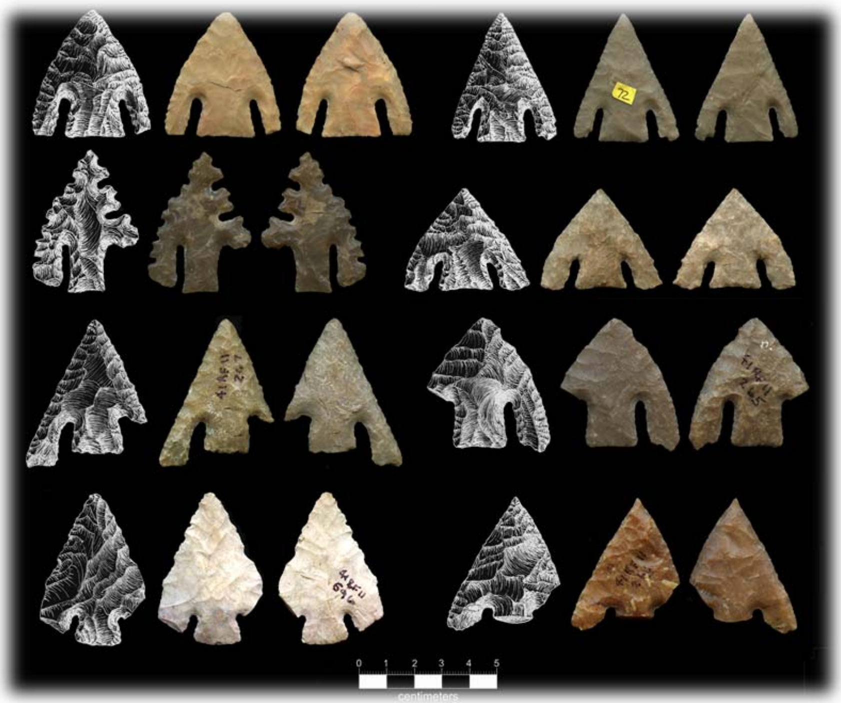


JOURNAL OF TEXAS ARCHEOLOGY AND HISTORY



Timothy K. Perttula, Editor-in-Chief

Steve Davis, Publisher

Volume 1 (2014)

2nd Edition, May 2016



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PUBLISHER'S NOTE: On January 07, 2015, Dr. Todd M. Ahlman, Director of Center for Archeological Studies at Texas State University, assumed the position of Editor-in-Chief for the Journal of Texas Archeology and History.org. This journal, the 2nd Edition of Volume 1, has been carefully revised and updated under Dr. Ahlman's supervision.

The cover art design for Volume 1 features animal figures from the historic watercolors of prehistoric Trans-Pecos rock art that was documented by Forrest Kirkland from 1936–1943. High-resolution digital copies of the original artwork were generously provided courtesy of Texas Archeological Research Laboratory, The University of Texas at Austin.

On the front cover: the photograph featured on the front cover is Figure 4, page 107 from Article 5: A PRECISE CHRONOLOGY OF MIDDLE TO LATE HOLOCENE BISON EXPLOITATION IN THE FAR SOUTHERN GREAT PLAINS. Examples of basally notched Calf Creek horizon points (Bell type). Top two rows are from Zapata County in South Texas (courtesy of Richard McReynolds). Bottom two rows are from the Hopper's Landing site (41RF11) (courtesy of the Museum of the Coastal Bend). All line drawings by Richard McReynolds.

The Journal of Texas Archeology and History.org is an organization dedicated to furthering research, education and public outreach in the fields of archeology and history concerning Texas and its bordering states of Louisiana, Arkansas, Oklahoma, New Mexico and Northern Mexico; a region we call the "Texas Borderlands." This volume is comprised of articles of original research that have been peer reviewed. It is our signature publishing effort for the year 2014 – *"The Journal of Texas Archeology and History, Volume 1".*

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FOREWORD TO VOLUME 1 (2014): PUBLISHER'S REFLECTIONS

Every journey begins with a first step. The seed thought for this Journal germinated during lunch at the Bob Bullock State History Museum barely a year ago. From that late November discussion with Tim Perttula, we have traveled much farther and faster than ever imagined. The rough concept we outlined that day has grown and matured rapidly. Today, we are putting the polishing touches on the premier volume and readying it for publication.

As I pen these thoughts, it is a time to give thanks and reflect on one's blessings for the year past. The Journal of Texas Archeology and History could not have been possible without the generous participation of many individuals who believe in our mission and purpose. Chief among these is our editor-in-chief, Tim Perttula, who has invested a great deal of his time to ensure the quality and accuracy of the Journal's content. Supporting Tim is our outstanding editorial board, Steve Black, Chris Lintz, Robert Z. Selden Jr., Frank de la Teja, Juliana Barr, and Todd Smith. These individuals have provided expert editorial review services to make sure the peer review process has been solid and seamless. Several subject matter experts also stepped up to add their expertise to the review process. It is important to note for posterity that everyone involved with this effort contributed freely and cheerfully their time and efforts to support this publication, indicating their commitment and enthusiasm to the goals of this Journal: free, open access to digital publication of archeological and historical research of the region.

Ranking highest on my list on this day of thanksgiving are the author Ranking highest on my list on this day of thanksgiving are the authors who trusted us with the fruits of their labor at an untested, unproven new publication. Researchers and writers pour their blood, sweat, and tears into their works. It is no small thing that they entrusted us with its safekeeping. So, to the 11 courageous authors of Volume 1, I salute you!

Finally, looking toward the future, we have already begun to assemble content for Volume 2. Based on early indications, we will build on the success and quality of the premier volume in size, breadth of coverage and concept of content. Beyond that, the Journal of Texas Archeology and History has broad plans to publish several "Special Publications" of important themed materials from multiple research groups and may offer Spanish and French versions as well. We hope to strengthen our ties with researchers and writers in the surrounding states and northern Mexico. 2015 will be an interesting and busy year at the Journal of Texas Archeology and History!

Journal of Texas Archeology and History

Steve Davis, Publisher

Thanksgiving Day, 2014

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SHRUB, SCRUB, AND GRASS: THE IMPORTANCE OF SHRUBLAND AND GRASSLAND PLANT COMMUNITIES TO THE DIET OF THE LATE PREHISTORIC (A.D. 900-1535) HUNTER-GATHERERS OF THE EASTERN TRANS-PECOS REGION OF TEXAS

Casey W. Riggs

ABSTRACT

The Eastern Trans-Pecos archeological region of Texas is an area rich in botanical diversity, a resource heavily utilized by both prehistoric and historic hunter-gatherers. A comparison of four paleoethnobotanical investigations of archeological sites dating to the Late Prehistoric Era (A.D. 900-1535) with ethnobotanical information of the Mescalero Apache reveal that the botanical component of prehistoric and historic diets have been similar for the past 1,000 years. Differences in the degree of similarity can be contributed to differential preservation and analytical techniques. Further, ecological sites from the Ecological Site Information System are demonstrated as a novel and useful tool for landscape-scale archeological analysis.

INTRODUCTION

This study examines the use of locally available plant food species at four Late Prehistoric Era (A.D. 900-1535) hunter-gatherer and forager-farmer sites in the Eastern Trans-Pecos archaeological region of Texas (Figure 1). The overarching objective of this study is to understand how Late Prehistoric hunter-gatherers utilized local landscapes for the botanical portion of their diet, specifically the kinds of plants consumed, and not necessarily the importance of a given taxa nor the primary foods consumed, processed, or stored at a given archeological site. With such subsistence related data available future studies can be expanded to examine seasonal dietary variation as well as changes in subsistence patterns, logistical strategies, and socio-cultural identities through time.

To identify potential food resources of Late Prehistoric peoples in the Eastern Trans-Pecos this study compares archeologically encountered plant foods to the ethnographically described diet of the Mescalero Apache. This comparison is undertaken at a site specific level through data extraction from an ecological spatial model. Data for this model were generated in a geographic information system via the Ecological Site Description system developed by the United States Department of Agriculture-Natural Resource Conservation Service (USDA-NRCS) in tandem with the United States Department

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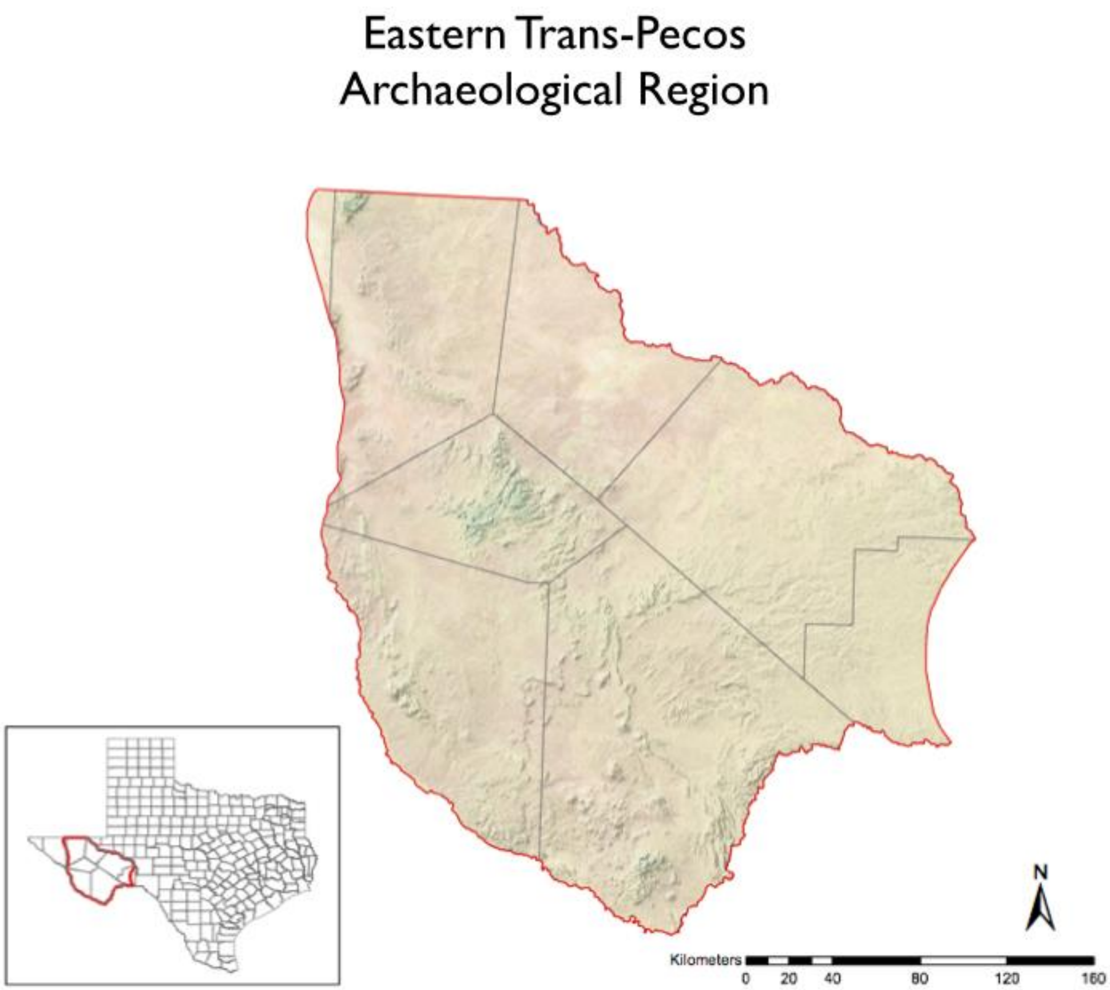

Figure 1. The study area.

of the Interior-Bureau of Land Management (BLM) and the USDA-Forest Service (USDA-NRCS et al. 2013).

The results demonstrate that there is a dramatic overlap between historic and prehistoric plant diet with only two ethnographically confirmed dietary outliers within the archeological record. Here a dietary outlier is considered plant taxa used for food by Late Prehistoric peoples but not by the Mescalero Apache. The Mescalero Apache show a more varied diet, although this discrepancy is likely the result of preservation bias as well as a lack of microbotanical analyses within the Eastern Trans-Pecos. Finally this project's utilization of a novel spatial ecological model, the USDA-NRCS Ecological Site Description system, for archeological inquiry demonstrates the utility of this model for related landscape level archeological investigations.

ECOLOGICAL AND ARCHEOLOGICAL BACKGROUND

The Eastern Trans-Pecos archeological region (see Figure 1) constitutes a large portion of the northeastern Chihuahuan Desert eco-region, and as such is an arid to semi-arid area with a bimodal precipitation regime (Hoyt 2000; Pronatura Noreste et al. 2004). Climatically the study area has cool dry winters and warm dry summers, is prone to frequent and intense droughts, and is heavily influenced by the El Niño-La Niña Southern Oscillation system (Poulos 2007; Warnock 2010).

Paleoenvironmental studies have demonstrated that little natural ecological change has occurred from A.D. 900 to the present (Wells 1966; Hoyt 2000). However, Euro-American arrival, settlement, and landscape use caused dramatic ecological change, primarily by removing fire as a disturbance and through livestock overgrazing (Poulos 2007; Warnock 2010). Both of these occurrences led to the transition from grassland to shrubland communities in many areas. Despite this, 91 plant communities, predominantly grasslands and shrublands, lie within the bounds of the Eastern Trans-Pecos according to USDA-NRCS plant community data. Higher elevation mountains support sky island ecosystems that are more pine (*Pinus* spp.) forest in nature, while the two rivers (Pecos River and Rio Grande) on the periphery of the study area, and several creeks, support a variety of tree species (Hatch et al. 1990; Powell 1994, 1998).

The Eastern Trans-Pecos is archeologically defined as the area lying south and west of the Pecos River, bordering the Lower Pecos region, north of the Rio Grande, west of Lobo Valley and the Great Salt Basin in Culberson County, and south of the Texas-New Mexico state border. Archeological remains demonstrate that this area was culturally distinct throughout prehistory, but more prominently so in the Late Prehistoric period. This is signaled by a lack of settlements, farming, and pottery production in comparison to the Western Trans-Pecos, with the exception of the La Junta District (Mallouf 1985; Miller and Kenmotsu 2004; Perttula 2004). In terms of distinguishing the Eastern Trans-Pecos from other archeological regions, the Southern Plains to the north of the study area show higher mobility and greater emphasis on bison (*Bison bison*) procurement (Perttula 2004). The Central Texas region to the east of the study area lacks the regionally specific Livermore, Diablo, Means, and Alazan arrow points and was dominated by the settlements of Austin phase and Toyah phase groups during the Late Prehistoric (Arnn 2012; Collins 2004; Johnson 1994; Mallouf 2012, 2013). Within the Lower Pecos to the southeast groups did not utilize the Livermore, Diablo, Means, and Alazan arrow points in their hunting equipment nor is the Cielo Complex present within the region (Mallouf 1985).

Within the Eastern Trans-Pecos the Late Prehistoric period is demarcated by the reliance on bow and arrow hunting technology with diagnostic arrow point types including Livermore, Toyah, Perdiz, and Fresno (see Turner et al. [2011] for a discussion of these types) as well as the recently defined Diablo, Means and Alazan types (see Mallouf [2012, 2013] for discussion of their morphological attributes). Pottery was minimally utilized throughout this era, with wares of local (created within the La Junta District) and exotic origin (originating from northern Mexico, the Western Trans-Pecos, central and southern New Mexico, and far East Texas) (Cloud 2004; Cloud et al. 2004; Kenmotsu 2013). Most pottery artifacts are encountered on sites in the La Junta District and the Pecos River valley (Mallouf 1985). Although horticulture occurred in the region, it was solely within the La Junta

District; cultigens are not examined in this study, as it focuses specifically on Late Prehistoric era hunter-gatherers and their collecting practices. Additionally, two primary archeological hunter-gatherer groups have been identified in the archeological record: the Livermore phase and the Cielo Complex.

Livermore Phase

Defined by Kelley et al. (1940) and revised by Kelley (1957), the Livermore phase (ca. A.D. 900-1300) is typified by nomadic hunter- gatherers who utilized bow and arrow hunting technology and occupied the area between southeastern New Mexico and northeastern Chihuahua. At this time the Livermore phase remains poorly defined, although elements of mountain-top ritualism and material culture remains are known (Seebach 2007). Projectile points typically found in association with one another include the Livermore, Toyah, and Fresno (Mallouf 1999) as well as Diablo, Means, and Alazan (Mallouf 2012). Mountain-top ritualism is noted because of the presence of two large arrow point caches, the Livermore and Means caches, atop two mountainous peaks in the study area (Mallouf 2009). Kelley (1957) posits that the Livermore phase indicates an incursion of Plains-based hunter-gatherers, while Mallouf (1999) cautions that the archeological culture it represents may be that of an indigenous group.

Cielo Complex

Another hunter-gatherer group in the study area, the Cielo Complex (ca. A.D. 1250-1680) represents a unique archeological complex identified by Mallouf (1985). Classic Cielo Complex sites have stacked stone-based wickiup structures atop readily defendable locations at both long term and short term locales (Mallouf 1999). Cielo Complex groups predominately utilized the Perdiz arrow point, but Garza and Soto points become more common later in prehistory (Mallouf 1999). Other chipped stone tool types include blades, blade drills, formal end scrapers, beveled knives, and prismatic blade cores. These chipped stone tools are also diagnostic of the Toyah phase of Central Texas (Johnson 1994), although a key difference between these two archeological groups is the absence of pottery at Cielo Complex sites. Mallouf (1999) suggests the Cielo Complex may be ancestral to the Protohistoric and Historic era Jumano, while Mallouf also hypothesizes that this archeological complex could be the remains of one or more indigenous groups in the region.

Relying on Spanish accounts it is understood that the majority of the Eastern Trans-Pecos inhabitants were hunter-gatherers during the Protohistoric period (A.D. 1535-1700) (Cloud 2004; Mallouf 1999; Miller and Kenmotsu 2004). The primary hunter-gatherer groups mentioned include the Jumano, Chisos, and Gediondo, while the La Junta District farmers are described primarily as the Patarbueye (Arnn 2012; Kelley 1986; Kenmotsu 1994; Kenmotsu and Wade 2002). Later, during the Historic Era (A.D. 1700-Present) these indigenous groups were replaced by Athabascan speakers (i.e., Mescalero Apache), later by settlers from Spain and Mexico, and finally Euro-Americans. All of these groups, whether Late Prehistoric, Protohistoric, or Historic/modern, have had a direct relationship with the biotic communities present within the Eastern Trans-Pecos. Although these relationships are obviously different (e.g., modern groups do not rely on foraging for subsistence as the Chisos hunter-gatherers would have), this harsh landscape undoubtedly left major impressions on these groups. With the understanding that all cultural groups have some sort of relationship with the landscape they inhabit, this study utilizes for the examination of biotic community relationships a spatial ecological proxy currently used by modern entities within the Eastern Trans-Pecos for natural resource management.

Plant Communities, Ecological Stable State Theory, and Archeology

Originally named the Soil Erosion Service, today's USDA-NRCS serves as a technical and financial assistance organization to help landowners in the United States maintain healthy landscapes (USDA-NRCS 2013). In this capacity the NRCS coordinated with the Bureau of Land Management and the U.S. Forest Service to create an interagency, standardized classification system of rangeland types to better monitor, inventory, evaluate, and manage the United States' rangelands (USDA-NRCS et al. 2013). This classification system, known as ecological site descriptions (ESD), is based upon soil characteristics, temperature and precipitation data, and topographic characteristics (e.g., slope and aspect), and plant community descriptions that define plant assemblages and disturbances that typify specific plant communities. These plant community descriptions provide taxa lists that typify the community as well as the percentages of the different taxa within the different communities (USDA-NRCS et al. 2013).

The ESD system is based on ecological stable state theory, wherein an ecosystem can experience a variety of stable states depending largely upon incipient ecological disturbance regimes (Beisner et al. 2003; Holling 1973; Law and Morton 1993). Once these disturbance regimes are altered (e.g., an increase or decrease in fire frequency, livestock overgrazing, global climate change, etc.) beyond a certain point the ecosystem then enters a transitional state. Upon entering its transition the ecosystem can revert to the previous stable state, if the original disturbance regime returns, or enter a different stable state (USDA-NRCS et al. 2013). It should be noted that this system only applies to small scale changes and not to more massive ecological transitions such as occurred in the Pleistocene-Holocene transition. However, the introduction of Old World plant taxa to the Americas is demonstrated in ecological sites as transitions away from the historic climax plant community.

Another key component to the ESD system is that the distinct plant communities can remain stable for extended periods of time (USDA et al. 2013), making them useful for archeological inquiry. Additionally, the entities involved with implementing the ESD system rely heavily upon paleoenvironmental data, historic accounts, and historic ecological data, as well as reference communities that possess little anthropogenic alteration since Euro-American settlement to define historic plant communities (USDA-NRCS et al. 2013). This, combined with studies demonstrating negligible environmental and climatic change since A.D. 900 within the Eastern Trans-Pecos (Davis 1989; Elias and Van Devender 1992; Hoyt 2000; Van Devender 1990), makes this system well suited as a spatial model for determining the availability of resources to Late Prehistoric era inhabitants within the study area. At this point the ESD system has not been fully completed for the study area—specifically that the species composition data for the historic climax plant community have not been determined—but the spatial extent of 70 ecological sites is currently available. This is unsurprising given the amount of data required to delineate and describe ecological sites and that the system classification was initiated only 17 years ago (USDA-NRCS 2007). How this shortcoming was dealt with analytically is described in later portions of this article.

METHODS

To determine how hunter-gatherer peoples in the Eastern Trans-Pecos utilized the landscape around them for botanical food resources, four archeological sites are examined from the study area: Arroyo de la Presa Site (41PS800) (Cloud 2004), Tres Metates Rockshelter (41PS915) (Seebach 2007), Granado Cave (41CU8) (Hamilton 2001), and 41PC502 (Antiquities Planning and Consulting 2002) (Figure 2). These archeological sites were included because they were the only available data sources at the time of analysis. Data from these reports are then compared to the available native botanical dietary resources of the Mescalero Apache via data extraction from a spatial model (ESD system) in a GIS. Implications of the incomplete ESD System are quantified as is the degree of botanical taxa diversity within each site catchment area. Finally, a series of queries and comparisons are undertaken to best understand (a) the applicability of historic group diet to prehistoric group diet as well as (b) determining the applicability of ESD historic climax plant community descriptions within archeological methodological frameworks.

The Late Prehistoric Eastern Trans-Pecos Botanical Diet Record

The Arroyo de la Presa site (41PS800) is a multi-component open campsite in southeastern Presidio County, located very close to the Rio Grande. Approximately 84 m^3 of the deposits were excavated via 19 hand excavated units and four backhoe trenches. Eight stratigraphic zones were encountered with occupations in Zone IV beginning around A.D. 700 and occupation continued sporadically through A.D. 1260, dating this site primarily to the Late Prehistoric period. Twenty-seven radiocarbon dates were obtained to date this zone. Investigations indicate that the Arroyo de la Presa site was predominantly a plant processing location based on feature types and macrobotanical analyses of feature contents. The recovery of faunal remains, combined with chemical analyses, demonstrated that terrestrial mammals and lotic (i.e., moving freshwater) resources were also processed at this location. Specific for this analysis, 33 matrix samples were analyzed for macrobotanical remains from 12 features: three stone hearths, five pits, two fire-cracked rock (FCR) concentrations within pits, a pavement of FCR, and a ring midden (Cloud 2004).

Tres Metates Rockshelter (41PS915) is located in southwestern Presidio County and was used first around A.D. 1200 and then again between A.D. 1440 and 1640, all during the Late Prehistoric. The presence of Toyah, Garza, and Livermore arrow points, a Perdiz arrow point preform, a Jornada Mogollon or Casas Grandes brownware sherd, a Carretas polychrome sherd, and two radiocarbon dates (750 ± 60 B.P. and 360 ± 40 B.P.) from six excavation units demonstrate that there were two occupations at the site. Evidence from a plant-lined storage pit demonstrate that the rockshelter was primarily used as a locale for plant food gathering, processing, and storage (Seebach 2007). Seebach (2007) also postulates that this site was utilized by La Junta District forager-farmers to gather local plant species before transporting them back to villages along the Rio Grande and Rio Conchos.

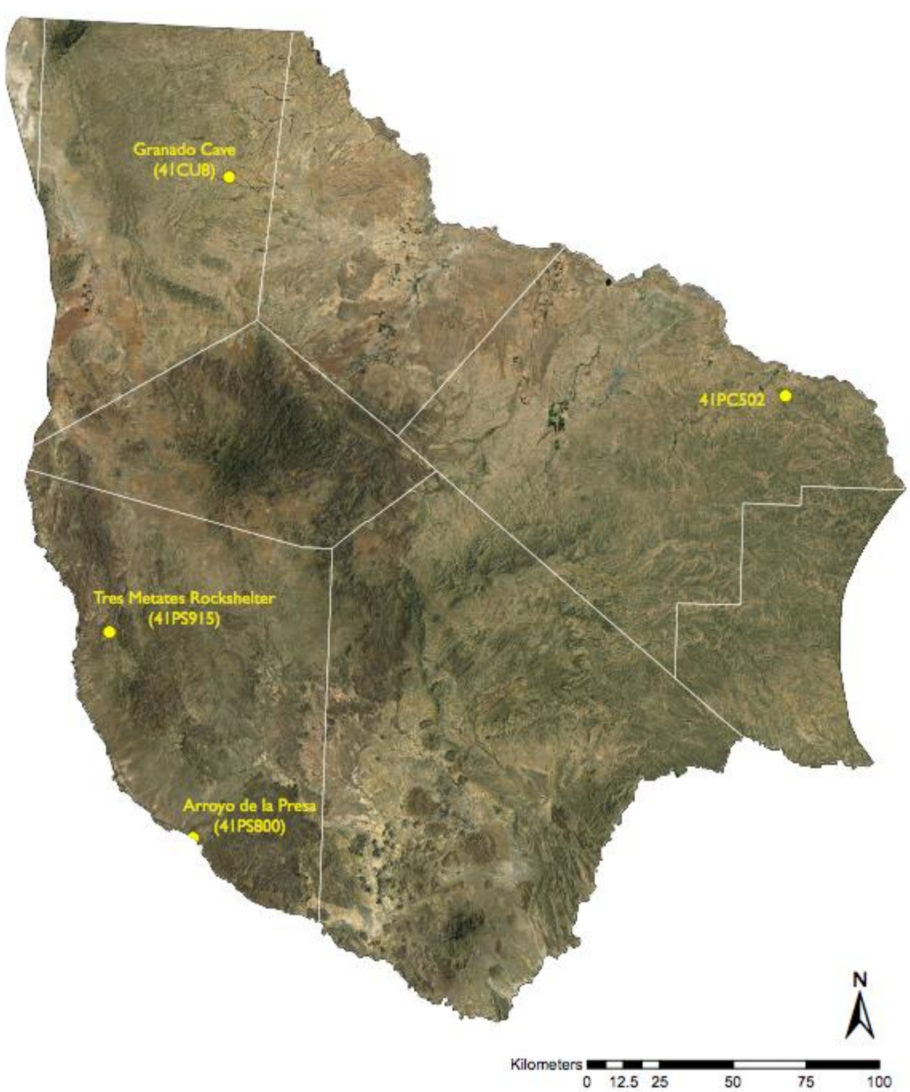

Figure 2. Map of archeological sites in the study area.

Granado Cave (41CU8), a sinkhole cave in eastern Culberson County, was occupied between A.D. 200 and A.D. 1450 based on 20 radiocarbon dates. Time diagnostic artifacts include five arrow points (one of which is a Livermore), and five pottery types: Matta Red-on-Brown, Chupadero Black-on-White, Convento Vertical Corrugated, Chihuahuan Brownware, and Jornada Brownware. The cave was used for habitation, food processing, and as a burial place based upon the variety of recovered artifacts and identified features. Botanical food sources were identified through pollen analysis of 16 human coprolites, one colon sample, and 10 sediment samples from human burials. These analyses indicate that the original inhabitants made full use of the limited faunal and many botanical resources of the surrounding landscape (Hamilton 2001).

41PC502, an open air campsite in eastern Pecos County on the Stockton Plateau, proved to be a multi-component site occupied during the Late Prehistoric. Eight radiocarbon dates were gathered from a hot rock oven facility and indicated that site use dated from A.D. 900 to A.D. 1430. Within this time frame the facility was used four times as a oven for processing members with side scrapers of the Agavaceae family. A crescent midden and hot rock baking pit (Feature 3) received the most attention during the excavations. Ten flotation and three macrobotanical samples were analyzed for macrobotanical remains (Antiquities Planning and Consulting 2002).

Ethnographic and Ethnohistoric Comparisons

To determine the degree to which Late Prehistoric groups utilized available plant species as food resources, the recorded diet of the historic Mescalero Apache is used for comparative analysis. This group was selected because the Mescalero Apache are historically known to be hunter-gatherers (Basehart 1960; Castetter and Bell 1936); the tribal group occupied the Chihuahuan Desert (Basehart 1960; Castetter and Bell 1936); there is ethnohistoric and archeological evidence for the displacement, absorption, or both, of peoples by Apache groups already occupying the Eastern Trans-Pecos (Mallouf 1999; Miller and Kenmotsu 2004; Seymour 2004); and ethnographic studies are available that provide extensive botanical diet information (i.e., Basehart 1960; Castetter and Opler 1936).

The Mescalero Apache had occupied virtually all of the study area by ca. A.D. 1500 based on ethnohistoric information and historic accounts (Arnn 2012; Hickerson 1994; Kelley 1986,;Kenmotsu and Arnn 2012). Additionally, archeological information from the Cielo Bravo site indicates that possible Athabascan speakers not only used the same site, but also occupied the same habitation features, as previous residents had done (see Mallouf [1999] for further discussion). This cultural absorption provides a unique grounds for dietary acculturation, this being a dynamic and complex phenomenon that can result in mixing of food ways by both cultural entities, wherein the immigrating group (i.e., the Mescalero Apache) adopts foods of the host, incipient group(s) (Satia-Abouta 2003). The extent of food way adoption is regulated by many factors such as religion, cultural beliefs and attitudes, as well as personal taste, texture, and color preferences (Satia-Abouta 2003). Hypothetically, dietary acculturation could have taken place in the Eastern Trans-Pecos by means of cultural contact or absorption. Examination of the literature indicate that dietary acculturation processes have never been examined in an archeological context but are increasing in number in applied anthropology situations to better understand processes of globalization (e.g., Kim et al. 2007; Regev-Tobias et al. 2012).

From an environmental deterministic perspective all Apachean groups would have needed to alter their diet to accommodate their adoption and use of resources in newly entered regions. The Mescalero Apache and other Athabascan speakers originated far to the north of the study area (Seymour 2012). Although two routes for ancestral Apachean migrations have been proposed (mountain [Seymour 2012] or plains [Wilcox 1981] routes), the Chihuahuan Desert is vastly different ecologically than any area Athabascan speakers originated from or moved through. If the newly arrived Apachean groups had not adapted their diet to the new environment, their likelihood of survival would have been greatly diminished.

Regardless of whether food adoption occurred as a result of cultural absorption/dietary acculturation, environmental adaptation, or a combination of the two, it should be reiterated that a primary purpose of this study is only to identify the similarity between the prehistoric and Mescalero

Apache use of dietary species. No attempt was made to identify aspects of cultural change or conditions for the adoption of practices from the host group(s). Future studies should be concerned with establishing the reasons for this dietary similarity as it may relate to dietary acculturation in order to better understand the cultural changes Apachean groups underwent after arriving in the American Southwest and Texas.

To determine how similar Late Prehistoric and Historic era native plant diet are, an examination of the ethnographic literature is needed. Castetter and Opler's exemplary study of plant use by Mescalero and Chiricahua Apache was undertaken from 1931-1934. During this three year period a variety of data was gathered from ethnographic fieldwork on the Mescalero Reservation in south central New Mexico that was concerned with the botanical characteristics of Chiricahua and Mescalero Apache cultures (Castetter and Opler 1936). That being said, some aspects of material culture, linguistics, hunting, religion, and social organization were also discussed. Most importantly for this study, 70 different plant taxa were identified for food use, and information was gathered as well concerning their preparation strategies. As such, Castetter and Opler's study provides the greatest amount of ethnographic information specific to plant diet compared to a second Mescalero Apache ethnobiological study by Basehart (1960).

In contrast to the work completed by Castetter and Opler (1936), the study by Basehart (1960) was undertaken primarily to better understand the subsistence patterns and political organization of the Mescalero Apache. Interviews and field work were undertaken on the Mescalero Reservation from 1957-1960. I am most concerned with the subsistence patterns described by Basehart (1960), because while Basehart did not identify as many plant taxa as Castetter and Opler (1936), he did identify the staples of native plant diet as well as seasonal movements to procure these resources.

When taken together these two data sources indicate 70 different native plant taxa constituted the plant-heavy diet of the Mescalero Apache (Castetter and Opler 1936). Seasonally, this group relied heavily upon three taxa: agave (*Agave* spp.), prickly pear (*Opuntia* spp.), and datil yucca (*Yucca baccata*) (Basehart 1960). Small seeds from grasses, berries, greens, piñon (e.g., *Pinus edulis*) nuts, oak (*Quercus* spp.) acorns, and the starchy bases of hydrophytic plants (e.g., cattail [*Typha* spp.]) were important portions of the native plant diet depending upon the season (see Castetter and Opler [1936] and Basehart [1960] for more detailed information).

Spatial Data Extraction

The exploitation of a plant community for native plant food resources from an archeological context is gained through knowledge of both plant communities and paleoethnobotanical remains, as well as comparisons with ethnographically described cultures of the same or similar geographic areas. To collect this knowledge, spatial and comparative analyses were undertaken to determine locally available dietary plant species use in hunter-gatherer and forager-farmer diets.

To identify what plant species were available, county level USDA-NRCS spatial data was downloaded from the "Web Soil Survey for Brewster, Culberson, Hudspeth, Jeff Davis, Pecos, Presidio, Reeves, and Terrell Counties in Texas." These data were incorporated into a Microsoft

Access Database, and the ecological site names and their plotted extent was loaded in an ESRI ArcGIS 10.0 blank ArcMap document using the SoilViewer PlugIn 6.1.

Because only portions of Hudspeth, Jeff Davis, Presidio, and Terrell counties are within the Eastern Trans-Pecos archeological region, a georeferenced regional map from Cloud and Piehl (2008) was outlined and the counties clipped to the study area. Site locations for Arroyo de la Presa, Tres Metates Rockshelter, Granado Cave, and 41PC502 were then gathered from the Texas Archeological Site Atlas and plotted on the ecological site map for the area.

Ethnographic information has generally concluded that the maximum one day catchment for individuals gathering plant resources is 15 kilometers (km) (Kelly 1995). Although the foraging radius from these sites may be smaller, by utilizing the maximum distance all possible variation in the distribution of plant resources is incorporated into the analysis. For the spatial analysis a 15 km buffer was generated around each site location and a union performed between the reconstructed foraging radii and the ecological site names layers (Figures 3 and 4). It should be noted that this analysis does not account for the consequences of terrain variability and labor expenditure in gathering plant resources but instead seeks to analyze the maximum possible ecological variability that occurs around these specific archaeological sites.

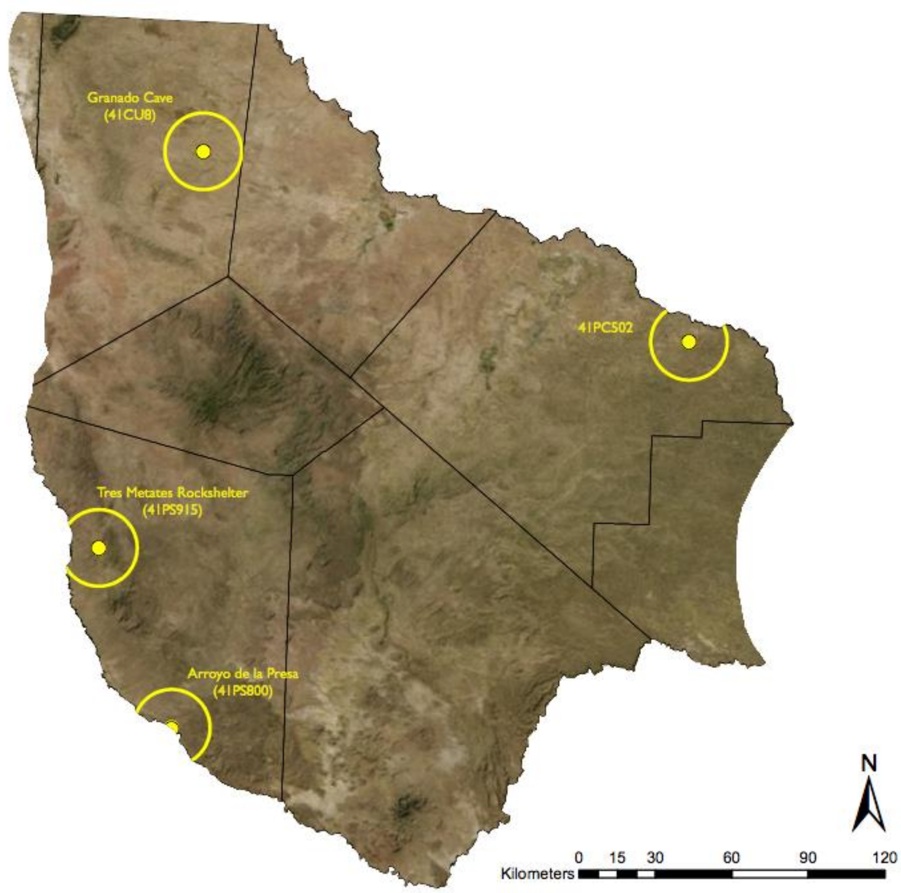

Figure 3. Reconstructed foraging radii of archeological sites in this study.

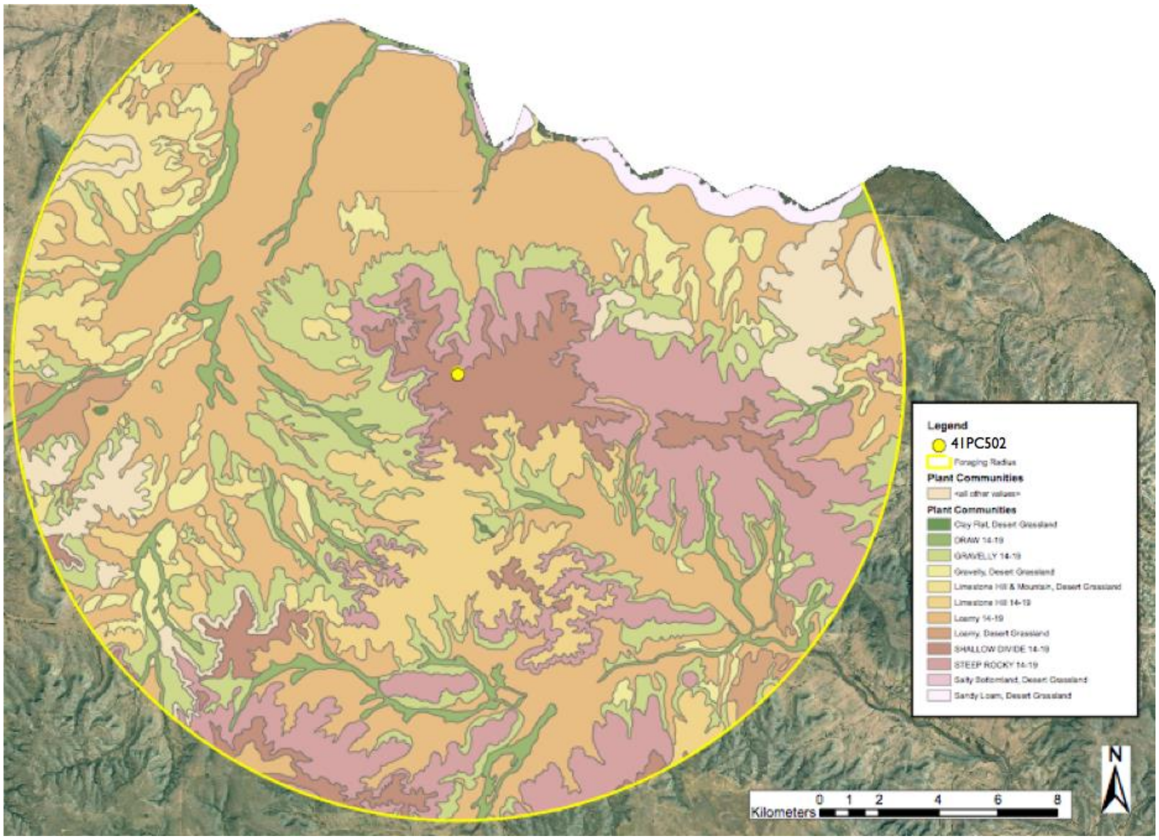

Figure 4. Example of ecological sites within the 41PC502 reconstructed foraging radius.

Plant Taxa Diversity and Evenness

To examine botanical diversity an index, Shannon's Diversity Index (SDI or *H'*) (Figure 5), was added to the analysis as it is frequently used in landscape ecology to determine taxa richness (McGarigal et al. 2013; O'Neill et al. 1988). Here *R* is the total number of species in the site catchment and p_i the proportion of *S* made up of the *i*th species (Shannon and Weaver 1949). Results of this index are relative and the value increases as the number of unique taxa increases (McGarigal et al. 2013). A table was also generated to determine the number of unique taxa within each taxa, as well as the number of taxa which are encountered multiple times within the site catchment.

$$H' = -\sum_{i=1}^{R} p_i \ln p_i$$

Figure 5. Shannon's Diversity Index (SDI) (Shannon and Weaver 1949).

$$E = \frac{H'}{H'_{\max}}$$

Figure 6. Shannon's Evenness Index (SEI) (Shannon and Weaver 1949).

Another index, Shannon's Evenness Index (SEI) (Figure 6), was also used as this identifies how evenly species are dispersed in a given landscape (O'Neill et al. 1988). For this, the SDI (*H')* is divided by the natural log of the total number of species on the landscape, H'_{max} (Shannon and Weaver 1949). With this index the closer the result (E) is to 1 the more evenly distributed species are on the landscape (McGarigal et al. 2013).

Comparative Analysis

To determine available plant species a process had to be developed to compile this data because the species composition for the ecological sites/plant communities are not available from the Web Soil Survey county level downloads. Identifying which ecological sites are present within the reconstructed foraging catchment was determined by copying the relevant attribute data from the ecological site name-foraging radii spatial union. For determining plant taxon composition the ESD System for Rangeland and Forestland Data was accessed and the species copied and pasted into an Excel spreadsheet. To double check the ESD System for Rangeland and Forestland Data, a series of "Area of Interest" was generated in a Web Soil Survey session approximating the reconstructed foraging radii. Species composition missing from the ESD System for Rangeland and Forestland Data was then incorporated into the plant community spreadsheets. When taxa were encountered in the archeological record but not the current ecological data Powell (1994, 1998) and the USDA PLANTS Database (USDA-NRCS 2013) were examined to determine if the particular taxa could be present within the site catchments.

In order to compare the sizeable amount of botanical data, a table was developed that compared the prehistoric diet from each archeological site to the wild plant foods utilized by the Historic Mescalero Apache available within the site catchments. The reason for compiling information in this manner was to determine if prehistoric foragers were utilizing the same botanical species in the plant communities surrounding these archeological sites as the Mescalero Apache might have.

RESULTS

Results of the comparative analysis portion of the study identify a few unique observations as well as some complications in the use of the USDA-NRCS historic climax plant community data. Before an examination of the archeological-ethnohistoric comparisons, the missing plant species data from the ecological proxy must be addressed.

Two major hurdles encountered in the comparative analysis was the presence of areas with no defined ecological site within the site catchments and the existence of defined ecological sites with no available plant species composition data. The occurrence of these phenomena is likely due to a lack of reporting from the USDA-NRCS, BLM, and USDA-Forest Service, which is unsurprising given the large amount of work involved and that the ESD System was only recently initiated (USDA-NRCS 2007). Analytical implications for this primarily relate to not knowing the full vegetative suite within the ecological sites. However as Table 1 indicates, the SDI values are not very high (> 6), which is indicative of the fact that the landscapes are mildly heterogenous at the site catchment scale. The most hypothetically important ecological sites (i.e., riparian corridors) are missing plant species data. In the near future, this deficit will be righted as the USDA-NRCS, BLM, and USDA-Forest Service continue their efforts in reporting; at this time no attempt was made to account for this missing data.

Table 1 identifies the percentage of site catchment areas that have unknown ecological sites, known ecological sites with no historic climax community plant taxa data, and known ecological sites with historic climax community plant taxa data. In the future it is expected that this missing data will gradually be included. The two sites from Presidio County (Arroyo de la Presa site and Tres Metates Rockshelter) are the most reliable in terms of known data for the total site catchment areas.

Table 1. Known vs. unknown ecological site and plant taxa data.

	41CU8		41PC502		41PS800		41PS915	
	n	% area	n	% area	n	% area	n	% area
Unknown ESD	NA	0.00	NA	5.3	NA	14.9	NA	21.1
ESD-Known, Plant Taxa-Unknown	2	50.7	5	42.0	1	0.1	4	2.0
ESD-Known, Plant Taxa-Known	8	49.3	12	52.8	9	85.0	16	76.9
Total Number of Known Taxa	97		109		135		174	

In relation to ecological information, Table 2 presents data regarding the total number of plant taxa, their frequency and uniqueness, and results of the SDI and SEI. The SDI demonstrates that the site catchment for Tres Metates Rockshelter (41PS915) has the most variation (SDI = 5.65) between the number of taxa while Granado Cave (41CU8) has the least variation (SDI = 4.43). In terms of the relative evenness of taxa, the SEI shows that the catchment of the Arroyo de la Presa (41PS800) site are dominated by fewer plant taxa (SEI = 0.83) than the three other site catchments. However, Tres Metates Rockshelter has the least evenly distributed number of taxa (SEI = 0.91). This combined information demonstrates that for the Tres Metates Rockshelter catchment area there are a higher amount of botanical taxa dominating the landscape with a high amount of variation compared to the other three site catchment areas. It should be noted that none of the site catchments have complete ecological data and these values will potentially change in the future.

Table 2. Plant taxa distribution across site catchments with SDI and SEI values.

# of ESDs with	Number of Taxa Shared			
Shared Plant Taxa	41CU8	41PC502	41PS800	41PS915
1	57	62	75	82
2	18	19	16	33
3	17	12	19	10
4	3	13	6	10
5	2	4	5	14
6	0	0	9	4
7	-	-	2	5
8	-	-	2	7
9	-	-	-	5
10	-	-	-	1
11	-	-	-	2
12	-	-	-	1
Shannon's Diversity Index	4.43	4.5	4.72	5.65
Shannon's Evenness Index	0.86	0.84	0.83	0.91

Granado Cave (41CU8) had eight ecological sites but two do not currently have described plant species composition data. Unfortunately, these two ecological sites account for 50.7 percent of the site catchment area. However, for the six plant communities which do have known compositions, there are 97 plant taxa available (see Table 1). Of the plant species 14 (14.4 percent) would have been used by the Mescalero Apache as food resources but only seven are encountered archeologically (Table 3). One taxa is present in the archeo-dietary record, grape (*Vitis* sp.), but not in the ecological data. According to Castetter and Opler (1936), Arizona grape (*Vitis arizonica*) was consumed by the Mescalero Apache in the summer and fall and thus is not a dietary outlier. Powell (1998:256) concluded that Arizona grape is present in Culberson County, Texas, where Granado Cave is located. However, Arizona grape requires access to large amounts of water for growth and, despite being in an arid area, there are two riparian zone ecological sites (Bottomland [R042XC017NM] and Draw, Desert Grassland [R042XC242TX]), within the site catchment area but neither have historic climax plant community botanical taxa data. The presence of these riparian locales and the presence of the taxa in recent prehistoric archeological deposits suggests that grape plants are a component of the incomplete plant taxa dataset. In addition to this, the coprolite study from Hamilton (2001) demonstrated that grass (Poaceae) pollen is present in a significant portion of the coprolites. Unfortunately non-cultivated members of the family Poaceae cannot be identified beyond the family level with pollen (Bryant 2006), so which of the three taxa used by the Mescalero Apache and present in the site catchment (muhly grass [*Muhlenbergia* spp.], vine mesquite [*Panicum obtusum*], and sand dropseed [*Sporobolus cryptandrus*]) cannot be determined; consequently, they must be treated as one taxonomic unit in the analysis.

Table 3. Ethnographically used and archeologically encountered plant taxa utilized in diet from Granado Cave.

Common Name	Taxon	Mescalero Apache	Prehistoric Diet	Present in ESD Data
Agave	*Agave* sp.	X	X	X
lambsquarters	*Chenopodium album*	X		X
smooth sotol	*Dasylirion leiophyllum*	X		X
common sumflower	*Helianthus annuus*	X	X	X
algerita	*Mahonia trifoliolata*	X		X
grass	POACEAE	X	X	X
Texas Sacahuista	*Nolina texana*	X		X
prickly pear	Opuntia spp.	X	X	X
Western honey mesquite	*Prosopis glandulosa*	X		X
grape	*Vitis* sp.	X	X	
littleleaf sumac	Rhus microphylla	X		X
yucca	*Yucca*	X	X	X

41PC502 had 12 ecological sites with only seven currently having species composition available. The seven ecological sites with known plant taxa account for 52.8 percent of the site catchment area and they have 109 botanical taxa present (see Table 1). Fourteen (12.8 percent) of these taxa would have been used as food by the Mescalero Apache but only four are archeologically represented. Two additional taxa (lambsquarters/amaranth [Cheno-Ams] and purslane [*Portulaca* sp.]) are encountered in the archeological record and are known to have been eaten by the Mescalero Apache (Castetter and Basehart 1936) but are currently absent in the ecological data (Table 4). It should be noted that the taxonomic unit of Cheno-Ams consists of members of the family Chenopodiaceae and the genus *Amaranthus* in the family Amaranthaceae, but are difficult to separately discern in many archeological contexts (Dering 2004). The absence of Cheno-Ams and purslane in the ecological data is most likely due to the incomplete ecological proxy. However, the USDA PLANTS Database indicates these are ubiquitous across the Eastern Trans-Pecos (USDA-NRCS 2013) and are likely to contribute to the taxa composition of the missing ecological site data.

Table 4. Ethnographically used and archeologically encountered plant taxa utilized in diet from 41PC502.

Common Name	Taxon	Mescalero Apache	Prehistoric Diet	Present in ESD Data
Agave	*Agave* sp.	X	X	X
four-wing saltbush	*Atriplex canescens*		X?	X
lambsquarters/amaranth	*CHENO-Ams*	X	X	
sotol	*Dasylirion* sp.	X		X
cruzilla	*Forestiera pubescens*	X		X
Indian rushpea	*Hoffmannseggia glauca*	X		X
algerita	*Mahonia trifoliolata*	X		X
muhly grass	*Muhlenbergia* spp.	X		X
Texas sacahuista	*Nolina texana*	X		X
prickly pear	*Opuntia* spp.	X	X	X
vine mesquite	*Panicum obtusum*	X		X
hogweed	*Portulaca* sp.	X		X
Western honey mesquite	*Prosopis glandulosa*	X	X	X
littleleaf sumac	*Rhus microphylla*	X		X
sand dropseed	*Sporobolus cryptandrus*	X		X
yucca	*Yucca* spp.	X		X

X?=taxa questionably included as dietarily important/

The reconstructed foraging radius for the Arroyo de la Presa site (41PS800) had a total of nine ecological sites, although only eight currently have plant species composition data. These eight ecological sites account for 84.9 percent of the site catchment area. Within the reconstructed foraging radius there are a total of 135 plant taxa currently known (see Table 1). Thirteen (9.6 percent) of these are known to have been consumed by the Mescalero Apache, but only four are found in archeological samples (Table 5). As at 41PC502, Cheno-Ams are present in the samples and were consumed historically by the Mescalero Apache (Castetter and Basehart 1936). Cheno-Ams are not currently in the ESD System data but most likely are present in the biota as mentioned above. The fruits of one taxa, saltbush (*Atriplex* spp.), were encountered in the archeological record but were not apparently used by the Mescalero Apache. The presence of these seeds may be due to the use of saltbush as fuel (see below).

