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CONTENTS

Prologue

Edward B. Jelks

ABSTRACT

The other articles in this tribute to Dee Ann focus on her role as teacher—in the classroom, in the laboratory, and in the field—after about 1970. This prologue traces the high points of her earlier development as an archeologist, from her days as an undergraduate student in 1952 to her becoming the Director of the Texas Archeological Research Laboratory at The University of Texas in 1968.

The participants in this tribute to Dee Ann Story have faithfully measured Dee Ann's stature as teacher, researcher, administrator, and curator, based largely on their own personal experiences. Her former students have recalled her genius as a teacher and a mentor, which is reflected in Harry Shafer's lengthy discussions of her students who made their marks as archeologists. Descriptions of Dee Ann's exacting fieldwork at the George C. Davis and Deshazo sites by others give us a good vision of Dee Ann in the field, and other tribute participants have described her skill in synthesizing and interpreting large data sets related to the Caddo and Southwestern peoples, and in how Dee Ann went out of her way to teach avocational archeologists how to conduct thoughtful research. Other participants to this tribute have related how Dee Ann was instrumental in training them in the basics of archeological research. A common thread through all these tributes is how the participants were influenced by Dee Ann's insistence on critical thinking in addressing archeological problems.

All these archeologists knew Dee Ann during the height of her career from 1970 on. My perspective is a little different, as I knew her at the beginning of her professional development, so I will dwell mainly on the early days of her remarkable career.

One day in the fall of 1951 a shy young woman stepped into the office of the Smithsonian's River Basin Surveys (RBS) in Austin that I was then directing and introduced herself as Dee Ann Suhm. She said that her anthropology professor, Dr. Tom Campbell, told her I was looking for a typist, and that she would like to apply for the job. I had to turn her down because I had hired a federal civil service stenographer the day before. However, it was only two or three weeks later that two policemen came to the office, arrested the stenographer for some serious crime (I never knew exactly what), and hauled her away to be incarcerated. I called Dee Ann and asked if she was still interested in the job, she said yes, I hired her, and thus began a collegial relationship and a close personal friendship that endured for 60 years.

I had never before seen such a quick learner or intensely dedicated worker. Ostensibly her job was to type correspondence, field notes, monthly reports and the like, but she showed such an enthusiastic curiosity about the workings of the lab that before long I had her processing artifacts coming in from the field and performing other routine lab and office chores. In early childhood she had developed a strong interest in classical Old World archeology, and at first she showed little interest in Texas archeology. Discussions about how to conduct surveys, how to dig a particular site, how to interpret findings in the field, and such went on constantly in the lab between our field archeologists, sometimes with input from such stimulating colleagues as Alex Krieger and geologist Glen Evans. Dee Ann began listening in on these discussions and soon recognized that Texas archeology was an exciting field that offered all the intellectual challenges that one could wish for. Then she began asking a question or throwing a comment into our discussions, a bit tentatively at first, then with confidence. Eventually her observations became incisive and consequential. Dee Ann worked at the RBS office until it was closed temporarily in October 1954.

One day in the spring of 1953 Dee Ann told me that she had to write a term paper for Dr. Campbell and asked me to suggest possible topics. A number of archeological foci (now called phases) for classifying Texas native cultures had been defined by various researchers over the years, but their published descriptions were widely scattered in the literature. Having a brief description of each focus—including estimated dates, major sites, geographical distribution, culture traits, and relevant publications—altogether in one place, would be a useful reference for researchers including the RBS archeologists. I suggested this would be a good topic for her paper. Although an exceedingly ambitious undertaking for an undergraduate student, Dee Ann, undaunted, jumped on it with unflagging enthusiasm and produced a superb product which so impressed Campbell that he suggested she publish an expanded version in the *Bulletin of the Texas Archeological Society*. Dee Ann asked me to help expand her paper, which I did. When Texas Archeological Society editor Alex Krieger saw our completed manuscript about a year later, he insisted that a section describing recognized artifact types be added, and he joined us in writing a typology section. The end product was "An Introductory Handbook of Texas Archeology" (Suhm et al. 1954), the typology section of which remains a standard reference after more than 50 years and through four reprinted editions

After earning a B.A. and an M.A. in anthropology at The University of Texas, Dee Ann entered graduate school at the University of California at Los Angeles (UCLA) in the fall of 1956. While she was still a graduate student, Jesse Jennings at the University of Utah hired her as an archeologist to work on the Glen Canyon Reservoir project, where she conducted fieldwork as a crew chief, but primarily supervised the lab where the artifacts were processed.

In 1960 Dee Ann returned to Austin to take a position as Curator of Anthropology at the Texas Memorial Museum. One of her assignments was to curate The University of Texas' archeological collections, then stored at the Little Campus facility near the main university campus. When she and Hal Story, the museum's illustrator and exhibit preparator, married in 1961, they ran afoul of a rather strict state nepotism regulation in force at the time that barred husband and wife from both working at the same state agency. So one of them had to leave the museum, and I hired Dee Ann as my assistant at the Texas Archeological Salvage Project (TASP) at The University of Texas, which had taken over administration of the Texas RBS program. She continued working on the curation of The University of Texas archeological collections, which, over the next few years, were moved from Little Campus to the Balcones Research Center (now the Jake Pickle Research Center) several miles northwest of Austin where TASP was located.

While still an undergraduate, Dee Ann had become close friends with my wife, Judy, and me. The three of us traveled on vacations together, hosted parties together, and carried out a couple of archeological field surveys together. After moving to Illinois in 1968, Judy and I kept in close touch with Dee Ann and Hal, visiting their place in Wimberley several times, and they visited us in Illinois. In 2009, together Dee Ann and I wrote a foreword to the 4th reprinting of the type description section of the "Handbook" (Suhm and Jelks 2009).

Dee Ann had left UCLA with everything completed for her Ph.D. except a dissertation. I would ask her every now and then how the dissertation was progressing but her answers were evasive. After several months it became clear that she had become so involved with her duties at TASP and with working on the curation of The University of Texas collections that she had found little time to devote to the dissertation. I told her to slack off some from her day job and concentrate on the dissertation—that if she got behind a little with her duties, she could play catch-up once she had her degree in hand. My admonishments did not do much good. But then Judy got on her case and that did the trick. Judy, who can be very forceful, put the screws to her, and in 1963 Dee Ann turned in her completed dissertation and became one of the first women to be awarded a Ph.D. in anthropology at UCLA.

In 1964 I assigned Dee Ann to direct field excavations at Waco Reservoir, despite reservations expressed by some that no woman should be given a job supervising a bunch of male shovel hands, whose crude language and off-color witticisms would be sure to offend her. But her unfailing enthusiasm and good humor won over the all male crew, mostly University of Texas students, and by the end of the season she had earned their unanimous respect. Her work at Waco Reservoir demonstrated that she was both a skilled field archeologist and an effective field crew supervisor.

I left The University of Texas to join the faculty at Southern Methodist University in 1965, about the time that Dee Ann took over as director of the newly created Texas Archeological Research Laboratory, and our professional paths diverged. Even so, we kept in close touch over the following years.

Dee Ann's field research in eastern, Central, southern, and western Texas contributed substantially to our knowledge and understanding of the prehistoric and historic Indian cultures of the region. As a professor she played a major role in educating a couple of generations of students, many of whom became professional archeologists, including most of those contributing to this tribute. She was an exacting, no-nonsense teacher whose infectious enthusiasm and insistence on professionalism among her students became legendary. Over the years she gained wide recognition as one of the major authorities on Texas archeology. The contributors to this tribute in the *Bulletin of the Texas Archeological Society* have attested clearly how much Dee Ann's students and colleagues respected her as a scholar, as well as the affection they held for her as a person.

In 1950 I attended my first annual meeting of the Society for American Archaeology. There was only a single slate of papers—no concurrent sessions—and everybody listened attentively to each paper. There were perhaps 100 archeologists in attendance, including one woman: Marie Wormington of the Denver Museum of Natural History.

Surely, one of Dee Ann's proudest achievements was to play a major role, along with a few others like Marie Wormington, in paving the way for the integration of women as equals in a discipline that traditionally had been almost exclusively the domain of men.

REFERENCES CITED

Suhm, D. A., A. D. Krieger, and E. B. Jelks
1954 An Introductory Handbook of Texas Archeology. *Bulletin of the Texas Archeological Society* 25:1-562.

Suhm, D. A. and E. B. Jelks (editors)
2009 *Handbook of Texas Archeology: Type Descriptions*. Reprint edition. Texas Archeological Society, San Antonio and Gustav's Library, Davenport, Iowa.

Critical Thinking in Archeology: Papers in Memory of Dee Ann Story

Nancy A. Kenmotsu and Timothy K. Perttula

ABSTRACT

We introduce the papers in this section of the *Bulletin of the Texas Archeological Society* that honor the memory of Dr. Dee Ann Suhm Story, a long time and well-respected Texas archeologist. The papers are written by colleagues, students, and friends of Dee Ann, and all share her perspective that consistently urged archeologists to critically evaluate their data through analyses of the strength of a given data set, employ contextual studies to better understand past human choices, and use thoughtful field and analytical approaches in combination with careful critiques of the results of those approaches.

The following sets of papers are published to honor the memory of Dee Ann Suhm Story who passed away in December 2010. Most of the papers were first presented in a symposium in 2012 at the annual meeting of the Society for American Archaeology in Memphis, Tennessee, and others by colleagues and friends have been added to this tribute. Dee Ann was a formidable force in Texas archeology, but also she had a delightful and engaging personality with a dry wit (Figure 1). Because of her deep roots in Texas and her long association with the Texas Archeological Society, we feel that it is fitting to publish these papers in the *Bulletin of the Texas Archeological Society*.

For more than four decades Dee Ann significantly influenced the nature of the archeological research carried out by students and colleagues as she urged them to critically assess biases, methods, and alternative explanations of their data. In general, the papers approach a subject—the critical assessment of the archeological record—that has been at the heart of the discipline nearly since its inception.

Dee Ann is best recognized for her archeological research on the Caddo Indian peoples of Southwest Arkansas, Northwest Louisiana, eastern Oklahoma, and East Texas, and carried out a number of field schools for the University of Texas at Austin in this region (Figure 2). She was a friend of the modern Caddo Indian peoples, namely the Caddo Nation of Oklahoma, and she recognized the importance of collaboration and consultation between the Caddo and the archeological community on historical and archeological research problems of mutual interest. Yet, that was only part of her contribution to the discipline. She had a significant influence on archeological studies in the Texas Gulf Coastal Plain where she was reared, as well as Central Texas, where she carried out a number of important early excavations while she was an undergraduate and graduate student at The University of Texas at Austin, and in the Trans-Pecos, where she also worked and shaped the research agenda there (see Dee Ann Story's bibliography of published works in the paper compiled by Harry J. Shafer, Nancy A. Kenmotsu, and Timothy K. Perttula, this volume). She also influenced the research trajectories of students she mentored who have pursued careers in the American Southwest.

The papers cover archeological inquiries in Texas and the American Southwest that exemplify the research that she fostered during her long career at the University of Texas at Austin. She consistently urged the critical evaluation of archeological data through analyses of the strengths and weaknesses of a given data set, employing contextual studies to better understand past human choices reflected in the archeological record, and implementing thoughtful field and analytical approaches that were followed up with careful critiques of the results of those approaches. Here, some of her former students and colleagues discuss archeological topics inspired by Dee Ann's broad and topical interests in North American archeology, ranging from hunter-gatherer economics, households and

Figure 1. Dee Ann with colleagues and friends in November 1995 at the reconstructed Caddo house at Caddo Mounds State Historic Site (left to right: A. J. Taylor, Jeri Redcorn [of the Caddo Nation of Oklahoma], Harry Shafer, Dee Ann Story, Jim Corbin, Carolyn Spock, Darrell Creel, and Jan Guy). Photograph courtesy of Velicia Bergstrom and Bob D. Skiles.

Figure 2. Participants of the 1976 University of Texas at Austin field school held at the Deshazo site (41NA27) in Nacogdoches County. Front row, left to right: Molly Godwin, Dee Ann Story, Deniese Palmer, Wessley Robinson, Lynda Robinson, Ulrich Kleinschmidt; 2nd row, left to right: Richard Wilshusen, Mike Krol, Lucye Enriques, Jeff Girard, Dale Vinson; 3rd row, left to right: Ricky Lightfoot, Terry Owen, Sue Amini-Minor, Mark Varien, Mary Williams, Harrison Kinney; Back row (standing, left to right: Charlie Locke, Margaret McDonald.

community structure, mortuary practices, social networks and interaction, subsistence and bioarcheological variation, human agency, and methodological advances in the disciple. The papers also provide insights into how she aided and shaped their own research over the years.

These papers are by archeologists who work in three primary culture areas—the American Southwest, the Caddo area of Texas, Oklahoma, Arkansas, and Louisiana, and Central Texas. The first paper, by Dr. Edward B. Jelks, who was Dee Ann's mentor when she was an undergraduate at the University of Texas as well as a life-long friend and colleague, describes the early part of Dee Ann's career from the perspective of a close friend. The remainder of the papers honors Dee Ann by demonstrating how her perspective of critical thinking influenced their research and how her approach to understanding and interpreting archeological data continues to resonate in the discipline.

The Legacy of Dee Ann Story

Harry J. Shafer and Thomas R. Hester

ABSTRACT

Dee Ann Story (1931-2010) taught two generations of professional archeologists and made lasting contributions in Central Texas and Caddo archeology. She teamed with Alex D. Krieger and Edward B. Jelks in producing the classic volume *An Introductory Handbook of Texas Archeology*. Much of her early work was in Central Texas, and she later added the Caddo area as a major research focus. Her most important archeological contributions were the excavations at the George C. Davis and Deshazo sites. Her lasting legacy is the number of professional archeologists she trained and mentored and opening the door for women in Texas archeology, and in her curation efforts in organizing and establishing the Texas Archeological Research Laboratory. We discuss and review her early contributions to Central Texas archeology at the Collins, Smith Rockshelter, and Williams sites and sites at Canyon Reservoir, and her efforts to establish the Texas Archeological Research Laboratory, as part of her lasting legacy in Texas archeology.

INTRODUCTION

Dee Ann Story (1931-2010), renowned Texas archeologist and former Director of the Texas Archeological Research Laboratory at The University of Texas at Austin (TARL), passed away on December 26, 2010, at the age of 79 in Wimberley, Texas, after a lengthy and courageous battle with cancer. She was born to Emma and Eugene Suhm in Houston on December 12, 1931, and was preceded in death by her husband Hal Story, whom she married in October 1961, her parents, and her sister Beverly Morgan. Four nephews survive her: Clayton Morgan, Tim Morgan, and Matt Morgan of Austin, and Russell Morgan of Houston. Her pets were like her children. Creature, a rescued blue jay, and dogs—Humphrey, Ginger, a Doberman Pincher named Bridget, and her surviving pet Callie—were all constant companions. She lived most of her adult life in Austin and retired to Wimberley in 1987.

Dee Ann attended Texas Women's University in Denton and completed her undergraduate degree in anthropology at The University of Texas at Austin in 1953. She was awarded her Master's degree from the same institution in 1956. Dee Ann received her doctoral degree in anthropology from the University of California at Los Angeles in 1963. While at the University of California, she worked with Jesse Jennings at the Glen Canyon Archeological Project; at Glen Canyon she served as an assistant director doing fieldwork and directing the laboratory. Dee Ann's place among the first professional female archeologists of the 1960s has been noted and is summarized in a book by Lister (1997). One excerpt is particularly important here regarding her early career, just after earning her Ph.D. from UCLA:

> [Dee Ann] was hired to set up and direct the archaeological laboratory for the University of Utah's portion of the Glen Canyon Project… efficient, knowledgeable, and comfortable in the *traditional woman's role* of bringing order to the masses of artifacts, photos and notes pouring in from surveys and excavations (Lister 1997:57; emphasis added).

She became assistant director of the Texas Archeological Salvage Project at The University of Texas at Austin (UT) in 1962, where she became the first female archeologist in Texas, not the first to actually work, but the first to be employed in that capacity. She was also a lecturer in the Anthropology Department at UT from 1963 to 1965, Assistant Professor from 1965 to 1972, Associate Professor from 1972 to 1978, and became Full Professor in

1978. In 1987, she became Professor Emeritus. She was the Director of TARL from 1965 to 1987. Dee Ann, as she was known among her friends and colleagues, and Dr. Story among her many students, had an accomplished career in archeology, teaching and publishing many articles and monographs on Texas archeology. She also directed many major archeological and research projects in Texas for which she received numerous honors of recognition.

Her main archeological interests were the ancestral Caddo culture of East Texas and later the Archaeological Conservancy. She also made significant contributions in Central Texas archeology. She was a member of national and regional professional societies, among them the American Anthropological Association, Society for American Archaeology, Society for Historical Archaeology, Plains Anthropological Society, Arkansas Archeological Society, and the Texas Archeological Society. She served on the board of the Archaeological Conservancy. She was awarded the Curtis D. Tunnell Lifetime Achievement Award, the Excellence in Archeology Award, and the Award for Historic Preservation, all from the Texas Historical Commission. She was a past president and a Fellow in the Texas Archeological Society, where she was the first recipient of the society's Lifetime Achievement Award. Other awards of recognition came from the Archaeological Conservancy, the Betty Lee Wright Award for Democratic Leadership from the Wimberley Democrats, the Houston Archeological Society, and the Society for American Archaeology for Outstanding Contributions.

As a teacher and mentor, Dee Ann made profound impacts on the lives and careers of her masters and doctoral students. She chaired the committees of many of Texas' leading archeologists, taught courses in basic anthropology and archeology, and taught field methods in archeology. In addition to her teaching and mentoring, Dee Ann created TARL as we know it today, a facility that benefited all of her students and at least two generations of researchers. It was through her efforts that the archeological collections and archives from all over the state have been compiled in a single location for research purposes. There are indeed few such facilities in the country. Like any outstanding teacher, mentor, and educator, her guidance and influence changed the lives and career directions for many of her students, who have gone on to other universities and agencies across the country continuing her remarkable legacy.

Dee Ann moved to Wimberley upon retirement and became active in the Wimberley Institute of Cultures, Wimberley Players, and Wimberley Democrats. A visit with her after retirement would invite stories of her worldwide travels accompanied by dear friends Lila Knight and Ann Dibble that took her to every continent. She visited Antarctica, Greenland, Peru, Chile, Australia, New Zealand, South Africa, China, Greece, Italy, Mexico, the Galapagos Islands, India, Bhutan, Tanzania, and Kenya, where she pointed out archeological sites to friends at the tent camps.

At the time Dee Ann entered the field of archeology, men dominated it; very few women entered the profession. Despite this imbalance, she not only persevered but also became a distinguished archeologist and scholar, and she opened the door for many more young women to get in the field and become professional archeologists. As Mike Collins stated at her memorial on February 5th, 2011, at Wimberley, she was one of the guys. When working in the field, Dee Ann worked in the pits, becoming saturated with red clay like everyone else, and she stretched the work time from daylight until late afternoon. Then, she would lean back, drink beer, and laugh with all the others in the evenings. As Margaret Jodry said at the same memorial gathering, she was one of the gals too. Dee Ann's work ethic was legendary and it rubbed off on all of her students. Her students gained a sense of pride and discipline, and she taught us all how to present ourselves as professional archeologists. She connected with her students in a way that gained her their utmost respect and admiration, truly a teacher's teacher. Her contributions to Texas archeology, the Texas Archeological Society, The Archaeological Conservancy, and to the lives of her former students and friends in Wimberley will stand as her lasting legacy.

Her legacy includes two generations of trained professional archeologists and major contributions in Central Texas and Caddo archeology. Her mentors were Alex D. Krieger and Edward B. Jelks, with whom she teamed while she as a graduate student in producing the classic volume *An Introductory Handbook of Texas Archeology* (Suhm, Krieger, and Jelks 1954; see also Shafer 2010, Tunnell 2000). Much of her early work was in Central Texas, but she later added the Caddo area as a major research focus. Perhaps her most important archeological contributions were the excavations at the George C. Davis and Deshazo sites in East Texas, but she also made significant contributions in Central Texas archeology, and established the research facility known as TARL; the latter two are discussed below. The Davis site has three mounds, one of which had been explored in the 1930s; she opened the two remaining mounds, Mounds B and C, and explored a large portion of the village. At Deshazo, she directed excavations of an historic Hasinai Caddo village. When combined, her lasting legacy was the foundation she helped to lay for Texas archeology and the number of professional archeologists she trained.

PIONEER OF CENTRAL TEXAS ARCHEOLOGY

Dee Ann was a pioneer in the archeology of Central Texas. Prior to the 1950s little archeological work had been published in Central Texas (see Suhm [1960] for an inventory of investigated archeological sites in the region). Despite the accumulation of large artifact collections from the Lake Buchanan and Fall Creek sites by J. E. Pearce (1932), A. T. Jackson (1938), and Woolsey (1938) and other investigations such as that of Vane Huseky (1935) in Nueces Canyon, especially the much more extensive and more sophisticated excavations at sites in what became Lake Travis near Austin, little was actually understood about site types, chronology, stratigraphy, artifact classification, or function. The most substantial previous contribution was by J. Charles Kelley with his work with the Cyrus Ray and E. B. Sayles collections and the Works Progress Administration (WPA) collections along the Colorado River establishing the foundation for the first systematics and projectile point typology (see Story 1960 for a review of Kelley's contributions; also Kelley 1947a; Kelley and Campbell 1942).

This was the setting that confronted Dee Ann as a graduate student at UT where she directed three archeological excavations in Travis County whose results she then had to interpret and publish. The three were the Collins site on Onion Creek, Smith Rockshelter, also on Onion Creek, and the Williams site on Bull Creek. Interestingly, each was a different type of site, and each provided new and significant data on Central Texas site types and chronology. The Collins site was a large open campsite with extensive Archaic and Late Prehistoric deposits on Onion Creek south of Austin; Smith Rockshelter was a well stratified Late Prehistoric site with predominantly Austin and Toyah phase components; and the Williams site was a burned rock midden site on Bull Creek near Austin. These projects illustrate her insightful understanding and imagination in approaching the data recovered from each of these types of sites. She did not hesitate to question conventional thinking at the time and to pose new questions and methods. Questioning conventional thinking was a character trait of Dee Ann's that she passed on to her students; she challenged us to do the same. A brief review of each of these early projects will show her devotion to critical thinking and foresight.

To understand Dee Ann's pioneering work in Central Texas, it is appropriate to put it within the context of her time: how archeologists viewed the prehistory and classification of material culture in the early and mid-1950s. The emphasis was on classification, typology, and chronology that were built on the efforts of J. Charles Kelley (1947a), Alex D. Krieger (1946), Newell and Krieger (1949), and Thomas N. Campbell (1948; Kelly and Campbell 1942) (Figure 1). Texas was in step with some areas of the country in applying archeological theory, and the theoretical frameworks used by J. Charles Kelley, Alex D. Krieger, and others remained in the Classificatory-Historical Period in American archeology as defined by Willey and Sabloff (1993).

Dee Ann's analysis of the material culture from each of these sites was conducted within the paradigm and systematics that were just being introduced and published in Texas; this was the *Introductory Handbook of Texas Archeology* of which she was the senior author (Suhm et al. 1954). The chronology was divided into broad "developmental periods:" Paleo-American, Archaic, Neo-American, and Historic. The systematics followed a modified Midwestern Taxonomic System where assemblages within a site were labeled *components,* sites with similar components were grouped under *foci*, and similar foci were grouped under *aspects*. For Central Texas, the Archaic was defined as the Edwards Plateau Aspect with three defined foci, Clear Fork, Round Rock, and Uvalde. The Central Texas Aspect of the Neo-American Stage was divided into two foci, Austin and Toyah.

The Sites

Collins Site

The Collins Site (41TV40) is located on a south bank terrace of Onion Creek about 10 km from downtown Austin (Figure 2). Students from

Figure 1. Drs. Thomas N. Campbell and Alex D. Krieger conversing as Dee Ann moves closer to hear their conversation at the Collins site ca. 1953: a, Dee Ann stands behind the back dirt pile; b, she takes notes closer to them. Photos courtesy of TARL.

Figure 2. View of the University of Texas excavations at the Collins site ca. 1953. Photo courtesy of TARL.

Figure 3. Dee Ann with fellow graduate students at the Collins site ca. 1953. Photo courtesy of TARL.

UT under Dee Ann's direction excavated it in 1953-1954. The excavation consisted of 30 5 x 5 ft. squares excavated to depths varying from 18 to 88 inches (Figures 3-4). The site contained an extensive Neo-American (Late Prehistoric) occupation overlying Late and Middle Archaic components. A significant sample of pottery was recovered from the UT investigations (849 sherds) that have provided an important reference collection (see Creel et al. 2013). The thick midden deposits at Collins were tested to a depth of five feet and were not clearly stratified although the artifact provenience charts show some hint of temporal trends. These findings were significant at the time in Texas archeology and provided a baby step toward building a regional chronology and confirming that changes in projectile point types could signal chronological changes (Suhm 1955).

Artifacts were labeled with conventional terminology such as dart points, arrow points, knives, scrapers, drills, and choppers—all labels that implied an assumed use. The term "knife" was applied to any unstemmed biface regardless of stage of reduction, and "scraper" was any artifact that exhibited unifacial flaking. The legitimacy of these assumed functional terms would be challenged in later years, although the dart point-arrow point division holds true in Central Texas today. The term knife, however, was based on the assumption that any unstemmed biface could have functioned as a knife. It was not until a decade later when the accomplished flint knapper Don Crabtree demonstrated to us at a Texas Archeological Society meeting in Dallas that many of these bifacial artifacts were in fact failures in a manufacturing process, and not knives at all (Figure 5).

Dee Ann's discussion of the Collins site is worth reading to understand the historical development of her interpretations. She aptly observed that while the Central Texas Aspect materials that contained Scallorn and Perdiz points (and bone artifacts—Figure 6) occurred in the upper 18 inches, there was considerable mixing with Archaic point types (Figure 7). Because of her observations, she questioned the separation between the Edwards Plateau and Central Texas Aspects that J. Charles Kelley (1947b) had proposed, and she further noted that many sites in Central Texas had both dart points and arrow points mixed together. In fact, she hinted of a continuity from one arrow point type to the other. She speculated on the size of the social group that occupied the site as well by inserting a bit of anthropology into the archeological discussion, something that was almost unheard of in the mid-1950s in Texas. She had begun excavations at the Smith Rockshelter at the time she wrote the Collins site report, and made reference to the preliminary findings at the Smith site of Layer I, the deepest component that contained mainly Darl points, stating that the same component was also present at Collins.

Dee Ann was able to tease out a very rough chronology for the distribution of dart points, noting that Pedernales, Bulverde, and Nolan occurred at the deeper levels whereas Ensor, Darl, Marcos, Williams, Marshall, and Edgewood were the predominant types in the middle level, and the upper 18 inches yielded a mixture of arrow points

Figure 4. The deep excavation at the Collins site ca. 1953, which was the subject of discussion among Drs. Campbell and Krieger and Dee Ann in Figure 1. Photo courtesy of TARL.

and dart points. She noted that this projectile point distribution more closely matched that of Pearce's (1932) scheme.

Her observations regarding the mixing of the Central Texas Aspect and Edwards Plateau Aspect materials in the upper level at Collins are also worth noting because the processes that led to the mixing of components in deep midden sites are still a matter of conjecture among archeologists today. She gave only a single sentence comment on the excellent stratigraphy at Smith Rockshelter and how that showed a separation of Austin and Toyah components, but made reference to Jelks' (1953) observation of the separation between the two at Blum Rockshelter. She did not discuss the stratigraphic separation between these two components in her Collins site report. However, she did report that burned rock hearth features occurred throughout the deposits below 18 inches, an observation that will not be a surprise to any archeologist that has excavated Archaic period sites in Central Texas.

Her Collins site report, while descriptive and lacking in detail based on today's standards, is full of insight and illustrates Dee Ann's forward and anthropological thinking at the time. The material culture she recovered has provided an important body of comparative data for others working in the region, especially with regards to the large ceramic sample (Figure 8). Creel (Creel et al. 2013) analyzed 10 of these sherds in his broad study of Central Texas ceramics.

Smith Rockshelter

Smith Rockshelter (41TV42) was excavated by students from UT under Dee Ann's direction in 1954 and 1955 (Figure 9a-b). Its location along Onion Creek is on the boundary between the Blackland Prairie and the Edwards Plateau in what is now McKinney Falls State Park. The shelter is about 130 ft. (40 m) long, and some 18 ft. (5.5 m) deep, and 40 ft. (12.2 m) above Onion Creek. It had been subjected to intermittent overbank flooding

Figure 5. Artifacts originally classified as "knives" but are currently interpreted as discarded blanks and broken biface preforms. Photo courtesy of TARL.

Figure 6. One of two bone fishhooks from the Collins site that were recovered from the 12-18 inch level probably associated with either the Austin or Toyah components. Photo courtesy of TARL.

resulting in frequent deposits of silt that provide excellent stratigraphic separation of the occupation middens. The shelter deposits reached a depth of about 8 to 9 ft. (2.4-2.8 m) and contained six distinct occupation zones dating from the Late, or Transitional, Archaic to the Toyah phase in the uppermost cultural layer. One significant factor in assessing the site's chronology was the stratigraphic separation of occupational zones with alluvial deposits.

A grid system of 5 ft. squares was superimposed over the site; initially the excavation strategy was to use 6 inch levels, but once the natural stratigraphy was recognized the procedure was to follow the occupation layers. All material was passed through a 1/4-inch hardware screen, and all lithics, "identifiable" bone fragments, and shell samples were collected for each level.

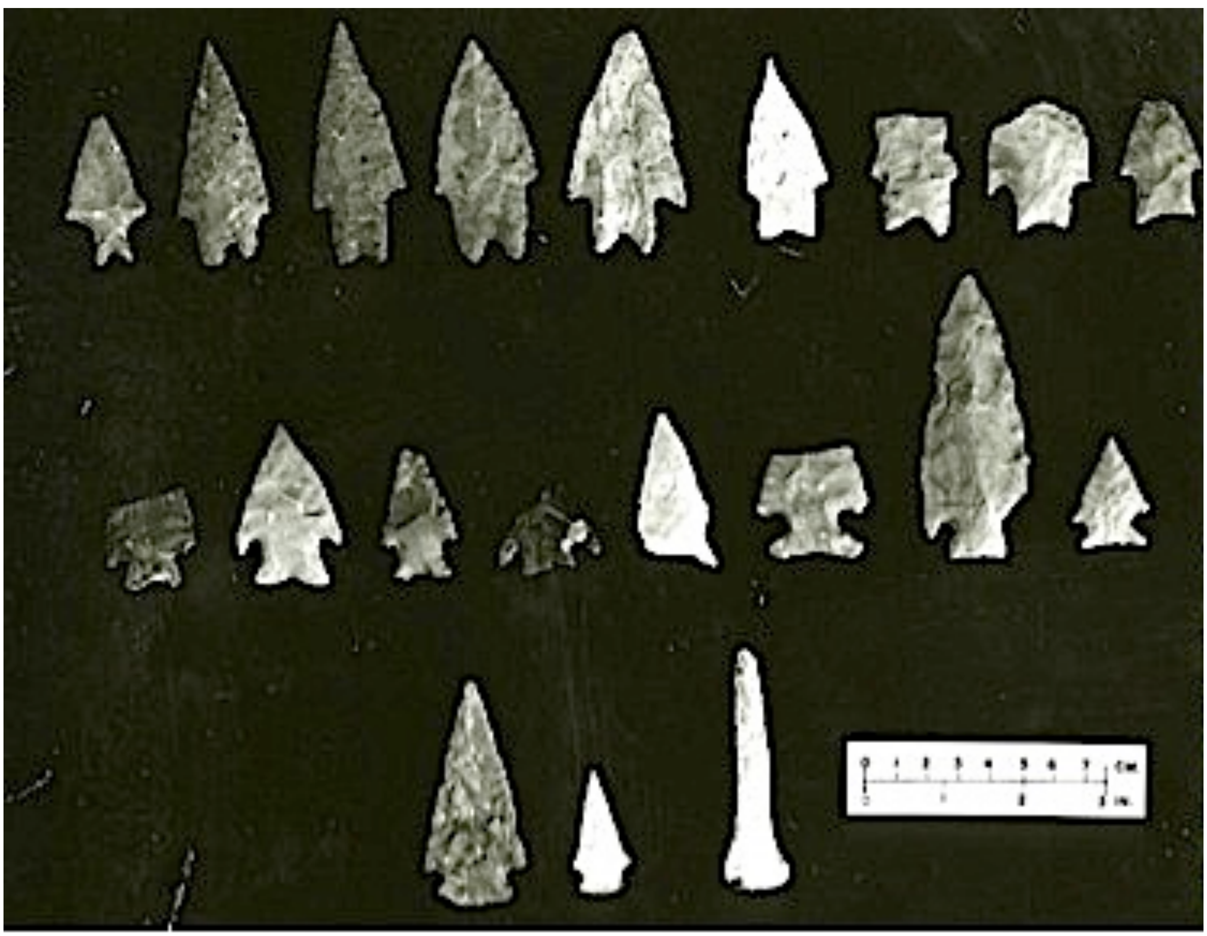

Figure 7. A selection of dart points including Pedernales, Martindale, Bandy, Edgewood, unnamed types, and a drill from the Collins site showing a mixture of Early, Middle, and Late Archaic types. Photo courtesy of TARL.

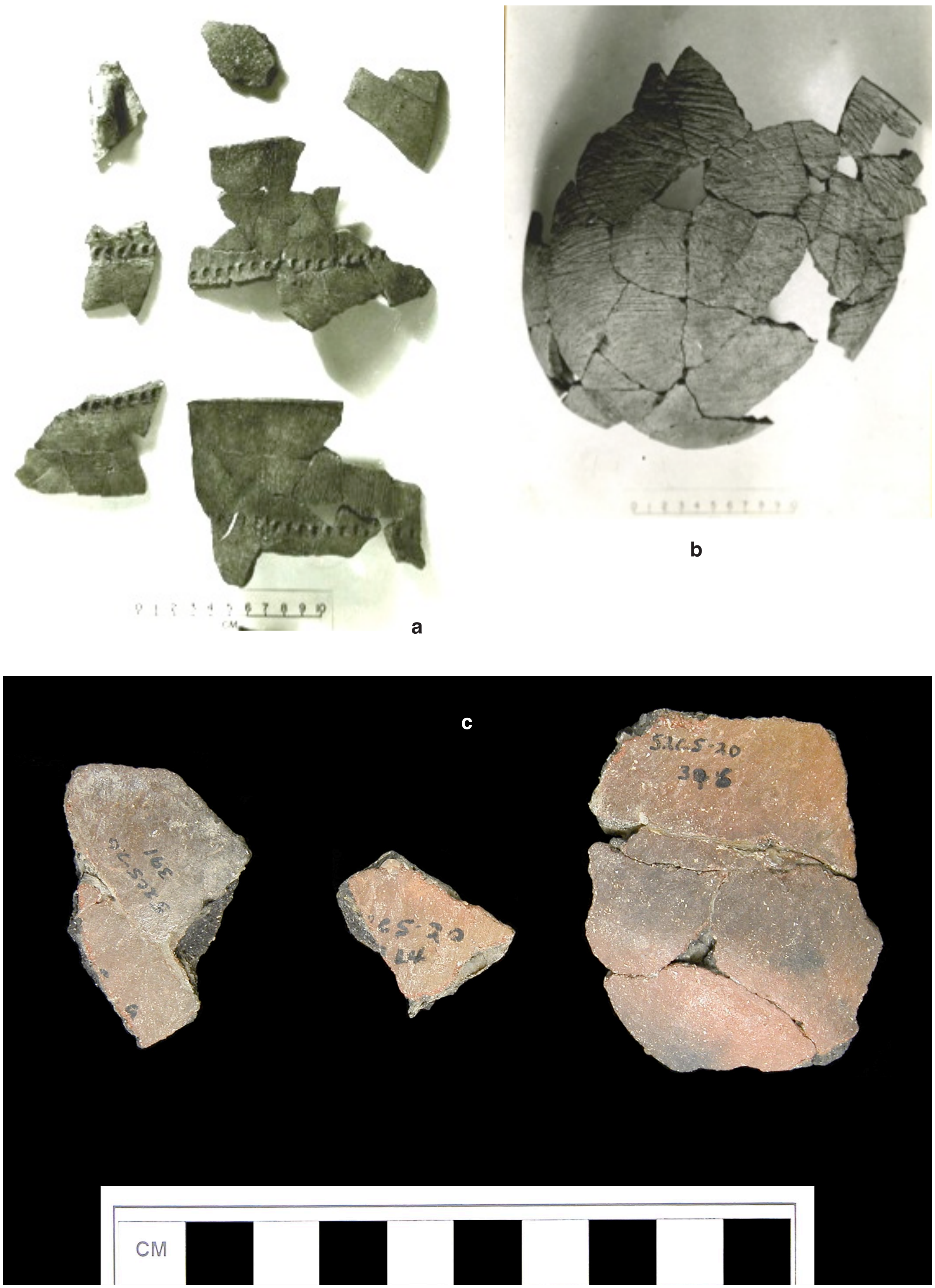

Figure 8. Examples of the ceramics recovered from the Collins Site: a-b, original photographs of Boothe Brushed used in the *Introductory Handbook of Texas Archeology*; c, Leon Plain bone-tempered sherds. Photos courtesy of TARL.

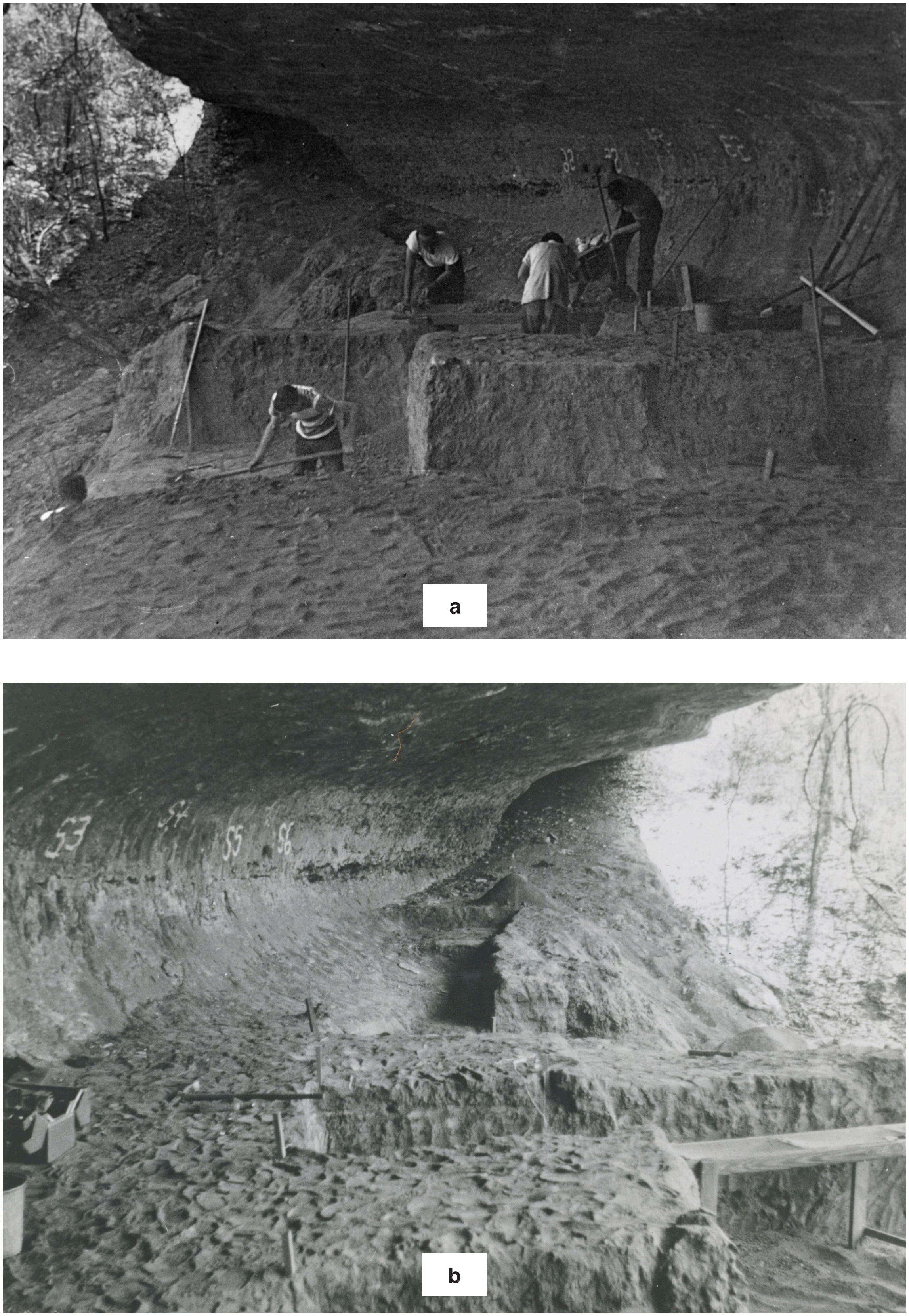

Figure 9. Smith Rockshelter excavations by University of Texas graduate students in progress ca. 1955: a, note the depth of the shelter; b, the width of the excavations. Photos courtesy of TARL.

Included in the sampling were 46 radiocarbon samples and 19 snail shell samples. Dee Ann's recognition of the value of charcoal for radiocarbon dating is notable, as the method was just coming into vogue in the mid-1950s, only a few years after Willard Libby was awarded his Nobel Prize in Physics in 1949 for developing the technique. Also, Smith Rockshelter was among the first archeological investigations in Central Texas in which snail shells were systematically collected and analyzed. Perhaps also forgotten by scholars was her assertion that *Bulimulus dealbatus* (now identified as *Rabdotus*) were utilized for food.

As noted above, the entire Archaic period as it was known in the 1950s was included in the Edwards Plateau Aspect, and the Neo-American (Late Prehistoric) period included the Austin and Toyah foci and was labeled the Central Texas Aspect. A full definition of the latter was yet to come (Jelks 1962) and it was over a decade later that a much better understanding of the long Archaic sequence in Central Texas was gained (see Sorrow et al. 1967:Figure 72). The Midwestern Taxonomic System has long been abandoned and now occupies only an interval in the theoretical history of Texas archeology. Vestiges of it remain with the retention of the Austin and Toyah phases.

The stratigraphy in Smith Rockshelter taken from Dee Ann's 1957 article is reviewed in some depth here because it shows the unequivocal separation between the Darl, Scallorn (Austin), and Perdiz (Toyah) components. First, it should be noted that the geological stratum forming the bedrock was montmorillonite or serpentine originating from the late Cretaceous volcano Pilot Knob several miles to the southeast. The overlying shelter deposits varied in thickness from several feet along the back wall to 8.5 ft. (2.6 m) in the front and middle sections. Eleven separate stratigraphic layers (I-XI) numbered from bottom to top were identified in the shelter deposits. The following stratigraphic descriptions are quoted verbatim from Suhm (1957:29-30):

> Layer I (66"-103"). Basal occupation zone. Very ashy with innumerable snail shells. Flint chips and bone scrap present throughout, but not very common. In a few squares hearthstones were particularly numerous. Soil loose, gray in color, and contained limestone spalls from the back of the shelter and serpentine fragments from the floor.
>
> Layer II (60"-66"). Soil was sandy, buff in color and comparatively sterile of cultural debris. Several small lenses of gravel occurred in this zone.
>
> Layer III (53"-60"). A light occupation zone, with notable concentration of snail shells. Soil gray in color. Flint chips present, but not abundant.
>
> Layer IV (49"-53"). A thin, sandy layer, buff in color, almost no artifacts were found in this level.
>
> Layer V (41"-49"). Concentrated occupation zone, with numerous hearthstones. Charcoal, ash, flint chips, and bone fragments found throughout.
>
> Layer VI (36"-41"). Contained very little evidence of occupation. Soil buff in color and somewhat sandy in texture.
>
> Layer VII (30"-36"). An occupation zone containing numerous flint chips, hearthstones, bone fragments, and lenses of charcoal. Soil gray in color, with considerable ash throughout.
>
> Layer VIII (24"-30"). A relatively sterile zone of coarse gray alluvium. At a depth of about 30 inches a thick band of small gravel was present in most squares. Bone scrap, flint chips, and charcoal absent.
>
> Layer IX (19"-24"). This layer was very irregular and, in several squares, was difficult to distinguish from Layer X. The soil was light gray silt, and well consolidated. Cultural material found throughout, although not nearly so frequently as in Layer XI.
>
> Layer X (10"-19"). Soil similar to above layer, but lacked evidence of occupation.
>
> Layer XI (0"-10"). A concentrated occupation layer, consisting of a loose to fairly well consolidated, light gray silt. The upper two-three inches had been reworked by wind action, making this soil much finer. Charcoal, flint chips, snail and mussel shells, and animal bones were very abundant. Largest number of artifacts came from these layers.

Dee Ann identified three cultural zones within this stratigraphic profile based on her artifact analysis (Figure 10). These were: Edwards Plateau Aspect, Zone I, in Layer I; Austin Focus, Zone II, in upper part of Layer I through Layer IX; and Toyah Focus, Zone III, in Layer XI.

The Smith Rockshelter report exemplifies Dee Ann's insightfulness and creative thinking with regards to new interpretive trends in American archeology. Her realization that radiocarbon dating, as elementary as it was at the time, was to be a major player in dating and structuring prehistoric assemblages was insightful. She systematically collected radiocarbon and snail samples for future dating although she had no means to date them at the time. Subsequently two radiocarbon dates have been run on charcoal from the Toyah component at Smith Rockshelter. These are Tx-504 and Tx-510 (Valastro and Davis 1970:271). Johnson (1994:258) recalculated these two dates at A.D. 1739-1820 and A.D. 1626-1813, respectively. Assuming the date ranges are accurate, these are among the youngest dates thus far obtained on a Toyah assemblage.

Based on her work at Smith, for the first time the distribution of projectile points from the site firmly established the distinctive stratigraphic sequence and position of Darl (Figure 11) and Ensor (Layer I), Scallorn (upper Layer I to Layer IX) (Figure 12), and Perdiz (Layer XI) (Figure 13). Bison bone tools were also identified in the Perdiz level (Figure 14). Mixed throughout the deposit were various Late Paleoindian and Archaic points (Figure 15). Plainview and Angostura were identified as the Paleoindian types although the specimen she identified as Plainview would be classified today as Golondrina. Other recognized Archaic types include Bulverde, Pedernales (Figure 16), Castroville, Uvalde, Pandora, Palmillas, and unclassified examples.

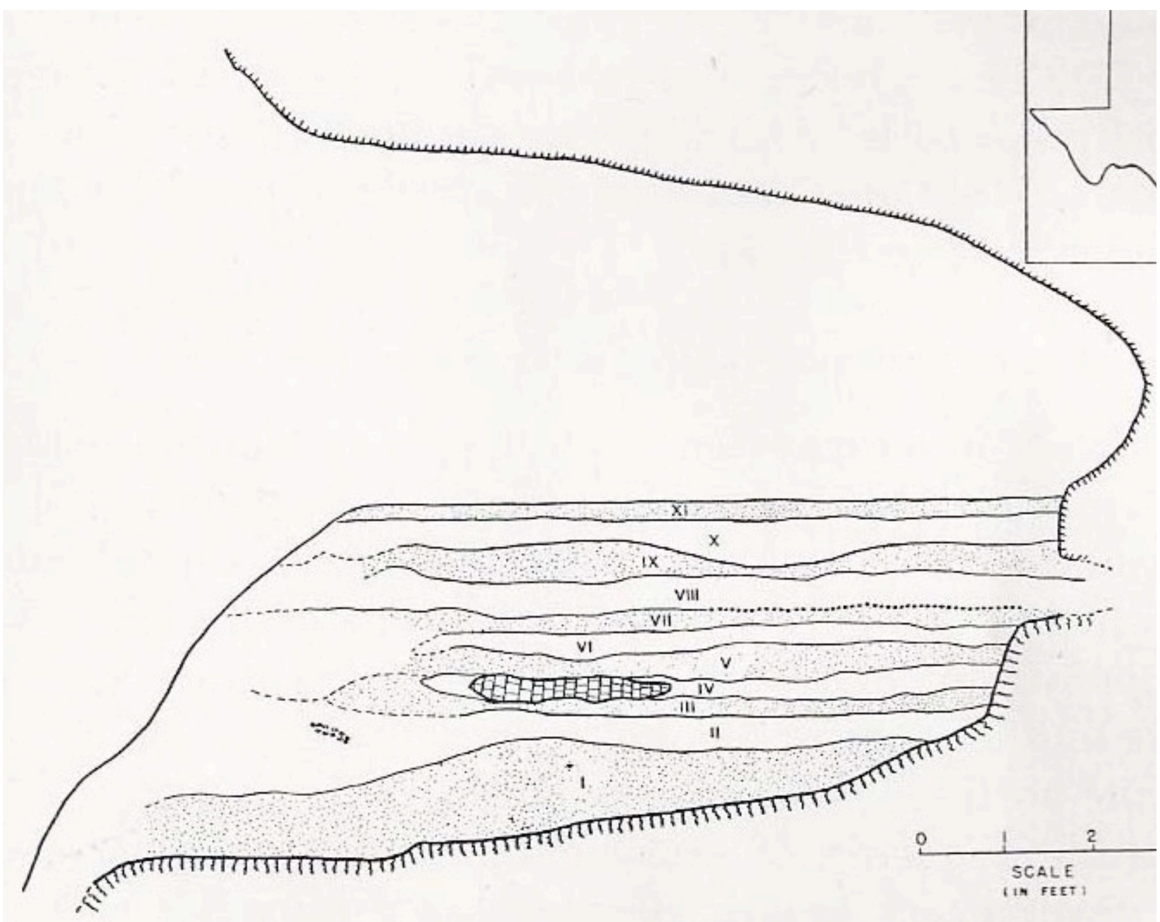

Figure 10. Smith Rockshelter stratigraphy (from Story 1957).

Figure 11. Darl points from Layer I at Smith Rockshelter. Photo courtesy of TARL.

Figure 12. Scallorn and Edwards points from Layers II-IX at Smith Rockshelter: top row: Scallorn; bottom row: Edwards, two Alba-like, and two Scallorn. Photo courtesy of TARL.

Dee Ann recognized that these artifacts were not in their proper stratigraphic context, especially the Paleoindian types which came from Layer V. She observed that several of these Archaic and Paleoindian points had been collected from gravels and introduced into the deposits by Late Prehistoric artifact collectors. Dee Ann's reasoning for the re-use of ancient tools was that the cultural landscape

Figure 13. Perdiz points from Layer XI at Smith Rockshelter. Photo courtesy of TARL.

Figure 14. Bison bone tools from Layer XI (Toyah phase) at Smith Rockshelter. Photo courtesy of TARL.

Figure 15. Paleoindian points from various levels at Smith Rockshelter. All are Angostura except for the specimen on the far right which is Golondrina. Photo courtesy of TARL.

Figure 16. Pedernales points from various levels at Smith Rockshelter. Photo courtesy of TARL.

of Central Texas of 1,000 years ago was littered with artifacts from 10,000 years of hunter-gatherer occupation and utilization. Projectile points and other tools were abundant on the surface and in stream gravels, and anyone at that time could easily find artifacts of any age by walking across the surface. Dee Ann recognized this possibility. Surely the Austin phase or Toyah phase people could recognize these ancient artifacts and pick them up as curios or as sacred objects of their ancestors. Those of us who have adventured into any site or region not previously visited by a collector and seen the surface littered with projectile points and other artifacts can only imagine how abundant surface artifacts were during Austin phase times. Archeologists should not be surprised to find Archaic or Paleoindian artifacts intermixed with later components, but this does not mean that the two weapon systems were used at the same time as some argue (Tomka 2013; Van Pool 2006). The stream-rolled Paleoindian and Archaic points, probably picked up in the Onion Creek gravels by the children or other occupants of Smith Rockshelter, attest to the curiosity of human behavior in recognizing and collecting something indicative of the past. The drill illustrated by Dee Ann (Suhm 1957:Figure 7K) is an example of an Archaic point as a recycled resource that was made into a Toyah drill or perforator.

Smith Rockshelter remains one of the most important sites in Central Texas because of its clear stratigraphic separation between the Austin and Toyah components. There was a question at the time whether or not these two components were contemporaneous. Kelley (1947b) thought they were, but the Belton Reservoir excavations conducted by E. O. Miller did not clarify that issue (Miller and Jelks 1952). However, the later work at Belton Reservoir at the Penny Winkle site substantiated the stratigraphic separation of the two components (Shafer et al. 1964:Table 2). Dee Ann was cautious in her approach to the real significance of the Smith site chronology. She provides only a brief mention of the stratigraphic separation in her 1960 review of Central Texas archeology and did not highlight the significance at that time (Suhm 1960). Nonetheless, the Smith Rockshelter chronology provided a major confirmation to Jelks' (1962) argument for separation based on his own work at the Blum Rockshelter (Jelks 1953) and the Kyle site (Jelks 1962). Furthermore, the distribution of bison bone confined to Layer XI (with one exception in Layer I) at Smith substantiates the argument that bison were not present in Central Texas during the Austin phase times but were present during the Toyah phase.

Williams Site

The Williams site (41TV75) is a burned rock midden site located on the third terrace of Bull Creek and is now within Austin city limits (Figure 17). There were two distinct middens and a scattered campsite area when investigated by UT students from October 1955 to May 1956 under Dee Ann's direction. The site report was published in 1959 (Suhm 1959).

The Williams site was one of only a few burned rock middens that were systematically excavated in the mid- 20th century. The main references available on previous work at burned rock midden sites throughout Central Texas at that time were: Huskey's (1935) survey in Nueces County; Jackson's (1938) Fall Creek sites; Woolsey's (1938) Lake Buchanan sites; the WPA excavations in Travis County (Kelley and Campbell 1942); Jelks' (1951) Master's thesis at UT; and Schuetz' (1957) and Sturgis' (1956) descriptions of artifact assemblages from burned rock middens. Dee Ann (Suhm 1959:218-220) provides a good review of Central Texas archeology and systematics in the article's introduction that sets the stage for her interpretations. This site report provides another example of her progressive and intuitive thinking in efforts to squeeze as much information out of the data and to find some relevance to the patterning, or lack thereof, that she defined. Anyone who has ever excavated a burned rock midden is aware of the jumbled nature of their deposits. The mystery of the burned rock midden had not been totally resolved in the mid-1950s, and the perplexing distribution of diagnostics is evident in Dee Ann's discussions. These were difficult sites to deal with as she clearly recognized: "[t]he basic problem lies in the homogenous content of the midden deposit, and in the frequent absence of clear cultural artifact stratigraphy" (Suhm 1959:219). However, she recognized that the diversity of projectile point types suggested repeated occupation, and that the point diversity could perhaps provide the best clues to factoring out possible geographic and temporal differences within the Archaic period.

The midden UT excavated extended over a relatively large area measuring approximately 140

Figure 17. View of the Williams site excavations looking west across the Bull Creek valley in Travis County. Photo courtesy of TARL.

x 70 ft., and reached a maximum depth of 3.4 ft. The site was gridded in 5 ft. squares and excavated in 6 inch levels, the standard procedure at the time for site investigations (Figure 18). This excavation control provided the horizontal and vertical structure for her analysis. She used the horizontal and vertical distribution of projectile points to posit at least four distinct occupations (or components) at the site based on systematics current at that time. The systematics she used in the Williams site analysis were the same she previously used, and followed Suhm et al.'s (1954) use of the Midwestern Taxonomic System (i.e., the Archaic Edwards Plateau Aspect and the post-Archaic Central Texas Aspect). The sample of 94 arrow points was dominated by Scallorn and Eddy types, which were confined to the upper 6 inches of the deposits. The large dart point sample (402 specimens) came from all levels.

Dee Ann attempted to verify the current classification of dart points versus arrow points by weighing each of the complete projectile points. This was a first for Texas archeology and was based on Fenenga's (1953) efforts in California, and is another example of her efforts to bring new ideas from other regions to Texas archeology. Her data showed that Scallorn and Eddy arrow points were the lightest in the sample and that weights of Darl and Ensor were transitional between the other dart point categories of Bulverde, Castroville, Pedernales, Frio, Martindale, Nolan, Tortugas, Travis, and Williams; she posited that perhaps Darl and Ensor were transitional arrow points. Weight rather than technology was the criteria used in this separation.

Dee Ann also collected land snails as she did at Smith Rockshelter and noted that *Bulimulus* or *Rabdotus* occurred in all levels. She again posited that they were a food source, and saved a sample for radiocarbon dating. This is significant in that charcoal is rarely preserved in Central Texas burned rock middens.

Edward Jelks' (1951) Master's thesis at UT dealt with the perplexing distribution of diagnostic projectile points excavated from burned rock middens in the Marshall Ford basin excavated by the WPA. Dee Ann tested Jelks' thesis model in her distributional study of projectile points. She found the point distribution within burned rock middens as perplexing as Jelks did, but tried every effort through vertical, horizontal, and chi-square analysis to factor out some type of significant patterning. Her efforts to glean patterning from the vertical

Figure 18. The Williams site excavations ca. 1956 in Travis County. Photo courtesy of TARL.

distribution proved only slightly successful in that arrow points were noted to occur in the uppermost levels with little admixture with dart points, but that dart points tended to show a more mixed distribution. Not to be defeated by the vertical data, Dee Ann divided the site into three horizontal units and examined the horizontal distribution of projectile points. She noted that various types occurred in all three units but differed in percentages. To test if the relative abundance of each type was significant, she applied chi-square statistics, a rather pioneering approach for the time. She formally stated her basic assumptions that: (1) the typology was accurate; (2) each type represented a cultural entity; and (3) "any two of the six dart point types analyzed differed with respect to the relative frequency with which group members fall into Units I and II" (Suhm 1959:233). Still, she struggled to make sense of the patterning, or lack thereof, in her horizontal analysis. In the end, the distributional trends of the projectile point types Pedernales, Nolan, Bulverde, Travis, and Ensor within the horizontal units were not clear cut, but she favored the conclusion that the point distribution reflected "several different occupations, each characterized by a slightly different assemblage of projectile points" (Suhm 1959:233). Readers should recall that the stratigraphic separation of dart point types had not been established in 1959; this did not occur until the analysis and synthesis of the Canyon Reservoir investigations (Johnson et al. 1962).

She apparently started her analysis with the assumption that the three Edwards Plateau Aspect foci (Clear Fork, Round Rock, and Uvalde as defined by Kelley [1947a]) were valid constructs as she attempted to relate the Williams site assemblages to these analytical units. However, she simply could not validate them with the Williams site data and lamented the fact that since pure components were unreported, the status of these foci was uncertain. In short, she could not find evidence to confirm their validity, and urged others to seek such confirmation or define other constructs.

Her discussion of burned rock middens origin and accumulation is also worth noting as it was well ahead of its time. Kelley and Campbell (1942:320) correctly identified the formation process for burned rock middens—specifically that they formed around stone hearths. But, the issue of why the middens contained such an admixture of projectile points had not yet been explained; it would take another 50 years before the formation processes of burned rock middens would be understood (Black et al. 1997; Nickels et al. 2000). Thus, Dee Ann (Suhm 1959:247) explained the occurrence of burned rock middens in the following way: (1) The abundance of native stone, especially limestone; (2) the extensive use of stone-lined and/or stone-encircled hearths; (3) repeated use of favored camping locations; and (4) slow deposition of alluvium.

Canyon Reservoir, Building a Chronology

The advances in projectile point typology and steps toward securing a cultural chronology taken by Dee Ann in her three student-led investigations became more solidified with the combined analysis of the data from three sites in Canyon Reservoir (Wunderlich, Footbridge, and Oblate), which she co-authored with LeRoy Johnson, Jr. and Curtis D. Tunnell (Johnson et al. 1962). The chronological trends Johnson noted at Wunderlich, combined with the stratigraphic information from Oblate, provided the necessary information to construct a chronology and periodic scale for certain projectile point types. This chronology, however, covered only the upper half of the long Central Texas archeological Archaic sequence and had Nolan and Bulverde types as the earliest in the sequence. Discoveries at the Youngsport site (Shafer 1963), and four years later with the combined chronologies at the Landslide and Evoe Terrace sites along the Lampasas River in Bell County (Sorrow et al. 1967), not only substantiated the Canyon Reservoir chronology but extended it by defining two earlier components not previously recognized. Campbell (1948) had indeed found evidence for Archaic components below Nolan dart points along Brushy Creek in Williamson County. Unfortunately, since his results had not been reported previously, it went largely unrecognized until the Stillhouse Hollow work. The Central Texas chronology was later expanded by Prewitt (1981), and more recently by Collins (1998). Nonetheless, the Canyon Reservoir excavations and its report proved to be the initial foundation for a chronological sequence for the Archaic period in Central Texas that built on the one proposed by J. Charles Kelley (1947a).

TEXAS ARCHEOLOGICAL RESEARCH LABORATORY

One of Dee Ann's most important legacies was the Texas Archeological Research Laboratory (TARL). UT had been massing archeological collections and archives since 1919, and they were significantly bolstered by the many WPA projects during the Great Depression. These combined collections had been housed in various places over time including "Little Campus" and the Texas Memorial Museum. The Little Campus was an historic complex of buildings constructed in 1858 along 19th street (now Martin Luther King Boulevard) that variously served as the Texas Asylum for the Blind, State Hospital for the Senile, men's dormitory, and, in one building, artifact collections storage after World War II. The Texas Archeological Salvage Project housed at the Balcones Research Center also was accumulating collections. The need for a consolidated research and collections facility was paramount for the Department of Anthropology and associated research projects. This task was formulated in 1961 as a joint venture of the Department of Anthropology and the Texas Memorial Museum (Story 1996).

Dee Ann returned to Austin in 1961, and worked first as a Curator at the Texas Memorial Museum. In 1962, she started her teaching role at UT. Although she was an active faculty member in anthropology, she had a special mission to get the scattered and poorly-kept collections of the University, accumulating since 1919, together in one place. The daunting task began under her supervision in 1961. In 1963, the Texas Archeological Research Laboratory (briefly, Center) was established at the University's Balcones Research Center. This is in north Austin and was initially based in about 100 buildings of various sizes, dating from a World War II federal magnesium plant (Kleiner 1996). TARL moved around some, but settled in Building 5 (where it is still situated, albeit in a greatly modified and upgraded status!). Offices were spare, staff were few, the floors polished concrete, and there was an area in which collections were being assembled, inventoried, and stored: initially in wooden shelving, then with steel framed cabinets with wooden drawers. Dee Ann was always working on ways to improve the collections, access to them, details of storage, and inventory of new (and many old) collections. To be assigned to work on collections in the winter, with a few heaters and that cold concrete floor, or in the hot summer with the stifling heat, was a test of a student's commitment to archeology! But oh what learning experience we all had working with those collections. Later, before her retirement in 1987, she obtained the first of several National Science Foundation (NSF) grants to construct a temperature-environment controlled building (Figure 19), fitting easily within the high roofs of the Building 5 warehouse. Later, TARL directors Thomas Hester and Darrel Creel obtained additional NSF funding for expansion and greater storage capacity.

Figure 19. Darrell Creel, former director of TARL, conducting research in the climate-controlled building within Building 5 at the J. J. Pickle Research Center.

The enormity of the task of making the University's collections accessible for research cannot be overstated. Some students participated in the work of moving old, poorly boxed, dirty, dusty, and disorganized collections from storage rooms at the University's Little Campus adjacent to the main campus. These were loaded into the "Blue Goose," an early 1950s International travelall, for the trip out to TARL. The collections derived from Professor J. E. Pearce's exploratory digging in Central Texas, later continued by A. T. Jackson and others (using Rockefeller Foundation grants). Then, there was the vast amount of material from the WPA excavations during the Great Depression. Dee Ann had to assemble the chaos from the 1950s, when she, Alex Krieger, and Edward Jelks had pulled together thousands of projectile points and other artifacts for the 1954 *Handbook*. In the late 1940s-1960s, River Basin reservoir salvage efforts were carried out, adding yet another layer of assemblages that needed to be processed for curation. Afterwards, the federal effort for reservoir salvage was assumed by the University's Texas Archeological Salvage Project that was housed at TARL.

Part of Dee Ann's goal for proper curation was, of course, the "clerical" work of compiling the cabinet-and-drawer numbers in which specific collections could be found, issuing trinomial numbers for new sites—and the old ones that had utilized different numbering systems—and setting up map files for all topographic maps of Texas (with each site plotted; sometimes in the 1960s, Texas County Highway maps had to suffice because topographic maps had not yet been published for all of the state). The work also required establishing a system for organizing and properly storing black and white photos and the later color slides. Indeed, many of the archived WPA photos were developed as nitrate negatives, and they had to be constantly stored in a freezer to retard decomposition which would lead to the accumulation of explosive gases! In these, and many other tasks, she was greatly aided in the 1960s-1970s, and in certain cases, the 1980s, by Dorris L. (Dodie) Olds, Terrisa Lazicki, Carolyn Spock, and numerous undergraduate and graduate students who worked part-time at TARL.

Much of the record of work by Dee Ann in terms of curation, collections, and the development of TARL is well-summarized by Bailey (1997). Many details can be found in that volume (see also Story 1996).

As part of her work at TARL, Dee Ann played a large role in the salvage, restoration, and curation of the 16th century shipwrecks found on the lower Texas coast in 1967 by a private out-of-state salvage company. The State of Texas filed suit and eventually acquired title to all of the salvage company finds. In 1969, before the final judgment, a judge placed the artifacts in the temporary custody of TARL. This began a multi-year inventory, cleaning, restoration, and study of the vast number of Spanish artifacts. With Dee Ann's key influence, in 1971 the UT Board of Regents awarded funds for the Antiquities Conservation Laboratory at TARL in the Balcones Research Center (now the J. J. Pickle Research Center) (Olds 1976; Davis 1977).

Dee Ann's role as a preservationist is well known. She served for several years on the board of The Archaeological Conservancy. She even gave the acreage occupied by a burned rock midden at her Wimberley property to the Conservancy. Perhaps, though, her greatest contribution to archeological preservation was the incredible effort she put into the curation of Texas artifact collections and archives. As Darrell Creel (2011) wrote in the *Friends of TARL Newsletter*, Dee Ann's "support of TARL continued even after her passing; she provided a substantial bequest to TARL's Excellence Endowment Fund that will help with funding needs for years to come. Her contributions to TARL, the University, and to archeology in general are prodigious and cannot be overstated."

TARL has become the premier archeological research facility in Texas. The century of archival data that it holds contains most of the history of Texas archeology and TARL continues to be used by most researchers today (see Figure 19). The lithic and ceramic collections from across the state provide an enormously important comparative resource tool for research and study.

SUMMARY

All the excavations Dee Ann directed and reported at the Collins, Smith, and Williams sites were done by volunteer labor provided by student colleagues using UT Anthropology Department equipment and supplies. There were no grants involved, only the support of the Anthropology Department. She undertook these projects to advance her own learning experience and in so doing provided lasting contributions to the on-going discussions regarding the validity of the systematics in vogue at the time and added important building blocks for a secure projectile point chronology for Central Texas. At the same time, she provided invaluable experience for the students who assisted her.

One of the main reasons that Dee Ann's contributions have stood the test of time is that she had the discipline to base her interpretations on empirical data and not rely on speculations or outdated assumptions. In fact, she continuously questioned the very systematics she helped to establish in the *Handbook*. If there was one character trait that best describes Dee Ann as an archeologist it was discipline in her research. We have all benefited from that legacy.

ACKNOWLEDGEMENTS

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REFERENCES CITED

Bailey, G. L.
1997 *A Guide to the Historic Materials of the Texas Archeological Research Laboratory.* Archival Series 1. Texas Archeological Research Laboratory, The University of Texas at Austin.

Black, S., L. W. Ellis, D. G. Creel, and G. T. Goode
1997 *Hot Rock Cooking on the Greater Edwards Plateau: Four Burned Rock Midden Sites in West Central Texas*. Studies in Archeology 22, Texas Archeological Research Laboratory, The University of Texas at Austin, Archeology Studies Program, Report 2, Texas Department of Transportation, Environmental Affairs Division, Austin.

Campbell, T. N.
1948 The Merrill Site: Archeological Remains Associated with Alluvial Terrace Deposits in Central Texas. *Bulletin of the Texas Archeological and Paleontological Society* 19:7-35.

Collins, M. B.
1998 Background to the Archeological Excavations. In *Wilson Leonard: An 11,000-year Archeological Record of Hunter-Gatherers in Central Texas, Volume I: Introduction, Background, and Synthesis*, assembled and edited by M. B. Collins, pp. 55-76. Studies in Archeology 31, Texas Archeological Research Laboratory, The University of Texas at Austin, Archeology Studies Program, Report 10, Texas Department of Transportation, Environmental Affairs Division, Austin.

Creel, D.
2011 Director's Notes. *Friends of the Texas Archeological Research Laboratory Newsletter*, December, p. 1. Texas Archeological Research Laboratory, The University of Texas at Austin.

Creel, D., J. R. Ferguson, and N. A. Kenmotsu
2013 A Compositional Analysis of Central Texas Hunter-Gatherer Ceramics and Its Implications for Mobility, Ethnic Group Territory, and Interaction. *Bulletin of the Texas Archeological Society* 84:29-83.

Davis, J. L.
1977 *Treasure, People, Ships and Dreams*. Texas Antiquities Committee, Austin.

Fennenga, F.
1953 The Weights of Chipped Stone Points: A Clue to their Functions. *Southwestern Journal of Anthropology* 9: 309-323.

Huskey, V.
1935 An Archeological Survey of the Nueces Canyon. *Bulletin of the Texas Archeological and Paleontological Society* 7:105-114.

Jackson, A. T.
1938 *The Fall Creek Sites*. University of Texas Publication No. 3802, Austin.

Jelks, E. B.
1951 Relationships between Foci of the Edwards Plateau Aspect: A Distributional Analysis of Diagnostic Projectile Point Types from Archaeological Sites in the Marshall Ford Dam Reservoir, Travis County, Texas. Master's thesis, Department of Anthropology, The University of Texas at Austin.
1953 Excavations at the Blum Rockshelter. *Bulletin of the Texas Archeological Society* 24:189-207.
1962 *The Kyle Site: A Stratified Central Texas Aspect Site in Hill County, Texas*. Archeology Series No. 5. Department of Anthropology, The University of Texas.

Johnson, L., Jr.
1994 *The Life and Times of the 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.

Johnson, L., Jr., D. A. Suhm, and C. D. Tunnell
1962 *Salvage Archeology of Canyon Reservoir: The Wunderlich, Footbridge, and Oblate Sites*. Bulletin 5. Texas Memorial Museum, The University of Texas at Austin.

Kelley, J. C.
1947a The Cultural Affiliations and Chronological Position of the Clear Fork Focus. *American Antiquity* 8:97-109.
1947b The Lehmann Rockshelter: A Stratified Site of the Toyah, Uvalde, and Round Rock Foci. *Bulletin of the Texas Archeological and Paleontological Society* 18:115-128.

Kelley, J. C. and T. N. Campbell
1942 What are the Burnt Rock Mounds of Texas? *American Antiquity* 7:319-322.

Kleiner, D.
1996 J. J. Pickle Research Campus. In *The New Handbook of Texas,* Volume 3, edited by R. Tyler, pp. 886-888. Texas State Historical Association, Austin.

Krieger, A. D.
1946 *Cultural Complexes and Chronology in Northern Texas*. University of Texas Publication No. 4640, Austin.

Lister, F. C.
1997 *Pot Luck: Adventures in Archaeology*. University of New Mexico Press, Albuquerque.

Miller, E. O. and E. B. Jelks
1952 Archaeological Excavations at the Belton Reservoir, Coryell County, Texas. *Bulletin of the Texas Archeological and Paleontological Society* 23:168-217.

Nickels, D. L., C. B. Bousman, J. D. Leach, and D. A. Cargill
2000 *Test Excavations at the Culebra Creek Site, 41BX126, Bexar County,* Texas. Archaeological Survey Report 265, Center for Archaeological Research, The University of Texas at San Antonio, and Archeological Studies Program, Report 3, Environmental Affairs Division, Texas Department of Transportation, Austin.

Newell, H. P., and A. D. Krieger
1949 *The George C. Davis Site, Cherokee County, Texas*. Memoirs 5. Society for American Archaeology, Menasha, Wisconsin.

Olds, D. L.
1976 *Texas Legacy from the Gulf*. Miscellaneous Papers 3. Texas Memorial Museum, The University of Texas at Austin.

Pearce, J. E.
1932 The Present Status of Texas Archeology. *Bulletin of the Texas Archeological and Paleontological Society* 4:44-54.

Prewitt, E. R.
1981 Cultural Chronology in Central Texas. *Bulletin of the Texas Archeological Society* 52:65-89.

Story, D. A.
1996 Texas Archeological Research Laboratory. In *The New Handbook of Texas*, Volume 6, edited by R. Tyler, pp. 286-287. Texas State Historical Association, Austin.

Schuetz, M. K.
1957 A Report on Williamson County Mound Material. *Bulletin of the Texas Archeological Society* 28:135-168.

Shafer, H. J.
1963 Test Excavations at the Youngsport Site: A Stratified Terrace Site in Bell County, Texas. *Bulletin of the Texas Archeological Society* 34:57-81.

2010 Review of *An Introductory Handbook of Texas Archeology*, by Dee Ann Suhm and Alex D. Krieger with the collaboration of Edward B. Jelks. Bulletin of the Texas Archeological Society 81:227-234.

Shafer, H. J., D. A. Suhm, and J. D. Scurlock
1964 *An Investigation and Appraisal of the Archeological Resources of Belton Reservoir, Bell and Coryell Counties, Texas, 1962*. Miscellaneous Papers No. 1. Texas Archeological Salvage Project, The University of Texas at Austin.

Sorrow, W. M., H. J. Shafer, and R. E. Ross
1967 *Archeological Excavations at Stillhouse Hollow Reservoir*. Papers of the Texas Archeological Salvage Project 11. The University of Texas, Austin.

Sturgis, H. F.
1956 A Burnt-Rock Midden Site in Travis County. *Bulletin of the Texas Archeological Society* 27:111-128.

Suhm, D. A.
1955 Excavations at the Collins Site, Travis County, Texas. *Bulletin of the Texas Archeological Society* 26:7-54.

1957 Excavations at the Smith Rockshelter, Travis County, Texas. *The Texas Journal of Science* 9:7-58.

1959 The Williams Site and Central Texas Archeology. *The Texas Journal of Science* 11(2):218-249.

1960 A Review of Central Texas Archeology. *Bulletin of the Texas Archeological Society* 29:63-107.

Suhm, D. A., A. D. Krieger, and E. B. Jelks
1954 An Introductory Handbook of Texas Archeology. *Bulletin of the Texas Archeological Society* 25:1-562.

Tomka, S.
2013 The Adoption of the Bow and Arrow: A Model Based on Experimental Performance Characteristics. *American Antiquity* 78(3):553-569.

Tunnell, C. D.
2000 In Their Own Words: Stories from Some Pioneer Archeologists. *Bulletin of the Texas Archeological Society* 71:1-146.

Valastro, S. and E. M. Davis
1970 University of Texas at Austin Radiocarbon Dates XI. *Radiocarbon* 12(1):249-280.

Van Pool, T. L.
2006 The Survival of Archaic Technology in an Agricultural World: How the Atlatl and Dart Endured in the North American Southwest. *Kiva* 71:429-452.

Willey, G. R. and J. A. Sabloff
1993 *A History of American Archaeology*. 2nd Edition. W. H. Freeman and Co., New York.

Woolsey, A. M.
1938 Additional Buchanan Lake Sites. In *Annual Report of the WPA and The University of Texas Archaeological Research, Lake Buchanan, 1936-1937*. University of Texas Publication 3802:119-145, Austin.

Publications of Dee Ann Suhm Story

Compiled by Harry J. Shafer, Nancy A. Kenmotsu and Timothy K. Perttula

1954 (with Alex D. Krieger and Edward B. Jelks) Introductory Handbook of Texas Archeology. *Bulletin of the Texas Archeological Society* 25:1-562.

1955 Excavations at the Collins Site, Travis County, Texas. *Bulletin of the Texas Archeological Society* 26:7-54.

1956 Archeological Excavations at the Collins and Smith Sites, Travis County, Texas. Master's thesis, Department of Anthropology, The University of Texas at Austin.

1957 Excavations at the Smith Rockshelter, Travis County, Texas. *The Texas Journal of Science* 9:26-58.

1959 The Williams Site and Central Texas Archeology. *The Texas Journal of Science* 11:218-250.

1960 Extended Survey of the Right on the Glen Canyon. In *1959 Excavations in the Glen Canyon Area,* edited by William Lipe, pp. 139-284. Anthropological Papers 39. University of Utah, Salt Lake City.

1960 Cataloguing Archeological Collections. *Utah Archaeology* 6:5-10.

1960 A Review of Central Texas Archeology. *Bulletin of the Texas Archeological Society* 29:63-107

1961 The Beidleman Ranch Site: An Early Man Kill Site in Stonewall County, Texas. *Bulletin of the Texas Archeological Society* 31:207-212.

1962 The White Site: An Historic Indian Burial in Yoakum County, Texas. *Bulletin of the Texas Archeological Society* 32:85-119.

1962 (with LeRoy Johnson, Jr. and Curtis D. Tunnell) *Salvage Archeology of Canyon Reservoir: The Wunderlich, Footbridge, and Oblate Sites*. Bulletin 5. Texas Memorial Museum, Austin.

1962 (editor with Edward B. Jelks) *Handbook of Texas Archeology: Type Descriptions: A Cumulative Compendium of Type Descriptions*. Special Publication No. 1, Texas Archeological Society, and Bulletin No. 4, Texas Memorial Museum, Austin.

1963 (editor with R. King Harris) *An Appraisal of the Archeological Resources of Forney Reservoir, Collin, Dallas, Kaufman, and Rockwall Counties, Texas*. Texas Archeological Salvage Project and the Dallas Archeological Society, Austin and Dallas.

1964 (with Harry J. Shafer and J. Dan Scurlock) *An Investigation and Appraisal of the Archeological Resources of Belton Reservoir, Bell and Coryell Counties, Texas: 1962*. Miscellaneous Papers No. 1. Texas Archeological Salvage Project, Austin.

1965 The Archeology of Cedar Creek Reservoir, Henderson and Kaufman Counties, Texas. *Bulletin of the Texas Archeological Society* 36:163-257.

1966 Introduction and Archeological Background. In *Preliminary Study of the Paleoecology of the Amistad Reservoir Area,* edited by Dee Ann Story, pp. 1-30. Report submitted to the National Science Foundation by the Texas Archaeological Salvage Project, Austin.

1967 (with Byron Barber and others) Indian Artifacts: Pottery Vessels. In "The Gilbert Site: A Norteno Focus Site in Northeastern Texas," edited by Edward B. Jelks. *Bulletin of the Texas Archeological Society* 37:112-187.

1968 *Archeological Investigations at Two Central Texas Gulf Coast Sites*. Archeological Program Report No. 13. State Building Commission, Austin.

1969 1968-1969 Field Work at George C. Davis. *Newsletter of the Southeast Archaeological Conference* 13:25-32.

1976 The Archaic of East Texas. In *The Texas Archaic: A Symposium,* edited by Thomas R. Hester, pp. 46-59. Special Report No. 2. Center for Archaeological Research, The University of Texas at San Antonio.

1977 (with Salvatore Valastro, Jr.) Radiocarbon Dating and the George C. Davis Site, Texas. *Journal of Field Archaeology* 4:63-89.

1978 Some Comments on Anthropological Studies Concerning the Caddo. In *Essays in Honor of R. K. Harris*, edited by Kurt House, pp. 46-68. Report of Investigations 3. Institute for the Study of Earth and Man, Southern Methodist University Press, Dallas.

1981 An Overview of the Archeology of East Texas. *Plains Anthropologist* 26:139-156.

1981 (Editor) *Archeological Investigations at the George C. Davis Site, Cherokee County, Texas, Summers of 1979 and 1980*. Occasional Papers No. 1. Texas Archeological Research Laboratory, The University of Texas at Austin.

1982 (Editor) *The Deshazo Site, Nacogdoches County, Texas, Vol. 1: The Site, Its Setting, Investigations, Cultural Features, Artifacts of Non-Native Manufacture, and Subsistence Remains*. Texas Antiquities Permit Series No. 7. Texas Antiquities Committee, Austin.

1982 (with Darrell G. Creel) The Cultural Setting. In *The Deshazo Site, Nacogdoches County, Texas, Vol*. 1, edited by Dee Ann Story, pp. 20-34. Texas Antiquities Permit Series No. 7. Texas Antiquities Committee, Austin.

1984 A Review of the Investigations at Cedar Grove. In *Cedar Grove: An Interdisciplinary Investigation of a Late Caddo Farmstead in the Red River Valley*, edited by Neal L. Trubowitz, pp. 278-280. Research Series No. 23. Arkansas Archeological Survey, Fayetteville.

1985 Adaptive Strategies of Archaic Cultures of the West Gulf Coastal Plain. In *Prehistoric Food Production in North America*, edited by Richard I. Ford, pp. 19-56. Anthropological Papers No. 75. Museum of Anthropology, University of Michigan, Ann Arbor.

1985 The Walton Site: An Historic Burial in McLennan County, Texas. *Central Texas Archeologist* 10:66-96.

1990 (with Janice A. Guy, Barbara A. Burnett, Martha D. Freeman, Jerome C. Rose, D. Gentry Steele, Ben W. Olive, and Kurt J. Reinhard) *The Archeology and Bioarcheology of the Gulf Coastal Plain*. 2 Vols. Research Series No. 38. Arkansas Archeological Survey, Fayetteville.

1990 Cultural History of the Native Americans. In *The Archeology and Bioarcheology of the Gulf Coastal Plain*, by Dee Ann Story, Janice A. Guy, Barbara A. Burnett, Martha D. Freeman, Jerome C. Rose, D. Gentry Steele, Ben W. Olive, and Kurt J. Reinhard, pp. 163-366. 2 Vols. Research Series No. 38. Arkansas Archeological Survey, Fayetteville.

1990 Excavated Caddoan Sites with Coles Creek Style Ceramics. In *The Archeology and Bioarcheology of the Gulf Coastal Plain*, by Dee Ann Story, Janice A Guy, Barbara A. Burnett, Martha D. Freeman, Jerome C. Rose, D. Gentry Steele, Ben W. Olive, and Kurt J. Reinhard, pp. 736-748. Research Series No. 38. 2 Vols. Arkansas Archeological Survey, Fayetteville.

1993 *Riddles of the Past: the Archeology of Hays County*. Hays County Historical Commission, Wimberley, Texas.

1993 Alex D. Krieger. *American Antiquity* 58(4):614-621.

1995 (editor) *The Deshazo Site, Nacogdoches County, Texas, Volume 2: Artifacts of Native Manufacture*. Studies in Archeology 21. Texas Archeological Research Laboratory, The University of Texas at Austin.

1996 Texas Archeological Research Laboratory. *The New Handbook of Texas*, Volume 6:286-287. Texas State Historical Association, Austin.

1997 Archeological Investigations at the George C. Davis Site, Cherokee County, Texas. *Bulletin of the Texas Archeological Society* 68:1-103.

1998 The George C. Davis Site: Glimpses into Early Caddoan Symbolism and Ideology. In *The Native History of the Caddo: Their Place in Southeastern Archeology and Ethnohistory,* edited by Timothy K. Perttula and James E. Bruseth, pp. 9-46. Studies in Archeology 30. Texas Archeological Research Laboratory, The University of Texas at Austin.

2000 Introduction. In *The George C. Davis Site, Cherokee County, Texas*, by H. Perry Newell and Alex D. Krieger, pp. 1-31. 2nd Edition. Society for American Archaeology, Washington, D.C.

2009 (with Edward B. Jelks). Foreword. In *Handbook of Texas Archeology: Type Descriptions: 2009 Reprint Edition*, edited by Dee Ann Story and Edward B. Jelks, pp. 1-5. Gustav's Library, Davenport, Iowa.

The Construction and Eventual Burning of the Experimental Caddo House Structure at the George C. Davis Site (41CE19) in East Texas

Timothy K. Perttula and Bob D. Skiles

ABSTRACT

Because of the research foresight of Dee Ann Story, an experimental Caddo grass-thatched house was constructed at the George C. Davis site in 1981, and then was burned down in a spectacular conflagration in the fall of 1995. The house was built as an interpretive exhibit for Texas Parks and Wildlife, who managed the site at the time. The completed cane thatch-covered Caddo house reconstruction was 7.6 m in diameter and 9.2 m in height. The later burning of the experimental house and an array of artifacts and organic remains placed in known positions within the house provide an excellent opportunity for future Caddo archeologists to observe the consequences of the burning of a grass-covered Caddo house on its structural materials and the material culture assemblage it contained.

INTRODUCTION

The George C. Davis site in Cherokee County is one of the best-known ancestral Caddo sites in East Texas, if not in the Caddo archeological area as a whole. The archeological deposits preserved here—in its three mounds, extensive habitation areas and structures, and borrow pits—have been under study by archeologists, including Dee Ann Story, for more than 70 years (Newell 1940; Newell and Krieger 1949; Story 1981, 1997, 1998, 2000; Walker 2009). The site was primarily occupied by ancestral Caddo peoples between ca. A.D. 850 and the early A.D. 1300s (based on an extensive suite of calibrated radiocarbon dates) on a large alluvial terrace of the Neches River (Figure 1). The site was a planned civic-ceremonial center that has three earthen mounds—Mound A, a large platform mound with elite residences and special purpose structures; Mound B, a second platform mound; and Mound C, a burial mound used as a cemetery for the elite or ranked members of the society—a borrow pit, and a large associated village (estimated at more than 110 acres) with more than 100 known or suspected structures. The structures include the domestic residences of the commoners that lived at the site as well as residences for the elites (chiefs and religious leaders) and special structures used for ritual and ceremonial purposes.

Archeological investigations at the George C. Davis site have yielded information of major scientific importance concerning the origins and development of the Caddo people, a still little-known but significant stratified and complex society that lived in the far western reaches of the Southeastern United States (i.e., southwestern Arkansas, northwest Louisiana, eastern Oklahoma, and East Texas) and whose cultural traditions have lasted for more than 1000 years. The expansive nature of the archeological and geophysical investigations at the George C. Davis site since WPA archeological investigations that began in 1939 has obtained unique information on Caddo community organization and social logic, the nature of Caddo symbolism and ideology, as well as the early existence of important community political, social, and religious activities within special precincts near Mounds A and B. The archeological work has also obtained key insights into the domestic nature of the community, with residential domiciles dated as early as ca. A.D. 850 organized into compounds with small courtyards; this was not a vacant mound center.

A particularly important part of the archeological record preserved at the George C. Davis is the deposits and features associated with the construction and destruction of the grass-thatched wood structures occupied by the Caddo elite and domestic commoners (see Schultz 2010; Spock 1977; Story 1998:26-38). In particular, Story (1998:14, 28, 31, 39) has noted that the destruction and rebuilding of certain structures at the site appears to relate to major ceremonies and rituals carried out during the life of the Caddo community; important structures were regularly and purposefully destroyed by fire.

The use of fire, and its associated smoke and steam, in destroying important buildings has been a characteristic feature of Caddo societies since the 10th century A.D. (Schambach 1996:41; Trubitt 2009:233). Trubitt (2009:233, 243-244) notes that "the cleansing properties of smoke continued to be important to Caddo Indians into the twentieth century" for life/renewal ceremonies associated with mortuary rites and the burning of temples. Perhaps structures were burned after the mortuary rites of important individuals "as a way of conveying souls to the world of the dead along an *axis mundi* of smoke…" and temples or the residences of important persons were burned as "a way of terminating the use of it and cleansing the location" (Trubitt 2009:244).

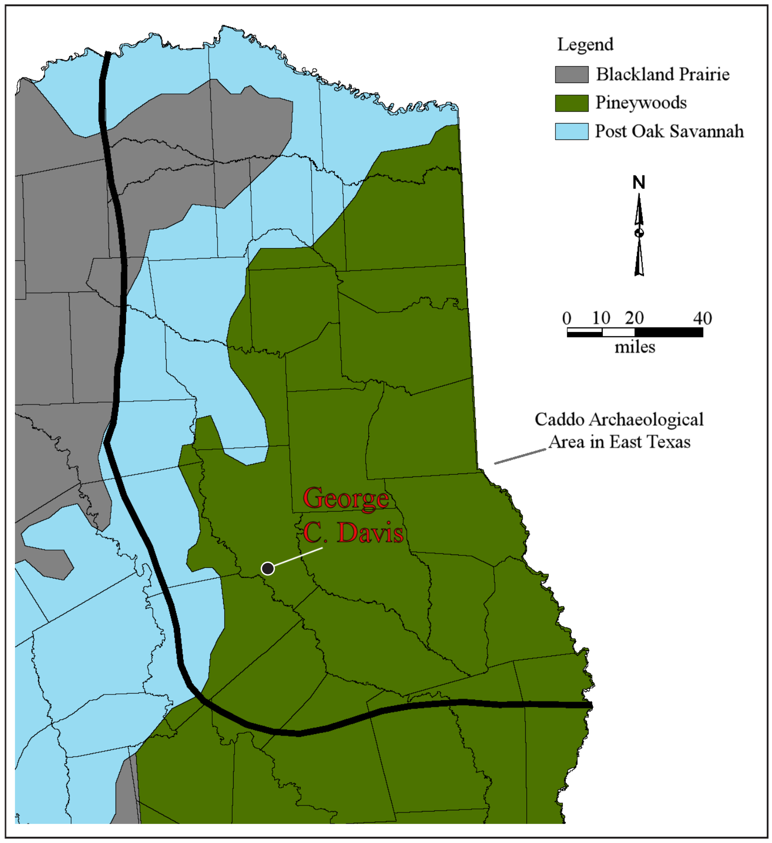

Figure 1. Location of the George C. Davis site in East Texas and the Southern Caddo Area.

