Such evidence as is available today—phonetic similarities in the names, association with the same territory, and fairly consistent usage in various mission records—shows that only one ethnic group is involved.

As a result of the *Handbook's* dual entry for Pacuache, that is, under headings "Pacuaches" and Pacuachiam," confusion developed in the lists of synonyms given. The entry "Pacuachiam" is acompanied by only one name variant, "Pacuchianis," which turns out to be acceptable. However, the entry "Pacuaches" is accompanied by seven name variants, two of which are demonstrable (Paguaches and Paquaches) but five are not (Paachiques, Pachagues, Pachaques, Pachoches, and Parchagues). The latter five should be dropped from the record as eqivalents of Pacuache.

The Pacuache identity problem is further confused by the fact that the *Handbook* has a third entry, "Pakawa," the first part of which was written by Bolton and the second by Cyrus Thomas (Hodge 1910, II:191-192), apparently without communication between the two authors. The editors of the *Handbook* failed to note certain discrepancies in the name variants given for Pakawa. These include, 1) Pacuaches, which was elsewhere given special entry treatment, as already noted above; 2) Paguaches, which the *Handbook* elsewhere (pp. 83,1115) gave as a variant of Pacuaches; and 3) Pacahuches, which seems to be a minor distortion of Pacuaches. All three are relatable only to Pacuache. Actually, Pakawa is a nineteenth-century construct which should now be abandoned. The key to the situation is provided by Bartholome Garcia an eighteenth-century missionary who knew several Coahuilteco dialects and which Indian groups spoke them. Garcia (1760: title page) indicates three Coahuilteco-speaking groups with similar names that are pertinent here: Pacao, Pacoa, and Pacuache. The *Handbook's* Pakawa entry failed to distinguish between the Pacao and the Pacoa and confused both with Pacuache.

The following 42 acceptable orthographic variants of the name Pacuache have been encountered in various primary and secondary sources (Spanish, French, and English).These name variants have been authenticated by detailed analyses and comparisons of the pertinent documents. Most variants represent attempts to record the sounds of a native Indian name in a Spanish alphabet. The remaining variants are demonstrably the result of later errors in copying and typesetting. Plural forms are given only if they were actually used. Since approximately 90 separate sources are involved, bibliographic citations are here omitted.

Nacuachi
Pacahuche (Pacahuches)
Pachuaches
Pacoache
Pacuache (Pacuaches)
Pacuachiam (Pacuachiams)
Pacuachian (Pacuachianas, Pacuachianis)
Pacuacian
Pacuafin (Pacuafines)
Pacuase
Pacuasian (Pacuasians)
Pacuasin
Pacuaxin
Pacuazin
Pacuchi
Pacuchiana
Pacuchiani (Pacuchianis)
Pagnachis
Paguache (Paguaches)
Paguachi (Paguachis)
Paguachiam
Paguachianes
Paguachianis
Pajauaches
Pajuache
Pakwace
Pakwaciam
Paquache (Paquaches)
Paquachi (Paquachis)
Paquachiam (Paquachiams)
Paquase
Paquasia
Paquasian
Paquasin
Paquasse
Paquatche
Paquazin
Pascuache (Pascuaches)
Puguahianes
Raquasiau
Taquaches
Tlacuache

SPANISH OBSERVATIONS OF THE PACUACHE

Berroteran, 1729

On April 8, 1729, a scouting party of Spanish soldiers, commanded by Joseph de Berroteran, was searching for hostile Indians believed to be Apaches in the Rio San Diego area some 15 to 30 miles south of present day Villa Acuna, Coahuila. Here the Spaniards encountered an unspecified number of "Indios Pacuaches" hunting bison. These were recognized as friendly Indians, and they told the Spanish soldiers that they had seen no other Indians in the vicinity (Berroteran 1729:191; accurate summaries are given by Alessio Robles 1938:483-484; Castaneda 1936,II:338-340; Weddle 1968:201). This locality, which is south of modern Del Rio, Texas, is the farthest west that any Pacuaches were ever seen by Europeans. The bison hunters reported by Berroteran were probably some of the Pacuache recorded on the map of Alvarez y Barreiro. This encounter seems to indicate that by this time the Pacuache were accustomed to the occasional presence of Apaches in the area and had learned that bison hunting was safe so long as they knew the Apaches were elsewhere at the time.

This account is also of archaeological interest as bison bones are occasionally found in Late Prehistoric and Protohistoric sites within the territorial range of the Pacuache. Of particular importance is the Tortuga Flat site (41ZV155) published by Hester and Hill (1975) and Inman et al. (1998). Buffalo continued to be hunted in the area well into the Spanish Colonial period times (Wade 2003).

Sevillano de Paredes, 1726-1727

In 1726 Sevillano de Paredes (1726:40-41) reported that the Pacuache on Nueces River had twice been attacked by Apaches, and the second of these attacks he dated as early January, 1726, when an unspecified number of Pacuaches had been killed and others captured. Sevillano was hoping that fear of the Apaches would lead the Pacuache to take up residence at Mission San Xavier de Naxera at San Antonio (see also Dunn 1911:218; Habig 1968:81). This mission, which in 1721 had been established on the site of later Mission Concepcion, was struggling for recruits. Evidently fear of Apaches did not induce any Pacuaches to go to this mission, since no Pacuache individuals are identified in the San Xavier baptismal records (Valero Records: "Ervipiame Baptisms"). In 1726 Mission San Xavier was merged with nearby Mission San Antonio de Valero (Bolton 1915:144).

In the report of his inspection of the Rio Grande missions in 1727, Sevillano de Paredes (1727:50) stated that many "Paguachis" had been living at Mission San Bernardo, but because of food shortages at the mission they had returned to their lands some 15 leagues away (about 40 miles). He failed to specify where these lands were, but his 1726 report and earlier documents reviewed above all point to the Nueces River valley, most likely in present-day Dimmit and Zavala counties, which is about the distance specified from Mission San Bernardo.

The number of Pacuache out in the brush (*en el monte*), he stated, was about 350. It may be noted that this is a continuation of the pattern of frequent return to the homeland described by Espinosa in 1708, nearly 20 years earlier. Incidentally, this allusion to Pacuache 15 leagues from San Bernardo is unquestionably the source of Orozco y Berra's isolated and somewhat cryptic reference to "los Paguachis a 15 leguas del mismo San Bernardo" (Orozco y Berra 1864:304), which has long puzzled historians of the northeastern frontier in Nueva Espana (see Bancroft 1883,I:611-612; Morfi 1932:70; Hoffman 1935:91, footnote 12; Portillo 1888:11).

Sevillano's various statements about the Pacuache seem to indicate that increasing Apache pressures constituted the prime reason for final abandonment of their Nueces valley homeland. Later, in a section that reviews the Pacuache experience at various missions in Coahuila and Texas, it will be shown that most of the Pacuache entered the mission nearest to them, San Bernardo, and that they did not permanently settle at San Bernardo until some unspecified time after the year 1734.

Extensive excavations were done of Mission Indian apartments found north of the 1767 unfinished church (Almaraz 1979:35). Guerrero points clearly dominated, but there were some untyped arrow points as well as a number of dart points. Some of these included small Frio, Ensor and especially Zavala points. While none of the material culture at San Bernardo can be isolated as Pacuache, there are certainly the parallels between sites in their territory and at the mission—particularly the small "dart" points (Hester 1975b, 1976, 1977; Eaton 1981: Figure 2).

Alvarez y Barreiro Map, ca. 1728

On a map prepared by Francisco Alvarez y Barreiro, an engineer who accompanied Pedro de Rivera on his long presidial inspection tour of 1724-1728, the location of the Pacuache is indicated (Wheat 1957, I: Map No.115). This map is undated, but it is believed to have been compiled and drawn ca. 1728. Five tiny, hut- shaped symbols, labeled "tierra de los Paquasin" are placed north of Presidio San Juan Bautista, which was just south of the Rio Grande at present day Guerrero, Coahuila. The map is somewhat distorted in comparison with modern maps of the same area. But by making use of such key reference points as San Antonio, San Juan Bautista, and the mouth of the Pecos River (Rio de Natagee), it can be said that the "land of the Pacuache" is probably the area now covered by eastern Maverick and the western portions of Zavala and Dimmit counties.

Dominguez de Mendoza, 1683-1684

The Pacuache seem to have been first recorded in 1684 under the name "Puguahianes" by Juan Dominguez de Mendoza (1683-1684; English translation by Bolton 1916:320-343). The original handwritten name was read as "Puguachianes" by Castaneda (1936, II:326) and also by Pichardo (Hackett 1934, II:338).

During the period of December, 1683 - May, 1684, Dominguez de Mendoza led a Spanish expedition from the vicinity of present-day El Paso eastward to the western part of the Edwards Plateau and spent six weeks at a locality which he called San Clemente and which, as indicated by a relatively recent study by Williams (1962), appears to have been on an upper branch of the Llano River in the general vicinity of modern Junction, Texas. In his itinerary, Dominguez de Mendoza recorded the names of 37 Indian groups, some of which he actually encountered on the plateau and others which he heard about while there. He did not distinguish between the two sets, but he did say that representatives of some groups were present and that, while at San Clemente, he was expecting to receive delegations from others. At this time the Spanish encampment was being frequently attacked by Apaches and Dominguez de Mendoza had to leave San Clemente earlier than he had intended. This is the earliest clear report indicating Apache movement from the southern High Plains southeastward into the Edwards Plateau.

What is significant about this list of 37 names is that many of the names can be recognized as those of Indian groups from a very large area in present Texas, names which were frequently recorded in later documents. In addition to "Puguahianes," there were other names which can be recognized as those of Indian groups that ranged over the area just south of the Edwards Plateau and across the Rio Grande into northeastern Coahuila. Among these are: Hume, Pagaiam (Bagnam), Papan (Papanac), Pucha (Putzau), Tojuma (Toamar), Aba (Hape), and Abau (Hiabu).

The identity of these groups is further confirmed by Dominguez de Mendoza's statement that "some of the nations departed toward their land with the Indian who governed them, who is a Christian and is proficient in the Mexican [Nahuatl] language and in Castilian" (Bolton 1916:340). This evidently refers to Indians of northeastern Coahuila and the adjoining part of Texas, among whom Father Juan Larios and other missionaries had been working for a decade (Figueroa Torres 1963: passim). If this interpretation is correct, Dominguez de Mendoza's data suggest that some of the more northwesterly hunter-gatherer groups usually associated with the area just south of the Edwards Plateau may also have ranged into the plateau before the southeastward expansion of Apaches. The major attraction of the Edwards Plateau was probably bison, particularly in the colder parts of the year. Dominguez de Mendoza had much to say about the abundance of bison on the plateau and this will be discussed later.

This evidence of Coahuilteco-speakers in the Edwards Plateau weakens Bolton's interpretation (Bolton 1916:338, footnote) of the location of San Clemente as near modern Ballinger, Texas, about 36 miles northeast of San Angelo, and strengthens the interpretation of Williams (1962), who made persuasive use of botanical evidence (presence of pinon trees in small canyons west of San Clemente) to show that Mendoza's route took him much farther south than Ballinger.

Mazanet 1688, 1690, and 1691

In 1688, Damian Mazanet, a missionary then stationed at Mission San Bernardo (or Bernandino) de Candela, near modern Candela, Coahuila, learned from Juan, a Pacpul Indian leader, that a Frenchman was living among Indians north of the Rio Grande. This was at a time when Spaniards were excited by reports of LaSalle's French settlement somewhere on the Texas coast. Mazanet asked Juan to go and find out where this Frenchman was living. Juan returned and said that the Frenchman, who the Spaniards later called Juan Jarri (probably Jean Gery), was at that time near the Sierra de Sacatsol in an encampment shared by Indians representing eight different groups: Mescales, Yoricas, Chomenes, Machomenes, Sampanales, Pacuachiams, Tilpayay, and Apis (Gomez Canedo 1968:8-9; English translation by Casis 1899:256, 384; Bolton 1916:356-357).

This Sacatsol encampment, according to Mazanet, was about 20 leagues or some 52 miles north of the Rio Grande and more or less due north of Mission Candela. Bolton (1916:297, footnote) has suggested that the name Sierra de Sacatsol referred to the Anacacho Mountains of southeastern Kinney County, Texas, an elevation only six miles long. It does not appear likely that the word *sierra* would have been used for such a minor topographic feature. [While this is perhaps the case, a drive on Highway 57 between La Pryor and Eagle Pass, or along Highway 90, east of Bracketville, the Anacacho range is a very distinctive feature.]

Instead Sierra de Sacatsol probably referred to the more impressive dissected southern margin of the Edwards Plateau not far north of the Anacacho Mountains. Elsewhere it has been suggested (Campbell 1975:5-6) that such evidence as is available indicates that the Frenchman's encampment was probably located near the margin of the plateau in either Kinney or Uvalde Counties.

Among the Indians named in Jarri's settlement were the Chomenes, a name which, in singular form, "Choman," was frequently used in both French and Spanish sources for the Jumano Indians of western Texas. Parties of Jumano made annual hunting and trading trips to both central and eastern Texas at this time (Kelley 1955). Machomenes probably refers to a subdivision of the Jumano, or at least a group closely associated with them. It was a Jumano leader, Juan Sabeata, who guided Dominguez de Mendoza on his expedition of 1683-1684 from El Paso to San Clemente in the Edwards Plateau, where Mendoza recorded the name "Puguahianes" (Bolton 1916: Mendoza itinerary, *passim*). Although today it is not possible to pinpoint the location of Jarri's Indian encampment, it was evidently not very far from other localities of the general area where Pacuache Indians were encountered by Spaniards during the next few years, as will be seen shortly.

With Alonso de Leon in 1690, when he led the first Spanish expedition from Coahuila to eastern Texas, was the same missionary, Damian Mazanet, who briefly summarized the trip in a letter to the Conde de Galve. This letter, unknown until recent years, has been published by Gomez Canedo (1968:159-165). In the letter Mazanet reported an encounter (p. 160) with six named Indian groups on a stream which he referred to as "rio Hondo." The six groups were: Sampanales, Pacuachianes, Putaay, Manico, Geyer and Ataxal. Mazanet's phrasing suggests that these six groups were sharing the same encampment (*los indios que in dicho puesto viven*).

In this document Mazanet was not very responsible in recording distances traveled, as is indicated by his giving the same figure, 20 leagues (como veinte leguas) for the distances between the expedition's river crossings (Rio Grande, Nueces, "rio Hondo," Medina, and Guadalupe). This is of little help in identifying his "rio Hondo," other than making clear that only the Frio River drainage system is involved. The itinerary of Alonso de Leon (Bolton 1916:407) indicates that the expeditionary party arrived at "rio Hondo" on April 11, but nothing is said about the Indians by Mazanet. Fortunately, Leon traced his route on a remarkably good sketch map (see reproduction in Bolton 1916: facing p. 370), and this map clearly shows that "rio Hondo" is the present Frio River. It is evident from Leon's map that the river was reached in a section where its course is almost due east. The

Spanish party traveled eastward downstream along the right bank for a distance of six leagues before the crossing was made at a point where the river resumes its general southeastward course. On a modern map only one section of the Frio River meets all the contextual conditions of the documents involved, namely, a stretch at and near the northwestern corner of present-day Frio County. this information gives a relatively firm basis for locating the Pacuache and their five associated groups in the year 1690. It may be noted that this locality is less than 100 miles from the probable site of San Clemente, where in 1684 Dominguez de Mendoza recorded the name "Puguahianes."

In his diary covering the Teran de los Rios expedition from Coahuila to eastern Texas in 1691, again the same Mazanet recorded that when the Spaniards were encamped near "rio Jondo" on June 10 they were visited by Indians identified by 13 group names, one of which was rendered as "Paquachiam" (Gomez Canedo 1968:236; also Mazanet 1957:356; English translation, Hatcher 1932:52). Assuming that Teran crossed the Rio Grande in the vicinity of modern Guerrero, Coahuila, which is generally acccepted, the terrain described, the travel directions indicated, and the distances recorded as traveled each day, all permit the "rio Jondo" to be identified as the present Frio River and the locality to be placed somewhere near the Leon crossing of 1690, that is, the northwestern corner of Frio County. As this locality was only 11 leagues or about 28 miles northwest of the point where the Nueces River had been crossed, it is difficult to accept other identifications of this particular locality. Hackett (1934, II:136) thought that Mazanet's "rio Jondo" was the Medina River, and Ximenes (1963:193) has more recently implied that it was the Atascosa River.

The complete list of names, following the text as given by Gomez Canedo, includes Sanpanal, Patchal, Papanaca, Parchiquis, Paquachiam, Aguapalam, Samampac, Vanca, Payavan, Patavo, Putaay, Apayie, and Patzai. Since individuals from these 13 groups came to the spot where Spaniards were halting for a day, it is not possible to assert that all of the groups represented were actually sharing a nearby native encampment. Individuals from the last three groups named, it is said, entered the Spanish encampment later in the day than those of the preceding 10 groups. All that can safely be said is that the 13 groups were apparently sharing the locality on a peaceful basis. The Spaniards distributed gifts among these Indians: tobacco, rosaries, knives, and glass beads (*abalorios*). Spanish Colonial artifacts that might be linked to exchange with the Pacuache and other others are few. At Mission San Bernardo, the Mission Indian dwellings yielded fragments of metal knives, scissors, needles, buckles, copper kettle fragments and glass beads (Hester 1977; Harris, Harris and Hester 1999). However, there is very limited evidence of Spanish trade items in the Pacuache territorial range. At a surface site near Asherton in Dimmit County, a number of glass trade beads were collected in the 1960s. At site 41MC296, within the Choke Canyon Reservoir, a metal knife blade was excavated. It is identical to those from mission and other 18th century contexts (Hall et al. 1986:391). Also at this locale, a probable Guerrero point was recovered.

When travel was resumed by the Spaniards the following day, numerous bison were seen (*hubo este dia mucha cibola*), which suggests that the Indians may have been hunting these animals cooperatively (see also Wade 2002).

When the list of six Indian groups encountered by Leon's party in 1690 is compared with the list of 13 groups encountered by Teran de los Rios in 1691, it will be noted that these names appear on both lists—Sanpanal, Pacuache, and Putaay.

Salinas Varona, 1693

On May 11, 1693, when he was traveling from Coahuila to eastern Texas, Salinas Varona visited a rancheria of "Pacuasse" Indians in what is now western Dimmit County, Texas (Gomez Canedo 1968:281-282). There can be little doubt about the identity of the "Pacuasse" because later in his diary (p. 306) Salinas Varona again refers to the same encampment as being occupied by "Pacuaches." Salinas Varona had found a suitable ford for crossing the Rio Grande, apparently in the vicinity of present-day Guerrero, Coahuila, and had proceeded northeastward no farther than seven leagues, or approximately 18 miles, when he arrived at the Pacuache encampment, which was located in a area with many arroyos and an abundance of mesquite trees, distantly bordered by low hills. In this locality Salinas Varona saw the first bison of his trip (*el primero ganado de cibola*), and these were so numerous that his herd of horses stampeded. No mention is made of the Pacuache actually hunting bison. As was customary, tobacco was distributed among the encamped Indians.

On May 12, after leaving the Pacuache, Salinas Varona went on northeastward for another seven leagues, passing on the way two additional Indian settlements. The first of these was said to be occupied by "Tepacuache," the second by "Sacuache" (ibid., 282). These encampments were probably also in what is now Dimmit County. As Salinas Varona is the only European who ever mentioned these two groups, their identity is largely a matter of speculation. Phonetic similarities in the names Pacuache, Tepacuache, and Sacuache, as well as simultaneous association with a relatively small area in present-day Dimmit County, suggest that they were very closely related. It is possible that some of the Pacuache later recorded at the Rio Grande and San Antonio missions were actually Tepacuache and Sacuache.

Espinosa, 1708-1709

In 1708, when writing about the establishment of several missions near the Rio Grande in northeastern Coahuila, Isidro Felix de Espinosa commented on the "Pacuasian" connected with Mission San Bernardo (near present-day Guerrero, Coahuila). In this year, said Espinosa (1708:29; Maas 1915:33-34), the "Paquasian" population consisted of more than 300 individuals, but it had been considerably reduced by recent epidemics (diseases unspecified). Maas (1915:34), who has published Espinosa's account, in effect has concealed this population estimate because at this particular place in the document he misread Espinosa's "Paquasian" as "Raquasiau." According to Espinosa, no Pacuache were then living permanently at Mission San Bernardo. They only visited the mission seasonally, coming in from their lands across the Rio Grande in what is now Texas. Espinosa referred to these lands as "east" of San Bernardo, but he would have been more accurate if he had used the word "northeast" instead, since in both earlier and later documents most of the Spanish encounters with Pacuache were at localities in that direction from San Bernardo, and never due east.

In 1709 Espinosa kept a diary of his trip with a Spanish party that traveled from Presidio San Juan Bautista on the Rio Grande (at modern Guerrero, Coahuila) northeastward to a section of the Colorado River valley just downstream from present-day Austin, Texas. On April 7, as the Spaniards approached the Nueces River, apparently either in northern Dimmit or southern Zavala Counties of today, they met three "Pacuasian" Indians who were out hunting mice (*ratones*). Faunal records from several Late Prehistoric or Protohistoric sites in this specific area indicate a heavy reliance on mice, rats and small mammals (Hester and Hill 1975; Inman et al. 1999).

The next day, April 8, after leaving the Nueces River, the Spaniards encountered about 20 Indians, two of which were identified as Xarame and the remainder as "Pacuasian." These Indians were on the banks of a stream which Espinosa called Rio Sarco, but he said that the Indians referred to it as Rio Frio (Maas 1915:51; Tous 1930b:4). Since this stream was only one day's journey from the place where the Nueces River was crossed, it was probably the present Leona River, a western tributary of the Frio River. The encounter must have taken place somewhere near the boundary between Frio and Zavala Counties.

Ramon, 1716

Some of the Pacuache were encountered by the Ramon expedition on April 28, 1716. This expedition was on its way from San Juan Bautista to eastern Texas, had crossed the Rio Grande at the ford known as "Paso de Diego Ramon," which was approximately six miles northeast of modern Guerrero, Coahuila (Weddle 1968; 5), and had traveled about 10 leagues northeastward to an overnight encampment somewhere in the western part of modern Dimmit County, Texas. On the morning of April 28 it was discovered that 20 horses were missing. The ensuing episode is reported in the diaries of both Ramon (Foik 1933:9-10) and Espinosa (Tous 1930a:6), which differ somewhat in the details recorded.

Ramon says that Pacuache Indians had taken the horses to their settlement, presumably nearby. However, he thereafter states that soldiers followed the horse tracks for four leagues and recovered the horses, leaving some doubt as to whether the horses were actually taken from the Indians at their encampment. Ramon reports that he did not punish the Indians in any way. He ends by saying that he distributed tobacco and informed the Pacuache that they would be hanged if such a thing happened again.

Espinosa merely says that some of the Spanish horses were discovered to be missing. He refers to the Indians not as Pacuaches but as *bozales* ("wild Indians") who had taken the horses to their encampment. He specifically says that five Indians had taken the horses, that the trail was followed by the soldiers, who caught three of the five Indians, again leaving some doubt about recovery of the horses at the Pacuache encampment. He too says that the Indians were not punished, but mentions no Spanish verbal threats.

St. Denis, 1717

In 1717 the Frenchman, Louis Juchereau de St. Denis traveled from Natchitoches, Louisiana, southwestward to Presidio San Juan Bautista, following the regular Spanish route through what is now San Antonio. He reported "Paquatche" as one of the Indian groups that ranged between the Medina River and the Rio Grande (Shelby 1923:177). This generalized information merely confirms the location of Pacuache encampments recorded in earlier documents.

Alarcon, 1718

The Alarcon expedition, in April, 1718, on its way from Presidio San Juan Bautista to establish missions and a presidio at San Antonio, encountered Pacuache Indians on both sides of the Nueces River in the vicinity of the present boundary between Dimmit and Zavala Counties. In the Celiz diary (Hoffman 1935:44-45) the name is recorded as "Pacuaxin" and in the Mezquia diary (Hoffman 1938:314) as "Paquasian." The first encounter was on April 13, when the Spaniards came upon a male Pacuache who was out hunting alone. This Indian was given unspecified gifts and then was asked to accompany Alarcon's Indian guide and one soldier to a nearby Pacuache rancheria and bring back other Pacuache individuals to receive presents. This is what Celiz said; Mezquia, however, said that Alarcon wanted the Pacuache to go along and take care of the expedition's herd of goats. The next day, April 14, nine Pacuache Indians came and were given tobacco and flour. They agreed to accompany the Spaniards. Two days later, April 16, after the Spaniards had crossed the Nueces River and had traveled a few leagues farther northeastward, two more Pacuache arrived and received tobacco. However, they soon left, and six of the nine Pacuache goat-herders left with them. How long the three remaining Pacuache accompanied the Alarcon expedition is not indicated.

PACUACHE AT THE SPANISH MISSIONS

Such records as have survived show the presence of Pacuache individuals at five Spanish missions of northeastern Coahuila and Texas. Two of these missions, San Francisco Solano (founded in 1700) and San Bernardo (founded in 1702; Figures 2, 3) were in northeastern Coahuila (vicinity of modern Guerrero). These two missions were nearest to the known territorial range of the Pacuache. The remaining three missions were established later in Texas: San Antonio de Valero (the present Alamo, moved from Coahuila to San Antonio in 1718), Nuestra Senora de la Purisima Conception de Acuna (moved from eastern Texas to San Antonio in 1731) and San Ildefonso (founded in 1749 in present Milam County of eastern central Texas). As will be shown, most of the Pacuache were associated with Mission San Bernardo, where they were still the dominant Indian population as late as 1775. Relatively few Pacuache were associated with the other missions designated above.

Since San Francisco Solano was abandoned in 1718 and was moved to San Antonio, where it was reestablished under the name San Antonio de Valero, it appears likely that the few Pacuache at Solano followed the mission to its new location in San Antonio. The surviving records of both missions provide some support for this statement. The Pacuache at Mission Concepcion were actually visitors from San Bernardo and did not remain very long. The records make it quite clear that the few Pacuache at San Ildefonso came there from San Antonio de Valero.

It is evident that most of the Pacuache Indians eventually lost their ethnic identity at Mission San Bernardo; the remainder simply faded away in the

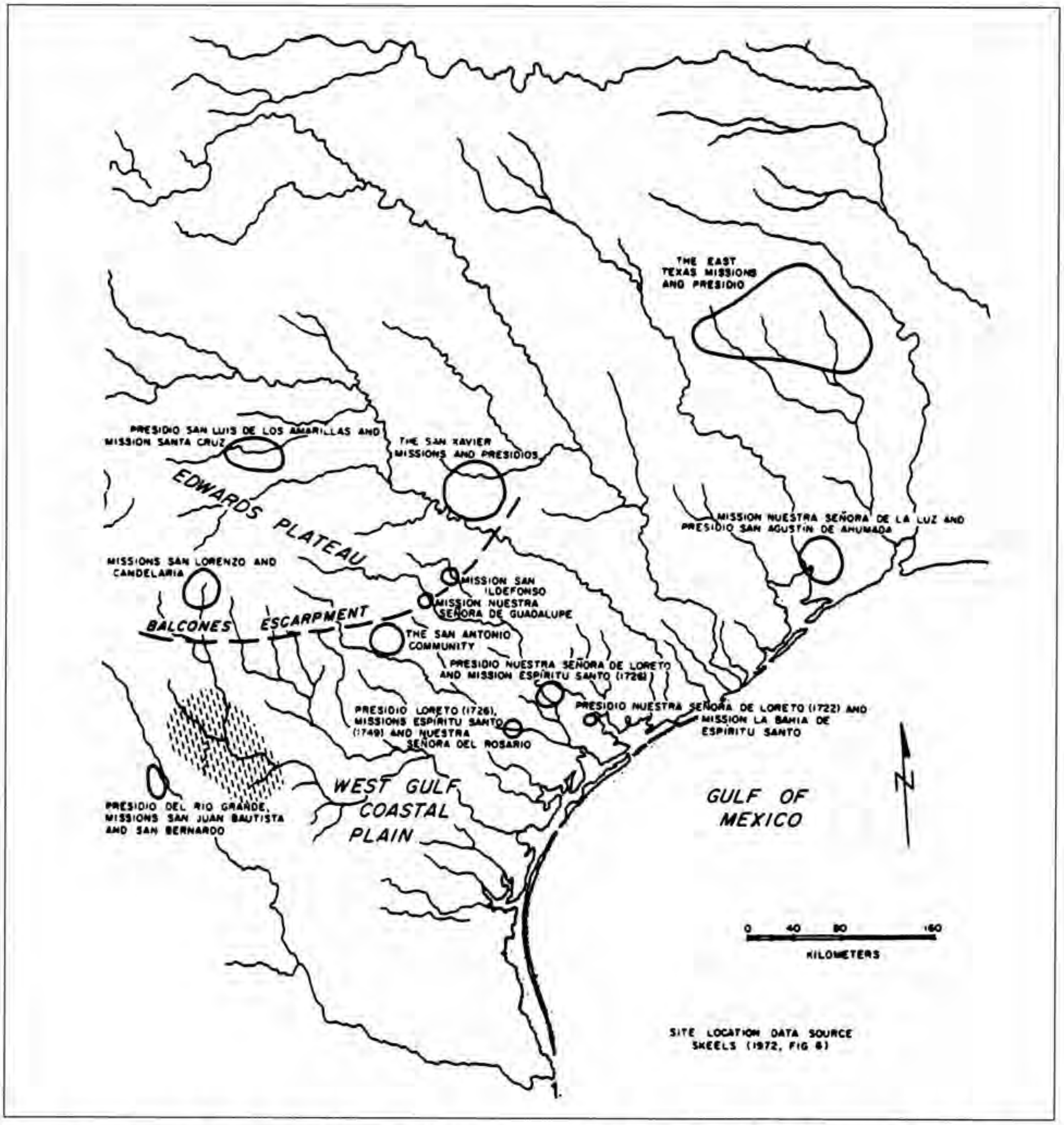

Figure 1. Territory of the Pacuache Indians, Early 18th Century. Map Adapted from D. E. Fox (1977) Special Report 8, Center for Archaeological Research, UTSA. The shaded area approximates the Pacuache territory.

missions of interior Texas. The information available on the Pacuache experience at each of the five missions is summarized below.

Mission San Francisco Solano

In the baptismal records of Mission San Francisco Solano two Pacuache females are identified, both for the year 1712. The first of these is Isabel, who was baptized on July 13, no age given, with both parents listed as unbaptized "Paquasia" (Solano Baptisms, No.13). This is probably the same Isabel whose name appears in a later baptism (ibid., No. 25, 1715), listed as a "Paquache" who was married to Gabriel de Ibarra, Xarame, their baptized daughter being Juliana de los Santos, Xarame. The names Gabriel, Isabel and Juliana de los Santos all appear later in the records of Mission San Antonio de Valero at San Antonio. The second Pacuache individual at Solano is Ana Maria, who was baptized July 23, 1712, at the estimated age of eight years (ibid., No. 14). Her parents are also identified as unbaptized "Paquasia." Since approximately 475 Indian individuals are listed in the surviving Solano records, it appears that the Pacuache were not numerically important at this mission. However, of the 475 persons, 131 are not identified as to ethnic affiliation, and it is possible that at least some of the 131 unknowns were Pacuache.

Although no excavations have been done, Hester and Jack D. Eaton located the probable site of Mission San Francisco Solano, near Guererro, in 1975 and 1976. One mound may have represented the church or some other major building, as traces of mortar and wall blocks suggested two parallel walls.

Mission San Bernardo

Since most of the missionized Pacuache entered San Bernardo in northeastern Coahuila, it is regrettable that the baptismal, marriage, and burial registers of this mission have not been found. All information on its various resident Indian populations must come from such documents as happen to refer to them. The mission is usually reported as having been founded in 1703, but Morfi (1950:294) cites a document which shows that it was established in the preceding year, 1702.

Until recently the principal source which identifies specific Indian groups represented at San Bernardo has been Orozco y Berra (1864:303), who does not cite the primary documents which he used. The Orozco y Berra list for San Bernardo consists of 12 Indian group names, including Pacuache, but the list ends with the phrase "and others," indicating that additional names could have been cited. This list of 12 group names has been repeated in unaltered or slightly altered form by later writers, among them Bancroft (1883,I:611), Portillo (1888:288), and Velasco (1897:14). To the Orozco y Berra source may now be added two mission Indian censuses, one compiled at San Bernardo in 1734 (Garza Falcon 1734:19-24), the other in 1772 (Rodriguez 1772:20-24). Both censuses confirm the 12 names given by Orozco y Berra and include 17 additional names, making a total of 29 Indian groups now known to have been represented at Mission San Bernardo.

Orozco y Berra states that persons from nine of the 12 groups listed by him came to San Bernardo when it was established. The Pacuache are listed among the nine, but no population figures are given. That some of the Pacuache were at San Bernardo in its earliest days is also indicated by Espinosa, who in 1708 named the "Paquasian" as one of five Indian groups, totaling over 300 persons, who were at San Bernardo when the first church building had been completed and equipped with proper ritual paraphernalia (Espinosa 1708:37).

The San Bernardo census of 1734 is disappointing because of discrimination in recording. Nearly all the Christianized Indians are identified by personal name and ethnic group affiliation, but very few non-Christian Indians (gentiles) are so identified. The census total is 351, but of these only 132 individuals are assigned to any particular ethnic unit. The number of ethnic group names that appear in this census is 24, which makes it especially valuable because for the first time it becomes possible to designate some of the groups referred to by Orozco y Berra as "and others."

While it has minimal value for determining the population size of each group present at the mission in 1734, this census does give some impression of how receptive certain groups had been to missionary persuasion. Five Pacuache are identified, but only one of these is designated as a Christian. Acually the five Pacuaches appear in two entries: (1) a man referred to as "el Capitan Pacuache," his wife (ethnic affiliation unspecified), and two children, one of whom had been baptized, and (2) two Pacuache bachelors (*solteros*). The Pacuache figures contrast with figures for other groups; for example, 16 out of 20 identified Pachal individuals are listed as Christians, 18 out of 19 "Chaguan" (Siaguan), and 14 out of 14 Pastaloco. This suggests that the Pacuache were a more conservative people and still more oriented to the native value system, and this seems to be supported by earlier records which refer to the Pacuache readiness to leave the mission and return to their original territory across the Rio Grande. As for the census as a whole, it would appear that by 1734 only one of every three Indians at San Bernardo had become even nominally Christian.

The census of 1772 is much more informative (by this time all Indians were Christians), revealing that 243 Indians lived at San Bernardo, and all but six of these are identified as representing at least 23 different ethnic groups, nearly all of them apparently Coahuilteco-speakers. Of the mission Indian population total, at least 84 (49 males, 35 females) are identifiable as "Paquachi," the name variant rather consistently used in this census report. These figures show that approximately 28 percent of the mission Indian population consisted of Pacuache individuals, making the Pacuache the most numerous people living at the mission. The next most numerous group, the "Paco" (Pacoa), was represented by 26 individuals or about 11 percent. These proportions suggest that the Pacuache eventually entered Mission San Bernardo in relatively large numbers and maintained numerical dominance at least until 1772. As the missionaries usually identified only the children of Pacuache fathers as Pacuache, it is evident that, so long as the sex ratio remained about the same, a numerically dominant group would persist longer than other groups.

In this 1772 census the Pacuache individuals are recorded in several categories: (1) married couples and their unmarried children; (2) widowers and their children; (3) widows; and (4) orphans. The married couples number 33 and show a total of 24 children (16 males, 8 females); widowers total three, all without children; and the orphans consist of two males.

Figure 2. View Looking North at Excavations of Indian Quarters at Mission San Bernardo 1975.

the number of children per married couple ranges from one to three (nine couples had one child; three had two children; and three had three children).

The married couples, as noted above, total 33; and of these only 15 couples had living children in 1772. The children assigned to Pacuache fathers number only 14. Since by mission custom only males could perpetuate Pacuache identity, it is clear that, although little is known of the death rate, the Pacuache at San Bernardo in 1772 were approaching inevitable loss of ethnic identity.

At San Bernardo, as shown by the 1772 census, the Pacuache freely intermarried with all other ethnic groups represented at the mission whenever suitable mates were available. Of the 24 married Pacuache males, 14 had wives who were also Pacuache; the remainder had wives from groups identified as follows: Canoa (1), Huacacil (1), Jacao (2), Minicau (1), Ocan (1), Paco (2), Patacal (1), and Paxac (1). Of nine married Pacuache females, aside from the 14 noted above, their spouses are listed as representing the following groups: Aguayan (2), Jacao (1), Huacacil (1), Passtancoya (2), and Patacal (3). All ethnic group names, except for Pacuache, are here rendered as given in the census report.

As noted in the section on Pacuache variants, the variants of Pacuache and Pacoa have sometimes been confused. The two San Bernardo censuses help to clarify this matter. In 1734 Pacuache individuals are indicated by the names Pacuache and Paquache, whereas Pacoa individuals are indicated by Paco, Pacua and Paqua. In 1772 Pacuache appears either as Paguachi or Paquachi; Pacoa is consistently given as Paco.

Of some interest as an example of Indian alienation in a Spanish mission setting is the case of four Pacuache males of San Bernardo who got into trouble in the year 1772 (Perez 1775;121-122; Ripperda 1775:119-120). The four were known by the Spanish names Francisco Pobre, Silvestre, Enrique and Pedro. Their names are found in the San Bernardo Indian census of 1772 (Rodriguez 1772), but Silvestre is identified as "Aguayan" instead of Pacuache. The four men were evidently dissatisfied with mission life, since it is said that they had "escaped" from the mission several times. One of them, Francisco Pobre, was described as "knowing the way" to the "gentile nations," which at that time probably meant Lipan

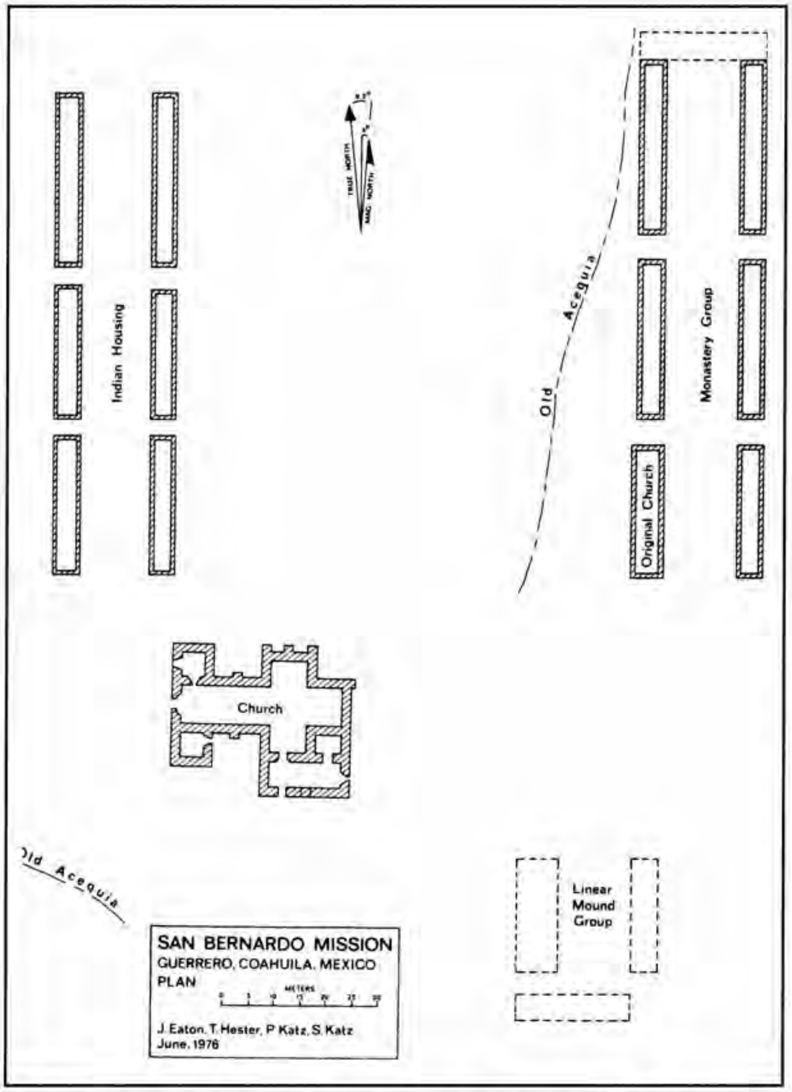

Figure 3. Plan of Mission San Bernardo, Based on the 1975 Excavations. Adapted from Eaton 1979. The parallel row of buildings in the upper left were the quarters for the Mission Indians, including the Pacuache.

and other Apaches. Two years earlier Francisco had gone to San Antonio and persuaded a woman of Mission Concepcion to run away with him.

In 1774 the four men went to San Antonio, stole Spanish horses, wounded an Indian at Mission Concepcion and killed an unidentified man. When arrested at Concepcion they had three local Spanish horses in their possession. They confessed their crimes, were convicted, and were sentenced to prison at hard labor. Fray Manuel Perez of San Bernardo wrote to the governor of Texas in their behalf and may have prevented them from receiving the death sentence. Disaffection was probably common enough among mission Indians, but just how many cases ended in similar violence remains unknown.