Tres Metates Rockshelter (41PS915) has the most ecological variability (SDI = 5.65, SEI = 0.91) within this reconstructed foraging radius compared to the other three sites. Sixteen ecological sites are present in the site catchment area while four have yet to be described. Those presently having plant taxa composition data available account for 76.9 percent of the site catchment area. Of the 12 plant communities with available plant taxa data, 174 different taxa are present (see Table 1). Nineteen of these taxa have recorded dietary use among the Mescalero Apache and 15 are encountered archeologically (Table 6). Of those recovered in the archeological record, four have no known food use among the Mescalero Apache (Castetter and Opler 1936; Basehart 1960). These include saltbush, bristlegrass (*Setaria* ssp.), buffalo gourd (*Cucurbita foetidissima*), paspalum grass (*Paspalum* spp.), and plantain (*Plantago* spp.). Of these four only buffalo gourd is not present in the current ESD System data.

Table 5. Ethnographically used and archeologically encountered plant taxa utilized in diet from the Arroyo de la Presa site.

Common Name	Taxon	Mescalero Apache	Prehistoric Diet	Present in ESD Data
Agave	*Agave* sp.	X	X	X
four-wing saltbush	*Atriplex canescens*		X?	X
lambsquarters/amaranth	*CHENO-Ams*	X	X	
sotol	*Dasylirion* sp.	X		X
cruzilla	*Forestiera pubescens*	X		X
muhly grass	*Muhlenbergia* spp.	X		X
Texas sacahuista	*Nolina texana*	X		X
prickly pear	*Opuntia* spp.	X	X	X
vine mesquite	*Panicum obtusum*	X		X
hogweed	*Portulaca* sp.	X		X
Western honey mesquite	*Prosopis glandulosa*	X	X	X
littleleaf sumac	*Rhus microphylla*	X		X
sand dropseed	*Sporobolus cryptandrus*	X		X
yucca	*Yucca* spp.	X		X

X?=taxa questionably included as dietarily important/

Table 6. Available, ethnographically used, and archeologically encountered plant taxa utilized in diet from Tres Metates Rockshelter.

Common Name	Taxon	Mescalero Apache	Prehistoric Diet	Present in ESD Data
Agave	*Agave* sp.	X	X	X
onion	*Allium* spp.	X	X	
amaranth	*Amaranthus* spp.	X	X	X
four-wing saltbush	*Atriplex canescens*		X?	X
buffalo gourd	*Cucurbita foetidissima*		X	
tree cholla	*Cylindropuntia imbricata*	X	X	X
sotol	*Dasylirion* sp.	X	X	X
rushpea	*Hoffmannseggia* sp.	X		X
muhly grass	*Muhlenbergia* spp.	X		X
sacahuista	*Nolina texana*	X		X
prickly pear	*Opuntia* spp.	X	X	X
vine mesquite	*Panicum obtusum*	X		X
paspalum grass	*Paspalum* sp.		X?	X
pinon pine	*Pinus cembroides*	X		X
plantain	*Plantago* sp.		X	X
purslane	*Portulaca* spp.	X	X	X
Western honey mesquite	*Prosopis glandulosa*	X	X	X
screwbean mesquite	*Prosopis pubescens*	X	X	X
oak	*Quercus* spp.	X	X	X
fragrant sumac	*Rhus trilobata*	X		X
sand dropseed	*Sporobolus cryptandrus*	X	X	X
bristlegrass	*Setaria* spp.		X?	X
yucca	*Yucca* spp.	X	X	X

X?=taxa questionably included as dietarily important/

DISCUSSION

Results of this study indicate there are four overlying patterns concerning Late Prehistoric Era native plant diet among hunter-gatherers and forager-farmers in the Eastern Trans-Pecos archeological region. These patterns can be grouped into three primary observations: similarity between the historic and prehistoric groups; preservation induced bias; and problems with the ecological proxy.

As demonstrated in Table 7, there is a wide variation in prehistoric subsistence use of plant taxa compared to the Mescalero Apache. However, the prehistoric samples are dominated by four taxa: prickly pear (*Opuntia* spp.), mesquite (*Proposis* spp.), yucca (*Yucca* spp.), and agave (*Agave* sp.) (see Tables 3-6). This furthers the dietary similarity between the historic and prehistoric groups as these four taxa are also the dominant botanical dietary species for the Mescalero Apache (Basehart 1960).

Table 7. Number of plant taxa available, used by the Mescalero Apache, and encountered in the archeological record.

Site	Total No. of Taxa	Total No. of Taxa Used by Mescalero Apache	Total No. of Taxa Encountered in the Archeological Record
41CU8	97	12	6
41PC502	109	16	4
41PS800	135	11	4
41PS915	174	18	17

Results of the comparative analysis indicate that there is not complete dietary overlap between the Mescalero Apache and Late Prehistoric groups that occupied the four sites, but the dietary plant species are quite similar. Any dissimilarity is caused by the presence of three confirmed dietary taxa based on the ethnographic record that are also present in archeological samples. Plantago seeds were encountered in the feature fill from 41PC502 and the seeds of one species, woolly plantain (*Plantago patagonica*), are known to have been consumed by three cultural groups (Moerman 2010). Because this taxa has no recorded use among Apachean groups it may never have been adopted by these immigrating peoples and would be indicative of dietary acculturation processes. The same can be said for buffalo gourd, which was used by four groups across the American Southwest and California as a food source, is present in the storage feature at Tres Metates Rockshelter, but was not used by the Mescalero Apache or any other Apachean group (Moerman 2010).

This analysis also questions the inclusion of two grass (*Paspalum* spp. and *Setaria* spp.) and one shrub taxa (*Atriplex* spp.) as dietarily important within the Eastern Trans-Pecos archeological region. Paspalum grass seeds were present at Tres Metates Rockshelter but were not used by the Mescalero Apache. In fact, only one species of paspalum grass, thin paspalum (*Paspalum setaceum*), is known to have had an ethnographic dietary use according to Moerman (2010) but this species is not found in Trans-Pecos Texas (Powell 1994; Vestal and Schultes 1939). However, four species of paspalum grass are known to occur in the Trans-Pecos Region (Powell 1994). Bristlegrass seeds and florets are also present at Tres Metates Rockshelter, but have no known ethnographic use (Moerman 2010). Because of this, and the fact that Seebach (2007) indicates grass was incorporated into the lining of the storage pit, it is likely that the bristlegrass and paspalum grass seeds are not reflective of diet but were incorporated instead because of these of these grasses in feature construction. Finally, one other plant taxa, saltbush (*Atriplex* spp.), may not have been used as a food resource in the region but was included in features for non-dietary reasons.

Within the Trans-Pecos region there are four native taxa of saltbush: tubercled saltbush (*Atriplex acanthocarpa*), obovate leaf saltbush (*Atriplex obovata*), spiny saltbush (*Atriplex confertifolia*), and four-wing saltbush (*Atriplex canescens*) (Powell 1998). Three of these (obovateleaf saltbush, spiny saltbush, and four-wing saltbush) are used primarily as flavorings for a variety of dishes or as greens (Moerman 2010). Of those present in the Trans-Pecos, spiny saltbush and four-wing saltbush are the only two whose seeds have been ethnographically documented as food sources (Chamberlin 1911; Moerman 2010). Obovate leaf saltbush was used as a spice and for greens (Colton 1974; Whiting 1939), while tubercled saltbush has no known dietary use (Moerman 2010). Spiny saltbush only occurs in the very far western portion of the region and obovate leaf saltbush is present only in the southwestern portion of the study area, making the identification of the saltbush seeds at 41PC502 as most likely four-wing saltbush, which is found throughout the Trans-Pecos (Powell 1998). Because the seeds of four-wing saltbush seeds are rarely consumed but used as a spice among the Ramah Navajo (Vestal 1952), and saltbush was a fuel or kindling source at 41PC502 (Antiquities Planning and Consulting 2002), it is more likely that the seeds reflect their incorporation in fuel/kindling or use as a spice used in cooking rather than as a food source.

Four-wing saltbush seeds are also present at Tres Metates Rockshelter in a plant-lined storage pit (Seebach 2007). However, as stated above, this taxon is a rarely used food source. Seebach (2007:26) did indicate that wooden sticks were included in the storage pit's structure but identification of these materials was not presented in the report. Therefore, if any of these wooden elements are from four-wing saltbush, which is present in the site catchment, there is a high likelihood that these seeds were originally from the structural elements rather than a stored food source.

Of the taxa which are not observed in the archeological samples, the vast majority are taxa utilized for fruit and starchy foods. While it is possible to recover starch residue from archeological contexts (e.g., Messner 2011; Perry and Quigg 2011), and I have attempted to obtain sources of this proxy, none have been published for the Late Prehistoric Era in the Eastern Trans-Pecos archeological region. Fruit and starchy foodstuffs are also the least likely to be preserved in the archeological record (Pearsall 2010). Unfortunately, the fruit foods were key to the warm season diet among the Mescalero Apache (Basehart 1960; Castetter and Opler 1936), and it can only be assumed that these were vital to Late Prehistoric peoples as well.

An overarching issue with this analysis are the incomplete ESD System historic climax plant community descriptions. At this time, 13 of the 34 plant communities within the reconstructed foraging radii are missing. This is most likely the reason some of the plant taxa found in the archeological samples are missing in the ecological proxy. However, with continued completion of these plant community descriptions, specifically those in the vastly important riparian areas, an even better understanding of prehistorically available native plant species can be developed. Regardless, this study demonstrates that the ESD System can be used for archeological landscape use studies as the majority of botanical taxa (80.2 percent) documented in the archeological samples are present in current plant community descriptions. Additionally, despite the incomplete ESD System for the study area, the results indicate that many more plant taxa would have been available to prehistoric hunter-gatherers than the archeological record indicates. However, future studies focusing on microbotanical remains, specifically starch grains and phytoliths, are needed to confirm this.

Finally, findings of this study support a hypothesis proposed by Seebach (2007) that La Junta District forager-farmers traveled away from villages to procure foodstuffs. Seebach (2007:44-45) stated that individuals utilized Tres Metates Rockshelter as a location for procuring and storing locally available foods. The 15 km reconstructed foraging radius for this archeological site has the most ecological variability of all four radii in both number of known botanical taxa, number of ecological sites, and heterogeneity of taxa across the site catchment (see Table 2). This variability is a potential reason why forager-farmers utilized this archeological site in addition to the food storage and preservation capabilities of the rockshelter.

CONCLUSIONS

The native botanical component of diet between the Historic Mescalero Apache and the Late Prehistoric inhabitants of the eastern Trans-Pecos is quite similar when comparing recovered plant remains to ethnographic information. A cursory examination of these data indicate that the Late Prehistoric native plant diet was much more restricted than the Mescalero Apache wild land botanical diet. However, plant parts with low preservation values (i.e., fruits, leaves, flowers, and flower stalks) account for 57 percent of plant species utilized as wild land foods in this group (Castetter and Opler 1936). Despite being of vital importance, these plant parts are highly unlikely to be encountered in the archeological record. By utilizing proxies solely derived from the archeological record, paleoethnobotanists would be greatly amiss in assessing hunter-gatherer paleonutrition. Results of this study also indicate native plant diet for Late Prehistoric era peoples was probably much more diverse than the archeological record indicates and that some form of dietary acculturation occurred during the absorption of incipient groups by the Mescalero Apache. However, four staples (prickly pear, mesquite, yucca, and agave) dominated native botanical foods for these Late Prehistoric Era peoples.

The utility of ESD historic climax plant community descriptions is also demonstrated to be of value in archeological analysis despite their incomplete status. Unfortunately, users of this spatial data system can only wait until the involved entities complete their reporting, but in the interim a similar analysis should be conducted in areas where the ESD System has been completed to further test the use of the system. Regardless, by utilizing a proxy that is more descriptive and more frequently used than others (e.g., Texas Parks and Wildlife Department Vegetation Types or U.S. Environmental Protection Agency Ecoregions as suggested by Arnn [2012]) for current landscape management, it is possible for multiple scientific fields to converge and expand the utility and accuracy of these plant community descriptions.

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REFERENCES CITED

Antiquities Planning and Consulting

2002 *Sustainable Subsistence: Archeological Survey and Data Recovery at the Indian Wind Mesa Turbine Farm near Bakersfield in Northeast Pecos County, Texas*. Kyle, Texas.

Arnn, J. W.

2012 *Land of the Texas: Native American Identity and Interaction in Texas, A.D. 1300-1700.* University of Texas Press, Austin.

Basehart, H. W.

1960 *Mescalero Apache Subsistence Patterns and Socio-Political Organization: Section I. A Report of the Mescalero-Chiricahua Land Claims Project*. Contract Research #290-154. The University of New Mexico, Albuquerque.

Beisner, B. E., D. T. Haydon, and K. Cuddington

2003 Alternative stable states in ecology. *Frontiers in Ecology and the Environment* 1(7):376-382.

Bryant, V. M.

2006 Pollen Analysis of Archaeological Sediments from the Paradise Site: Appendix II. In *The Paradise Site: A Middle Archaic Campsite on the O2 Ranch, Presidio County, Texas*, by A. J. Ohl, pp. 149-170. Papers of the Trans-Pecos Archaeological Program, No. 2. Center for Big Bend Studies, Sul Ross State University, Alpine.

Castetter, E. F. and M. E. Opler

1936 *Ethnobiological Studies in the American Southwest: The Ethnobiology of the Chiricahua and Mescalero Apache, A: The Use of Plants for Foods, Beverages and Narcotics*. Bulletin 297. University of New Mexico, Albuquerque.

Chamberlin, R. V.

1911 *The Ethnobotany of the Gosuite Indians of Utah*. Memoirs of the American Anthropological Association 2(5):331-405.

Cloud, W. A.

2004 *The Arroyo de la Presa Site: A Stratified Late Prehistoric Campsite Along the Rio Grande, Presidio County, Texas*. Reports in Contract Archeology 9. Center for Big Bend Studies, Alpine, Texas and Texas Department of Transportation, Austin.

Cloud, W. A. and J. C. Piehl
2008 *The Millington Site: Archaeological and Human Osteological Investigations.* Papers of the Trans-Pecos Archaeological Program 4. Center for Big Bend Studies, Sul Ross State University, Alpine.

Collins, M. B.
2004 Archeology in Central Texas. In *The Prehistory of Texas*, edited by T. K. Perttula, pp. 101-127. Texas A&M University Press, College Station.

Colton, H. S.
1974 Hopi History and Ethnobotany. In *Hopi Indians*, edited by D. A. Horr, pp. 279-373. Garland Publishing, New York.

Davis, O. K.
1989 The Regionalization of Climatic Change in Western North America. In *Paleoclimatology and Paleometeorology: Modern and Past Patterns of Global Atmospheric Transport*, edited by M. Leinen and M. Sarnthein, pp. 617-636. Kluwer Academic, Amsterdam.

Dering, J. P.
2004 Plant Remains from the Arroyo de la Presa Site (41PS800), Presidio County, Trans-Pecos Texas: Appendix III. In *The Arroyo de la Presa Site: A Stratified Late Prehistoric Campsite Along the Rio Grande, Presidio County, Texas*, by W. A. Cloud, pp. 201-210. Reports in Contract Archeology 9. Center for Big Bend Studies, Alpine, Texas, and Texas Department of Transportation, Austin.

Elias, S. A. and T. R. Van Devender
1992 Insect Fossil Evidence of Late Quaternary Environments in the Northern Chihuahuan Desert of Texas and New Mexico: Comparisons with the Paleobotanical Record. *The Southwestern Naturalist* 37(2):101-116.

Hamilton, D. L.
2001 *Prehistory of the Rustler Hills, Granado Cave.* University of Texas Press, Austin.

Hatch, S. L., K. N. Gandhi, and L. E. Brown
1990 *Checklist of the Vascular Plants of Texas*. Texas Agricultural Experiment Station, Texas A&M University System, College Station.

Hickerson, N. P.
1994 *Jumanos: Hunters and Traders of the South Plains*. University of Texas Press, Austin.

Holling, C. S.
1973 Resilience and stability of ecological systems. *Annual Review of Ecological Systems* 4:1-24.

Hoyt, C. A.
2000 Grassland to Desert: Holocene Vegetation and Climate Change in the Northern Chihuahuan Desert. Ph.D. dissertation, Department of Anthropology, The University of Texas at Austin.

Johnson, L.
1994 *The Life and Times of Toyah-Culture Folk: The Buckhollow Encampment, Site 41KM16, Kimble County, Texas*. Office of the State Archeologist, Report 38. Texas Department of Transportation and Texas Historical Commission, Austin.

Kelley, J. C.
1957 The Livermore Focus: A Clarification. *El Palacio* 64(1-2):44-52.

1986 *Jumano and Patarabueye: Relations at La Junta de los Rios*. Anthropological Papers 77. Museum of Anthropology, University of Michigan, Ann Arbor.

Kelley, J. C., T. N. Campbell, and D. L. Lehmer
1940 The Association of Archaeological Materials with Geological Deposits in the Big Bend Region of Texas. *Sul Ross State Teachers College Bulletin* 21(3):1-173.

Kelly, R. J.
1995 *The Foraging Spectrum*. Smithsonian Institution Press, Washington, D.C.

Kenmotsu, N. A.
1994 Helping Each Other Out: A Study of the Mutualistic Relations of Small Scale Foragers and Cultivators in the La Junta de los Rios Region. Ph.D. dissertation, Department of Anthropology, University of Texas at Austin.

2013 Pottery at La Junta: One View of Regional Interaction Along the Rio Grande. *Bulletin of the Texas Archeological Society* 84:5-29.

Kenmotsu, N. A. and J. W. Arnn
2012 The Toyah Phase and the Ethnohistorical Record: A Case for Population Aggregation. In *The Toyah Phase of Central Texas: Late Prehistoric Economic and Social Processes*, edited by N. A. Kenmotsu and D. K. Boyd, pp. 19-44. Texas A&M University Press, College Station.

Kenmotsu, N. A. and M. F. Wade
2002 *American Indian Tribal Affiliation Study, Phase I: Ethnohistoric Literature Review.* Archeological Studies Program, Report No. 34. Texas Department of Transportation, Austin, and National Park Service, Amistad National Recreation Area, Del Rio.

Kim, M. J., S. J. Lee, Y. Ahn, P. Bowen, and H. Lee
2007 Dietary Acculturation and Diet Quality of Hypertensive Korean Americans. *Journal of Advanced Nursing* 58(5):436-445.

Law, R. and R. D. Morton.
1993 Alternative permanent states of ecological communities. *Ecology* 74:1347-1361.

Mallouf, R. J.
1985 A Synthesis of Eastern Trans-Pecos Prehistory. Master's thesis, Department of Anthropology, The University of Texas at Austin.

1999 Comments on the Prehistory of Far Northeastern Chihuahua, the La Junta District and the Cielo Complex. *Journal of Big Bend Studies* 11:49-92.

2009 The John Z. and Exa Means Cache, New Discovery Yields Insights into Big Bend's Prehistoric Indians. *La Vista de la Frontera* 20:1-3.

2012 Some New and Revised Projectile Point Classifications for the Eastern Trans-Pecos and Big Bend Regions of Texas. *La Tierra: Journal of the Southern Texas Archeological Association* 39:5-22

2013 New and Revised Projectile Point Classifications for the Eastern Trans-Pecos and Big Bend Regions of Texas. In *Archaeological Explorations of the Eastern Trans-Pecos and Big Bend: Collected Papers, Volume 1*, edited by P. Dasch and R. J. Mallouf, pp. 191-214. Papers in the Trans-Pecos Archaeological Program, No. 6. Center for Big Bend Studies, Sul Ross University, Alpine.

McGarigal, K., S. A. Cushman, and E. Ene
2013 FRAGSTATS Help Manual. In *FRAGSTATS v4: Spatial Pattern Analysis Program for Categorical and Continuous Maps*. Computer software program produced by the authors at the University of Massachusetts, Amherst.

Messner, T. C.
2011 *Acorns and Bitter Roots: Starch Grain Research in the Prehistoric Eastern Woodlands*. The University of Alabama Press, Tuscaloosa.

Miller, M. R. and N. A. Kenmotsu
2004 Prehistory of the Jornada Mogollon and Eastern Trans-Pecos Regions of West Texas. In *The Prehistory of Texas*, edited by T. K. Perttula, pp. 205-266. Texas A&M University Press, College Station.

Moerman, D. E.
2010 *Native American Food Plants: An Ethnobotanical Dictionary*. Timber Press, Portland.

O'Neill, R.V., J. R. Krummel, R. H. Gardner, G. Sugihara, B. Jackson, D. L. DeAngelis, B. T. Milne, M. G. Turner, B. Zygmunt, S. W. Christensen, V. H. Dale, and R. L. Graham
1988 Indices of Landscape Pattern. *Landscape Ecology* 1(3):153-162.

Pearsall, D. M.
2010 *Paleoethnobotany: A Handbook of Procedures*. Second Edition. Left Coast Press, Walnut Creek.

Perry, L. and J. M. Quigg
2011 Starch Remains and Stone Boiling in the Texas Panhandle Part 1: The Pipeline Site. *Plains Anthropologist* 56:95-107.

Perttula, T. K.
2004 An Introduction to Prehistoric Texas Archaeology. In *The Prehistory of Texas*, edited by T. K. Perttula, pp. 5-15. Texas A&M University Press, College Station.

Poulos, H. M.
2007 Top down and bottom up influences on fire regimes, diversity, and vegetation patterns in the Chihuahuan Desert Borderlands. Ph.D. Dissertation, School of Forestry and Environmental Studies, Yale University, New Haven.

Powell, A. M.
1994 *Grasses of the Trans-Pecos and Adjacent Areas.* University of Texas Press, Austin.

1998 *Trees and Shrubs of the Trans-Pecos and Adjacent Areas*. University of Texas Press, Austin.

Pronatura Noreste, The Nature Conservancy, and World Wildlife Fund
2004 *Ecoregional Conservation Assessment of the Chihuahuan Desert*. Second Edition. PDF file retrieved from: http://www.conservationgateway.org/ConservationPlanning/SettingPriorities/EcoregionalReports/Pages/EastData.aspx.

Regev-Tobias, H., R. Reifen, R. Endevelt, O. Havkin, E. Cohen, G. Stern, and A. Stark
2012 Dietary Acculturation and Increasing Rates of Obesity in Ethiopian Woman Living in Israel. *Nutrition* 28(1):30-34.

Satia-Abouta, J.
2003 Dietary Acculturation: Definition, Process, Assessment, and Implications. *International Journal of Human Ecology* 4(1):71-86.

Seebach, J. D.
2007 *Late Prehistory Along the Rimrock, Pinto Canyon Ranch.* Papers of the Trans-Pecos Archaeological Program, Number 3. Center for Big Bend Studies, Sul Ross State University, Alpine.

Seymour, D. J.
2004 A Ranchería in the Gran Apachería: Evidence of Intercultural Interaction at the Cerro Rojo Site. *Plains Anthropologist* 49:153-192.

2012 Gateways for Athabascan Migration to the American Southwest. *Plains Anthropologist* 57(222):149-161.

Shannon, C. E. and W. Weaver
1949 *The Mathematical Theory of Communication*. University of Illinois Press, Urbana.

Turner, E. S., T. R. Hester, and R. L. McReynolds
2011 *The Stone Artifacts of Texas Indians*. Taylor Trade Publishing, Lanham.

Turpin, S. A.
2004 The Lower Pecos River Region of Texas and Northern Mexico. In *The Prehistory of Texas*, edited by T. K. Perttula, pp. 266-283. Texas A&M University Press, College Station.

USDA-NRCS
2007 Ecological Sites and Forage Suitability Groups. In *National Range and Pasture Handbook*. Grazing Lands Technology Institute, Fort Worth, Texas.

2012 *About NRCS.* http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/about/. Accessed March 20, 2013.

2013 The PLANTS Database. http://plants.usda.gov. Accessed March 20, 2013

USDA-NRCS, U.S. Department of the Interior, and U.S. Forest Service
2013 *Interagency Ecological Site Handbook for Rangelands.* http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=33943.wba. Accessed June 24, 2013.

Van Devender, T. R.
1990 Late Quaternary Vegetation and Climate of the Chihuahuan Desert, United States and Mexico. In *Packrat Middens: The Last 40,000 Years of Biotic Change*, edited by J. L. Betancourt, T. R. Van Devender, and P. S. Martin, pp. 104-133. University of Arizona Press, Tucson.

Vesta, P. A. and R. E. Schultes
1939 *The Economic Botany of the Kiowa Indians*. Botanical Museum of Harvard University, Cambridge.

Warnock, B. J.
2010 A Brief History of Fire in the Trans-Pecos Region of Texas. In *Proceedings: Trans-Pecos Prescribed Fire Symposium 2010*, edited by K. A. Cearley, pp. 23-27. Texas AgriLife Extension Service, College Station.

Wells, P. V.
1966 Late Pleistocene Vegetation and Degree of Pluvial Climatic Change in the Chihuahuan Desert. *Science* 153: 970-975.

Whiting, A. F.
1939 *Ethnobotany of the Hopi*. Bulletin No. 15. Museum of Northern Arizona, Flagstaff.

Wilcox, D. R.
1981 The Entry of the Athabaskan into the American Southwest: The Problem Today. In *The Protohistoric Period in the American Southwest, A.D. 1450-1700*, edited by D. R. Wilcox and W. B. Masse, pp. 213-256. Anthropological Research Papers No. 24. Arizona State University, Tempe.

POST OF LAMPASAS: FORGOTTEN RECONSTRUCTION ERA U.S. ARMY POST (1867-1870)

Richard S. Jones

ABSTRACT

While it is well known that troops were stationed in and around Lampasas during the Reconstruction era (1865-1877), the existence of an army post in Lampasas County, Texas, has been rediscovered through the recent digitization of army post returns. The post returns, available through the U.S. National Archives and Records Administration and Ancestry.com, indicated that the post operated between 1867 and 1870. These post returns are utilized to highlight significant events that occurred in this area during the Reconstruction era. Circumstantial evidence obtained while conducting this research has identified the actual location of the post within the City of Lampasas.

INTRODUCTION

A letter from W. B. Pace, Chief Justice of Lampasas County and four citizens to Texas Senators Burney and Cooley, dated August 15, 1866, stated that:

> This is one more to the long list of depredations that have been committed on the frontier within the past fifteen months, and which are now of almost daily occurrence. It is not our wish to exaggerate the reality is bad enough. It will be observed that these depredations are now extended to Cattle, and not confined, mostly, as heretofore, to horses…This shows the audacity of the parties, and the impunity with which they expect to carry on their robberies. This country used to count its horses by the thousands, now scarcely a hundred can be mustered, and still the work goes on, each moon, diminishes the number of stock and settlers and unless a remedy is applied, and that immediately, the Frontier will and must be abandoned… Can the Government be ignorant of our situation? We think not, will it continue to be deaf to the call of justice and humanity? We trust not. Then why delay, when the lives and property of its citizens are in danger? Is there any interest of more vital importance, or that requires more immediate action? (Jackson, McCaleb, Mullins, Pace, and Townsend 1866).

From this letter, it is evident that the citizens of Lampasas were living in fear; one must ask whether or not the U.S. Government answered the call for aid. Until my recent analysis of post returns, it was believed that very little, if any, aid was provided by the U.S. Government during this

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time. Until recently it was thought that the aid provided by the government consisted only of setting up a temporary encampment that was sometimes used by a cavalry detail (Clardy et al. 1991; O'Neal 2012). This article delves into the violent background of the Lampasas area around the mid-nineteenth century and provides evidence that proves the U.S. Government did indeed answer the call for help from the citizens of Lampasas by establishing U.S. Army Post Lampasas.

HISTORY OF VIOLENCE

The chaotic and violent nature of the Reconstruction period in Texas has its roots both in U.S. Government Indian policies as well as the greatest conflict this Nation has ever faced, the Civil War, which strained the very fabric of the Nation and had an adverse impact on almost every man, women, and child that lived in this country at the time. From the Civil War extending into the Reconstruction period, areas surrounding Lampasas County, including Hamilton, Coryell, and Bell counties, were under constant threat of attack from Comanches and numerous outlaw gangs, as well as the threat of mob violence primarily conducted by groups like the Ku Klux Klan (KKK) that were very active in this region by 1868 (Howell 2012).

Comanches

The Comanche were by far the most populous Indian tribe in Texas with around 20,000 members reported in 1849 to 1851, according to population estimates by Indian agent Robert Simpson Neighbors and ethnologist Frederick Webb Hodge (Kavanagh 1996). Their territory during the late eighteenth to early nineteenth centuries included a vast expanse of land including northeastern New Mexico, southeastern Colorado, western Oklahoma, the Texas panhandle, and the Central Texas Hill Country (Gelo 2013). In the nineteenth century, the Comanches were comprised of six bands/divisions: Kotsotecka (Buffalo Eaters), Yamprika (Root Eaters), Kwahadi (Antelope), Nokoni (Wanderers), Penateka (Honey Eaters, Wasps), and Tenewa (Downstream People) (Gelo 2013). The area around Lampasas and adjacent areas were within the range of the Penateka band/division (Richardson 1933). Muguara was the Peneteka division leader until his death in 1840, after which Buffalo Hump, Ketumse, Sanaco, and Yellow Wolf filled the breach (Gelo 2013). Raids against Anglo-Americans increased after 1840 when the Comanches formed an alliance with the Kiowa and Cheyenne to stop the Anglo-American western expansion. This effort was largely successful during this time and towns such as Lampasas were under the constant threat of attack. O'Neal (2012:15) summarizes the conditions in the Lampasas area:

> From 1857 to 1874, usually in the spring and summer, Comanches raided at will in Lampasas County. The raiders stole large numbers of horses, often at night under a "Comanche Moon," and sometimes murdered and mutilated unwary settlers. This long Comanche menace retarded population growth, forced many settlers to leave for a safer county, and filled others who stayed with a nagging fear. The Lampasas Dispatch reported that in 1871, "the population of the county was about fifteen hundred, and they lived in constant dread of the murdering savages of the plains."

News reports at the time reflect similar sentiments. For example, the *Southern Intelligencer* (SI) reported in March 1866 that an Indian raid occurred where "a large number of horses, the number being variously estimated at from two to four or five hundred" were taken; locals lamented that: "[w]e are now waiting to hear of help from some quarter. If the government knew our conditions, they undoubtedly would lend a helping hand. The marauders took nearly all the horses in the town of Lampasas" (*SI*, March 1, 1866).

In Texas, the homeland of the Comanches was not secured by the U.S. Government until after the Civil War when several treaties were made and reservation set up within Texas and later in western Oklahoma. However, resistance by Comanches to reservation settlement continued until their unsuccessful attack on the Adobe Walls trading post, after which they were forced back onto the reservation in a concerted campaign by the U.S. Army between 1874-1875 (Gelo 2013).

Outlaw Gangs

During the Civil War, the region was a safe haven to numerous outlaw gangs comprised of confederate and union deserters, profiteering horse/cow thieves, and outcast union civilian sympathizers (Cooper 1863; McCulloch 1864). These gangs were generally attracted to areas surrounding Cowhouse Creek and the Lampasas River because of several factors: (1) the region's remote location on the frontier; (2) virtually no law enforcement presence; (3) dense concentrations of cedar thickets that provided highly defensible positions; and (4) support from some in the local populace who backed Sam Houston and his belief in not seceding from the Union.

Two of the main gangs that were active in Hamilton, Lampasas, Coryell, and Bell counties were led by Elisha (or Lige) Bevins and Samuel S. Gholson, both of whom were confederate deserters. According to reports, the two gangs had around 100 to 300 men that roamed the area stealing at will and threatening the local populace (Cooper 1863). Confederate Major John Henry Brown in a July 1863 letter to Major General Magruder believed them to be an armed Union guerrilla force that was in secret consultation with noted Union sympathizer George Washington Pashal (Brown 1863). Major Brown also stated that he had information from spies that had infiltrated the gangs that they were actively plotting executions and attempting to stockpile weapons from Mexico for some unknown purpose (Brown 1863). In response to this letter, General Magruder sent Company B, 37 Texas Calvary led by Captain George Cooper to the area for a temporary assignment in August 1863. While the gangs still avoided capture, Captain Cooper and his men were successful in temporarily lowering tensions in the area. As their assignment came to an end the citizens of Bell County, fearing a return to gang violence, petitioned General Magruder to allow Captain Cooper to stay until the gangs were dealt with (Petition from Citizens of Bell County 1863).

Of note, one of the modus operandi of these gangs was to dress up in Indian garb in order to fool victims and settlers into believing Indians were responsible. One story reported in the *Weekly Telegraph* (WT) in November 1863 stated: "One Thomas Fulgum and others have been arrested in Coryell County, having in their possession an abundance of Indian arrows, moccasins, and other Indian disguises, by the aid of which they had been playing Indian on the frontier, stealing, shooting stock, etc. They were in communication with men who had deserted and concealed themselves in the woods. One Augustus (Gus) Fore was associated with the same gang of deserters" (WT*,* November 17, 1863). Gus Fore was a known member of the Lige Bevins gang (Brown 1863). Another story reported in the *Georgetown Watchman* (GW) in June 1869 reported that "[w]e are informed by Mr. D. T. Guinn, just down from Lampasas Springs, that the late Indian depredations reported in the county are erroneous. That there have been depredations committed is true, but the depredators are white men" (GW, June 5, 1869).

The Bevins and Gholson gangs that roamed the area were eventually routed and defeated by a combined force led by Captain George Cooper from Company B, 37 Texas Cavalry, a civilian volunteer mob led by Belton resident Dred Hill, and a squad of men from Company B, 30 Texas Cavalry. This campaign lasted over five months (August to December 1863) and ended when Lige Bevins was captured and hung with several comrades while Gholson and remaining stragglers fled toward Mexico before getting stopped by Confederate Forces near Eagle Pass (Brown 1863; *Frontier Times* [FT], July 1926; *WT*, December 1, 1863; Williams 1930-1934). Following the Civil War, Gholson was known as one of the best cattle men and frontiersman of his day, having established his own cattle ranch in Coleman County before moving to New Mexico where he was reported to have teamed up with legendary ex-Texas Ranger Ira Aten, range boss of the vast XIT Ranch (*Dallas Herald [DH],* May 25, 1872; FT, February 1927 and July 1928; Gillett 1921:9-10; *Intelligencer-Echo [IE]*, November 4, 1874; Stevens 1975; Williams 1930-1934).

Of further interest, the possible association of gangs in the region with Union forces first suspected by Major John Henry Brown in 1863 is corroborated in a May 20, 1864, letter from Captain William Pace, who commanded the Confederate Second District State Troops in Lampasas. In this letter Captain Pace noted:

> Sir: William E. Willis and Gideon Willis came into this county about ten days ago from Mexico, for the purpose, as they say, of recruiting for the Federal Army, and taking a list of all would be Union men. They have recruited until their forces are said to be about 100 strong. They pass over the country in small parties with perfect impunity, and threaten destruction of property of secessionists. In view of these outrages and the fatal results of a longer stay in the country by them, we beseech you to come immediately to our relief (McCulloch 1864).

Major General McCullouch, Commander Northern Sub-District, forwarded Captain Pace's letter to Brig. General J. E. Slaughter, Chief of Staff, on May 30, 1864 with the accompanying statement:

> General: I herewith transmit a letter from Captain Pace to Lieutenant Colonel Jackson, which will call your attention to the condition of affairs on our border. Lampasas is in the edge of a rough mountainous region, which extends to the Concho country, and I have no doubt a large portion of the deserters and disloyal men who are embodied are in that region of country, and if it were to clean out all that country, commencing on Cowhouse Creek and Lampasas, Pecan bayou, Colorado, Concho, and notify me of the time, so that I could co-operate with them from above that place. I do not know that any force can be spared

> from below, but this section is far from me, out of my district, and needs immediate attention, if it is possible to give it, and I feel that it is my duty to so inform the general commanding (McCulloch 1864).

When the Civil War ended, many of these deserters and criminals ended up settling in this region, with some becoming honorable citizens while others continued their criminal lifestyle. Notable outlaws that were active in the area during the Reconstruction period included: John Wesley Hardin, the James Gang, Sam Hasley, John Early, William Perryman, the McRae Gang, Ace Langford, King Fisher, Bat Masterson, the Horrell brothers, and the Shackelford Gang, to name a few (For a complete history of outlaw violence in the Lampasas area the reader is referred to O'Neal [2012].)

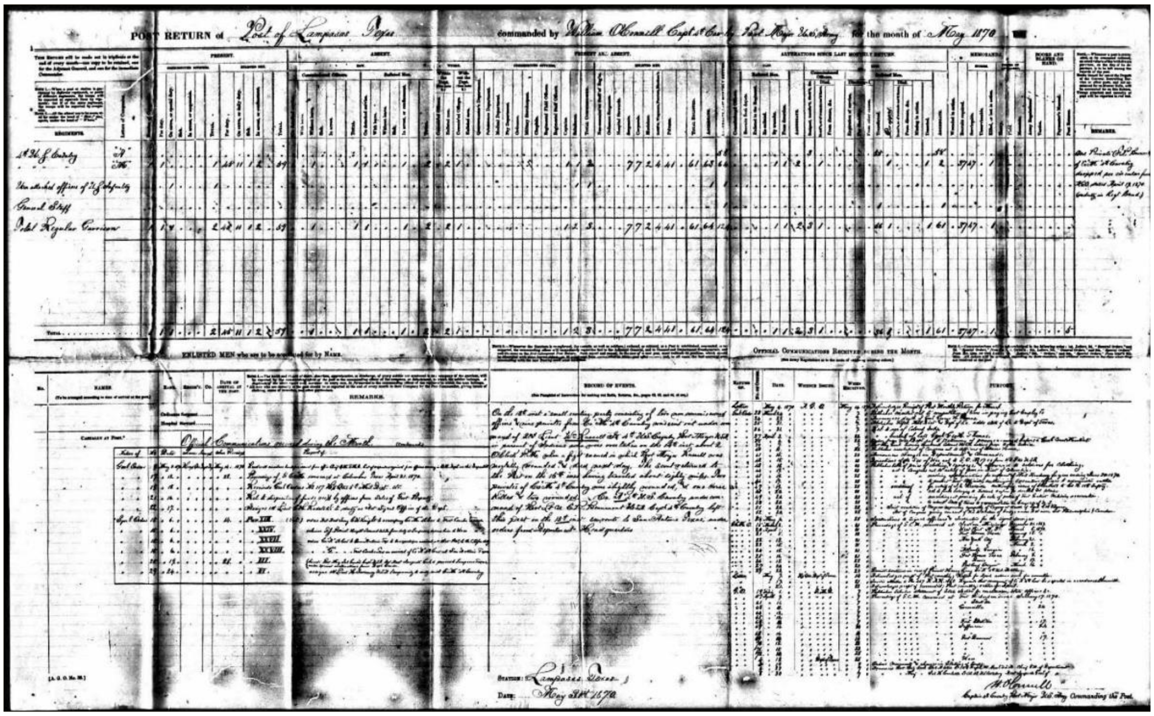
Mob Violence

In addition to threat of attack from Indians and outlaws, the citizens of Texas during the Reconstruction period also had to deal with the specter of organized mob violence. During this period Texas was home to more than 60 organized groups that went by various names, including the KKK, the Knights of the White Camellia, the Teutonic Knights, the Sons of Washington, the White Brotherhood, and the Knights of the Rising Sun. All these groups were generally comprised of ex-confederate Anglo-Americans that were committed to perpetuating violence against minorities, freedman, and the occupying Union forces. In particular, the newly established Freedman's Bureau locations and employees were a favorite target of these groups (Howell 2012). Violence and lynching's from these type mobs in Texas persisted throughout the Reconstruction period and into the mid-twentieth century in many local communities.

POST LAMPASAS

Based on the information presented above, it is clear the settlers in the Lampasas area lived in a constant state of fear every day of their lives for almost a quarter of a century (1853-1875). During the early Reconstruction period, the violence was so severe that citizens including W. B. Pace, Chief Justice of Lampasas, pleaded to the U.S. Government for help. From recently digitized post returns, it is now known that on May 30, 1867, the U.S. Government finally came to the aid of the citizens of Lampasas by establishing a post within the city that was permanently occupied by a company of soldiers from the 26th Infantry, and later 4th Calvary, from 1867 to 1870. From detailed entries within these post returns it is now known that the soldiers of Post Lampasas were tasked to protect the local populace from attacks from both Comanches and outlaw gangs. They were sent on multiple scouts to make their presence known on the frontier and to also search and destroy any hostile parties encountered, with some U.S. soldiers even losing their lives while performing these duties.

A substantial amount of historical information regarding the activities and duties of soldiers stationed at Post Lampasas can be gleaned directly from the post returns that the U.S. Army required every post commander to fill out every month (Figure 1). These post returns are a valuable and often underutilized primary resource that show monthly summaries of events, deaths, wounded in action, desertions, units present, numbers of soldiers and officers present/absent/sick, numbers of horses and


POST RETURN of Post of Lampasas Texas commanded by William O'Connell Capt 8 Cavly ... for the month of May 1870

Station: Lampasas Texas
Date: May 31st 1870

Figure 1. Post of Lampasas post return dated May 1870 (National Archives and Records Administration, Washington, D.C.)

artillery, and official communications (see Appendix 1). These post returns have recently been digitized and are available for viewing at the U.S. National Archives and the website Ancestry.com.

Prior to my analysis of post returns from Post Lampasas, recent publications (Clardy et al. 1991; O'Neal 2012:25) described troops stationed at Lampasas as never occupying more than a temporary encampment:

> But none of the reopened or new forts were near Lampasas, and Comanches continued to raid throughout the county. So a cavalry detail sometimes was assigned to Lampasas, camping in the grove at Hancock Springs. There were no permanent buildings, so this little outpost was not designated "fort" or even "camp."

In this article, the analysis of post returns has filled the void regarding what was previously known about this post, and these post returns clearly indicate that the U.S. Government did indeed answer the citizens of Lampasas' call for help and established a post that was permanently occupied by U.S. Army troops from 1867-1870. In addition, the post returns designate this location as an actual U.S. Army post called "Post Lampasas." It is evident that the post was not just a temporary encampment that was intermittently utilized by a cavalry sensu O'Neal (2012).

UNITS, OFFICERS, AND EVENTS

The following sections contain a summary and discussion of the units that were stationed at the post, notable officers, and significant events. All of this information can be found within the post returns that were submitted by the commanders of Post Lampasas between 1867 to 1870 (Appendix 1).

Units

Based on information contained in the post returns, Figure 2 represents the overall number of soldiers stationed at Post Lampasas during this three year period.

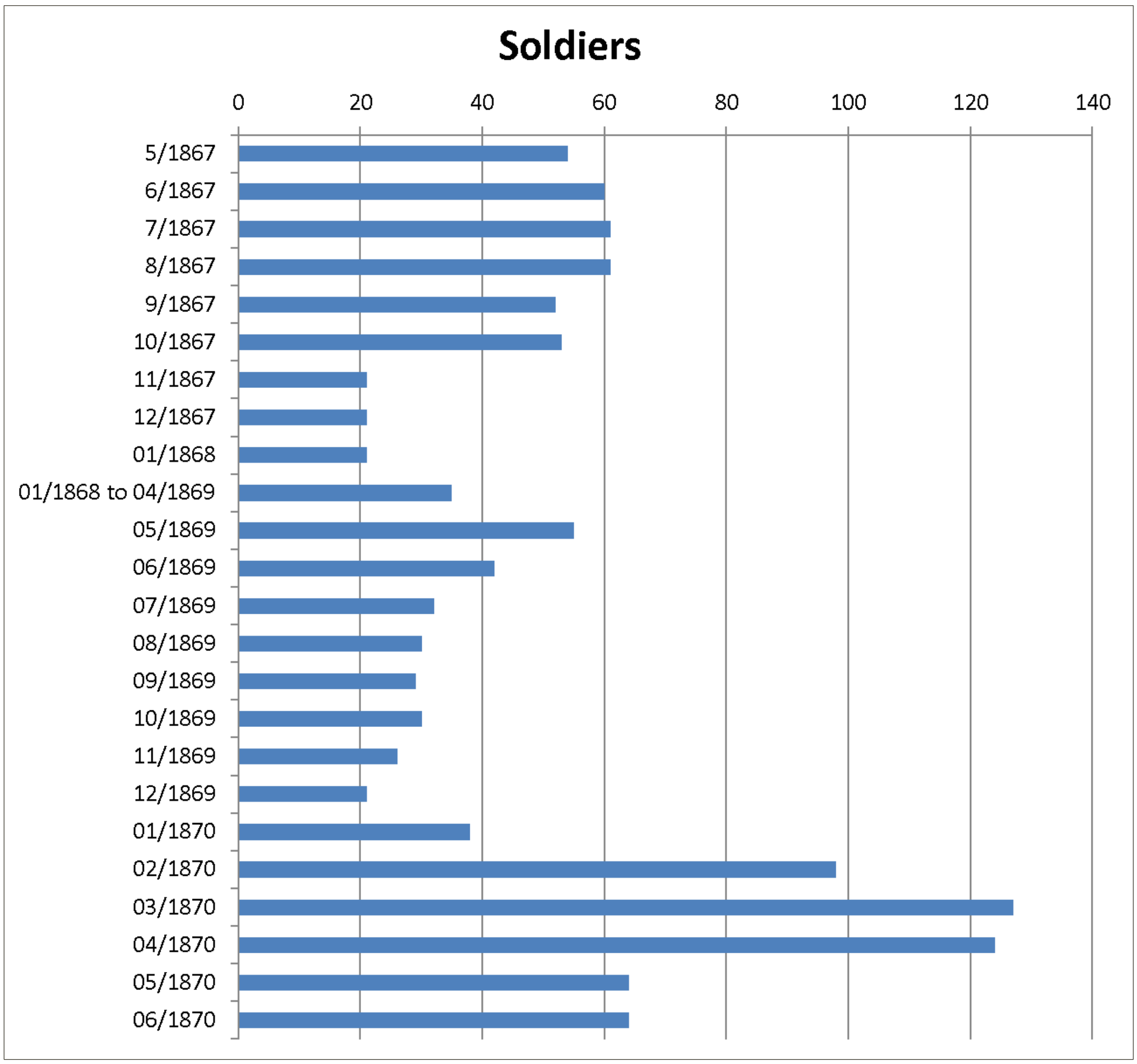


Figure 2. Number of soldiers stationed at Post Lampasas (From U.S. post returns 1867-1870).

May 1867 to January 1868: 26th Infantry, Company K

The 26th was a company out of Austin that was the first stationed at Post Lampasas. The 26th Infantry was moved to the Rio Grande valley in January 1868.

January 1868 to March 1869: 17th Infantry, 2nd Battalion

Post returns for the 17th and 35th Companies while stationed at the post either were not completed, were lost, or were not turned in by the post commanders. It has been documented that the 17th Infantry, 2nd Battalion was stationed in Austin to assist in frontier defense. According to Richter (1987:180), elements from the 35th Infantry were sent in March 1869 to relieve elements of the 17th Infantry in frontier garrisons within Texas. The mention of 35th Infantry troops on the post returns in May 1869 suggests that there were troops from the 17th Infantry stationed at this garrison before the arrival of the 35th.

March 1869 to May 1869: The 35th Infantry, Company H

This company likely relieved elements of the 17th around March 1869 (Richter 1987). Proof for the presence of 35th Infantry, Company H is found in the May 1869 post return completed by the 4th Cavalry post commander and also in the May 8, 1869 *Georgetown Watchmen* newspaper article that mentioned the post was commanded by 35th Infantry, Company H 1st Lieutenant Thomas Stevens. The Post Lampasas commissioned officer roster also listed 1st Lieutenant Stevens as present during May 1869.

May 1869 to June 1870: 4th Cavalry, Companies A and M

These companies were sent out of Austin and, thereafter, were stationed at the post. The 4th Cavalry, Company A under Captain Beaumont was sent to San Antonio in April 1870. Company M under the command of Captain William O'Connell closed the post in June 1870 and was then sent to Fort Concho.

Notable Officers

Eugene Beauharnais Beaumont (August 2, 1837-July 17, 1916).

Eugene Beaumont was a graduate of the United States Military Academy at West Point in 1861, ranking 32nd out of 45 cadets. He was a Union Army officer in the Civil War (Figure 3) and a recipient of the United States Military's highest decoration, the Medal of Honor. His Medal of Honor Citation reads, in part:

> Obtained permission from the corps commander to advance upon the enemy's position with the 4th U.S. Cavalry, of which he was a lieutenant; led an attack upon a battery, dispersed the enemy, and captured the guns. At Selma, Ala., charged, at the head of his regiment, into the second and last line of the enemy's works. After Civil War served with 4th Cavalry on numerous Texas posts including: Camp Sheridan, Fredericksburg, Ft. Mason, Ft. Chadborn, Ft. McKavett; Lampasas, San Antonio, Ft. Richardson, and Ft. Clark (Cullum 1920:802).

Figure 3. Eugene Beaumont, Civil War portrait. Photo courtesy of: www.homeofheroes.com.

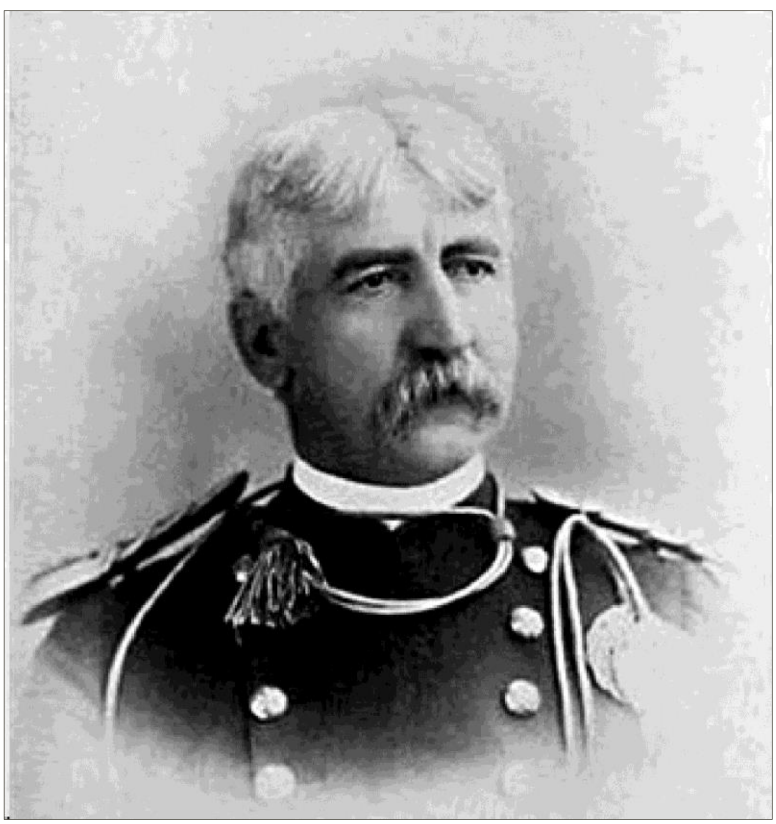


Figure 4. Eugene Beaumont, later service photo. Photo courtesy of: www.Findagrave.com.