EXPERIMENTAL ARCHEOLOGY AND ITS IMPLICATIONS FOR CADDO ARCHEOLOGY

Experimental archeology has been a significant component of the archeological discipline since the 1960s (see Ascher 1961; Coles 1979; Ferguson 2010; Ingersoll et al. 1977; Mathieu 2002; Millson 2013; Schiffer and Skibo 1987; Shimada 1978; Skibo 1992; Schiffer et al. 1994; Stone and Planel 1999; for a comprehensive list of experimental archeology publications world-wide, see also *http://exarc.net/bibliography*) because it "is a method of testing our ideas about and discovering the past through experiments" (Shimada 2005:603). The experimental archaeology projects that have been, or will be, conducted at the George C. Davis site are viewed as ways to better understand or test hypotheses about the nature of the Caddo archeological record that have arisen through a concerted study of the material remains and features (i.e., structures, mound constructions, burials, etc.) found preserved in archeological deposits.

An experimental archeology effort was carried out at a reconstructed house at the Caddo Mounds State Historic Site. Although the effort was ad hoc, and was done in the absence of the development of a specific research design or the formulation of research expectations about what could be learned from the experiment, as recommended by Marsh and Ferguson (2010:2-9), nevertheless the burning of the experimental house and an array of artifacts and organic remains placed in known positions within the house provides an excellent opportunity for future Caddo archeologists to observe the consequences of the burning of a grass-covered Caddo house on its structural materials and the material culture assemblage it contained. In particular, the plan as discussed by Dr. Dee Ann Story in the fall of 1995 with Bob D. Skiles, who led the house burning experiment, was to concentrate on what the effects of burning would be on the wood posts as well as the organic remains (which included mats, plant remains, and bone ornaments) that were to be placed at various locations inside the house.

The experimental archeological investigations of the burned Caddo house reconstruction were also intended to provide information regarding preservation of the archeological record at habitation sites, particularly those occupied for only a few years before they were abandoned, through documentation of the degradation of material culture items over a known span of years. This is particularly relevant for the short- and long-term preservation of organic remains on Caddo sites, as several kinds of organic remains (i.e., plant foods, bone, basketry, mats) were placed in the house reconstruction before it was intentionally burned. Furthermore, the experimental archeological record created with the known placement of a range of artifact types of different material types within the house before it was burned lends itself to the study of the post-occupational movement of material culture items and a better understanding of formation processes (cf. Schiffer 1987) on Caddo habitation sites.

Finally, the archeo-geophysical record of the 9th-14th century Caddo occupation of the George C. Davis site is spatially extensive and well studied (see Walker 2009, 2011; Walker and McKinnon 2012). There are numerous geophysical signatures of different structures, these being primarily circular in shape, although there are a few that are sub-square with rounded to diagonal corners (see Schultz 2010:71-85 and Figures 132-187), and there is also geophysical evidence for plazas and community areas within the village (Walker 2009; Walker and McKinnon 2012). Geophysical survey investigations that can be conducted over the area of the burned Caddo house reconstruction should provide a data set on the preservation and interpretation of those components of the burned house (i.e., post holes, pit features, and concentrations of burned material remains), whose internal structural plan is known, that are visible to geophysical instruments after 30+ years compared to what is seen of Caddo architectural features after hundreds of years since they were abandoned and/or burned (e.g., Hammerstedt et al. 2010; Lockhart 2010; McKinnon 2013; Walker and Perttula 2010).

CONSTRUCTION OF THE CADDO EXPERIMENTAL HOUSE STRUCTURE

It was appropriate that on an archeological site so well known for its architectural features that a grass-covered wood post structure was built in the fall of 1981 by Scooter Cheatham and assistants at the George C. Davis site[1], now known as Caddo Mounds State Historic Site. The house was built as an interpretive exhibit for Texas Parks and Wildlife, who managed the site at the time (cf. Scott 1984). The house reconstruction followed the model of Feature 125, a 7.6 m diameter circular Caddo house about 1000 years old that had been excavated nearby a few years before (Figure 2a) by Dee Ann Story of The University of Texas at Austin (UT), although it was actually built over Excavation Unit 11 (Figure 2b), not far from Feature 125.

Feature 125 had 88 wall posts, a central hearth, and four large interior posts (see Figure 2a). The wall posts were vertically set and equally-spaced around the wall, and averaged 20 cm in diameter; they had been set in holes between 16-48 cm in depth (Story 1997:83). The house walls had no clearly defined entrance, although there were several 40 cm gaps between posts along the north, south, and east walls. The four interior support posts formed a rectangle around the central hearth. These post holes were about 70 cm in diameter, although the posts within them were estimated to be only between 15-20 cm in diameter (Story 1997:86). The support posts were placed in deeper holes: between 34-66 cm in depth.

The Caddo house reconstruction took shape in three phases. The first phase was the manufacture of traditional tools that would have been used in house construction, including ground stone celts made from Ouachita Mountains greenstone, chipped stone bifaces and flake cutting tools, bone awls (made from metatarsals or ulnas) and hafted deer mandible sickles, hardwood digging sticks, as well as wood handles and mallets.[2] The handles and mallets were made of white oak and post oak (for the celt) and persimmon was used for the digging sticks (Cheatham 1992:23). Deer hide work belts with scabbards and pouches made with leather and sewn with gut or sinew were also made to hold the basic tools, and rabbit skin glue was used for tool hafting.

The second phase of the house reconstruction consisted of the gathering of construction

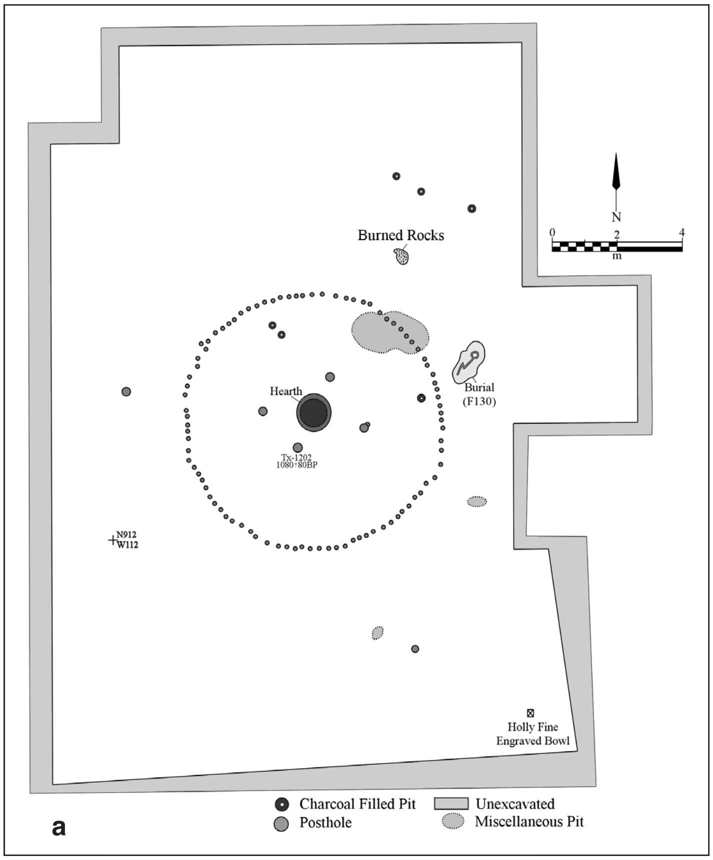

Figure 2. Plan of excavations at the George C. Davis site used as the framework for the Caddo house reconstruction: a, Structure Feature 125 as the model for the house plan (after Story 1997:Figure 42); b, house reconstruction built over Excavation Unit 11 (after Story 1997:Figure 43).

materials, including cane thatch (*Phragmites australis*) bundles[3], as well as the cutting of wood structural members.[4] The wall posts were short leaf pine (*Pinus echinata*) that were 10.7 m tall and 10 cm in diameter, and oak and hickory were used for interior structural members; the pine poles were debarked with traditional knives and hoes. Also prepared were deer and cow rawhide and leather lashings for the thatch as well as plant lashings (grape vines) (Cheatham 1992:23-24).

The third and final phase of the house reconstruction was the construction of the house itself. The house was laid out in the area of Unit 11 after a 15 cm thick sterile dirt layer was placed on the ground surface over the excavation area. After the radius of the house was laid out from its center point, the wall posts were marked and excavated, either with a stake and mallet or by tractor auger. A total of 48 pine posts marked the walls (Cheatham 1992:24). The first set of 16 poles was set individually, with attached ropes at the top of each pole. Once the poles were set in the holes and tamped down, they were bent and then lashed together. The second and third sets of poles, shorter than the primary wall poles at 7.0-8.5 m in length, were attached and lashed to the primary poles below the main crotch of the walls. Next, the four interior support poles were installed and bent to attach to the external house framework (Cheatham 1992:24). A series of horizontal oak members were then fit to the walls to create several internal decks and racks made of oak and pine.

Once the wood walls and internal wood features had been constructed, the house was finished by adding bundles of cane thatching from the bottom to the top of the structure. Wood needles, awls, and paddles were employed to hang, clamp and sew, and paddle the thatch into horizontal rows around the walls (Cheatham 1992:24).

The completed cane thatch-covered Caddo house reconstruction was 7.6 m in diameter and 9.2 m in height (Figure 3). An entrance was created to face to the south-southeast towards Mound A, the principal temple mound at the George C. Davis site.

EXPERIMENTAL PLAN AND THE BURNING OF THE HOUSE

Over the years, the Caddo house reconstruction at the George C. Davis site became an iconic feature of the state park and a visible symbol of the significant ancestral Caddo occupation that

Figure 3. Completed 1981 Caddo house reconstruction. Mound B is in the background.

Figure 4. Caddo house shortly before it was burned; note the range of artifacts that were to be put inside the house before it was set on fire.

occurred there. The house had deteriorated over the years and became a safety hazard, especially after it had been vandalized in 1990, and then a tornado damaged it a few years later, after which it had started to lean to one side (Figure 4). When it was decided that the structure needed to be removed, due to a variety of circumstances, the Caddo house that had been built in 1981 was intentionally burned down on November 5, 1995, as the culmination of the 1995 annual meeting of the Texas Archeological Society held in Nacogdoches, Texas. What better way to commemorate this important structure than to destroy it by fire in the Caddo's traditional manner?

Under the guidance and direction of Dr. Dee Ann Story (professor emeritus, of UT) and Bob D. Skiles (then staff archeologist of the Texas General Land Office), before the house was burned a variety of artifacts, organic materials, and a dog burial were placed inside it (Figure 5). The dog was placed in a steep-walled pit approximately 1.5 m in length (north-south) and 80 cm in width (east-west) in the northwestern quadrant of the house, but near the center of the house, and the pit reached to a maximum of 72 cm bs. Placed with the dog burial were a variety of artifacts—as this was meant to simulate an ancestral Caddo burial—including: four dried palmetto stalks (simulating arrow shafts); two conch shell columellae under the body; two large mussel shell valves; 50 shell beads; 400 turquoise beads and 15 turquoise stones; 10 buffalo bone beads; leather thong necklaces; two bone pendants; freshwater pearls on a filament string; a woven mat underneath the body and another covering the head and neck; a deliberately broken or "killed" Gahagan biface placed under a wicker basket; a wicker basket containing several lithic artifacts; and two modern ceramic vessels, a plain bottle and a Southwestern style bowl. Three modern ceramic vessels were also placed north to south atop the slightly mounded dog burial pit fill.

From north to south across the house floor were placed a series of modern artifacts and organic materials. This includes three small pits (ca. 30

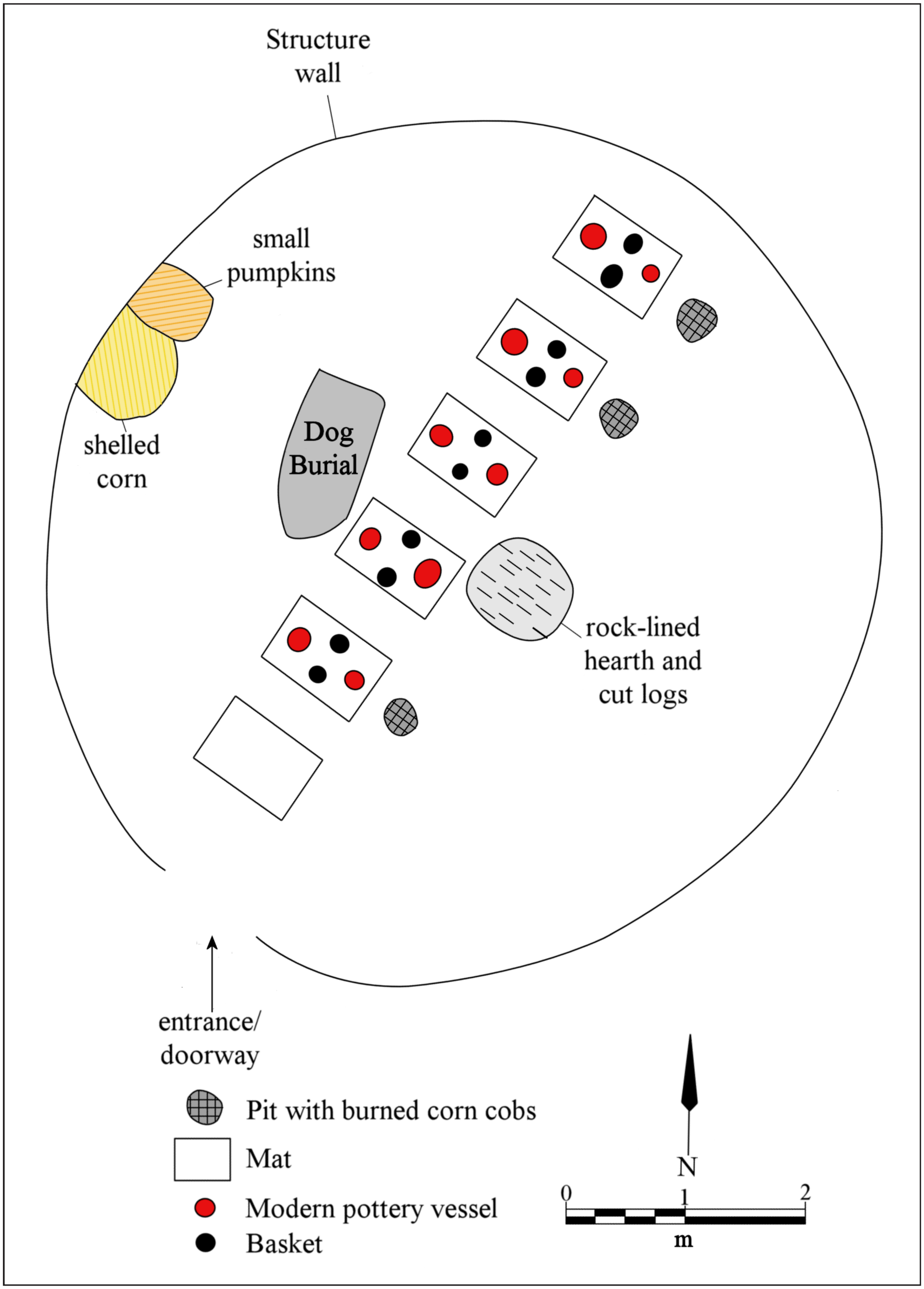

Figure 5. 1995 Map of the interior of the 1981 Caddo House Reconstruction, showing layout of features and artifacts.

cm in diameter) filled with burned corn cobs (Figure 6) and a series of six mats where two modern baskets and two ceramic vessels filled with food stuffs were arranged as "offerings" (Figure 7). Along the west wall of the house, on the dirt floor, were two piles of plant foods: 35 kg of small pumpkins and 30 kg of shell corn (see Figures 5 and 7). Table 1 lists the range and number of modern artifacts that were placed in various locations within the reconstructed house.

A ca. 1 m diameter rock-lined hearth had previously been constructed on the house floor ca. 1993, as an exhibit added by Texas Parks & Wildlife, just east of two of the mats (see Figures 5 and 7). Although this feature had to be temporarily removed to provide space to excavate the dog burial pit, it was replaced in its original condition and position prior to the burning. Several chainsaw-cut and unburned oak log sections were within the ring of hearth stones. The feature sat upon the compact surface of the house floor without any pit or other preparation beneath it.

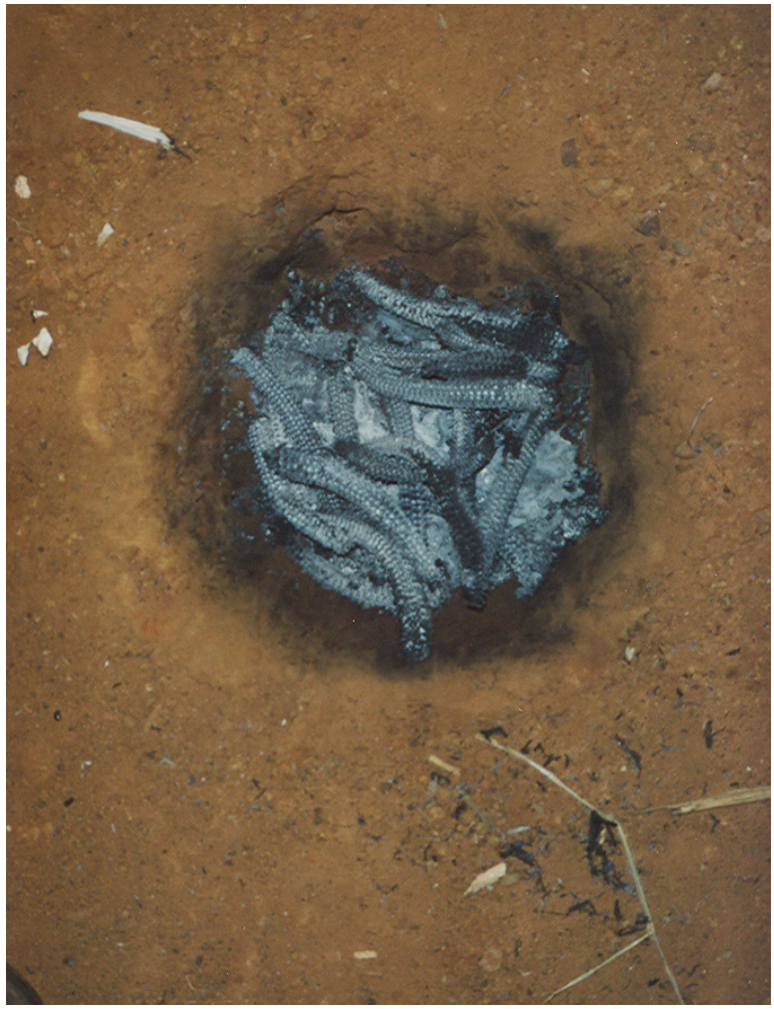

Figure 6. Burned corn cobs in one of the small pits in the house floor.

Before the house was set on fire, Rufus Davis of the Adai tribe led a prayer for all those in attendance (Figure 8); the crowd numbered in excess of 100 people. Dr. Dee Ann Story, Cecile Carter, Jeri Redcorn, and Rufus Davis simultaneously lit fires at the four cardinal points, and it burned with great ferocity, sending up walls of fire and plumes of smoke, until the structure had collapsed into a considerable mass of charred grass thatch and wood within only a few minutes (Figure 9a-e).

The house area had been enclosed by metal posts and fencing to leave the burned area protected as much as possible. About a month after the fire, the area was marked by considerable burned debris, exposed dirt fill (that had been put down over the modern surface in 1981 before the house reconstruction was built), and an assortment of burned whole and broken artifacts, principally ceramic vessels (Figure 10a).

Unfortunately, the area with the burned house and material remains was not off-limits to visitors, and within a year, most of the visible modern artifacts had been removed, and the area was becoming overgrown with grass (Figure 10b). By 2013, there were no visible surface traces of the burned house or its associated debris.

A second house reconstruction at a different location at the George C. Davis site was begun in 1997 by a group of volunteers led by Bob D. Skiles and the Friends of Caddoan Mounds State Historic Site. However, it was only partially completed before a hiatus and changes in park personnel led to its abandonment, and in 2000, Texas Parks & Wildlife personnel dismantled, but did not burn, the partially completed house.

Figure 7. Array of modern ceramic vessels, mats, and baskets on the house floor. Note the piles of small pumpkins and shell corn against the west wall of the house, and one of the small pits filled with burned corn cobs on the right side of the image. The slightly mounded dog burial pit is visible just above two of the mats.

Table 1. Modern artifacts placed in the reconstructed Caddo house before it was burned.

No.	Description
16	multi-colored glass beads, ca. 18 mm in diameter
6	shell buttons, 28 mm
2	conch shell sections, including columellae
10	buffalo bone beads, 8 mm
400	turquoise beads, ca. 2 mm in diameter
15	turquoise stones, 4 x 7 mm
30	dentalium shell wampum beads, 7 mm
20	sea shell fragments (ca. 10 x 10 mm)
20	fresh water pearls, 5 mm
5	bone disks, 29-42 mm
9	3-holed shells on cotton string, 20 x 25 mm
4	bone pendants, 32-50 x 32-43 mm
2	moon-shaped buffalo bones, 50 x 20 mm
1	turtle-shaped engraved bone figurine, 50 x 23 mm
4	bone fragments, 23 x 18 mm
4	bone hair tubes, 51 mm in length, 4 mm in diameter
2	bone picks, 53 mm in length, 4 mm in diameter

Table 1. *(Continued)*

No.	Description
10	red coral beans, 10 mm
11	beads, 5 mm
1	modern knapped Gahagan biface[5]
2	modern knapped Hayes and Alba points
1	modern knapped and "killed" Gahagan biface
Lots 5-10	lithic flakes
Lots 11-12	antler and mussel shell
2	turtle shells
5	white egret feathers
1	large mussel shell with blue paint
1	unifacial stone tool
1	Southwestern style bowl with polychrome interior
1	plain ceramic bottle
8-9	terra cotta ceramic vessels
6-7	mats
6-7	baskets

Figure 8. Ceremony before the Caddo House was burned in November 1995. Cecile Carter, noted Caddo historian, is in the center of the photograph and Rufus Davis is to her left.

Figure 9. The Caddo house on fire: a, the walls begin to burn; b, fire and smoke billowing from the walls; c, conflagration; d, mass of charred grass thatch and wood posts; e, charred grass thatch, wood poles, and visible charred modern artifacts.

Figure 10. Remains of the burned house and its contents: a, about a month after it was burned. The metal pipes mark the periphery of the house wall; b, about a year after it was burned. Note that most of the larger items that were exposed on the surface a year earlier have been carried off by visitors.

CONCLUSIONS

The construction and eventual destruction by burning of the reconstructed Caddo house at the George C. Davis site, now Caddo Mounds State Historic Site, is an ad hoc experimental archeological project now more than 30 years in the making. The time seems right to begin the next stage in the project, namely the archeological and geophysical investigation of the archeological deposits associated with the burning of the Caddo house in November 1995. If such work can be done, it should provide an excellent opportunity to observe the consequences of the burning of a grass-covered Caddo house on its structural materials and the material culture assemblage contained within it. The experimental archeological investigations of the burned Caddo house reconstruction should also provide information regarding preservation of the archeological deposits on habitation sites through documentation of the degradation of material culture items over a known span of years, particularly the short- and long-term preservation of organic remains on Caddo sites. The experimental archeological record created with the known placement of a range of artifact types of different material types within the house before it was burned also lends itself to the study of the post-occupational movement of material culture items on Caddo habitation sites.

Future geophysical survey investigations that can be conducted over the area of the burned Caddo house reconstruction should provide a data set on the preservation and interpretation of post holes, pit features, and concentrations of burned material remains whose internal structural plan is known within the house. Those features that are visible to geophysical instruments after 30+ years can then be compared to what is seen of Caddo architectural features after hundreds of years since they were abandoned and/or burned.

END NOTES

1. The Caddo house reconstruction crew included Scooter Cheatham, Norma Dean Jefferson, Lynn Marshall, Tom Hodges, Logan Wagner, Diane Young, and A. J. Taylor.

2. During the manufacture and use of the traditional tools, forms were filled out on who made the tool, how it was made, what material it was made from, and how much time it took for each stage of manufacture. Each member of the house reconstruction crew was required to make and maintain their own tool kit. It is our understanding that the tools and forms remain on file at the Texas Archeological Research Laboratory at UT.

3. The cane thatch was cut along the side of the road and in fields near Winnie, Texas, with deer sickle mandibles as well as machetes; the machetes worked better.

4. The trees acquired for the poles were cut in nearby Davy Crockett National Forest using the stone celts. One participant who wielded the stone celts described the process as having been more like "beating the trees in two" rather than like "cutting" (Glenn T. Goode to Skiles, personal communication, November 5, 1995).

5. The stone tools placed inside the house before it was burned (see Table 1) were knapped from Georgetown chert by Glenn T. Goode, an Austin archeologist and well-known knapper.

REFERENCES CITED

Ascher, R.
1961 Experimental Archaeology. *American Anthropologist* 63:793-816.

Cheatham, S.
1992 The Caddo House Reconstruction. *Bulletin of Primitive Technology* 1(3):22-24.

Coles, J. M.
1979 *Experimental Archaeology*. Academic Press, London.

Ferguson, J. R. (editor)
2010 *Designing Experimental Research in Archaeology: Examining Technology Through Production*. University Press of Colorado, Boulder.

Hammerstedt, S. W., A. L. Regnier, and P. C. Livingood
2010 Geophysical and Archaeological Investigations at the Clement Site, A Caddo Mound Complex in Southeastern Oklahoma. *Southeastern Archaeology* 29(2):279-291.

Ingersoll, D. W., J. E. Yellen, and W. MacDonald (editors)
1977 *Experimental Archaeology*. Columbia University Press, New York.

Lockhart, J. J.
2010 Tom Jones (3HE40): Geophysical Survey and Spatial Organization at a Caddo Mound Site in Southwest Arkansas. *Southeastern Archaeology* 29(2):236-249.

Marsh, E. J. and J. R. Ferguson
2010 Introduction. In *Designing Experimental Research in Archaeology: Examining Technology Through Production*, edited by J. R. Ferguson, pp. 1-12. University Press of Colorado, Boulder.

Mathieu, J. R. (editor)
2002 *Experimental Archaeology: Replicating Past Objects, Behaviors and Processes*. BAR International Series, Volume 1035. Archaeopress, Oxford.

McKinnon, D. P.
2013 Battle Mound: Exploring Space, Place, and History of a Red River Caddo Community in Southwest Arkansas. Ph.D. dissertation, Department of Anthropology, University of Arkansas, Fayetteville.

Millson, D. C. E. (editor)
2013 *Experimentation and Interpretation: The Use of Experimental Archaeology in the Study of the Past*. Theoretical Archaeological Group, Southampton, England.

Newell, H. P.
1940 Alto Mound. *Texas Archaeological News, An Occasional Report issued by The Council of Texas Archaeologists* 2:22-23.

Newell, H. P and A. D. Krieger
1949 *The George C. Davis Site, Cherokee County, Texas*. Memoir No. 5. Society for American Archaeology, Menasha, Wisconsin.

Schambach, F. F.
1996 Mounds, Embankments, and Ceremonialism in the Trans-Mississippi South. In *Mounds, Embankments, and Ceremonialism in the Midsouth*, edited by R. C. Mainfort and R. Walling, pp. 36-43. Research Series No. 46. Arkansas Archeological Survey, Fayetteville.

Schiffer, M. B.
1987 *Formation Processes of the Archaeological Record*. University of New Mexico Press, Albuquerque.

Schiffer, M. B. and J. M. Skibo
1987 Theory and Experiment in the Study of Technological Change. *Current Anthropology* 28:595-622.

Schiffer, M. B., J. M. Skibo, T. C. Boelke, M. A. Neupert, and M. Aronson
1994 New Perspectives on Experimental Archaeology: Surface Treatments and Thermal Response of the Clay Cooking Pot. *American Antiquity* 59(2):197-217.

Scott, K. W.
1984 An Interpretive Plan for Caddoan Mounds State Historic Site (The George C. Davis Site), Cherokee County, Texas. Master of Science thesis in Forestry, Stephen F. Austin State University, Nacogdoches.

Schultz, T. C.
2010 *Architectural Variability in the Caddo Area of Eastern Texas*. Special Publication No. 16. Friends of Northeast Texas Archaeology, Pittsburg and Austin.

Shimada, I.
1978 Behavioral Variability and Organization in Ancient Constructions: An Experimental Approach. In *Papers on the Economy and Architecture of the Ancient Maya*, edited by R. Sidrys, pp. 209-235. Institute of Archaeology, UCLA, Los Angeles.

2005 Experimental Archaeology. In *Handbook of Archaeological Methods, Volume I*, edited by H. D. G. Maschner and C. Chippendale, pp. 603-642. AltaMira Press, Lanham, Maryland.

Skibo, J. M.
1992 Ethnoarchaeology, Experimental Archaeology and Inference Building in Ceramic Research. *Archaeologia Polona* 30:27-38.

Spock, C.
1977 An Analysis of the Architectural and Related Features at the George C. Davis Site. Master's thesis, Department of Anthropology, The University of Texas at Austin.

Stone, P. and P. Planel (editors)
1999 *The Constructed Past: Experimental Archaeology, Education, and the Public*. Routledge, New York.

Story, D. A.
1997 1968-1970 Archeological Investigations at the George C. Davis Site, Cherokee County, Texas. *Bulletin of the Texas Archeological Society* 68:1-113.

1998 The George C. Davis Site: Glimpses into Early Caddoan Symbolism and Ideology. In *The Native History of the Caddo: Their Place in Southeastern Archeology and Ethnohistory*, edited by T. K. Perttula and J. E. Bruseth, pp. 9-43. Studies in Archeology 30. Texas Archeological Research Laboratory The University of Texas at Austin.

2000 Introduction. In *The George C. Davis Site, Cherokee County, Texas*, by H. P. Newell and A. D. Krieger, pp. 1-31. 2nd Edition. Society for American Archaeology, Washington, D.C.

Story, D. A. (editor)
1981 *Archeological Investigations at the George C. Davis Site, Cherokee County, Texas: Summers 1979 and 1980*. Occasional Papers, Vol. 1. Texas Archeological Research Laboratory The University of Texas at Austin.

Trubitt, M. B.
2009 Burning and Burying Buildings: Exploring Variation in Caddo Architecture in Southwest Arkansas. *Southeastern Archaeology* 28(2):233-247.

Walker, C. P.

2009 Landscape Archaeogeophysics: A Study of Magnetometer Surveys from Etowah (9BW1), The George C. Davis Site (41CE19), and the Hill Farm Site (41BW169). Ph.D. Dissertation, Department of Anthropology, The University of Texas at Austin.

2011 *Geophysical Survey at the George C. Davis Site (41CE19) South of Highway 21, Cherokee County, Texas*. AGA Report 2011-6. Archaeo-Geophysical Associates, LLC, Austin.

Walker, C. P. and D. P. McKinnon

2012 Exploring Prehistoric Caddo Communities through Archaeogeophysics. In *The Archaeology of the Caddo*, edited by T. K. Perttula and C. P. Walker, pp. 177-208. University of Nebraska Press, Lincoln.

Walker, C. P. and T. K. Perttula

2010 Archaeogeophysical Investigations at an Eighteenth-Century Caddo Site in Nacogdoches County, Texas. *Southeastern Archaeology* 29(2):310-322.

What Does "Long Hat's Camp" Really Tell Us? A Consideration of the Meaning of Two Popular Photographs to Caddo Studies

Ann M. Early

ABSTRACT

Will Soule's photographs of a Caddo family taken in western Oklahoma have been iconic images used in many situations by historians and archeologists. Although they sometimes are not even aware of the location or circumstances of the pictures, many archeologists treat them as a 'living fossil' that present images of ancient Caddo life and offer them as a 'model' to interpret excavation discoveries. A critical evaluation of the photographer and his subjects, in the spirit of Dee Ann Story's approach to her own research, suggests that the meaning may not be what everyone has assumed.

INTRODUCTION

This article is about two photographs that are familiar to anyone who is interested in Caddo Indian archeology or history. They are used as backdrops and visual features in exhibits, one or both images frequent power point presentations at professional and public events, and they are incorporated into research plans and academic studies. The two images were created by photographer Will Soule in the mid-19th century in southwest Indian Territory and identified by him as Long Hat's Camp. They consist of two views of a single encampment, one showing only buildings and other facilities, and the other with a group of people present that one presumes to be the residents of the camp. The images were attributed to the Caddo by scattered notations on photographic prints, and by the surname Longhat. Several generations have borne the surname Longhat in the Caddo Tribe.

These photographs are commonly offered up, usually implicitly and rarely with contextual discussion, as views of Caddo life in the mid-19th century. They are readily available through a variety of sources, they are free, and they are clear, technically well composed, and rare 19th century images. Archeologists can use them as graphic representations of features that they believe they have found in excavations. Historians and anthropologists can offer them as 'real' images of traditional cultural practitioners. Book editors can use them as interesting images of Native people 'other' than contemporary American schoolchildren.

Over the years I have seen these photographs in all the above contexts. Some times the images are never identified or provenienced. Captions vary widely, particularly with respect to the location where the photographs were taken and the subject matter. This is true for publications, and for live and written presentations offered by scholars. The lasting impression is that people are using the images in ways that suit their immediate research or public outreach needs, and in ways that support their own quick interpretations. The captions are frequently inaccurate. I have used the images myself dozens of times over many years and infrequently thought deeply about what they conveyed.

In the last few decades, as historical and archeological research has blossomed and the Longhat images appear more frequently, they have been paired with another image from the Caddo past, the ca. 1691 illustration of a Native community on Red River created by an unknown scribe accompanying the Spanish expedition through Northeast Texas led by Don Domingo Teran de los Rios. Commonly referred to as the Teran Map, scholars situate the subject as a community upstream from the Great Bend, perhaps a Nasoni community in the general location of the modern day Hatchel, Mitchell, and

Moores sites in Bowie County, Texas (cf. Wedel 1978; Sabo 2012).

The Soule photographs and the Teran map have been referred to as the Teran-Soule model, and they are proffered as a two level visualization of historic (and prehistoric) Caddo social and settlement organization. (cf. Schambach 1982a:120-122, 1982b). This proffer relates that the images show how Caddo communities were organized. Discussions tend to go further to assert that the Teran illustration depicts a community center featuring a mound that is devoid of accompanying features and facilities, a vacant ceremonial precinct, with widely dispersed domestic residential units. The Soule photographs are offered, often implicitly, as a sort of close up view of a residential unit within the larger community.

The Teran-Soule images do not actually constitute a model, singly or together, however representational or accurate their depiction of some observer's experience with Caddo society may be, because the images do not actually identify the component properties of communities and explain their relationships. They further do not actually constitute a linked pair. Time, distance, and an unknown amount of diverse cultural tradition among the Caddo separate the two, as do the cultural backgrounds, worldviews, life experiences, and motivations of their creators. As they are used today, however, they are a meme, asserting a reality and an interpretation through repetition. Their common use should raise several questions about the content of the images themselves, the reasons for their creation, the intent and rationale behind their creators, and the various meanings that observers invest in these artifacts. These are the kinds of critical questions that Dee Ann Story encouraged, and it is the spirit of her persistent critical approach to research that I want to focus on one of these images in the remainder of this article.

Photographs, paintings, video images, and even live scenes do not speak for themselves. This is hardly news because we all experience internal processes of observation, evaluation, and interpretation of scenes throughout our lives. We rarely pause to consciously deconstruct familiar images, though, and instead recall a familiar set of meanings that may actually be external to the images themselves. Film and art historians, ethnohistorians, and visual anthropologists are among the people who undertake critical analyses of individual images or the work of selected creators, and demonstrate the complexities that can lie between image creation and the observer's interpretation.

One set of Soule's images has been the subject of such an analysis already. Thomas W. Kavanaugh recounts a painstaking analysis of 11 photographs taken of a large Indian encampment featuring Plains style tipis. Over the years, members of this set of images were published in numerous venues with a variety of tribal identifications and situations. Kavanaugh's methodology and analysis in contextualizing the images, and his informative results testify to the challenge and the fruits of careful photo interpretation (Kavanaugh 1999:1-24).

Further afield, Errol Morris (2011) provides a detailed conversational expedition into a group of case studies that 'excavate' the sources and contexts of several famous images and the consequences of their creation. "*Believing is Seeing (Observations on the Mysteries of Photography)*" integrates the background of both the photographers and the events that precipitated the images, and recounts the impact the images have had on the subjects and on the creation of social memory. In reviewing the creation of some powerful and controversial photographs purporting to depict the environmental and social catastrophes of drought and poverty in early 20th century America, Morris (2011:185) observes "[t]heir views show the many different ways that a photograph can be seen and the different functions it can serve as staged propaganda, documentary evidence, and fine art. A photograph can capture a patch of reality, but it can also leave a strange footprint: an impression of an instantly lost past around which memories collect."

In the remainder of this article I will consider some contextual information about the photographer, the subjects, and the situation in which the photographs were taken. Finally, I offer an alternative interpretation of what we are seeing when we look at Long Hat's Camp.

THE PHOTOGRAPHER

William Stinson Soule was one of the first photographers to work in the southern Plains. Some of his photos, like the image of the scalped corpse of buffalo hunter Ralph Morrison lying on the prairie outside Fort Dodge, Kansas, were widely circulated in the 19th century and contributed significantly to Soule's reputation as a western photographer. That particular image was converted to an engraving and appeared less than a month after the killing in the *Harper's Weekly* political magazine, no doubt to the fascination of many of the magazine's 200,000 or so readers. Soule had very recently arrived in western Kansas when he took this photograph. The notoriety that resulted from the image must have given his ambitions to take and sell photographs in this setting a huge boost.

Today the Soule images are frequently used to illustrate books, websites, and other products that tell stories about American Indians or Great Plains history. Most of us have seen some of his photographs more than a hundred times without realizing who the photographer was.

Most of Soule's photographs are virtually mute with regard to the photographer's intent, because no journals, diaries, or extended narratives about the images by him, or anyone who knew him, have been located. Despite Soule's six year sojourn in the region, Belous and Weinstein (1969:18), who have published the only book length study of Soule's work, estimate that only 166 paper prints and 69 glass plate negatives are known to have survived. Kavanaugh (1999) believes that the surviving body of work is 240 photographs. There is no record of how many photographs were originally made. Soule and his brother John sold prints individually and put together albums of his prints for sale. Many of those albums were marketed from his studio in the Evans trading post near Fort Sill (Nye 1968:x). John Soule received and copyrighted nine of Soule's Indian photos in 1873 even before Will left the southern Plains in 1874 (Kavanaugh 1999:2). Will Soule likely continued to sell his western Indian images throughout his career, in the later years from his photographic business in Boston, until his retirement. Cabinet cards of Indian subjects taken by Soule continue to sell in auctions today (Cowan Auctions 2013)

There are several groups of Soule images housed in archives across the country, including at Kansas State University, the Huntington Library and Los Angeles County Museum of Natural History, the Bureau of American Ethnology, the Smithsonian Institution, the Dolph Briscoe Center for American History at The University of Texas, and at the Fort Sill Museum. Many have the briefest of captions, and many have no identification at all. Soule himself wrote some of the captions, but others may have been additions placed there by the photographs' subsequent owners and collectors. More troubling is the fact that notations on some photos are inconsistent from one source to another, so that a tedious and not always rewarding research program is required to identify the actual subject of a photo and the place where it was taken. Taking the confusion a step further, Soule prints frequently come up for sale and the accompanying catalog information varies wildly in subject matter, photograph location, and photographer biography.

Soule took both portraits and landscape photographs. Many of his portraits were of well-known tribal figures residing near Fort Dodge, Kansas, Camp Supply, or Fort Sill, the latter two in Indian Territory. His landscapes typically show Native settlements that infrequently include Western style houses and other facilities. The subjects in his portrait photographs display a mix of American commercial clothing and gear and objects that we take to be traditional attire. We do not know if these surviving images are typical of his body of work in the region, or if they have survived because they represent that portion of his archive that most captured the interest of the buying public. Pictures of Indians in skins and silver jewelry, partially clothed women, and panoramas showing fields filled with tipis, were popular and highly marketable subjects.

Few records disclosing Will Soule's life and work have been unearthed, but it is possible to gain some insights into his career in photography. He was born in Maine in 1836. At some time before the Civil War, he and his elder brother John (1828-1904) were living in Boston where the latter had a photographic shop. Will seems to have lived in his brother's household in Boston and worked as a clerk in his shop (*www.familystacks.com*). In the mid-19th century, photographic shops marketed prints and photographic supplies. Proprietors may have been photographers themselves, and/or they may have purchased exposed negatives produced by other individuals, then marketed the prints as their own product.

Will Soule enlisted with the Massachusetts Volunteer Infantry early in the Civil War. He was a Private in Company A, 13th regiment, and was seriously wounded in the hip in the battle of Antietam in 1862. He finished his enlistment in 1864, but Nye reports that he reenlisted in the Invalid Corps (later known as the Veterans Reserve Corps) with a desk job as a government clerk. It is not clear whether he continued in this position until the end of the war.

Soule subsequently operated a photographic gallery in Chambersburg, Pennsylvania, not far north of the site of his wartime service, until the property burned, seemingly in 1867 (Thrapp 1991). It is unclear where Soule was between this incident and when he appears in Kansas in late 1868. One source indicates that he worked in the Philadelphia area at least part of that time. Another suggests that he returned to New England. Wherever he was employed, he made enough money to assemble a variety of photographic supplies and equipment that he took west with him, probably traveling to Kansas in 1868 (Nye 1967; Belous and Weinstein 1969). This destination may have been related to the fact that Soule's former supervisor in the Invalid Corps, Major General Wilfred S. Hancock, was based at Fort Leavenworth as commander of the Military Department of Missouri. Once at Fort Leavenworth, Hancock was seconded to General Sherman to assist in warfare with the Cheyenne and Arapaho, events that foreshadowed later confrontations that took place during Soule's residence in the west.

At Fort Dodge, and later at Fort Sill, Soule supported himself by clerking in a trading house and taking pictures as the opportunity arose. Although he has been characterized as an amateur photographer in some publications, it is clear that from the outset Soule derived at least part of his income from photography from this point forward. At Fort Dodge he was chief clerk in John E. Tappin's trading post. He may have worked part time in John Evan's store outside Fort Sill when he moved there from Camp Supply, but Soule also acquired funds for a short time while serving as the official Fort photographer. Some of his photographs of the Fort buildings under construction survive.

Soule's studios were erected inside the stores. Soule had the equipment and furniture to stage standing, seated, and reposing portraits, and used props that included a short architectural column, a couch, and a bison hide blanket with the hair attached. He used a custom modified wagon as a base when taking landscape and village photos away from his studio.

In addition to the financial benefits of a regular income, Soule's association with the post sutler gave him a prime location to encounter military personnel, civilian travelers and residents, and Indians, and to hear news of events with photographic possibilities. Most correspondents believe that it was at Fort Sill that Soule took most of his photographs, and compiled photo albums of Indian subjects for sale. One album was passed down in the Evans family.

Will Soule returned East in late 1874 or early 1875. This may have coincided with a flare-up of violence known as the Red River War in which the U.S. Army subdued and drove on to reservations Comanche, Kiowa, Southern Cheyenne, and Arapaho bands that had been living in a traditional manner in southwest Indian Territory and the Texas Panhandle. With the heavy pressure of U.S. Military and political forces, the free-ranging lifestyle of the southern Plains tribes and their Native neighbors was in its last days. Unmolested access to bison and wild horse populations was increasingly difficult. Raiding into Texas and Mexico generated retaliatory violence. Quakers with educational and social welfare interests and a host of White Americans with philanthropic, materialistic, and entrepreneurial agendas became common on the landscape. Annuities to many bands, promised as part of various treaties, agreements, and understandings, brought increasing amounts of western goods, clothing, tools, and foods to Tribal people. Some Indians, including many Caddo, worked as paid scouts for the soldiers, or at other tasks that may have given them access to cash. Life was changing rapidly for the Kiowa, Arapaho, Comanche, and Cheyenne, as well as for the smaller groups such as the Delaware, Wichita, and Caddo, and Soule may have seen his photographic subject matter dwindling rapidly. Retaliatory raiding, the development of new enemies, and U.S. Military initiatives to force the tribes into reservations that periodically included the destruction of entire encampments and imprisonment of some prominent leaders would have changed the Indian-White relational dynamic and affected Soule's access to willing photographic subjects. And maybe there was a woman involved.

Nye reports that Soule met Ella Augusta Blackman back East in 1875 while he was helping to escort some Indian leaders to Washington D.C. Soule may have undertaken this task for the pay that probably went along with it, and he may have been scouting out new job prospects. He had discussed his return East openly at Fort Sill as early as December of 1874. When he returned to Fort Sill, Soule found that someone had taken most of his equipment and photographic prints but left him the glass negatives for the Indian collection (Nye 1967:ix-xiii).

Will Soule and Ella Blackman were married on April 29,1875, in Lakewood, New Jersey. Their whereabouts for the next seven years are unclear, but they reportedly resided part of the time in Vermont, and lived in Melrose, Massachusetts, late in life. In 1882 or 1883, Soule bought his brother's art publishing business in Boston, and with a partner, William B. Everett, continued in the photography and art print business until his retirement in 1900 or 1902 (Belous and Weinstein 1969:19). There is no indication that Soule returned to the West after early 1875.

It is worth mentioning that the photography business was a family affair for Will Soule and his brother, John. The latter was also a photographer, and a pioneer in the photography and photographic print business. Except for a stint with the Massachusetts volunteers in the Civil War, John ran a successful photo and print shop in Boston until the early 1880s when he sold out to his brother Will and went to work as a railroad photographer. In the late 1880s he settled in Seattle, where he continued to take and market photographs of people, landscapes, and architectural views.

It seems evident from this albeit fragmentary biography that William S. Soule was trained in the emerging field of photography early in life. He made a living by taking and selling pictures for much of his adult life, whenever finances and circumstances permitted. He left few personal records behind, but there is no indication that he went west to photograph the tumultuous post-Civil War years on the southern Plains for scholarly or historical reasons. He was capturing images of the exciting, exotic, and famous people and cultures of the southern Plains. He knew that these images would sell well, both in the frontier forts and infant towns and in the rest of the country hungry for news of events in the untamed West.

Most of Will Soule's Indian views were of people and tribes that played prominent roles in the events that took place in the southern Plains in the post-Civil War years. The Caddo were numerically small, and did not participate in most of the raids and other troublesome actions that took place in the region, except that the Military forces recruited several Caddo as scouts. Caddo George Washington, Showetat (Little Boy), also became

Figure 1. Photograph 1.

well known to various Fort military and civilian residents as he famously supplied guns and liquor to Indians and to some white residents in a bootleg operation based at his store near Anadarko. Soule's portrait of Caddo George survives.

THE PHOTOGRAPHS

The two photographs of Long Hat's Camp show a group of buildings in a clearing with woodland in the background (Figures 1 and 2). The photographs were certainly taken between 1869 and early 1875, and the camp is probably within the general Wichita-Caddo reserve that was situated between Fort Sill and Anadarko. The exact location of this site is still unknown. It is also uncertain whether Soule took his pictures of a Wichita camp on the same trip. There may be evidence still available to identify the time and place of these photographs.

One view, that I will call Photograph 1, has a group of people seated and standing around a ramada, an open air work and rest facility, facing the photographer. Five other buildings are visible behind them. The second view, Photograph 2, is taken apparently after the photographer moved to his right about 90 degrees. In this view there are two small figures, presumably children, seated or crouched beneath a ramada on the left side of the image, but there are no other people present. This second view shows four standing buildings in addition to the ramada and a heap of debris that seems to be the roof of a collapsed building.

One discovery that I made is that not all Long Hat's Camp photographs on websites and in publications are equal. The frequently used images that have been available as slides in the Pictures of Record *Late Caddo* slide set since the mid-1970s are cropped versions of the images obtained from the Smithsonian Institution. The non-cropped example of Photograph 2 shows a board fence in the right background, separating the yard from the timber beyond. An extension of that fence, or another architectural feature, is shown in the distance beyond the ramada on the left side of the photo and between the children and the standing building closest to the photographer. The non-cropped version of Photograph 1 shows the edge of the architectural rubble on the left hand side of

Figure 2. Photograph 2.

the photo, a feature missing in the cropped image. Although there is little doubt that the two images were taken at the same place, the rubble and the group of buildings that appear in both images link the two together. The question remains, though, how many prints of these two images survive, and are they identical? Do the glass negatives of both images survive? Are we seeing all that we can possibly see in the photos that remain?

Let us look first at the actual composition of the settlement that is visible to us, assuming that the two photographs were taken during a single visit and the two show an overlapping set of features and facilities. Photograph 2 shows the buildings most clearly. To the far left is an open-sided, shaded facility. This is different from the ramada where the residents sit, because it is smaller in size; it has a roof of some sort to block the sun; the horizontal roof poles are not the same size or shape as those in Photograph 1; there is no seating or working platform visible; and the vertical supports are smaller and straighter than those in Photograph 1.

The building to the right of this ramada in Photograph 2 is what we have come to consider a dwelling. It is square or rectangular, and is constructed of widely-spaced vertical posts. The intervening spaces appear to be in-filled with some mixture of sediment and plant material. The building may have rounded corners. The only opening visible has a high sill of closely spaced posts—more closely spaced than the wall spacing—and has no visible door on the outside. The structure has a steeply pitched roof, generally hipped in design, that features a horizontal ridge pole, grass-like sheathing and eaves that extend well away from the wall line. The interior support architecture is not visible. The ridgeline is a little swaybacked, but appears to be clean of soot and other residues from an interior fireplace. In contrast, two other similar buildings in these photographs have dark sooty areas and deeper swayback profiles for their ridgelines. The roof sheathing of the building in the foreground looks fresh. This may be a newly finished structure.

To the right of this structure, and further away from the photographer, is the pile of debris that looks like another grass-sheathed roof. There is a pick-up-sticks spread of debarked saplings extending out from the edge of the grass pile. This appears to be a structure like the preceding one that has collapsed. There is no indication of fire, and the neighboring structures appear undamaged, so this heap is very likely a building that collapsed in on itself, or was pulled down for some reason. This may be the predecessor to the already described first building.

To the right of the grassy heap is an open-sided structure. It has widely spaced saplings holding up the roof, an oval to rectangular outline, and a steeply pitched hip-like roof design with a ridge. The roof is sheathed in bark. Small saplings or more likely large vines run horizontally around the roof to hold down the bark sheets. The roof supports are two to three times more widely spaced than the vertical load-bearing timbers in the dwelling house. Inside this open structure is a seating/sleeping or work platform. Taken together, this structure has the appearance of a third work area, this one with a sturdy permanent roof.

To the right of this structure in Photograph 2 is a feature that has been identified as a storage facility. It has an oval to circular outline, widely-spaced support posts that are closer together than those in the roofed work facility mentioned above, and further apart than those visible in the dwelling. This facility has a dome-shaped roof sheathed in some kind of grass. The sheathing has an undulating, stacked ring profile that indicates the sheathing consists of short grass sheaves tied to a series of horizontally placed saplings that form the framework for the roof in a manner roughly equivalent to the relationship between rafters and purlins. Soule photographed a Wichita camp with a grass house that has a similar construction pattern. Part of the lowermost of the horizontal braces is visible on the right hand side of the structure, as is a fuzzy image that appears to be a horse that may be responsible for the missing grass.

Behind and to the right of this structure is another building that matches the first dwelling. Only a portion of the building is visible in this photograph, but it appears more clearly in Photograph 1. The structure has an oval to rectangular outline, with relatively closely placed vertical wall posts, infilling of some sort of organic matter, a steeply pitched hipped roof, overhanging eaves, and a saggy ridgeline. The walls appear to lean in slightly. The doorway has a high sill of closely spaced vertically placed timbers. A group of timbers rest against the outside wall adjoining the doorway and may be firewood. The ridgepole sags and shows a dark deposit that may be accumulated soot at its center. The soot and firewood indicate that this structure is currently in use.

Photograph 1 also shows another structure that is not visible on Photograph 2. On the far right, behind the group of three men, is another building that has the characteristics of a dwelling: a hipped roof, grass sheathing, overhanging eaves, and apparently a wall line made up of vertical timbers. It is in the distance, and is out of focus. Nevertheless, it indicates that the two photographs do not capture all of the structures and other facilities that made up this settlement.

What can we learn from these photographs about this settlement? It has been here for several years, long enough for one building to collapse or be torn down. It has at least two and perhaps as many as four dwellings currently occupied. There may be more that Soule did not choose to include in his photograph. Interestingly, there is no sign of agriculture. If there are fields, or kitchen gardens, they are not visible, and if the above ground storage facility is the sole one in the settlement, it does not seem as if it has very much capacity.

The grass covering the yard area between the buildings is very short. This may be the result of grazing by more stock than we see in the photos, but may be another indicator of the length of time that the location has been occupied, with frequent movement in the yard keeping the ground cover in check. Since most Caddo removed to Kansas during the Civil War, these photos may have been taken after the Longhat family established itself in this spot after the war. If so, it is likely that the photographs were taken shortly before Soule departed for the East.

THE PEOPLE

Photograph 1 features a group of people that are assumed to be the residents of the settlement. There are 12 or 13 people, including at least eight adults, in view. Four of the adults are men. Three sit together on the right of the viewer, apart from the main group, and one sits among the women and children clustered at the ramada. Both men and women are wearing a mixture of commercially available western clothes and items that, acquired through purchase or annuity, were decorative items popular among tribal members. The most obvious of the latter are silver brooches worn by the women. It is not clear whether any members of the group continue to wear any traditional garments. Are all these people the local residents? Are some just visiting and live elsewhere? Are there some people who declined to be photographed? Who in the photo are the Longhat's? Soule does not tell us.

Soule may have named the camp for one or more of the adult males who were connected to the place, a decision that would be reasonable for a White man unfamiliar with the details of kinship and residence customs among the Caddo and neighboring tribes at that time. The composition of this group may have been considerably different from that of Victorian White society, however. Elsie Clews Parsons found that as late as the 1920s, Caddo residential groups were frequently composed of sisters and brothers and their close kinsmen, or groups of female lineal relatives and their immediate families (Parsons 1941:20-21, 71-75). Residential mobility is also well documented among the Caddo. Some of the people in the photograph may simply have been visiting relatives or friends when the photograph was taken, or they were staying temporarily with relatives who resided in the compound.

A member of the Longhat family who would have been an adult in the mid-1870s has not yet been linked to the photographs. The Longhats are well represented in early 20th century Caddo affairs, however, and one or more of their immediate ancestors would likely have been tied to this settlement. Brothers Francis, Joshua, and Amos Longhat were born between 1870 and 1874 (1915 Caddo Census), so it is possible that they are one or more of the children in the photographs, or that they resided in this compound. The adult woman second from the left in the photo one is holding a toddler in her lap. One Internet source gives Saw win yin and Do shin ko as the names of the boys' parents, but offers no elaboration or English alternative (Longhat-Caddo-Family History and Genealogy Message Boards n.d.).

The Longhat family comes from the southern Caddo population block that identifies with the Hasinai of East Texas. Both Francis Longhat and his brother Amos served as chiefs in the early 20th century. Frances was chief of the Fort Cobb division and had died before Harry Age (Edge) became chief in 1922, according to Parsons (1941:10). In those days, the Caddo had two chiefs, still called *kadhi* (caddi), who headed the two population blocks at the same time, and who were required to act in tandem for the benefit of the entire tribe. Parsons reported that after Francis Longhat's death, his stepson Harry Edge was eventually named chief (1920-1922). Amos Longhat succeeded Edge (1922-1923) and was the next to last man selected under traditional criteria.

Although Hasinai leadership did not pass directly along matrilineal or patrilineal lines, family background established the eligibility of some men for this leadership position (Newkumet and Meredith 1988:53). Men of the Longhat family were clearly eligible for the most important surviving leadership positions, and two of them were willing to assume this responsibility when they were recruited. Eligibility for the position of *kadhi* was open to only select families, and traditional leaders would have been well grounded in tribal traditions and values.

Should we consider this pair of photographs a depiction of a 'typical' Caddo residence in 1870s Indian Territory? Perhaps so, but there are several factors that suggest we should do otherwise. First involves the photographer's choice of subject. Soule's photographs of Indian settlements are filled with traditional features that convey images of lifestyles far removed from post-Civil War American society. At this time, though, Western material culture and cultural institutions were present and accessible to Native communities. The large scale construction projects at Fort Sill were only one of many developments bringing Western architecture and institutions into the region in the 1870s. By 1871, the Quaker-led Butler Indian School was housed in a brick and mortar building at Fort Sill, and timber frame architecture housing trading posts, dwellings, and other institutions were present on the landscape.

There are no real indications of Western material culture in the Longhat Camp photographs beyond personal adornment. Were the residents unable to acquire Western goods through lack of capital? Did the residents choose to forego Western goods for cultural reasons? Were Western goods deliberately removed from sight for the photograph session? The little we can see of clothing and personal adornment suggests that the people in the photograph had the means to acquire both necessary and luxury items, so it seems likely that other physical indicators of acculturation were absent by choice.

A scarcity of Western material culture beyond personal adornment in the Longhat compound may have been attractive to Soule because it would produce an image that he knew from experience was marketable back East. The style of image was consistent with his preferred style of outdoor photography that also produced the dramatic images of Wichita grass houses and creek valleys filled with tipis. It is the style of image that attracts us today.

Another aspect of the Longhat Camp photographs that suggests they are atypical is the style of domestic architecture. For nearly 200 years, European explorers, missionaries, and other observers encountered Hasinai settlements and described the buildings and associated activities in reports, diaries, and memoirs (cf. Swanton 1942; Bolton 1987; Newkumet and Meredith 1988). Domestic buildings are consistently described as circular, dome-shaped, and grass-covered. This architectural style appears to have been shared with other regional Caddo populations, including those residing in the Red River valley. Joutel remarks on these similarities that he encountered while passing through several Caddo villages in East Texas and South Arkansas (Foster 1998). The Teran map, made a few years after Joutel's visit, depicts conical or dome-shaped dwellings that are interpreted to be grass house style constructions (Sabo 2012:435-436). This is one important difference between the Teran and Soule images. The latter are not a close up view of the former because, at the very least, they show a distinctly different kind of house architecture pattern.

Archeologists commonly encounter circular post hole outlines at Caddo tradition sites in the four-state Caddo archeological region. Some are in or on mounds, and others are at non-mound sites that are classified as domestic sites. The circular house style was clearly a commonly known architectural form, and it was made for hundreds of years across thousands of square miles. Why, then, would members of a privileged lineage sensitive to Caddo cultural traditions, residing among the consolidated Caddo population, and sufficiently respected by fellow tribal members to produce two important tribal leaders, build and live in houses that were not built in the well-known traditional way? Had all Caddo abandoned grass houses by the time that they resettled in Indian Territory after the Civil War? Was the Longhat family in the minority?

There has long been archeological evidence that from the very beginnings, Caddo tradition people built more than one type of structure. Posthole outlines of straight-walled buildings in square or rectangular configurations are also well documented in and on mounds, and at non-mound sites. These buildings are also found across the

Caddo area and were made for hundreds of years. Archeologists continue to speculate about the reasons for different architectural models. Were some building styles used for domestic purposes, and others restricted to ritually infused uses (cf. Early 2001; Perttula 2009; Trubitt 2009)? What clues do we have of the purpose of buildings from the location where they were built, the contents and interior facilities present, and the treatment they received when they were no longer in use?

There is good evidence that some proportion of straight-walled buildings were constructed for non-domestic purposes. Straight-walled buildings are also frequently found buried within multiple stage flat-topped mounds, and burned and buried beneath low domed mounds and subsequently used as elite cemetery locations. Not all straight-walled buildings belong to these two categories, but there is a significant association of straight-walled structures with special places and special treatments.

During his discussion of the features found on the Teran map, Sabo points out that all but one of the symbols believed to be domestic buildings are of the same conical-topped form. In the compound labeled "cadi" there is a conical-topped building, and there is a solitary symbol of a building with a ridgeline configuration. Sabo (2012:435-436) suggests that it might represent a short-term structure built to house the European visitors. That may be the case, but perhaps it was there before the Europeans arrived, and is a special place associated with the various activities delegated to and undertaken by the *Cadi* who occupied the compound.

I suggest that the architectural style exhibited in the Longhat camp photographs was a very old Caddo architectural model that retained powerful associations with core Caddo traditions and leadership roles. Whether by choice or obligation, the Longhat family employed this building style at a time when the Caddo had been uprooted from their ancestral lands and were facing monumental challenges in adapting to a new social, economic, and religious landscape.

The Soule photographs have much to tell us, although what they convey may not be what many people think they are saying. Further research into Soule and his subjects may provide us with even more insights into Caddo history.

REFERENCES CITED

Belous, R. E. and R. A. Weinstein
1969 *Will Soule: Indian Photographer at Fort Sill, Oklahoma 1869-74*. The Ward Ritchie Press, Pasadena.

Bolton, H. E.
1987 *The Hasinais: Southern Caddoans as seen by the Earliest Europeans*. University of Oklahoma Press, Norman.

Caddo Census
1915 Caddo County Census, Caddo Indians at Kiowa Indian Agency. MF # 2031240 Okla 00810.

Cowan Auctions
2013 Sale item description. Cowanauctions.com/auctions/item.aspx?ItemId=54542. Accessed December 20, 2013.

Early, A. M.
2001 The Winding Stair Site. In *Forest Farmsteads*, edited by A. M. Early, pp 69-92. Research Series 57. Arkansas Archeological Survey, Fayetteville.

Foster, W. C. (editor)
1998 *The LaSalle Expedition to Texas*. Texas State Historical Association, Austin.

Kavanaugh, T. W.
1999 Whose village? Photographs by William S. Soule Winter 1872-1873. *Visual Anthropology* 4(1):1-24.

Longhat-Caddo-Family History & Genealogy Message Board
n.d. *http://boards.ancestry.com/thread.aspx?mv=flat&m=125&p=localities.northam.usa.states.oklahoma.counties.caddo*, Accessed December 28, 2013.

Morris, E.
2011 *Believing is Seeing (Observations on the Mysteries of Photography)*. The Penguin Press, New York.

Newkumet, V. B. and H. L. Meredith
1988 *Hasinai: A Traditional History of the Caddo Confederacy*. Texas A&M University Press, College Station.

Nye, W. S.
1968 *Plains Indian Raiders*. University of Oklahoma Press, Norman.

Parsons, E. C.
1941 *Notes on the Caddo*. Number 57, Memoirs of the American Anthropological Association and Supplement to American Anthropologist Volume 43, No. 3, Part 2. Menasha, Wisconsin.

Perttula, T. K.

2009 Extended Entranceway Structures in the Caddo Archaeological Area. *Southeastern Archaeology* 28(1):27-42.

Sabo, G. III
2012 The Teran Map and Caddo Cosmology. In *The Archaeology of the Caddo*, edited by T. K. Perttula and C. P. Walker, pp. 431-447. University of Nebraska Press, Lincoln and London.

Schambach, F. F.
1982a A Research Design for Continued Investigations. In *Contributions to the Archeology of the Great Bend Region*, edited by F. F. Schambach and F. Rackerby, pp. 118-122. Research Series No. 22. Arkansas Archeological Survey, Fayetteville.

1982b The Archeology of the Great Bend Region in Arkansas. In *Contributions to the Archeology of the Great Bend Region*, edited by F. F. Schambach and F. Rackerby, pp. 1-11. Research Series No. 22. Arkansas Archeological Survey, Fayetteville.

Swanton, J. R.
1942 *Source Material on the History and Ethnography of the Caddo Indians*. Bulletin 132. Bureau of American Ethnology, Smithsonian Institution, Washington, D.C.

Thrapp, D. L.
1991 *Encyclopedia of Frontier Biography P-Z*. University of Nebraska Press, Lincoln.

Trubitt, M. B.
2009 Burning and Burying Buildings: Exploring Variations in Caddo Architecture in Southwest Arkansas. *Southeastern Archaeology* 28(2):233-247.

Wedel, M. M.
1978 *La Harpe's 1719 Post on Red River and Nearby Caddo Settlements*. Bulletin 30. Texas Memorial Museum, Austin.

The James Pace Site (16DS268) and Early Caddo Developments Along the Upper Sabine River

Jeffrey S. Girard

ABSTRACT

Excavations at the James Pace site (16DS268) in 1967 demonstrated its importance for understanding early Caddo developments but left questions regarding the time of occupation, the presence of mounds, and relationships to Coles Creek groups of the Lower Mississippi Valley. This article summarizes investigations conducted between 1992 and 1994 that demonstrated the presence of at least two mounds and yielded radiocarbon dates indicating that occupation took place from the 9th to the early 11th century. The article discusses the Pace site in relation to pan-regional ceramic trends and the early development of multiple mound centers in the Caddo Area.

INTRODUCTION

Dee Ann Story's meticulous research at the George C. Davis site in East Texas initiated interest on the part of her and her students in exploring the origins of the Caddo cultural tradition. A particularly important topic was the relationship between indigenous Late Woodland period peoples of the Caddo Area and Coles Creek groups in the Lower Mississippi Valley.

The James Pace site (16DS268), located along the Sabine River near the Louisiana-Texas border, was considered by Story (1990) to be of exceptional importance due to the apparent dominance of Coles Creek pottery and a paucity of that traditionally classified as "Caddo." The Pace site had been identified and subjected to limited excavation in the 1960s as a salvage project conducted in association with construction of Toledo Bend Reservoir, and Story and student Tineke Van Zandt re-examined the site collections in the 1980s. In a summary of this work, Story (1990:315-319) focused on three important issues raised by the Pace site investigations:

1. Time of occupation. The ceramic assemblage appeared to immediately pre-date, or to be on the cusp of, what has been considered the beginnings of the Caddo cultural tradition. Lacking radiocarbon dates, it was not known how this time related to calendar years. Story (1990) set out several possible scenarios regarding how the Pace site might relate to other contexts thought to be of similar age.

2. Nature of occupation. Not clear from the 1960s field work was whether the site served exclusively as a residential area or also contained mounds likely to be of ceremonial significance. Scurlock and Davis (1962:42-43) initially reported four mounds and an adjacent village area. Jensen (1968:31) later reported "four gas or pimple mounds which are quite numerous in the area..." along with a larger mound that was thought to be of cultural origin. A backhoe trench was excavated through one of the rises indicating that it was natural. Story (1990:317), suggesting that this probably was the potentially cultural mound, concluded: "Until there is good evidence to the contrary, the James Pace site is best regarded as being a habitation locale without any mounds." The question of whether or not mounds were present at the Pace site is important for understanding the early development of regional settlement configurations and possible site hierarchies in the Caddo Area.

3. Cultural affiliation of the site inhabitants. Should we consider the Pace site a Coles Creek or a Caddo site? Story (1990:318-319) noted that the site contained an

unusually high, if not uniquely high, percentage of Lower Mississippi Valley-like sherds in terms of decoration, but paste characteristics, particularly the frequent use of crushed bone as temper, suggested local manufacture. What are the implications of the pottery similarities for how we construct and interpret cultural taxonomies at regional spatial levels?

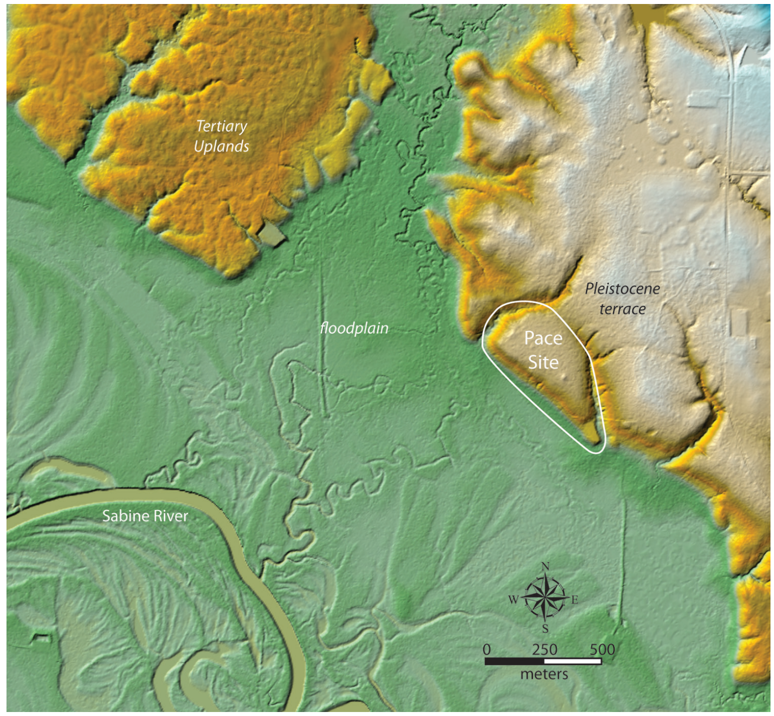

Figure 1. Elevation model of site area constructed from LIDAR elevation data. LIDAR contour data distributed by "Atlas: The Louisiana Statewide GIS." LSU CADGIS Research Laboratory, Baton Rouge, LA, 2006, http://atlas.lsu.edu.

Between 1992 and 1994, I conducted limited excavations at the Pace site, the most important results of which were: (1) demonstration that at least two, and perhaps three, mounds are present; (2) radiocarbon analysis of charcoal samples suggesting that occupation took place between the 9th and early 11th centuries A.D.; and, (3) recovery of additional artifacts that are within the range of those recovered earlier that suggested a relatively limited temporal span of site occupation. A summary report of the mound investigations was published (Girard 1994). Since that time, additional radiocarbon dates from the Mounds Plantation (Girard 2012a) and Crenshaw (Samuelson n.d.) sites have refined our understanding of regional chronologies; significant research has been conducted in the upper Sabine River drainage (e.g., Perttula 1994, 2011; Bruseth and Perttula 2006; Fields and Gadus 2012); and, new perspectives on early Caddo developments have been offered (e.g. Girard et al. 2014). This article summarizes the 1992-1994 investigations at Pace and discusses how the site relates to early Caddo developments.

FIELD INVESTIGATIONS AT THE PACE SITE

The Pace site was recorded initially in 1961 by archeologists from the University of Texas during a survey for the proposed Toledo Bend Reservoir (Scurlock and Davis 1962). The site is situated on a Pleistocene terrace remnant flanking Tertiary uplands, adjacent to Holocene alluvial deposits associated with the Sabine River, the channel of which is located 1.5 km to the southwest (Figure 1). It covers a relatively level landform bordered by the floodplain and relatively steep upland drainages on the east and north sides.

In 1961, the site was described as consisting of four mounds and an adjacent village area. Following limited test excavations in 1963 (Scurlock 1964:22), a crew from Southern Methodist University (SMU) conducted more intensive work in 1967. Noted at that time were five topographic rises, only one of which was considered to be a probable cultural feature (Jensen 1968:31). Four 50 m long backhoe trenches, each 1 m wide and 50 cm deep, were excavated in the northern part of the site. A fifth backhoe trench was excavated into a slight rise in the southern "area of investigation," but this rise was interpreted as a natural feature. In addition to the backhoe trenches, 16 test pits were excavated by hand. One backhoe trench hit a flexed human burial with no accompanying grave goods. The excavations also encountered a clay-lipped fire basin (without charcoal) and 14 possible post holes, but these did not form patterns that could be interpreted as representing structures.

The Pace site remained above the maximum pool level of Toledo Bend Reservoir and, during the spring of 1992, I carried out limited investigations to: (1) determine whether or not topographic rises identified during earlier investigations represented cultural features; (2) recover charcoal in good context for radiocarbon analysis; and (3) obtain a more spatially diverse sample of artifacts. Pine trees planted on the site in the 1970s had recently been cut resulting in numerous shallow surface disturbances from heavy equipment, and surface visibility was poor due to debris from the timber harvesting.

We first made a topographic map of the site and attempted, based on information provided by the landowner, to plot the location of the SMU excavations. Artifacts were collected from portions of logging roads on the site periphery. Mapping indicated that two well-defined rises were present, one on the northwest and one on the southeast margin of the site (Figure 2). Auger tests placed in each suggested that they were constructed earthworks and they were designated Mounds A and B, respectively. Several additional low rises were noted, but augers indicated that, with one exception, all were natural. The exception was located near the head of the eastern drainage where a low rise appeared to contain less than 1 m of fill overlying a buried A soil horizon. No additional work was done in this area and the cultural status of the rise remains unconfirmed.

Mound A

A 1 x 1 m test unit was excavated near the top of Mound A, a low dome-shaped rise measuring a little more than 15 m in diameter (Figure 3). The mound was constructed on the margin of the Pleistocene terrace as it slopes down to the west and is between 1.3 to 1.4 m high at its summit. The landowners stated that previously it was taller, and contours suggest that sediments from the top of the mound might have been displaced to the southeast at some time in the past. The test unit revealed a series of alternating strata of fine sandy loam and sandy clay loam (Figure 4). Deposits within the mound were assigned feature numbers and these are described in Table 1.

In order to find the extent of Mound A, a 50 x 50 cm unit was excavated on the southeast edge of the rise. The upper 20-25 cm was a pale brown fine sandy loam, likely to be slope wash or deposits pushed off the top of the mound. This material was underlain by yellowish-brown fine sandy loam representing the upper deposits of the natural Pleistocene terrace landform. Sherds and chipping debris were recovered beneath the slope wash.

Ten 1 x 1 m units were excavated on the east side of Mound A in February 1994 (see Figure 3). Unfortunately no features or charcoal in datable contexts were encountered. However, we did obtain better information concerning the site deposits, and recovered a collection of artifacts for comparison with the earlier SMU excavations. The units revealed that a well-developed soil was present on the site with artifacts confined to 35-40

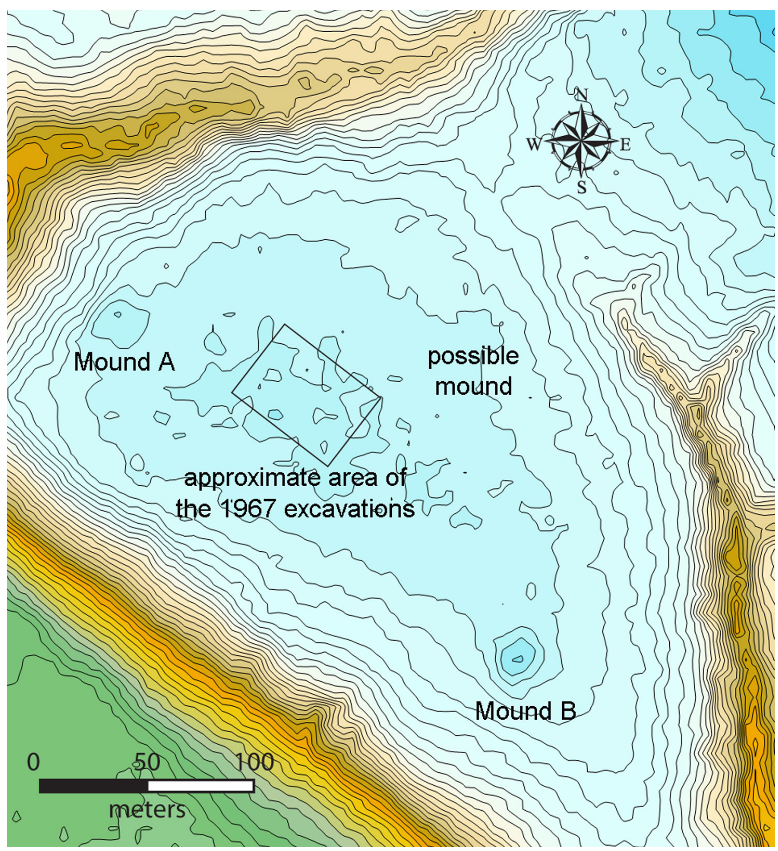

Figure 2. 50 cm interval contour map of the Pace site. LIDAR contour data distributed by "Atlas: The Louisiana Statewide GIS." LSU CADGIS Research Laboratory, Baton Rouge, LA, 2006, http://atlas.lsu.edu.

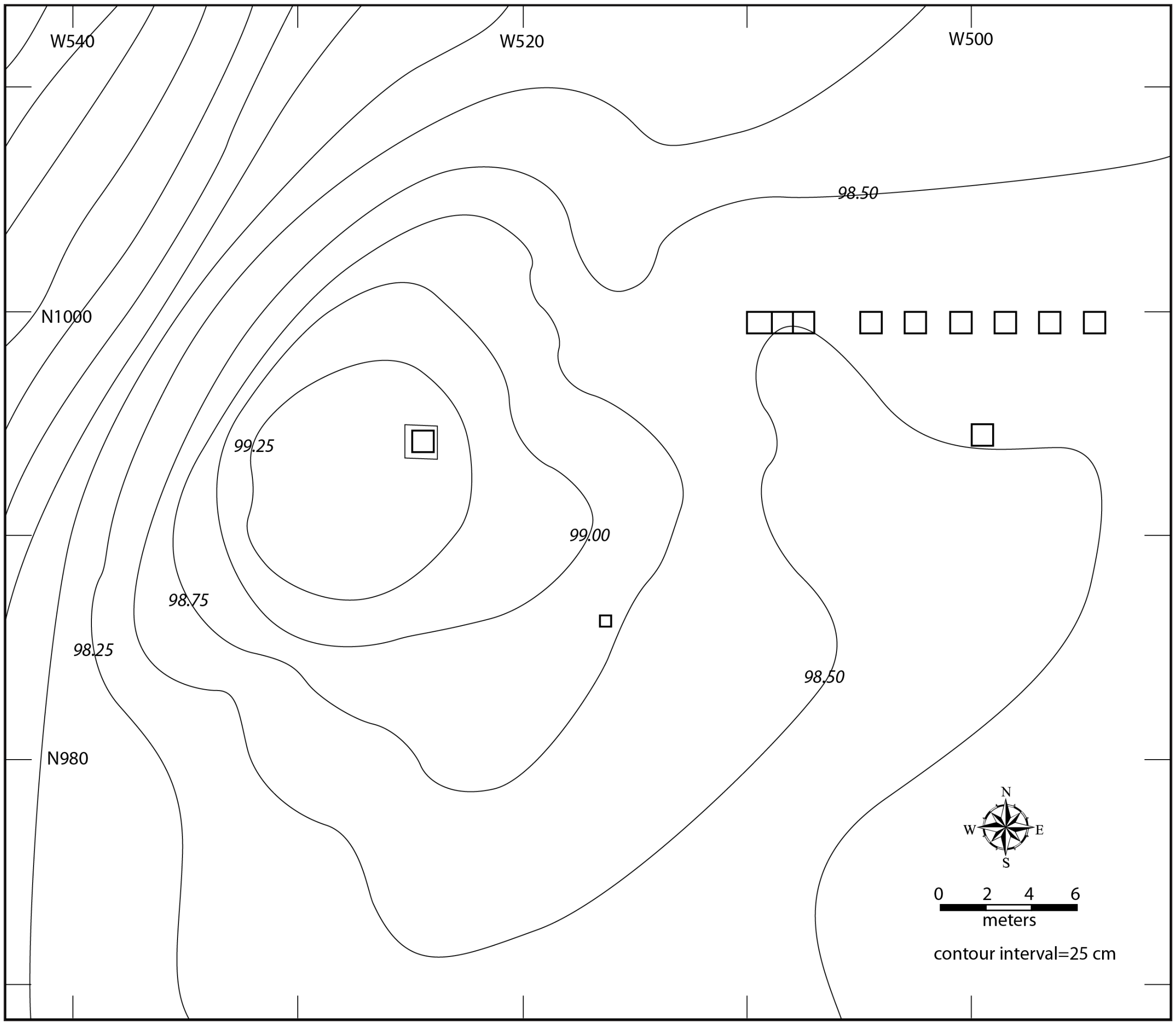

Figure 3. Contour map of the Mound A area.

cm of sandy loam A- and E-horizons that overlay a sandy clay loam Bt horizon.

Mound B

Mound B (Figure 5) measures approximately 30 x 40 m and rises a little more than 1 m above the terrace surface to the north. As with Mound A, it was constructed on a slope and probably is at least 1.5 m tall at its highest point. In the fall of 1993 we excavated a 1 x 2 m unit on the northwest edge of the mound in order to confirm its status as a cultural feature. A single stratum of brown to yellowish-brown fine sandy loam with clay bodies, 25-35 cm thick, was encountered in the upper deposits (Figure 6). Beneath this were the terrace surface deposits: strong brown fine sandy loam, about 30 cm thick, over a sandy clay loam Bt soil horizon. Small chert/quartzite pebbles were scattered in the mound deposit. Similar pebbles are exposed on the upper slopes of the landform suggesting the deposits originated from there. The pre-mound sediments contained scattered wood charcoal, a sample of which was radiocarbon dated to 1080 ± 80 B.P., or cal A.D. 727-1154 at 2 sigma (Beta-67677). A Homan arrow point was recovered from the pre-mound deposits.

Discussion

It now is clear that, in addition to an extensive habitation area, the Pace site contains at least two, and perhaps three, small mounds. The small scale of the test excavations limits interpretations of the

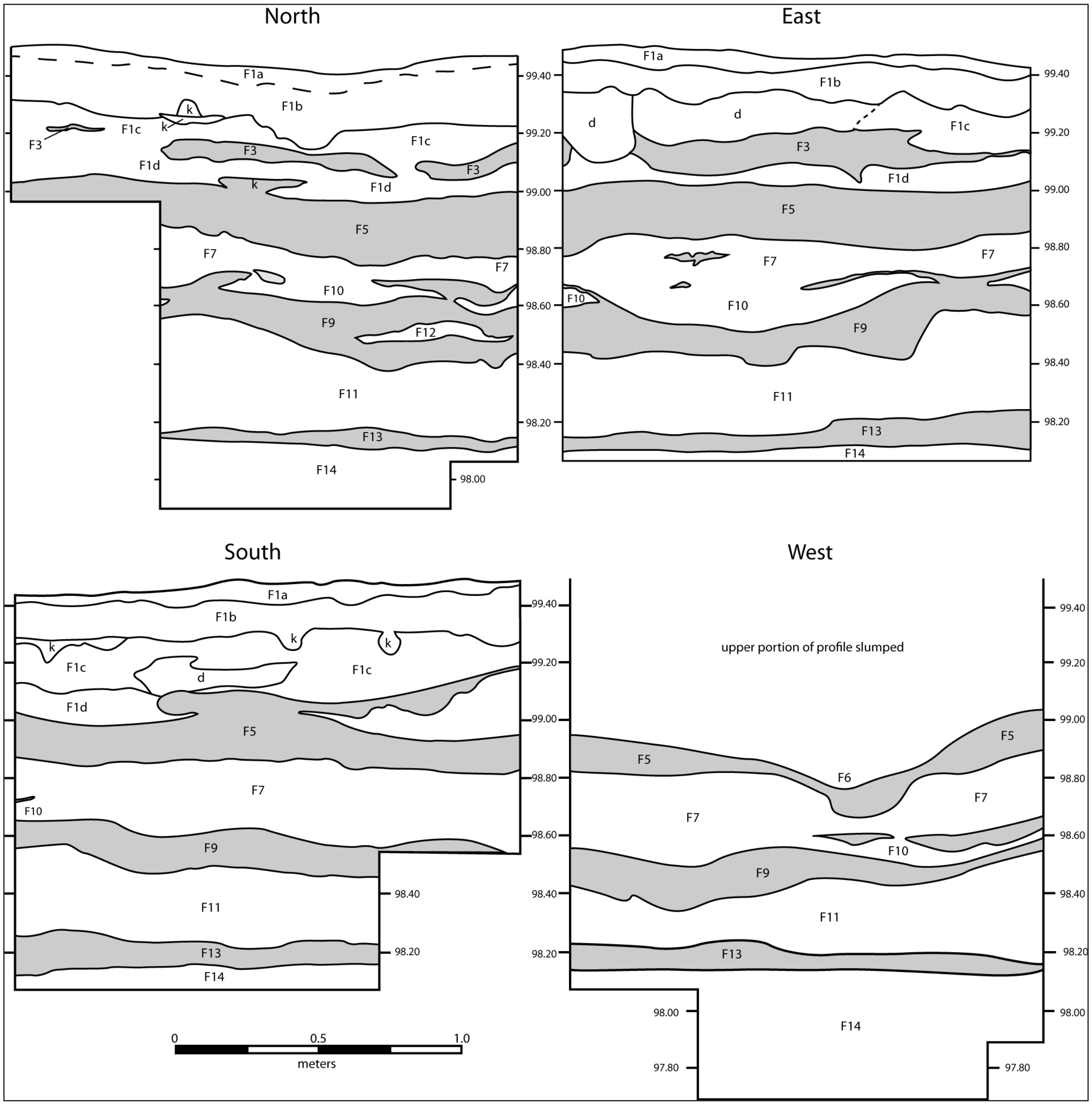

Figure 4. Mound A Profiles.

functions of the mounds, but there is no evidence that Mound A contains human burials or platforms for structures. Recovered from the underlying deposits were stone chipping debris and limited amounts of pottery indicating that cultural activity took place prior to construction of the mound, but our spatial sample is too small to determine whether the mounds cover typical habitation loci, outdoor activity zones, or perhaps ritual areas. The presence of substantial amounts of chipping debris and the absence of faunal remains suggest that it is unlikely that feasting residue is represented.

The pre-mound surface was intentionally covered by several layers of sediment that alternated in color and texture. With the exception of the lowest layer (Feature 13), the finer-grained sandy clay loam layers were smooth at the top, but wavy, and did not appear to represent platforms for structures or cultural activities. Although there was some leaching of finer-grained sediments into underlying sandy strata, evidence of weathering was minimal and it appears that the mound was constructed relatively quickly.

Radiocarbon dates help place the mound construction at the James Pace site on a chronological

Table 1. Descriptions of Features in Mound A.

Feature	Description	Artifacts
Feature 1	thin very dark gray (10YR3/1) humus layer and A horizon (F1a) underlain by brown (10YR5/3) fine sandy loam with krotovinas and root casts (F1b); subtle color change with depth to pale brown (10YR6/3) with fewer disturbances (F1c, F1d).	2 flakes, 4 cores/angular fragments
Feature 2		
(not visible in profiles)	oval dark gray (10YR3/1) area, approximately 20 x 15 cm, in the western portion of the unit; probable burned tree stump.	none
Feature 3	discontinuous series of lenses of mixed sandy loam (10YR6/3, pale brown) and sandy clay loam (yellowish-brown, 10YR5/6) near the base of the Feature 1 deposit; lenses range from 1-5 cm thick.	none
Feature 4		
(not visible in profiles)	concentration of charcoal flecks near the base of F1d	none
Feature 5	upper stratum of sandy clay loam; well defined upper boundary, smoothed surface, a few disturbances; strong brown (7.5YR5/6) to yellowish-brown (10YR5/6) with laminations visible in places; 15-20 cm thick.	1 flake and 2 undecorated sherds
Feature 6	Basin-shaped depression in F5; approximately 35 x 45 cm; pale brown (10YR6/3) fill (F1 material) with lens of organically stained sediment (grayish-brown 10YR5/2) near center; no sign of in situ burning; intrudes into F7.	None
Feature 7	sandy loam stratum ranging from 10-30 cm thick; light brownish-gray (10YR6/2) with patches of grayish-brown and pale brown; sediments identical to those of Features 10 and 11; contained a few scattered flecks of charcoal but none recovered for dating.	4 stream pebbles in upper portion, but no artifacts.
Feature 8		
(not visible in profiles)	disturbance in upper part of profile detected in slumped area west of the original unit; detected about 15 cm below surface, but perhaps truncated by plowing and bioturbation; extended to 55 cm below surface; dark-yellowish brown (10YR4/6) fine sandy loam; lenses within feature appear to be washed in sediment.	none
Feature 9	stratum of sandy clay loam, strong brown (7.5YR5/8) to yellowish-brown (7.5YR4-5/6) with brown, brownish-yellow, and reddish-yellow mottles; upper contact with sandy Feature 7 compact, smooth, but wavy—did not constitute a flat surface and no sign of weathering; at base, clay particles had leached into underlying sandy deposits of Feature 11.	none

Table 1. ***(Continued)***

Feature	Description	Artifacts
Feature 10	discontinuous lenses of sandy loam in upper portion of Feature 9; in places merged directly with the overlying sandy stratum (F7); in the south profile, Features 10 and 7 were not differentiated.	1 flake
Feature 11	thick (20-30 cm) stratum of sandy loam; pale brown (10YR6/3) to light brownish-gray (10YR6/2); radiocarbon date on scattered charcoal: 950 ± 30 B.P. (Beta-348450, wood charcoal, -26.5‰); cal A.D. 1024-1155	none
Feature 12	Grayish-brown (10YR5/2) zone in northeast corner of F11 under F9 and a lens within F9; two dates on scattered charcoal: 2080 ± 190 B.P. (Beta-58870, wood charcoal, -25.0‰), cal 733 B.C.-A.D. 381 and 1660 ± 60 B.P. (Beta-62511, wood charcoal, -26.4‰), cal A.D. 249-538; probable basket load of sediment consisting of A horizon from surrounding surface.	none
Feature 13	thin clay surface or platform at base of mound; compact sandy loam from 4-15 cm thick; yellowish-brown with gray clay bodies and numerous strong brown to brownish-yellow mottles; upper boundary very smooth and wavy; small scattered charcoal lumps; AMS date: 1180 ± 30 B.P. (Beta-348451, wood charcoal, -28.0‰), cal. A.D. 729-960.	1 undecorated sherd
Feature 14	pre-mound upper soil horizon; reddish-brown to yellowish-red with strong brown mottles; radiocarbon date from scattered flecks of charcoal: 1230 ± 100 B.P. (Beta-58871, wood charcoal, -25.0‰), cal. A.D. 644-1011; excavated 40 cm below contact; gradual increase in clay marking Bt soil horizon	3 undecorated sherds; 81 pieces of chipping debris

time scale (see Table 1), but, as is often the case with a small number of dates, there is considerable room for interpretation. The charcoal sample from the deposits beneath Mound A (Feature 14) was very small and submitted prior to the time that AMS techniques were routinely available. Calibration suggests that the sample relates to the 8th or 9th centuries, perhaps to as late as the early 10th century. It is possible that charcoal recovered from the initial platform (Feature 13) had been present in the fill used for construction, and thus also might relate to activity pre-dating mound construction. With a 1 sigma calibration, the two dates overlap in the 9th century. The date on scattered charcoal in the first sandy loam stratum (Feature 11) is considerably later, suggesting that Mound A was not constructed until the 11th century. Unfortunately, it is not clear how the charcoal was incorporated into Feature 11. The two dates from Feature 12, although consistent with one another, are too early to relate to mound construction or the primary site occupation, and likely date charcoal already present in sediments borrowed from surrounding areas to construct this stratum. As with Mound A, the date beneath Mound B suggests 9th or 10th century cultural activity. It thus is possible that throughout most of the occupation of the Pace site (likely during the 9th and 10th centuries), no mounds were present. Ceramic data presented below suggest that the site was abandoned by the late 11th century.