Mission San Antonio de Valero

Relatively few Pacuache found their way northeastward to the San Antonio missions, and the only mission which they seem to have entered there was San Antonio de Valero. The Valero baptismal, marriage, and burial records contain the names of at least 13 individuals who can be identified as Pacuache (the missionaries customarily assigned all Indians to the ethnic group of their fathers). Santos (1966-67), who used burial records only, reports a total of eight Pacuache at Valero. For some unexplained reason he distinguished Pacuache from Paguache, indicating four individuals for each. Of the 13 Pacuache at this mission, seven are referable to one family (Juan Baptista and his six children by two successive Xarame wives). The first Pacuache entry is connected with a burial record of 1722 (Valero Registers, Burial No. 29); the last entry is in a burial record of 1766 (No. 1275). This gives the Pacuache a known time range of 44 years in the Valero records.

In these records the name Pacuache appears in several forms: Nacuachi, Pacoache, Pacuache, Pacuase, and Paquache. There is no question about these name variants all referring to the same ethnic unit. Juan Baptista, referred to above, is identified by four of these variants: Pacoache (1728), Nacuachi (1735), Paquache (1736), and Pacuache (1738, 1740, 1743, 1748, 1755); and Isabel is referred to as both Pacuase (1729) and Pacuache (1748). These entries seem to indicate that as time passed the group name became regularized to the form Pacuache.

Actually, in any given year between 1722 and 1766, there were very few Pacuache present at San Antonio de Valero. The following table indicates the number of identifiable Pacuache who can be proved by records to have been alive during the years indicated:

1730 - 3
1740 - 4
1750 - 2
1760 - 1

It should be pointed out, however, that the records are incomplete. Some entries are now illegible, and many individuals named, especially in later years, were given no ethnic identification. Making allowances for these defects, it seems very likely that in any specific year there were no more than 8 or 10 Pacuache living in this mission.

Of the 13 Pacuache individuals recorded over a period of 44 years at Valero not much can be said. Six are indicated as males and seven as females. For only eight of the 13 is there any indication of age at time of death; and of these eight, six individuals died before reaching their 11th year. The only adults for which ages at death are recorded are two females, one of whom died at 34 years, the other at an estimated age of 70 years.

The single identifiable Pacuache family, headed by Juan Baptista, casts some light on the disappearance of the Pacuache as an ethnic group at Valero. He lived long enough to have three wives; the first two wives were Xarame, the third Sana. By the two Xarame wives he had six children, five of whom did not live beyond the age of 10 years; and the sixth disappears from the record after being baptized. Under these circumstances, it was impossible for the Pacuache to maintain ethnic identity for very long.

The Valero records indicate that both before and after entering Valero, adult Pacuache individuals had spouses representing five other ethnic groups: Aujuiap (1), Pastaloca (1), Pataguo (1), Sana (1), and Xarame (2).

Mission San Ildefonso

A few Pacuache, apparently all from Mission San Antonio de Valero, were sent to Mission San Ildefonso to serve as teachers and interpreters, a common practice when new missions were founded (Bolton 1915:202); Gilmore 1969:11,49- 50). San Ildefonso was one of the three so-called San Xavier missions of present-day Milam County in east central Texas. It was established in 1749 but lasted only a few years—until 1755. The records of Mission San Antonio de Valero identify one Pacuache family of three persons that served at San Ildefonso in 1749-1750 (Valero Records: Baptism No. 779 and Burial No. 736).

Mission Nuestra Senora de la Purisima Concepcion de Acuna

As noted previously, in 1774 four Pacuache males from Mission San Bernardo were reported at Mission Concepcion of San Antonio (Ripperda 1775:119-120). One of these men is said to have had a wife and child with him. The four Pacuache from San Bernardo were convicted of murder and horse theft at San Antonio. Their names are given as Francisco Pobre, Silvestre, Enrique, and Pedro. Francisco Pobre is said to have taken an Indian woman from Mission Concepcion two years earlier. This was probably the Pacuache who had a wife and child, and this relationship is very likely the reason for the presence of the four Pacuache at Mission Concepcion. In the census of 1772 a Pacuache identified as Francisco Pobre is listed as a widower at San Bernardo (Rodriguez 1772:71). Apparently Francisco Pobre and his three associates were as troublesome at Mission Concepcion as they were in the general San Antonio community. It is said that they "shot" an Indian of Concepcion in the jaw. These Pacuache are, of course, not identified in the surviving records (marriages only) of Mission Concepcion.

PACUACHE TERRITORIAL RANGE

Perhaps the simplest way to demonstrate the probable aboriginal Pacuache territorial range is to plot on a map all of the localities with a circle or oval (see Figure 1). When this is done it becomes evident that, except for the late report (1729) of Pacuache bison hunters in northern Coahuila south of present-day Del Rio, Texas, all the localities are confined to parts of the following Texas counties: most of Dimmit and Zavala Counties, eastern

Maverick County, southeastern Kinney County, southern Uvalde County, southwestern Medina County, and northwestern Frio County. All the designated counties are south of the margin of the Edwards Plateau and entirely within the northwestern portion of the South Texas Coastal Plain. Sections of the Nueces, Leona, and Frio Rivers are included. In terms of the more reliable records the core of the probable Pacuache territorial range lies in Dimmit and Zavala Counties; but this to some extent may be more apparent than real, since the most common route of early Spanish travel from Coahuila to eastern Texas passed diagonally across these counties. All Spanish encounters with Pacuache outside of missions occurred during the months of April, May and June.

The preceding statements are based on Spanish documents that were written after the Apaches had begun their expansion southeastward. It is possible that, prior to this expansion, the Pacuache and some of their associates ranged into the Edwards Plateau, particularly in the winter season, to hunt bison. This is suggested by the data recorded in 1684 by Dominguez de Mendoza when he was at San Clemente. It appears doubtful that the Pacuache were formerly restricted to the Edwards Plateau, since what is known of their culture suggests adaptation to the environment of the South Texas Plain. It is not unreasonable, however, to hypothesize that the Pacuache territorial range formerly included the eroded southern margin of the plateau and that winter hunting took them some distance northward into the plateau.

The 1729 report of a group of Pacuache hunters in Coahuila south of modern Del Rio, Texas, raises the question of whether the Pacuache range may at an earlier date have extended father west. This is possible, but no additional evidence can be cited. It may be significant that the Bosque-Larios expedition of 1675 passed across this more westerly area and recorded no encounters with Indian groups having names that resemble the name Pacuache (Bolton 1916:283-309). Likewise the rather extensive body of documents published by Portillo (1888; see also Figueroa Torres 1963) fails to record Pacuaches in Coahuila northward from Monclova prior to 1729. In brief, there seems to be little evidence of Pacuache ranging westward, southward, or eastward from the designated area on the South Texas Plain.

This review of data on the Pacuache territorial range helps to clarify the confused statements in the *Handbook of American Indians North of Mexico* (Hodge 1910, II), which in one place (p. 183) refers to "Pacuaches" as a "former tribe of northeastern Mexico or southern Texas" and in another place (p. 264) refers to "Pacuaches" as an Indian group that lived east of the "middle Nueces r., Texas." It also refers (p. 183) to a separate people, the "Pacuachiam," who lived on the "Rio Hondo, Texas." Both names refer to the population here formally designated as Pacuache, whose territorial range seems to have been almost entirely within what is now southern Texas.

Of some interest here is a ford on the Rio Grande that bears the name "Pacuache Crossing." According to Weddle (1968:5, footnote; 1973:137,footnote), who has visited the localities, two fords were commonly used during the Spanish Colonial period, and even later, to cross the Rio Grande in the vicinity of modern Guerrero, Coahuila, which is opposite extreme southern Maverick County, Texas. One of these fords, located approximately six miles southeast of Guerrero, has been variously known as Paso de Francis, Lower Crossing, Las Islas Crossing and Isletas Crossing. The other ford, farther up the Rio Grande and about six miles northeast of 'Guerrero, has been known as Paso Pacuache, Paso Paguache, Paso de Nogal, Paso de Diego Ramon, and Tlacuache ("Possum Crossing").

Weddle states that "El Paso Pacuache" (ibid.) was "so-named for the Coahuiltecan Indian nation known by that name" and then further says that "Some natives of the area maintain that the correct name is Tlacuache, or 'Possum Crossing." This raises a puzzling question. Since the Pacuache originally ranged the area north and northeast of the crossing and were the dominant group at Mission San Bernardo (near Guerrero), it seems appropriate and satisfying to find the name Pacuache attached to it. Yet, I have been unable to find a single reference to a Paso de Pacuache in documents of the Spanish Colonial period, when the Pacuache Indians still retained their ethnic identity. The few references encountered all refer to the nineteenth century and later. The earliest is the place name "Pacuache Crossing" on the Colton map of Texas published in 1873. In 1900 Coopwood, who lived near the lower Rio Grande, wrote that the ford was "still known as the Pacuache Crossing" (Coopwood 1900: 240- 241). More recently, Weddle and Warren (1969:end paper map and p. 9, footnote) indicate no pre-nineteenth-century origin of the name.

Possibly Weddle has provided an answer to this question when he cited his Guerrero informants as saying that the correct name is Tlacuache Crossing. Ximenes (1963:107,footnote), without giving a specific source, has said that "The Spanish settlers along the river called this ford El Paso de los Taquaches." Weddle's modern informants and Ximenes's "Spanish settlers" do afford some basis for an alternative explanation of how Pacuache Crossing received its name: migrants from southern Mexico to Coahuila could have brought the Aztec (Nahuatl) name for opossum *(tlacuache)*, and applied it to the river crossing. Somehow this became transformed into Pacuache during the nineteenth century.

PACUACHE POPULATION ESTIMATES

The only informative early estimates of total Pacuache population at specific times are those of Espinosa for 1708 and Sevillano de Paredes for 1727. Neither estimate appears in the table published by Ruecking (1953:493) showing recorded population figures for specific Coahuilteco-speaking groups.

Espinosa (1708:29; Maas 1915:34), who was a resident missionary at San Bernardo, stated that in the year 1708 the Pacuache population totaled more than 300 individuals, but he also said that the number had been considerably reduced by recent epidemics. At that time no Pacuache were living permanently at Mission San Bernardo. They were living most of the year across the Rio Grande in their traditional habitat. If it is assumed that the epidemics had reduced Pacuache population by a maximum of 25 percent, it is possible to argue that at the beginning of the eighteenth century there were probably at least 400 Pacuache in the general area. It may be that Espinosa's figure of 300 included small remnants of other local Indian groups associated with the Pacuache, such as the Sacuache and Tepacuache mentioned by Salinas Varona in 1693, but at present there is no way to determine if this is true.

The estimate of Sevillano de Paredes (1727:50) agrees well with that of Espinosa some 20 years earlier. Sevillano de Paredes, who had made an official inspection of Mission San Bernardo in 1727, noted that about 350 Pacuache had left the mission because of a food shortage and were living some 40 miles away, presumably in their homeland along the Nueces River and vicinity. The figure of 350 for 1727 suggests some recovery from earlier losses through epidemics.

The figures recorded by Espinosa and Sevillano de Paredes seem to indicate that the Indians designated as Pacuache in Spanish records constituted the most populous ethnic group in the vicinity of the Rio Grande missions early in the eighteenth century. This is supported by the San Bernardo mission Indian census of 1772 (Rodriguez 1772) in which 237 surviving Indian individuals are identified by ethnic group affiliation. Of these, 84 individuals (about 28 percent) are designated as Pacuache. For the next most populous group, the Pacoa, only 26 individuals (less than 11 percent) are recorded. Since relatively few Pacuache entered other missions in the Coahuila-Texas area, the figures for Pacuache population at each of these has little bearing on estimates of former maximum Pacuache population size.

Such evidence as is available today seems to indicate that the Pacuache numbered about 400 when the first missions were established in northeastern Coahuila, that most of them eventually entered Mission San Bernardo, and that they slowly declined in numbers during the eighteenth century, eventually losing their identity in the Spanish-speaking population that still exists in the vicinity of modern Guerrero, Coahuila.

PACUACHE LANGUAGE

Although words attributed specifically to the Pacuache alone have never been recorded, no doubt has ever been expressed about the Pacuache linguistic affiliation. This is because Bartholome Garcia (1760:title page), in his manual for administering Catholic rituals in the Coahuilteco language, listed the Pacuache among those who spoke that language. In a number of linguistic studies the Pacuache are referred to as Coahuilteco-speakers (Pimental

1865:409; Powell 1891:69; Swanton 1940:135; Troike 1959:2), and in each case classification is based on the Garcia evidence. Garcia's partial list of Coahuilteco-speaking groups is especially valuable, as noted earlier, because it appears to clarify the relationships of Pacao, Pacoa, and Pacuache. He clearly identifies the three as distinctively named populations who spoke the same language. The similarities in these names have been the source of considerable confusion, some of which still remains.

HOUSES AND SETTLEMENTS

At the time (1708) when he reported that "Pacuaches" were represented at Mission San Bernardo, Espinosa (1708:38–39) referred to their tendency to revisit their native territory north of the Rio Grande and temporarily resume their traditional way of life as a hunting and gathering people. In this passage he mentioned that they protected themselves when the weather was bad by constructing small shelters of tree branches covered by grasses. He further remarked that this particular structure, which he called *gruta* (grotto), was more appropriate for animals than for rational men. Since the context here seems to imply that the Pacuache took to the woods intermittently, the housing described suggests a simple, temporary shelter such as might be used when small parties were away from the main encampment and were caught by disagreeable weather. It was probably a semicircular structure with the open side facing away from the wind. Griffen (1969:104) reports what appears to be a similar structure used in 1600-1602 in southern Coahuila: "a place near Parras where the houses were small huts in the form of caves (*chosuelas a manera de cuebas).*"

In documents which refer to European observations of Pacuache temporary encampments, only four settlements are described in such a way that the accounts reveal any useful detail about the Pacuache settlement pattern, and this detail refers only to topographic positioning. These four cases seem to indicate that the Pacuache and their encampment associates preferred localities in wooded areas near streams (e.g. the Tortuga Flat site; Inman et al. 1999). Mazanet in 1690 (Gomez Canedo 1968:160) reported Pacuache and Indians from five other distinctly named groups as encamped on the "Rio Hondo," which is rather firmly identifiable as the Frio River. This shared encampment was evidently somewhere near the northwestern corner of modern Frio County. In 1693 Salinas Varona (ibid.:281-282) visited a Pacuache encampment in western Dimmit County. This was in an area traversed by numerous small streams and having an abundance of mesquite trees. Then in 1709 Espinosa (Tous 1930b:4) encountered three Pacuaches hunting mice near the right bank of the Nueces River in either northern Dimmit or southern Zavala County of today. Their encampment, although not visited , was said to be nearby in thick bottomland woods along the river. This is likely in the vicinity of site 41DM55, on the east side of the Nueces, where farming has exposed large numbers of Late Prehistoric, and possibly Protohistoric, artifacts

Later, after crossing the Nueces River and traveling northeastward to the "Sarco," believed to be the modern Leona River of eastern Zavala County, the Spanish party came to an encampment shared by 18 Pacuache and two Xarame. Presumably the flood plain of the "Sarco" was wooded, but Espinosa failed to comment on local vegetation.

The settlement pattern indicated by these four cases agrees with that of Late Prehistoric archaeological sites along the Nueces River and its short tributary creeks in Dimmit and Zavala Counties as reported by Hester and Hill 1975:3-7,17). It may be noted that Espinosa's Pacuache "mice hunters" (cf. Hester and Hill 1975) were searching an area in the vicinity of their encampment, presumably in a more upland area where the hunters could be readily seen by traveling Spaniards.

The observational records of European travelers are not particularly informative about the number of individuals in each encampment. The only record that appears to have value is that of Espinosa for the year 1709, the next year after he had reported that a total of over 300 Pacuache lived most of the year across the Rio Grande from Mission San Bernardo. Espinosa (Tous 1930b:4) refers to the encampment on the Leona River as consisting of 18 Pacuache and two Xarame individuals. Since Espinosa states that the Spanish party encountered these Indians when they (the Spaniards) had stopped to spend the night, it seems safe to conclude that the Indians were encamped nearby. This suggests that Espinosa's 300 Pacuaches north of the Rio Grande were living in dispersed small encampments most of the time. This would certainly be in line with the archaeological settlement patterns in Pacuache territory (Hester and Hill 1975).

SUBSISTENCE

Relatively little is specifically recorded about Pacuache subsistence activities, and this is connected with hunting certain kinds of animals—bison, deer, rats, and mice. Spanish eyewitness accounts of hunting refer only to bison (Berroteran 1729) and mice (Espinosa 1709), but these accounts can be supplemented by inferences made from other kinds of recorded data.

Dominguez de Mendozas itinerary is remarkably informative about bison in the Edwards Plateau because he took the trouble to record the number of bison killed to feed his men as well as the numerous Indians who joined him, seeking protection from Apaches. Mendoza reports that the first bison seen and killed were in the vicinity of present Fort Stockton, Texas, which is some 35 miles west of the Pecos River. Between that point and San Clemente, now believed to have been in the vicinity of Junction, Texas, his men killed 523 bison, and his daily notes indicate that bison became more numerous as the party moved eastward. During the six weeks at San Clemente (March 16 - May 1, 1684) Mendoza records the killing of 4,030 bison. While there he also wrote that "the number of buffalo is so great that only the divine Majesty, owner of all, is able to count them" (Bolton 1916:328). On the return trip to El Paso, between San Clemente and the Pecos River, 600 bison were killed, making a grand total of 5,153 bison killed by the Spaniards for food. This leaves little doubt about the winter food potential of the Edwards Plateau at that time, and it provides a very plausible explanation for the presence of the Coahuiltecan groups, such as the Pacuache, at or near Mendoza's San Clemente area. It also suggests that Apaches with horses, and this same food base, had a strong competitive advantage that eventually may have forced Coahuilteco speakers to curtail use of the plateau for winter bison hunting.

While no documents record actual observations of the Pacuache hunting deer, Spanish travel records, as might be expected, are liberally sprinkled with references to the abundance of deer in Texas south of the Edwards Plateau. For example, Espinosa (Tous 1930b:11) states that ". . . deer and fauna are so numerous that they resemble flocks of goats and are met with at every step."

In 1709 Espinosa (1708:38-39) made statements which permit us to link the Pacuache with a thriving trade in bison and deer hides at the San Juan Bautista presidio and associated missions. This trade is described in terms of exchanges with Indians living across the Rio Grande in present-day Texas. To quote from Espinosa (translation by Tous 1930b:12):

> They are much inclined to the chase, the men engaging in no other occupation. The women are trained to cure and tan the hides of buffalo and deer. These they curiously paint to trade to the Spaniards. . . The red and yellow dirt with which the Indians paint their hides. . . is very hard. . .

The pigments referred to are probably hematite and limonite. Although brief and generalized, these statements shed a little light on quadrupeds hunted, on kinds of hides processed and decorated, on the pigments used in a special art form, and on sex-linked activities.

The reference by Espinosa (Tous 1930b:4) to Pacuache use of mice for food in the area now embraced by Dimmit and Zavala Counties is of special interest because archaeological investigations in that area have produced abundant evidence of the use of mice and rats for food during the Late Prehistoric and Protohistoric periods (Hester 1975a:116-117; Hester and Hill 1972:39,59,75; Hester and Hill 1975:25-29; Hester et al. 1975:226). In the bone refuse from midden contexts of six archaeological sites at least four species have been identified: packrat (*Neotoma micropus*), cotton rat (*Sigmodon hispidus*, white-footed mouse (*Peromyscous* sp.), and pocket mouse (*Perognathus* sp.). The report of Pacuache interest in mice as a food resource seems to indicate continuity of a dietary tradition from the Late Prehistoric into the early Historic period of the area specified.

Hester and Hill (1975:21) and Weddle (1968) refer to a documented case of "rat hunting" by an

Indian woman in the same general area and suggest (p. 22) that rat hunting may have been a sex-linked activity. Espinosa's report of mice hunting by three Pacuache individuals does not specify their sex. Spanish documents of the time, however, customarily identify females when they are present; if the sex is not indicated, the individual or individuals may be assumed to be male. In my opinion, Espinosa's three "Pacuasian" individuals seen hunting mice were probably males. This, of course, is presumptive evidence and does not discredit Hester and Hill's suggestion. As a matter of fact, their suggestion is supported to some extent by an additional case reported by Espinosa (1746:482-484) summarized by Rios (1959:109-110). This refers to an incident of the year 1715, when Indians at missions San Bernardo and San Juan Bautista rebelled, and a missionary and two friendly Indians fled southward. They were overtaken by a group of Payuguan Indians and held captive for eight days before being released. During their captivity it is said that a Payuguan woman fed them rats and roots. This does not prove that Payuguan women actually hunted rats. It does suggest that, since rats and roots are mentioned together, both sexes may have taken rats when the opportunity arose. If women customarily dug roots, they would undoubtedly sometimes encounter rats while searching for roots. Likewise, when men were out looking for larger game but were finding none, they might settle for any smaller game encountered. The Payuguan, incidentally, were reported in association with Pacuache on the Frio River by Mazanet in 1691 (Gomez Canedo 1968:236).

No written sources refer to weapons used by Pacuache in hunting. The bow and arrow were undoubtedly used, and this is supported by late documents (1775) which refer to four Pacuache males from Mission San Bernardo who were convicted of murdering an unidentified man at San Antonio (Perez 1775; 121-122; Ripperda 1775:119). According to these documents, one of the Pacuache "shot" the man (weapon not specified), a second put an arrow into the victim, and a third clubbed him with a stick. It is doubtful if guns were often used by Pacuache prior to 1730. Indeed, only three gunflints were found during excavations in the Indian quarters at Mission San Bernardo (Inman 1999).

USE OF HORSES

No documents report Pacuaches routinely riding horses either in hunting or in travel, and it seems unlikely that they ever had very many horses at any time. This may help to explain loss of their territory to mounted Apache populations. Only two records link the Pacuache with horses, and both of these refer to individuals who were caught with horses stolen from Spaniards.

The first case appears in records of the Ramon expedition of 1716. Some 20 Spanish horses were stolen by five Pacuache males when the expedition was encamped overnight in what is now western Dimmit County, Texas (Foik 1933:9-10; Tous 1930a:6). Apparently these Pacuache had learned Apache raiding techniques: a small group of men slipped in at night, drove off a small herd of horses without being detected, and managed to get at least 10 miles away before being overtaken by the Spanish soldiers who trailed them. This feat certainly indicates that by 1716 the Pacuache had learned much about handling horses and considered them desirable. Ruecking (1955:355), in referring to this episode, has suggested that the stolen horses may have been taken for food. This is possible, but the diaries of Ramon and Espinosa say nothing that lends support to such an interpretation. Archaeologists have not yet found horse bones or horse trappings in controlled excavations at Protohistoric sites of inland southern Texas (Hester 1975a:116-120).

The second reference to Pacuache and horses is late in time, 1774, when four Pacuache males from Mission San Bernardo stole several horses at San Antonio. When arrested, three horses were in their possession (Ripperda 1775:119).

COMMUNICATION METHODS

In 1709, when Espinosa (Maas 1915:51; Tous 1930b:4) reported a few Pacuache out hunting near the boundary of present-day Dimmit and Zavala Counties, he mentioned that some of the Indians nearby remained in the wooded bottomland and never showed themselves. He said that these Indians in the woods made a thick smoke when the Spaniards approached. Ruecking (1955a:335; 1955b:382) has referred to this use of smoke as a "smoke screen," presumably meaning that it was for concealment while taking evasive action. If these Indians were already hidden in the woods, smoke would only have served to call attention to their presence. A more plausible hypothesis is that the smoke served as a means of communication (smoke signaling) with others who were out hunting or gathering in the vicinity.

In 1693, when Salinas Varona visited a Pacuache encampment in what is now western Dimmit County, he recorded in his diary a few details that throw light on distant communication among Indian groups of southern Texas. These Pacuache warned Salinas Varona, who was on his way to eastern Texas, that on the "*rio de San Marcos* (Colorado River)... *la nacion jumana y tobosos*" was waiting to attack the Spaniards and take their horses, mules, and cargo of supplies. This information turned out to be reasonably accurate, for Salinas Varona (Gomez Canedo 1968:281-282,287) later encountered a large party of Jumano Indians from western Texas in the area northeast of present-day San Antonio, not far from the Guadalupe River. Having been forewarned, Salinas Varona took the necessary military precautions and was not attacked. The airline distance between the Pacuache of Dimmit County and the Jumano encampment near the Guadalupe River was at least 110 miles. Apparently these Pacuache were well informed about things that were going on at considerable distances, which suggest that there was some kind of informal but rapid communication system ("bush telegraph") among the hunting and gathering Indians of southern Texas.

TRADE

In 1708 Espinosa (1708:38; also Tous 1930b:38-39) referred to an interesting set of trading relationships that had developed between Indians who still lived under native conditions north of the Rio Grande and both Spaniards and mission Indians at and near Presidio San Juan Bautista. The Indians from north of the river brought in dressed hides of bison and deer, some of which had designs in red and yellow paint, as well as additional unspecified artifacts which Espinosa referred to as "otras curiosidades." Presumably the trans-Rio Grande Indians received in exchange various items of European and Mesoamerican Indian manufacture.

This trade was of such volume, according to Espinosa, that local Spaniards jokingly referred to San Juan Bautista as "el Cadiz de los Indios," that is, a notable locus of trade reminiscent of Cadiz, the famous seaport of southern Spain. As the Pacuache at this time spent most of the year north of the Rio Grande, coming into Mission San Bernardo only seasonally, they were undoubtedly active in this early, informal frontier trade. However, only a few *Oliva* ornaments and shell beads made of marine shell from the Texas Gulf Coast appear to be related to trade (Hester 1975b).

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AEG	Archaeology and Ethnohistory of the Gateway area, Middle Rio Grande of Texas. Mimeographed reports submitted to the National Endowment for the Humanities by The University of Texas at San Antonio
AGI	Archivo General de Indias, Seville
AGN	Archivo General de la Nacion, Mexico.
AHSJB	Archaeology and History of the San Juan Bautista Mission Area, Coahuila. The University of Texas at San Antonio.
BAE-B	Bureau of American Ethnology, Bulletin. Washington.
BTAS	Bulletin of the Texas Archeological Society.
BTHCA	Barker Texas History Center Archives, the University of Texas at Austin.
SA	Saltillo Archives, Saltillo, Coahuila.
SFA	San Fernando Archives, San Antonio, Texas.
SHQ	The Southwestern Historical Quarterly (formerly the Quarterly of the Texas State Historical Association). Austin.
TCHS	Preliminary Studies of the Texas Catholic Historical Society. Austin.
TJS	The Texas Journal of Science. San Angelo.

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Prehistoric Land Use Patterns Along the Southern Edge of the Edwards Plateau: A View from Camp Bullis, Texas

Peter Pagoulatos

ABSTRACT

This study presents summary results of prehistoric archaeological investigations at the Camp Bullis military installation, Texas. With the completion of a systematic 30-meter-interval transect base-wide survey, a standardized research methodology was employed using random sampling (nonsite) units to statistically compare environmental attributes such as soils, drainage, hydrology, and topography against documented archaeological site locations. These data were collected using GPS/GIS technology. This analytical approach has resulted in the development of predictive models and a better understanding of Native American land-use patterns along the southern edge of the Edwards Plateau.

Prehistoric sites consist of generalized camp sites (Bases) and specialized extractive stations (Targets) which span the entire prehistory of the region, dating from 11,500 to 350 years B.P. Although sites date from Paleoindian to Late Prehistoric times, the majority of sites date to the Middle and Late Archaic periods. Site distributions produce a dual, or two-level settlement system, where multiple activity base camps were situated on low terraces and floodplains proximate to Salado Creek, where populations exploited a variety of resources during the warmer (summer-fall) months, while sites predominantly contained within adjacent drainage systems (and tributaries) are mostly found on higher elevated (south-facing) landforms, and may represent more specialized burned rock mounds and extractive stations, which may imply occupation of these areas during the colder months (winter-spring) of the year.

INTRODUCTION

The primary purpose of this study is to present results from a large-scale archaeological survey at the Camp Bullis military installation, in Bexar and Comal counties, in south-central Texas (Figure 1). By the late-1970s, a long-term cultural resource survey had begun to inventory all archaeological sites for National Register (NR) eligibility. In 2003, in conjunction with these surveys, a research methodology was initiated using random sampling (nonsite) units to statistically compare environmental attributes such as soils, slope, drainage, hydrology, and topography against documented archaeological site locations. These data were collected using Global Positioning Systems (GPS) technology and then entered into a Geographic Information System (GIS) database at Camp Bullis. This analytical approach has allowed the Army to better predict for prehistoric site occurrence at Camp Bullis, as well as to better manage land on the installation in relation to the Army training mission, with the ultimate goal of developing archaeological sensitivity assessments and corresponding predictive models.

The Camp Bullis military installation encompasses nearly 27,987 acres (11,285 hectares), which is subdivided into Cantonment, Maneuver and Impact areas (Figure 2). The installation is entirely located within the Edwards Plateau physiographic province, locally known as the Texas Hill Country, or Balcones Canyonlands, which is unique in its combination of topography, karst geology, soils, water resources, flora, and fauna. This region (Camp Bullis) was inhabited by Native American populations long before European colonization took place. Native American populations occupied this unusual and diverse ecosystem during the last 11,500 years, including Paleoindian, Archaic, Late Prehistoric and historic

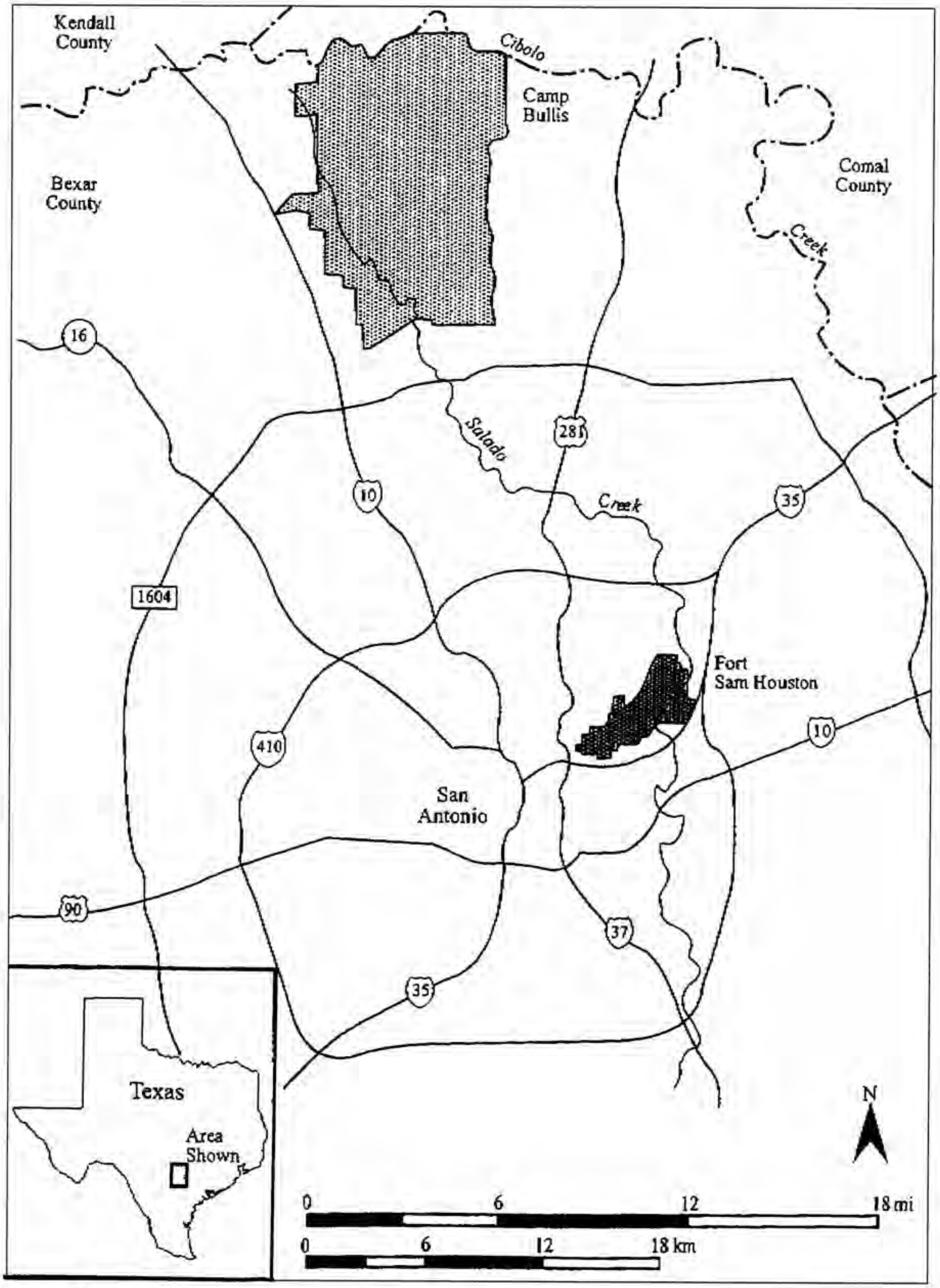

Figure 1. Location of Camp Bullis Military Installation.

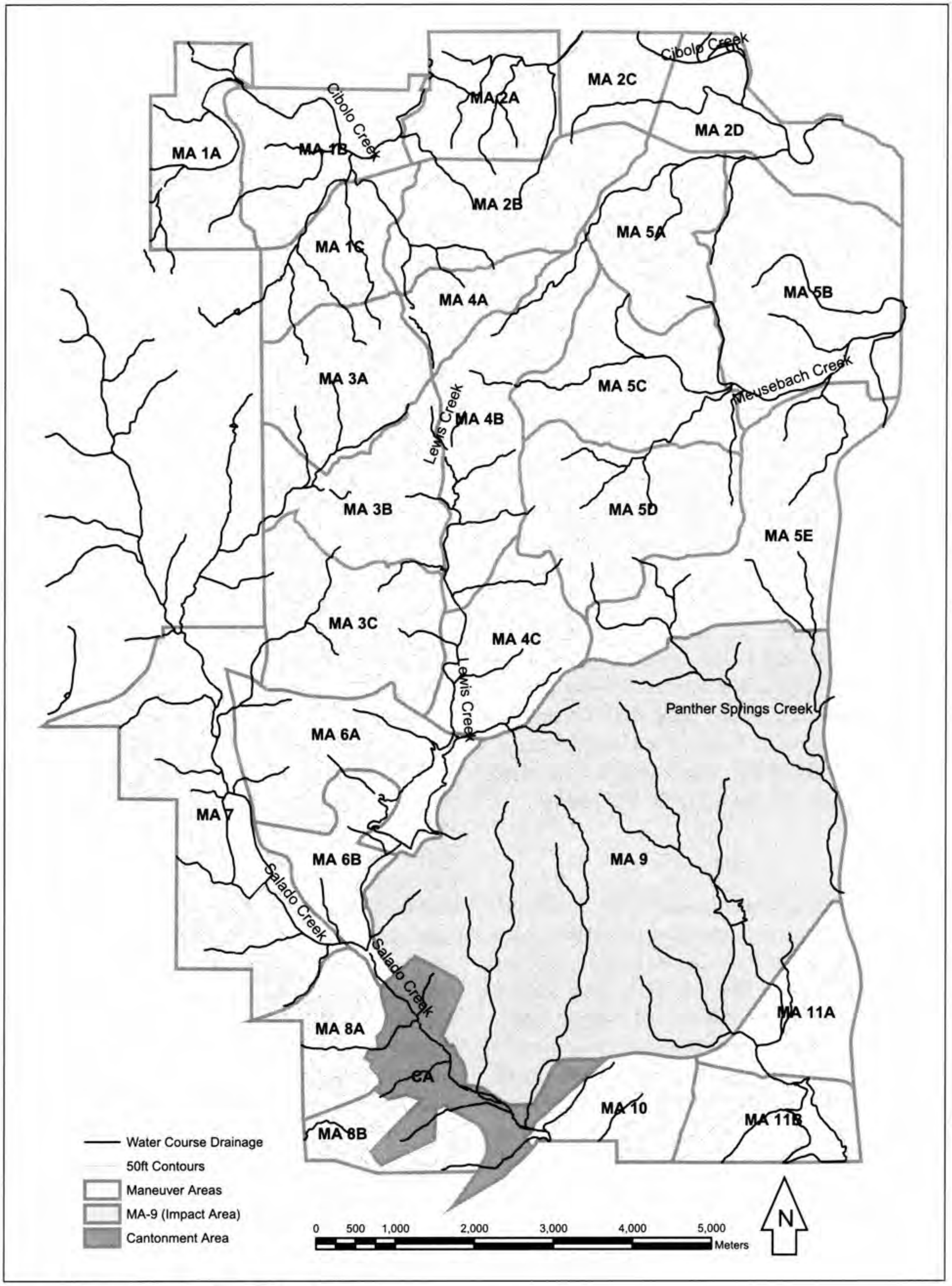

Figure 2. Location area—Camp Bullis, Texas.

(Coahuiltecan/Apache/Comanche) cultural groups. Initial settlement of the present-day Camp Bullis area by Euroamerican (German and Anglo) populations occurred by the mid-nineteenth century, with the establishment of agricultural settlements, such as ranches and stock farms.

The Camp Bullis military installation was established in 1906, primarily serving as a training and demobilization center during the two World Wars. Currently, the installation primarily serves as a field-training environment in support of the Army Defense Medical Readiness Training Institute from Fort Sam Houston.

PHYSICAL ENVIRONMENT

Ecosystem

Camp Bullis is entirely located within the Edwards Plateau physiographic province, an important ecological area in south-central Texas, which closely borders the Blackland Prairie and Gulf (Inner) Coastal Plain. The Edwards Plateau is composed of smooth plains and hills; the dominant ecosystem on Camp Bullis is juniper-oak woodland. This Edwards Plateau area, locally known locally as the Texas Hilly Country, or Balcones Canyonlands, is unique in its combination of topography, karst geology, soils, water resources, flora, and fauna as described below (FSHNRO 2001).

Geology

Camp Bullis is primarily underlain by formations of the Edwards Group, including the Lower Glen Rose, the Upper Glen Rose, and the Kainer Formation of the Edwards Group. The Upper Glen Rose consists of beds of moderately resistant and massive chalky limestone alternating with beds of less resistant limestone; this formation is predominantly found across the central and northern portions of the property. The Lower Glen Rose is present along the northern edge of the installation; overlying a small portion of the Glen Rose at the southern edge of Camp Bullis is the Kainer Formation. The Edwards Group contains mostly limestone and lesser amounts of chert inclusions, especially in the southeastern corner of the property; limestone predominates, however, which is gray to white, dense and hard semicrystalline in nature (FSHNR 2001; Veni 2005).

Topography

Camp Bullis is located in south-central Texas and lies on the eastern edge of the Edwards Plateau; this portion of the Edwards Plateau is situated on a fault zone, separating it from the Blackland Prairie and the Gulf (Inner) Coastal Plain. The topography of the property consists of numerous hills and valleys that are drained by numerous streams that flow east and south into the San Antonio River. The topography of Camp Bullis generally ranges from 300 to 460 meters above mean sea level (amsl), with lower elevations along stream courses and floodplains and higher elevations on ridges and hilltops in the central and northern parts of the installation (FSHNR 2001).

Soils

The Tarrant and Bracket series are the two dominant soil association contained with Camp Bullis; these tend to be well-drained, thin clay loam soils, formed in association with stream deposits or from the erosion and weathering of underlying limestone. Tarrant Association soils occur on gently undulating (1-5%) slopes, while Brackett Association soils are on steeper (12-30%) slopes. Other soil mapping units on the property include Crawford, Krum, Trinity and Frio, Lewisville, Patrick, Venus, and Comfort soils; these soils are generally located on the lower portion of slopes, in floodplains of drainages, and in streambeds. Crawford soils are predominantly stony and occur on nearly level to gently undulating (0-5%) areas; Krum soils are moderately deep clay and are situated on gentle foot slopes below the Tarrant and Brackett soils. Trinity and Frio soils are clayey and generally occur in floodplains and drainage systems, while Lewisville, Comfort, Patrick, and Venus soils are found scattered along stream terraces (Batte 1991; Taylor et al. 1991; FSHNR 2001).

Hydrology

Five major creeks known as Cibolo Creek, Salado Creek, Lewis Creek, Panther Springs Creek, and

Meusebach Creek have their headwaters at or near Camp Bullis, and flow into the San Antonio River, to the south (Figure 2). Cibolo Creek flows from west to east across the northernmost portion of the installation; Salado Creek, beginning near the northwestern boundary, generally flows in a south-southeasterly direction across the property. Lewis Creek drains the central portion of the installation and flows into Salado Creek to the southwest. Meusebach Creek drains the northern part of Camp Bullis and feeds into Cibolo Creek. Panther Springs Creek drains the southeastern part of the property and joins with Salado Creek south of the installation (FSHNR 2001).

Climate

The Camp Bullis area has a modified subtropical climate, characterized by a moderate range of temperature, with relatively mild winters, warm in the spring and fall, and hot and humid during the summer months. The average monthly temperature typical ranges from a low of 40 degrees Fahrenheit (F) in January to a high of 95 degrees F in July and August. The average annual precipitation is 71cm. This area has an average of 265 frost-free days per year (FSHNR 2001).