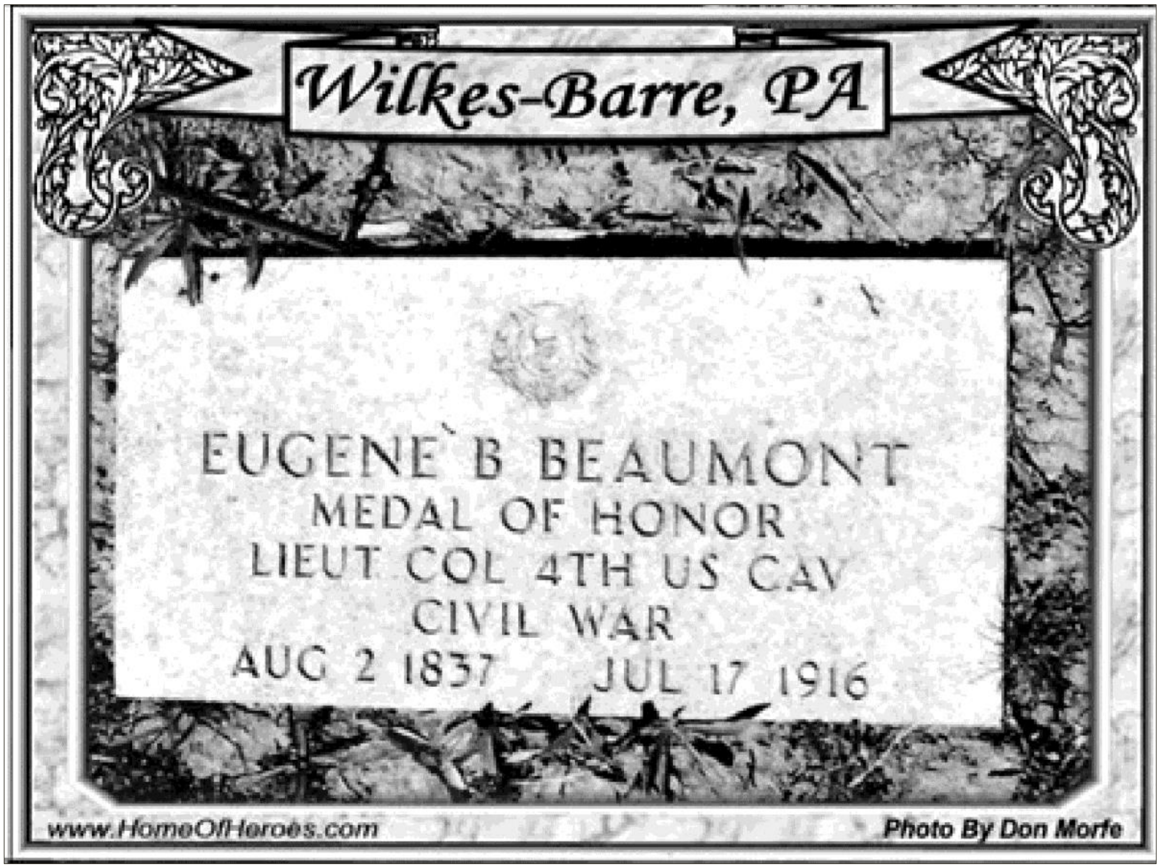


Figure 5. Eugene Beaumont headstone in Hollenback Cemetery, Wilkes-Barre, Pennsylvania. Photo courtesy of www.homeofheroes.com.

At Fort Clark, Beaumont was engaged in the attack on the Kickapoo and Lipan villages in Mexico on May 18, 1873. At Fort McKavett, he led an expedition into Indian Territory from August 18th to December 29, 1874. Beaumont commanded a battalion of 4th Cavalry troops in the fight at Palo Duro Canyon on September 28, 1874, which resulted in the destruction of numerous camps and the capture of 1700 horses and mules, and the defeat of a band of Comanches (Carter 1935:25). Beaumont also served as Assistant Instructor of Cavalry Tactics at the Military Academy from March 1, 1875, to August 28, 1879. He retired on May 6, 1892, as a Lieutenant Colonel (Figure 4). Beaumont died at the age of 78 in Harvey's Lake, Pennsylvania. He was buried in Hollenback Cemetery in his hometown of Wilkes-Barre, Pennsylvania (Figure 5).

William O'Connell (date unknown)

William O'Connell was born in Ireland and served as an enlisted man in the Dragoon Detachment at the U.S. Military Academy. In April 1855, he transferred to the 1st U. S. Cavalry. O'Connell was promoted to First Sergeant in June 1855. He served at Fort Leavenworth in 1857 and participated in the Cheyenne and Utah expeditions of 1857 and 1858. He also served at Fort Riley, Fort Smith, Indian Territory, and Fort Arbuckle. In 1860, he engaged in the Kiowa and Comanche Indian expedition and later participated in the Battle of Wilson's Creek, Missouri.

In October 1861, he was promoted to Second Lieutenant in the 4th U.S Cavalry and attained First Lieutenant in 1862. O'Connell served with the Army of the Potomac in Maryland and Virginia in 1863 and the Army of the Cumberland in 1863. He commanded a regiment in Alabama and Georgia from March to May 1865, and was transferred to Texas in 1866; he was promoted to Captain in 1869. O' Connell was awarded Brevet Captain for gallant and meritorious services in action at Middleton, Tennessee, and Brevet Major for gallant and meritorious services at the capture of Selma, Alabama. He was stationed at Post of Lampasas, Texas, in 1870 and later transferred to Fort Concho (Henry 1873:160). Captain O'Connell was described as one of the best old Irish soldiers in the U.S. Army (Carter 1935:35). He died in 1895 and was interred in the San Francisco National Cemetery, California.

Significant Events

May 1867 to January 1868: Post Established

Post Lampasas was established May 30, 1867, per Special Order No. 50. The 26th Infantry, Company K was then stationed at the post. A skirmish with citizens occurred at 10 p.m. on June 17 in which 2nd Lieutenant Roe and 16 men participated. 1st Sergeant George C. Lyon and Private Track were wounded. Private Henry Pearson died June 4, 1867 of typhoid fever. Private Pearson is likely still buried at the post. Private Daniel Jones, Company L 6th U.S. Calvary, died at the post on September 17, 1867, from wounds received while in discharge of duty on August 17, 1867, near Lampasas, Texas. Private Jones is likely also still buried at the post. The incident is recorded in the *Georgetown Watchman*, which describes the shooting of Mr. Jackson, a local merchant, "and probably the death of a soldier" killed by "three men, who were armed each with a double-barreled gun and two six-shooters. They had just before driven away the inmates of a house in the suburbs of the town [Lampasas] and robbed it. They resisted, and a running fight ensued, in which Mr. Jackson was shot dead, and one of the soldiers shot through the lungs"(GW, August 24, 1867). The post was evacuated per Special Order No. 228 HQ District of Texas, Austin, Texas, on December 28, 1867. The 26th Infantry, Company K then left Post Lampasas.

January 1868 to May 1869: Lost Post Returns

The 35th Infantry, Company H left this Post May 17, 1869. Complete Post returns for the 17th and 35th Infantry units, which would show events during the period from January 1868 to May 1869, were either not completed by the commander or were lost.

May 1869 to June 1870: Scouting Parties and Post Closure

The garrison had been employed in furnishing escorts and scouting parties to the Sheriff and other civil authorities during this time period. Each of these is listed in further detail below:

- Unsuccessful pursuit (May 25th, 1869): 2nd Lieutenant James H. Jones 4th Cavalry left on May 22 with six men and a non-commissioned officer in an unsuccessful pursuit of J. W. Nash (or J. McNash), an absconding Deputy Colonel of a Reserve unit from Burleson County.

- First scout (June 17, 1869): a detailed 10 day route of scout consisting of 26 enlisted men and one officer is provided under Record of Events. The scout covered 200 miles and traversed west to the San Saba area, north to the abandoned Civil War Confederate Camp Colorado (south of Brownwood), northeast across Pecan Bayou, south to San Saba, and then returned to Post Lampasas. No Indian signs were discovered.

- Second scout (June 28, 1869): approximately 20 men left the post in an unsuccessful pursuit of Indians that were reported to have attacked herders and driven off 100 horses 10 miles from the post. The distance traveled was 200 miles.

- Third scout (March 14, 1870): Captain E. B. Beaumont, 2nd Lieutenant James H. Jones, and 25 enlisted men left the post on a scout for Indians. The detachment proceeded to Antelope Gap, Lampasas County, a distance of 25 miles and there encamped. Five Indians with more were seen but the soldiers did not camp for want of a competent guide with the detachment. The scout returned to the post on March 19, 1870, for want of forage after marching a distance of 85 miles.

- Fourth scout (April 13, 1870): 2nd Lieutenant James H. Jones, 4th U.S. Cavalry, with a detachment of 25 enlisted men left the post to watch the mountain passes at Antelope Gap, Lampasas County, with the intent of intercepting bands of hostile Indians. The detachment was out 10 days and returned for want of forage. No Indians were seen or heard during the distance marched, over 90 miles.

- Fifth scout (May 18, 1870): A small scouting party consisting of two non-commissioned officers and nine privates from Company M, 4th Cavalry, was sent out under command of 2nd Lieutenant (Brevet Major) William Russell (Figure 6) in pursuit of Indians. The Indians were overtaken at Mount Adam, Lampasas, Texas, on May 14, 1870, at about 2 p.m. and in the ensuing skirmish 2nd Lieutenant Russell was mortally wounded. The scout returned to the post on May 15, having traveled about 80 miles. Two privates of Company M, 4th Cavalry, were slightly wounded, one horse was killed, and two horses were wounded.

Second Lieutenant Russell died at midnight, May 15th, in the line of duty. The surgeon's report indicated "the ball from a Remington revolver, entered just beneath the tenth rib of the right side, at about four inches from the vertebral column" and that "a citizen extracted the ball by incision some two hours before the writer arrived upon the spot. There had been extensive hemorrhage" (Otis 1871:51). The surgeon decided an autopsy would be impractical but suggested the ball likely penetrated Russell's liver, and the immediate causes of death seem to have been the shock of the injury and the hemorrhage (Otis 1871:51). Second Lieutenant Russell was initially buried at Post Lampasas but was moved two years later and interred at Albany Rural Cemetery, Albany, New York. This incident was covered by numerous Texas newspapers such as the *Belton Weekly Journal*, which reported the particulars of this sad event:

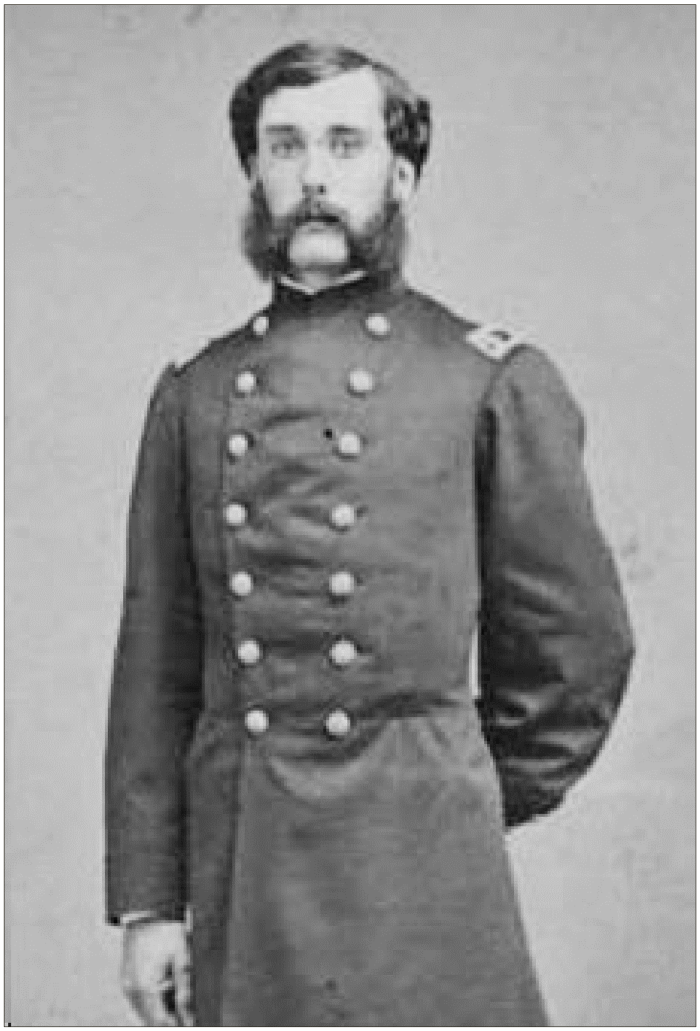


Figure 6. 2nd Lt. (Brevet Major) William Russell Jr. Photo courtesy of New York State Military Museum.

> After the charge, the Major seeing the unequal position, ordered 'dismount and retreat in front of horses' which gave evidence of discretion and coolness; but most unfortunately as he was in the act of alighting he received a mortal wound which took effect in the region of the liver. The Commander being thus cut down so early in the action, of course, gave rise to more or less confusion; consequently the fighting ceased and the Indians in a manner were the victors. However, the general impression of those who were present is, that had not the gallant Major been so unfortunate at the particular crisis he would have whipped them and recaptured all the stolen property (*The Belton Weekly Journal*, May 28, 1870).

DISCUSSION

Post Lampasas was established by the U.S. Army at the request of citizens of Lampasas County for the purpose of providing frontier protection to residents who suffered continual attacks from both Comanches and outlaw gangs. Despite being undermanned at times, the troops stationed there did an exemplary job performing their mission during the three years (1867-1870) the post was active.

The analysis of the post returns was a key factor in providing a clear understanding of this Reconstruction era post on the frontier that has never been fully researched and studied by historians. The post returns revealed that Post Lampasas was anything but a temporary encampment that was sporadically utilized as a campsite with no permanent buildings (cf. O'Neal 2012:25). On the contrary, the post returns suggest this installation was in fact a well-established U.S. Army Post that was permanently occupied between 1867 to 1870 by hundreds of soldiers from two infantry and two cavalry companies. Post returns revealed that these troops were active building stables and other infrastructure. This likely indicates that Post Lampasas would have had a number of permanent wooden structures (with rock fireplaces) used to house troops during the approximately three years of occupation.

While the exact location of Post Lampasas was never mentioned in the post returns, I was able to ascertain its location by assembling strong circumstantial evidence uncovered in newspaper reports and the Post Return Officer Roster. The key to confirming the location was found in a newspaper article in the *Georgetown Watchman*. The newspaper article states "Col. Stevens is in command here with two companies Infantry and one of Cavalry. They have a beautiful camp around the oaks at the upper springs" (GW, 8 May 1869). This Colonel Stevens is in all likelihood 1st Lieutenant (Brevet Captain) Thomas Stevens, who commanded Company H, 35th Infantry while the unit was stationed at Post Lampasas and left May 17, 1869, just nine days after this newspaper article was released. Also, this article mentions that the post is located around the oaks of the Upper Springs. The name Upper Springs is another key in locating the post.

Historian Bill O'Neal (2012:3) writes that in Lampasas "…to the southwest, in a magnificent grove of shade trees, was a bubbling spring with the greatest flow in the area. Because of the location it was often called the Upper Springs; because of its bubbling action (not its brisk, cool temperature) it was sometimes known as the Great Boiling Spring; it also occasionally was called Rock Springs. But within a few years it would become Hancock Springs, after settler John Hancock acquired the property." Accordingly, Upper Springs is most likely one and the same as Hancock Springs, and the presence of 1st Lieutenant Stevens mentioned above confirms that Post Lampasas is at this location. Since the post was abandoned in 1870, the current area around Hancock Springs (Figure 7) has been significantly altered with a golf course, roads, buildings, and parking lots covering much of the area. However, it cannot be ruled out that remains of the original Post Lampasas including such features as building foundations, piles of rock from toppled chimneys, activity areas, and other features remain hidden in the ground waiting to be discovered through archeological investigations.

The analysis of post returns has led to the discovery and reporting of the existence of this previously unknown Reconstruction era U.S. Army post. It is hoped that by demonstrating the importance of these documents, more historians and scholars will utilize this primary source material that has been digitized and is now easily accessible. When combined with traditional secondary source materials, researchers studying historic U.S. Army garrisons should arrive at a more accurate understanding of what was actually taking place at these historically significant sites, clearing a path for future research.

Figure 7. Current map of Hancock springs area, Lampasas County, 2013.

REFERENCES CITED

Belton Weekly Journal (BWJ)

1870 Fatal Rencontre With Indians. May 28, 1870, Volume 4, No. 23. Belton, Texas.

Brown, Major J. H.

1863 Letter from Major Brown to Major General Magruder, dated July 23, 1863. Location: Waco, Texas. Muster Records from Compiled Service Records of Confederate General and Staff Officers, and Non-regimental Enlisted Men.

Carter, R. G.

1935 *On the Border with Mackenzie: or Winning West Texas from the Comanches*. Enyon Printing Co., Washington D.C.

Clardy, J. J. Jackson, R. Wright, V. Wright, R. McMillin, W Prugh, D. Henry, C. Price, R. Gadbury, and C. Nash

1991 *Lampasas County, Texas: Its History and its People*. Walsworth Publishing, Marceline, Missouri.

Cooper, Captain G. W.

1863 Letter from Captain Cooper (37th Texas Cavalry) to Colonel Terrell dated September 2, 1863. Location: Camp near Belton, Bell County, Texas. Muster Record from Compiled Service Records of Confederate General and Staff Officers, and Non-regimental Enlisted Men.

Cullum, G. W.

1920 *Biographical Register of the Officers and Graduates of the U.S. Military Academy at West Point, N.Y.* 3rd edition. Seeman & Peters Printers, Saginaw, Michigan.

Dallas Herald

1872 The Indian Raid into Coleman County. May 25, 1872, Volume 19, No. 37. Dallas, Texas.

Frontier Times (FT)

1926 Lige Bevins and Gang Exterminated. July 1926, Volume 3, No. 10, p. 10. Bandera, Texas.

1927 From Curley Hatcher. February 1927, Volume 4, No. 5, p. 8. Bandera, Texas.

1928 From S. P. Elkins. July 1928, Volume 5, No. 10, p. 407. Bandera, Texas.

Gelo, D. J.

2013 *Ethnohistorical and Ethnographic Assessment of Comanche Activity in the Fort Hood Area.* Archeological Resource Management Series, Research Report Number 63. United States Army Fort Hood, Fort Hood, Texas.

Georgetown Watchman (GW)

1867 Reported Shooting at Lampasas. August 24, 1867, Volume 1, No. 34. Georgetown, Texas.

1869 From Lampasas. May 8, 1869, Volume 3, No. 10. Georgetown, Texas.

1869 Lampasas. June 5, 1869, Volume 3, No. 14. Georgetown, Texas.

Gillett, J. B.

1976 *Six Years with the Texas Rangers: 1875-1881.* University of Nebraska Press, Lincoln and London. First published in 1921.

Henry, G. V.
1873 *Military Record of Army and Civilian Appointments in the United States Army, Vol. II*. D. Van Nostrand Publisher, New York.

Howell, K. W.
2012 *Still the Arena of Civil War: Violence and Turmoil in Reconstruction Texas 1865-1874.* University of North Texas Press, Denton.

Intelligencer-Echo (IE)
1874 Texas Items. November 4, 1874, Volume 1, No. 3. Austin, Texas.

Jackson, T. C., N. W. McCaleb, I. Mullins, W. B. Pace, and R. Townsend
1866 Letter From Lampasas Citizens to Senators Burney and Cooley. In *The Indian Papers of Texas and the Southwest, 1825-1916*, edited by D. H. Winfrey and J. M. Day, pp. 103-104. Texas State Historical Association, Austin.

Kavanagh, T. W.
1996 *Comanche Political History*. University of Nebraska Press, Lincoln.

McCulloch, Major General H. E.
1864 Letter from Major General McCulloch to Brigadier General J. E. Slaughter, Chief of Staff, dated May 30, 1864. Location: Headquarters Northern Sub-District of Texas, Bonham.

O'Neal, B.
2012 *Lampasas 1855-1895: Biography of a Frontier Texas Town*. Eakin Press, Waco, Texas.

Otis, G. A.
1871 *A Report of Surgical Cases Treated in the Army of the United States from 1865 to 1871.* Circular No. 3. War Department Surgeon General's Office, Washington D.C., August 17, 1871. Government Printing Office, Washington, D.C.

Petition from Citizens of Bell County
1863 Letter From Citizens of Bell County to Major General J. Bankhead Magruder dated September 7, 1863. In *United States, Civil War Confederate Papers of Citizens or Businesses, 1861-1865*. National Archives Microfilm Publication, M346, Roll 0479, Number 111.

Richardson, R. N.
1933 *The Comanche Barrier to South Plains Settlement.* Arthur H. Clark Company, Glendale, California.

Richter, W. L.
1987 *The Army in Texas During the Reconstruction: 1865-1870.* Texas A&M University Press, College Station, Texas.

Smith, T. T.
2000 *The Old Army in Texas: A Research Guide to the U.S. Army in Nineteenth Century Texas.* Texas State Historical Association, Austin.

The Southern Intelligencer (SI)
1866 Indian Raid. March 15, 1866, Volume 1, No. 37. Austin, Texas.

1866 Higgledy-Piggledy. May 3, 1866, Volume 1, No. 44. Austin, Texas.

Stevens, R. W.
1975 *Texas Ranger Indian War Pensions*. Nortex Press, Quanah, Texas.

The Weekly Telegraph Newspaper (WT)
1863 Letter from Bonham. November 17, 1863, Volume 29, No. 34. Houston, Texas.

1863 Condensed Correspondence. December 1, 1863, Volume 29, No. 36. Houston.

Williams, F. C.
1930-1934 *Glimpses from the Past: Hamilton County History. As recorded by Mr. Williams in Interviews from 1930-1934.* Electronic document, http://freepages.genealogy.rootsweb.ancestry.com/~gazetteer2000/ williams/williams.htm, accessed January 1, 2014.

APPENDIX 1.
SELECTED TRANSCRIBED ENTRIES FROM POST RETURNS

Date	Unit	Commander	Enlisted	Officers	Deaths	Record of events
May 1867	26th Infantry, Co K	2 Lieut Charles F. Roe	54	1	-	Post established May 30, 1867 per Special Order No. 50.
June 1867	26th Infantry, Co K	2 Lieut Charles F. Roe	53	1	Pvt Henry Pearson, June 4, Typhoid fever	A skirmish with citizens occurred at 10PM on June 17, in which 2nd Lieut Roe and 16 men participated. 1st Sgt George C Lyon and Pvt Track (sp?) wounded. The post was reinforced with one Sgt and 6 men of the 6th Cav on 21 June.
	6th Cavalry, Detachment		7	-	-	-
July 1867	26th Infantry, Co K	2nd Lieut Charles Roe (end July 6, 1867)	53	1	-	Capt and Bvt Lt. Col. AW Evans assumed command at Post in compliance with Special Order No. 81 Hqs Post of Austin June 29, 1867. Absent to Austin, Texas in attendance upon general court martial. Private Lance McCormick apprehended from desertion June 29, 1867 near Fort Columbus. Private Bryant apprehended from desertion July 13, 1867 near Lampasas, Texas. Private Cahill discharged by Surgeons Certificate of Disability June 27, 1867 Austin, Texas.
	6th Cavalry, Detachment	Capt., Bvt. Lt Col Andrew W Evans (started July 29, 1867)	7	1	-	-
Aug 1867	26th Infantry, Co K		53	-	-	Private Lance McCormick taken up from desertion on last post return is dropped from this one it having been ascertained that he did not belong to the 26th infantry. Private B Jones, B Thompson Co B and Co L 6th US Calvary returned to duty with their Companies at Austin. 2nd Lieut JA Richardson 26th Infantry in charge of detachment 6 Calvary in pursuit of fugitive from justice, arrived August 31, 1867.
	6th Cavalry, Co L	Capt, Bvt Lt Col Andrew W Evans	8	1	-	-

Date	Unit	Commander	Enlisted	Officers	Deaths	Record of events
Sept 1867	26th Infantry, Co K	2 Lieut Charles F Roe	52	1	-	Capt., Bvt Lt Col. Evans relinquished command of Post in compliance with orders from ? Office, Sept 6th 1867. Private Daniel Jones Co L 6th US Calvary died at the Post Sept 17 1867 from wounds received while in discharge of duty, August 17, 1867 near Lampasas, Texas. Sgt Daniel Walker and Pvt Rice L Co 6th Calvary and Private Goderin B Co 6th Cav returned to duty with their Companies at Austin, Texas.
	6th Cavalry, Detachment	-	-	-	Pvt Daniel Jones, Sept 17, from wounds received Aug 17, 1867	-
Oct 1867	26th Infantry, Co K	2 Lieut Charles F Roe	53	1	-	Capt William H McLaughlin assigned to Co. K by SO No. 101 HQ 26th Infantry Oct 14, 1867. Absent sick at York, Penn since Oct 1867.
Nov 1867	26th Infantry, Co K	2 Lieut Charles F Roe	21	1	-	Garrison reduced to one officer and twenty men by SO No. 212. HQ Dist of Texas. November 25, 1867 ordering 20 Co. K 26th Inf to Austin, Texas.
Dec 1867	26th Infantry, Co K	2 Lieut Charles F Roe	21	1	-	-
Jan 1868	26th Infantry, Co K	2 Lieut Charles F Roe	21	1	-	Post Evacuated per SO No. 228 HQ District of Tx, Austin, Texas. Dec 28, 1867.
Jan 1868-Apr 1869	36th Infantry, Co H	1 Lieut, Bvt Capt. Thomas Stevens	35	2	?	May 1869 Post Returns indicate 36th Inf was at post Before 4th Cav took over on May 17, 1869. Garrison personnel numbered 33 enlisted and 2 officers. Post Returns for 36th Inf are missing or were possibly not submitted/done by unit.

Date	Unit	Commander	Enlisted	Officers	Deaths	Record of events
May 1869	4th Cavalry, Co A	Capt. EB Beaumont	55	2	-	Co. H 36th Infantry left this Post May 17, 1869. 1st Lt J Murphy US 4th Cav assumed command same date and was relieved by Bvt Lt. COL, Capt. EB Beaumont May 19 1869. The Garrison has been employed in furnishing escorts to the Sheriff and other civil authorities during the month. Lt JH Jones 4th Cav left May 22 with 6 men and NCO in pursuit of JW Nash (? or J McNash) an absconding Deputy Col. of Res (?) from Burleson Co dated May 25th. Unsuccessful.
June 1869	4th Cavalry, Co A	Capt. EB Beaumont	42	5	-	Detachment of Company from US 4th Cav Consisting of Eighteen enlisted men under Command of Company Commander (Beaumont) and eight enlisted men of Co. B and A US 4th Cav Commanded by 1 Lieut Robert Warren USA Left Post of Lampasas Texas June 17th to Scout for Indians. The detachment marched westward (?) the San Saba was five miles above the town. Approaching 78:W crossed Richland Creek 18 miles from San Saba town. Moving north crossed the Colorado a mile above the mouth of Deep Creek (?). Marched to Camp Colorado (a mile above the mouth of D). Arrived at that deserted (???) Post June 21. Left Camp Colorado June 22nd marching north by east crossed Pecan Bayou 6 1/2 from Camp Colorado. Marched 8 (3?) miles from Bayou. Turned south along the mountain through wooded and broken country (or Brown County?) towards Walkers Pass from thence south East passing San Saba to Post of Lampasas. arriving at that place June 27, 1869. Distance marched 203 miles no fresh Indian signs discovered. Water, wood, and grass (?) abundant at all camps. June 28th detachment of B (?) Co 15 enlisted men B and H (?) ? Men under Lt Robert Warren Co H (?) accompanied by 2Lt James H Jones Cmd 4th Cav and (?) Surgeon JH Lunning left Post of Lampasas in pursuit of Indians reported to have attacked herders and driven off one hundred horses ten miles from post. This party has not yet returned.

Date	Unit	Commander	Enlisted	Officers	Deaths	Record of events
July 1869	4th Cavalry, Co A	Capt. EB Beaumont	32	4	-	Detachment under Lt Warren returned to Post July 3 1869 after an unsuccessful scout Distance traveled 200 miles. The garrison has been so weak that it has been simply been doing Camp duty. Taking care of Public animals and property furnishing occasionally from one to three men to escort to civil offices and trains.
Aug 1869	4th Cavalry, Co A	Capt. EB Beaumont	30	5	-	The garrison has been employed in furnishing scouts and details to the Sheriff and other court authorities during the past month.
Sept 1869	4th Cavalry, Co A	Capt. EB Beaumont	29	5	-	The garrison has been so weak that it has simply been doing Camp duty taking care of public animals and property. Furnishing occasionally from one to two men as escort to civil offices and trains.
Oct 1869	4th Cavalry, Co A	Capt. EB Beaumont	30	6	-	The garrison has been so weak that it has simply been employed in guarding the public property and occasionally furnishing two or three men for escorts to offices employed or civil business.
Nov 1869	4th Cavalry, Co A	Capt. EB Beaumont	26	6	-	Nothing worthy of interest transpired. The company performed the usual Post duty.
Dec 1869	4th Cavalry, Co A	Capt. EB Beaumont	21	6	-	The garrison has been employed in the usual duties performed at the Post. Has furnished small escorts of one and two men to officers on public duty.
Jan 1870	4th Cavalry, Co A	Capt. EB Beaumont	38	6	-	The garrison has been employed in the usual post duties and has furnished small details to assist civil officers in the performance of their duties.
Feb 1870	4th Cavalry, Co's A, M	Capt. EB Beaumont (Co A); Capt. William O'Connell (Co M)	98	9	-	Company M 4th Cav reinforced this Post Feb 1 1870 Cpt Bvt Major William O'Connell commanding. The troops at this post have been engaged in building stables and furnishing small escorts to trains and civil offices. M Co 4th Cav joined this post Feb 1 1870 per SO No. 4 HQ military District dated Austin Texas Jan 6 1870 from Post of Austin Texas. Total strength shown on line of "Total Regular Garrison" under head of Gain since last monthly return.

Date	Unit	Commander	Enlisted	Officers	Deaths	Record of events
?	4th Cavalry, Co's A, M	Capt. EB Beaumont (Co A); Capt. William O'Connell (Co M)	98	9	-	Company M US 4th Cav reinforced this post Feb 1870. Capt and Bvt Maj William O'Connell commanding. The troops at this post have been engaged in building stables and furnishing small escorts to trains and civil officers.
Mar 1870	4th Cavalry, Co's A, M	Capt. EB Beaumont (Co A); Capt. William O'Connell (Co M)	127	8	-	Bvt Lt Col EB Beaumont Capt 4th Cav and 2Lt James H Jones 4th US Cav and 25 enlisted left this post March 14 1870 on a scout for Indians. The Detachment proceeded to Antelope Gap distance 25 miles and there encamped five Indians more seen but camped for want of a competent guide with the detachment. The scout returned to the post March 19 1870 for want of forage after marching a distance of 85 miles. The troops of this command have been instructed during the past month in mounted drill and target practice.
Apr 1870	4th Cavalry, Co's A, M	Capt. EB Beaumont (Co A); Capt. William O'Connell (Co M)	124	8	-	A detachment of 14 enlisted men escorted Maj Ferrell Paymaster USA from this post to the post of Waco Texas, leaving here April 4th and returning April 12 1870. 2LT James H Jones 4th US Cav with a detachment of 25 enlisted men left this post April 13 1870 to watch the mountain passes at Antelope Gaps, Lampasas County, Texas, with the view of intercepting bands of hostile Indians. The detachment was out 10 days and returned for want of forage. No Indians were seen or heard of the distance marched over 90 miles. The Troops at this post have been instructed during the past month in target practice and dismounted drill.

Date	Unit	Commander	Enlisted	Officers	Deaths	Record of events
May 1870	4th Cavalry, Co M	Capt. William O'Connell	64	4	2 LT Bvt Major William Russell died May 15 as a result of gunshot wound received May 14 in encounter with Indians	On the 18th May a small scouting party consisting of two NCOs and nine privates from Co M 4th Cav was sent out under command of 2LT William Russell 4th US Cav in pursuit of Indians who were overtaken on May 14th about 2 PM when a fight ensued in which 2LT Russell was mortally wounded and died the next day. The scout returned to the post on the 15th May having traveled about 80 miles. 2 privates of Co M 4th Cav were slightly wounded and one horse killed and 2 wounded. Co. A 4th Cav under command of Capt EB Beaumont left this post on the 15th May en route to San Antonio Texas under orders from Dept of HQ.
June 1870	4th Cavalry, Co M	Capt. William O'Connell	64	3	-	Post evacuated on the June 16, 1870. Capt. William O'Connell Post of Lampasas, Texas to proceed to Fort Concho, Texas with his command.

EVIDENCE FOR A LONG-DISTANCE TRADE IN BOIS D'ARC BOWS IN 16TH CENTURY TEXAS (*MACLURA POMIFERA*, MORACEAE)

Leslie L. Bush

ABSTRACT

A piece of wood charcoal identified as bois d'arc (*Maclura pomifera*) was recovered from the Janee site (41MN33) in Menard County, Texas. The specimen has been directly dated to 400 ± 30 B.P., a period when no naturally-occurring bois d'arc stands are believed to have been present within 400 miles of the site. Bois d'arc ecology, economic uses of bois d'arc wood, and historical accounts of bois d'arc trade indicate the specimen is best interpreted as part of a trade item related to Caddo bow-making traditions in Northeast Texas and adjacent areas of other states.

INTRODUCTION

A single fragment of bois d'arc wood charcoal was recovered from Feature 2-B at the Janee site (41MN33) on the Edwards Plateau of Central Texas (Figure 1). A direct date on the specimen produced a measured radiocarbon age of 400 ± 30 B.P. with a 13C/12C ratio of -25.1‰, resulting in a conventional radiocarbon age of 400 ± 30 B.P. and 2 sigma calibrated age ranges of A.D. 1440 to 1520 and A.D. 1590 to 1620 (Beta-305763). The Janee site lies on terrace 3-4 m above the San Saba River near Menard, Texas, far outside what is typically cited as the range of bois d'arc trees during that period. The feature in which the bois d'arc was found belongs to a thick (25 cm) buried Toyah phase component with well-defined activity areas (Arnn 2007:393). The feature represents the remnant of a large burned rock feature, most of which was destroyed in the backhoe trench (BHT 5) that revealed the cultural deposits (Arnn 2007:396). The site is interpreted as a "broad spectrum hunter-gatherer residential base" (Arnn 2007:403). This article discusses the probable origin and use of the bois d'arc specimen in light of the evolutionary ecology of bois d'arc and historic accounts of its use and trade in the North American midcontinent.

BIOLOGY AND ECOLOGY OF BOIS D'ARC

The tree known botanically as *Maclura pomifera* has many common names, including bois d'arc, bodark, bowwood, Osage-orange, yellowwood, hedge-apple, horse-apple, monkey balls, and Indiana brains. It is a small deciduous tree with wind-pollinated male and female flowers produced on separate individuals, which can be completely separate trees or separate stems within a single stand of

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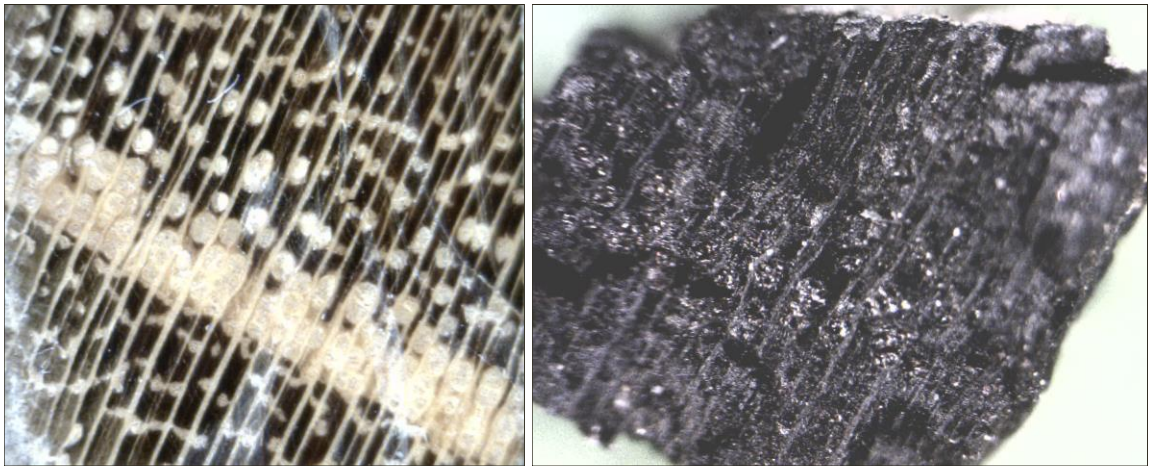


Figure 1. Modern bois d'arc wood (*Maclura pomifera*) (left) and Sample C-2 wood charcoal from the Janee site (right) in transverse section. Bands of earlywood (medium-large pores filled with tyloses) run from upper left to lower right across each image. Rays run orthogonally, from upper right to lower left. Photographed at 58 X.

trees (Bonner 2008) (Figure 2). Bois d'arc fruits are large (8-15 cm diameter) syncarps, aggregate fruits composed of single-seeded drupelets (Figure 3). Each fruit can thus have several male and female seeds, making it possible for a single fruit to generate a fertile stand of trees (Burton 1990; Carey 1994; Coder 1999; Smith and Perino 1981; Starr et al. 2003). Sterile fruits are also possible, however, when a female tree is not fertilized. The coarse fruits contain latex, which renders them unpleasantly sticky to most people. Bois d'arc fruits require contact with bare soil for germination and sunlight. The growing plants require direct sunlight, and sources agree that even mature bois d'arc is shade intolerant (Carey 1994; Smith and Perino 1981). Hence, it is not a tree of climax forests (Burton 1990; Smith and Perino 1981:30) Bois d'arc prefers deep bottomland soils such as those associated with forest edges or stream channels, but its taproot helps it tolerate a wide variety of situations as long as the requirements for bare soil and light are met (Elias 1980:257). Bois d'arc branches typically have thorns, although thornless cultivars exist today (Coder 1999). The branches are often curved or crooked (Coder 1999; Smith and Perino 1981:28), but the tree sprouts after cutting (coppice growth), typically providing straight wood under those circumstances (Carey 1994; Coder 1999; Starr et al. 2003). Bois d'arc wood is dense, with a specific gravity of 0.81 at 12 percent moisture (Hoadley 1990:Table 5.1). The wood is deep orange in color and highly resistant to decay thanks to the antifungal agents in the wood (Hoadley 1990; Smith and Perino 1981:34). Bois d'arc wood has extremely high strength and toughness under bending pressure. At 261 kilojoules per cubic meter (kJ/m^3), the work-to-maximum load value for bois d'arc is the highest of any wood for which the USDA Forest Service provides data (Table 1), making it particularly suitable for use in bow making (Hamilton 1982).

BOIS D'ARC AS AN ECONOMIC PLANT

Since its discovery by Euro-Americans in the early 19th century, bois d'arc trees have been commonly used as hedge plants. Their tough, durable wood has been in demand for fence posts, railway ties, and wooden wheels (Smith and Perino 1981; Westbrook 1973). Bois d'arc wood and root bark make yellow dye (Smith and Perino 1981). The coarse, sticky fruits are not considered edible by

Figure 2. Bois d'arc tree (*Maclura pomifera*) near FM 1626 in Travis County, Texas. June 11, 2014.

humans, but they are not toxic to horses and cattle (Smith and Perino 1981:33-34). Proteolytic enzymes are found in the fruits, which makes them valuable in processes such as cheese-making and tenderizing meat that involve breaking down proteins into peptides or amino acids (Smith and Perino 1981:33). The fruits are widely considered to repel cockroaches (Ball 2000; Peattie 2007; Smith and Perino 1981; Turner 2009).

Bois d'arc's principal use among Native Americans gives the plant its common name. "Wood of the bow" was so named by the French explorers, soldiers, and trappers who were the first European inhabitants of the region where bois d'arc grew. Nineteenth century observers indicate that bois d'arc bows were highly prized on the American plains (Moerman 1998), and many authorities consider bois d'arc one of the two best bow woods in the world (Schambach 1995:11). In 1810, John Bradbury

Figure 3. Bois d'arc fruit (*Maclura pomifera*) at Clear Creek Natural Heritage Center, Denton, Texas.

reported that the cost of a bow made from bois d'arc for Arikara Indians was a horse and a blanket. He described war clubs made of the same wood (Bradbury 1817:159-160). Prince Maximilian of Wied-Neuwied reported that Blackfeet Indians of Montana bartered for bois d'arc bows in the 1830s (Peattie 2007:387). On September 8, 1853, Lieutenant A. W. Whipple encountered a group of Kiowas on the Llano Estacado with outstanding bois d'arc bows (Whipple 1856:32). Archeological evidence indicates a long tradition of such use of the wood; an Early Caddo period (ca. A.D. 1000-1200) bow reportedly made from bois d'arc was excavated at the Mounds Plantation site (16CD12) in Caddo Parish, Louisiana (Webb and McKinney 1963, 1975). A few uses of bois d'arc for purposes other than bows are known among Native people. Kiowas and Pimas used the roots and wood for dye, and Comanches used a decoction of the root as an eyewash (Moerman 1998).

BOIS D'ARC RANGE

Pre-Holocene

Just as bois d'arc biology is unusual, so is its history, or at least what is known of its history. Ann Early (2000) pointed out more than a decade ago that much less is known about the evolutionary and geographical history of bois d'arc than is generally realized. Although recent progress has been made

Table 1. Work to Maximum Load (WML) statistics for reputed bow woods and common woods of Central Texas (from Alden 1995).

		WML (kJ/m3)	
Common name	**Botanical name**	**Dry**	**Green**
Bois d'arc*	*Maclura pomifera*	no data	261
Shagbark hickory*	*Carya ovata*	178	163
Pacific yew*	*Taxus brevifolia*	129	139
Cedar elm	*Ulmus crassifolia*	128	138
Black locust*	*Robinia pseudoacacia*	127	106
Pecan*	*Carya illinoinensis*	95	101
Black walnut	*Juglans nigra*	74	101
Hackberry	*Celtis spp.*	88	100
Sugar maple	*Acer saccharum*	114	92
Persimmon	*Diospyros spp.*	106	90
Live oak	*Quercus virginiana*	130	85
Green ash	*Fraxinus pennsylvanica*	92	81
Madrone	*Arbutus spp.*	61	77
Silver maple	*Acer saccharinum*	57	76
Post oak	*Quercus stellata*	91	76
Black willow	*Salix nigra*	61	76
Holly/Yaupon	*Ilex spp.*	74	74
Sumac	*Rhus spp.*	58	74
Bigleaf maple	*Acer macrophyllum*	54	60
Southern red oak	*Quercus falcata*	65	55
Sycamore	*Platanus occidentalis*	59	52
Cottonwood	*Populus deltoides*	51	50
Mesquite	*Prosopis spp.*	no data	no data

*good bow wood, probably not present in Central Texas at the advent of bow technology.

in distinguishing pollen from different genera of the botanical family to which bois d'arc belongs (Moraceae) (Burn and Mayle 2008), pollen studies frequently include both *Morus* (mulberry) and *Maclura* in a single category (sometimes with the Urticaceae [nettle family] as well), rendering them less than useful for understanding the prehistoric range of *Maclura*. Researchers thus rely on the record of fossil woods, leaves, and fruits.

Widely-cited secondary sources indicate an extensive Pleistocene range for the genus *Maclura* in North America (e.g., Barlow 2000; Peattie 2007). Examination of the primary sources, however, reveals the wide range to be an extrapolation from a very few data points. Hugo Martínez-Cabrera and colleagues report fossil woods from early Miocene sediments in Baja California that may be ancestral to *Maclura tinctoria*, the species of *Maclura* found today in the Caribbean, Mexico, and Central and South America (Martínez-Cabrera et al. 2006). Theodore Delevoryas (1964:584) identifies "a multiple fruit, most closely allied to the Moraceae" from Upper Cretaceous deposits in South Dakota. Perhaps the most commonly cited finding for determining the Pleistocene range of bois d'arc is the presence of *Maclura pomifera* leaves and/or wood in the Don Beds in Ontario (Coleman 1933:9-10; Terasmae 1960; Woodcock 1989). The deposits date to the last interglacial period, 125,000-75,000 years ago (Woodcock 1989). The Don Beds wood in general is characterized as decaying and much flattened by glaciers (Coleman 1933:9), but the leaves are not described, and the criteria for identification of individual wood and leaf taxa are not discussed. It appears that D. P. Penhallow, the botanist at McGill University who made the initial identifications, passed away prior to completion of the project (Coleman 1933:9). Two successor botanists are mentioned, Arthur Hollick and J. H. White, and they may have confirmed Penhallow's identifications. Fossil *Maclura* is known outside North America as well (Cheng et al. 2011).

Pleistocene-Holocene Transition

These spotty and imprecise records undergird the current theory that the genus *Maclura* had a wide distribution during the Pleistocene, with *M. pomifera* extending into what is now southern Canada and *M. tinctoria* (or its ancestor) present in Mexico. Daniel Janzen and Paul Martin (1982) have proposed that plants like bois d'arc were dispersed by Pleistocene megafauna. Although they mention bois d'arc only in passing, their theory has such explanatory power that it has been widely adopted for that species (Barlow 2000; Bonner 2008; Peattie 2007; Turner 2009). As North American populations of the dispersal organisms to which *Maclura* is adapted became reduced and eventually extinct (e.g., Pleistocene horses and camels), so *Maclura*'s distribution shrank over the Holocene. As discussed below, historic records that explicitly refer to bois d'arc date to the early years of the 19th century, by which time its range seems to have been restricted to a small area in Northeast Texas and adjacent parts of Arkansas and Oklahoma.

The Janzen-Martin hypothesis has the virtue of explaining several oddities about bois d'arc. The large fruits are poorly dispersed by the small animals that are attracted to them today (Smith and Perino 1981). The larger animals (i.e., bison) available to disperse large fruits during most of the Holocene apparently cannot consume bois d'arc fruits because they lack upper incisors (Barlow 2000). Although the tree can grow over a very wide swath of the North American continent under Holocene conditions, it apparently did not do so until it was planted extensively in the second half of the 19th century. Even in conditions where bois d'arc has naturalized after an initial planting, reports of its continued reproductive success are mixed. Starr et al. (2003) argue that bois d'arc should be considered invasive in Hawai'i. They note bois d'arc is already prohibited as an invasive plant in Elburn, Illinois, and it has become a pest in Italy (Starr et al. 2003). Clearly, bois d'arc is a good pioneer species, but whether it is capable of persisting in a more mature landscape is unclear (Burton 1990; Coder 1999; Smith and Perino 1981). Bois d'arc stands were being shaded out by oaks in Hueston Woods State Park in Ohio as of 1981 (Smith and Perino 1981).

On the Possibility of Pleistocene Remnant Populations

Several logical possibilities exist for the origin of the bois d'arc specimen at the Janee site. One is that it derives from Pleistocene refuge stands of bois d'arc that could, theoretically, have been present in West Texas during Toyah phase times. Anomalous stands of bois d'arc are known in Trans-Pecos Texas, for example in the Chisos Mountains and various locations around Marathon, Texas (Powell 1998:100-101; Roberts 2011; Simpson 1999:195; Turner et al. 2003; Wilson 1966:228). Some Chisos Mountain trees, notably Texas pinyon (*Pinus remota*), are believed to represent species that have managed to survive in small patches of microclimates to which they are well-suited (refugia) since Pleistocene times (Lanner and Van Devender 2000:173-174). The bois d'arc populations in West Texas do not have indicators of great antiquity in these locations, however. Botanists collecting the specimens have not indicated morphological differences between the West Texas and East Texas specimens that could be expected to have accumulated over a separation of 12 millennia. The Chisos Mountains specimens were collected in the 1930s and the identification re-checked by Dr. B. L. Turner in 2006 (TEX-LL 2007). To my knowledge, no archeological or geological specimens of Early or Middle Holocene-age bois d'arc have been recovered in Texas. Linguistic evidence also argues against great antiquity for these stands. The only Spanish name for bois d'arc I am aware of indicates an exotic origin for the plant: Naranjo Chino. Although its taproot makes bois d'arc relatively drought tolerant once established, even springs in West Texas may not provide enough moisture for long-term survival: of the 12 West Texas stands of bois d'arc known in the 1930s, only seven were alive in 2009 (Roberts 2011). Finally, bois d'arc populations are less numerous and contain fewer individuals than the more certain refugia populations of pinyon in West Texas (Thomas Alex, personal communication, September 6, 2011).

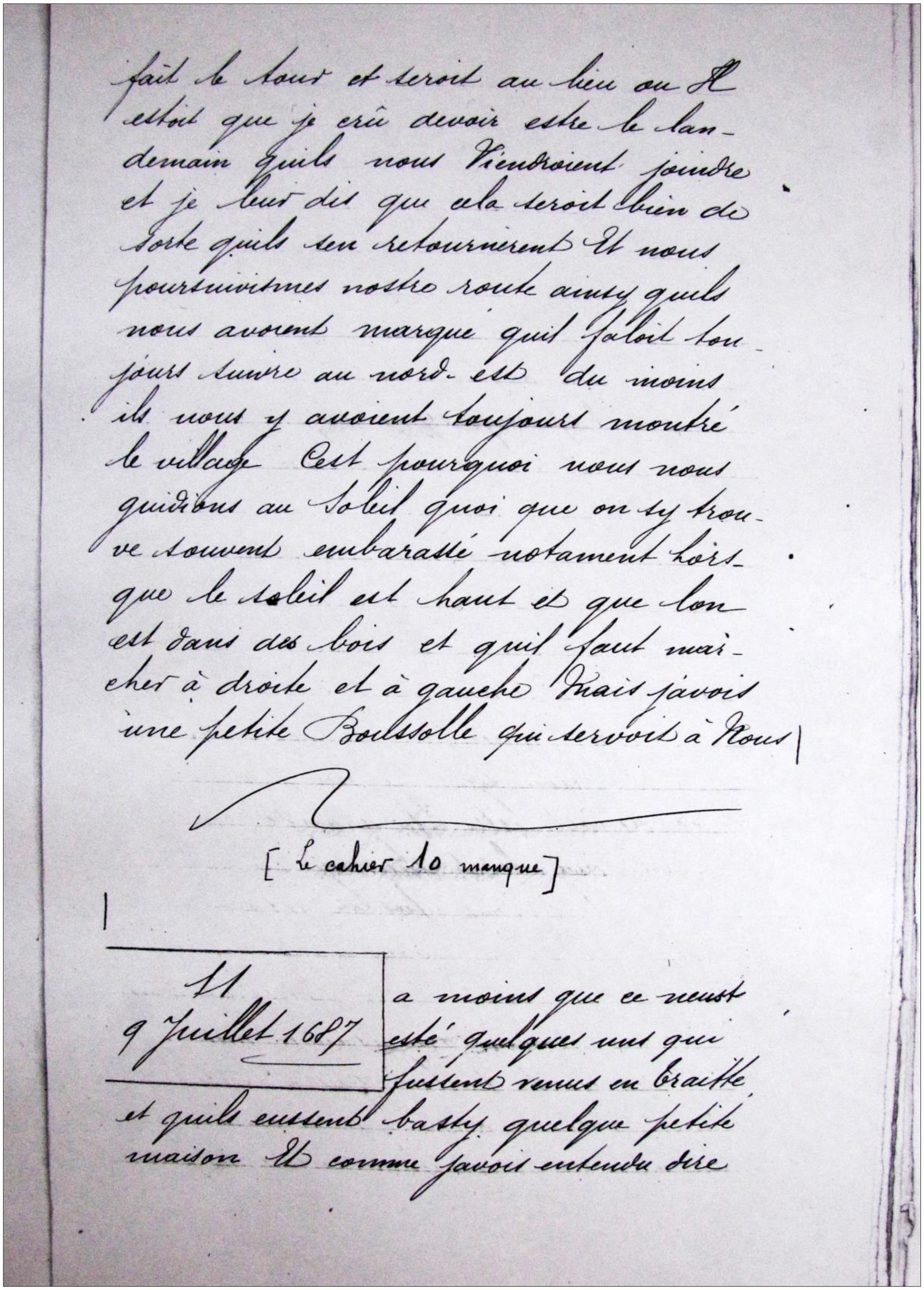
On the Possibility of Holocene Native American Bois d'Arc Arboriculture

Since the success of modern plantings indicate bois d'arc is capable of growing over a much larger range than it did in the early 19th century, and Native Americans quickly adopted tree crops such as peaches (Gremillion 1993), the question of why Native Americans (apparently) did not plant this economically valuable tree deserves serious consideration. Frank Schambach, one of the few researchers who has approached the question, proposes a radically restricted range for bois d'arc trees—confined to Bois d'Arc Creek in Fannin County, Texas—that came under the control of a group that monopolized the resource for economic and political advantage during the Late Prehistoric (Schambach 1995). Although she comes to a slightly different conclusion about the Late Prehistoric range of bois d'arc trees, Ann Early also considers the possibility of Native American planting. She reviews historic accounts and General Land Office Records and concludes that bois d'arc range in the early historic period extended at least into the Little Missouri River valley if not the Arkansas River valley in Arkansas (Early 2000:108). She suggests that Caddo agricultural plots provided optimal growing conditions for casually-introduced bois d'arc fruits (Early 2000:110). Deliberate establishment of bois d'arc stands would require a great deal of effort, and the deposition of a fertile fruit or viable cutting at exactly the right spot for optimum growth would likely provide only a fairly slim chance of a reward in bow wood 10-15 years in the future (Early 2000).