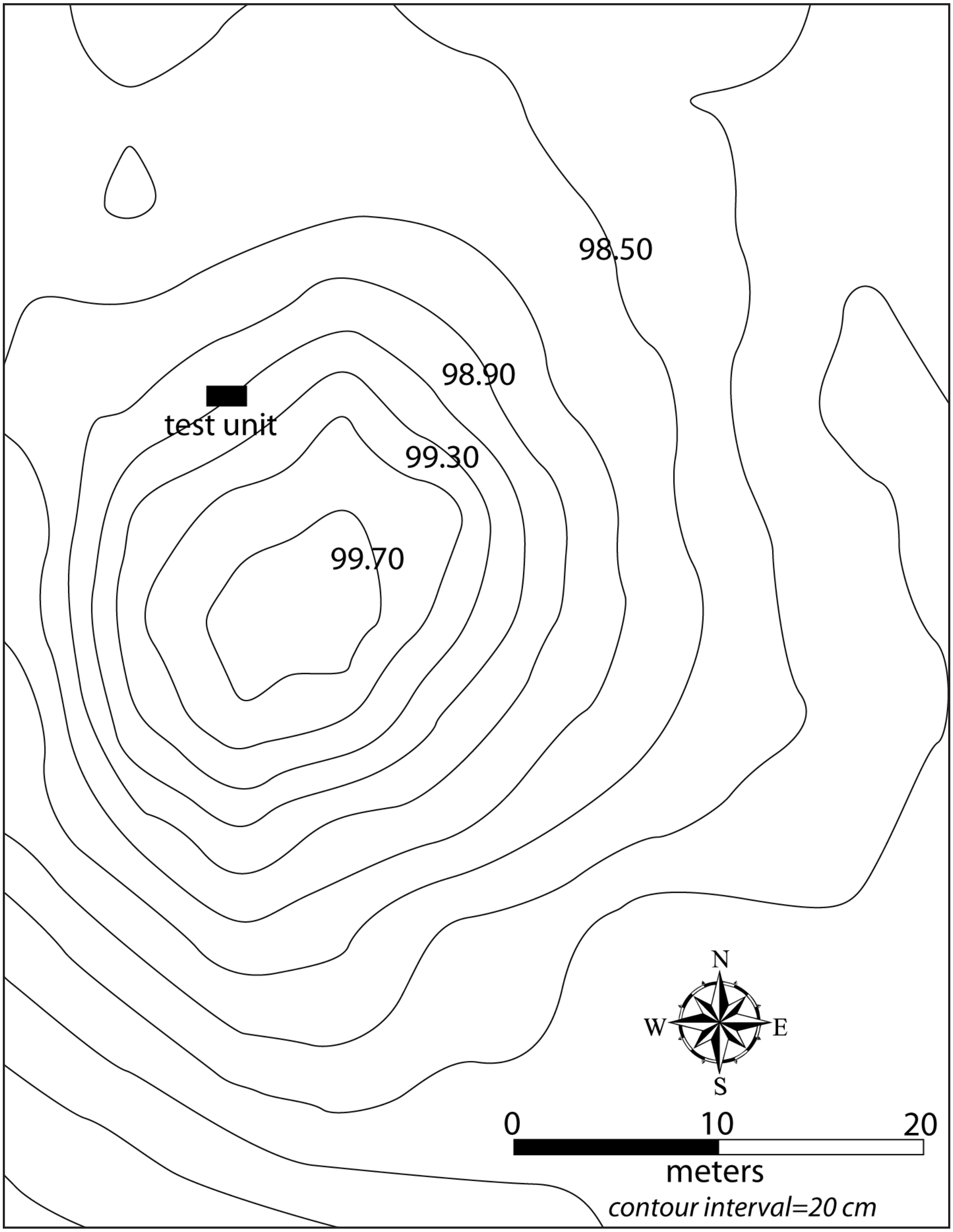

Figure 5. Contour map of Mound B.

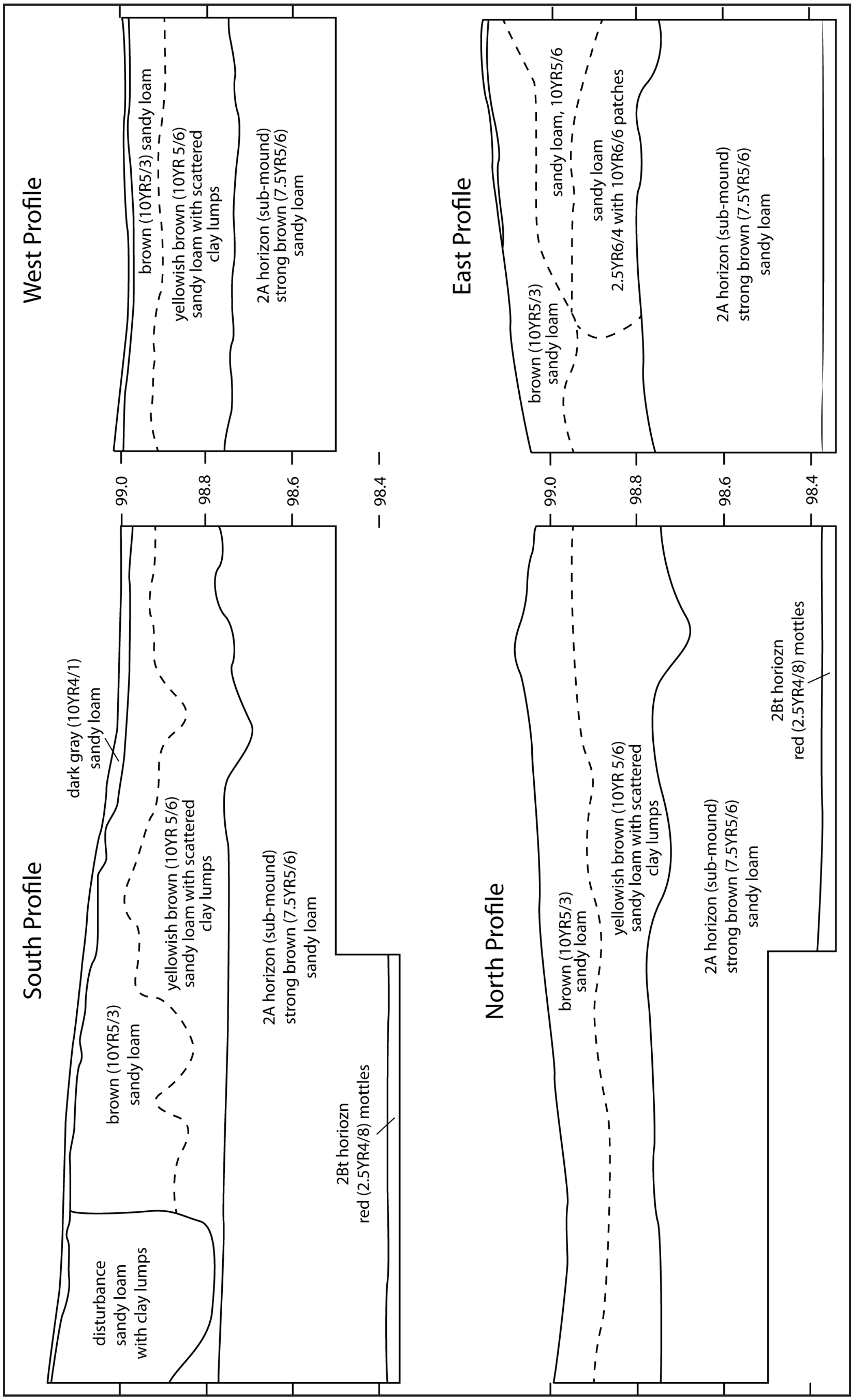

Figure 6. Profiles of test unit, Mound B.

Artifacts from the 1992-1994 Investigations

Pottery

Most of the recovered 289 sherds have either grog temper (197 or 68.2%) or crushed bone and grog temper (82 or 28.4%). The remaining sherds (all undecorated) have no visible temper. Seven of these specimens (2.4%) have sandy clay pastes and appear to relate to the Goose Creek ceramics characteristic of Late Woodland period "Mossy Grove" culture in the Neches/Angelina River drainage and Gulf Coast regions. Three specimens (1.0%) have only sparse fine sand inclusions: two of these are engraved and one is undecorated.

Although little can be inferred about vessel forms, simple jars and bowls appear to dominate. Only 14 rim sherds are present: 11 undecorated, two incised, and one punctated. One undecorated rim sherd is polished and black, and appears to represent a carinated bowl. One possible bottle rim was recovered, but there are no other specimens suggestive of the presence of bottles. A stem and leaf plot of sherd thickness shows a unimodal curve with a median thickness of 7 mm (Figure 7). Sherds with thickness values above 10 mm appear to represent flat vessel bases.

By far the most numerous decorated sherds recovered during the 1992-1994 investigations have two or more horizontal incised lines spaced at 1 cm or more (Figure 8a-n and Table 2). These 15 specimens generally are comparable to the *Blakely* or *Greenhouse* varieties of Coles Creek Incised as described by Phillips (1970:69-76). However, they also could be classified as Davis Incised as they have friable, coarse-textured paste, and tend to be reddish-brown in color, strongly suggesting local manufacture (Newell and Krieger 1949:116-118; Suhm and Jelks 1962:35). Relatively wide lines on a few specimens (e.g., Figure 8a, l) are suggestive of early Coles Creek varieties, particularly *var. Hunt*. Seven other sherds have horizontal incised lines and can be classified as varieties of Coles Creek Incised. Two sherds have closely-spaced overhanging lines and two have triangular punctations underlying horizontal incised lines characteristic of Coles Creek Incised, *var. Coles Creek* (Figure 8o-r). Three sherds (Figure 8s-u) have closely-spaced lines that do not overhang, and can be classified as Coles Creek Incised, *var. Hardy*.

Diagonal incised lines are present on two specimens. One has a field of diagonal lines underlain by triangular punctations (see Figure 8w) and seems to relate to the type Mazique Incised, *var. Mazique* (Phillips 1970:129). The other (see Figure 8v) has relatively wide lines and could be an example of Marksville Incised, but the specimen is too small to classify. One sherd has sloppy curvilinear incised lines (see Figure 8x) and is similar to the *Leist* or *Spanish Fort* varieties of

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Minimum:      3.000
Lower hinge:      6.000
Median:      7.000
Upper hinge:      8.000
Maximum:      15.000

   3   00
   4   0000000000000000000000
   5   000000000000000000000000000000000000000000000000
   6 H 00000000000000000000000000000000000000000000000000000000000*
   7 M 00000000000000000000000000000000000000000000000000000
   8 H 000000000000000000000000000000000
   9   00000000000000000000000000
  10   000000000000000000
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Figure 7. Stem and leaf plot of sherd thickness.

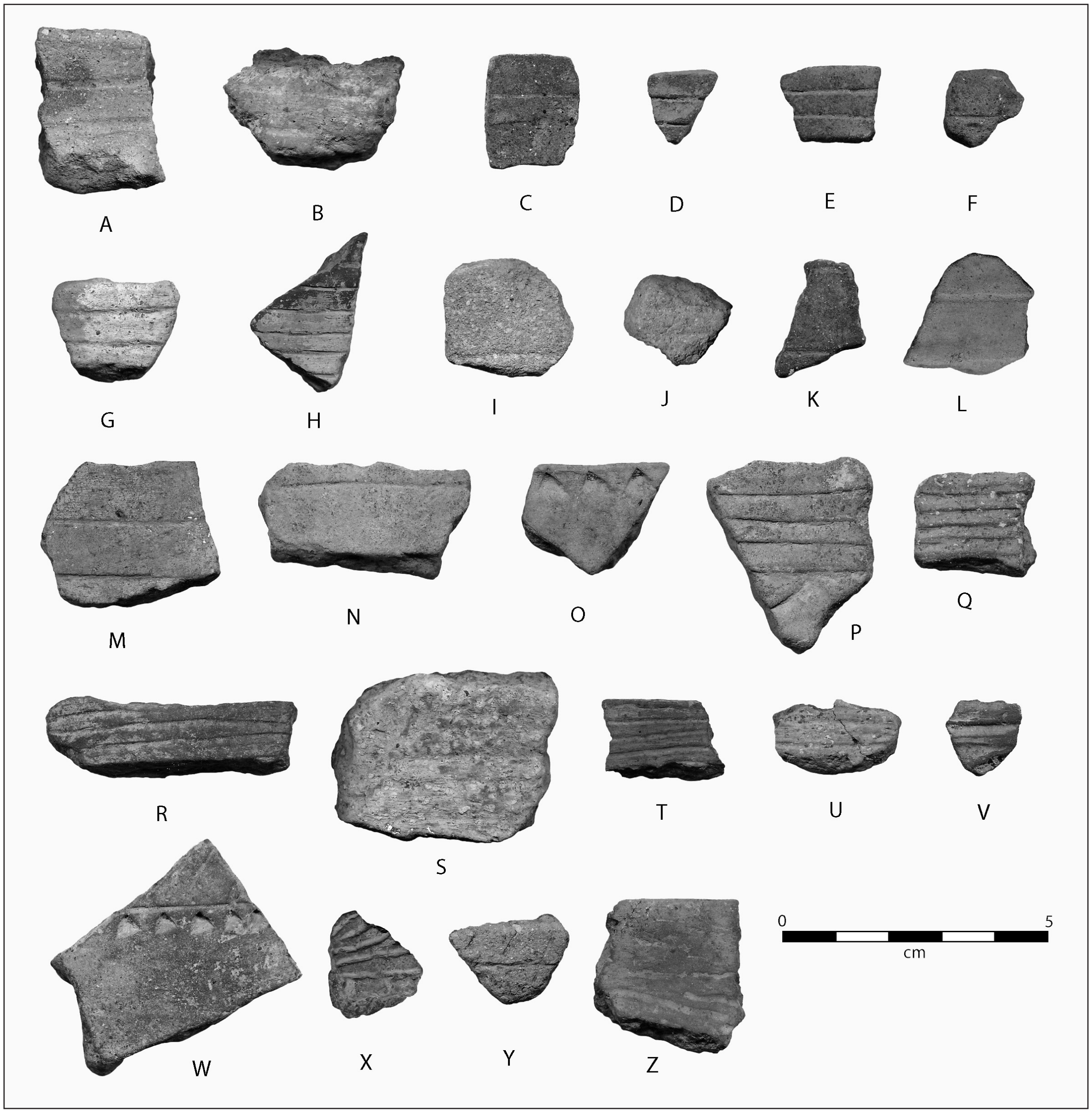

Figure 8. Incised sherds from the Pace site.

Marksville Incised (Phillips 1970:113-115). Three other sherds with incised lines (see Figure 8y-z) cannot be classified.

Other decorated sherds include five punctated sherds. One is a rim with a horizontal incised line beneath the lip with underlying triangular punctations randomly spaced (Figure 9a). Two body sherds have deep crescent or pinched punctations (Figure 9b-c), and one large rim sherd (Figure 9d) has cane or reed punctations characteristic of Evansville Punctated, *var. Rhinehart* but similar decorative elements are also present on some Crockett Curvilinear Incised vessels. The final specimen has a single incised line with small randomly scattered pointed punctations (Figure 9e).

The only other decorated sherds are engraved. Two small sherds (see Figure 9f-g) have single, horizontal engraved straight lines and possibly relate to the type Hickory Engraved. Another sherd (see Figure 9h) has parallel curvilinear lines, possibly part of a scroll or concentric circle element associated with Holly Fine Engraved or Spiro Engraved. Finally, one specimen (see Figure 9i) has curvilinear lines in an unknown pattern.

Table 2. Classification of sherds from the Pace Site.

	Mound A fill	Mound A sub-mound	Test Units	Mound B fill	Mound B sub-mound	surface	Total
Coles Creek Incised, *var. Blakely* or *Greenhouse*		2	12			1	15
Coles Creek Incised, *var. Coles Creek*			2			2	4
Coles Creek Incised, *var. Hardy*	1		1			1	3
incised, unclassified		2	1				3
diagonal incised			1			1	2
curvilinear incised			1				1
engraved			2			2	4
Evansville Punctated, *var. Rhinehart*			1				1
punctated, unclassified	1	1	1			1	4
undecorated	1	15	177	1	3	55	252
Total	3	20	199	1	3	63	289

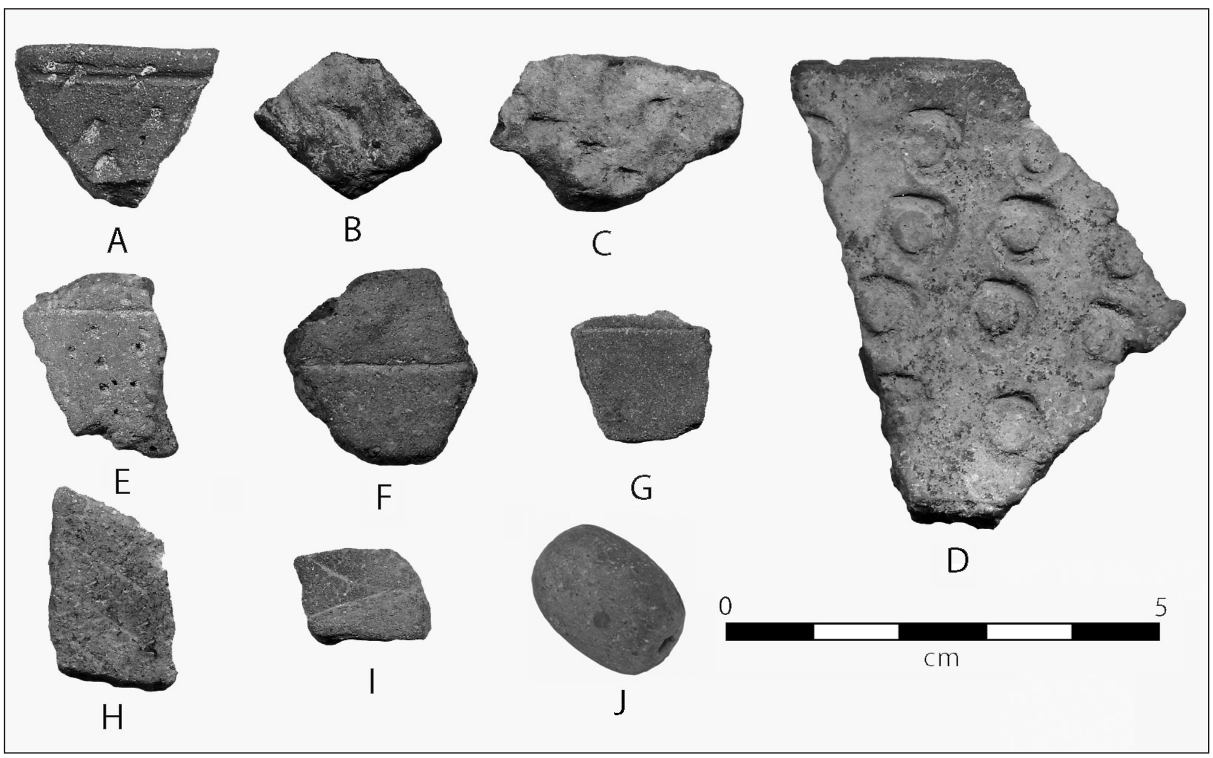

Figure 9. Other decorated sherds and ceramic bead from the Pace site.

An unusual ceramic artifact was recovered from one of the test units east of Mound A. This is a barrel-shaped ceramic bead (see Figure 9j) that measures 1.9 cm long and 1.4 cm in diameter. It appears to be made from sandy clay (with no visible temper) that is similar to that of most of the sherds from the site. Small patches of red pigment are present and it is possible that the entire surface originally may have had a red slip. Three additional ceramic beads (and one red jasper bead) were reported by Jensen from the 1967 excavations. To my knowledge, no examples of similar ceramic beads have been reported from northwest Louisiana, nor are any known from the Caddo Area in Texas or Arkansas (Timothy K. Perttula and Ann M. Early, personal communication 2013).

The pottery collection does not differ substantively from that reported by Story (1990:Table 77) from the 1967 excavations, except perhaps for the greater prevalence of close-spaced horizontal incised line specimens (Coles Creek Incised *vars. Hardy* and *Mott*) in the earlier collection.

Stone

Almost all of the chipped stone artifacts recovered during the 1992-1994 investigations are made from local materials: small chert pebbles and tabular pieces of silicified wood. Amongst the chipping debris from the test units, 164 of 1310 artifacts (12.5%) are silicified wood, with only two flakes of fine-grained quartzite, a material generally quite common to the west in East Texas sites. Five flakes of light gray to white chert and one flake of pink novaculite probably are from non-local sources. The remaining specimens are yellowish-brown to dark red chert, a common component of local gravels, including those exposed on the slopes of the site landform.

Eight complete arrow points were recovered. Two have bulbous stems and can be classified as Homan (Figure 10a-b). Three have broad stems and relatively straight bases (Figure 10c-e), similar to Colbert points as described by Webb (2000). Three arrow points have rectangular stems and relate to the widespread Alba type (Figure 10f-h). One unusual specimen has an indented base, an attribute similar to the Late Caddo/early historic Caddo Cuney type, but it might just be a variant of Alba (Figure 10i).

Eight specimens are flake blanks or arrow point preforms (Figure 10j-q). These represent varying degrees of reduction from slightly retouched flakes to initial formation of stems and shoulders. All have obvious breaks or flaws that caused them to be abandoned prior to completion and their presence demonstrates that point manufacture was carried out at the site. Four distal fragments of arrow points (Figure 10r-u), in complete or nearly complete states, were recovered.

Other flake tools consist of one perforator or drill (see Figure 10v) with a broken proximal end; two cortical flakes with unifacially chipped margins (see Figure 10w-x); and, one small slab of petrified wood with bifacial chipping on opposing margins (see Figure 10y).

A few specimens represent direct reduction from pebble cores or split pebble cores. Two (see Figure 10z-aa) are thick broken pebbles with margins partially shaped through bifacial reduction. One (see Figure 10bb) is the distal end to a dart point or bifacial knife, and another (see Figure 10cc) is a small (probably frequently re-sharpened) Gary dart point or knife. The final specimen is a well-made triangular biface made on a thin slab of fine-grained silicified wood (see Figure 10dd).

No detailed analysis of the recovered chipping debris has been carried out, but its abundance probably reflects the site position on a Pleistocene terrace that contains chert gravels. Silicified wood was available on nearby Tertiary upland ridges. The chipping debris can be separated into cortical flakes, interior flakes, and cores/angular fragments (Table 3). The latter category consists of angular fragments of chert and silicified wood for which distinct flake attributes (striking platforms, dorsal, and ventral surfaces) are not definable. Many angular fragments appear to have resulted from being subjected to heat (fire-cracked rock) but it was not possible to sort and quantify these. The assemblage lacks formally reduced cores. It appears that small pebbles were split for production of expedient flake tools or for production of flakes that could be reduced further into arrow points or perforators. The high ratio of cortical to interior flakes reflects this pattern as well. As noted above, only three specimens have visible retouch on flake margins.

CERAMIC CHRONOLOGY

In this section, I examine how the Pace site ceramics relate to pan-regional trends for the Late Woodland to Early Mississippian periods. The Late

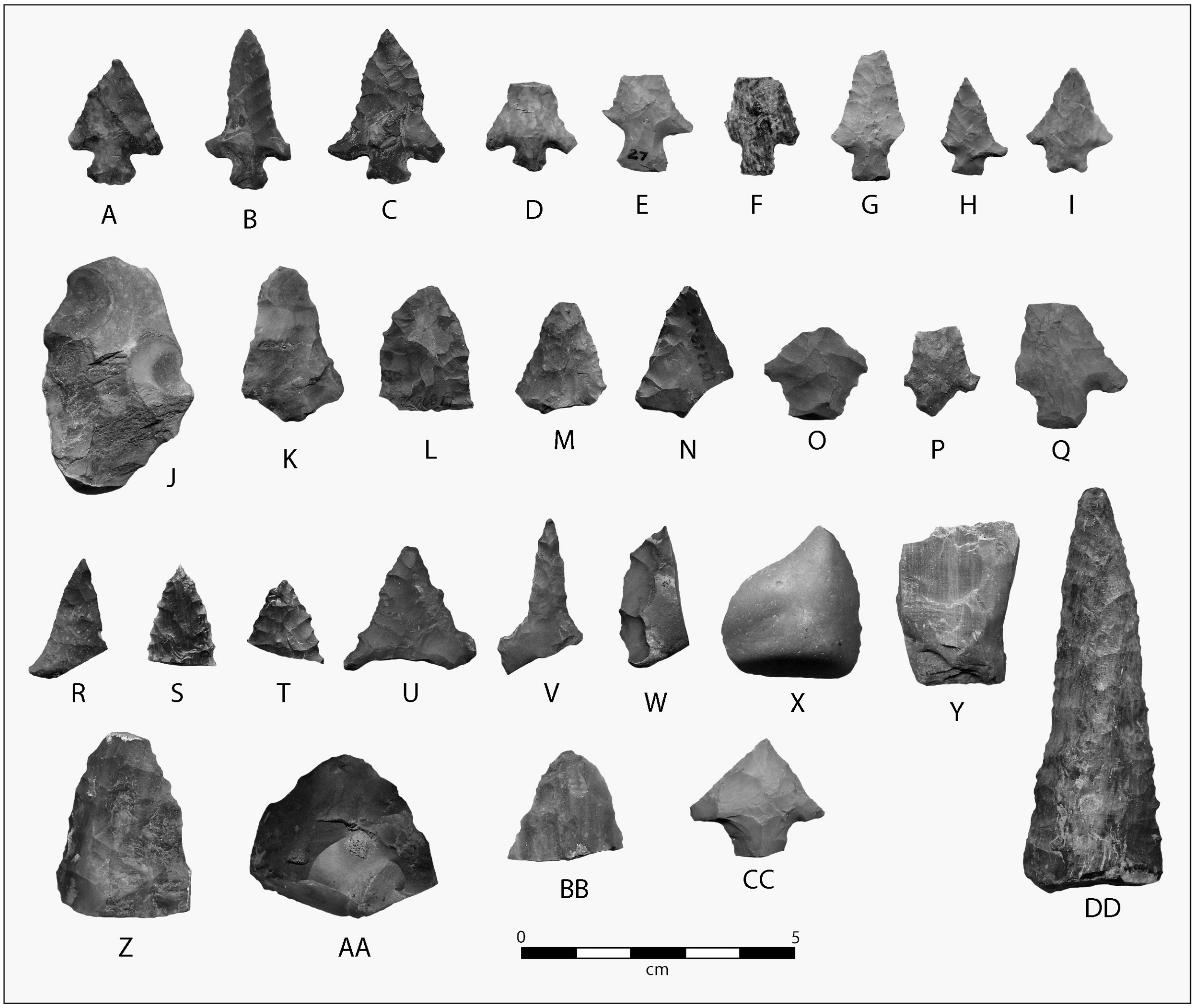

Figure 10. Chipped stone tools from the Pace site.

Table 3. Classification of chipped stone artifacts.

	Mound A fill	Mound A sub-mound	Test Units	Mound B sub-mound	surface	Total
complete arrow points			5	1	3	9
perforator			1			1
arrow point fragments			2		2	4
blanks and preforms for arrow points			3		5	8
edge retouched flakes			1		2	3
pebble blanks			2			2
biface fragment			1			1
dart point					1	1
triangular biface					1	1
cortical flakes		14	534			548
interior flakes	3	19	477			499
angular fragments/cores	4	20	299			323

Woodland or Baytown period (ca. A.D. 400-800) in the Lower Mississippi Valley is represented by a suite of pottery types often designated Troyville after the type site (16CT3). The nearest Troyville site to what would become the Caddo Area is the Fredericks site along the lower reaches of Black Lake Bayou near the city of Natchitoches (Figure 11). Although less than 10 percent of the ceramic collection from Fredericks was decorated, recovered specimens consisted of several varieties (most commonly *Yokena, Leist,* and *Spanish Fort*) of Marksville Incised (characterized by bold, "U"-shaped incised lines generally in curvilinear patterns); Marksville Stamped (primarily the pseudo-dentated rocker stamped *var. Troyville*); Churupa Punctated, a zoned punctated type with bold lines and punctations; and small numbers of Larto Red and Coles Creek Incised *var. Hunt*. The pottery also exhibits much variation in rim forms, with rims often thickened in various ways, sometimes including decorations on the lip. In the Lower Mississippi Valley, cord-marked pottery also was common during the Late Woodland period, but no cord-marked sherds were recovered from Fredericks. Many of these types once were considered diagnostic of the Late Marksville period Issaquena phase (Greengo 1964), but more recent work clearly demonstrates their continuation into the 8th century (Girard 2000; McGimsey 2004; Lee et al. 2011). Late in this period, probably during the 8th century, early varieties of Coles Creek Incised (vars. *Hunt, Keo, Phillips, Wade, Stoner,* and *Chase*) became increasingly common and new types such as French Fork Incised appeared. This is the time of the Logtown phase on the lower Ouachita River (Kidder 1990), which corresponds to the Bayland phase farther east in the Lower Yazoo region (Phillips 1970).

Sherds relating to these types have been found along Toledo Bend Reservoir and in the Red River drainage north of Fredericks, but are sparse and generally mixed with later pottery. On the upper Sabine, the Resch (41HS16), Holmes (41SM282), and possibly the Hadden's Bend (16DS203) sites have yielded small amounts of Troyville pottery (Jensen 1968; Webb et al. 1969; Walters and Perttula 2010). At the Pace site a small number of possible Marksville Incised and Churupa Punctated sherds have been recovered, but the primary occupation likely postdates the 8th century.

Early Coles Creek varieties continued into the 9th century, but the Troyville types dropped out and several new types and varieties appeared including Coles Creek Incised, *var. Coles Creek*, Mazique Incised, Avoyelles Punctated, and Chevalier Stamped marking the Crawford phase on the lower Ouachita (Kidder 1990). The Fredericks site lacks this suite of types, and radiocarbon dates suggest that it was abandoned early in the 9th century. Radiocarbon dates and Coles Creek Incised pottery indicate that occupations took place in the Red River drainage to the north at sites such as Festervan (Girard 2012b:251) and Caney Branch II (Cliff and Peter 1994). This also probably was the time of the earliest development of aggregated settlement at sites that later developed into mound centers such as Mounds Plantation (16CD12) and Crenshaw (3MI6). The earliest permanent occupation at the Pace site, and perhaps Hudnall-Pirtle (41RK4) and Boxed Springs (41UR30), appears to fit here as well.

A broader range of pottery types and varieties appeared in the A.D. 900 to 1050 interval, including Coles Creek Incised, vars. *Blakely, Greenhouse,* and *Mott,* Beldeau Incised, Evansville Punctated, and new varieties of French Fork Incised, Avoyelles Punctated Incised, and Mazique Incised. This period is known as the Pritchard's Landing phase in the lower Ouachita drainage and the Greenhouse phase in the lower Red River region (Belmont 1967; Kidder 1990). Decorations on ceramics in both the Caddo Area and Lower Mississippi Valley remained similar with only minor differences evident between types such as Davis Incised and Coles Creek Incised, vars. *Greenhouse* or *Blakely*, Pennington Punctated-Incised and Avoyelles Punctated, Kiam Incised and Evansville Punctated, and Dunkin Incised and late varieties of Mazique Incised. Coles Creek Incised or Davis Incised appears to have dominated assemblages until late in this interval along the Red River (Girard 2012a), but a wider variety of types apparently was used to the west, particularly at the Davis site along the Neches River. The first widespread use of polished/engraved "fine wares" probably took place at this time. Although the simple type Hickory Engraved resembles (often finely polished) Coles Creek Incised, the more elaborately decorated Holly and Spiro fine engraved types have no counterparts in the Lower Mississippi Valley.

Assuming widespread contemporaneity of general ceramic trends, the combination of decorated types present at the Pace site suggests that most of the occupation there took place in the range of A.D. 800-1050, and the few available radiocarbon

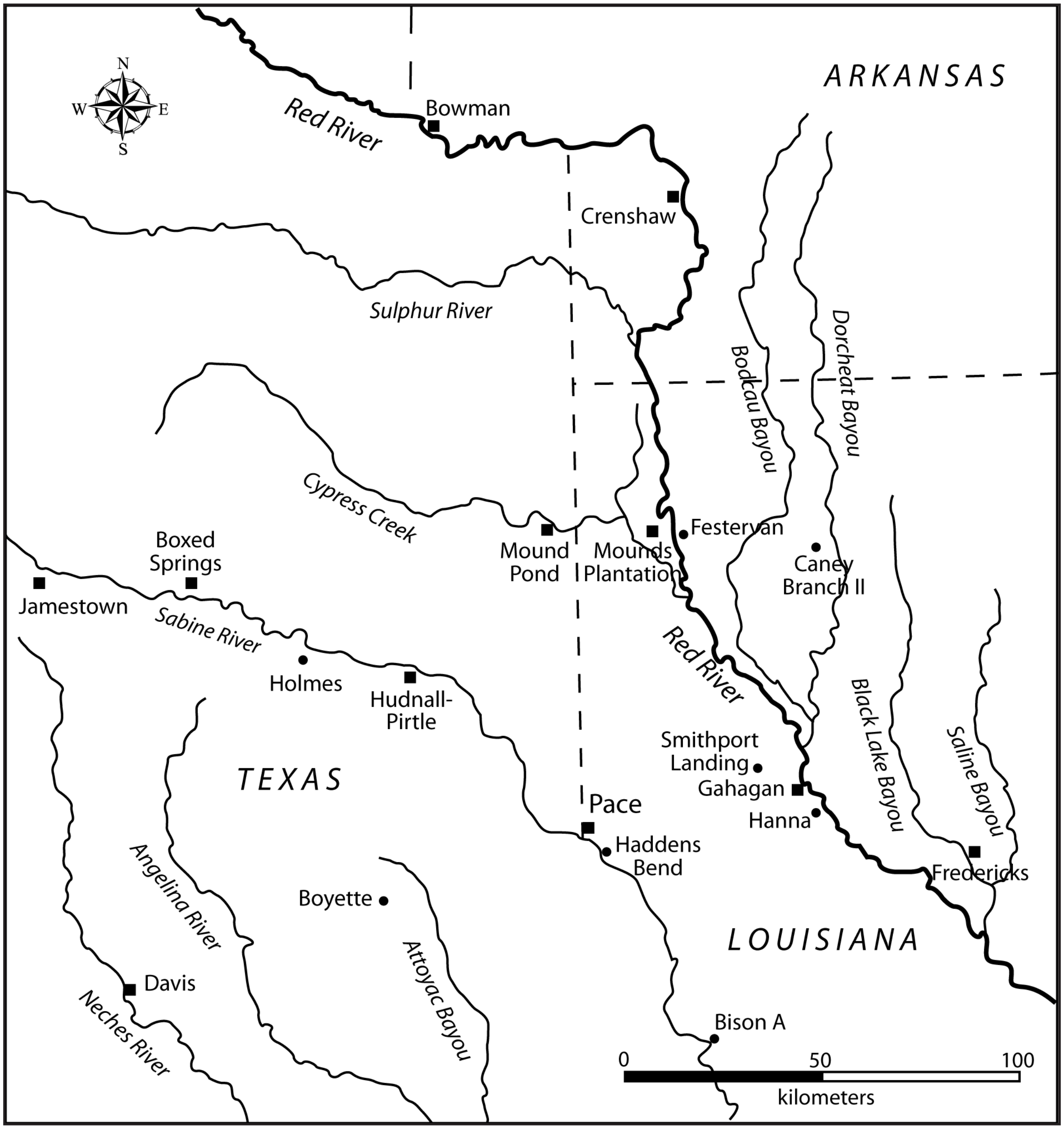

Figure 11. Selected Formative and Early Caddo period sites. Squares are sites with mounds; circles are sites without mounds.

dates, as noted previously, corroborate this interpretation. The recovery of a small number of Marksville Incised and Churupa Punctated sherds hint that some occupation might have occurred slightly earlier. The Pace site ceramic collection is dominated by Coles Creek Incised or Davis Incised, but also includes small numbers of diagonal incised, punctated, and punctated-incised specimens. Engraved pottery, although present, is very sparse. If the Pace site inhabitants followed the pan-regional trends, I suspect that the site was abandoned during the middle 11th century, a time when major construction was being carried out at places such as Hudnall-Pirtle, Mounds Plantation, and Crenshaw (see Figure 11).

Although the Pace site was established as a permanent village before A.D. 1000, the mounds appear to have been constructed late in the history of the site, probably during the early 11th century. At least two other sites (Hudnall-Pirtle and Boxed

Springs) in the Sabine River drainage with ceramic assemblages similar to Pace have multiple mounds (see Figure 11). Radiocarbon dates from these sites fall in the 11th century, slightly later than those from sub-mound contexts at Pace, but similar to the date (Pace-4) from the Mound A fill (Figure 12). Some pottery from Hudnall-Pirtle and Boxed Springs appears to relate to the 10th century, but other aspects of these assemblages (moderately greater percentages of free punctated and zoned punctated sherds, and significantly greater percentages of engraved sherds), as well as the radiocarbon dates, suggest that these sites continued to be inhabited through the 11th century, and likely well into the 12th century.

MULTIPLE MOUND CENTERS

Between ca. A.D. 400-800 in the Lower Mississippi Valley several sites contained multiple mounds and evidence of elaborate mortuary programs and other ceremonies. The Troyville site (16CT3) contained at least 13 mounds, including the massive Great Mound with its conical upper stage reported to be about 24 m high. Ceremonial centers such as Insley (16FR3), Marsden (16RI3), DePrato (16CO37), and Pritchard's Landing (16CT14) were started during this period, and continued to be occupied after A.D. 800. Bathtub-shaped fire pits at Marsden (16RI3), Gold Mine Plantation (16RI13), and Neely (16WC4), similar to those first identified by Ford at the Greenhouse (16AV2) site, are thought to be associated with large, communal feasts, and perhaps funerary rituals (Lee 2010:138). Cemeteries or ossuaries such as those at the Old Creek site (Gibson 1984) and Gold Mine Plantation (McGimsey 2004) contain a variety of bundle and flexed burials, as well as unassociated skeletal elements. Although mortuary items (effigy vessels, conch cup) are sparse and not associated with specific individuals and no other evidence of social hierarchies exist, it is likely that ceremonial participants included both

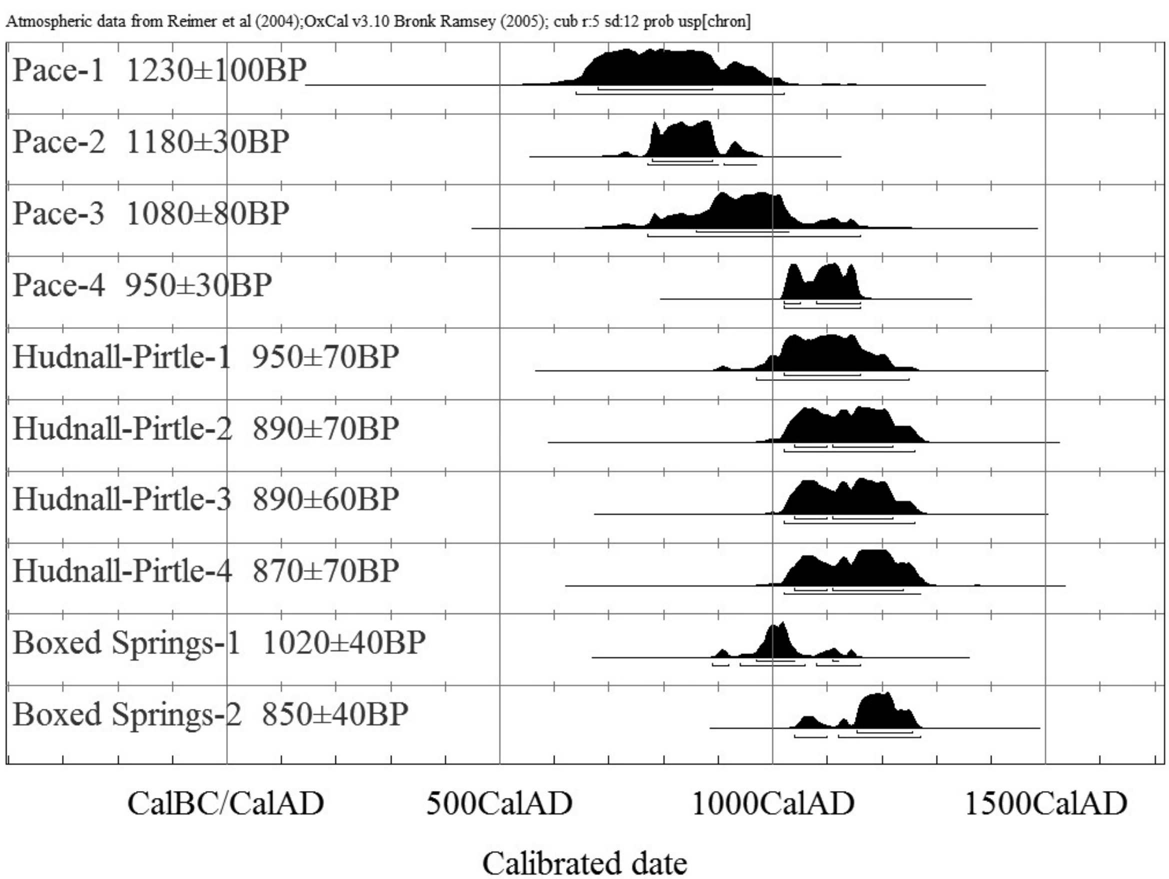

Figure 12. Radiocarbon dates from mound sites in the upper Sabine River drainage.

site populations and residents of smaller peripheral communities. The existence of mound centers likely represents social integration on regional, rather than strictly local, spatial scales.

Late Woodland period mound centers extended upstream along the Red River drainage as far north as the Fredericks site (16NA2) on a rise overlooking the Black Lake Bayou bottom east of the Red River near Natchitoches. The site consists of five mounds along with a dense midden deposit situated on a ridge along the bluff edge. Eight calibrated radiocarbon dates indicate that occupation took place in the A.D. 400-800 range. Although investigations have been limited, it appears that the Fredericks site represents a ceremonial center where populations congregated for rituals involving feasting and human burial (Girard 2000).

In the Trans-Mississippi South to the north and west of Fredericks, several solitary mounds were constructed and used for burials during the Middle Woodland period (Fulton and Webb 1953; Girard 2012c; McClurkan et al. 1980; Schambach 1982; Webb 1984). However, none of these sites appear to have had substantial residential populations and there is little evidence of ceremonial activities other than interment of small numbers of individuals within the mounds. For several centuries after ca. A.D. 400 no mounds were built in the Trans-Mississippi South. Late Woodland period peoples of the Fourche Maline, Mill Creek, and Mossy Grove cultures varied in the degree to which they occupied settled villages, but there is little evidence of social or political integration beyond relatively local spatial levels. This situation changed in the Red River drainage during the 9th century as substantial villages developed at places such as Mounds Plantation and Crenshaw, and perhaps at the same time or a little later along the upper Sabine River at Pace, Hudnall-Pirtle, and perhaps Boxed Springs and Jamestown (41SM54). The Hudnall-Pirtle site, located approximately 60 km upstream from Pace, eventually consisted of eight earthen mounds arranged around an extensive plaza, with middens that probably represent habitation areas on the periphery (Bruseth and Perttula 2006). Boxed Springs includes four mounds, at least one of which contained a shaft tomb burial, several habitation areas, and a large cemetery (Perttula 2011). Although few investigations have been carried out at Jamestown, as many as seven mounds might be present along with habitation areas (Perttula 1994; Perttula and Walker 2008). Other possible sites with single mounds that date to the Early to Middle Caddo period were noted by Perttula (1994:12). Initial construction of mounds at these places might not have occurred until the late 10th or early 11th centuries, but I suspect that with more excavation we will find evidence of ceremonial activities or residences of ritual or political leaders in contexts pre-dating mound construction.

Based on the relatively regular geographic spacing, Perttula (1994) suggested that the major mound centers on the upper Sabine represent nodes of extensive communities or small polities with premier centers placed at approximately 50 km intervals. Because so little work has been carried out, the timing of mound construction and other events at these centers is not known. Questions regarding social, political, and economic relationships between centers also cannot be addressed with currently available data. The Pace site appears to have been a substantial residential community in the 9th and 10th centuries, and the small mounds suggest that the site hosted ceremonies or was the residence of religious or social elites at the time that the other mound centers also were developing. However, for unknown reasons, Pace was abandoned prior to the late 11th century when the major mound centers of the Early Caddo period were occupied and the full range of what has been considered Caddo pottery was in use.

CADDO AND COLES CREEK: SUMMARY AND CONCLUSIONS

Caddo archeology developed in terms of the culture area concept with the assumption that a discrete group of people left a distinctive archeological record within a specific territory. Recent theoretical perspectives have emphasized understanding past human networks of ideological, social, and economic interaction that often crosscut geographical regions, including traditional culture areas (Girard et al. 2014). The Pace site presented a dilemma in being located within the Caddo culture area, but exhibited traits, particularly pottery decoration, that closely resembled those found on sites classified as Coles Creek in the Lower Mississippi Valley. It now is apparent that Coles Creek style pottery was spread over most of the Caddo Area (see Story 1990:Appendix 4) between ca. A.D. 800 and 1050. Although almost undoubtedly locally made, pottery decorations reflected pan-regional, not local, decorative ideas. Peoples in the Caddo Area may have emulated the pottery styles of the larger and more dynamic polities to the east. Population dispersal, including movement of families and larger corporate groups between the regions, also may have occurred. Connections between Lower Mississippi Valley groups and those in the Red and Sabine River drainages undoubtedly were strong, even though we cannot specify their nature. These connections stimulated population aggregation and perhaps the formation of multi-community polities in the Caddo Area that were similar to those that had longer histories of development to the east.

Evidence from Pace and other sites in the Caddo Area suggests that the emergence of the Caddo cultural tradition was a complex series of events that occurred over the course of several centuries. Distinctive traits such as mound construction, fine ware ceramics, and elite mortuary programs, appeared at different times in different regions. Our understanding of chronologies is becoming increasingly precise although dilemmas remain such as the apparently early appearance at the George C. Davis site of traits that only occurred later along the Red River. Stimulus from groups in the Lower Mississippi Valley who were undergoing both population aggregation and territorial expansion was important for generating changes in the Caddo Area. However, the earliest mound centers in the Caddo Area developed at relatively large local villages at the end of the Late Woodland period, and these centers do not represent colonization by Lower Mississippi Valley peoples. Dee Ann Story liked to compare archeological inquiry to using a zoom-lens camera: we need to look both at the broad picture and zoom in for local views, re-focusing while we do so. Our investigations into Caddo origins need to involve studies of specific contexts such as the Pace site, and to examine the broad pan-regional conditions within which local events took place.

ACKNOWLEDGEMENTS

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REFERENCES CITED

Belmont, J. S.
1967 The Cultural Sequence at the Greenhouse Site, Louisiana. *Southeastern Archaeological Conference Bulletin* 6:27-35.

Bruseth, J. E. and T. K. Perttula
2006 Archeological Investigations at the Hudnall-Pirtle Site (41RK4) An Early Caddo Mound Center in Northeast Texas. *Caddo Archeology Journal* 15:59-158.

Cliff, M. B. and D. E. Peter
1994 *Test Excavations at the Caney Branch I and Caney Branch II Sites (16BO198 and 16BO200), Louisiana Army Ammunition Plant, Bossier Parish, Louisiana*. LAAP Archeological Technical Series Report of Investigations No. 5. Geo-Marine, Inc., Plano, Texas.

Fields, R. C. and E. F. Gadus
2012 The Pine Tree Mound Site and the Archeology of the Nadaco Caddo. *Bulletin of the Texas Archeological Society* 83:23-80.

Fulton, R. L. and C. H. Webb
1953 The Bellevue Mound: A Pre-Caddoan Site in Bossier Parish, Louisiana. *Bulletin of the Texas Archeological and Paleontological Society* 24:18-42.

Gibson, J.
1984 Old Creek, A Troyville Period Ossuary in LaSalle Parish, Louisiana:Reflections after a Quarter Century. *Louisiana Archaeology* 9:127-204.

Girard, J. S.
1994 Investigations at the James Pace Site (16DS268), DeSoto Parish, Louisiana. *Caddoan Archeology Newsletter* 5(1):8-16.

2000 Excavations at the Fredericks Site (16NA2), Natchitoches Parish, Louisiana. *Louisiana Archaeology* 24:1-106.

2012a Recent Investigations at the Mounds Plantation Site (16CD12), Caddo Parish, Louisiana. *Caddo Archeology Journal* 22: 21-62.

2012b Settlement Patterns and Variation in Caddo Pottery Decoration: A Case Study of the Willow Chute Bayou Locality. In *The Archaeology of the Caddo*, edited by T. K. Perttula and C.P. Walker, pp. 239-287. University of Nebraska Press, Lincoln.

2012c The Bellevue Site (16BO4): A Woodland Period Mound in Northwest Louisiana. *Louisiana Archaeology* 35:53-78.

Girard, J. S., T. K. Perttula, and M. B. Trubitt
2014 *Caddo Connections: Cultural Interactions within and beyond the Caddo World*. Rowman & Littlefield, Lanham, Maryland.

Greengo, R. E.
1964 *Issaquena: An Archaeological Phase in the Yazoo Basin of the Lower Mississippi Valley*. Memoir No. 18. Society for American Archaeology, Salt Lake City, Utah.

Jensen, H. E.
1968 *Archaeological Investigations in the Toledo Bend Reservoir: 1966-1967*. Archaeology Salvage Project, Southern Methodist University, Dallas.

Kidder, T. R.
1990 Ceramic Chronology and Culture History of the Southern Ouachita River Basin: Coles Creek to the Early Historic Period. *Midcontinental Journal of Archaeology* 15(1):51-99.

Lee, A.
2010 Troyville and the Baytown Period. In *Archaeology of Louisiana*, edited by M. A. Rees, pp. 135-156. Louisiana State University Press, Baton Rouge.

Lee, A., J. Biddescombe, D. Bruner, D. Harlan, A. Montana, J. McKnight, C. Nolan, R. Smith, and J-K. Yakubik
2011 *Archaeological Data Recovery and Monitoring at the Troyville Mounds Site (16CT7), Catahoula Parish, Louisiana*. Earth Search, Inc., New Orleans.

McClurkan, B.B., E.B. Jelks, and H.P. Jensen
1980 Jonas Short and Coral Snake Mounds: A Comparison. *Louisiana Archaeology* 6:173-206.

McGimsey, C. R.
2004 *The Gold Mine Site (16RI13): An AD 825 Ossuary in Northeast Louisiana*. Regional Archaeology Program, Management Unit III, 2003/2004 Annual Report. Report on file with the Louisiana Division of Archaeology, Department of Culture, Recreation, and Tourism, Baton Rouge.

Newell, H. P. and A. D. Krieger
1949 *The George C. Davis Site, Cherokee County, Texas*. Memoirs No. 5. Society for American Archaeology, Menasha, Wisconsin.

Perttula, T. K.
1994 Caddoan Mound Sites in the Sabine River Basin of Northeast Texas. *Caddoan Archeology Newsletter* 4(4):4-19.

2009 Lake Naconiche Archaeology and Caddo Origins Issues. *Journal of Northeast Texas Archeology* 31:61-86.

2011 (editor) *Archaeological and Archaeogeophysical Investigations at an Early Caddo Mound Center in the Sabine River Basin of East Texas*. Special Publication No. 15. Friends of Northeast Texas Archaeology, Austin and Pittsburg.

Perttula, T. K. and C. P. Walker
2008 *The History of Archaeological Investigations and Geophysical Survey at the Jamestown Mound Site (41SM54), an Archaeological Conservancy Preserve in Smith County, Texas*. Archeological & Environmental Consultants, LLC and Archaeo-Geophysical Associates, LLC, Austin.

Phillips, P.
1970 *Archaeological Survey in the Lower Yazoo Basin, Mississippi, 1949-1955*. Papers of the Peabody Museum of Archaeology and Ethnology Vol. 60, Pts. 1 and 2. Harvard University, Cambridge.

Samuelsen, J. R.
n.d. AMS and Radiocarbon Dating of the Crenshaw Site (3MI6). MS submitted for publication to *The Arkansas Archeologist*.

Schambach, F. F.
1982 An Outline of Fourche Maline Culture in Southwest Arkansas. In *Arkansas Archeology in Review*, edited by N. L. Trubowitz and M. D. Jeter, pp. 132-197. Research Series No. 15. Arkansas Archeological Survey, Fayetteville.

Scurlock, J. D.
1964 *Archeological Reconnaissance at Toledo Bend Reservoir, 1962-1963 Season*. Texas Archeological Salvage Project, The University of Texas at Austin.

Scurlock, J. D. and W. A. Davis
1962 *Appraisal of the Archeological Resources of Toledo Bend Reservoir, Pinola, Newton, Sabine, and Shelby Counties, Texas; Sabine and DeSoto Parishes, Louisiana*. Texas Archeological Salvage Project, The University of Texas at Austin.

Story, D. A.
1990 Cultural History of the Native Americans. In *The Archeology and Bioarcheology of the Gulf Coastal Plain: Volume 1*, by D. A. Story, J. A. Guy, B. A. Burnett, M. D. Freeman, J. C. Rose, D. G. Steele, B. W. Olive, and K. J. Reinhard, pp. 163-366. Research Series No. 38. Arkansas Archeological Survey, Fayetteville.

2000 Introduction. In *The George C. Davis Site, Cherokee County, Texas*, by H. P. Newell and A. D. Krieger, pp. 1-31. 2nd Edition. Society for American Archaeology, Washington, D.C.

Suhm, D. A. and E. B. Jelks (editors)
1962 *Handbook of Texas Archeology: Type Descriptions*. Special Publication No. 1, Texas Archeological Society, and Bulletin No. 4, Texas Memorial Museum, Austin.

Walters, M. and T. K. Perttula
2010 The Holmes Site (41SM282): An East Texas Site with Lower Mississippi Valley Ceramic Sherds. *Louisiana Archaeology* 31:34-42.

Webb, C. H.
1984 The Bellevue Focus: A Marksville-Troyville Manifestation in Northwestern Louisiana. *Louisiana Archaeology* 9:251-274.

2000 *Stone Points and Tools of Northwestern Louisiana*. Special Publication No. 1. 2nd Edition. Louisiana Archaeological Society, Baton Rouge.

Webb, C. H., F. E. Murphey, W. G. Ellis, and H. R. Green
1969 The Resch Site, 41HS16, Harrison County, Texas. *Bulletin of the Texas Archeological Society* 40:3-106.

Early European Descriptions of Hasinai Elites and Understanding Prehistoric Caddo Mortuary Practices in Shelby County, Texas

Tom Middlebrook

ABSTRACT

During late 17th and early 18th century mission-building entradas to the northeastern frontier of Spanish Texas (the "Kingdom of the Tejas"), several European chroniclers provided descriptions of the socio-political elites amongst the Hasinai Caddo groups. Civil leadership was centered in a headman referred to as a caddi while several constituent groups gave principle religious allegiance to a shamanistic figure known as the grand xinesi who resided with two "heavenly children" or coninesi. Mortuary findings at the prehistoric Tyson site (41SY92) and the Morse Mound site (41SY27) will be discussed in light of these later descriptions of Hasinai elites.

AN APPRECIATION

The impact of Dee Ann Story's prodigious professional career on colleagues and students is certainly mirrored by the lasting effects of her tireless encouragement and mentoring of countless avocational archeologists for well over a half-century. She had been in the middle of Texas archeology for years when she, Ed Jelks, and Mott Davis gave direction to the Texas Archeological Society's first Field School at the Gilbert Site in 1962 (Jelks 1967). Three of the young avocational participants of that Field School, Jay Blaine, Charlie Bollich, and Bob Turner, met with Dee Ann during a Caddo Conference 40 years later at Stephen F. Austin State University (Figure 1).

I first met Dee Ann in 1978 during an earlier Caddo Conference. She wrote me a short letter after the meeting, and her words have inspired my efforts since. Both at the Texas Archeological Research Laboratory and later at her home near Wimberley, Dee Ann patiently listened to the details of my latest field projects. She pointed out some areas of strength in my work, but always gently gave correction to weaknesses and missed opportunities. She consistently urged me to observe more carefully, think more cogently, and read more broadly. In 1985 during the Texas Archeological Society's Field School in Nacogdoches, Dee Ann visited my excavation project at the Henry M site (41NA60), a small Caddo farmstead (Middlebrook and Perttula 2008; Perttula et al. 2010). This site was contemporaneous with the Deshazo site (41NA13/27) that she had used for the University of Texas Field School a decade before (Story 1982, 1995). For a long time that afternoon she had me down in the block troweling very carefully in order to notice the subtle changes in soil compaction or the frequency of the smallest rootlets that might signal a cultural feature. I had the impression that Dee Ann could treat avocational students with almost the same intensity as paying students. But for all that rigor and push for erudition, Dee Ann was one of the warmest and kindest persons I have known in archeology or any field. I never met Dee Ann after the mid-1980s without being the recipient of a big hug and a kiss on one or both cheeks.

Just a few days before her passing, when I had called to tell her of the establishment of the Dr. Dee Ann Story East Texas Archeology Scholarship at Stephen F. Austin State University, she expressed her appreciation, but then she really wanted to know what I had been doing lately and "what are you finding?" Her concern for others and her boundless curiosity remained strong to the very end of her life. It is a privilege to represent, in this collection of papers, the many avocational archeologists with whom Dee Ann worked.

Figure 1. Dee Ann Story with Jay Blaine, Charlie Bollich, and Bob Turner in 2002.

EUROPEANS IN EAST TEXAS

The territorial claim on behalf of the French sovereign made on April 9, 1682, by René Robert Cavelier, Sieur de La Salle at the mouth of the Mississippi River, effectively separated La Florida from Spain's other North American holdings. In response to La Salles's misadventures establishing a colony during 1684-1687 along Garcitas Creek in the Texas mid-coastal region, the Spanish sent numerous expeditions across the Rio del Norte to confront the French threat from the east (Weddle 1991, 1999; Bruseth and Turner 2005). The Spanish established their first significant presence in the northeastern Texas frontier in the form of Mission San Francisco de los Tejas (May 1690-October 1693). This mission was placed along San Pedro Creek in Houston County on the westernmost edge of the renowned "Kingdom of the Tejas," the loosely affiliated Hasinai Caddo groups in the Neches-Angelina River valleys (Chipman and Joseph 2010). The military and political leaders that established and re-supplied the mission included Governors Alonso De León and Domingo Terán de los Ríos. The spiritual work was fostered by Fray Damián Massanet, Francisco Casañas de Jesús María, and Francisco Hidalgo. A second mission, Santisimo Nombre de Maria on the nearby Neches River, was occupied from September 1690 until January 1692, when it was destroyed by a flood. Ultimately, this first Spanish missionary effort amongst the Caddo was abandoned due to physical hardships, Caddo epidemics, and ultimately, stiff Native opposition sparked by desecration of some holy buildings (Swanton, 1942:218) and molestation of Hasinai women by the European soldiers (Barr 2007:66).

During the next 20 years, the relationships between the East Texas Caddo and the two European powers were complex and dynamically evolving owing to their divergent motivations and agendas. The implicit dominant power in the region was the Hasinai Caddo, while the engagement of the Spaniards in establishing their claim was often mediated by their French rivals who the Caddo more comfortably tolerated. The French infiltrated into native communities, embraced local kinship traditions, stressed mutually beneficial trade, and had less need to control, congregate, and convert (Barr 2007).

Pierre Le Moyne, Sieur d'Iberville, established settlements at Biloxi in 1699 and Mobile in 1702. Iberville's bother, Jean Baptiste Le Moyne, Sieur de Bienville, along with a young French Canadian named Louis Juchereau de St. Denis, ascended the Red River in 1700 and succeeded in meeting many of the Caddo related groups from Louisiana and Texas (Burton and Smith 2008:4f). This initiated an intensification of relationships between the French and friendly indigenous peoples. By 1714, St. Denis was able to establish a post at Natchitoches that grew to be the earliest European settlement in what would later be known as the Louisiana Purchase.

Meanwhile, back in Mexico, Fray Francisco Hidalgo maintained his passion for the spiritual salvation of the Hasinai. On January 17, 1711, Hidalgo penned a letter to the French governor proposing trade and collaboration with missionary efforts. This letter made its way to Governor Antoine d la Mothe, Sieur de Cadillac, in Mobile who signed a passport on August 1, 1713 authorizing St. Denis to travel as far as Coahuila and to establish trade agreements with the Spaniards (Nardini 1963). Over the next year, St. Denis moved in and out of the Hasinai territory amplifying trade relationships with the native peoples while also hoping to find Hidalgo. Ultimately, in the summer of 1714, St. Denis traversed Texas in six weeks with three Frenchmen, four Indians, horses, and merchandise to arrive at Presidio San Juan Bautista south of the Rio Grande (Byrd 2008). Despite arrest, interrogation, and transport to Mexico City, St. Denis was eventually successful in ingratiating himself to the Spaniards: so much so that he married the step-granddaughter of the Commandant at San Juan Bautista (Lemee 1998, 2003:43f, n. 5). It is in this context then that the Frenchman, Louis Juchereau de St. Denis, became the quartermaster and guide to the Domingo Ramón Expedition of 1716, the first permanent European entrance into Spanish Texas.

The principal goal of the 1716 entrada was the establishment of four missions in the "Kingdom of the Tejas" shoring up the eastern Spanish frontier. Father Félix Isidro Espinosa, President of the Franciscan Religious College of Querétaro, was in charge of the missionary effort. He was soon joined by Fray Antonio Margil de Jesús, President of the Religious College of Zacatecas. In 1716, Ramón wrote possession documents to Mission Nuestra Padre de San Francisco de los Tejas east of the Neches River, Mission Nuestra Señora de la Purísima Concepción de los Hainai just east of the Angelina River, Mission San José de los Nasonis in southern Rusk County, and Mission Nuestra Señora de Guadalupe de los Nacogdoches (Chipman and Joseph 2010). The next year, in 1717, with much assistance from St. Denis, Ramón and Margil founded two other missions further east, Mission Nuestra Señora de los Dolores de los Ais at modern San Augustine (Corbin et al. 1980) and Mission San Miguel de Linares de los Adaes near Robeline, Louisiana (Gregory 1973). Ramón also built a small fortification to protect the missions. A total of 25 soldiers and another 45 or so people manned Ramón's Presidio, later named "Dolores," in western Nacogdoches County near Mission Concepción. Over the next five years, the missions were re-supplied by Governor Martín de Alarcón (Celiz 1935), but abandoned between 1719-1721 due to fear of the French following the "Chicken War" (Castaneda 1936), and ultimately re-established by the Marqués de San Miguel de Aguayo in 1721 (Hackett 1945). The three western Querétaro missions (San Francisco, Concepción, and San Jose) were removed to the San Antonio area by 1730 and Presidio Dolores was extinguished. The eastern three Zacatecan missions (Guadalupe, Dolores, and San Miguel) and Presidio Los Adaes were closed in 1772.

In 2010, a team led by Morris K. Jackson, George Avery, and me discovered the location of Mission Nuestra Señora de la Purísima Concepción de los Hainai, the original headquarters of Espinosa's missionary effort in 1716 (Jackson et al. 2012:127-194). Our initial investigations of Mission Concepción, recorded as the Gallant Falls site (41NA344), indicated that the core mission was a modest sized compound (approximately 30 x 60 m) with at least three structures situated on a narrow terrace just above the eastern floodplain of the Angelina River. Approximately 150 m to the southwest of the mission is a large Caddo site (41NA345), which may represent the village of Cheocas, who was the caddi of the Hainai, the lead tribe of the Hasinai Caddo. Three hundred m to the north of the mission is a related site (41NA338) that has yielded forged nails, colonial gun parts, glass beads, and a magnetometer signature of a round Caddo-style house. Later in 2010, our team relocated the Mayhew site (41NA21) on Lake Nacogdoches, which we contend is San Denis's trading post for supplying the western missions and the local Hasinai (cf. Jackson et al. 2012:195-217), not an Hasinai farmstead (Kenmotsu 1992). Those discoveries led to our renewed interest in ethnohistoric documents pertaining to European and Caddo interactions.

THE HASINAI AND THEIR ELITES

Records and diaries from many of these early European figures give us a rich picture of Hasinai Caddo life (Hatcher 1927; Swanton 1942; Bolton 1987; Perttula 1992). All Caddo groups had a sedentary agricultural lifeway supplemented by the collecting of nuts and berries as well as local opportunistic hunting and fishing. Planned annual buffalo hunts to the Southern Plains and other ventures outside their home territory were common. They hunted with bows and arrows but readily became proficient with firearms once the French made them available. In their gardens grew corn, beans, squash, pumpkins, sunflowers, other native oily seed plants, and tobacco. They were renowned for their skill as potters; their ceramic vessels often have beautiful wet paste and engraved designs. The Caddo were known to trade in ceramics, salt, bow-wood, animal hides, Lipan Apache slaves, and horses.

The Hasinai communities were clearly hierarchical in social structure although perhaps less so compared to Caddo groups from some other geographical and temporal settings (see Fields, this volume). Sabo (1998) discussed the ritual interaction between community hierarchy and the hierarchical organization of the supernatural realm. Early chroniclers describe extended Hasinai villages that had socio-political centers at the residence of a key leader referred to as the caddi. Wyckoff and Baugh (980:234-235) enumerate the many functions performed by the caddi, including such activities as settling inter-village disputes, calling assemblies, hosting feasts and various ceremonies, organizing house construction, welcoming guests, dividing gifts, conducting war councils, and holding calumet ceremonies. Near the houses of these local headmen stood another building for the meeting of the village elders known as canahas. Other Hasinai officials included chayas (pages), tammas (enforcers), connas (medicine men), and amayxovas (proven warriors). A number of villages, each with their own specific social identity and led by their own caddi, gave allegiance to a supreme religious figure or priest referred to as the grand xinesi. In essence, the caddi operated with authority within a single community to maintain cohesion, ceremonial fidelity, and structural integrity, while the grand xinesi's role led him to be the communication conduit between all the people and the supernatural realm.

Reflecting on the early European accounts, and their research at the Deshazo site in western Nacogdoches County, Dee Ann Story and Darrel Creel (1982) proposed a synthetic model for integrating archeological settlement patterns and ethnohistorically derived socio-political organization. They discussed specific drainage "Constituent Groups" centered on a lesser center (the residence of a caddi) as one element within a larger "Affiliated Group" that had an associated major center (the residence of a grand xinesi).

What do we know about the principal leader or grand xinesi of the Hasinai who resided at the major center? The reports of Hidalgo, Casañas, and Espinosa provide the clearest descriptions (Hatcher 1927). This personage was revered by all, had regional religious significance and served multiple tribes, or "constituent groups." While he was primarily a spiritual leader, the grand xinesi had some final say regarding political and diplomatic issues. For example, the Nabedache caddi sent for the xinesi as part of obtaining final approval for de León and Massanet's plan to establish the first Mission San Francisco in 1690 (Letter of Massanet to Siguenza in Bolton [1908:380f]). The xinesi had a special relationship with Caddi Ayo Amay, the "Captain of the Sky" or most high god. Cecile Elkins Carter (1995:73) has speculated that the name xinesi may have derived from Caddo words meaning "Mr. Moon" and that this figure is associated with "Neesh" or Moon of Hasinai oral traditions. There are stories recorded by George Dorsey over a century ago in which Moon is described as the first created Hasinai man, and he was selected to be the first caddi or headman of the people (Dorsey 1997:7).

The chroniclers' description of the xinesi's village involved at least three kinds of structures (Hatcher 1927; Swanton 1942). First, there was a very large building, akin to a "cathedral," which served as a "fire temple." The xinesi tended the fire to keep it going, and embers from this eternal flame were sent around to connect the central fires of all the villages. Four large logs radiated from the fire in the cardinal directions. He placed ash from the fire outside the house in mounds. Through fire and smoke, the grand xinesi mediated between the cycles of community life that depended on seed crops, successful hunting, and warfare, and the supernatural realm that included the souls of deceased leaders, mythic heroes, and Caddi Ayo Amay. Ceremonialism around the fire temple involved dancing, burning of tobacco and fat from a buffalo's heart, and drinking of a tea. This tea may have been a stimulant, purgative, or hallucinogenic "Black Drink" made from *Ilex vomitoria*, or possibly a peyote tea (Hidalgo in Hatcher 1927:56). In a second structure about 100 paces away from the fire temple, the xinesi had his residence (Casañas in Hatcher 1927:292). Lastly, about a gunshot distance away from the temple, perhaps 50 m, stood one or two smaller houses for the cononisi, also known as "the little ones" or the "heavenly children" (see Casañas, Hidalgo, and Espinosa in Hatcher 1927:50-52, 160-162, and 290-292). These were said to be two little boys, cared for by the xinesi and used by him to speak to Caddi Ayo Amay and to the Hasinai people. No one but the xinesi was allowed to see the children; the consequence was instant death. Whether or not these little ones were twins, a concept that figures large in Southeastern Native American mythology, is unknown (Lankford 2011:160-175). The children had spiritual or mystical qualities and had been sent by the Great Captain in the Sky. The people said prayers to them at night. Ceremonies that involved the cononisi consisted of the elders going into the temple nude, sitting in the dark while the xinesi burned fat-laden incense, shook a gourd rattle, and spoke to the children about the needs of the people and Caddi Ayo Amay's current feelings about the Hasinai. According to Spanish witnesses, the xinesi, using a childlike falsetto voice, conducted both sides of the conversation.

Perhaps the cononisi were mythical as well. Outraged by their superstition, two of the Franciscan padres, Fray Casañas and Fray Bordoi, barged into the temple or the cononisi houses looking to see the little ones. No children were seen. Frustrated, or perhaps embarrassed, the xinesi explained to the Catholic priests that the cononisi used to be visible but had burned in a fire and their spirits had risen as smoke. In 1690, Casañas (Hatcher 1927:293) was told that this had happened in the distant past shortly after the children were sent to earth by the Captain of the Sky. Interestingly, a quarter century later, in 1716, a translator explained to Espinosa (Hatcher 1927:160) that the children had been burned in a fire set by the Yojaunes, a Tonkawa band, during an attack on the xinesi village just two years before (Dye and King 2007:160-161). All that was left to represent the children were two little boxes or chests made of reeds. One description of these boxes indicated that they may have been receptacles for offerings such as tobacco or food (Casañas in Hatcher 1927:292-293); another suggested that the chests may have contained zoomorphic vessels, ornamental feathers, and bird bone flutes (Espinosa in Hatcher 1927:160). Another reference to the boxes implies that they may be curated sacred bundles of the deceased. Therefore, when Casañas wanted to throw the boxes into the fire in order to destroy them, the xinesi resisted and said that all the Hasinai loved the "little ones" very much.

THE ARCHEOLOGY OF CADDO ELITES

Given these ethnohistorical descriptions, what are the expected characteristics of archeological sites that were once occupied by Caddo elites? Five attributes will be considered here: (1) presence of one or more earthen mounds, (2) remains of atypical house structures, (3) evidence of a plaza area, (4) ceremonial use of fire as suggested by ash heaps or indications of burned structures, and (5) presence of elite burials.

Numerous ceremonial sites with large earthen structural and burial mounds are found throughout the Caddo region. Caddo elites lived, worshiped, governed, and conducted diplomacy at these localities. Four well known prehistoric mound centers within Hasinai country of the Angelina/Neches drainages are the George C. Davis site in Cherokee County (Newell and Krieger 1949; Story 1981, 1997), the Washington Square Mound site in Nacogdoches County (Corbin 1984; Corbin and Hart 1998), the A. C. Saunders site (Kleinschmidt 1982) in Anderson County, and the Pace McDonald site in Anderson County (Perttula, Walters, and Nelson 2012). Other extensively excavated mound sites useful for comparison but outside the Hasinai region include the Belcher site (Webb 1959), the Pine Tree Mound site (Fields this volume; Fields and Gadus 2012) and the Hatchel site (Creel 1996; Perttula 2005). The last mentioned site appears to represent the mound and "templo" for a xinesi as seen on the western periphery of the famous map of the Upper Nasoni village drawn from the Domingo Terán de los Ríos expedition in 1691-1692

(Bolton 1915:Figure 1; Wedel 1978; Schambach 1982; Perttula 1992; Sabo 2012).

Typical non-elite Caddo domiciles in East Texas were circular in shape and 8 to 12 m in diameter. Schultz's (2010) review of 215 non-mound structures found that 86 percent were circular. In the more than seven decades since Webb (1940) made some architectural observations regarding Caddo house types at the Belcher Mound, a number of researchers have discussed characteristics of structures at elite sites (Spock 1977; Perttula and Rogers 2007; Walker 2009; Schultz 2010). While Schultz (2010) did not find significant differences in the diameters between mound and non-mound houses in his study, Webb (1983) described a submound 25 m diameter round atypical structure (with an inner circle of support postholes 14.4 m in diameter) at the Werner site in northwestern Louisiana. Architectural complexity may be a key marker of elite use of a structure. This is no more apparent than at the fantastic quadrated, multi-trenched Feature 35 under the southern flank of Mound A at the George C. Davis site (Newell and Krieger 1949). Extended entranceways on specialized function buildings are discussed in detail by Perttula (2009:39), and they appear to be associated with "the material manifestations of important cosmological, ritual, and mortuary beliefs." Caddo structures used for specialized ceremonial purposes or by elite individuals could also be constructed in pits or with earthen berms or could exhibit a colorful prepared floor (Schultz 2010:322-325).

A maintained open area or plaza for community activities within a site may also suggest the residence of a personage of elite religious or political status nearby. Renewal and harvest ceremonies, festivals, war celebrations, and other pageants would require space for dancing, formalized outdoor greeting, and participation of a broader shared community life. A structure for the council meeting of the canahas would be found at some place outside the plaza in the caddi's village, while a fire temple would likely have loomed large over the plaza at the xinesi's compound (Wyckoff and Baugh 1980:246-249). Walker and McKinnon (2012:186-189) have demonstrated the use of geophysics in delineating putative plazas at George C. Davis and other East Texas sites. Research at Oak Hill Village (41RK214) yielded a remarkable outline of a large plaza that was maintained through multiple periods of building construction around it (Rogers and Perttula 2004; Perttula and Rogers 2007). Good (1982:98), in her review of the Deshazo site community structure that included a plaza, suggested that "Deshazo could plausibly represent a site where at least some ceremonial functions were performed by resident caddi and canahas." Story (1995:239) was a bit more cautious, however, stating that identifying elite residence at this site in the heart of Hasinai country was "highly tentative."

Fire with its associated smoke was sacred in the Hasinai Caddo world. The management and ceremonial use of the sacred fire was mediated through priestly elites. The reverence for fire was rooted in the belief that fire was crucial in the creation of the Hasinai and the items they used (Morfi 1932:26; Swanton 1942:215). At times fire was employed in acts of renewal, as when important structures were burned and then capped with earth as a platform for a new elite structure or site of veneration. The Hasinai made offerings of meat, tobacco, and crops to the sacred fire at the priest's temple. There was a fear of displeasing that fire and a strong belief that letting the fire go out would result in death (Espinosa 1927:161). The perpetual fire was like a living entity that bound together the entire community as the flames in houses on dispersed farmsteads and hamlets were all derived from the fire in the caddi's residence, which in turn came from the fire temple tended by the xinesi. Smoke arose from the distributed eternal flame in all parts of the villages. In the fire temple, sacred incense arising from burning tobacco and fat intensified the mystical connection between the elites and Caddi Ayo Amay. Smoke was cleansing and holy. As with many cultures, smoke represented to the Caddo the nature of spirit as it flows, surrounds, engulfs, and moves where it will in an unbounded fashion. It is emblematic of spiritual realities from the numinous realm impinging upon the phenomenal realm (Sabo 1998).

Hearths, ash deposits, and burned structures are the archeological remains of the importance of fire. In the 1930s, A. T. Jackson (1938) noticed the use of fire in burial rites of Northeast Texas Caddo. Frank Schambach's (1972, 2002) work at the Ferguson mound and the Tom Jones site mound demonstrated remarkable evidence of structural burning at elite sites in Southwest Arkansas. Impressive ash beds were discovered in the central basins, just interior to the peripheral walls and in the floors of the extended entranceways of several houses excavated by Clarence Webb (1959) at the Belcher Mound. In the Hasinai country of the Neches-Angelina watershed, the A. C. Saunders site (Kleinschmidt 1982) stands out because of the presence of a 40 x 50 m oval, 2.3 m high mound that contained a layer of "hard packed ashes" up to 1.1 m thick. Nearby was a 0.7 m high "midden mound" overlaying a 14 m diameter circular house with five hearths. The midden contained an enormous amount of animal bones, some bone and shell tools, and much pottery, including effigy vessels and a large number of pipes. A. T. Jackson (1936:171), who excavated Saunders in the early to mid-1930s, proposed that the site was "the location of a fire house and ash mound such as described by early Spanish writers," a place for the keeping of the "perpetual fire."

Lastly, sites occupied and used by socio-political elites often include burials with evidence of the elevated standing of the interred. Large shaft tombs, containing multiple individuals along with carefully placed objects to intensify veneration or suggest cosmological information, would easily be understood as high status graves. Non-elite graves in the Caddo Area of East Texas are typically seen as single, extended supine interments with zero to several associated pottery vessels and perhaps a few arrow points or other items. At times, there can be an overlap in the presentation of elite and non-elite in the archeological record. The mere number of ceramic offerings may not be a reliable indicator of the status of a grave. For example, at the Belcher Mound (Webb 1959), Burial 5 with three individuals contained 22 pottery vessels while a larger Burial 23 with four interred individuals had only two vessels; many of the non-elite single burials at the Titus phase Tuck Carpenter cemetery in Camp County contained 10 to 14 associated ceramic vessels (Turner 1992).

What then does differentiate between common and elite mortuary presentations? Apart from a carefully planned spatial arrangement of contents seen in some elite graves, the most suggestive indications of high status burials are the presence of valuable objects and items representative of sacred activity. Social value often derived from the rarity of exogenously derived material. Marine shells from Florida, the Gulf Coast, or California could be used to manufacture objects of personal adornment or for ritualistic artistry. *Busycon* sp. was the raw material for columella beads as well as the elaborately engraved shell cups and gorgets seen in some Caddo sites (Webb 1959; Phillips and Brown 1978-1984, Vol. 1:26-30). *Olivella dama* beads from the Gulf of California have been identified at Spiro's Craig Mound while *Olivella nivea* from the Gulf of Mexico show up at sites in East Texas (Kozuch 2002). Copper from the Great Lakes region, turquoise from New Mexico, and quartz crystals from the Ouachita Mountains are also present in some elite graves. Conspicuous ceramic trade items were occasionally included in the mortuary offerings, perhaps commemorating key relationships or identification with distant ceremonial sites. Sacred items in elite burials can also include large chipped stone knives or ceremonial celts, carved stone pipes, rattles, embossed copper plates, and sacred bundles (Brown 2012).

Two sites excavated during the past 20 years in Shelby County, in East Texas, appear to represent important local Caddo ceremonial centers. Mortuary findings at these sites may hint at the later Spanish ethnohistoric descriptions of Caddo elites.

THE TYSON SITE (41SY92)

The Tyson site in western Shelby County sits atop a high second terrace affording it a commanding view of the territory surrounding the confluence of the adjacent Attoyac River with two major tributaries, Naconiche Creek and West Creek. Its dominating position on the landscape is unique for Caddo sites in the area (Figure 2). From 1992 until 2002 a small army of volunteers under the sponsorship of the East Texas Archeological Society excavated 144 m^2 to a typical depth of 40 cm in sandy loam deposits. Three radiocarbon dates from a large cooking and trash pit suggest that the site may have been occupied between A.D. 1390-1440 (Middlebrook 1993).

During a weeklong East Texas Archeological Field School in July 1993, a 6 x 6 m block and an attached westward-projecting 12 m long trench were excavated under the direction of Bob Skiles, then an archeologist with the U.S. Forest Service (Middlebrook 1994). Other professional archeologists participating in the field school included Jim Corbin, Jim Bruseth, Alan Skinner, John Ippolito, Jack Keller, and Velicia Bergstrom. The block appeared to be placed near the center of a structure because of the exposure of a well-defined hearth (Feature 9) and two large associated postholes (Features 12 and 17) thought to be center posts of a house (Middlebrook and Middlebrook 1996). In

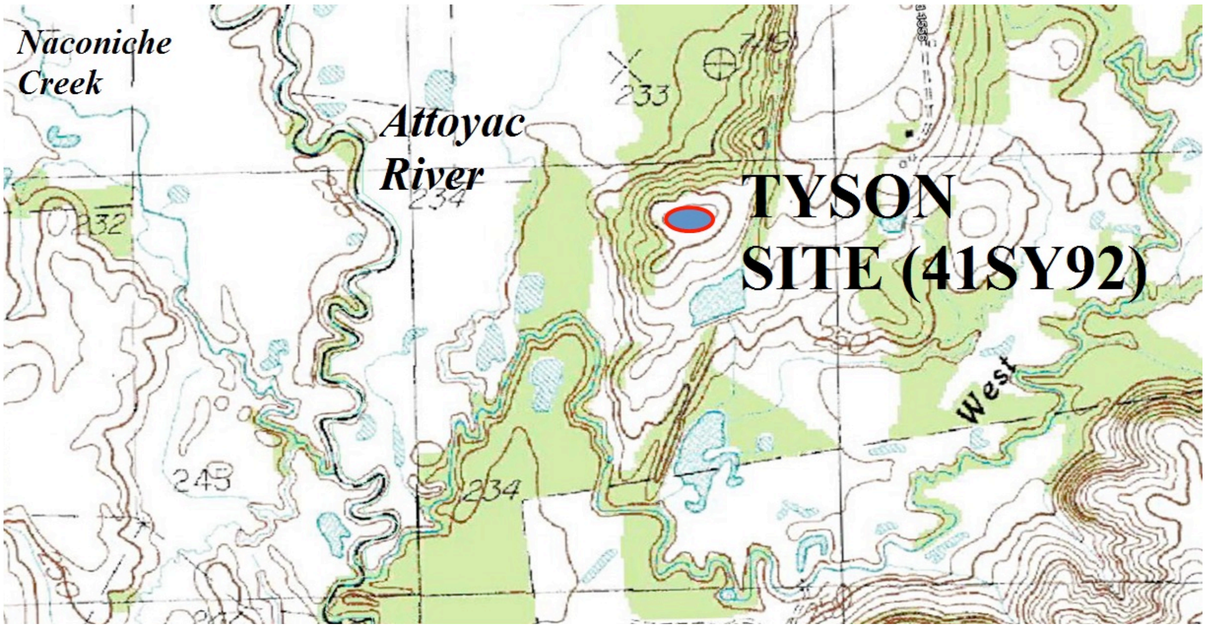

Figure 2. Location of the Tyson site east of Attoyac River near its confluence with Naconiche and West creeks.

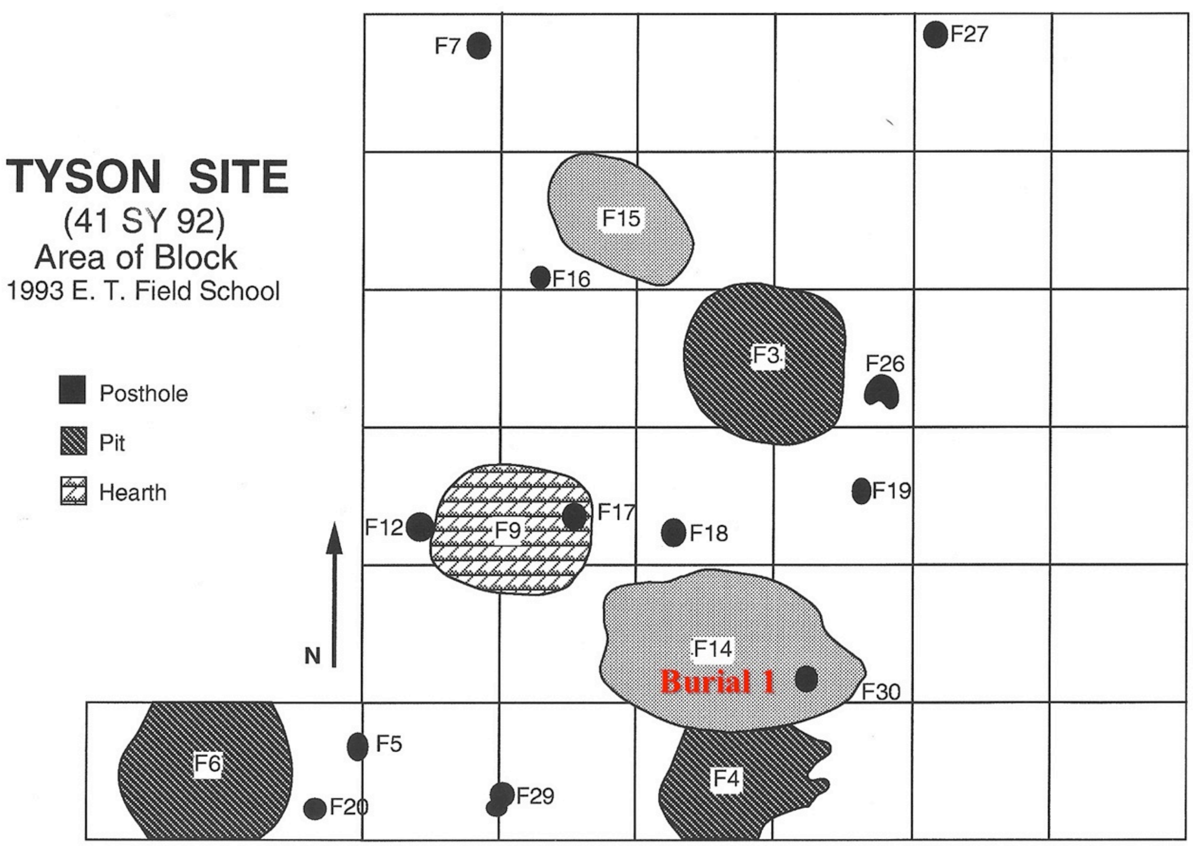

Figure 3. Area of 6 x 6 m block excavation, 1993 East Texas Archeological Field School.

addition to these cultural features, the excavation of the block and the first two units of the trench yielded 10 more postholes or post molds, three storage or refuse pits, and two juvenile burials (Feature 3) (Figure 3).

One of these graves, Burial 1 (Feature 14), was found to be one of the most richly furnished infant burials ever excavated in the Caddo region. The amount and diversity of the material goods placed in this grave certainly suggests high social status, and some of the items likely point to their religious/ceremonial content as well.

After the majority of grave offerings were mapped and carefully removed, a trench was excavated into the sterile soil outside the expected limits of the human remains forming a pedestal. Bement's Spray Sealant was applied to paper towels placed over the pedestal and the entire block was removed intact (Dockall 1995). Helen Danzeiser Dockall (1994) excavated the human remains at the Physical Anthropology Laboratory of Texas A&M University. The most striking finding of the laboratory excavation was the discovery that the interment contained two individuals in very close proximity. The remains of the first individual consisted of a number of cranial elements, six fragmentary teeth, clavicle, scapula, ribs, and a few long bones. A second individual, apparently lying slightly to the left of the first, was only represented by two petrosal ridges of the temporal bones and the glenoid/acromion area of the left scapula. The first individual was judged by Dockall to have been one to two years of age, most likely around 18 months. This individual displayed some evidence of possible cranial modification. Based on much more limited evidence, the second individual, also an infant, was thought to be of approximately the same age at death or slightly younger. The heads of the children were placed in the west end of the burial pit.

In total, there were 114 recovered objects intentionally placed in the grave with the human remains. Because the burial pit was considerably larger than required for the recovered material, it is likely that a considerable amount of perishable offerings may have also been present originally. The list of the recovered grave goods includes:

Ceramic vessels	n=8 (bottle=1, bowls=4, jars=3)
Deer antlers	n=2
Deer femur	n=1
Deer tibia	n=1
Carved bone "ear spools"	n=2
Small shell inlays with "circle and dot"	n=4
Large round shell inlays	n=2
Elongated shell inlays	n=6
Olivella nivea beads	n=30
Columella beads	n=10
Small broken shell beads	n=3
Ridged marine bivalve shell	n=1
Turtle carapace with drilled dimples	n=1
Fresh water mussel shells (4 in cache with rocks)	n=8
Ferruginous sandstone rocks (associated with mussel shells)	n=3
Pitted stones	n=2
Tools for knapping (in cache) (deer ulna tools=6, beaver teeth=2)	n=8
Knapping raw material (in cache) (lithic=14, shell=6)	n=20
Smoothed pebbles (Burnishing stones?)	n=2

The complex placement of grave goods with the two infants is likely important in understanding their identity and their meaning to the community who buried them (Perttula 2004:Figure 13.17). The most remarkable feature of the grave was the placement, directly over the crania, of a large well-made Tyson Engraved carinated bowl that was itself covered by a carefully placed set of deer antlers and bordered by a deer ulna and femur (Figures 4 and 5).