Flora and Fauna

Camp Bullis contains a wide variety of Edwards Plateau ecosystem flora and fauna. Over 500 plant species have been identified on Camp Bullis lands, with the dominant plant species being live oak (*Quercus fusiformis)* and Ashe's juniper (*Juniperus ashei)*. The forests and savannas of the installation are also home to 57 mammal, 358 bird, 8 anthropod species, as well as 92 species of reptiles and amphibians. Primary mammal species consist of white-tailed deer (*Odocoileus virgininaus)*, eastern cottontail (*Sylvilagus floridanus)*, black-tailed jackrabbit (*Lepus californicus)*, fox squirrel (*Scuirus latrans)*, gray fox (*Urocyon cineroargenteus*), raccoon (*Procyon lotor*), coyote (*Canis latrans)*, and bobcat (*Lynx rufus)* (FSHNR 2001).

Lithic (Stone) Resources

The ready availability of sources of lithic raw materials is known to be one of many key factors influencing prehistoric Native American settlement and natural resource exploitation patterns. The Edwards limestone formation contains surface-visible (bedded) chert in the southeastern corner of Camp Bullis, which is underlain by Edwards limestone. Chert nodules also exist along terraces of Cibolo Creek across the northern portion of the installation; Cibolo Creek lies on the Glen Rose limestone formation, which is not chert bearing, so the chert nodules in this area were probably transported from upstream, where Cibolo Creek runs through the Edwards limestone formation (FSHNR 2001).

Cultural Environment

The prehistoric habitation of south-central Texas is generally subdivided into three periods, Paleoindian, Archaic and Late Prehistoric. The *Paleoindian Period* of the region occurred between 11,500 and 8,800 B.P. The Late Pleistocene climate of this portion of the state was cool and moist, with a trend toward warmer and drier conditions by the early Holocene (Bryant and Shafer 1977; Bryant 1977; Shaw et al. 1980; Toomey et al. 1993; Nordt et al. 1994; Johnson and Goode 1994; Collins 1995; Bousman 1994; Hudler 2000). Paleoindians were migratory hunter-gatherers traveling in small bands, exhibiting a high degree of mobility. Settlement patterns indicate small, ephemeral sites with low density artifact scatters; subsistence procurement appears to reflect the exploitation of a wide range of plant and animal resources, rather than a concentration on megafauna (Collins 1995:381). Collins (1995:381-382) subdivides projectile point types into two primary groupings; the earlier subperiod (11,500-10,000 B.P.) consists of Clovis and Folsom forms, while the latter subperiod (10,000-8,800 B.P.) includes Wilson, Plainview, Golondrina, and Barber varieties.

Warming and drying conditions occurred after 8,800 B.P., with a gradual trend toward less effective moisture and high aridity until about 2,500 B.P. (Bryant and Shafer 1977; Johnson and Goode 1994; Bousman 1994; Hudler 2000). Climatic intervals returned to more mesic, or wet conditions between 2500 and 1200/1000 B.P. (Bousman 1994; Toomey et al. 1993; Johnson and Goode 1994; Collins 1995). This overall trend toward drier conditions in the region corresponds with what is traditionally known as the beginning of the *Archaic Period*. The Archaic generally dates between 8,800 and 1,200 B.P. The Archaic is characterized by a broad spectrum economy, as foragers exploited a wider range of plants and animals, from the preceding cultural period. Technological innovations included the introduction of ground stone tool technology and a variety of dart point forms (Turner and Hester 1999). Settlement patterns reflect longer-term habitation sites, suggesting greater territoriality, a decrease in mobility patterns, and a trend toward greater residential stability (Collins 1995).

The *Archaic Period* is subdivided into three subperiods: Early, Middle and Late. The *Early Archaic Period* (8,800-6,000 B.P.) is characterized by small sites with varied assemblages; however, there is a tendency for Early Archaic sites to be concentrated along the southern margins (Camp Bullis area) of the Edwards Plateau, which may indicate that locally favorable climatic conditions may have resulted in abundant plant and animal resources in this region (Collins 1995:383). A variety of new point forms and artifact classes appear, consisting of Angostura, Gower, Uvalde, and Martindale point types, as well as Clear Fork and Guadalupe tools, which were probably used as woodworking implements (Collins 1995:383; Turner and Hester 1999). By the Early Archaic, rock hearths and ovens become more common, which may have been used for specialized root/bulb cooking; these may have been predecessors of subsequent burned rock mounds (Collins 1995:383).

The *Middle Archaic Period* (6,000-4,000 B.P.) yields larger and more numerous sites, which may reflect higher residential stability and possible population increases (Story 1985:40; Collins 1995: 379); burned rock mounds make their initial appearance at this time, as groups may have concentrated there efforts cooking xerophytes, which would have thrived in this region, as conditions continued to dry (Collins 1995:384). Bell, Andice and Taylor point varieties have been identified during the earlier portion of the Middle Archaic, while La Jita, Nolan and Travis types were used by the latter portion of the period (Collins 1995:383-384).

Population growth continued into the *Late Archaic Period* (4,000-1,200 B.P.), as occupations (still using burned rock mound technology) are even larger and more numerous; also, large cemeteries were established along major drainage systems, suggesting that certain groups had strong territorial ties in the region by this time (Story 1985:44-45). An even wider variety of projectile point forms have been identified; those of the early portion of the Late Archaic consist of Bulverde, Pedernales, Kinney, Lange, Marshall, Williams, Marcos, Montell, and Castroville varieties, while those of the latter part of the Late Archaic include Ensor, Frio, Fairland, and Darl forms (Collins 1995:384).

The *Late Prehistoric Period* in south-central Texas generally dates between 1,200 and 260 B.P. Climate and physiography closely approximated modern conditions by this time across the southern Edwards Plateau region, as conditions were generally more moist from preceding times, with a returning dry episode from 500 to 400 B.P. (Bousman 1994:80; Collins 1995: 379). The chronological division of the *Late Prehistoric Period* is based primarily on the introduction of the bow and arrow, followed by bone-tempered pottery. Sites tend to be smaller and less numerous by this period, and groups may have been more dependent upon bison-hunting at this time. Arrow typology consisted of Edwards, Scallorn and Perdiz varieties (Collins 1995:379).

Local Chronology

Hunter-gatherer groups of the Edwards Plateau region appear to have been characterized by high residential mobility, dependent upon seasonally available resources; a wide range of occupation (site) types have been encountered, such as quarries, campsites, special purpose loci, and cemeteries (Collins 1995). Although hunter-gatherer groups appear to have been mobile, without permanent village settlements, scholars have debated the degree of mobility and territoriality across the Edwards Plateau and surrounding biomes (Potter et al. 1995).

Regionally important archaeological sites have been identified along the Salado, Panther Springs, Leon, Olmos and Culebra creeks, proximate to Camp Bullis; these sites generally represent seasonal encampments with varied features (i.e., burned rock mounds, hearths, activity areas) which were re-used by aboriginal groups, spanning the entire prehistoric period (Collins 1995).

Paleoindian and Early Archaic sites in this region tend to be situated on upland terraces, ridges, and floodplains, including sites such as 41BX27 (Hester and Kohnitz 1975), 41BX52 (Collins et al. 2003), 41BX228 (Black and McGraw 1985), and 41BX229 (Hester 1995). Middle and Late Archaic loci tend to be found on lower terraces, proximate to water sources, containing complex burned rock mounds, hearths, and cemeteries. Sites such as 41BX47 (Tennis and Hard 1995; Tennis 1996), 41BX126 (Nickels et al. 2001), 41BX184 (Black et al. 1998), 41BX228 (Black and McGraw 1985), and 41BX300 (Katz 1987) have produced multiple hearths and burned rock mounds, while 41BX1 (Lukowski 1988) and 41BX17 (Schuetz 1966) contain numerous Late Archaic human interments. Late Prehistoric sites such as 41BX228 contain Scallorn (arrow) projectile point forms and clay pottery, directly associated with bison procurement and processing (Black and McGraw 1985).

To date, about one-fifth (N=350, 21%) of all state-registered sites in Bexar county are located within Camp Bullis. Even so, relatively few (N=17, 4.9%) of the registered prehistoric sites have been subjected to large-scale (subsurface) testing (Kibler and Gardner 1997; Kibler and Scott 2000; Wilder et al. 2003; Pagoulatos 2007). The vast majority of sites at Camp Bullis have only been surface inspected, yielding stone tool and burned rock scatters; however, more substantial occupations and burned rock mounds have also been encountered. Temporally-diagnostic point forms from these sites span the entire prehistory of the region, dating from the Paleoindian to Late Prehistoric periods. Selected projectile point forms from Camp Bullis are illustrated in Figure 3.

Although prehistoric sites are generally oriented toward creek beds and rock outcroppings, they are also found on hilltops, ridges, flats, benches, side slopes, caves, sinkholes, and rockshelters. Sites have been provisionally classified as residential camps, quarries, special-purpose loci, and human interments, or burial cemeteries (Gerstle et al. 1978; Hines 1993; GMI 2001; Pagoulatos 2007).

RESEARCH METHODS

Fieldwork and Sampling Schemes

Phase 1 Fieldwork

Initially, the whole installation was subjected to a 30-meter-interval transect pedestrian survey to identify surface-visible archaeological resources; this first phase of investigation consisted of field crew walking parallel transects at intervals of 30m. This survey technique proved to be largely successful since much of Camp Bullis is characterized by thin sediments and limestone bedrock exposures.

Discovered archaeological sites were defined based on three or more artifacts within a 25m-diameter area. When cultural materials were encountered, the surrounding area was closely examined, located on corresponding 7.5-minute USGS topographic maps, and recorded using a Garmin E-Trex GPS receiver. All surface-visible cultural material was recorded, but only diagnostic artifacts were retained; surface-visible features were also mapped using GPS. Corresponding site information was recorded onto State of Texas Site Data Forms and subsequently transferred to the computerized TexSite database.

Phase 2 Fieldwork

The second phase of investigation consisted of revisiting archaeological sites which were determined

Figure 3. Selected prehistoric artifacts from Camp Bullis, Texas: (a) Paleoindian, Clovis; (b) Early Archaic, Uvalde; (c) Middle Archaic, Nolan; (d) Late Archaic, Perdenales; (e) Late Prehistoric, Perdiz.

as potentially eligible to the NRHP. These sites were usually subjected to a closer inspection of surface-visible artifacts and features, shovel tests, larger excavation units, and occasional backhoe trenches, when necessary. The initial surface inspection consisted of a one hundred percent (field) analysis of surface-visible artifacts; code sheets were used in the field to analyze all individual artifacts. Only chronologically diagnostic items were retained.

Once the surface examination was completed, shovel tests were systematically placed at 15 or 30m-intervals, according to a grid pattern, to define site size and boundaries; shovel testing was decreased to 5m-intervals, when high artifact densities were encountered. Shovel tests measured 30 centimeters (cm) in diameter and were hand-excavated in 10 cm arbitrary levels with all soil matrix screened through one-quarter ($^1/_4$) inch hardware mesh cloth. The shovel tests were usually excavated to a maximum of 60 cm below surface, or until sterile deposits were encountered.

With the completion of the shovel test program, larger, hand-excavated one-meter by one-half meter (1m x 0.5m) and one-meter-square (1m x 1m) units were placed in areas yielding high artifact densities or where cultural features were encountered; larger unit testing was designed to illicit more fine-grained information on site stratigraphy, function and activities. Also, occasional backhoe trenches were excavated to examine complex site stratigraphy across certain sites (Wilder et al. 2003). Excavation units were generally dug in 10 cm artificial levels unless natural or cultural stratigraphic/depositional units were detected. Natural depositional zones were dug in 10 cm or thinner layers making sure that each zone was kept separate from underlying zones. Discovered cultural features were cross-sectioned, mapped, and photographed; soils samples from features were collected, whenever possible for analysis.

DATA COLLECTION

Locational Data

Both GIS and GPS technology were utilized on cultural resource surveys at Camp Bullis. GPS point data was collected using a Garmin E-Trex GPS receiver; GIS data was in Intergraph Modular GIS Environment (MGE) Version 6.0 format operating on a Microsoft Windows NT configuration. The associated attribute data for each element was compatible with the current data base management system (DBMS) supporting MGE at Camp Bullis, MSSQL. Additionally, the data collection system was required to meet the current Tri-Service GIS/Spatial Data Standards for cultural data for all delivered data sets. These techniques allowed for greater accuracy and standardization of field testing and data collection procedures.

Standardized procedures were used to record the location of all documented archaeological sites; all archaeological sites were recorded using GPS and entered into the GIS system at Camp Bullis. Once in the GIS system, cultural attributes were recorded for each site, such as site chronology, type, size, function, features types, and the presence or absence of different artifact classes. Subsequently, these site data were then entered into the GIS database, and evaluated against GIS data layers such as geology, topography, soils, streams, and military training zones.

Environmental Data

A standardized methodology has been implemented, as GPS data from both archaeological sites and randomly selected nonsite collection points (from 500 meter square block units) were evaluated against certain GIS environmental data layers. Five variables were selected to examine the relationship between human land use and the environment: (1) distance to major streams, (2) surface slope, (3) elevation, (4) aspect, and (5) soil type. Environmental data was collected from existing United States Department of Agriculture Soil Conservation Service soil surveys (Batte 1991; Taylor et al. 1991), the Natural Resources Conservation Society (NRCS), and United States Geological Survey (USGS) maps. Each form of environmental data is described in greater detail below.

Distance to Major Streams

As freshwater is basic to human existence, land use should be closely correlated to flowing bodies of water such as streams. Even more importantly, the ease of travel and the amount of food will generally increase as the freshwater source becomes larger and more permanent; therefore, human land use should be expected to be most intense in the vicinity of large bodies of freshwater such as streams.

Stream rank is an indirect measure of the size and volume of any flowing body of water (Strahler 1952). Streams are defined as any flowing body of water, including rivers, streams and other intermittent watercourses. According to a modified Strahler system, small unbranched headwater streams were designated as Rank 1. Below the confluence of two Rank 1 streams, a stream was designated as Rank 2. Two, Rank 2 streams became a Rank 3, two Rank 3 streams became Rank 4, and so forth.

Using stream rank data from Camp Bullis and the surrounding region, the San Antonio River drainage basin contains headwaters and corresponding feeder streams which have their origin in Camp Bullis and sources to the north. The San Antonio River would be considered a Rank 4 watercourse, while feeder streams such as Cibolo Creek and Salado Creek would be typical of Rank 3 tributaries. By contrast, watersources such as Lewis Creek and Panther Springs Creek which feed into Salado Creek and Meusebach Creek which feeds into Cibolo Creek would be considered Rank 2 tributaries; smaller, headwater streams which feed into these streams would be intermittent, Rank 1 streams.

While these creeks (Salado, Cibolo, Lewis, Panther Springs, Meusebach) would generally be considered secondary feeder streams within the greater San Antonio River basin, they are the dominate, or major streams within the boundary of the installation. Using USGS maps, NRCS information and GIS data, the nearest distance of both site and nonsite points was measured (as were all environmental variables listed below) against these major streams.

Surface Slope

Humans tend to locate themselves in places which are generally level, with little slope, for ease of travel, habitation and communication. Thus, the degree of slope is an important factor in site location. Surface slope is defined as the vertical distance divided by the horizontal distance, multiplied by 100 (Taylor et al. 1991). For example, surface slope is 10 percent when there is a drop of 3 meters in 30 meters of horizontal distance. For the purposes of this study, surface slope types included level to nearly level (0 to 5 percent), gently sloping (6 to 10 percent) and steep (greater than 10 percent). The initial step in determining the slope value was to identify the soil types and slope within it, based upon existing NRCS and GIS data. The percentage of each slope type is then calculated, generally measuring between 0 and 30 percent. Selection of surface slope was also based on the soil type a test point was located on.

Aspect

Humans tend to position themselves to maximize exposure to sun (warmth) in winter, and tend to minimize exposure to wind and cold in winter. For example, a southern (aspect) exposure will maximize exposure to sun and warmth during the winter months in the northern hemisphere. Aspect is defined as the direction in which the slope of the ground descends, or the compass direction a test point faces. Aspect was determined by using USGS maps, existing NRCS information, and GIS data. Aspect type (slope direction) was based on the cardinal directions. Aspect type was based on test point location.

Elevation

Elevation is determined by using USGS maps and GIS data, by assigning the elevation above mean sea level (amsl) in meters. Surface elevation was measured based on test point location.

Soil Types

Humans tend to locate themselves in optimal habitat locations, close to several resource zones, thus minimizing movement across the landscape. Soil types are considered important because they are a major determinant of biotic communities which develop on them. Soil types differ in drainage and slope characteristics. Information concerning different soil types was gathered from USDA soils maps, NRCS data, and the GIS system. Selection was based on the soil type a test point was located on.

Cultural Data

Different types of cultural data were used to interpret human behavior, as reflected in the archaeological record. Cultural Data used in this study included: (1) the classification of specific prehistoric artifact classes in conjunction with statistical methods to discern the range of human (cultural) activities at a site, (2) the establishment of occupation types, and (3) settlement patterns and an assessment of land use models. Each form of cultural data is discussed below.

Artifact Class Index

The Artifact Class Index (ACI) is a simple statistical measure which is designed to assess the range of human activity at archaeological sites based upon the presence of specific artifact classes (Pagoulatos 2001, 2004). The ACI was determined by the presence or absence of 20 major artifact classes, including projectile points, unspecified unifaces, scrapers, unspecified bifaces, unspecified groundstone, knives, drills, utilized flake tools, unspecified waste flakes, preforms, shatter, tested cobbles, cores, hammerstones, choppers, manos, metates, gouges, gravers and burned rock.

The ACI is calculated by adding up the total number of different artifact classes from a particular site artifact assemblage and dividing this sum total by the total number of categories (20) recorded in this study. The ACI ranges from 0 to 1.00. For example, a site containing only two different artifact classes (i.e., points, scrapers) would yield an ACI of 0.10. In this example, the presence of only projectile points and scrapers suggests that the hunting (and possibly processing) of mammals was an important activity at this location. Therefore, this ACI reflects a rather specialized location where a limited range of activities took place. By contrast, an ACI of 0.80 would contain 16 of 20 possible artifact classes, and would represent a much more variable assemblage, reflecting a wider range of activities.

Occupation Diversity Index

The Occupation Diversity Index (ODI) is a measure which is designed to assess activity classes across archaeological sites, on the basis of specific artifact groupings. The ODI was determined by the presence or absence of six primary artifact groupings from the 20 major artifact classes constituting the ACI, including hunting (H), plant processing (P), woodworking (W), tool manufacturing (T), burnt rock (B), and general purpose (G) implements. For example, hunting implements consist of projectile points, drills, scrapers, and knives.

The ODI is calculated by adding up the total number of different artifact groupings from a single site assemblage. The ODI ranges from 1 to 6. For example, a site containing only two artifact groupings (i.e., hunting, burnt rock) would yield an ODI of 2. In this example, the presence of only hunting implements and burnt rock would likely indicate that specialized mammal processing and cooking took place. By contrast, an ODI of 6 would reflect a wider range of artifact groupings, perhaps representing a wider range of cultural activities

Occupation Types

This measure of activity variability as expressed by the ACI is used in part for the definition of occupation types (an occupation, or site, is defined as any location which yields evidence of past human behavior). This measure can be used in combination with other characteristics such as occupation size, location, feature types, and preserved subsistence remains, to define occupation types. The frequency and distribution of occupation types are then used to assess prehistoric land use systems. Originally, prehistoric sites at Camp Bullis were provisionally described (Gerstle et al. 1978; Hines 1993) as camps (with burned rock), scatters (without burned rock) and quarries (with tested cobbles), but using the criteria outlined above, the following occupation types are now established (Pagoulatos 2001):

Base One (B1) locations are usually characterized by a wide range of artifact types, indicative of manufacturing, maintenance, and procurement activities. Artifact density is high and cultural depositions are often deeply stratified, reflecting recurrent and long-term use. Numerous types of features are also found at B1 locations, including hearths, trash pits, activity areas of various kinds (toolmaking, food processing), house structures, burned rock mounds and middens, burials, caches, and other storage facilities. This occupation type is often situated on major drainages and at contrasting ecological boundaries, thus minimizing the necessity for travel to any specific resource zone. The social unit usually consists of the largest aggregate population that occurs at any time of the year, including numerous related extended families, or the macroband. *Base Two* (B2) locations are often characterized by a relatively wide range of cultural activities similar to those found at larger B1 locations. However, artifact densities are moderate and archaeological deposits less complex, suggesting limited seasonal re-use. Feature types most often consist of cooking (earth-ovens and mounds), activity activities, trash middens, and sometimes household areas; burials and storage facilities are rare. The social unit represents a few related families (or the microband), operating out of B1 locations.

Target One (T1) locations are characterized by fewer, more specialized activities (e.g., hunting, plant processing). Artifact densities are lower, reflecting short-term episodes of use. Feature types are more limited, represented by resource processing, cooking, and related work areas, frequently associated with burned rock mounds and middens. T1 locations are usually found close to a specific resource zone; resources are processed at the site, prior to their transport back to B1 and B2 locations. The social unit represents organized task groups, or families, operating out of base locations. *Target Two* (T2) locations are often characterized by few artifact types, very low artifact density, and limited cultural deposition, reflecting brief occupation of a specialized nature. T2 locations are usually found near a specific resource zone. Features are rare and resource procurement is usually a single commodity (mammal, plant, raw material) on a periodic, or as-needed basis. The social unit generally represents a family, specialized task group, or individual, operating out of larger B1, B2, or T1 locations.

As part of the site type interpretation, sites were also evaluated for site use intensity and function, using the Feature Diversity Index (FDI; Pagoulatos 2001, 2004). In the case of the FDI, prehistoric feature types common to south-central Texas were first classified as follows: refuse pits, hearths, storage, activity areas, human interments, human bone residue, burned rock mounds, earth-ovens, burned rock middens, and stone-boiling dumps. Each feature classification is described in greater detail below.

In defining prehistoric feature types, I employed definitions that I felt were relevant to my controlled earth-oven experiments. For example, my terminology for burned rock deposits are at variance with recent studies of the function of such sites (Black et al. 1997; Nickels et al. 2001). I have used *burned rock mounds* to describe an accumulation of burned rock, which exhibits discernable relief above ground surface and are usually circular, or oval in shape; this feature type usually represents primary deposition of burned rock (discard) debris from internal *earth-ovens*, which were prepared pits to slow-cook plant items. And, for the purposes of my research, I have used b*urned rock middens* to denote thick deposits of burned rock, organic matter and lithic debris, which do not show any significant relief; this feature type may represent secondary deposition of garbage from hearths and occupation floors (Kleinbach et al. 1995: 773-776). *Hearths* used as fireplaces to prepared foods for consumption varied in form, including basin-shaped, flat slab layered, and angular rock/cobble-layered forms (Kleinbach et al. 1995: 777); *Storage* facilities were prepared pits to cache items (Kleinbach et al. 1995: 781). *Stone-boiling Dumps* are roughly oval-shaped (tight) clusters of highly spalled rocks used to cook foods or heat water for soups and broths; *Refuse Pits* served as small (buried) garbage dumps; this feature type may have previously functioned as a storage pit, which was subsequently filled with trash (Pagoulatos 2007). *Activity Areas* are clusterings of artifacts, organics and features, which reflect specific extractive and/or maintenance tasks (Kent 1987). While *Human Bone Residue* represent the recovery of only portions of individuals (i.e., teeth, femur) because of poor organic preservation, *Human Interments* contain whole individuals intentionally placed within a cave or sinkhole (Veni 2005).

Once each of the 10 major feature types were formally classified, the total number of feature types were counted for each site, as each site received a count based on the number of different feature types present; the FDI ranges from one (1) to ten (10). For example, if a site had only refuse pits and hearths, it would receive a FDI rating of two (2). Finally, all sites were computed and the total number of feature types were divided by the total number of sites. The FDI is designed to produce the average number of feature types per site. Thus sites with a high FDI may represent multiple activity sites or sites that were intensely re-used; sites with a low FDI are more likely to represent sites with a limited range of activity.

Chronological interpretation and re-use of these site types was also evaluated using a simple Component Diversity Index (CDI) (Pagoulatos 2001, 2004). Sites were subdivided into individual components by typical classification schemes: Paleo-Indian, Early-Middle-Late Archaic, Late Prehistoric, and Contact periods. If a site did not yield any chronologically diagnostic materials, then it was designated as *Unknown*. The CDI ranges from one (1) to six (6). Then each site received a count based on number of components present. For example, if a site had Early Archaic through Late Prehistoric components, it would receive a CDI rating of four (4). If sites could not be assigned to a specific cultural period because of the lack of chronologically diagnostic, or time sensitive artifacts, then a CDI was not assigned. Finally, all sites were computed and the total number of components were divided by the total number of sites. The CDI is designed to produce the average number of components per site. Therefore, sites with a high CDI were used by various cultural groups in the past.

Land Use Models

A set of principles for organizing settlement systems have been proposed by Binford (1980) and Pagoulatos (2001, 2004) and implemented in this study. Using these logistical models, it is suggested that the mobility and organizational complexity of hunter-gatherer groups is related in part to spatial and seasonal variability of resources. Each general logistical model is discussed below.

Binford (1980) presents a model of human land use along a forager-collector continuum. *Foragers* are characterized by high residential mobility, exploiting seasonally available resources across a variety of resource zones. A foraging strategy necessitates the frequent movement of people to resources, in environments where resources are uniformly distributed, with little variation from season to season. Foraging groups tend to be small, scheduling their movements across the landscape so as to exploit seasonally available resources. Foragers operate out of base locations, leaving to procure food and returning on a daily basis. Target locations are usually established nearby, where specialized tasks are performed (e.g., mammal butchering, plant processing). When resources are depleted, the entire group abandons the area and moves elsewhere. *Collectors* show evidence of less residential mobility, greater sedentism, and the increased use of storage facilities. A collecting strategy is characterized by the movement of resources to people (to base locations), rather than moving people to the resource. This strategy is more efficient when resources are not evenly distributed, and resource variation in the availability of resources is high. According to this system, organized task groups establish target locations a distance from the larger resident population, where they acquire and initially process materials from specific resource zones. Subsequently, these resources are transported back to base locations, for final processing and storage or consumption.

A modified scheme of land use has been developed, further subdividing foraging and collecting settlement systems into Foraging I/II and Collector I/II settlement systems (Kelly 1995; Binford 2001; Pagoulatos 2001). This four-level logistical model bridges the gap between highly mobile foragers and sedentary collectors, along a Forager-Collector continuum. Foraging settlement systems are composed of Foraging I and II strategies. *Foraging II* settlement systems represent frequent residential shifts by individual family units to specific resource zones; this type of mobility pattern would only generate T2 loci. *Foraging I* systems are better characterized by residential shifts by microbands (extended family) across different resource zones, producing both B2 and T2 sites. Collectors are also subdivided into Collecting I and II strategies. *Collecting II* settlement systems represent microband groups characterized by greater residential stability, with the movement of specific task-groups, or domestic units away from B2 camps and establishing T1 encampments on a seasonal basis. *Collector I* land use represents highly stable groups, with fewer residential shifts, yielding mostly B1 and T1 site types, although T2 sites would still be present. In this settlement system, macrobands (multiple families) establish semi-permanent bases, from which family or task groups venture to seasonally used temporary encampments (T1) sites. Although Collecting settlement systems produce new site types such as B1 and T1 loci, B2 and T2 loci would still be present.

Prehistoric Predictive Models

Studies using predictive models have contributed significantly to archaeological method and theory (Thomas 1975; Cleland 1976; Wobst 1983; Kohler and Parker 1986; Judge and Sebastian 1988; Neumann 1992; Della Bona 1994; Hudak et al. 2002; Pagoulatos 2004). Predictive models differ, as certain approaches have been developed to predict settlement systems for hunter-gatherers using ethnographic data (Binford 1980, 2001; Bettinger 1980; Mandryk 1993; Kelly 1995) or historical data/optimal foraging theory (Winterhalder and Smith 1981; Winterhalder 2001).

A predictive model is designed to locate archaeological sites in relation to environmental and geographic parameters, based on site distribution data, habitats, and historical data (Plog and Hill 1971). The development of a predictive model for Camp Bullis would provide the Army with a powerful planning tool toward identifying probable areas of archaeological resource occurrence during the planning stages of military training and construction projects (Ahler et al. 2000, Johnstone 2002; Rush et al. n.d.; Pagoulatos 2004).

Prior to the archaeological survey of the installation, no reliable basis existed for evaluating potential impacts to resources from military training exercises and other land use activities, making the development of useful predictive models important. Even though the present state-mandated 30-meter-interval pedestrian survey of Camp Bullis has been completed, two issues still exist. First, prior to this synthesis document, collected archaeological data since the 1970s at Camp Bullis had not been properly evaluated in order to address regional prehistoric research questions pertaining to the Edwards Plateau. Second, even with the completion of the archaeological survey, two-thirds of the property still has not been systematically surveyed for archaeological resources, making the development of a useful predictive model even more important toward assisting in the Army's training mission and protecting cultural resources.

SUMMARY RESULTS AND INTERPRETATIONS

A total of 287 documented archaeological sites have prehistoric components; the vast majority of these sites are situated along terraces, benches and sideslopes, in the general proximity to major streams. Table 1 lists all documented prehistoric archaeological sites within the current boundary of Camp Bullis. Evaluated sites have a mean ACI of 0.22, an ODI of 2.87, and a FDI of 0.21 (Table 1). The average size of each site was 21,139sqm, or 2.11 hectares.

While a total of 140 sites (49%) could be assigned to a specific cultural affiliation, 147 sites (51%) could not be assigned to a specific prehistoric time period, lacking diagnostics artifacts; these nondescript prehistoric sites were designated as *Unknown.* A total of 257 different components were encountered, with a mean CDI of 1.9 per site, indicating that the majority of prehistoric sites with identifiable components were reused by different prehistoric populations. Nearly three-quarters (N=186, 72%) of the components were Early, Middle or Late Archaic, while 59 (23%) were Late Prehistoric. Relatively fewer sites (N=12, 5%) had components attributed to the earlier Paleoindian period.

In the sections that follow, all prehistoric sites will be evaluated against specific environmental associations. These prehistoric site associations will then be measured using statistical measures such as frequency distributions and graphs. Then, the archaeological site data will be quantified and compared to nonsite point data using the Chi Square statistic; this approach will allow the Army to evaluate the probability of site occurrence and result in the development of sensitivity or predictive models. Once these environmental associations were assessed, then the archaeological data will be evaluated to address questions concerning activity diversity, occupation types, settlement patterns, and land use.

Table 1. Prehistoric Archaeological Site Data.

SITE NO.	CHRONOLOGY	CDI	SIZE	FEAT	FDI	ORG	ACI	ODI	CATEGORIES	DESCRIPTION	SITE TYPE	SOURCE
BX0036	PA-LPR	5	2400	H M	2	ABMR	0.85	6	TBGHWP	Camp	B2	1,2,13
BX0371	EA	1	217500				0.50	3	TGH	Scatter	T2	1,3
BX0372	LPR	1	292500				0.55	4	TBGH	Camp	T2	1,4,5
BX0373	PA,LA-LPR	3	360000				0.50	3	TGH	Scatter	T2	1,3
BX0374	UKN		1350				0.45	3	TGH	Scatter	T2	1,5
BX0375	EA,LA	2	17600				0.35	3	TGH	Scatter	T2	1
BX0376	PA-EA	2	126000				0.50	5	TBGHW	Camp	T2	1,3
BX0377	EA-LPR	4	1200	H X	2	MS	0.60	5	TBGHW	Camp	T2	1,19
BX0378	UNK		25				0.15	2	TH	Scatter	T2	1,3
BX0379	MA-LPR	3	54000				0.50	3	TGH	Scatter	T2	1,3
BX0380	LA-LPR	2	60000				0.35	3	TGH	Scatter	T2	1,2,3,6
BX0381	PA-EA	2	33600				0.35	3	TGH	Scatter	T2	1,2,6
BX0382	EA-LA	3	125000				0.50	3	TGH	Scatter/quarry	T2	1,3,13
BX0383	MA-LPR	3	375000				0.35	3	TGH	Scatter/quarry	T2	1,3
BX0384	UNK		60000				0.30	3	TBH	Scatter/quarry	T2	1,5
BX0385	LA-LPR	2	104000				0.40	3	TGH	Scatter/quarry	T2	1,3,5
BX0386	LPR	1	2500				0.25	3	TGH	Scatter	T2	1
BX0387	UNK		8250				0.40	3	TGH	Scatter	T2	1,5
BX0388	LA	1	90				0.40	3	TGH	Scatter	T2	1,3
BX0390	UNK		200				0.45	3	TGH	Scatter	T2	1
BX0391	PA-LA	4	90000				0.35	3	TGH	Scatter	T2	1,5
BX0392	LPR	1	10				0.35	5	TBGHP	Camp	T2	1,5
BX0393	UNK		2500				0.45	3	TGH	Scatter	T2	1,5
BX0395	UNK		800				0.20	2	T	Scatter	T2	1
BX0396	LPR	1	600				0.50	3	TBGH	Scatter	T2	1,5
BX0399	UNK		200000				0.45	3	TGH	Scatter/quarry	T2	1,5,6
BX0400	MA-LPR	3	9800				0.55	4	TGHP	Scatter	T2	1,5
BX0402	EA-LA	3	1200				0.60	5	TBGHP	Camp	T2	1,5
BX0403	PA-LA	4	2400				0.50	5	TBGHP	Camp	T2	1,5
BX0404	UNK		126000				0.35	3	TGH	Scatter	T2	1,5,6
BX0405	UNK		500				0.10	1	T	Scatter	T2	1,5
BX0406	UNK		70000				0.40	3	TGH	Scatter/quarry	T2	1,5
BX0407	EA-LA	3	1250				0.40	3	TGH	Scatter	T2	1,5
BX0408	EA-MA	2	2875				0.35	3	TGH	Scatter	T2	1,2
BX0409	EA,LA	2	540				0.50	4	TBGHW	Camp	T2	1,5,6
BX0410	UNK		450				0.30	2	TG	Scatter	T2	1,5
BX0411	UNK		6400				0.30	3	TGH	Scatter	T2	1,5
BX0412	UNK		8250				0.35	3	TGH	Scatter/quarry	T2	1,5,6
BX0413	UNK		450				0.25	3	TGH	Scatter	T2	1,5

BX0414	UNK		70000				0.30	3	TGH	Scatter/quarry	T2	1,5,7
BX0415	UNK		240000				0.35	3	TGH	Scatter/quarry	T2	1,8
BX0416	UNK		300				0.20	2	TG	Scatter	T2	1,8
SITE NO.	CHRONOLOGY	CDI	SIZE	FEAT	FDI	ORG	ACI	ODI	CATEGORIES	DESCRIPTION	SITE TYPE	SOURCE
BX0417	UNK		200				O.40	3	TGH	Scatter/quarry	T2	1,8
BX0418	UNK		1600				0.35	2	TG	Scatter/quarry	T2	1,8
BX0419	UNK		3000				0.30	2	TH	Scatter	T2	1,5
BX0420	PA-LPR	5	1050	DHP	4	MF	0.55	4	TBGH	Camp	T2	1,9,10,20
BX0421	UNK		210000				0.35	3	TGH	Scatter/quarry	T2	1,5
BX0423	LA-LPR	2	800	H	1		0.50	4	TBGH	Camp	T2	1,13,20
BX0424	PA	1	1600				0.25	3	TGH	Scatter	T2	1,13,20
BX0425	MA-LPR	3	800	H M	2		0.50	5	TBGHP	Camp	T1	1,3
BX0426	MA,LPR	2	400				0.35	3	TGH	Scatter	T2	1,3
BX0428	EA-LA	3	900	ABDHM	5	M	0.75	6	TBGHWP	Camp	T1	1,20
BX0429	UNK		20000				0.50	3	TGH	Scatter	T2	1,20
BX0430	EA-LPR	4	900	AHMO	4	M	0.60	6	TBGHWP	Camp	T1	1,20
BX0431	EA-LPR	4	210000				0.65	5	TBGHP	Camp	T2	1,20
BX0432	PA-LA	4	900	AHMO	4	M	0.55	6	TBGHWP	Camp	T1	1,11,20
BX0434	UNK		200				0.15	2	TG	Scatter	T2	1,3,4
BX0504	UNK		500				0.10	1	T	Scatter	T2	5
BX0802	LPR	1	10				0.15	3	TBH	Camp	T2	10,20
BX0803	EA	1	2950				0.15	2	TH	Scatter	T2	10
BX0804	LA	1	18000				0.10	2	TH	Scatter	T2	10
BX0805	MA	1	6400				0.15	3	TGH	Scatter	T2	10
BX0806	UNK		4900	H	1		0.20	3	TBH	Camp	T2	10
BX0807	LA	1	7500				0.25	4	TBGH	Camp	T2	10
BX0808	UNK		2500				0.15	3	TBH	Camp	T2	10
BX0809	UNK		400				0.20	3	TBG	Camp	T2	10
BX0810	UNK		8500				0.20	4	TBGH	Camp	T2	10
BX0811	LA-LPR	2	900	H	1		0.30	4	TBGH	Camp	T2	10,20
BX0812	UNK		1000				0.20	4	TBGH	Camp	T2	10
BX0813	UNK		3750				0.30	4	TBGH	Camp	T2	10
BX0814	UNK		1000				0.05	1	T	Scatter	T2	10
BX0815	UNK		5000				0.10	2	TH	Scatter	T2	10
BX0816	UNK		15000				0.10	2	TG	Scatter	T2	10
BX0817	LA	1	10000				0.20	3	TBH	Camp	T2	10
BX0818	EA-LA	3	16900	M	1		0.30	4	TBGH	Camp	T1	10
BX0819	LA-LPR	2	15000				0.25	3	TGH	Camp	T2	10
BX0918	PA-LPR	5	5600	ADHM	4	FM	0.80	6	TBGHWP	Camp	B2	2,9,20
BX0919	UNK		400				0.10	2	TB	Camp	T2	9
BX0920	EA	1	1600				0.35	4	TBGH	Camp/quarry	T2	2,6,9
BX0921	UNK		2400				0.10	2	TB	Camp	T2	9
BX0922	UNK		42000				0.25	4	TBGH	Camp	T2	9,10

BX0923	LA-LPR	2	4800				0.25	4	TBGH	Camp	T2	2,9
BX0924	EA	1	2400				0.15	3	TBH	Camp	T2	9
BX0925	UNK		2400				0.15	3	TBG	Scatter	T2	9
BX1010	LA	1	104575				0.15	3	TGH	Camp	T2	2
BX1011	EA,LA	2	32000				0.25	4	TBGH	Camp	T2	2
SITE NO.	**CHRONOLOGY**	**CDI**	**SIZE**	**FEAT**	**FDI**	**ORG**	**ACI**	**ODI**	**CATEGORIES**	**DESCRIPTION**	**SITE TYPE**	**SOURCE**
BX1016	MA-LA	2	4200				0.35	5	TBGHP	Camp/quarry	T2	2
BX1017	EA,LA	2	6000	I	1		0.25	3	TGH	Scatter/Burial	T2	2,17
BX1018	LPR	1	1575				0.20	2	TH	Scatter	T2	2
BX1022	LA	1	210				0.15	3	TBH	Camp	T2	2,21
BX1023	EA-LPR	4	237600	H	1		0.15	3	BGH	Camp	T2	2
BX1025	EA	1	60000				0.10	2	HP	Scatter	T2	2
BX1026	LA-LPR	2	90000				0.20	4	TBGH	Camp	T2	2
BX1027	EA	1	4400				0.25	4	TBGH	Camp	T2	2,13,20
BX1029	PA-LPR	5	1050	ABDHM	5	FM	0.60	6	TBGHWP	Camp	T1	2,20
BX1030	UNK		600				0.05	1	T	Scatter	T2	2
BX1031	EA-LPR	4	105			BM	0.45	5	TBGHP	Camp	T2	2,5
BX1032	EA-LPR	4	30	H	1	BM	0.45	5	TBGHP	Camp	T1	2,5
BX1033	LA-LPR	2	22800				0.15	3	TBH	Camp	T2	2
BX1035	EA-MA	1	5000				0.20	4	TBGH	Camp	T2	2,5
BX1037	MA	1	10800	H	1		0.25	4	TBGH	Camp	T2	2,21
BX1038	EA	1	36800				0.20	4	TBGH	Camp	T2	2
BX1039	EA	1	400				0.20	3	TGH	Scatter	T2	2,13
BX1040	LPR	1	4000				0.10	2	TH	Scatter	T2	2
BX1041	UNK		11500				0.15	3	TBH	Camp	T2	2
BX1043	LA	1	7200				0.30	4	TBGH	Camp	T2	2
BX1044	EA,LPR	2	28125	I	1		0.35	5	TBGHP	Camp/Burial	T2	2,3,6,17
BX1045	EA	1	6500				0.20	2	TB	Camp	T2	6,13,17
BX1046	UNK		9800				0.15	3	TGH	Scatter	T2	6,17
BX1047	EA	1	27500				0.20	3	TGH	Scatter	T2	6,17
BX1048	EA	1	500				0.15	3	TBH	Camp	T2	2,3
BX1049	EA	1	10200				0.30	4	TBGH	Camp	T2	2
BX1051	UNK		500				0.20	3	TGH	Scatter	T2	2,11
BX1052	UNK		100				0.15	3	TGH	Scatter	T2	2
BX1053	EA	1	16200				0.25	3	TGH	Scatter	T2	2
BX1132	UNK		40000				0.15	1	T	Scatter/quarry	T2	12
BX1133	UNK		225				0.15	1	T	Scatter/quarry	T2	12
BX1134	UNK		100				0.05	1	T	Scatter	T2	12
BX1135	UNK		325				0.10	1	T	Scatter/quarry	T2	12
BX1136	UNK		440	H	1		0.20	3	TBG	Camp	T2	12,20
BX1137	UNK		225				0.20	2	TB	Camp/quarry	T2	12
BX1153	EA	1	120000				0.45	3	TGH	Scatter/quarry	T2	5,6,13,21
BX1154	UNK		4800				0.15	1	T	Scatter/quarry	T2	5,6