The possibility of deliberately-introduced bois d'arc stands becomes correspondingly less probable in the less hospitable climate of West Texas. As noted above, small stands of bois d'arc currently exist in West Texas. Bois d'arc trees fruit for only about 75 years (Burton 1990; Coder 1999) and the oldest known trees are less than 200 years old (Smith and Perino 1981:28). Transplanted bois d'arc populations in West Texas must therefore have reproduced over several generations if they represent Late Prehistoric plantings. Many historically-known stands of bois d'arc died in the drought of the 1950s, suggesting the trees would not have survived through severe Late Prehistoric droughts such as those of the 12th and 16th centuries A.D. (Stahle et al. 2000; Woodhouse et al. 2010). (It should be noted, however, that the population at Bois D'Arc Springs in the Chisos Mountains, documented in 1937, survived the drought of the 1950s, and was still alive as of July 2011 [Thomas Alex, personal communication, September 6, 2011]). Perhaps more significantly, the wood from these bois d'arc stands, located far from their optimal habitat, is small and brittle, and thus ill-suited to bow-making (Thomas Alex, personal communication, September 6, 2011).

17th Century

The earliest historic reference to bois d'arc is believed to be that of Henri Joutel, who notes a bow-making tradition in the Texas-Oklahoma-Arkansas-Louisiana area in 1687. He indicates that the wood is of excellent quality for bow-making ("du bois très proper à en faire [les arcs]"), that people travel great distances (50 or 60 leagues) to obtain the bows, and that the tree grows in quantity in the area (Margry 1879:412). Neither the wood nor the tree from which it came are named or described, however, either in the most recent English translation (Foster 1998:248) or in the French printed editions (DeMichel 1713:282; Margry 1879:412, 424). Joutel's omission is odd since he was reportedly the son of a gardener (Harisse 1872:165), and he took the trouble to describe a sweetgum tree that La Salle had marked near the Trinity River (Foster 1998:202, fn22) and palm trees near Garcitas Creek (Foster 1998:124). It seems likely that Joutel did not actually encounter a bois d'arc tree himself but only the bows or talk of bows. Ann Early (2000:102) points out it is possible that the entire bow-trading episode was inserted into Joutel's published account by the editors from Henry de Tonti's account of the expedition or a forged account falsely attributed to Tonti that circulated in Paris prior to 1713 (Delanglez 1985). To determine whether the episode was inserted into Joutel's account by an editor, a copy of the Joutel manuscript in the United States Library of Congress was examined but found to be inconclusive: the notebook covering the period of the Joutel's first mention of the bow trade (Cahier 14) was missing from the French National Marine archives at the time of transcription (Joutel 1684-1687) (Figure 4). A second reference to the bow trade is present, however, in the manuscript and in the Margry edition (Margry 1879:424). Although the notebook is missing, the first episode seems plausible given the second manuscript reference, the early 19th century distribution of bois d'arc, the suitability of bois d'arc for bow making, and a probable history of bois d'arc bows in the area as evidenced by an Early Caddo bow reportedly made from bois d'arc recovered at Mounds Plantation in Caddo Parish, Louisiana (Webb and McKinney 1963, 1975).



fait le tour et seroit au lieu ou il
estoit que je crû devoir estre le lan-
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et je leur dis que cela seroit bien de
sorte quils sen retournerent Et nous
poursuivismes nostre route ainsy quils
nous avoient marqué quil falloit tou-
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le village Cest pourquoi nous nous
guidions au soleil quoi que on sy trou-
ve souvent embarassé notament lors-
que le soleil est haut et que lon
est dans des bois et quil faut mar-
cher à droite et à gauche mais javois
une petite Boussolle qui servoit à nous

[Le cahier 10 manque]

11
9 Juillet 1687

a moins que ce neust
esté quelques uns qui
fussent venus en traitte,
et quils eussent basty quelque petite
maison Et comme javois entendu dire

Figure 4. Manuscript page from Joutel 1684-1687 indicating missing Notebook 10.

18th Century

Although there are few to no historic records of bois d'arc for the 18th century, it is likely that bois d'arc expanded its range into West Texas during this time. Horses became common among Native American communities in Texas at the turn of the 18th century, re-introducing a possible large mammal dispersal agent for bois d'arc populations. In his 1846 journal, Ferdinand Roemer indicates travelers progressed through Texas on horseback at about 40 miles per day (Roemer 2011:61). Horses

have a gut rate of about 24 hours (Town and Country Veterinary Hospital, personal communication, 2011). Bois d'arc stands reproduce after about 10 years (Smith and Perino 1981). Calculations from these data point to a maximum rate of advance for bois d'arc populations of about 40 miles per decade or four miles per year. In this scenario, the earliest bois d'arc could possibly become horse-dispersed in Menard is about 1804. Thus, the West Texas stands of bois d'arc could have become established prior to most European settlement but after the collapse of Toyah/Caddo trade networks.

19th Century (Early)

After 1803, historic references to bois d'arc become numerous. Meriwether Lewis famously sent bois d'arc samplings, which had been transplanted at an Osage village, to President Thomas Jefferson in 1804, with a note that their original source was 300 miles away, presumably on the Red River (Jurney 1995; Turner 2009). William Dunbar and George Hunter reported bois d'arc in the Ouachita River valley in 1804 (Early 2000:103; Jurney 1995). Peter Custis saw a very large specimen near Natchitoches in 1806 that may have been transplanted (Flores 1984:260). Anthony Glass described the first large wild stands in 1807 on the Red River, including the population on Bois D'Arc Creek that Schambach believes was the post-Pleistocene remnant population (Early 2000:106; Jurney 1995).

Smith and Perino (1981:Figure 2) noted that the extent of the "natural" range of bois d'arc was not known and provided four possible native distributions, all of which included Northeast Texas/Southwest Arkansas and two of which centered on that region. Later authors' examinations of documentary evidence have clarified the probable distribution of bois d'arc, at least as of 1860 in Texas.

Archeologist David Jurney (1995) and historian Del Weniger (1996) attempted to reconstruct the early historic and late prehistoric range of bois d'arc trees. Their efforts have focused on Texas, using historical accounts and General Land Office records prior to 1860. Weniger restricts the range of bois d'arc to 12 counties in Northeast Texas (Figure 5). Jurney (1995) comes to very nearly the same conclusion but couches it in more satisfying ecological terms by naming the streams along which he believes the major populations of bois d'arc were dispersed: the East Fork of the Trinity River and one tributary, Rowlett Creek; the North Fork Sulphur River and some tributaries; and Bois D'Arc Creek, a tributary of the Red River in Fannin and Lamar counties, Texas. In the absence of Pleistocene megafauna, most authors believe water became the main dispersal agent of bois d'arc fruits (Barlow 2000; Jurney 1995). Weniger's and Jurney's findings may probably be extrapolated to areas immediately across the Red River in Oklahoma and Arkansas.

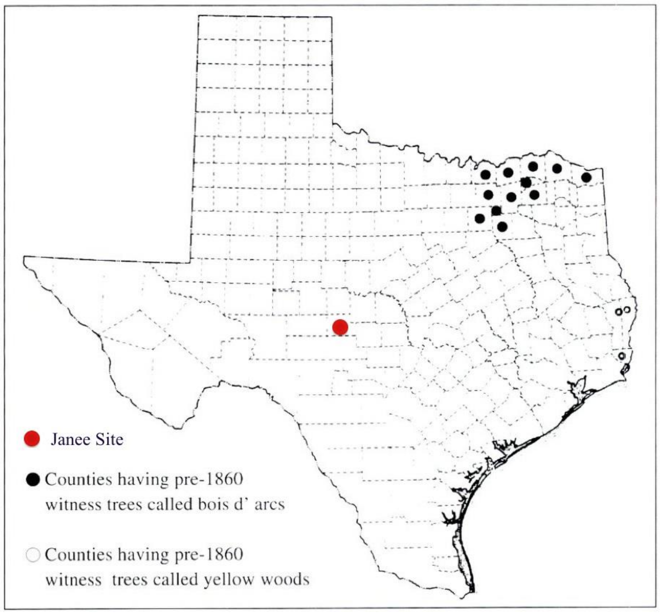

Figure 5. Pre-1860 range of bois d'arc (*Maclura pomifera*) indicated in solid black dots and the Janee site location in red. After Weniger (1996:Figure 2).

19th Century (Late)

The *Prairie Farmer* magazine was instrumental in greatly expanding the range of bois d'arc in the last half of the 19th century, when it began to promote the tree as a hedge plant (Turner 2009). The first issue of *Prairie Farmer* in 1841 featured an editorial inquiry seeking information about such a use of bois d'arc. Over the next 14 years, bois d'arc discussions become increasingly commonplace in the journal, such that by 1855 another editorial attempted to settle the question of who should receive primary credit for introducing bois d'arc as a hedge plant. Bois d'arc place names can be found today throughout much of the United States, reflecting the success of the planting program. In fact, modern visitors to the Janee site usually travel Bois D'Arc Road to reach it.

THE JANEE BOIS D'ARC SPECIMEN

Identification of bois d'arc from fossil specimens, including archeological specimens, typically faces several difficulties, the most important of which is that identification is not usually made from the entire plant but from one or more parts of it. *Maclura pomifera* wood is ring-porous and packed with tyloses (Hoadley 1990; Panshin and deZeeuw 1980). It can be separated from mulberry (*Morus* spp.) and locust (*Robinia pseudoacacia* and *R. neomexicana*), which share these characteristics, by the presence of vestured intervessel pits (in *Robinia*) or crystals (in *Maclura*), or on the basis of ray seriation (the number of cells across the widest point in a ray). Mulberry wood has the widest rays, typically 7-8 seriate, while black locust rays are usually 3-5 seriate and bois d'arc's are 2-4 seriate (Hoadley 1990). The *Maclura* specimen at Janee was identified on the criterion of ray seriation: it has rays that are usually 2-3 seriate, with the largest rays being 4 seriate. It was not examined for the presence of vestured intervessel pits or crystals, but since the range of *Robinia pseudoacacia*, another good bow wood, is even more distant from the Janee site than bois d'arc, and *R. neomexicana* is also distant (250 miles, in the Guadalupe Mountains) and at 12-15 feet in height too small to provide good bow wood, examination of ray seriation is believed to be sufficient in this instance. Wood tissue of *Maclura tinctoria*, the Central American species, is diffuse-porous and easily distinguishable from *Morus*, *Robinia,* and *Maclura pomifera* in transverse section at low magnification.

Bois d'arc wood charcoal has been identified at post-A.D. 900 Caddo sites in East Texas, including Stallings Ranch (41LR297), Henry M. (41NA60), and Murphy Branch (41MX5) (Brewington et al. 1992; Bush 2008; Perttula et al. 2010). As discussed above, available evidence indicates the range of bois d'arc did not include Central Texas during the early 16th century, when the Janee specimen was growing. The question of how and why bois d'arc wood arrived at the Janee site is thus more interesting than is usual for wood charcoal specimens on archeological sites.

Other woods identified at Janee are interpreted as fuel wood, both from their archeological contexts (hearths) and their taxa identifications. The six wood charcoal samples identified consisted of pecan, oak (red group, white group, and live group), mesquite, acacia, elm, and hoptree. These are all types of trees that would have grown along the San Saba River or in the uplands nearby, and which continue to grow in the area today. Both the transportation costs and properties of bois d'arc wood argue strongly against its use as a fuel wood at the Janee site. The transportation costs of using non-local wood for fuel are generally prohibitive (Asch and Asch 1986; Shackleton and Prins 1992), making the exotic bois d'arc an unlikely fuelwood. Further, although its wood is very dense, producing high heat and good coals, bois d'arc also produces so many sparks that it makes a distinctly unpleasant firewood (Graves 1919; Smith and Perino 1981:33). Given the probable range of bois d'arc in the early 16th century and the wood's historically-documented uses among Native Americans, the Janee bois d'arc specimen was probably part of a bow or a stave for bow making.

Early historic trade routes between East Texas and La Junta (the confluence of the Rio Conchos and the Rio Grande) are documented through the Menard area, making it possible to identify the traders and the routes they traveled into Northeast Texas where the bows or their raw material would have been available. Arnn (2007:218, 420 and Figure 10.2) emphasizes the frequency and routine nature of travels by Jumanos between La Junta and Caddo villages in Northeast Texas. Exotic items other than bois d'arc were recovered from Janee in the form of arrow points (Arnn 2007:361), and exotic items are known from other Toyah phase sites in the area as well (Arnn 2007:359). Arnn proposes a continuity between the Late Prehistoric Toyah in this area and historic Jumano traders. Mariah Wade (2003:221, 248, note 44) notes that one sub-group of the Jumanos were known as the Good Bows (Arcos Buenos; also Arcos Fuertes or Arcos Tuertos or Los que Hacen Arcos). The "twisted" bows of this group are also referred to as "Turkish" bows; the term apparently describes a re-curved or double-curved bow. Double-curving does not necessarily make for a good bow (Hamilton 1982:6) but use of bois d'arc wood often does. Given the known location of large bois d'arc populations in Northeast Texas and the early historic evidence that Jumano traders with good bows traveled through the Janee site area, it seems likely that the bois d'arc fragment at Janee is best interpreted as part of a trade item from Northeast Texas, a bow or stave intended for bow-making.

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REFERENCES CITED

Alden, H. A.
1995 *Hardwoods of North America.* General Technical Report FPL-GTR-83. United States Department of Agriculture, Forest Service, Forest Products Laboratory, Madison.

Arnn, J. W.
2007 Transformation and persistence of indigenous cultural identity during the early colonial and late prehistoric periods in Texas. Ph.D. dissertation, Department of Anthropology, University of Kentucky, Lexington.

Asch, N. B. and D. L. Asch
1986 Woodland Period Archeobotany of the Napoleon Hollow Site. In *Woodland Period Occupations of the Napoleon Hollow Site in the Lower Illinois Valley*, edited by M. D. Wiant and C. R. McGimsey, pp. 427-512. Research Series Vol. 6. Kampsville Archaeological Center, Kampsville.

Ball, J.
2000 The Versatile Osage-Orange. *American Forests* 106(3):60-62.

Barlow, C.
2000 T*he Ghosts of Evolution: Nonsensical Fruit, Missing Partners, and Other Ecological Anachronisms*. Basic Books, New York.

Bonner, F. T.
2008 Maclura pomifera (Raf.) Schneid. In *Woody Plant Seed Manual*, edited by F. T. Bonner and R. P. Karrfalt, pp. 697-699. Handbook 727. United States Department of Agriculture, Forest Service, Washington, D.C.

Bradbury, J.
1817 *Travels in the Interior of America in the Years 1809, 1810, and 1811.* Sherwood, Neely, and Jones, London. Accessed via Google Books, http://books.google.com. September 9, 2011.

Brewington, R. L., J. E. Dockall, and H. J. Shafer

1992 *Archaeology of the Murphy Branch Site (41MX5): A Middle Caddoan Hamlet in Morris County, Texas*. Reports of Investigations No. 1. Center for Environmental Archaeology, Texas A&M University, College Station.

Burn, M. J. and F. E. Mayle

2008 Palynological Differentiation between Genera of the Moraceae family and Implications for Amazonian Palaeoecology. *Review of Palaeobotany and Palynology* 149:187–201.

Bush, L. L.

2008 Macrobotanical Remains from the 2005 and 2006 Texas Archeological Society Field Schools at the Gene and Ruth Ann Stallings Site (41LR297). Manuscript on file, Texas Archeological Society, San Antonio.

Burton, J. D.

1990 *Maclura pomifera* (Raf.) Schneid. Osage-orange (Moraceae – Mulberry family). In *Silvics of North America: Volume 2. Hardwood*s, edited by R. M. Burns and B. H. Honkala. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, D.C. Available online, http://www.na.fs.fed.us/spfo/pubs/silvics_manual/table_of_contents.htm. Accessed September 10, 2011.

Carey, J. H.

1994 Maclura pomifera. Fire Effects Information System. http://www.fs.fed.us/database/feis. United States Department of Agriculture, Forest Service. Accessed July 28, 2011.

Cheng, Y., X. Jiang, C. Li, and Y. Wang

2011 Pliocene charcoals from Shanxi Province of China and their application to studies of prehistoric wildfires. *Science China Earth Sciences* 54(4):508-518.

Coder, K. D.

1999 *Osage-orange (Maclura pomifera): An American Traveler*. Publication FOR99-022. University of Georgia School of Forest Resources Extension, Athens.

Coleman, A. P.

1933 The Pleistocene of the Toronto Region. *Ontario Department of Mines Annual Report for 193*2, Volume 41, Part VII.

Delanglez, J.

1985 Tonti Letters. In *A Jean Delanglez, S.J., Anthology*, edited by M. M. Wedel,, pp. 209-238. Garland Publishing, Inc., New York and London. Originally published 1932 in *Mid-America* 21(3).

Delevoryas, T.

1964 Two Petrified Angiosperms from the Upper Cretaceous of South Dakota. *Journal of Paleontology* 38(3):584-586.

DeMichel, M. (editor)
1713 *Journal historique du dernier voyage que feu M. de La Sale fit dans le golfe de Mexique : pour trouver l'embouchure & le cours de la riviere de Missicipi, nommée à present la riviere de Saint Louis qui traverse la Louisiane : où l'on voit l'histoire tragique de sa mort, & plusieurs choses curieuses du Nouveau Monde* by Henri Joutel. http://www.archive.org/details/cihm_35739. Internet Archive. Accessed September 1, 2011.

Early, A.
2000 *Forest Farmsteads: A Millennium of Human Occupation at Winding Stair in the Ouachita Mountains*. Research Series 57. Arkansas Archeological Survey, Fayetteville.

Elias, T. S.
1980 *The Complete Trees of North America: Field Guide and Natural History.* Van Nostrand Reinhold Company, New York.

Flores, D. L. (editor)
1984 *Southern Counterpart to Lewis and Clark: The Freeman and Custis Expedition of 1806*. University of Oklahoma Press, Norman.

Foster, W. C. (editor)
1998 *The La Salle Expedition to Texas: The Journal of Henri Joutel, 1684-1687.* Translated by J. S. Warren. Texas State Historical Association, Austin.

Graves, H. S.
1919 *The Use of Wood for Fuel.* Bulletin No. 753. United States Department of Agriculture, Washington, D.C.

Gremillion, K. J.
1993 Adoption of Old World Crops and Processes of Cultural Change in the Historic Southeast. *Southeastern Archaeology* 12(1):15-20.

Hamilton, T. M.
1982 *Native American Bows*. 2nd edition. Special Publications No. 5. Missouri Archaeological Society, Columbia.

Harrisse, H.
1872 *Notes pour servir à L'Historie, à la Bibliographie et à la Cartographie de la Nouvelle France et des Pays Adjacents, 1545-1700*. Librairie Tross, Paris. Accessed via Google Books, http://books.google.com, September 9, 2011.

Hoadley, R. B.
1990 *Identifying Wood: Accurate Results with Simple Tools*. The Taunton Press, Newtown, Connecticut.

Janzen, D. H. and P. S. Martin

1982 Neotropical Anachronisms: The Fruits the Gomphotheres Ate. *Science* 215(4528):19-27.

Joutel, H.

1684-1687 *Relation du Voyage de M. de la Salle dans le nord de l'Amerique Septentrionale en 1684 pour y faire un Etablissement dans la partie qu'il en avoit auparavant découverte*. "Copie imparfaite du journal de Joustel qui a été imprime 1684-1687". Volume 67, No. 1. Archives Nationales Marine, Service Hydrographique, Cartes et Plans. France, Foreign Copying. Manuscript Division, Library of Congress, Washington D.C.

Jurney, D. H.

1995 The Original Distribution of Bois D'Arc, Revised manuscript. http://www.smu.edu/anthro/collections/boisdarc.html. Accessed June 26, 2008. Originally published in the *Caddoan Archeology Newsletter* V(2), 1994.

Lanner, R. M. and T. R. Van Devender

2000 The Recent History of Pinyon pines in the American Southwest. In *Ecology and Biogeography of* Pinus, edited by D. M. Richardson, pp. 171-182. Cambridge University Press, Cambridge, United Kingdom.

Margry, P. (editor)

1879 *Découverte et établissements des Français dans l'ouest et dans le sud de L'Amérique septentrionale, 1614-1754 : mémoires et documents inédits*. Volume 3. *Recherche des bouches du Mississippi et voyages à travers le continent depuis les côtes du Texas jusqu'à Québec (1669-1698).* http://www.archive.org/details/dcouverteett03marg. Internet Archive. Accessed September 1, 2011.

Martínez-Cabrera, H. I., S. R. S. Cevallos-Ferriz, and I. Poole

2006 Fossil woods from early Miocene sediments of the El Cien Formation, Baja California Sur, Mexico. *Review of Palaeobotany and Palynology* 138:141-163.

Moerman, D.

1998 *Native American Ethnobotany*. Timber Press, Portland.

Panshin, A. J. and C. de Zeeuw

1980 *Textbook of Wood Technology: Structure, Identification, Properties, and Uses of the Commercial Woods of the United States and Canada*. Fourth edition. McGraw-Hill Book Company, New York.

Peattie, D. C.

2007 *A Natural History of North American Trees.* Houghton Mifflin Company, Boston. Originally published 1953 in two volumes.

Perttula, T. K., L. L. Bush, L. Schniebs, T. Middlebrook, and P. S. Marceaux

2010 *An Early Historic Caddo Farmstead at the Henry M. Site (41NA60) in Nacogdoches, County, Texas*. Stephen F. Austin State University Press, Nacogdoches, Texas.

Powell, A. M.
1998 *Trees and Shrubs of the Trans-Pecos and Adjacent Areas.* University of Texas Press, Austin.

Roberts, T.
2011 Tracing the Comanche Trail across the Trans Pecos-Big Bend Region of Texas From Horsehead Crossing on the Pecos to the Rio Grande. Paper presented at the Annual Meeting of the County Historical Commissions from the Mountain-Pecos Region, Marathon, Texas, January 22, 2011.

Roemer, F.
2011 *Roemer's Texas, with particular reference to German immigration and the physical appearance of the country*. Translated by Oswald Mueller. Mockingbird Books. Retrieved from http://books.google.com/books/about/Roemer_s_Texas.html. Originally published 1935.

Schambach, F. F.
1995 A Probable Spiroan Entrepot in the Red River Valley in Northeast Texas. *Caddoan Archeology Newsletter* 6(1):9-25.

Shackelton, C. M. and F. Prins
1992 Charcoal analysis and the "Principle of Least Effort": A Conceptual Model. *Journal of Archaeological Science* 19:631-638.

Simpson, Benny J.
1999 *A Field Guide to Texas Trees*. Lone Star Books, Laham, Massachusetts.

Smith, J. L. and J. V. Perino
1981 Osage Orange (*Maclura pomifera*): History and Economic Uses. *Economic Botany* 35(1):24-41.

Stahle, D. W., E. R. Cook, M. K. Cleaveland, M. D. Therrell, D. M. Meko, H. D. Grissino-Mayer, E. Watson, and B. H. Luckman
2000 Tree-ring Data Document 16th Century Megadrought Over North America. *Eos* 81(12):121-132.

Starr, F., K. Starr, and L. Loope
2003 *Maclura pomifera* (Osage orange), Moraceae. http://www.hear.org/starr/hiplants/reports/pdf/maclura_pomifera.pdf. United States Geological Survey, Biological Resources Division, Haleakala Field Station, Maui, Hawai'i. Accessed September 8, 2011.

Terasmae, J.
1960 A Palynological Study of Pleistocene Interglacial Beds at Toronto, Ontario. *Geological Survey of Canada Bulletin* 56 (Part II):23-41.

TEX-LL (Flora of Texas Database)
2007 Flora of Texas Database, Plant Resources Center, University of Texas at Austin. http://www.biosci.utexas.edu/prc/Tex.html. Accessed September 9, 2011.

Turner, B. L., H. Nichols, G. Denny, and O. Doron
2003 *Atlas of the Vascular Plants of Texas, Volume 1:Dicots*. Botanical Research Institute of Texas Press, Fort Worth.

Turner, M. W.
2009 *Remarkable Plants of Texas: Uncommon Accounts of Our Common Natives.* University of Texas Press, Austin.

Wade, M. F.
2003 *The Native Americans of the Texas Edwards Plateau, 1582-1799.* University of Texas Press, Austin.

Webb, C. H. and R. R. McKinney
1963 An Unusual Pottery Vessel from the Mounds Plantation Site, Caddo Parish, Louisiana. *Arkansas Archaeologist* 4(5):1-9.

1975 Mounds Plantation (16CD12), Caddo Parish, Louisiana. *Louisiana Archaeology* 2:39-127.

Weniger, D.
1996 Catalpa (*Catalpa bignoniodes*, Bignoniaceae) and Bois d'Arc (*Maclura pomifera*, Moraceae) in Early Texas Records. *Sida* 17:231-242.

Westbrook, R. F.
1973 *State-Wide Service Test of Fence Posts: Twenty-Year Progress Report*. Publication 110. Texas Forest Service, Forest Products Department, Texas A&M University, Lufkin.

Whipple, A. W.
1856 Extracts from the [Preliminary] Report of Lieutenant A. W. Whipple, Corps of Topographical Engineers, upon the Route near the Thirty-Fifth Parallel, with an Explanatory Note by Captain A. A. Humphreys, Corps of Topographical Engineers. In *Reports of Explorations and Surveys, to ascertain the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean, made under the direction of the Secretary of War, in 1853-4*. Volume III. Washington, Government Printing Office. Accessed online http://cprr.org/Museum/Pacific_RR_Surveys/, September 9, 2011.

Wilson, O. W.
1966 *Pioneer Surveyor, Frontier Lawyer: The Personal Narrative of O. W. Williams, 1877-1902*. Edited by S. D. Myres. Texas Western College Press, El Paso.

Woodcock, D. W.
1989 Significance of Ring Porosity in Analysis of a Sangamon Flora. *Palaeogeography, Palaeoclimatology, Palaeoecology* 73:197-204.

Woodhouse, C. A., D. M. Meko, G. M. MacDonald, D. W. Stahle, and E. R. Cook
2010 A 1,200-year Perspective of 21st Century Drought in Southwestern North America. *Proceedings of the National Academy of Sciences of the United States of America* 107(50):21283-21288.

DEFLATION TROUGHS, WATER, AND PREHISTORIC OCCUPATION ON THE MARGINS OF THE SOUTH TEXAS SAND SHEET

Juan L. González, Russell K. Skowronek, and Bobbie Lovett

ABSTRACT

Within the South Texas Plains, the area broadly defined by the Rio Grande to the south and the Nueces River to the north, a distance of ca. 175 km, evidence of open human occupation is remarkably abundant. Because it is predominantly a region of loose, sandy soils and active and relict sand dunes where wind processes dominate, the area is known as the South Texas Sand Sheet (STSS). There is no running water within the STSS and all streams are ephemeral. Existing drainage systems are small, localized, and not integrated, carrying water for a few days and up to two weeks after the passage of a storm. The lack of running water makes human occupation on this semi-arid area even more remarkable. The STSS and the adjacent wind deflated areas have hundreds of small and shallow elongated deflation troughs. Most of these poorly drained swales retain seasonal fresh water that sustain high moisture plants and are ephemeral wetlands; a small percentage of them hold water year round. As a result, the long history of human occupation of the STSS was possible due to the presence of the deflation troughs. This study explores the connection between human occupation of the STSS and deflation troughs at four previously unreported archeological sites in northern Hidalgo County using a combination of intensive archeological and geological survey, oral history, GIS technology, and existing soil maps.

INTRODUCTION

Located in the central part of the general area defined by the Rio Grande to the south and the Nueces River to the north is the South Texas Sand Sheet (STSS) occupying an area of approximately 4,200 km^2 of predominantly loose, sandy soils, and active and relict sand dunes where wind processes are dominant. The STSS includes most of Kenedy and Brooks counties, and parts of northern Hidalgo and northwestern Willacy counties (Figure 1). There is no running water within the STSS or the areas adjacent to it; all streams are ephemeral, carrying water only for a few days to a few weeks after the passage of a storm (Brown et al. 1980). The area is considered a subtropical desert with limited precipitation and high summer temperatures. In the interior away from the gallery forests that line the

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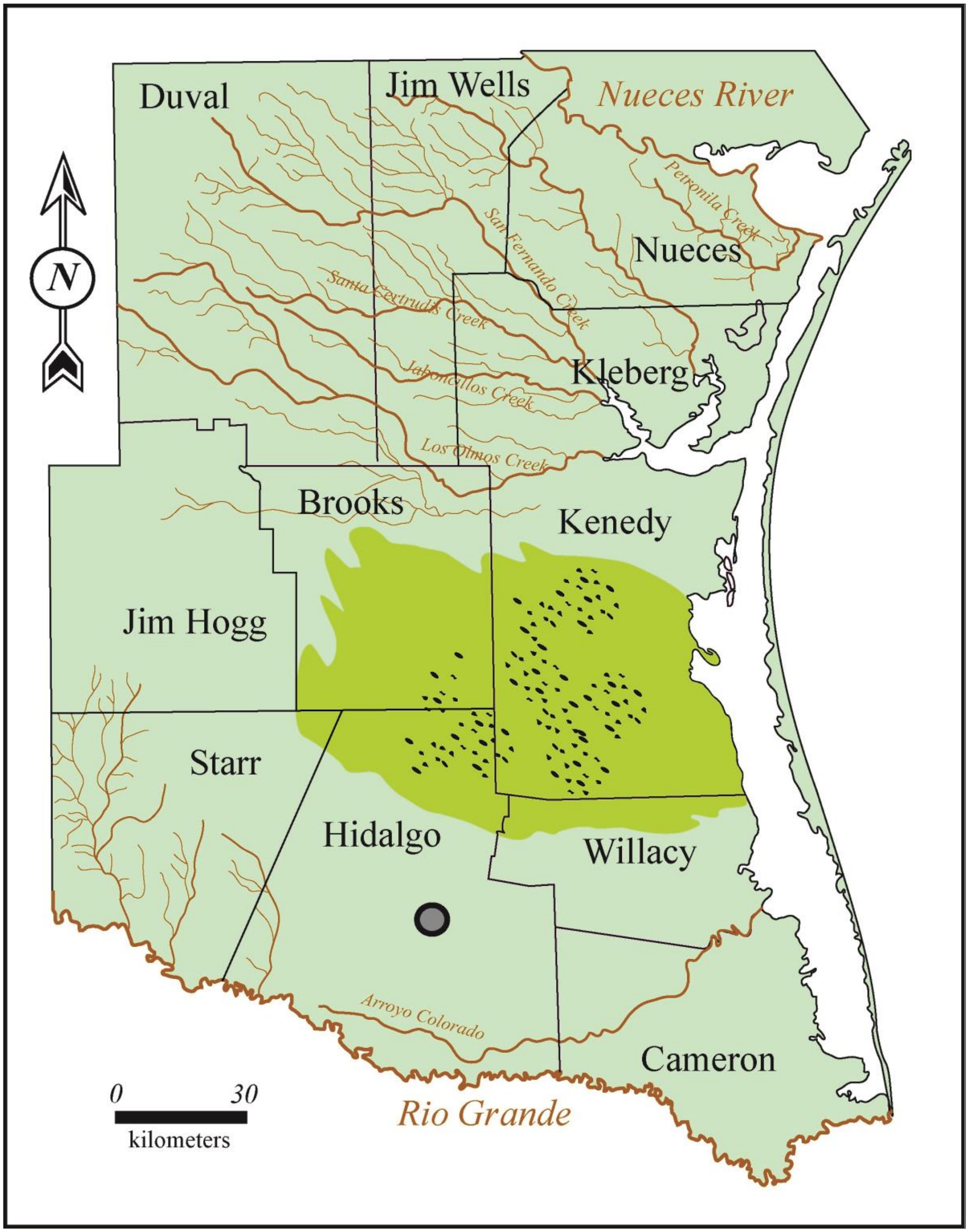

Figure 1. Map of South Texas between the Nueces River to the north and the Rio Grande to the south. Area in yellow shows the location of the STSS; deflation troughs are shown schematically. The black circle denotes the study area. Note that there is no running water between the two river systems, a distance of ca. 175 km. Los Olmos, Jaboncillos, Santa Gertrudis, San Fernando, and Petronilla streams are ephemeral and carry water only for a short time following heavy rain.

two bounding rivers and their adjacent *resacas*, vegetation cover consists mostly of sparse grasses and brush; stands of live oak trees cover most of the relict dunes and provide the only shade in the sand sheet. Deflation (wind erosion) is evident on the land surface in the form of hundreds of small, shallow, deflation troughs across the STSS and adjacent areas, and these serve as temporary water reservoirs following occasional heavy rains. Areas north and south of the STSS lack loose sediments but are also subject to wind erosion. In the study area, located outside the STSS in central Hidalgo County, the surface geology is a deeply deflated bedrock surface of the Pleistocene Beaumont Formation. North of the STSS, in the vicinity of Baffin Bay, deflation troughs are abundant on the surface of the Pliocene Goliad Formation.

Despite the lack of running water and high temperatures for much of the year, evidence of human use and occupation of the STSS and deflated areas that border it is remarkably abundant and extends back to ca. 3500-6000 B.C. This research study from an area outside the STSS, where running water is absent and deflation is the dominant geologic process, can be used to explain the long history of human occupation of this harsh environment. We contend that human occupation was made possible by natural water storage in deflation troughs following heavy rains.

CLIMATIC CHARACTER OF THE STSS

There is a climatological gradient along the STSS with a reduction in rainfall from north to south and east to west (Figure 2) (Norwine et al. 1978; Le Houerone and Norwine 1988). Average annual rainfall for Kleberg and Kenedy counties in the northeast is 67.6 cm and 67.3 cm, respectively, while Willacy and Hidalgo counties in the south receive 65.5 and 50.5 cm (Brown and Macon 1977; Brown et al. 1980). Over 55 percent of the precipitation occurs between May and September when ca. 65 percent of the days have temperatures greater than 32 degrees C, enhancing evaporative losses (Southern Regional Climate Center 2014). Precipitation is often bimodal with peak amounts in May-June and September-October, the later period associated with tropical storms (Norwine et al. 1978; Le Houerone and Norwine 1988). Across the STSS annual evaporation values range from 50 to 70 cm, matching and sometimes exceeding precipitation values; thus there is a water deficit throughout the STSS (Brown et al. 1980).

WIND EROSION AND DEFLATION TROUGHS

The landscape of the STSS is shaped by both wind deposition and deflation; much of the sheet is covered with active dune complexes that migrate under the influence of the prevailing southeasterly winds. According to Brown and Macon (1977), in areas underlain by a shallow water table the amount of deflation is controlled by soil moisture derived from the intersected water table. Where this occurs, the land surface is marked with hundreds of small, 50 to 500 m diameter, circular, oval, or irregularly-shaped deflation troughs that average 1.0 m in depth (Figure 3). Such is the case in parts of southern Brooks County and in western Kenedy County, where deflation troughs are the most conspicuous geomorphic element of the landscape, reaching densities of 10 troughs per km^2.

Figure 2. Annual precipitation for South Texas showing the location of the STSS (in gray shade). Isohyets are the average for the period 1961-1990. Data from NOAA Cooperative and USDA-NRCS.

Figure 3. Google Earth image of a portion of western Kenedy County where deflation troughs are the most conspicuous landscape feature. The area encompasses 105 km^2. The image date is March 11, 2011.

Observations from exploratory boreholes drilled in central Hidalgo County indicate that the water table is often deeper than 3.5 m and thus we favor the idea that eolian erosive forces are stymied when underlying clay and clay/loam substrate soil layers are encountered (Hernandez-Salinas et al. 2012; Garcia et al. 2014). Most of these poorly drained swales hold water only after the passage of a storm. A small percentage of them retain some water year-round and become ephemeral wetlands that sustain high-moisture plants like California bulrush, common three-square bulrush, spikerushes, flatsedges, cattails, white-topped sedge, paspalums, and gulf cordgrass (Texas Coastal Sand Sheet Wetlands 2014). Water levels fluctuate during the course of the year depending on seasonal rains and tropical storms: a graphic example is shown in Figure 4 for a small area in central Hidalgo County

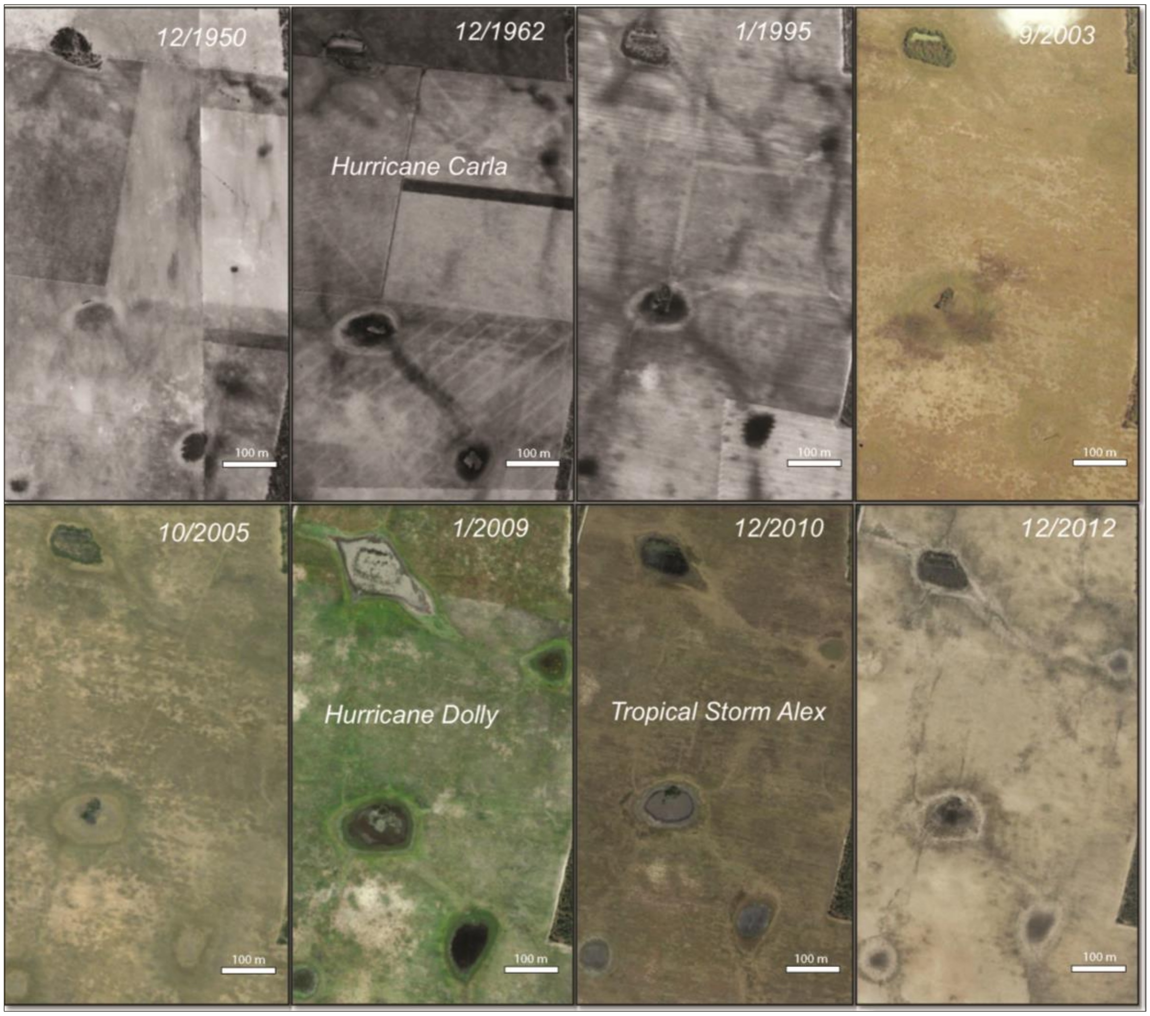

Figure 4. Google Earth time series imagery encompassing the period 1950-2012 for an area in central Hidalgo County (centered around Lat. 26˚32'27.37"N. Long. 97˚57'27.32"W). The four deflation troughs in the images retain water during wet years (1962, 2009, and 2010), and shrink during drought years (1950, 1995, 2003, 2005, and 2012).

It is unclear when deflation started in the STSS and adjacent areas. In South Texas the Holocene climate became increasingly arid as glaciations ended and sea level rose. Assessments of climate stability using isotopic studies (Ricklis and Cox 1998), and geologic mapping (Price 1958; Fisk 1959; Brown and Macon 1977, Brown et al. 1980; Russell 1981) have concluded that little variability in climate occurred in the Holocene. More recently other studies have presented evidence suggesting climatic instability. Forman et al. (2009) used luminescence dating to recognize two episodes of dune formation at 2700-2000 years B.P., most likely occurring with decreased ground cover caused by climatic fluctuations, and 200 years B.P., likely associated with historic land use grazing practices. Collins et al. (2011) used the distribution of time diagnostic projectile points to infer several climatic intervals characterized by different moisture regimes. Furthermore, Hall et al. (1987) and Collins et al. (1989) have suggested that Early to Middle Holocene erosion may have been fairly widespread. This observation is supported with geomorphic evidence from 41HG118, where a gully eroded into a Beaumont Formation knoll, the Pleistocene basement in the area, began to fill by 4500 ± 130 radiocarbon years B.P. (Beta-17434) (4835-5578 radiocarbon years B.P., calibrated at 2 sigma) B.P. On these grounds we assume that deflation started at least by 8000 years B.P., if not at the onset of the Holocene, and deflation troughs have been an important part of the landscape since then. Some evidence, however, seems to indicate that at least some of the troughs may have been formed in the Late Pleistocene, and may be inherently related to antecedent topography. Evidence for this include a radiocarbon date from a fragment of a molar identified as *Bison latifrons* found in organic-rich sediments from one trough north of Edinburg, Texas, excavated to increase water capacity (Armando Vela, personal communication, August 2013). It yielded an age of 18,670 ± 45 radiocarbon years B.P. (UGA-17416), (2 sigma calibrated age range of 22,670-22,930 radiocarbon years B.P.). In addition, excavations of La Paloma site (41KN18) in Northern Kenedy County encountered Pleistocene fauna, including mammoth, ground sloth, horse, and extinct bison (Suhm 1980), in close proximity to large deflation troughs.

SOILS AND DEFLATION TROUGHS

The shape, dimensions, and general orientation of the deflation troughs are best observed on satellite images and aerial photographs of the land surface (see Figure 3). But to understand why the troughs can retain water and become temporary lakes, it is best to examine soil maps. The removal of the top sandy soils by wind action causes the formation of depressions. The *Soil Survey for Hidalgo County* (Jacobs 1981) describes a soil unit that is most common on deflation troughs throughout Hidalgo County in an area south of the STSS where deflation is intense: soil unit 60, Rio clay loam (Figure 5). Deflation troughs in neighboring Willacy County are characterized by soil unit 67, Tiocano clay. Both soil types are described as poorly drained, with very low permeability, and high water capacity. Areas of the land surface where these soils are exposed contain pond water from runoff and most of the year are saturated with water.

Deflation Troughs as Water Reservoirs

In the STSS and peripheral deflated areas water collects in deflation troughs following rain events. Observations made in the field confirmed that water starts ponding quickly during moderate rain events, even after a prolonged drought (Figure 6a-b). In exceptional cases involving extreme rainfall, water depths can exceed 1 m in some troughs. This was well documented when, following Hurricane Beulah's landfall in South Texas in 1967, many troughs retained water for more than a year. Once filled with water the temporary ponds serve as haven for local fauna, offering not only a source for food and water, but also ground cover for wildlife habitats and protection from predators. Waterfowl, particularly ducks, gather at the larger depressions during the rainy season in September and October.

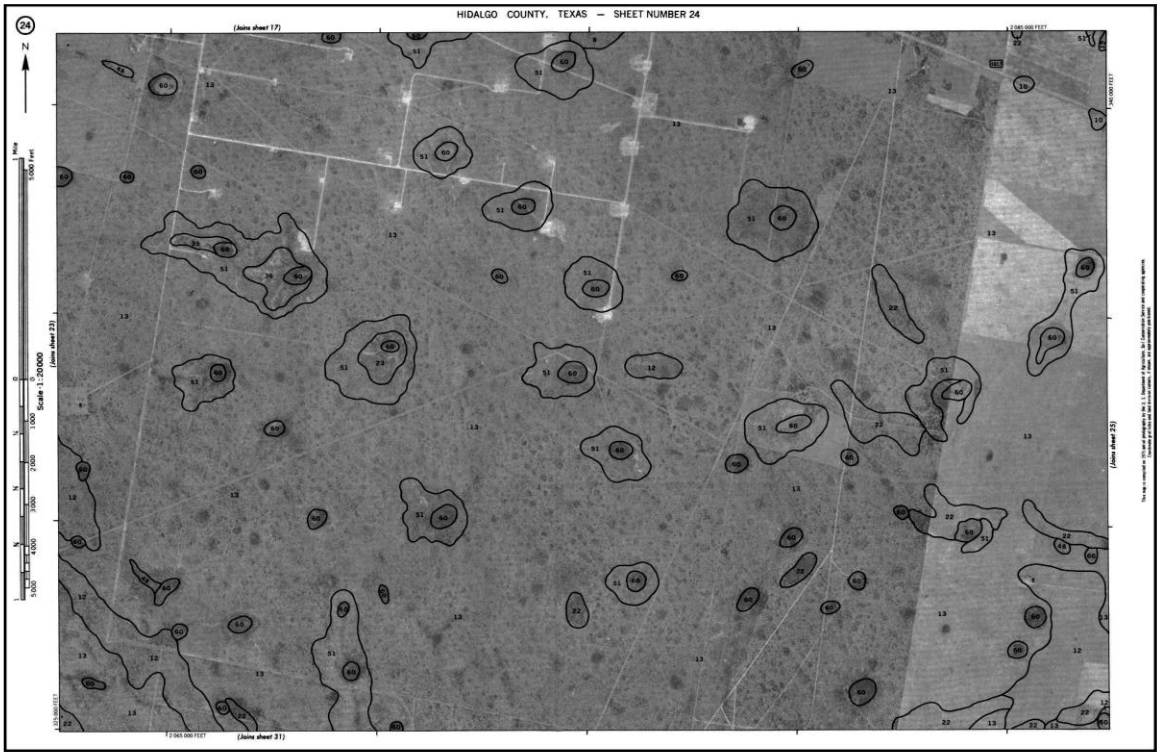

Figure 5. Sheet 24 of the Hidalgo County Soil Survey. Notice the soil unit 60, Rio clay loam, at the center of the circular or elongated deflation troughs. This soil type has low permeability and high water capacity.

HUMAN OCCUPATION OF THE STSS

Evidence abounds of prehistoric human use and occupation of the STSS and adjacent areas where deflation occurs and water is limited. The Texas Archeological Site Atlas indicates that there are more than 300 recorded sites in Willacy, Kenedy, Brooks, and central Hidalgo counties (Table 1). This record is biased, however, and underestimates the extent of occupation since the majority of the reported sites occur along main highways, drainage canals, and transmission power lines, and they were recorded as part of cultural resource management surveys. Beyond these survey projects, only a handful of archeological sites have been excavated in the region (Mallouf et al. 1977:87; Day et al. 1981; Hall et al. 1987; Bousman et al. 1990; Kibler 1994; Hester 2004). These investigations have revealed the archeological record in the STSS and adjacent areas to be characterized by poorly stratified campsites, low preservation of non-lithic remains, and overall very sparse cultural remains (Hester 2004:129). As a result, cultural chronology, subsistence strategies, and settlement patterns for the sand sheet and adjacent water-limited areas remain poorly known. The lack of a reliable radiocarbon chronology further hinders an understanding of the region's prehistory. For these reasons Ricklis (2004:177) described the area as "virtually unknown archeologically."

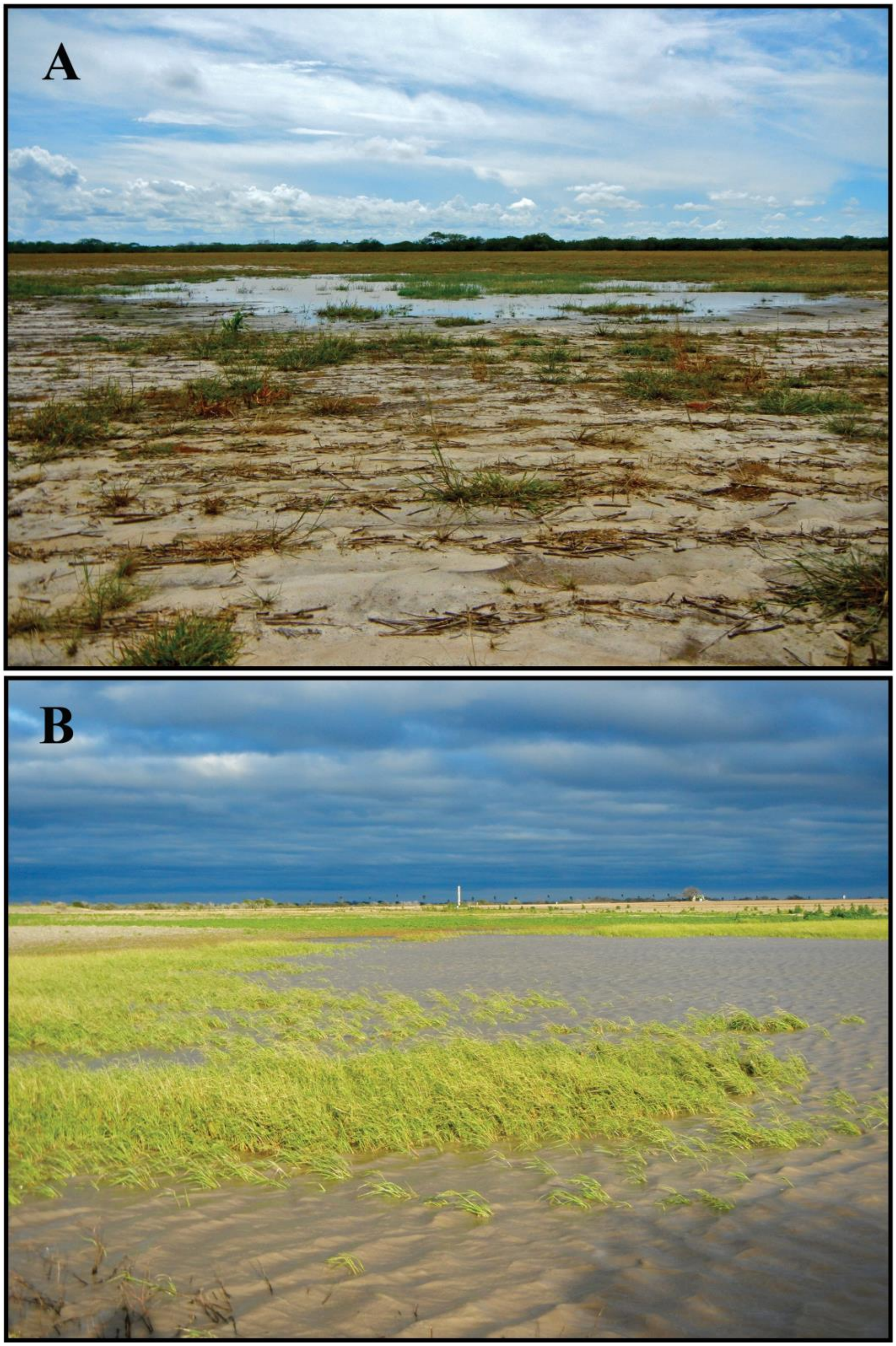

Figure 6. Deflation troughs with water near the town of McCook in central Hidalgo County: A, the water in this trough accumulated after an hour-long rain event; B, pool of water with wave ripples. Water depth in this trough reached a depth of 0.3 m and had accumulated two weeks before the picture was taken in the Fall of 2013.