Tyson Engraved refers to a group of carinated bowls and bottles from the Shelby County area that display the following elements: (1) a straight or biconcave "pillar" covered with two semi-circle lines, alternating with (2) fat negative S-shaped scrolls (or "SZ" design), and (3) attaching lines connecting the first two elements (Middlebrook 1994:24). This motif is prominent at the Tyson site with a second vessel found in Burial 1 (Figure 4g) and a number of sherds recovered from the midden and large pit. This engraved design has also been noted at the Morse Mound site (41SY27), the Buddy Hancock site (41SY45), the Jerald Hughes Ranch site (documented by the author, April 1994), and a site reported near Shelbyville (Connie Hodges, personal communication, May 1998). Some vessels from the Buddy Hancock site also show stylistic simplifications of the core design.

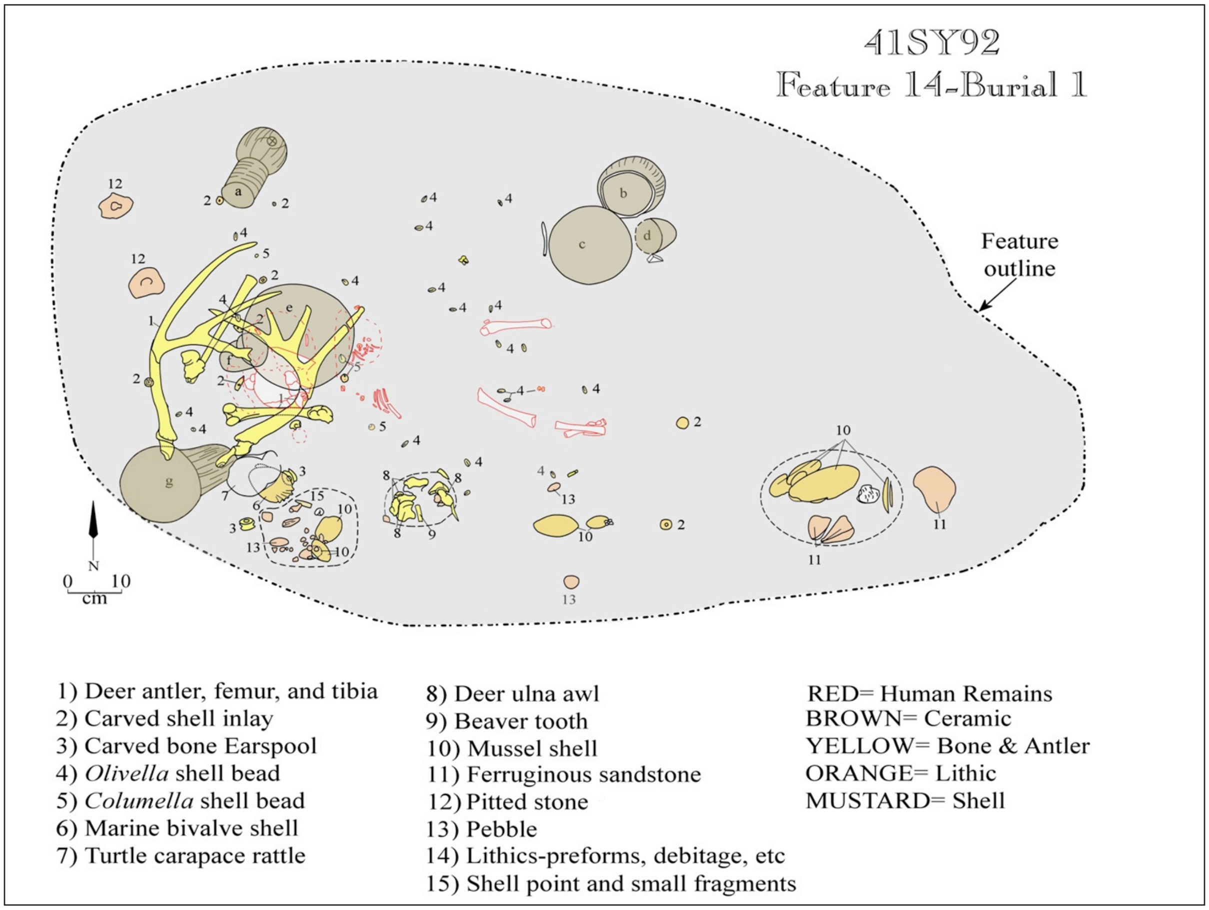

Figure 4. Plan of Burial 1 at the Tyson site.

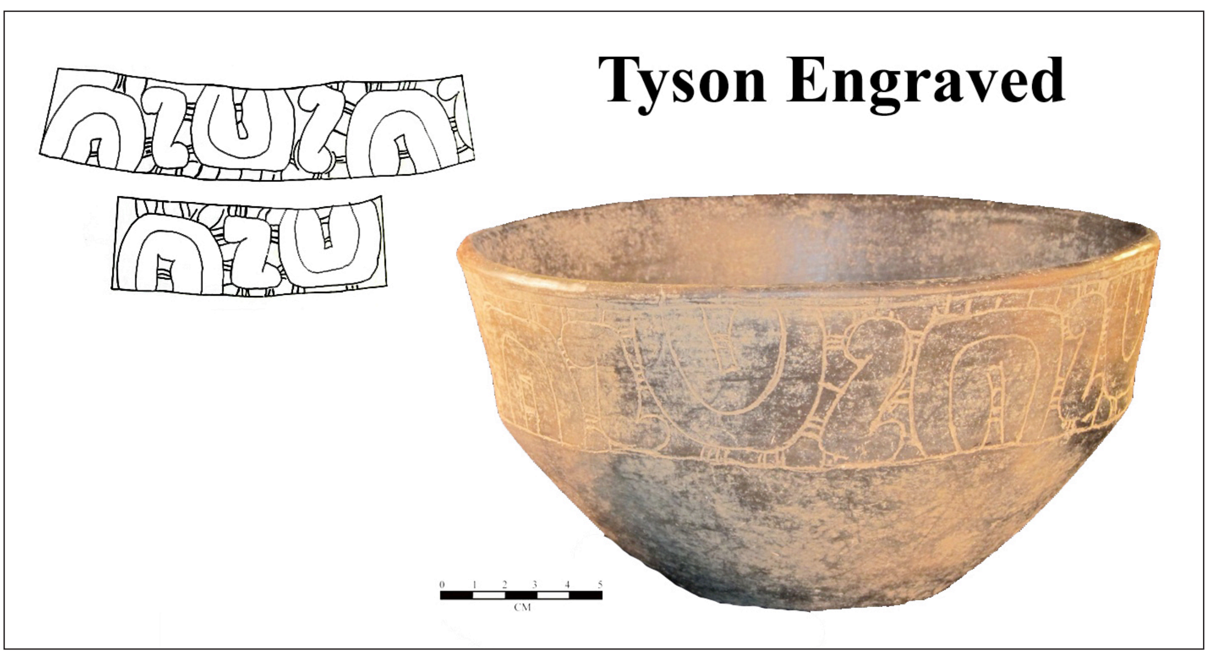

Figure 5. Tyson Engraved carinated bowl placed over the Burial 1 crania.

While certainly not the focus of this article, the combination of design elements in Tyson Engraved is interesting in light of the emerging discussion of the representational meaning that engraved motifs may have vis-á-vis native cosmology and iconography (Reilly and Garber 2007; Lankford et al. 2011). Gadus (2013:239) has proposed that the SZ element may be related to serpent figures of lower world imagery. The pillars covered by two semi-circles could reference the sacred pole (axis mundi) and upper world imagery. The attaching lines may purposefully connect the other two mythic-cosmological constructs. Regardless of these speculations, there can be no doubt that the antlers placed over the Tyson Engraved carinated bowl resting on the infant crania gives clear focus to the ceramic vessel and elevates the communication of its design.

The antlers appear to be from a 12 point whitetail buck with the longest tine being 20 cm in length (Figure 6). Deer antlers are exceedingly rare in Caddo mortuary contexts. Careful excavation did not reveal compelling evidence as to whether or not the antlers were attached to perishable material as part of a headdress or if the femur and tibia were physically linked to the deer antlers. The key observation is that both children's heads were nested within the confines of the Caddo vessel, deer bones, and antlers.

The European chroniclers were relatively brief in description of deer-related ceremonialism among the Hasinai. Espinosa (1927:170) does describe an hour long pre-hunt ceremony during which the deer hunters would pray to Caddi Ayo Amay over a dry deer head and antlers placed on a post. During the ritual, they would throw tobacco into the fire. For the hunt itself, the Hasinai would remove theirs clothes, cover themselves with white dirt, and carry another deer head and antlers with them. If successful in the hunt, the hunter would whisper unknown things into the ear of the deer for a long time.

While reflecting on the 2,042 paired antlers excavated at the Crenshaw site (3MI6), Jackson et al. (2012:84) comment that deer "played this central role in facilitating and reinforcing critical cosmological relations, defining social, political and religious inequality, and reinforcing social solidarity. The accumulation of deer remains ...reflects the preferential access by the politico-religious elite to certain cuts of meat…and also reflects the rituals performed to maintain the successful relationship between this critical species and the Caddo people." On an even broader scale, antlered

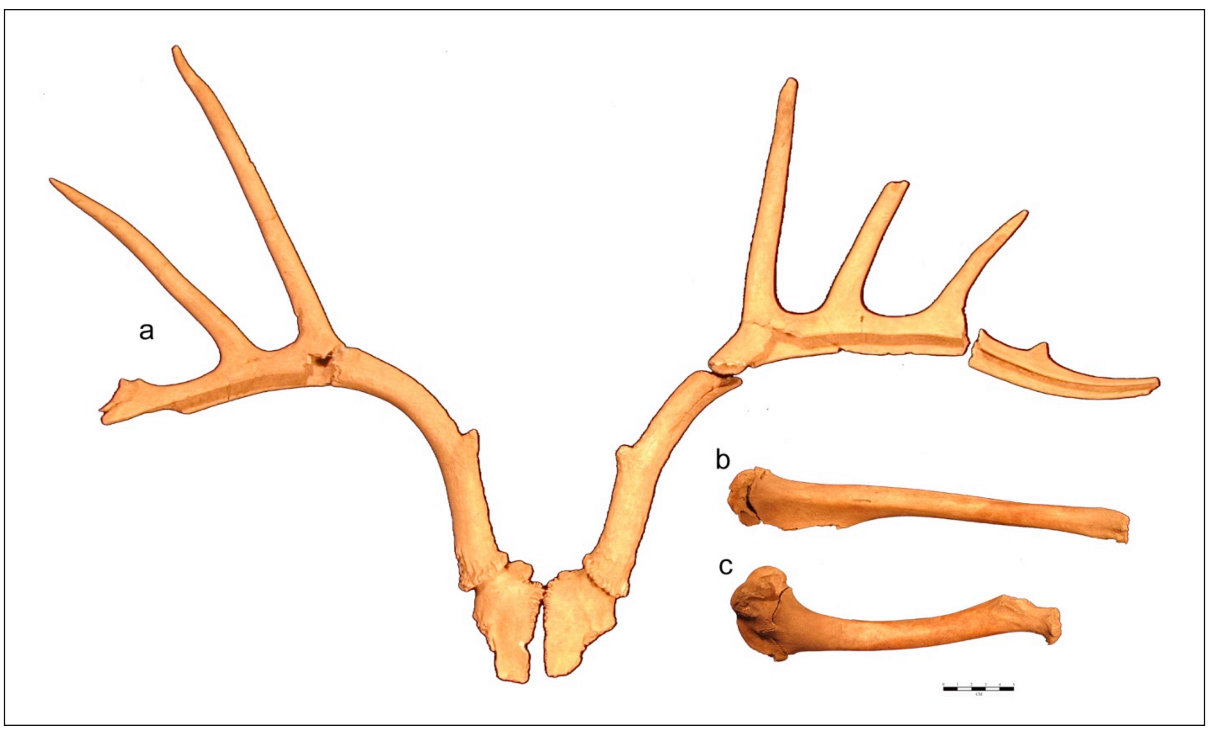

Figure 6. Deer antlers and long bones placed around the Tyson Engraved carinated bowl and children's crania.

deer had wide usage in Southeastern Mississippian period iconography by representing aspects of culture heroes and other mythic entities in the supernatural realm. At times, antlers were attached to occupants of the lower world, as in the case of Horned Water Serpent (Lankford 2007), or from Spiro shell engravings with Intertwined Snake Men and Janus-Headed Rattlesnake Crowned with Antlers (Phillips and Brown 1978-1984:Plates 194 and 307). Antlers were associated with upper world culture heroes as well. In discussing the unusual Cat-Man Cup with Warlike Figure Carrying Bow and Displaying Many Scalps, Phillips and Brown (1978-1984:Plate 305) note the figure's "antler headdress signifying chieftainship." Birdman imagery with antlers is prominent in Hightower anthropomorphic or Big Toco Style shell gorgets from Etowah and upper Tennessee Valley sites (Phillips and Brown 1978-1984:126-127; Brain and Phillips 1996:44-50; Marceaux and Dye 2007:168-175; King 2011:282; Reilly and Garber 2011:296-305). The magnificent carved red cedar mask with antlers inlayed with marine shell from Spiro's Craig Mound is a vivid illustration of the ceremonial importance of the deer in Caddo religion (Townsend 2004). The placement of the impressive deer antlers in a supreme location in the Tyson site burial, therefore, represented the highest level of veneration for the little children commemorated here.

In terms of items of personal adornment, 10 conch shell columella beads with smooth rounded ends were found in the neck or lower facial area of the young children's remains. Marceaux and Dye (2007:182) comment that: "Shell beads functioned throughout eastern North America as wealth indicators." Webb (1959:174) notes at the Belcher Mound in Caddo Parish, Louisiana that "there were 268 shell beads, made from conch columella, in 21 groups related to 17 individuals in 12 burial pits." Most of these beads were worn as necklaces but a few were bracelets. At the Washington Square Mound site (41NA49) in Nacogdoches, 36 columella beads were recovered from the two elite burials in the mound; all but four of these were in clusters around the wrists (Perttula et al. 2010). Other East Texas sites with reported columella beads include Womack (Harris et. al. 1965:305), Sam Kaufman (Skinner et al. 1969:96), Tuck Carpenter (Turner 1978:89), and Clements (Perttula et al. 2010:38). There are also sites that have yielded columella beads in the interments of very young children. Jelks (1965) found a single columella bead in the grave of a 2 to 4 year old child at the Walter Bell site in the McGee Bend project area. Three "large barrel-shaped" beads were found in Burial 5 of an infant at the McClelland site in Bossier Parish, Louisiana (Kelley 1994). At the Tyson site, another infant grave, Burial 2 or Feature 15 (see Figure 3), had two columella beads in the chest area of a neonate. Unlike the Burial 1 artifacts, these beads were squared off at the ends rather than rounded (Middlebrook 1994).

Other remarkable shell objects were placed in the grave. Four small round marine shell objects with engraved circle and dot design were recovered in the proximal end of Burial 1 just above the cranial area of the infants and to their upper left. These discs range from 7.3-13.0 mm in diameter and 1.9 -2.5 mm in thickness. The circles, often crudely engraved, were 4.7-8.4 mm in diameter (Figure 7a-d). In recent years, Perttula has described Clements style shell ear discs (Perttula and Green 2006; Perttula et. al. 2010), including ones from the Clements site near the headwaters of Black Bayou in Cass County, and the Culpepper and Anglin Midden sites along Stouts Creek in Hopkins County. These shell discs were compared to similar ones from Cedar Grove (Kay 1984), Hardman (Early 1993:140), and Belcher (Webb 1959). The central dot can perforate the disc in some cases and not in others. The Clements style shell discs vary greatly in size. The four circle and dot shell discs from Tyson are among the smallest yet described. They are best compared to a 12.7 mm diameter disc from the Anglin Midden site (Perttula and Green 2006:Figure 3) and five discs from Belcher's Burial 25, which were part of a collection of 33 "disc and cutouts" found next to the right hand and were 13-15 mm in diameter (Webb 1959:Figure 101l). Perttula et al. (2010:38) appears to follow Perino's (1983) proposal that these objects were part of a compound ear ornaments, but they also mention A. T. Jackson's suggestion that they may have been used as hair ornamentation. Webb (1959:Figure 101L) proposes a third notion when he described "small circular inlays possibly representing eyes." While the fact that the number of discs (four) is intriguing, the placement of the Tyson circle and dot discs do not tend to support their use as ear ornaments because only two were found close to the crania. Consistent with Webb's proposal, perhaps these small discs were eye inlays in a mask or other ceremonial gear. Interestingly, two other

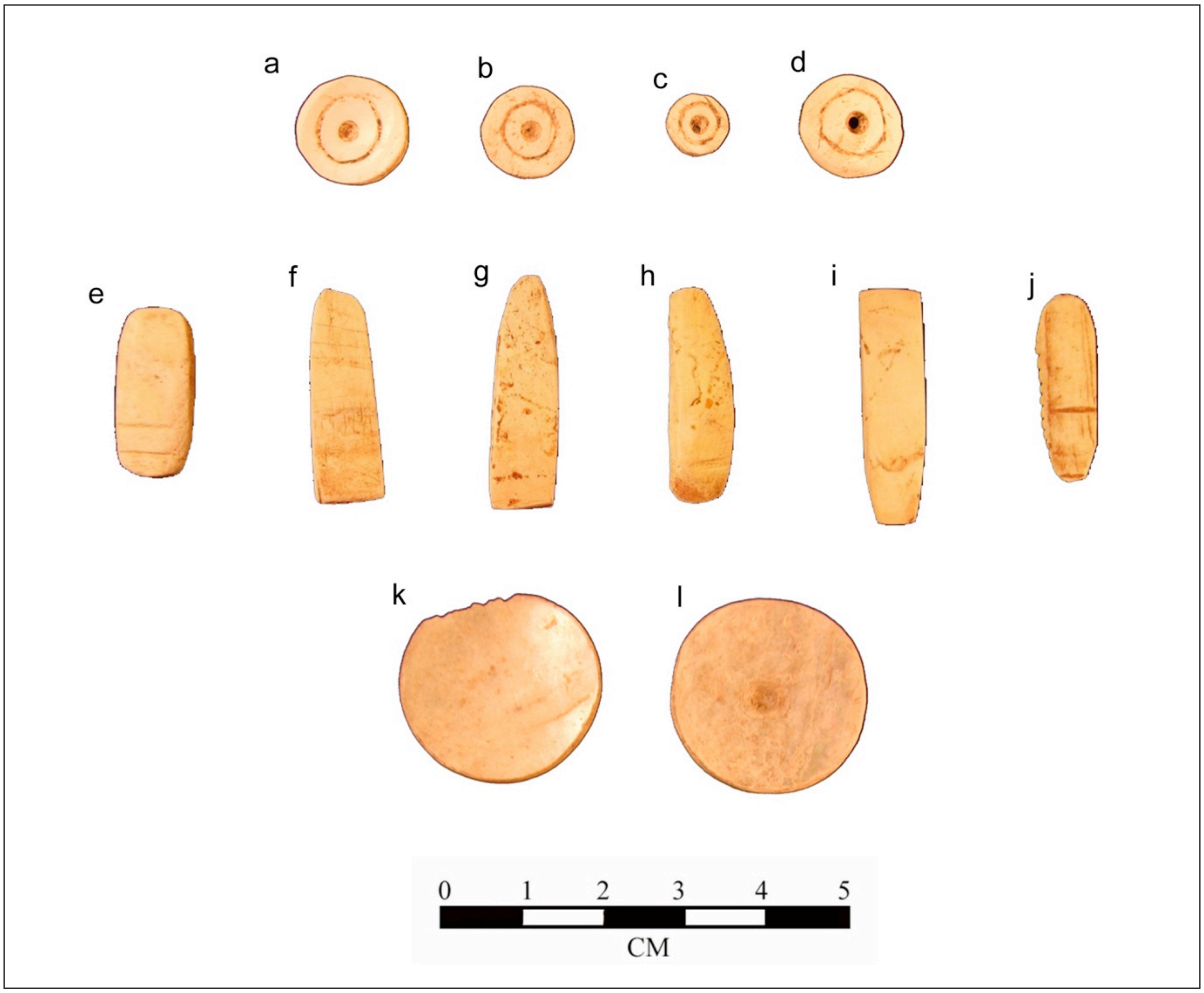

Figure 7. Marine shell artifacts: a-d, small marine shell disc with circle and dot design; e-j, elongated shell inlays; and k-l, large round shell discs.

larger shell discs (both 23.7 mm in diameter), one undecorated and the other with a central engraved dot (Figure 7k-l), were found at the distal end of the burial 15 to 20 cm away from the bones of the lower extremities. It is likely that these objects were being used in some different manner than the four smaller discs.

Perhaps a stronger case could be made for six elongated marine shell artifacts being shell inlays. They were found intimately associated with or underneath the crania of the two infants (see Figure 7e-j). These slightly curved artifacts are typically narrowed on one end and four showed evidence of fine striations or engraved lines at 90 degrees to the long axis. One had 11 serrations on one edge. These objects are 20.5-28.5 mm in length and 7.3-9.3 mm in width. Possibly these shell artifacts were decorative inlays in some ceremonial regalia. Given their roughly petaloid shape, if they were clustered together, they may have given the impression of the avian tail feathers in some representations of upper world winged culture heroes.

Another set of marine shell objects placed in the grave are 30 *Olivella nivea* beads that are scattered widely over the presumed area of the bodies. The pattern of bead distribution suggests that they were attached to some fabric, perhaps a blanket or garment.

Just to the right of the infants' crania were placed a group of special objects that may have enhanced the adoration of these deceased children. Two carved bone ear spools were placed far enough away from the skulls, however, to indicate that they were not in use by the infants (Figure 8c-d). Perhaps they were attached through their central holes to some other perishable regalia. Seven bone ear spools were reported from Belcher Mound by Webb

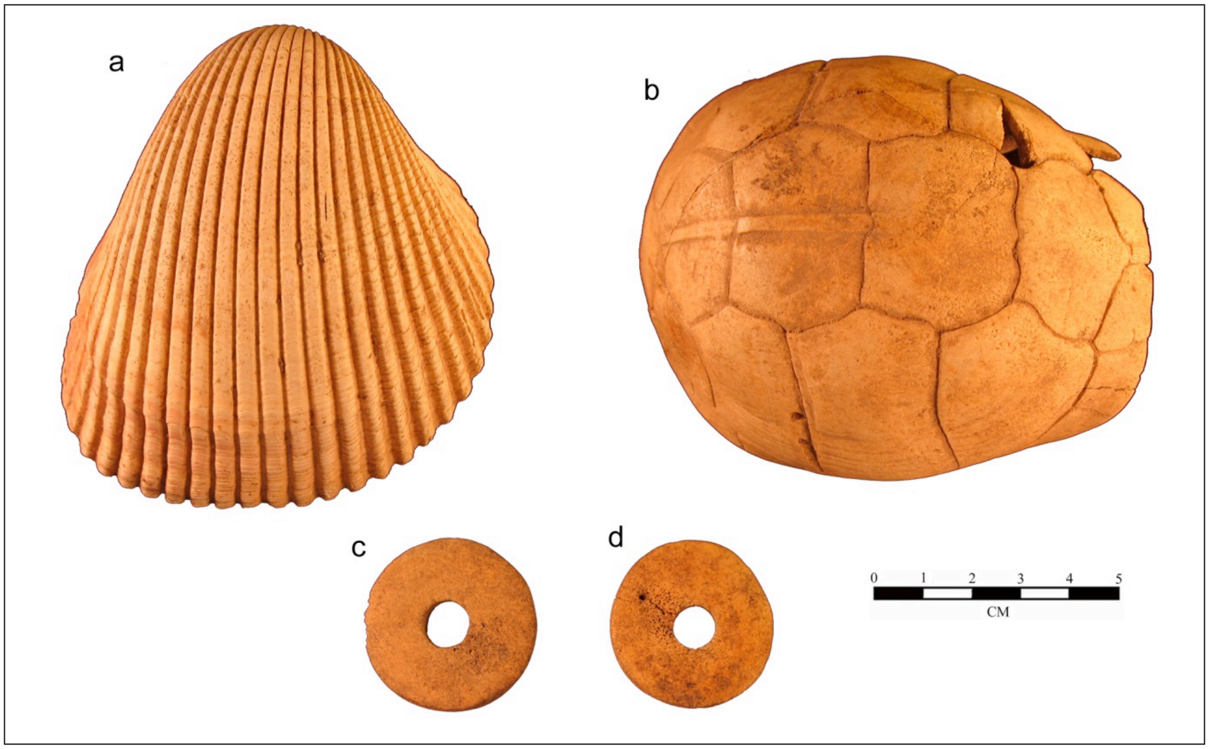

Figure 8. Objects found to the right side of the crania in Burial 1: a, marine bivalve; b, turtle carapace cup; and c-d, carved bone ear spools.

(1959:168), although none of them were very similar to the Tyson objects. Four of these artifacts from Belcher were described as "napkin ring" ear spools (Webb 1959:Figures 31e, 37m, 93a, and 128i), two others were thought to be made of the bodies of large fish vertebrae (Webb 1959:Figures 37l and 56h), and one was cone-shaped (Webb 1959:Figure 37n). The Hatchel Mound excavations of the 1930s yielded a bone ear spool as well (Timothy K. Perttula, personal communication, December 2013).

A second type of object in this grouping was an unmodified cockle shell (family Cardiidae), a ridged marine bivalve (see Figure 8a). This offering would have had significance to Tyson inhabitants for its rarity, its expense to obtain, as well as its probable reference to trade relationships. Based on its placement with the concave side up, it may have held important contents as well. The last object of this group was a box turtle (*Terrapene carolina*) carapace cup which was positioned with the open side up as if it may have contained a liquid (see Figure 8b). The carapace had been clearly modified. The vertebrae and all other bones had been removed. Two or three small dimples had been drilled on the exterior of the carapace near the anterior margin of the third costal scutes bilaterally. These dimples appear to be result of attaching the carapace to a handle. Initially, it was thought that this may be a turtle rattle, but careful excavation did not reveal any pebbles inside or around the carapace. David Kelley (1994:153-155) describes three modified box turtle carapace cups or bowls from the McLelland site. The largest of these was discovered just to the right of a one year old infant's cranium in Burial 5. Another box turtle carapace cup was found in adult Burial 4 at the McLelland site, again just right of the skull but under an inverted plain bowl. There is no mention of any modifications to the exterior of these turtle shells.

Four of the eight ceramic offerings in the Tyson site Burial 1 are engraved fine wares. Three of the engraved items have associated utility wares adjacent to them. The three clusters of vessels are under the deer antler, above the right shoulder, and to the left of the infants' feet (see Figure 4). The one item that stands alone is a handsome bottle with engraved vertical scrolls around a circle and cross figure and wide horizontal lines on the neck (Figure 9). This vessel rests well to the left of the crania. The circle and cross design is a variant that

Figure 9. Bottle with vertical scroll around a circle and cross element.

has excised areas where the lines cross and contact the outside circle; the net effect of this treatment is to produce four negative circular or sub-circular elements. This variant has reminded some recent researchers of peyote buttons and may reference the content of the bottle (TXARCH-L discussions "Black Drink Comments," August 8-9, 2012). No residue analysis has yet been performed on this bottle (or the turtle carapace cup), but it would not be surprising if it served as a container of some stimulant, purgative, or hallucinogenic liquid or Black Drink (Crown et al. 2012).

The remaining contents of Tyson's Burial 1 consist of five groups of objects that may have been placed in the grave to signify the importance of the children's activity in the afterlife and give material support to it. Four of the sets of artifacts were arranged on the right side of the bodies (see Figure 4). First, a cache of six vertically standing modified deer ulna tools and two beaver teeth were found in a tight arrangement just to the right of the infants' thorax. These objects were likely placed in a leather pouch and may represent tools for knapping. Alternatively, Perttula has suggested that the beaver teeth may have been used in tattooing as well (personal communication, November 2013). Comparable mortuary findings have been reported in Burial 11 at Belcher (Webb 1959:71-72 and Figure 74), Burials 4 and 11 at Cedar Grove (Kay 1984:192-193), Burial 6 at McLelland (Hunter 1994:147-149), and Feature 8.1092 at Pine Tree Mound (Fields and Gadus 2012:351, 354). Second, a collection of 14 lithic items and six shell objects appeared to be nested inside a separate leather pouch immediately adjacent, and 20 cm proximal, to the collection of knapping tools. These perhaps represent raw material and preforms for knapping activity. Third, a collection of four mussel shells and three ferruginous sandstone rocks were located in the far distal end of the grave and to the infants' left side. This grouping may represent a shell inlay construction kit with raw material and grinding implements stacked together. Fourth, there were two smooth siliceous pebbles to the right of the lower extremity that may have been used as ceramic vessel burnishing stones in fine ware ceramic production. Fifth and finally, there were two pitted stones at the most apical aspect of the burial that could have been useful in nut or dried corn meal processing.

Perttula (personal communication, November 2013) drew my attention to A. T. Jackson's (1932) report on his excavation at the Eli Moores Plantation (41BW2) and Carolyn Good's (1977) thesis prospectus that reviewed the excavation at this site, now believed to be the residence of the Upper Nasoni caddi. Burial J-8 in the Moores mound was a double burial of two children; one was 7-8 years old, and the other was 4-5 years old at the time of death. Good (1977) mentions that this grave was "by far the richest of the burials in quantity of grave goods." The artifacts associated with the two juveniles included a "conch shell bead (beneath chin)," a Barkman Engraved bowl, another "pot," three arrow points, two *Olivella* beads, a terrapin shell rattle with two drilled holes, a raccoon bacculum, mussel shells, a deer mandible, and several long bones thought to be deer. The parallels of this Eli Moores site burial to the double infant grave at Tyson are striking, but the offerings in Burial 1 at Tyson are significantly more numerous and elaborate.

Three other tantalizing facts about the Tyson site should be mentioned. First, there is little question that a house surrounding the burial was burned at some point, based on a nearby charred postmold (Feature 7) and the fact that the adjacent pit (Feature 3) was filled with daub that is only formed from firing. Fire and the burning of sacred structures are important Caddo practices. Second, just 20 m from the burial is an enigmatic 2.3 x 1.6 m sub-rectangular dense homogeneous orange-red clay feature (Feature 1) that lies just beneath the plow zone. A backhoe trench excavated through the feature during the 1993 East Texas Archeological Field School demonstrated its depth and atypicality (Middlebrook 1994:6-8). One possibility to be entertained is that the clay feature is a peyote altar (Cast 2007). Third, a 2007 magnetometer survey by the Texas Historical Commission has suggested the possibility of a very large 24 m structure not far from the summit of the site. Excavations have not been done to ground truth this geophysical anomaly.

In summary, the Tyson site is a distinctive late 14th to early 15th century Caddo site situated on a remarkable prominence with a grand viewscape. Excavations have uncovered important evidence concerning the burial of two very young children who were treated with nearly unparalleled reverence. What do we make of this double juvenile burial? Is this a burial of coninisi? Is this prominent site the village of a grand xinesi? Of course, while speculative, it is nevertheless very reasonable to conclude that these young interred children were venerated in a highly specialized manner, and they were sent on the journey with items, such as deer antler, suggestive of ritualism associated with supernatural mythical figures. Their passage likely involved transcendence of cosmological realms.

THE MORSE MOUND SITE (41SY27)

The Morse Mound site is located ca. 29 km to the northeast of Tyson (Figure 10). It is situated 400 m up a sloping terrace above a tributary of Chicken Bayou (Figure 11). During the early months of 2000, members of the Texas

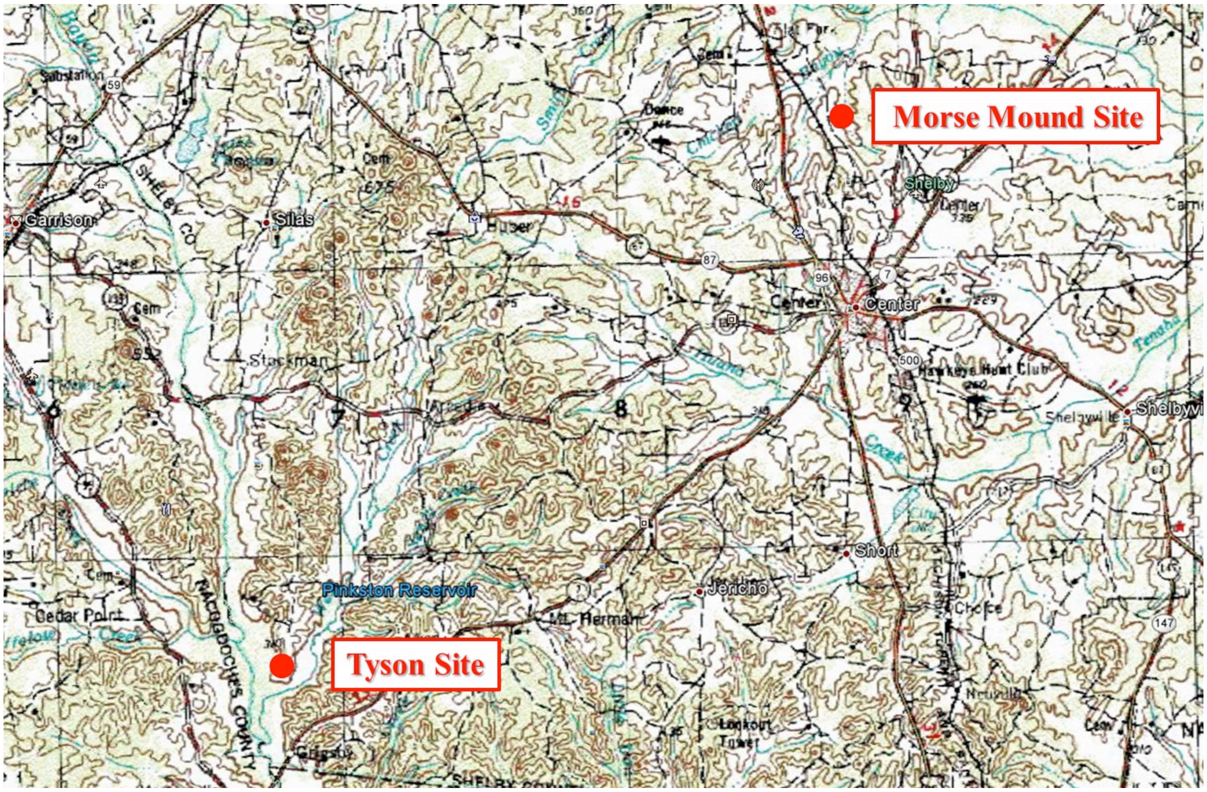

Figure 10. The location of the Tyson site relative to the Morse Mound site in Shelby County, Texas.

Figure 11. The Morse Mound's location on the landscape.

Archeological Stewardship Network and archeologists Jim Bruseth and Mark Parsons of the Texas Historical Commission (THC) excavated a 1.0 m high mound measuring approximately 15 m in diameter (Bruseth et al. 2000). The site had originally been recorded by Tom Mayhew in August 1974, who noted a "4 [ft.] red clay rise." Test excavation in October 1999 demonstrated that the rise was an artificial mound with a few Caddo sherds in its fill. When intensive investigation began in January 2000, a north-south and an east-west backhoe trench were dug to 40 cm below the original ground surface (bs) and intersected in the center of the mound (Mound A). Following careful trowelling of the trench floors that revealed cultural features, a large 5 x 6.5 m block of sediments was removed by a backhoe from the central area of the mound. Additional trowelling and mapping demonstrated that the mound was constructed over a 5.6 m round house that contained a centrally located 3.6 m round pit (Figure 12). This was a large shaft tomb dug by the Caddo, while the house was still standing, to a depth of 1.25 m bs. Some of the dirt from the pit was placed outside the walls of the house as a berm. After the burial of the individuals in the pit and partial filling of the tomb with soil, the house was burned and the charred timbers were pushed over onto the central pit. The entire house/grave site was then capped with clayey soil from a borrow pit just a few m south of the mound.

While the work in Mound A was ongoing, a second mound, Mound B, was discovered by Mark Parsons 150 m to the north. This was a 40 cm rise situated over a re-built 5 m diameter Caddo house with a prepared red clay floor and a centrally located basin-shaped hearth containing much charred nut shell. This structure is believed to have had a ceremonial purpose. Additional excavations were conducted in a midden area just north of Mound B.

Based upon two radiocarbon samples obtained by the THC from Mound A, the site appears to date approximately 100 years later than Tyson. The mean calibrated age of two woody charcoal samples is A.D. 1478 (Beta-140046) and A.D. 1527 (Beta-140047) when calculated using OxCal 4.2 (Bronk Ramsey et al. 2013) and the IntCal 13

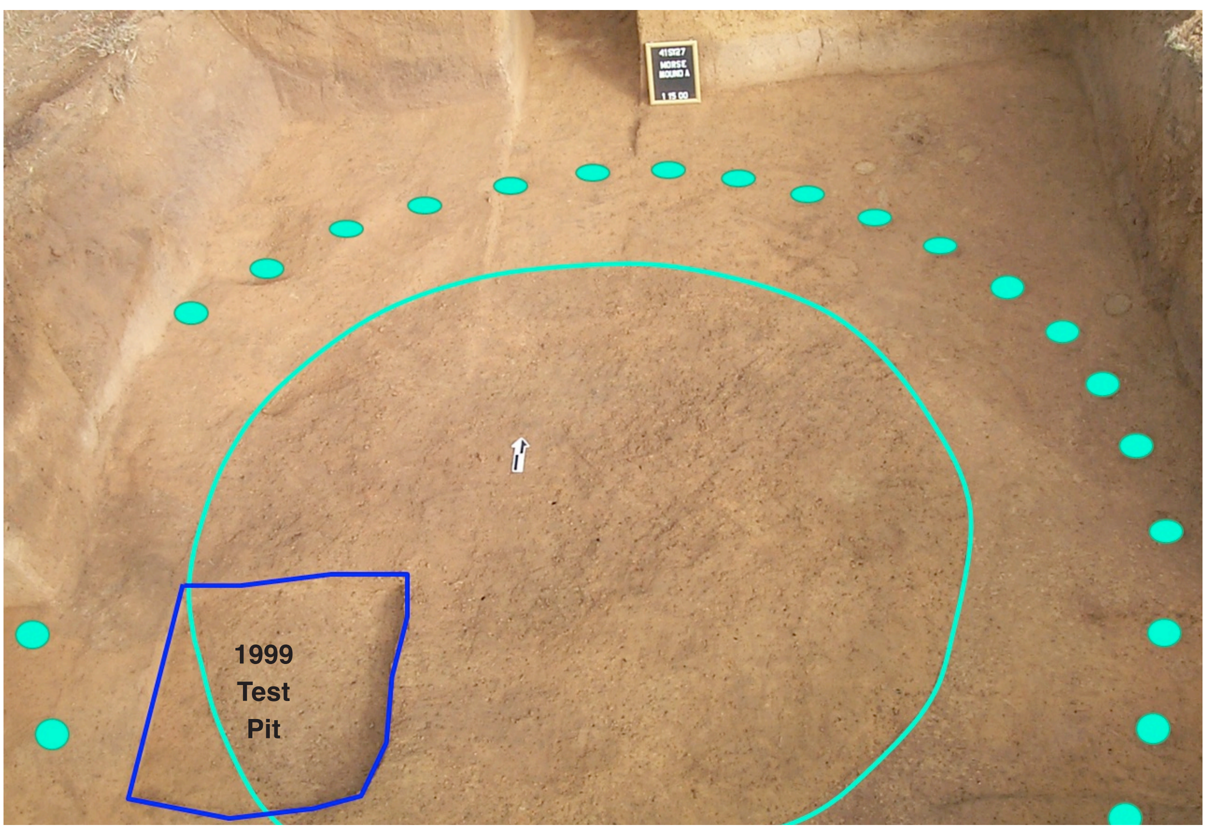

Figure 12. Large block in central area of Morse Mound A showing the location of the October 1999 test pit, the postholes for the burned and buried house, and the outline of the shaft tomb placed in the center of the house.

radiocarbon curve (Reimer 2013).

The findings within Mound A's shaft tomb were remarkable and perhaps unprecedented in East Texas archeology. Doubtless, these finding are the result of local soil chemistry. Although no human skeletal remains were found in the grave, many perishable objects were visible, to a degree, by their replacement with contrasting fine gray silt after their decay. In this odd ephemeral fossilization of sorts, wood, basketry, and cordage were visible with careful troweling. Straight and curved gray lines were observed early on in the excavations. Some appeared to represent containers, either wooden boxes or baskets. The largest container, Container 1, clearly appeared to be the coffin of an important person (Figure 13). Early Spanish missionaries described seeing the funeral and burial of a grand xinesi interred in "a coffin as big as an ox cart" (Casañas 1927:299).

Inside the container was a large blade, and two quivers of arrows tipped with Bassett points, or "Bassett/Perdiz hybrids" (Figure 14a-b, d). Careful excavation of the quivers allowed the investigators to see the gray silty ghosts of the arrow shafts and the cordage of the quivers. They were placed near the chest area of the interred individual. The large Edwards (Georgetown) chert biface with pumpkin florescence under UV light was 25.7 cm long, 6.7 cm wide, and 9.3 mm in thickness. It was located in the area of the interred individual's right hand and certainly suggests the high social or religious status of the deceased. Although somewhat longer at 36.8 cm, C. B. Moore (1912:Figure 92) illustrates a similar blade recovered from the Foster Place in Arkansas. Two ear spools were located near the west-northwest end of the coffin suggesting the orientation of the body (Figure 15a-b). South of the coffin, or on the individual's right side, were placed 11 ceramic vessels. Two of the fine ware vessels were placed in the grave upside down; both had Tyson Engraved designs (Figure 16). Two large carinated bowls (Figure 17)

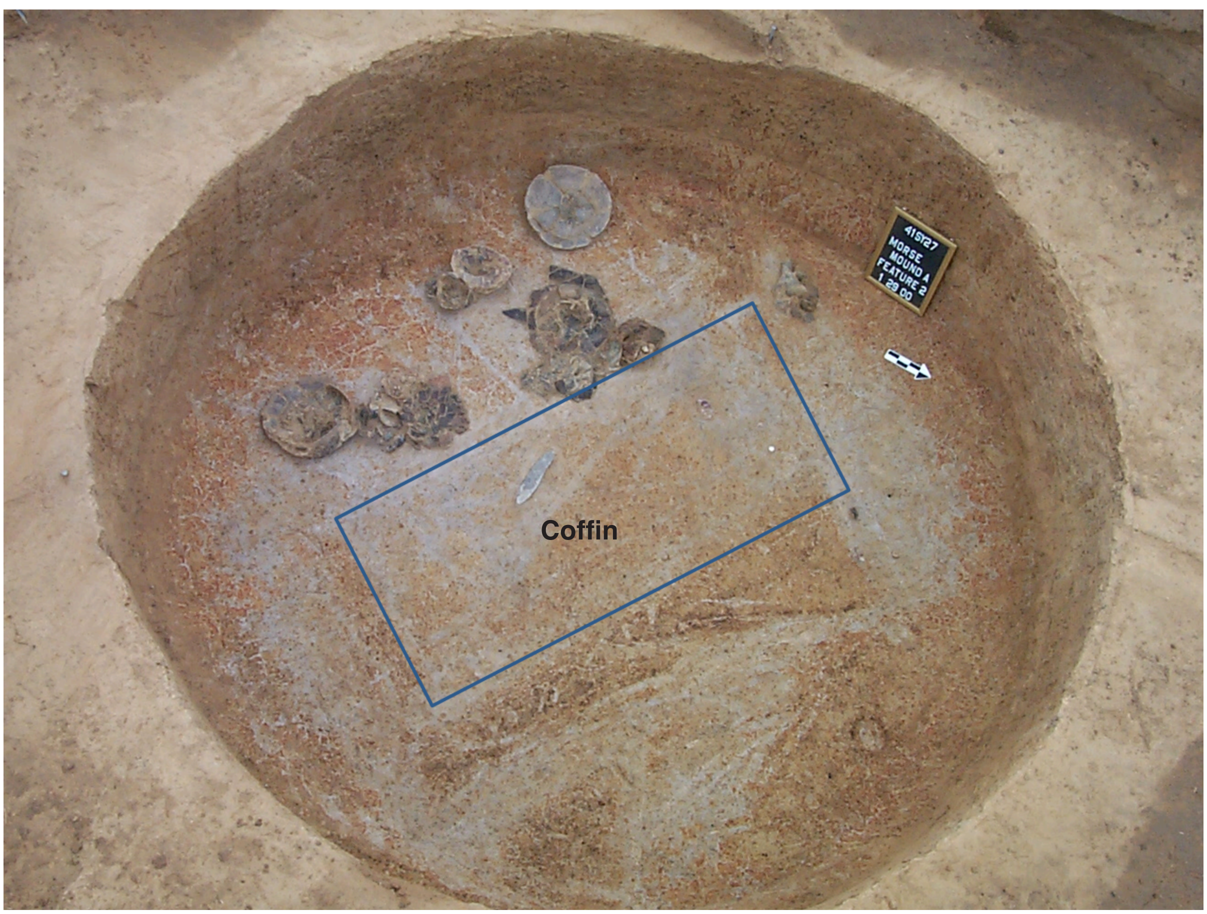

Figure 13. The shaft tomb following complete excavation showing the outline of the coffin.

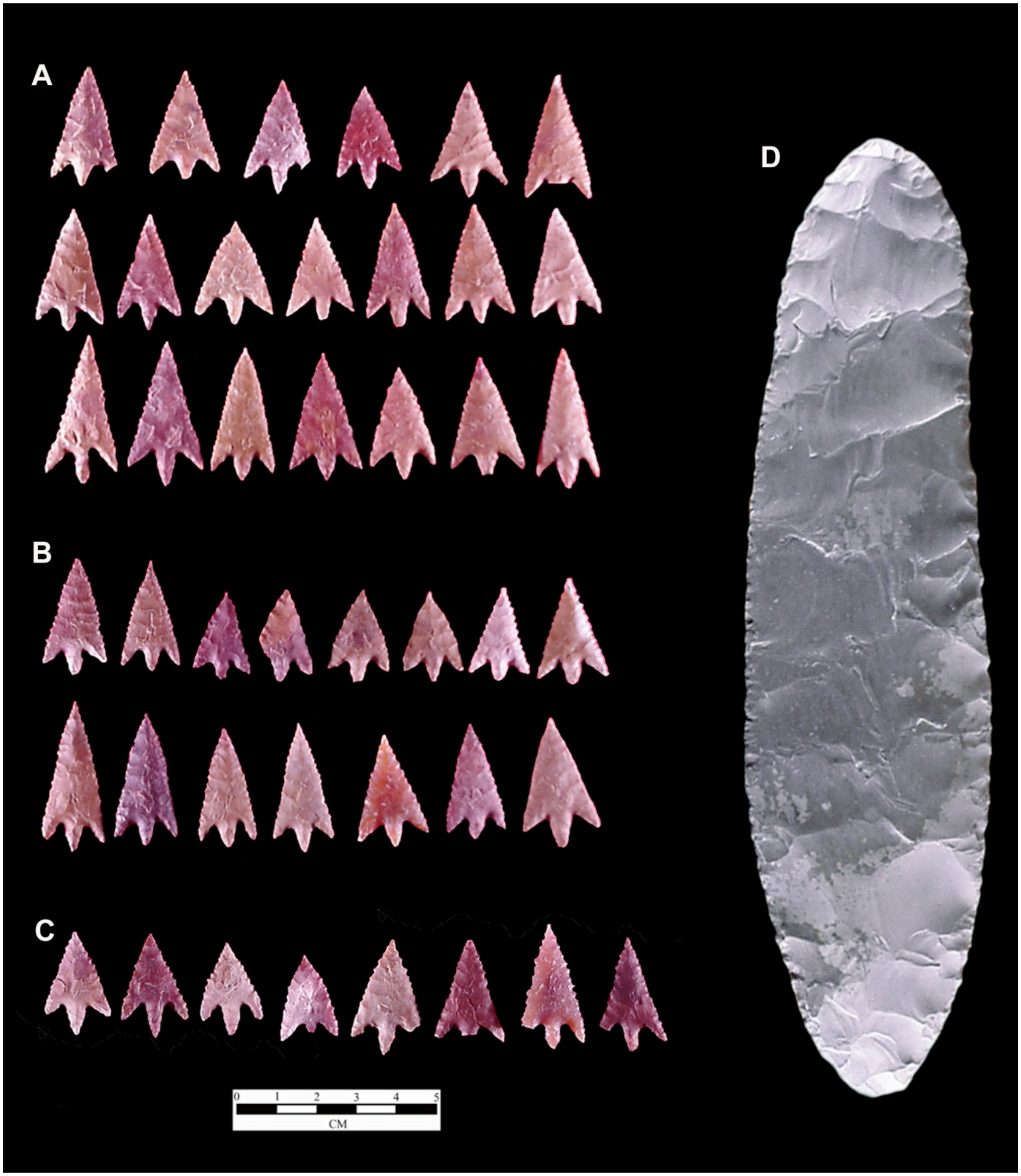

Figure 14. Lithics found in and around Container 1 or Coffin: A, Group 1 arrow points found in quiver near chest area of interred individual; B, Group 2 arrow points found in quiver near chest area of interred individual; C, Group 3 arrow points found just north and outside of the Coffin at its west-northwest end; D, large Edwards chert biface found in the area of the interred individual's right hand.

had a different Tyson Engraved design featuring the SZ element and attaching lines inside two diamond elements, informally dubbed "Armata Engaved" in the field; these were placed upright in the usual manner. One wonders if the different treatment of the two sets of bowls communicated something about the ideological narrative referred to by the contrasting engraved designs, or if there was some meaning to their placement related to religious fealty to a particular major center or leader.

Just to the west and north of the proximal (west-northwest) end of the coffin, there was a distinctive area that contained a large amount of gray silt material with a third quiver of arrow points (see Figure 14c), a pipe, and a set of ear spools (see Figure 15c-d). I believe that these artifacts mark the associated goods for the interment of a second individual, perhaps a young boy buried just outside the principal individual's coffin.

The most striking feature of the Morse Mound tomb was the evidence of the perishable materials that suggested the outlines of boxes and basketry. Eight containers of various sizes were identified. These certainly remind one of Espinosa's (Hatcher 1927) descriptions of looking in "two chests made of reeds and curiously painted with their lids measuring about three spans square" in which he found vessels of black wood, zoomorphic figurines, feather headdresses, and bird bone flutes. Kent Riley has discussed (in a PowerPoint presentation shared with the author) "sacred bundles" that come in many forms, including basketry, which hold objects of ritual intensification. He states that these bundles and their contents are animated, are foci for supplication, are portals to the power of the natural or other worlds, and can function to contact ancestors and the voices of deities. George Sabo and Elizabeth Horton (n.d.) have recently been working on Double-woven lidded baskets from the Great Mortuary in Spiro's Craig Mound as containers for "regalia associated with mythic lineage heroes." The working hypothesis here is that the ephemeral containers at the Morse Mound shaft tomb represent sacred bundles, placed to heighten the veneration given to a fallen grand xinesi-like individual.

SUMMARY AND CONCLUSIONS

Three centuries ago, Spanish and French soldiers, traders, diplomats, and missionaries made

Figure 15. Ear spools: a-b, found in the west-northwest end of Container 1 or Coffin; c-d, found just north and outside of the Coffin at its west-northwest end.

Figure 16. One of two Tyson Engraved vessels found upside down south of the Coffin.

Figure 17. One of two "Armata Engraved" carinated bowls [Tyson Engraved] found upright south of Coffin.

their way for various reasons into the Kingdom of the Tejas. Some of them wrote diaries, letters, reports, and, later, memoirs of their initial contact with the Hasinai Caddo. In the early decades, the Spanish were allowed into the Kingdom only so far, usually being kept at its western periphery. From the European descriptions, the Hasinai were in control of their territory and had an organized and well-ordered society. Even if the Spanish priests and soldiers had little respect for the Caddo beliefs, the native groups had an elaborate religious perspective on their own lives, the powerful spiritual forces in the cosmos, and the methodologies of integrating their communities with transcendence. Perhaps nowhere in the archeological record can people today develop an understanding of the worldview of ancient societies as they can by witnessing the treatment of people after death, in light of contemporaneous accounts and the shared cultural memories of modern day descendants.

The two prehistoric Shelby County Caddo sites discussed here yield glimmers of elite mortuary practices and ceremonialism witnessed by Europeans several centuries later. It is clear that great care was taken to provide these deceased people with the materials that would be needed in their journey on the "path of souls" and to equip them for encounters with supernatural beings. The fallen elites were real people, adults and infants, that the community knew and loved, but they were also representative of greater forces that resided in upper and lower tiers of the universe. Their burial allowed the community to touch and encounter the unseen. They prayed that their supplications would be pleasing to Caddi Ayo Amay.

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My first expression of appreciation is to a true East Texas original, Joe Louis Jones of Center, Texas. Louis first took me to the Tyson site in November 1991, and then he pushed the Texas Historical Commission (THC) to test the Morse Mound site (then known as the Calvin Davis site) in October 1999. Both actions led to the remarkable discoveries discussed in this article. His passion for archeology has made a lasting contribution to the history and prehistory of Shelby County.

I remain indebted to the landowners of the Tyson site, Mary Evelyn Tyson Johnson and the late E. F. "Foots" Johnson, and to Ronald and Kay Morse, owners of the Morse Mound site, for their tremendous support of the field work on their property and the wonderful access to the artifacts by researchers in the years since. Members of the East Texas Archeological Society, the Dallas Archeological Society, students from the Episcopal School of Dallas, and many others volunteered their effort at the Tyson site. In 50 days in the field from 1991 until 2002, a remarkable 276 people contributed a total of 4,700 hours of work! My heartfelt thanks goes out to all the professional archeologists mentioned herein, especially Bob Skiles and Velicia Bergstrom, and to several others who came by to visit. Thanks to Jim Bruseth and Mark Parsons of the THC for making the Morse Mound excavations possible. Many stewards of the Texas Archeological Stewardship Network (Patti Haskins, Connie Hodges, Louis Jones, Art Tawater, Alice Stultz, Gladys Swanson, Mark Walters, Reeda Peel, Charlie Bollich, and Bryan Boyd) contributed their time in the field along with many local supporters such as Tem Morrison, Nelda Robinson, and Richard Wright. The National Park Service provided the GPR assessment of the mound. The late Cecile Elkins Carter graced the excavation for several days. Thanks to all.

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REFERENCES CITED

Barr, J.
2007 *Peace Came in the Form of a Woman: Indians and Spaniards in the Texas Borderlands*. The University of North Carolina Press, Chapel Hill.

Bolton, H. E.
1908 *Spanish Exploration in the Southwest, 1542-1706*. Charles Scribner's Sons, New York.

1915 *Texas in the Middle Eighteenth Century: Studies in Spanish Colonial History and Administration*. University of California Press, Berkeley.

1987 *The Hasinais: Southern Caddoans as seen by the Earliest Europeans*. University of Oklahoma Press, Norman.

Brain, J. P. and P. Phillips
1996 *Shell Gorgets: Styles of the Late Prehistoric and Protohistoric Southeast*. Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge.

Bronk Ramsey C., E. M. Scott, and J. van der Plicht
2013 Calibration for archaeological and environmental terrestrial samples in the time range 26–50 ka cal BP. *Radiocarbon* 55(4):2021-2027.

Brown, J. A.
2012 Spiro Reconsidered: Sacred Economy at the Western Frontier of the Eastern Woodlands. In *The Archaeology of the Caddo,* edited by T. K. Perttula and C. P. Walker, pp. 117-138. University of Nebraska Press, Lincoln.

Bruseth, J. E. and T. S. Turner
2005 *From a Watery Grave: The Discovery and Excavation of La Salle's Shipwreck, La Belle*. Texas A&M University Press, College Station.

Bruseth, J., M. Parsons, T. Middlebrook, and B. Martin
2000 Unprecedented Find Uncovered at the Ronald and Kay Morse Site (41SY27). *Current Archeology in Texas* 2(1):4-7.

Burton, H. S. and F. T. Smith
2008 *Colonial Natchitoches: A Creole Community on the Louisiana-Texas Frontier.* Texas A & M University Press, College Station.

Byrd, K. M.
2008 *Colonial Natchitoches: Outpost of Empires*. Xlibris Corporation, United States of America.

Cast, R.
2007 Documentation of a Native American Church Altar in Caddo County, Oklahoma. *Journal of Northeast Texas Archeology* 26:168-178.

Castaneda, C. E.
1936 *Our Catholic Heritage*. 6 Volumes. V. Von Boeckmann-Jones Co., Austin.

Carter, C. E.
1995 *Caddo Indians: Where We Come From*. University of Oklahoma Press, Norman.

Celiz, F. de
1935 *Diary of the Alarcon Expedition into Texas, 1718-1719, by Francisco de Celiz*. Translated and edited by F. L. Hoffman. Quivira Society, Los Angeles.

Chipman, D. E. and H. D. Joseph
2010 *Spanish Texas: 1519-1821*. Revised Edition. The University of Texas Press, Austin.

Corbin, J. E.
1984 *An Archaeological Assessment of a Portion of the Washington Square Mound Site (41NA49), Nacogdoches County, Texas*. Archaeological Investigations No. 1. Stephen F. Austin State University, Nacogdoches.

Corbin, J. E., T. C. Alex, and A. Kalina
1980 *Mission Dolores de los Ais*. Papers in Anthropology No. 2. Stephen F. Austin State University, Nacogdoches.

Corbin, J. E. and J. P. Hart
1998 The Washington Square Mound Site: A Middle Caddo Mound Complex in Sounth Central East Texas. *Bulletin of the Texas Archeological Society* 69:47-78.

Creel, D. G.
1996 Hatchel-Mitchell Site. In *The New Handbook of Texas, Vol. 3,* edited by R. Tyler, pp. 504-505. Texas State Historical Association, Austin.

Crown, P. L., T. E. Emerson, J. Gu, W. J. Hurst, T. R. Pauketat, and T. Ward
2012 Ritual Black Drink consumption at Cahokia. *Proceedings of the National Academy of Sciences* 109(35):13944-13949.

Dockall, H. D.
1994 Human Skeletal Remains from the Tyson Site (41SY92). *Journal of Northeast Texas Archaeology* 3:37-50.

1995 Application of Bement's Spray Sealant Technique to Infant Skeletal Remains. *Journal of Field Archaeology* 22(3):385-387.

Dorsey, G. A.
1997 *Traditions of the Caddo*. University of Nebraska Press, Linclon.

Dye, D. H. and A. King
2007 Desecrating the Sacred Ancestor Temples: Chiefly Conflict and Violence in the American Southeast. In *North American Indigenous Warfare and Ritual Violence*, edited by R. J. Chacon and R. G. Mendoza, pp. 160-181. University of Arizona Press, Tuscon.

Early, A. M. (editor)
1993 *Caddoan Saltmakers in the Ouachita Valley: The Hardman Site*. Research Series No. 43. Arkansas Archeological Survey, Fayetteville.

Fields, R. C. and E. F. Gadus (editors)
2012 *Archeology of the Nadaco Caddo: The View from the Pine Tree Mound Site (41HS15), Harrison County, Texas*. 2 Vol. Report of Investigations No. 164. Prewill and Associates, Inc., Austin.

Gadus, E. F.
2013 Twisted Serpents and Fierce Birds: Structural Variation in Caddo Engraved Ceramic Motifs. *Bulletin of the Texas Archeological Society* 84:213-245.

Good, C. E.
1977 Moores Plantation: Thesis Prospectus. MS on file, Texas Archeological Research Laboratory, The University of Texas at Austin.

1982 Analysis of Structures, Burials and other Cultural Features. In *The Deshazo Site, Nacogdoches County, Texas, Volume 1,* edited by D. A. Story, pp. 51-112. Texas Antiquities Permit Series No. 7. Texas Antiquities Committee, Austin.

Gregory, H. F.
1973 Eighteenth Century Caddoan Archaeology: A Study in Models and Interpretation. Ph.D. dissertation, Department of Anthropology, Southern Methodist University, Dallas.

Hackett, C. W.
1945 The Marquis of San Miguel de Aguayo and his Recovery of Texas from the French, 1719-1723. *Southwestern Historical Quarterly* 49:193-214.

Harris, R. K., I. M. Harris, J. C. Blaine, and J. Blaine
1965 A Preliminary Archeological and Documentary Study of the Womack Site, Lamar County, Texas. *Bulletin of the Texas Archeological Society* 36:287-365.

Hatcher, M. A.
1927 Descriptions of the Tejas or Asinai Indians, 1691-1722. *Southwestern Historical Quarterly* 30:206-218, 283-204, 31:50-62, 150-180.

Hunter, D. G.
1994 Miscellaneous Artifacts. In *The McClelland and Joe Clark Sites: Protohistoric-Historic Caddoan Farmsteads in Southern Bossier Parish, Louisiana,* edited by D. B. Kelley, pp.147-164. Coastal Environments, Inc., Baton Rouge.

Jackson, A. T.
1932 Exploration of a Burial Site on E. H. Moores Plantation in Bowie County, Texas. MS on file, Texas Archeological Research Laboratory, The University of Texas at Austin.
1936 A Perpetual Fire Site. *Bulletin of the Texas Archeological and Paleontological Society* 8:134-174.
1938 Fire in East Texas Burial Sites. *Bulletin of the Texas Archeological and Paleontological Society* 10:77-113.

Jackson, H. E., S. L. Scott, and F. F. Schambach
2012 At the House of the Priest: Faunal Remains from the Crenshaw Site (3MI6), Southwest Arkansas. In *The Archaeology of the Caddo,* edited by T. K. Perttula and C. P. Walker, pp. 47-85. University of Nebraska Press, Lincoln.

Jackson, M. K., T. Middlebrook, G. Avery, H. Shafer, and B. Meissner.
2012 *Trade and Cultural Interaction along El Camino Real de los Tejas during the Spanish Colonial and Republic Periods in Nacogdoches County, Texas*. 2 Vols. Nine Flags Museum, Nacogdoches.

Jelks, E. B.
1965 The Archeology of McGee Bend Reservoir, Texas. Ph.D. dissertation, Department of Anthropology, The University of Texas at Austin.

Jelks, E. B. (editor)
1967 The Gilbert Site: A Norteño Focus Site in Northeastern Texas. *Bulletin of the Texas Archeological Society* 37:1-248.

Kay, M.
1984 Late Caddo Subtractive Technology in the Red River Basin. In *Cedar Grove: An Interdisciplinary Investigation of a Late Caddo Farmstead in the Red River Valley,* edited by N. L. Trubowitz, pp. 174-206. Research Series No. 23. Arkansas Archeological Survey, Fayettville.

Kelley, D. B. (editor)
1994 *The McClelland and Joe Clark Sites: Protohistoric-Historic Caddoan Farmsteads in Southern Bossier Parish, Louisiana*. Coastal Environments, Inc., Baton Rouge.

Kenmotsu, N. A.
1992 The Mayhew Site: A Possible Hasinai Farmstead, Nacogdoches County, Texas. *Bulletin of the Texas Archeological Society* 63:135-175.

King, A.
2011 Iconography of the Hightower Region of Eastern Tennessee and Northern Georgia. In *Visualizing the Sacred: Cosmic Visions, Regionalism, and the Art of the Mississippian World*, edited by G. E. Lankford, F. K. Reilly, and J. F. Garber, pp. 279-273. University of Texas Press, Austin.

Kleinschmidt, U. K. W.
1982 Review and Analysis of the A. C. Saunders Site, 41AN19, Anderson County, Texas. Master's thesis, Department of Anthropology, The University of Texas at Austin.

Kozuck, L.
2002 Olivella Beads from Spiro and the Plains. *American Antiquity* 67(4):697-709.

Lankford, G. E.
2007 The "Path of Souls": Some Death Imagery in the Southeastern Ceremonial Complex. In *Ancient Objects and Sacred Realms: Interpretations of Mississippian Iconography,* edited by F. K. Reilly and J. F. Garber, pp. 174-212. University of Texas Press, Austin.
2011 *Native American Legends of the Southeast: Tales from the Natchez, Caddo, Biloxi, Chickasaw, and Other Nations*. The University of Alabama Press, Tuscaloosa.

Lankford, G. E., F. K. Reilly, and J. F. Garber (editors)
2011 *Visualizing the Sacred: Cosmic Visions, Regionalism, and the Art of the Mississippian World*. University of Texas Press, Austin.

Lemee, P. R.
1998 Tíos and Tantes: Famial and Political Relationships of Natchitoches and the Spanish Colonial Frontier. *Southwestern Historical Quarterly* 101:341-350.

2003 Ambivalent Successes and Successful Failures: St. Denis, Aguayo, and Juan Rodriquez. In *The French in Texas*, edited by F. Lagarde, pp. 35-45. University of Texas Press, Austin.

Marceaux, S. and D. H. Dye
2007 HightowerAnthropomorphic Marine Shell Gorgets and Duck River Sword-Form Flint Bifaces: Middle Mississippian Ritual Regalia in the Southern Appalachians. In *Southeastern Ceremonial Complex: Chronology, Content, Context,* edited by A. King, pp. 165-184. The University of Alabama Press, Tuscaloosa.

Middlebrook, T. A.
1993 Radiocarbon Dates from the Tyson Site (41SY92). *Caddoan Archeology Newsletter* 3(4):2-8.
1994 An Update on the Archaeological Investigations at the Tyson Site. *Journal of Northeast Texas Archaeology* 3:1-36.

Middlebrook, T. and R. Middlebrook
1996 Of Hearth and House. *Caddoan Archeology Newsletter* 6(4):11-22.

Middlebrook, T. and T. K. Perttula
2008 Archaeological Investigations at the Henry M. Site (41NA60): An Early Historic Caddo Farmstead in Nacogdoches County, Texas. *Journal of Northeast Texas Archaeology* 28:13-20.

Moore, C. B.
1912 Some Aboriginal Sites on Red River. *Journal of the Academy of Natural Sciences of Philadelphia* 14(4):526-636.

Morfi, J.
1932 *Excerpts from the Memorias for the History of the Province of Texas*. Edited and translated by F. C. Chabot. Naylor Printing Company, San Antonio.

Nardini, L. R.
1963 *My Historic Natchitoches, Louisiana and its Environment*. Nardini Publishing Company, Natchitoches.

Newell, H. P. and A. D. Krieger
1949 *The George C. Davis Site, Cherokee County, Texas*. Memoir No. 5. Society for American Archaeology, Menasha, Wisconsin.

Perino, G.
1983 *Archaeological Research at the Bob Williams Site (41RR16), Red River County, Texas*. Museum of the Red River, Idabel.

Perttula, T. K.
1992 *"The Caddo Nation": Archaeological and Ethnohistoric Perspectives*. University of Texas Press, Austin.
2004 The Prehistoric and Caddoan Archeology of the Northeast Texas Pineywoods. In *The Prehistory of Texas,* edited by T. K. Perttula, pp. 370-407. Texas A&M University Press, College Station.
2005 1938-1939 WPA Excavations at the Hatchel Site (41BW3) on the Red River in Bowie County. *Southeastern Archaeology* 24(2):180-198.
2009 Extended Entranceway Structures in the Caddo Archaeological Area. *Southeastern Archaeology* 28(1):27-42.

Perttula, T. K. and L. Green
2006 Marine Shell Disks from Protohistoric Sites on Stouts Creek, Hopkins County. *Journal of Northeast Texas Archaeology* 25:19-25.

Perttula, T. K. and R. Rogers
2007 The Evolution of a Caddo Community in Northeast Texas: The Oak Hill Village Site (41RK214), Rusk County, Texas. *American Antiquity* 72(1):71-94.

Perttula, T. K., M. Walters, and B. Nelson
2012 *Archeological Investigations at the Pace McDonald Site (41AN51): A Middle Caddo Mound Center in the Neches River Basin in East Texas*. Special Publication No. 21. Friends of Northeast Texas Archaeology, Pittsburg and Austin.

Perttula, T. K., B. Nelson, R. L. Cast, and B. Gonzalez
2010 *The Clements Site (41CS25): A Late 17th- to Early 18th-Century Nasoni Caddo Settlement and Cemetery*. Anthropological Papers No. 92. American Museum of National History, New York.

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.

Perttula, T. K., M. Walters, B. Nelson, B. Gonzalez, and R. Cast, with a contribution by R. G. Franciscus
2010 *Documentation of Associated and Unassociated Caddo Funerary Objects in the Stephen F. Austin State University, Nacogdoches, Texas*. Stephen F. Austin State University Press, Nacogdoches.

Phillips, P., and J. A. Brown
1978-1984 *Pre-Columbian Shell Engravings from the Craig Mound at Spiro, Oklahoma*. 6 Vols. Peabody Museum Press, Cambridge.

Reilly, F. K. and J. F. Garber
2011 Dancing in the Otherworld: The Human Figural Art of the Hightower Style Revisited. In *Visualizing the Sacred: Cosmic Visions, Regionalism, and the Art of the Mississippian World*, edited by G. E. Lankford, F. K. Reilly, and J. F. Garber, pp. 294-312. University of Texas Press, Austin.

Reilly, F. K. and J. F. Garber (editors)
2007 *Ancient Objects and Sacred Realms: Interpretations of Mississippian Iconography*. University of Texas Press, Austin.

Reimer, P. J.
2013 IntCal13 and Marine13 Radiocarbon Age Calibration Curves 0-50,000 years Cal BP. *Radiocarbon* 55(4):1869-1887.

Rogers, R. and T. K. Perttula
2004 *The Oak Hill Village (41RK214), Rusk County, Texas*. Document No. 030083. PBS&J, Austin.

Sabo, G., III
1998 The Structure of Caddo Leadership in the Colonial Era. In *The Native History of the Caddo: Their Place in Southeastern Archeology and Ethnohistory*, edited by T. K. Perttula and J. E. Bruseth, pp. 159-174. Studies in Archeology 30. Texas Archeological Research Laboratory, The University of Texas at Austin.

2012 The Terán Map and Caddo Cosmology. In *The Archaeology of the Caddo,* edited by T. K. Perttula and C. P. Walker, pp. 431-447. University of Nebraska Press, Lincoln.

Sabo, G., III and E. Horton
n.d. Baskets for the Ancestors: Sacred Bundles in the Great Mortuary at the Spiro Ceremonial Center. In *Sacred Bundle*s, edited by D. Dye and K. Reilly. University of Texas Press, Austin, in press.

Schambach, F. F.
1972 Preliminary Report on the 1972 Excavations at the Ferguson Site (3HE63). *The Arkansas Archeologist* 13(1-2):1-13.

1982 The Archeology of the Great Bend Region in Arkansas. In *Contributions to the Archeology of the Great Bend Region,* edited by F. F. Schambach and F. Rackerby, pp. 1-11. Research Series No. 22. Arkansas Archeological Survey, Fayetteville.

2002 The Grandview Archeological Project: The Arkansas Archeological Survey/Arkansas Archeological Society's 2002 Field Season at the Grandview Wildlife Management Area, Columbus, Arkansas. *Field Notes* (Newsletter of the Arkansas Archeological Society) 308:3-8.

Schultz, T. C.
2010 *Architectural Variability in the Caddo Area of Eastern Texas*. Special Publication No. 16. Friends of Northeast Texas Archaeology, Pittsburg and Austin.

Skinner, S. A., R. K. Harris, and K. M. Anderson (editors)
1969 *Archaeological Investigations at the Sam Kaufman Site, Red River County, Texas*. Contributions in Anthropology No. 5. Department of Anthropology, Southern Methodist University, Dallas.

Spock, C.
1977 An Analysis of the Architectural and Related Features at the George C. Davis Site. Master's thesis, Department of Anthropology, The University of Texas at Austin.

Story, D. A.
1997 Archeological Investigations at the George C. Davis Site, Cherokee County, Texas. *Bulletin of the Texas Archeological Society* 68:1-103.

Story, D. A. (editor)
1981 *Archeological Investigations at the George C. Davis Site, Cherokee County, Texas: Summers 1979 and 1980*. Occasional Papers, Vol 1. Texas Archeological Research Laboratory, The University of Texas at Austin.

1982 *The Deshazo Site, Nacogdoches County, Texas, Vol. 1: The Site, Its Setting, Investigations, Cultural Features, Artifacts of Non-Native Manufacture, and Subsistence Remains*. Texas Antiquities Permit Series No. 7. Texas Antiquities Committee, Austin.

1995 *The Deshazo Site, Nacogdoches County Texas, Vol. 2: Artifacts of Native Manufacture*. Studies in Archeology 21. Texas Archeological Research Laboratory, The University of Texas at Austin.

Story, D. A. and D. G. Creel
1982 The Cultural Setting. In *The Deshazo Site, Nacogdoches County, Texas, Vol. 1,* edited by D. A. Story, pp. 20-34. Texas Antiquities Permit Series No. 7. Texas Antiquities Committee, Austin.

Swanton, J. R.
1942 *Source Material on the History and Ethnology of the Caddo Indians*. Bulletin 132. Bureau of American Ethnology, Smithsonian Institution, Washington, D. C.

Townsend, R. P. (editor)
2004 *Hero, Hawk, and Open Hand: American Indian Art of the Ancient Midwest and South*. Art Institute of Chicago and Yale University Press, Chicago and New Haven.

Turner, R. L.
1992 *Prehistoric Mortuary Remains at the Tuck Carpenter Site, Camp County, Texas*. Studies in Archeology No. 10. Texas Archeological Research Laboratory, The University of Texas at Austin.

Walker, C. P.
2009 Landscape Archaeogeophysics: A Study of Magnetometer Surveys from Etowah (9BW1), The George C. Davis Site (41CE19), and the Hill Farm Site (41BW169). Ph.D. Dissertation, Department of Anthropology, The University of Texas at Austin.

Walker, C. P. and D. P. McKinnon
2012 Exploring Prehistoric Caddo Communities through Archaeogeophysics. In *The Archaeology of the Caddo*, edited by T. K. Perttula and C. P. Walker, pp. 177-208. University of Nebraska Press, Lincoln.

Webb, C. H.
1940 House Types Among the Caddo Indians. *Bulletin of the Texas Archeological and Paleontological Society* 12:49-75.

1959 *The Belcher Mound, a Stratified Caddoan Site in Caddo Parish, Louisiana*. Memoirs No. 16. Society for American Archaeology, Salt Lake City.

1983 The Bossier Focus Revisited: Montgomery I, Werner, and other Unicomponent Sites. In *Southeastern Natives and Their Pasts*, edited by D. G. Wyckoff and J. L. Hofman, pp. 183-240. Studies in Oklahoma's Past No. 11. Oklahoma Archeological Survey, Norman.

Wedel, M. M.
1978 *LaHarpe's 1719 Post on the Red River and Nearby Caddo Settlements*. Bulletin No. 30. Texas Memorial Museum, Austin.

Weddle, R. S.
1991 *The French Thorn: Rival Explorers in the Spanish Sea, 1682-1762*. Texas A&M University Press, College Station.

1999 *Wilderness Manhunt: The Spanish Search for La Salle*. Texas A&M University Press, College Station.

Wyckoff, D. G. and T. G. Baugh
1980 Early Historic Hasinai Elites: A Model for the Material Culture of Governing Elites. *Midcontinental Journal of Archaeological* 5:225-283.

The Titus Phase from the Top and Bottom: Looking at Sociopolitical Organization through the Pine Tree Mound and U.S. Highway 271 Mount Pleasant Relief Route Projects

Ross C. Fields

ABSTRACT

This article explores how two recent excavation projects in Northeast Texas—one at the Pine Tree Mound site in the middle Sabine River basin and the other on Tankersley Creek in the upper Cypress Creek basin—have contributed to a better understanding of the people who lived there in Middle–Late Caddo period times, in particular, how their patterns of settlement relate to sociopolitical complexity. The Pine Tree Mound site project started with a primary ceremonial center and surrounding village and moved out from there to look at the community that supported that center. The Tankersley Creek project started at the other end with a set of rural farmsteads and went in search of their community and ceremonial center. The combined evidence from the projects indicates that previous models of sociopolitical organization and settlement patterning among the Caddo do not do justice to the complexity that characterizes the groups who occupied the region. These projects suggest that at least three Caddo groups occupied the Titus phase area, two centered on Big Cypress Creek and one centered on Potters Creek on the north side of the Sabine River. These three groups appear to have been equivalent sociopolitically, although one of them may have been more powerful than the other two. They maintained their identities over time but were bound together by ideology and the notion that they were more connected to one another than to their Caddo neighbors. The peoples of these three core communities, and almost certainly others yet to be identified, were part of something larger though, a cohesive group of Caddo people that rivaled the ethnohistorically better-known ones to their south and north in terms of power and influence.

INTRODUCTION

I summarize two recent, and very different, experiences with trying to look at how prehistoric Caddo sociopolitical organization may have been expressed through the spatial arrangement of sites. Both involved large-scale excavations at Middle to Late Caddo period sites in Northeast Texas. One was the Pine Tree Mound site project in the middle Sabine River basin of Harrison County, and the other was the U.S. Highway 271 Mount Pleasant relief route project in the upper Cypress Creek basin of Titus County (Figure 1). These areas are at the opposite ends of the Titus phase area, and each in its own way was instructive about the challenges of interpreting that spatio-temporal construct. In one case, Pine Tree Mound, we started with a great deal of data about the primary ceremonial center and its associated village and tried to move out from there to identify the community that supported that center. In the other, the U.S. Highway 271 Mount Pleasant relief route, we started at the other end of the spectrum, i.e., a set of rural farmsteads, and went in search of their community and ceremonial center.

So how is this study relevant to Dee Ann Story and her insistence that her students and colleagues think critically? Although Dee Ann was not directly involved in the work on either project, she had a role that stemmed from five things: (1) she was one of the leading scholars on Caddo archeology; (2) I was a student of hers, and much of my thinking about how to do archeology, including distinguishing between speculation and conclusions based on hard data, is based on what I learned from her; (3) she mentored another student, Pete Thurmond, who wrote a Master's thesis in 1981 that brought together a massive amount of information about the archeology of the Cypress Creek basin and that presented ideas and hypotheses about the Titus phase we are still testing today; (4) as a board member for the Archaeological Conservancy, she

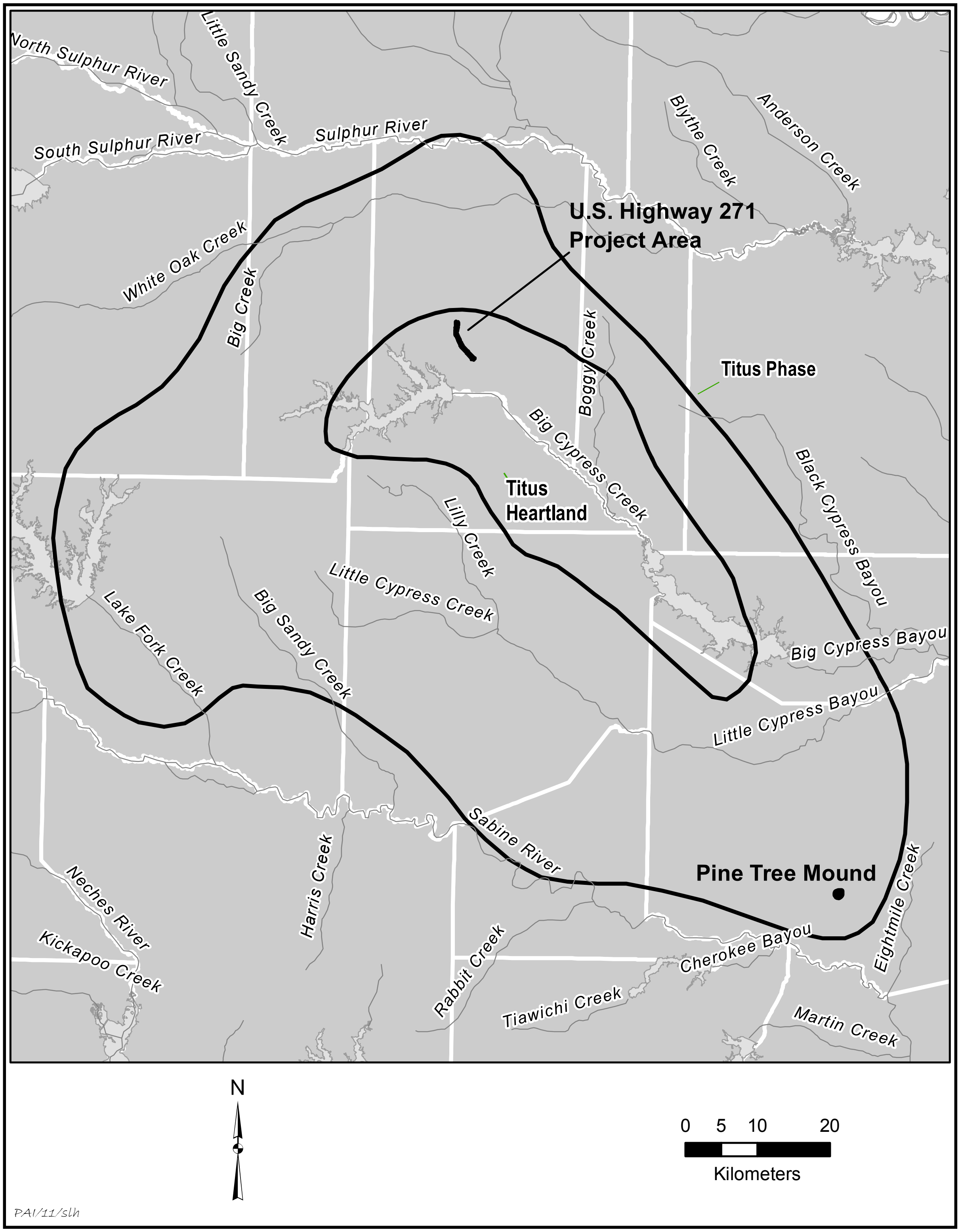

Figure 1. Map showing project area locations.

was instrumental in the Conservancy acquiring part of one of the sites we looked at, Pine Tree Mound, for long-term preservation; and (5) some of her earlier work, specifically that on the Deshazo site, provides a useful model for how Caddo sociopolitical organization might relate to community layout.

This last point bears some elaboration. In 1975–1976, Dee Ann directed field schools at Deshazo, a protohistoric Caddo hamlet on Bayou Loco in the Angelina River basin. A few years later, she and Darrell Creel developed a model of sociopolitical organization and settlement patterning to help interpret Deshazo within its proper cultural context, i.e., that of the Hasinai Caddo who populated the Neches and Angelina River valleys when the French and Spanish visited East Texas in the seventeenth and eighteenth centuries (Story and Creel 1982). The archeological correlates of the Hasinai Caddo are the Frankston and Allen phases. This model was based largely on ethnohistoric accounts, but also on actual archeological evidence, and drew on considerable work by other researchers, particularly Don Wyckoff, Tim Baugh, and Kathleen Gilmore (Gilmore 1973; Wyckoff and Baugh 1980). The model involved two levels of group identity and weakly hierarchical organization (Figure 2). The larger one, which she called the affiliated group, consisted of a number of closely allied and culturally similar groups, which she called constituent groups. The affiliated group was considered analogous to what others have called the Hasinai confederacy, and the constituent groups were analogous to a number of smaller groups named in ethnohistoric accounts. A single major ceremonial center, or temple-residential complex associated with the *grand xinesi* (high priest with primary religious authority), was proposed as the primary unifier for the affiliated group. Each constituent group consisted of a mix of residential sites of varying sizes, ranging from single domiciles to small villages, along with cemeteries, short-term use sites, and a single lesser ceremonial center associated with the *caddi's* (local chief with both political and religious authority) residential-ritual complex and assembly house. The model did not address other recorded positions of authority among the Hasinai Caddo—*canaha*, village elder with mostly political authority; *chayah*, page or assistant to the *canaha*; *tamma*, messenger or errand man; *amayxovas*, warrior; and *cona*, healer or shaman (Wyckoff and Baugh 1980:232–237)—likely because of the presumption that any relationships between those positions and settlement patterning would be invisible archeologically.

This model is relevant to studies of the Titus phase because that phase was contemporaneous with the prehistoric Frankston and early historic Allen phases, and because they were neighbors (Figure 3). In fact, some have suggested that the Titus phase represents a set of social groups equivalent to the Hasinai of the Neches-Angelina basin and the Kadohadacho of the Red River valley, just one that lacked seventeenth- and eighteenth century ethnohistorical documentation because it was too fragmented by that time and its territory was off the beaten path (Perttula and Nelson 2007a:129; Thurmond 1985). While there is no reason to think that the people who made up these groups had to have identical sociopolitical systems, there is reason to suggest that there were commonalities, even though there are indications of greater complexity among Titus peoples than their southern neighbors, for example, in the much greater frequency of mound sites and occurrence of numerous large cemeteries, some with deep shaft graves, in the Titus phase area.

The remainder of this article consists of four sections. The first outlines the state of thinking about Titus phase sociopolitical organization and settlement patterning at the inception of our Pine Tree Mound site and U.S. Highway 271 relief route projects. The second summarizes how the work at the first of these contributed to some new ways of thinking about that subject; this information is somewhat abbreviated, since it reiterates what Fields and Gadus (2012a) presented in Volume 83 of this bulletin. The third describes the more-modest and more-sobering contributions of the second project, drawing from the recent technical report by Fields et al. (2013). The fourth summarizes conclusions about what the Titus phase represents based on the combined evidence from the two projects.

TITUS PHASE SOCIOPOLITICAL ORGANIZATION AND SETTLEMENT PATTERNS

One comprehensive attempt to look at spatial organization among the Titus phase Caddo was J. Peter Thurmond's Master's thesis (1981, 1990). In it, he associated the Titus phase with the Cypress cluster, a group of similar sites that he considered

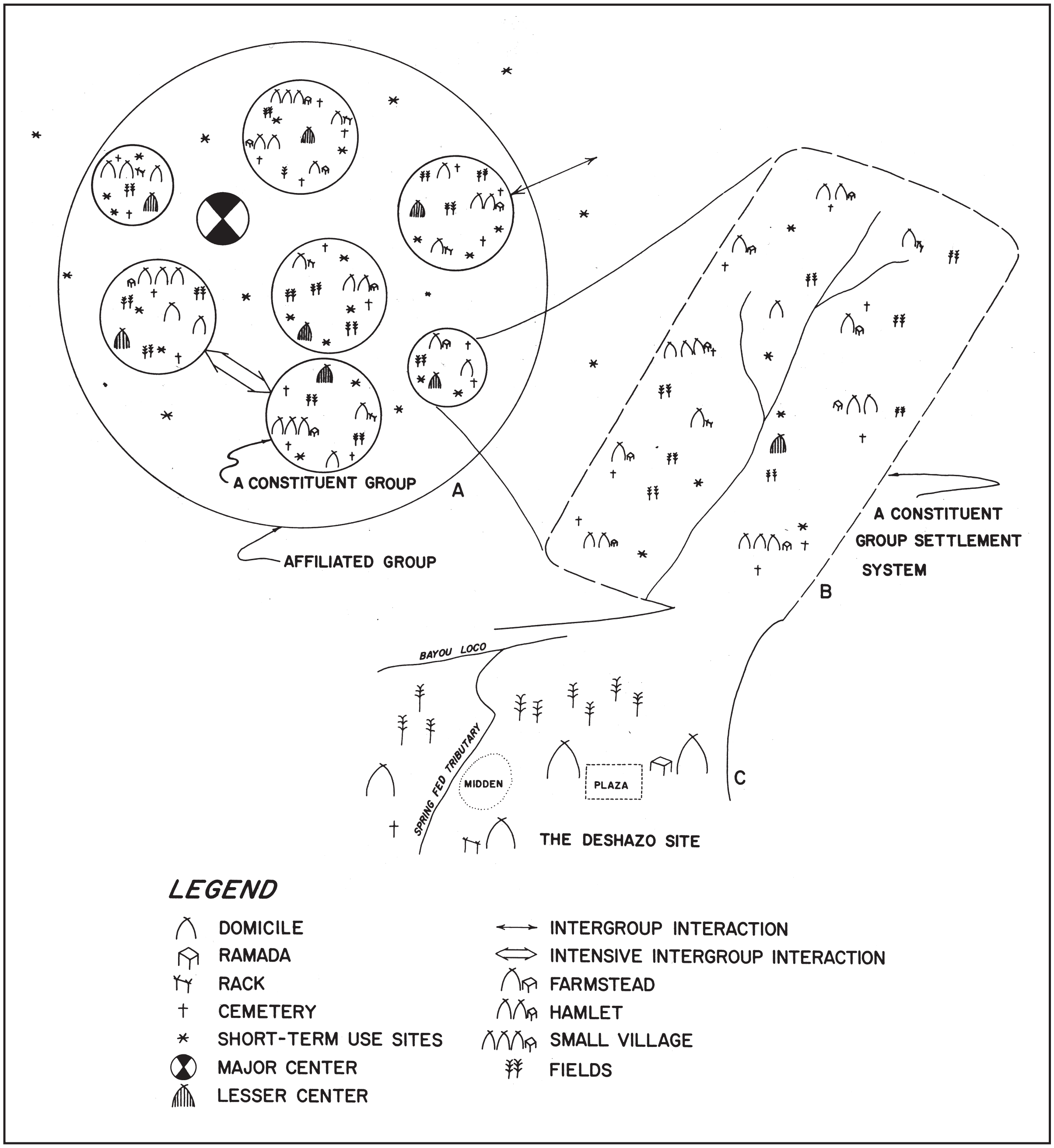

Figure 2. Story's (Story and Creel 1982) model of sociopolitical organization and settlement patterning for the Hasinai Caddo of the Neches and Angelina River valleys.

to represent a third Caddo Indian confederacy, or affiliated group using Story and Creel's (1982) terminology. Thurmond (1990:232) saw the Cypress cluster as being "centered geographically on the upper Cypress Creek, White Oak Bayou, and Lake Fork Creek basins" and as extending across a large area from the eastern arm of Lake Fork Reservoir on the west to Black Cypress Bayou on the east and from White Oak Creek and the Sulphur River on the north to the Sabine River on the south (Figure 4).