BX1155	UNK		1575				0.10	1	T	Scatter	T2	5,6,21
BX1211	UNK		50				0.05	1	T	Scatter	T2	3,17
BX1212	MA, LPR	2	87500				0.30	4	TBGH	Camp	T2	8
BX1213	UNK		5000				0.15	3	TBG	Camp	T2	8
BX1214	UNK		800				0.05	1	B	Camp	T2	8
BX1215	UNK		1500				0.10	2	BG	Camp	T2	8
BX1216	EA	1	1500				0.15	3	BGH	Camp	T2	8
SITE NO.	**CHRONOLOGY**	**CDI**	**SIZE**	**FEAT**	**FDI**	**ORG**	**ACI**	**ODI**	**CATEGORIES**	**DESCRIPTION**	**SITE TYPE**	**SOURCE**
BX1217	UNK		1080				0.15	3	TBG	Camp	T2	8
BX1218	UNK		5625				0.15	3	TBG	Camp	T2	8
BX1219	EA-MA	1	22400				0.25	4	TBGH	Camp	T2	8
BX1220	EA-LPR	4	1200	AHM	3	S	0.40	5	TBGHP	Camp	T1	5,8
BX1221	UNK		200				0.20	3	TBG	Camp	T2	8
BX1224	UNK		1500				0.30	5	TBGHP	Camp	T2	8
BX1225	UNK		750				0.10	1	T	Scatter/quarry	T2	8
BX1226	UNK		40000				0.25	2	TG	Scatter/quarry	T2	8,21
BX1227	UNK		675	H	1		0.25	4	TBGH	Camp	T2	8
BX1228	UNK		1625				0.10	1	T	Scatter	T2	8
BX1229	MA-LA	2	2000				0.30	4	TBGH	Camp	T2	8,21
BX1230	LA	1	35000				0.40	4	TBGH	Camp/quarry	T2	8
BX1231	UNK		1350				0.25	4	TBGH	Camp	T2	8
BX1243	UNK		900				0.10	2	TH	Scatter	T2	5,15
BX1244	UNK		400				0.10	2	TG	Scatter	T2	5,15
BX1245	UNK		600				0.10	2	TG	Scatter	T2	15
BX1246	UNK		150				0.15	2	TG	Scatter	T2	15
BX1247	UNK		400				0.15	2	TG	Scatter/quarry	T2	15
BX1248	UNK		600				0.10	2	TG	Scatter	T2	15
BX1249	UNK		300				0.10	1	T	Scatter/quarry	T2	15
BX1251	UNK		22000				0.25	3	TGH	Scatter/Burial	T2	5,16,17
BX1252	UNK		15625				0.20	1	T	Scatter/quarry	T2	17,21
BX1253	LPR-CONT	1	9				0.10	2	TG	Scatter	T2	16,17
BX1261	UNK		50000				0.25	2	TG	Scatter	T2	7
BX1278	UNK		2400				0.10	2	TH	Scatter	T2	11
BX1279	LPR	1	900				0.20	3	TGH	Scatter	T2	11
BX1280	UNK		1200				0.20	2	TH	Scatter	T2	11
BX1281	EA-LA	3	62500				0.30	3	TGH	Scatter	T2	11
BX1282	UNK		9600				0.25	3	TBH	Camp	T2	11
BX1284	EA	1	1225				0.30	3	TGH	Scatter	T2	11
BX1285	UNK		900				0.15	2	TG	Scatter	T2	11
BX1286	LPR	1	19200				0.30	3	TGH	Scatter	T2	11
BX1287	UNK		18000				0.25	3	TGH	Scatter	T2	11
BX1288	UNK		10000				0.15	2	TH	Scatter	T2	11
BX1289	LA	1	4000				0.25	3	TGH	Scatter	T2	11

BX1290	LA	1	900				0.25	3	TGH	Scatter	T2	11
BX1291	LPR	1	600				0.30	3	TGH	Scatter	T2	11
BX1292	UNK		100				0.20	2	TG	Scatter	T2	11
BX1293	UNK		1875				0.30	3	TGH	Scatter	T2	11
BX1294	UNK		900				0.10	1	T	Scatter	T2	11
BX1295	UNK		540				0.10	1	T	Scatter	T2	11
BX1304	EA,LPR	2	7500				0.25	3	TGH	Scatter/quarry	T2	18
BX1324	MA	1	9000	H	1		0.35	4	TBGH	Camp	T2	4
BX1326	LPR	1	6000				0.15	3	TGH	Scatter	T2	4
SITE NO.	CHRONOLOGY	CDI	SIZE	FEAT	FDI	ORG	ACI	ODI	CATEGORIES	DESCRIPTION	SITE TYPE	SOURCE
BX1327	EA	1	200				0.20	4	TBGH	Camp	T2	4
BX1328	UNK		600				0.10	2	TH	Scatter	T2	4
BX1329	UNK		900				0.15	3	TGH	Scatter	T2	4
BX1330	UNK		25				0.10	1	T	Scatter	T2	4
BX1331	UNK		200				0.10	2	TG	Scatter	T2	4
BX1332	UNK		1000				0.15	2	TH	Scatter	T2	4
BX1333	LA	1	800				0.15	2	TH	Scatter	T2	4
BX1334	EA,LA,LPR	3	60000				0.30	3	TGH	Scatter	T2	4
BX1337	UNK		2400				0.15	3	TGH	Scatter	T2	4
BX1338	EA-LA	3	900	AHM	3		0.60	6	TBGHWP	Camp	T1	4,5,20
BX1339	PA-EA,LA	3	1600				0.20	3	TGH	Scatter	T2	4
BX1340	UNK		75				0.15	2	TG	Scatter	T2	4
BX1341	UNK		25				0.25	2	TG	Scatter	T2	4
BX1342	UNK		200				0.15	2	TH	Scatter	T2	4
BX1343	EA,LA-LPR	3	2000				0.15	2	TH	Scatter	T2	4
BX1344	LA	1	6000				0.20	4	TBHP	Camp	T2	4
BX1345	LPR	1	60000				0.25	3	TGH	Scatter/quarry	T2	4
BX1346	LA	1	23100				0.15	3	TBH	Camp	T2	3
BX1347	UNK		4000				0.05	1	T	Scatter	T2	3
BX1348	EA,LPR	2	6000				0.25	3	TGH	Scatter	T2	3
BX1349	EA	1	5600				0.15	3	TGH	Scatter	T2	3
BX1350	LA-LPR	2	32000				0.15	2	TH	Scatter	T2	3
BX1351	MA-LA	2	1600	M	1		0.30	4	TBGH	Camp/quarry	T1	3
BX1352	LPR	1	12650				0.15	3	TGH	Scatter	T2	3
BX1353	UNK		21600				0.15	3	TGH	Scatter	T2	3
BX1354	LPR	1	52800				0.30	4	TGHW	Scatter	T2	3
BX1356	UNK		65600				0.20	3	TGP	Scatter	T2	3
BX1358	UNK		16800	H	1		0.30	3	TBG	Camp	T2	3
BX1361	UNK		2000				0.15	3	TGH	Scatter	T2	3
BX1362	LPR	1	7800				0.20	3	TGH	Scatter	T2	3
BX1363	LPR	1	1250				0.15	3	TGH	Scatter	T2	3
BX1364	LPR	1	1050				0.15	3	TGH	Scatter	T2	3
BX1367	UNK		1500				0.15	2	TG	Scatter	T2	3

BX1368	LA	1	80000				0.20	3	TGH	Scatter	T2	3
BX1387	UNK		11100				0.15	2	TG	Scatter	T2	5,17
BX1390	UNK		900				0.25	3	TGH	Scatter	T2	3
BX1391	LA	1	68750				0.30	3	TGH	Scatter	T2	3
BX1392	UNK		14000				0.20	2	TG	Scatter	T2	3
BX1393	LPR	1	67600				0.10	2	TH	Scatter/quarry	T2	3
BX1430	LA	1	6300				0.15	2	TH	Scatter	T2	5
BX1431	UNK		34500				0.20	3	TGH	Scatter	T2	5
BX1433	LPR	1	1950				0.15	3	TGH	Scatter	T2	5
BX1436	UNK		100				0.10	2	TH	Scatter	T2	5
BX1437	UNK		2100				0.10	1	T	Scatter	T2	5
SITE NO.	**CHRONOLOGY**	**CDI**	**SIZE**	**FEAT**	**FDI**	**ORG**	**ACI**	**ODI**	**CATEGORIES**	**DESCRIPTION**	**SITE TYPE**	**SOURCE**
BX1439	UNK		25000				0.10	1	T	Scatter	T2	5
BX1440	UNK		1200				0.10	1	T	Scatter	T2	5
BX1441	UNK		5000				0.10	1	T	Scatter	T2	5
BX1442	EA	1	3000				0.20	3	TBH	Camp	T2	5
BX1443	UNK		1800				0.15	3	TGH	Scatter	T2	5
BX1446	LA	1	15000				0.15	3	TGH	Scatter	T2	5
BX1449	EA	1	3600				0.15	3	TGH	Scatter	T2	5
BX1450	UNK		22100				0.15	2	TH	Scatter	T2	5
BX1451	LPR	1	4200				0.10	2	TH	Scatter	T2	5
BX1452	EA	1	22500				0.15	3	TGH	Scatter	T2	5
BX1454	UNK		1500				0.05	1	T	Scatter	T2	5
BX1455	LA	1	400				0.10	2	GH	Scatter	T2	5
BX1456	UNK		18700				0.15	2	TG	Scatter	T2	5
BX1468	UNK		5	I	1					Burial	T2	16,17,20
BX1469	UNK		5	H	1		0.10	2	TB	Camp	T2	16,17,20
BX1470	UNK		5	X	1					Wash-in	T2	16,17,20
BX1471	UNK		400	X	1		0.10	2	TG	Scatter/Wash-in	T2	16,20
BX1472	LA	1	9				0.05	1	H	Scatter	T2	16,17
BX1539	UNK		640				0.20	2	TG	Scatter	T2	17,20
BX1540	UNK		200				0.10	2	TG	Scatter	T2	17,20
BX1542	UNK		600				0.10	2	TG	Scatter	T2	17,20
BX1543	UNK		5250				0.30	3	TGH	Scatter	T2	17,20
BX1576	UNK		250				0.20	3	TBG	Camp	T2	14
BX1635	UNK		150				0.10	2	BG	Camp	T2	20
BX1636	UNK		100				0.10	2	TB	Camp	T2	20
BX1637	UNK		100				0.25	2	TG	Scatter	T2	20
BX1638	UNK		25				0.05	1	T	Scatter	T2	20
BX1639	UNK		45000				0.45	2	TG	Scatter/quarry	T2	20
BX1640	LA	1	2500				0.35	5	TBGHP	Camp	T2	20
BX1641	UNK		225				0.20	3	TGH	Scatter	T2	20

BX1642	EA	1	10000				0.60	5	TBGHW	Camp	T2	20
BX1643	UNK		100				0.35	3	TGH	Scatter	T2	20
BX1644	UNK		200				0.10	2	TB	Camp	T2	20
BX1645	UNK		200				0.15	2	TG	Scatter	T2	20
BX1646	UNK		25				0.05	1	T	Scatter	T2	20
BX1647	UNK		50				0.10	2	TG	Scatter	T2	20
BX1648	EA-MA, LPR	3	600	H	1		0.35	4	TBGH	Camp	T2	20
BX1649	UNK		300				0.25	3	TGH	Scatter	T2	20
BX1650	UNK		200				0.25	3	TGH	Scatter	T2	20
BX1651	UNK		2500				0.15	3	TGH	Scatter	T2	20
BX1652	UNK		100				0.10	1	T	Scatter	T2	20
BX1653	UNK		100				0.05	1	T	Scatter	T2	20
BX1654	UNK		100				0.15	3	TGH	Scatter	T2	20
BX1655	UNK		100				0.15	3	TGH	Scatter	T2	20
SITE NO.	CHRONOLOGY	CDI	SIZE	FEAT	FDI	ORG	ACI	ODI	CATEGORIES	DESCRIPTION	SITE TYPE	SOURCE
CM070	MA-LA	2	6				0.40	4	TBGH	Camp	T2	1,3
CM094	LPR	1	400				0.45	3	TGH	Scatter	T2	1,3
CM095	EA-LA	3	15000				0.25	4	TGHW	Scatter	T2	1,3
CM096	MA	1	400				0.25	4	TBGH	Camp	T2	1,5
CM098	EA-LA	3	62500				0.55	5	TBGHW	Camp/quarry	T2	1,5
CM099	MA-LPR	3	86000	H	1		0.65	5	TBGHP	Camp	T2	1,3
CM100	UNK		59125				0.45	3	TGH	Scatter	T2	1,3
CM101	LPR	1	26250				0.50	3	TGH	Scatter	T2	1,3
CM102	PA-LPR	5	1600	AHM	3	MS	0.60	6	TBGHMP	Camp	T1	1,2,6,20
CM211	EA-LPR	5	350	H M	2		0.45	5	TBGHP	Camp	T1	2,5,6
CM212	UNK		7500				0.35	3	TBG	Camp	T2	2,6,20
CM213	MA	1	10350				0.20	3	TBH	Camp	T2	2,5,6
CM214	MA	1	25600				0.35	4	TBGH	Camp/quarry	T2	2,5,6
CM217	UNK		12000				0.10	1	T	Scatter/quarry	T2	2,14,16,17
CM233	UNK		68400				0.25	3	TGH	Scatter/quarry	T2	3,17
CM234	LA	1	67200				0.20	3	TGH	Scatter/quarry	T2	3
CM235	LA	1	66000				0.30	3	TGH	Scatter/quarry	T2	3
CM236	UNK		7200				0.20	3	TGH	Scatter	T2	3
CM237	LA	1	19200				0.20	3	TGH	Scatter	T2	3
CM238	UNK		2600				0.10	2	TG	Scatter	T2	3
CM239	LPR	1	2800				0.15	3	TGH	Scatter	T2	3
CM240	UNK		3600				0.15	2	TG	Scatter	T2	3
CM241	UNK		8400				0.10	2	TP	Scatter	T2	3
CM242	EA-MA	2	1400	M	1		0.35	4	TBGH	Camp	T1	3,21
CM244	UNK		400				0.15	2	TG	Scatter	T2	3

Key: CHRONOLOGY categories include Paleoindian (PA), Early Archaic (EA), Middle Archaic (MA), Late Archaic (LA), Late Prehistoric (LPR), and Contact (CONT) CDI is Component Diversity Index. Size is site area is square meters. Feature categories include Activity Area (A), Stone Boiling Dump (B), Midden (D), Heart (H), Human Interment (I), Mound (M), Oven (0), Refuse Pit (P), Storage (S) and Human Bone Residue (X). FDI is Feature Diversity Index. ORG I s Organics. Organic categories include amphibian(A), bird (B), floral (F), mammal (M), nuts (N), reptile (R) and mollusks/shellfish (S), ACI is Artifact Class Index. ODI is Occupation Diversity Index. ODI categories include Tool Manufacturing (T), Burned Rock (B), General Purpose (G), Hunting (H), Plant Processing (P), and Woodworking (W). Site Types categories include Base 2 Locations (B2), Target I Locations (T1), and Target 2 Locations (T2). Sources: 1-Gerstle, Kelly & Assad 1978; 2-Kibler & Gardner 1997; 3-Cestaro, Freeman, Biake & Scott. 2001; 4-Cestaro, Scott & Kibler 2000; 5-Wilder, McWilliams, Kibler & Freeman 2003; 6-Beene & Buysee 1996; 7-Scot 1998; 8-Maslyk & Kibler 1998: 9-Quigg 1988; 10-Boyd, Cox & Uecker 1990; 11-Scott 1999; 12-Dalbey 1995; 13-Hudler 2000; 14-Mahoney 2004; 15-Scott 1997; 16-Kibler 2002; 17-Veni 2005; 18-Maslyk 1999; 19-Kibler & Scott 2000; 20-Pagoulatos 2007; 21- Camp Bullis Site Files.

Prehistoric Sites and Environmental Associations

As part of this study, all prehistoric site data was downloaded into the GIS and attributed by Fort Sam Houston GIS staff. The archaeological site (positive) data was evaluated against corresponding nonsite (negative) data, using quantitative procedures such as the Chi Square (x2) statistic, to assess whether significant correlations exist to the .01 level of confidence (Thomas 1986:265). A total of 287 site (positive) and 372 nonsite (negative) point data were collected. Table 2 lists all evaluated prehistoric sites

Table 2. Prehistoric Site Location Data.

SITE NO.	PDR	WDIST	LFM	SLOPE	ASPECT	ELEVATION	SOILTYPE
BX0036	SAL	100	TER	5	NE	318	Kr
BX0371	CIB	15	TER	5	NE	391	Ca
BX0372	CIB	100	TER	5	SE	379	TaB
BX0373	CIB	50	TER	5	NW	367	TaB
BX0374	CIB	770	FPN	3	NE	367	PaB
BX0375	CIB	15	FPN	15	NW	367	TaC
BX0376	CIB	1000	SLP	30	NW	382	BtE
BX0377	CIB	30	TER	15	SW	358	TaC
BX0378	CIB	100	TER	15	NW	364	TaC
BX0379	CIB	100	TER	15	NW	364	TaC
BX0380	CIB	250	TER	5	SW	376	Cb
BX0381	CIB	1000	TER	15	NW	370	TaC
BX0382	CIB	300	HTP	30	SE	382	BtE
BX0383	CIB	50	FPN	5	NE	355	Cb
BX0384	CIB	1000	FPN	5	NE	376	TaB
BX0385	CIB	100	TER	5	NE	370	Cb
BX0386	CIB	200	TER	15	NW	367	TaC
BX0387	CIB	100	TER	3	NW	370	PaB
BX0388	CIB	1000	TER	5	NW	388	Cb
BX0390	CIB	1000	SLP	30	NW	376	BrE
BX0391	MBH	100	TER	5	NW	358	TaB
BX0392	CIB	1000	SLP	30	NE	397	BrE
BX0393	CIB	600	SLP	30	SE	398	BrE
BX0395	SAL	500	SLP	30	NE	346	TaC
BX0396	SAL	1600	TER	30	SW	352	TaD
BX0399	SAL	1000	SLP	30	SE	388	TaD
BX0400	MHB	100	TER	5	NW	382	Kr
BX0402	SAL	1000	SLP	30	NE	364	BtE
BX0403	SAL	1000	SLP	5	NE	346	Cb
BX0404	SAL	1000	RDG	15	NW	342	TaC
BX0405	SAL	30	SLP	15	SE	333	TaC
BX0406	SAL	1000	SLP	5	NW	324	TaB
BX0407	PAN	800	SLP	15	SW	364	TaC
BX0408	LEW	100	TER	5	SE	364	Kr
BX0409	PAN	1400	TER	5	SW	324	TaB
BX0410	PAN	200	TER	5	SE	324	TaB
BX0411	PAN	300	TER	5	SW	321	TaB
BX0412	PAN	270	TER	5	SE	324	TaB
BX0413	PAN	1400	TER	5	SE	318	TaB
BX0414	SAL	1500	SLP	30	NW	346	TaB
BX0415	PAN	500	TER	15	NW	349	TaC

BX0416	PAN	800	TER	15	SW	346	TaC
SITE NO.	**PDR**	**WDIST**	**LFM**	**SLOPE**	**ASPECT**	**ELEVATION**	**SOILTYPE**
BX0417	PAN	700	TER	5	SE	333	TaB
BX0418	PAN	1600	TER	5	SE	333	Cb
BX0419	SAL	200	SLP	15	NW	349	TaC
BX0420	SAL	100	RDG	5	NE	364	TaB
BX0421	SAL	1250	SLP	15	SE	349	TaC
BX0423	PAN	1400	SLP	15	SE	367	TaC
BX0424	PAN	300	SLP	5	SE	385	TaB
BX0425	CIB	100	TER	15	NW	358	TaC
BX0426	CIB	250	TER	5	NW	367	Cb
BX0428	SAL	1200	TER	5	SE	333	Kr
BX0429	PAN	900	TER	5	SE	336	Cb
BX0430	PAN	1200	TER	5	NW	358	TaB
BX0431	PAN	300	TER	5	NE	349	TaB
BX0432	CIB	50	TER	5	SE	385	Kr
BX0434	CIB	300	TER	5	NW	379	Ca
BX0504	PAN	100	SLP	5	NE	349	TaB
BX0802	SAL	200	ROC	5	SE	358	TaB
BX0803	SAL	150	TER	1	NE	355	Tf
BX0804	SAL	500	RDG	15	SE	370	TaC
BX0805	SAL	500	BCH	5	NE	367	TaB
BX0806	SAL	400	BCH	5	SE	364	TaB
BX0807	SAL	1300	BCH	5	SE	349	TaB
BX0808	SAL	800	SLP	5	SE	349	TaB
BX0809	SAL	900	SLP	30	SW	376	BtE
BX0810	SAL	950	SAD	5	SE	342	TaB
BX0811	SAL	600	RDG	5	SE	330	Cb
BX0812	SAL	800	SLP	5	SE	336	Cb
BX0813	LEW	800	SLP	5	SE	336	Cb
BX0814	LEW	500	SLP	5	NE	364	TaB
BX0815	LEW	500	SLP	5	SE	358	TaB
BX0816	LEW	500	SLP	5	SE	358	TaB
BX0817	SAL	400	SLP	5	SW	358	Cb
BX0818	SAL	500	SLP	1	NW	355	Tf
BX0819	SAL	300	SLP	5	SE	355	TaB
BX0918	SAL	25	TER	5	NE	318	TaB
BX0919	SAL	100	TER	5	SE	312	Kr
BX0920	SAL	150	SLP	5	NE	324	TaB
BX0921	SAL	100	TER	5	SE	327	Cb
BX0922	LEW	100	SLP	5	SE	333	Cb
BX0923	SAL	250	SLP	5	NE	336	Cb
BX0924	SAL	500	SLP	5	NW	333	Cb
BX0925	SAL	50	KNL	1	NE	333	Tf

BX1010	SAL	250	BCH	5	NE	330	TaB
BX1011	SAL	600	BCH	30	SE	370	BrE
SITE NO.	**PDR**	**WDIST**	**LFM**	**SLOPE**	**ASPECT**	**ELEVATION**	**SOILTYPE**
BX1016	LEW	15	TER	5	SE	349	Kr
BX1017	LEW	50	BCH	5	SE	352	TaB
BX1018	LEW	50	BCH	5	NE	336	Kr
BX1022	SAL	175	SLP	1	SW	330	Tf
BX1023	LEW	250	SLP	5	SW	361	Kr
BX1025	LEW	850	SLP	5	NW	391	TaB
BX1026	LEW	800	RDG	30	NE	400	BtE
BX1027	LEW	350	BCH	5	SW	397	TaB
BX1029	LEW	1100	SLP	30	SW	394	BtE
BX1030	LEW	1400	SLP	5	SW	391	Kr
BX1031	LEW	50	ROC	5	SW	358	Kr
BX1032	LEW	30	ROC	5	SW	358	Kr
BX1033	LEW	750	SLP	30	SW	391	BtE
BX1035	LEW	20	FLT	30	SE	384	BrE
BX1037	LEW	400	SLP	30	SW	424	BrE
BX1038	SAL	480	TER	5	SW	382	Kr
BX1039	SAL	450	SLP	30	SW	388	BrE
BX1040	SAL	760	SAD	5	NW	385	Kr
BX1041	CIB	1800	BCH	5	NE	403	Cb
BX1043	CIB	1800	RDG	5	NE	398	Cb
BX1044	CIB	15	TER	3	NE	346	VaB
BX1045	CIB	1800	SLP	30	NW	388	TaD
BX1046	CIB	2100	BCH	30	SW	442	BrE
BX1047	LEW	2000	FLT	5	NW	400	Kr
BX1048	CIB	2000	BCH	30	SW	424	BrE
BX1049	CIB	1850	SLP	5	NW	409	TaB
BX1051	CIB	1000	FLT	5	SE	394	TaB
BX1052	LEW	225	SLP	5	SW	397	Kr
BX1053	CIB	2300	SLP	30	SE	406	BrE
BX1132	PAN	1200	FLT	5	NE	342	Cb
BX1133	PAN	1100	FLT	5	SW	342	TaB
BX1134	PAN	700	FLT	5	SW	345	TaB
BX1135	PAN	1100	FLT	5	SE	345	TaB
BX1136	PAN	1000	FLT	5	SW	339	TaB
BX1137	PAN	1230	FLT	5	SW	339	TaB
BX1153	SAL	1100	RDG	15	SW	358	TaC
BX1154	SAL	900	RDG	15	NE	339	TaC
BX1155	SAL	740	RDG	15	NW	324	TaC
BX1211	CIB	15	TER	5	SW	339	Cb
BX1212	CIB	400	RDG	5	NE	379	TaB
BX1213	CIB	1250	BCH	5	NW	376	Kr

BX1214	CIB	1600	BCH	5	SE	391	Cb
BX1215	CIB	1650	BCH	5	N W	385	Cb
BX1216	CIB	1800	SLP	5	N W	385	Cb
SITE NO.	**PDR**	**WDIST**	**LFM**	**SLOPE**	**ASPECT**	**ELEVATION**	**SOILTYPE**
BX1217	CIB	2200	SLP	5	NE	397	Cb
BX1218	CIB	1300	BCH	5	N W	394	Cb
BX1219	CIB	1600	SLP	5	N W	397	Cb
BX1220	CIB	1900	TER	5	NE	385	Cb
BX1221	SAL	1500	BCH	30	SE	412	BrE
BX1224	PAN	1300	BCH	30	SE	412	BrE
BX1225	PAN	940	SLP	5	SE	345	TaB
BX1226	PAN	830	SLP	15	NE	348	TaC
BX1227	PAN	830	FLT	5	SE	330	Cb
BX1228	PAN	175	BCH	5	SW	333	TaB
BX1229	PAN	75	TER	5	SE	324	Kr
BX1230	PAN	300	SLP	5	N W	339	TaB
BX1231	PAN	135	BCH	5	SE	349	TaB
BX1243	MBH	800	SLP	5	NE	385	TaB
BX1244	MBH	800	BCH	30	N W	385	BrE
BX1245	MBH	600	SLP	30	N W	388	BrE
BX1246	MBH	600	SLP	30	NE	388	BrE
BX1247	SAL	500	SLP	5	SW	318	Kr
BX1248	SAL	400	BCH	5	SW	318	Kr
BX1249	SAL	350	SLP	15	SW	321	TaC
BX1251	SAL	800	FLT	5	SE	394	TaB
BX1252	SAL	1700	SLP	5	SE	355	TaB
BX1253	SAL	1500	CAV	1	NE	336	Tf
BX1261	SAL	2000	SLP	15	SE	345	TaC
BX1278	LEW	200	HTP	30	SE	385	BrE
BX1279	CIB	2700	SLP	30	N W	424	BrE
BX1280	CIB	2700	BCH	30	N W	398	BrE
BX1281	CIB	270	BCH	3	SW	379	PaB
BX1282	CIB	1200	SLP	5	N W	388	Cb
BX1284	CIB	1250	HTP	30	SW	403	BrE
BX1285	CIB	1100	LOB	30	NE	397	BrE
BX1286	CIB	1400	BCH	30	SW	430	BrE
BX1287	CIB	1800	BCH	30	SE	418	BrE
BX1288	CIB	1600	BCH	30	SE	415	BrE
BX1289	CIB	1700	HTP	5	SE	400	TaB
BX1290	CIB	1500	TER	5	N W	394	TaB
BX1291	CIB	1400	TER	5	N W	397	Kr
BX1292	CIB	1400	BCH	5	N W	394	Kr
BX1293	CIB	1400	BCH	5	N W	397	TaB
BX1294	CIB	1300	BCH	5	SW	397	TaB

BX1295	CIB	1200	BCH	5	N W	385	Kr
BX1304	MBH	150	SLP	1	NE	342	Ca
BX1324	CIB	1000	SLP	5	N W	358	Kr
BX1326	CIB	1500	TER	5	N W	372	Kr
SITE NO.	**PDR**	**WDIST**	**LFM**	**SLOPE**	**ASPECT**	**ELEVATION**	**SOILTYPE**
BX1327	CIB	1600	SLP	30	NE	378	BrE
BX1328	CIB	1500	SLP	30	SE	385	BrE
BX1329	CIB	1800	SLP	5	NE	376	Kr
BX1330	CIB	1800	SLP	30	N W	378	BrE
BX1331	CIB	1300	TER	5	SE	358	Cb
BX1332	MBH	50	FLT	5	NE	358	TaB
BX1333	CIB	370	SLP	15	N W	361	TaC
BX1334	CIB	450	SLP	15	NE	372	TaC
BX1337	MBH	425	SLP	30	SW	388	BrE
BX1338	MBH	50	TER	5	N W	381	TaB
BX1339	MBH	500	KNL	5	SE	385	Cb
BX1340	MBH	40	FLT	5	NE	379	Kr
BX1341	MBH	40	FLT	5	NE	376	Kr
BX1342	MBH	500	FLT	5	NE	367	Kr
BX1343	MBH	50	SLP	5	SE	379	Cb
BX1344	MBH	50	ROC	5	SE	367	Kr
BX1345	CIB	250	FLT	5	NE	379	Ca
BX1346	CIB	800	TER	5	NE	391	Cb
BX1347	CIB	1000	SLP	5	N W	407	Cb
BX1348	CIB	500	TER	5	N W	397	Cb
BX1349	CIB	600	SLP	5	SW	391	Cb
BX1350	CIB	200	TER	5	N W	385	Cb
BX1351	CIB	15	TER	15	N W	370	TaC
BX1352	CIB	300	SLP	30	N W	364	BtE
BX1353	CIB	120	SLP	15	SE	358	TaC
BX1354	CIB	200	SLP	15	NE	364	TaC.
BX1356	CIB	15	SLP	3	NE	348	PaB
BX1358	CIB	80	SLP	5	N W	351	TaB
BX1361	LEW	300	SLP	30	SE	397	BrE
BX1362	CIB	600	SLP	5	N W	370	TaB
BX1363	MBH	400	SLP	5	NE	358	TaB
BX1364	MBH	200	TER	5	SE	355	TaB
BX1367	CIB	1600	HTP	30	NE	379	BtE
BX1368	MBH	15	TER	1	NE	355	Tf
BX1387	CIB	300	SLP	5	SW	370	TaB
BX1390	CIB	820	SLP	5	NE	386	Cb
BX1391	CIB	400	TER	5	NE	370	Cb
BX1392	CIB	640	SLP	5	NE	376	Cb
BX1393	CIB	200	SLP	5	SE	367	Cb

BX1430	SAL	1600	TER	15	SW	315	TaC
BX1431	SAL	1800	HTP	15	SE	349	TaC
BX1433	SAL	1100	BCH	30	NW	354	TaD
BX1436	SAL	1000	SLP	5	SE	333	TaB
BX1437	LEW	2000	TER	5	NW	354	Kr
SITE NO.	**PDR**	**WDIST**	**LFM**	**SLOPE**	**ASPECT**	**ELEVATION**	**SOILTYPE**
BX1439	PAN	800	RDG	15	SE	333	TaC
BX1440	PAN	700	SLP	15	SE	327	TaC
BX1441	PAN	1200	SLP	15	NW	327	TaC
BX1442	SAL	1100	SLP	30	NW	364	TaD
BX1443	SAL	1300	SLP	15	SE	364	TaD
BX1446	MBH	1500	BCH	30	NE	397	BrE
BX1449	PAN	1800	BCH	30	SE	385	BrE
BX1450	PAN	2100	BCH	30	SE	400	BrE
BX1451	PAN	1700	TER	5	NE	373	Kr
BX1452	PAN	600	TER	5	SW	376	Kr
BX1454	PAN	600	TER	5	NE	379	TaB
BX1455	PAN	800	TER	5	NE	379	TaB
BX1456	CIB	25	TER	5	SE	370	TaB
BX1468	SAL	1500	CAV	5	SE	347	TaB
BX1469	SAL	640	ROC	5	NW	354	TaD
BX1470	MBH	640	C/S	5	SE	382	TaB
BX1471	PAN	580	CAV	5	NE	333	Cb
BX1472	PAN	175	C/S	5	SW	318	TaB
BX1539	PAN	450	HTP	15	SW	376	BrE
BX1540	SAL	1400	TER	15	SE	332	TaC
BX1542	PAN	150	SLP	5	NW	382	TaB
BX1543	PAN	3000	HTP	15	SE	376	TaC
BX1576	SAL	320	TER	5	NE	330	TaB
BX1635	SAL	245	HTP	15	SW	388	TaC
BX1636	SAL	60	TER	5	SE	330	Kr
BX1637	SAL	343	HTP	15	SE	381	TaC
BX1638	SAL	402	HTP	15	SE	384	TaC
BX1639	SAL	162	TER	5	NE	350	Cb
BX1640	SAL	602	TER	5	SE	298	TaB
BX1641	SAL	102	TER	5	NW	320	TaB
BX1642	SAL	163	TER	5	SE	315	Kr
BX1643	SAL	29	TER	5	NW	329	Cb
BX1644	PAN	65	TER	5	SW	345	Kr
BX1645	PAN	50	TER	5	SW	340	Kr
BX1646	PAN	82	SLP	5	SE	395	TaB
BX1647	PAN	61	TER	5	NE	398	Kr
BX1648	PAN	307	SLP	5	NW	406	TaB
BX1649	SAL	96	BCH	5	SE	333	Kr

BX1650	PAN	418	HTP	30	SE	374	TaD
BX1651	PAN	565	HTP	30	SE	377	TaD
BX1652	PAN	276	HTP	30	SW	401	TaD
BX1653	PAN	128	SLP	5	SE	386	TaB
BX1654	PAN	1156	BCH	30	SE	390	TaD
BX1655	LEW	213	TER	5	N W	360	Kr
SITE NO.	**PDR**	**WDIST**	**LFM**	**SLOPE**	**ASPECT**	**ELEVATION**	**SOILTYPE**
CM070	CIB	100	FPN	8	NE	376	CrD
CM094	CIB	200	TER	8	SW	370	CrD
CM095	CIB	200	TER	5	SE	373	Kr
CM096	CIB	100	FPN	1	SE	367	Ok
CM098	CIB	300	TER	1	SE	376	Ca
CM099	CIB	15	TER	8	NE	370	CrD
CM100	CIB	100	TER	8	SE	364	CrD
CM101	CIB	200	FPN	8	SE	364	CrD
CM102	CIB	50	TER	8	SE	349	CrD
CM211	CIB	15	TER	5	SE	346	TaB
CM212	CIB	25	TER	3	NE	346	LvB
CM213	CIB	100	FLT	8	N W	367	CrD
CM214	CIB	50	FLT	5	NE	379	RdC
CM217	CIB	25	SLP	3	NE	379	TbB
CM233	CIB	400	SLP	3	NE	379	TbB
CM234	CIB	800	O/S	3	SW	379	TbB
CM235	CIB	15	TER	8	SE	376	CrD
CM236	CIB	500	TER	8	N W	376	CrD
CM237	CIB	200	TER	8	SW	376	CrD
CM238	CIB	100	SLP	8	N W	370	CrD
CM239	CIB	300	SLP	8	SW	382	CrD
CM240	CIB	200	SLP	8	SW	376	CrD
CM241	CIB	15	TER	8	SW	370	CrD
CM242	CIB	1400	TER	8	SE	376	CrD
CM244	CIB	350	FLT	3	SE	370	Ca

PDR is Primary Drainage System. Primary Drainage Systems include Cibolo Creek (CIB), Lewis Creek (LEW), Meusebach Creel (MHB), Panther Springs Creek (PAN), and Salado Creek (SAL). WDIST is Distance to major streams in meters. LDFM is Landform type. Landform types include Bench (BCH), Cave (CAV), Cavelsinkhole (CIS), Flat (FLT), Floodplain (FPN), Hilltop (HTP), Knoll (KNL), Lobe (LOB), Rockshelter (ROC), Ridge (RDG), Rockshelter (ROC), Sideslope (SLP), Terrace (TER) and Toeslope (TSLP). SLOPE is measured slope in percent. ASPECT is direction of Slope. ELEVATION is measured in meters above mean sea level. SOIL TYPE is dominant soil type. Soil type series include Brackett (BrE), BrackettTarrant Association (BtE), Crawford (Ca, Cb), Comfort-rock outcrop complex (CrD), Krum Complex (Kr), Lewisville (LvB, LvC), Oakalia (0k), Patrick (PaB), Rock outcrop (RdC), Tarrant Association (TaB, TaC, TaD), Trinity and Frio (Tf), Venus (VaB).

in this study. Environmental associations included nearest distance to major streams, soil type, surface slope, aspect, and elevation. Each variable is evaluated below.

Distance to Major Streams

Archaeological sites were more likely to be found near major streams (Salado, Cibolo, Panther Springs, Lewis, Meusebach) than nonsites. The mean distance of sites to nonsites was 693 meters and 1,150 meters, respectively. A total of 76% of archaeological sites and 44% of nonsite points were found within 1,150 meters of major streams (Table 3). The x2 is 26.07, showing a very strong correlation between sites and proximity to major streams.

Soil Types

Archaeological sites were much more likely to be distributed on moderately to well-drained, nearly level to gently sloping surfaces typical of Tarrant (TaB), Krum (Kr), Crawford (Cb) and Comfort (CrD) soils than nonsite points (Batte 1991; Taylor et al. 1991). A total of 63% of sites and only 40% of nonsite points were encountered on these soils (Table 4). The x2 value is 39.69, indicating a very strong association between site location and these soils.

Surface Slope

The vast majority of sites (64%) and nonsites (63%) were found on nearly level to gently sloping surfaces, ranging from 0 to 5 percent slope (Table 5). The x2 value is 0.09, indicating no significant association between site location and surface slope. These data also indicate that although nearly all sites were encountered on gently sloping terrain, most of the Camp Bullis area contains gently to moderately sloping terrain, and that surface slope, in itself, does not necessarily predict site occurrence.

Table 3. Prehistoric Sites and Distance to Major Streams.

Distance to Streams	Nonsite Points	Sites	Totals
0-1150 meters	165	218	383
>1150 meters	207	69	276
Totals	372	287	659

*CST Value is 26.07

**Critical Table Value is 6.64, .01 level of significance (Thomas 1986:265)

Table 4. Prehistoric Sites and Soil Types.

Distance to Streams	Nonsite Points	Sites	Totals
High Potential	147	180	327
Low Potential	225	107	332
Totals	372	287	659

*CST Value is 39.69

**Critical Table Value is 6.64, .01 level of significance (Thomas 1986:265)

Table 5. Prehistoric Sites and Surface Slope.

Distance to Streams	Nonsite Points	Sites	Totals
0-5%	233	183	416
>5%	139	104	243
Totals	372	287	659

*CST Value is 0.09
**Critical Table Value is 6.64, .01 level of significance (Thomas 1986:265)

Aspect

As previously noted, humans tend to locate themselves in places with a southern aspect to maximize their exposure to the sun, for warmth and comfort during the colder months. However, current data from the installation show that sites (53%) and nonsite points (50%) were almost evenly distributed with southern aspects (Table 6). The x2 value is 0.68, indicating no significant association between site location and aspect, as sites and nonsites were just as likely to exhibit southern exposures.

Elevation

Archaeological sites were more likely to be found in lower elevated areas (66%) than nonsite points (49%) (Table 7). While the range of elevation across the installation generally ranges 300 to 400 meters amsl, the mean elevation of sites and nonsite points was 366 meters and 378 meters, respectively. The x2 value is 19.46, indicating that there is an association between site occurrence and lower elevation. Although portions of Camp Bullis exhibit relatively rugged terrain and high relief, there

Table 6. Prehistoric Sites and Aspect.

Distance to Streams	Nonsite Points	Sites	Totals
Southern	185	152	337
Northern	187	135	322
Totals	372	287	659

*CST Value is 0.68
**Critical Table Value is 6.64, .01 level of significance (Thomas 1986:265)

Table 7. Prehistoric Sites and Elevation.

Distance to Streams	Nonsite Points	Sites	Totals
0-377 meters a.m.s.l.	181	189	370
>377 meters a.m.s.l.	191	98	289
Totals	372	287	659

*CST Value is 19.46
**Critical Table Value is 3.84, .05 level of significance (Thomas 1986:265)

does appear to be a tendency toward lower elevation and prehistoric site selection, which most likely is related to proximity to major streams and low-lying floodplains.