Table 1. Archeological sites within and adjacent to the STSS (Texas Archeological Site Atlas).

County	Number of archeological sites
Kenedy	22
Brooks	28
Willacy	152
Central Hidalgo	104
Total	306

There is limited environmental and cultural data suggesting a human presence in the STSS during the Paleoindian and Early Archaic periods. At a site in Kenedy County (41KN18), located in the northeastern part of the sand sheet, mammoth and bison bones were found close to several dart points and one fluted lanceolate specimen. Suhm (1980) radiocarbon-dated four samples of mammoth bone, only two of those yielded reliable ages: 9,560 ± 120 radiocarbon years B.P. (TX- 2195), (calibrated at 2 sigma to 10,575-11,202 radiocarbon years B.P.), and 9,830 ± 110 radiocarbon years B.P. (TX-2196), (calibrated at 2 sigma to 10,794-11,709 radiocarbon years B.P.). An isolated Lerma projectile point, dating from the Early Archaic period (3500-6000 B.C.), was reported by Mallouf et al. (1977:167) on a site in Willacy County to the east of the sand sheet. Both Mallouf et al. (1977) and Bousman et al. (1990) excavated a number of low-density sites in northern Hidalgo and Willacy counties and their findings suggest a human presence from as early as the Early Archaic.

The later part of the Archaic period is also poorly represented and understood (Kibler 1994). Early to Middle Archaic periods sites are rare, and Mallouf et al. (1977:118) suggest that the sparse distribution of sites could be related to migrating aeolian deposits that have effectively buried cultural deposits. Bousman et al. (1990) interpreted their rarity as being due to the onset of more xeric conditions and to aeolian deflation of occupational surfaces during the Early and Middle Archaic periods. Most evidence of prehistoric land use comes from surface-collected artifacts, primarily unstemmed triangular thin bifaces, gouges, and stemmed dart points (Hall et al. 1987).

Late Archaic period sites are not infrequent in the region but often their components are mixed with cultural materials from later Late Prehistoric assemblages. Hall et al. (1987) propose that it is probably no coincidence that the apparent increase in sites during the Late Archaic is contemporaneous with the beginning of landscape stability, in agreement with the chronologic data that constrained eolian activity of the STSS (Forman et al. 2009). Finally, evidence of occupation during the Late Prehistoric period is widespread. The Late Prehistoric period is defined by the presence of small triangular arrow points on sites (Hester 1981, 2004:143-147).

Water as the limiting factor for human occupation of the STSS and neighboring areas was first discussed by Mallouf et al. (1977) in a study prepared for the U.S. Army Corps of Engineers assessing the potential impact of drainage canal construction on cultural resources. In their predictive assessment of cultural resources in Hidalgo and Willacy counties, Mallouf et al. (1977:113) recognized that the distribution of archeological sites was closely associated with the location of deflation troughs as the only source of fresh water, remarking that "archeological sites are associated with intermittent water supplies provided by the eolian plain depressions."

The rapidly changing cultural environment that characterizes South Texas at the beginning of the twenty-first century is rapidly erasing millennia of human occupation. These changes are serving as an opportunity to reexamine Mallouf et al.'s (1977) observations regarding the juxtaposition of deflation troughs, ponded water, and prehistoric archeological sites in the STSS and its margins.

IDENTIFICATION OF ARCHEOLOGICAL SITES BY THE CHAPS PROGRAM

The Community Historical Archaeology Project with Schools (CHAPS) Program at The University of Texas-Pan American reaches out to farmers and ranchers in northern Hidalgo County to salvage the rapidly disappearing cultural heritage associated with this way of life. Collected information includes oral histories focusing on natural disasters (hurricanes, floods, and droughts), soil types, depth to the water table, and observed changes in flora and fauna. Archeological and biological surveys are conducted of each property, while title searches trace the land use history of each parcel to the era of Spanish colonial and more recent land grants. In the last three years, the CHAPS Program has worked with four families (the Atwood, Eubanks, Norquest, and Sekula families) around the city of Edinburg. These families have either a long farming tradition or work history in agriculture and have found prehistoric lithic artifacts that can be precisely located on their properties. Classifying these collections led to the identification of four previously undocumented archeological sites and has enabled us to test the hypothesis that prehistoric human occupation in an area adjacent to the STSS, where there is no running water, was possible because deflation troughs provided temporary storage for rainwater.

For this project an area of approximately 70 km^2 in central Hidalgo County (see Figure 1) was studied using geographic information systems (GIS). The surface geology of this area, located just south of the STSS and north of the Rio Grande and its associated *resacas*, consists of deflated sandstones and siltstones of the Goliad Formation. It has a long history of human occupation and is dotted with hundreds of small deflation troughs.

On a base map of Hidalgo County all areas that are known to flood during episodes of heavy rain were plotted. Topographically, much of the pooled water coincides with circular, oval, or irregularly-shaped deflation troughs (Figure 7A). A plot of the distribution of the Rio clay loam soil for Hidalgo County (Figure 7B), which matches the locations prone to flooding, validates the notion that impermeable soils promote the ponding of rainwater in the wind-carved troughs. Next, each newly discovered archeological site was plotted on the flood map, and a 5 km diameter collection catchment circle was drawn around each site to indicate a one hour walk distance. Finally, a projectile point chronology, using Turner et al. (2011), was built to provide an estimate on the history of occupation for each site.

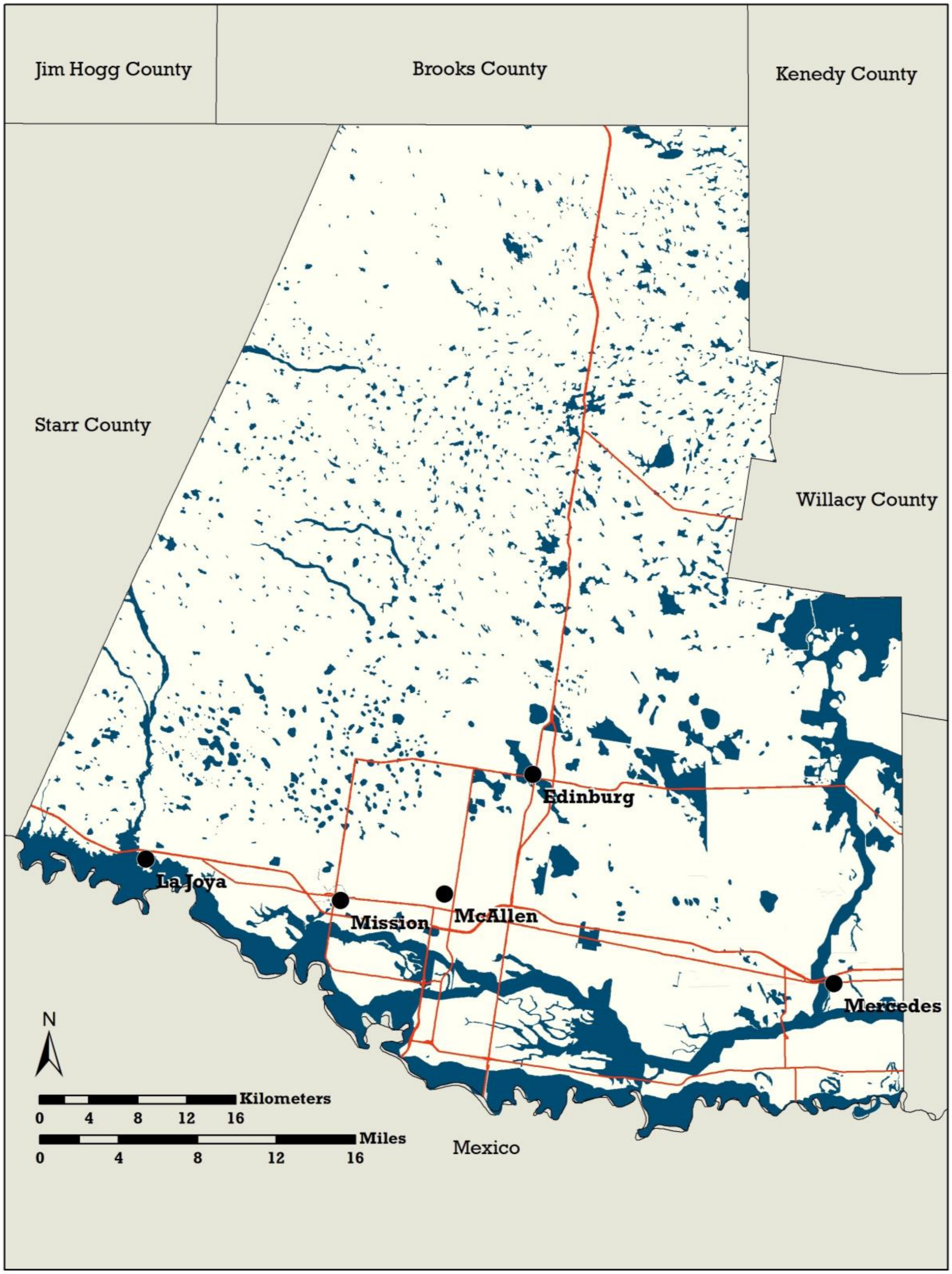

Figure 7. Hidalgo County base: A, GIS flood map based on data collected following Hurricane Beulah (1967). Notice the patchy flooding pattern coinciding with deflation troughs;

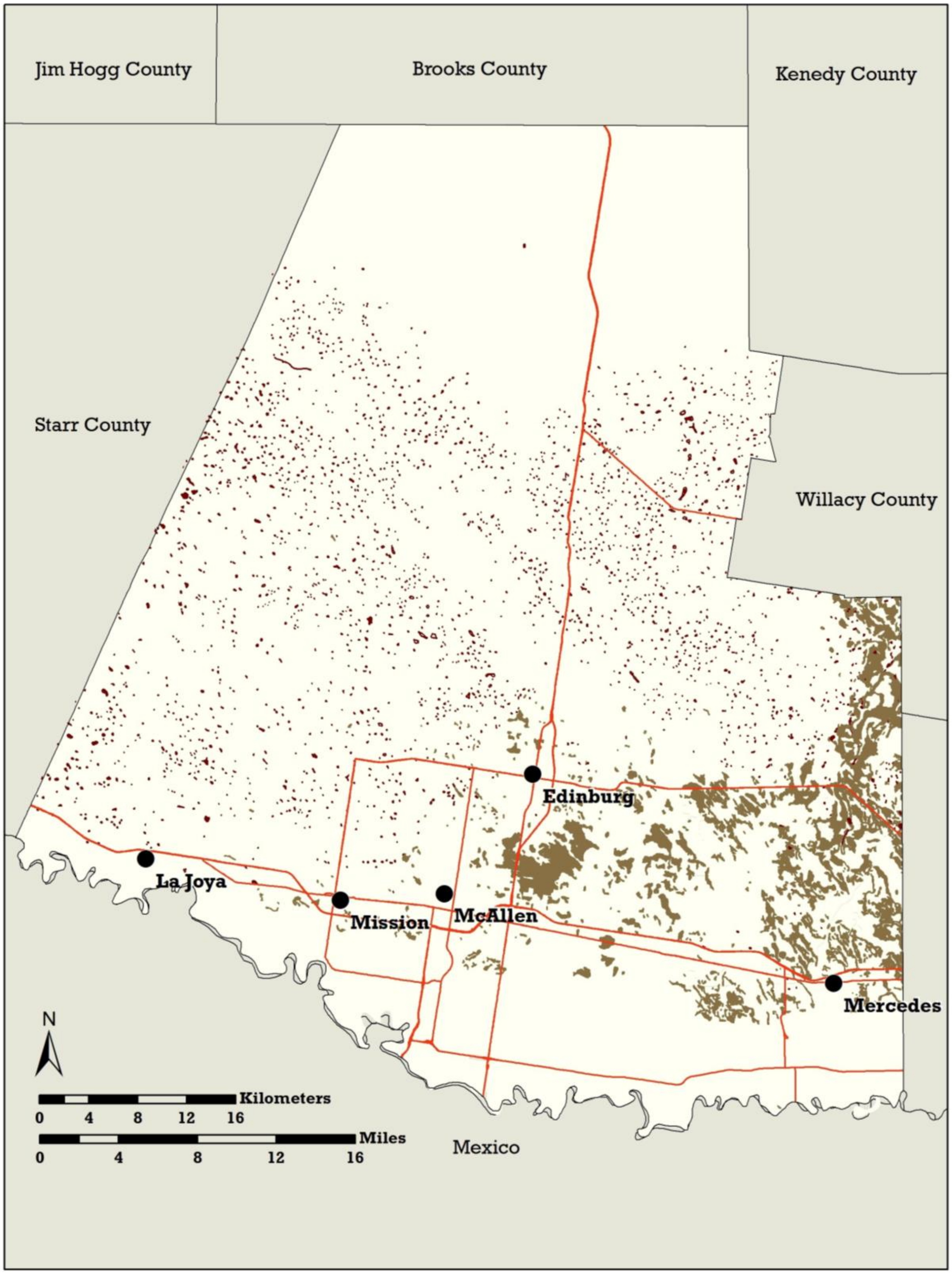

Figure 7. *Continued.* B, GIS map depicting the Rio clay loam soil. The distribution of this soil type matches the position of deflation troughs.

Results

Norquest Site

Following their emigration from Sweden in the 1860s the Norquests arrived, by way of Nebraska, in Edinburg in the 1920s. The Norquests have been engaged in commercial agriculture for the last 90 years. Evidence of a prehistoric human presence on what is today the Norquest's farm includes an assortment of projectile points, a whelk shell, and a stone pestle collected over years of farming. The projectile point types found on the farm indicates continuous human presence from the Early Archaic to the Late Prehistoric (Figure 8) (Hernandez-Salinas et al. 2012:22-24). The closest point of the Rio Grande, the nearest source of running water, is 23 km away. There is a large northwest-southeast-oriented deflation trough within the defined collection catchment circle associated with this site (Figure 9). The flood map suggests that about 40 percent of the area contained within the collection catchment circle would have been under water following heavy rains.

Atwood Site

The Atwood family has farmed their land since the 1920s. Only one diagnostic Hidalgo point, dated to the Early Archaic period, has been found in their property (Figure 10) (Garcia et al. 2014). This point is made of the distinctive El Sauz chert, which outcrops 62 km west of the Atwood's farm in Starr County (Gonzalez et al. n.d.). The Atwood property is located 4 km due west from the Norquest farm, so the collection catchment circles for the two sites overlap. This site is located 21 km from the Rio Grande. There are several large and small troughs that retain water within the 5 km diameter circle around the site (see Figure 9).

Eubanks Site

The Eubanks have been in the citrus growing business since 1979. A large collection of whole and broken points has been recovered from their orchard. Like the Norquest family collection, the projectile points from the Eubanks farm spans the periods from the Early Archaic to the Late Prehistoric (Figure 11) (Bacha-Garza 2014). The citrus grove is located 25 km north of the Rio Grande. The associated collection catchment circle circumscribes two small troughs, and several others are just outside it (see Figure 9). The circle intersects the Atwood and the Norquest sites, suggesting that perhaps this area north of Edinburg was a favorite seasonal camp by many prehistoric groups.

Sekula Site

Danielle Sekula worked for many years as the entomologist for the Rio Queen Citrus Groves. She gathered and cataloged an impressive collection of projectile points in the Rio Queen orchard. The projectile point types in this collection date from the Early Archaic to the Late Prehistoric period (Figure 12) (Leal 2013). The Rio Grande flows 18 km from the Rio Queen orchard. Many small troughs are within an hour's walk from the site (Figure 13).

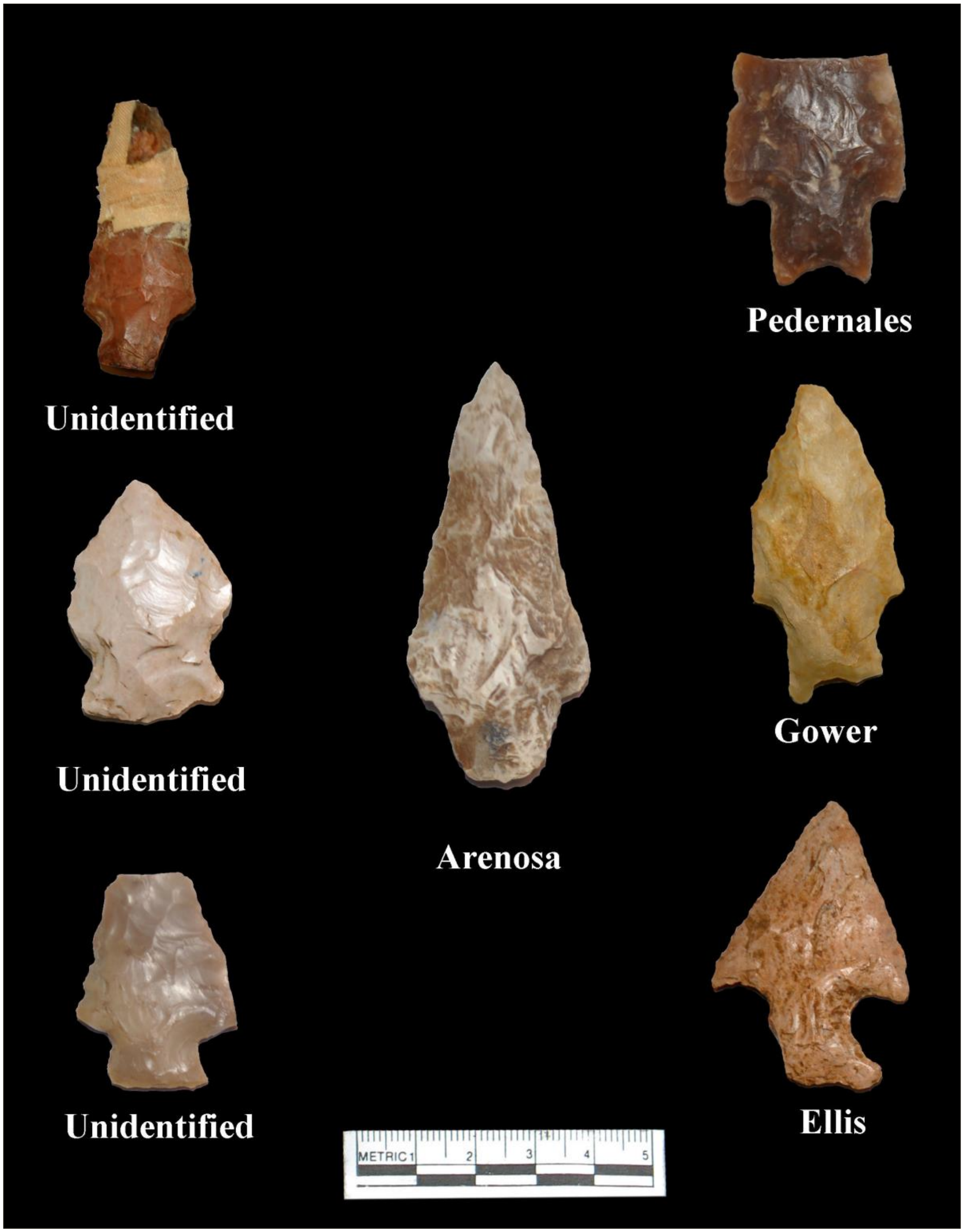

Figure 8. Selection of projectile points from the Norquest site spanning the Early Archaic to the Late Prehistoric. Early Archaic: Gower; Middle Archaic: Arenosa, Pedernales, and Ellis; Late Archaic: unidentified projectile points.

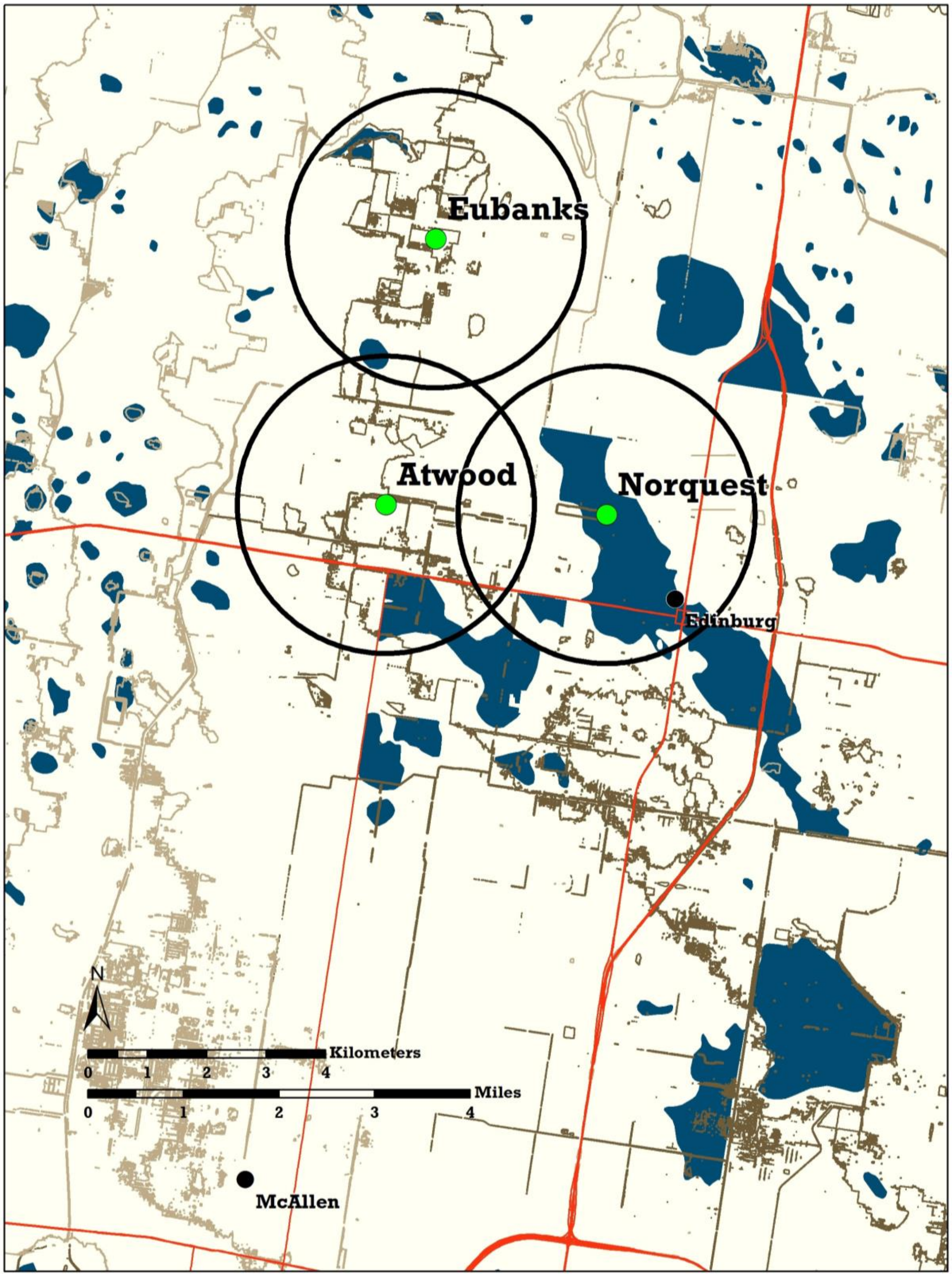

Figure 9. Collection catchment circles for the Norquest, Atwood, and Eubanks sites. All circles have a diameter of 5 km and represent a distance that can be easily covered in an hour's walk. Within the circles the flood map indicates that water can accumulate following heavy rain.

Figure 10. Hidalgo point from the Early Archaic period found by the Atwood family on their farm.

DISCUSSION

We draw three conclusions from the archeological record discussed above. First, there is evidence for a human presence in northern Hidalgo County, dating to as early as the Early Archaic period. This is an area far from the nearest source of running water, the Rio Grande. Second, deflation troughs known to have held fresh rainwater are widely distributed in this area. And third, newly identified single and multi-component archeological sites lie adjacent to these potential water sources associated with deflation troughs. Mallouf et al. (1977) acknowledged the role of deflation troughs in human occupation in the STSS and neighboring water-poor areas. Our findings lend further support to the hypothesis that these aeolian features, which have been a persistent element of the landscape on the STSS for most of the Holocene, were determinants of settlement and subsistence strategies, and thus, most of the evidence of widespread human occupation in the STSS and neighboring areas, even if it is in the form of sparse surface materials, owes it presence to deflation troughs.

Figure 11. Selection of projectile points from the Eubanks site spanning the Early Archaic to the Late Prehistoric periods: Early Archaic: Hidalgo; Middle Archaic: Tortugas; Transitional Archaic: Ensor; Late Prehistoric: Fresno, Caracara, Starr, Catan, and Padre.

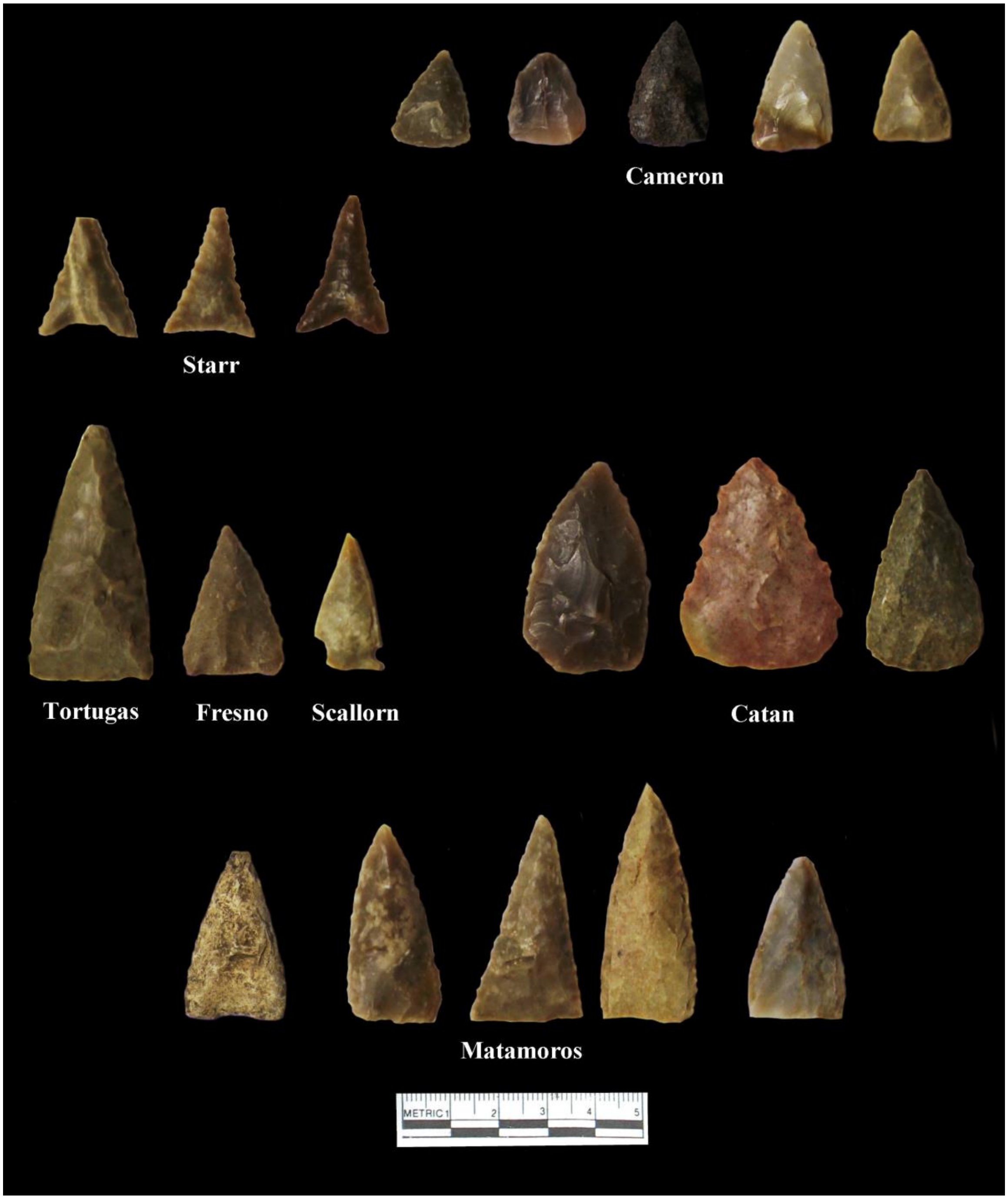

Figure 12. Selection of projectile points from the Sekula site spanning the Middle Archaic to the Late Prehistoric: Middle Archaic: Tortugas; Late Archaic: Catan and Matamoros; Late Prehistoric: Cameron, Fresno, Starr, and Scallorn.

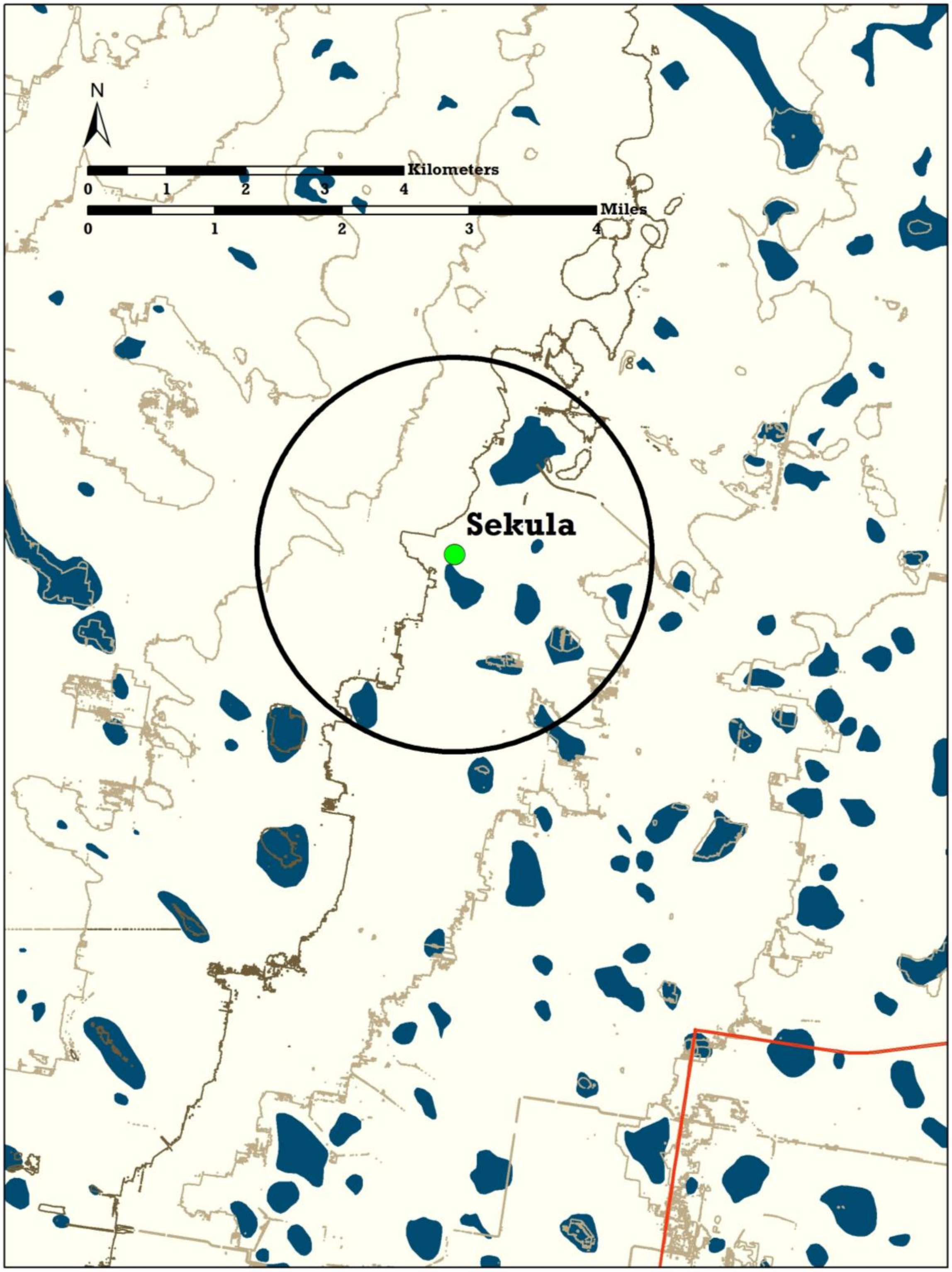

Figure 13. Sekula collection catchment circle. Many small troughs are found within the circle and at a short distance outside of it. Those fill with water following heavy rains.

Traversing the STSS in prehistoric times between the nearest sources of running water, the Rio Grande to the south and the Nueces River to the north, a distance of over 175 km, would have been possible only seasonally or after heavy rains. The only other prehistoric sources of water were seeps that originated from underground aquifers; Brune (2002) reported on a saline spring in Hidalgo County. Even today the unforgiving conditions of the STSS claim on average the lives of 100 immigrants who die of dehydration and exposure trying to cross it to enter the United States (*The Monitor*, May 18, 2014).

The lack of water, the high constant temperatures for eight months of the year, and the limited protection from sun exposure precluded year round use and occupation of the STSS. In our view the annual cycles of drought and high temperature that alternated with wetter periods and cooler temperatures favor the interpretation that prehistoric groups only made seasonal incursions into this harsh terrain and established temporary camps. This observation underlines Ricklis' (2004:180) interpretation of the fact that most investigations in the STSS show low densities of archeological material remains and thus suggest short-term occupations by highly mobile groups. The motivation to venture into the STSS and neighboring deflated areas for a stay, of few weeks to a few months, either from the Nueces River to the north or from the Rio Grande, would have been driven by the procurement of salt from one of the three salt lakes at the southern boundary of the STSS or for hunting and gathering forays. It is also possible that river flooding following episodes of heavy rain along the course of the Rio Grande encouraged prehistoric peoples to move temporarily into the STSS where they would find drier land as well as plant, animal, and water resources clustered at the deflation troughs.

If, as proposed by Forman et al. (2009), the onset of dune movement in the STSS most likely occurred between 2700 and 2000 B.P. with decreased ground cover probably caused by climatic fluctuations, then our findings of a number of Early and Middle Archaic points at or near the land surface in an area of deeply deflated bedrock but lacking moving sand, provides additional support to Mallouf et al. (1977) explanation regarding the sparse distribution of sites. Migrating aeolian deposits have effectively buried archeological sites of comparable ages in the STSS.

A century of commercial agriculture plowing and other surface altering activities has not completely obliterated the deflation troughs, which made feasible the prehistoric occupation of the STSS and areas peripheral to it. Building from the observations made by Mallouf et al. (1977) regarding the use of the STSS in prehistory and using a combination of intensive archeological and geological survey, oral history, GIS technology and existing soil maps, details of this occupation are being systematically salvaged and recorded before it is lost through development. Future research will focus on coring the organic-rich sediments that have been deposited in deflation troughs to obtain botanical macrofossils (seeds, pollen, or peat), and faunal remains that are dateable and can shed light on changing climatic conditions and plant and animal communities in the STSS and its margins.

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REFERENCES CITED

Bacha-Garza, R.

2014 *Tom Eubanks Collection: Arrow, Dart and Fragmented Projectile Points Found Within the Lower Rio Grande Valley Region*. CHAPS Special Report No. 5. CHAPS Program, the University of Texas-Pan American, Edinburg, Texas.

Bousman, C. B., S. A. Tomka, and G. L. Bailey

1990 *Prehistoric Archeology and Paleoenvironments in Hidalgo and Willacy Counties, South Texas: Results of the phase II test excavations*. Reports of investigations No. 76. Prewitt and Associates Inc., Austin.

Brown, L. F. and J. W. Macon

1977 *Environmental geologic atlas of the Texas coastal zone: Kingsville area*. Bureau of Economic Geology, The University of Texas at Austin.

Brown, L. F., J. L. Brewton, T. J. Evans, J. H. McGowen, W. A. White, C. G. Groat, and W. L. Fisher

1980 *Environmental geologic atlas of the Texas coastal zone-Brownsville-Harlingen area*. Bureau of Economic Geology, The University of Texas at Austin.

Brune, G. M.

2002 *Springs of Texas, Volume 1*. Texas A&M University Press, College Station.

Collins, M. B., G. D. Hall, and C. B. Bousman

1989 Archeological applications of geochronological techniques in southern Texas. *La Tierra* 16:14-27.

Collins, M. B., D. M. Yelacic, and C. B. Bousman

2011 "Realms," A Look at Paleoclimate and Projectile Points in Texas. *Bulletin of the Texas Archeological Society* 82:3-30.

Day, D.W., J. L. Day, and E. R. Prewitt

1981 *Cultural Resources Survey and Assessments in portions of Hidalgo and Willacy Counties, Texas*. Reports of Investigations No. 15. Prewitt and Associates Inc., Austin.

Fisk, H. N.

1959 Padre Island and the Laguna Madre flats, coastal south Texas. In *2nd Coastal Geography Conference* pp. 103-151. Louisiana State University, Baton Rouge.

Forman, S. L., L. Nordt, J. Gomez, and J. Pierson

2009 Late Holocene dune migration on the south Texas sand sheet. *Geomorphology* 108:159-170

Garcia, J. D., J. N. Alaniz, R. Garza, S. L. Lopez, D. E. Neal, A. Casiano, A. L. Aparicio, J. A. Hernandez, B. A. Martinez, J. P. Meave, M. A. Allen, N. Perez, R. Pena, R. C. Fink, and C. J. Newton

2014 Atwood acres: A Porción of Edinburg. Report Prepared for the Atwood Family and for the University of Texas-Pan American, Community Historical Archaeology Project with Schools Program. University of Texas-Pan American, Edinburg, Texas.

Gonzalez, J. L., J. Hinthorne, R. Skowronek, T. Eubanks, and D. Kumpe

n.d. Characteristics and genesis of El Sauz chert, an important prehistoric lithic resource in south Texas. *Lithic Technology*, in press.

Hall, G. D., M. B. Collins, and E. R. Prewitt.

1987 *Cultural Resources Investigations along Drainage Improvements, Hidalgo and Willacy Counties Texas: 1986 Investigations*. Reports of Investigations No. 59. Prewitt and Associates Inc., Austin.

Hernandez-Salinas, S. Flores, S. l., D. Nicholson, R. Silva, M. Vallejo, M. Noell, G. Waters, A. De La Fuente, G. Shwartz, O. Ysasi, P. Rodriguez, M. Martinez, E. Robles, R. Galloso, and M. Gutierrez

2012 The Norquest Family: A Porción of Edinburg. Report Prepared for the Norquest Family and for the University of Texas-Pan American, Community Historical Archaeology Project with Schools Program. University of Texas-Pan American, Edinburg, Texas.

Hester, T. R.

1981 Tradition and diversity among the prehistoric hunters and gatherers of southern Texas. *Plains Anthropologist* 26(92):119-128.

2004 The Prehistory of South Texas. In *The Prehistory of Texas*, edited by T. K. Perttula, pp. 127-151. Texas A&M University Press, College Station.

Jacobs, J. L.

1981 *Soil Survey of Hidalgo County, Texas*. United States Department of Agriculture, Soil Conservation Service in cooperation with the Texas Agricultural Experiment Station, Washington D.C.

Kibler, K.W.

1994 *Archeological and Geomorphological Investigations at Prehistoric Sites 41WY50 and 41WY60, Willacy County, Texas*. Reports of Investigations No. 95. Prewitt and Associates, Inc., Austin.

Leal, A.

2013 *Danielle Sekula Collection: Arrow, Dart and Fragmented Projectile Points Found Within the Lower Rio Grande Valley Region*. CHAPS Special Report No. 2. CHAPS Program, the University of Texas-Pan American, Edinburg, Texas.

Le Houerone, H. and Norwine, J.

1988 The ecoclimatology of south Texas. In *Arid lands: today and tomorrow*, edited by E. E. Whitehead, pp. 417-443. Westview Press, Boulder.

Mallouf, R. J., B. J. Baskin, and K. L. Killen.

1977 *A Predictive Assessment of Cultural Resources in Hidalgo and Willacy Counties, Texas*. Archeological Survey Report 23. Texas Historical Commission, Austin.

Norwine, J., R. Bingham, and V. Zepeda

1978 Twentieth century semiarid climates and climatic fluctuation in Texas and Northeastern Mexico. *Journal of Arid Environments* 1:313-325.

Price, W. A.

1958 Sedimentology and Quaternary Geomorphology of South Texas Gulf Coast. *Association of Geological Society Transactions* 3:41-75.

Ricklis, R. A.

2004 Prehistoric occupation of the central and lower Texas coast. In *The Prehistory of Texas*, edited by T. K. Perttula, pp. 155-180. Texas A&M University Press, College Station.

Ricklis, R. A. and K. A. Cox

1998 Holocene climatic and environmental change in the Texas coastal zone: some geoarchaeological and ecofactual indicators. *Plains Anthropologist* 43(164):125-136.

Russell, J. L.

1981 The south Texas Eolian sand sheet. In *Modern depositional environments of sands in south Texas*, edited by J. L. Russell and C. E. Sterling, pp. 43-46. Gulf Coast Association of Geological Societies, Corpus Christi, Texas.

Southern Regional Climate Center

2014 Texas Normal Monthly Precipitation webpage, Texas. http://www.srcc.lsu/southernClimate/atlas/images/TXprcp.html

Suhm, R. W.

1980 The La Paloma mammoth site, Kenedy County, Texas. In *Papers on the Archaeology of the Texas Coast*, edited by L. Highley and T. R. Hester, pp. 79-103. Special Report No 11. Center for Archaeological Research, The University of Texas at San Antonio.

The Monitor

2014 Webpage, http://www.themonitor.com.

Texas Coastal Sand Sheet Wetlands

2014 Texas A&M Agrilife Extension. Webpage, http://texaswetlands.org/wetland-types/texas-coastal-sand-sheet-wetlands/.

Turner, E. S., T. R. Hester, and R. L. McReynolds

2011 *Stone Artifacts of Texas Indians*. Taylor Trade Publications, Lanham, Maryland.

A PRECISE CHRONOLOGY OF MIDDLE TO LATE HOLOCENE BISON EXPLOITATION IN THE FAR SOUTHERN GREAT PLAINS

Jon C. Lohse, Brendan J. Culleton, Stephen L. Black, and Douglas J. Kennett

ABSTRACT

In regions on the margins of the Great Plains grasslands, documenting the intermittent history of bison exploitation has presented challenges to archeologists. Chronologies based on archeological associations have long been useful in regional research, but can be imprecise and of inadequate resolution for constructing precise sequences of prehistoric events. Here, we present a record of directly dated bison from archeological contexts spanning the last 6000 years on the very southern extent of the Great Plains. This study includes 61 specimens from archeological contexts that were dated by XAD purified AMS radiocarbon, with reported errors of only 15-20 14C years for most dates. The resulting record of bison exploitation for this area defines four main periods (Calf Creek, Late Archaic 1 and 2, and early Toyah) during which bison were exploited. Several dates also indicate an early historic presence of bison; this period may represent a late facet of the Toyah horizon. This study adds significant chronological resolution to the regional record of bison in parts of Texas and begins to help correlate cultural chronologies with important climatic data. It also points to the research value of obtaining additional directly dated bison samples from temporally and geographically diverse archeological contexts in our study area and beyond.

INTRODUCTION

The North American genus *Bison* was among the very top-ranked resources available to hunter-gatherers up to and even following the arrival of European explorers. Millennia of bison hunting on the Plains are documented from Early Paleoindian times onward (Bamforth 1988, 2011; Bement and Buehler 1994; Bozell et al. 2011; Carlson and Bement 2013; Cooper 2008; Frison 1991, 1998, 2004; Guthrie 1980). In Late Prehistoric times, agriculturalists in the American Southwest and Mississippi River drainages to the east often hunted bison or traded for their products, bringing them into frequent contact with Plains tribes (Creel 1991; Spielmann 1991; Speth 2004; Speth and Newlander 2012; Vehik 1990, 2002). Bison exploitation, for meat and other uses, has played a significant role in shaping prehistoric and early historic economies across the Plains. As a top-ranked food resource, the

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presence of bison would have had tremendously important implications for prehistoric subsistence practices, mobility, the organization of labor, and other social characteristics.

While bison were present almost continuously in the cool, predominantly C_3 grasslands of the Northern Plains, only occasionally in the Middle to Late Holocene periods did they extend into other environments characterized by mixed grasslands or other habitats. These areas include parts of the Great Basin (Grayson 2006), northern Mexico (List et al. 2007), and the southern limits of the Plains that include Central and coastal Texas (Baugh 1986; Dillehay 1974; Huebner 1991; Lynott 1979; Mauldin et al. 2012; Ricklis 1992). Understanding precisely when bison were present in regions located around the periphery of the Plains is important not only for our general knowledge regarding bison ecology, climate, and environmental change in North America, but also for providing insights into human responses during these periods.

In this study, we present and evaluate AMS radiocarbon data for 61 XAD purified samples of bison bone recovered from archeological contexts at seven sites located in Central and South Texas. The culture history of these areas shares much with Plains traditions to the north during some time intervals, while maintaining their own distinct patterns during others (Collins 1995, 2004; Hester 2004; Lohse et al. 2014a). Precisely defining periods when bison were present in these areas has been a challenge, largely as a result of the traditional reliance on dating bison by association with other archeological remains. Our approach involves directly dating bison from archeological contexts as a way to avoid the imprecision that can result from dating by association. The resulting chronology defines four primary periods of prehistoric bison exploitation beginning around 6000 cal B.P. and also indicates an early Historic use by North American Indians. Earlier periods of bison presence remain to be worked out for these areas, ideally using a similar methodology to the one we discuss herein. This precise chronology not only clarifies regional prehistoric subsistence and related technological practices, but can also help researchers correlate cultural developments with environmental or paleoclimatic data that may be associated with periods of rapid cultural change.

DATING BISON IN THE STUDY AREA AND THE PRESENT SAMPLE

Beginning with Dillehay (1974), many investigators have examined the issue of bison presence in the region (Baugh 1986; Collins 1995; Huebner 1991; Lynott 1979; Mauldin et al. 2012; Quigg 1997; Ricklis 1992). These studies commonly evaluate the presence of bison at a regional scale based on archeological components that are themselves dated by radiocarbon or by cross-dating using associated time-marker artifacts (Table 1). Typically, bison presence is modeled as a series of long periods of presence or absence, the beginnings and endings of which are imprecisely dated.

In contrast to regional models, single-site records (such as the one at Wilson-Leonard, 41WM235 [Collins 1998]), where bison were not present for certain intervals when they appear elsewhere, exemplify the limitations of site-specific studies. A given site's stratigraphy may be compressed or mixed, affecting an analysts' ability to precisely reconstruct periods of bison exploitation. This condition most directly and adversely affects bison chronologies that rely on archeological association. In other cases, a single site's occupation history may not include periods during which bison were present nearby. For example, Bonfire Rockshelter (41VV218) offers a fascinating record of bison hunting during certain periods in the Lower Pecos of southwest Texas, including Late Archaic,

Table 1. Some models of bison presence and visibility in the study region.

Southern Plains (Dillehay 1974)	Central Texas (Mauldin et al. 2012)		Wilson-Leonard (Sichler et al. 2011, from data by Baker 1998)	
Presence Period 3 800 B.P.	473.8 avg. NISP/ component	700-400 B.P.	18 NISP/ component	1700-4200 B.P.
Absence Period 2 1500-800 B.P.	2.9 avg. NISP/ component	1250-700 B.P.	1 NISP/ component	4200-5200 B.P.
Presence Period 2 4500-1500 B.P.	7.3 avg. NISP/ component	1600-1250 B.P.	59 NISP/ component	>11,000-9000 B.P.
Absence Period 1 ca. 7000 B.P.-4500 B.P.	316.9 avg. NISP/ component	2500-1600 B.P.		
Presence Period 1 >11,000-7000 B.P.	6.0 avg. NISP/ component	4450-2500 B.P.		

Folsom, and perhaps Clovis times (Bement 1986; Dibble and Lorrain 1968). However, this record does not include bison remains from the Calf Creek horizon, material traces of which are reported in nearby Eagle Cave (41VV167, Ross 1965) as well as from Jeff Davis and Brewster counties some 150 km to the west (Gray 2013; Walter 2013), indicating that the record at Bonfire Rockshelter does not completely reflect the character of regional bison histories.

Our study draws from several sites geographically dispersed across a wide area. We do not imply that our study area corresponds with any particular archeological region(s). Indeed, the size of what might be called a "bison catchment" that is represented by this study is not precisely known. However, previous research indicates the potential size of prehistoric bison ranges. Carlson and Bement (2013) estimate mobility ranges from ca. 100 km (Clovis times) to up to ca. 600 km (late Folsom times) in diameter in an area centered on Oklahoma that includes southern Kansas, the Texas Panhandle, and eastern New Mexico. Widga et al. (2010) reconstruct inter-annual movements of ≤500 km over a period of about 4-5 years for Early/Middle Holocene (ca. 7-8.5 ka) bison in the eastern Great Plains of eastern Nebraska, South Dakota, western Iowa, and southwest Wisconsin. An area of ca. 600 km in diameter easily encompasses all of the sites from which samples in this study were taken (Figure 1).