Based on burial assemblage variability in this area, which was ca. 100 km across both east-west and north-south, Thurmond saw four spatial subclusters of sites—which he named Three Basins, Tankersley Creek, Swauano Creek, and

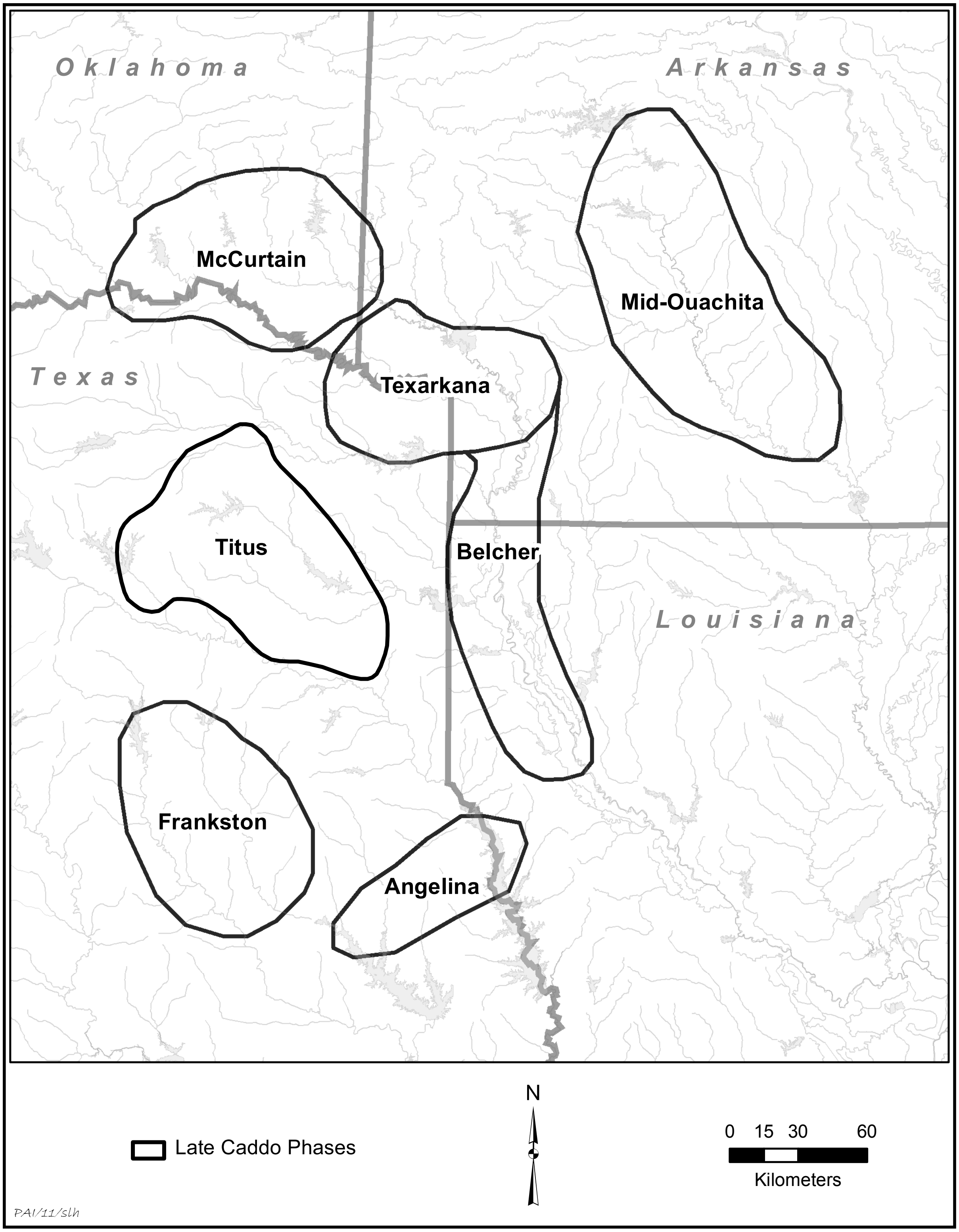

Figure 3. Map showing locations of Late Caddo phases.

Big Cypress Creek—and proposed that they represented contemporaneous sociopolitically integrated tribes or subtribes (Thurmond 1985:191-196). The Three Basins subcluster sites were in the western part in the Lake Fork Creek and Big Sandy Creek drainages, the upper-middle part of the White Oak

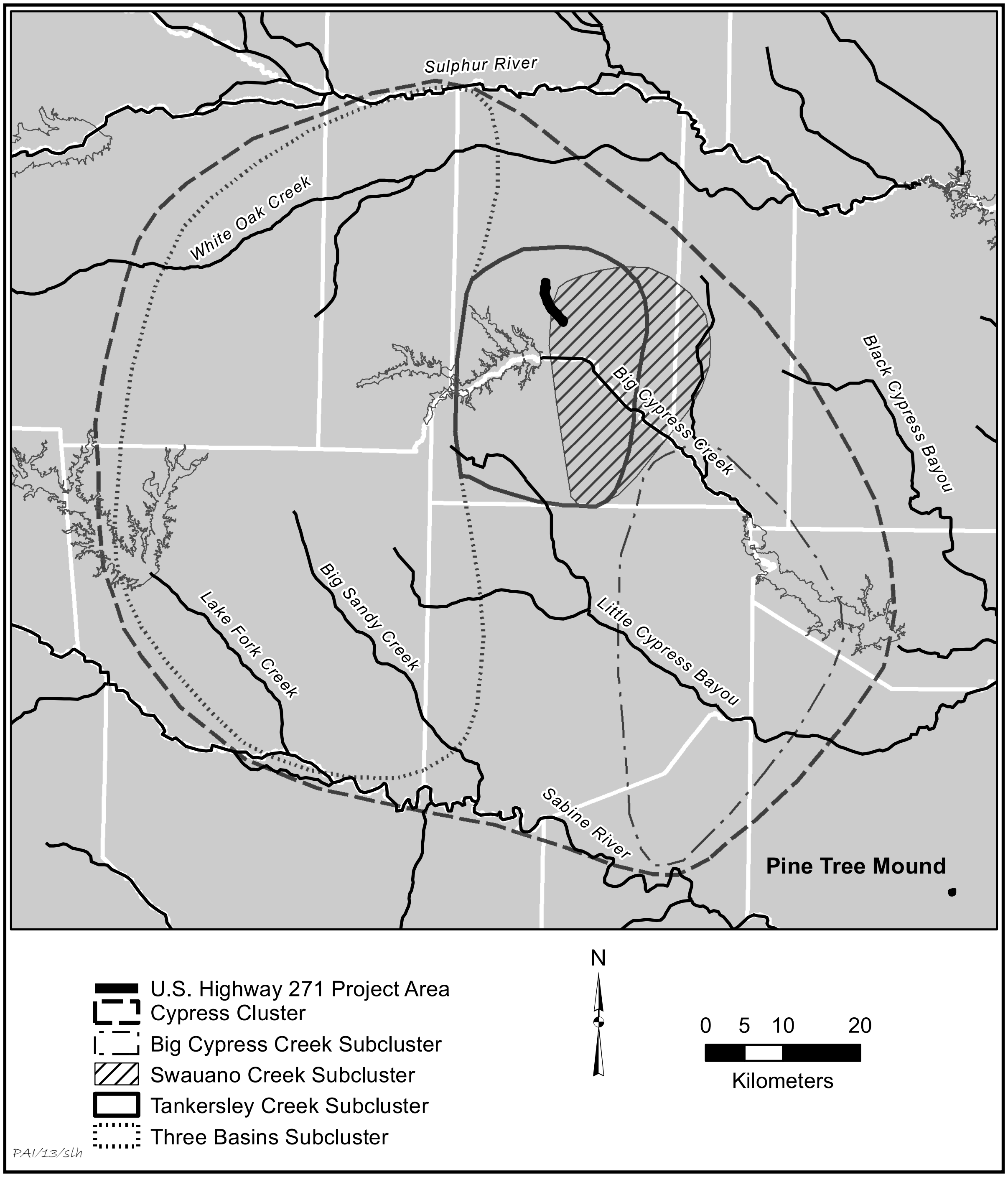

Figure 4. Map of Thurmond's (1990) Cypress cluster showing extents of hypothesized Titus phase subclusters.

Creek basin and north to the Sulphur River, and the extreme upper reaches of Big Cypress and Little Cypress Creeks, extending over an area of 45 km east-west by 90 km north-south (ca. 3,200 km^2). The Big Cypress Creek subcluster sites were at the downstream end of the region, mostly on Big Cypress Creek itself but also south of there on Little Cypress Creek and the Sabine River, extending over an area of 30 km east-west by 55 km north-south (ca. 1,300 km^2). The other two much smaller (ca. 550 km^2 each) subclusters overlapped each other in the area between the Three Basin and

Big Cypress Creek subclusters. Tankersley Creek was the western one, and Swauano Creek was the eastern one.

As Thurmond (1990:214) well knew, the limitations of the data made his interpretations speculative, and he was not able to take his analysis further than just suggesting that the spatial differences in burial assemblages related to different Titus groups. New data acquired since then have allowed more synthetic studies that have led to a better understanding of spatial organization among the Titus phase Caddo. Foremost among the more-recent studies are those of Timothy K. Perttula (1992, 2004, 2005; Perttula and Sherman 2009).

While agreeing that the four Titus subclusters could represent distinct groups that persisted over time, Perttula (2004:397) concluded that some of the variability that distinguishes the subclusters might relate to temporal changes rather than geographic differences, echoing Turner's (1978) earlier conclusions. Further, in his analysis of the mortuary ceramics from the Pilgrim's Pride site in Camp County, he could not get the assemblage to fit well with any of the subclusters, and he concluded that "the Pilgrim's Pride site, and probably other Titus phase sites in the immediate vicinity, apparently represents part of another local but separate Titus phase community from those subsumed under the subcluster groupings proposed by Thurmond" (Perttula 2005:280–281). He reached much the same conclusion in his analysis of the ceramics from the Mockingbird site (Perttula et al. 1998:251–253).

The syntheses of the evidence from the Pilgrim's Pride and Ear Spool sites (Perttula 2005:357–364; Perttula and Sherman 2009:375–377) barely mention the four subclusters and instead identify a string of Late Caddo communities along Big Cypress Creek within the Titus heartland. Three of these communities, in the southeast part, are within the northern section of Thurmond's Big Cypress Creek subcluster, and two crosscut both the Swauano Creek and Tankersley Creek subclusters (Figure 5). More recently, a sixth community has been suggested at the upstream end of the heartland, in the area of the central part of the Tankersley Creek subcluster (Perttula, Marceaux, and Nelson 2012:6–7)[1]. None of these communities was in the area of the Three Basins subcluster, as it is almost entirely outside the heartland.

According to Perttula and Sherman (2009:375–377), these heartland communities consisted of dispersed farmsteads and villages affiliated with key sites that contained public architecture (mounds and ritual buildings) or community cemeteries, i.e., places that were reserved for activities that integrated the community and bound its parts together. They propose that the five communities downstream from Tankersley Creek were anchored by the following key sites, moving from southeast to northwest: (1) Whelan (41MR2), with four mounds, at the confluence of Arms Creek and Big Cypress Creek, and H. R. Taylor (41HS3) and Peanut Patch or Patton (41HS825) nearby, with more than 150 graves at the main cemeteries; (2) in the vicinity of Meddlin Creek, the four mounds at the Harroun (41UR10) site and three mounds at the Chastain/Dalton/Camp Joy (41UR11, 41UR18, and 41UR144) complex, along with community cemeteries at Pleasure Point (41MR63), Henderson-Southall (41UR3), Big Oaks (41MR4), and Sandy Creek (41MR122), which probably contained more than 500 graves; (3) the single-mound Shelby (41CP71), P. S. Cash (41CP2), and Sam Roberts (41CP8) sites on Greasy and Prairie Creeks, with community cemeteries at Shelby and Gold Star Ballroom (41UR107) containing more than 250 graves; (4) the community cemeteries at Tuck Carpenter (41CP5) and Harold Williams (41CP10), with more than 166 graves, on Dry and Swauano Creeks and maybe the community cemetery at the W-S site with 118 graves not far away, perhaps accompanied by the single-mound Tom Hanks site (41CP239); and (5) the single-mound Pilgrim's Pride site (41CP304) on Walkers Creek and perhaps Tiddle Lake (41CP246) with another mound nearby. The proposed key sites for the sixth community, on Big Cypress upstream from Tankersley Creek, are Sandlin Dam (41TT726) and Lower Peach Orchard (41CP17). The former was a community cemetery with more than 150 graves. The latter, with 35+ known graves, apparently was not large enough to be considered a community cemetery, but with some of the graves being large shaft tombs it clearly was an important place to the Caddo who lived nearby.

All together, there are nine known mound sites in the Titus heartland (considering Chastain, Dalton, and Camp Joy as a single complex) in the list of key sites above (excludes the recently identified probable mound at the Frank Benson site in Titus County [Perttula 2012:83], as well as two others discussed later in this paper). Six have single mounds, one has three mounds, and

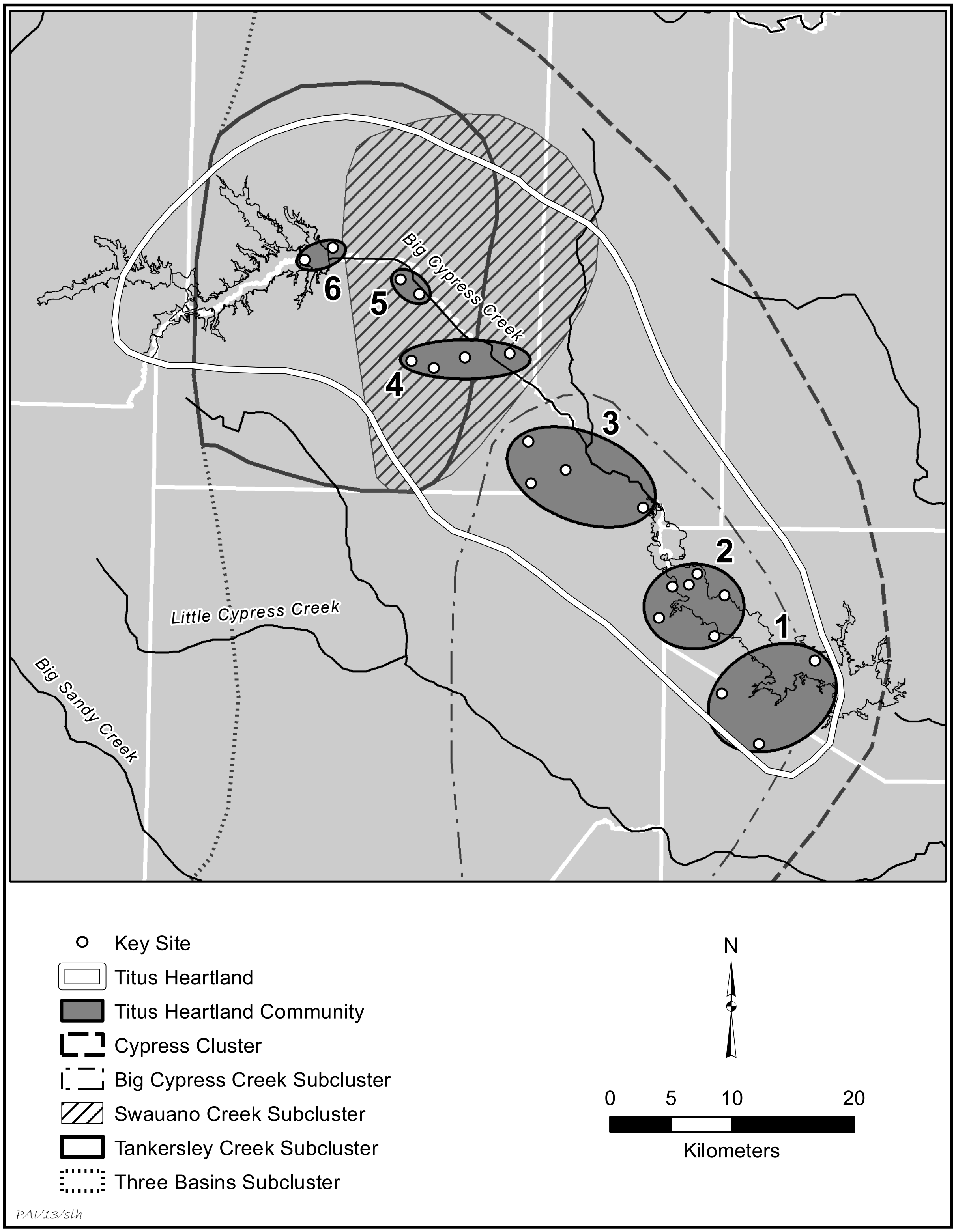

Figure 5. Map of the extents of the key sites for the six hypothesized Titus heartland communities and Cypress subclusters (key site extents do not equate to the likely extents of the communities themselves).

two have four mounds. Although not all are well understood, most of the 17 small rounded mounds apparently were erected to cap burned ceremonial structures, some of which had extended entryways (one mound at the Harroun site was put atop a grave). All three of the known multiple mound sites (Whelan, Harroun, and the Chastain/Dalton/Camp Joy complex) are in the southeastern part of the heartland, which suggests that not all communities along Big Cypress Creek were equivalent sociopolitically (Perttula and Sherman 2009:391).

The 12 known community cemeteries listed as key sites above are distributed more equably than the mounds, with only half being in the southeastern two communities where the multiple mound sites are and the other half being upstream from there (Perttula 2004:Figure 13.31). Hence, they may have served more universally to integrate communities, sometimes in the absence of ceremonial landscapes defined concretely by mounds and plazas. The fact that the three Titus heartland cemeteries known to contain large shaft graves, which surely held elite members of the society—Pleasure Point, Shelby, and Lower Peach Orchard—are distributed such that they are in separate groups of key sites argues that at least some of these truly were distinct communities occupied by groups of people who, though related, considered themselves different than their neighbors.

In terms of hierarchical organization, a case can be made that these six communities belonged to two larger core communities with a dichotomy of "belief and cultural practices" within the heartland, each covering about 675 km^2. The boundary between them was between where Greasy Creek and Dry Creek join Big Cypress Creek, meaning that one encompasses the three downstream groups of key sites listed above and the other contains the three upstream ones. Perttula and Sherman (2009:397–401) see a split in ceramic traditions between these core communities. Trade wares such as Avery Engraved from McCurtain phase sites on the Red River to the north are more common in burial assemblages of the northwestern core community, along with more La Rue Neck Banded and untyped jars and plain vessels overall. In the southeastern core community, Taylor Engraved, Bailey Engraved, and Simms Engraved appear as important secondary types along with trade wares from the Belcher phase on the Red River to the east. Utility wares for the southeastern sites include more Harleton Appliqué, Bullard Brushed, and Karnack Brushed-Incised jars. Ripley Engraved dominates the fine wares of both sub-traditions, though bowl motifs vary some between them (Perttula and Sherman 2009:400).

This reconstruction of Titus phase spatial organization certainly implies something more complicated than Story and Creel's (1982) Hasinai model or Thurmond's (1985) application of it to the Titus area. If the Titus phase does represent an affiliated group, then the presence of two core communities in the heartland alone, each composed of multiple constituent communities and distinguished from one another by differing levels of social complexity, suggests a more-strongly hierarchical system than the two-part Hasinai model calls for.

THE PINE TREE MOUND SITE PROJECT

Description and Synopsis of Work Accomplished

The Pine Tree Mound site (41HS15), in south-central Harrison County, is on a broad upland surface between Potters and Starkey Creeks, ca. 7.3 km north of where Potters Creek flows onto the floodplain of the Sabine River (Figure 6). It is a large (800 x 720 m) ceremonial and civic complex that the Caddo occupied from sometime in the A.D. 1300s to the 1700s, with the most intensive use between A.D. 1400–1525. Excavations there were sponsored by the Sabine Mining Company, a subsidiary of the North American Coal Corporation, and was prompted by the planned expansion of the Sabine Mine, a lignite operation that produces fuel for the H. W. Pirkey Power Plant nearby. The plant is operated by American Electric Power (AEP), which was the ultimate funding source for the project.

The work was done in two phases, as reported by Fields and Gadus (2012a, 2012b), with testing over all of the site in 2004 and data recovery excavations in three possible village areas at the west edge in 2006–2007. All told, the excavations covered almost 15,000 m^2 and exposed about 3,300 cultural features relating to at least 38 Caddo houses, their associated ancillary structures and activity areas, and four cemeteries. The large collection of ceramic vessels and sherds includes ones typed as Ripley Engraved, Wilder Engraved, Pease Brushed-Incised, Belcher Ridged, Cass Appliquéd, Cowhide Stamped, Harleton Appliquéd, Hodges Engraved, Karnack Brushed-Incised, La Rue Neck

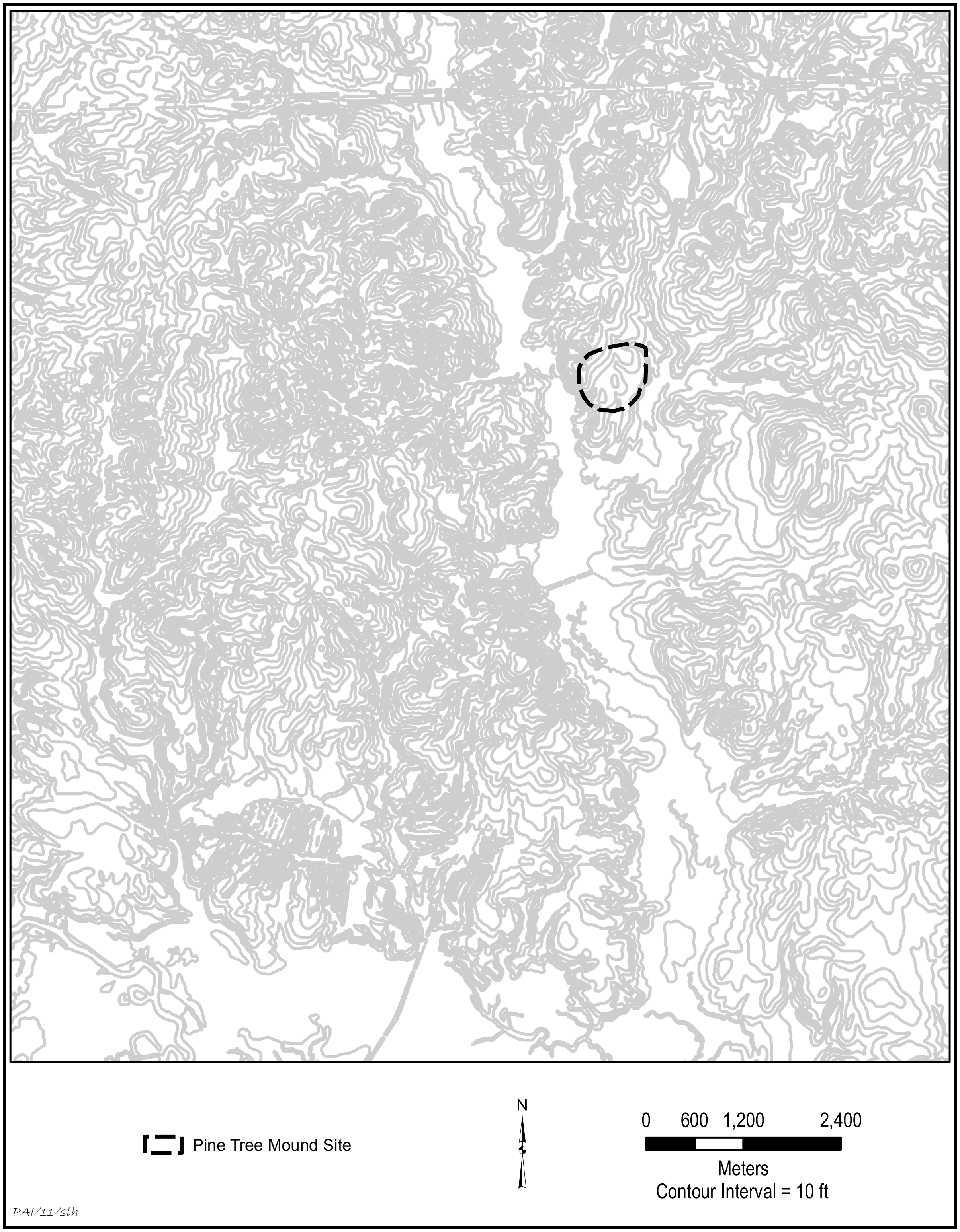

Figure 6. Topographic map showing the location of the Pine Tree Mound site relative to the Potters and Starkey Creek valleys.

Banded, Maydelle Incised, Poyner Engraved, and Taylor Engraved. The predominant arrow point styles are Perdiz, Perdiz-Bassett, and Bassett.

The 105 radiocarbon dates indicate that the history of Native American occupation in the excavated parts of the site evolved through five stages. The first, in the A.D. 1300s, involved a slow start to residential and ceremonial activities. By the early 1400s and continuing through the early 1500s, residential activities were widespread and intensive, as was use of the core area for ceremonial activities. These patterns continued through the 1500s, but in a less intensive fashion than before. One area continued to be used for residential activities into the mid-1600s, but it appears that ritual-associated construction was no longer taking place in the core area. The focus of such activities had shifted elsewhere by then. The final stage, in the 1700s, may have little to do with what came before. Area 2 saw residential use, but it was not intensive and may have been by people whose main villages were elsewhere. Any connections to the Pine Tree Mound community that thrived there in the 1400s and 1500s may have been based only on oral traditions and distant memories. It is even possible that there were no connections at all, with the latest occupations having been short-term stays by Caddo or non-Caddo people traveling through the area.

The Pine Tree Mound Community

The heart of the community established on Potters Creek in the A.D. 1300s was, of course, the ceremonial precinct at Pine Tree Mound. This area, encompassing 5.7 hectares, is a well-defined ceremonial landscape that undoubtedly served as the center for higher-level religious and political activities for a community that extended far beyond this one location (Figure 7). An open central plaza covered most of the area, with the largest mound, Mound A, at its south end. This was a platform mound that was built rapidly, probably to support one or more important buildings on its summit, although other such buildings likely stood here before the mound was erected. Mound C is a similar but much smaller platform mound about 60 m northeast of Mound A. About 90 m northwest of Mound A, on the western side of the plaza, is Mound B. It accumulated through the construction, destruction, and capping of a sequence of important buildings. Postholes and other features indicate that various structures bordered the plaza between Mounds A and B, north of Mound B, east of Mound A, and south and north of Mound C; these probably were buildings with ritual functions or houses for people critical to those functions. The plaza may have been defined topographically on its north side by the slope down to a spring-fed drainage, but its northwest corner also appears to have been marked by a large cemetery where important members of the community were buried. Aboveground poles probably marked some of the graves in this cemetery.

Combining the testing and data recovery evidence with that from two other adjacent tested sites, it appears that there may have been 15 or so residential areas on the same landform within 100–370 m of the ceremonial precinct (Figure 8). Based on the evidence from Areas 2 and 8, it seems that each area usually consisted of a single circular pole-and-thatch house averaging 6.3 m in diameter, although occasionally two houses may have stood silultaneously in some areas. Auxiliary structures such as ramadas and granaries were likely present as well but are not well-defined in the Pine Tree Mound site data set. The evidence from the excavated ones suggests that most residential areas were not occupied continuously. A house was built and then rebuilt once, twice, or three times, spanning perhaps no more than 40 years, and then that area was abandoned for a period of time before being reoccupied again and a new house built. These are interpreted as multi-generational family house compounds. Figure 9 illustrates what one of the excavated ones looks like archeologically. It was the aggregate of these residential areas in use at any one time that made up the Pine Tree Mound village.

With almost 16,000 hectares of land within the Sabine Mine north of the Sabine River having been surveyed, about 400 Native American sites having been documented, and 35 sites having seen some amount of excavation, it is possible to look beyond the immediate vicinity of Pine Tree Mound and identify other places where Caddo people who probably were members of this community lived. For a small number of sites, this can be done using radiocarbon dates or sizeable and well-reported samples of diagnostic artifacts, especially decorated fine ware ceramics. For most, though, it hinges on one simple factor: whether a site contains brushed pottery. This simple piece of evidence may not constitute proof, since multiple Caddo groups over a wide area used utility wares with brushed surfaces over a long time period, but

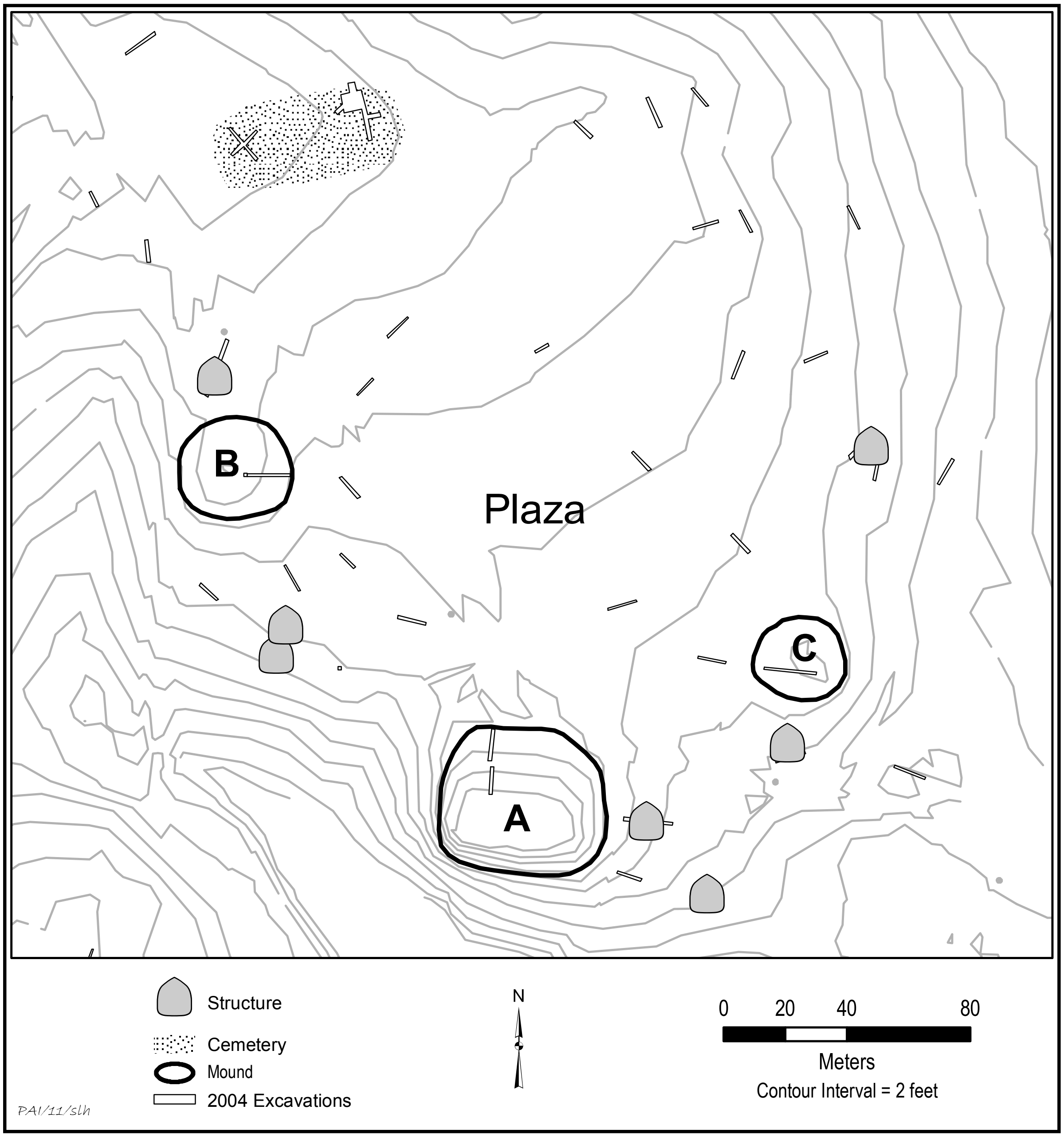

Figure 7. Layout of the ceremonial precinct at the Pine Tree Mound site.

given the prominence of brushing in the Pine Tree Mound assemblage, the fact that the site spans all of the Late Caddo period and parts of the Middle Caddo and Historic Caddo periods as well, and the fact that brushed pottery does not occur much in contexts clearly predating the A.D. 1300s in this area (e.g., at the Hudnall-Pirtle site), the presence of brushing at sites in the immediate vicinity seems like a reasonable indicator that they were occupied at the same time Pine Tree Mound was.

Forty of the known sites at the mine, or 10 percent, appear to be associated with Pine Tree Mound. They are heavily concentrated in the Potters Creek valley, with much smaller numbers on Spring Creek, Hatley Creek, Hardin Creek, and Clarks Creek to the west and along the valley wall overlooking the Sabine River floodplain (Figure 10). This suggests that the principal Pine Tree Mound community village extended for a distance of about 5.5 km along Potters Creek,

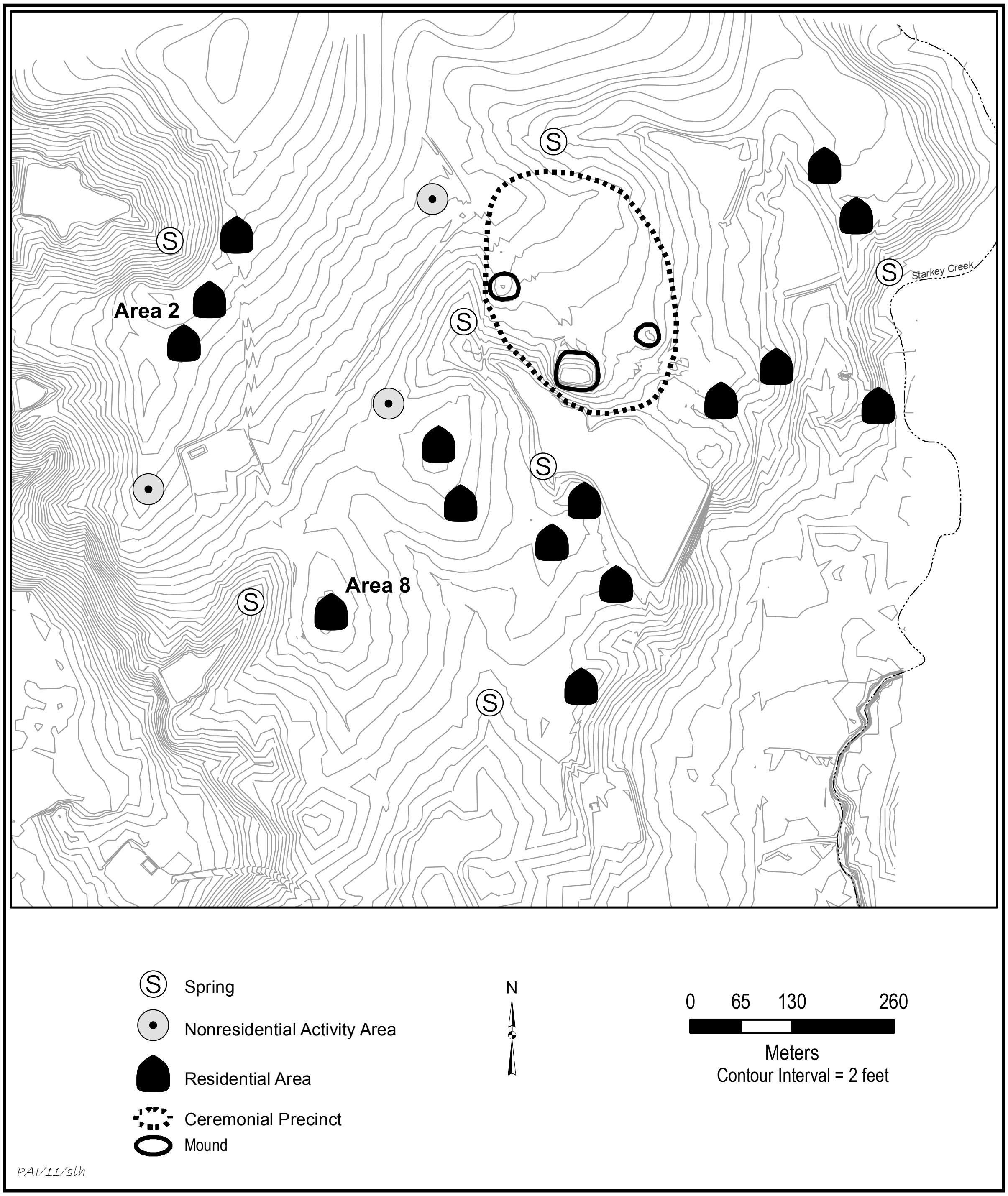

Figure 8. Map showing components of the Pine Tree Mound community around the ceremonial precinct.

with the ceremonial precinct at its northern upstream end, mirroring what Terán mapped at the Nasoni village on the Red River in A.D. 1691 (Perttula 1992:159–161). Although part of the Potters Creek valley above Pine Tree Mound has not been surveyed systematically, sufficient acreage has been examined to indicate that associated sites there are scattered rather than clustered as they are downstream. For many of the associated sites, we do not have enough information to know their function within the community, or even if the Late Caddo occupation was the major one at that

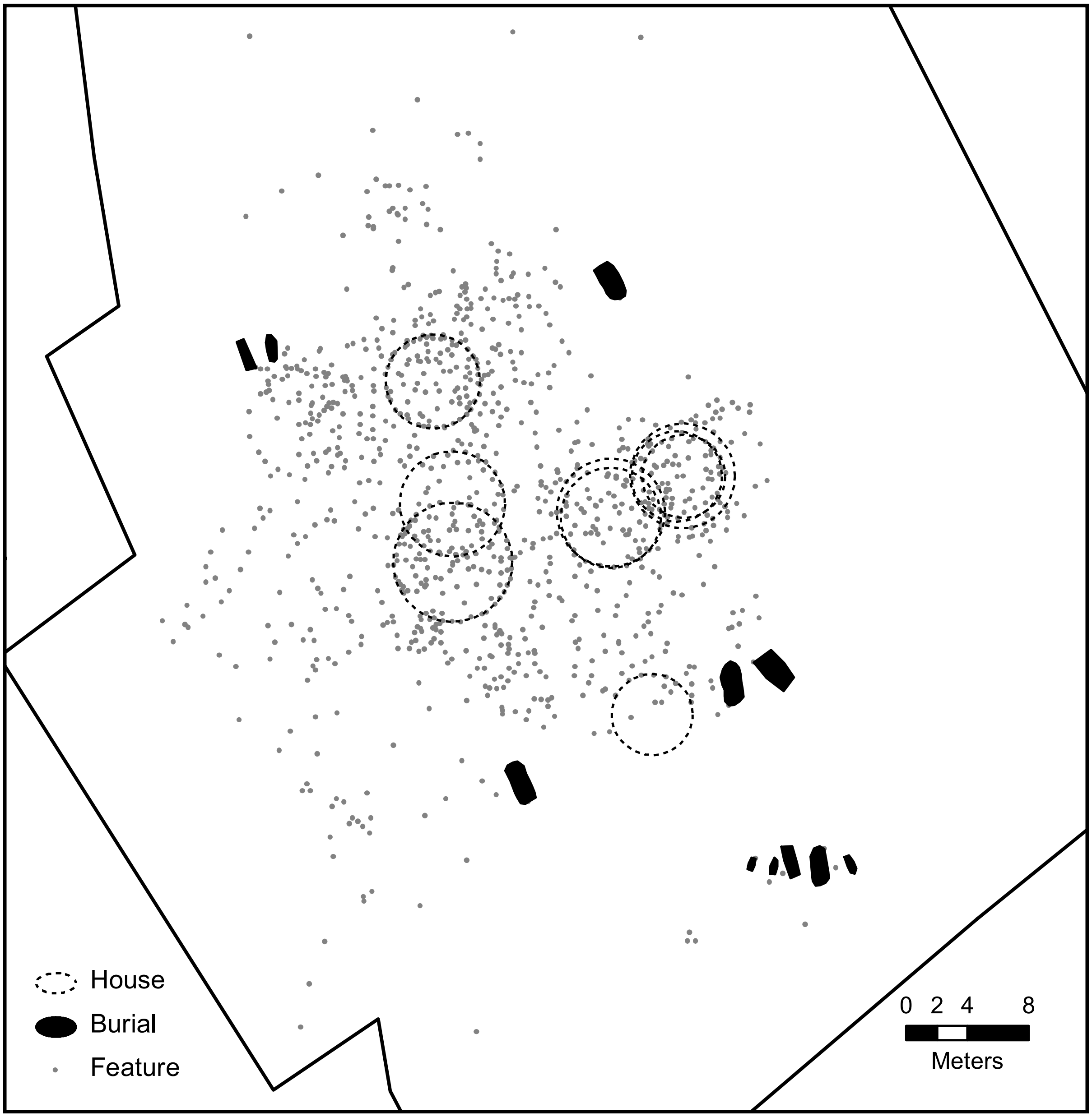

Figure 9. Plan of a residential area at the Pine Tree Mound site (Area 8) showing feature locations and identified houses.

location. From the better known ones, though, it is clear that there is variability among them. At one end of the spectrum, for example, is the Lane Mitchell site, which overlooks lower Hatley Creek just north of the Sabine River floodplain. With four or five small mounds and perhaps lacking the kind of surrounding village that Pine Tree Mound had, it may have been a subsidiary nexus of ceremonial activities for the community. At the other end are sites such as Resch on Potters Creek, 41HS231 overlooking Hatley Creek and the Sabine River floodplain, 41HS74 on Hatley Creek, and 41HS488 and Gray's Pasture on Clarks Creek that have earlier primary components and apparently were used in a non-intensive fashion, perhaps as short-term campsites during procurement or processing forays, by members of the Pine Tree Mound community (Dockall et al. 2008:57–96; Heartfield, Price and Greene, Inc. 1988:6-1 through 7-20; Keller 1993:43–45, 70–72; Keller and Speir n.d.; Perttula 2000; Webb et al. 1969:96–99). In between these extremes are sites like 41HS588, on the north wall

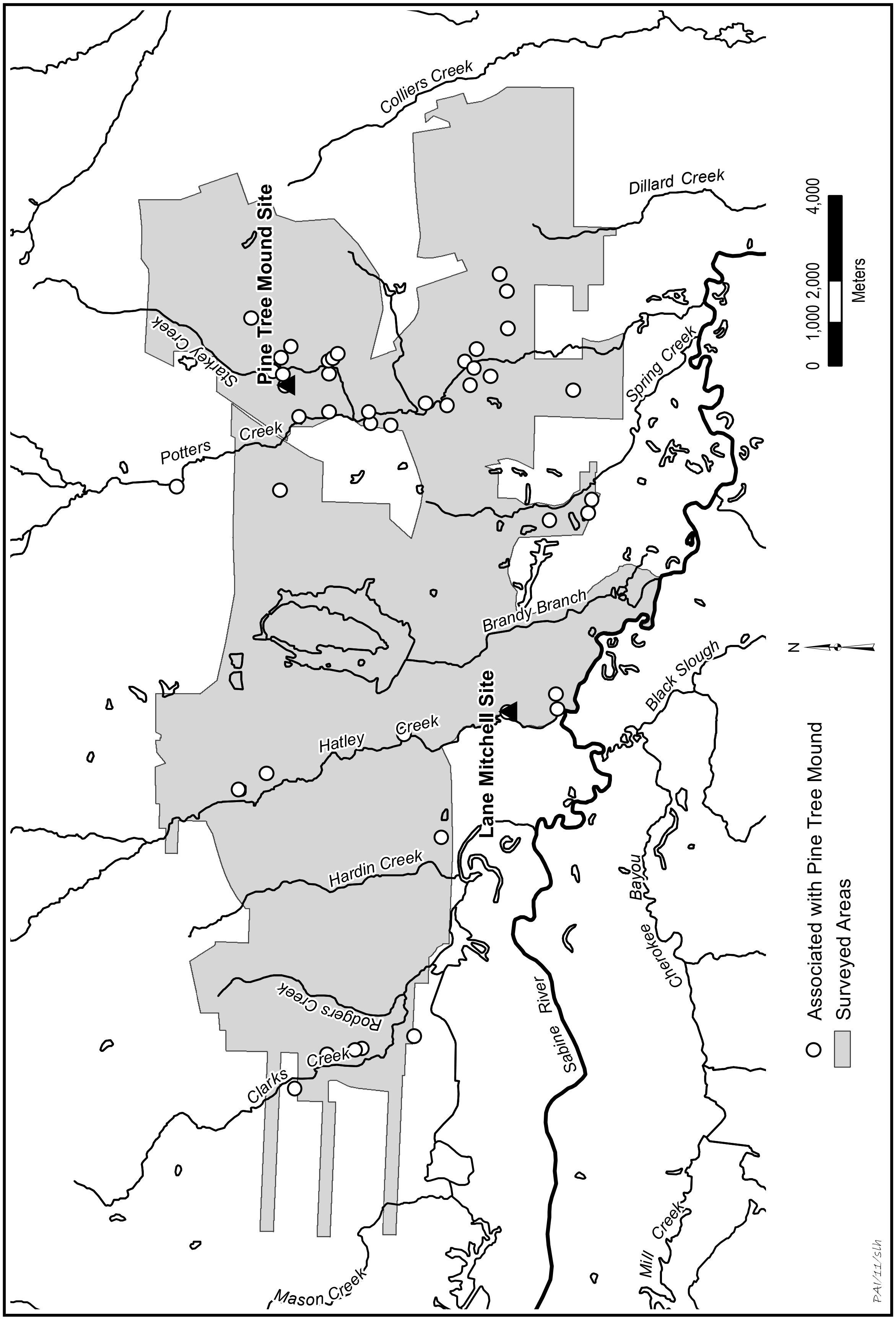

Figure 10. Map showing the distribution of Native American sites at the Sabine Mine that appear to be associated with the Pine Tree Mound site.

of the Sabine River valley just downstream from Hatley Creek, near the Lane Mitchell site. This site was tested extensively and found to be a Late Caddo residential site with one or more houses and other features, including at least one burial, and artifacts and radiocarbon dates demonstrating contemporaneity with Pine Tree Mound (Dockall et al. 2008:96–143); it clearly is an outlying hamlet.

Of course, it is highly unlikely that people who were affiliated with the Pine Tree Mound community lived solely within the 160 km^2 of land that make up today's Sabine Mine. There are no other sites like Pine Tree, with its conspicuous ceremonial landscape, anywhere nearby, and it is certain that the religious and political leaders who lived there exerted influence over an expansive territory. Lacking large numbers of excavated sites, it is hard to know how far that territory might have extended, but it is possible to make some educated guesses (Figure 11).

To the north, it likely went no farther than the divide between the Sabine River and Cypress Creek basins. The latter, and particularly Big Cypress Creek, is the heartland of the contemporaneous Titus phase, and there are enough differences between Pine Tree Mound and the Titus sites to indicate they represent distinct, though related, groups. To the west on the north side of the Sabine River, evidence from a series of looted cemeteries on Hawkins Creek in Gregg County, northwest of Longview, suggests that the boundary may have been somewhere east of there and west of Clarks Creek. East of Pine Tree Mound north of the river, it certainly went as far as Eightmile Creek, based on evidence from C. D. Marsh and other nearby sites (Griffith et al. 2012:146; Jones 1968:85–97). East beyond Eightmile and its upper tributary Quapaw Creek is the divide between the Sabine and Red River basins, and this would be a logical place for the boundary of the Pine Tree Mound territory. There is no way to know if this boundary should follow the Eightmile Creek valley closely as it moves south toward the Sabine or encompass the next two drainages to the east, Caddo and Jackson creeks. Figure 11 depicts the latter, though, based on the fact that it is a long distance down river to the next large north-side tributary, Socagee Creek.

To the south, between the Sabine River and the upper parts of the Neches basin, sites with Late Caddo components are present but not frequent. Recent survey and testing efforts in other areas of the Sabine Mine immediately south of the river have identified four sites that probably are connected to Pine Tree Mound both in terms of function, i.e., as outlying residential sites or camp sites, and via the Hasinai Trace, an ancient Indian trail (Dockall et al. 2010:229; Dockall and Fields 2011:82), but there are no large Late Caddo villages or mound sites in this area. This is true as well for nearby Martin Lake and Martin Lake Mine in Panola and Rusk counties. There are two sites with Historic Caddo components (Jones 1968:67–84; Perttula and Nelson 2007b), and at least 11 other sites where the ceramics or arrow points imply that Late Caddo components are present (Clark and Ivey 1974), but the overall density of sites that appear to be contemporaneous with Pine Tree Mound is low. This is even more obvious at Oak Hill Mine farther to the southwest. Once again, there are occasional sites that appear to have Late Caddo components (n=8), but the primary Caddo occupation of this area, as represented at the Oak Hill Village site on Mill Creek, occurred during the Middle Caddo period and mostly predates Pine Tree Mound. Oak Hill Village did yield some ceramics, arrow points, and radiocarbon dates indicating use after A.D. 1400, though, and thus people continued to live there as the ceremonial center at Pine Tree Mound was starting to reach its zenith (Rogers and Perttula 2004:96). It's hard to believe that the people who remained at Oak Hill Village were not connected to the leaders of that center just 35 km to the northeast.

In short, this part of the Sabine River basin, extending probably to the Sabine-Neches drainage divide, appears to have been settled, but only sparsely so, by people affiliated with the Pine Tree Mound Caddo. Based on the large surveys done at the Sabine Mine, Martin Lake Mine, and Oak Hill Mine (ca. 44,000 acres combined), it appears that sites contemporaneous with Pine Tree Mound occur here in a density only one-third (1 site per 2,200 acres) that of the part of the Sabine Mine north of the river (1 site per 740 acres). Deciding where to draw the Pine Tree territory boundary line moving east and west on the south side of the Sabine is more speculative, but placing it beyond Mill and Tiawichi creeks on the west and Irons Bayou, the next drainage beyond Martin Creek, on the south, makes it line up well with the boundaries suggested above for the north side of the river.

This exercise suggests that the larger Pine Tree Mound territory extended across an area roughly 50 km north-south by 60 km east-west, encompassing

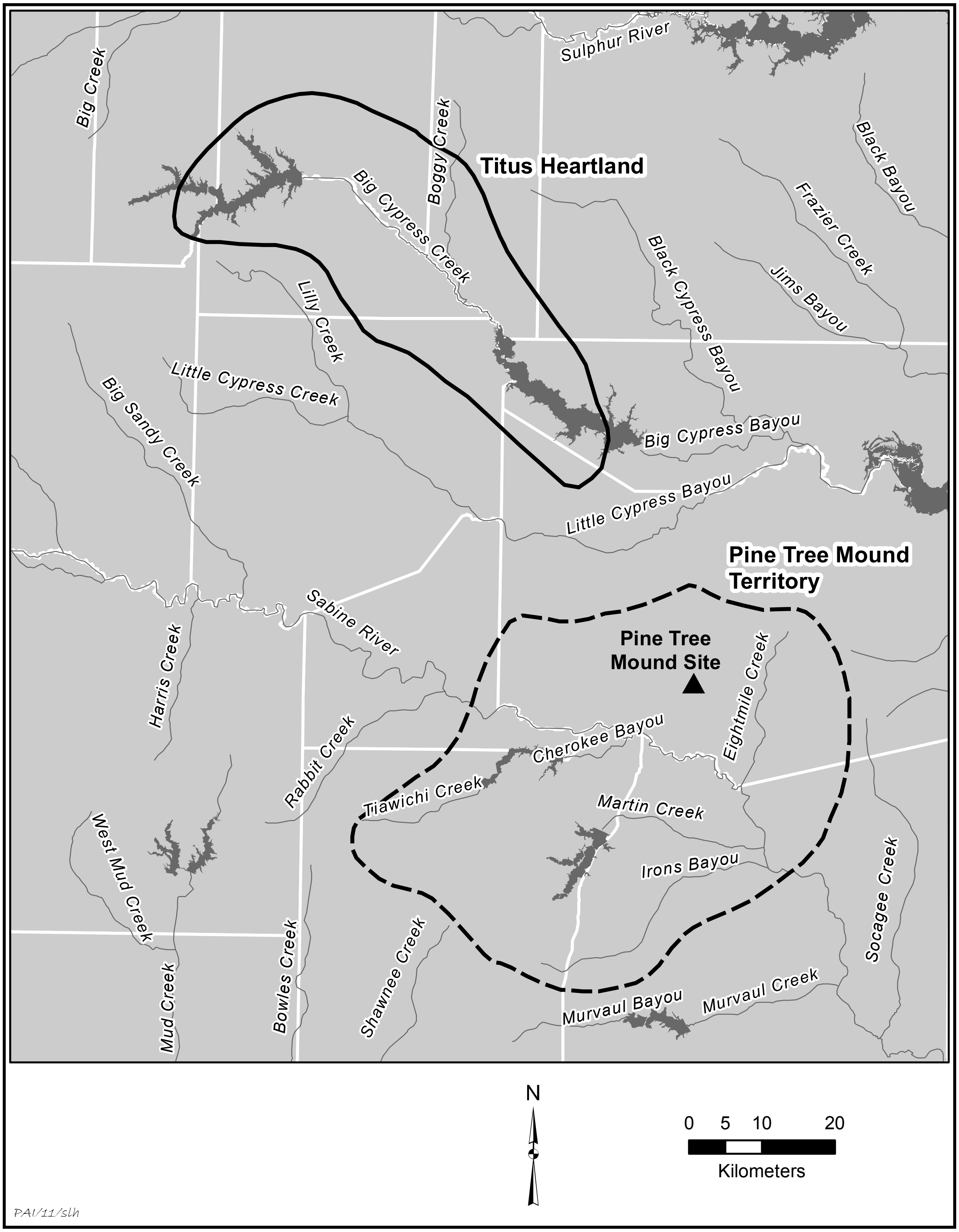

Figure 11. Map showing the hypothesized extent of the territory of the Pine Tree Mound community relative to the Titus phase heartland.

some 2,400 km^2 with the Sabine River running through the middle. People were not distributed evenly throughout this area, though. The main village was north of the river, stretching for 5.5 km along the Potters Creek valley and anchored by the Pine Tree Mound site at its north end. The rest of the community appears to have been more rural, although at two different scales. Other north-side tributary valleys, extending from maybe Mason Creek on the west to Eightmile, Caddo, or Jackson Creek on the east, may have supported moderately scattered settlements. The entire territory south of the river, accounting for well over half of it, appears to have been sparsely settled.

This largely hypothetical reconstruction is similar in some ways to Story and Creel's (1982) model of sociopolitical organization and settlement patterning for the Frankston and Allen phases described above. The evidence that is most consistent with this model is the Pine Tree Mound site itself, which certainly is a paramount ceremonial center, and the distribution and variety of associated sites; together, they make this community look like an affiliated group, using Story and Creel's terminology. What is not readily apparent are constituent groups. While it would be possible to look at Figure 10 and suggest that some clusters of sites represent constituent groups, we know too little about most of these sites to begin to address that question, and the problem becomes even more acute moving away from Potters Creek and adjacent valleys into areas where less archeological work has been done. There is some logic to interpreting the Lane Mitchell site, with four mounds, as a lesser center for a constituent group in the Hatley Creek valley, but this seems unlikely because it is so close to Pine Tree Mound and its associated village along Potters Creek. Instead, the rituals performed there may have had a different role, for example, to link the ritual space at Pine Tree with the earlier one at the Hudnall-Pirtle site south of the Sabine River.

More important than its relationship to the Frankston-Allen phase model, though, is what the evidence from Pine Tree Mound says about the Titus phase. This evidence indicates that Pine Tree Mound and its associated sites may represent a third Titus core community comparable to the two that Perttula has proposed for the heartland, i.e., a group of Caddo people who were intimately tied to their neighbors in the Cypress basin to the north (based largely on similarities in pottery styles and site types, i.e., ritual places defined by mounds, plazas, and high-status cemeteries with large shaft graves) but who maintained their separateness (based largely on different burial practices). If true, this would expand the boundaries of the greater Titus phase beyond what either Thurmond or Perttula suggested. The Pine Tree Mound project emphasizes just how important it is to look beyond the heartland to gain a fuller understanding of what the Titus phase is all about. The maximum extent of the phase as shown by Perttula (2005:358) encompasses about 6,240 km^2 beyond the 1,350-km^2 heartland (i.e., 4.6 times larger), and the Pine Tree Mound project analysis suggests that in some areas this maximum boundary should be pushed even farther out. These other non-heartland areas may contain few or no communities like that around Pine Tree Mound, with its well-defined ceremonial space (multiple mounds around a plaza) and elite community cemetery all in one place, but they surely contain Titus communities of one sort or another. As appears to be the case in the heartland itself, these likely varied in terms of social complexity and connectedness to other nearby communities.

THE U.S. HIGHWAY 271 MOUNT PLEASANT RELIEF ROUTE PROJECT

Description and Synopsis of Work Accomplished

This project stemmed from the planned construction of a relief route for U.S. Highway 271 around the west side of Mount Pleasant in Titus County. The early part of the work was done for the Texas Department of Transportation, Environmental Affairs Division, and the later part was done for PTP, LP, acting on behalf of Titus County. The project involved work at 11 Native American archeological sites within a 6 km long stretch along the east side of Tankersley Creek, 4 km upstream from where it flows onto the floodplain of Big Cypress Creek (Figure 12). The work was done in three phases between 2005 and 2010, with the final one consisting of data recovery excavations at three sites: George Richey (41TT851), William Ford (41TT852), and James Richey (41TT853).

The excavations covered a total of about 7,000 m^2 and found 378 cultural features, mostly postholes and pits with much smaller numbers of burials, burned rock concentrations, artifact clusters, and middens. Some of the postholes at the

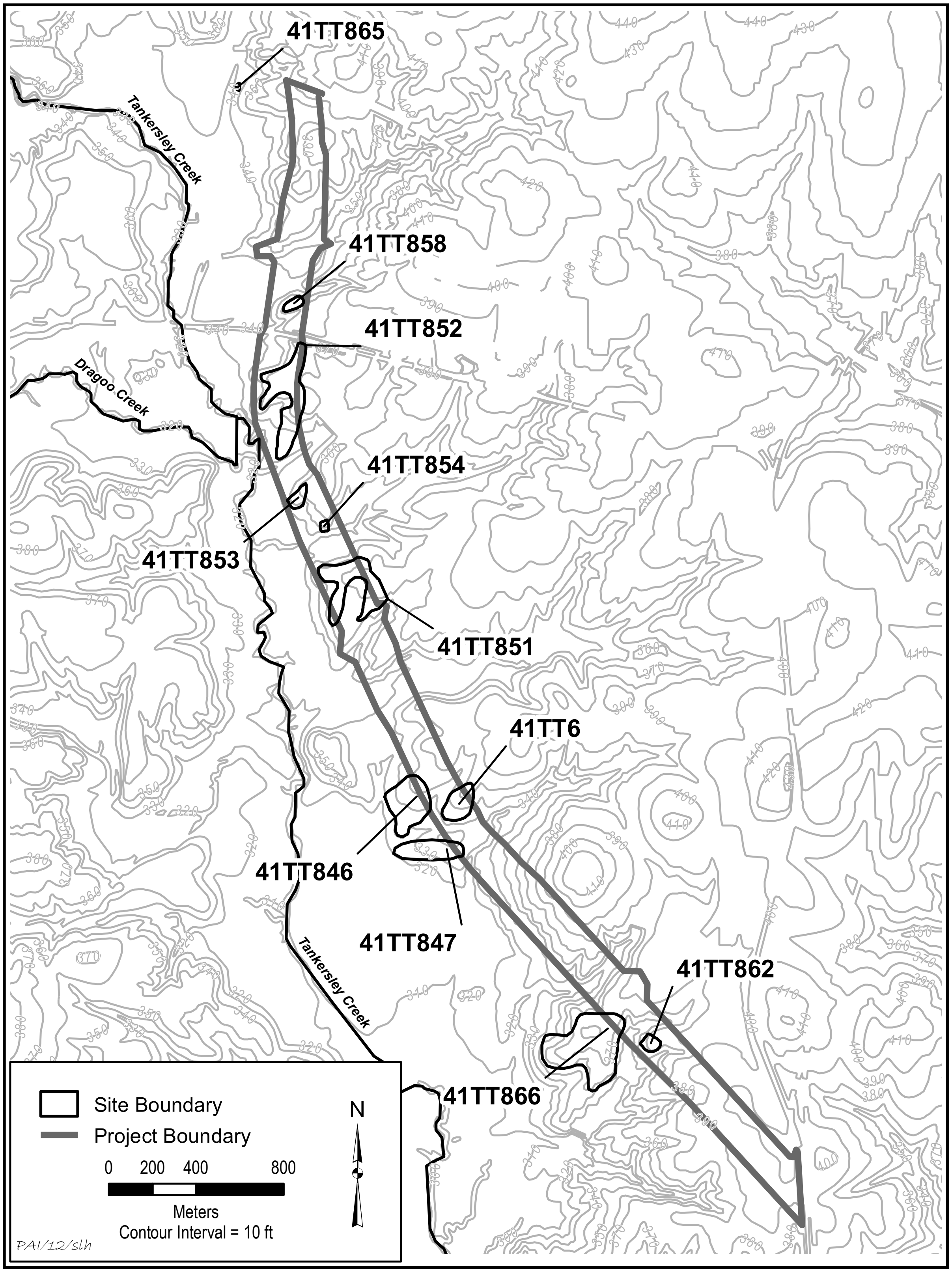

Figure 12. Topographic map of the U.S. Highway 271 project area showing site locations.

George Richey and William Ford sites represent single Caddo houses that were rebuilt once or twice. The sizeable collection of ceramics consists mostly of items typed as Ripley Engraved, Wilder Engraved, Harleton Appliquéd, Maydelle Incised, Pease Brushed-Incised, Killough Pinched, La Rue Neck Banded, Belcher Ridged, Bullard Brushed, Mockingbird Punctated, and Sanders Engraved. Identified arrow point types are Alba, Bassett, Bonham, Catahoula, Colbert, Friley, Homan, Maud, Steiner, and Talco.

Of the 130 radiocarbon dates obtained (127 from the three excavated sites), 116 entirely postdate A.D. 1200 (at two-sigma) and four others partially do, accounting for 92 percent of the total. Combined, these 120 dates form a continuous series spanning the Middle and Late Caddo periods and even the Historic Caddo period. This data set provides compelling evidence for dramatically increased use of the middle part of the Tankersley Creek valley after the Early Caddo period, reflecting the establishment and florescence of a local Caddo community there.

Each location investigated archeologically had its own history, though. The dates indicate a primary residential occupation at the George Richey site between A.D. 1250 and 1325; primary residential occupation at the William Ford site at 1425–1500 and a secondary one at 1650–1700; and a primary residential occupation at the James Richey site between 1400 and 1500. All three sites also have other minor Middle–Late Caddo components that are probably non-residential, or perhaps very short-term residential. These date to the mid-1100s–mid-1200s (George Richey and William Ford), 1300s (William Ford), early 1400s (George Richey), 1500s (George Richey, William Ford, and maybe James Richey), and the 1600s (James Richey). In addition, dates and diagnostic artifacts (i.e., gunflints) indicate that both the William Ford and James Richey sites have minor Historic Caddo components dating to the 1700s.

Most of the time span indicated by the radiocarbon dates falls squarely within the Titus phase interval (A.D. 1430–1680), but it starts earlier (A.D. 1250) and extends later (A.D. 1800). The late end of the sequence cannot be correlated with a defined spatio-temporal construct, but there is no reason to think that these relatively minor occupations were by groups other than the Titus phase peoples who had lived here for several centuries. The traditional end date for the Titus phase is based more on the perception that the Caddo abandoned most of the Big Cypress Creek basin after 1680–1700 (Perttula and Sherman 2009:37–38) than on radiocarbon dating, but recent evidence, such as that from several cemeteries on Gum Creek in the Little Cypress Creek basin (Perttula, Walters, and Nelson 2012:1), indicates that some Titus groups remained in the region until at least the early 1700s. This apparently happened in the Tankersley Creek valley as well.

On the early end, the sequence overlaps the Whelan phase, which Perttula and Sherman (2009:26) date to A.D. 1350–1430 and long has been seen as ancestral to the Titus phase. This is a construct that probably should be discarded, however (Davis et al. 2010:45–46, 99–102; Fields and Gadus 2012b:673; Perttula 1992:106–107), because it is so poorly defined. Also relevant here is another poorly defined construct, the Sanders phase. Its relevance comes from the fact that a small amount of the pottery from two of the project area sites appears to be related to it, and this ties these sites to the mound at the George L. Keith site not far away (see discussion below). Although centered on the middle Red River valley well north of the project area, the people of the Sanders phase, which Bruseth (1998:58) dates to A.D. 1100–1300 based on limited radiocarbon dating, appear to have had some effects on early developments in the Tankersley Creek community.

The Tankersley Creek Community

Local Settlement Patterns

The primary Middle–Late Caddo components represent use of the three excavated sites as rural, single-family farmsteads within a dispersed Caddo community. The work at two of them whose main occupations were separated by a century or two—George Richey and William Ford—resulted in a clear picture of what the basic Middle to Late Caddo habitation unit along middle Tankersley Creek looked like (Figure 13). It consisted of a domiciliary area with a single house that was rebuilt once or twice separated from a main work area with large pits, small pits, smudge pits, and scattered postholes. The George Richey site had the clearest representation of this pattern with a northern cluster of features marking the main work area and a southern cluster composed of mostly postholes representing a house that was 6.0–6.4

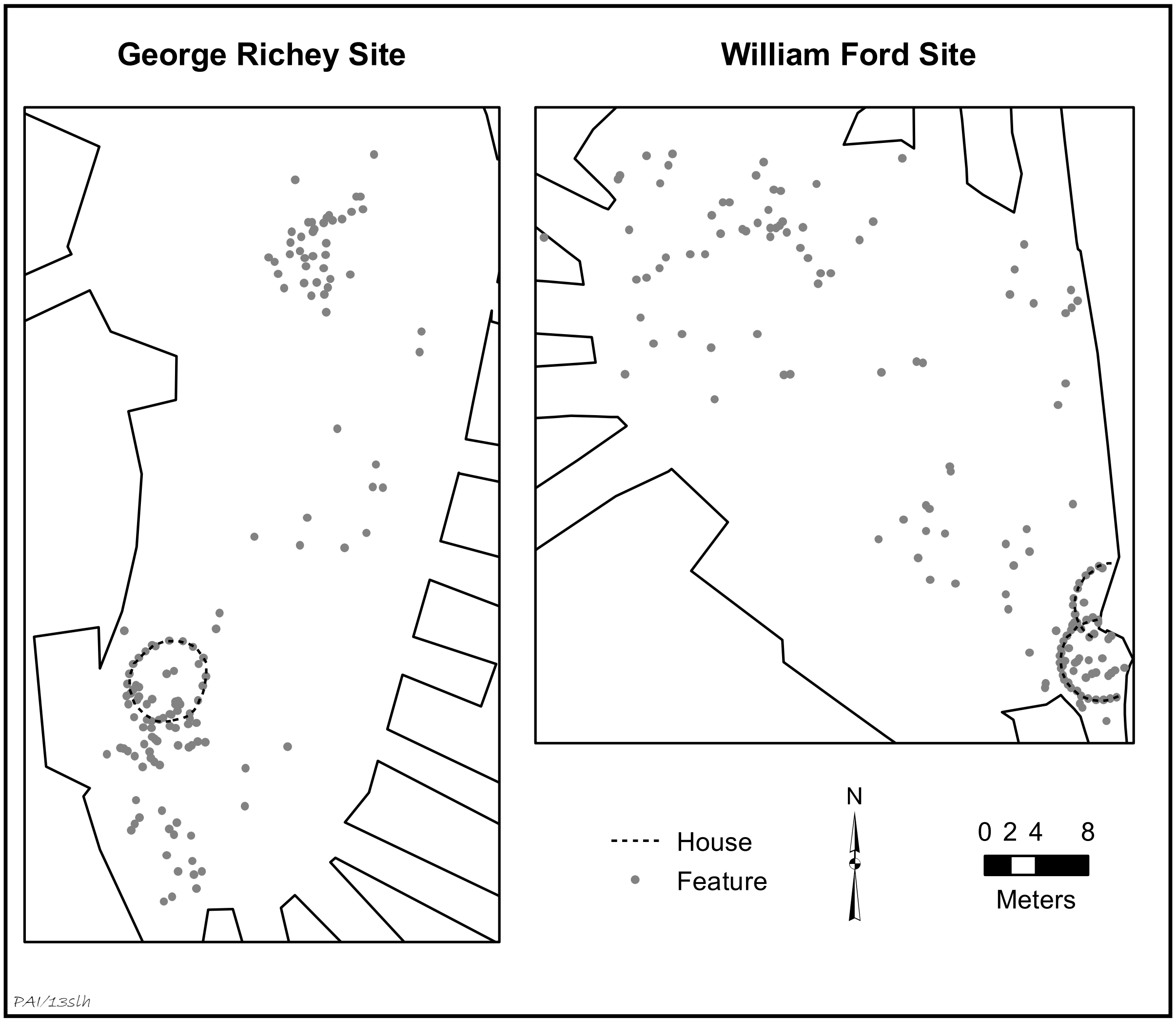

Figure 13. Plans of the George Richey and William Ford sites showing Tankersley Creek farmstead layout.

m in diameter. The southern feature cluster and its house patterns were separated from the northern feature cluster by 23 m. Though there was a scatter of features marking a work area on the east side of this space, it was mostly empty and may have been a plaza. An additional work area represented by small and large pits, smudge pits, and a few postholes was south of the house. Radiocarbon dates indicate that this basic layout was extant during the primary residential occupation, although some features that make up the feature concentrations are from earlier and later minor occupations.

The William Ford site also had two main clusters of features separated by open space interpreted as a plaza. The southeastern feature concentration was mainly domiciliary, with a house that was rebuilt once. This house was 6.3 m in diameter, the same size as that at the George Richey site. Small pits, smudge pits, postholes, and a large pit west of the house represent a nearby work area like that south of the house at George Richey. Also like George Richey, the northwestern feature concentration was a work area with large and small pits, smudge pits, and scattered postholes probably representing drying racks or other ancillary structures. Radiocarbon dates indicate that this basic layout was in place during the primary residential occupation. On the northeast side of the possible plaza was a concentration of postholes that could be the remains of a small rectangular structure such as a ramada, but it is not certain that this was contemporaneous with the house area to the south. Instead, it is speculated that the remains in this part of the site may go with a later residential occupation centered just outside the project area to the east.

The houses at George Richey and William Ford were similar in size and construction (e.g., with postholes averaging 15–17 cm in diameter) to those at the Pine Tree Mound site, which were large enough to shelter a nuclear family or small extended family and probably had average use lives of 10 years or so before decay of support posts made rebuilding necessary (Fields and Gadus 2012b:277–280). Extending that argument to this project area would mean that the main occupations of these farmsteads lasted only 20–30 years, i.e., a generation or two, after which the family moved on to occupy another interfluve along Tankersley Creek or a stream nearby.

It is hard to address how these sites were used during the multiple minor occupations that the radiocarbon dates suggest. The fact that there are more than a few such dates indicates that these occupations involved more than just short-term activities, although short stays with very limited archeological visibility certainly are likely as well. Something more substantial seems to be indicated, for example, campsites at agricultural fields distant from farmsteads, or locations where quantities of plant or animal foods were processed, or even farmsteads that, for whatever reason, were occupied only very briefly before being abandoned. Such uses probably explain not only the minor components at the three sites where data recovery was done, but also the Caddo components at five sites within the project area where only testing was done.

The overall picture of local settlement patterns during the Middle–Late Caddo periods is one of frequent residential moves and reoccupation of elevated landforms along water courses, but for varied activity sets (Figure 14). Farmsteads occupied for a generation or two and family cemeteries are the parts of this system that are most visible and interpretable archeologically, but shorter domestic and non-domestic occupations (labeled "Campsite" on Figure 14) may be even more common. Certainly, there were no aggregated villages along the middle reach of Tankersley Creek, but it is likely (and probably necessary from a biological perspective) that there were enough occupied farmsteads at any given time along Tankersley Creek, other tributaries, and Big Cypress Creek that in the aggregate they formed the kind of dispersed village that was documented historically for other Caddo groups.

There are three other important points to be noted about this settlement pattern based on the work done on the U.S. Highway 271 project. First, with radiocarbon evidence indicating that the main feature concentrations at the George Richey and William Ford sites reflect not just the main occupations but also some minor earlier and later ones, it appears that some spatial patterns in how these sites were used persisted through time in spite of changes in site function. This implies that the Middle–Late Caddo people who lived there retained longstanding cultural memories that conditioned site layout, or perhaps that there were landscape features, such as clearings in the woods, that affected where activities were performed. We will never know which, but the former explanation is attractive because it is consistent with a scenario in which this area was home to a particular group of people, i.e., a local community, who were intimately familiar with their territory and maintained traditions over centuries about how to use it, even in the face of needing to move farmsteads frequently. In other words, the decisions they made about where to situate their farmsteads, cemeteries, agricultural fields, field-monitoring camps, and procurement and processing locations, and when to move them, were strategic rather than haphazard. This fits well with the level of sociopolitical complexity that we presume these people had.

Second, the evidence from these sites and two known cemetery sites nearby—Thomas B. Caldwell and A. P. Williams—indicates that the Tankersley Creek Caddo created farmsteads and family cemeteries, but usually not in the same places. The excavations at the three residential sites were extensive enough to show that no cemeteries were present adjacent to them, and the closest known residential sites that could be associated with the Thomas B. Caldwell and A. P. Williams cemeteries are several hundred meters away. The Duncan Anderson site in this same area could be an exception to this pattern, since "abundant habitation refuse" was found there in addition to the cemetery (Perttula, Marceaux, and Nelson 2012:9), but too little is known about it to be sure. The fact that farmstead occupations lasted only a generation or two, and that those occupations were by single households, may explain why residential and burial sites were not closely tethered. In other words, typical family cemeteries like Thomas B. Caldwell and A. P. Williams may have been used longer than individual farmsteads, unlike at longer-occupied village sites such as Pine Tree Mound and Pilgrim's Pride, for example (Fields and Gadus 2012b:313,

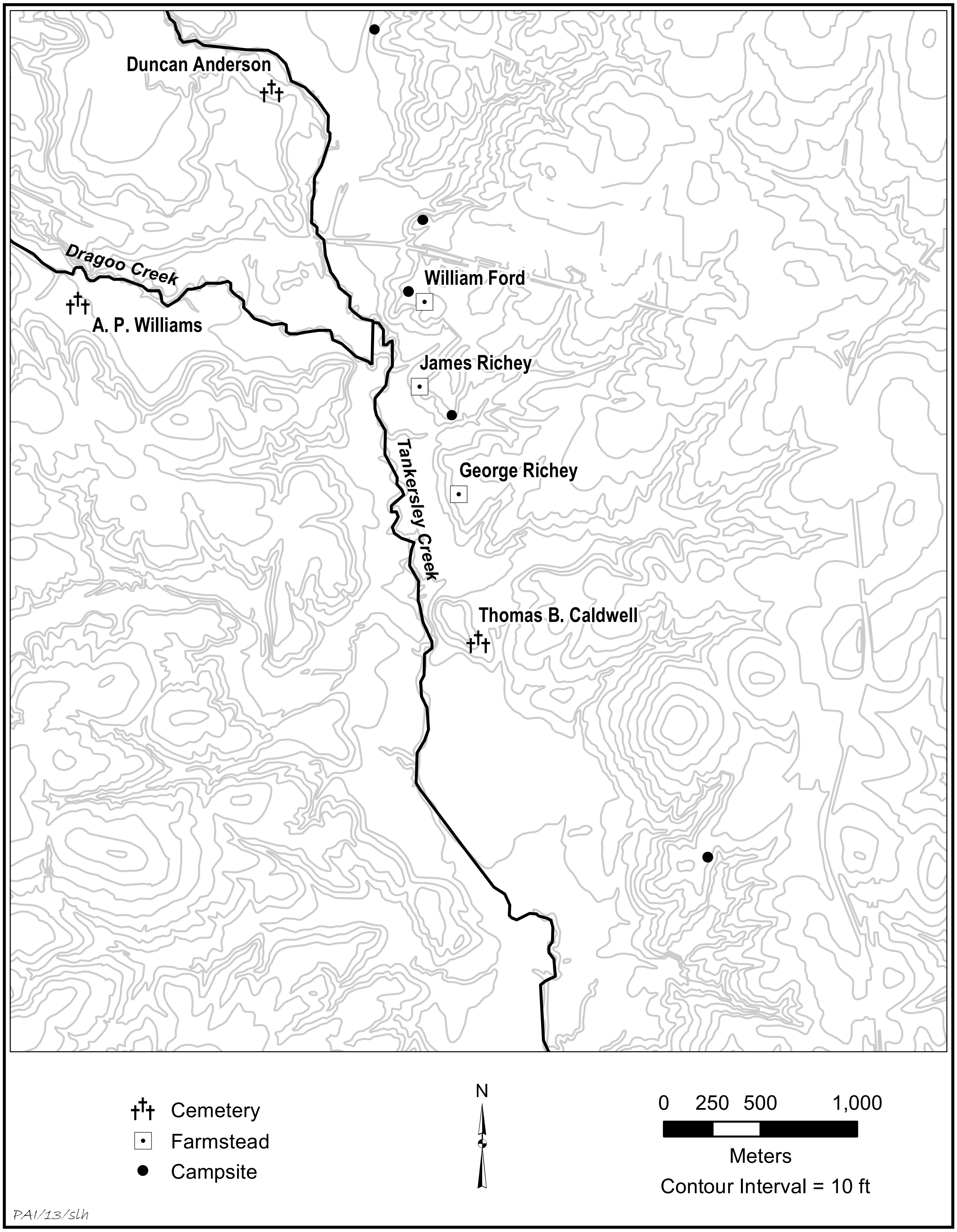

Figure 14. Components of the Middle–Late Caddo period community along middle Tankersley Creek. This map includes only sites within the U.S. Highway 271 project area and a few cemeteries outside it; since not all of the area has been investigated archeologically, it is an incomplete picture of this section of the community.

338; Perttula 2005:67). If an individual household used a cemetery while they were living at successive farmsteads, it stands to reason that there would not necessarily be close spatial relationships between them.

The issue of sociopolitical complexity is the third point highlighted here. One omission from the discussion of settlement patterns above are sites that served community integrative functions, such as mound sites or community cemeteries. The reason for that is there are no such sites in the U.S. Highway 271 project area. These kinds of sites certainly were important to the people who lived there, though, and they and what they tell us about complexity must be part of the discussion of their settlement system. This topic is important enough that it warrants more extended consideration below.

Potential Integrative Sites

Unlike the Pine Tree Mound site example discussed earlier, the U.S. Highway 271 analysis started with rural farmsteads and went looking for integrative sites to tie them to. Five sites jump out as candidates based on their proximity: 41TT890, George L. Keith, Ear Spool, Sandlin Dam, and Lower Peach Orchard (Figure 15). Site 41TT890 is closest to the project area, just 0.75 km southwest of its southern end. It contains a ca. 2 m high, 20 m diameter rise that likely is a constructed mound (Bo Nelson, personal communication 2011), but little else is known about it, as it has not been investigated professionally. Given the ages of the other Caddo sites nearby and the fact that single mounds are the rule on Titus phase mound sites in the upper half of the Big Cypress Creek basin, there is a good chance it was used by the people who lived at the George Richey, William Ford, and James Richey sites.

The George L. Keith site is on Hart Creek ca. 6 km east of the U.S. Highway 271 project area. Walter Goldschmidt (1934) of the University of Texas (UT) trenched the mound in 1934, and Kenneth Brown, then a student at UT, performed some limited work there in 1971. Thurmond (1990:183–185) recognized that the site has a substantial Late Caddo component based on the presence of a small Titus phase cemetery with at least seven graves (Perttula, Walters, and Nelson [2010a:9] report at least 15 graves) containing Ripley Engraved, Wilder Engraved, Cass Appliquéd, and La Rue Neck Banded vessels and Talco and Maud arrow points on the upland margin east of the mound, as well as the presence of a variety of Middle–Late Caddo sherds from non-burial contexts. He concluded that the most intensive use, including most or all of the mound construction, occurred during the Early Caddo period based on the presence of some early pottery, but others have argued convincingly that the predominant component at Keith is later than the Early Caddo period (Fields et al. 2013; Perttula, Walters, and Nelson 2010a:10). Among the evidence supporting this is a radiocarbon date on charcoal obtained in 1971 from the cleaned wall of the 1934 trench. Although its context is not the best, its raw one sigma age (540±70 B.P.) and projected calibrated two sigma date (A.D. 1285–1464) implies that at least part of the mound was constructed in the Middle or Late Caddo period, contemporaneous with occupation of one or all of the Tankersley Creek sites.

The single mound at Keith was very large, extending 73 m north-south and 49 m east-west and standing at least 4.6 m tall. Thurmond (1990:183) noted that the mound was about a meter taller before it was cleared of vegetation and that it was "rectangular in plan, with steep sides and a broad, flat platform on top." The mound was built in four major episodes, with each major event probably associated with the erection of an important building (or maybe more than one, given the size of the mound), although firm evidence of this was found only on the pre-mound surface and on top of the third major fill episode. The structure that preceded the mound was large, ca. 11 m in diameter, and apparently was within a rectangular perimeter wall that was 17 m across. Destruction of this building and capping of its remains, probably in the Middle Caddo period, are what started the cycle of events that over a span of maybe as much as several hundred years resulted in the impressive platform mound at Keith.

While the picture is far from complete, the Keith site may be best interpreted as a ceremonial site with multiple associated residential areas that was established during the Middle Caddo period and continued to be used during the Late Caddo period. Given its proximity and the impressive and persistent presence on the landscape that the mound provided, it is hard to believe that the rituals performed there did not include family groups who lived a short distance to the west on Tankersley Creek. What is intriguing about Keith is that the mound there is far larger than any other

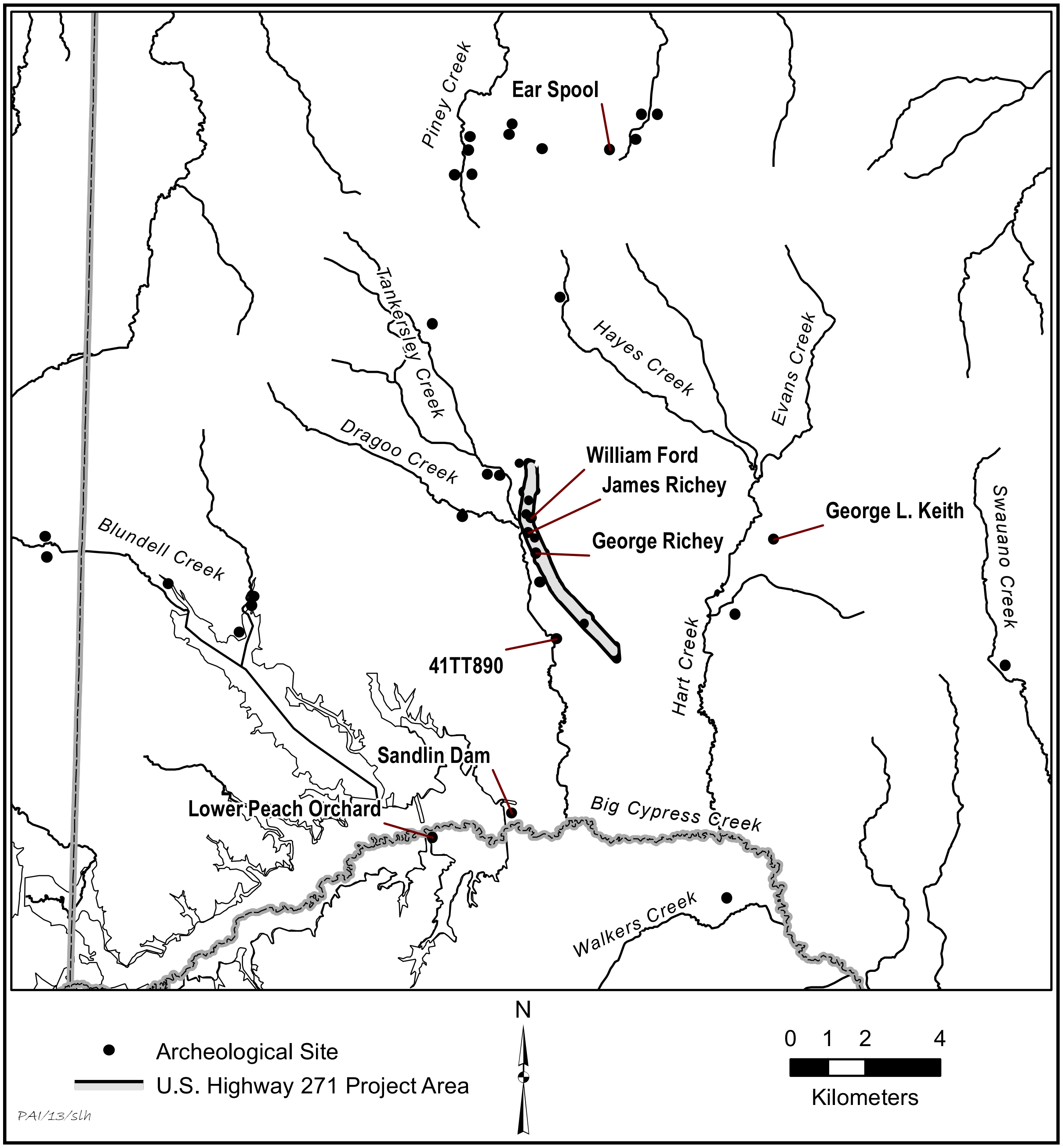

Figure 15. Map showing the locations of tested and excavated sites and important unexcavated sites in and near the Tankersley Creek drainage that could be associated with the George Richey, William Ford, and James Richey sites. Site 41TT890, George L. Keith, Ear Spool, Sandlin Dam, and Lower Peach Orchard are potential integrative sites.

Titus phase mound. It covers almost 14 times the area and is 5–6 times taller than the average Titus heartland mound for which size data are known (the 15 mounds at the Harroun, Whelan, Chastain, Dalton, Camp Joy, Shelby, Sam Roberts Pilgrim's Pride, and Tiddle Lake sites are 7–35 m long, 7–20 m wide, and 0.6–2.2 m tall, with average dimensions of 17.1 x 15.3 x 1.2 m). The size difference relates partly to the fact that the mound at Keith likely served a different function than most Titus phase mounds, i.e., it was a platform built in stages to support important buildings rather than a small tumulus that formed through the destruction and capping of one or two small ritual-associated structures. This implies that the ceremonies performed there may have been different than those at most other mound sites.

Why this happened along the middle reach of Hart Creek, well up from the Big Cypress Creek valley, is unknown, but it may have something to do with the Sanders phase connections seen in the pottery from Keith and some other sites in the area. The main reasons to think this are: (1) construction of the mound at Keith probably began at a time when Sanders phase people were building mounds on the Red River and its tributaries to the north; and (2) some of the Sanders ceremonial centers have large, probable temple mounds (Bruseth 1998:59–60; Krieger 1946:172–174, 195; Mallouf 1976:69; Prikryl 2008:126; Wyckoff and Fisher 1985:25). It may have been the Keith site's connection to people of the Sanders phase that initially made it a center of political power for this part of the Cypress basin. Even allowing for this possibility, though, it seems that at least some of the ideas that led to the mound being built here persisted among the local Titus peoples who lived along Hart Creek, since it appears that at least the upper part of the mound was erected during Titus times, and Titus peoples certainly were living and burying their dead nearby.

The third possible mound site that could have been associated with the middle Tankersley Creek sites is Ear Spool; it is farther, ca. 9 km, from the U.S. Highway 271 project area but still within easy walking distance. The excavations at Ear Spool revealed that it "was the product primarily of a domestic occupation during the Titus phase, but one with a special character given the identification of two distinctive structures built within pits and then deliberately burned down" (Perttula and Sherman 2009:1). These two special structures both were associated with occupation between A.D. 1400 and 1480 (Perttula and Sherman 2009:371). One had an extended entranceway, and both had characteristics, namely burned structural remains and intentional fill deposits, very similar to what is seen in constructed mounds, even though little or no mounding was evident on the surface. This led Perttula and Sherman (2009:371, 376) to conclude that the "symbolic treatment of Structures 1 and 3 suggests that these structures held a cultural significance beyond that of purely domestic concerns" and that Ear Spool was a key site in a community centered along Piney Creek in the White Oak Creek basin.