Summary Evaluation of Environmental Associations

Archaeological site and nonsite point data has been presented and evaluated against environmental variables to assess prehistoric land use sensitivity. Environmental variables such as distance to major streams, surface slope, soil types, aspect, and elevation were measured using both nonsite and site locations, for comparative purposes.

The majority of site and nonsite point data were found in a region containing moderately to well-drained soils, and level to gently sloping surfaces, with southerly exposures, indicating that site and nonsite points were just as likely to be found in these types of places. Therefore, these data suggest that the presence of surface drainage, surface slope, and aspect orientation are not critical in predicting the presence of site locations across this portion of the southern Edwards Plateau.

By contrast, strong statistical associations were discovered when evaluating variables such as distance to major streams, elevation, and soils, in relation to nonsite points and site locations. The distribution of nonsite points differed from that of site locations, as the majority of sites were situated along low-lying landforms, within close proximity to major streams and on particular soil series, such as Tarrant, Krum, Crawford and Comfort.

Occupation Types

The presentation in this section begins with a definition and description of specific occupation types. Occupation types are then assessed in relation to environmental association and particular microenvironments, when possible. Subsequently, a comparison of occupation types and land use models is made, on a regional basis. Finally, recommendations are made for further research and inquiry.

Activity variability and use as expressed by the ACI, ODI, FDI and CDI were used in part for the definition of occupation types. These measures were used in conjunction with other characteristics such as occupation size, location, and preserved subsistence remains, to define occupation types. Three occupation types were identified: Base 2, Target 1, and Target 2 site locations (Table 1).

Most sites (N=260, 91%) yielded a rather narrow range of artifact classes (less than 10 artifact classes) such as points, waste flakes, and occasional retouched tools; these sites most likely represent rather specialized loci where task groups processed resources or made tools. By contrast, relatively few sites (N=27, 9%) contained more varied assemblages (greater than 10 artifact classes); these sites typically contained points, scrapers, knives, waste flakes and occasional features, and most likely represent short-term encampments where family units or task groups skinned and butchered mammal resources, processed wild plant foods, and manufactured tools. Even so, these sites were largely of limited duration of occupancy and re-use. Although the majority of these sites can best be classified as T2 locations, there appears to be a degree of occupation differentiation on the basis of discovered artifact classes, when one considers low density scatters and sites with larger and relatively more varied assemblages. Each occupation type is described in greater detail below.

BASE II LOCATIONS

B2 (N=2, <1%) locations yield a mean ACI of 0.83 (Figure 4), an ODI of 6.0 (Figure 5), a FDI of 3.0 (Figure 6), and a CDI of 5.0 (Figure 7). Sites BX36 and BX918 are both situated on terraces, proximate to Salado Creek. Field testing from B2 loci has produced a mean of 1,213 lithics (Figure 8; Table 8) and 1,020 pieces (126kg) of burned rock per square meter (Figures 9-10; Table 8). The average size of each site was 4,000sqm, or 0.40 hectares (ha) (Figure 11). B2 sites generally contain lithic workshops and activity areas, hearths, as well as burned rock mounds and middens, reflecting repeated seasonal re-uses, spanning the entire prehistory of the region.

BX36 was an open campsite with burned rock features situated on the terrace edge of the Salado Creek floodplain in TA3; this site has since been

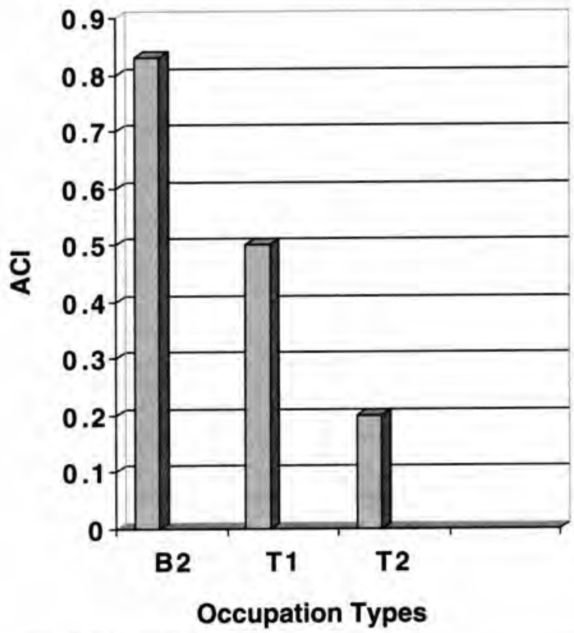

Figure 4. Occupation Types and ACI.

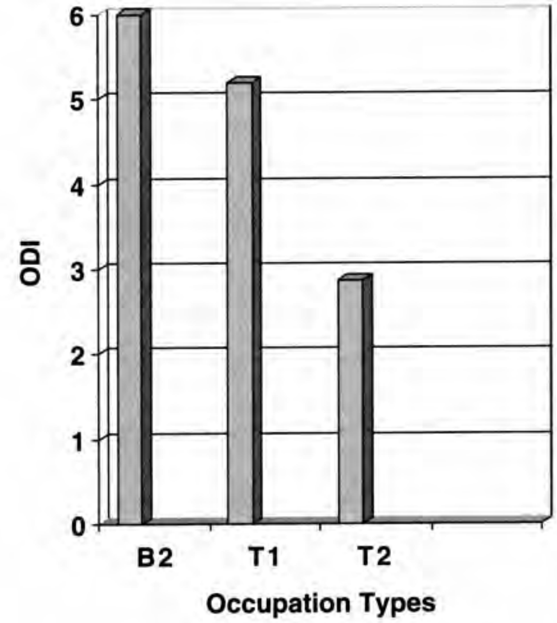

Figure 5. Occupation Types and ODI.

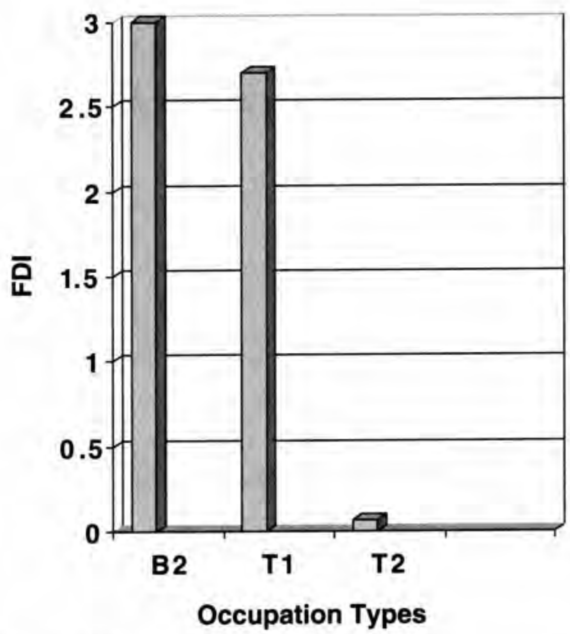

Figure 6. Occupation Types and FDI.

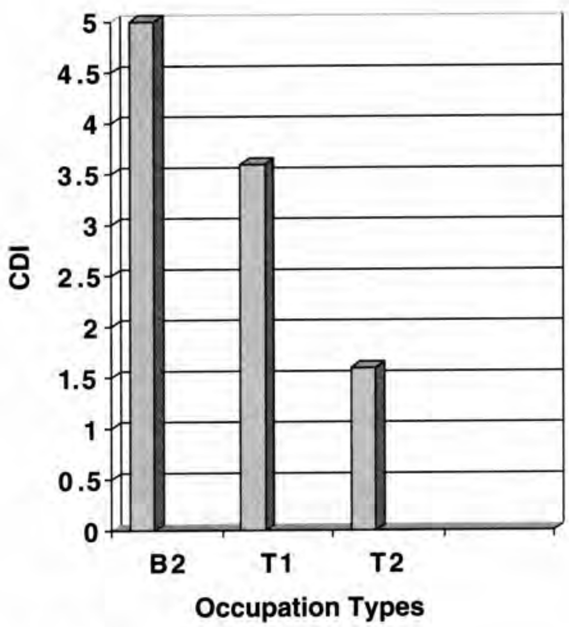

Figure 7. Occupation Types and CDI.

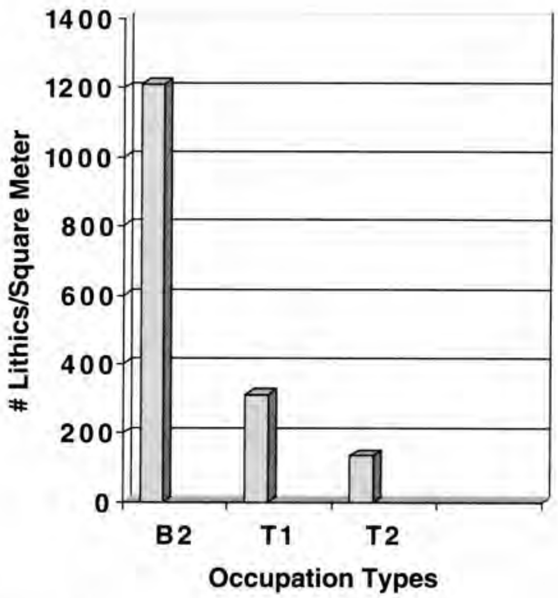

Figure 8. Occupation Types and Number of Lithics/Square Meter.

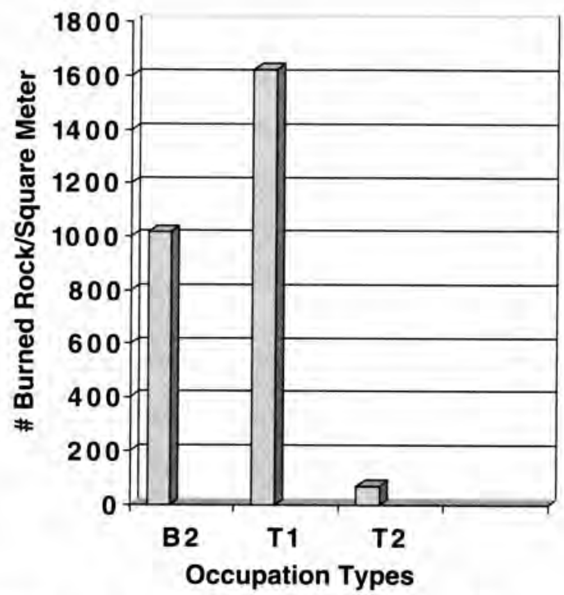

Figure 9. Occupation Types and Number of Pieces of Burned Rock.

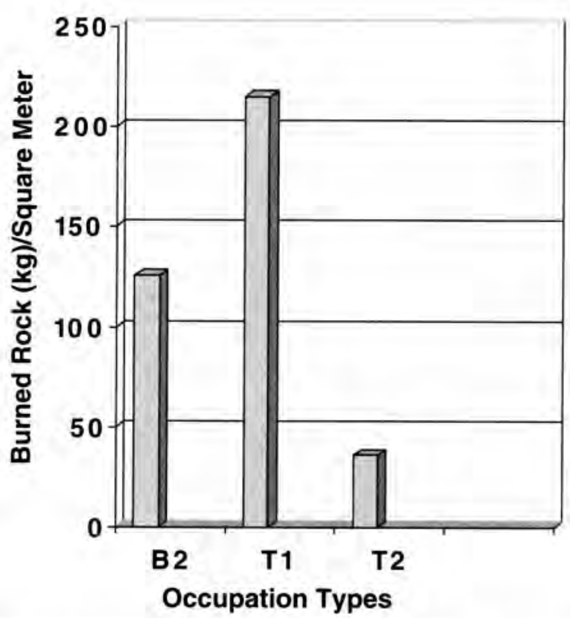

Figure 10. Occupation Types and Burned Rock(Kg)/Square Meter.

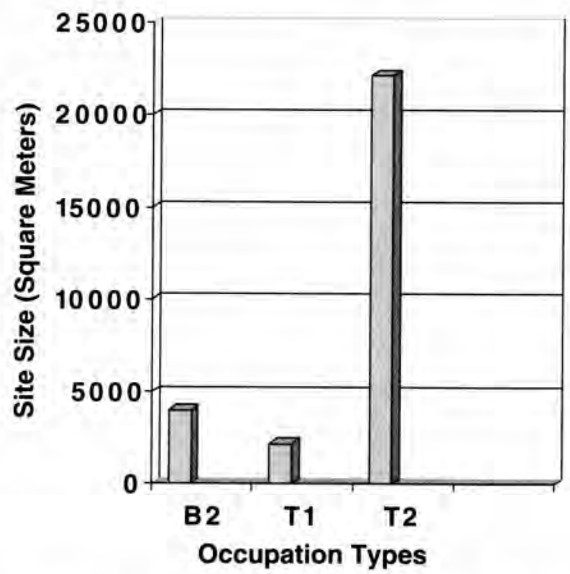

Figure 11. Occupation Types and Site Size (Square Meters).

Table 8. Field Testing of Selected Occupation Types and Artifacts/Square Meter.

B2 Site Locations	#Lithics/Sqm	#Burned Rock/Sqm	Burned Rock(Kg)/Sqm
BX36	998	Not Available	Not Available
BX918	1,428	1,020	126
Average Totals	1,213	1,020	126
T1 Site Locations			
BX428	519	4,654	591
BX430	223	2,046	245
BX432	126	2,696	430
BX1029	228	1,268	212
BX1032	258	11	7
BX1220	114	Not Available	112
BX1338	60	966	152
CM102	734	1,206	152
CM211	231	160	31
Average Totals	313	1,625	215
T2 Site Locations			
BX377	253	Not Available	37
BX420	172	850	134
BX431	194	68	36
BX1031	52	27	8
BX1035	2	0.14	0.05
Average Totals	135	236	43

destroyed by heavy equipment in the construction of sewage settling basins. This site had been subjected to several excavations over the years, beginning in the 1950s and 1960s by both professional archaeologists and relic collectors (Gerstle et al. 1978: 36). The Center for Archaeological Research (CAR) systematically excavated relatively undisturbed portions of this site back in the 1970s, producing thousands of artifacts, burned rock accumulations, and preserved fauna, such as bison and deer. Although the site contained diagnostic items dating from Paleoindian to Late Prehistoric times, the site was dominated by Middle to Late Archaic assemblages (Gerstle et al. 1978: 115-125).

BX918 is an open campsite with burned rock features located on a terrace escarpment edge of Salado Creek in TA3, about 600m east of BX36. This site was previously identified by Quigg (1988) and Kibler and Gardner (1997), but had not been subjected to large-scale subsurface testing until recently, as part of an intensive National Register testing survey (Pagoulatos 2007). The site was revisited using surface survey and larger, excavation units. Initially, the site was subjected to a 30m-interval transect surface survey; this method revealed the presence of extensive prehistoric lithic scatters and surface-visible burned rock concentrations. One of these burned rock concentrations represented a remnant burned rock mound which had been completely destroyed by gravel road construction (Quigg 1988; Pagoulatos 2007). Although prehistoric artifacts were scattered over much of the site area, surface-derived cultural materials were predominantly concentrated across bedrock exposures, as only places containing buried sediments were field tested.

As a result of all field testing at BX918, over 12,000 prehistoric artifacts were discovered, including burned rock, chipped and groundstone debris, chronologically diagnostic Lanceolate-like bifaces, Archaic stemmed dart points, and Late Prehistoric arrows, as well as preserved fauna and flora from features. Closer inspection of artifact clusters across BX918 has yielded the presence of at least three spatially separate cultural loci, or activity areas, containing lithic workshop areas, burned rock mounds and middens, as well as hearths. Recovered burned rock from the tested midden was heavily cracked, spalled and had white and reddish hues, with an overall mean weight of 122 grams (Figure 12); these data most closely correspond to experimentally-produced stones which were repeatedly reheated in earth-ovens for longer-term durations, generally ranging from 24 to 48 hours (Pagoulatos 2005). Even though this site has occupation spanning the entire prehistory of the area, burned rock concentrations, indicative of intensive reuse, tend to be dominated and associated with Middle and Late Archaic projectile point forms (Pagoulatos 2007).

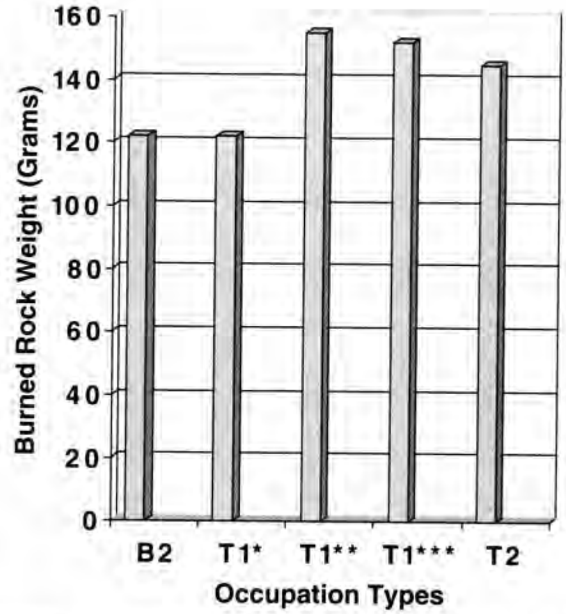

Figure 12. Occupation Types and Burned Rock Weight (Grams). B2 is BX918. T1* is BX428, BX430 and CM102. T1** is BX432 and BX1338. T1*** is BX1029. T2 is BX420.

Target Locations

Target loci as a whole, are situated across a wide range of microenvironments, primarily along headwater feeder tributaries of Salado, Cibolo, Lewis, Panther Springs, and Meusebach creeks. T1 (N=13, 5%) locations yield a mean ACI of 0.50 (Figure 4), an ODI of 5.23 (Figure 5), a FDI of 2.7 (Figure 6), and a CDI of 5.0 (Figure 7); field testing resulted in a mean of 313 lithics (Figure 8; Table 8) and 1625 pieces (215kg) of burned rock per square meter (Figures 9-10; Table 8). The average size of each site is 2,195 sq m, or 0.22 ha (Figure 11). T1 sites such as BX428, BX430, BX432, BX1029, BX1032, BX1220, BX1338, and CM102 produce somewhat varied artifact classes, reflecting multiple resource (mammal, plant) processing loci, associated with burned rock (mound) accumulations.

While B2 and T1 contain varied artifact assemblages and features, these sites are not common, as the vast majority of recorded sites represent diffuse (lithic) scatters, camps and quarries which are collectively classified as T2 (N=272, 95%) locations. T2 loci have a mean ACI of 0.20 (Figure 5), an ODI of 2.87 (Figure 6), a FDI of 0.07 (Figure 7), and a CDI of 1.61 (Figure 8); field testing resulted in a mean of 135 lithics (Figure 9) and 236 pieces (43kg) of burned rock per square meter (Figures 10-11). The average size of each site is 22,171sqm, or 2.22ha (Figure 12). T2 sites such as BX377, BX420, BX431, BX1031, and BX1035 yield less varied assemblages and features, but still reflect repeated uses by prehistoric groups.

As a whole, T2 are quite specialized in nature, but different types of T2 site categories have been detected, as originally defined by Gerstle et al. (1978): scatters, camps and quarries. Although these sites are widely distributed across microenvironments, a closer examination of these T2 site categories produce unlike site sizes. For example, quarry sites tend to be the largest (N=38, 58,761sqm, 5.88ha), while camps (N=76, 21,575sqm, 2,16ha) and scatters (N=158, 13,889sqm, 1.39ha) are considerably smaller in size. While Camps and quarries tend to have more activity variability (ACI=0.27) than scatters (ACI=0.16), features are much more common at camps (FDI=0.21) and less so at quarries (FDI=0.03) and scatters (FDI=0.01).

Target I Locations

Sites such as BX428, BX430, BX432, BX1338 and CM102 are open campsites found on slightly elevated terraces, proximate to small tributaries which feed into major streams such as Salado, Cibolo, Meusebach and Panther Springs Creeks. These sites tend to be relatively small, typically ranging around 1,000 sq m (.10 ha), but yield relatively variable assemblages associated with large burned rock mounds, typically containing earth-ovens and hearths. These burned rock mounds are also typically surrounded by activity areas where tools were manufactured, maintained, and resources were processed (Pagoulatos 2007).

Recovered burned rock from these sites suggest variable durations of cooking episodes. For example, burned rock from BX428, BX430, and CM102 is heavily cracked and spalled, with white and reddish hues, with an overall mean weight of 122 grams (Figure 12); these data most resemble experimentally-produced stones which were repeatedly reheated in earth-ovens for longer-term durations, generally ranging from 24 to 48 hours (Pagoulatos 2005). By contrast, recovered burned rock from BX432 and BX1338 was not as heavily cracked or spalled, and generally exhibited reddening, with lesser amounts of whitening hues, with an overall mean weight of 155 grams (Figure 12); these data broadly correspond to experimentally-produced stones which were reheated in earth-ovens for shorter intervals, typically less than 12 hours in duration (Pagoulatos 2005). Even though these sites appear to have differed in occupation intensity, they were generally dominated by Middle and Late Archaic projectile point forms (Pagoulatos 2007).

In all lilkelihood, these mounds contained earth-ovens for cooking plant-related resources (see Thoms 1989; Mauldin et al. 2001), which may have then been transported by specialized task groups back to larger bases (Pagoulatos 2007). Alternatively, these sites could represent highly seasonal encampments where whole family groups occupied, as part of their seasonal round, while away from their base camps (Pagoulatos 2007).

Sites such as BX1029 and BX1032 are found across different landforms, as the former is an open campsite situated on a side slope, while the latter, is within a rockshelter; both sites overlook Lewis Creek. BX1029 is about 1,050 sq m (0.11 ha) in size and contains numerous hearths and two small burned rock mounds; this site primarily has Middle to Late Archaic dart points (Pagoulatos 2007). Recovered burned rock from BX1029 was reddened in color, but not as heavily cracked or spalled, with an overall mean weight of 152 grams (Figure 12); these data are most similar to experimentally-produced stones which were reheated in earth-ovens for shorter intervals, typically less than 12 hours in duration (Pagoulatos 2005). BX1032 is quite small (30sqm, 0.003ha), has several hearths, but was predominantly used during the Late Archaic and Late Prehistoric periods (Wilder et al. 2003).

Target II Locations

By contrast, sites such BX377, BX420, BX431, BX1031 and BX1035 have produced less varied artifact assemblages, when compared to Base II and Target I Locations. Even so, some of these sites appear to have been reused by prehistoric populations over time to perform specialized tasks. BX377 is an open campsite located on a terrace close to Cibolo Creek; this site is about 1,200 sq m (0.12 ha) in size and contains several hearths associated with mostly Middle and Late Archaic dart points (Kibler and Scott 2000). Site BX420 is situated on a ridgetop overlooking Salado Creek; this site is about 1,050sqm (0.11ha) associated with hearths and an incipient burned rock midden dating to the Late Archaic (Pagoulatos 2007). Recovered burned rock from BX420 was not as heavily cracked or spalled, but was reddened, with an overall mean weight of 145 grams (Figure 12); these data broadly correspond to experimentally-produced stones which were reheated in earth-ovens for shorter intervals, typically less than 12 hours in duration (Pagoulatos 2005). Site BX 431 is an extensive scatter of artifacts extending some 210,000sqm (21 ha) along Panther Springs Creek; three primary loci, or activity areas were encountered, primarily dating to the Late Archaic and Late Prehistoric periods (Pagoulatos 2007). BX1035 is a relatively small (5,000 sq m, 0.5 ha) open campsite located along a feeder stream of Lewis Creek; this site contains a scatter of flake debris and points, mostly attributed to the Early and Middle Archaic (Wilder et al. 2003). BX1031 is a small (105 sq m, 0.01 ha) rockshelter overlooking Lewis Creek; this site contains preserved deer and cottontail rabbit bones associated with predominantly Late Prehistoric arrow points (Wilder et al. 2003).

As a whole, occupation types tend to show evidence for considerable activity variability across the property. Base 2 are situated on low terraces, adjacent to floodplains along Salado Creek; these encampments appear to contain evidence for high activity variability. Target 1 locations tend to be situated on elevated terraces on smaller tributaries, which feed into major streams; although these sites are somewhat more specialized, they were repeatedly used by task, or family groups. Target 2 loci are distributed across a wide range of microenvironments and are the most ephemeral in nature. Even though Base 2, Target 1 and Target 2 sites appear to reflect different occupation types, experimental (burned rock) studies indicate that Middle/Late Archaic- aged mounds, earth-ovens and middens exhibited different occupation intensities, with some sites exhibiting shorter (BX420, BX432, BX1029, BX1338) versus longer-term (BX428, BX430, BX918, CM102) reuse.

Occupation Types and Environmental Associations

Occupation Types and Distance to Major Streams

Base and Target locations had a mean distance to major streams of 63 meters and 697 meters, respectively. Generally, prehistoric archaeological sites closer to major streams exhibited higher activity (ACI, ODI), feature (FDI), and re-use (CDI) diversity than sites further from water. While Target I locations (such as burned rock mound sites) are situated somewhat closer to major streams (606m) than more specialized T2 sites (701m), they tend to be proximate to lower order streams, which feed into major streams such as Salado, Cibolo and Panther Springs creeks. As a whole, these data reflect more generalized activities near major streams; sites further from major streams were primarily characterized by a more limited range of occupation diversity (Tables 1-2).

Occupation Types and Soil Types

Archaeological sites are generally present on well-drained to moderately well-drained soils types. Bases are present on moderately well-drained Tarrant (TaB) and Krum complex (Kr) soils, while Targets (including burned rock mounds) are widely distributed on a variety of soils, consisting of the moderately to well-drained Brackett, Comfort, Crawford, Krum, Lewisville, Patrick and Tarrant soil series. Poorly drained soils such as Frio and Trinity were not frequently selected for site locations, as they constitute less than 5% of soil series occurrences. Although both bases are found on terrace-specific Tarrant (TaB) and Krum (Kr) there is no apparent relationship between soil types and activity diversity (Tables 1-2). These data indicate that a wide range of land uses took place on a variety of soils (moderately to well-drained); other places (poorly drained soil series) were used less frequently.

Occupation Types and Surface Slope

Bases and Targets are predominantly found on level to gently sloping terrain, typically ranging from 1% to 5% slope. While both Bases are found on land surfaces with little slope, 37% of Targets are situated on moderately sloping terrain, usually between 6% to 10% slope. Although these data may indicate that Bases are more likely to be placed on generally level terrain, there is little relationship between activity diversity and surface slope (Tables 1-2).

Occupation Types and Aspect

Archaeological sites exhibit a variety of aspect, or settings. While both Bases have northern exposures, over half (54%) of all Targets (including burned rock mounds) are oriented toward a southern aspect. These data may indicate that the positioning of Bases with north facings may indicate that orientation was either unimportant to residents of bases or that they could represent summer occupations, when northerly exposures could minimize the sun's exposure. Alternatively, south facings are more common among Targets, which could indicate that this was a more important site location determinant for Targets, since southerly exposures would maximize sun exposure at sites, especially during the colder months (Tables 1-2).

Occupation Types and Elevation

Bases have a mean elevation of 318 meters above mean sea level (amsl), while Targets have a mean of 365 meters amsl. Bases at lower elevations tend to be characterized by higher activity variability, while Target sites positioned at slightly higher elevations (benches, side slopes, hilltops) had a lower activity diversity. This pattern of land use may suggest that more generalized activity occurred at lower elevations, and specialized tasks took place at higher elevations (Tables 1-2).

Occupation Types and Landform Types

Sites are predominantly found on low terraces and floodplains and higher elevated benches, side slopes, upland flats, ridges and hilltops, and to a lesser degree, saddles, caves and rockshelters. While both Bases and the majority of Target I (burned rock mounds, 77%) are situated on terraces, only 26% of Target II sites are found on this landform type. Instead, Target II sites are distributed across a variety of landforms, or resource zones, with three-fourths (75%) of sites on upland benches, side slopes and hilltops. Perhaps these data suggest that Bases were placed on low terraces in proximity to major streams, where multiple tasks were performed by family groups. From these Bases, task groups may have ventured across a wide variety of upland (benches, side slopes, hilltops) and lowland zones (floodplains) to procure seasonally available resources (Tables 1-2).

Summary Evaluations of Environmental Associations

As a whole, prehistoric sites are located on lower-lying moderate to well drained soils which are nearly level to gently sloping, in close proximity to major streams. However, when subdividing sites by occupation types, certain patterns appear to emerge, implying occupation diversity, differential mobililty, and perhaps, seasonality.

Bases such as BX36 and BX918 are both situated on low-elevated terraces, adjacent to major streams, with northern exposures. These two sites exhibit high ACI, ODI, FDI, and CDI measures, suggesting that a wide range of cultural activities took place at these sites; also, these sites were reused by populations, spanning from the Paleoindian to Late Prehistoric periods. By contrast, Target sites tend to be located across a wider range of landforms; however, about three-fourths (75%) of these sites are found on elevated, upland benches, side slopes and hilltops, considerably further from major streams, with southern aspects. Also, these sites tend to yield lower ACI, ODI, FDI, and CDI measures, implying more specialized and less frequent reuse by prehistoric populations.

Although it is difficult to ascertain particular temporal sequences of land use, due to the general lack of large-scale excavations to identify sequential stratigraphic deposits associated with features, diagnostic artifacts, and chronometric dates, certain general tendencies have been detected. The majority of sites produce multiple temporal uses, indicating a degree of land use continuity, although Middle and Late Archaic diagnostic artifact distributions appear to represent heavier temporal reuses during these times. Paleoindian-Early Archaic and Late Prehistoric occupation uses are the most ephemeral, suggesting a *foraging* pattern; Middle to Late Archaic occupation uses appear to be more extensive with numerous features and activity areas, represented by Base 2, Target 1 and Target 2 locations, most resembling a *collecting* strategy.

Certain land use patterns were evident which will require additional investigation. First, site selection was generally oriented toward low terraces and upland benches, side slopes and hilltops. Second, activity diversity seems to be related to distance to major streams and elevation: Bases (generalized sites) tend to be found in lower lying areas, in close proximity to major streams, while Targets (specialized sites) are generally distributed across elevated (upland) zones, further from freshwater-related resources. Third, over half of all prehistoric sites exhibit southern exposures.

Perhaps these data reflect a dual, or two-level settlement system, in which generalized camps (Bases) were positioned (with north facings) along low-lying streams, where prehistoric populations exploited a variety of mammal, and wild plant resources during the warmer months (summer-fall). Conversely, sites with predominantly south facings (Targets) in upland settings may represent specialized extractive stations, where task groups (from Bases) performed specific hunting, gathering, and tool-making tasks during the cooler months of the year (winter-early spring). This settlement-subsistence model will necessitate further investigation, including the need to recover features containing organic remains, which might imply site seasonalilty.

While few examples of preserved subsistence remains have been discovered in association with prehistoric components, which might indicate seasonal movements between regions, over half of the sites yield southern aspects. The southern orientation of sites might reflect occupation uses during the colder months of the year, such as winter and early spring. Recovered organic remains from both Bases and Targets primarily consist of mammal bone and charred seed fragments; these data reflect at least fall season uses of these areas. Therefore, this duality, or two-level settlement system might represent summer/fall and winter/spring season land uses, where task groups dispersed from low-lying Base camps to establish shorter-term loci (Targets) in upland resource zones, from which they procured animal and wild plant resources.

Settlement Patterns

Occupation Types and Drainage Systems

Although prehistoric occupations are widely distributed along major streams and their feeder tributaries of the Salado, Cibolo, Lewis, Panther Springs and Meusebach, B2 camps have only been encountered proximate to Salado Creek. For the purposes of this study, settlement pattern analysis will concentrate upon the Salado in relation to all other drainage systems. Five general patterns become apparent when comparing site ACI, ODI, FDI, CDI and drainage systems: 1) Salado Creek contains sites with a rather wide dispersal of the ACI measure, while all other tributaries tend to have a lower dispersal, 2) site aspects are generally dissimilar when comparing bases and targets, 3) target location categories (i.e., camps, scatters, quarries) are not evenly distributed between major drainage systems, 4) there appear to be different orientations toward specific landforms and elevation in the region, and 5) documented types of sites such as campsites and cemeteries are not evenly distributed between different physiographic provinces such as the Edwards Plateau (uplands) and the Coastal Plain (lowlands) of south-central Texas.

Drainage Systems and Activity Variability

Current data indicate that activity variability differed between Salado Creek and the other major drainage systems in the region. Salado Creek (and its feeder streams) contain 72 sites, including Bases (N=2), T1 (N=2) and T2 (N=68) Locations, with a mean ACI of 0.25 (ACI range .05-.85) (Figure 13), ODI (2.9) (Figure 14), CDI (1.80) (Figure 15), and FDI (0.28) (Figure 16); the mean site size is 18,353sqm, or 1.84ha (Figure 17).

By contrast, sites along all remaining major streams and feeder streams (Cibolo, Lewis, Panther Springs, Meusebach) only consist of T2 (N=204) and T1 (N=11) Locations; sites within these tributaries showed somewhat less measure diversity, with a mean ACI of 0.21 (ACI range .05-.65) (Figure 13), ODI (2.85) (Figure 14), CDI (1.79) (Figure 15), and FDI (.15) (Figure 16). The mean site size is 22,073 sq m, or 2.21 ha (Figure 17).

While Bases are only positioned along the Salado Creek, Target locations are widely distributed across the different drainage systems, with the majority of T1 sites (85%) found away from Salado Creek in drainage systems such as Lewis, Panther Springs, Meusebach and Cibolo Creeks (Tables 4-5). Also, both documented Bases (BX36, BX918) have northern facings and tend to contain a wide variety of artifact classes and features; over half (60%) of the T1 locations have southern exposures, are somewhat less varied assemblages, but tend to yield large burned rock mounds and associated activity areas. Although these site types are not similar, they

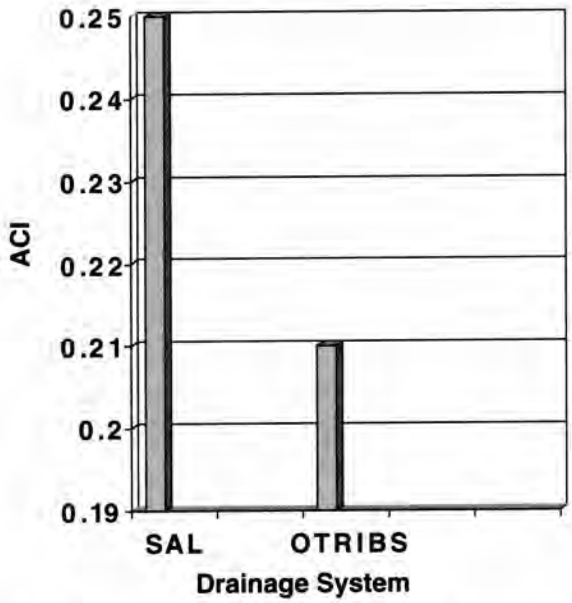

Figure 13. Drainage Systems and ACI (SAL is Salado Creek. OTRIBS is all other tributaries within the military installation).

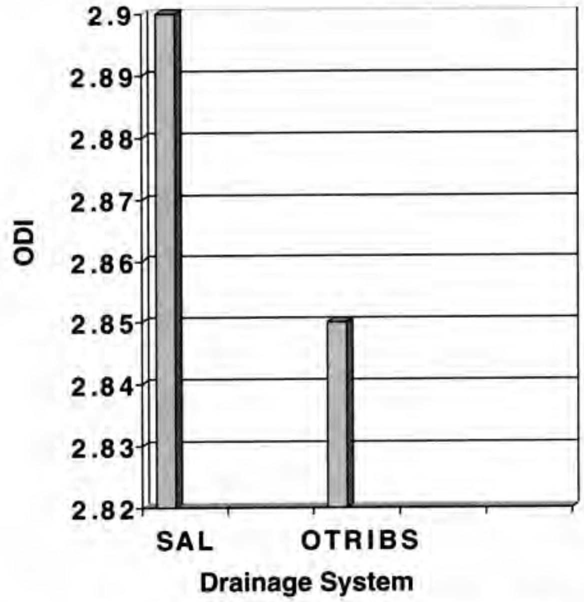

Figure 14. Drainage Systems and ODI (SAL is Salado Creek. OTRIBS is all other tributaries within the military installation).

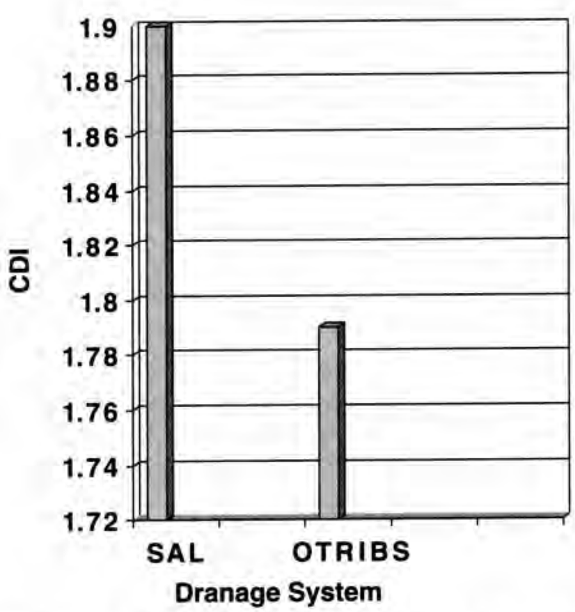

Figure 15. Drainage Systems and CDI (SAL is Salado Creek. OTRIBS is all other tributaries within the military installation).

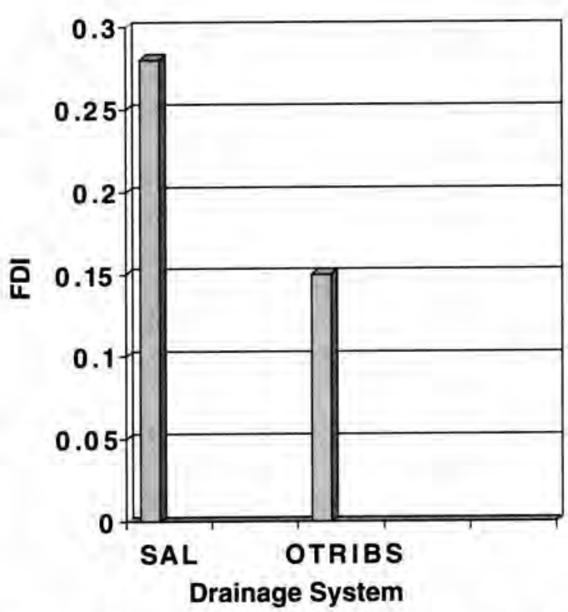

Figure 16. Drainage Systems and FDI (SAL is Salado Creek. OTRIBS is all other tributaries within the military installation).

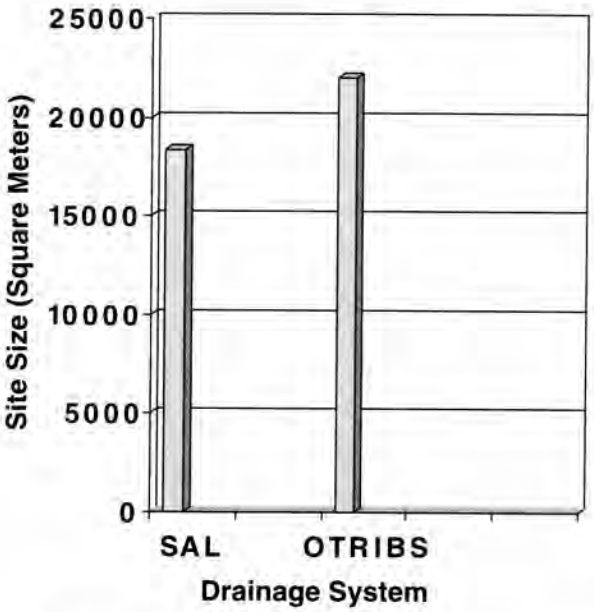

Figure 17. Drainage Systems and Site Size (SAL is Salado Creek. OTRIBS is all other tributaries within the military installation).

both predominantly contain Middle and Late Archaic assemblages (Tables 1-2).

When examining the breakdown of T2 Location categories such as quarries, camps and scatters, an uneven pattern emerges between drainage systems. For example, Salado Creek contains a higher number of camps (43%) and a lower number of scatters (41%), when compared to the other drainage systems in the region, which have a higher percentage of scatters (64%) over camps (23%). Quarry sites are almost evenly distributed in the Salado Creek (16%) and other combined drainage systems (13%), respectively (Tables 1-2).

These data suggest that drainage systems may not have been used in a similar manner, in terms of activity diversity and perhaps, seasonality. Multiple family groups may have occupied bases along Salado Creek during the warmer months (north-facing B2 sites) and may have dispersed into individual family units, or smaller task groups within specific drainage systems to temporary (burned rock mound) encampments in winter (south-facing T1 sites), especially during the Middle and Late Archaic periods; also, it might indicate family groups linked to specific drainages, at least on a seasonal basis.