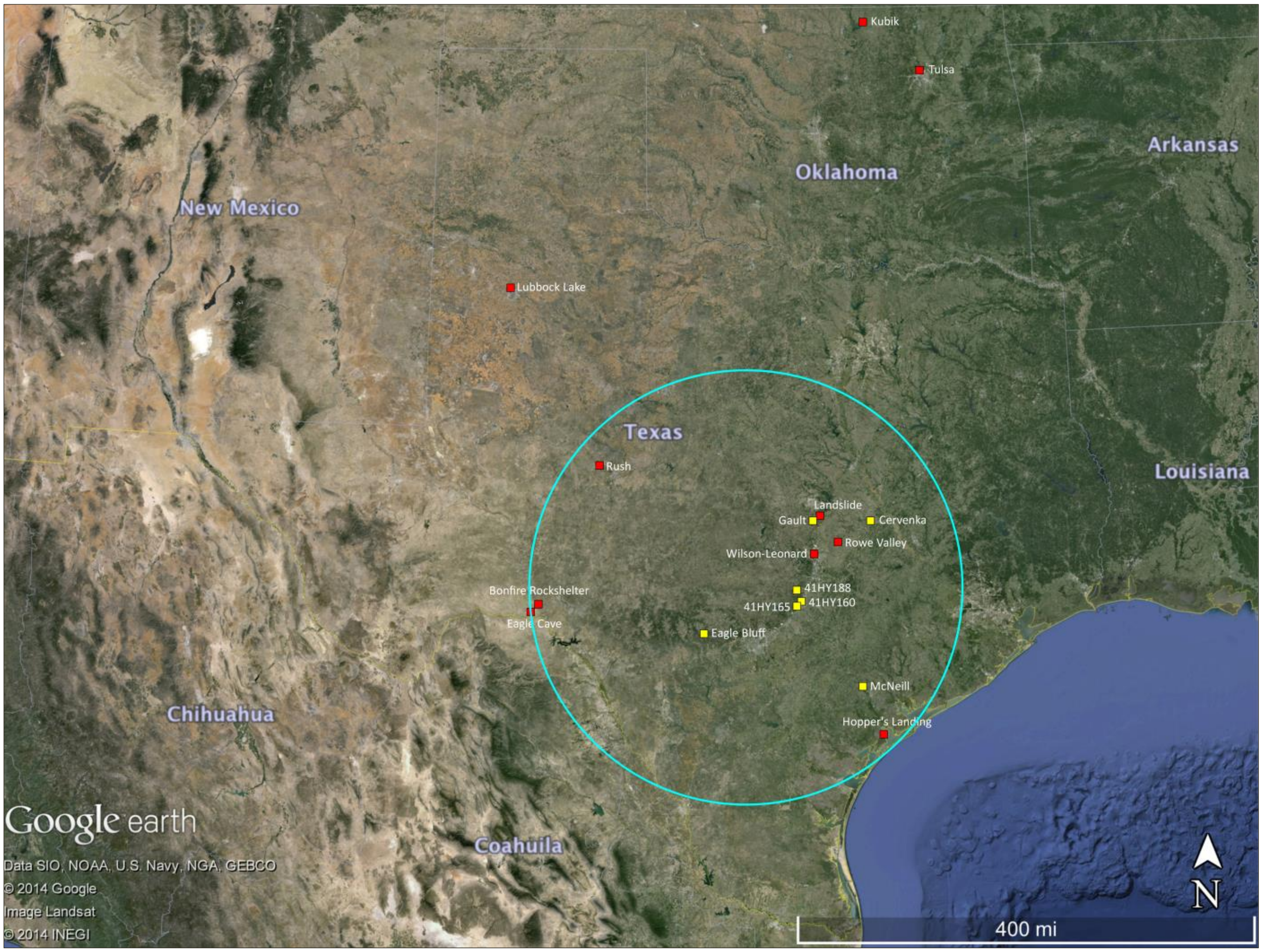

Figure 1. 600 km diameter study area illustrating the distance prehistoric herds may have travelled if they maintained mobility patterns comparable to those reconstructed elsewhere in North America. Sites dated in this study are shown in yellow; other sites discussed in the text are shown in red.

The presence of bison in the archeological record is, first, the result of environmental process and, second, a reflection of hunter-gatherer behavior. The key to building reliable bison chronologies, therefore, involves the number of temporal components that are sampled (i.e., selected for direct dating) within a given bison range. We propose that bison histories can be accurately reconstructed using sites with intermittent occupation records, so long as each period of bison presence in the total study area is well represented in at least one site's deposits. Alternatively, large portions of a bison chronology can also be compiled from a small number of sites, assuming that each period during which bison were present on the landscape is represented in site components and has been sampled. In this approach, compiling a large number of assays (i.e., high sample density) helps to ensure that all or most intervals of bison presence within the region are included. A weakness of this approach is that the geographic limits of bison territorial ranges will likely remain poorly known until sampling densities clearly define the geographic limits for each temporal period of bison presence.

Minimally, the patterns presented below are valid for the sites and time periods included in our study. Although we consider it likely that these patterns reflect larger-scale trends across a much broader area, only future sampling following the methods we employ here can precisely identify the extent of territorial ranges that are associated with the temporal periods in our chronology. For example, reports of bison presence throughout the Holocene at Lubbock Lake (41LU1) (Johnson 1987; Johnson and Holiday 1987) seem to suggest that the chronology presented here does not extend to the Texas Panhandle (see Figure 1).

Our sample draws heavily from 41HY160 and HY165, sites that are associated with Spring Lake, formed by impounded freshwater springs at the headwaters of the San Marcos River in Hays County, Texas. Based on temporally diagnostic artifacts and radiocarbon data (Figure 2), the Spring Lake sites exhibit a nearly continuous record of occupation from Clovis to historical periods (Lohse 2013). These sites are important to this study because their essentially continuous sequence means that remains of bison, as a top-ranked food resource, should be expected to occur whenever bison were present on the surrounding landscape. The occupation record of these sites distinguishes them from others, like Bonfire, with intermittent histories of site use. Controlled excavations at Spring Lake have generally not extended below the Early Archaic archeological deposits and intensive archeological sampling has only been conducted to ca. 6000 cal B.P. depths (Lohse et al. 2013), which represents the temporal limit of our study. Another site (41HY188) is less than 5 km from Spring Lake and evidences Late Prehistoric and Late Archaic occupation associated with bison (Bettis 1996). Two other specimens come from Eagle Bluff (41ME147) in Medina County (Hester 2010, 2011), one from Gault (41BL323) in Bell County, two from McNeill (41VT141) in Victoria County, and one from Cervenka (41WM267) in Williamson County (Peter et al. 1982). Each site contains deep, multi-component deposits in stratified alluvial settings, and is interpreted as a long-term encampment, making it unlikely that bison were killed at any of these locations. Rather, butchered remains were likely transported from kill sites back to these occupation areas for additional processing.

Assemblages from 41HY160, 41HY165, and 41HY188 were examined for bison remains suitable for dating. Virtually all specimens identified as bison were fragmented to the point that age and sex could not be consistently estimated. Therefore, no age and sex data are presented for the bison from any of our study sites. All cataloged contexts were evaluated, and specimens were selected from as many different proveniences by depth and site area as possible. Through this approach, every time period characterized by bison presence (and sampled by controlled excavation) had an equal chance of being identified. As noted, high sampling density was a priority in order to better model periods of bison presence. Samples were included from the other sites based on accessibility, preservation, and the limits of available funding.

Selected specimens were pre-treated for collagen extraction and purification using a XAD process modified from earlier work by Stafford that isolates individual amino acid chains (Stafford et al. 1988, 1991). Two modern approaches to removing exogenous carbon from bone collagen samples have been developed and refined over the last two decades: modified Longin (1971) extraction with *ultrafiltration* (Brown et al. 1988) and *XAD-purification* (Stafford et al. 1988, 1991). Ultrafiltration works

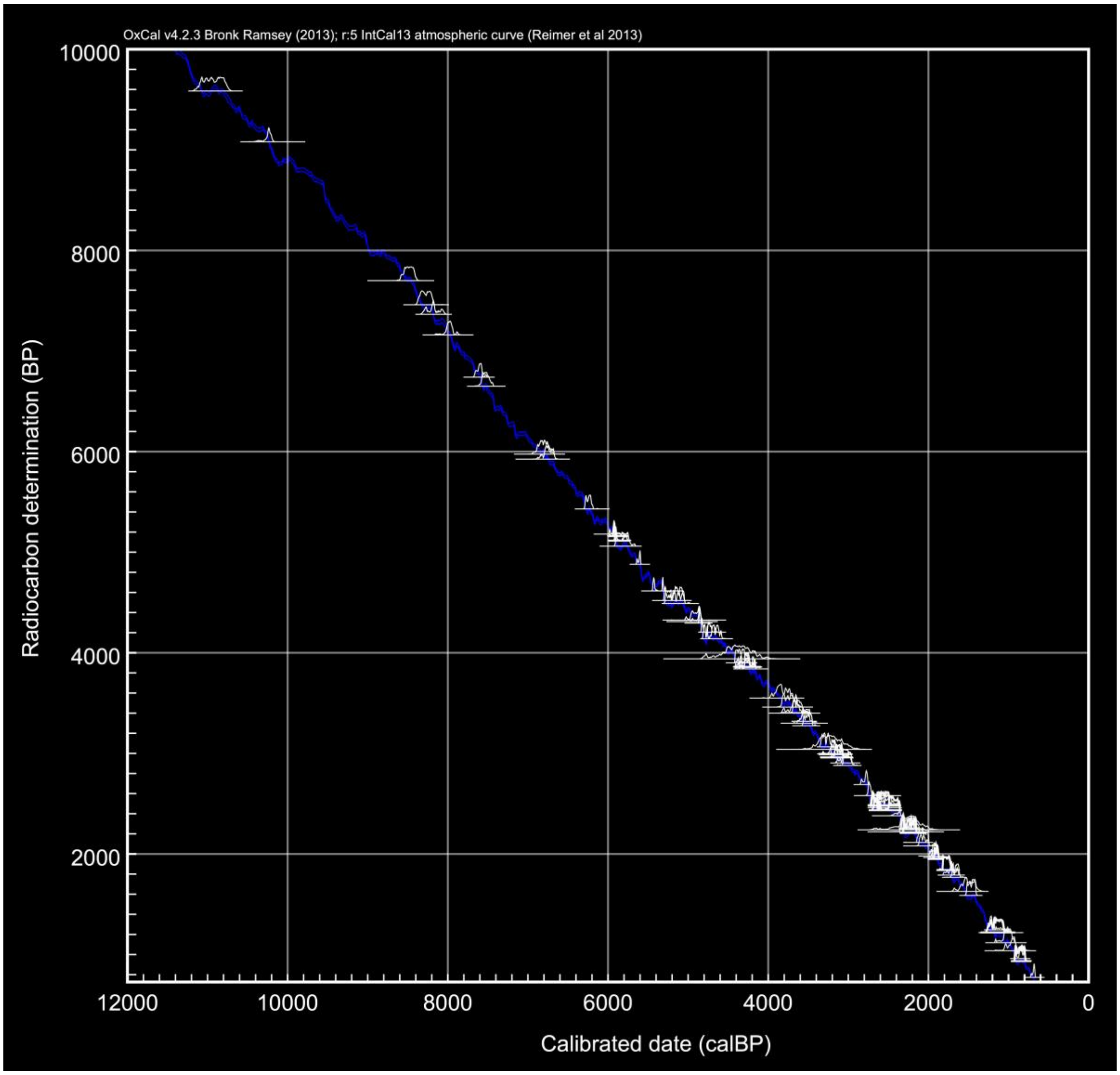

Figure 2. Calibrated results of 94 radiocarbon dates from Spring Lake, showing the nearly continuous occupation record extending to just after 6000 cal B.P. and the subsequent decline of dates that reflects the limits of controlled excavations. Two older dates not from archeological contexts are excluded (redrawn from Lohse 2013:Figure 4-1).

by retaining long-chain gelatin molecules (typically larger than 30kDa) and filtering out smaller, potentially degraded gelatin molecules and contaminating humates smaller than 30kDa. The lower yield of datable gelatin that results from ultrafiltration can limit its use on very poorly preserved bone (e.g., in cases where little or no long-chain protein survives), but smaller chains may be recoverable. One advantage of the modified XAD method is that all of the crude gelatin extracted from the bone can be processed for stable isotope measurement and AMS ^{14}C dating. Another advantage is that exogenous carbons that can remain following ultrafiltration treatments are removed, ensuring greater accuracy of measured ages.

Stafford et al. (1988, 1991) argued that gelatinization as described by Longin (1971) is not adequate to disassociate all humic and fulvic acids bound to collagen and that contaminants may cross-bind with smaller degraded collagen chains to create longer chains that would be retained in the filter. Our approach to eliminating these contaminants is to break the collagen down to individual amino acids by hydrolysis in concentrated (6N) HCl, thereby releasing humic and fulvic acids into solution. Polar contaminants are then removed from the solution by chromatography using a column filled with XAD resin. The method used in this study is adapted from that of Stafford et al. (1988, 1991). Similar methods of XAD amino acid dating has been used to reliably reevaluate pre-Clovis, Clovis, and other Early Paleoindian chronologies in North America (Waters and Stafford 2007, 2014; Waters et al. 2011) by dating osseous remains and artifacts clearly associated with Terminal Pleistocene cultural deposits.

At the Human Paleoecology and Isotope Geochemistry Lab at Pennsylvania State University, each sample was cleaned and sectioned with disposable Dremel cut-off wheels and then demineralized in 0.5 N HCl for two to three days at 5°C. The demineralized collagen pseudomorph was then gelatinized at 60°C in 4-5 mL 0.01N HCl for eight to 10 hours. Sample gelatin was pipetted into a pre-cleaned 10ml disposable syringe with an attached 0.45 μm Millex Durapore PVDF filter (precleaned with methanol and Nanopure H_2O) and driven into a thick-walled culture tube. The filtered solution was then lyophilized and percent gelatinization and yield determined by weight. The sample gelatin was then hydrolyzed in 2mL 6N HCl for 22 hours at 110°C. Supelco ENVI-Chrom® SPE (Solid Phase Extraction; Sigma-Aldrich) columns were prepped with two washes of methanol (2mL) and rinsed with 10ml DI H_2O. With a 0.45 μm Millex Durapore filter attached, the SPE Column was equilibrated with 50mL 6N HCl and the washings discarded. 2 mL collagen hydrolyzate as HCl was pipetted onto the SPE column and driven with an additional 10ml 6N HCl dropwise with the syringe into a 20 mm culture tube. The hydrolyzate was finally dried into a viscous syrup by passing UHP N_2 gas over the sample heated at 50°C for ca. 12 hr.

Stable carbon and nitrogen isotope measurements, %C and %N, were determined on amino acid hydrolyzate samples (~0.7 mg) at the University of California, Irvine Keck Carbon Cycle Accelerator Mass Spectrometer facility, on a Fisons NA1500NC elemental analyzer/Finnigan Delta Plus isotope ratio mass spectrometer with a precision of <0.1‰ for $\delta^{13}C$ and $\delta^{15}N$. Only samples with atomic C:N ratios between 3.0-3.4, indicative of good collagen preservation (Ambrose and Norr 1992; DeNiro 1985; van Klinken 1999), were submitted for AMS ^{14}C dating and are included in this study. AMS samples (~4.0 mg) were combusted for three hours at 900° C in vacuum-sealed quartz tubes with CuO wire and Ag wire to produce sample CO_2. Sample CO_2 was reduced to graphite at 550°C using H_2 and a Fe catalyst, with reaction water drawn off with C-9 Mg $(ClO_4)_2$ (Santos et al. 2004). Graphite samples were pressed into targets in Al boats and loaded on a target wheel with OX-1 (oxalic acid) standards, known age bone secondaries, and a ^{14}C-free Pleistocene whale blank. The ^{14}C measurements were made on a modified National Electronics Corporation compact spectrometer with a 0.5MV accelerator (NEC 1.5SDH-1). Analytical error in the 2-3‰ range was achieved, which for the current study translates to standard deviations in the range of ± 15-20 ^{14}C years. Radiocarbon ages were $\delta^{13}C$-corrected for mass dependent fractionation with $\delta^{13}C$ values measured on the AMS (Stuiver and Polach 1977), and compared with samples of Pleistocene whale bone (background, >48k ^{14}C B.P.), a ca. 12400 ^{14}C B.P. horse bone, ca. 1840 ^{14}C B.P. bison bone, late A.D. 1800s cow bone, and OX-1 oxalic acid standards for calibration. All dates are calibrated with the IntCal13 curve (Reimer et al. 2013) using OxCal 4.2 (Bronk Ramsey 2010) and are presented in calibrated years before present (cal B.P.). In order not to imply undue precision, all results are rounded to the nearest five-year interval (Table 2).

Regarding data presented in Table 2, a small number (n=4) of statistical outliers are present in our sample. Statistical outliers in each temporal period that contain five or more specimens are those samples with $\delta^{13}C$ values more than 1.5 times the interquartile range below the first quartile or higher than the third quartile (Fenner 2007). These specimens are identified in Table 2 as having very low (negative) $\delta^{13}C$ values. No statistical outliers were identified based on $\delta^{15}N$. Outliers such as these are often reported from archeological bison herds such as at Folsom (Meltzer 2006:Table 6.19) and Jones-Miller (Tieszen et al. 1997), and elsewhere we have speculated that these may represent sexually mature bulls that had migrated into the study area from elsewhere (Lohse et al. 2014b). We are not aware of any research to date that has focused specifically on explaining or interpreting these outliers, but they are not uncommon in archeological studies of prehistoric bison isotopes.

We define periods of bison presence (also called temporal groups) based on the clustering of calibrated ^{14}C dates. In addition to standard calibration we calculate the duration of each period as the *Difference* of the earliest and latest samples in each group using OxCal, and summarize the range with means of those dates. Because we are unlikely to have directly dated the earliest or latest bison for any of our temporal groups, future dating is likely to affect the span of one or more groups. OxCal's *Sum* command is used to visually summarize the distributions within each group of dates, but this is merely a heuristic rather than an analytical tool. Because of the high density of samples taken from 41HY160, 41HY165, and 41HY188, it is possible that the same animals from these sites may have been dated more than once. If such cases exist, however, they do not adversely affect our chronology, since assays are only used to indicate when bison were hunted, and are not used to reconstruct herd population dynamics. Evaluating the individual carbon and nitrogen isotope measurements for each sample (shown in Table 2) shows that no two samples returned the same radiocarbon and isotope values. This suggests that any duplicate measurement of the same animal is minimal.

As noted, one result of our analytical approach is that the resulting chronology has greater precision than temporal models based on traditional (i.e., non-pretreated) bone dating and/or those relying on archeological association. While such methods have long provided useful information about the general timing of events, they are not well suited for addressing the precise timing of prehistoric events or when researchers are interested in documenting periods of rapid or punctuated cultural adaptations. Precise chronologies, sometimes also called "short chronologies" (e.g., Denham et al. 2012; Kennett et al. 2011, 2014; Tzedakis 2003; Wilmshurst et al. 2011) because they cover shorter spans of time than "long chronologies" of the same phenomena, are based on careful selection and AMS ^{14}C measurement of short-lived, pretreated species that minimizes the difference between the dated and target events. This approach can be differentiated from simple "dating," which might include no particular strategy to help ensure greater chronometric precision, and "high precision" dating, which we see as efforts that begin with the kind of sample selection and treatment we use but that also employ appropriate statistical manipulation, such as Bayesian statistics, of constrained data

Table 2. XAD-purified bison dates by lab number and provenience and stable isotope measurements discussed in this study. All dates are calibrated using IntCal13 (Reimer et al. 2013) (from Lohse et al. 2014b:Table 2).

UCIAMS Number	Provenience	C:N Ratio	^{14}C Age	delta^{15}N	delta^{13}C	2σ calibrated range (cal BP)
29246	41VT141, Area B, N376, E826, level 10	3.26	190 ± 20	5.5	-7.8	290-265 (19.6%), 215-145 (52.9%)
81005	41HY165, Unit 2, level 7	3.16	215 ± 15	8.6	-11.1	300-275 (34.5%), 175-150 (50.2%)
81002	41HY165, Unit 2, level 2	3.14	250 ± 15	8.9	-9.4	310-285 (86.7%), 165-155 (8.7%)
87921	41HY160, Unit 4, level 3	3.16	275 ± 15	6.9	-14.3	425-395 (27.6%), 320-290 (67.8%)
106463	41HY160, Unit 3, level 5	3.03	515 ± 15	6.72	-11.51	545-515
129247	41VT141, Area 5(B), N376, E826, Feature 2, level 10	3.26	515 ± 15	5.5	-7.8	545-515
81003	41HY165, Unit 2, level 3	3.14	520 ± 15	5.3	-9.0	545-515
80131	41HY165, Unit 7, level 2	3.16	535 ± 20	6.2	-9.8	625-605 (11.8%), 555-515 (83.6%)
87940	41HY188, Unit 35 SE, level 5	3.16	535 ± 15	5.9	-8.7	620-610 (4.6%), 555-520 (90.8%)
87929	41HY188, Unit 4, level 5	3.21	540 ± 15	5.7	-9.4	620-610 (10.0%), 555-520 (85.4%)
87926	41HY188, Unit 1 NE, level 4	3.21	545 ± 15	6.4	-10.8	625-605 (17.5%), 560-525 (77.9%)
87932	41HY188, Unit 11 NE, level 4	3.17	545 ± 15	6.1	-9.6	625-605 (17.5%), 560-525 (77.9%)
87928	41HY188, Unit 4 NW, level 3	3.19	545 ± 15	7.9	-10.2	625-605 (17.5%), 560-525 (77.9%)
87937	41HY188, Unit 22 SW, level 11	3.19	545 ± 15	6.2	-9.3	625-605 (17.5%), 560-525 (77.9%)
81007	41HY165, Unit 11, level 3	3.15	555 ± 15	6.7	-8.9	630-600 (34.7%), 560-530 (60.7%)

UCIAMS Number	Provenience	C:N Ratio	^{14}C Age	delta^{15}N	delta^{13}C	2σ calibrated range (cal BP)
87930	41HY188, Unit 6 NE, level 8	3.15	555 ± 15	8.4	-10.5	630-600 (34.7%), 560-530 (60.7%)
111183	41ME147, N807 E629, level 3	3.07	560 ± 15	5.5	-8.6	630-600 (42.7%), 560-530 (52.7%)
80133	41HY165, Unit 7, level 4	3.11	565 ± 20	4.6	-7.3	635-595 (51.8%), 560-530 (43.6%)
87927	41HY188, Unit 2 SW, level 3	3.19	570 ± 15	5.9	-10.2	635-595 (56.1%), 560-535 (39.3%)
80132	41HY165, Unit 2, level 4	3.12	575 ± 20	5.1	-9.6	640-590 (61.2%), 565-535 (34.2%)
87935	41HY188, Unit 22 SE, level 5	3.21	580 ± 15	6.1	-10.9	635-590 (65.4%), 565-540 (30.0%)
87931	41HY188, Unit 7 NW/NE, level 3	3.19	580 ± 15	6.7	-10.2	635-590 (65.4%), 565-540 (30.0%)
87936	41HY188, Unit 22 NE, level 10	3.23	585 ± 15	6.1	-9.7	640-590 (68.5%), 565-540 (26.9%)
87933	41HY188, Unit 11 NE, level 5	3.21	595 ± 15	5.9	-10.2	645-585 (73.6%), 565-545 (21.8%)
80134	41HY165, Unit 11, level 7	3.12	2205 ± 20	6.6	-8.5	2310-2150
80137	41HY160, Unit 10, level 7	3.13	2210 ± 20	5.7	-7.6	2310-2155
80135	41HY160, Unit 13, level 5	3.12	2255 ± 20	5.5	-8.4	2345-2305 (41.3%), 2245-2180 (51.4%), 2170-2160 (2.7%)
87925	41HY160, Unit 23 SE, level 10	3.19	2270 ± 15	5.2	-8.6	2345-2305 (73.1%), 2235-2185 (22.3%)
87922	41HY160, Unit 4, level 8	3.26	2275 ± 15	5.0	-9.3	2350-2305 (82.4%), 2230-2205 (12.3%), 2195-2190 (0.7%)
106470	41HY160, Unit 3, level 14	3.04	2415 ± 20	7.4	-14.5	2680-2665 (2.1%), 2655-2645 (2.5%), 2490-2355 (90.8%)
87920	41HY160, Unit 1, level 2	3.21	2460 ± 15	6.0	-8.2	2705-2630 (41.5%), 2620-2560 (20.3%), 2545-2430 (32.8%), 2390-2385 (0.8%)
81004	41HY165, Unit 3, level 8	3.29	2460 ± 25	5.1	-9.0	2705-2630 (31.8%), 2620-2380 (63.6%)

UCIAMS Number	Provenience	C:N Ratio	^{14}C Age	delta^{15} N	delta^{13}C	2σ calibrated range (cal BP)
87938	41HY188, Unit 23 SE, level 8	3.22	2470 ± 15	6.3	-8.6	2705-2630 (37.9%), 2620-2465 (57.5%)
87923	41HY160, Unit 6, level 10	3.20	2470 ± 15	5.6	-8.9	2705-2630 (37.9%), 2620-2465 (57.5%)
81006	41HY165, Unit 3, level 6	3.18	2475 ± 15	5.9	-8.1	2710-2485
106465	41HY160, Unit 3, level 6	3.05	2475 ± 20	5.3	-8.05	2715-2465
87924	41HY160, Unit 6, level 11	3.18	2480 ± 15	5.1	-8.4	2710-2490
87934	41HY188, Unit 20, level 12	3.21	2480 ± 15	5.6	-8.4	2710-2490
106464	41HY160, Unit 3, Level 6	3.08	2480 ± 15	5.41	-9.19	2710-2490
106471	41HY160, Unit 4, level 7	3.07	2490 ± 20	6.57	-9.25	2720-2650 (21.8%), 2645-2490 (73.6%)
80138	41HY160, Unit 13, level 13	3.11	2955 ± 20	5.5	-7.8	3210-3200 (1.1%), 3180-3060 (93.0%), 3050-3040 (1.2%)
80130	41HY165, Unit 8, level 11	3.15	2965 ± 20	5.1	-8.4	3210-3190 (4.4%), 3185-3065 (91.0%)
80140	41HY160, Unit 13, level 13	3.12	2985 ± 20	5.4	-9.5	3225-3075
87939	41HY188, Unit 25, level 14	3.24	2995 ± 15	5.2	9.3	3230-3140 (88.2%), 3130-3115 (2.8%), 3095-3080 (4.3%)
80129	41HY165, Unit 3, level 7	3.12	3000 ± 20	5.6	-7.8	3320-3310 (1.7%), 3240-3140 (85.4%), 3130-3110 (3.8%), 3095-3080 (4.4%)
106472	41HY160, Unit 4, level 7	3.11	3000 ± 20	7.18	-8.77	3320-3310 (1.7%), 3240-3140 (85.4%), 3130-3110 (3.8%), 3095-3080 (4.4%)
129245	41BL323, N1161, E1081, 94.4-94.37 elevation	3.32	3000 ± 15	5.6	-8.3	3235-3140 (91.6%), 3125-3115 (1.3%), 3095-3080 (2.5%)
95718	41HY165, Unit 11, level 10	3.24	3065 ± 15	4.9	-20.0	3350-3225

UCIAMS Number	Provenience	C:N Ratio	^{14}C Age	delta^{15} N	delta^{13}C	2σ calibrated range (cal BP)
80999	41HY160, Unit 9, level 14	Too small	5060 ± 40	-	-	5910-5715
95717	41HY160, Unit 14, level 13	3.21	5110 ± 15	8.1	-10.7	5915-5885 (47.2%), 5820-5760 (48.2%)
80139	41HY160, Unit 7, level 14	3.14	5115 ± 20	6.8	-9.8	5920-5880 (48.4%), 5825-5755 (47.0%)
80136	41HY160, Unit 7, level 15	3.15	5120 ± 20	9.3	-9.6	5925-5885 (56.4%), 5820-5760 (39.0%)
80998	41HY160, Unit 7, level 14	3.13	5120 ± 20	8.5	-10.5	5925-3935 (56.4%), 5820-5760 (39.0%)
129248	41WM267, Area D, E-6, level 120-121, 93.3-93.2 elevation	3.28	5135 ± 20	5.7	-8.6	5935-5890 (81.4%), 5810-5765 (14.0%)
106473	41HY160, Unit 13, level 13	3.14	5140 ± 20	9.38	-11.9	5935-5890 (87.3%), 5805-5770 (8.1%)
106468	41HY160, Unit 3, level 14	3.11	5140 ± 20	7.43	-19.0	5935-5890 (87.3%), 5805-5770 (8.1%)
106469	41HY160, Unit 3, level 14	3.17	5145 ± 20	9.59	-11.9	5940-5890 (91.3%), 5805-5795 (1.8%), 5785-5770 (2.3%)
81000	41HY160, Unit 16, level 13	3.25	5155 ± 15	8.7	-11.1	5935-5900
81001	41HY160, Unit 16, level 13	3.19	5165 ± 15	8.3	-11.5	5980-5980 (1.8%), 5940-5905 (93.6%)
80997	41HY160, Unit 7, level 9	3.12	5180 ± 15	8.5	-9.4	5990-5970 (16.4%), 5945-5910 (79.0%)
111182	41ME147, N802 E631, level 4	3.46	5205 ± 20	3.6	-16.7	5990-5920

to construct or build chronological models characterized by greatly reduced age range probabilities. While this study focuses on precisely dating bison, we include an example of high-precision chronology, below, based on our work with the Calf Creek archeological component at Spring Lake.

RADIOCARBON RESULTS

Prehistoric bison exploitation is dated to four main periods in our study area, the first lasting from ca. 5955-5815 cal B.P.; the second and third involving two pulses between 3295-3130 cal B.P. and

2700-2150 cal B.P. separated by a 400+ year hiatus from ca. 3130 to 2700 cal B.P.; and the fourth consisting of a short Late Prehistoric interval from 650 to 530 cal B.P (Figure 3). Four historic period dates range from approximately 400-150 cal B.P. This last interval is hard to date precisely because of variations in atmospheric radiocarbon concentration during this period. However, historic documents record widespread bison hunting across Texas and nearby regions (e.g., Speth 2004; Wade 2003), and this period is critical for understanding regional culture historical events for the preceding three or four centuries. The prehistoric periods include the widespread Calf Creek horizon, found across the Southern Plains (Thurmond and Wyckoff 1999); two different periods in the regional Late Archaic (termed Late Archaic Bison 1 and Late Archaic Bison 2, LA_B1 and LA_B2, to distinguish these bison periods from subdivisions in the regional chronology); and what appears to be an early facet of the Toyah phase or horizon (Kenmotsu and Boyd 2012).

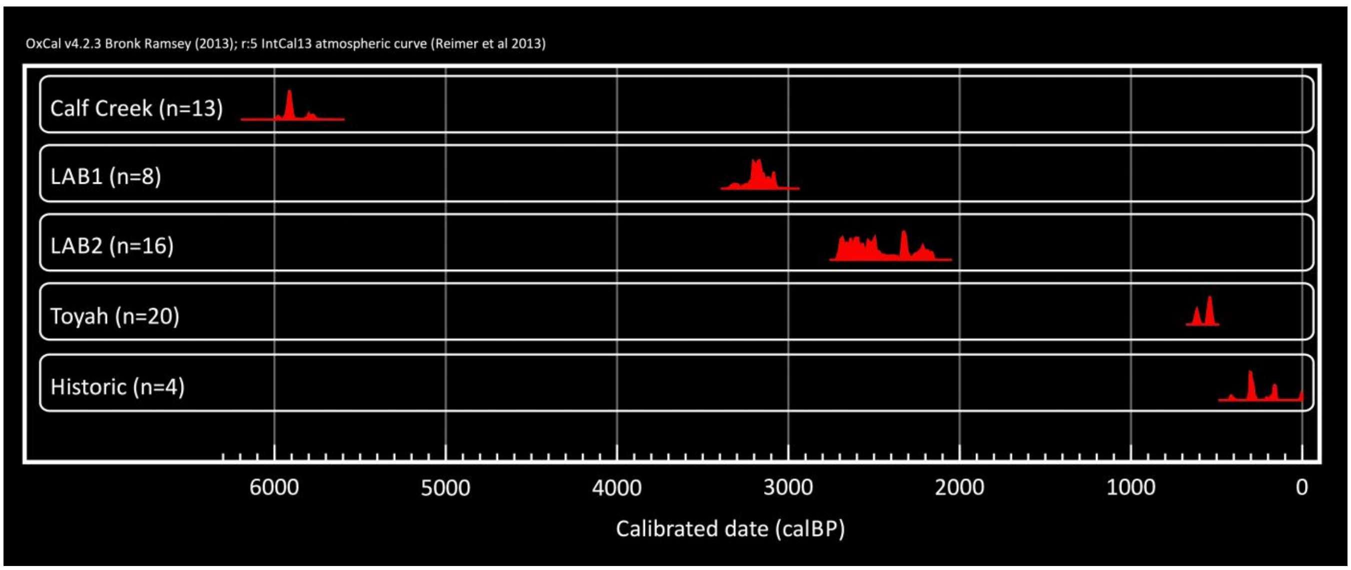

Figure 3. Summed probabilities for 61 XAD-purified AMS dates on bison bone from archeological contexts in Central and South Texas.

Calf Creek: ca. 5955-5815 cal B.P.

The earliest period of bison presence in our study is associated with the Calf Creek horizon. This period, which marks the end of the Early Archaic in Central Texas (Lohse et al. 2014a), is defined by the widespread occurrence of distinctive basally notched Bell and Andice points (Figure 4) often found in direct association with bison. Calf Creek materials are reported across Oklahoma (Bement et al. 2005; Duncan 1996; Neal 1999; Neal and Duncan 1998; Thurmond and Wyckoff 1999; Wyckoff 1994, 1995; Wyckoff et al. 2009); Central and South Texas, the Trans Pecos, and northern Tamaulipas (Calame et al. 2002; Collins 1994; Gray 2013; McReynolds 2002; Prewitt 1983; Ricklis 1988; Ross 1965; Sorrow et al. 1967; Walter 2013); western Arkansas (Dickson 1970); and into eastern New Mexico (Carmichael 1986). They are also present but less well documented in eastern Colorado, Missouri (O'Brien and Wood 1998), and Kansas (Stites 2006). Two Calf Creek points have recently been reported as far north as southern Utah (Wyckoff and Richens 2010). The brevity of this period has made it difficult to date these deposits with any precision. For example, this horizon is not represented in Dillehay's (1974) model for the Southern Plains (see Table 1), and is only poorly resolved at many sites (e.g., Wilson-Leonard). Stable carbon and nitrogen isotope data from samples in this study indicate that Calf Creek climates were among the coldest and perhaps driest experienced in the entire Holocene (Lohse et al. 2014b).

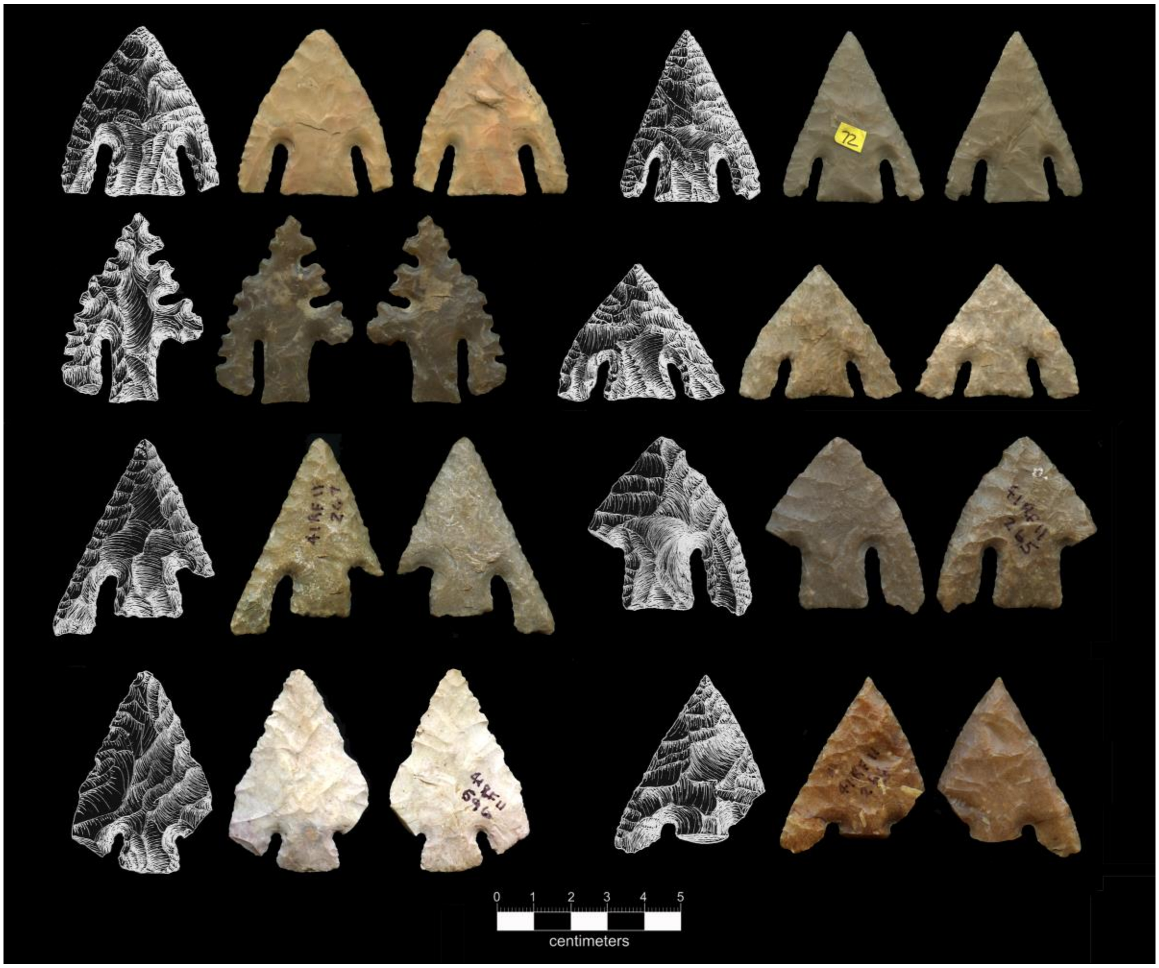

Figure 4. Examples of basally notched Calf Creek horizon points (Bell type). Top two rows are from Zapata County in South Texas (courtesy of Richard McReynolds). Bottom two rows are from the Hopper's Landing site (41RF11) (courtesy of the Museum of the Coastal Bend). All line drawings by Richard McReynolds.

Our Calf Creek bison data derive from three sites: Spring Lake (41HY160), Eagle Bluff, and Cervenka; the latter two have only a single date each. A bison bone sample associated with a Bell point from Feature 2 at the Landslide site (41BL85; Sorrow et al. 1967) was curated at the Texas Archeological Research Laboratory and was submitted for dating as part of this study, but did not yield enough collagen to be reliably measured. Two separate contexts at Spring Lake, over 40 m apart, have yielded Calf Creek remains including 11 AMS dates on bison (Lohse et al. 2013). Conservatively, the 13 dates together span the interval from 5990-5715 cal B.P., taking the extreme 2 sigma ranges for the earliest and latest dates. However, most dates fall onto an ideal part of the calibration curve, centering around 5900 cal B.P., between a modest reversal at about 5960 cal B.P. and a minor plateau spanning from approximately 5850-5770 cal B.P. (Figure 5). The effect of these two parts of the curve is to draw out or extend the calibrated probabilities of the earliest and last dates.

However, the difference of the earliest and latest dates allows us to estimate the duration of the Calf Creek components to be between 25 and 260 calibrated years (mean=140 cal years).

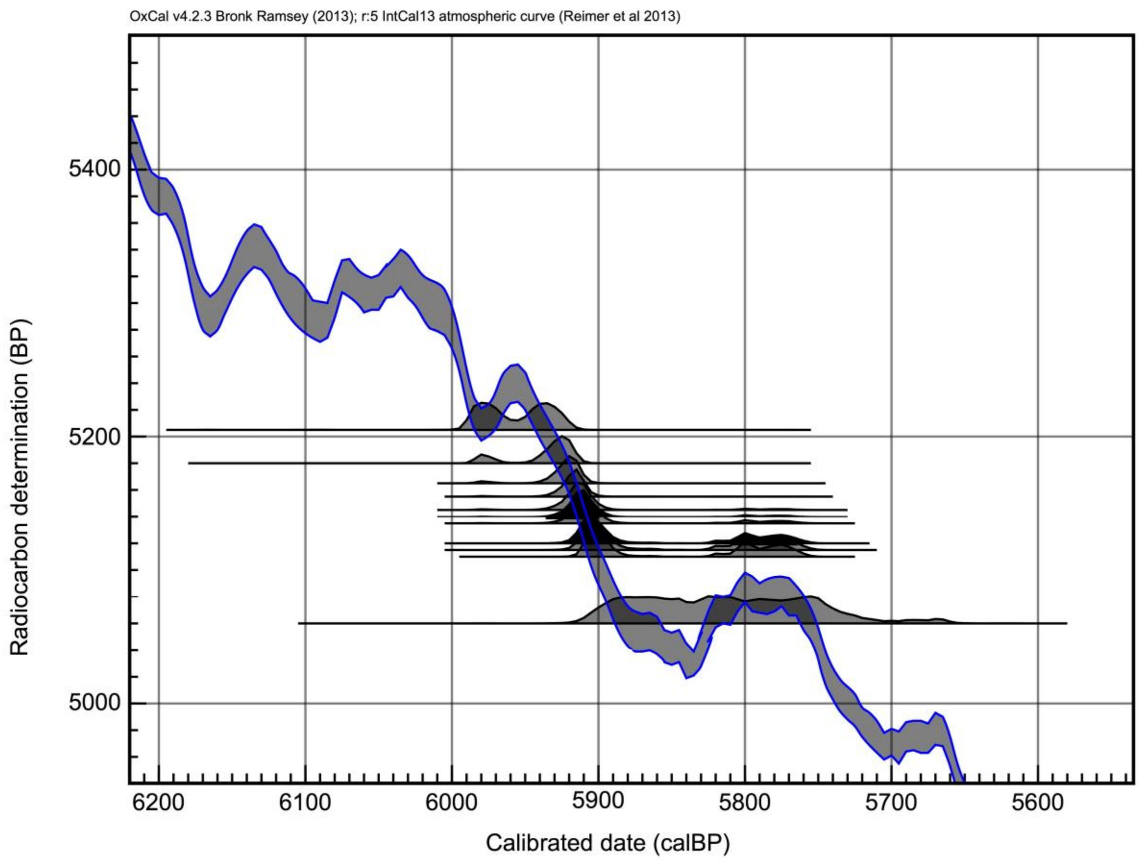

Figure 5. Calibrated probabilities for 13 Calf Creek dates superimposed on IntCal13 calibration curve.

Radiocarbon dates reported in association with Calf Creek materials commonly span over seven hundred years (see Wyckoff et al. 2009), and some "long" chronologies ascribe as much as a thousand years to this period (e.g., Collins 2004). Based on our results, however, we argue that this horizon may have been considerably shorter in duration. A moderately conservative treatment of these dates suggests a period of about 140 years. However, Bayesian modeling of the calibrated dates from Spring Lake suggests the presence of bison during a very short interval of no more than about 40 years (Figure 6), from 5937-5897 cal B.P. (A_{model}=122.3). This model indicates the short duration that can be identified with calibrated radiocarbon dates under ideal circumstances and with high-density sampling. The single date from Eagle Bluff is slightly earlier than this range, indicating regional variation in terms of timing and age of different site components. This model substantially narrows the overall age span for Calf Creek, and creates an opportunity to develop and test hypotheses relating to the overall chronology of bison movements and cultural responses during this period.

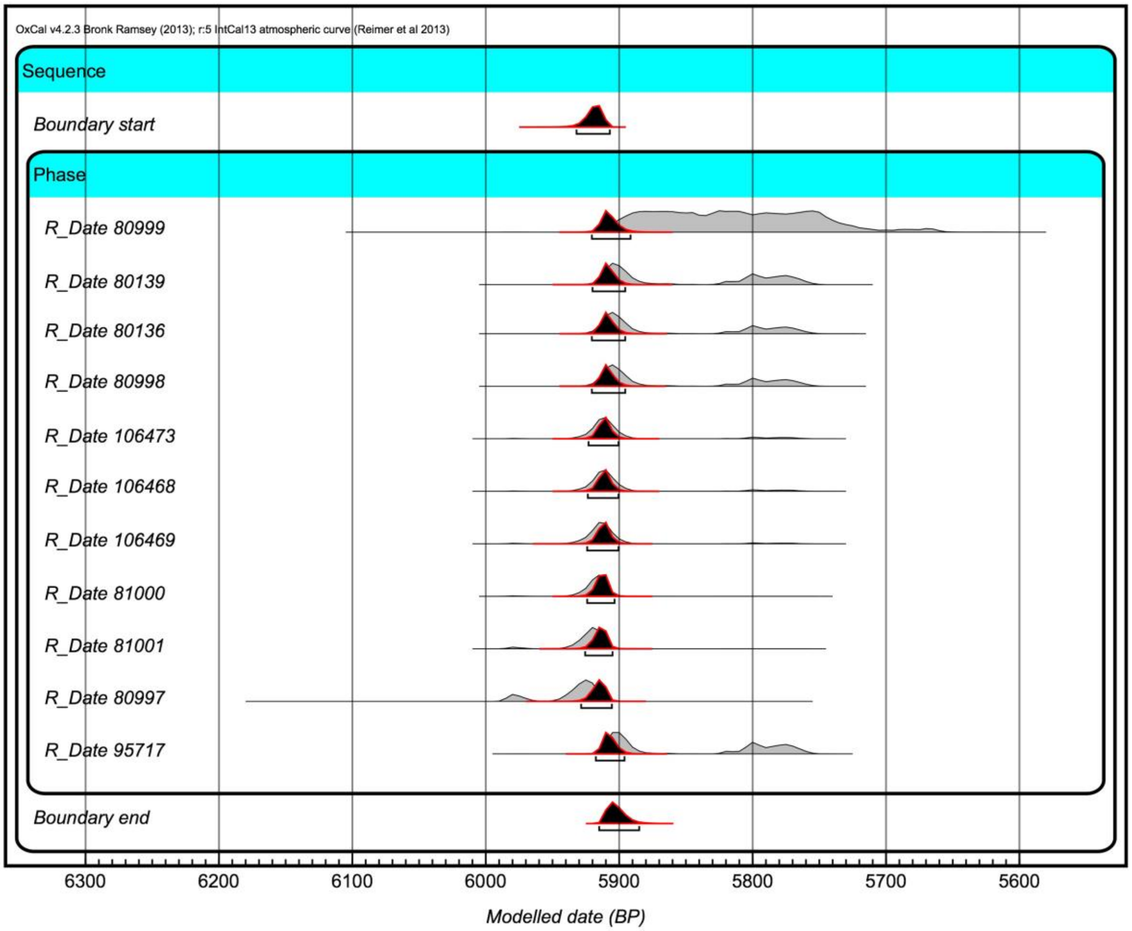

Figure 6. Simple Bayesian phase model of AMS ^{14}C from Calf Creek deposits at Spring Lake. These data suggest that the occupation during this horizon may have been limited to only a single event or a few rapid visitations.

Other than our data, very few precise assays are available for this time period. A Calf Creek point embedded in a juvenile bison (*B. occidentalis*) skull found in river gravels near Tulsa, Oklahoma (Bement et al. 2005) and dated at 5120 ± 20 ^{14}C years B.P. (approximately 5925-5760 cal B.P.) falls squarely within the range of dates we report. The Calf Creek component at the Kubik site, also in Oklahoma, has produced three dates: 4990 ± 100 (NZA6601) (5950-5465 cal B.P.), 5020 ± 120 (NZA6602), and 5050 ± 60 (Beta 98146) radiocarbon years B.P. (Neal 1999). The latter two dates, from a split nut hull, average to about 5895-5735 cal B.P. All three partially overlap with but are generally younger than our bison dates by a couple of centuries. The large 2 sigma probabilities of the Kubik dates relate to their large standard deviations compared with samples in our study, and also partly to a reversal in the calibration curve that occurs at ca. 5800 cal B.P. (see Figure 5). However, the nutshell dates are considered highly reliable, and the Kubik data suggest that the Calf Creek horizon extended later in Oklahoma than in our study area. Additional sampling using precision dating protocols will be necessary to define the temporal extent of the Calf Creek horizon as it occurred elsewhere on the Southern Plains.

Late Archaic: ca. 3295-3130 and 2700-2150 cal B.P.

Following Calf Creek, bison appear to have been absent from the landscape for more than two thousand years, from ca. 5750-3300 cal B.P. Regional models (see Table 1) show bison throughout the Late Archaic, but are vague about when they appear and tend to treat the Late Archaic as a single undifferentiated period. Single component sites with bison dating to this time are uncommon. Most sites, like Wilson-Leonard, have mixed or compressed Late Archaic components. Our Late Archaic bison dates come from four sites: two Spring Lake sites (41HY160 and 41HY165), 41HY188, and Gault.

Our data suggest that Late Archaic bison exploitation took place over two distinct intervals. The first period (LA_B1) began by 3295 cal B.P. (mean of 3355-3220 cal B.P., UCIAMS-95718) and continued until approximately 3130 cal B.P. (mean of 3215-3005 cal B.P., UCIAMS-80138). The duration of the period is estimated at between 55 and 270 cal years, with a mean of 165 cal years. This bison pulse is followed by a hiatus of at least 400 years (the 2 sigma difference is 380-700 cal years) after which a subsequent pulse, LA_B2, lasts from about 2700-2150 cal B.P. The more than 400 year hiatus after 3130 cal B.P. is previously unreported, likely as a result of the reliance on archeological associations for reconstructing cultural patterns (Figure 7). Stable carbon and nitrogen isotope data indicate that Late Archaic climates were relatively stable for the entire LA_B1 and LA_B2 periods, and that both periods were somewhat warmer and had more effective moisture than the earlier Calf Creek or later Toyah periods (Lohse et al. 2014b). However, both also correspond with a period of globally cool climates (Wanner et al. 2011). Importantly, Viau et al. (2006) identify the period around 3000 B.P., approximately the middle of our postulated hiatus, as among the warmest of the entire North American Holocene and van Geel et al. (1996) identify a cool, moist period in Europe and North America starting by around 2650 cal B.P. If verified, these temperature changes could help explain or contextualize bison movements into and out of the study area at different times during the Late Archaic period.

Although there appears to be a gap in bison exploitation in LA_B2 between ca. 2275 and 2415 ^{14}C B.P. (see Table 2), this gap is likely an artifact of the calibration curve. A plateau in the curve occurs during LA_B2, followed by a steep decline and then another mild reversal. These statistical plateaus affect the interpretation of radiocarbon data most obviously by creating very broad calibrated distributions for the dates in these groups. Indeed, the estimated length of LA_B2 (200-550 cal years) is the longest in our study, and it is possible that the duration of this period is overestimated because of fluctuations in the calibration curve during this interval.