Two other likely candidates for integrative sites for this community are two cemeteries on Big Cypress Creek about 5–8 km southwest of the project area: the community cemetery at Sandlin Dam with 150+ graves, and another one at Lower Peach Orchard that had fewer graves (35+) but clearly had burials of elite individuals in large shaft tombs. The Sandlin Dam site was on a prominent ridge jutting out into the Big Cypress Creek floodplain 1.5 km west of where Tankersley Creek joins the Big Cypress; this ridge is the first one west of the Tankersley Creek valley. The graves contained Titus phase pottery and Bassett arrow points. With so little information, it is impossible to address the question of specific ties between this site and those in the U.S. Highway 271 project area, other than to say they likely were contemporaneous and that it would have been an easy trip between the two.

There is a bit more information for Lower Peach Orchard, even though it too was mostly removed by looters and dam construction. It was on a terrace edge above Big Cypress ca. 2.2 km west-southwest of Sandlin Dam. No mounds were reported, but it is possible that special buildings had been erected on the four knolls on the site or elsewhere. The Titus phase cemetery contained mostly graves of single individuals that were 1.8–2.4 m deep, but five or six graves were different in that they were much deeper (3.7–5.5 m) and contained multiple individuals (Thurmond 1990:149). Grave offerings included Ripley Engraved pots and vessels of other Titus phase types, Maud and Bassett arrow points, celts, ceramic pipes, and large Galt bifaces. The sizes of these graves, the presence of multiple bodies, and the inclusion of high status offerings such as Galt bifaces clearly mark this as an important place. The pottery and arrow point styles indicate that this site was contemporaneous with those in the U.S. Highway 271 project area, and like Sandlin Dam, it certainly would have been a short trip to this cemetery from middle Tankersley Creek. Fortunately, 20 ceramic vessels reportedly from this site were in the Margaret Hinton collection that Perttula, Marceaux, and Nelson (2012:117–136) analyzed. The 15 that can be typed consist of Ripley Engraved bowls (varieties Galt, Caldwell, Carpenter, and Gandy), Turner Engraved bowls, a Wilder Engraved bottle, a Wilder Engraved olla, a Bullard Brushed jar, a Mockingbird Punctated jar, Harleton Appliquéd jars, and a Cass Appliquéd jar. All but two of these types and all four of the Ripley varieties are represented at one or more of the Tankersley Creek sites, implying connections between them and Lower Peach Orchard.

In sum, there are five known sites that could be candidates for locales where the Caddo who lived at the George Richey, William Ford, and James Richey sites participated in rituals and ceremonies that helped bind them and their neighbors into a cohesive community. None is more than a half day's walk from the middle reach of Tankersley Creek, and one, 41TT890, is actually on that stretch of the creek. None of the five is like any of the others, however, and it is hard to see any patterns in the data that make it clear how they might fit together as ritual components of a local settlement system. The only obvious pattern is that the large cemeteries are on Big Cypress Creek, while the mound and mound-like sites are on tributaries well away from the main stem. This would imply spatial segregation of activities associated with these kinds of sites, but the significance of this is unclear. Part of this lack of clarity undoubtedly can be traced to the very fragmentary nature of the archeological record.

Community Extent and Boundaries

Implicit in the discussion of potential integrative sites above is the notion that the local community that the George Richey, William Ford, and James Richey sites were a part of was larger than just the Tankersley Creek valley. The people who lived on Hart Creek to the east, Piney Creek to the north, and Big Cypress Creek to the south—extending over an area of about 220 km^2—easily could have been part of the same community, based largely on geography, the small distances between the sites, and general similarities in material culture. Given the short-term nature of the farmstead occupations (a generation or two) and the frequent residential moves, though, it stands to reason that a community large enough to be viable would have been spread out over an even larger area, perhaps extending farther east to include the Swauano Creek valley, farther west to include Blundell Creek, or even farther south to include south side tributaries of Big Cypress Creek.

The archeological information collected from the region prior to the U.S. Highway 271 project was robust enough to show that the ceramic tradition of the northwestern part of the Big Cypress Creek basin was different in some ways than that of the southeastern part (Perttula and Sherman 2009:397–404), thus forming the basis for seeing two core communities there, but those data were not useful for addressing the extent of any local communities within the northwestern part of the basin. Thurmond's (1990:116–119) maps certainly indicated widespread and intensive occupation of the whole upper basin by Late Caddo peoples, but the data were not fine-grained enough to distinguish one community from another. Recent testing and excavation efforts in the vicinity succeeded in identifying a number of Middle–Late Caddo residential or ephemeral-use sites that could be associated with the Tankersley Creek sites (see Figure 15): five sites on Blundell Creek (Brown et al. 1986:151, 182; Espey, Huston and Associates, Inc. 1984:43, 48–51; Kotter et al. 1991:38, 40); two sites in the Hart Creek drainage (Burden et al. 2012:31; Perttula et al. 1998); 11 sites on Piney Creek (Galan et al. 1997:39, 54, 65; Nash et al. 1995:46–47, 68, 90, 107–108, 130, 148–149, 201; Perttula and Sherman 2009); and two sites on Tankersley Creek (Barnhart et al. 1997; Dixon et al. 1995). With a few notable exceptions, however (e.g., Ear Spool and Mockingbird), the data were too sparse for meaningful comparisons, and even when comparisons could be made, they tended to have ambiguous results. A primary reason for this is that the comparisons mostly involved samples of sherds rather than vessels and sample sizes often were small.

To try to address this question in a detailed and systematic way, and following up on the work of Perttula and Sherman (2009:400), the analysis of the U.S. Highway 271 data took another look at the distributions of the various motifs on Ripley Engraved bowls to assess whether they might be informative about local community extent, not just for the vicinity of Tankersley Creek but for the broader Titus phase area as well. There were several reasons to think this might be worth doing. First, there are historical precedents, with motif variation being an important part of what Thurmond used to define his Cypress subclusters and a less-important part of what Perttula and Sherman used to distinguish ceramic sub-traditions. Second, Perttula and his colleagues have codified some of the Ripley Engraved bowl variation by assigning motifs to named varieties of the type, and they are using this system in their ongoing efforts to document vessel collections from the region. Third, there has been a persistent feeling among archeologists familiar with Titus phase pottery that some of the extensive variability in designs subsumed under Ripley Engraved must have signified something important, for example, group identity, to the people who made and used the pots.

The Ripley motif study included vessels from the three cemeteries in the middle Tankersley Creek valley (Thomas B. Caldwell, A. P. Williams, and Duncan Anderson); the three other excavated cemeteries closest to the project area at the Mockingbird (Perttula et al. 1998), Alex Justiss (Bell 1981; Rogers et al. 2003), and Pilgrim's Pride (Perttula 2005) sites; two sites, Tuck Carpenter and Johns (Perttula, Walters, and Nelson 2010a, 2010b; Turner 1978), farther south in the Big Cypress basin; three cemeteries in the middle part of the basin at the Lone Star Lake, Rumsey, and Keeling sites (Perttula, Walters, and Nelson 2010a); and four cemeteries at the Henry Williams, Enis Smith, Henry Spencer, and Frank Smith sites in the Little Cypress Creek basin (Perttula, Nelson, and Walters 2012; Perttula, Walters, and Nelson 2012) (Figure 16). Also added were two points of comparison in the Sabine River drainage. These are the two family cemeteries at the Pine Tree Mound site (Fields and Gadus 2012b) and a collection from sites on Caney Creek southwest of the project area (Perttula, Walters, Marceaux, and Nelson 2009). Conspicuously missing from this list are sites in the southeastern part of the Titus phase heartland; this is a significant limitation because it means the study included no samples from the two downstream heartland communities proposed by Perttula and Sherman (2009:375–377).

Eighteen varieties of Ripley Engraved bowls were recognized in the analysis based on structural differences in the engraved motifs. Nine varieties were newly defined (McKinney-Enis Smith, Gandy-Mockingbird, Gandy-Pine Tree, Richey, Starkey, Pine Tree, Spencer, Harvard, and Tiddle), and the others were defined by Perttula and colleagues (Perttula, Nelson, and Walters 2012; Perttula, Walters, and Nelson (2010a, 2010b, 2012) based on motifs originally illustrated by Thurmond (1990:Figure 6).

Analysis of the distributions of these varieties found a great deal of overlap spatially, providing little support for the idea that variation in Ripley bowl motifs is a productive way to consistently see group identity and local community boundaries, at least not variation as captured by this analytical scheme. Some varieties are very widely distributed, and while there are hints that community-level information might be present in some of the less-ubiquitous varieties, this is not consistently the case. The strongest pattern relates to Titus communities viewed broadly, but not to communities narrowly defined, and may be part of the same pattern that led Perttula and Sherman (2009:401–410) to see southeastern and northwestern ceramic subtraditions in the Titus area. It could be seen in the fact that 12 of the collections could be placed into two groups, albeit ones that are not very homogeneous, and that most members of these groups have distinct spatial distributions (see Figure 16).

One group consisted of collections from the following seven sites: Thomas B. Caldwell, A. P. Williams, Duncan Anderson, Mockingbird, Tuck Carpenter, Johns, and Henry Spencer. In all seven, Carpenter is the predominant Ripley Engraved variety, with variety Spencer being equally dominant at the Henry Spencer site alone. Beyond this, no two assemblages look exactly alike. The second group consisted of the following five collections: Frank Smith, Enis Smith, Henry Williams, the Middle Cypress sites, and Alex Justiss. What unites them is that each is dominated by variety McKinney and/or variety McKinney-Enis Smith and that variety Gandy ranks second or third. Three collections were unlike any of the others and are outliers: Pilgrim's Pride, Pine Tree Mound, and the Caney Creek sites.

All of the sites in the first group but one, Henry Spencer, are in the northwestern part of the basin, and all of those in the second group, except Alex Justiss, are in the southeastern part. Not surprisingly, two of the outliers, Pine Tree Mound and the Caney Creek sites, are geographically separated from the other sites. The third, Pilgrim's Pride, is not. These distributions suggest six main conclusions. First, they support the contention that distinct but related core communities occupied the two parts of the Titus heartland. Second, they suggest that Ripley Engraved bowl varieties as used here are not now, and may never be, useful for seeing distinctions between smaller communities within the core ones. Third, they suggest ties between the southeastern heartland core community and whatever was going on in the Little Cypress basin to the south. Fourth, with one site in each group being out of place spatially, they suggest that there was movement of potters and people between core communities. Fifth, parts of the Titus phase area outside the Cypress Creek basin supported their own core communities. And sixth, sites like Pilgrim's Pride, which is an outlier ceramically but not spatially, imply that at certain times and places within the heartland there were small local communities that chose to decorate their pottery differently than their neighbors, presumably reflecting different ideas

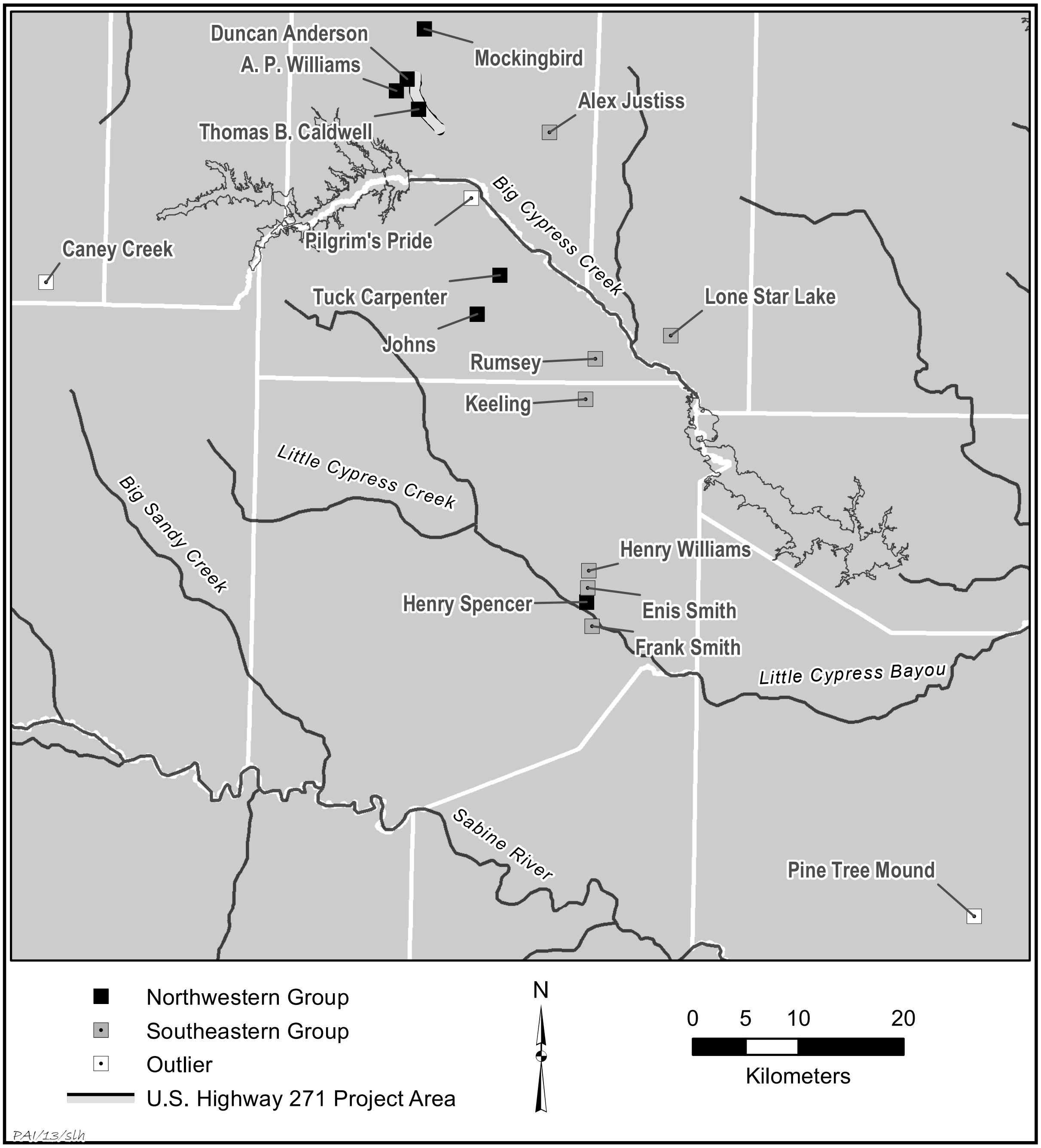

Figure 16. Map showing the locations of Titus phase cemeteries used in Ripley Engraved bowl variety comparisons.

about connections between engraved motifs and a widely held Caddo belief system.

Conclusions

Analysis of the data from the U.S. Highway 271 project area was successful in describing a basic building block of a Titus phase community, i.e., the rural farmstead, but it did not make much headway in understanding the makeup and extent of the local community of which the Tankersley Creek sites were a part. Notwithstanding certain data limitations that apply to more than just that project area, including too few professionally excavated sites (especially cemeteries and mound sites), poor chronological controls that make it hard to distinguish changes that relate to the passage of time as opposed to other factors, and the difficulty of interpreting sherd assemblages from residential sites, it is true that some of the ceramic vessels in the Tankersley Creek mortuary assemblages look different than those from the Alex Justiss and Pilgrim's Pride sites to the east and south, implying boundaries between communities. However, the Tankersley Creek ceramics are decidedly similar to those from the Tuck Carpenter and Johns sites even farther south, as well as those from the Mockingbird site to the north, and they are consistent with assemblages across a large area covering much of the upper part of the Big Cypress basin. Even if potters and groups of potters chose motifs and variable expressions of those motifs in part to reflect social identify, they did that within the context of a common widespread ideology. Further, Caddo potters could and did innovate in motif construction, while still using a set number of basic structures and elements, and these motifs were understood and accepted by communities across and beyond the Titus heartland. Thus, vessel trade, shifting community boundaries and centers of political power through time, and group coalescence and splitting would make it extremely difficult to see community associations in the ceramics.

Of course, just because we cannot use Ripley Engraved bowls to see boundaries between local communities does not mean those communities did not exist. The distributions of mound sites and large cemeteries and of cemeteries with large shaft graves continue to provide compelling evidence for long-term settlement by multiple related Caddo groups distributed throughout the Cypress Creek basin and adjoining valleys. One thing that analysis of sites in the Tankersley Creek area tells us, though, is that there likely are (or were) many more mound and large cemetery sites out there than we know about, and that missing information will hamper efforts to define communities based on the distributions of these types of sites. Certainly, the difficulty of deciding how sites such as 41TT890, George L. Keith, Ear Spool, Sandlin Dam, and Lower Peach Orchard relate to the farmsteads and family cemeteries along Tankersley Creek emphasizes how much more there is to know about the archeology of this one part of the Titus phase area.

CONCLUSIONS

Ultimately, the conclusions of both projects about Caddo sociopolitical and spatial organization do not accord very well with Story and Creel's (1982) Hasinai model. The suggested reconstruction for the Pine Tree Mound community differs in that it consists of a single main village tethered to the sole major ceremonial center, all ringed by a zone with moderately scattered settlements and a sparsely settled zone beyond. The size and makeup of the Pine Tree Mound site itself are consistent with what one might expect for the ceremonial center for an affiliated group, and the hypothesized territory size of 2,400 km^2 seems reasonable for such a group. But there is no good evidence that this community comprised multiple constituent groups, each with a lesser ceremonial center, as in the Hasinai model. Of course, this may be because we just do not have the kind of data needed to see this. But the model seems even less appropriate in light of one of the main higher-level conclusions, i.e., that Pine Tree Mound is the nexus of a core Titus phase community comparable to those on Big Cypress Creek to the northwest. That sets up a scenario where the Titus phase could consist of at least three affiliated groups, as opposed to the Hasinai model's single one.

In the case of the U.S. Highway 271 Mount Pleasant relief route project, it would be easy to see the Tankersley Creek sites as elements of a constituent group settlement and to speculate that 41TT890, for example, was the lesser ceremonial center for that settlement. Tying all the evidence summarized above to the rest of the Hasinai model is problematical, though. Perttula's six heartland communities (or five, as in Perttula [2012:83]), each containing multiple mound and/or large cemetery sites distributed over sizeable areas, and segregated into southeastern and northwestern groups perhaps characterized by differing levels of social complexity, present a scenario that is simply too complicated to fit the Hasinai model. And that is just for the heartland, ignoring the greater Titus phase area. Acknowledging that some of this apparent complexity probably is due to poor temporal controls (i.e., we are seeing agglomerations of human behavior over several hundred years), it still seems that, whatever the Titus phase represents, it must have involved more than two levels of organization, and this implies a sociopolitical system that was more-strongly hierarchical than what Story and Creel proposed for the Hasinai.

So, what do the combined Pine Tree Mound and U. S. Highway 271 analyses tell us about what the Titus phase represents? Consistent with previous interpretations, it does appear to reflect a series of related Caddo groups who controlled a large area. Its boundary probably should be extended southeast and south of its traditional position to capture the most-rural part of the Pine Tree Mound territory (Figure 17), but this is a minor change dealing with a periphery that could have vacillated over time. The main point here is that Titus phase peoples probably considered some lands south of the Sabine River as part of their territory, but they never established large communities there. The boundary shown in Figure 17 jumps back northward to follow the north side of the Sabine River in the western half of the Titus phase area. This is based on information from archeologist Mark Walters, who knows a great deal about the archeology of that area and who reports that there is not much Late Caddo archeology, either Titus or Frankston phase, south of the Sabine River in northern Smith County (Mark Walters, personal communication 2013). He notes that the Caddo who lived there abandoned the area around A.D. 1400, perhaps moving northward into the Titus area proper. If so, it could be appropriate to view that area as the sparsely settled periphery of the greater Titus territory, as we have for the area downstream from there, rather than a no-man's-land between the Titus and Frankston phases.

Current data suggest that at least three Caddo groups occupied the Titus area, two centered on Big Cypress Creek (Perttula's two heartland core communities) and one anchored by Pine Tree Mound on Potters Creek on the north side of the Sabine River. Figure 17 depicts the likely extents of the main parts of these communities, exclusive of all the outlying sections (though these depictions are partly conceptual rather than fully data-based). It is improbable that these were the only groups who lived there, however, and as more work is done, others almost surely will be identified. The most obvious places for such communities are on Little Cypress Creek and on the Sabine River and its north side tributaries west of the Pine Tree Mound community. The two Big Cypress groups apparently comprised multiple small local communities, but these are hard to detect archeologically, except perhaps through the distribution of key sites, and thus they are hard to talk about. This difficulty probably stems from their fluidity. Some undoubtedly were long-term features on the landscape, but others may not have been, and movement of people between them, shifts in their boundaries, and group coalescence and splitting all likely play a role in making them difficult to deal with archeologically.

The conclusion that the three larger communities represent separate groups hinges partly on chronology. Although absolute temporal controls are not good for all parts of the Titus phase area, both the Pine Tree Mound and the U.S. Highway 271 projects resulted in robust radiocarbon chronologies demonstrating that these areas were occupied contemporaneously. Combined with radiocarbon dates from other sites and the ceramic evidence, it is clear that the three core communities identified to date do not represent a single group moving around the region over time (which is not to say that the multiple apparent local communities within the two on Big Cypress Creek are not partly a function of this). The dates indicate that the period of most intensive occupation in both project areas extended from the early A.D. 1400s into the 1600s, consistent with the traditional view of the chronology of the Titus phase, but both also were occupied earlier and later. The earlier occupations, after ca. A.D. 1250 on Tankersley Creek and ca. A.D. 1300 on Potters Creek, apparently reflect the founding of the communities and their early stages of development. The later occupations, in the 1700s, represent limited use by historic Native Americans, presumably descendants of Titus phase peoples who lived there earlier.

So, both areas, and by extension probably the three core communities, had separate but parallel histories lasting several hundred years. The people who made up these communities were united by a shared ceramic tradition reflecting a common ideology, which also can be seen in the kinds of ritual places they created. These ranged from small family cemeteries, to sites with small mounds (mostly singly but sometimes in groups) reflecting the construction and destruction of important buildings, to plaza-centered groups of mounds (some of which were platforms for important buildings), to large cemeteries. The most important of the cemeteries contained large deep shaft graves where the highest-ranked members of the groups were buried.

Acknowledging that what we know (or think we know) about this subject is controlled to some extent by varying quantities of work in different parts of the region, it appears that the lower Big Cypress community may have been more complex sociopolitically than the other two. It has the largest number of key sites (n=13), both those with

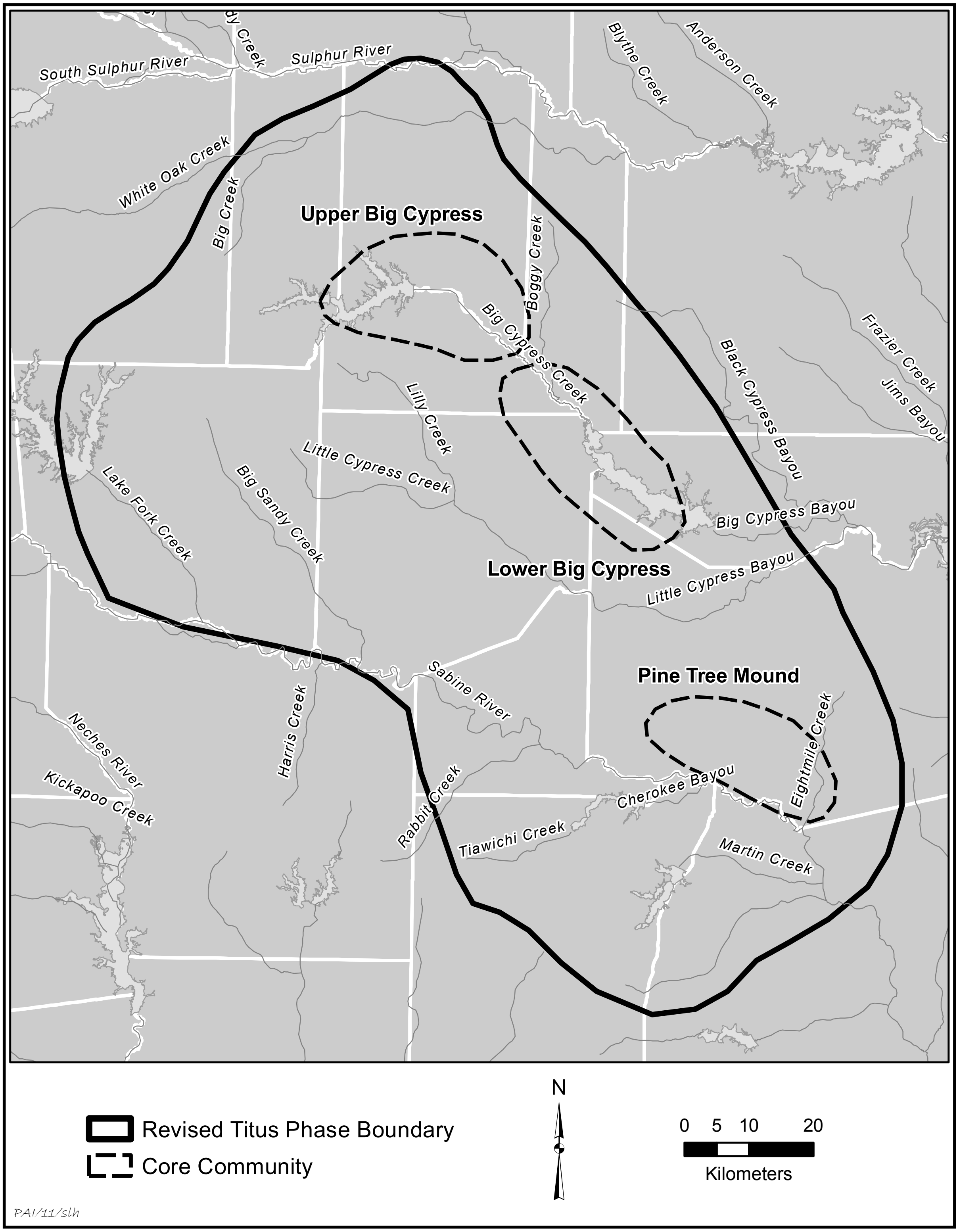

Figure 17. Map showing revised greater Titus phase boundary and three known core communities.

mounds and those with large cemeteries. There are six known mound sites (counting Chastain, Dalton, and Camp Joy as one), with three of them containing multiple mounds (three at Chastain/Dalton/Camp Joy and four at both Whelan and Harroun). At Whelan, the mounds are positioned such that they could be encompassing a large central plaza, i.e., a well-defined ceremonial space. This could be the case at Chastain/Dalton/Camp Joy as well, since the three mounds are all within several hundred meters of each other, but it is less clear there than at Whelan. The mounds at the Harroun site appear not to have an associated plaza, since they are arranged in a roughly linear fashion over a distance of about 250 m following a terrace edge. The mounds are generally small and may have been erected mostly to cap burned ceremonial structures, though this cannot be confirmed since few have been excavated. The largest mound, at Camp Joy, measures 35 x 18 m and 2.2 m high and has an unusual shape suggesting that it could have been built to serve as a platform for a ceremonial building. If so, it would bolster the argument for a well-defined ceremonial space at Chastain/Dalton/Camp Joy.

The eight large cemeteries in the lower Big Cypress community, only one of which is at a site with a mound (Shelby), apparently contained more than 900 graves. Most of these, and probably all or almost all of those in the small family cemeteries, were burials of commoners, but two of the large cemeteries (Pleasure Point and Shelby) contained large shaft graves for the highest elites. Analysis of a subset of Titus cemeteries as part of the U.S. Highway 271 project indicates that high-ranking individuals also were buried in non-shaft graves at community cemeteries.

The upper Big Cypress community has fewer key sites (10, if one includes both George L. Keith and 41TT890), five of which have single mounds, and five of which are large cemeteries containing more than 470 graves. One of the cemeteries (Lower Peach Orchard) does not qualify as large in terms of the number of graves, but it is the only one where shaft graves were present and thus clearly was an important place. Two of the mounds for which dimensions are known are smaller than the average mound in the lower Big Cypress community, and two are larger, with one of these (George L. Keith) being the largest known mound by far in the Titus phase area. It both capped an important pre-mound building and served as a platform for others.

The Pine Tree Mound community has the fewest key sites, but both of those have multiple mounds—three at Pine Tree Mound and four or five at Lane Mitchell—and at the former the mounds clearly are part of a very well-defined ritual space with a plaza at its center and a cemetery containing high-status members of the community at one end. We can only speculate about how big this cemetery is, but it could contain more than 200 graves. One of the mounds is the second-largest one in the Titus phase area and probably was a platform for important buildings. The smallest one also is a platform mound. Lane Mitchell, with its small mounds arrayed roughly linearly for a distance of about 130 m and no obvious plaza, is reminiscent of the Harroun site in the lower Big Cypress community.

While each of the other two core communities has something that argues for social complexity—the very large mound at George L. Keith and shaft graves at Lower Peach Orchard in the upper Big Cypress community and the large mound, shaft graves, and well-defined ritual space in the Pine Tree Mound community—the concentration of important sites in the lower Big Cypress community suggests even greater complexity there. Whether each core community was governed by elites in all of the highest positions of authority, i.e., *grand xinesi, caddices, and canahas* (Sabo 1998:159–162), or just *caddices* and *canahas* with a single *grand xinesi* for all of the Titus phase area is unknown, but it appears that those who ruled the lower Big Cypress community had more power than those in the other two. Lacking excavation of the key sites associated with these individuals, especially cemeteries, we can only speculate about whether this translated into a strongly hierarchical relationship between them or something subtler involving near peers.

These three groups maintained their identities over time, but it seems they were always bound together by ideology and the notion they were more connected to one another than to the Caddo who lived on the Red River to the east and north and the Neches and Angelina Rivers to the south. The two Big Cypress groups likely were more connected to one another than to the Pine Tree Mound group, partly just because of physical proximity but also perhaps because they shared a history that differed from that of their neighbor on Potters Creek. Regardless of whether they came from different places or whether their contacts and influences came from different directions, though, the peoples of these three core communities, and almost certainly others yet to be identified, were part of something larger, a cohesive group of Caddo people that rivaled the ethnohistorically better-known ones to their south and north in terms of power and influence.

ENDNOTES

1. Another recent version combines the fourth and fifth original communities into one, such that the sixth community referenced here becomes the fifth one (Perttula 2012:83).

REFERENCES CITED

Barnhart, E., B. Dixon, S. Kotter, M. Nash, K. Reese-Taylor, E. Skokan, and R. Taylor
1997 *Data Recovery Excavations at Site 41TT372 in the Tankersley Watershed, Monticello B-2 Surface Mine, Titus County, Texas*. Document No. 940608. PBS&J, Austin.

Bell, M.
1981 *The Alex Justiss Site: A Caddoan Cemetery in Titus County, Texas*. Publications in Archaeology, Highway Design Division Report No. 21. Texas State Department of Highways and Public Transportation, Austin.

Brown, D., L. Jones, J. L. C. Ibanez, K. White, T. Bearden, S. Victor, C. Green, W. Glander, C. Carruthers, and J. Lara
1986 *Cultural Resources Survey and Testing of the Monticello-Winfield Coal Surface Mine, Titus County, Texas, Volume II, Tract H*. Document No. 851200. Espey, Huston and Associates, Inc., Austin.

Bruseth, J. E.
1998 The Development of Caddoan Polities along the Middle Red River Valley of Eastern Texas and Oklahoma. In *The Native History of the Caddo: Their Place in Southeastern Archeology and Ethnohistory*, edited by T. K. Perttula and J. E. Bruseth, pp. 47–68. Studies in Archeology 30. Texas Archeological Research Laboratory, The University of Texas at Austin.

Burden, D. A., S. L. Katauskas, and R. C. Fields
2012 *National Register Testing at 41TT896 and 41TT906 and Archeological Survey of Three Parcels, FM 1000 Realignment Project (CSJ No. 1226-04-001), Titus County, Texas*. Technical Reports No. 91. Prewitt and Associates, Inc., Austin.

Clark, J. W., Jr. and J. E. Ivey
1974 *Archeological and Historical Investigations at Martin Lake, Rusk and Panola Counties, Texas*. Research Report No. 32. Texas Archeological Survey, The University of Texas at Austin.

Davis E. M., W. A. Davis, J. R. Gipson, and B. Golden
2010 *Archeological Investigations at Lake O' the Pines, Marion and Upshur Counties, Texas, 1957–1959*. Archival Series 4. Texas Archeological Research Laboratory, The University of Texas at Austin.

Dixon, B., E. Skokan, R. Rogers, S. Kotter, M. Nash, and E. Barnhart
1995 *Archeological Testing of Site 41TT672 and Geomorphological Exploration of the Tankersley and Dragoo Creek Drainages, Titus County, Texas*. Espey, Huston and Associates, Inc., Austin.

Dockall, J. E. and R. C. Fields
2011 *National Register Testing of Three Sites in the Sabine Mine's South Hallsville No. 1 Mine-Rusk Permit, Rusk County, Texas*. Reports of Investigations No. 162. Prewitt and Associates, Inc., Austin.

Dockall, J. E., R. C. Fields, S. L. Katauskas, A. E. Dase, and K. W. Kibler
2010 *Archeological and Historic Resources Surveys of 6,925 Acres in the East Part of the Sabine Mine's South Hallsville No. 1 Mine-Rusk Permit, Panola and Rusk Counties, Texas*. Reports of Investigations No. 158. Prewitt and Associates, Inc., Austin.

Dockall, J. E., S. L. Katauskas, and R. C. Fields
2008 *National Register Testing of Four Sites in the Sabine Mine's Area M, Harrison County, Texas*. Reports of Investigations No. 157. Prewitt and Associates, Inc., Austin.

Espey, Huston and Associates, Inc.
1984 *Archaeological Site Evaluations, Monticello-Winfield Mine, Titus and Franklin Counties, Texas*. Document No. 82532. Espey, Huston and Associates, Inc., Austin.

Fields, R. C. and E. F. Gadus
2012a The Pine Tree Mound Site and the Archeology of the Nadaco Caddo. *Bulletin of the Texas Archeological Society* 83:23–80.
2012b (Editors) *Archeology of the Nadaco Caddo: The View from the Pine Tree Mound Site (41HS15), Harrison County, Texas*. Reports of Investigations No. 164. Prewitt and Associates, Inc., Austin.

Fields, R. C., V. L. Hatfield, D. A. Burden, E. F. Gadus, M. C. Wilder, and K. W. Kibler
2013 *Testing and Data Recovery Excavations at 11 Native American Archeological Sites along the U.S. Highway 271 Mount Pleasant Relief Route, Titus County, Texas*. Draft, Reports of Investigations No. 168. Prewitt and Associates, Inc., Austin.

Galan, V., R. Rogers, T. K. Perttula, and E. S. Switek
1997 *National Register Testing of Seven Sites in the Monticello B-2 Surface Mine, Titus County, Texas*. Document No. 971085. Espey, Huston and Associates, Inc., Austin.

Gilmore, K.
1973 Caddoan Interaction in the Neches Valley. Ph.D. dissertation, Department of Anthropology, Southern Methodist University, Dallas.

Goldschmidt, W. R.

1934 Field Report of an Excavation Through the George L. Keith Mound, Titus County, Texas, and Test Trenching on the C. T. Coley Farm, Titus County, Texas. Manuscript on file, Texas Archeological Research Laboratory, The University of Texas at Austin.

Griffith, T. B., R. C. Fields, S. L. Katauskas, and A. E. Dase

2012 *Archeological and Historic Resources Surveys on 2,144 Acres in the Proposed Marshall Mine, Harrison and Panola Counties, Texas*. Reports of Investigations No. 163. Prewitt and Associates, Inc., Austin.

Heartfield, Price and Greene, Inc.

1988 *Data Recovery at Site 41HS74, Harrison County, Texas*. Heartfield, Price and Greene, Inc., Monroe, Louisiana.

Jones, B. C.

1968 The Kinsloe Focus: A Study of Seven Historic Caddoan Sites in Northeast Texas. Master's thesis, Department of Anthropology, University of Oklahoma, Norman.

Keller, J. E.

1993 *Archaeological Survey and Testing at the South Hallsville No. 1 Mine, Harrison County, Texas, 1992*. Report of Investigations 3-93. Southern Archaeological Consultants, Inc., Harlingen, Texas.

Keller, J. E. and T. E. Speir (compilers)

n.d. Excavations at the Gray's Pasture Site, 41HS524, Harrison County, Texas: Northeast Texas Archeological Society 1992 Field School. Unpublished manuscript on file with the authors.

Kotter, S. M., L. Jones, C. F. Frederick, and W. Glander

1991 *An Archaeological Investigation of 41TT182 in the Monticello-Winfield South Surface Mine, Titus County, Texas*. Document No. 910264. Espey, Huston and Associates, Inc., Austin.

Krieger, A. D.

1946 *Culture Complexes and Chronology in Northern Texas, With Extension of Puebloan Datings to the Mississippi Valley*. Publication No. 4640. The University of Texas, Austin.

Mallouf, R. J.

1976 *Archeological Investigations at Proposed Big Pine Lake, 1974–1975, Lamar and Red River Counties, Texas*. Archeological Survey Report 18. Office of the State Archeologist, Texas Historical Commission, Austin.

Nash, M. A., S. M. Kotter, and K. V. Reese-Taylor

1995 *National Register Testing of Ten Sites in the Monticello B-2 Surface Mine, Titus County, Texas*. Document No. 930529. Espey, Huston and Associates, Inc., Austin.

Perttula, T. K.

1992 *"The Caddo Nation": Archaeological and Ethnohistoric Perspectives*. University of Texas Press, Austin.

2000 The Caddoan Ceramics from the Gray's Pasture Site (41HS524), Harrison County, Texas. *Journal of Northeast Texas Archeology* 13:1–39.

2004 The Prehistoric and Caddoan Archeology of the Northeastern Texas Pineywoods. In *The Prehistory of Texas*, edited by T. K. Perttula, pp. 370–407. Anthropology Series No. 9. Texas A&M University Press, College Station.

2005 (Editor) *Archeological Investigations at the Pilgrim's Pride Site (41CP304), a Titus Phase Community in the Big Cypress Creek Basin, Camp County, Texas*. Report of Investigations No. 30. Archeological & Environmental Consultants, LLC, Austin.

2012 Risky Business: Caddo Farmers Living at the Edge of the Eastern Woodlands. *Bulletin of the Texas Archeological Society* 83:81–97.

Perttula, T. K., P. S. Marceaux, and B. Nelson

2012 *Study of the Margaret Hinton collection of Pottery Vessels from Northeast Texas Caddo Cemeteries*. Archeological & Environmental Consultants, LLC, Austin.

Perttula, T. K. and B. Nelson

2007a The Gum Creek Cluster: Protohistoric Caddo Sites in the Little Cypress Creek Basin, ca. 1670–1720. *Journal of Northeast Texas Archaeology* 26:128–135.

2007b Documentation of a Collection of Archaeological Materials from the Millsey Williamson Site (41RK3), a Historic Nadaco Settlement. *Journal of Northeast Texas Archaeology* 26:120-127.

Perttula, T. K., B. Nelson, and M. Walters

2012 *Caddo Archaeology at the Henry Spencer Site (41UR315) in the Little Cypress Creek Basin of East Texas*. Special Publication No. 20. Friends of Northeast Texas Archaeology, Pittsburg and Austin.

Perttula, T. K. and D. L. Sherman

2009 *Data Recovery Investigations at the Ear Spool Site (41TT653), Titus County, Texas*. Document No. 07025. PBS&J, Austin.

Perttula, T. K., M. Tate, H. Neff, J. W. Cogswell, M. D. Glascock, E. Skokan, S. Mulholland, R. Rogers, and B. Nelson

1998 *Analysis of the Titus Phase Mortuary Assemblage at the Mockingbird Site, "Kahbakayammaahin" (41TT550)*. Document No. 970849. Espey, Huston and Associates, Inc., Austin.

Perttula, T. K., M. Walters, S. Marceaux, and B. Nelson

2009 *Caddo Pottery Vessels and Pipes from Sites in the Middle and Upper Sabine and Upper Neches River Basins, Smith and Wood Counties Texas*. Special Publication No. 7. Friends of Northeast Texas Archaeology, Pittsburg and Austin.

Perttula, T. K., M. Walters, and B. Nelson

2010a *Caddo Pottery Vessels and Pipes from Sites in the Big Cypress, Sulphur, Neches-Angelina, and Middle Sabine River Basins in the Turner and Johns Collections, Camp, Cass, Cherokee, Harrison, Morris, Titus, and Upsher Counties, Texas and Sabine Parish, Louisiana*. Special Publication No. 10. Friends of Northeast Texas Archaeology, Pittsburg and Austin.

2010b *Caddo Pottery Vessels and Pipes from the Johns Site (41CP12) in the Big Cypress Creek Basin in the Turner and Johns Collections, Camp County, Texas*. Special Publication No. 11. Friends of Northeast Texas Archaeology, Pittsburg and Austin.

2012 *Little Cypress Creek Basin Archeology: Six Late Caddo Period Cemeteries in Upshur County, Texas*. Special Publication No. 22. Friends of Northeast Texas Archeology, Pittsburg and Austin.

Prikryl, D. J.

2008 The 1991 and 1992 Texas Archeological Society Field School Excavations at the Fasken Site (41RR14), Red River County, Texas. In *Collected Papers from Past Texas Archeological Society Summer Field Schools*, edited by T. K. Perttula, pp. 125–172. Special Publication No. 5. Texas Archeological Society, San Antonio.

Rogers, R., M. B. Cliff, T. K. Perttula, G. Rutenberg, S. Victor, P. Dering, and M. Malainey

2003 *Excavations at the Alex Justiss Site, 41TT13, Titus County, Texas*. Archeological Studies Program Report No. 36. Environmental Affairs Division, Texas Department of Transportation, Austin. Document No. 030089. PBS&J, Austin.

Rogers, R. and T. K. Perttula

2004 *The Oak Hill Village Site (41RK214), Rusk County, Texas*. Document No. 030083. PBS&J, Austin.

Sabo, G., III

1998 The Structure of Caddo Leadership in the Colonial Era. In *The Native History of the Caddo: Their Place in Southeastern Archeology and Ethnohistory*, edited by T. K. Perttula and J. E. Bruseth, pp. 159–174. Studies in Archeology 30. Texas Archeological Research Laboratory, The University of Texas at Austin.

Story, D. A. and D. G. Creel

1982 The Cultural Setting. In *The Deshazo Site, Nacogdoches County, Texas, Volume 1: The Site, Its Setting, Investigation, Cultural Features, Artifacts of Non-Native Manufacture, and Subsistence Remains*, edited by D. A. Story, pp. 20–34. Texas Antiquities Permit Series No. 7. Texas Antiquities Committee, Austin.

Thurmond, J. P.

1981 Archeology of the Cypress Creek Drainage Basin, Northeastern Texas and Northwestern Louisiana. Master's thesis, Department of Anthropology, The University of Texas at Austin.

1985 Late Caddoan Social Group Identifications and Sociopolitical Organization in the Upper Cypress Basin and Vicinity, Northeastern Texas. *Bulletin of the Texas Archeological Society* 54:185–200.

1990 *Archeology of the Cypress Creek Drainage Basin, Northeastern Texas and Northwestern Louisiana*. Studies in Archeology 5. Texas Archeological Research Laboratory, The University of Texas at Austin.

Turner, R. L.

1978 The Tuck Carpenter Site and Its Relation to Other Sites within the Titus Focus. *Bulletin of the Texas Archeological Society* 49:1–110.

Webb, C. H., F. E. Murphey, W. G. Ellis, and H. R. Green

1969 The Resch Site, 41HS16, Harrison County, Texas. *Bulletin of the Texas Archeological Society* 40:3–107.

Wyckoff, D. G. and T. K. Baugh

1980 Early Historic Hasinai Elites: A Model for the Material Culture of Governing Elites. *Midcontinental Journal of Archaeology* 5(2):225–288.

Wyckoff, D. G. and L. R. Fisher

1985 *Preliminary Testing and Evaluation of the Grobin Davis Archeological Site, 34Mc-253, McCurtain County, Oklahoma*. Archeological Resource Survey Report No. 22. Oklahoma Archeological Survey, The University of Oklahoma, Norman.

At the Confluence of GIS and Geochemistry: Identifying Geochemical Correlates of Ripley Engraved Caddo Ceramics

Robert Z. Selden, Jr. and Timothy K. Perttula

ABSTRACT

We discuss a new approach to the identification and definition of spatial trends in archeologically-recovered ceramics associated with geochemical results produced using instrumental neutron activation analysis (INAA). Using all of the Ripley Engraved INAA samples, we posit that clays in the Claiborne and Wilcox Groups can be successfully demarcated by sodium (Na), cerium (Ce), and zinc (Zn). Using a subset of those data from the Big Cypress Creek basin, we find that ceramics manufactured in three different Caddo political communities can be successfully demarcated based upon differential concentrations of arsenic (As), iron (Fe), and vanadium (V) found in the ceramic paste of Ripley Engraved sherds. With the larger dataset, we then identify six spatial trends associated with the geochemistry of Ripley Engraved Caddo ceramics.

INTRODUCTION

Over the last 17 years, 1308 instrumental neutron activation analysis (INAA) samples have been run on Caddo ceramic vessels recovered from 186 archeological sites throughout the ancestral Caddo region. The Caddo INAA sample was produced by the University of Missouri Research Reactor (MURR), and is only surpassed in size by datasets from the Valley of Mexico and the Mimbres and Jornada Mogollon regions of the American Southwest. However, the complex nature of this dataset has created substantive challenges regarding the interpretation of geochemical results (see Ferguson 2010). Those difficulties have led to a recent reinterpretation of the Caddo dataset by MURR (Ferguson et al. 2010), but challenges in determining probable locations of ceramic production have become increasingly difficult due to a perceived homogeneity of local alluvial and upland clays used to manufacture the vessels (Ferguson and Glascock 2011; Perttula and Ferguson 2010).

Selden (2013:Figures B.2-B.34) created a series of 33 geochemical maps, one for each rare earth element in the INAA dataset, that conversely illustrates a high degree of diversity in the geochemistry of clays used by East Texas Caddo potters. What follows is a discussion of these maps, and how unique spatial patterns found to correlate with local geology and proposed political communities can be further highlighted using data from the well-known 15th to late 17th century A.D. Caddo ceramic type of Ripley Engraved (see Suhm and Jelks 1962).

Ripley Engraved (Figure 1) is the principal ceramic fine ware in Titus phase settlements and communities in the Big Cypress Creek and mid- and upper Sabine River basins. The type was defined by Suhm et al. (1954:346 and Plate 57) and Suhm and Jelks (1962:127-129 and Plates 64 and 65). There are a number of distinctive decorative elements and motifs associated with Ripley Engraved carinated bowls, compound bowls, or bottles, as recognized by Suhm et al. (1954:Plate 57), Turner (1978), Thurmond (1990:Figure 6), and Gadus (2013:Figures 5 and 6). In recent years, the engraved motifs found on Ripley Engraved vessels, especially carinated bowls, have been identified as distinctive varieties of the type (Perttula 2013:195 and Figure 12; Perttula et al. 2010a, 2010b; Fields et al. 2013) that likely have distinctive temporal, geographic, and social characteristics.

Figure 1. Ripley Engraved, *var. McKinney* Caddo vessel.

METHODS

The methods we employ to illustrate geochemical variability in clays from across the ancestral Caddo region relies first upon the identification of shell- and bone-tempered sherds in the INAA dataset (Selden et al. 2013a). Subsequent to this identification, a calcium correction was applied only to geochemical results from shell- or bone-tempered samples due to the capacity of calcium-rich tempers to dilute certain elements associated with clays (Cogswell et al. 1998; Steponaitis et al. 1996). This deviates from MURR's current practice of applying the calcium correction to the entirety of the Caddo INAA dataset (see Ferguson 2010:6; Ferguson and Glascock 2006:3, 2007:3, 2009a:3, 2009b:266, 2010:93, 2012:3, Perttula and Ferguson 2010:11). The proportion of shell- and bone-tempered sherds in this dataset is small, and we consider the application of the calcium correction to the remainder of the sample to be unwarranted for the grog-tempered sherds since "such correction is unnecessary because the grog itself is made of clay, presumably the same clay that comprises the rest of the paste" (Steponaitis et al. 1996:559).

The calcium correction was applied to shell- and bone-tempered sherds in version 3.2.2 of R, after which those data were recombined with the other-tempered data, where the log-10 for each element was calculated, after adding a value of one to each sherd/element in the database, effectively replacing all missing values with a zero (Selden et al. 2013a). Subsequently, the dataset was imported in ArcGIS10.2 where the Getis-Ord Gi* statistic was employed to calculate a z-score for each log-10 value using the formula:

$$G_i^* = \frac{\sum_{j=1}^{n} w_{i,j}\, x_j - \bar{X}\sum_{j=1}^{n} w_{i,j}}{s\sqrt{\frac{\left[n\sum_{j=1}^{n} w_{i,j}^2 - \left(\sum_{j=1}^{n} w_{i,j}\right)^2\right]}{n-1}}} \qquad (1)$$

where $x_j x_j$ is the attribute value for feature $j, w_{i,j}$ $j, w_{i,j}$ is the spatial weight between feature $i i$ and $j j$, $n n$ is equal to the total number of features and:

$$\bar{X} = \frac{\sum_{j=1}^{n} x_j}{n} \qquad (2)$$

$$S = \sqrt{\frac{\sum_{j=1}^{n} x_j^2}{n}} - (\bar{X})^2 \qquad (3)$$

The $G_i^* G_i^*$ statistic is a z-score so no further calculations are required (ESRI 2013).

Following the calculation of z-scores for each element, these data were used to calculate the deterministic statistic of inverse distance weighted

(IDW) for each element. This statistic illustrates whether discrete geochemical signatures exist close to one another, or in the same location.

We begin with a sample of 98 Ripley Engraved sherds recovered at 24 Caddo sites in East Texas to establish links between local geology and geochemistry, and include sites in the Big Cypress, Little Cypress, and Sabine River basins. Then we employ a sub-sample of the dataset—23 Ripley Engraved sherds from 12 sites in the Big Cypress Creek basin—to focus on an analysis of their chemical composition within previously-defined political communities. We then return to the larger dataset from the Big Cypress, Little Cypress, and Sabine River basins to explore six spatial patterns identified during the analysis. In all cases, the maps are used to identify geochemical correlates.

RESULTS

Three elements were identified using the resultant geochemical maps that correspond with the variation in geologic groups across the study area (cerium [Ce], sodium [Na], and zinc [Zn]) (Figure 3). Although Na represents a new tool for discriminating between the Claiborne and Wilcox Groups in East Texas, its ability to do so appears to be unique to the Ripley Engraved sample, and further INAA research in this region may assist in clarifying this distinction. Earlier studies have pointed to analytical gains in demarcating between these geologic groups using the lanthanides (rare earth elements) contrasted with Zn; Ce and La in particular (Selden et al. 2013b).

Using the current Caddo INAA sample, Caddo sites located atop the Claiborne Group can be

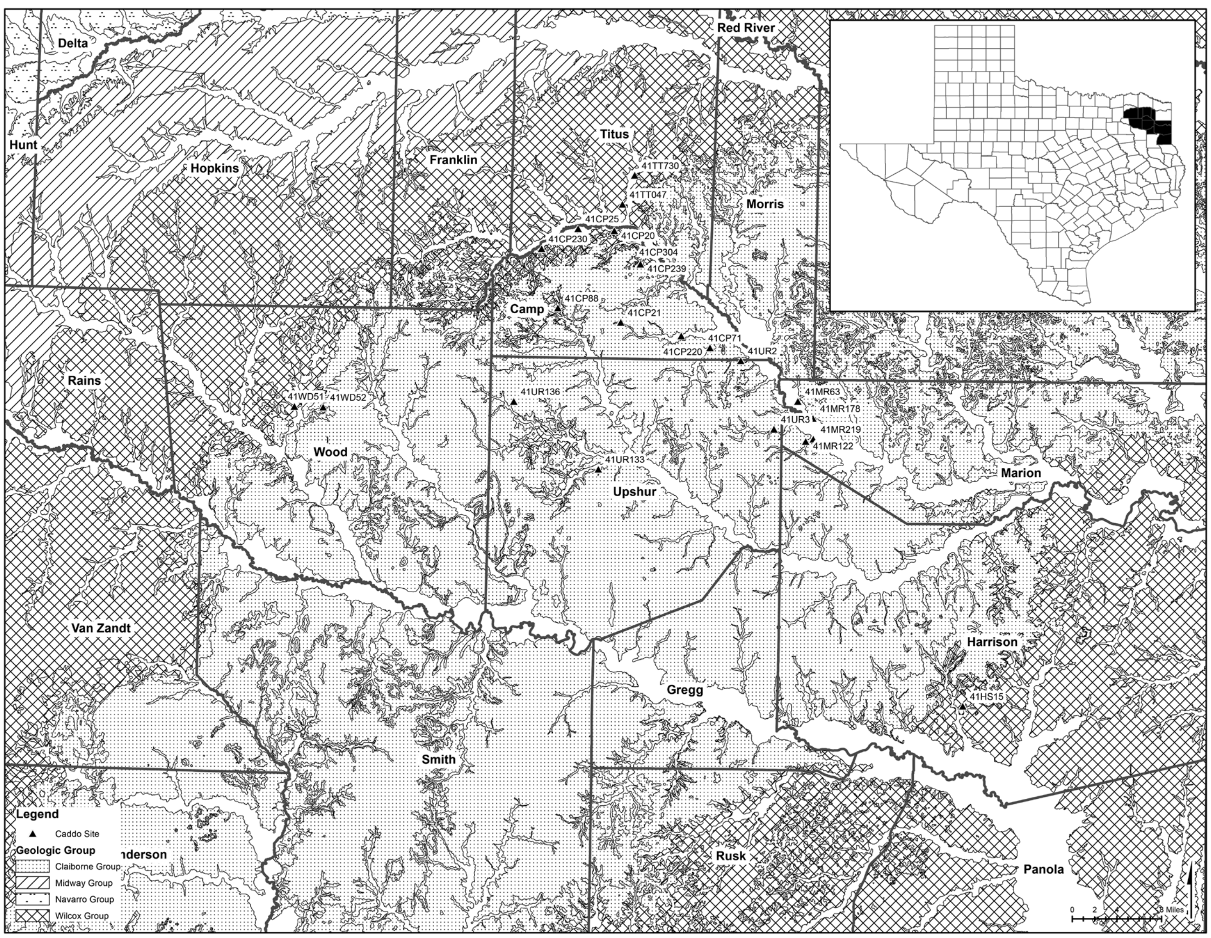

Figure 2. Counties, archeological sites, and geologic groups mentioned in the text.

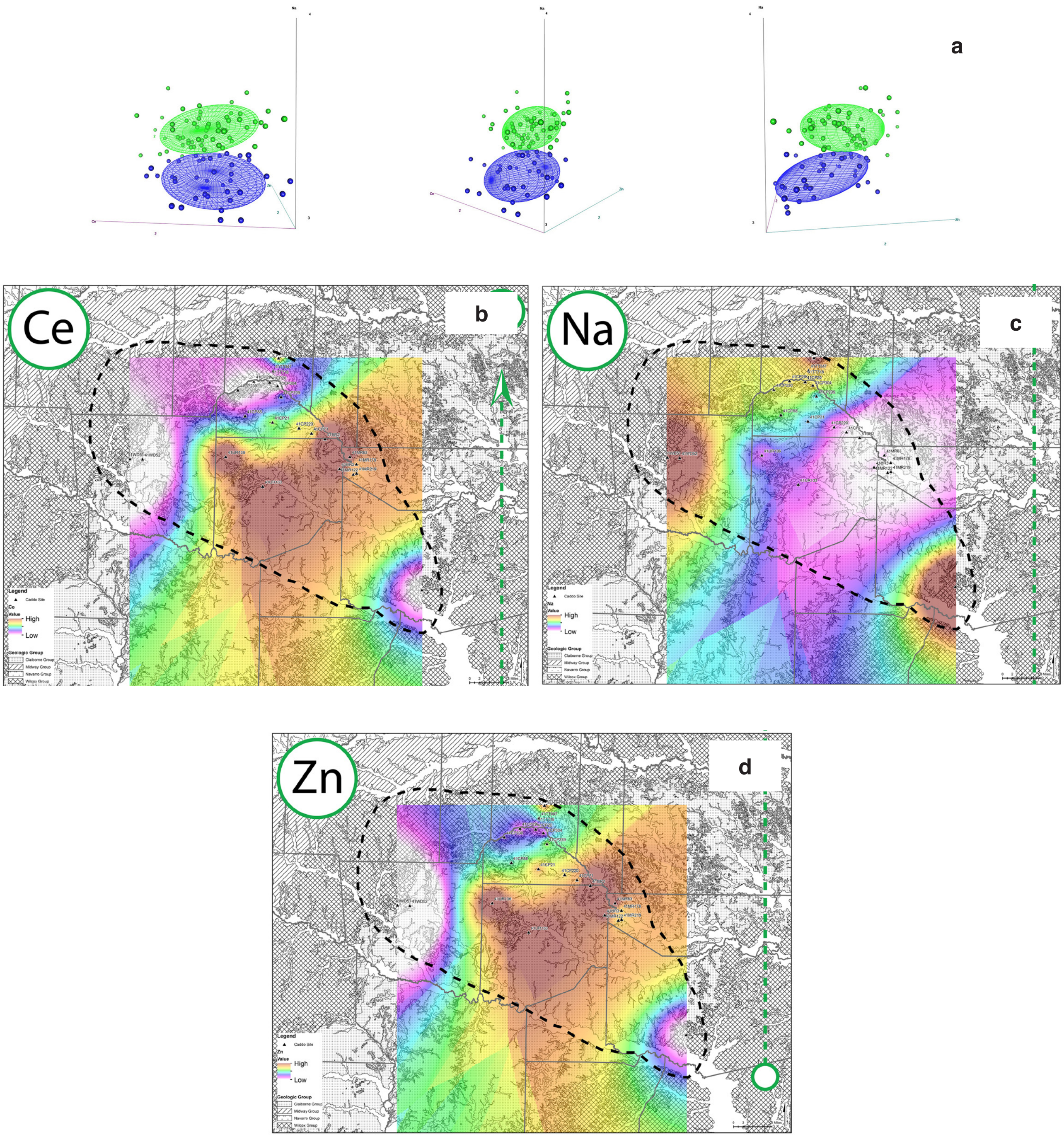

Figure 3. Claiborne and Wilcox Groups (a) demarcated in a 3D scatterplot using Ce, Na, and Z, and (b) geochemical maps of Ce, Na, and Zn.

subdivided when Zn is contrasted with tantalum (Ta) and Ce, pointing to potential geochemical differences between the Queen City Sand, Weches, and Sparta Sand Formations that comprise it. These potential differences could lead to new developments in ceramic geochemical research throughout the region. For example, increasing the number of INAA and petrographic samples could foster significant gains in further linking ceramic geochemical data with the local geology. Noting the presence or absence of glauconite—commonly associated with the Weches Formation—in petrographic samples could also aid in further delineating between the Weches and Sparta Sand Formations (Selden et al. 2013b). Additionally, there are color differences that exist between quartz sands found in the Sparta Sand Formation (light to brownish-gray), and those in the Queen City Sand Formation (grayish-orange to pink) that may prove useful in future macroscopic and microscopic research (USGS 2007).

Similarly, because the Wilcox Group can be further subdivided on the basis of Zn, neodymium (Nd), and dysprosium (Dy), elucidating geochemical differences between the larger undivided Wilcox Formation and the Carrizo Sand Formation (Selden et al. 2013b), additional INAA and petrographic analyses in the area could assist in further parsing out the geochemical and paste constituents that are most often associated with ceramics produced from clays in or near these two formations. Color and compositional differences also exist between these formations; the Carrizo Sand Formation is comprised of brown and red quartz sand that may have ironstone inclusions, while the Wilcox Formation is comprised of a silty and sandy clay with common gray ironstone inclusions (USGS 2007).

Local Political Communities and Geochemistry in the Big Cypress Creek Basin

In archeological terms, the Titus phase is marked by several clusters of settlements that apparently represent parts of contemporaneous ancestral Caddo communities (see summary in Fields, this volume; also Perttula 2012). These are thought of as *political communities* represented by concentrations of interrelated settlements and associated cemeteries that are centered upon a key site or group of sites distinguished by public architecture (i.e., earthen mounds) and large domestic village areas (Figure 4). The mounds were built over wooden structures that probably had a special religious and ritual purpose to the Caddo communities and/or with particular leaders, and the earthen mounds were built atop the structures after they had been burned. In some political communities, the community cemeteries are not found in close association with the mound centers, but instead are situated along the major streams and tributaries, presumably in general proximity to the many contemporaneous farmsteads that must have been dispersed across the countryside.

There are a number of key sites within these Titus phase political communities in the Big Cypress and mid-Sabine River basin, some of which have had INAA done on sherds in their ceramic assemblages. This includes places such as Lower Peach Orchard (41CP17) on Big Cypress Creek in the vicinity of the Sandlin Dam community cemetery (political community [PC] 1 in the Big Cypress Creek basin); Pilgrim's Pride (41CP304) on Walkers Creek, and Tom Hanks (41CP239), Harold Williams (41CP10) and Tuck Carpenter (41CP5) on Dry Creek (Turner 1978) (PC 2); Sam Roberts (41CP8), P. S. Cash (41CP2), and the Shelby (41CP71) sites on Greasy and Prairie creeks (PC 3); Harroun (41UR10), Dalton (41UR11), Chastain (41UR18), and Camp Joy Mound (41UR144) on Big Cypress Creek and Meddlin Creek (PC 4); the Whelan (41MR2), H. R. Taylor (41HS3), and Patton (41HS825) sites on Big Cypress Creek and Arms Creek (PC 5); and the Pine Tree Mound site (41HS15) and community in the mid-Sabine River basin (Fields and Gadus 2012; Perttula 2012, 2013).

Using a subset of the Ripley Engraved INAA data from sites in the Big Cypress Creek basin, as discussed above, three elements—arsenic (As), iron (Fe), and vanadium (V)—were found to share a similar spatial pattern with previously defined Caddo political communities in the Big Cypress Creek basin. The results of the analysis indicate that ceramic sherds from three of the five Caddo political communities in this drainage basin can be successfully segregated using elements that share similar spatial patterns (Figure 5 and Table 1), suggesting a preponderance of ceramic production in these Titus phase contexts using local clays. While As and Fe have very similar spatial distributions, the distribution of V is more comparable to chromium (Cr) and scandium (Sc).

Results of the geochemical analysis tentatively point to both the local manufacture of ceramics by Titus phase political communities—using clays with distinctive chemical constituents (Groups 1-3)—and the movement of vessels between political communities. Geochemical Group 1 is represented by PC 2, including Ripley Engraved sherds from 41CP21; Group 2 by PC 3, including 41CP220 and 41UR2 Ripley Engraved sherds; and Group 3 by PC 4, including sherds from 41MR178, 41MR219 and 41UR3 (see Figure 4 and Table 1).

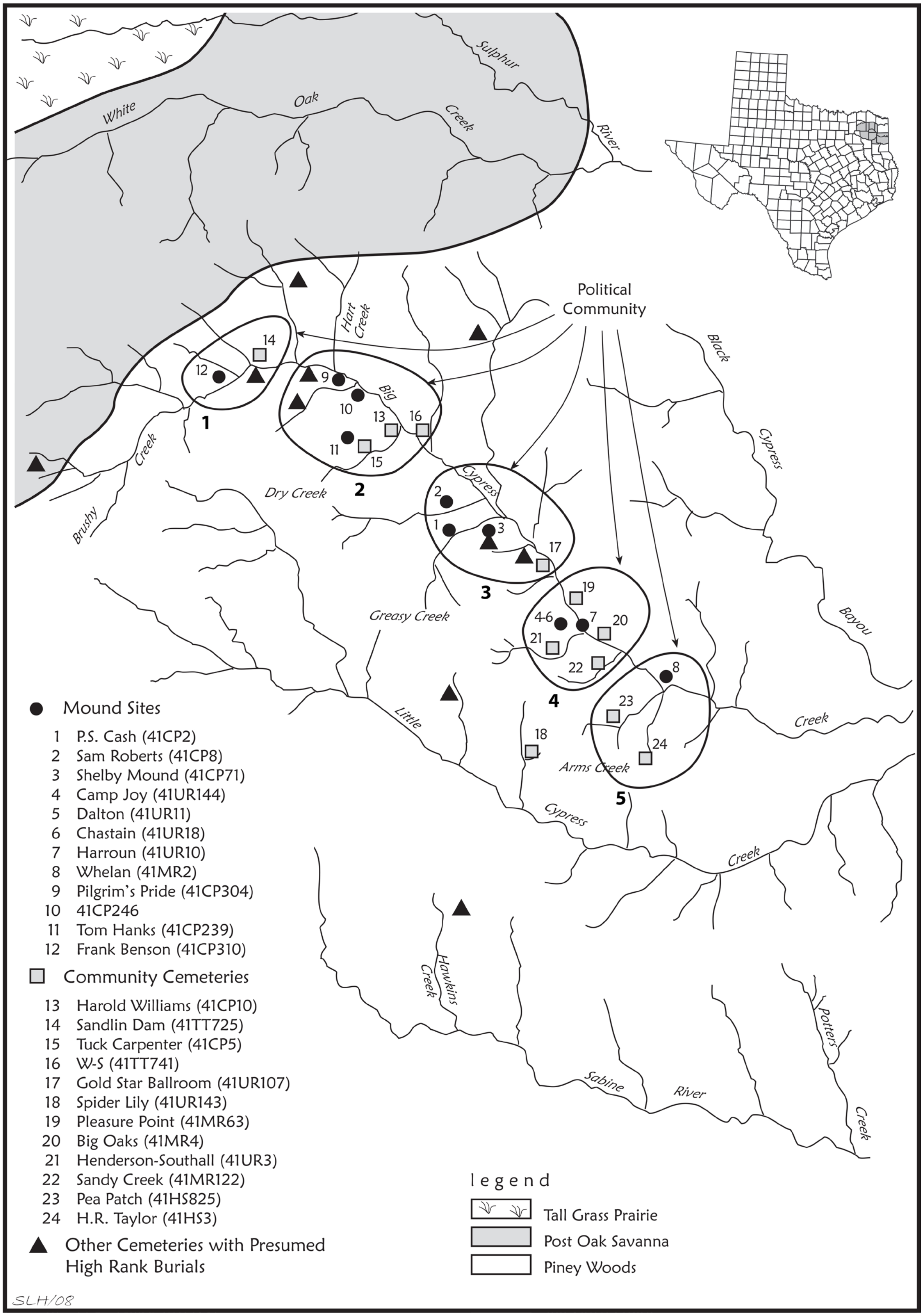

Figure 4. Map of local political communities in the Big Cypress Creek basin.

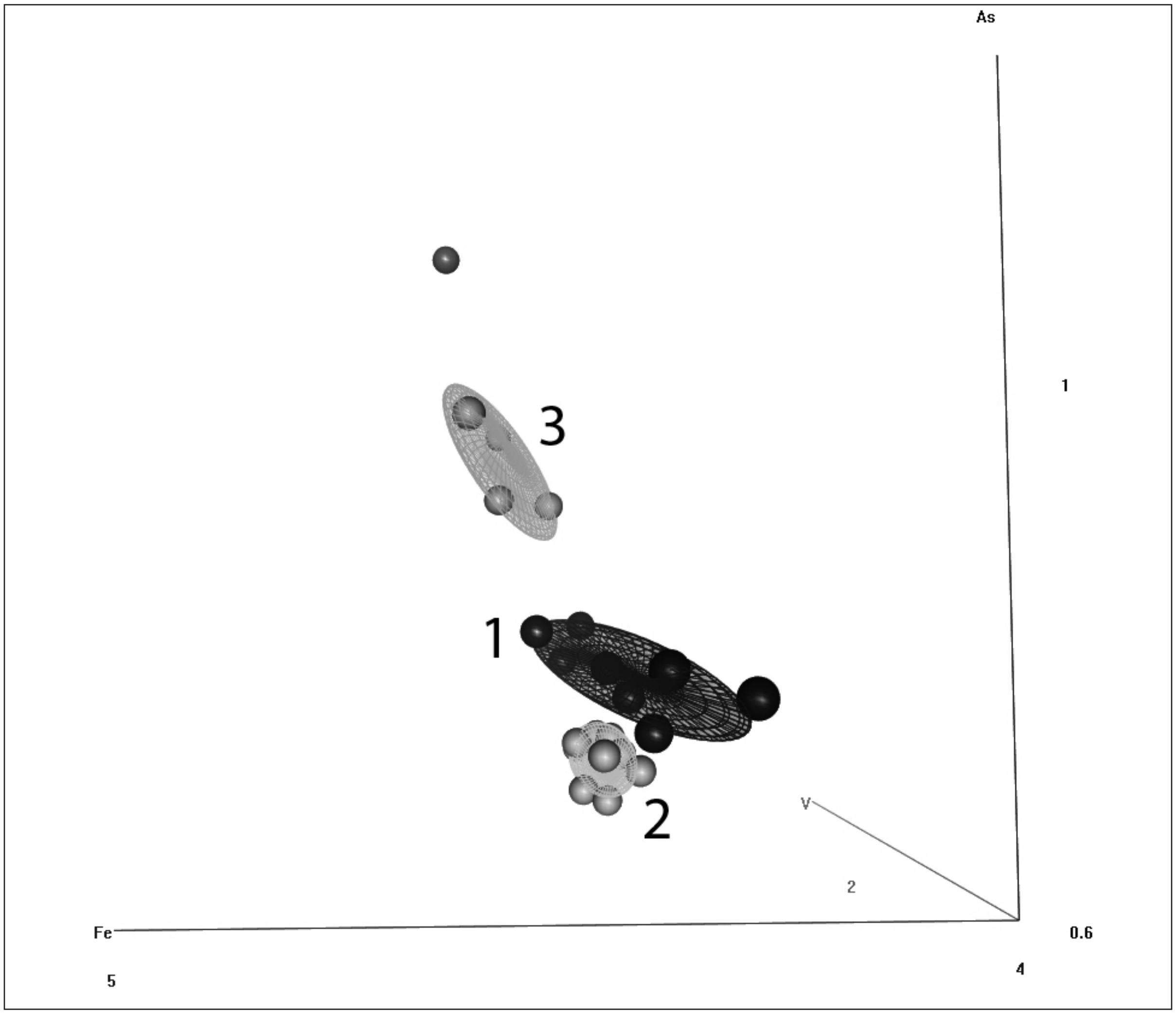

Figure 5. 3D scatterplot of As, Fe, and V illustrating geochemical variation between Caddo political groups

Seven sherds comprise Group 1/PC 2 (see Table 1). Group 1 sherds from 41CP220 (Group 2/PC 3) and Group 3/PC 4 sherds from 41UR2 point to potential interaction between these three political communities, and the movement of pottery vessels between communities. Ten sherds comprise Group 2/PC 3 (see Table 1). The four sherds from 41CP304 (Group 1/PC2) point to interactions between peoples in PC 2 and PC 3. The Group 3/PC4 sherds come only from that political community.

These results are also consistent with the notion that social interaction existed between these three Caddo political communities (see Perttula 2012). With regard to inter-political community variability in ceramic chemical composition, the analysis places sherds from 41MR63, 41MR219, 41MR122, and 41UR3—all in the Lake O' the Pines area (see Figure 4)—in Group 3; these sites are considered to belong to a single PC. However, even within this group, there appears to be greater variability that may represent at least two different groups of potters; one group is represented by sherds from 41MR63 and 41UR3 while the other is represented by sherds from 41MR219 and 41MR122. The latter subgroup is higher in As, Fe, and hafnium (Hf), and lower in Ce, cobalt (Co), cesium (Cs), lutetium (Lu), samarium (Sm), and rubidium (Rb). More INAA samples could clarify whether two distinct groups of potters were manufacturing Ripley Engraved vessels within this community. The single outlier from this analysis (TKP381 from 41MR178) is assumed to be representative of either intra- (downstream from the currently-defined political communities since this sample is higher in both As and Fe) or inter-drainage basin interaction and ceramic vessel

Table 1. Sites, samples, elemental values for As, Fe, and V, and group assignments for Ripley Engraved sherds from the Big Cypress Creek basin.

Site	anid	As	Fe	V	Group
41CP021	KIT030	0.729117343	4.389284876	1.882761956	1
41CP021	KIT023	0.764864015	4.292512839	1.839798858	1
41CP071	TKP139	0.695079569	4.402843968	2.005783887	2
41CP071	TKP680	0.779311395	4.481183509	2.02135384	2
41CP071	TKP678	0.689256096	4.428742513	1.955596747	2
41CP220	KIT019	0.667828427	4.365364915	1.974527462	2
41CP220	KIT001	0.688693177	4.458972834	2.008838674	2
41CP220	KIT018	0.681756695	4.39121382	1.988853041	2
41CP220	KIT020	0.778407991	4.429251629	1.941309574	1
41CP220	KIT017	0.749101062	4.39506549	1.947198766	1
41CP239	TKP135	0.820173912	4.450291467	2.018236853	1
41CP304	TKP111	0.696123442	4.423317945	2.013975173	2
41CP304	TKP125	0.784560942	4.385133516	1.852981125	1
41CP304	TKP114	0.62675833	4.409033957	2.001738139	2
41CP304	TKP119	0.671984439	4.450118637	2.047348771	2
41CP304	TKP122	0.636632592	4.447822577	2.007017087	2
41MR063	TKP373	1.027048007	4.63402484	1.936636611	3
41MR122	TKP383	0.9593684	4.591831599	1.996209048	3
41MR178	TKP381	1.265835012	4.692604629	2.036945281	-
41MR219	TKP386	0.960440923	4.505102804	2.022271662	3
41UR002	TKP332	0.814076785	4.532161723	1.952206284	1
41UR003	TKP370	1.058717281	4.597009558	2.063364531	3

exchange between Caddo peoples, but more INAA samples are needed from a variety of sites in the Little Cypress and Sabine River drainages before this assumption can be fully evaluated.

Spatial Patterns in the Geochemistry of Ripley Engraved

Returning to the larger sample from the Big Cypress, Little Cypress, and Sabine River drainages, six spatial patterns are identified in the geochemical data that may be useful in future geochemical investigations. While the first of these (Na, Ce, and Zn) has been discussed above and found to define geochemical differences in Ripley Engraved Caddo ceramics made from clays that originated from local geologic groups in the Big Cypress Creek basin, allusions were made to two additional patterns (As and Fe, and Cr, Sc, and V) that warrant clarification. Further, three other spatial patterns exist that have not yet been discussed: Co and manganese (Mn); dysprosium (Dy), neodymium (Nd), Sm, and terbium (Tb); and Hf, Rb, and zirconium (Zr). The majority of the spatial trends in this dataset point to a gradual increase in geochemical values from the northwest to the southeast (upstream to downstream) within the Big Cypress, Little Cypress, and Sabine River drainages.

In the case of Cr, Sc, and V, the increase in geochemical values from the northwest to the southeast is apparent in the Big Cypress, Little Cypress, and Sabine River drainages, with the sole exception of a ceramic sherd from 41CP88 in the Little Cypress Creek basin (Figure 6a). In a contrasting pattern, Hf, Rb, and Zr values share similar geospatial patterns, although the pattern associated with Rb represents the inverse of Hf and Zr (Figure 6b). This pattern demonstrates an increase in Hf and Zr from the northwest to the southeast

(Rb is inverted) in the Big Cypress Creek basin, but values remain high in all areas of the Little Cypress and Sabine River drainages, again with the single exception of the sherd from 41CP88. This latter pattern may hold the key to discriminating between clay compositions in ceramics from these three drainages as more samples from a greater number of sites become available.

Four elements—Dy, Nd, Sm, and Tb—also increase in value from the northwest to the southeast, with the exception of the single Ripley Engraved sample (TKP318) from 41TT730, which has elemental values that are higher than sherds from other nearby sites like 41CP25, 41CP20, and 41TT47 in the northern part of the Big Cypress basin, which may represent an example of the trade

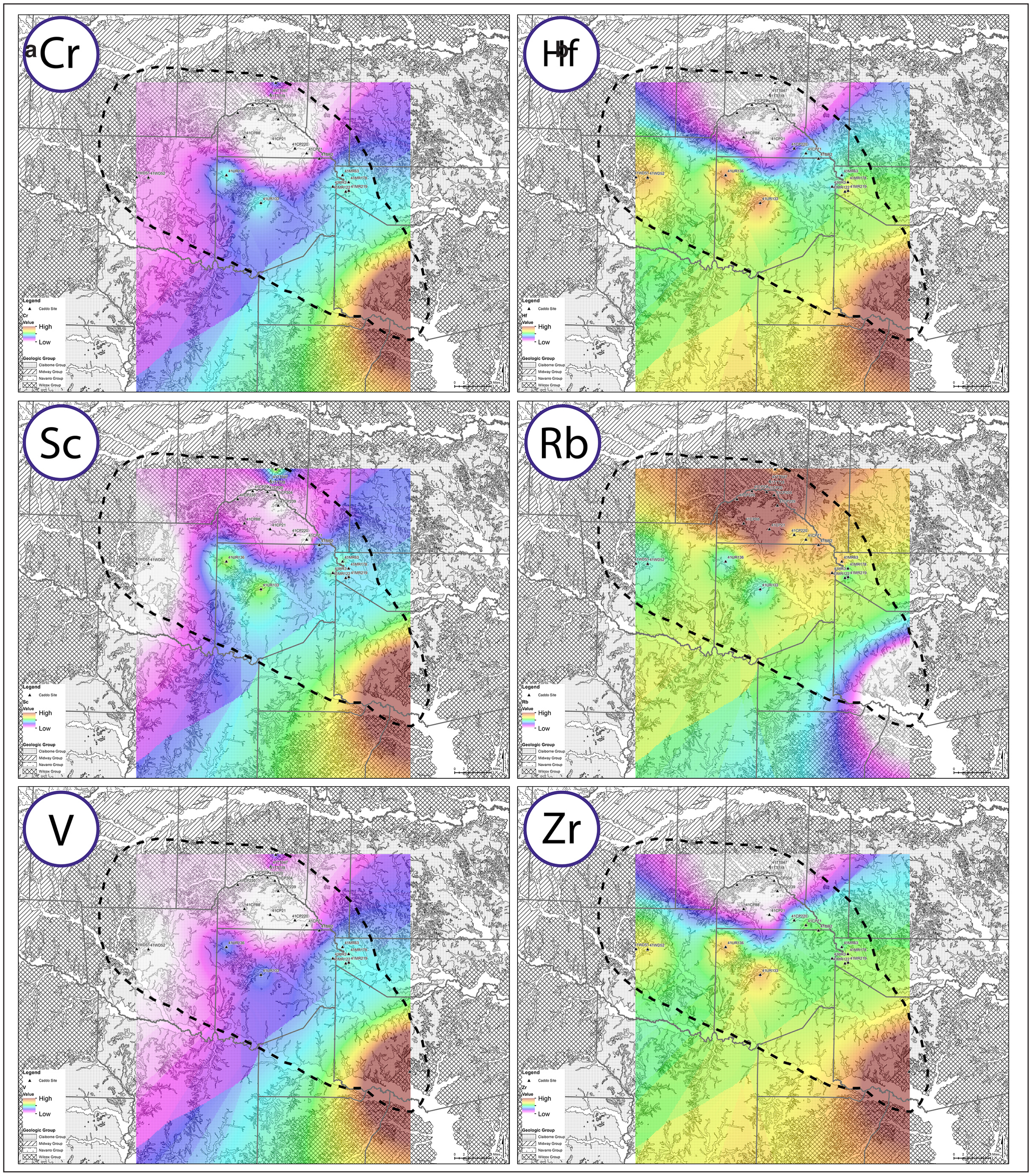

Figure 6. Geochemical distributions of (a) Cr, Sc, and V; and (b) Hf, Rb, and Zr.

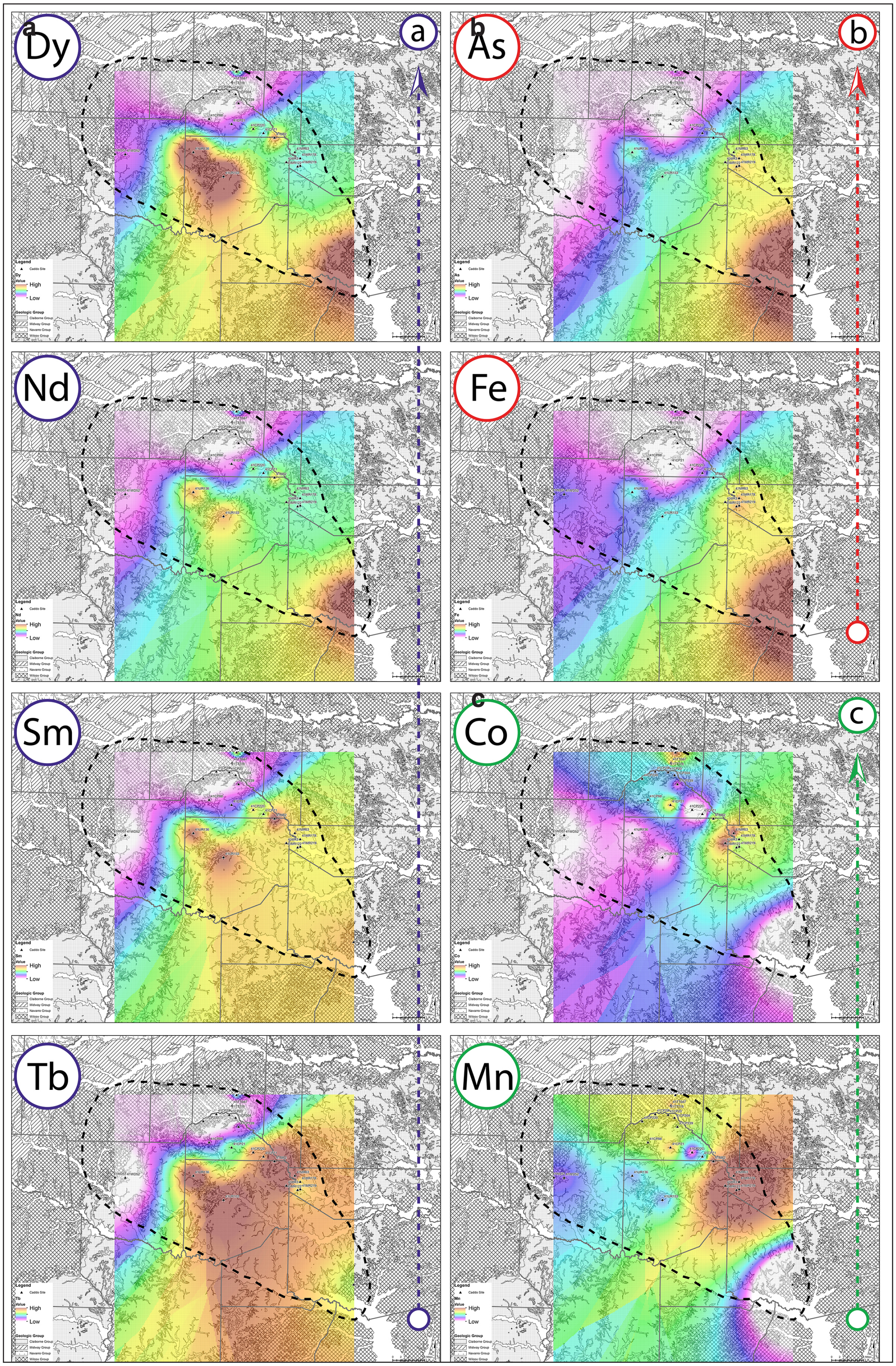

Figure 7. Geochemical distributions of (a) Dy, Nd, Sm and Tb; (b) As and Fe; and (c) Co and Mn.

of ceramic vessels with Caddo polities located to the southeast (Figure 7a). The northwest-to-southeast trend continues with As and Fe, as both show increases in values downstream, but less so in the Little Cypress basin (Figure 7b). One of the more unique geospatial trends is that of Co and Mn, which have high values in ceramic sherds in the upper Big Cypress Creek basin, a quick shift to lower values in the area of 41CP220 and 41CP71 on Prairie and Greasy creeks, and then a return to high values at 41UR2 (Figure 7c).

CONCLUSIONS

This analysis represents the first ceramic type-specific discussion of INAA results from the ancestral Caddo region, and highlights the successful application of GIS to the analysis and interpretation of the Ripley Engraved dataset. In this case, GIS was used to examine the spatial patterns associated with geochemical elements produced from archeologically-recovered ceramics in East Texas. Three different elements (As, Fe, and V) were employed to demarcate between Ripley Engraved ceramics from three previously identified political communities along Big Cypress Creek. Additionally, three chemical elements (Na, Ce, and Zn) were identified that successfully discriminate between clays in the Claiborne and Wilcox Groups, and a total of six spatial patterns were documented in the geochemical data. While the Ripley Engraved INAA sample is small, and much remains to be learned with regard to the chemical constituents of ceramic pastes in the Caddo region, this analysis marks a substantive step toward furthering our understanding of this complex dataset.

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REFERENCES CITED

Cogswell, J. W., H. Neff, and M. D. Glascock
1998 Analysis of Shell-Tempered Pottery Replicates: Implications for Provenance Studies. *American Antiquity* 63(1):63-72.

ESRI
2013 How Hot Spot Analysis: Getis-Ord-Gi* (Spatial Statistics) Works. Electronic resource, http://resources.esri.com/help/9.3/arcgisdesktop/com/gp_toolref/spatial_statistics_tools/how_hot_spot_analysis_colon_getis_ord_gi_star_spatial_statistics_works.htm, accessed December 22, 2013.

Ferguson, J. R.
2010 Preliminary Report on the Reanalysis of the Texas Caddo NAA Database. In *Studies on the Instrumental Neutron Activation Analysis of Woodland Period and Caddo Tradition Ceramics from Eastern Texas*, compiled by T. K. Perttula, Article 1. Special Publication No. 17. Friends of Northeast Texas Archaeology, Austin and Pittsburg.

Ferguson, J. R. and M. D. Glascock
2006 Instrumental Neutron Activation Analysis of Caddoan Pottery and Clay Samples from Texas and Louisiana. Research Reactor Center, University of Missouri, Columbia.

2007 Instrumental Neutron Activation Analysis of Caddo Pottery from Ten Sites in Eastern Texas. Letter report to Timothy K. Perttula with enclosed figures and tables, July 16, 2007. Research Reactor Center, University of Missouri, Columbia.

2009a Instrumental Neutron Activation Analysis of Caddo Ceramics from the Ear Spool Site, 41TT653, in Northeastern Texas. In *Data Recovery Investigations at the Ear Spool Site (41TT653), Titus County, Texas*, by T. K. Perttula and D. L. Sherman, pp. 265-277. Document No. 070205. PBS&J, Austin.

2009b Letter Report to Timothy K. Perttula with enclosed figures and tables, April 29, 2009. Research Reactor Center, University of Missouri, Columbia.

2010 Instrumental Neutron Activation Analysis of Ceramic Samples from 41CP28, Camp County, Texas. In *National Register of Historic Places Eligibility Testing on Three Late Prehistoric Sites (41CP28, 41CP88 and 41CP414) Within the Leesburg Mine, Camp County, Texas*, by D. L. Sherman, L. W. Ellis, C. Heligenstein, S. Laurence, R. Rogers, H. Rush, J. Shipp, and C. Wallace. PBS&J, Austin.

2011 Instrumental Neutron Activation Analysis of Caddo Pottery from Ten Sites in Eastern Texas. In *Archeological Investigations at the Lang Pasture Site (41AN38) in the Upper Neches River Basin of East Texas*, edited and assembled by T. K. Perttula, D. B. Kelley, and R. A. Ricklis, pp. 591-612. Report 129. Archeological Studies Program, Environmental Affairs Division, Texas Department of Transportation, Austin.

2012 Instrumental Neutron Activation Analysis of Ceramic and Burned Clay Samples from 41CP220 and 41CP21, Camp County, Texas. Archaeometry Laboratory, Research Reactor Center, University of Missouri, Columbia.

Ferguson, J. R., T. K. Perttula, and M. D. Glascock

2010 Dividing Up the Caddo Cultural Landscape: Small-Scale Analysis of a Large Ceramic INAA Database. In *Studies on the Instrumental Neutron Activation Analysis of Woodland Period and Caddo Tradition Ceramics from Eastern Texas*, compiled by T. K. Perttula. Special Publication No. 17. Friends of Northeast Texas Archaeology, Austin and Pittsburg.

Fields, R. C. and E. F. Gadus (editors)

2012 *Archeology of the Nadaco Caddo: The View from the Pine Tree Mound Site (41HS15), Harrison County, Texas*. 2 Vols. Reports of Investigations No. 164. Prewitt and Associates, Inc., Austin.

Fields, R. C., V. L. Hatfield, D. A. Burden, E. F. Gadus, M. C. Wilder, and K. W. Kibler

2013 *Testing and Data Recovery Excavations at 11 Native American Archeological Sites along the U.S. Highway 271 Mount Pleasant Relief Route, Titus County, Texas*. Draft, Reports of Investigations No. 168. Prewitt and Associates, Inc., Austin.

Gadus, E. F.

2013 Twisted Serpents and Fierce Birds: Structural Variation in Caddo Engraved Ceramic Bottle Motifs. *Bulletin of the Texas Archeological Society* 84:213-245.

Perttula, T. K.

2012 The Character of Fifteenth- to Seventeenth-Century Caddo Communities in the Big Cypress Creek Basin of Northeast Texas. In *The Archaeology of the Caddo*, edited by T. K. Perttula and C. P. Walker, pp. 363-410. University of Nebraska Press, Lincoln.

2013 Caddo Ceramics in East Texas. *Bulletin of the Texas Archeological Society* 84:181-212.

Perttula, T. K. and J. R. Ferguson

2010 The Chemical Variation in Prehistoric and Early Historic Caddo Ceramics in Eastern Texas. In *Studies on the Instrumental Neutron Activation Analysis of Woodland Period and Caddo Tradition Ceramics from Eastern Texas*, compiled by T. K. Perttula, pp. 3-1 to 3-62. Special Publication No. 17. Friends of Northeast Texas Archaeology, Austin and Pittsburg.