Landform Orientation, Elevation and Activity Variability

Current data also indicate that site types are not evenly distributed by landform and elevation across the region. For example, B2 and T1 camps are primarily (80%) found along terraces, where groups performed a variety of activities; however, B2 sites are located on lower terraces (318m) along Salado Creek, while T1 sites (burned rock mounds) tend to be found on more elevated terraces (365m), generally associated with smaller feeder tributaries. By contrast, T2 sites are widely distributed across a variety of landforms, predominantly along upland side slopes, benches, ridges, hilltops, and rockshelters (69%), and less so, along terraces (31%); these sites tend to be highly elevated, ranging up to an elevation of 442m amsl. Even so, terrace-based T2 locations yield a higher ACI (0.34) than other combined landform categories (ACI=0.18), respectively.

These data indicate that prehistoric populations operated out of Bases (BX36 and BX918), positioned on low terraces (lowland settings) in close proximity to Salado Creek; task groups ventured out of these camps to exploit resources from nearby upland (elevated terraces, side slopes, benches, hilltops) zones, on a seasonal basis.

Drainage Systems and Mobility Patterns

An examination of the distribution of prehistoric sites indicate that there is a differential distribution of occupation types; this may imply that aboriginal populations used landscapes differently in the past, perhaps reflecting seasonally specific land use (mobility) patterns. Specific drainage system site settlement patterns are presented below.

For example, Salado Creek contains a full range of occupation types: T2, T1, and B2 site locations (Table 1). B2 site locations such as BX36 and BX918 yield a variety of artifact classes and features, reflecting seasonal reuses by multiple family groups, primarily from the Middle and Late Archaic periods. T1 site locations such as BX428, BX430, BX432, BX1220, BX1338, and CM102 are mostly concentrated on elevated terraces along feeder tributaries across different drainage systems; these sites yield large burned rock (mound) accumulations, indicating seasonal reuses by task groups, or individual domestic units. These burned rock mounds are also dominated by Middle and Late Archaic assemblages. T2 loci are widely scattered with a very narrow range of artifact classes. All other drainage systems in the region predominantly contain T2 locations; these sites are distributed across a wide variety of microenvironments, but reflect very specialized extraction loci by individuals, or task groups, away from T1 and B2 site locations.

When comparing the different drainage systems in this region, unlike settlement systems have been detected. For example, Salado Creek yields a variety of occupation types such as B2, T1 and T2 site locations, while all other drainage systems contain only T1 and T2 locations. Although these settlement patterns indicate differential residential mobility between drainages, as a whole, this regional pattern most resembles a *Collecting II* pattern, at least during the Middle and Late Archaic periods. By contrast, sites attributed to the Paleoindian-Early Archaic and Late Prehistoric are much more ephemeral in nature, implying greater residential mobility, broadly corresponding to a *Foraging I/II* pattern.

Land Use Models

Camp Bullis is situated along the upland margins of the Balcones Escarpment, a rugged geological fault line marking the interface between the Edwards Plateau, Gulf Coastal Plain, and the Blackland Prairie zones in south-central Texas (Potter et al. 1995). Ethnohistoric data from this region indicate that aboriginal groups such as the Mariame and the Payaya exhibited seasonal residential mobility stretching across these three resources zones (Campbell 1988).

Archaeological settlement pattern data from this region indicate that prehistoric site classes are not evenly distributed across the landscape. While settlement data from adjacent lowland zones of the Inner Coastal Plain and Blackland Prairie produce heavily reused campsites and cemeteries, indicating a degree of residential stability and territoriality, the upland margins of the southern portion of the Edwards Plateau generally yields transient camps, burned rock mounds and middens, as well as smaller cemetery loci (Schuetz 1966; Hall 1981; Black and McGraw 1985; Story 1985; Katz 1987; Lukowski 1988; Hester et al. 1989; Hines 1993; Bement 1994; Potter et al. 1995; Taylor and Highley 1995; Black et al. 1998; Perttula 2001).

This pattern of settlement associated with the Inner Coastal Plain and Blackland Prairie has produced habitation loci and extractive camps, which broadly correspond to Bases (B1, B2) and Targets (T1, T2), most typical of well-developed collectors, as the presence of central bases and cemeteries suggest a degree of residential stability and territoriality, especially during the Middle and Late Archaic periods (Hester et al. 1989; Hester 1995; Potter 1995; Perttula 2001). By contrast, the southern Edwards Plateau (upland margins) portion of the study area produces a different settlement pattern, characterized by more diffuse lithic scatters, quarries, campsites, and isolated human interments; these loci tend to most resemble B2, T1 and T2 site types, which is indicative of higher group mobility, and more typical of weakly-developed collectors or foragers (Hines 1993; Potter et al. 1995).

Settlement pattern data from south-central Texas could represent either highly territorial hunter-gatherer groups seasonally shifting within specific physiographic zones or highly mobile groups moving from one physiographic zone to another, to exploit seasonally available resources (See McCulloch 1986; Potter et al. 1995). These two competing hypotheses allow for the development of two possible scenarios, as follows: The first scenario, or the *Subcultural System Hypothesis* states that the distribution of discovered sites contained within the present-day Camp Bullis area represent only a portion (or subset) of a larger settlement-subsistence unit. The second scenario, or *Single Cultural System Hypothesis* states that the distribution of sites within the confines of the installation represent hunter-gatherers making use of this portion of the southern Edwards Plateau according to an annual subsistence-settlement cycle.

According to the *Subcultural System Hypothesis*, the Camp Bullis area only served as a specialized procurement zone used by hunter-gatherer groups from adjacent Inner Coastal and Blackland Prairie physiographic zones. If this is the case, then the distribution of seasonal camps, lithic scatters, and quarries, represent small organized task groups who ventured from primary settlements elsewhere to seasonally procure resources from uplands margin zones along the southern edge of the Edwards Plateau in the present-day Camp Bullis area. The alternative *Single Cultural System Hypothesis* would imply that the general Camp Bullis region contained highly territorial, but mobile hunter-gatherer groups who seasonally used different portions of the southern Edwards Plateau zone to procure resources on a year-round basis. Current available data from this study do not enable researchers to adequately address these proposed hypotheses.

CONCLUSIONS AND RECOMMENDATIONS

This current study presents the results from a synthesis of archaeological survey data at the Camp Bullis military installation. A total of 287 prehistoric archaeological sites have been identified within the boundaries of the installation; these sites span the entire span of prehistoric cultural history of the region from 11,500 years B.P. to 350 B.P.

The primary focus of this study has been on the prehistoric uses of the installation, as Paleoindian to Late Prehistoric populations inhabited this region during prehistoric times. A systematic testing methodology was developed to identify prehistoric archaeological sites, using both nonsite and site data against specific environmental variables; both GPS and GIS technology were used to collect these data in a standardized manner.

Five primary environmental variables were used to assess prehistoric land use sensitivity across the study area. Environmental variables (i.e., distance to major streams, slope, etc.) were measured using randomly selected nonsite points and archaeological site locations, for comparative purposes. Subsequently these data were quantified and interpreted using analytical approaches such as frequency distributions and the Chi Square statistic. These statistical approaches were used to assess the probability of site occurrences in association with specific environmental associations.

The majority of nonsite points and archaeological sites were found in areas characterized by moderately to well-drained soils found on level to gently sloping surfaces, indicating that sites and nonsite points were just as likely to be found in these types of places. Therefore, these data suggest that surface drainage and surface slope, in themselves, are not critical in predicting the presence of site locations across the installation. By contrast, stronger statistical associations were discovered when evaluating variables such as distance to major streams, soil types, and elevation, in relation to nonsite points and site locations. The distribution of nonsite points differed from that of site locations, as the majority of sites were situated along low-lying terraces and floodplain settings, near major streams and on particular soil series, such as Tarrant, Krum, Crawford and Comfort soils.

Specific prehistoric land use patterns have been detected which will require additional investigation. First, site selection was generally oriented toward low terraces and floodplains. Second, activity diversity seems to be related to distance to major streams, elevation, landform and possibly aspect. Sites exhibiting higher activity diversity, possibly representing generalized maintenance and processing base locations were found on low-lying terraces and floodplains with north facings; sites which had a lower activity diversity (Targets), indicative of more specialized tasks such as sites containing burned rock mounds (Target 1) or even more specific resource extractive functions (Target 2), were generally found on smaller feeder tributaries further from major streams, and set back on higher elevated terraces, upland benches, side slopes, ridges, hilltops and rockshelters, with southern exposures.

Perhaps these data reflect a dual, or two-level settlement system, in which generalized base camps were situated along low terraces and floodplains proximate to Salado Creek, where prehistoric populations exploited a variety of mammal and wild plant resources during the warmer (summer-fall) months. Conversely, sites predominantly contained within adjacent drainage systems such as Cibolo, Lewis, Panther Springs and Meusebach creeks may represent more specialized burned rock mounds and extractive stations. While burned rock mounds generally tend to be found on elevated terraces along smaller, feeder tributaries, and more specialized extractive stations are usually found even further from major streams and on even higher elevated (upland) benches, side slopes, ridges, hilltops and rockshelters, both of these site types tend to exhibit south-facings, which may imply occupation of these areas during the colder months (winter-early spring) of the year. This settlement-subsistence model will necessitate further investigation.

Further research should focus on the development and refinement of this predictive model with data from the surrounding southern Edwards Plateau region. On the basis of this study, one thing is certain that contributed research from Camp Bullis makes it abundantly clear that no one single model adequately explains prehistoric land use patterns in this portion of south-central Texas (southern Edwards Plateau-Inner Coastal Plain-Blackland Prairie transition), as different drainage-specific and watershed models must be developed to explain how prehistoric (Texas) populations moved across the landscape and used resources in the past.

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A Bioarchaeological Investigation of 41VT141: Osteological and Isotope Analysis of a Burial at the McNeill Ranch Site

Jennifer L. Z. Rice

ABSTRACT

This paper presents results from the analysis of a recently excavated burial at the McNeill Ranch site in Victoria County, Texas. In order to determine a definitive habitation time for this newly discovered individual, radiocarbon analysis was necessary. In November 2005, a Donors Fund Grant from the Texas Archeological Society (TAS) provided the necessary funds. Accelerator Mass Spectrometry (AMS) and carbon stable isotope analysis were performed yielding a date of 3,650 BP and a value of -17.1 respectively. Although incomplete and fragmentary, the skeletal material yielded important biological and cultural information regarding early inhabitants of the Texas Coastal Plain.

INTRODUCTION AND BACKGROUND

For decades, bioarchaeological information has contributed greatly to our knowledge of human adaptation of early populations along the Texas Coast and Coastal Plain. Archaeological sites containing cemeteries and single burials provide insight into biological characteristics of individuals as well as entire populations. Information extracted from human skeletal material in particular, contributes to our understanding of mortuary practices, demographic history, and biocultural adaptation (e.g. Huebner and Comuzzie 1992a).

The McNeill Ranch site (41VT141) is a large archaeological site in the Deweyville Formation along the Guadalupe River floodplain just south of Nursery, Texas in Victoria County. It is on the property of Mr. and Mrs. John McNeill. Since its discovery in 2003, the site has yielded new and valuable information pertaining to aboriginal life along the Texas Coastal Plain. Excavation at the McNeill Ranch site began in the summer of 2003 and continues today by a group of dedicated volunteers, as well as summer archaeological field schools from The University of Texas at Austin. The site is a large habitation and burial area that incorporates an expanse of approximately 16 acres. Based on surface collections and extensive excavation, it is apparent that human habitation in this area dates to the Late Paleoindian periods and extends into Historic times (Hester 1996; Birmingham and

Figure 1. Surveying at Burial Area 3 (Photo courtesy of Pat Braun)

Shook 2005). To date, three main burial areas have been excavated. Burial areas 1 and 2 are in close proximity to one another at the northernmost portion of the site, while Burial area 3 is located approximately 400 yards away to the south.

Excavation and removal of the burial described here, in Burial area 3, was completed on July 23, 2005. After the surface discovery of a human tooth, additional surface survey was conducted in the vicinity. Subsequently, human bone was found, and excavation began. One fragmentary and incomplete human burial was discovered very close to the surface which led to the removal of a core sample taken for geologic study in the area. This core sample, taken approximately 150 centimeters from the first burial in Burial area 3, contained a human bone fragment which prompted further excavation. This single burial was approximately 110 centimeters deep, much deeper than the previously excavated burial located in Burial area 3 and those excavated from Burial areas 1 and 2. One distal portion of a dart point was discovered next to this burial, but unfortunately, the tip fragment is not diagnostic.

Although incomplete and fragmentary, the skeletal remains are in relatively good condition. It is difficult to determine if the condition of the remains is due to animal and/or plant perturbation or some other cause such as human manipulation as a result of cultural practices, i.e., secondary burial. Regardless of the paucity of skeletal material, it was possible to extract biological and cultural information from the remains.

Figure 2. Burial 2.

DIET

The investigation of diets of past populations enhances our understanding of human adaptation as well as subsistence economy (Larsen 1987). Hunting and gathering populations tend to maintain a diet that includes a wide variety of foods. Smaller groups of hunter-gatherers can be selective in the foods they choose because of the wide geographical range covered and because of the lack of population pressure. They are able to select foods that are nutritious and also easy to process (Cohen 1989).

With the Guadalupe River nearby, aquatic and terrestrial resources at 41VT141 were certainly abundant. In addition to aquatic foods, early inhabitants of the area would have utilized terrestrial flora and fauna such as nuts, acorns, berries, mesquite beans, mustang grapes, persimmons, prickly pear, herbs, and both large and small animals (Hall 1998; Robert Hard, personal communication, 2006). Due to these varied resources and subsequent complementary seasonal availability, food sources in the area could have been utilized year-round (Hall 1998).

In addition to identifying dietary habits from the archaeological record, (i.e., floral and faunal remains), stable isotope analysis can be utilized as a more specific indicator of food intake (cf. 41VT94, on the Guadalupe drainage; Huebner and Commuzie 1992b:193-200). Stable isotope levels can be measured in skeletal remains, thus revealing specific dietary intake relative to environment. This dietary information can be used to determine food resources utilized by populations therefore revealing nutrient intake as well as levels of sedentism and/or migratory practices.

MATERIALS AND METHODS

During excavation, selected bone fragments from the burial were collected for radiocarbon dating. A diaphysis fragment of the femur was sent to Beta Analytic, Inc. in Miami, Florida for AMS dating. The AMS technique for dating was preferred given that such a small amount of material was necessary for analysis.

Skeletal remains from this individual were cleaned, reconstructed, and macroscopically examined in order to determine age, sex, and incidence of pathological lesions and trauma. Assessment of age was determined on the basis of ectocranial suture closure, stage of epiphyseal fusion, and dental attrition as outlined by Bass (1971), Buikstra and Ubelaker (1994), and Lovejoy et al. (1985). Assessment of sex was determined on the basis of circumference of the femur as outlined by Bass (1971), Black (1978), Buikstra and Ubelaker (1994), and Steele and Bramblett (1988). Presence of pathological lesions and trauma of the skeleton were assessed based on methods presented by Buikstra and Ubelaker (1994), Steinbock (1976), and White (1991).

RESULTS

Dietary Intake

Stable carbon isotope analysis provided a ^{13}C value ofrom this individual of -17.1, which suggests the inclusion of C_4/CAM resources in a diet most likely dominated by C_3 resources (Robert Hard, personal communication, 2006; see also Huebner and Commuzie 1992b). C_3 resources include trees, shrubs, flowering plants, and temperate-zone grasses. This value of -17.1 is similar to those in other inland hunter-gatherers of south Texas such as the populations of the Blue Bayou cemetery (41VT94; Huebner and Comuzzie 1992b), Bering Sinkhole (Bement 1994:101), 41WY113, and Olmos Dam (41BX1; Cargill and Hard 1999: 207). C_4/CAM resources in the region include prickly pear, tropical grasses, and animals that feed on these resources. Marine resources are also a source of C_4 dietary items, but this seems an unlikely source of food given the distance to the coast (Huebner and Comuzzie 1992b:200; Robert Hard, personal communication, 2006).

Pathology

Skeletal analysis of the remains of this individual revealed no pathology or trauma. Taphonomic markers are present on the remains, therefore making assessment of pathology and trauma difficult. The right tibia and fibula diaphyseal fragments possess possible lytic lesions, but due to the presence of numerous animal gnaw marks, it is difficult to be certain.

Age and Sex

Most skeletal features generally used to determine age and sex of an individual are not present, thus only estimations of age and sex of this individual are presented. Of the long bones present, fusion of the epiphyses is complete, indicating cessation of growth. Based on ectocranial suture closure (from numerous skull fragments), epiphyseal fusion, and dental attrition, the remains appear to be that of a middle-aged adult. Although the dentition is represented by only 6 teeth and 2 teeth fragments, severe attrition is apparent with exposed dentin. Sex of this individual was more difficult to evaluate due to the lack of skeletal remains usually associated with sex determination (skull and pelvis). Based on femur circumference and the gracile nature of the skeleton, the remains appear to be that of a female.

DISCUSSION AND CONCLUSION

Although the excavated remains from 41VT141 are fragmentary, extraction of information from this burial was possible. Analysis of the skeletal remains from this adult female revealed an absence of pathological occurrence and trauma, but without additional skeletal material from this individual, a more detailed description is not possible. However, it is worth noting that hunter-gatherers usually exhibit low rates of pathological occurrences such as infectious disease due to low population density. Most pathological occurrences observed in hunter-gatherers are the result of injury.

Dietary information was also extracted from the skeletal remains. Stable carbon isotope analysis revealed that the diet of the individual included both

C_3 and C_4/CAM resources similar to those in other inland hunter-gatherers of south Texas (Huebner and Comuzzie 1992b:200; Bement 1994; Cargill and Hard 1999). This varied and seasonal diet of meat and vegetable foods from both aquatic and terrestrial resources is optimal since it assures a needed balance of vitamins and minerals.

Even though a larger sample size is optimal, single burials remain an important contribution to bioarchaeology. Bioarchaeological data obtained from a single burial can be limiting, however, any information gained from the archaeological record is helpful in our knowledge of early human populations. Based on the skeletal remains of this early Texas inhabitant, it is apparent that she lived well into her adult years and maintained a lifestyle typical of other hunter gatherers in south Texas. Results from skeletal analysis indicate an absence of any pathological occurrence. This absense is expected expected in hunter gatherers.

Excavation at 41VT141 continues today and will certainly contribute further to the archaeological record of south Texas. Victoria County, in particular, has yielded important archaeological information pertaining to early inhabitants of the Texas Coastal Plain (e.g., Hester 1996:19-20). The hard work of experienced avocational archaeologists and volunteers make it possible to continue broadening our knowledge of Texas prehistory.

ACKNOWLEDGMENTS

I am very grateful to the Texas Archeological Society (TAS) for awarding the TAS Donors Fund Grant for the purpose of obtaining the AMS analysis. Without this grant, obtaining radiocarbon dates would not have been possible. Excavation at 41VT141 would not be possible without the unending support and encouragement from the property owners, Mr. and Mrs. John McNeill. I am also grateful to the archaeological stewards Jimmy Bluhm, Bill Birmingham, Pat Braun, and Nelson Marek for their continued assistance throughout excavation. Also, I thank Ben McReynolds, Pat Braun, Bill Birmingham, Jimmy Bluhm, Jud Austin, Frank Condron, Howard Camp, and Matt Taylor, for their help and hard work during excavation. A special thanks to Pat Braun for her extensive help and assistance throughout the writing of this paper. I also thank Dr. Robert Hard at The University of Texas at San Antonio for his help and assistance with stable isotope information and Michael Aiuvalasit, graduate student at Texas A&M University, for extraction of the core sample at the site.

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A Possible Case of Syphilis from the Lower Pecos Region of Texas

Matthew S. Taylor

ABSTRACT

While the author was collecting dental morphometric data from human skeletal remains from the Lower Pecos region of Texas, a cranial fragment was found from 41VV39 that displayed stellate lesions. These lesions are consistent with bacterial diseases caused by the *Treponema* genera, which include such maladies as pinta, yaws, endemic syphilis, and venereal syphilis. Unfortunately, this cranial fragment is all that remains of the individual. The extent of the infection in the remainder of the skeleton is unknown. Given the characteristics of the lesions, endemic syphilis is the most likely diagnosis. This discovery places treponemal disease in an area of the state where it has not been previously reported.

INTRODUCTION

Lesions associated with treponemal infections have been found on human remans excavated along the Texas coast (Dockall 1997; Jackson et al. 1986; Taylor 2005; Wilson 2000), Central Texas, and the Caddo cultural areas of northeast Texas (Wilson 2000, 2005). However, there is little or no evidence of treponematosis in the Lower Pecos region (Diane Wilson, personal communication). Recently, while examining dental nonmetric traits of Lower Pecos remains, the author found lesions on a cranial fragment from an individual excavated at 41VV39 that are indicative of treponemal disease.

Treponemal diseases have a long history in North America and were present for at least two thousand years before Christopher Columbus landed on the continent. Skeletal lesions associated with these diseases have been found in nearly every region of the Americas (see articles in Powell and Cook 2005). This evidence has been taken by some researchers as evidence that syphilis was native to the New World (Baker and Armelagos 1988). However, new discoveries of syphilitic-like lesions in medieval British samples hint that it may have had a presence in Europe well before Columbus (Brothwell 2005). In spite of these new findings, the Old World evidence for the disease is scanty compared to the hundreds, if not thousands, of cases documented in North America (Larsen 1997:95-96).

The *Treponema* bacterium is responsible for a range of chronic and subacute infections. These infections include pinta, yaws, bejel (or endemic syphilis), and venereal syphilis (Aufderheide and Rodriguez-Martin 1998:154). Unfortunately, these lesions all leave a similar signature on bone and the specific infection can not be differentiated (Wilson 2000:84).

Treponemal diseases often leave a distinctive pattern on the skeleton. However, diagnostic lesions will not express themselves on bone tissue in most cases. Steinbock (1976) reported that bone lesions will appear in only 5-20% of all cases. The most frequently affected bones (in decreasing order) are the tibia, frontal, parietal, the nasal-palatal region, sternum, clavicle, vertebrae, femur, fibula, humerus, ulna, and radius. Of the skeletal lesions associated with treponematoses, the "most characteristic are those of the skull bones, most commonly affecting [the] parietal and frontal bones" (Aufderheide and Rodriguez-Martin 1998:158).

These cranial lesions are described as "raised, smooth nodules (nodes) surrounding singular or coalesced areas of bone loss (cavitation) that have undergone destructions and subsequent healing (sclerosis). Linear striations (stellate or radial scars) will be seen radiating from the nodes" (Mann and Murphy 1990:22). Frequently these lesions are associated with periostitis (infection of the periosteum that surrounds bony surfaces) and osteomyletis (infection of the bone tissue) in distal extremities, such as the tibia and bones of the forearm (Hackett 1976; Ortner and Putschar 1985).

DESCRIPTION OF FINDING

The site 41VV39 is a rockshelter located in Big Satan Canyon in Val Verde County (Figure 1). Artifacts discovered in test excavations suggest an Archaic provenience for the site (TARL files 1955). Among the human remains discovered at 41VV39 was an isolated fragment of an unsided parietal bone (TARL H.O. #3532). This fragment is 51x47 mm in size and 9.1 mm thick. No estimation of sex was possible. The age of the individual can only be broadly estimated. The size and thickness of the surviving bone suggests that this individual was an adult, i.e. over 20 years of age at death. The outer surface of the bone is marked by healed or healing stellate lesions (Figure 2). The endocranial surface is porous and has a puffy, sponge-like appearance. As a result of this expansion of the endocranial surface, the meningeal grooves are poorly defined (Figure 3). The diploe (or cancellous bone between the outer and inner tables of the cranial vault) has expanded, resulting in overall thickening of the parietal.

This type of focal destructive lesion correlates to stage 5 of Hackett's (1976) caries sicca sequence. Hackett (1976:31) developed a 1 to 5 sequence for describing single discrete units of bone remodeling associated with treponemal disease. Sequence 5 (radial scars) is described as: "continued healing covers the walls and base of the cavity with new bone which then fills the cavity until only a shallow depressions remains with a radial pattern of scanty, thin wavy lines and perhaps a small, finely granular central area" (Hackett, 1976:40).

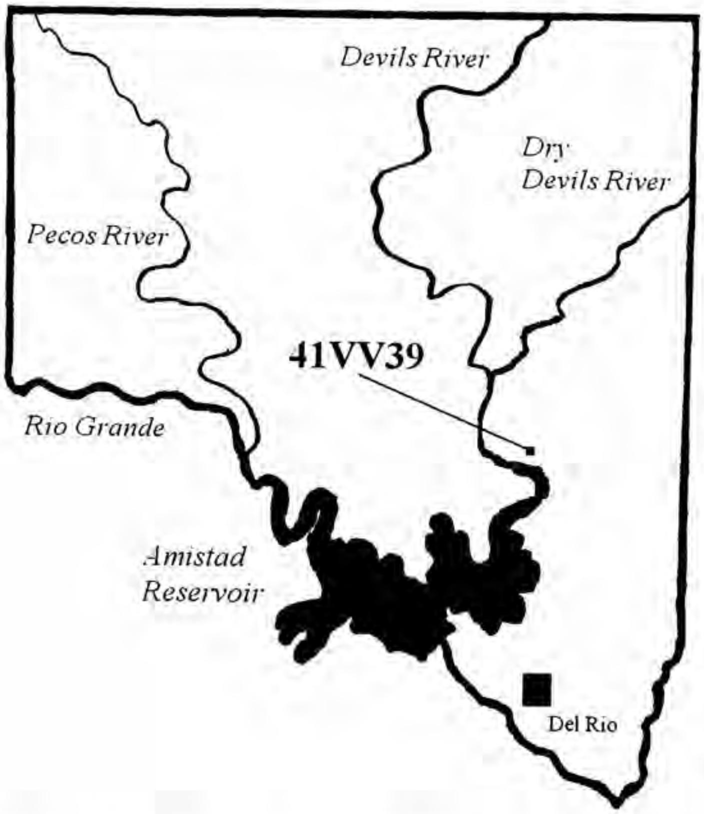

Figure 1. Approximate location of 41VV39 in Val Verde County, Texas.

DISCUSSION

The cranial lesions exhibited on the cranial fragment recovered from 41VV39 appear to be diagnostic of treponemal disease. However, other diseases should be considered before a final diagnosis is rendered. Cranial tumors (malignant neoplasms), tuberculosis, and osteomyletis of the skull may all produce lesions that can be confused with syphilis (Bogdan and Weaver 1992).

Cranial tumors (such as metastic carcinoma and multiple myeloma) usually produce lesions that are only destructive in nature. There is typically no bone remodeling or regeneration of tissue. Lesions are usually have jagged edges and may perforate the cranial vault (Morse et al. 1974).

Tuberculosis may also produce cranial lesions, but these are typically found only on the inner table of the vault. The bacterium

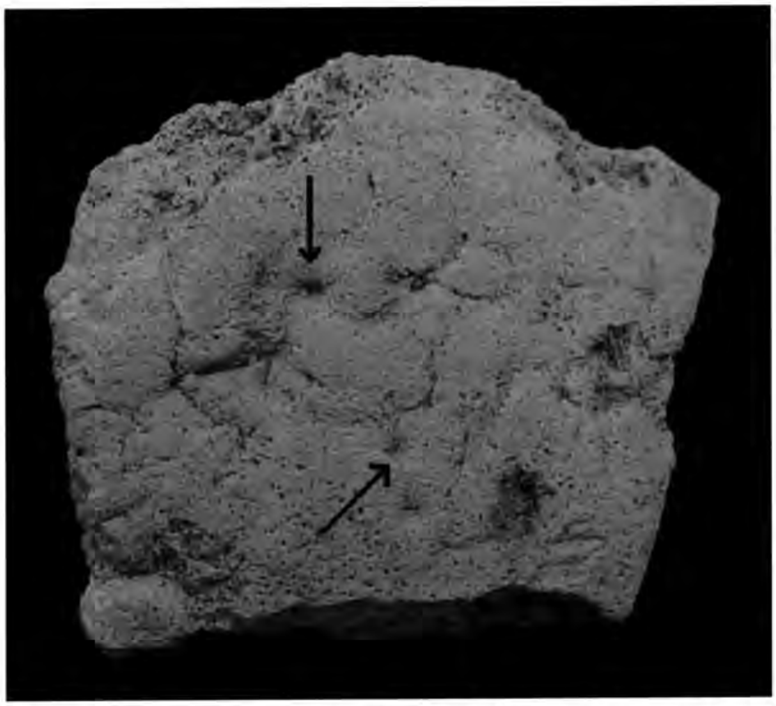

Figure 2. Photo showing the outer table of the cranial fragment from 41VV39. Arrows point to stellate lesions that are commonly associated with treponemal disease.

responsible for tuberculosis was present in the Americas before European contact, but there have been no reported North American cases that predate A.D. 1000 (Aufderheide and Rodriguez-Martin 1998:127). Furthermore it is likely that the population of the Lower Pecos was so sparse that tuberculosis would not have been able to readily pass from one host to another, making it extremely unlikely that the disease was present.

Of the differential diagnoses, perhaps the best alternative is cranial osteomyletis (bone infection). Infections resulting osteomyletis are usually caused by the common *Staphylococcus aureus* bacterium (Aufderheide and Rodriguez-Martin 1998:173). Pathways to the cranium could be created by an accidental cut or bites from lice or other parasites. *Staphylococcus* infections can create changes in the surface of the cranium that mimic treponemal disease (Hackett 1976:52). However, some changes associated with osteomyletis are not present on the cranial fragment from 41VV39. Pyogenic (pus-producing) osteomyletis would create cloacae (holes in the infected bone) to drain away pus (Larsen 1997:84). These cloacae are not present on the fragment.

CONCLUSIONS

Based upon the available evidence, the following conclusions can be drawn about the cranial fragment from 41VV39: 1) the stellate scaring and thickening of the cranial vault is diagnostic of a syphilitic infection, 2) treponemal infections were common in other regions of Texas and there are no geographic barriers to prevent its spread to the

Figure 3. Photo showing the inner table of the cranial fragment from 41VV39. The surface appears puffy and porous, distorting the meningeal grooves.

Lower Pecos region, 3) a *Staphylococcus* infection can mimic the scarring and bony destruction usually associated with syphilis, but some key diagnostic criteria are absent. Therefore, the most likely diagnosis of the lesions observed on the fragment from 41VV39 is a treponemal infection associated with endemic syphilis. Unfortunately the lack of post-cranial remains reduces the confidence of this diagnosis. While endemic syphilis cannot be diagnosed beyond a reasonable doubt, it remains the best possible explanation.

The individual from 41VV39 demonstrates that treponemal disease was present in the Lower Pecos region prehistorically. Given the lack of other skeletal material the extent and effect of disease on this individual is unclear. The information provided by this cranial fragment has shown that small, incomplete samples of human skeletal remains can provide valuable paleopathological data.

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Human Bone Artifacts from the Lower Rio Grande

James B. Boyd

ABSTRACT

Several human bone artifacts have been found at sites along the Lower Rio Grande in South Texas and adjacent areas of Mexico, near International Falcon Reservoir. These specimens include examples of both ornamental and utilitarian artifacts, most of which were found with burials. Other human bone artifacts collected in South Texas sites during the 1940s-1960s are also described and a comparison is made with the more recently collected specimens. A discussion follows about the significance of artifacts fashioned out of human bone and the possible ritual implication of their inclusion with burials.

THE GEOGRAPHIC REGION

The human bone artifacts described here were found in a narrow zone centered around International Falcon Reservoir (Figure 1), on the Lower Rio Grande. The reservoir was constructed in the early 1950s, and the subsequent impoundment of water caused hundreds, perhaps thousands, of archaeological sites to become inundated. At its mean elevation of 301.'2 (91.8 m) above mean sea level, the lake covers over 88,000 acres. The reservoir sites are only exposed during low water levels that usually occur during periods of drought (Boyd and Perttula 2000a:6-21) or after the release of large amounts of water through Falcon Dam for downstream use, mainly irrigation in the Lower Rio Grande Valley. The sites in and immediately surrounding the reservoir are quite numerous and very diverse in their characteristics (Boyd 2004:5-25), while only a small fraction of them have ever been recorded (e.g. Perttula et al. 1996; McCulloch et al. 2003).

The area surrounding the reservoir is mesquite savannah and chaparral, moderately dry, and is drained by innumerable dry washes or arroyos that usually merge with the Rio Grande. Some of the arroyos are major watersheds and drain geographically large areas. Often many prehistoric archaeological sites are found along the banks of these now dry watercourses, and many of the sites indicate repeated use over very protracted periods of time. Evidence seems to indicate that water once flowed or at least was contained in these now dry streambeds, and supported the inhabitants of the sites. Many of these sites are located miles away from the Rio Grande, indicating that water must have been available close to the campsites. Although nearly all of the arroyos in the region are now dry, many have rock-bottomed waterholes, or *tinajas*, that probably held water for periods of time after rains. These sites in the higher elevations away from the reservoir are even less well known, occurring for the most part on private ranches on the U.S. and Mexican sides of the lake. The Mexican sites are virtually unexplored, save for the efforts of a few avocational archaeologists.

In the vicinity of Falcon Reservoir and just across from Zapata, Texas another major river, the Rio Salado, flows into the lake. This river originates far to the northwest, in the state of Coahuila, Mexico, and countless prehistoric sites are located along its banks and along the innumerable tributary arroyos that flow into it (Boyd n.d.a). The Rio Salado and the Rio Grande merge approximately 8 km southwest of Zapata, Texas (Figure 1). The junction of these two rivers seems to have attracted prehistoric people to settle in the area, and the possibility that the Rio Salado might have been a migratory route used by the ancient nomadic hunters and gatherers that roamed the area has been previously discussed (Boyd

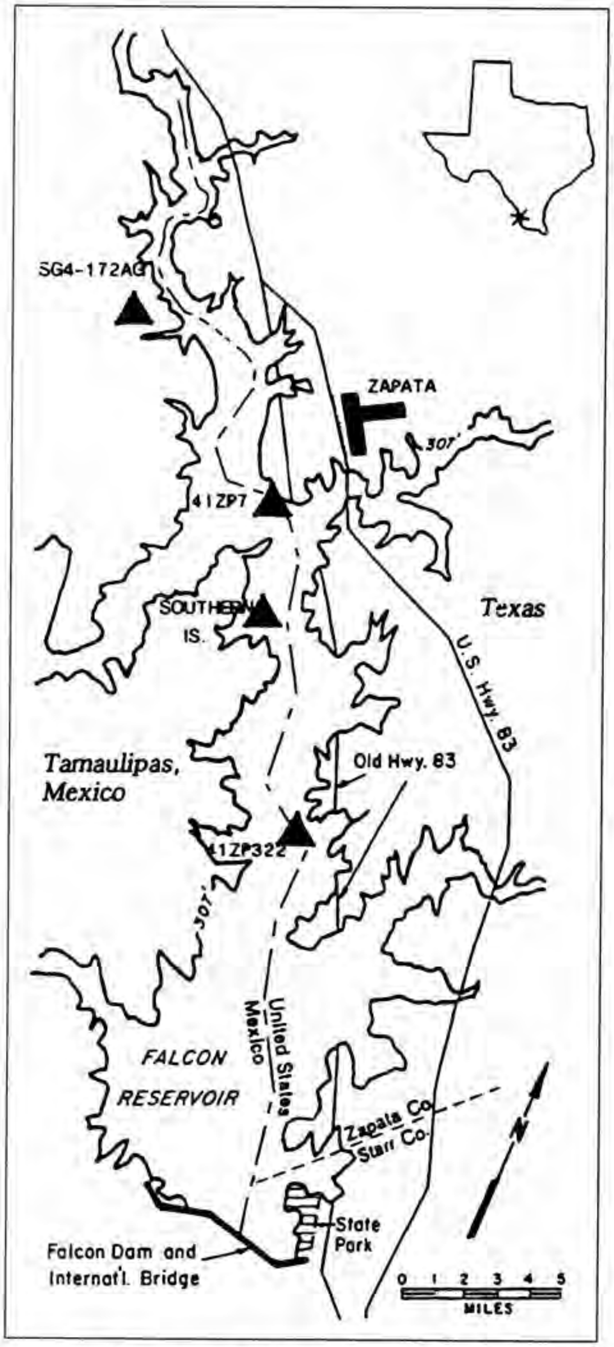

Figure 1. General map of International Falcon Reservoir, showing approximate locations where the human bone artifacts described in text were found. Inset shows location of area in the state.

1997:47; 2004:6).

The geographic area along the Lower Rio Grande and the types of prehistoric archaeological sites found in the region have been previously described and discussed in detail (Black 1989:39-62; Boyd 2004:5-25; Hester 1995:427-459; Perttula et al. 1996). However, much work remains in the recording and study of the innumerable archaeological sites that abound in this very understudied region. The previously reported human bone artifacts (see below) were recovered in the Coastal Bend and Rio Grande Delta biogeographical areas of South Texas and adjacent northeastern Mexico, and this area has also been described in detail by Black (1989:39-62 and Figure 19).

THE HUMAN BONE ARTIFACTS

The artifacts described below were recovered from sites on both sides of the river, in Zapata County, Texas, and in adjacent areas of the state of Tamaulipas, Mexico. All but one of the artifacts were recovered from sites that are within the conservation pool area of the reservoir. The single exception was found at a site approximately 2 km from the original riverbed of the Rio Grande, in the northern area of the reservoir on the Mexican side.

The Texas specimens include a severed and polished ulna (2 pieces) and 7 human teeth beads. The Tamaulipas specimens include two bone pipe stems, the distally severed humerus, and another artifact of unknown function that *may* be fashioned from human bone.

Artifact function includes both utilitarian and ornamental. At least one of the bone pipe stems was found in direct association with a stone pipe and appears to have served as its stem. The other similar bone artifact that is presumed to also be a pipe stem was not found in association with a pipe, but it may well have originally served that purpose. The distally severed humerus, the severed and polished ulna, and the other possible human bone artifact are of unknown function, but they do not appear to have been ornamental in function. However, it is unknown whether these three specimens represent "finished" artifacts, or whether they were abandoned during manufacture. The human teeth beads are obviously ornamental in nature, and are the only known ones to have been found with any burial in this region.

Bone tubes (pipe stems). Two bone tubes, both fashioned from segments of human ulnae, were recovered in the study area in the last few years. Evidence suggests that both of these specimens represent utilitarian artifacts, i.e. pipe stems.

The first specimen (Figure 2) was recovered with the burial of a child (burial #1) at the Southern Island site in Falcon Reservoir in 1995 (Boyd et al. 1997:396; Chandler 1996:44-47). An osteological analysis of the skeletal remains revealed that they were of a child of about 10 years of age (Wilson n.d.a). In addition to the bone tube, an extremely varied array of associated mortuary artifacts was also recovered with the burial, including a distally severed humerus, another possible human bone artifact (both described below), a stone pipe, and many other types of artifacts. The bone tube and pipe were found in close proximity within the burial feature, and it is reasonable to believe that the bone represents the stem for the pipe. Interestingly, no binding material such as pitch or tar is evident on the surface of the bone tube, though the pipe still contained ashes indicating that it had been used. The bone tube is made from the medial section of a human right ulna, and measures 8.9 cm in length, with a maximum diameter of 1.47 cm. The smaller end of the bone has been rounded and polished, and the wider end has been cut and only lightly polished and one side exhibits 3-4 deeply incised, transverse lines. Additionally, the exterior surface of the artifact has a polished appearance, either by intent or through extensive use.

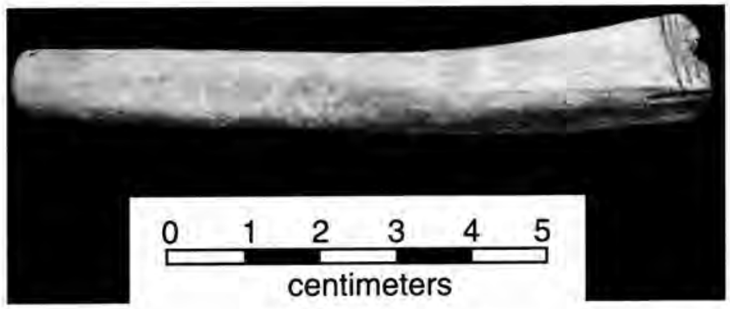

Figure 2. Bone tube, or pipe stem, found with burial #1 from the Southern Island cemetery site in Tamaulipas, Mexico. Note the transverse incised lines near the right edge of the artifact. This specimen was found with a tubular sandstone pipe and many other mortuary artifacts, and is made from a human right ulna. The surface of the bone has been smoothed or polished.

Also, there are numerous small cut marks on the surface of the bone, and the interior has been enlarged or reamed out. Altogether, eight burials were salvaged in this site in 1995, but only burial #1 had human bone artifacts as mortuary inclusions. This artifact is nearly identical to another bone tube found with a burial at the Castillo Site (41ZP2) in what is now Falcon Reservoir in the early 1950s (Hester 1997:4-8 and Figure 4).

The other bone tube (Figure 3) was recovered in 1999 as it eroded from the surface of a prehistoric site (SG4-172AG) near the Arroyo Chapote, a tributary of the Rio Grande in the northern portion of Falcon Reservoir on the Mexican side of the lake. The site exhibited artifacts spanning from the Archaic through the Late Prehistoric periods, and is about 2 km from the original riverbed of the Rio Grande. When this artifact was found, I immediately remembered the Southern Island bone tube and an examination of the site was performed, but no burial feature was observed. Also, no stone pipes were found. I later excavated the soil matrix where the bone tube was found with no affirmative results.