A less obvious effect of the plateaus and associated steep segments of the curve is that even with precise measurements and very dense sampling, conventional ages corresponding to plateaus will be overrepresented, and those during steep sections may tend to be underrepresented (Calf Creek is an

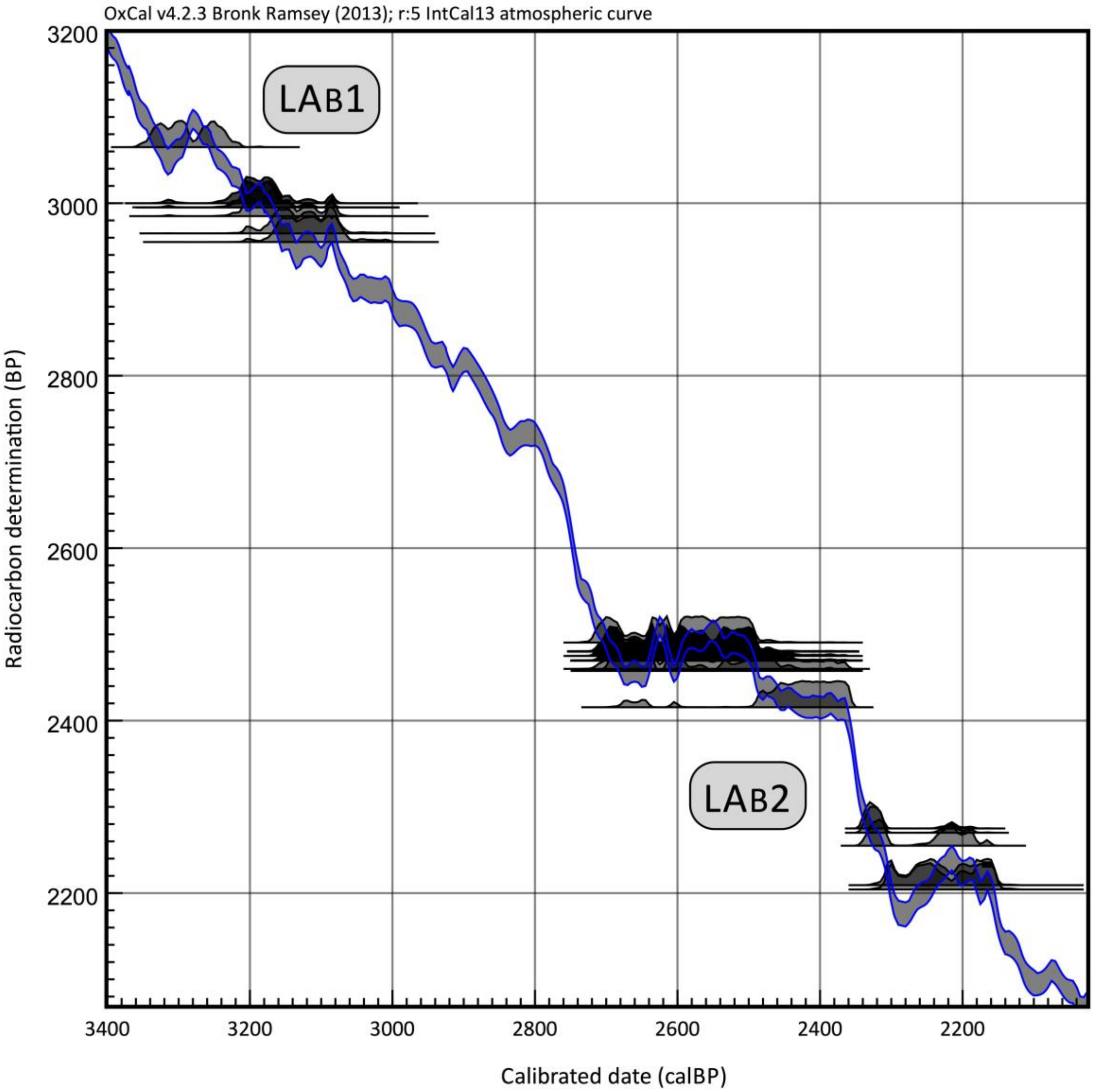

Figure 7. Calibrated probability distributions for 24 Late Archaic AMS ^{14}C bison dates. The LAB2 occupies a relatively flat part of the curve from about 2700-2360 cal B.P., which contributes to temporal imprecision during this interval. The steep decline following this plateau creates the appearance that a brief hiatus separates this period from a third Late Archaic period of bison exploitation.

exception; see Figure 5). This phenomenon can be modeled with OxCal using the *R_Simulate* command, which produces a conventional age from a calendar age with a given measurement error, and then calibrates it. To better understand the effect of the curve on our calibrated sample, we simulated a group of 170 dates (10 dates every 25 years) from 2500 to 2100 cal B.P. assuming a measurement precision of ± 20 ^{14}C years to mirror the precision of our study. This very dense dataset is analogous to recovering and dating 40 bison per century from the archeological record, or roughly 10 times what we have sampled for the period. Plotting the frequency of conventional ages demonstrates that even at this density, conventional ages from ca. 2380 to 2260 cal B.P. are relatively unlikely (roughly 10-20 percent as likely) to be sampled compared with ages on the plateaus before and after that time (Figure 8). The congruence between the distributions of simulated and observed conventional ages through this period suggests that the apparent gap is an artifact of the calibration curve, and that further sampling is unlikely to produce many more conventional ages between 2415 and 2275 ca. B.P.

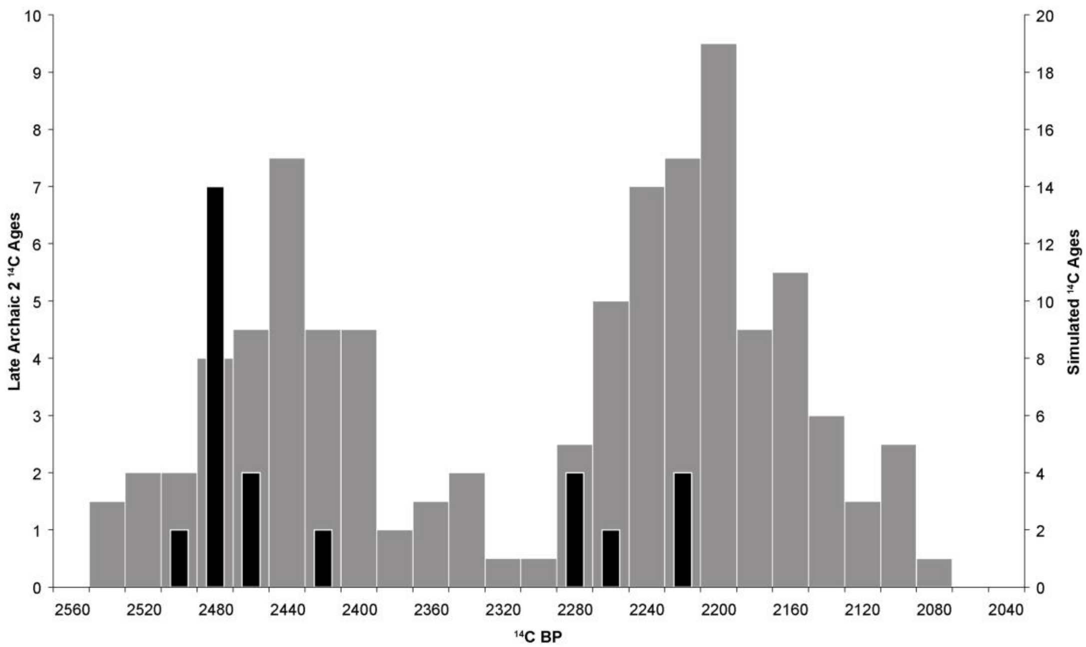

Figure 8. Frequency of simulated ^{14}C ages (gray columns) versus measured ^{14}C ages (black columns) on bison across two plateaus in the Late Archaic from 2500-2100 cal B.P. (2560-2040 14C yr B.P.) and the apparent gap in ^{14}C ages that is an artifact of the calibration curve. Simulated ages were generated in OxCal 4.17 (Bronk Ramsey 2010) using R_Simulate, assuming 10 dates every 25 cal years and a precision of ± 20 ^{14}C yr, comparable to the precision of the dates in this study. The "gap" in LA_B2 ^{14}C ages is likely not a true hiatus in bison exploitation.

Toyah: 650-530 cal B.P.

Following the Late Archaic, bison again appear to have been absent from the study area for approximately 1500 years, until ca. 650 cal B.P. They reappeared suddenly and may have been present for less than 120 cal years before once again disappearing. This Toyah bison interval is the shortest in our study. Climatically, our early Toyah bison period occurred immediately after the onset of the Little Ice Age (LIA), a prolonged cool and dry period, the beginning of which corresponds with one of the largest volcanic events of the entire Holocene as well as severely reduced solar activity (Mayewski et al. 2004; Wanner et al. 2011). Stable carbon and nitrogen isotope data (Lohse et al. 2014b) indicate that temperatures during this brief interval were not as cool as the Calf Creek period, and that effective moisture was slightly greater than in the Calf Creek period. However, the period was still cooler and drier than either LA_B1 or LA_B2. The LIA was complex climatologically, and significant variation has been documented within it. Based on over a thousand tree-ring, ice core, coral, sediment, and other proxy records, Mann et al. (2009) reconstruct a brief cold period in the northern hemisphere centering around A.D. 1340 (ca. 610 cal B.P.) that precedes a short warm interval before temperatures decline once again just prior to ca. A.D. 1500 (ca. 450 cal B.P.). The reconstructed cool periods correspond with the Wolf and Spöer grand solar minima, respectively

(Bard et al., 2000; Steinhilber and Beer 2011), brief intervals of reduced solar activity (e.g., sun spots, solar flares, etc.) that are associated with global cooling.

The bimodal calibrated distributions of our 20 dates from this period (Figure 9) partially reflect the shape of the calibration curve during this interval, which exhibits a sharp reversal resulting in paired intercepts for each assay. Taking the difference of the oldest and youngest dates in our Toyah bison period, the period lasted between 10 and 120 cal years, with a mean of 70 cal years. Toyah dates come from five sites: two Spring Lake sites (41HY160 and 41HY165), 41HY188, Eagle Bluff, and McNeill.

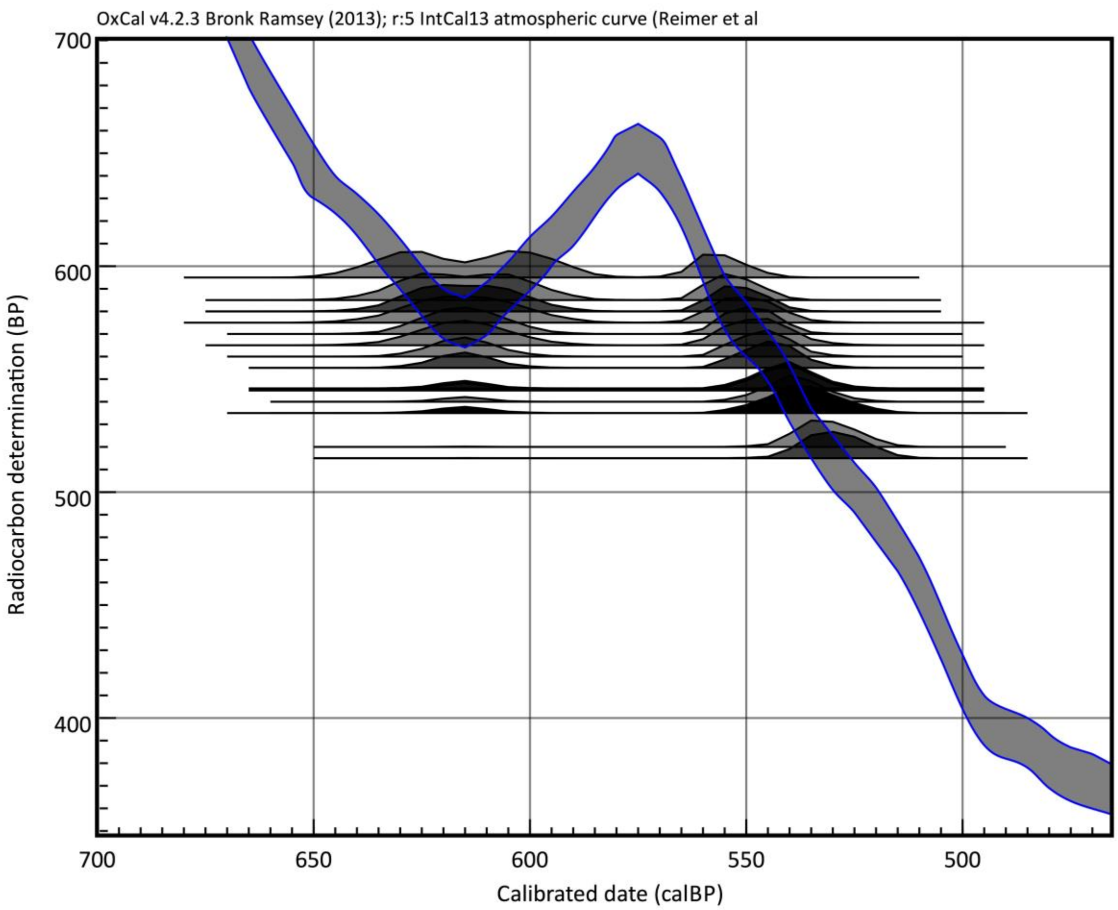

Figure 9. Calibrated probability distributions for 20 early Toyah AMS 14C bison dates. The reversal at ca. 575 cal B.P., resulting in bimodal distributions, causes the calibrated span of time to cover a longer period than is likely. Nonetheless, this is the shortest period of bison exploitation documented in our study.

The brevity of this period of bison exploitation is significant in the culture history of North America. In the regional sequence, the Toyah horizon begins by approximately 650 cal B.P. or A.D. 1300, and lasts as late as A.D. 1700. Native American cultural practices extending to the end of this sequence are difficult to link with earlier prehistoric antecedents because of the influences of Spanish *entradas and* colonization, not to mention population declines and social disruptions due to European diseases and group displacement practices that started in the early 1500s (Arnn 2012; Kenmotsu and

Hester 2001). Nonetheless, Toyah culture has typically been defined as exhibiting a technological focus on the exploitation of bison (Johnson 1994; Kenmotsu and Boyd 2012; Prewitt 2012; Ricklis 1994) and artiodactyls generally (Black 1986). Some have noted variation in Toyah subsistence practices (e.g., Dering 2008; Mauldin et al. 2013), including what appears as a decreased emphasis in bison, but temporal controls frequently lack the precision needed to demonstrate whether this variation is temporal or geographic in nature.

Archeologists argue that Toyah is important for our broader anthropological understanding of hunter-gatherer cultural patterns just prior to ethnographically-documented foragers that occupied the region when the Spanish arrived (Collins 1995). Our data suggest that the Toyah horizon may have been characterized by more varied subsistence practices and associated social and technological adaptations than conventional views suggest. From the early A.D. 1500s through the late 1700s, historical groups were recorded pursuing bison across Texas (Arnn 2012; Speth 2004; Wade 2003), and it has been widely presumed that this pattern is an extension of practices that began as early as A.D. 1300 (ca. 650 cal. B.P.). Prior research on the southern Plains has documented widespread trade between Puebloan settlements to the west and Plains groups focusing on bison meat, hide, and other products (Boyd 1997; Creel 1991; Krieger 1946; Prewitt 1982; Speth and Newlander 2012; Spielmann 1991; Vehik 1990, 2002). Considering the sudden appearance of bison and their role in both subsistence and economic patterns, we suggest that early Toyah (ca. A.D. 1300-1420, or 650-530 cal B.P.) can be partly understood as a southern extension of this interregional system. Our findings suggest, however, that middle Toyah sites, those dating after around 530 cal B.P. (A.D. 1420), but pre-dating the reappearance of bison in the mid-1500s, may have maintained an altogether different orientation, with significantly less reliance on bison than previously thought. Although sites with late Toyah material such as the Rush site (41TG346, ca. A.D. 1575; Quigg 1997) or the upper Toyah component at Rowe Valley (41WM437; Prewitt 2012) contain bison and appear to support this three-part model of Toyah chronology, dating resolution is so far lacking to demonstrate the postulated middle Toyah facet. However, the four historic dates in our sample provide partial support for this model. More dates are needed from this late period before this model can be further developed.

DISCUSSIONS AND CONCLUSIONS

Our record of 61 AMS dates on bison bone recovered from archeological contexts from the southeastern periphery of the Great Plains adds to what is known about the exploitation of a top-ranked resource starting approximately 6000 years ago. We show that bison were present only occasionally since the Early-Middle Holocene. While our study is generally consistent with previous regional models, it adds important precision to the overall understanding of these periods. It is well known that bison were present in the region prior to 6000 cal B.P., but this part of the record has not been directly dated using the XAD-based protocols we report here. Because the early sequence for bison exploitation is dated primarily by archeological association, in our view it remains imprecise.

In spite of its limitations in terms of geographic and temporal coverage, our record of XAD-purified AMS ^{14}C dates on bison offers one of the most precise models for the presence and prehistoric exploitation of this key resource anywhere in North America. In addition to refining local and regional chronologies, our findings also contribute to hypotheses about fluctuations in "Plains-like" cultural patterns that depended, in part, on environmental and climatic change and the subsequent exploitation of bison for subsistence and economic purposes. For example, what appears as the sudden onset of bison-related cultural patterns, especially Calf Creek and Toyah, may have been associated with rapid climate change (Mayewski et al. 2004). This important possibility, which deserves further attention, would have significant implications for how archeologists understand the nature and timing of prehistoric culture change. Additionally, the rapid appearance of widespread horizons associated with the Calf Creek and early Toyah periods is ostensibly linked to the sharing of weapons- and processing-related technologies involved with logistically organized bison hunting at these times. Projectile point styles associated with these intervals are among the most widespread post-Paleoindian styles in Texas (cf. Prewitt 1995), and may reflect the distances traveled by bison hunters and the kinds of social encounters that occurred as part of these forays.

More than only subsistence practices are implicated as well. Trade patterns beginning by A.D. 1250 (ca. 700 cal B.P.) in the Southern Plains and focused on bison are also well known (e.g., Creel 1991; Speth 2004). Toyah sites commonly show a sharp increase in exotic materials compared with earlier periods (Kibler 2012), suggesting that exchange networks also extended south into Central and southern Texas. Like connections with climate change, this proposition also requires much additional research before these economic processes are fully understood. Future AMS radiocarbon dating work on Toyah sites should be mindful of our evidence suggesting a three-part bison chronology. Sample selection should avoid large carbonized wood fragments susceptible to the old wood effect and focus instead on annuals or perennials. Radiocarbon results should be matched against zooarcheological assemblages indicating the presence or absence of bison.

Our study highlights the research value of adding to the record of XAD-purified AMS dates of bison remains. Adding samples with greater time depth and from additional sites will help improve the bison record and increase its usefulness as a means for understanding larger cultural and environmental processes at the southern extent of the far Southern Plains.

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REFERENCES CITED

Ambrose, S. H. and L. Norr

1992 On Stable Isotopic Data and Prehistoric Subsistence in the Soconusco Region. *Current Anthropology* 33:401-404.

Arnn, J. W. III

2012 *Land of the Tejas: Native American Identity and Interaction in Texas, A.D. 1300 to 1700*. The University of Texas Press, Austin.

Baker, B. W.

1998 Vertebrate Faunal Remains from the ¼-Inch and 1/8-Inch Screens. In *Wilson-Leonard, an 11,000-Year Archeological Record of Hunter-Gatherers in Central Texas. Volume V: Special Studies*, edited by M. B. Collins, pp. 1463-1509. Studies in Archeology 31, Texas Archeological Research Laboratory, The University of Texas at Austin and Archeology Studies Program, Report 10, Texas Department of Transportation, Environmental Affairs Division, Austin.

Bamforth, D. B.

1988 *Ecology and Human Organization on the Great Plains*. Plenum Press, New York.

2011 Origin Stories, Archaeological Evidence, and Post-Clovis Paleoindian Bison Hunting on the Great Plains. *American Antiquity* 76:24-40.

Bard, E., G. Raisbeck, F. Yiou, and J. Jouzel

2000 Solar Irradiance During the Last 1200 Years Based on Cosmogenic Nuclides. *Tellus* 52B:985-992.

Baugh, S. T.

1986 Late Prehistoric Bison Distributions in Oklahoma. *Plains Anthropologist* 31:83-96.

Bayliss, A.

2009 Rolling Out Revolution: Using Radiocarbon Dating in Archaeology. *Radiocarbon* 51(1):123-147.

Bement, L. C.

1986 *Excavation of the Late Pleistocene Deposits of Bonfire Shelter, 41VV218, Val Verde County, Texas*. Archeology Series 1. Texas Archeological Survey, The University of Texas at Austin.

Bement, L. C. and K. J. Buehler

1994 Preliminary Results from the Certain Site: A Late Archaic Bison Kill in Western Oklahoma. *Plains Anthropologist* 39:173-183.

Bement, L. C., E. L. Lundelius, Jr., and R. A. Ketcham

2005 Hoax or History: A Bison Skull with Embedded Calf Creek Projectile Point. *Plains Anthropologist* 50:221-226.

Bettis, Jr., A. C.

1996 Archaeological Investigations at 41HY188, Hays County, Texas, 1988: A Study of the Archaeological Remains and Lithic Technology. Master's Thesis, Department of Anthropology, The University of Texas at Austin.

Black, S. L.

1986 *The Clemente and Herminia Hinojosa Site, 41JW8: A Toyah Horizon Campsite in Southern Texas*. Special Report 18. Center for Archaeological Research, University of Texas at San Antonio.

Boyd, D. K.

1997 *Caprock Canyonlands Archeology: A Synthesis of the Late Prehistory and History of Lake Alan Henry and the Texas Panhandle-Plains*. Reports of Investigations No. 110. Prewitt and Associates, Inc., Austin.

Bozell, J. R., C. R. Falk, and E. Johnson

2011 Native American Use of Animals on the North American Great Plains. In *The Subsistence Economies of Indigenous North American Societies: A Handbook*, edited by B. D. Smith, pp. 353-385. Smithsonian Institution Scholarly Press, Washington, D.C.

Bronk Ramsey, C.

2010 OxCal version 4.17. http://c14.arch.ox.ac.uk/embed.php?file=oxcal.html.

Brown T. A, D. E. Nelson, J. S. Vogel, and J. R. Southon

1988 Improved Collagen Extraction by Modified Longin Method. *Radiocarbon* 30(2):171–177.

Calame Sr., D., C. Weber, L. Banks, and R. McReynolds

2002 Projectile Points of the Calf Creek Horizon from Frio, Medina, and Uvalde Counties, Southern Texas. *La Tierra* 29:29-38.

Carlson, K. and L. Bement

2013 Organization of Bison Hunting at the Pleistocene/Holocene Transition on the Plains of North America. *Quaternary International* 297:93-99.

Carmichael, D.

1986 *Archaeological Survey in the Southern Tularosa Basin.* Historic and Natural Resources Report No. 3, Environmental Management Office, Directorate of Engineering and Housing, United States Army Air Defense Artillery Center, Fort Bliss, and Publications in Anthropology No. 10, El Paso Centennial Museum, University of Texas at El Paso.

Collins, M. B.
1994 Evidence of Early Archaic Occupation. In *Human Ecology in the Middle Onion Creek Valley, Hays County, Texas*, by R. A. Ricklis and M. B. Collins, pp. 67-100. Studies in Archeology 19. Texas Archeological Research Laboratory, The University of Texas at Austin.

1995 Forty Years of Archeology in Central Texas. *Bulletin of the Texas Archeological Society* 66:361-400.

2004 Archeology in Central Texas. In *The Prehistory of Texas*, edited by T. K. Perttula, pp. 101-126. Texas A&M University Press, College Station.

Collins, M. B. (assembler and editor)
1998 *Wilson-Leonard: An 11,000-Year Archeological Record in Central Texas*. 6 Volumes. Studies in Archeology 31, Texas Archeological Research Laboratory, The University of Texas at Austin, and Archeology Studies Program Report 10, Texas Department of Transportation, Environmental Affairs Division, Austin.

Cooper, J. R.
2008 Bison Hunting and Late Prehistoric Human Subsistence Economies in the Great Plains. Ph.D. Dissertation, Department of Anthropology, Southern Methodist University, Dallas.

Creel, D. G.
1991 Bison Hides in Late Prehistoric Exchange in the Southern Plains. *American Antiquity* 56:40-49.

Denham, T., C. Bronk Ramsey, and J. Specht
2012 Dating the Appearance of Lapita Pottery in the Bismarck Archipelago and its Dispersal to Remote Oceania. *Archaeology in Oceania* 47:39-46.

Dering, P.
2008 Late Prehistoric Subsistence Economy on the Edwards Plateau. *Plains Anthropologist* 53:59-77.

DeNiro, M.
1985 Postmortem Preservation and Alteration of In Vivo Bone Collagen Isotope Ratios in Relation to Palaeodietary Reconstruction. *Nature* 317:806-809

Dibble, D. S. and D. H. Lorrain
1968 *Bonfire Shelter: A Stratified Bison Kill Site, Val Verde, County, Texas.* Miscellaneous Papers No. 1. Texas Memorial Museum. The University of Texas at Austin.

Dickson, D. R.
1970 Excavations at Calf Creek Cave. *The Arkansas Archeologist* 11:50-82.

Dillehay, T. D.
1974 Late Quaternary Bison Population Changes on the Southern Plains. *Plains Anthropologist* 19:180-196.

Duncan, M.
1996 Test Excavations at the Kubic Site, 34KA354. *Oklahoma Archeological Survey Newsletter* 15:1.

Fenner, J. N.
2007 Prehistoric Hunting on the Range Where the Antelope Play: Archaeological Pronghorn Bed Formation Analysis. Ph.D. Dissertation, Department of Anthropology, University of Wyoming, Laramie.

Frison, G. C.
1991 *Prehistoric Hunters of the High Plains*. Second edition. Academic Press, New York.

1998 The Northwestern and Northern Plains Archaic. In *Archaeology of the Great Plains*, edited by W. R. Wood, pp. 140-172. University Press of Kansas, Lawrence.

2004 *Survival by Hunting: Prehistoric Human Predators and Animal Prey*. University of California Press, Berkeley.

Gray, R. W.
2013 Diagnostic Artifacts of Paleoindian and Early Archaic Cultures in the Eastern Trans-Pecos Region of Texas. In *Archeological Explorations of the eastern Trans-Pecos and Big Bend: Collected Papers, Volume 1*, edited by P. Dasch and R. J. Mallouf, pp. 1-59. Papers of the Tans-Pecos Archaeological Program 6. Center for Big Bend Studies, Sul Ross State University, Alpine.

Grayson, D. K.
2006 Holocene Bison in the Great Basin, Western USA. *The Holocene* 16:913-925.

Guthrie, R. D.
1980 Bison and Man in North America. *Canadian Journal of Anthropology* 1:55-73.

Hester, T. R.
2004 The Prehistory of South Texas. In *The Prehistory of Texas*, edited by T. K. Perttula, pp. 127-151. Texas A&M University Press, College Station.

2010 An Overview of Excavations at the Eagle Bluff Site and Other Activities of the 2010 Texas Archeological Society Field School. *Texas Archeology (Newsletter of the Texas Archeological Society*) 54:1, 3-5.

2011 A Summary of the 2011 Texas Archeological Society Field School. *Texas Archeology* (*Newsletter of the Texas Archeological Society*) 55:1, 3-11.

Huebner, J.

1991 Late Prehistoric Bison Populations in Central and Southern Texas. *Plains Anthropologist* 36:343-358.

Johnson, E.

1987 Vertebrate Remains. In *Lubbock Lake: Late Quaternary Studies on the Southern High Plains*, edited by E. Johnson, pp. 49-89. Texas A&M University Press, College Station.

Johnson, E. and V. T. Holliday

1987 Introduction. In *Lubbock Lake: Late Quaternary Studies on the Southern High Plains*, edited by E. Johnson, pp. 3-13. Texas A&M University Press, College Station.

Johnson, L., Jr.

1994 *The Life and Times of Toyah-Culture Folk: The Buckhollow Encampment, Site 41KM16, Kimble County, Texas*. Office of the State Archeologist Report 38. Texas Historical Commission and Texas Department of Transportation, Austin.

Kenmotsu, N. A. and D. K. Boyd (editors)

2012 *The Toyah Phase of Central Texas: Late Prehistoric Economic and Social Processes*. Texas A&M University Press, College Station.

Kenmotsu, N. A. and T. R. Hester

2001 Conflict, Migration, and Coalescence: Native American Groups in Texas, A.D. 1530-1878. *Bulletin of the Texas Archeological Society* 72:1-3.

Kennett, D. J., B. J. Culleton, J. Dexter, S. A. Mensing, and D. H. Thomas

2014 High-Precision AMS 14C Chronology for Gatecliff Shelter, Nevada. *Journal of Archaeological Science*, http://dx.doi.org/10.1016/j.jas.2014.06.008. Manuscript in press.

Kennett, D. J., B. J. Culleton, B. Voorhies, and J. R. Southon

2011 Bayesian Analysis of High-Precision AMS 14C Date from a Prehistoric Mexican Shellmound. *Radiocarbon* 53:245-259.

Kibler, K. W.

2012 The Role of Exotic Materials in Toyah Assemblages in a Late Prehistoric Economic and Social System. In *The Toyah Phase of Central Texas: Late Prehistoric Economic and Social Processes*, edited by N. A. Kenmotsu and D. K. Boyd, pp. 76-89. Texas A&M University Press, College Station.

Krieger, A. D.

1946 *Culture Complexes and Chronology in Northern Texas with Extension of Puebloan Datings to the Mississippi Valley*. Publication 4640. The University of Texas, Austin.

List, R., G. Ceballos, C. Curtin, P. J. P. Gogan, J. Pacheco, and J. Truett

2007 Historic Distribution and Challenges to Bison Recovery in the Northern Chihuahua Desert. *Conservation Biology* 21:1487-1494.

Lohse, J. C. (editor)

2013 *Underwater Archaeology at 41HY147, the Terrace Locality at Spring Lake*. Archaeological Studies Report No. 28. Center for Archaeological Studies, Texas State University-San Marcos.

Lohse, J. C., S. L. Black, and L. M. Cholak

2014a Toward an Improved Archaic Radiocarbon Chronology for Central Texas. *Bulletin of the Texas Archeological Society* 85:251-279.

Lohse, J. C., D. B. Madsen, D. J. Kennett, and B. J. Culleton

2014b Paleoecological Implications of a High-Precision Chronology for Episodic Mid-to-Late Holocene Bison Population Expansions in the Southern Plains, U.S.A. *Quaternary Science Reviews*, in press.

Lohse, J. C., A. E. Reid, D. M. Yelacic, and C. L. Timperley

2013 *Data Recovery and Analysis of the Texas State University Ticket Kiosk at 41HY160, Spring Lake, Hays County, Texas*. Archaeological Studies Report No. 32. Center for Archaeological Studies, Texas State University-San Marcos.

Longin, R.

1971 New method of collagen extraction for radiocarbon dating. *Nature* 230:241-242.

Lynott, M. J.

1979 Prehistoric Bison Populations of North Central Texas. *Bulletin of the Texas Archeological Society* 50:89-101.

Mann, M. E., Z. Zhang, S. Rutherford, R. S. Bradley, M. K. Hughes, D. Shindell, C. Ammann, G. Faluvegi, and F. Ni

2009 Origins of the Little Ice Age and Medieval Climate Anomaly. *Science* 326:1256-1259.

Mauldin, R. P., R. J. Hard, C. M. Munoz, J. L. Z. Rice, K. Verostick, D. R. Potter, and N. Dollar

2013 Carbon and nitrogen stable isotope analysis of hunter-gatherers from the Coleman site, a Late Prehistoric cemetery in Central Texas. *Journal of Archaeological Science* 40:1369-1381.

Mauldin, R., J. Thompson, and L. Kemp

2012 Reconsidering the Role of Bison in the Terminal Late Prehistoric (Toyah) Period of Texas. In *The Toyah Phase of Central Texas: Late Prehistoric Economic and Social Processes*, edited by N. A. Kenmotsu and D. K. Boyd, pp. 90-110. Texas A&M University Press, College Station.

Mayewski, P. A., E. E. Rohling, J. C. Stager, W. Karlén, L. A. Laasch, L. D. Meeker, E. A. Meyerson, F. Gasse, S. van Kreveld, K. Holmgren, J. Lee-Thorp, G. Rosqvist, F. Rack, M. Staubwasser, R. R. Schneider, and E. J. Steig
2004 Holocene Climate Variability. *Quaternary Research* 62:243-255.

McReynolds, R. L.
2002 Calf Creek Horizon Points from Wilson County, Texas. *La Tierra* 29:39-44.

Meltzer, D. J.
2006 *Folsom: New Archaeological Investigations of a Classic Paleoindian Bison Kill*. University of California Press, Berkeley.

Neal, L.
1999 Dating the Kubic Site, 34KA354. *Oklahoma Archeological Survey Newsletter* 19:1-3.

Neal, L. and M. Duncan
1998 Mid-Holocene Radiocarbon Dates from the Kubic Site (34KA354). *Oklahoma Archeological Survey Newsletter* 18:2.

O'Brien, M. J. and W. R. Wood
1998 *The Prehistory of Missouri*. University of Missouri Press, Columbia.

Peter, D., D. Prikryl, O. McCormick, and M.-A. Demunck
1982 Site Excavation Reports: Primary Contract. In *Archaeological Investigations at the San Gabriel Reservoir Districts, Central Texas. Volume 1*, edited by T. R. Hays, pp. 8-1 to 8-297. Archaeology Program, Institute of Applied Sciences, North Texas State University, Denton.

Prewitt, E. R.
1982 *Archeological Investigations at the Loeve-Fox, Loeve and Tombstone Bluff Sites in the Granger Lake District of Central Texas*. Volume 4, Archaeological Investigations of the San Gabriel Reservoir Districts, Central Texas. Archaeology Program, Institute of Applied Sciences, North Texas State University, Denton.

1983 Andice: An Early Archaic Dart Point. *La Tierra* 10:1-10.

1995 Distributions of Typed Project Points in Texas. *Bulletin of the Texas Archeological Society* 66:83-173.

2012 Toyah: Reflections on Evolving Perceptions. In *The Toyah Phase of Central Texas: Late Prehistoric Economic and Social Processes*, edited by N. A. Kenmotsu and D. K. Boyd, pp. 181-203. Texas A&M University Press, College Station.

Quigg, J. M.
1997 Bison Processing at the Rush Site, 41TG346, and Evidence for Pemmican Production in the Southern Plains. *Plains Anthropologist* 42:145-161.

Reimer, P. J., E. Bard, A. Bayliss, J. W. Beck, P. G. Blackwell, C. B. Ramsey, C. E. Buck, H. Cheng, R. L. Edwards, M. Friedrich, P. M. Grootes, T. P. Guilderson, H. Haflidason, I. Hajdas, C. Hatté, T. J. Heaton, D. L. Hoffmann, A. G. Hogg, K. A. Hughen, K. F. Kaiser, B. Kromer, S. W. Manning, M. Niu, R. W. Reimer, D. A. Richards, E. M. Scott, J. R. Southon, R. A. Staff, C. S. M. Turney, and J. van der Plicht

2013 IntCal13 and Marine 13 Radiocarbon Age Calibration Curves, 0-50,000 Years Cal BP. *Radiocarbon* 55:11869-1887.

Ricklis, R. A.

1988 Archeological Investigations at the McKinzie Site (41NU221), Nueces County, Texas: Description and Contextual Interpretations. *Bulletin of the Texas Archeological Society* 58:1-76.

1992 The Spread of a Late Prehistoric Bison Hunting Complex: Evidence from the South-Central Coastal Prairie of Texas. *Plains Anthropologist* 37:261-273.

1994 Toyah Components: Evidence for Occupations in the Project Area during the Latter Part of the Late Prehistoric Period. In *Archaic and Late Prehistoric Human Ecology in the Middle Onion Creek Valley, Hays County, Texas*, by R. A. Ricklis and M. B. Collins, pp. 207-316. Studies in Archeology 19. Texas Archeological Research Laboratory, The University of Texas at Austin.

Ross, R. E.

1965 *The Archaeology of Eagle Cave*. Papers of the Texas Archeological Salvage Project 7. The University of Texas at Austin.

Santos G. M., J. R. Southon, K. C. Druffel-Rodriguez, S. Griffin, and M. Mazon

2004 Magnesium Perchlorate as an Alternative Water Trap in AMS Graphite Sample Preparation: A Report on Sample Preparation at the KCCAMS Facility at the University of California, Irvine. *Radiocarbon* 46(1):165-173.

Sichler, J. A., J. L. Vavrasek, K. D. Hollenbach, and J. C. Lohse

2011 Faunal Remains and Analysis. In *Prehistoric Life, Labor, and Residence in Southeast Central Texas: Results of Data Recovery at 41HY163, the Zatopec Site, San Marcos, Texas*, edited by J. C. Lohse, pp. 351-386. Archaeological Studies Report No. 18. Center for Archaeological Studies, Texas State University-San Marcos.

Sorrow, W. M., H. J. Shafer, and R. E. Ross

1967 *Excavations at Stillhouse Hollow Reservoir*. Papers No. 11. Texas Archeological Salvage Project, The University of Texas at Austin.

Speth, J. D.

2004 *Life on the Periphery: Economic Change in Late Prehistoric Southeastern New Mexico*. Memoirs No. 37. Museum of Anthropology, University of Michigan, Ann Arbor.

Speth, J. D. and K. Newlander
2012 Plains-Pueblo Interaction: A View from the Middle. In *The Toyah Phase of Central Texas: Late Prehistoric Economic and Social Processes*, edited by N. A. Kenmotsu and D. K. Boyd, pp. 152-180. Texas A&M University Press, College Station.

Spielmann, K. A. (editor)
1991 *Farmers, Hunters, and Colonists: Interaction Between the Southwest and the Southern Plains*. University of Arizona Press, Tucson.

Stafford, T. W., Jr., K. Brendel, and R. C. Duhamel
1988 Radiocarbon, 13C and 15N Analysis of Fossil Bone: Removal of Humates with XAD-2 resin. *Geochimica et Cosmochimica Acta* 52:2257-2267.

Stafford, T. W., Jr., P. E. Hare, L. A. Currie, A. J. T. Jull, and D. Donahue
1991 Accelerator Radiocarbon Dating at the Molecular Level. *Journal of Archaeological Science* 18:35-72.

Steinhilber, R. and J. Beer
2011 Solar Activity – the Past 1200 Years. *PAGES news* 19:5-6.

Stites, M. D.
2006 The Calf Creek Complex: Preliminary Research on the Lithic Technology in Kansas. *Oklahoma Archeology* 54:10-42.

Stuiver, M. and H. A. Polach
1977 Discussion: Reporting of ^{14}C Data. *Radiocarbon* 19(3):355-363.

Thurmond, J. P. and D. G. Wyckoff
1999 The Calf Creek Horizon in Northwestern Oklahoma. *Plains Anthropologist* 44:231-250.

Tieszen, L. T., K. J. Reinhard, and D. L. Foreshoe
1997 Appendix C: Stable Isotopes in the Central and Northern Great Plains. In *Bioarchaeology of the North Central United Stated: A Volume in the Central and Northern Plains Archeological Overview*, edited by D. W. Owsley and J. C. Rose, pp. 329-336. Research Series No. 49. Arkansas Archeological Survey, Fayetteville.

Tzedakis, C.
2003 Timing and Duration of Last Interglacial Conditions in Europe: A Chronicle of Changing Chronology. *Quaternary Science Reviews* 22:763-768.

Van Geel, B., J. Buurman, and H. T. Waterbolk
1996 Archaeological and Palaeoecological Indications of an Abrupt Climate Change in the Netherlands, and Evidence for Climatological Teleconnections around 2650 BP. *Journal of Quaternary Science* 11:451-460.

van Klinken, G. J.
1999 Bone Collagen Quality Indicators for Palaeodietary and Radiocarbon Measurements. *Journal of Archaeological Science* 26:687–695.

Vehik, S. C.
1990 Late Prehistoric Plains Trade and Economic Specialization. *Plains Anthropologist* 35:125-145.

2002 Conflict, Trade, and Political Development on the Southern Plains. *American Antiquity* 67:37-64.

Viau, W. E., K. Gajewski, M. C. Sawada, and P. Fines
2006 Millennial-Scale Temperature Variations in North America During the Holocene. *Journal of Geophysical Research*, vol. 111. Doi:10.1029/2005JD006031.

Wade, M.
2003 *Native Americans of the Edwards Plateau, 1582-1799*. The University of Texas Press, Austin.

Walter, R. W.
2013 The Elusive Calf Creek Horizon in the Big Bend. In *Archeological Explorations of the eastern Trans-Pecos and Big Bend: Collected Papers, Volume 1*, edited by P. Dasch and R. J. Mallouf, pp. 61-70. Papers of the Tans-Pecos Archaeological Program 6. Center for Big Bend Studies, Sul Ross State University, Alpine.

Wanner, H., O. Solomina, M. Grosjean, S. P. Ritz, and M. Jetel
2011 Structure and Origin of Holocene Cold Events. *Quaternary Science Reviews* 30:3109-3123.

Waters, M. R. and T. W. Stafford
2007 Supporting Online Material for Redefining the Age of Clovis: Implications for the Peopling of the Americas. *Science* 315:1122-1126.

2014 Redating the Mill Iron Site, Montana: A Reexamination of Goshen Complex Chronology. *American Antiquity* 79:541-548.

Waters, M. R., T. W. Stafford, H. G. McDonald, C. Gustafson, M. Rasmussen, E. Cappellini, J. V. Olsen, D. Szklarczyk, L. J. Jensen, M. T. P. Gilbert, and E. Willerslev
2011 Pre-Clovis Mastodon Hunting 13,800 Years Ago at the Manis Site, Washington. *Science* 334:351-353.

Widga, C., J. D. Walker, and L. D. Stockli
2010 Middle Holocene Bison diet and mobility in the eastern Great Plains (USA) based on $\delta^{13}C$, $\delta^{18}O$, and $^{87}Sr/^{86}Sr$ analyses of tooth enamel carbonate. *Quaternary Research* 73:449-463.

Wilmshurst, J. M., T. L. Hunt, C. P. Lipo, and A. J. Anderson
2011 High-Precision Radiocarbon Dating Shows Recent and Rapid Initial Human Colonization of East Polynesia. *Proceedings of the National Academy of Sciences* 108:1815-1820.

Wyckoff, D. G.

1994 Introduction to the 1991 Bulletin. *Bulletin of the Oklahoma Anthropological Society* XL:1-8.

1995 A Summary of the Calf Creek Horizon in Oklahoma. *Bulletin of the Oklahoma Anthropological Society* XLII:179-210.

Wyckoff, D. G., E. Dowd, and D. J. Cranford

2009 Summary Perspectives of Soils and Prehistory along Oklahoma's Cross Timbers. In *Geoarchaeology and the Cross Timbers*, edited by D. J. Cranford, E. L. Dowd, and D. G. Wyckoff, pp. 75-104. Memoir 13. Oklahoma Anthropological Society, Norman.

Wyckoff, D. G. and L. D. Richens

2010 The Curious Archaic: Calf Creek in Utah? *Bulletin of the Oklahoma Anthropological Society* LVIII:1-18.

ARCHIVAL RESEARCH OF THE HISTORY OF THE FRANCISCO FLORES RANCH

Adriana Muñoz Ziga

ABSTRACT

The Francisco Flores Ranch, located northwest of Floresville, Texas, encompassed five *sitios* of land and one *labor* on the west bank of the San Antonio River at the *paraje* known as Chayopines. The Flores Ranch is one of the last surviving privately owned colonial ranches that have been identified in the San Antonio River valley containing standing structures possibly dating to the original date of occupation. I outline previous research on the property and offer new interpretations on the farm and ranch complex.

INTRODUCTION

Francisco Antonio Flores de Abrego was a Canary Island immigrant who settled the area around the town of Lodi, which became present day Floresville (Hazlewood 2010). The Francisco Flores Ranch, located northwest of Floresville, Texas, encompassed five *sitios* of land and one *labor* on the west bank of the San Antonio River at the *paraje* known as Chayopines. In order to understand the property, one must comprehend the history of the area and early settlement along the San Antonio River.

Much of the area along the San Antonio River belonged to the San Antonio missions (Figure 1). The main goal of the missions was to become self-sufficient, which meant that they each had to grow enough food and raise enough cattle to support its inhabitants (Cargill et. al. 1998:7). Missions had additional land outside their complexes that was used for agriculture and grazing. The boundaries of these ranch areas were never clearly defined as "none of the [San Antonio] missions were established with their later ranch lands included in the original land grant," and ownership shifted between missions at diff rent periods in time (Cargill et al. 1998:7). Once private ranchers began settling in the area, confusion between the mission land and private ranches' boundaries was common, since in many cases no title existed and descriptions were based on individual accounts.

Evidence suggests that multiple Chayopines ranchos on either side of the river existed since the area was first settled. Archival documents show that at least four ranches using the name Chayopines were present in the area between 1760-1810, including Francisco Flores' ranch; this has added to the confusion concerning the property's history over the years. I attempt to reconcile the differences through archival research of primary and secondary sources, including original Spanish documents.

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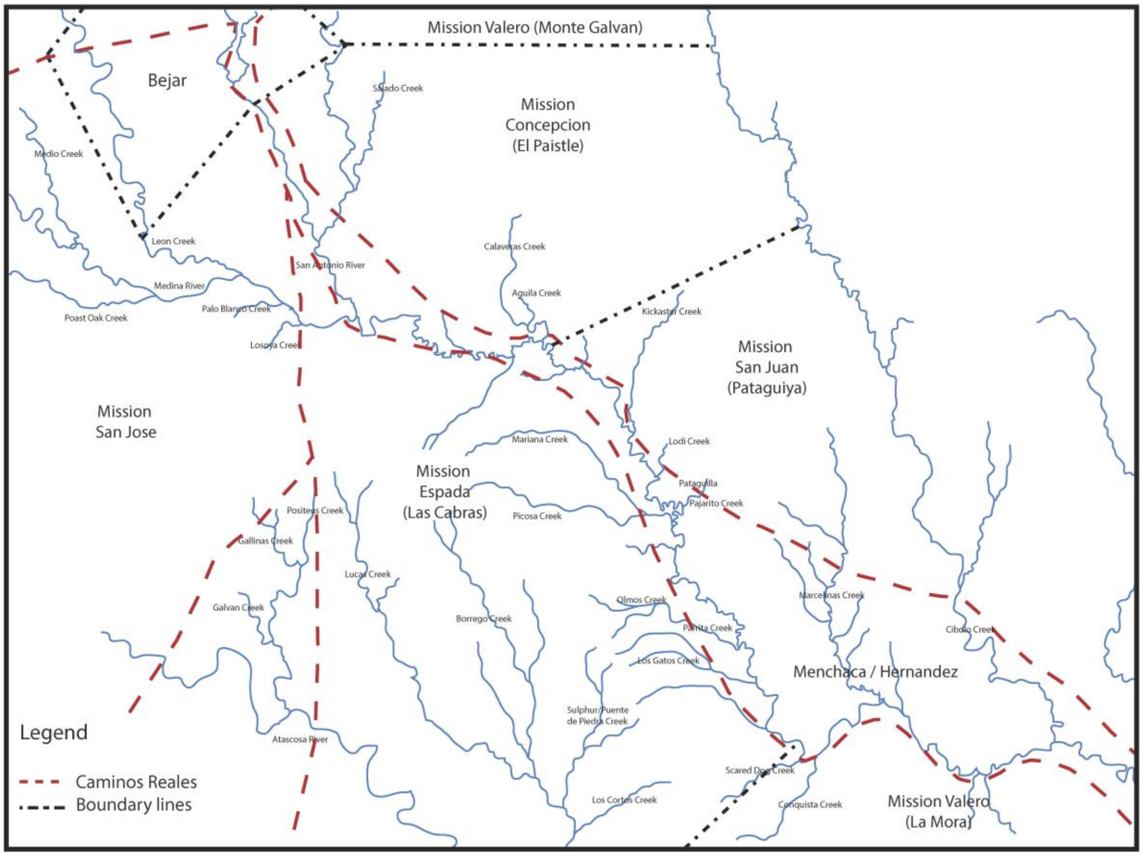

Figure 1. Ranch Lands of the San Antonio missions, showing mission fields in 1770-1771.

RANCHO DE SAN YLDELFONSO DE LOS CHAYOPINES

The first recorded private settler of the area around the Flores Ranch appears to have been Martin de la Pena with his Rancho de San Yldelfonso de los Chayopines in 1768 (Oca 1778). As mentioned previously, mission ranch lands were not included in their original land grants, and this created confusion concerning the boundaries between the missions and their private neighbors. This confusion led to the litigation of 1768-1772 between the lands of Mission Concepcion, Espada, and Valero and private landowners including Vicente Alvarez Travieso, the heirs of Martin Lorenzo de Armas, Domingo Delgado, Jacinto Delgado, and Manuel Delgado (Pena 1770). During the litigation, the ranch lands of the three missions were re-surveyed using actual field measurements of the areas the missions were actively using and those that were not being actively used (Ivey 1991:35). At that time it was determined that Martin de la Pena's ranch was occupying land belonging to Mission Espada, which led to litigation between the two parties (Pena 1770). The notice issued by Don Simon de Arocha in June of 1770 regarding this issue reads as follows:

> respecto a que dicha informacion resulta a si mismo que Don Martin de la Pena en las tierras que tiene pobladas como de tres anos esta parte esta entrado como un cuarto de legua en las que posee dicha mision de la Espada por la parte del norte en el Paso que llaman de los Chayopines (Pena 1770).

> In respect to said information, resulting indeed that Don Martin de la Pena in the lands he has inhabited for about three years, has encroached about a quarter of a league in the ones owned by the said Mission Espada, on the north part at the crossing known as Chayopines (all translations are by the author).

Martin de la Pena responded to this notice:

> desde el ano de mil cetecientos sesenta y ocho es verdad aver poblado el paraje de los chayopines con mi hijo y tres mozos, que me puse con buena fee, siendo con el permiso expreso de el Senor Governador interino Don Hugo Oconor y con la licencia del Senor Capitan Don Luis Antonio Menchaca, aviendome informado primero de que dicho sitio no estaba comprehendido en los agostaderos de la Mision de la Espada…pues estando el terreno que ocupo entre el paso de los Chayopines y el que llaman de las Mujeres (Pena 1770).

> From the year of 1768, it is true I have inhabited the *paraje* de los Chayopines with my son and three servants, that I settled in good faith, being with the expressed permission of the Interim Governor Don Hugo Oconor and with license of Captain Don Luis Antonio Menchaca, informing myself first that said land was not included in the pastures of Mission Espada…thus being the land I occupy between the Chayopines crossing and the one called las Mujeres.

It is known that Rancho las Cabras on the west bank of the river belonged to Mission Espada (Cargill et. al. 1998:7). If Pena encroached 1/4 of a league (0.66 miles) over the north boundary of Mission Espada lands, it is likely that his ranch was on the west bank of the river north of Las Cabras. At the end of the litigation Espada's northern boundary was moved south at Janisos/Los Alamos/Pena creek, and the area between Pena's southern boundary at Chayopines crossing and the new northern boundary for Las Cabras (Figure 2) was made available to private ranchers for lease (Ivey 1991:38). Pena never received clear title during the 1770 litigation, which opened him up to a lawsuit between Juan Joseph Montes de Oca and his Rancho de la Candelaria and Ygnacio de la Pena, Jose Martin's son and the Rancho de los Chayopines in 1778 (Oca 1778).

To clarify further we can look at the 1778 claim over this land. According to Montes de Oca his lands went:

> de la junta del Rio de Medina con este de San Antonio hasta donde entra el arroyo de los alamos con el propio rio lindando por el sur con tierras pertenesientes al rancho de la Mission de la Espada por el Poniente con el arroyo del Borrego y por Norte y oriente con tierras de la Mission de San Juan que serán quatro sitios de ganado mayor de largo y de ancho quando mas tres cuartos de legua de tierra (Oca 1778).

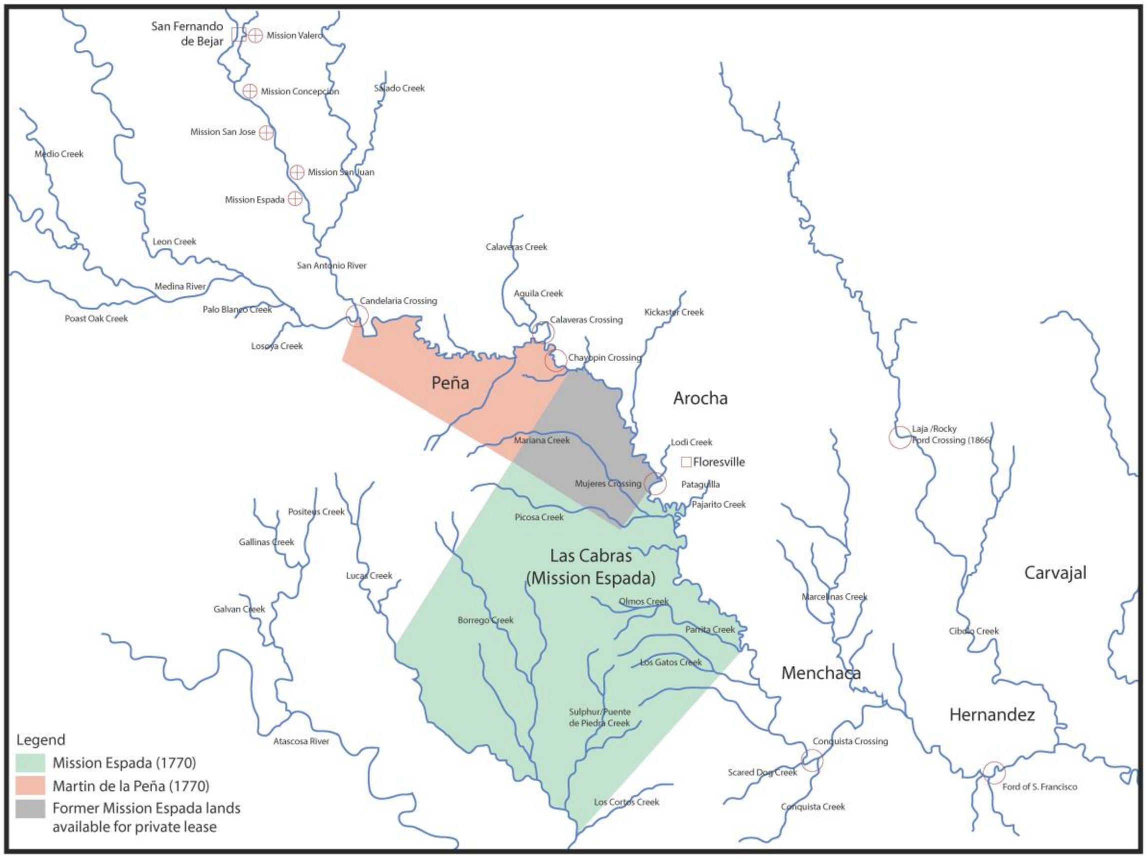

Figure 2. Map showing lands of Mission Espada and Martin de la Pena in 1770. Figures 2-6 are based on information available to the author at this time. Further research is necessary to confirm boundaries.