Perttula, T. K., M. Walters, and B. Nelson

2010a *Caddo Pottery Vessels and Pipes from Sites in the Big Cypress, Sulphur, Neches-Angelina, and Middle Sabine River Basins in the Turner and Johns Collections, Camp, Cass, Cherokee, Harrison, Morris, Titus, and Upshur Counties, Texas and Sabine Parish, Louisiana*. Special Publication No. 10. Friends of Northeast Texas Archaeology, Pittsburg and Austin.

2010b *Caddo Pottery Vessels and Pipes from the Johns Site (41CP12) in the Big Cypress Creek Basin in the Turner and Johns Collections, Camp County, Texas*. Special Publication No. 11. Friends of Northeast Texas Archaeology, Pittsburg and Austin.

Selden, Jr., R.Z.

2013 Consilience: Radiocarbon, Instrumental Neutron Activation Analysis, and Law in the Ancestral Caddo Region. Ph.D. dissertation, Department of Anthropology, Texas A&M University, College Station.

Selden, Jr., R. Z., T. K. Perttula, and D. L. Carlson

2013a INAA and the Provenance of Shell-Tempered Sherds in the Ancestral Caddo Region. Manuscript on file, Center for Regional Heritage Research, Stephen F. Austin State University, Nacogdoches, Texas.

Selden, Jr., R. Z., T. K. Perttula, S. L. Eckert, and D. L. Carlson

2013b Linking Instrumental Neutron Activation Analysis (INAA) with Geology in the Ancestral Caddo Region. Manuscript on file, Center for Regional Heritage Research, Stephen F. Austin State University, Nacogdoches, Texas.

Steponaitis, V. P., M. J. Blackman, and H. Neff

1996 Large-Scale Patterns in the Chemical Composition of Mississippian Pottery. *American Antiquity* 61(3):555-572.

Suhm, D. A. and E. B. Jelks (editors)

1962 *Handbook of Texas Archeology: Type Descriptions*. Special Publication No. 1, Texas Archeological Society and Bulletin No. 4, Texas Memorial Museum, Austin.

Suhm, D. A., A. D. Krieger, and E. B. Jelks

1954 An Introductory Handbook of Texas Archeology. *Bulletin of the Texas Archeological Society* 25:1-562.

Thurmond, J. P.

1990 *Archeology of the Cypress Creek Drainage Basin, Northeastern Texas and Northwestern Louisiana*. Studies in Archeology 5. Texas Archeological Research Laboratory, The University of Texas at Austin.

Turner, R. L.

1978 The Tuck Carpenter Site and Its Relation to Other Sites within the Titus Focus. *Bulletin of the Texas Archeological Society* 49:1–110.

USGS

2007 Geologic Atlas of Texas. Electronic resource, http://www.tnris.org/get-data, accessed December 22, 2013.

Corn is Life: Temporal Trends in the Use of Corn (*Zea mays*) by Caddo Peoples from Radiocarbon-dated Samples and Stable Isotope Analyses

Timothy K. Perttula, Robert Z. Selden, Jr., and Diane Wilson

ABSTRACT

We examine temporal trends in the use of corn by Caddo peoples based on radiocarbon dates on corn samples from Caddo sites and from diachronic data on diet reconstructed from stable carbon and nitrogen isotope analyses in Caddo bioarcheological datasets to establish trends in its adoption and use by Caddo peoples. Summed radiocarbon probabilities of dated corn samples are used as a proxy for the use of corn by Caddo peoples, primarily in the Southern Caddo area. The majority of the calibrated age ranges on corn fall after A.D. 1300. There are notable temporal peaks at ca. A.D. 1350 and A.D. 1450, and then a plateau in probability density after ca. A.D. 1500. Plotting median calibrated ages in 10 year intervals indicates that corn is present in low numbers of dated samples from as early as ca. A.D. 900 until ca. A.D. 1300, but there are significant increases in dated corn samples from ca. A.D. 1330-1580.

The stable carbon isotope information from burials in both the Southern and Northern Caddo areas indicates that only after ca. A.D. 1200 was there a significant increase in the consumption of maize. Apatite signatures, in particular, indicate that maize consumption significantly increased in the overall diet in both areas, and that the importance of maize continued to increase in the diet of Caddo peoples after that time, likely peaking after ca. A.D. 1650.

INTRODUCTION

To better understand the development and florescence of ancestral Caddo societies in the Caddo area of the Trans-Mississippi South, an accurate chronology is required. Dee Ann Story knew this, of course, and she was a pioneer in Caddo chronology building through her efforts in obtaining and critically assessing radiocarbon dates from Caddo sites such as George C. Davis (41CE19) in East Texas (Story 1981, 1997, 2000; Story and Valastro 1977), and in her compilation of radiocarbon assays from the Gulf Coastal Plain of southwest Arkansas, southeast Oklahoma, and East Texas (Story 1990). Since her work in the 1970s-1990s, and the advent of AMS dating of miniscule samples of organic remains, a large number of Caddo radiocarbon dates have been obtained from a number of sites across the Caddo area; several more recent compilations of Caddo radiocarbon dates have been prepared since Story's work (McGimsey and van der Koogh 2001; Perttula 1998a, 1998b; Perttula and Selden 2011; Selden 2013; Selden and Perttula 2013). Currently there are, as best as we can determine as of this writing, 1,387 dates from 274 Caddo sites in the states of Arkansas, Louisiana, Oklahoma, and Texas; about 66 percent are from Caddo sites in East Texas.

Another significant development in Caddo archeology since the 1990s has been the study of stable carbon isotope analyses from human remains to investigate subsistence patterns and changes in diet. This is particularly the case in the use of stable carbon isotope analysis to determine the amount of corn consumed by Caddo peoples from ca. A.D. 800 to Historic Caddo times (Perttula 2008; Rogers 2011; Rose et al. 1998; Wilson 2012; Wilson and Perttula 2013), as it is the most direct means available of determining ancestral diets and what people ate, especially if they ate certain kinds of domesticated plant foods (e.g., Greenlee 2006; Kellner and Schoeninger 2007; Schoeninger 2009).

In this article, our concern is three-fold. First, we summarize the corpus of radiocarbon dates on corn (*kisi'*)[1] (also known as maize) samples from Caddo sites to establish trends in its adoption and use by Caddo peoples. Second, we provide diachronic data on the Caddo diet that can be reconstructed from stable carbon and nitrogen isotope analysis of apatite and/or collagen values from Caddo datasets, particularly focusing on the consumption of corn as a dietary staple. Finally, we employ both the radiocarbon dates on corn and the stable carbon isotope analyses of Caddo human remains to identify temporal trends in the use—and possible intensification in its use—of corn. Corn was the principal tropical cultigen grown and consumed by Caddo peoples and became their most important food source, as it was for many New World Native American cultures (see Bonavia 2013), along with beans (*ba:hay*) and squash/pumpkin (*k' unu' kaki:kasni'*). The Caddo believe that these plants are gifts from the earth that "they were to hold and use for their benefit. The two gifts most closely associated with the earth were corn and pumpkin" (Newkumet and Meredith 1988:30).

RADIOCARBON-DATED CORN SAMPLES FROM CADDO SITES

The Caddo chronology we use herein is based on Story (1990). There are five periods that date from ca. A.D. 800 to post-A.D. 1680:

Formative Caddo	ca. A.D. 800-1000
Early Caddo	ca. A.D. 1000-1200
Middle Caddo	ca. A.D. 1200-1400
Late Caddo	ca. A.D. 1400-1680
Historic Caddo	ca. A.D. 1680-1860+

Currently, there are 114 radiocarbon-dated corn samples from 33 sites in the Caddo area of southwestern Arkansas, northwestern Louisiana, eastern Oklahoma, and East Texas; this represents approximately eight percent of the known radiocarbon dates from all Caddo sites. The samples of Caddo sites with radiocarbon dates on corn include two sites in Arkansas, one site in Louisiana, three sites in Oklahoma, and 27 sites in Texas. Only one date from Oklahoma (from 34Hs9) is not from the Southern Caddo area (Figure 1 and Table 1).[2]

In Arkansas, the two Caddo sites with dated corn samples have median calibrated ages that range from A.D. 1446-1664, in the Late Caddo period, with the highest probabilities for two sigma age ranges of A.D. 1395-1523, A.D. 1450-1530, A.D. 1540-1635, and A.D. 1632-1682 (see Table 1). The one dated corn sample from a Louisiana Caddo site, with an extremely large standard deviation (see Table 1), has a median calibrated age of A.D. 1406, and appears to be associated with a substantial Middle Caddo period settlement on the Red River (Thomas et al. 1980).

The single corn date from a Caddo site in the Arkansas River basin in eastern Oklahoma has a median calibrated age of A.D. 1480, while Caddo sites in the Glover and Mountain Fork River drainages in Southeast Oklahoma have median calibrated ages on corn that range from A.D. 1354-1526 (see Table 1). The highest probabilities for two sigma age ranges for these dated samples of corn are A.D. 1271-1444, A.D. 1294-1521, A.D. 1392-1443, A.D. 1396-1642, and A.D. 1424-1646. These median calibrated ages and two sigma age ranges indicate that corn was being grown and consumed by Caddo peoples in these areas during the Sanders phase (ca. A.D. 1100-1300) in parts of the Early and Middle Caddo periods and the early (ca. A.D. 1300-1500) and late (ca. A.D. 1500-1700) parts of the McCurtain phase (see Dowd 2012; Regnier 2013).

To the south, the much more expansive sample of corn dates from East Texas Caddo sites has median calibrated ages that range from as early as A.D. 902 at the George C. Davis site on the Neches River to as late as A.D. 1654 at the Pine Tree Mound site on a tributary to the Sabine River (Fields and Gadus 2012). Most of the dates on corn are from only a few sites, including dates from Formative Caddo, Early Caddo, and Middle Caddo period components at the George C. Davis mound center and village site (n=12) (Story 2000), a Late Caddo period Titus phase (ca. A.D. 1430-1680) component with a single mound and village areas at the Pilgrim's Pride site (n=6, Perttula 2005) in the Big Cypress Creek basin, a Titus phase component at the expansive Pine Tree Mound site (n=10), a Middle Caddo period component at the Oak Hill Village site (41RK214) on a tributary to the Sabine River (n=5, Rogers and Perttula 2004; Perttula and Rogers 2012), and the George E. Richey (n=10), William A. Ford (n=22), and James E. Richey (n=6) sites in the Big Cypress Creek basin (Fields et al. 2013).

A summed probability distribution of all the corn dates from the Caddo area was produced using Version 4.2 of OxCal and IntCal09 (Figure 2). The majority of the calibrated age ranges at two sigma fall after A.D. 1300 (see Table 1), with notable temporal peaks at ca. A.D. 1350 and A.D. 1450, followed by a plateau in probability density after ca. A.D. 1500.

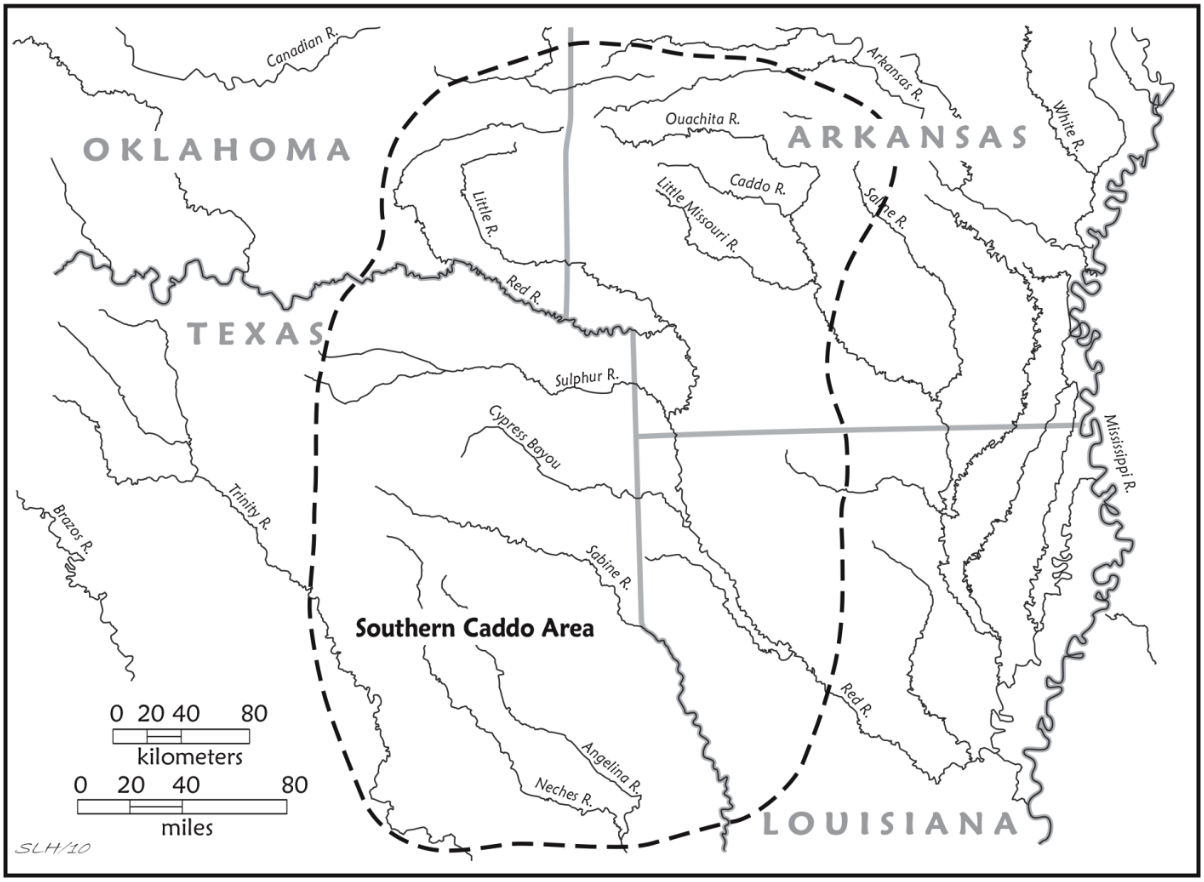

Figure 1. The Southern Caddo area. Figure prepared by Sandra L. Hannum.

Median calibrated ages from Table 1 plotted in 10 year intervals illustrate the same temporal trends in corn dates from the Caddo sites (Figure 3). Corn is present in low numbers of dated samples from as early as ca. A.D. 900 until ca. A.D. 1300, but there are significant increases in dated corn samples from ca. A.D. 1330-1580. There are notable peaks in the median calibrated age of dated samples of corn between A.D. 1341-1350, in the latter part of the Middle Caddo period, between A.D. 1421-1430 at the beginning of the Late Caddo period, as well as between A.D. 1561-1570, also in the Late Caddo period.

A few pre-A.D. 800 dates on corn come from the George C. Davis site (see Story 1990). The calibrated median ages of these six dates range from A.D. 222-773. The OxCal data combination process for these dates indicates that the early George C. Davis dates occur in one group with a 2 sigma calibrated age range of A.D. 415-606 and a median calibrated age of A.D. 506. There is also a single pre-A.D. 800 date on corn from a Southwest Missouri Ozark rock shelter in Barry County in the Northern Caddo area: Montgomery 4 (Fritz 1986:Tables 4.3 and 9.2), although it has a large (± 232 years) standard deviation and is not considered particularly reliable. This date (SMU-1578) has a calibrated two sigma age range of A.D. 55-1021, with a calibrated median age of A.D. 553.[3]

It is possible that these pre-A.D. 800 corn dates indicate that corn was being grown in parts of East Texas and the western Ozark Highland as early as ca. A.D. 400, during the latter part of the Woodland period. Even if these dates are accurate, which we consider dubious (see End Notes 2 and 3), the cultivation and consumption of corn was sporadic at best during those times.

TEMPORAL TRENDS IN CADDO MAIZE CONSUMPTION FROM STABLE CARBON ISOTOPE ANALYSES

Ratios of carbon and nitrogen stable isotopes in human bone are used to trace back the food

Table 1. Caddo radiocarbon dates on corn from sites in Southwest Arkansas, Northwest Louisiana, Eastern Oklahoma, and East Texas. Calibrations follow Version 4.2 of OxCal (Bronk Ramsey 2013) and IntCal (Reimer et al. 2009).

Site Name and Trinomial	Assay No.	Conventional Radiocarbon Age (B.P.) and SD	1 Sigma Calibrated Age Range**	2 Sigma Calibrated Age Range**	Median Calibrated Age
Arkansas					
Hedges (3HS60)	B-306763	240 ± 30	AD 1644-1668 (0.45), AD 1783-1797 (0.23)	AD 1526-1556 (0.05), AD 1632-1682 (0.51), AD 1762-1803 (0.29)	AD 1664
Battle (3LA1)	Tx-579*	455 ± 30	AD 1412-1477 (0.68)	AD 1395-1523 (0.85), AD 1574-1627 (0.09)	AD 1446
Battle (3LA1)	B-316762	360 ± 30	AD 1466-1522 (0.39), AD 1575-1584 (0.05), AD 1590-1625 (0.24)	AD 1450-1530 (0.48), AD 1540-1635 (0.48)	AD 1536
Louisiana					
Hanna (16RR4)	UGA-1770	550 ± 220	AD 1226-1531 (0.55), AD 1538-1635 (0.13)	AD 1020-1697 (0.88)	AD 1406
Oklahoma					
Robinson-Solesbee (34HS9)	B-194414	410 ± 40	AD 1437-1495 (0.59), AD 1602-1616 (0.10)	AD 1427-1524 (0.72), AD 1558-1632 (0.23)	AD 1480
Clement (34MC8)	Tx-825*	595 ± 80	AD 1299-1370 (0.48), AD 1380-1410 (0.20)	AD 1271-1444 (0.95)	AD 1354
Clement (34MC8)	Tx-820*	495 ± 70	AD 1320-1351 (0.14), AD 1391-1465 (0.54)	AD 1294-1521 (0.91)	AD 1422
Clement (34MC8)	Tx-824*	435 ± 70	AD 1414-1518 (0.58), AD 1594-1619 (0.10)	AD 1396-1642 (0.94)	AD 1480
Clement (34MC8)	Tx-823B*	385 ± 70	AD 1445-1523 (0.42), AD 1573-1629 (0.27)	AD 1424-1646 (0.95)	AD 1526

Table 1. *(Continued)*

Site Name and Trinomial	Assay No.	Conventional Radiocarbon Age (B.P.) and SD	1 Sigma Calibrated Age Range**	2 Sigma Calibrated Age Range**	Median Calibrated Age
Ramos Creek (34MC1030)	B-317796	520 ± 30	AD 1404-1435 (0.68)	AD 1324-1345 (0.11), AD 1392-1443 (0.85)	AD 1416
Texas					
Lang Pasture (41AN38)	B-236772	600 ± 40	AD 1306-1363 (0.54), AD 1385-1400 (0.14)	AD 1294-1411 (0.95)	AD 1349
Pace McDonald (41AN51)	B-305694	610 ± 30	AD 1302-1329 (0.28), AD 1341-1367 (0.27), AD 1382-1396 (0.13)	AD 1295-1404 (0.95)	AD 1348
George C. Davis (41CE19)	Tx-3307*	1121 ± 117	AD 776-1020 (0.68)	AD 666-1059 (0.88), AD 1065-1155 (0.10)	AD 902
George C. Davis (41CE19)	Tx-3694*	1061 ± 72	AD 890-1030 (0.68)	AD 800-1058 (0.84), AD 1076-1155 (0.10)	AD 970
George C. Davis (41CE19)	Tx-1308*	1041 ± 81	AD 892-1045 (0.60), AD 1095-1120 (0.06)	AD 802-1168 (0.94)	AD 992
George C. Davis (41CE19)	Tx-914a*	1031 ± 81	AD 895-925 (0.10), AD 937-1048 (0.45), AD 1088-1122 (0.10)	AD 808-1184 (0.95)	AD 1004
George C. Davis (41CE19)	Tx-3270*	1011 ± 81	AD 900-918 (0.05), AD 966-1058 (0.37), AD 1075-1155 (0.26)	AD 868-1216	AD 1028
George C. Davis (41CE19)	Tx-906a*	951 ± 72	AD 1020-1160 (0.68)	AD 969-1226 (0.94)	AD 1096
George C. Davis (41CE19)	M-1168*	896 ± 85	AD 1041-1110 (0.28), AD 1116-1213 (0.40)	AD 995-1271 (0.95)	AD 1131
George C. Davis (41CE19)	Tx-3310*	851 ± 108	AD 1046-1094 (0.16), AD 1120-1141 (0.06), AD 1148-1266 (0.45)	AD 979-1309 (0.94)	AD 1163

Table 1. *(Continued)*

Site Name and Trinomial	Assay No.	Conventional Radiocarbon Age (B.P.) and SD	1 Sigma Calibrated Age Range**	2 Sigma Calibrated Age Range**	Median Calibrated Age
George C. Davis (41CE19)	Tx-3267*	801 ± 72	AD 1166-1278 (0.68)	AD 1040-1297 (0.95)	AD 1216
George C. Davis (41CE19)	Tx-3276*	791 ± 72	AD 1174-1281 (0.68)	AD 1041-1109 (0.10), AD 1116-1302 (0.84)	AD 1224
George C. Davis (41CE19)	Tx-4340*	761 ± 99	AD 1159-1306 (0.62), AD 1364-1385 (0.06)	AD 1040-1110 (0.10), AD 1116-1332 (0.73), AD 1337-1398 (0.12)	AD 1239
George C. Davis (41CE19)	Tx-3274*	681 ± 99	AD 1258-1399 (0.68)	AD 1155-1441 (0.95)	AD 1309
41CE299	B-144428	330 ± 90	AD 1469-1644 (0.68)	AD 1418-1684 (0.86), AD 1733-1807 (0.07)	AD 1569
Kitchen Branch (41CP220)	B-204251	550 ± 30	AD 1325-1344 (0.25), AD 1394-1421 (0.44)	AD 1310-1360 (0.40), AD 1386-1435 (0.55)	AD 1396
Kitchen Branch (41CP220)	B-319967	470 ± 40	AD 1415-1450 (0.68)	AD 1396-1489 (0.94)	AD 1435
Kitchen Branch (41CP220)	B-319969	470 ± 30	AD 1425-1446 (0.68)	AD 1409-1457 (0.95)	AD 1435
Kitchen Branch (41CP220)	B-327614	390 ± 30	AD 1447-1496 (0.54), AD 1602-1616 (0.12)	AD 1441-1524 (0.69), AD 1571-1631 (0.25)	AD 1488
Pilgrim's Pride (41CP304)	B-138860	650 ± 70	AD 1281-1325 (0.32), AD 1344-1394 (0.36)	AD 1252-1425 (0.95)	AD 1338
Pilgrim's Pride (41CP304)	B-138856	450 ± 70	AD 1406-1515 (0.61), AD 1599-1618 (0.07)	AD 1320-1350 (0.05), AD 1391-1637 (0.91)	AD 1463
Pilgrim's Pride (41CP304)	B-132240	420 ± 80	AD 1422-1522 (0.50), AD 1589-1625 (0.15)	AD 1394-1649 (0.94)	AD 1500
Pilgrim's Pride (41CP304)	B-138863	380 ± 70	AD 1447-1523 (0.40), AD 1572-1630 (0.28)	AD 1425-1649 (0.95)	AD 1531

Table 1. *(Continued)*

Site Name and Trinomial	Assay No.	Conventional Radiocarbon Age (B.P.) and SD	1 Sigma Calibrated Age Range**	2 Sigma Calibrated Age Range**	Median Calibrated Age
Pilgrim's Pride (41CP304)	B-132244	320 $\pm$ 60	AD 1495-1602 (0.54), AD 1615-1642 (0.14)	AD 1447-1665 (0.94)	AD 1563
Pilgrim's Pride (41CP304)	B-132245	310 $\pm$ 60	AD 1495-1602 (0.53), AD 1616-1646 (0.15)	AD 1448-1668 (0.93)	AD 1568
41HE139	UGA-12888	500 $\pm$ 40	AD 1408-1442 (0.68)	AD 1320-1351 (0.10), AD 1390-1455 (0.86)	AD 1423
41HE343	UGA-12892	380 $\pm$ 40	AD 1448-1521 (0.51), AD 1592-1620 (0.18)	AD 1441-1530 (0.55), AD 1540-1635 (0.40)	AD 1513
Hurricane Hill (41HP106)	B-108169	770 $\pm$ 30	AD 1225-1275 (0.68)	AD 1217-1282 (0.95)	AD 1253
Pine Tree Mound (41HS15)	B-260380	510 $\pm$ 40	AD 1403-1441 (0.68)	AD 1318-1353 (0.15), AD 1390-1450 (0.81)	AD 1418
Pine Tree Mound (41HS15)	B-260381	470 $\pm$ 40	AD 1415-1450 (0.68)	AD 1396-1489 (0.94)	AD 1435
Pine Tree Mound (41HS15)	B-260378	400 $\pm$ 40	AD 1442-1513 (0.57), AD 1601-1617 (0.11)	AD 1432-1527 (0.67), AD 1556-1633 (0.29)	AD 1490
Pine Tree Mound (41HS15)	B-260365	350 $\pm$ 40	AD 1475-1524 (0.29), AD 1570-1631 (0.36)	AD 1455-1637 (0.95)	AD 1552
Pine Tree Mound (41HS15)	B-260389	350 $\pm$ 40	AD 1475-1524 (0.29), AD 1570-1631 (0.36)	AD 1455-1637 (0.95)	AD 1552
Pine Tree Mound (41HS15)	B-260375	330 $\pm$ 40	AD 1495-1530 (0.20), AD 1538-1602 (0.37), AD 1616-1635 (0.11)	AD 1465-1645 (0.95)	AD 1559
Pine Tree Mound (41HS15)	B-260397	320 $\pm$ 40	AD 1515-1600 (0.54), AD 1618-1641 (0.15)	AD 1468-1649 (0.95)	AD 1562

Table 1. *(Continued)*

Site Name and Trinomial	Assay No.	Conventional Radiocarbon Age (B.P.) and SD	1 Sigma Calibrated Age Range**	2 Sigma Calibrated Age Range**	Median Calibrated Age
Pine Tree Mound (41HS15)	B-260384	300 ± 40	AD 1520-1593 (0.49), AD 1619-1648 (0.19)	AD 1475-1662 (0.95)	AD 1567
Pine Tree Mound (41HS15)	B-260393	290 ± 40	AD 1521-1592 (0.46), AD 1620-1653 (0.22)	AD 1482-1666 (0.94)	AD 1572
Pine Tree Mound (41HS15)	B-260383	250 ± 40	AD 1527-1555 (0.13), AD 1632-1670 (0.36), AD 1780-1799 (0.15)	AD 1513-1601 (0.24), AD 1616-1684 (0.42), AD 1735-1805 (0.23) AD 1933-1955 (0.06)	AD 1654
Ray (41LR135)	B-88418	1000 ± 50	AD 986-1048 (0.44), AD 1087-1123 (0.19), AD 1138-1150 (0.06)	AD 952-1162 (0.92)	AD 1038
Ray (41LR135)	B-88419	910 ± 50	AD 1040-1110 (0.38), AD 1116-1172 (0.30)	AD 1025-1217 (0.95)	AD 1118
Ray (41LR135)	B-88423	890 ± 50	AD 1047-1091 (0.24), AD 1121-1140 (0.09), AD 1149-1213 (0.35)	AD 1027-1226 (0.95)	AD 1136
Washington Square (41NA49)	Tx-4873*	1081 ± 64	AD 894-1017 (0.68)	AD 776-1045 (0.93)	AD 949
Washington Square (41NA49)	Tx-4875*	871 ± 72	AD 1045-1095 (0.21), AD 1120-1141 (0.09), AD 1147-1225 (0.39)	AD 1027-1266 (0.95)	AD 1155
Washington Square (41NA49)	Tx-4258*	601 ± 81	AD 1299-1370 (0.50), AD 1380-1407 (0.18)	AD 1268-1444 (0.95)	AD 1352
Beech Ridge (41NA242)	B-201987	570 ± 40	AD 1315-1356 (0.42), AD 1389-1414 (0.27)	AD 1298-1370 (0.57), AD 1380-1429 (0.38)	AD 1354
Tom Moore (41PN149)	B-124359	360 ± 60	AD 1459-1524 (0.34), AD 1570-1631 (0.31)	AD 1442-1646 (0.95)	AD 1545

Table 1. *(Continued)*

Site Name and Trinomial	Assay No.	Conventional Radiocarbon Age (B.P.) and SD	1 Sigma Calibrated Age Range**	2 Sigma Calibrated Age Range**	Median Calibrated Age
Murvaul Creek (41PN175)	B-344094	660 ± 30	AD 1285-1306 (0.33), AD 1363-1385 (0.35)	AD 1277-1322 (0.48), AD 1348-1393 (0.48)	AD 1340
Murvaul Creek (41PN175)	B-344091	350 ± 30	AD 1481-1523 (0.29), AD 1572-1630 (0.39)	AD 1457-1635 (0.95)	AD 1555
Murvaul Creek (41PN175)	B-344087	310 ± 30	AD 1521-1591 (0.52), AD 1620-1643 (0.16)	AD 1485-1650 (0.95)	AD 1563
Hudnall-Pirtle (41RK4)	B-129983	950 ± 70	AD 1022-1159 (0.68)	AD 970-1225 (0.95)	AD 1096
Hudnall-Pirtle (41RK4)	B-129884	890 ± 60	AD 1045-1095 (0.24), AD 1120-1141 (0.10), AD 1148-1214 (0.34)	AD 1026-1253 (0.95)	AD 1136
Nawi haia ina (41RK170)	B-166763	630 ± 80	AD 1288-1330 (0.29), AD 1339-1397 (0.40)	AD 1253-1439 (0.95)	AD 1344
Oak Hill Village (41RK214)	B-73939	810 ± 100	AD 1051-1082 (0.09), AD 1152-1284 (0.57)	AD 1020-1315 (0.92)	AD 1197
Oak Hill Village (41RK214)	B-110061	640 ± 40	AD 1290-1319 (0.29), AD 1352-1390 (0.39)	AD 1281-1400 (0.95)	AD 1348
Oak Hill Village (41RK214)	B-110065	630 ± 40	AD 1295-1320 (0.26), AD 1350-1391 (0.42)	AD 1285-1401 (0.95)	AD 1349
Oak Hill Village (41RK214)	B-73940	610 ± 80	AD 1297-1402 (0.68)	AD 1266-1441 (0.95)	AD 1350
Oak Hill Village (41RK214)	B-110067	570 ± 40	AD 1315-1356 (0.42), AD 1389-1414 (0.27)	AD 1298-1370 (0.57), AD 1380-1429 (0.38)	AD 1354
Oak Hill Village (41RK214)	B-110066	570 ± 40	AD 1315-1356 (0.42), AD 1389-1414 (0.27)	AD 1298-1370 (0.57), AD 1380-1429 (0.38)	AD 1354
41RK243	B-144818	660 ± 90	AD 1279-1320 (0.34), AD 1350-1391 (0.34)	AD 1260-1412 (0.95)	AD 1333

Table 1. *(Continued)*

Site Name and Trinomial	Assay No.	Conventional Radiocarbon Age (B.P.) and SD	1 Sigma Calibrated Age Range**	2 Sigma Calibrated Age Range**	Median Calibrated Age
Broadway (41SM273)	B-173088	620 ± 40	AD 1297-1325 (0.26), AD 1344-1394 (0.42)	AD 1288-1405 (0.95)	AD 1349
Leaning Rock (41SM325)	B-210925	500 ± 40	AD 1408-1442 (0.68)	AD 1320-1351 (0.10), AD 1390-1455 (0.86)	AD 1423
41SM404	B-289204	680 ± 40	AD 1276-1306 (0.42), AD 1363-1385 (0.27)	AD 1263-1325 (0.57), AD 1344-1394 (0.39)	AD 1307
41SM404	B-289208	600 ± 40	AD 1306-1363 (0.54), AD 1385-1400 (0.14)	AD 1294-1411 (0.95)	AD 1349
Ear Spool (41TT653)	B-119006	420 ± 50	AD 1430-1512 (0.60), AD 1601-1616 (0.08)	AD 1415-1527 (0.71), AD 1555-1633 (0.25)	AD 1480
Ear Spool (41TT653)	B-229321	150 ± 40	AD 1669-1697 (0.12), AD 1726-1780 (0.24), AD 1798-1814 (0.07), AD 1851-1877 (0.10), AD 1917-1945 (0.12)	AD 1665-1785 (0.46), AD 1795-1893 (0.33), AD 1906-1952 (0.17)	AD 1800
George E. Richey (41TT851)	B-300034	830 ± 30	AD 1185-1255 (0.68)	AD 1160-1265 (0.95)	AD 1215
George E. Richey (41TT851)	B-300039	790 ± 30	AD 1223-1264 (0.68)	AD 1206-1280 (0.93)	AD 1242
George E. Richey (41TT851)	B-300027	770 ± 30	AD 1225-1275 (0.68)	AD 1217-1282 (0.95)	AD 1253
George E. Richey (41TT851)	B-300038	730 ± 30	AD 1262-1287 (0.68)	AD 1224-1297 (0.95)	AD 1274
George E. Richey (41TT851)	B-300046	680 ± 30	AD 1279-1300 (0.46), AD 1368-1381 (0.22)	AD 1270-1317 (0.60) AD 1354-1390 (0.36)	AD 1300
George E. Richey (41TT851)	B-300043	620 ± 30	AD 1298-1324 (0.27), AD 1346-1371 (0.27), AD 1379-1393 (0.14)	AD 1292-1400 (0.95)	AD 1350

Table 1. *(Continued)*

Site Name and Trinomial	Assay No.	Conventional Radiocarbon Age (B.P.) and SD	1 Sigma Calibrated Age Range**	2 Sigma Calibrated Age Range**	Median Calibrated Age
George E. Richey (41TT851)	B-300037	620 ± 30	AD 1298-1324 (0.27), AD 1346-1371 (0.27), AD 1379-1393 (0.14)	AD 1292-1400 (0.95)	AD 1350
George E. Richey (41TT851)	B-300044	330 ± 30	AD 1496-1530 (0.18), AD 1540-1602 (0.39), AD 1616-1634 (0.12)	AD 1477-1643 (0.95)	AD 1562
George E. Richey (41TT851)	B-300048	310 ± 30	AD 1521-1591 (0.52), AD 1620-1643 (0.16)	AD 1485-1650 (0.95)	AD 1563
George E. Richey (41TT851)	B-300035	290 ± 30	AD 1522-1574 (0.46), AD 1627-1651 (0.23)	AD 1492-1603 (0.65), AD 1615-1663 (0.31)	AD 1567
William A. Ford (41TT852)	B-300090	620 ± 30	AD 1298-1324 (0.27), AD 1346-1371 (0.27), AD 1379-1393 (0.14)	AD 1292-1400 (0.95)	AD 1350
William A. Ford (41TT852)	B-300094	600 ± 30	AD 1307-1362 (0.55), AD 1386-1399 (0.13)	AD 1297-1409 (0.95)	AD 1347
William A. Ford (41TT852)	B-300074	600 ± 30	AD 1307-1362 (0.55), AD 1386-1399 (0.13)	AD 1297-1409 (0.95)	AD 1347
William A. Ford (41TT852)	B-300092	580 ± 30	AD 1317-1354 (0.46), AD 1389-1408 (0.22)	AD 1300-1369 (0.63), AD 1381-1419 (0.32)	AD 1348
William A. Ford (41TT852)	B-300103	550 ± 30	AD 1325-1344 (0.25), AD 1394-1421 (0.44)	AD 1310-1360 (0.40), AD 1386-1435 (0.55)	AD 1396
William A. Ford (41TT852)	B-300096	520 ± 30	AD 1404-1435 (0.68)	AD 1324-1345 (0.11), AD 1392-1443 (0.85)	AD 1416
William A. Ford (41TT852)	B-300082	520 ± 30	AD 1404-1435 (0.68)	AD 1324-1345 (0.11), AD 1392-1443 (0.85)	AD 1416
William A. Ford (41TT852)	B-300059	520 ± 40	AD 1332-1338 (0.05), AD 1397-1439 (0.63)	AD 1316-1356 (0.21), AD 1388-1448 (0.74)	AD 1413

Table 1. *(Continued)*

Site Name and Trinomial	Assay No.	Conventional Radiocarbon Age (B.P.) and SD	1 Sigma Calibrated Age Range**	2 Sigma Calibrated Age Range**	Median Calibrated Age
William A. Ford (41TT852)	B-300078	510 ± 30	AD 1410-1435 (0.68)	AD 1328-1341 (0.05), AD 1395-1445 (0.91)	AD 1421
William A. Ford (41TT852)	B-300089	510 ± 30	AD 1410-1435 (0.68)	AD 1328-1341 (0.05), AD 1395-1445 (0.91)	AD 1421
William A. Ford (41TT852)	B-300068	490 ± 30	AD 1417-1440 (0.68)	AD 1403-1450 (0.95)	AD 1428
William A. Ford (41TT852)	B-300084	490 ± 30	AD 1417-1440 (0.68)	AD 1403-1450 (0.95)	AD 1428
William A. Ford (41TT852)	B-300087	460 ± 30	AD 1425-1450 (0.68)	AD 1412-1469 (0.95)	AD 1439
William A. Ford (41TT852)	B-300081	450 ± 30	AD 1427-1454 (0.68)	AD 1414-1454 (0.95)	AD 1442
William A. Ford (41TT852)	B-300083	400 ± 30	AD 1444-1492 (0.61), AD 1603-1611 (0.07)	AD 1436-1523 (0.77), AD 1574-1626 (0.19)	AD 1478
William A. Ford (41TT852)	B-300073	370 ± 30	AD 1454-1519 (0.49), AD 1594-1619 (0.19)	AD 1447-1528 (0.55), AD 1553-1634 (0.40)	AD 1515
William A. Ford (41TT852)	B-300105	360 ± 40	AD 1465-1522 (0.36), AD 1574-1628 (0.32)	AD 1450-1635 (0.95)	AD 1542
William A. Ford (41TT852)	B-300099	300 ± 30	AD 1522-1575 (0.46), AD 1625-1646 (0.18)	AD 1489-1604 (0.69), AD 1610-1654 (0.26)	AD 1564
William A. Ford (41TT852)	B-300080	300 ± 30	AD 1522-1575 (0.46), AD 1625-1646 (0.18)	AD 1489-1604 (0.69), AD 1610-1654 (0.26)	AD 1564
William A. Ford (41TT852)	B-300056	290 ± 30	AD 1522-1574 (0.46), AD 1627-1651 (0.23)	AD 1492-1603 (0.65), AD 1615-1663 (0.31)	AD 1567
William A. Ford (41TT852)	B-300100	280 ± 30	AD 1523-1571 (0.38), AD 1630-1660 (0.30)	AD 1513-1601 (0.54), AD 1616-1666 (0.38)	AD 1578
William A. Ford (41TT852)	B-300088	280 ± 30	AD 1523-1571 (0.38), AD 1630-1660 (0.30)	AD 1513-1601 (0.54) AD 1616-1666 (0.38)	AD 1578

Table 1. *(Continued)*

Site Name and Trinomial	Assay No.	Conventional Radiocarbon Age (B.P.) and SD	1 Sigma Calibrated Age Range**	2 Sigma Calibrated Age Range**	Median Calibrated Age
James E. Richey (41TT853)	B-300116	380 ± 30	AD 1450-1515 (0.54), AD 1600-1617 (0.14)	AD 1445-1525 (0.62), AD 1558-1632 (0.34)	AD 1503
James E. Richey (41TT853)	B-300109	340 ± 30	AD 1491-1526 (0.23), AD 1557-1603 (0.31), AD 1610-1632 (0.15)	AD 1470-1640 (0.95)	AD 1560
James E. Richey (41TT853)	B-300117	340 ± 30	AD 1491-1526 (0.23), AD 1557-1603 (0.31), AD 1610-1632 (0.15)	AD 1470-1640 (0.95)	AD 1560
James E. Richey (41TT853)	B-300112	320 ± 30	AD 1518-1594 (0.54), AD 1619-1640 (0.15)	AD 1482-1646 (0.95)	AD 1563
James E. Richey (41TT853)	B-300113	300 ± 30	AD 1522-1575 (0.46), AD 1625-1646 (0.18)	AD 1489-1604 (0.69), AD 1610-1654 (0.26)	AD 1564
James E. Richey (41TT853)	B-300115	280 ± 30	AD 1523-1571 (0.38), AD 1630-1660 (0.30)	AD 1513-1601 (0.54), AD 1616-1666 (0.38)	AD 1578
Boxed Springs (41UR30)	B-288476	850 ± 40	AD 1158-1252 (0.68)	AD 1046-1093 (0.12), AD 1148-1267 (0.79)	AD 1190

B=Beta Analytic, Inc.; UGA=University of Georgia; Tx=University of Texas
*C13/C12 isotopic value for these samples is assumed to be -10.0 o/oo for purposes of estimating the conventional radiocarbon age
**age ranges with probabilities of less than 0.05 are not listed on this table

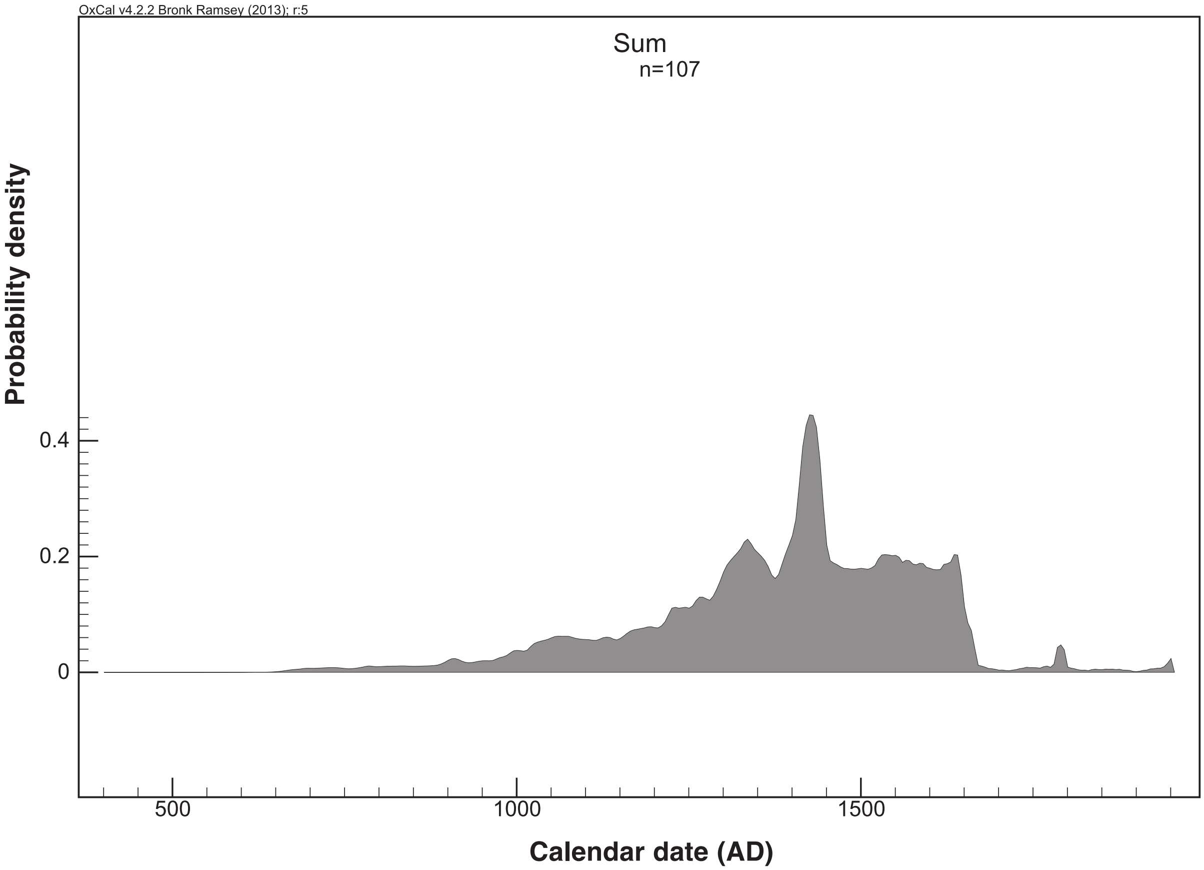

Figure 2. A summed probability distribution for calibrated dates on corn samples from Caddo sites in Arkansas, Louisiana, Oklahoma, and Texas.

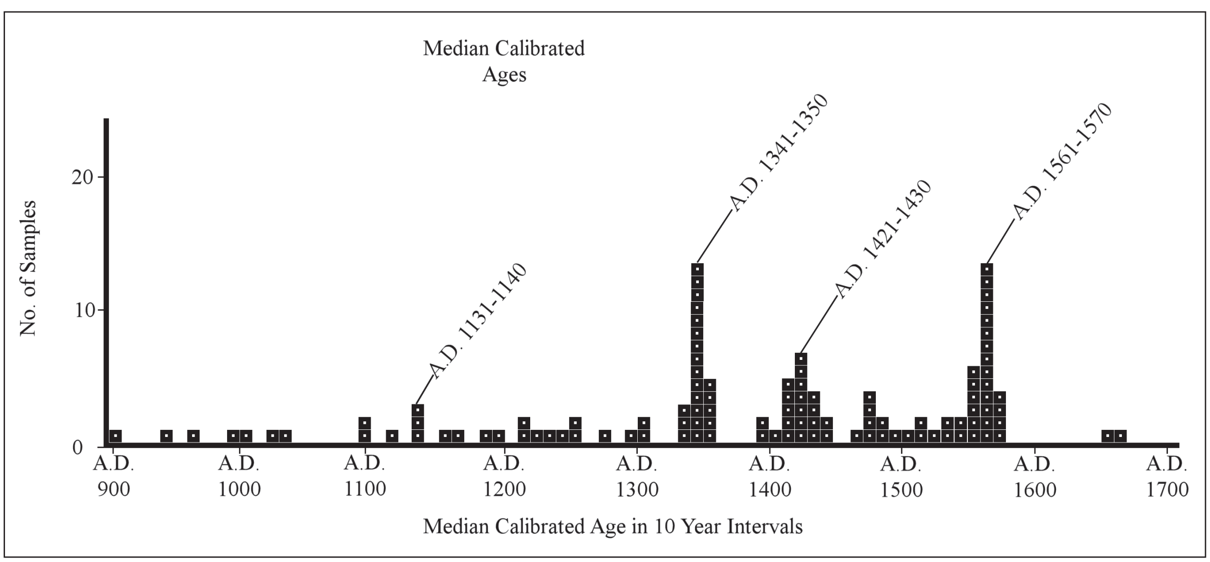

Figure 3. Median calibrated ages of corn samples, in 10 year intervals, from Caddo sites in Arkansas, Louisiana, Oklahoma, and Texas. Figure prepared by Lance Trask.

chain a particular person had over their lifetime, C_3 and C_4 plant groups utilize distinct photosynthetic pathways that incorporate different amounts of stable carbon isotopes (C^{12} and C^{13}) in their tissues. In C_3 plants, photosynthesis discriminates against C^{13}. This results in lower $\delta^{13}C$ values than in C_4 plants, which are adapted to more sunlight and higher temperatures. These values are carried through the food chain to consumers. The Gulf Coastal Plain where the Caddo people lived until the mid-19th century is a C_3 plant environment, but corn is an introduced C_4 species. Thus, once Caddo peoples began consuming corn, the carbon stable isotope ratio in their bones increased to reflect the increased amounts of C_4 foods in their diet.

Similarly, nitrogen stable isotopes (N^{14} and N^{15}) are the ultimate result of how plants obtain their nitrogen, either symbiotically or through direct absorption. Nitrogen stable isotope studies have been most successful in showing the difference between marine and terrestrial food webs and in examining trophic levels.

In stable carbon isotope studies both collagen and apatite of bone can be examined to better understand diet. Apatite is the mineral component of bone and preserves over a greater length of time than collagen. Animal studies have shown that apatite represents the whole diet whereas collagen represents the carbon from protein contribution to the diet. Collagen is the main protein in the organic component of bone.

In all, 137 stable isotope results are available from the bioarcheological study of Caddo individuals in the southern Caddo area (Table 2; see Wilson and Perttula 2013). Most of these measure C^{13} in bone collagen. It is important to note that we used the 16 individuals for which two samples have been run to give an idea of the standard of error among different laboratory facilities. The mean difference between samples for carbon collagen from the same individual is 0.71‰; we will return to this standard of error below.

The samples are from 35 Caddo sites. Nineteen results from the 16 individuals from the Crenshaw site (3MI6) on the Red River are included here, while samples run on individuals represented by skull and mandible features have been excluded due to their questionable cultural affiliation (Schambach et al. 2011). The majority of the stable isotope testing for the Southern Caddo area is from East Texas (n=89, 65 percent of the overall sample), followed by Arkansas (n=33, 24 percent) and Louisiana (n=15, 11 percent). The individuals tested are from a range of contexts, including single and multiple interments, and different types of sites, including mound centers and settlements.

The 33 samples from Arkansas in the Southern Caddo area are estimated to range from the Formative Caddo to Historic Caddo (post-A.D. 1680) periods with the majority of samples (85 percent) dating to the Formative period (see Table 2). The C^{13} collagen samples indicate that there was little to no C_4 contribution to the protein portion of the diet in the Formative Caddo period, supporting our conclusion that the pre-A.D. 800 dates on corn from the George C. Davis site and the Montgomery Farm site in southwest Missouri are suspect. The two samples from the Middle Caddo period Ferguson (3HE63) site have nearly identical C^{13} collagen values to the Historic Caddo samples from the Cedar Grove (3LA97) site, and samples from both sites indicate a significant amount of C_4 in the protein portion of the diet. No C^{13} apatite values are available from Arkansas and the 10 N^{15} values are all from the Crenshaw site. These nitrogen values (-9.30 ± 0.82‰) can be used as a baseline for later determinations of the impact of corn on trophic levels.

There are 15 stable isotope results from 14 individuals from Louisiana (see Table 2). These are from the Hanna (16RR4), Belcher Mound (16CD13), and McLelland (16BO236) sites. These burials date from the Early to the Historic Caddo periods. The C^{13} collagen samples show a clear and dramatic increase in the amount of C_4 in the protein portion of the diet, with little to no C_4 in the diet at Hanna, a multi-component Early to Middle Caddo period site (Thomas et al. 1980). In contrast, the C^{13} apatite and N^{15} stable isotopes available from the Historic McLelland sample (see Table 2) show apatite signatures that indicate that approximately 25 percent of the diet originated in C_4 sources. Nitrogen values from McLelland clearly show that the two infants were nursing and their mothers were consuming C_4 plants (presumably corn). The remaining five adult values show one outlier with low protein and little C_4 while the others have a higher quantity of protein in their diet but similar amount of maize in the diet.

The 89 samples from East Texas Caddo sites date from the Formative through Historic Caddo periods (see Table 2). There are 77 results for C^{13} collagen, 49 for C^{13} apatite, and 32 for N^{15}. Stable isotope values indicate that maize consumption

Table 2. Summary of Southern Caddo and Oklahoma's Arkansas river basin stable isotope means and adjusted standard deviations.

Time Period (A.D.)	$\delta^{13}C_{col} \pm$ s.d. collagen	N	$\delta^{13}C \pm$ s.d. apatite	N	$\delta^{15}N \pm$ s.d. collagen	N
Late Woodland-Formative Caddo period (ca. A.D. 400-1000)						
Mean values	-19.5 ± 1.8	47	-9.7 ± 2.0	4	9.6 ± 0.8	29
Arkansas	-20.2 ± 1.3	28	–		9.3 ± 0.8	10
Oklahoma	-19.2 ± 1.3	20	–		10.0 ± 0.7	16
Texas	-17.2 ± 3.0	5	-9.7 ± 2.0	4	8.9 ± 0.2	3
Early Caddo period (ca. A.D. 1000-1200)						
Mean values	-17.9 ± 2.5	22	-10.4 ± 2.4	5	9.9 ± 0.9	13
Louisiana	-19.6	1	–	–		
Oklahoma	-17.3 ± 2.7	13	–		10.1 ± 0.7	9
Texas	-18.5 ± 2.0	8	-10.4 ± 2.4	5	9.3 ± 1.0	4
Middle Caddo period (ca. A.D. 1200-1400)						
Mean values	-14.8 ± 2.6	39	-9.8 ± 2.1	14	10.2 ± 1.5	24
Arkansas	-13.6 ± 1.0	2	–	–		
Oklahoma	-14.6 ± 3.1	17	–		10.5 ± 0.8	17
Texas	-15.1 ± 2.3	20	-9.8 ± 2.1	14	9.2 ± 2.3	7
Late Caddo period (ca. A.D. 1400-1680)						
Mean values	-15.9 ± 3.5	54	-8.0 ± 1.7	19	9.4 ± 2.6	18
Louisiana	-17.4 ± 2.5	8	–	-		
Oklahoma	-12.7 ± 3.6	8	–		9.7 ± 0.8	7
Texas	-16.3 ± 3.3	38	-8.0 ± 1.7	19	9.3 ± 3.3	11

Table 2. *(Continued)*

Time Period (A.D.)	$\delta^{13}C_{col} \pm$ s.d. collagen	N	$\delta^{13}C \pm$ s.d. apatite	N	$\delta^{15}N \pm$ s.d. collagen	N
Historic Caddo (post-A.D. 1680)						
Mean values	-13.9 ± 1.4	17	-8.3 ± 1.4	14	8.6 ± 4.1	14
Arkansas	-14.4 ± 0.4	3	–	–		
Louisiana	-14.7 ± 2.2	5	-9.0 ± 0.8	5	9.1 ± 2.2	5
Texas	-13.7 ±0.7	7	-7.4 ± 1.4	7	6.6 ± 4.3	7

Isotope ratios are expressed in parts per thousand (δ). Stable isotope values are summarized in Wilson and Perttula (2013).

peaked in the Historic Caddo period, with the largest change in consumption patterns occurring between the Middle and Late Caddo periods.

Stable isotope results from the Formative Caddo period are from two sites that have radically different results. Results from the George C. Davis site (41CE19) indicate little to no maize in the diet at this time despite its presence in the site's archeological record (see Ford 1997; Jones 1949). Conversely, results from the Hurricane Hill site (41HP106) indicate diets significantly enriched in C_4. However, nitrogen values from this time suggest that some of the C_4 was the result of eating bison in addition to or rather than from corn. The pattern of limited corn consumption holds through the Early Caddo period. From the Early to the Middle Caddo period there is a small increase in the overall amount of C_4 in the diet, but an apparent increase in the C_4 contribution to protein as shown in the nitrogen isotope values (see Table 2). Overall in the East Texas part of the Southern Caddo area for the period from ca. A.D. 800 to after A.D. 1680, the largest increases in mean collagen values occurred from the Early Caddo period to the Middle Caddo period (Figure 4a). When nitrogen signatures are factored in, however, at least along the Red River, it appears that there was a small increase in the amount of corn coupled with an increase in the consumption of bison. The highest $\delta^{13}C$ collagen signatures are seen at the Sanders site (41LR2) on the Red River, a site with bison in the archeological assemblage (see Jackson et al. 2000; Krieger 1946).

The largest increase in C_4 in the total diet (as gauged by changes in apatite values) among the East Texas Caddo, and indeed in the Southern Caddo area as a whole, occurs between the Middle and Late Caddo periods (Figure 4b). This corresponds to several of the temporal peaks in radiocarbon data (see Figures 2 and 3). At this time there is also a decrease in C_4 in the protein portion of the diet, which indicates that the source of change is maize. Nitrogen isotope values decrease as carbon isotope values increase (see Table 2), further supporting the rise in the importance of maize at the expense of higher protein food. While there is more corn in the diet overall during the Late Caddo period, there is also a high degree of dietary variability, with some individuals consuming a considerable amount of corn and others eating little to none. This diversity likely reflects differences in individual diets because of the relative success through time in corn production in dispersed family planting plots.

Apatite signatures peak in the Historic Caddo period (see Table 2), but only seven results are available, all from the Jim Allen site (41CE12) in the upper Neches River basin. At this time mean apatite signatures indicate that an estimated 56 percent of the diet was based in C_4 plants. Mean $\delta^{13}C$ collagen values are also at their highest levels at this time (see Figure 4a). The only significant decrease in nitrogen isotope values takes place between the Late and Historic Caddo periods, indicating a lowering of trophic level as corn replaced the total amount of meat protein in the East Texas Caddo diet.

In comparing the Southern Caddo area isotope values to the Northern Caddo area, specifically sites in the Arkansas River basin in eastern Oklahoma (see Figure 1), the stable isotope database (57 samples from 21 sites) runs from the latter part of the Fourche Maline period (dating after ca. A.D. 400) through the Fort Coffee phase (A.D. 1450-1660) (Rogers 2011). The stable isotope values document an increase in C_4 in the protein portion of the diet through time, peaking in the Fort Coffee phase (see Table 2). As C_4 increased, individual variation of diets also increased. While this pattern is apparent in the Southern Caddo stable isotope values, the differences are greater to the north in the Arkansas River basin. For example, a young adult male from the Lymon Moore (34Lf31) site has a $\delta^{13}C$ collagen signature of -21.6‰ compared to a young adult female from the same site with a signature of -10.48‰. Nitrogen values show that trophic level decreases only during the Fort Coffee phase (see Table 2), suggesting that the increase in C_4 among the Caddo peoples in the Arkansas River basin at this time is the result of an increase in maize at the expense of a higher protein food source.

SUMMARY AND CONCLUSIONS

This article is an examination of temporal trends in the use of corn by Caddo peoples from the Late Woodland period to post-A.D. 1680 times. Corn was the principal tropical cultigen grown and consumed by ancestral Caddo peoples and became their most important food source. Our examination of temporal trends in corn use is based on (a) the corpus of radiocarbon dates on corn samples from Caddo sites and from (b) diachronic data on diet reconstructed from stable carbon and nitrogen isotope analysis of apatite and/or collagen values

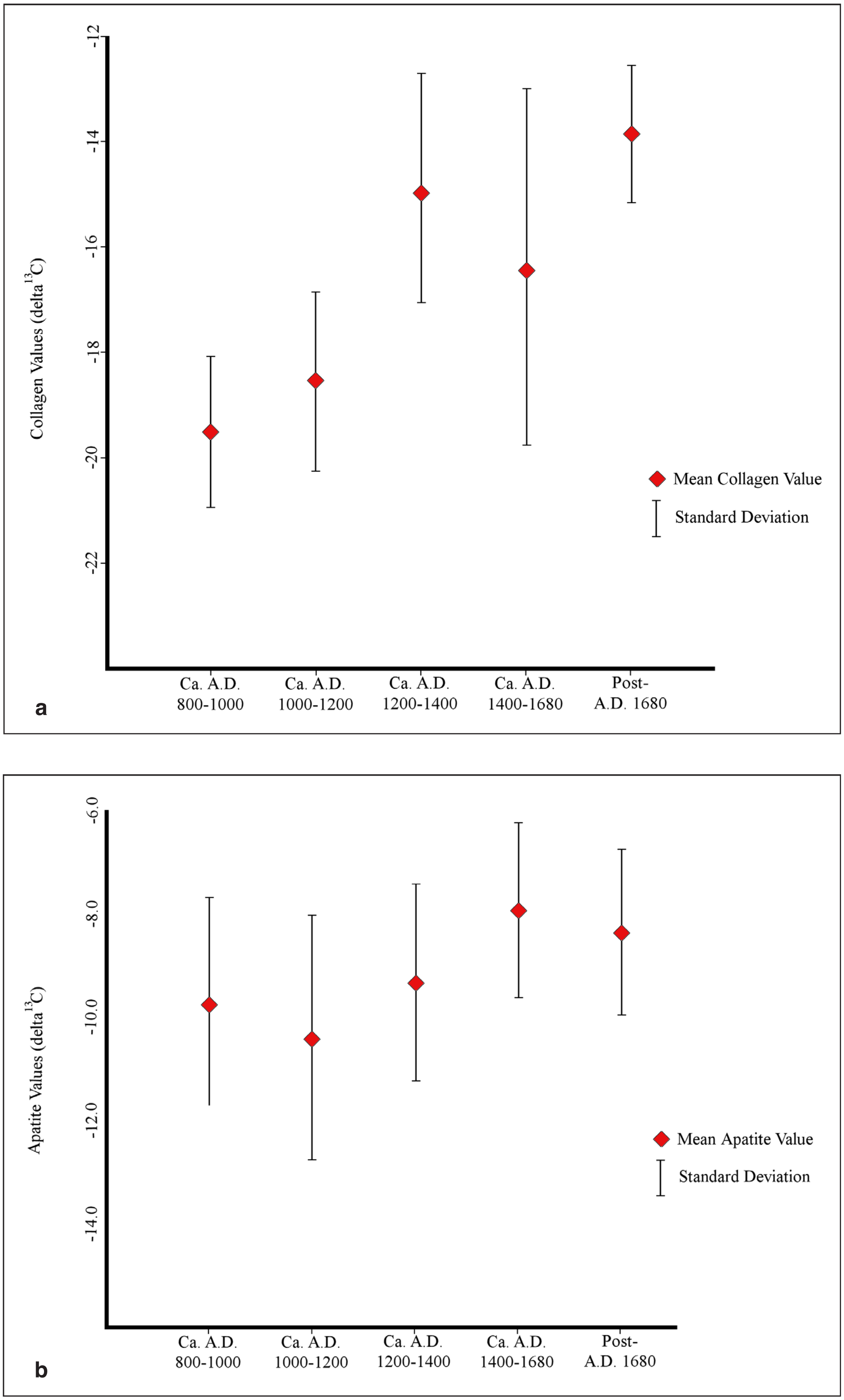

Figure 4. Mean stable isotope values on individuals from the southern Caddo area: a, collagen; b, apatite.

in Caddo bioarcheological datasets to establish trends in its adoption and use by Caddo peoples. Of particular interest is establishing through the archeological and bioarcheological records when the consumption of corn by Caddo peoples became a dietary staple as well as what evidence exists for possible intensification in its use.

The use of summed radiocarbon probabilities of dated corn samples from Caddo samples can be used as a proxy for the use of corn by Caddo peoples, at the present time primarily in the Southern Caddo area. There are issues with relying on radiocarbon dating for such a proxy—including biases in maize survival in the archeological record, in the intensity of archeological investigations of Caddo sites in different regions and in different time periods, and finally in differential investments in dating programs across the Caddo area by different investigators. But as a first order of approximation, given that a large number of dated samples are available, "there should be a relationship between the number of dates falling within a given time interval in a given region (or their summed probabilities) and the amount of human activity, which depends on the population size…the accumulation of the probability distributions of a large number of dates produces a high degree of chronological resolution" (Shennan 2013:49). Furthermore, the stable isotope data from Caddo burials is an independent source of data that can then be compared with the radiocarbon reconstructions of maize use in the Southern Caddo area.

The summed probability distribution of all the corn dates from the Caddo area indicates that the majority of the calibrated ages in the two sigma range fall after A.D. 1300. There are notable temporal peaks at ca. A.D. 1350 and A.D. 1450 in the summed probability distribution, and then a plateau in probability density after ca. A.D. 1500. Plotting median calibrated ages in 10 year intervals illustrate the same temporal trends in corn dates from Caddo sites. That is, corn is present in low numbers of dated samples from as early as ca. A.D. 900 until ca. A.D. 1300, but there are significant increases in dated corn samples from ca. A.D. 1330-1580. Furthermore, there are notable peaks in the median calibrated age of dated samples of corn between A.D. 1341-1350 (in the latter part of the Middle Caddo period), between A.D. 1421-1430 at the beginning of the Late Caddo period, and between A.D. 1561-1570 in the Late Caddo period.

The stable carbon isotope information from burials recovered from single and multiple mound centers, cemeteries, villages, farmsteads, and hamlets at more than 55 sites in both the Southern and Northern Caddo areas supports the summed probability distribution of corn dates. It indicates that after around A.D. 1200, there was a significant increase in the consumption of maize, as well as an increase in diet variability, as marked by C_4-enriched collagen and apatite samples from sites of known age. Apatite signatures in particular indicate that maize consumption remained at a consistent but low level of consumption from the Formative Caddo period through the Middle Caddo period. Relying in particular on stable carbon apatite values, not until ca. A.D. 1400 in the Late Caddo period is there a rather significant increase in maize contribution to the overall diet in both the Southern and Northern Caddo areas. Isotopic values in these later samples suggest that the importance of maize continued to increase in the diet of Caddo peoples after that time, likely peaking after ca. A.D. 1650 (Wilson 2012). Based on apatite values, the percentage of C_4-based foods in the diet of Caddo peoples was as much as 66-72 percent after ca. A.D. 1400.

Combined, the radiocarbon and stable isotopic data from a wide range of Caddo sites in the Southern and Northern Caddo areas provide complementary archeological and bioarcheological evidence regarding the establishment of temporal trends in the use of corn by Caddo peoples. It is only after ca. A.D. 1200/1300, and most notably after ca. A.D. 1400 that the consumption of corn became the principal food source in Caddo diets in both areas, and its use appears to have intensified during the latter part of the Late Caddo period, namely after the mid-16th century A.D.

END NOTES

1. For the Caddo words in italics, the apostrophe is a glottal stop, and the colon indicates that the preceding vowel is long (Wallace Chafe, personal communication, July 29, 2013).

2. Table 1 does not include six corn samples from the George C. Davis site that have calibrated age ranges and calibrated median ages that date prior to A.D. 800 (see Perttula 1998a:Table 1, assays C-153, Tx-105, Tx-674, Tx-3693, Tx-3695, and Tx-4624). Based on the context of these samples, and other radiocarbon dates on non-corn organic materials from the site, these dates are suspect. Table 1 also does not include the 17 radiocarbon dates on corn from Southwest Missouri and Northwest Arkansas bluff shelters (Fritz 1986:Table 9.2). In this case, the

cultural affiliation of these samples is ambiguous, and there is no consensus that late prehistoric occupations in the Ozarks were by Caddo peoples.

3. Youngblood (2008:Table 1) provides a list of 19 dates in the Caddo area of East Texas that are supposedly early direct dates on corn. Unfortunately, the dates Youngblood lists have a number of problems and should be ignored as not being relevant to the issue of pre-A.D. 800 corn because: (1) they are sometimes inaccurate; i.e., Tx-4624 is listed as 101 B.P., when the correct raw age is 1010 B.P.; (2) they are all raw ages that have not been corrected for isotopic fractionation; dates on corn, when corrected for isotopic fractionation, will typically be 240-250 years older in age than the raw radiocarbon age; and (3) Youngblood mistook the raw age in years B.P. of the radiocarbon dates as the A.D. age for all the samples listed in her Table 1. For example, B-73939 from the Oak Hill Village site is listed as an early corn date, one that is supposed to predate A.D. 800. Youngblood apparently considers the "early date" from this sample to be A.D. 610 ± 100, when in fact the raw age is 610 ± 100 B.P. (A.D. 1340). Correcting this sample for isotopic fractionation produces a conventional age of 810 ± 100 B.P., and a two sigma calibrated age range of A.D. 1020-1315 (see Table 1 in this paper). None of Youngblood's "early dates," which are listed in Youngblood (2008:Table 1) as ranging from 101-880 C14 Age B.P., predate A.D. 800.

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REFERENCES CITED

Bonavia, D.
2013 *Maize: Origin, Domestication, and its Role in the Development of Culture*. Cambridge University Press, Cambridge.

Bronk Ramsey, C.
2013 OxCal 4.2/ORAU. Electronic resource. https://c14.arch.ox.ac.uk/login/login.php?Location=/oxcal/OxCal.html, accessed July 2013.

Dowd, E. L.
2012 Alternative Conceptions of Complexity: Sociopolitical Dynamics of the Mountain Fork Caddo. Ph.D. dissertation, Department of Anthropology, University of Oklahoma, Norman.

Fields, R. C. and E. F. Gadus (editors)
2012 *Archeology of the Nadaco Caddo: The View from the Pine Tree Mound Site (41HS15), Harrison County, Texas*. 2 Vols. Reports of Investigations No. 164. Prewitt and Associates, Inc., Austin.

Fields, R. C., V. L. Hatfield, D. Burden, E. F. Gadus, M. C. Wilder, and K. W. Kibler
2013 Testing and Data Recovery Excavations at 11 Native American Archeological Sites along the U.S. Highway 271 Mount Pleasant Relief Route, Titus County, Texas. Review draft. Prewitt and Associates, Inc., Austin.

Ford, R. I.
1997 Preliminary Report on the Plant Remains from the George C. Davis Site, Cherokee County, Texas 1968-1970 Excavations. *Bulletin of the Texas Archeological Society* 68:104-107.

Fritz, G. J.
1986 Prehistoric Ozark Agriculture: The University of Arkansas Rockshelter Collections. Ph.D. dissertation, Department of Anthropology, The University of North Carolina, Chapel Hill.

Greenlee, D. M.
2006 Dietary Variation and Prehistoric Maize Farming in the Middle Ohio Valley. In *Histories of Maize: Multidisciplinary Approaches to the Prehistory, Linguistics, Biogeography, Domestication, and Evolution of Maize*, edited by J. E. Staller, R. H. Tykot, and B. F. Benz, pp. 215-235. Academic Press, Burlington, Vermont.

Jackson, A. T., M. S. Goldstein, and A. D. Krieger
2000 *The 1931 Excavations at the Sanders Site, Lamar County, Texas: Notes on the Fieldwork, Human Osteology, and Ceramics*. Archival Series 2. Texas Archeological Research Laboratory, The University of Texas at Austin.

Jones, V. H.
1949 Maize from the Davis Site: Its Nature and Interpretation. In *The George C. Davis Site, Cherokee County, Texas,* by H. P. Newell and A. D. Krieger, pp. 241-249. Memoirs No. 5. Society for American Archaeology, Menasha, Wisconsin.

Kellner, C. M. and M. J. Schoeninger
2007 A Simple Carbon Isotope Model for Reconstructing Prehistoric Human Diet. *American Journal of Physical Anthropology* 133:1112-1127.

Krieger, A. D.
1946 *Culture Complexes and Chronology in Northern Texas, with Extensions of Puebloan Datings to the Mississippi Valley*. Publication No. 4640. The University of Texas, Austin.

McGimsey, C. R. and J. van der Koogh
2001 *Louisiana's Archaeological Radiometric Database*. Special Publication No. 3. Louisiana Archaeological Society, Baton Rouge.

Newkumet, V. B., and H. L. Meredith
1988 *Hasinai: A Traditional History of the Caddo Confederacy*. Texas A&M University Press, College Station.

Perttula, T. K.
1998a A Compendium of Radiocarbon and Oxidizable Carbon Ratio Dates from Archaeological Sites in East Texas, with a Discussion of the Age and Dating of Select Components and Phases. *Radiocarbon* 39(3):305-342.
1998b Radiocarbon and Oxidizable Carbon Ratio Dates from Archaeological Sites in East Texas, Part II. *Journal of Northeast Texas Archaeology* 11:66-90.
2005 (Editor) *Archeological Investigations at the Pilgrim's Pride Site (41CP304), a Titus Phase Community in the Big Cypress Creek Basin, Camp County, Texas*. 2 Vols. Report of Investigations No. 30. Archeological & Environmental Consultants, LLC, Austin.
2008 Caddo Agriculture on the Western Frontier of the Eastern Woodlands. *Plains Anthropologist* 53(205):79-105.

Perttula, T. K. and R. Rogers
2012 The Evolution of a Caddo Community in Northeast Texas. In *The Archaeology of the Caddo*, edited by T. K. Perttula and C. P. Walker, pp. 209-238. University of Nebraska Press, Lincoln.

Perttula, T. K. and R. Z. Selden, Jr.
2011 East Texas Radiocarbon Database. Electronic resource, http://counciloftexasarcheologists.org/?page_id=27, accessed July 1, 2013.

Regnier, A. L.
2013 The McDonald Site: An Analysis of WPA Excavations at a Caddo Site in the Glover River Drainage, McCurtain County, Oklahoma. *Caddo Archeology Journal* 23:27-66.

Reimer, P. J., M. G. L. Baillie, E. Bard, A. Bayliss, J. W. Beck, P. G. Blackwell, C. Bronk Ramsey, C. E. Buck, G. S. Burr, R. L. Edwards, M. Friedrich, P. M. Grootes, T. P. Guilderson, I. Hajdas, T. J. Heaton, A. G. Hogg, K. A. Hughen, K. F. Kaiser, B. Kromer, F. G. McCormac, S. W. Manning, R. W. Reimer, D. A. Richards, J. R. Southon, S. Talamo, C. S. M. Turney, J. van der Plicht, and C. E.Weyhenmeyer
2009 IntCal09 and Marine09 radiocarbon age calibration curves, 0-50,000 years cal BP. *Radiocarbon* 51(4):1111-1150.

Rogers, J. D.
2011 Stable Isotope Analysis and Diet in Eastern Oklahoma. *Southeastern Archaeology* 30(1):96-107.

Rogers, R. and T. K. Perttula
2004 *The Oak Hill Village (41RK214), Rusk County, Texas*. Document No. 030083. PBS&J, Austin.

Rose, J. C., M. P. Hoffman, B. A. Burnett, A. M. Harmon, and J. E. Barnes
1998 Skeletal Biology of the Prehistoric Caddo. In *The Native History of the Caddo: Their Place in Southeastern Archeology and Ethnohistory*, edited by T. K. Perttula and J. E. Bruseth, pp. 113-126. Studies in Archeology 30. Texas Archeological Research Laboratory The University of Texas at Austin.

Schambach, F. F., M. Zabecki, D. G. Akridge, and J. Samuelsen
2011 *Determining the Cultural Affiliation of Detached Crania and Mandibles at the Crenshaw Site, Miller County, Arkansas*. Arkansas Archeological Survey, Fayetteville.

Schoeninger, M. J.
2009 Stable Isotope Evidence for the Adoption of Maize Agriculture. *Current Anthropology* 50:633-640.

Selden, R. Z., Jr.
2013 Consilience: Radiocarbon, Instrumental Neutron Activation Analysis and Litigation in the Ancestral Caddo Region. Ph.D. dissertation, Department of Anthropology, Texas A&M University, College Station.

Selden Jr., R. Z. and T. K. Perttula
2013 Radiocarbon Trends and the East Texas Caddo Tradition (ca. A.D. 800-1680). *Southeastern Archaeology* 32(1):85-96.

Shennan, S.
2013 Cultural Evolution of Neolithic Europe. *Archaeology International* 15:45-53.

Story, D. A.
1990 Radiocarbon Assays In *The Archeology and Bioarcheology of the Gulf Coastal Plain*, by D. A. Story, J. A Guy, B. A. Burnett, M. D. Freeman, J. C. Rose, D. G. Steele, B. W. Olive, and K. J. Reinhard, pp. 658-735. Research Series No. 38. 2 Vols. Arkansas Archeological Survey, Fayetteville.

1997 1968-1970 Archeological Investigations at the George C. Davis Site, Cherokee County, Texas. *Bulletin of the Texas Archeological Society* 68:1-113.

2000 Introduction. In *The George C. Davis Site, Cherokee County, Texas*, by H. P. Newell and A. D. Krieger, pp. 1-31. 2nd Edition. Society for American Archaeology, Washington, D.C.

Story, D. A. (editor)
1981 *Archeological Investigations at the George C. Davis Site, Cherokee County, Texas: Summers 1979 and 1980*. Occasional Papers, Vol. 1. Texas Archeological Research Laboratory The University of Texas at Austin.

Story, D. A. and S. Valastro, Jr.
1977 Radiocarbon Dating and the George C. Davis Site, Texas. *Journal of Field Archaeology* 4(1):63-89.

Thomas, P. M., Jr., L. J. Campbell, and S. R. Ahler
1980 The Hanna Site: An Alto Focus Village in Red River Parish. *Louisiana Archaeology* 5:1-381.

Wilson, D.
2012 Bioarchaeological Evidence of Subsistence Strategies among the East Texas Caddo. In *The Archaeology of the Caddo*, edited by T. K. Perttula and C. P. Walker, pp. 86-116. University of Nebraska Press, Lincoln.

Wilson, D. and T. K. Perttula
2013 Reconstructing the Paleodiet of the Caddo through Stable Isotopes. *American Antiquity* 78(4):702-723.

Youngblood, D.
2008 The Windfall/Shortfall Model: A Seasonal Theory of Crop Inclusion Based on Analysis of Woodlands Frontier Plant Remains. *Plains Anthropologist* 53(205):107-120.

Maintaining Ties, Seeking Opportunities: Excavations at Columbus Pueblo (LA 85774), Luna County, New Mexico

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ABSTRACT

Recent excavations at Columbus Pueblo (LA 85774), a Mimbres settlement on the U.S. border, are used to explore the issues of settlement intensity as well as ties within Mimbres society in the southern Mimbres area. We focus on the extent to which site occupants were casual visitors or migrants from Mimbres settlements to the north, with a critical evaluation of ways they adapted cultural traditions to accommodate an environment and a social landscape that differed from the north.

INTRODUCTION

In 2009, Geo-Marine, Inc. conducted excavations at LA 85774, a Mimbres site in New Mexico on the U.S. border, called Columbus Pueblo (Kenmotsu et al. 2010). The site was inadvertently impacted during construction of the U.S./Mexico Border Fence (Border Fence) and the efforts at the site were designed to mitigate that damage by characterizing the nature of the deposits through limited excavations and by investigating the nature of its settlement well south of the heartland of the Mimbres region (Figure 1). While many heartland Mimbres towns have been investigated (e.g., Anyon and LeBlanc 1984; Bradfield 1931; Cosgrove and Cosgrove 1932; Haury 1936; Shafer 2003; Woolsey and McIntyre 1996) and some smaller settlements also explored (Roth 2007, 2013), few Mimbres sites south of the heartland have been excavated. The closest is the Hermanas ruin, excavated in 1970 (Fitting 1971) and located just south of the Cedar Mountains, some 40 km west of Columbus Pueblo. Minnis (Minnis and Wormser 1984) conducted excavations at the Florida Mountain site near Deming. However, no Mimbres sites have been investigated this far south in the Deming grassland plains where Columbus Pueblo is located.

From the outset, we had many questions. Was Columbus Pueblo a settlement of migrants? Or, had the occupants always resided on the periphery, partaking of some of the social traditions and practices of the larger towns to the north but not others? Did distance preclude strong ties to northern Mimbres sites, and were those ties in the form of language, ideology, and kinship? How did this Mimbres settlement maintain its cultural identity, or did it blend with multiple cultures as many border communities do? Were these people living at Columbus Pueblo, in essence, a point on a cultural continuum between several different cultural groups, more Mimbres than Jornada Mogollon, a cultural area located around El Paso some 50 miles east of Columbus, or Casas Grandes, located some 70 miles southwest, but still a hybrid of all three?

These were just the sort of questions that Dee Ann would have relished: maximize archeological data in an area where little exists, inflict minimal impact from excavations, and critically analyze the results in a broader regional context to better understand the relationships between this site and Mimbres towns in the heartland. Evenings with her were fun, exhilarating, and daunting. While pondering an issue, she would ask a stream of thoughtful questions, consider responses, offer analogies from work in the region and elsewhere, suggest special studies, and recommend reviewing a plethora of publications. Columbus Pueblo required this level of pondering, both in the field and during subsequent analyses.

As mentioned above, our questions centered on how Columbus Pueblo fit into the broader

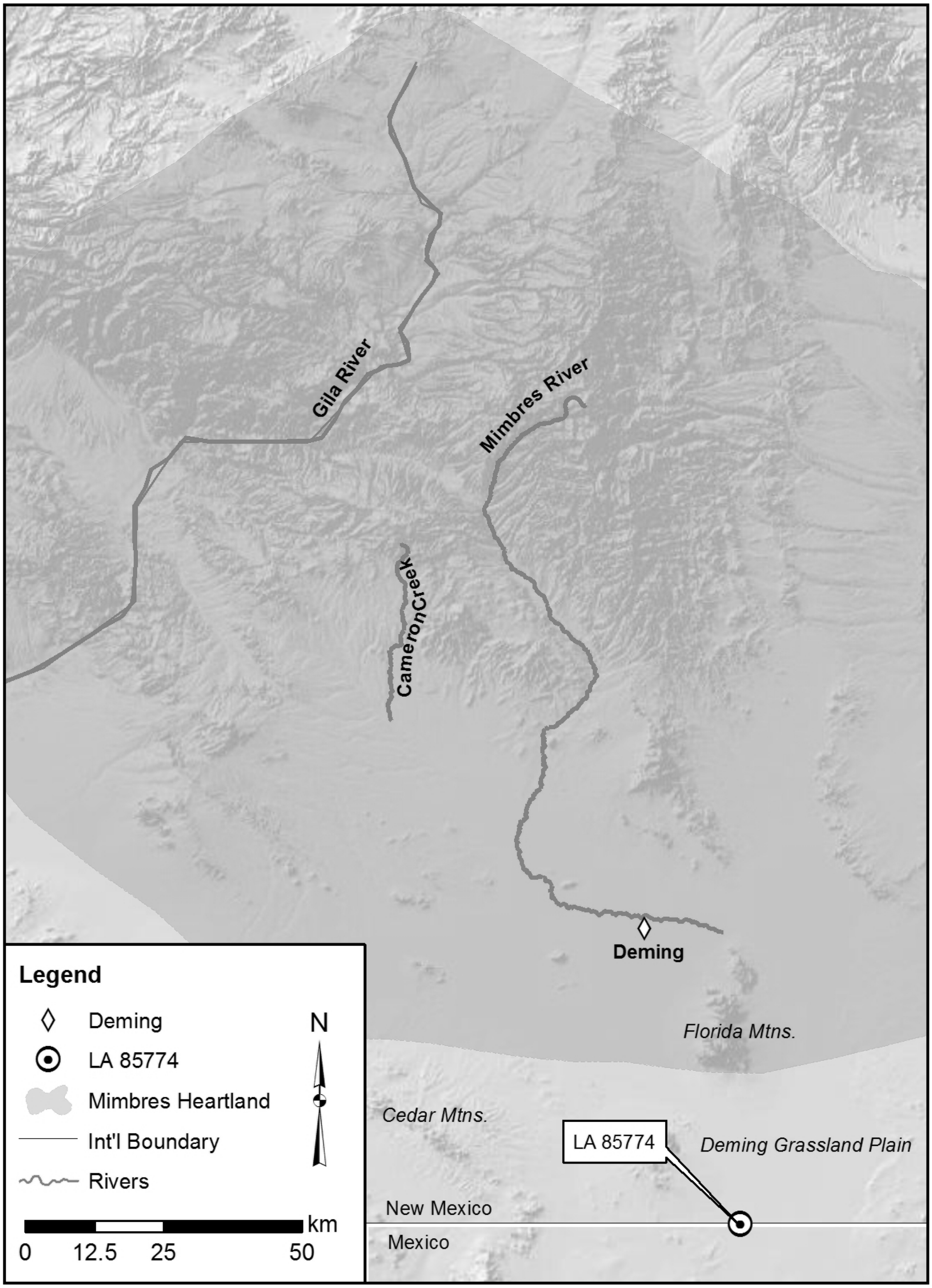

Figure 1. Columbus Pueblo in relation to the Mimbres heartland.

context of Mimbres society. Mimbres sites have been recorded in the Cedar Mountains, the Florida Mountains, and in what is known as the Deming grassland plain (see Figure 1), all well south of the heartland. Generally, however, this area is understudied (Lekson 1992:80, 2001:56; Schriever and Holcomb 2005), and survey coverage has been spotty (Lekson 2001:55-57), although the on-going efforts of the University of Oklahoma-Deming Archaeological Project (now known as the Southern Mimbres Archaeological Project) under the direction of Dr. Patricia Gilman (Schriever and Holcomb 2005) and those reported by Kemrer (2003) are improving the data base.

Schriever and Holcomb (2005) summarize recent findings in the southern Mimbres area, underscoring both similarities and differences between this region and the heartland. They note that some sites in the area have more than 100 rooms, but the evidence suggests that, unlike the villages along the Mimbres River that were often built on top of earlier villages, these appear to be single component sites that were abandoned as the population dispersed into a number of smaller sites nearby. Most sites are situated close to streams or springs, including Hermanas ruin (Fitting 1971). However, even these water sources were not always reliable, and the general scarcity of available surface water in this region, even during non-droughty periods such as the period from A.D. 1040-1125 (Grissino-Meyer et al. 1997), may have contributed to the limited length of time sites were occupied (see Lekson 2001:60). Nonetheless, without intensive excavations combined with a solid chronological study of settlement histories, it is not clear if the corporate society model proposed by Shafer (2006) for Mimbres groups to the north operated at all or in the same way in the southern Mimbres area. For this reason, Schriever and Holcomb (2005) argue that a cautious interpretive approach should be followed, as they believe that uncritical application of the Mimbres systematics defined in the heartland could potentially obscure the ultimate understanding of adaptive strategies in the south.

Mindful of Schriever and Holcomb's caution, we first outline the cultural and archeological character of Mimbres society between A.D. 200-1140. Then we turn to the results of our excavations and offer tentative conclusions about the relationship between Columbus Pueblo and the heartland. In general, we conclude that Columbus Pueblo was a special-use site with interesting ties to the heartland but with facets of cultural independence. Yet, because we have more questions than answers, the results do not present dramatic new understandings of social organization in the southern Mimbres area. Rather, the results offer glimpses of the relationships between this site and those to the north that can be employed as other researchers continue to explore Mimbres sites outside of the heartland.

ARCHEOLOGICAL BACKGROUND

During the period from ca. A.D. 200-1140 (Table 1), archeological sites along the Mimbres River, its tributaries, and the upper Gila River in southwestern New Mexico form the heartland of the Mimbres cultural region (see Figure 1). Within this area, pithouse villages began to form around A.D. 200 as hunter-gatherers added agricultural products to their subsistence commodities (Anyon and LeBlanc 1984:22; Shafer 2003:25). Typically, Early Pithouse period sites contained from five to 20 structures, although as many as 80 pithouse depressions have been noted at one site. The smaller settlements may have been occupied by a single family group composed of several related nuclear families; the larger settlements were probably occupied by several extended family groups. Often one pithouse is larger than the others and presumably it was used for communal or ritual activities (Shafer 2003:25). Manufacture of ceramics (Alma Plain) began during this period, and cultivated foods included corn and squash. The thin midden deposits at Early Pithouse sites indicate these egalitarian settlements were used only seasonally and the occupants were highly mobile.

Between A.D. 550 and 900-1010 (the Late Pithouse period), many of these pithouse villages grew, and the superimposed structures encountered in excavations indicate persistent use of the same site over long periods of time. At Old Town (Creel 2006), the NAN Ranch Ruin (Shafer 2003, 2006), and the Harris site (Roth 2013), some structures formed courtyard groups thought to be comprised of related families. Shafer (2003, 2006) interprets these courtyard groups at the NAN Ranch as core households of the community: "[p]rime families, or more likely those who were there first, may have laid claim to residential space as shown by a succession of construction episodes spanning three phases in the South room block [at NAN]" (Shafer 2006:18). Roth (2007:16) describes a similar

Table 1. Chronological scheme for the Mimbres (after Shafer 2003:6).

Date	Period	Phase	Ceramics
A.D. 1110-1140	Classic	Terminal Classic	Late Style III Mimbres Black-on-white; Fully & partially corrugated
A.D. 1010-1110	Classic	Classic	Early & Middle Style III Mimbres Black-on-white; Fully & partially corrugated
A.D. 900-1010	Transitional	Late Three Circle	Style II Mimbres Black-on-white; Three Circle Neck Corrugated
A.D. 750-900	Late Pithouse	Three Circle	Style I Mimbres Black-on-white; Three Circle Red-on-white; Three Circle Neck Corrugated
A.D. 650-750	Late Pithouse	San Francisco	Mogollon Red-on-Brown; San Francisco Red; Alma Plain
A.D. 550-650	Late Pithouse	Georgetown	Unnamed red slipped; Alma Plain
A.D. 200-550	Early Pithouse	None designated	Alma Plain

process based on her work and that of Haury (1936) at the Harris site:

> Harris began as a small agricultural village during the Georgetown phase, but quickly became a large, bustling village…[L]and-holding family groups established households at the site by A.D. 600 and continued to live there through the A.D. 900s. We can trace the development of clusters of pithouses that we think are extended family households from these initial occupants. I refer to these as founding households.

Structures of founding households at the Harris site are large and superimposed over earlier structures; some have elaborate child burials in their floors. Combined, Roth argues that the evidence indicates ancestry and land tenure were important to those families.

During the same period, however, isolated pithouses at Harris and other pithouse communities have been excavated with no evidence of re-use or re-modeling (Roth 2013). Roth concludes that these residents of Harris were mobile, moving in and out of the larger community. Similarly, her work at a smaller, upland pithouse community (Lake Roberts Vista [Roth 2007]) indicates high mobility and seasonal re-use of the site by what were likely the same households through A.D. 900.

Settlement stability and household movement remain important topics of research throughout the Mimbres region. Shafer (2006:17) concludes that while agricultural production was important to households prior to A.D. 900, storage evidence, including the lack of granaries and the storage of shelled corn in baskets, indicates continued mobility. Gilman and Stone (2013:611) concur, rejecting the notion that "all domestic structures found at Pithouse period sites in the Mimbres area were occupied simultaneously," a view they believe has long-standing among Southwestern archeologists. Instead, they argue that these villages were often occupied by a few families at a time, and suggest that great kivas—large structures used to perform ritual and communal activities—were built in nearly all the large towns of the heartland to attract people from other settlements to attend rituals where local residents could "construct and negotiate relationships with families in a number of adjacent settlements." The end result of these activities would be the creation of far flung relationships in order to negotiate such things as water rights and access to wild resources and raw materials. Their analysis shows great kivas exhibit an increasing diversity of construction details over time. The diversity suggests to them that the people who built the structures and hosted the rituals were seeking to differentiate themselves and their ritual space from rituals held elsewhere as a means to negotiate social relationships with outsiders.