This bone tube has been so extensively modified that it is hard to be positive that it is of human origin. The ends are clearly rodent-gnawed. However, close examination reveals that it *may* be a portion of the shaft of a human radius from between the interosseous crest and

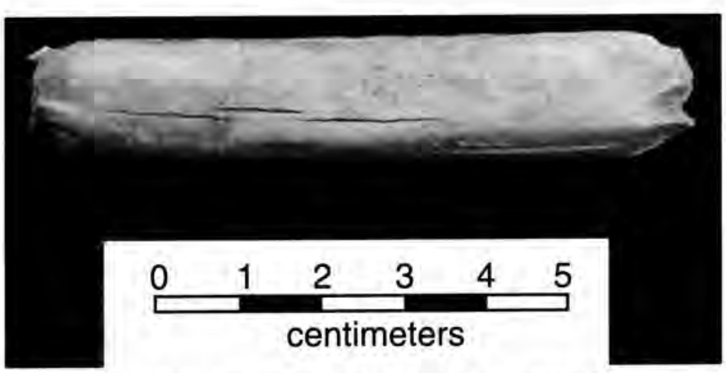

Figure 3. Bone tube (possible pipe stem) found at the SG4-172AG site in Tamaulipas, Mexico. This artifact exhibits numerous transverse cuts or incisions on its obverse and reverse faces. Note the apparently unfinished ends. This artifact may have been fashioned from a human radius.

the ulnar notch. The specimen is 7.8 cm in length and it has a maximum diameter of 1.5 cm. Both ends of the bone have been longitudinally cut with a sharp implement so that they are tapered. The ends have not been smoothed, or if they were, the rodent gnawing has eliminated all traces. The surface of the bone exhibits very large numbers of transverse cut marks and is polished in appearance. These cut marks are reminiscent of those seen on the cranium from the Toyah 1 burial (Boyd 2002:4-11), and those produced on animal bones through the use of thin chert flakes during a replicative experiment (ibid.:7-8). There is evidence that some longitudinal scraping cuts were made along the surface of the bone prior to the transverse cuts being made. Also, when the artifact was found it was half eroded from the surface of the site and the upward facing side is bleached white from exposure to the sun and elements. The reverse side is still yellowish brown in color. Several deep longitudinal cracks appear to be the result of exposure to the elements as it eroded from the surface of the site.

Figure 4. Distally severed right humerus artifact from burial #1 at Southern Island. The cut end (top) has been rounded and highly polished, and the surface of the bone has also been smoothed. The function of this artifact is unknown.

Distally severed humerus. This artifact, of unknown function (Figure 4) was recovered with burial #1 from the Southern Island cemetery site in 1995 (Boyd et al. 1997:396 and Figure 9). The artifact is a left humerus fragment, measuring 6.9 cm in length, and transversely cut and polished about 5.4 cm above the olecranon fossa. In addition to the transverse cut, other modifications to the bone include a generally "polished" appearance over the exterior surface of the artifact, and the interior of the bone appears to have been enlarged or reamed out. The characteristics of this artifact are not suggestive of its use as an ornament, but no inferences can be made as to its possible utilitarian use, or whether it represents a "finished" artifact.

Possible human bone artifact (femur?). This artifact (Figure 5), also of unknown function, was recovered with burial #1 from Southern Island (Boyd et al. 1997:396-397 and Figure 10). The bone has been highly modified—the exterior has been smoothed or polished and one end of the bone has been smoothed and rounded in a convex fashion so that it has a similar appearance to the end of a broomstick. Also, the interior appears to have been reamed out, and a significant portion of the bone shaft has broken (or been broken) away along about half the length of the artifact. The specimen measures 8.9 cm in length with a maximum diameter of 2.9 cm. This artifact has been so extensively modified that confirmation that it is of human origin cannot be positively determined. However, it obviously was made from a long bone of a large mammal, perhaps a human femur segment. Significant is the fact that two other human bone artifacts accompanied this burial (see above).

Severed/polished ulna. This very interesting specimen (Figure 6) is represented by a complete human right ulna, severed 9.5 cm below the radial notch. Both pieces of the ulna fit together, but the cut ends have been slightly smoothed after the cut was

Figure 5. Highly modified bone artifact of unknown function from burial #1 at the Southern Island cemetery site. The proximal (bottom in photo) end of the specimen has been rounded and smoothed, as has the exterior surface. This artifact is *possibly* fashioned from a human femur.

made (Figure 7). The overall length of the bone is 28.6 cm. The artifact was found with an eroding burial in a Falcon Reservoir prehistoric site (41ZP322) in 2000, and the ulna appears to be a part of the skeletal assemblage. At the time the burial was found, it had been scattered by wave action, and may also have been disturbed by looters. Osteological analysis of the skeletal remains has yet to be performed, but they are somewhat fragmentary and appear to be an adult, sex undetermined.

The real importance of this specimen is that the ulna has been modified by the transverse cut and smoothing of the ends, and yet is part of the burial's skeletal assemblage. This raises interesting conjecture about the circumstances in which the bone was modified. A close examination of the severed ulna shows no other apparent modification of the bone. The purpose or function of the cut is not known, but it is conceivable that an attempt was being made to manufacture a bone tube or pipe stem similar to the

Figure 6. Severed (right) human ulna from a burial at 41ZP322 in Falcon Reservoir. The bone has been cut and the ends have been polished (see arrows). This specimen was part of the skeletal assemblage of the burial.

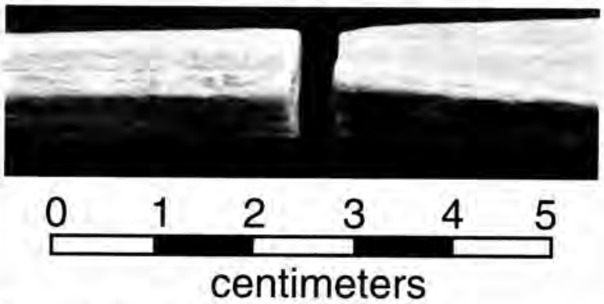

Figure 7. Detailed macro-photo of severed human right ulna shown in Figure 6. Note the polished ends of the severed bone.

one found with Southern Island burial #1 (see above). The position of the cut on the ulna correlates to the area of ulnar use in the Southern Island burial and the Castillo Site burial bone tubes. The fact that this bone was severed and otherwise altered and then deposited with the burial is notable.

Human teeth beads. Arguably the most interesting and unique of the human bone artifacts found on the lower Rio Grande are the seven human teeth beads (Figure 8) that were recovered with a burial from the Beacon Harbor Lodge site (41ZP7) in 1984 (Boyd n.d.b). This burial, consisting of a young adult male and an infant (Wilson n.d.b), also was accompanied by Caracara arrow points, a small stone scraper, large numbers of bird bone beads, and marine shell beads. These other classes of associated mortuary inclusions are often found with burials in the region, but human teeth as beads have never been previously reported. The Beacon Harbor Lodge site has yielded numerous sets of human remains since the 1980s (Wesolowsky 1983), and is now recognized as one of several prehistoric cemetery sites in the Falcon Reservoir (Boyd n.d.c).

The teeth exhibit biconically drilled perforations in the root areas, indicating their probable usage as beads, perhaps strung on a necklace. Since this burial also had bird bone and marine shell beads as mortuary inclusions, this represents three classes of included ornamental artifacts. However, the human teeth beads are uniquely distinctive due to their human derivation. Canine (coyote) teeth beads as mortuary inclusions have been previously reported with burials in this region (Boyd et al. 1997:397;405-406) and in burials in the Lower Rio Grande Valley (Collins et al. 1969:141 and Figures 4 and 9; Hester and Ruecking 1969:154 and Figure 3), but not human teeth. Also, two complete unmodified canine teeth and 18 fragmentary specimens were recovered with a Willacy County burial (Day et al. 1981:337 and Figure 31e-f) during a cultural resource survey in 1980.

OTHER HUMAN BONE ARTIFACTS FROM SOUTH TEXAS

Human bone artifacts have been previously described from South Texas sites, both as mortuary

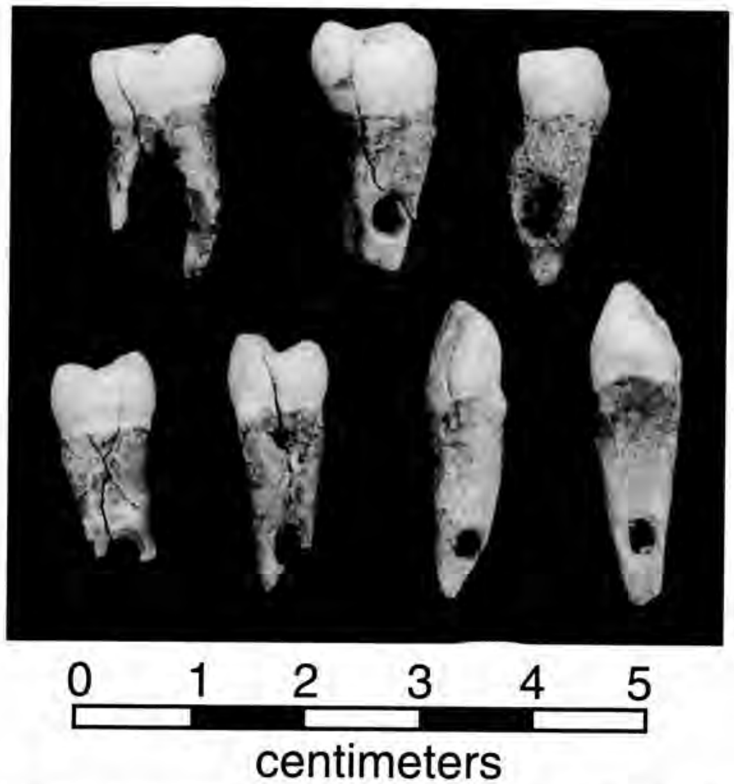

Figure 8. Seven biconically-drilled human teeth from a burial at the 41ZP7 Beacon Harbor Lodge burial site in Falcon Reservoir (see Table 1). These are the only known human teeth beads known from the region. Top row (L to R): lower left 1st molar; lower right 2nd molar; lower left molar. Bottom row (L to R): left 1st bicuspid; right 1st bicuspid; maxillary central; maxillary canine.

Table 1 : Perforated Human Teeth Beads from 41ZP7

Specimen	Tooth Classification	Length
01	lower left 1st molar	20.9 mm
02	lower right 2nd molar	22.1 mm
03	lower left molar	21.5 mm
04	left 1st bicuspid	18.6 mm
05	right 1st bicuspid	23.0 mm
06	maxillary central	26.7 mm
07	maxillary canine	28.8 mm

inclusions and occasionally as isolate finds. Thomas R. Hester has referenced the subject in at least 5 papers (cf. Hester 1969a:39-41; 1969b:326-328; 1997:4-8; Hester and Rodgers 1971:368; Collins, Hester, and Weir 1969:138-140 and Figure 8). In his 1969 archaeological investigations in Kleberg and Kenedy counties in southern Texas, Hester documented at least 47 human bone artifacts (Hester 1969a:39-41 and Figs. 16-18 and Table 1; 1969b:326-328 and Fig. 2-3) from sites in Kleberg County, with 22 being from a single site (41KL39). Thirty six of the 47 specimens are reported to be segments of human long bone shafts, three are rib segments, one is a severed ulna distal end, one a severed fibula proximal end, one a severed humerus distal end, and there are 5 unidentified human bone sections (ibid.:39). The artifacts are described as having been segmented by using the groove-and-snap technique, in which the bone is partially sawed through and then snapped into the component segment. Also, the severed or snapped ends were polished, and some of the cancellous interior portions of the constituent bones have been reamed out. The outer surfaces of the artifacts are reported to have been smoothed, and in some cases actually exhibit a "polish." At least one of the specimens exhibits a decorative incised zigzag design on one side, as well as reddish staining possibly caused by the application of red ochre. This same specimen also exhibits multiple notching on the opposite side, creating either a decorative motif or a more utilitarian rasp-like implement (ibid.:39; see Figure 18d-e). Some of the other specimens exhibit traces of what appears to be red pigment applied to the exterior, and in some cases the interior, of the artifact. In other cases, though rarer, black pigment was also used to decorate the bone artifacts. One of the Kleberg County specimens was reportedly a stone pipe with ". . . a mouthpiece fashioned from a human ulna" recovered in 1927 at 41KL14 (Hester 1969b:327), and Reed (1937:221) reported that ". . . there were numerous other segments of hollow bone which without a doubt

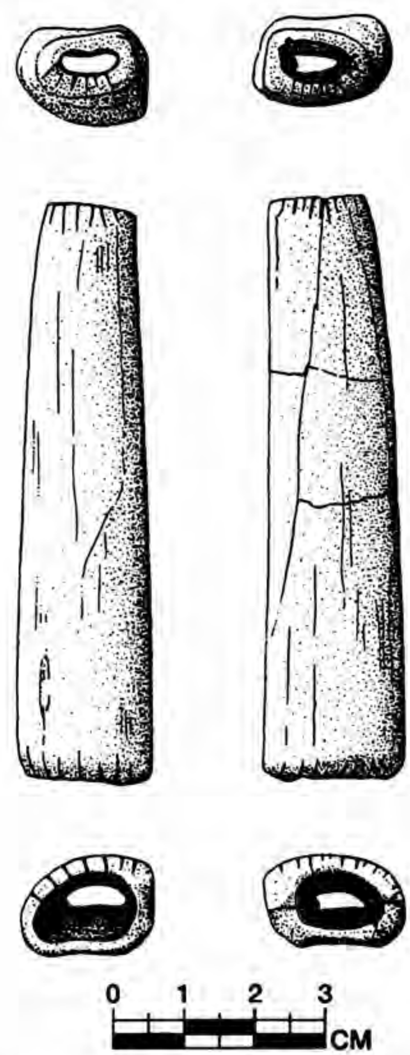

Figure 9. Tubular Bone Artifacts with Incising at Each End. Both are from northern Tamaulipas, across from Starr County, Texas. Left, Mike Ryan collection;right, Frank Dudley collection. Illustration courtesy of Richard McReynolds.

were 'spare' mouthpieces. . ." for the stone pipes found in the site.

The distally severed humerus from Southern Island burial #1 (Figure 5) described above is strikingly similar to one illustrated (Hester 1969a:Figure 17d; 1969b:Figure 2g) from the 41KL39 site. However, the Kleberg County specimen is severed closer to the olecranon fossa than the Southern Island artifact. Also, the proximal portion of the Southern Island specimen has either broken away or has been deliberately removed and is much better preserved in the Kleberg County artifact. The Kleberg County sites both (41KL14 and 41KL39) yielded significant numbers of prehistoric burials and other human skeletal remains, and represent still another occurrence of human bone artifacts in conjunction with burials in South Texas.

A bone tube fashioned from a segment of a human right ulna was recovered with a burial in a site (41ZP2, Castillo Site) in what is now Falcon reservoir in the early 1950s. The burial was that of a female aged 25-30 years, and other associated mortuary artifacts included tubular (bird) bone beads, a bone awl, and Tortugas points (Cason 1952:239-240; Hester 1969a:41 and Fig. 18f;1969b:328 and Fig. 3g; Hester 1997:4-8 and Fig. 4). This artifact is almost identical in appearance to the bone tube, or pipe stem, recovered with the Southern Island burial (#1) in 1995 (see above). Interestingly, however, a stone pipe did not accompany the Castillo Site burial, as far as is known.

A single human bone artifact consisting of a cut segment of a tibial shaft (Hester 1969b:327 and Figure 3h) is reported from the Oso cemetery site (41NU2) in Nueces County in southern Texas. The artifact has remnant red and black pigments on its surface.

Hester also reports (1969b:328) a fragment of a human bone tube recovered by A.E. Anderson at a site in northeastern Tamaulipas, Mexico, about 20-25 km south of Brownsville in the 1920s. It is reported to have been a fragment of a right humerus with some smoothing and reaming of the interior. Details about the specific site where the artifact was found are sketchy, and it is indeterminable whether the specimen was found in conjunction with a burial.

Several human bone artifacts were recovered with burials at the Floyd Morris cemetery site (41CF2) in Cameron County in the late 1960s (Collins et al.1969:138-140 and Figure 8). These include a human radius with a severed and smoothed distal end and a broken proximal end. The distal end has a "plug" of asphaltum and the surface of the artifact exhibits remnants of red and black pigments. Another radius fragment, apparently from the same individual, exhibited a broken proximal end and a severed distal end through which the cancellous interior has been reamed out. Two severed human radii distal end fragments were also recovered, unmodified except for the cut(s) and remnants of red pigmentation on their outer surfaces. It is believed that these two specimens are the severed distal radii segments from the above two artifacts (ibid.:138). All four specimens were recovered with the same burial (11C) at the Floyd Morris site. Also with this burial was a large bone bead with a reamed out interior made from human bone. Other similar beads, some *possibly* human, were also found with this burial. Most of these exhibit traces of black pigmentation on their surfaces, believed to be asphaltum (ibid.:140).

Burial 11B at the Floyd Morris site also had human bone artifacts as mortuary inclusions (Collins et al.1969:140). At least three beads from human bone are reported, with reamed-out and smoothed interiors, and well-polished exteriors bearing remnant red and black pigment staining. Other bone beads present with the burial are also *possibly* made from human bone. Two other beads of possible human (bone) origin were also found in the general area of burials 11B and 11C (ibid.:140).

Another burial found eroding in a site on the Rio Alamo, in northeastern Tamaulipas, Mexico in the mid-1980s reportedly had many bird bone beads as mortuary inclusions, as well as two large bone tubes (Boyd n.d.d Figure 9). The bone tubes were reportedly found with one on either side of the pelvic area of the skeletal remains. The tubes were cut and polished at both ends with short incised lateral lines at each polished end. Although it has not been confirmed, it is believed that these tubular artifacts were manufactured from human bone. Unfortunately, this burial was disturbed by collectors and very little data was recorded. The artifacts are currently not available for study, though excellent drawings of them were made (Boyd n.d.d).

DISCUSSION

Human bone artifacts in South Texas and northeastern Mexico occur with some frequency. South Texas examples are known from various counties in the coastal corridor, as well as the Falcon Reservoir area. Thomas Hester documented large numbers of human bone artifacts in the late 1960s and early 1970s. Based on information available at that time, he noted that the majority of the known human bone artifacts had been recovered in Kleberg County in southern Texas, with a few examples known from other sites in South Texas and in the coastal areas of northern Tamaulipas. Hester (1969b:328) also noted a pattern in the distribution and characteristics of these kinds of artifacts, namely that (1) most of the specimens had been recovered with burials, and most were from large cemetery sites; (2) most of the recovered specimens were fashioned from long-bone shaft sections; (3) generally, the human bone artifact was not the only mortuary inclusion with the burial, and; (4) the specimens recovered from sites in coastal regions sometimes had reddish or black pigment or staining on their exterior, and sometimes interior, surface(s), the red pigmentation believed to be ochre and the black asphaltum.

Based on studies of human bone artifacts I have recovered on the Lower Rio Grande (Boyd n.d.a), Hester's proposed trait list is still valid. Five of the six (with the 7 human teeth beads being counted as 1) "new" human bone artifacts reported in this paper were recovered in direct association with burials, and four of those five artifacts were with burials from recognized prehistoric cemetery sites, conforming to Hester's criteria (1). The 41ZP322 site, where the severed human ulna (Figures 6-7) was recovered has yielded a significant amount of skeletal remains during low water episodes the last few years, but it is unknown whether it is actually a prehistoric cemetery site (Boyd n.d.a). Also, five of the six newly reported artifacts described above are fashioned from human long-bone segments, conforming to Hester's criteria (2). The bone tube or pipe stem (Figure 3) recovered in the SG4-172AG site was not found with a burial, but it *might* have eroded from a burial that I failed to locate. Hester's criteria (3) also applies to the human bone artifacts I have recovered. With the exception of the bone tube from the SG4-172AG site, and the severed ulna from the 41ZP322 site, the other artifacts were mortuary inclusions in addition to other classes of artifacts. The pipe stem, the severed humerus, and the other possible human bone artifact from Southern Island burial #1 were also accompanied by various other artifact types. These include a sandstone pipe, dart points (Matamoros and Catan), various other chipped stone artifacts, a bone awl, an antler billet flaking tool, a bone rasp and several broken rasps, perforated canine (coyote) teeth, hundreds of bird bone beads, animal claws, disc-shaped marine shell beads, *Oliva sayana* beads and tinklers, and long rectangular shell pendants (Boyd et al. 1997:393-403). This collection of burial artifacts constitutes the most diverse array of mortuary inclusions yet found with any burial on the Lower Rio Grande. In addition to this burial, at least seven others were identified or otherwise salvaged at the Southern Island site.

The human teeth beads from the Beacon Harbor Lodge site were also accompanied by other mortuary inclusions, including hundreds of bird bone beads, marine shell beads, a small scraper, and several Caracara arrow points, found in the chest cavity area of the adult skeletal remains and perhaps the cause of death of the individual (Boyd and Perttula 2000b:7-8). Many other sets of skeletal remains were recovered at this site as well (Boyd n.d.c; Wilson and Hester 1996; Wesolowsky 1983), and it is one of at least five recognized cemetery sites in the International Falcon Reservoir (Boyd n.d.c).

The severed ulna recovered at the 41ZP322 site was recovered with a burial, but no other accompanying artifact(s). However, at the time the remains were salvaged, erosion caused by dropping water levels and wave action in Falcon Reservoir had scattered and otherwise disturbed the burial feature. Also, the burial might have been disturbed by looters prior to being salvaged, and it can't be said with any degree of certainty that other accompanying artifacts were not originally present with the burial. Furthermore, no excavation was performed—only the remains visible at the surface, including the severed ulna, were salvaged (Boyd n.d.a). Other skeletal remains were noted in the site, but they had been significantly dispersed by wave action. Interestingly, however, a stone pipe was recovered at 41ZP322 (McCulloch et al. 2003:153, 212) during a National Park Service Survey in 1998. The severed ulna *might* conceivably have been a bone pipe stem in the process of manufacture.

Consequently, though the bone tube from the SG4-172AG site was not recovered with a burial, it might have eroded from one that simply was not found. And although other artifacts were not recovered with the severed ulna found with the 41ZP322 burial, it is possible that they might originally have been present, but disturbance of the burial feature inhibited their being identified. Regardless, Hester's criteria in respect to the occurrence of human bone artifacts with burials or in conjunction with other mortuary inclusions are sustained in the other described artifacts. However, Hester's criteria (4), staining of the human bone artifacts' surfaces with either red or black pigmentation has not been observed in the specimens recovered near Falcon Reservoir. This could be due to cultural differences between the peoples that inhabited this area and those from the coastal regions, or it could be due to differing conditions and preservation of the artifacts once they were buried in the constituent soil(s) in the two diverse geographic regions.

The Falcon Reservoir human bone artifacts exhibit several inherent technological characteristics including severing, reaming, drilling, smoothing/"polish," and scratching/incising. The bone tubes from Southern Island burial #1 and the SG4-172AG site were probably severed from the constituent long bone. The Southern Island specimen was severed from a human ulna, whereas the bone from which the SG4-172AG artifact was manufactured remains unidentified, though might have been a radius. Also, the distally severed humerus from Southern Island burial #1 was also severed just above the olecranon fossa, and the severed ulna from the 41ZP322 burial was cut near the middle of the bone. The only human bone artifacts not subject to severing were the 7 human teeth beads from the Beacon Harbor Lodge site. Also, it is not known if severing was part of the process of manufacture in the other possible human bone artifact from Southern Island burial #1.

Reaming, or otherwise widening of the interior cavities of the bone artifacts, including the removal of the cancellous interiors, was performed in the case of the bone pipe stem from Southern Island burial #1, and the distally severed humerus found with the same burial was also reamed from the distal, or cut end. Additionally, the other possible human long-bone artifact found with the burial also appears to have been reamed out. However, the bone tube from SG4-172AG did not appear to have been reamed. Also, the interior portions of the severed ulna from the 41ZP322 burial do not appear to have been reamed. This artifact may have been abandoned at an early stage in its manufacture. And of course, the human teeth beads from the Beacon Harbor lodge site were not subject to the process of reaming, but rather the root portions of the teeth were biconically drilled in order to form holes by which they were probably suspended as beads. The instrument with which these holes were drilled must have been small, hard, and very precise in application, and the drilling process must have required a great amount of time to complete. Presumably, small stone "pin" drills must have been used. These types of drills are found only very infrequently in sites in the Falcon Reservoir area (Boyd n.d.a), though they are more common in sites in the coastal regions (cf. Campbell 1956:15, 30 and Plates 1 and 3; Gunter 1985:9-11 and Figures 3-4; Chandler and Kumpe 1993:5-7). Although these types of stone drills are often associated with drilling holes in shell, they could have also been used to drill holes in bone, including the teeth from the 41ZP7 burial.

The exterior surfaces and severed ends of several of the Falcon Reservoir specimens exhibit smoothing or polish. The Southern Island burial #1 pipe stem exhibits a polish on its surface, indicative of deliberate smoothing or much handling or use, or both. Also, the smaller end is smoothed and rounded in cross-section, whereas the larger end has only been lightly smoothed. The distally severed humerus from Southern Island burial #1 also has a polished-in-appearance surface. The possible human bone artifact fashioned from a long bone found with the same burial also has been lightly polished on its exterior surface. The bone tube from the SG4-172AG site has a polished exterior surface, but one side of the specimen has been bleached and weathered due to exposure to the elements. Also, both ends of the tube are still rough, and have not yet been smoothed or rounded. Also, considering that the interior has not been reamed, this may not be a finished artifact.

Scratching and/or incising occurs on several of the Falcon Reservoir human bone artifacts. The bone tube from Southern Island burial #1 exhibits 3 or 4 deeply incised, transverse lines or cuts near the wider end of the specimen, near one of the apertures. Whether these are decorative incisions or a remnant of the manufacturing stage (groove-and-snap) of the artifact is debatable. Also, the exterior surface of the artifact has numerous randomly distributed short and shallow cut or incision marks. Clearly these are not for decoration, but are a result of the manufacture or use of the artifact which is believed to have served as a pipe stem. Conversely, the bone tube from the SG4-172AG site exhibits a very large number of parallel, transverse cuts or incisions along the length of the bone shaft that were clearly applied in a deliberate fashion. The purpose of the incisions, whether ritual or decorative is not known, but there are simply too many incisions to merely be a result from the manufacture of the artifact. The distally severed humerus from Southern Island burial #1 exhibits no scratch marks or other incising, nor does the exterior surface of the possible human bone artifact found with the same burial. The severed ulna from the 41ZP322 burial does not exhibit any scratch marks or other types of incisions on any portion of the bone, even when examined under magnification. This is unusual, given the commonality of this type of technological feature on the other human bone artifacts. Obviously, the human teeth beads in their comparative uniqueness also do no exhibit any incisions or scratches on their surfaces.

Pigmentation of any type, either red (ocher) or black (asphaltum), is absent in the human bone artifacts from the Falcon Reservoir area. As discussed earlier, this may be due to cultural differences between the two regions being compared (i.e., inland versus coastal), or it may be a result of differential preservation variables. Also, deliberate and decorative incising that is evident in some of the human bone artifacts from sites closer to the coastal areas is absent in the specimens so far recovered and identified in the Falcon Reservoir area. This may be due in part to the fact that the inventory of coastal specimens is much larger than the Falcon samples, or again, it might be due to cultural differences between the regions. The latter is less likely since mussel shell and marine shell ornaments found in Falcon Reservoir sites are sometimes decorated (Boyd n.d.a; n.d.e; n.d.f).

The Falcon Reservoir human bone artifacts represent both ornamental and utilitarian wares. The majority of the artifacts *appear* to be utilitarian in nature. The bone tube recovered with the Southern Island burial evidently is a pipe stem, and was probably associated with the sandstone pipe found with the burial. The function of the bone tube from the SG4-172AG site is unknown, but its general similarity in size and shape to the Southern Island pipe stem indicates it might have ultimately served the same purpose. The function of the severed humerus from the Southern Island burial, though unknown, does not logically appear to be ornamental, nor does the other possible human bone artifact found with the burial. Whether these are "finished" artifacts is not even known for sure. The severed ulna from the 41ZP322 burial clearly is not a finished artifact even though the severed ends of the specimens have been smoothed. Although ornamental bone tubes or beads could have been ultimately made from the specimen, the area where the bone was severed is suggestive that *perhaps* a bone pipe stem was in the process of being made. Finally, the Beacon Harbor Lodge burial [human] teeth beads are obviously ornamental in nature, probably having served as beads. Whether they were strung on a necklace or other type of jewelry, or attached to a garment, is unknown.

In the larger sample of human bone artifacts collected in South Texas in the 1940s-1960s, both utilitarian and ornamental artifact uses are represented. A few of the specimens are deliberately incised with decorative motifs or were used as beads, but the use of the majority of the specimens remains indeterminable. A large number of the representative specimens are comprised of bone tubes, the function of which is difficult to ascertain. Some of these probably functioned as pipe stems, as evidenced by the one found in-situ still inserted in the stone pipe at the 41KL14 site in the 1920s, and the presence of both the pipe and bone stem with Southern Island burial #1. Still other specimens of the bone tube category might have served as pipe stems, but only circumstantial evidence exists to support this theory. Some of the bone tubes could have even served other utilitarian purposes, or perhaps even ornamental uses, such as beads. Another consideration is that decoration does not always imply that an artifact is ornamental, since several decorated utilitarian specimens (e.g. decorated stone pipes, bone awls, etc.) are known from the Falcon Reservoir area and coastal sites in this diverse geographic region along the Lower Rio Grande.

The most unusual of the newly reported Falcon Reservoir human bone artifacts are the severed human ulna from the 41ZP322 burial and the human teeth beads from the Beacon Harbor Lodge site. The severed ulna is particularly interesting because it *appears* to be an "artifact" in the process of manufacture. Since the ulna from which it was being manufactured is a constituent part of the burial's skeletal assemblage, this also makes it unusual and unique. The circumstances which initiated the manufacture of the artifact and the ultimate disposal of the unfinished artifact with the rest of the skeletal remains must have been unusual, at best. The human teeth beads are the only definitive artifacts manufactured from human bone and used for ornamental purposes from the Falcon reservoir collection. To date, they are truly unique as mortuary items when compared to other mortuary inclusions from innumerable burials excavated or salvaged in the geographic region during the last 75 years or so.

The occurrence of human bone artifacts with burials in this region raises interesting conjecture about the circumstances that would lead the aboriginal people to utilize skeletal remains of other humans for ornamental or utilitarian wares. It is apparent, judging by the incredible numbers of dart and arrow points found in sites in the geographic region that hunting animals consumed a significant amount of their time, and the longevity of their occupation in the area as a whole indicates some degree of success in the hunt. Remains of various classes of fauna have been recovered in archaeological sites in the region, including larger animals such as bison, deer, and others. This would have provided the peoples with adequate raw bone material from which they could have fashioned utilitarian implements or ornaments, which they often did, but it is apparent that sometimes they preferred to use human bone for these purposes.

The specific reasoning for the preference in using human bone in the manufacture of implements/ornaments is not known with any degree of certainty, and it is sometimes presumed that some sort of ritualistic objective was the motive. This viewpoint is possibly supported by evidence so far realized, i.e. that most of the human bone artifacts recovered to date have been recovered as mortuary items with burials. Were the human bone artifacts used as mortuary inclusions bones from relatives of the deceased? Or were the bone artifacts made from the bones of enemies killed in battle, and the artifact utilized as a symbol of power or control? These and many other related questions are elicited in these circumstances. Furthermore, the use of ochre or asphaltum as a decorative medium on some human bone artifacts from the coastal regions of South Texas may imply a ritualistic decoration or use of the artifacts (Perttula 2001:65).

The majority of human bone artifacts are manufactured from human long bones, but other similar long bones are present in some of the larger classes of game known to have been hunted by the aboriginal populations. Apparently some factor or factors induced the artisans who manufactured the bone artifacts to use human bone in certain instances. This artistic trait was apparently widespread throughout South Texas and into northeastern Mexico, judging by the distributional pattern of the artifacts collected to date, so perhaps the ritualistic use of human bone as a raw material was actually a widespread cultural trait as well. An overview of the usage and distribution of human bone artifacts in surrounding regions could possibly lead to a more comprehensive synthesis of information that might help to resolve this very intriguing field of study.

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An Overview of Archaeological Work Conducted in Frio County, SouthernTexas

William E. Moore

ABSTRACT

A review of archaeological studies in Frio County, southern Texas, provides data on the history of investigations, the recording of sites, and relevant publications.

INTRODUCTION

In 2004, while writing a contract report for the United States Fish and Wildlife Service, I learned that no large-scale archaeological investigations had been conducted in Frio County. The majority of the 48 sites (n=21) registered at the Texas Archeological Research Laboratory (TARL) were recorded by avocational archaeologists (a total of 44% of the total site inventory) and archaeologists with the Texas Department of Transportation (TxDOT) who registered 18 sites (37%) with TARL. Only four private contract firms have been active in the county, and these agencies are responsible for documenting eight sites (17%). The low number of sites in Frio County is contrasted with the number of sites recorded in adjacent counties such as Atascosa (200), Dimmit (150), LaSalle (103), McMullen (427), Medina (131), and Uvalde (436). The lack of work in Frio County has prompted the following statement by Shafer and Baxter (1974:1) that ". . . the archaeology in the south-central Texas region is poorly known despite several surveys which have been conducted along major streams." In a contract report by Frkuska and Frkuska (1982:8) they state that the archaeology of Frio County is "very poorly known."

ENVIRONMENTAL SETTING

The terrain of Frio County consists of rolling hills to nearly level plains. Topographically, the county is situated in the Coastal Plain Province as defined by Carr (1967:3), and the Tamaulipan Biotic Province as defined by Blair (1950). Soils in the Coastal Plain Province consist of dark calcareous clay loams, and slightly acidic to neutral sandy loams. The climate for Frio County is within the southern climatic division and averages 22 inches of rainfall annually. The moisture from this rainfall supports a mesquite-chapparal savanna with small trees, shrubs, cactus, and large areas of brush. Although no major springs occur in Frio County, a few major streams drain the area. The two largest are the Frio River and San Miguel Creek. From its headwaters, San Miguel Creek flows over a 45-mile course through eastern Frio, southwestern Atascosa, and northern McMullen counties. It roughly parallels the Frio River, which it joins near Calliham in McMullen County (Figure 1).

ARCHAEOLOGICAL BACKGROUND

Frio County is located in southern Texas in the Southern Coastal Plains as defined in a statistical overview by Biesaart et al. (1985). In 1985, when the overview was published, there were only 18 recorded sites in the county making it sixth in the Southern Coastal Plains according to statistics compiled by Biesaart et al. (1985:94).* In 1985, this figure accounted for 1.19% of the region and .09% of the state. The majority of sites (n=11) were described as General Archaic. According to Biesaart et al. (1985),

*In 1983, there were 22 sites recorded in Frio County at TARL.

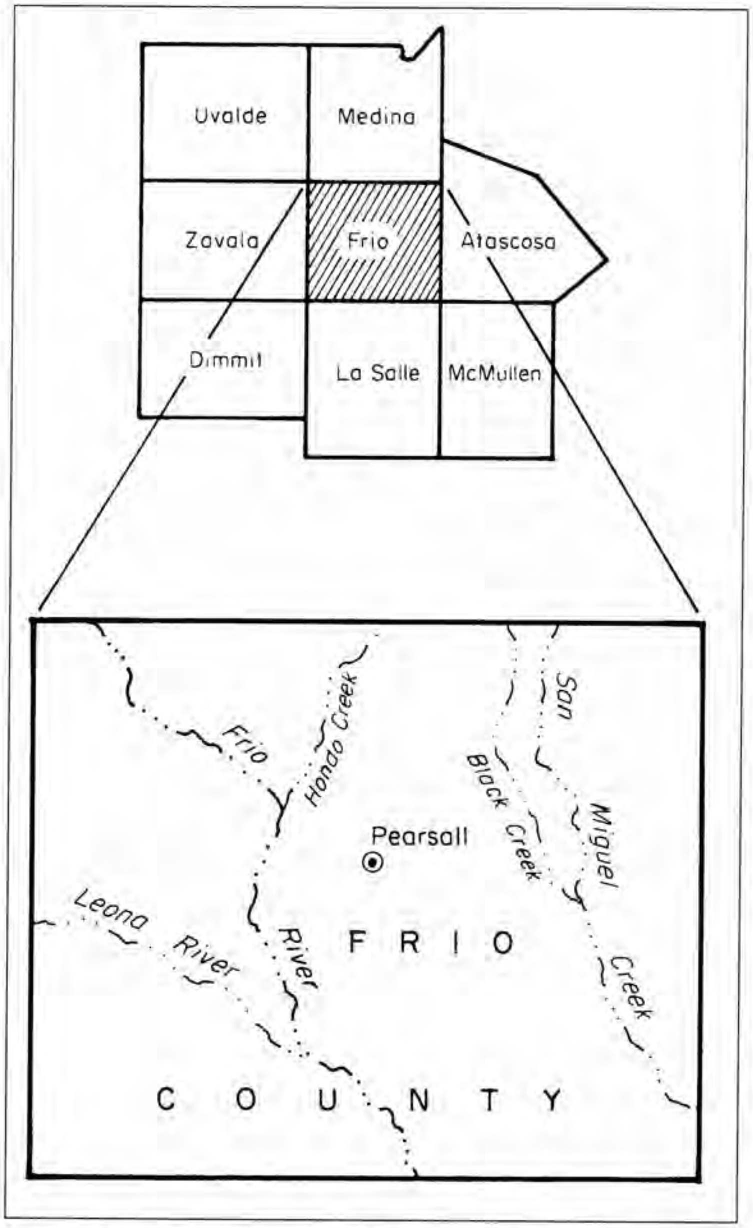

Figure 1. General Location Map of Frio County, Texas.

all 18 sites had been surface collected, and not one had been excavated. As of June 2003, there were 48 sites recorded at TARL.

Published Papers

La Tierra, a journal that specializes in articles regarding South Texas prehistory, has been in publication since 1974. A review of volumes 1 through 30 produced only six articles dealing with Frio County. Four articles report on surface collected artifacts found along San Miguel Creek and its tributaries. C. K. Chandler and Kay Hindes (1993) discuss the presence of *Scottsbluff* points in Atascosa, Frio, and McMullen counties. Of the 10 points described in this paper, only one was found in Frio County, on San Miguel Creek. Chandler and Hindes (1995) report on the presence of *Folsom* points from Atascosa, Frio, and McMullen counties. Of the 10 points described in this paper, only one is from Frio County. It was found on an unnamed drainage in the northeastern part of the county. C. K. Chandler and Richard McReynolds (1996) reported on the presence of *Guadalupe* tools in Frio and Atascosa counties. Of the four tools described in this article, three were found on Braceros Creek in Frio County. David Calame, Sr. (2000) reported the presence of *Guadalupe* bifaces in Frio and Medina counties. Of the nine bifaces described in this article, only two are from Frio County. All nine specimens were found on Hondo and San Miguel creeks.

An article written by T. R. Hester and others (1993), reports on an Austin Phase burial found by local landowners on the banks of San Miguel Creek in 1934. An arrow point, probably a *Scallorn*, was found in direct association with the body. Several deer-sized mammal bones were in the same box with the human remains when it was brought to TARL for analysis. However, it is not known if they were found in the same matrix as the body. Diane Wilson performed a detailed osteological analysis, and her manuscript is on file at TARL. No site number has been assigned to this burial due to a lack of information on the precise location of the site.

The sixth paper, written by Perttula (2001), contains mortuary data for the Rio Grande and Coastal Plain areas of Texas. Two sites in Frio County are mentioned in Table 3 of Perttula's article. No site numbers are given, and more information regarding these sites can be found in articles by Hester et al. (1993). A check of all 72 volumes of the *Bulletin of the Texas Archeological Society* yielded only one article specific to Frio County. This is by Hester (1968) and is discussed below.

FIELD INVESTIGATIONS

The first investigation in the county led by a professional archaeologist was conducted in 1954 when students from The University of Texas in T. N. Campbell's Anthropology 340 class collected artifacts exposed on the surface along San Miguel Creek in southeast Frio County (also in Atascosa and McMullen counties). No formal report documenting this event was written until Hester (1968) published a paper in the *Bulletin of the Texas Archeological Society* in which he described their findings. Although the sites in this area contain primarily Archaic assemblages (Hester 1968:147), Paleoindian point types Angostura, Plainview, Meserve, Golondrina, and Milnesand were found on the surface along San Miguel Creek in the three counties. It is these Paleoindian points that are the focus of Hester's (1968) paper. Specimens specifically from Frio County are in Area 1 (Hester 1968: Figure 1), Campbell's sites 71A4-1 through A4-3. Paleoindian specimens represented at those site, in the southeastern corner of the county, and on the east side of San Miguel Creek, include: Angostura (5), Plainview (2), and Meserve (1; Hester noted that the latter was likely a reworked Golondrina).

Recorded Sites

The 48 recorded sites were identified by archaeologists from the Texas Highway Department (now Texas Department of Transportation [TxDOT]), four contract archaeology firms, and three avocational archaeologists (Table 1).