> From the mouth of the Medina River at the San Antonio, to the mouth of Elm Creek with the said river, adjoining to the south, lands belonging to the ranch of Mission Espada, to the west with Borrego creek, and to the north and east with lands of Mission San Juan. That might be four *sitios of ganado mayor* in length and at least 3/4 of a league in width.

His account appears problematic since the area Montes de Oca describes is much larger than the four *sitios* he claims it to be. However, all of the markers noted on his description are located west of the San Antonio River. On January 1778 Baron de Ripperda wrote after visiting the de la Pena family to settle Montes de Oca's claim:

> Halle poblado el rancho llamado los Chayopines por Don Martin de la Pena padre de Don Josef Antonio Yldelfonso de la Pena cura parroco que era de esta poblacion donde se puso desde el mes de marzo de mil setezientos sesenta y ocho hallándose Juan Josef Montes en el rincón de la Candelaria como expresa con una laborcita aunque no de continua asistencia y retirándose de dicho parage continuaron los hijos del sitado Don Martin de la Pena teniendo poblado aun quando todos los ranchos se despoblaron por las hostilidades de los indios nortenos mediante su mas favorable situación en cuya atención y el perjuicio que a dichos pobladores resultava devolverse a establecer el sitado Juan Josef Montes en el referido parage no permitiéndoselo condecendi a que se estableciera tres o mas leguas rio

> arriba junto al paso de Josef Miguel con motivo de tener a su cuidado unas reses dadas al ssma. donde hizo corral y jacal pero sin mantenerlo poblado mas que para las juntas de su ganado manifestándose no procede con la devida realidad en lo que expone respecto ser parte de las tierra que zita comprehendidas en las medidas que de superior orden se hicieron y posee la misión de la espada como por que componen mucho mas que duplicado terreno de los quatro sitios de ganado mayor de largo y tres quartos de legua de ancho que supone (Oca 1778).
>
> I found the ranch named los Chayopines inhabited by Don Martin de la Pena, father of Don Josef Antonio Yldelfonso de la Pena, who was parochial priest of this town, where he settled since the month of March of 1768, being Juan Josef Montes at the Rincon de la Candelaria as he expresses, with a small labor although not of continuous assistance, and [after] removing himself from the said *paraje*, the sons of the said Don Martin de la Pena continued inhabiting even when all the ranches became uninhabited due to the hostilities of the northern Indians. Through his most favorable situation in which attention and the perjury that re-establishing caused those inhabitants not permitting the said Juan Josef Montes at the said *paraje*, I conceded him to establish three or four leagues upriver next to the Josef Miguel crossing so that he could have under his care some cattle given to His Excellency, where he built a corral and jacal but inhabiting it only while gathering his cattle. Manifesting to not proceed with the necessary reality in what he presents in respect to being part of the lands he cites within the measures that by superior order were made and belong to the Mission Espada, as they compose much more than double land from the four *sitios de ganado mayor* in length and 3/4 of a league in width that he supposes.

Baron de Ripperda noted the issue between Montes de Oca's claim and the actual size of the described property. On a subsequent letter Martin de la Pena described the boundaries of his ranch as follows:

> desde el Paso que llaman de Jose Miguel en el Rio de este Presidio por de este lado, hasta el de las Mugeres con su fondo correspondiente hasta el complete de sinco sitios de ganados maiores (Oca 1778).
>
> From the crossing called Jose Miguel at the River of this presidio, through on this side, to the Mujeres with its corresponding end at the completion of five *sitios* of *ganado mayor*.

The boundaries of the property were expanded considerably from the description given by Martin de la Pena in 1770 to the one from 1778 (Figure 3). It is important to note that during this time Ignacio Calvillo was petitioning to rent land from Chayopines to Mujeres crossing that he had been using since 1775 as his Rancho de las Mujeres (Ivey 1991:41). Calvillo had settled the area between the northern boundary of Las Cabras (as determined during the 1770 litigation between the private ranchers and the missions) and the southern boundary of Pena's ranch just south of Chayopines Crossing. Although this area appears to have stayed in control of Mission Espada, private citizens were allowed to lease this land, which allowed Calvillo to rent and establish his ranch as mentioned previously. No full legal title appears to have been issued to Pena or Montes de Oca during the 1778 lawsuit but the Pena family occupied the land until at least 1791 (Ivey 1991:41). Montes de Oca did not receive his request to dispossess Pena of his land, but does seem to have been granted a ranch on the north side of the San Antonio River, between La Bahia Road and Mission San Juan lands to the north, and Salado Creek to the west (Ivey 1991:41). At any rate, evidence seems to be clear in locating the Pena ranch on the west bank of the river north of Las Cabras.

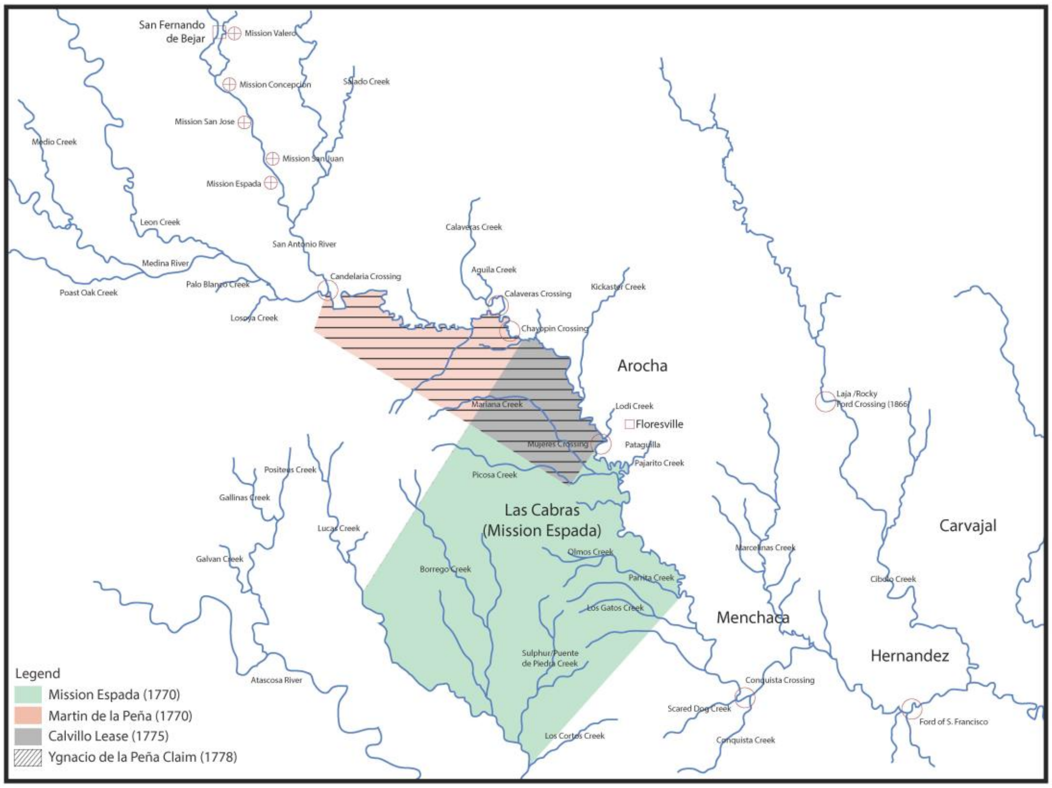

Figure 3. Map showing lands of Ygnacio de la Pena in 1778.

FRANCISCO FLORES ACQUISITION OF CHAYOPINES RANCH

In 1773, Ignacio Calvillo requested title of the Rancho de las Mujeres between Rancho de las Cabras and Chayopines Crossing. It is likely he received it since he was recognized as a landowner in the area in future documents. At some point after securing a lease to use the land, he lost part of the property due to failing to pay rent in about 1780, and it appears the two *sitios* he lost were immediately re-granted to Francisco Flores (Ivey 1991:42). According to the proceedings of a case between Mariana Curbelo versus Vizente Flores in 1783, Vizente, his father Francisco, and his cousins Juan Jose and Joaquin were operating a ranch at Chayopines (Curbelo 1783). It is important to note that the proceedings included Ygnacio Penaas one of the persons who accompanied Vizente when he reportedly stole cattle from his grandmother Mariana Curbelo, Vicente Alvarez Travieso's widow (Curbelo 1783). In 1809, Calvillo finally received clear title to his remaining two *sitios* of land (Ivey 1991:42).

By 1783, Francisco Flores and his son Vicente were operating Chayopines (Ivey 1991:42). The Flores property extended from about Chayopines crossing downriver about five miles (Figure 4); this was the portion Calvillo lost in 1780. Eventually the de la Pena family sold their rights to half of the original Rancho de San Yldelfonso del Chayopin in 1792 to Francisco Flores, losing control over Chayopines Crossing (Ivey 1991:42).

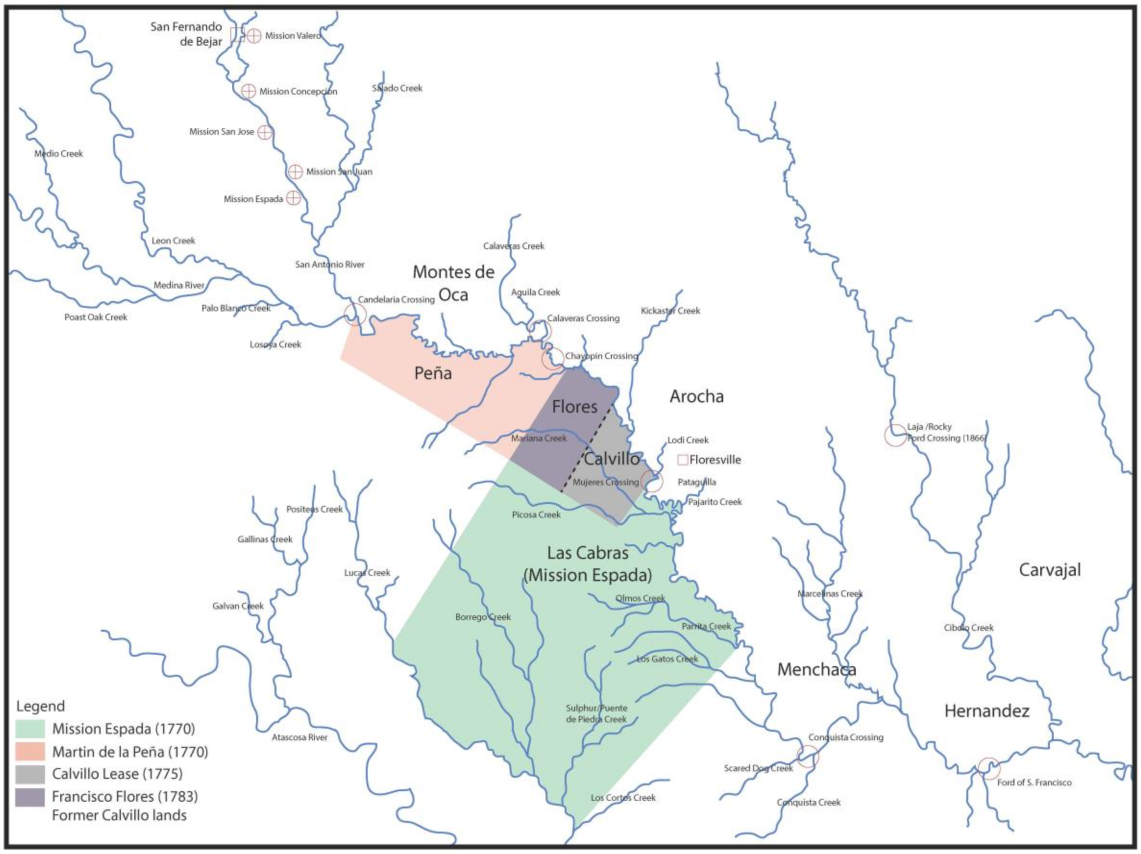

Figure 4. Map showing Flores Ranch in 1783.

THE SOLIS EXPEDITION OF 1767-1768

Th first accounts of settlement in the area near the location of the Flores Ranch were written by Fray Gaspar Jose de Solis in 1767-1768 during his inspection trip to Texas. Evidence suggests that multiple Chayopines ranchos on either side of the river existed since the area was first settled. In 1791 there were at least two ranches with the Chayopines name: Ygnacio de la Pena's Rancho de San Yldelfonso del Chayopin and Dona Manuela Montes' Rancho de Nuestra Senora de Guadalupe del Chayopin (Cabildo's Report 1791), apparently the northernmost section of Simon de Arocha's San Rafael ranch adjacent to Chayopin crossing (Ivey 1991:44). Previous research has shown that Solis passed through the Flores rancho, owned by Pena at the time. In order to clarify this matter, and because there were multiple Chayopines ranches in the vicinity, it is important to look at Solis' accounts of his trip.

In 1767, Solis traveled from Mexico to Bexar to inspect the Texan missions. He crossed the Rio Grande close to present-day Laredo, Texas, and then traveled north on the Camino Real to La Bahia (present day Goliad); from there he traveled along the San Antonio River north to the San Antonio missions. Afterwards, he traveled back south along the river down to the area near the intersection with Cleto Creek before turning northeast on his way to East Texas. Upon his return from East Texas he visited missions La Bahia and Concepcion, traveled upriver for a second time to Mission San Jose, and made his way to Rancho El Atascoso before returning to Mexico (Figure 5). His travel diary provides a description of the ranches along his route.

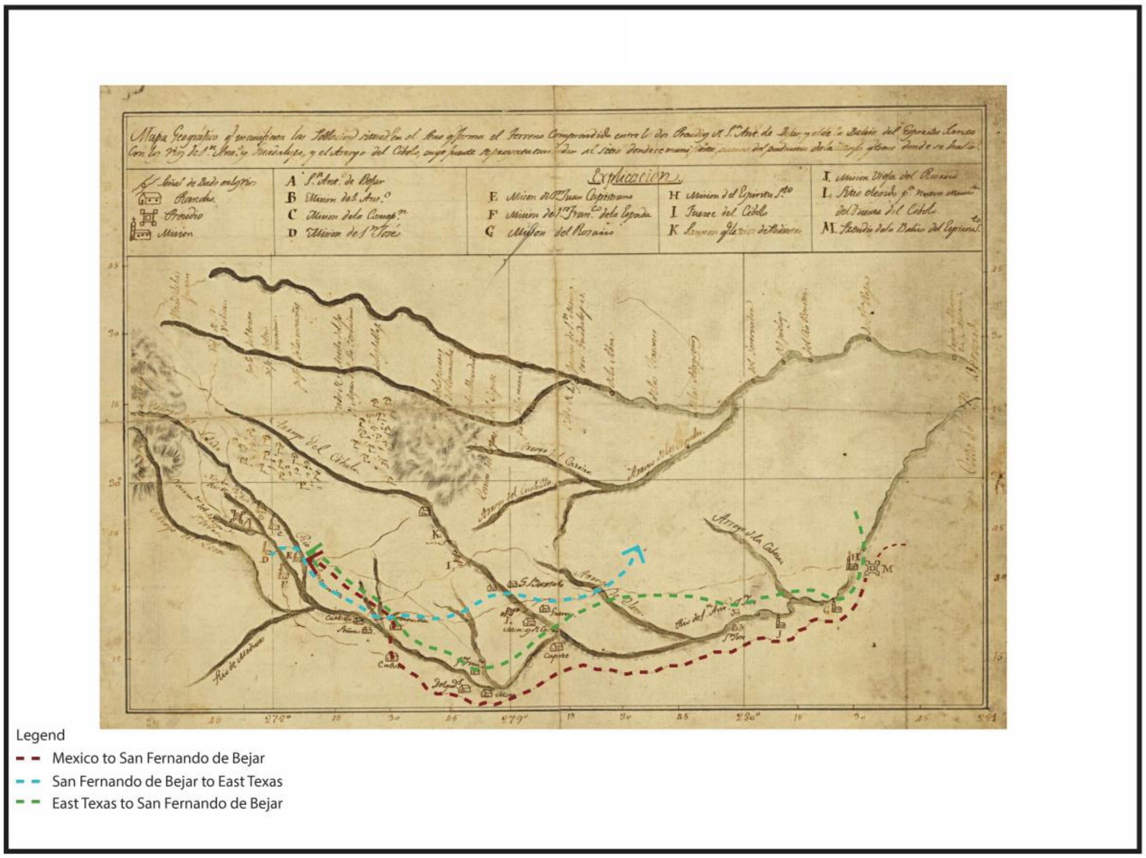

Figure 5. Overlay of the route of the Fray Gaspar Jose de Solis expedition in 1767-1768 on Domingo Cabello's (1780) map of the San Antonio River valley.

According to the translation of the diary by Kress (1932), after leaving La Bahia he "passed through the ranch of the S. S. Joseph, which belongs to the captain of La Bahia…journeyed almost to the River of San Antonio de Vejar going upstream…[and] came to La Escondida" (Kress 1932:47-48). The next day he "passed through La Parrita, through the ranch called El Capote, which is on the bank of the San Antonio River; through the ranch of La Mora belonging to the Mission of San Juan Capistrano on the bank of the same river…came to the Rancho de Labor of Father Cardenas, also on the bank of the river" (Kress 1932:48). It is important to note that all of these landmarks are located on the west bank of the river; until this point it is clear Solis was traveling upriver on the west bank. He then continued: "I passed through the goat ranch on the bank of the same San Antonio River, through La Mota and Arroyo del Padre Mariano…*crossed said river* [emphasis added] and came to the corral of San Juan Capistrano" (Kress 1932:48). According to the landmarks mentioned in his account Solis crossed on to the east bank of the river somewhere near present day Mariana/Picosa Creek, likely through Mujeres Crossing on to Pataguilla, Mission San Juan's Ranch (Ivey 1991:23). The next day he "passed the Salado River at the crossing of the San Antonio River, near the Mission of San Juan Capistrano" (Kress 1932:48). If there was a Chayopines ranch on the west bank of the river it would have been further upriver from where he crossed over to Pataguilla on the east bank of the river.

Fray Gaspar Jose de Solis then visited the San Antonio missions and traveled back the same way on his way to East Texas. He "left the mission of San Joseph…went by the Mission of San Juan Capistrano, crossed the Salado River…and came to the pool of Quinones…that is on the edge of the big woods, or Monte del Diablo" (Kress 1932:53). He remained there for the next day because of bad weather and then he "set out, passing through the Calaveras, and came to the Chayopines crossing of the San Antonio River…said mass and set up the Holy cross" (Kress 1932:53). After leaving Mission San Jose, on the west bank of the river, he implied crossing over to the east bank since he passed by Mission San Juan and Calaveras Creek, both located east of the river. His description puts Chayopines south of Calaveras Creek on the east bank of the river. The Chayopines that Solis stopped at, said mass, and set up a cross at, was close to the Pena ranch but on the east bank of the river. The next day he "passed through La Patanya, through Los Pajaritos, and came to Marcelino creek" (Kress 1932:53), all located east of the river. This corroborates the possibility mentioned above that at this point he was traveling on the east bank of the river. After going by the ranches of San Bartolo, Guerra, and Amoladeras he continued his travel to East Texas.

On his way back to San Antonio from East Texas and after stopping at the missions of La Bahia and Rosario he wrote that he "came to La Escondida…reached the ranch of the Honorable Captain of the Presidio of San Antonio de Bejar, which is called San Francisco…reached the Chayopines, ranch of the honorable Priest of said presidio" (Kress 1932:73). From there, he traveled upriver to Mission San Jose. Solis' account is unclear and not very descriptive, making it difficult to locate exactly where he was along the river. He first noted crossing La Escondida after passing through the ranch of S. S. Joseph on his initial travel from La Bahia to San Antonio; this is likely Escondida Creek, west of the River. He then mentioned stopping at San Francisco, which belonged to Captain Jose Antonio Menchaca and was located on the east bank between the river and Marcelinas Creek (Jackson 1986:93). Solis did not mention crossing the river, so it is possible that he left La Bahia, traveled on the east bank, passed by the mouth of Escondida Creek at the river, continued on to San Francisco, and then upriver to Chayopines.

According to Solis, he stopped at the Chayopines ranch of the "honorable Priest of the said presidio" (Kress 1932:73). It is possible, although highly unlikely, that this priest was Jose Antonio Yldelfonso de la Pena, Martin de la Pena's son, who was priest at the parochial church of Nuestra Senora de la Candelaria in San Fernando (Ivey 1991:41). Solis did not mention which route he took from Chayopines to Mission San Jose. On his previous visit he had followed the east bank of the river up to Calaveras Creek, went by Mission San Juan, and then crossed the river to get to Mission San Jose. It is likely that he would have followed his previous route. If he was at San Francisco on the east bank of the river he would have had to cross over to the west bank to get to Pena's ranch, then go back to the east bank to follow his previous route to Mission San Jose.

It is also known that Simon de Arocha settled Rancho de San Rafael by 1766 on the east bank of the river and that he was head of the Bexar militia. Thus it is possible that Solis was referring to the Arocha's settlement (Jackson 1986:91). According to a letter from Santiago de Zuniga written in 1788 regarding "an order of payment issued against Don Simon de Arocha, when [Zuniga] called upon him to make payment, he offered to do so with cattle from his Rancho de los Chayopines" (Santiago de Zuniga 1788). The Chayopines rancho owned by Simon de Arocha in 1788 does not appear on a 1791 report of ranches along the San Antonio River (Appendix A). It is unknown at this time if his Rancho Chayopines changed name and became San Rafael, or if he originally had two ranches. The 1791 report does list the Rancho de Nuestra Senora de Guadalupe del Chayopin owned by Manuela Montes de Oca (Cabildo's Report 1791), Juan de Dios Arocha Curbelo's widow. Juan de Arocha was Simon's brother, suggesting that the Chayopines rancho referred to in Zuniga's letter later became Juan's rancho. It is likely that the Chayopines ranch visited by Solis was Manuela Montes' and not Martin de la Pena's, as previous research had shown. My research indicates that it is highly possible Solis did not visit the Flores property during his trip.

FLORES RANCH

As mentioned previously, the Pena family was occupying their land up until at least 1791 (Cabildo's Report 1791), and Francisco Flores and his son Vicente were operating Chayopines by 1783 (Ivey 1991:42). It appears that Francisco Flores acquired two *sitios* of land that Ignacio Calvillo lost due to failing to pay rent to Mission Espada in 1780 (Ivey 1991:42). It is likely that the Francisco that acquired Calvillo's property and inhabited Chayopines in 1783 was Francisco Javier Flores de Abrego, Juan Jose Flores de Abrego's brother, and not his grandson Francisco Antonio, who received title to the Flores Ranch in 1834.

According to land grant #694 at the Bexar Archives, Ignacio Villaseñor and Concepcion Flores requested title of one *sitio* of land for *ganado mayor* in 1809 (Villaseñor 1809). Concepcion Flores was Francisco Antonio's sister and Ignacio Villaseñor was their brother in law, married to Maria Gertrudis Flores. Th document reads as follows:

> nuestro padre Don Pedro Flores ya difunto conpro al defunto Don Ygnacio Pena, un Citio de tiera de ganado mayor. Mi padre no obtuvo titulo de propiedad, ni el que le vendio lo tubo y de ese modo estamos manteniendo nuestros vienes en aquel citio en terreno nomvrado los chayopines (Villaseñor 1809).
>
> Our father Don Pedro Flores, deceased, bought from Don Ygnacio Pena, deceased, …my father did not get a property title, neither he who sold to him had it and in that way we are maintaining our property in that location at the site known as Chayopines.

It is unknown why if Francisco Javier Flores and his son Vicente inhabited the property in the 1780s, his niece Concepcion claimed the land was inhabited by his father Pedro. However, it is possible that as noted previously although Pedro's brothers Juan Jose and Joaquin were at Chayopines in the 1780s, Pedro might have taken over the rancho at some point.

Jose Flores responded to Ignacio Villaseñor and Concepcion Flores' request after visiting the property as follows:

> [el terreno] se haya citado en las marjenes del Rio San Antonio y Medina, en los agostaderos nombrados San Yldelfonso de los Challopines…se haya el suplicante radicado con jacal y corrales, a la parte de abajo ynmediato a las fabricas del interesado se ha establecido Don Francisco Farias…con un chamacuero y corral y labor…[en el] llano que esta enfrente de la fabrica del interesado; en dicho llano se halla una senal o mojonera de piedra la qual se ignora quien la puede haver puesto, respecto a que el padre Frai Pedro Norema dice se hayan los documentos de las Miciones en el archivo de Gobierno y algunos de los interesados dicen haverlas puesto sin medida de Juez los padres de las Miciones (Villaseñor 1809).
>
> [the site] is located at the bank of the San Antonio and Medina Rivers, at the pastures named San Yldelfonso de los Chayopines…the applicant is found residing with jacal and corrals, on the lower part immediate to the applicant's building Don Francisco Farias has established…with a *chamacuero* and corral and labor…[at the] plain that is in front of the applicant's building; in said plain there is a stone signal or *mojonera* and is unknown who placed it there, in respect to Father Pedro Norena saying that the documents of the Missions are at the Government archives and some of the interested parties say the Missions put them without any measurement of a Judge.

The Chayopines rancho that Concepcion and Ignacio were claiming was located immediately south of Francisco Farias' settlement (Figure 6). Francisco Farias was Maria Micaela de la Pena's son, and Micaela was Ignacio de la Pena's sister. A list of *sindicos* in the area published in 1810 shows two ranches in the Chayopines area: the Ranch of San Ildelfonso de los Chayopines occupied by Jose Francisco Farias and his wife Maria Encarnacion Rosales, and the Ranch of los Dolores y Chayopin occupied by Ignacio Villaseñor and Maria Gertrudis Flores (Appendix B). It is likely that at least by 1810, the original San Ildelfonso de los Chayopines was still owned by the Pena family (or at least part of it), and the *sitio* that Concepcion Flores and Ignacio Villaseñor requested in 1809 was the area between Chayopines and Las Cabras that Ignacio Calvillo had lost. However, if this was the case, Pena would have to have acquired the land Calvillo lost and then sold that to Flores. It is unknown why Concepcion requested title to only one *sitio* in 1809 if according to Ivey (1991:42), by 1792 the Flores family was occupying half of the original San Yldelfonso de los Chayopines land which would have amounted to more than one *sitio* of land.

It is also unknown if Concepcion Flores' claim was found valid in 1809 since title to the Flores property was not issued until 1834. It is possible that since a *mojonera* was found at the site and the records of the mission lands were not available for reference, the claim remained unprocessed. It is also possible that the *mojonera* found in 1809 marked one of the original boundaries of former Mission Espada lands, which would substantiate the fact that Flores was granted part of Ignacio Calvillo land that had belonged to the mission. Regardless, this document provides clear evidence that Pedro Flores, Francisco Antonio's father, purchased land from Pena prior to 1809.

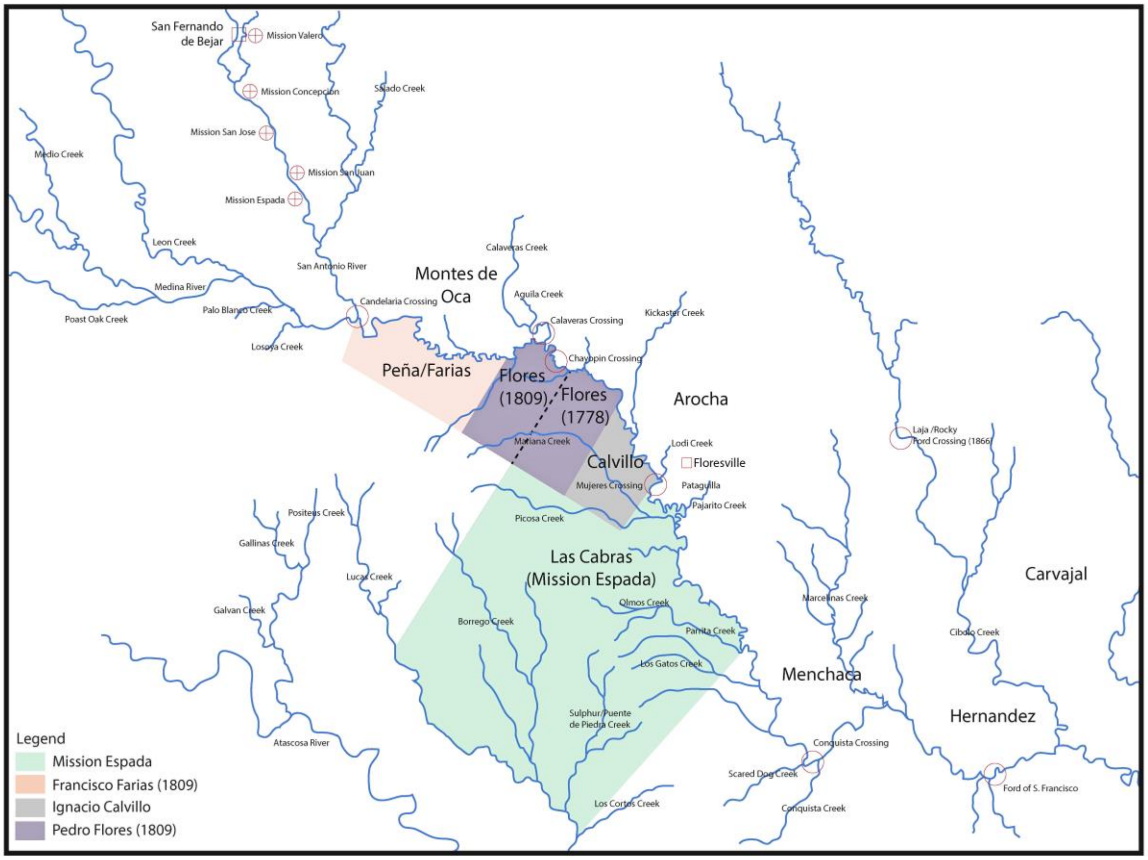

Figure 6. Map of Flores Ranch in 1809.

According to the property's 1834 survey, Francisco Antonio Flores initially requested title to four sitios of land in 1827 (Figure 7). His request reads as follows:

> hago presente que tanto mi difunto padre como yo despues de su muerte hemos ocupado y poceido de buena fee con nuestros vienes de campo y labores el terreno sobre la banda occidental del Rio de Bexar en el paraje Nombrado los Chayopines y que hayandome en el dia con numerosa familia y algunos vienes de ganado mayor que me vinieron por erencia del sitado mi difunto padre y que con mi industria e procurado conservar y aumentar en los tiempos mas aciagos de la Guerra y revoluciones padecidas en esta frontera…suplico a V.S. que havida consideración al merito y derecho que por todo lo espuesto tengo adquirido sobre el referido terreno se sirva mandar se me marsenen en el cuatro citios de tierra para labor y agostadero…otorgándome de ellos el correspondiente titulo (Flores 1834).

> I make present that my deceased father, as well as myself after his death, have occupied and possessed in good faith, with our field goods and labor, the site on the west bank of the Rio de Bexar at the *paraje* named los Chayopines, and that finding myself this day with numerous family and some *ganado mayor* that came to my by inheritance from the said my

> deceased father, and that with my industry I've procured to conserve and augment in the hardest times of War and revolutions endured in this frontier…I ask His Lordship, that taking into consideration the merit and right that I have acquired over the said site due to all the previously exposed, to order the four *sitios* of land for labor and pasture furrowed… giving me the corresponding title over them.

According to his request he and his family had inhabited the land prior to 1827 with cattle and other goods he inherited from his father. He also claimed that his father settled the land before him, thus implying an even earlier date for the occupation of the ranch by the Flores family. Flores' request was approved by the Governor in 1828 (Flores 1834).

Figure 7. Survey of four sitios granted to Francisco Flores in 1828 showing location of the ranch as indicated in the survey notes ("Flores" 1834).

In 1833, Flores requested an additional two *sitios* and two *labores* adjacent to the four he previously received on the west bank of the San Antonio River, or wherever there was vacant land available (Flores 1834). In his request he stated he was over 50 years old, that the land he had at that time was not large enough to contain sufficient cattle for him to comply with the Law of Colonization no. 190, that he met the requirements of the article 12 of Law no. 128 of 1830 and that he was making his request according to a certification issued by the City of San Fernando de Bejar which included a list of all public positions he served on (Flores 1834). A response to his request was issued a few months later stating that no land was vacant on the river banks and that at that time it was not possible to verify if any land was vacant to the west of his property since there were too many claims over the same area. The response also stated that if the land has not been awarded to anybody else, he should have priority over such land.

In 1834, the Governor awarded him one *sitio* and one *labor* of land (per the Law no. 128 of 1830) in the area he initially requested as long as title had not been previously issued to anyone else (Figure 8). The land, including five *sitios* and one *labor*, was surveyed by Byrd Lockheart in 1834. The

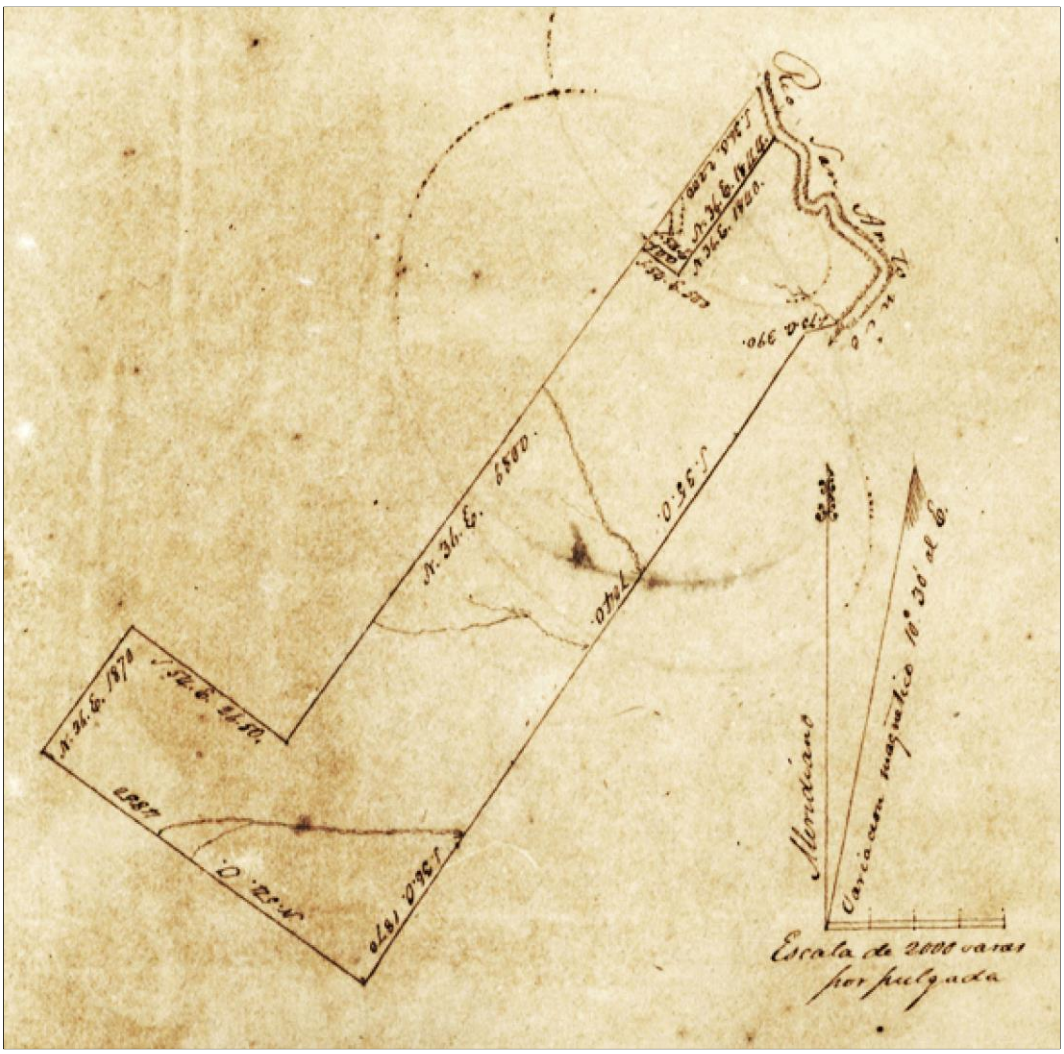

Figure 8. Survey of one sitio and one labor granted to Francisco Flores in 1834 (Flores 1834).

Figure 9. Overlay of original survey showing the location of the existing structures on site (Flores 1834).

1834 survey clearly showed that a structure existed on the property. It is likely that at the time the property was surveyed, the original adobe rooms of the main house (still extant) were present and according to page 14 of the deed, the "Rancho de Don Francisco Flores" was identified both in the survey notes and the metes and bounds (Flores 1834). The location of the Rancho on the survey corresponds to the location of the structure today, clearly supporting the premise that the building was present by 1834 (Figure 9). Francisco Flores claimed to be over 50 years old in 1833 and according to Ivey, Francisco Flores and his son Vicente were operating Chayopines by 1783 (Ivey 1991:44); it is likely that the original adobe structure at the Ranch was built prior to at least the 1780s.

According to a 1932 interview of Bruno Villareal, who was 88 years old at the time, "the old Flores house…had only three rooms when he was a boy of eight [in 1852]…the roof was thick with adobe…at each of the four corners of the house there was a little fort. The corners were just big enough for one man and had loopholes…when Indians were on the warpath, people from miles around came to the Flores house for protection" (Hagner 1940). It appears that a stone church was located across from the house, and a cemetery with at least three to eight graves and a monument with a partially legible description (Figure 10) were found in the church yard (Harlohs 1968:2).

Figure 10. Headstone marker found on site (Harlohs 1968).

Figure 11. Southeast elevation (South front and East side), Francisco Flores Ranch House, Floresville, Wilson County, Texas. Source: HABS/HAER/HALS Collection from the Library of Congress, photo by Arthur W. Stewart.

Figure 12. Southwest elevation (South front and West side), Francisco Flores Ranch House, Floresville, Wilson County, Texas. Source: HABS/HAER/HALS Collection from the Library of Congress, photo by Arthur W. Stewart.

Figure 13. North elevation (rear), Francisco Flores Ranch House, Floresville, Wilson County, Texas. Source: HABS/HAER/HALS Collection from the Library of Congress, photo by Arthur W. Stewart.

Figure 14. Northwest elevation (West side and North rear), Francisco Flores Ranch House, Floresville, Wilson County, Texas. Source: HABS/HAER/HALS Collection from the Library of Congress, photo by Arthur W. Stewart.

The present-day ranch complex includes a small adobe house with multiple additions in wood and brick. Th main house was documented and recorded in the Historic American Building Survey (HABS) in 1936 (Figure 11-14). Evidence visible from the interior of the structure shows the original flat roof was extended to form a gable roof at some point after its original construction. The exterior walls of the house have remains of the plaster cladding, which has a red tint and scoring to give a stone block appearance to the walls. The house has wooden doors and windows. In front of the house there is a brick oven with a pyramidal corbel that forms the top. Across from the main house, there are the remains of a large tree and evidence of a stone wall is visible.

CONCLUSIONS

Investigation of primary and secondary sources, including original Spanish documents, demonstrates that it is likely that the Francisco Flores rancho was acquired in part from lands that belonged to Ygnacio Pena and Mission Espada/Ignacio Calvillo. The archival information also demonstrates that at least four "Chayopines" ranchos existed in the area. The information I have collected shows that although Father Solis did stop at one of the Chayopines ranchos during his expedition in 1767-1768, it is likely he visited one of the other Chayopines ranchos and not the Francisco Flores property. Further investigation of additional available archival records in the Bexar Archives and others may clarify some of the questions about these ranchos. In addition, further investigation of the history of the surrounding ranches may clarify the boundaries and timeline for the use of these properties.

REFERENCES CITED

Cabello, D.

1780 *Mapa geografi que manifi sta las poblaciones situadas en el seno que forma el terreno comprendido entre los dos presidios de San Antonio de Bejar y el de la Bahia del Espiritu Santo con los rios de San Antonio y Guadalupe, y el Arroyo del Cibolo*. Map No. Q47, Records of the Bureau of the Chief of Engineers, National Archives at College Park, Maryland.

Cabildo

1791 Cabildo's report on number of ranches in Bexar as requested by Salcedo on Oct. 3, 1791. Official Report. Bexar Archives Online, Briscoe Center for American History, The University of Texas at Austin, http://www.cah.utexas.edu/projects/bexar/gallery_doc.php?doc=e_bx_006459, accessed June 4, 2014.

Cargill D. A., M. Brown, L. C. Nordt, and C. B. Bousman

1998 *Archaeological Survey at Rancho de las Cabras, San Antonio Missions National Historical Park, 41WN30, Wilson County, Texas*. Archaeological Survey Report No. 286. Center for Archaeological Research, The University of Texas at San Antonio.

Curbelo, M.

1783 Mariana Curbelo vs. Francisco Vicente Flores, demanding stock taken from the plaintiff's ranch. Proceedings. March 8, 1783. Bexar Archives Online, Briscoe Center for American History, The University of Texas at Austin, http://www.cah.utexas.edu/db/dmr/image_lg.php?variable=e_bx_008266_045, accessed June 19, 2014.

Flores, F.

1834 Flores, Francisco. March 23, 1834. Patent 99, Vol. 31, Patents, Archives and Records Program, Texas General Land Offi e, Austin.

Hagner, L. M.

1940 *Alluring San Antonio, Through the Eyes of an Artist*. The Naylor Company, San Antonio.

Harlohs, K.

1968 Rancho Floreno. *Floresville Chronicle Journal*, June 27, 1968.

Hazlewood, C.

2010 "Floresville, TX.," *Handbook of Texas Online*. June 12, 2010. http://www.tshaonline.org/handbook/online/articles/hgf03, accessed April 14, 2014.

Ivey, J.

1991 Mission Land Use in the San Antonio River Valley. Unpublished MS on file with the author.

Jackson, J.

1986 *Los Mestenos: Spanish Ranching in Texas*, 1721-1821. Texas A&M University Press, College Station.

Kress, M. K. (translator)

1932 Diary of a Visit of Inspection of the Texas Missions Made by Fray Gaspar Jose de Solis in the Year 1767-1768. *Southwestern Historical Quarterly* 35:28-75.

Oca, J. J. Montes de

1778 Oca, Juan Jose Montes de. Unfinished Titles, Archives and Records Program, Texas General Land Office, Austin.

Pena, M. de

1770 Pena, Martin de la. Unfinished Titles. Unfinished Titles, Archives and Records Program, Texas General Land Office, Austin.

Santiago de Zuniga

1788 Santiago de Zuniga vs. Simon de Arocha for payment of debt. Legal Instrument. 14 May 1788. Bexar Archives Online, Briscoe Center for American History, The University of Texas at Austin, http://www.cah.utexas.edu/projects/bexar/gallery_doc.php?doc=e_bx_005131&t=53&s=40, accessed June 4, 2014.

Villaseñor, I.

1809 Villaseñor, Ignacio and Concepcion Flores. Unfinished Titles. Bexar Archives, Land Grants and Sells, No. 694. Bexar County, Texas.

APPENDIX A

TRANSLATION OF "CABILDO'S REPORT ON NUMBER OF RANCHOS IN BEXAR AS REQUESTED BY SALCEDO ON OCT. 3, 1791" (CABILDO'S REPORT 1791)

Señor Governor of this Province of Texas, Lieutenant Colonel Don Manuel Munoz.

The *cabildo*, justice and regiment of this villa of San Fernando, imposed by the officio of the 6th of the current [month] in the superior disposition that is communicated by Senor commandant general dated October 3rd last, so that it is given prompt notice to all cities, villas, places, haciendas and ranchos within this province, we state that the ranches inhabited by people and cattle are the following:

Don Simon de Arocha owner of the Ranch of San Rafael de la Pataguiya
Don Luis Antonio Menchaca owner of San Francisco de los Tarais

The following are without people but with property:

Don Tomas Travieso owner of the Ranch of San Vicente de las Mulas
Don Jose Placido Hernandez owner of San Bartolo del Cerrito
Doña Leonor Delgado owner of San Jose de los Alamos
Don Salvador Rodriguez owner of Nuestra Señora de la Candelaria
Don Ygnacio Calvillo owner of Nuestra Señora de Guadalupe de las Mujeres
Don Ygnacio Peña owner of San Ildefonso del Chayopin
Doña Manuela Montes owner of Nuestra Senora de Guadalupe del Chayopin
Don Macario Zambrano owner of Nuestra Senora de Candelaria de las Calaveras
Don Diego Irineo Enriquez owner of Santa Cruz de la Laja

The ones without people or property are the following:

Doña Antonia de Armas owner of San Lorenzo de las Mulas
Don Manuel Delgado owner of San Cristobal de Espanta Perros
Doña Josefa Quinones owner of San Miguel de las Amoladeras

This is what we know and can inform to you on this particular, which we forward to your hands for your intelligence.

God keep you many years. Bexar, November 8, 1791.

Francisco Arocha
Pedro Flores
Marcos de Zepeda
Angel Navarro
Salvador Rodriguez
Juan Joseph de la Santa
Clemente Delgado
Francisco Bueno
Vicente Amador

APPENDIX B

TRANSCRIPTION OF "SINDICO REPORTS OF THE BEXAR JURISDICTION, TAKEN IN THE YEAR 1810" (JACKSON 1986:630-631)

Jurisidction of Sindico Ignacio de Arocha:

- San Rafael de Pataguia: Ignacio de Arocha (son of Simon); wife, Maria Josefa Salinas (age 34, Bexar); children Jose Felix (14), Maria Gertrudis (12), Jose Antonio (10), 2 servants and families.

- Nuestra Senora de Guadalupe y Paso del Chayopin: Dona Manuela Montes (55, widow of Juan de Arocha); children Manuel (33), Jose Maria (30); 3 servants and families.

- Los Dolores y Chayopin: Ignacio Villaseñor (45, Saltillo); wife, Maria Gertrudis Flores (36, Bexar); daughter Maria Josefa (13); 3 servants.

- San Ildelfonso de los Chayopines; Francisco Farias (45, Bexar); wife, Encarnacion Rosales (43, Bexar); children Jose Antonio (20), Domingo (11, adopted); niece Antonia Rodriguez (4); 2 servants (In 1791 this ranch was owned by Ignacio Pena).

- La Santa Cruz y Paso de las Mujeres: Ignacio Calvillo (77, Aguascalientes); and wife, Antonia de Arocha (65, Bexar, sister of Simon de Arocha); grandchildren Ignacio Casanova (22); Francisco Casanova (10); 3 servants. Also agregados (tenants) Gavino Delgado (55) and wife, Maria Calvillo (45, Ignacio's daughter); Jose Saucedo (46); wife, Juana Calvillo (35); 3 children; 4 servants.

- San Juan Nepomuceno y Pataguias: Jose Clemente de Arocha, curate (45); 11 servants (see no. 1 above).

- Pataguia: Tomas de Arocha; 2 servants and families (see no. 1 above).

- La Soledad, in Pataguia: Francisco de Arocha; 2 servants. (Nos. 6-8 were divisios of Simon and Juan de Arocha's 8-league grant, along with no. 2. Juan died in 1788; Simon, in 1796).

- San Antonio del Sabinito: Manuel Nunez, who lived in Bexar; 3 servants.

- Santa Gertrudis, in Las Cabras Viejas: Manuel Barrera (son of the diezmero Juan), who lived in Bexar; ranch kept by 3 servants and families.

- La Laguna de las Animas (Lagoon of the Souls): Juan Manuel Sambrano (38, subdeacon, son of Jose Macario); 32 servants and 2 slaves.

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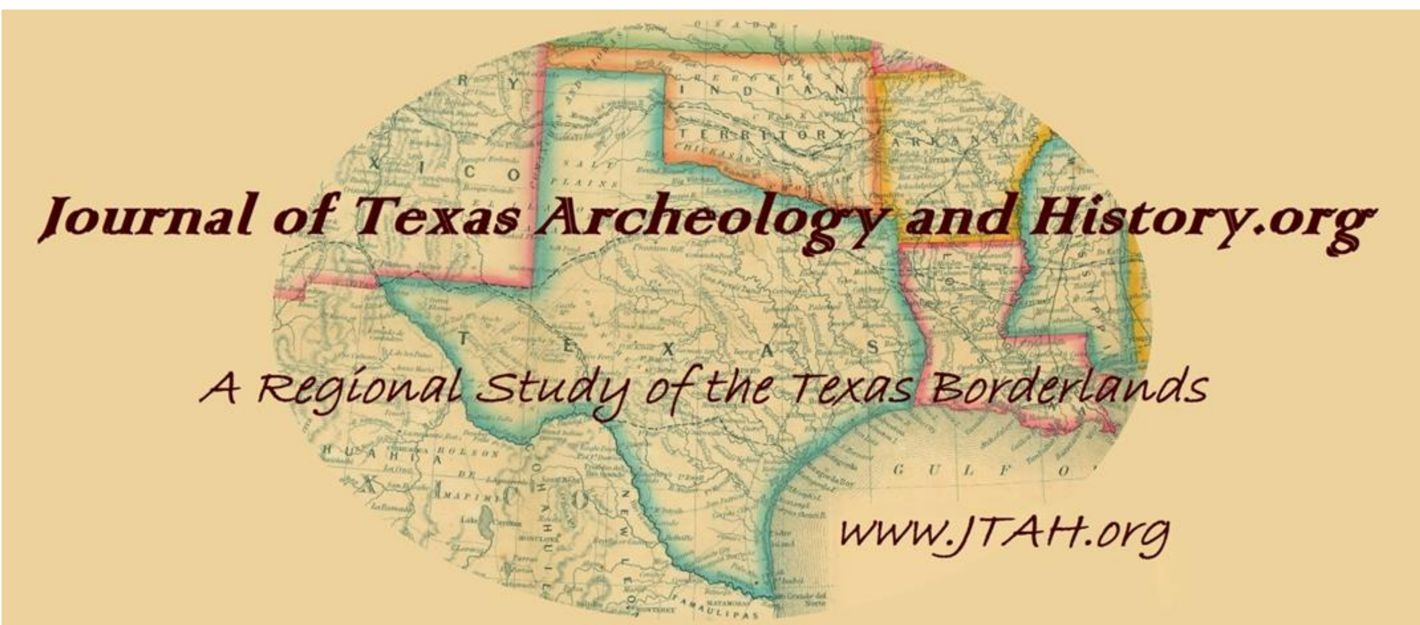

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