In 1974, archaeologists from the Texas Highway Department recorded the first 16 archaeological sites. Gary L. Moore was the lead archaeologist during these investigations and was assisted at various times by Milton Bell, Phillip Bandy, and a Mr. Wallis. The results of these studies are documented at TARL by site forms, key site cards, and map plottings. The only letter reports documenting any of these sites on file at TARL or the Texas Historical Commission are associated with site 41FR22. Copies of the remaining letter reports are believed to be on file at TxDOT; however, this has not been confirmed. Very little work, other than surface collection, was conducted at these sites. Test pits were dug at two sites (41FR1 and 41FR14). Types of sites are described on the site forms as hearths, lithic scatters, and a quarry site. In general, the sizes of the 16 sites are estimates. Artifacts observed or collected are not described in detail, and projectile point types are not mentioned. The categories observed at these sites include projectile points, bifaces, cores, flakes, and scrapers. None of the sites was recommended for additional work.

Sites 41FR17 and 41FR18 were recorded in 1974 by avocational archaeologist Harvey Smith, Jr. a member of the STAA (TARL site files). Site 41FR17 is described on the site form as a buried midden dating from Late Paleoindian through Late Prehistoric times. The artifacts are not discussed, and no additional documentation was found. Site 41FR18 is described on the site form as a midden or campsite. Two Tortugas points were collected. No additional documentation was found. No recommendations for additional work were made for either site.

In 1980, Pat Irwin and Marshall Eiserer recorded 41FR19 while working for the Texas Highway Department. A copy of this report is believed to be on file at TxDOT. This site produced a point described as a Frio or Ensor, a Clear Fork Gouge, biface fragments, burned sandstone, and cores. No recommendations regarding future work were made.

The first cultural resource management (CRM) archaeological survey was conducted by The University of Texas at San Antonio in 1981 (Frkuska and Frkuska 1982). Two lithic scatters (41FR20 and 41FR21) were recorded during a power line survey. At site 41FR21, a possible Gower dart point was collected. These sites lack depth and were not considered worthy of additional work. A copy of the report is on file at the Texas Historical Commission, Archeology Division and the TARL library.

Daymond D. Crawford recorded site 41FR22 in 1983 while working for the Texas Highway Depart-

Table 1. Recorded Sites in Frio County

Sites	Date	Recorder	Reference
41 FR1–41 FR1 6	1974	Gary Moore et al.	TxDOT 1976
41 FR17–41 FR18	1974	Harvey Smith	TARL files
41 FR1 9	1980	Pat Irwin and Marshall Eiserer	TxDOT letter report
41 FR20–41 FR21	1981	Augustine and Elizabeth Frkuska	Frkuska and Frkuska 1982
41 FR22	1983	Daymond Crawford	TxDOT 1983a, 1983b
41 FR23–41 FR26	1989	Kay Hindes	TARL files
41 FR27–41 FR30	1990	David 0. Brown and Dana Anthony	Brown and Anthony 1990
41 FR31	1993	Kay Hindes and C. K. Chandler	TARL files
41 F R32	1998	Daniel E. Fox	Fox 1998
41 FR33–41 FR45	1998	David L. Calame, Sr.	TARL files
41 FR46	2001	Rita D. Fields	TARL files
41 FR47	1999	David L. Calame, Sr.	TARL files
41 FR48	2002	Kirk D. French and Kevin A. Miller	French and Miller 2002
41 FR49	2004	James E. Warren and Herbert G. Uecker	Uecker and Warren 2004
41 FR50	2001	David L. Calame, Sr.	TARL files
41 FR51	2000	David L. Calame, Sr.	TARL files
41 FR52	2000	David L. Calame, Sr.	TARL files
41 FR53	2006	David L. Calame, Sr.	TARL files

ment. The site is described on the site form as a terrace knoll. The recorder did not determine its size and age. No artifacts were collected, and no test pits were excavated. Testing was recommended. A letter report was prepared by the Texas Department of Transportation (1983a) and is on file at the Texas Historical Commission, Texas Department of Transportation, and TARL. In 1983, this site was tested by Glenn Goode and Harold Wooldridge of the Texas Highway Department (1983b). Seven 1 x 1 meter test units yielded approximately 200 flakes, one small biface, and a small amount of burned rock.

Sites 41FR23, 41FR24, and 41FR26 were identified in 1989 by STAA member Kay Hindes, (TARL site files), although no site forms have been submitted to TARL.

The second CRM firm to operate in the county was Hicks & Company, Inc. in Austin, Texas (Brown and Anthony 1990). An archaeological survey of a 40-acre water treatment plant site and water line located four archaeological sites (41FR27 - 41FR30). Three of these sites are prehistoric and one contains prehistoric and historic components. The prehistoric sites are identified in the report as areas of scattered lithic debris with no features or subsurface materials. The historic component of one of the sites is part of a modern ranching complex. These sites were viewed by the investigators as not significant. No further work was recommended. A copy of the report is on file at TARL; however, it is not in the library of the Texas Historical Commission, Archeology Division.

Kay Hindes and C. K. Chandler recorded the second documentation of human remains in the county in 1993 (TARL site files). Site 41FR31 is located on private property, on San Miguel Creek. Artifacts found at the site include burned sandstone rock, baked clay lumps, mussel shell, ochre, ground stone, *Rabdotus* shell, flakes, and bifaces. No diagnostic artifacts were found, but the recorders describe it as probably Late Archaic to Middle Archaic. No report is on file at TARL.

Site 41FR32 was recorded in 1998 by Daniel E. Fox (1998) while working for the Texas Water Development Board (report on file at TARL). Surface inspection of the treatment plant site revealed a thin scatter of "prehistoric chipped stone quarry-like material and early to mid-20th century historic farmstead scatter." This site was not considered to be significant, and no additional work was recommended.

The second largest cluster of sites in the county (41FR33–41FR45 and 41FR47) was recorded by avocational archaeologist, David Calame, Sr. between 1998 and 2001 (TARL site files). The site types (all prehistoric) are described by Calame as biface caches (n=1), lithic scatters (n=6), lithic procurement sites (n=1), quarries (n=1), open campsites (n=4), and unknown (n=2). The method of inspection of these sites consisted of surface inspection and analysis of existing artifact collections. No shovel testing or excavation was conducted. Diagnostic artifacts observed include Plainview bifaces (41FR33); dart and arrow points, gouges, scrapers, and Guadalupe bifaces (41FR34); Scallorn (n=1) and Perdiz (n=1) arrow points (41FR35); a Fairland dart point (41FR36); a Montell dart point (41FR38); Fairland, Marcos, Montell, Frio, Travis, and Tortugas dart points, a Clear Fork Gouge, and Guadalupe bifaces (41FR41); Tortugas, Ensor, Frio, and Marcos dart points plus Scallorn and Perdiz arrow points (41FR42); Pedernales and Palmillas dart points and a Clear Fork Gouge (41FR43); and a Langtry dart point (41FR47). Site survey forms are in the "restricted" files at TARL.

The last two sites to be recorded in the county were 41FR46 in 2001 by Rita D. Fields of PBS&J of Austin, Texas and 41FR48 in 2002 by Kirk French and Kevin Miller (2002) for SWCA Environmental Consultants of Austin, Texas. Site 41FR46 is described on the site form as a lithic scatter with no structural integrity. No shovel tests were excavated, the inspection being restricted to the surface. No report was found at the Texas Historical Commission or at TARL. Site 41FR48 is described on the site form as a surface/subsurface scatter of chipped stone debitage. Shovel testing yielded only three flakes and one chert core fragment. This site is viewed by the investigators as lacking research value due to extensive disturbance. A copy of the report documenting 41FR48 is on file at SWCA in Austin. No copies are on file at the Texas Historical Commission or TARL.

SUMMARY

It is obvious, based on the literature regarding Frio County that no major studies have been carried out in the area. A review of the *Abstracts in Texas Contract Archeology* for the years 1987 -1992 produced no references to contract reports in Frio County on file at the Texas Historical Commission for those years. A check of TARL records produced only nine CRM abstracts. Of this number, six document work conducted by the Texas Department of Transportation (TxDOT), in the form of letter reports, one is an overview of the Old San Antonio Road which passes through the county (McGraw et al. 1991), and the remaining two present the results of a waste water facility (Brown 1990) and a survey for the Medina Electric Cooperative (Frkuska 1982).

The major reason for the low number of recorded sites is the lack of large-scale surveys in the county. This lack of professional research illustrates the importance of avocational archaeologists in terms of providing the archaeological community with valuable data. The efforts of David Calame, C. K. Chandler, Kay Hindes, and Harvey Smith, Jr. are applauded here as they combined to record 21 of the 48 known sites in Frio County for a total of 43.75% of all sites.

For additional information regarding the prehistory of Frio County and South Texas the above-mentioned reports are recommended as well as overviews by Hester (1980, 1981, 1995) and Campbell (1988).

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Golondrina Points From Duval County, Texas

David S. Calame

ABSTRACT

This paper documents and describes four Golondrina points and one medial Paleoindian point fragment from a site in northeast Duval County. The discoveries were made by an oil field worker while surface collecting during the extended drought of the 1950s.

THE SITE

The find site is described as a location northeast of Freer, Texas, in Duval County, not far off of Hwy 59 to the northwest, on a high spot in that area. The high spot is described as a hill with two "knobs" or high points, which lies due north of an oil field pipeline pumping station. All specimens reportedly were found on the westernmost high point of this hill within a fairly tight area described as "the top of the western knob". There are no sites recorded within the USGS Freer NW quad within which these artifacts where found.

THE ARTIFACTS

Golondrina points are described by Turner and Hester (1993:126) as a lanceolate point with a deep basal concavity (more than 4 mm) and basal corners, or "ears" that are usually flared. Both the basal edge and concavity are heavily ground. Hester and Word (2004) have recently reviewed the age for this point type, suggesting that it dates to around 10,000 years ago, based on radiocarbon assays from Baker Cave (41VV213) and Devils Mouth (41VV188). The type is widely distributed across central and southern Texas and the Lower Pecos region. All below described specimen's fluoresced standard responses that would be expected for Edwards cherts.

Specimen A

(Figure 2,a) This is a Golondrina point basal fragment made of fine-grained, light tan chert of good quality. This point appears to have been broken in the haft by impact, as it exhibits classic impact fracture characteristics laterally across the face and along one lateral edge. Edge grinding extends from the base along the lateral edges up to the impact fracture, which suggests the point was broken in the haft. Edge grinding is heavy on both lateral edges as

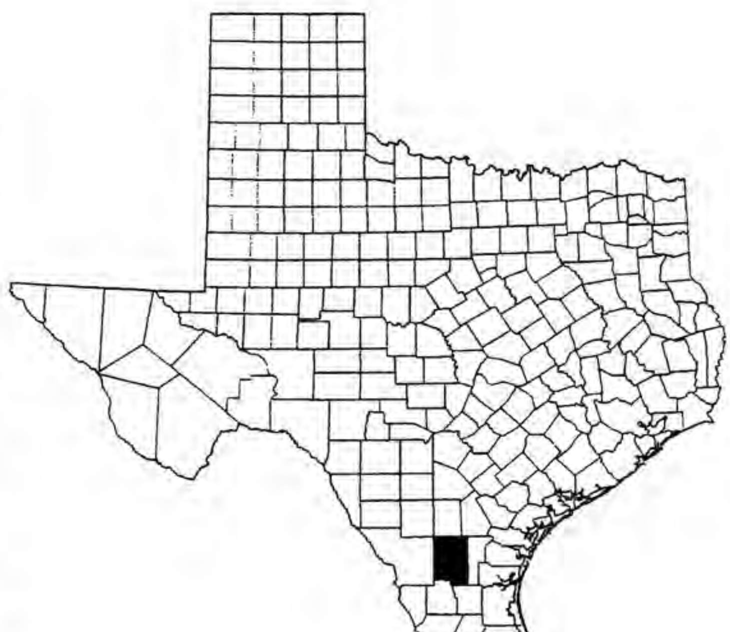

Figure 1. Location of Duval County.

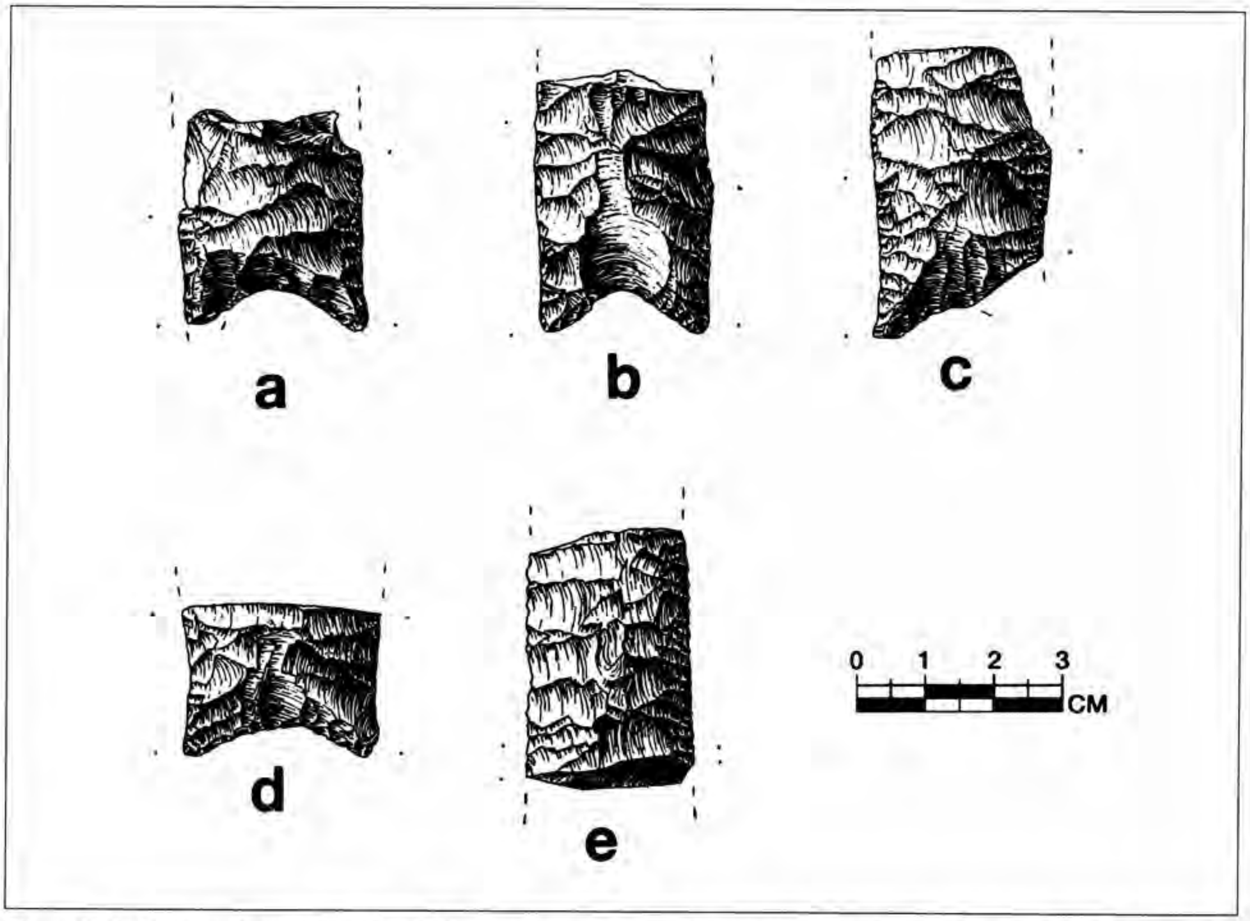

Figure 2. Golondrina Points from Duval County, Texas. a-d, basal fragments (Specimens A-D); e, medial section of a Paleoindian point (Specimen E).

well as in the basal concavity. Since the point was broken in the haft, there is no evidence of resharpening. Flaking on this point appears to be very controlled, parallel, collateral pressure flaking, similar to that reproduced by Swoose Alexander as documented by Calame et al. (2003). The basal "ears" do start to flare out slightly on this specimen just above the basal concavity. One "ear" is broken off, giving that lateral edge the appearance of being straight. This specimen is lightly covered by a ghost white patina. The basal concavity was thinned bifacially with a series of short pressure flakes no longer than 7 mm. Edge grinding extends up from the base 25 mm on the longest lateral edge. Maximum width of this specimen is 25 mm. Basal concavity depth is 5 mm. Maximum thickness of this artifact is 6 mm. Point is biconvex in cross section.

Specimen B

(Figure 2,b). Specimen B is a Golondrina point basal fragment made of fine-grained, light tan chert of good quality, very similar to Specimen A. This specimen was broken by an impact fracture just slightly above the haft, and exhibits classics characteristics of impact fractures in removing a portion of one lateral edge. Edge grinding is heavy and extends up the left lateral edge 30 mm as seen in Figure 2,b. The base was thinned by one large flute like pressure flake from the top of the basal concavity measuring 20 mm. The obverse base was thinned by a series of pressure flakes no longer than 9 mm. Flaking on both faces appears to be controlled pressure, with generally parallel collateral flaking. No evidence of resharpening remains on this basal point fragment.

Maximum width of this specimen is 25 mm and maximum thickness is 7 mm. Depth of the basal concavity is 7 mm and grinding in the basal concavity can best be described as "light". The base begins to flare outward slightly, right at the top of the basal concavity. The specimen is bi-convex in cross section.

Specimen C

(Figure 2,c). The artifact is a Golondrina point missing the distal end and one basal corner. This specimen is made of fine-grained, light tan chert of good quality very similar to the previously described specimens. The type of fracture that broke this point is not obvious because of later rechipping of one lateral edge. This rechipping is recent enough to not have any patina on it and when subjected to the UV light, the rechipped area fluoresces much brighter than the remaining surface of the point. It appears the missing basal corner is a snap fracture created from pressure applied to one face of this specimen. Edge grinding is heavy and extends 23 mm up from the base of the point. Maximum width of this specimen is 25 mm, although it may have been a bit wider above the rechipped area. Maximum thickness is 7 mm. The basal concavity is 5 mm deep and exhibits heavy grinding. The specimen is bi-convex in cross section. The pronounced flaring on the remaining basal "ear" occurs just slightly above the basal concavity.

Specimen D

(Specimen 2,d). Another Golondrina basal fragment, Specimen D is also made of fine-grained, light tan chert of good quality. The fracture of this specimen appears to be a bending fracture cause by pressure applied to the obverse face of the artifact. The break occurred in the hafted area as heavy grinding of the lateral edges continues from the base along the lateral edges to the fracture. Grinding extends 21 mm maximum from the base, however, it appears that grinding continued on farther prior to the artifacts breakage. Maximum width of this specimen is 27 mm and maximum thickness is 5 mm. The basal concavity, which exhibits heavy grinding, is 3 mm deep. The basal "ears" flare outward beginning at 11 mm above the base. The base was thinned by a series of bifacial pressure flakes, the longest of which measures 13 mm. Flaking appears to be very organized, collateral pressure flaking, with edge retouch and heavy grinding. The specimen is bi-convex in cross section.

Specimen E

(Figure 2,e). This specimen is a medial fragment of a Paleoindian lanceolate dart point. There is no edge grinding on the specimen's lateral edges. Indeed, both lateral edges are alternately beveled from re-sharpening. The material again is a fine-grained light tan chert of good quality. Flaking is highly controlled collateral pressure flaking. Both end fractures occurred in antiquity, and exhibit the same light covering of patina found over the entire piece. One end fracture maybe the result of re-sharpening effort got awry. The obverse face has some small specks of what this author considers iron staining, probably inflicted by contact with iron implements, such as plowing equipment. Maximum width of this specimen is 23 mm, while the maximum thickness is 6 mm.

DISCUSSION

Although Golondrina points are widely found across south Texas, they are most often found as isolated artifacts, or as single specimens from an eroded site surface. Thus, it is significant that all five of these reported artifacts were found on the surface in a relatively small area atop a small knoll in northern Duval County. Since four of the specimens include bases, it maybe that these artifacts were removed from the haft during retooling efforts. This suggests that the knoll top was being used as a campsite. The four specimens were broken in or just above the hafting area and three exhibit impact fractures, traits that reflect hunting episodes in the vicinity of the campsite. Although Golondrina point distribution was assumed to include Duval County, this paper verifies the existence of this point type in that county of southern Texas.

ACKNOWLEDGMENTS

The author wishes to acknowledge the late Elmer Maxwell, finder of the reported artifacts, who transferred ownership of these artifacts to the author so that they could be thoroughly studied. And of course, special thanks to my wife, Debbie, who always takes up my slack around the house while I am writing.

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Folsom Points from Crane County, Texas: Site 41CR10 (The Hot Tubb Site)

Cindy Smyers, Debbie Calame, and David L. Calame, Sr.

ABSTRACT

A multi-component Folsom-Midland bison kill site has been studied in Crane County, Texas. Originally recorded in the 1980s, it was later excavated in 2002-2003 by archaeologists from Southern Methodist University. Since that time, the authors have been able to document seven additional Folsom points from this site and the data are presented here.

INTRODUCTION

Seven Folsom points found at a site on the Tubb Ranch (41CR10), Crane County, Texas, are reported and discussed in this paper (Figure 1). The artifacts were surface collected over a period of several years, having been exposed in a deep sand blowout, along with remnants of a bison kill. The finder, Nick Esquivel, reported the site to Dr. Michael Collins early in the 1980s. Dr. Collins visited the site in 1984 and recorded it with the Texas Archeological Research Laboratory (TARL). During his visit, Collins was accompanied by Dennis Stanford and Pegi Jodry. The site is located on the Sandhills Ranch, and more specifically in the Tubbs Oilfield Lease. Given the scorching temperatures in west Texas during the visit, it seemed only appropriate for the site to be named "Hot Tubb."

In 2002 and 2003, Dr. David Meltzer, of Southern Methodist University (SMU) conducted two seasons of excavations at this site and subsequently published a complete report on his excavations (Meltzer et al. 2006). At the time of his publication, these artifacts were not available for study and documentation. In the fall of 2006, the authors were fortunate enough to borrow and record the specimens. This short paper is therefore intended to be a supplement to the work previously published by Dr. Meltzer on this site (Meltzer et al. 2006).

The archaeology of Crane County has been summarized by Harrell (1995). He was aware of the Hot Tubb site and noted the limited evidence for Folsom within the county. The Hot Tubb Site is located in the Monahans Dunes of central Crane County between the towns of Monahans and Crane This locale is just southwest of the geological feature known as the "Caprock." The area is best described as a transitional zone between the Southern High Plains and the Chihuahuan Biotic Province (Blair 1950).

The site is multi-component, including a Folsom-Midland era bison kill of at least six *Bison antiquus*. Other Paleoindian and Archaic artifacts are also reported (Meltzer et al. 2006: Figure 7).

Figure 1. Location of Crane County.

ARTIFACT DESCRIPTIONS

Specimen 1 (Figure 2)

This is a complete Folsom point made of fair quality, light brown, Edwards chert. Both faces are fluted with a single flute scar. The flute on side one (obverse) is well defined and runs the entire length of the specimen, while the flute on the reverse is obliterated by pressure flaking above the hafting point on the lateral edges. An uninitiated fluting nipple was prepared for the reverse face, apparently for another fluting attempt, but never used. The specimen exhibits heavy grinding on both lateral edges.

Specimen 2 (Figure 3)

The specimen is a complete Folsom point fluted on both faces by single flutes. The material is a good quality, light brown to dark brown Edwards chert. There are no remnants of a fluting nipple on either face. Both lateral edges are heavily ground. This point is distinctly lanceolate in shape as opposed to typical Folsoms. This specimen has the widest flutes of all of the artifacts reported in this paper.

Specimen 3 (Figure 4)

This is another complete Folsom point, made of high quality, gray chalcedony or agatized wood. The material contains fine, black linear features. One feature cuts diagonally across the distal end of the Folsom point and appears to be a healed fracture. Under light magnification, there are yellow and white streaks dispersed longitudinally across both faces. The left basal ear is predominately yellow in color and which could possibly be indicative of the material directly under the core cortex. The base has been thinned with two flutes, which may have initiated simultaneously. A third flute on the obverse face appears to have initiated from the distal tip and terminates in a hinge under one of the basal flutes. This is possible evidence that this point was fluted by using a method of compression, by placing the distal tip against an anvil. The distal flute does not exhibit characteristics one would expect from an impact fracture. The origin of the distal flute have been obliterated by resharpening. Both lateral edges are moderately ground. No fluting nipple remnants remain. This specimen was heavily resharpened. The reverse face of this point has only one flute, which extends the entire length of the point and has been intruded upon by resharpening of the distal tip. The reverse flute is moderately erratic in both surface and flute margins.

Specimen 4 (Figure 5)

This Folsom point is complete, with a single flute on both faces. The lateral edges are heavily ground. No remnants of a fluting nipple remains on either face. Material is of a good quality, light brown, Edwards chert, which under light magnification exhibits tiny, off-white speckles dispersed throughout the material. Flutes on both faces have been obliterated by resharpening above the hafting point.

Specimen 5 (Figure 6)

The specimen is a complete, heavily resharpened Folsom point. The specimen was thinned on both faces by single flutes. No fluting nipple remnants remain. The material is a good grade, light tan, Edwards chert with tiny brown speckles dispersed throughout the material. Flute surfaces on this specimen are very smooth. This specimen has been subjected to heat and exhibits several potlids and internal heating fractures. The lateral edges are heavily ground. No fluting nipple remnants remain. Resharpening on this specimen was done alternately.

Specimen 6 (Figure 7)

This tiny specimen may be an unfluted Folsom preform. Lateral edges are not ground, though lightly tried. A prepared, uninitiated fluting nipple exists which would have fluted the obverse face. This specimen is obviously made on a small flake with side one (obverse) exhibiting the original flake surface. The material is a good quality, light brown, Edwards chert which, under light magnification exhibits tiny red speckles uniformly dispersed through out the material. This specimen was not found at the bison kill site, 41CR10, but it was in the same draw, about 1000 feet west (upstream).

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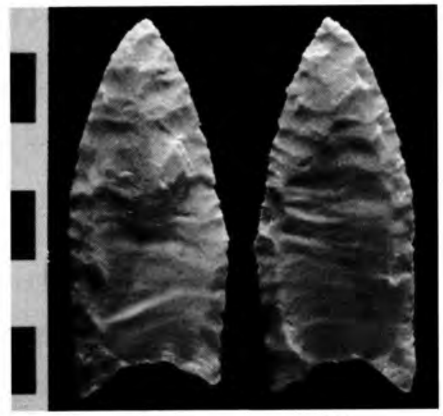

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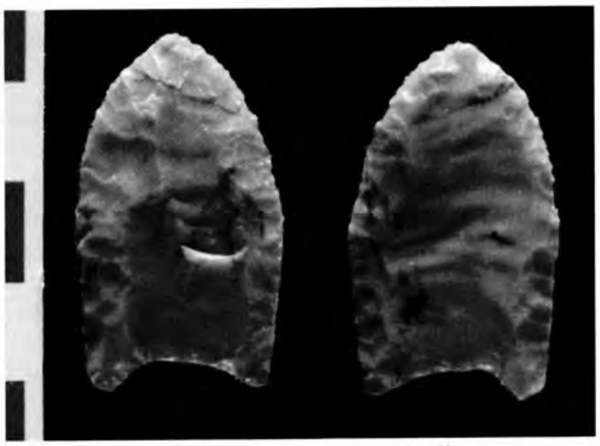

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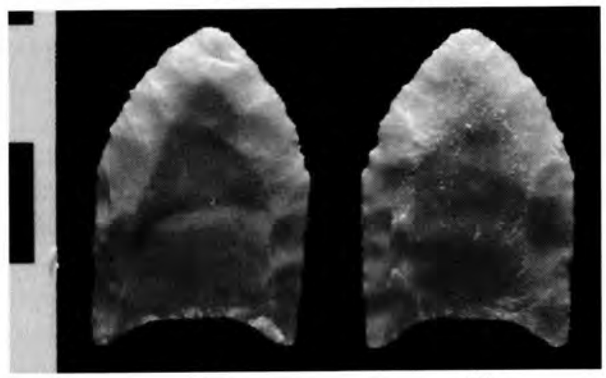

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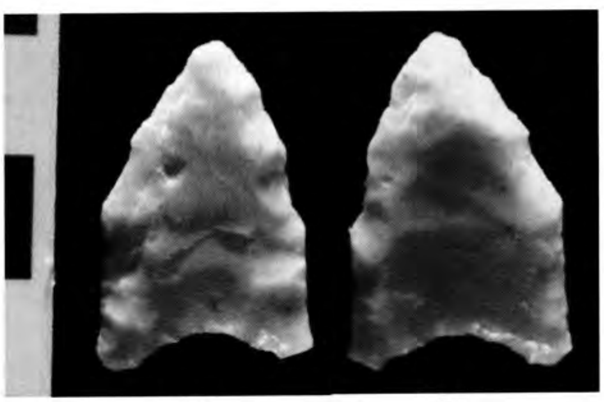

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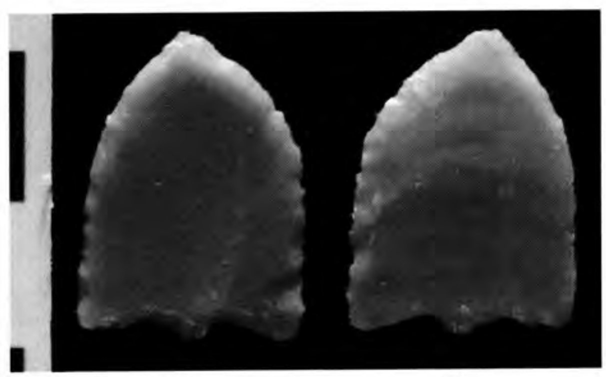

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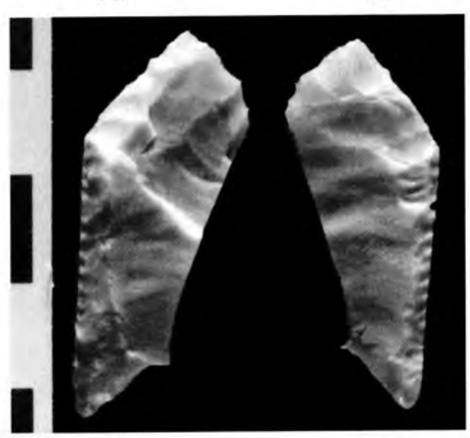

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Figures 2-8. Folsom Points from the Hot Tubb Site, Crane County, Texas. Each specimen is described in text. Jerry Bridwell helped edit the photographs.

Table 1. Munsell Color Chart Readings Obtained During UV Light Analysis.

UV Light Responses	Long Wave	Short Wave	Natural Light
Specimen 1	10YR 6/6	2.5Y 6/6	7.5YR 5/3
Specimen 2	10YR 4/6	10YR 5/4	7.5YR 5/3
Specimen 3	GLEY2 2.5/5PB	GLEY2 7/10B	GLEY2 4/10B
Specimen 3	GLEY2 7/5PB	White Streak Only	GLEY2.5/5PB
Specimen 4	7.5YR 6/6	7.5YR 6/6	7.5YR 5/4
Specimen 5	2.5YR 3/6	10YR 4/6	10YR 6/4
Specimen 6	10YR 7/6	5YR 6/8	10YR 4/3
Specimen 7	2.5YR 5/6	2.5YR 4/8	10YR 7/2

Table 2. Measurements for the Folsom Specimens from 41CR10.
All measurements are in millimeters (mm).

Specimen *(side 1)*	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Maximum Length	38	57	36	29	29	22	39
Maximum Width	29	27	23	18	17	16	N/A
Maximum Width to Base	23	25	20	15	18	14	N/A
Basal Width	20	21	19	13	19	16	N/A
Maximum Thickness	4.5	4.5	4.0	3.3	4.1	2.2	4.6
Flute Thickness	2.5	4.0	3.5	2.8	4.0	N/A	N/A
Basal Concavity Depth	6.0	6.0	5.0	3.0	2.0	2.0	N/A
Number of Flutes	1	1	2	1	1	0	N/A
Flute Length	32	36	30 /20	21	22	N/A	N/A
Flute Width	15	18	12	11	10	N/A	N/A
Edge Grinding (left)	25	23	13	15	13	none	19
Edge Grinding (right)	23	23	17	14	10	none	N/A
Reworked?	yes	yes	yes	yes	yes	yes	yes
Impact Fracture?	no	no	no	no	no	no	yes
(side 2)							
Number of flutes	1	1	1	1	1	0	N/A
Flute Length	25	37	32	21	18	N/A	N/A
Flute Width	13	18	12	14	15	N/A	N/A

Specimen 7 (Figure 8)

A fragmentary Folsom point, consisting of one basal ear and the distal tip. The specimen was fractured longitudinally. Only one lateral edge remains which exhibits very fine, highly controlled, pressure retouching. This specimen was fluted on both faces, however the number of flutes cannot be determined. The reverse face exhibits remnants of what may have been an impact fracture, which originated from the distal end, but has been obliterated by resharpening. The longitudinal fracture, which broke this specimen in two, may have occurred during resharpening. Observable flute surfaces are very smooth. The material is a high quality, light tan Edwards chert.

ARTIFACT PROVENIENCE WITHIN THE SITE

The Folsom points documented in this report, with the exception of Specimen 6, were found by Mr. Nick Esquivel in two general groupings near or within the bone bed excavated by Meltzer et al. 2006). Mr. Esquivel pointed out the find locations of the artifacts, at which time it became apparent the artifacts were "grouped" in two separate locations within the northeast quadrant of Meltzer's grid system (Meltzer et al. 2006:Figure9). UTM coordinates were obtained with a GPS unit at these group locations. These "groupings" are designated here as *Group 1* consisting of Specimens 1 and 2 and *Group 2* consisting of Specimens 3, 4, 5 and 7. As shown in Figure 9, Group 1 was located by Mr. Esquivel as found in the main bone bed, southeast of Meltzer's. datum HTA, approximately corresponding to Meltzer's site map at 986 meters north and 1007 meters east. Group 2 was pointed out farther east of Group 1, approximately corresponding to Meltzer's site map at 987 meters north and 1057 meters east.

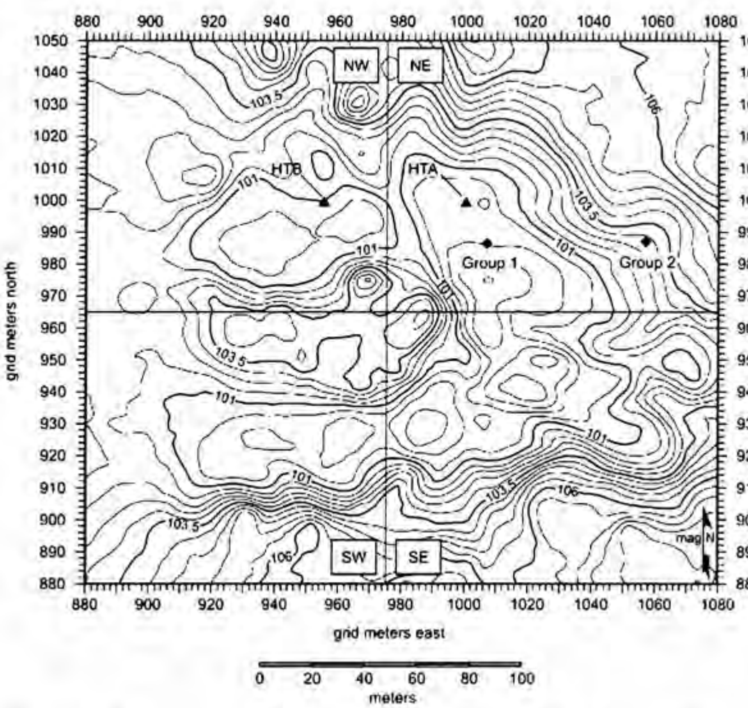

Figure 9. Topographic Map of Locality 2 at the Hot Tubb Site, 41CR10. This map reflects the work of Meltzer et al. (2006:Figure 2). However, the approximate locations of the points reported here are indicated by Group 1 and Group 2. Courtesy of *Plains Anthropologist.*

It must be noted that these locations pointed out by Mr. Esquivel, were taken years after their discovery, and, being in a dune setting, that the site has changed greatly. Thus provenience for these reported artifacts within 41CR10 can be considered only as approximations.

Ultra Violet Light Analysis

UV light analysis was accomplished using a UVGL-55 Multiband UV-254/365 NM and a Munsell Color Chart. First, all specimens colors were compared to the color chart in natural light, then all specimens placed under the UV light and responses noted in long wave, and finally in short wave responses were noted per specimen. UV light responses were taken in a dark room using an ordinary flash light to view the color chart. Results of this study can be found in Table 1.

ACKNOWLEDGMENTS

The authors wish to thank Nick Esquivel for generously loaning the seven Folsom points reported in this paper, and for taking us to 41CR10, to point out where he found these artifacts in relationship to existing datums. Thanks also to Roy Smyers of Odessa, Texas for facilitating this project. Special thanks are due to Dr. David Meltzer for his advice and suggestions and to the *Plains Anthropologist* for permitting the use of the grid map in Figure 9 of this paper. Thanks also to Bruce Moses for his work on plotting the Folsom groupings shown in this paper. Last but the least, the authors would like to thank Dr. Thomas R. Hester for his help in editing the manuscript for publication in *La Tierra*.

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A Polyhedral Blade Core from Travis County, Texas

David L. Calame, Sr.

ABSTRACT

A polyhedral core found at a site southwest of Austin, in Travis County, Texas is reported and discussed. Examination indicates that it is derived from Clovis blade technology.

THE SITE

The specimen described in this paper came from the surface of site 41TV2266. The site is located on a hilltop approximately 5 miles southwest of the City of Austin and just east of FM1826. The locale is described by the finder as an uplands setting overlooking Slaughter Creek to the north. There are sparse amounts of debitage scattered on the surface, along with thick bifacial cores, all related to the site's use as a small lithic procurement area,

Figure 1. Location of Travis County.

THE ARTIFACT

This small, heavily patinated, blade core (Figure 2, 3) strongly resembles conical blade cores from Clovis contexts (Collins 1999; Collins and Lohse 2004; see also Turner and Hester 1993:39). The artifact is heavily patinated except for two, unpatinated blade removals, which were probably struck off this core at a much later date, as both blade scars appear to have removed patina. The material appears to be light grayish tan Edwards chert, of a medium grade with some inclusions. The specimen is roughly conical in shape, with the striking platform roughly polygonal in shape. As seen in Figure 2, there are five blade facets existing on this specimen. The core total length is 91 mm and its maximum width is 59 mm. The maximum blade removal is 89 mm and, interestingly, this is the unpatinated blade scar. The maximum width of any blade removal scar is 30 mm. It is possible that this blade core was exhausted by Clovis standards. It is important to remember that this specimen's measurements are representative of an exhausted Clovis blade core, as discussed by Collins and Headrick (Collins 1992).

Scattered Clovis blade cores have been reported from Bexar County (Chandler, 1992, 1999; Kelly 1992) and Victoria County (Birmingham and Bluhm 2003. Collins (1999) illustrates such cores from other central Texas sites, and from the Gault site in Bell County.

UV LIGHT ANALYSIS

The core from 41TV2266 was subjected to ultraviolet light analysis using a Model UVGL-55

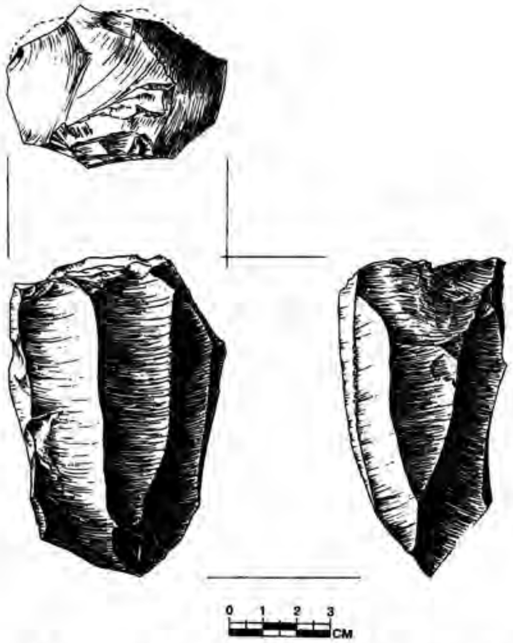

Figure 2. Views of the Polyhedral Core from 41TV2266. Drawings by Richard McReynolds.

Figure 3. Views of the Polyhedral Core from 41TV2266. Drawings by Richard McReynolds.

Mineralight Lamp. This model emits ultraviolet light in both short and long wave. Only the unpatinated surfaces on this specimen fluoresced, responding with a "pumpkin orange," so common in Edwards cherts. All patinated surfaces on this specimen simply reflected the ultraviolet light, shining quite purple. This response occurred in both short and long wave.

ACKNOWLEDGMENTS

The author wishes to thank. Jeff Gregg, of Austin, Texas for his trust in loaning this artifact for documentation. Thanks as well to Richard McReynolds for his excellent illustrations of this artifact. A great debt of gratitude is owed to Dr. Michael Collins for his comments on this specimen, and to Glenn Goode for his keen observations, and Dr. Thomas Hester, for his editing assistance.

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