Recent research by Creel and Shafer (n.d.) lends some support to the idea that communal activities in or near great kivas were used to attract outsiders. Creel and Shafer note that the plazas in front of great kivas contain cremated remains of "a small number of residents who were treated in death differently than were the great majority of people" who were interred in their room blocks without cremation. Further, they argue that these plazas "were special places within those communities." Moreover, noting Hohokam influences in Mimbres sites during the A.D. 800s-900s, they conclude that the current evidence suggests some of the people cremated and interred in the plazas were Hohokam (see also Creel 2013a).

The tenth century was a time of change and social reorganization in the Mimbres region, and Shafer (2006:17; see also Creel [2006]) attributes it to an increase in population and a concomitant increase in labor needed to expand irrigation so that additional lands could become productive agricultural fields. The increase in moisture regimes noted in tree rings by Grissino-Meyer et al. (1997) between A.D. 1040-1125 is believed to have promoted this expanded production (Harry Shafer, personal communication 2013).

Shafer (2003:25) states: "A village composed of...an extended family usually functions well simply on the basis of division of labor and communal reciprocity. When a community is made up of...more families a higher organization is needed to bond the families against the outside world and to broaden the ties with neighboring communities." Shafer (see also Creel 2006; Creel and Anyon 2003) concludes that corporate strategies were employed for this reorganization. Under corporate political organizations, economic resources are distributed by the household, clan, or other organization; leadership is shared or event-specific; and rituals are communal and integrative (Feinman et al. 2000). As extended families evolved into corporate groups, pithouses gave way to surface architecture of room blocks that contained living areas as well as rooms for lineage cemeteries, communal activities, and storage. This change "correlates with the demise of the great kiva, whose functions were presumably taken over by secret corporate group ceremonies" (Shafer 2006:18). The change also promoted smaller kivas, built as part of individual room blocks, that were used to integrate and negotiate relationships within one's lineage through ancestral ties until the close of the Terminal Classic period around A.D. 1140. Additionally, Shafer (2003:88-89) argues that each Mimbres village from A.D. 1000-1140 had within it corporate groups with higher political prestige who had first-arrival rights to productive lands and other resources (see Gilman [2006] for another view). Lineages with rights to productive lands could exclude other lineages during periods of drought.

The corporate nature of Mimbres society can be demonstrated by the independent households evident in the Classic Mimbres room blocks (Shafer 2003), the broad distribution of rare and exotic goods among all families, and a general lack of specialists (Gilman 2006:79). In a recent study of ceramics to investigate when people in the region began to establish their identify as "Mimbres," Schriever (2008:128) concludes that "an informal identify may already [have] exist[ed] within the region by the San Francisco phase and...it persist[ed] through the Classic period."

Additional support for Shafer's model of Mimbres society can be found in recent studies of the iconography, movement, and trade of Mimbres Black-on-white ceramics (Creel 2013b; Creel and Speakman 2012; Powell-Martí and James 2006). These distinctive and well-recognized ceramics began to be produced around A.D. 800 and they continued to be made until around A.D. 1140 (Shafer 2003:182-185; Shafer and Brewington 1995). Instrumental neutron activation analyses (NAA) indicate that these vessels were primarily made in the large villages within the heartland, although a small number were made in the Rio Grande valley east of Galaz and Mattocks (Creel and Speakman 2012:11). LeBlanc (2006) argues that the vessels were made by select potters within those villages.

Building on this data base, Powell-Martí and James designed a study using the iconography painted on the vessels to determine the direction of trade between Galaz, NAN, Old Town, Cameron Creek, and Saige McFarland. From A.D. 970-1010, they found that trade of these Mimbres vessels was fairly unilateral among the five villages. Through time, however, Galaz exported vessels to some or all of these villages, but none of those villages sent their vessels to Galaz (Powell-Martí and James 2006:171). A recent NAA study of 648 whole vessels from the Mimbres River valley—470 of which are vessels dating between A.D. 1050-1100—has identified reasons for this unbalanced trade in ceramics (Creel and Speakman 2012; see also Creel 2013b): after A.D. 1000 the vessels were only produced at villages above 5,400 feet, because of the lack of available wood resources to fire the pottery at lower elevations after that date.[1] Thus, after A.D. 1000, pottery production was largely confined to Swarts and other towns to its north in the Mimbres River drainage; the NAN Ranch, Old Town, and Cameron Creek are at lower elevations. Galaz was probably the largest production center among these towns. Yet, the vessels continued to be traded throughout the heartland and beyond. Creel (2013b:21) notes that this indicates a pervasive "domestic demand for pottery on the part of non-pottery producing families regardless of where they lived." Powell-Martí and James (2006:171) argue that the Black-on-white vessels from Galaz were given as part of communal feasting or ritual events held in that village, but never in exceedingly large quantities. The vessels were "for cementing social bonds and conveying messages" serving to "reinforce group ties" (Powell-Martí and James 2006:172).

Shafer (2006:28) links the collapse of the Mimbres corporate system after A.D. 1110 to environmental change based on climate data showing the end of the wet cycle around A.D. 1125 and a tree-ring date from the NAN Ranch of A.D. 1127, the most recent from the Mimbres Valley. He argues that the towns, at least along the Mimbres River, were inter-dependent because they all used the same water source. Tree-ring evidence suggests below-level moisture regimes operated in the early twelfth century (Powell-Martí and James 2006). "As food surpluses waned, the corporate groups broke up…Abandonment of even one town would weaken the system, and of more than one town probably destroyed it" (Shafer 2006:29).

Based on this archeological background, Kenmotsu et al. (2010:4-8 to 4-13) proposed two hypotheses with expectations related to how tied the residents at Columbus Pueblo were to Mimbres towns in the heartland:

- If the residents of Columbus Pueblo were recent migrants and closely tied to Mimbres societies in the Mimbres River valley, material correlates of that association would include room construction styles mirroring those to the north. Room blocks, if present, would contain one larger room representing communal space. Ceramic and lithic artifacts would mirror those found at the NAN (Shafer 2003), Galaz (Anyon and LeBlanc 1984), Old Town (Creel 2006), and other sites. In particular, NAA analysis of Mimbres Black-on-white ceramics would indicate a close relationship with one of the Mimbres towns—likely the one from which they migrated—and sources of obsidian would mirror sources found at that same northern town (Schriever 2008:144, 181). Floral remains should indicate evidence of domesticated crops.
- Alternatively, residents of Columbus Pueblo were only loosely tied to the Mimbres towns to the north. Rooms would exhibit considerable variation from the pithouses and surface rooms or room blocks in the heartland. Ceramics, including the Mimbres Black-on-white styles, might indicate manufacture in the southern area, and obsidian would have been obtained from sources more convenient to the Columbus Pueblo area.

COLUMBUS PUEBLO

Columbus Pueblo is located in the Deming grassland plain, some 90 km south of Old Town. It is situated in the southeastern portion of the Mimbres River basin, and lies on a nearly flat, alluvial plain that is on a slightly elevated linear ridge flanked on the east and west by slightly lower grassy floodplain surfaces that represent fluvial fans of the Mimbres River (Frederick 2010). This alluvial plain consists of gravel, sand, and mud derived from the adjacent mountains and transported by streams and sheet wash.

Columbus Pueblo was first recorded in 1994 and described as a large scatter of prehistoric and historic artifacts (Sechrist 1994). Sechrist (1994) noted that the site may extend into Mexico, but that portion of the site remains unexamined. Ceramics recorded include Mimbres Style III Black-on-white, Mimbres Corrugated, Playas Red, Casas Grandes Scored, and Casas Grandes Corrugated. In 1999, the site was tested using a series of 1 x 1 m units and shovel scrapes (Rieder 1999) that led to its determination as being eligible for the National Register of Historic Places by the Bureau of Land Management (BLM), the federal agency managing the property. Gibbs (2007) conducted a damage assessment after the inadvertent impacts to the site during the construction of the Border Fence. Our investigations were carried out for the U.S. Customs and Border Protection through the U.S. Army Corps of Engineers, Fort Worth District, and completed in cooperation with the BLM's Las Cruces Office.

Several features were recorded at the site during past efforts. One is an historic-era earthen tank measuring ca. 18 m in diameter and constructed in what was the core of the site (Tom Holcomb, personal communication 2013). The damage was extensive as adobe and stained sediments were noted in and around the tank, and back dirt from the tank's construction contained "thousands of artifacts, burned adobe, and prehistoric structural remains" (Gibbs 2007:5). How the core of the site was different from our findings, if at all, will never be known. Another feature is a wellhead pipe located a few m east of the tank.

To mitigate the impacts to the site, Myles Miller and Duane Peter developed strategies to maximize information about the character of the deposits for the BLM, who are tasked with managing the site in the future. Excavations were preceded by a geophysical survey of the site that identified several anomalies suspected to be cultural in origin (Walker 2010) (Figure 2). Following the geophysical investigations, six backhoe trenches were excavated, some over the anomalies and others placed at the discretion of the geoarcheologist (Frederick 2010). While Frederick was conducting his field study, excavation of 10 shovel-scraped units, nine hand-dug trenches, two test units, and two excavation blocks began (Figure 2). Excavated sediments were passed through 1/8-inch screen. All cultural features were drawn in plan view and plotted with a Total Station; flotation samples were collected from most features; and chronometric samples were also collected. The investigations were carried out from May-July 2009. As a result of these efforts, 37 features were identified, including six rooms, several possible walls, 24 postholes, three thermal features, and at least one pit house (Figure 2).

Dating Columbus Pueblo

Radiocarbon and ceramic cross-dating indicate that the site dates between A.D. 870 and 1100 (Table 2). The three radiocarbon dates, taken from rooms 1 and 2, yielded fairly consistent calibrated dates that have age ranges between A.D. 870 and A.D. 1040. The ceramics recovered from Columbus Pueblo have a broader age range from A.D. 200 (Alma Plain and El Paso Brown) to about A.D. 1650 (Chupadero Black-on-white) (Table 3). However, except for the two Chupadero Black-on-white sherds, any of the 14 decorated El Paso sherds that may actually be El Paso Polychrome, [2] and the 40 Playas Red sherds, the majority of the sherds have comparable manufacturing ranges to those of the calibrated radiocarbon ages.

Assuming the Chupadero, El Paso decorated, and Playas sherds represent a late, post-Mimbres use of the site, the ceramic analysis suggests that its use is by at least two separate Mimbres occupations. The first is the radiocarbon-dated occupation of A.D. 870-1040 in rooms 1 and 2. A later occupation is suggested by the Mimbres Black-on-white ceramics from the site. This ceramic style had a broad production life of over three centuries. Shafer (2003:182-184) and Shafer and Brewington (1995) defined micro-styles within the sequence for Mimbres Black-on-white Styles II and III, each micro-style lasting for approximately 50 years. Harry Shafer (2010) analyzed the 89 Mimbres Black-on-white rim sherds from Columbus Pueblo using color photographs (Figure 3). Nearly all are from the Middle Style III that dates from A.D. 1060-1100, indicating the site contains at least one additional occupation after the abandonment of rooms 1 and 2. This is supported by the identification of a nearly complete Mimbres Black-on-white vessel that also dates to the Middle Style III.

Site Function and Settlement Mobility at Columbus

The remainder of the article will focus on several lines of evidence at Columbus Pueblo that provide insights into both site function and

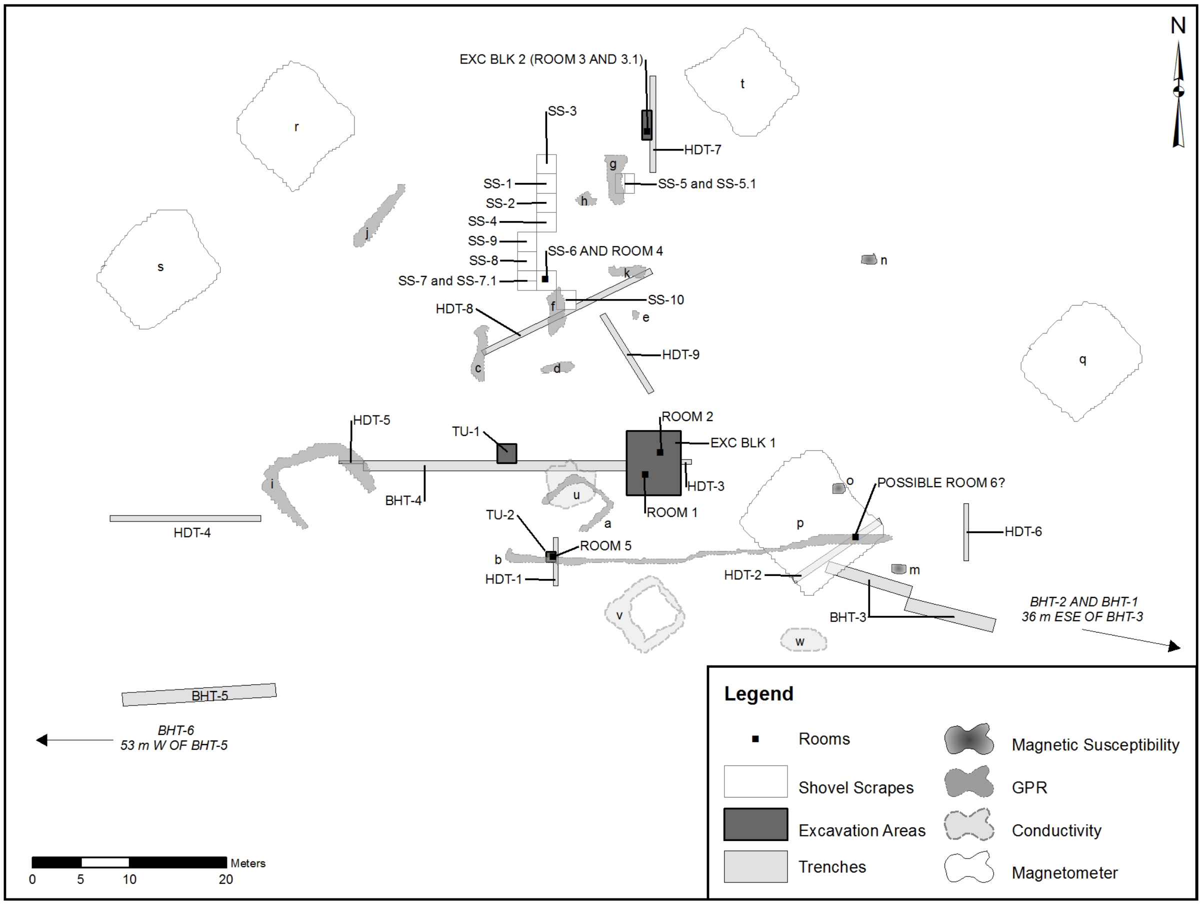

Figure 2. Map of Columbus Pueblo showing selected geophysical anomalies, backhoe trenches, excavation blocks, shovel scrapes, and test units.

Table 2. Radiocarbon dates from Columbus Pueblo (LA85774).

Feature	Lab No.*	Measured 14C Age (B.P.)	δ13C	Corrected 14C Age (B.P.)	Calibrated Age, 2 sigma
5 (Room 1)	B-263499	1070 ± 40	-22.3	1110 ± 40	A.D. 870-1010
5.1 (Room 1)	B-263500	880 ± 40	-13.7	1070 ± 40	A.D. 890-1030
6.2 (Room 2)	B-263501	1010 ± 40	-23.4	1040 ± 40	A.D. 900-920 and A.D. 950-1040

*B=Beta Analytic, Inc.

settlement mobility, specifically the evidence that it served as a special-use site. These include construction details of rooms, lithic analyses, sourcing of ceramics and obsidian, and the study of ornaments. Considering the limited area that was excavated, individually each line of evidence is insufficient to demonstrate function or mobility, but when combined they suggest that Columbus Pueblo functioned as a special-use site and the residents remained there for only brief, intermittent periods. They also provide evidence to suggest that while the site and its occupants were tied to the Mimbres system, it remained a southern Mimbres occupation.

Table 3. Dates of Ceramic Types Recovered by Region at LA 85774.

Ceramic Type	Dates	Number/Percentage of Total
Mimbres Mogollon Region		
Mimbres Corrugated	A.D. 1000-1135	1,998/41.5
Alma Plain	A.D. 200-950	941/19.5
Mimbres Black-on-white	A.D. 800-1135	670/13.9
Alma Textured Varieties	A.D. 200-950	19/0.4
San Francisco Red	A.D. 400-950	4/0.1
Jornada Mogollon Region		
El Paso Brown	A.D. 200-1150	718/14.9
El Paso Bichrome and El Paso Polychrome	A.D. 1000-1150 and A.D. 1250-1450	14/0.3
Chupadero Black-on-white	A.D. 1150-1550+	2/Trace
San Andres Red-on-Terracotta	A.D. 950-1150	1/Trace
Casas Grandes Region		
Convento Corrugated and Plain	A.D. 700-1200	343/7.1
Playas Redware	A.D. 1200-1450	40/0.8
Mata Polychrome and Mata Red-on-brown	A.D. 700/800-1200 and A.D. 1100-1200	4/0.1
Unidentified Chihuahuan Polychrome	–	1/Trace
Other		
Unidentified Brownware	–	31/0.6
Unidentified Textured	–	1/Trace
Total Ceramics		4,813/100.0

Rooms at Columbus

Turning first to the rooms, most were surface rooms constructed with puddled adobe walls and plastered floors. The best information comes from rooms 1 and 2, sub-rectangular, side by side rooms that received the greatest amount of excavation (Figure 4). Each of these rooms contained a series of small postholes just inside exterior walls (Kenmotsu et al. 2010:8-15 to 8-23). The postholes ranged from 10-15 cm in diameter and were 12-24 cm deep. Large postholes that would have served to support heavy roof timbers were not found, but conical pits were present in the approximate center of rooms 1 and 2. One may have served originally as a hearth but it is suspected to have later functioned as a place for an interment;[3] the other pit may have served as a cradle for a vessel as some pithouses and Classic Mimbres rooms at the NAN Ranch contained whole vessels sitting in floor pits (Shafer 2003:49, 64) presumably for storage. The other rooms at Columbus Pueblo received only minimal investigation but were identified as individual walls and partial floors were encountered during shovel scraping. Two (rooms 3 and

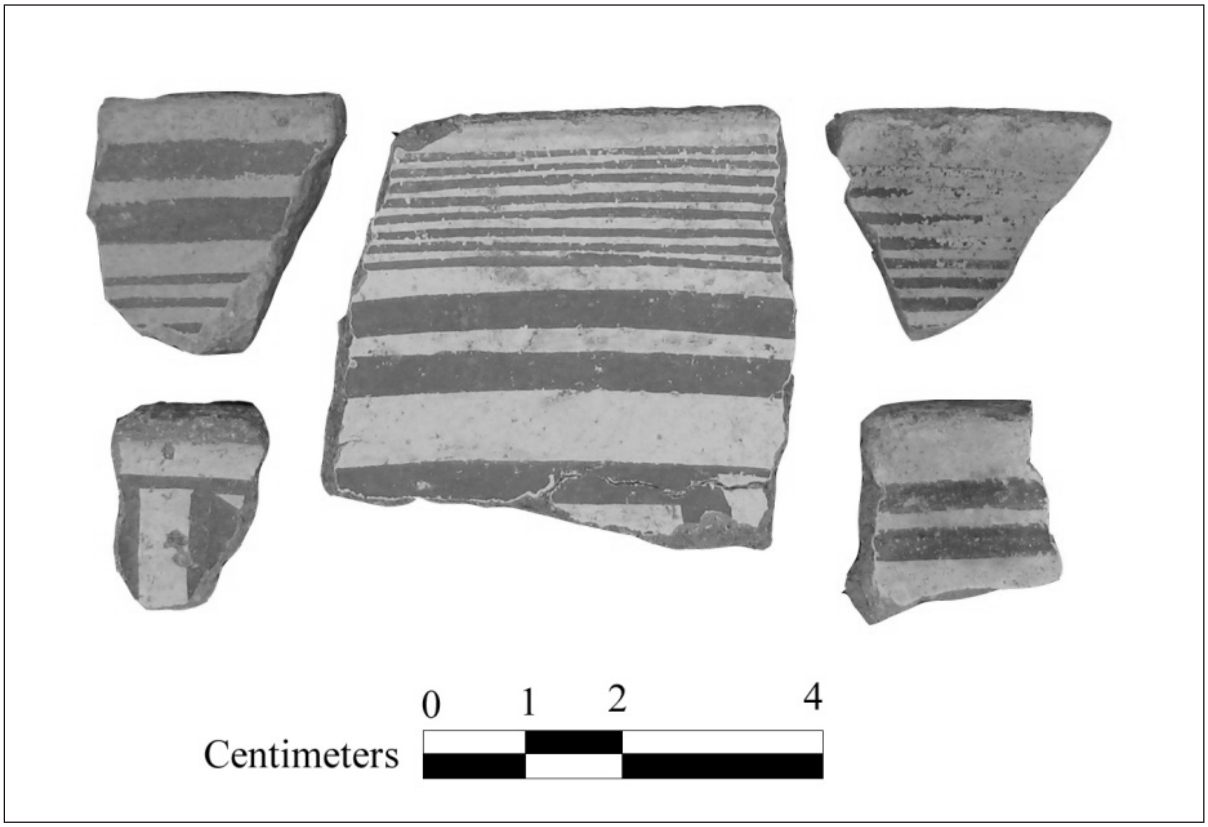

Figure 3. Mimbres rims from Columbus Pueblo. The top three and the bottom right show typical Middle Style III framing lines.

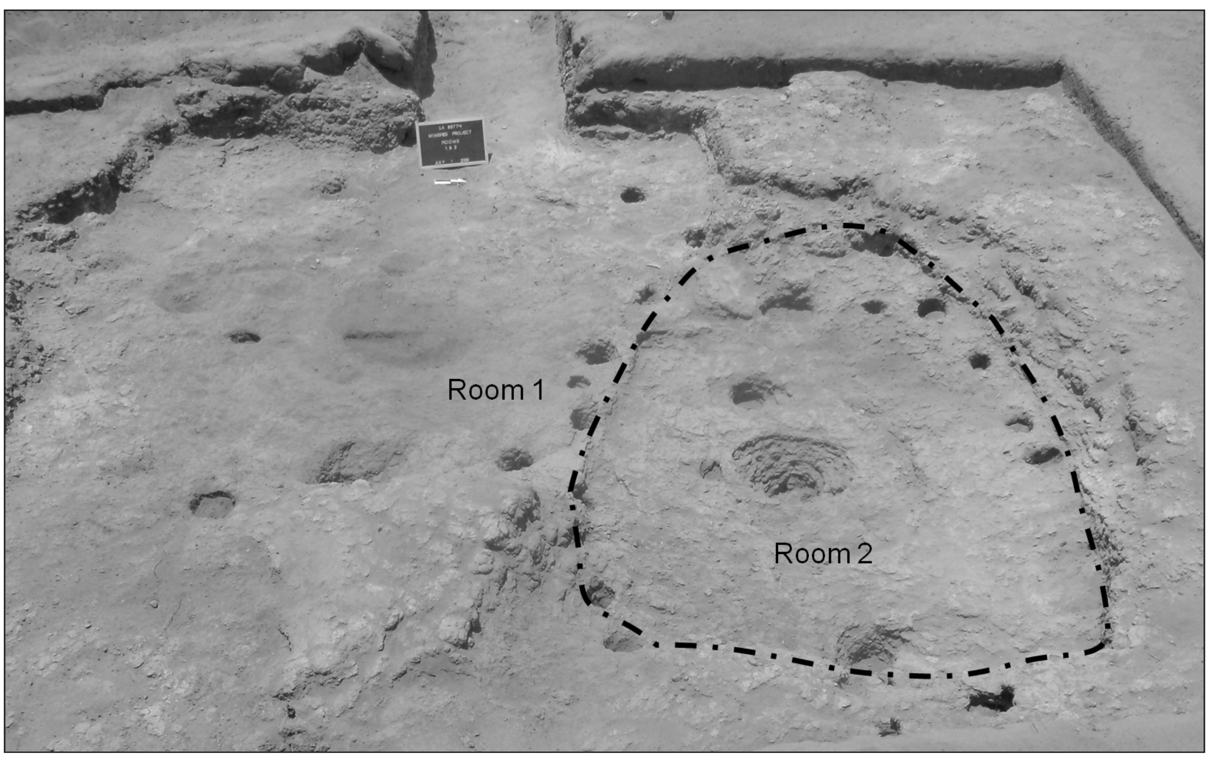

Figure 4. Looking west at Rooms 1 and 2; note postholes and pits.

3.1) were overlapping and postholes adjacent to puddled adobe walls were encountered in two other rooms. Refuse from subsequent use of the site was found in all rooms as well as in general midden deposits across the site.

The construction details from rooms 1 and 2 suggest repeated visits of limited duration. The neat, squared corners identified in rooms in Galaz (Anyon and LeBlanc 1984) and other Mimbres sites (see Shafer 2003; Woolsey and McIntyre 1996) are not present in these rooms. In addition, the use of small posts along the interior walls rather than large, interior support beams and the lack of roof fall in room interiors hint that roofs were insubstantial, and that they consisted of only small poles and brush laid across them. In part, this may reflect the dearth of wood that would likely have been encountered in the vicinity of the site at the time of occupation, forcing the residents to improvise. Nonetheless, 11 of the postholes in Room 2 were excavated through melted adobe from an earlier use of the room, indicating its episodic re-use. Room 2 also lacked an internal hearth, suggesting occupation of the site was long enough to warrant room construction but not long enough to warrant creation of an interior cooking/heating element.

Use of puddled adobe at Columbus Pueblo is intriguing because permanent water sources that would have been used to make the puddle adobe are not currently present close to the site. Although a modest channel was noted in Trench 1, it is unknown if it flowed during the time of site occupation (Frederick 2010:3-13). Summer storm waters can and do pond in small depressions near the site. Toward the end of our investigations (July 2009), a significant rain event hit the site. A total of 0.62 inches of rain was recorded at Columbus, New Mexico, and it is probable that the same amount fell at the site. The low-lying, grassy area west of the site filled with 2-6 inches of water that was still ponded when we terminated excavations six days later. This leaves open the possibility that similar, episodic water ponding occurred in the Late Holocene. Nonetheless, rainfall playa studies undertaken in the Chihuahuan and Mojave deserts indicate that consistent annual ponding is highly unlikely (Johnson 1997; Lichvar et al. 2004; Patrick and Stephenson 1990).

The limited availability of water at the site suggests that it was used for fairly brief periods, a few weeks or a season. Thus, it seems reasonable to suggest that the rooms were constructed during seasonal water ponding in the shallow grassy area next to the site. In the desert, large rain events can be seen from long distances; people living far away could watch to see if areas of interest were possibly being hit by such storms. As Johnson (1989:372) notes, visitors or travelers through a region often bring news of weather and, in desert environments, water availability would be a topic of interest. The archeological evidence at Columbus Pueblo indicates this place was an area of interest for Mimbres people living in the region.

While we are uncertain what resource the residents sought in the Columbus Pueblo area, it required staying long enough to warrant constructing shelters. To do so, they would have had to work quickly while water ponded, and perhaps forego more precise room construction templates used at sites occupied for longer durations. Hence, the archeological data suggest that Columbus Pueblo was visited by one or a few families traveling quickly to the site following a rain event sufficient to pond water that could be used to create shelters. Because of this, it is probable that the average stay at the site at any one time was also brief, perhaps only a few weeks.

Lithics at Columbus

Lithic technology at any site is structured by a number of factors such as settlement intensity, raw material availability, and subsistence pursuits. Several aspects of Columbus Pueblo's chipped stone assemblage provide insights into this structure.

The lithics recovered at Columbus Pueblo constitute the largest class of material culture recovered from the site (n=5,482). It was anticipated that this assemblage would exhibit an expedient core technology since this technology, where stone is minimally altered to fit a need, used, and then discarded, has been found at many agriculturally-based sites in the Mimbres (e.g. Dockall 1991; Nelson 1984; Shafer 2003:19) and Jornada Mogollon (Dockall 1999; Miller 1990, 2007) regions. What we found, however, was an expedient technology, but one that differed significantly from agriculturally-based communities in the composition of the tool assemblage, proportion of raw materials used, and flake-to-core ratios.

The site contains many of the tool types that have been associated with residential occupations, including cores, core tools, projectile points, unifaces, etc. Table 4 compares the flakes, cores, and tool types recovered from Columbus Pueblo with those recovered from the Late Pithouse and Classic Mimbres groups at Galaz (Nelson 1984) and from Jornada pithouses excavated at 41EP1661 that date from A.D. 1010-1150 (Kenmotsu et al. 2008:4-20). Several distinctions can be noted between these sites and Columbus Pueblo. First, a significant departure from other residential sites is the ratio of tools to flakes. Chipped stone tools represent 48 percent of the lithic assemblage. At Galaz, lithic tools make up 15 percent of the assemblage; similarly, at 41EP1661, they comprise 14 percent of the assemblage. The distinction is a result of the large number of utilized flakes in the lithic assemblage at Columbus Pueblo. A total of 5,148 flakes were recovered during the investigations. Of these, 2,507 were analyzed. All flakes from lots containing less than 50 flakes were analyzed; 50 flakes were analyzed from lots containing 50-200 flakes; and with lots with 200-400 flakes, 100 flakes were analyzed. Forty-two percent of the analyzed flakes were utilized. Assuming the number of utilized flakes (n=1,108) from the sample analyzed is also representative of the unanalyzed flakes, then there are approximately 2,270 utilized flakes in the collection from Columbus Pueblo. This is considerably higher than anticipated. Utilized flakes overwhelm all other lithic tools. They also appear to be ubiquitous across the site, and are not confined to any one area of investigation.

The proportion of unutilized flakes at Columbus Pueblo (52 percent) is significantly lower than at Galaz (87.5 and 85 percent, respectively) or at 41EP1661 (88 percent). These simple tools represent over 90 percent of all the tools recovered from Columbus Pueblo, giving a flake/flake tool ratio of 1:9. The flake/flake tool ratio at Galaz is 7:6 in both the Late Pithouse and Classic Mimbres periods, illustrating Columbus Pueblo's unique lithic technological and functional position compared to larger residential sites.

Another attribute of the utilized flakes is their nearly universal fragmentary condition. Of the 1,108 utilized flakes, only 57 were classified as

Table 4. Counts and Percentages of flakes, cores, and tool types from Columbus (Kenmotsu et al. 2010), Galaz (Nelson 1984), 41EP1661.

Type	Columbus (Late Pit House)	Galaz (Classic Mimbres)	Galaz	41EP1661
Flakes*	2962 (52%)**	5658 (87%)	1323 (85%)	702 (86%)
BTF	60 (1%)	32 (0.5%)	8 (0.5%)	–
PP	25 (0.4%)	43 (0.7%)	54 (3%)***	18 (2.2%)
Cores	16 (0.2%)	Unknown	unknown	12 (1.5%)
Core tools	9 (0.2%)	unknown	unknown	–
Unifaces	7 (0.1%)	unknown	unknown	–
Biface	6 (0.1%)	unknown	unknown	2 (0.2%)
Utilized Flake	2270** (42%)	775 (12%)	175 (11.2%)	41 (5%)
Modified flake	58 (1%)	unknown	unknown	21 (3%)
End scraper	1 (Trace%)	unknown	unknown	4 (0.4%)
Side scraper	5 (Trace%)	unknown	unknown	2 (0.2%)
Agave knife	–	unknown	unknown	1 (0.1%)
Drill/perforator	–	unknown	unknown	3 (0.3%)
Hammerstone	16 (0.2%)	unknown	unknown	12 (1.5%)
Totals	5435	6508	1560	818

BTF-biface thinning flake; PP=projectile point
*Includes angular debris. **Reflects assumption discussed that a high portion of the unanalyzed flakes are utilized flakes. ***Listed in the Galaz report as either Late Pithouse or Classic Mimbres.

whole (Kenmotsu et al. 2010:10-20). Many were utilized on more than one edge (n=519). Utilized flakes are expedient tools that tend to be used quickly and then discarded (Shafer 2003:194). The fragmentation and multi-edge wear suggest that the utilized flakes from Columbus Pueblo were intensely used. In part, this use intensity may be related to the lack of cobbles or geological bedrock outcrops at or near the site. People exploiting a resource at this site would have had to transport their own tool stone from elsewhere, underscoring a need to use each flake to its maximum capacity.

The site also differs in a preference for fine-grained tool stone, a preference driven by the need for suitable flakes that could be used in an activity in the immediate site environment. Fine-grained cherts are especially suitable when the toolmaker needs greater control over the final product (i.e., the tool) as they fracture more predictably than many coarse-grained materials, and their thin edges can cut sharply. Chert, chalcedony, and obsidian represent 57 percent of the tool stone recovered at Columbus Pueblo. In contrast, Nelson's (1984:231) analysis of the lithics at Galaz indicates a clear preference for coarse-grained material; only 14 percent of the analyzed lithics in Classic Mimbres assemblages were fine-grained. Dockall (1991) also notes a preference for coarse-grained raw material from the NAN Ranch although this may relate to a lack of fine-grained materials in the immediate area of the site. Interestingly, however, the lithic assemblage from the Hermanas ruin, located 25 miles west of Columbus, was predominantly comprised of fine-grained materials: 42 percent were Pauley jasper and another 22 percent were Pauley chert, a fine-grained rhyolite (Fitting 1971:15). Quarries for both were nearby. The similarities in tool stone suggest site residents at Hermanas ruin carried out activities similar to those carried out at Columbus Pueblo. Hermanas ruin, however, differs in other respects from Columbus Pueblo. No rooms were found in the excavations, but five burials were excavated and pothunters reported at least 40 other burials had been found at the site (Fitting 1971:8).

As shown in Table 4, Columbus Pueblo also lacks a number of tool types that are usually contained in Mimbres domestic tool kits: specifically axes, mauls, drills, perforators, hoes (i.e., *tcamahias*), palettes, and preforms. Their absence may reflect sampling bias, but nonetheless we concluded that at least some should have been recovered in the investigations. Instead, the absence of these utilitarian household artifacts appears to be related to the preponderance of utilized flakes in the tool assemblage. That is, if the site was occupied for only a short period and that occupation was tied to the extraction of a particular resource that required smaller, thinner, implements made from fine-grained materials that had to be transported to the site, large knives to cut coarse vegetation along with drills, awls, and perforators—used in a wide variety of household activities—may not have been the kinds of tools needed at the site.

Finally, it is interesting to note that one of the 25 projectile points recovered at Columbus Pueblo is typed as a Snaketown Triangular Concave Base (Kenmotsu et al. 2010:10-23, point number CN-39), representative of Hohokam occupations in south-central Arizona. This type is chronologically compatible for the dates at Columbus Pueblo, but well outside its recognized distribution area (Justice 2002:279). Several hundred examples were recovered from Snaketown "and apparently the entire sample [at that site] is derived from cache associations" (Justice 2002:285). While there is clear evidence of contact between the Hohokam and Mimbres settlements based on plaza cremations and exchange of jewelry and pottery (Creel 2013a; Parks-Barrett 2001:123), there is little evidence that this projectile point type was exchanged. Only a single example is known from the Reserve area of western New Mexico (Justice 2002:286), and only a single example (from Old Town) is known from the Mimbres heartland (Creel, personal communication 2013). Its presence in the Columbus Pueblo assemblage suggests an additional difference between this site and those to the north.

This lithic assemblage was unexpected, but it argues that the site represents a locale chosen for a seasonally exploited resource that could be extracted via sharp-cutting tools. Given the rooms and other evidence at the site, it appears that this resource extraction, and any other site activities, required a limited residence at this locale when water was locally available.

Ceramic Production and Obsidian Procurement at Columbus Pueblo

Examination of the production locales for ceramics recovered from Columbus Pueblo and the sources where the obsidian at the site had been procured provide insight into their place within the broader Mimbres society. Nineteen sherds from the site were submitted for NAA studies at the Archaeometry Laboratory at the University of Missouri (Glascock and Ferguson 2010); portions of five of the 19 sherds were also submitted for petrographic analysis (Robinson 2010). These samples were dominated by Mimbres Black-on-white and Corrugated sherds (n=13), but Convento ware (n=1), an undetermined corrugated ware (n=4), and El Paso ware (n=1) were also represented in the sample. The NAA data suggests that all the ceramics recovered from the site are non-local, a finding corroborated by the petrographic analysis.

It was not surprising that the El Paso ware sherd fit within the El Paso core group from the Tularosa Basin north of El Paso (Glascock and Ferguson 2010) as nearly all El Paso wares from outside the region that have been subjected to NAA or petrographic analysis indicate production in that region (Burgett 2007; Kenmotsu 2013; Miller 2005; Robinson 2004; Speakman and Glascock 2005). However, the Mimbres wares analyzed produced unexpected results. As noted earlier, the black-on-white vessels appear to have only been produced in the large Mimbres towns along the Mimbres and Gila rivers, and in the Mimbres Valley after A.D. 1000 they were only produced at Swarts and sites to its north (Creel 2013b). Thus, it was expected that the occupants of Columbus Pueblo either lived in one of those towns and traveled south a considerable distance to exploit a local resource, or they had a long standing affiliation with one town and acquired their black-on-white vessels through that affiliation. NAA indicates the vessels did not come from just one Mimbres town. Rather, they came from ceramic groups produced at several towns in the middle and upper Mimbres valley and two groups produced in the upper Gila (Figure 5).

Some background is needed for Figure 5. Over 30 Mimbres production centers have been identified through NAA sampling and to date over 2,600 Mimbres samples—most from the black-on-white series—have been analyzed (Creel and Speakman 2012:2). Individual production centers are numbered Mimbres-1, Mimbres-2, and etc. In some cases these production centers refer to individual Mimbres towns. In other cases, the production centers are larger areas. The NAA samples from Columbus Pueblo indicate they were produced at Swarts (Mimbres-2a and -2b), Galaz/Perrault (Mimbres-4), Perrault (Mimbres-11), Upper Gila (Mimbres-21), and the Wind Mountain area (Mimbres-24).[4]

The NAA results suggest two different explanations for the occurrence of compositionally distinct Mimbres pottery at the site. First, if the people using Columbus Pueblo were long time residents of one of the towns in the heartland, over time the people came to Columbus Pueblo from different towns bringing with them their locally manufactured vessels. The accumulating evidence of the persistent use of sites by family groups over generations (Creel and Anyon 2003; Gilman 2006; Roth 2007; Schriever 2008, 2013; Shafer 2006), however, weakens the argument that Columbus Pueblo was intermittently used by people from a variety of Mimbres towns and instead suggests that people returning to the site were of the same family groups. The latter possibility assumes that the people using Columbus Pueblo resided in the southern Mimbres area and maintained ties with a number of Mimbres towns to the north. While we argue that this explanation better fits the situation at Columbus Pueblo, the number of towns they maintained ties with remains uncertain because the vessels made at Galaz/Perrault, Perrault, and Swarts may have been obtained at Old Town or other locales below the 5,400 ft. elevation (see Creel 2013b). Nonetheless, the presence of samples from Columbus Pueblo that were produced in the Wind Mountain area and further north along the Gila River suggest that the samples are evidence that ties and interaction with more than one Mimbres town were maintained.

Gilman and Stone's (2013) argument that great kiva ceremonies in the Late Pithouse period vied for non-local attendees suggests a possible mechanism for the presence of sherds from a variety of distinct manufacturing locales. Although most of the Mimbres Black-on-white sherds recovered from the site date after the fall of the great kivas, contacts established between core families in the Mimbres towns and Mimbres families living outside the heartland may have continued with repeated visits to the many locales where they had established relationships in previous centuries. Over time, the people using Columbus Pueblo would have brought vessels from several of the northern towns where they maintained contact.

The type of pottery brought to the site is also instructive. We opined the residents came here to exploit a resource of importance to them. Yet, they did not restrict their vessels to utilitarian pots, vessels one would expect on a limited use site. Mimbres Black-on-white vessels were brought

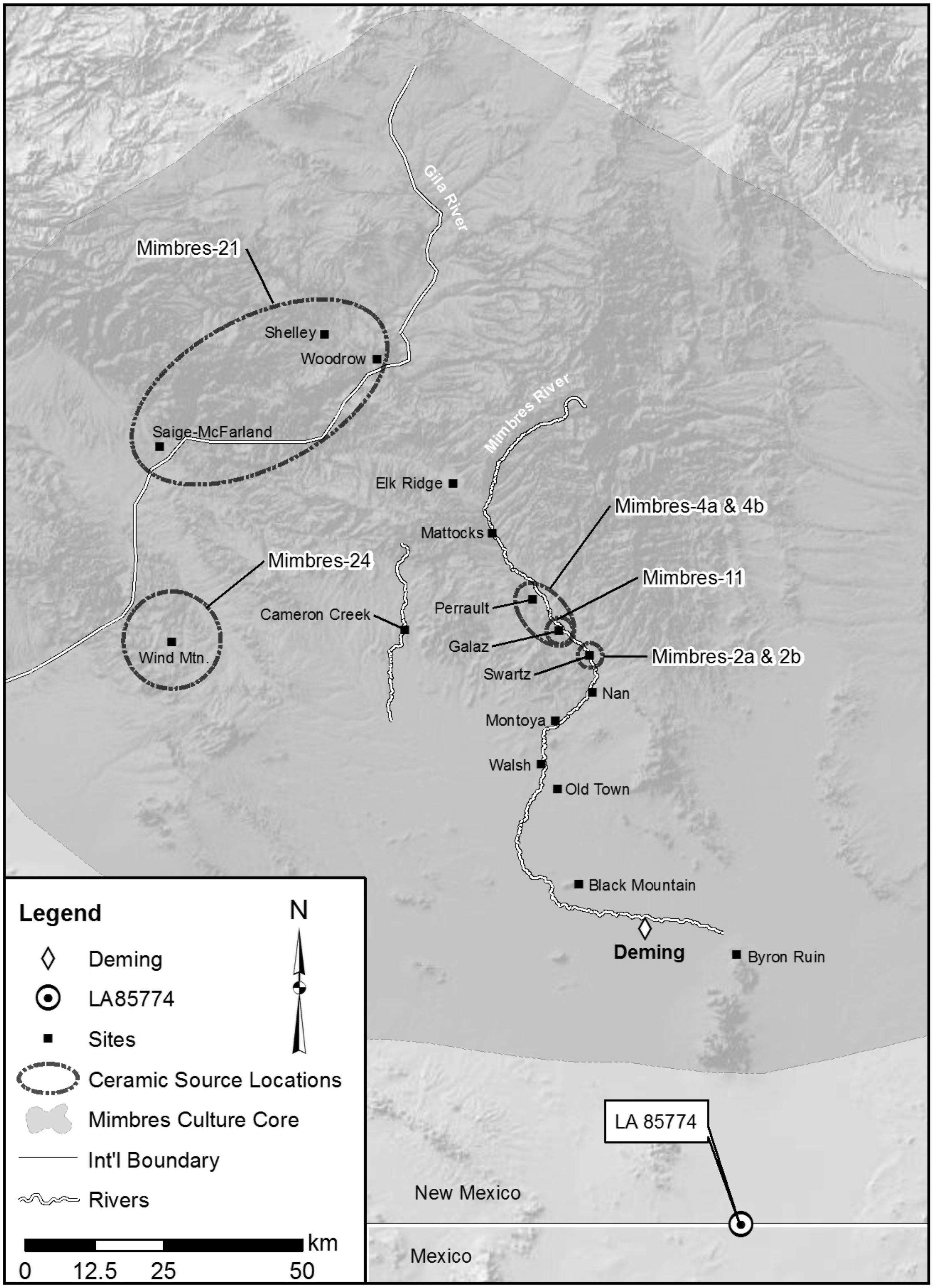

Figure 5. Geographic distribution of Mimbres compositional groups identified at Columbus Pueblo.

as well. The majority are Middle Style III dating from A.D. 1060-1100. During this period, there appears to have been a reinforcement of "'Mimbres consciousness' toward a stronger sense of community as opposed to *loosely* associated groups" (Powell-Martí and James 2006:172-173, emphasis in original). Creel's (2013b:21) perspective that throughout the Classic period there remained a demand for these vessels by non-pottery producing families supports this reinforcement. Hence, black-on-white vessels on a site where one would expect utilitarian ceramics suggests that the move to reinforce this collective cohesiveness operated even in the southern Mimbres area.

As a final note on the ceramics, Columbus Pueblo contains more non-Mimbres wares than Galaz, the NAN Ranch, and Wind Mountain combined. Following the argument that black-on-white vessels were used for gifting or feasting (Powell-Martí and James 2006), the presence of larger quantities of ceramics from two distant regions could indicate that this limited use site was a place where people from other regions came together with Mimbres extended families to trade, exploit the resource—possibly a grass whose seed was germinated when waters were sufficient—that required the use of utilized flakes, feast, or all of the above.

The results of obsidian and rhyolite artifacts from Columbus Pueblo submitted to Berkley's XRF Laboratory for sourcing (Shackley 2010) strengthen the conclusion that the residents of the site were from the southern Mimbres region. Figure 6 shows the locations where the sampled specimens originated. The rhyolite likely came from the alluvial cobbles in the Rio Grande floodplain located some 150 km to the east. Seven obsidian samples are from Sierra Fresnal in Chihuahua, Mexico (90 km south of Columbus), and one each came from Antelope Wells and Mule Creek (respectively 120 and 210 km from Columbus).

Schriever (2008:140-158) has summarized obsidian sourcing studies conducted for Mimbres sites. For sites in the Mimbres River valley, including Galaz, Old Town, Swarts, and Mattocks, Mule Creek was the principal source. Wind Mountain, on the Gila River, followed that same pattern. However, for southern Mimbres sites, obsidian from Antelope Wells and Sierra del Fresnal, located south and southeast of the heartland (see Figure 6), dominate the assemblages as they do at Columbus Pueblo. Because the samples from Columbus Pueblo reflect the sources for sites in the southern Mimbres area, they suggest that the Mimbres families who came to this locale did not call the Mimbres Valley their home. Rather they were residents of Mimbres villages south of that valley.

Jewelry from Columbus Pueblo

Jewelry (i.e., beads, pendants, and bracelet fragments) was found in the general fill throughout the site (Table 5). The dominant jewelry item at Columbus Pueblo was small shell disk beads (n=30). These materials have been found in other Mimbres sites. The Galaz sample of shell is quite impressive, with thousands of specimens (Anyon and LeBlanc 1984:294-306), and copper and quartz crystals were commonly recovered from structures (Anyon and LeBlanc 1984:308). Wind Mountain had a similar array of shell, bone, and crystal (Woosley and McIntyre 1996), as did the NAN Ranch Ruin (Parks-Barrett 2001; Shafer 2003) and Old Town (Creel n.d.).

While much smaller, the collection from Columbus Pueblo is notable, particularly since the site has been interpreted as a limited use site that was re-visited episodically. Because the lithic assemblage at the site is not a full domestic tool kit, this suggests that the families left their drills, knives, and other domestic tools at home. Yet, they brought their Black-on-white ceramic bowls, items considered to hold "a unique and valued position in Mimbres society" (Powell-Martí and James 2006:172), and they also brought a relatively robust array of ornaments, jewelry, and special items such as crystals.

CONCLUSIONS

In summary, the archeological investigation at Columbus Pueblo is a small step in the characterization of southern Mimbres sites. The site contains at least six rooms, a pithouse, and possibly other structures. However, the evidence indicates it was only occupied episodically when water ponded on its margins. Its artifactual assemblage is surprisingly rich and offers information on trade and connections with other groups. The site contains a remarkably high proportion of utilized flakes that were intensely used and many highly fragmented by that use. Other larger, well-studied Mimbres lithic collections do not have this ratio of flakes to

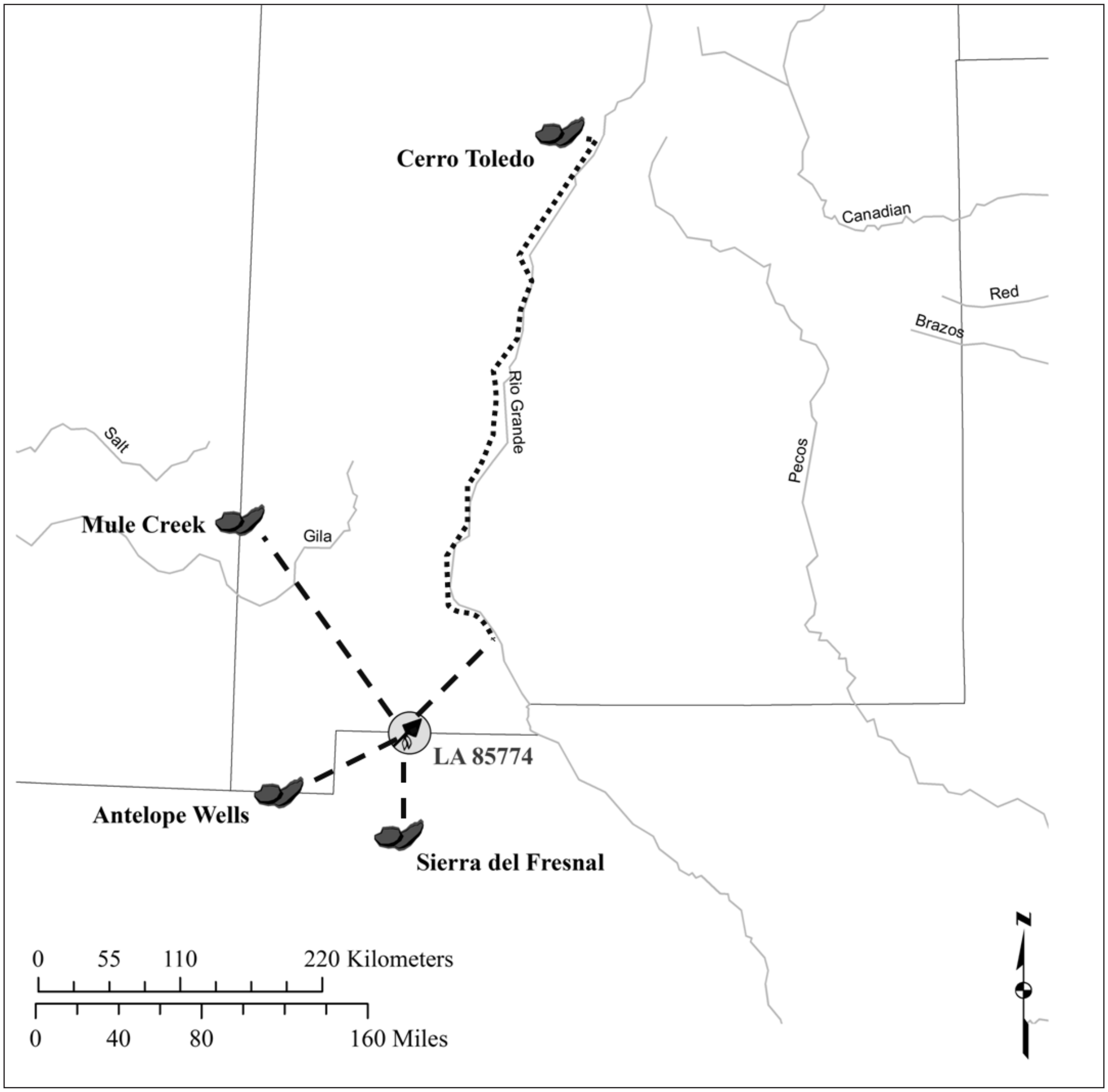

Figure 6. Map of obsidian sources and a source of a single rhyolite example from Columbus Pueblo.

utilized flakes or lithic tools. The lithics were also carried to the site as no stone sources are available at or close to it.

All ceramics are non-local and also had to be transported. Moreover, the families brought their special Black-on-white wares with them. Other Mimbres sites contain evidence of outside contact with other groups in the form of ornaments, non-local pottery, etc. Columbus Pueblo, however, despite its limited assemblage size, has much higher raw counts of non-local pottery than many of the large, excavated villages to the north. NAA demonstrates that the people in the southern Mimbres region had strong ties with people in the Mimbres River valley and these ties were steadfastly maintained, ensuring that people that lived at Columbus Pueblo retained connections with their heartland.

Sourced obsidian from Columbus Pueblo also suggests that these families resided in the southern Mimbres area, not on the Mimbres River. Ornaments and jewelry are not unusual at Mimbres sites, but their presence on a limited use site, along with Black-on-white vessels that were held dear to Mimbres people, likely indicates that ties between families from the southern Mimbres region and groups to the south and east were more strongly

Table 5. Jewelry from Columbus Pueblo.

Item	N
Small shell disk beads	30
Stone disk beads	20
Nasa beads	12
Large shell disk beads	6
Fossilized bone tube beads	4
Shell pendants	2
Stone tube bead	1
Olivella	1
Abalone	1
Glycymeris bracelet fragment	1
Unknown	1

8 quartz crystals from Hermanas (6 may be from one of the 7 burials at the site), 1 Olivella bead.

maintained, perhaps through the venue of sharing the exploitation of a sought-after resource.

ACKNOWLEDGEMENTS

Tom Holcomb of the Las Cruces BLM office deserves our gratitude for his many kindnesses during this investigation, and also for his advice based on his knowledge of southern Mimbres sites. He, along with Harry Shafer, Darrell Creel, and Tim Perttula reviewed an early draft of the article and we appreciate the comments that aided our thinking. We also appreciate the support of Duane Peter of Geo-Marine, Inc. and Nancy Parrish of the U.S. Army Corps of Engineers, Fort Worth District. They were instrumental in handling many contractual and management issues.

END NOTES

1. Creel and Speakman confine their conclusions to the Mimbres River Valley as they were unable to sample whole vessels from the upper Gila River.

2. El Paso Polychrome and Bichrome are extremely recognizable decorated brownwares produced in the Jornada Mogollon region of Texas and New Mexico. Bichrome is the earlier of the two, dating from A.D. 1000-1250, while the polychrome type dates from A.D. 1250-1450 (Miller 2005). However, on small sherds, it is impossible to distinguish between the two.

3. The vessel was encountered at the top of Feature 20. Although it was not clear if this was a burial, the feature was treated as if it were a primary inhumation and was not excavated. BLM personnel from the Las Cruces office took charge of the vessel.

4. At the time our samples were subjected to NAA, the physical area for the Mimbres-24 production zone spread from Old Town to Wind Mountain. Subsequent research by Creel (2013b) and Creel and Speakman (2012) have demonstrated that Old Town and other areas below the 5400 ft. elevation did not produce black-on-white ceramics. Hence, we conclude that the Mimbres-24 production center should be reduced to a smaller area around Wind Mountain.

REFERENCES CITED

Anyon, R. and S. A. LeBlanc
1984 *The Galaz Ruin A Prehistoric Mimbres Village in Southwestern New Mexico*. Maxwell Museum of Anthropology and the University of New Mexico Press, Albuquerque.

Bradfield, W.
1931 *Cameron Creek Village: A Site in the Mimbres Area in Grant County, New Mexico*. School of American Research, Santa Fe.

Burgett, J.
2007 Just Like That, but Different: El Paso Polychrome in the Casas Grandes Region, Chihuahua, Mexico. In *Viva la Jornada! Papers from the 14th Biennial Jornada Mogollon Conference,* edited by J. Jurgena, L. Jackson, and M. Thompson, pp. 53-59. El Paso Museum of Archaeology, El Paso.

Cosgrove, H. S. and C. B. Cosgrove
1932 *The Swarts Ruin: A Typical Mimbres Site in Southwestern New Mexico*. Papers of the Peabody Museum of American Archaeology and Ethnology 15(1). Harvard University, Cambridge.

Creel, D. C.
n.d. Ornaments at Old Town. Manuscript on file with the senior author.

2006 Evidence for Mimbres Social Differentiation at the Old Town Site. In *Mimbres Society*, edited by V. S. Powell-Marti and P. A. Gilman, pp. 32-44. University of Arizona Press, Tucson.

2013a The Hohokam, the Mimbres, and the Land Between: a Mimbres Perspective. In *Between Mimbres and Hohokam: Exploring the Archaeology and History of Southeastern Arizona and Southwestern New Mexico*, edited by H. D. Wallace, pp. 122-140. Anthropological Papers No. 51. Archaeology Southwest, Tucson.

2013b The Mimbres Vessel Sourcing Project. Paper presented at the Annual Meeting of the Archeological Society of New Mexico, May 4, 2013, Albuquerque.

Creel, D. C. and R. Anyon
2003 New Interpretations of Mimbres Public Architecture and Space: Implications for Cultural Change. *American Antiquity* 68(1):67-91.

Creel, D.C. and H. J. Shafer
n.d. Mimbres Great Kivas and Plazas during the Three Circle Phase, ca. A.D. 800-1000. Manuscript on file with the senior author.

Creel, D. C. and R. Speakman
2012 The Mimbres Vessel Project: An Update on the Neutron Activation Analysis Effort. Paper presented at the 17th Annual Mogollon Conference, Silver City, New Mexico.

Dockall, J. E.
1991 Chipped Stone Technology at the NAN Ruin, Grant County, New Mexico. Master's thesis, Department of Anthropology, Texas A&M University, College Station.

1999 Lithic Analysis Research Design. In *Archaeology of Ojasen (41EP289) and Gobernadora (41EP321) Sites, El Paso County, Texas: The Texas Department of Transportation Investigations*, by H. J. Shafer, J. E. Dockall, and R. L. Brewington, pp. 199-210. Texas Department of Transportation, Austin, and Texas A&M University, College Station.

Feinman, G. M., K. G. Lightfoot, and S. Upham
2000 Political Hierarchies and Organizational Strategies in the Puebloan Southwest. *American Antiquity* 65:449-470.

Fitting, J. E.
1971 *The Hermanas Ruin, Luna County, New Mexico*. Southwestern New Mexico Research Reports Number 3. Department of Anthropology, Case Western Reserve University, Cleveland.

Frederick, C.
2010 Geoarchaeology at the Columbus Pueblo. In *Archaeological Investigations at Columbus Pueblo (LA 85774), a Southern Mimbres Occupation in Luna County, New Mexico,* by N. A. Kenmotsu, T. L. Griffith, L. J, Legare, W. Russell, and M. R. Miller, pp. 3-1 to 3-15. GMI Report No. 783EP. Geo-Marine, Inc., El Paso.

Gibbs, V.
2007 *Damage Assessment for Site LA 85774 in Luna County, New Mexico*. Zia Engineering and Environmental Consultants, Inc., Las Cruces, New Mexico.

Gilman, P. A.
2006 Social Differences at the Classic Period Mattocks Site in the Mimbres Valley. In *Mimbres Society*, edited by V. S. Powell-Marti and P. A. Gilman, pp. 66-83. University of Arizona Press, Tucson.

Gilman, P. A. and T. Stone
2013 The Role of Ritual Variability in Social Negotiations of Early Communities: Great Kiva Homogeneity and Heterogeneity in the Mogollon Region of the North American Southwest. *American Antiquity* 78:607-623.

Glascock, M. and J. Ferguson
2010 Neutron Activation Analysis. In *Archaeological Investigations at Columbus Pueblo (LA 85774), a Southern Mimbres Occupation in Luna County, New Mexico,* by N. A. Kenmotsu, T. L. Griffith, L. J. Legare, W. Russell, and M. R. Miller, pp. F-1 to F-18. GMI Report No. 783EP. Geo-Marine, Inc., El Paso.

Grissino-Mayer, H.D., C.H. Baisan, and T.W. Swetnam
1997 *A 1,373 Year Reconstruction of Annual Precipitation for the Southern Rio Grande Basin*. Legacy Program, Natural Resources Division, Directorate of Environment, Fort Bliss, Texas.

Haury, E.
1936 *The Mogollon Culture of Southwestern New Mexico*. Medallion Papers No. 20. Gila Pueblo, Globe, Arizona.

Johnson, D.
1997 *Geomorphological, Geoecological, Geoarchaeological and Surficial Mapping Study of McGregor Guided Missile Range, Fort Bliss, New Mexico*. Miscellaneous Report of Investigations No. 157. Geo-Marine, Inc., Plano.

Johnson, G. A.
1989 Dynamics of Southwestern Prehistory: Far Outside Looking In. In *Dynamics of Southwestern Prehistory*, edited by L. S. Cordell and G. J. Gumerman, pp. 371-389. Smithsonian Institution Press, Washington D.C.

Justice, N. D.
2002 *Stone Age Spear and Arrow Points of the Southwestern United States*. Indiana University Press, Bloomington.

Kemrer, M. F.
2003 Mimbres Expansion into South Central New Mexico. In *Proceedings of the 13th Mogollon Archaeological Conference* (2004), edited by L. C. Ludeman, pp. 164-172. For information on CD publication contact Dr. Lonnie C. Ludeman, Kipsch School of Electrical and Computer Engineering, New Mexico State University, Las Cruces, New Mexico.

Kenmotsu, N. A.
2013 Pottery at La Junta: One View of Regional Interaction along the Rio Grande. *Bulletin of the Texas Archeological Society* 84:5-28.

Kenmotsu, N. A., T. Graves, L. Jackson, C. Burt, and M. R. Miller
2008 *Archaeological Testing and Data Recovery at Seven Sites, Maneuver Area IB, Fort Bliss Military Reservation, El Paso, Texas*. Fort Bliss Historic and Natural Resources Report No. 04-18, and Report of Investigations No. 687EP, Geo-Marine, Inc., El Paso.

Kenmotsu, N. A., T. L. Griffith, L. J. Legare, W. Russell, and M. R. Miller
2010 *Archaeological Investigations at Columbus Pueblo (LA 85774), a Southern Mimbres Occupation in Luna County, New Mexico*. GMI Report No. 783EP. Geo-Marine, Inc., El Paso.

LeBlanc, S. A.
2006 Who Made the Mimbres Bowls? Implications of Recognizing Individual Artists for Craft Specialization and Social Networks. In *Mimbres Society*, edited by V. S. Powell-Marti and P. A. Gilman, pp. 15-31. University of Arizona Press, Tucson.

Lekson, S. H.
1992 Scale and Process in the Southwest. In *Interpreting Southwestern Diversity: Underlying Principles and Overarching Patterns*, edited by P. R. Fish and J. .J. Reid, pp. 15-25. Anthropological Research Papers No. 48. Arizona State Museum, Tempe.
2001 Archaeology in Southern New Mexico: The Southwest, Synthesis and Status of the Prehistoric Resources. In *The Archaeological Record of Southern New Mexico Sites and Sequence of Prehistory,* edited by S. R. Katz and P. Katz, pp. 1-101. New Mexico Historic Preservation Division, Santa Fe.

Lichvar, R., G. Gustina, and R. Bolus
2004 Ponding Duration, Ponding Frequency, and Field Indicators: A Case Study on Three California, USA, Playas. *Wetlands* 24(2):406-413.

Miller, M. R.
1990 *The Transitional Period in the Southern Jornada Mogollon: Archaeological Investigations in the North Hills Subdivision, Northeast El Paso, Texas*. Research Report No. 1. Batcho & Kauffman Associates, Las Cruces.
2005 Revision of the Jornada Mogollon Ceramic Sequence and Alignment with the Greater South. In *Archaeology Between the Borders: Papers from the 13th Biennial Jornada Mogollon Conference,* edited by M. Thompson, J. Jurgens, and L. Jackson, pp. 59-88. El Paso Museum of Archaeology, El Paso.
2007 *Excavations at El Arenal and Other Late Archaic and Early Formative Period Sites in the Hueco Mountain Project Area of Fort Bliss, El Paso County, Texas*. Historic and Natural Resources Report No. 02-13. Directorate of Environment, Conservation Division, Garrison Command, Fort Bliss.

Minnis, P. E. and A. J. Wormser
1984 Late Pithouse Occupation in the Deming Region: Preliminary Report of Excavations at the Florida Mountain Site (LA 18839). In *Recent Research in Mogollon Archaeology,* edited by S. Upham, F. Plog, D. G. Batcho, and B. E. Kauffman, pp. 229-284. Occasional Papers No 10. The University Museum, New Mexico State University, Las Cruces.

Nelson, M. C.
1984 Food Selection at Galaz: Inferences from Chipped Stone Analysis. In *The Galaz Ruin: A Prehistoric Mimbres Village in Southwestern New Mexico*, by R. Anyon and S. A. LeBlanc, pp. 225-246. Maxwell Museum of Anthropology, University of New Mexico Press, Albuquerque.

Parks-Barrett, M. S.
2001 Prehistoric Jewelry of the NAN Ranch Ruin (LA 15049), Grant County, New Mexico. Master's thesis, Department of Anthropology, Texas A&M University, College Station.

Patrick, N. A. and D. Stephenson
1990 Spatial Variation of Rainfall Intensities for Short Duration Storms. *Hydrological Sciences* 35: 667-680.

Powell-Marti, V.S. and W. D. James
2006 Ceramic Iconography and Social Asymmetry in the Class Mimbres Heartland, A.D. 970-1140. In *Mimbres Society,* edited by V. S. Powell-Marti and P. A. Gilman, pp. 151-175. University of Arizona Press, Tucson.

Reider, M.
1999 *JTF-6 Border Road Improvement Project, Columbus, New Mexico*. Archaeological Report No. 8. Aztlan Archaeology, Inc., Tucson.

Robinson, D. G.
2004 Petrographic Analysis of Prehistoric Ceramics from Two Sites in the La Junta Archeological District, Presidio County, Trans-Pecos Texas. In *Arroyo de la Presa Site: A Stratified Late Prehistoric Campsite along the Rio Grande, Presidio County, Trans-Pecos Texas*, by W. A. Cloud, pp. 227-236. Reports in Contract Archeology 9. Center for Big Bend Studies, Sul Ross State University, Alpine.

2010 Ceramic Petrographic Analysis of Five Pottery Sherds from LA 85774, Luna County, Southern New Mexico. In *Archaeological Investigations at Columbus Pueblo (LA 85774), a Southern Mimbres Occupation in Luna County, New Mexico,* by N. A. Kenmotsu, T. L. Griffith, L. J. Legare, W. Russell, and M. R. Miller, pp. G-1 to G-11. GMI Report No. 783EP. Geo-Marine, Inc., El Paso.

Roth, B. J.
2007 The Pithouse Period Occupation at the Lake Roberts Vista Site. In *Exploring Variability in Mogollon Pithouses*, edited by B. J. Roth and R. J. Stokes, pp. 5-11. Anthropological Research Papers No. 58. Arizona State University, Tempe.

2013 Settlement Stability and Household Movement during the Pithouse Period in the Mimbres Region of Southwestern New Mexico. *NewsMAC* 2013-4:16-17.

Schriever, B.
2008 Informal Identity and the Mimbres Phenomenon: Investigating Regional Identity and Archaeological Cultures in the Mimbres Mogollon. Ph.D. dissertation, Department of Anthropology, University of Oklahoma, Norman

Schriever, B. and T. Holcomb
2005 Remembering the Origins of the Mimbres Phenomenon and Reexamining Its Distribution. In *Proceedings of the 13th Mogollon Archaeological Conference* (2004), edited by L. C. Ludeman, pp. 164-172. CD publication, for information contact Dr. Lonnie C. Ludeman, Kipsch School of Electrical and Computer Engineering, New Mexico State University, Las Cruces, New Mexico.

Sechrist, M.
1994 *The Joint Task Force-Six Border Survey, Archaeological Survey along the U.S./Mexico Border Road from Anapra to Antelope Wells, New Mexico.* Report 9114A. Human Systems Research, Tularosa.

Shackley, S.
2010 X-Ray Fluorescence Analysis. In *Archaeological Investigations at Columbus Pueblo (LA 85774), a Southern Mimbres Occupation in Luna County, New Mexico,* by N. A. Kenmotsu, T. L. Griffith, L. J. Legare, W. Russell, and M. R. Miller, pp. E-1 to E-10. GMI Report No. 783EP. Geo-Marine, Inc., El Paso.

Shafer, H. J.
2003 *Mimbres Archaeology at the NAN Ranch Ruin*. University of New Mexico Press, Albuquerque.

2006 Extended Families to Corporate Groups: Pithouse to Pueblo Transformation of Mimbres Society. In *Mimbres Society*, edited by V. S. Powell-Marti and P. A. Gilman, pp. 15-31. University of Arizona Press, Tucson.

2010 A Review of Micro-Styles on Mimbres Black-on-white Rims from Columbus Pueblo. In *Archaeological Investigations at Columbus Pueblo (LA 85774), a Southern Mimbres Occupation in Luna County, New Mexico,* by N. A. Kenmotsu, T. L. Griffith, L. J. Legare, W. Russell, and M. R. Miller, pp. H-1 to H-6. GMI Report No. 783EP. Geo-Marine, Inc., El Paso.

Shafer, H. J. and R. L. Brewington
1995 Microstylistic Changes in Mimbres Black-on-White Pottery: Examples from the NAN Ruin, Grant County, New Mexico. *The Kiva* 64(3): 5-29.

Speakman, R. J. and M. D. Glascock
2005 *Instrumental Neutron Activation Analysis of Pottery from Presidio and Hudspeth Counties, Texas*. Archaeometry Laboratory, Missouri University Research Reactor, University of Missouri, Columbia, Missouri.

Walker, C.
2010 Multi-Instrument Geophysical Investigations at LA 85774. In *Archaeological Investigations at Columbus Pueblo (LA 85774), a Southern Mimbres Occupation in Luna County, New Mexico,* by N. A. Kenmotsu, T. L. Griffith, L. J. Legare, W. Russell, and M. R. Miller, pp. 6-1 to 6-35. GMI Report No. 783EP. Geo-Marine, Inc., El Paso.

Woosley, A. J. and A. J. McIntyre
1996 *Mimbres Mogollon Archaeology, Charles C. DiPeso's Excavations at Wind Mountain*. An Amerind Foundation Publication, University of New Mexico Press, Albuquerque.

Identifying Causes of the Thirteenth Century Depopulation of the Northern Southwest

Kristin A. Kuckelman

ABSTRACT

Archeologists have long endeavored to discover the circumstances surrounding the thirteenth century depopulation of the northern Southwest by Pueblo farmers, and researchers have proposed numerous theories for this population movement. In this article, I synthesize recent research results and review pertinent historic accounts that illuminate some causes of these pivotal emigrations. Data generated from excavations at Sand Canyon, Castle Rock, and Goodman Point pueblos—terminal Pueblo III villages in the northern San Juan region—contain evidence of crop failure and widespread, lethal hostilities as the "great drought" descended about A.D. 1276. A large body of data yields compelling evidence that famine and warfare were crucial factors in regional depopulation.

I am pleased with this opportunity to contribute to this issue of the *Bulletin of the Texas Archeological Society* honoring Dee Ann Story. Dee Ann was a true icon of Texas archeology, and it would be difficult to overstate her influence on the archeological profession, especially her role in the educating, training, and shaping of students in Texas over the past several decades. Her influence was subtle yet powerful and enduring; she exemplified what the profession of archeology should be, how it should work, what it should be about, and how it should be done. As a young graduate student, I absorbed and internalized Dee Ann's ethical and scientific standards as well as her approach to archeological interpretation. My first field experience, excavating at the Loeve-Fox site on the Granger Lake project in the winter of 1978, was shared with many alumni of Dee Ann's various field schools. Through these experienced excavators, I absorbed her approach to field work and data recovery. Her influence was precisely what I needed as I entered the profession: a template after which to model my own research, excavation projects, values, and professional philosophy.

In the many years that have followed her service on my Masters committee in the mid-1970s, Dee Ann held a special place in my relationship with archeology. In a discipline that sometimes pressures researchers to cut corners or refrain from addressing controversial or unpleasant topics, or even to conceal particular types of findings, Dee Ann's scientific honesty and integrity was a model by which I have fashioned my own projects, research, and publications, and has been the yardstick by which I have measured the quality of research and professional conduct of others.

Dee Ann encouraged critical thinking and the challenging of assumptions, and I think she would be pleased with the recent critical re-evaluation and resulting debunking of such long-held assumptions as, for example, that Pueblo peoples did not engage in violence or warfare, that walled villages and cliff dwellings were not built for defense, and that subsistence stress was not a major factor in the permanent depopulation of the northern San Juan region by Pueblo peoples. Perhaps most importantly, as a successful, influential, and highly respected woman in professional archeology, Dee Ann was a role model for countless women who would follow her footsteps in the archeological profession. I am grateful to Dee Ann for providing such strong and capable shoulders on which I and many other women now stand, and if she thought well of my research, I ask for no greater compliment.

Thank you, Dee Ann, for generously sharing your many gifts and preparing so many women and men to perform successfully in the archeological profession. Although my career path ultimately led out of Texas, I carried your influence with me through many projects in numerous locations and, ultimately, to the northern Southwest.

INTRODUCTION

Much of my research for more than two decades at the Crow Canyon Archaeological Center in southwestern Colorado has focused on various conditions, forces, and circumstances that prompted the thirteenth century depopulation of the northern Southwest. This long-standing, wide-ranging, and important issue regarding a particularly crucial hinge point in Pueblo prehistory has also been a primary stated focus of the research conducted by Crow Canyon for much of its 30 year history. Critical thinking applied to the abundant and varied data generated by Crow Canyon's long-term excavation projects has yielded results that have greatly expanded our understanding of the Pueblo experience in the northern Southwest just before the region underwent complete and permanent depopulation about A.D. 1280.

Crow Canyon was fortunate to have the opportunity to conduct multi-year excavation projects at numerous sites within a major area of study defined by Crow Canyon as the Sand Canyon locality (Figure 1). Three of these sites—Sand Canyon, Castle Rock, and Goodman Point pueblos—were terminal Pueblo III villages that were constructed and occupied just before the region was depopulated (Figures 2-7). In the decades before complete regional depopulation, Sand Canyon and Goodman Point pueblos, with 500 to 800 residents each, were in all likelihood the two largest settlements in the northern Southwest, and Castle Rock Pueblo was a medium-size village of about 100 residents. Although contemporaneous with Cliff Palace in nearby Mesa Verde National Park, both Sand Canyon and Goodman Point pueblos were about four times the size of that largest cliff dwelling. Crow Canyon excavated five percent of Sand Canyon Pueblo from 1984 through 1993, five percent of Castle Rock Pueblo from 1990 through 1994, and slightly less than one percent of Goodman Point Pueblo from 2005 through 2008. Those 19 field seasons, totaling approximately 150 months of field work, generated abundant data from these three single-component sites that stand as an enduring record of the Pueblo experience in the final 20 to 30 years of the occupation of the northern Southwest.

Of primary importance in using data from these excavations to address the issue of regional depopulation is the precise dating of the settlements; that is, we must first establish that the empirical data generated by these excavations do, in fact, represent conditions and events that occurred just before the region was depopulated. Tree-ring dates for the three villages in question suggest that the settlements were founded between A.D. 1250 and 1260, and the quantity of refuse deposited in each village indicates that the pueblos were occupied for a significant length of time. The latest tree-ring date for Sand Canyon Pueblo is A.D. 1277vv, for Castle Rock Pueblo it is 1274vv, and for Goodman Point Pueblo it is 1269vv. The suffix "vv" indicates that analysts at the Laboratory of Tree-Ring Research in Tucson could not determine how many years after the stated year that the tree died. The many thousands of tree-ring dates for structures across the region as a whole indicate that few new timbers were obtained for construction in the late A.D. 1270s, and that the acquisition of new timbers virtually ended in A.D. 1280; thus, depopulation of the northern San Juan as a whole was probably complete by the early A.D. 1280s. The latest dates for Sand Canyon, Castle Rock, and Goodman Point pueblos indicate that these villages were constructed in the final decades of regional occupation by Pueblo peoples, and that the occupations of these settlements ended during the final depopulation of the region. In all likelihood, residents departed from these settlements in order to emigrate from the region, and they reached decisions to emigrate while residing in these villages. Therefore, evidence of reasons for these decisions should exist in the remnants of these pueblos.

Tree-ring data influenced our research on the depopulation of the northern Southwest in an additional way. That a serious and prolonged drought, referred to by archeologists as the "great drought," descended on the Southwest by at least A.D. 1276 and persisted until 1299 has long been known through tree-ring data (Berry and Benson 2010:Figures 3.2 and 3.4; Dean and Van West 2002; Douglass 1929). However, empirical evidence of the actual effects of this drought on farming families has historically been challenging to detect in the archeological record. One result of this problem is that the effects of the drought and their possible role in the depopulation of the region have been minimized or dismissed as environmental determinism by some archeologists, even though this drought was unquestionably detrimental to the success of farming in the region and thus probably played a significant role in the

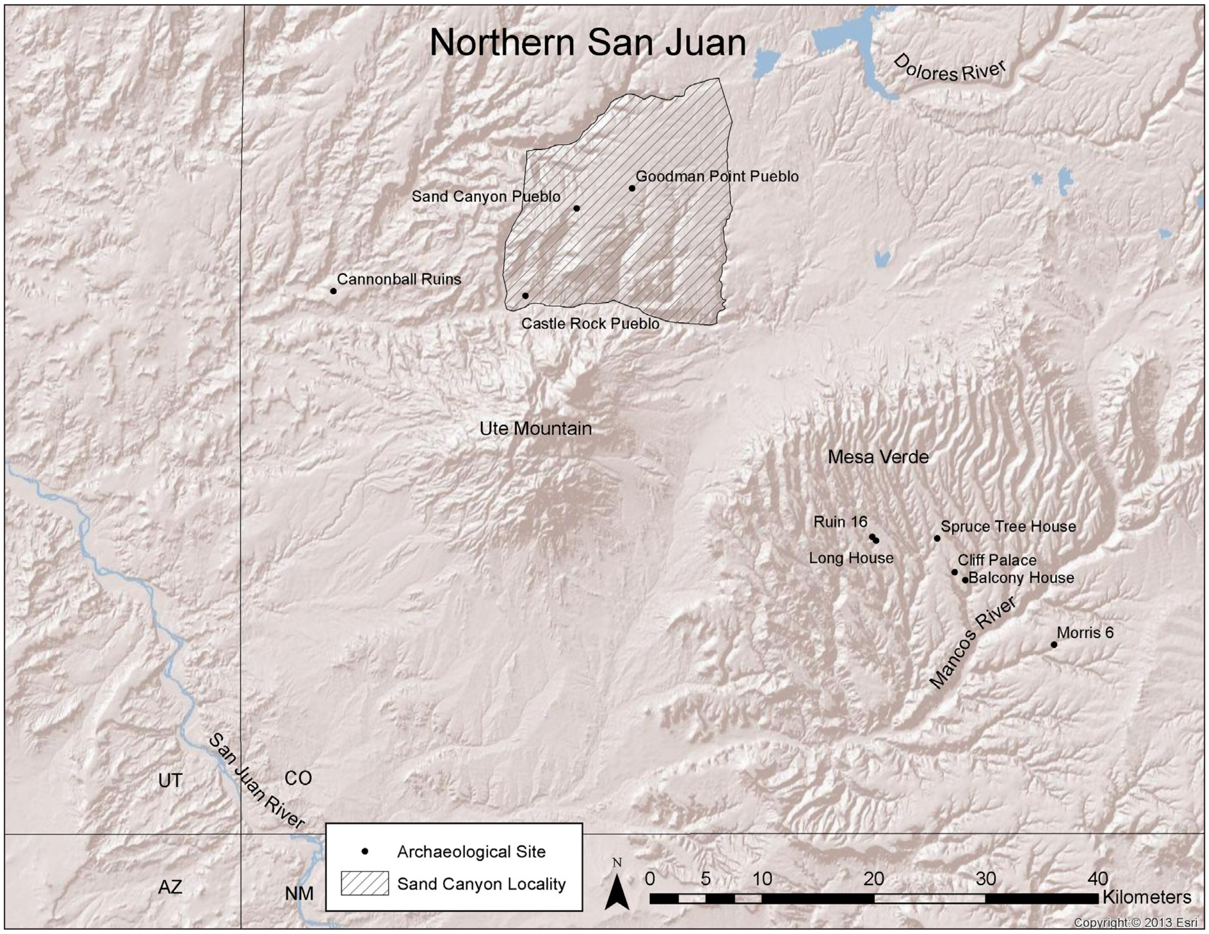

Figure 1. GIS image of the central portion of the northern San Juan region, showing locations of sites mentioned in text (courtesy Crow Canyon Archaeological Center).

complete depopulation of the area. The problem was to design research, using the abundant data from Sand Canyon, Castle Rock, and Goodman Point pueblos, that could reveal whether residents suffered subsistence stress or famine, resulting from whatever cause, that could have influenced Pueblo peoples to emigrate from their homeland of many hundreds of years.

SUBSISTENCE

In the northern San Juan, the success of Pueblo farming rested predominantly on a very specific array of environmental conditions that included a bimodal precipitation pattern: winter precipitation resulting in adequate ground moisture for seed germination in the spring as well as summer rainfall at specific times during the growing season (Cordell et al. 2007; Wright 2010). Survival for Pueblo farmers meant enduring numerous types of environmental downturns, including periodic drought and shifting seasonal precipitation patterns (Benson et al. 2006; Dean and Van West 2002; Douglass 1929; Larson et al. 1996; Van West and Dean 2000; Wright 2010:78). Another specific requirement was a growing season of adequate length for the maturation of maize crops. Paleoenvironmental data indicate that climatic shifts to cooler temperatures, compounded in some areas by high elevation and by cold-air drainage, no doubt at times resulted in a growing season too brief for maize to mature (Adams and Petersen 1999; Petersen 1988; Salzer 2000; Wright 2010). Thus, in most years there existed a "dry-farming belt," within which climatic conditions were adequate for growing successful maize crops. Above the upper boundary of the belt, the growing season was too brief, and below the lower boundary, precipitation was insufficient or did not fall at the necessary

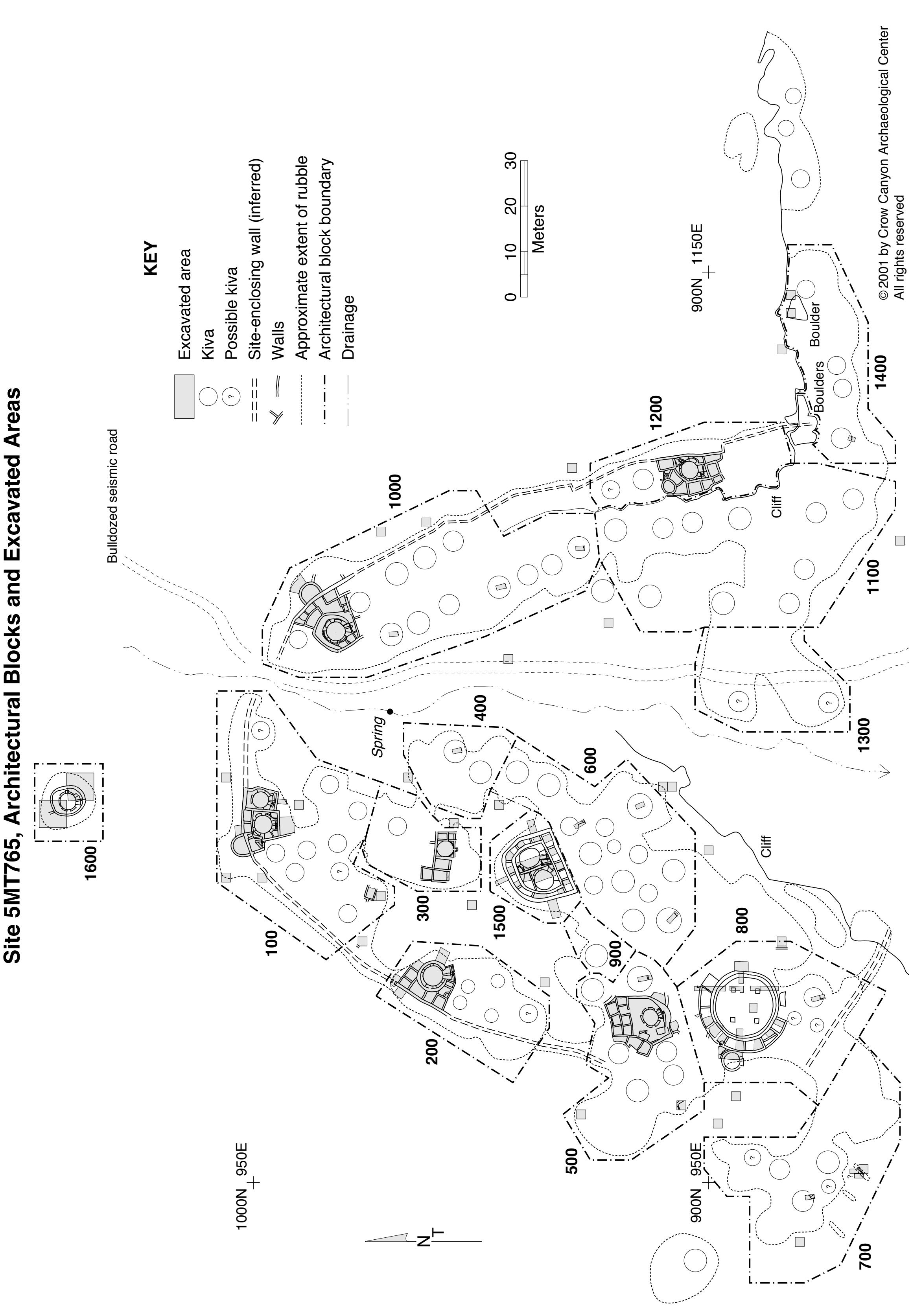

Figure 2. Plan map of Sand Canyon Pueblo (courtesy Crow Canyon Archaeological Center).

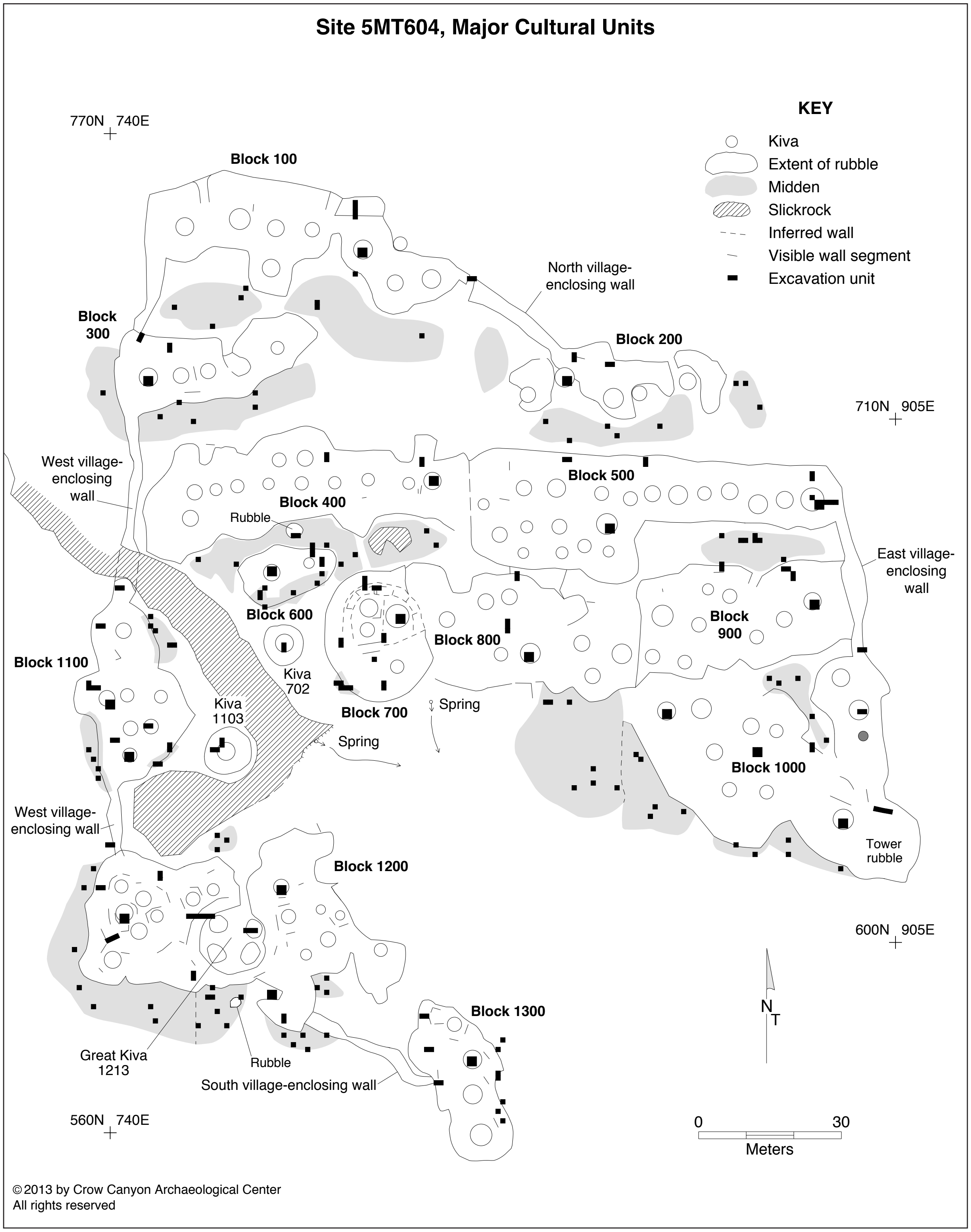

Figure 3. Plan map of Castle Rock Pueblo (courtesy Crow Canyon Archaeological Center).

times for successful crops. Pueblo families were thus repeatedly forced to seek out, and re-settle within, the current "dry-farming belt" (Petersen 1988), the location and width of which shifted erratically across the northern San Juan through time (Van West and Dean 2000; Wright 2010).

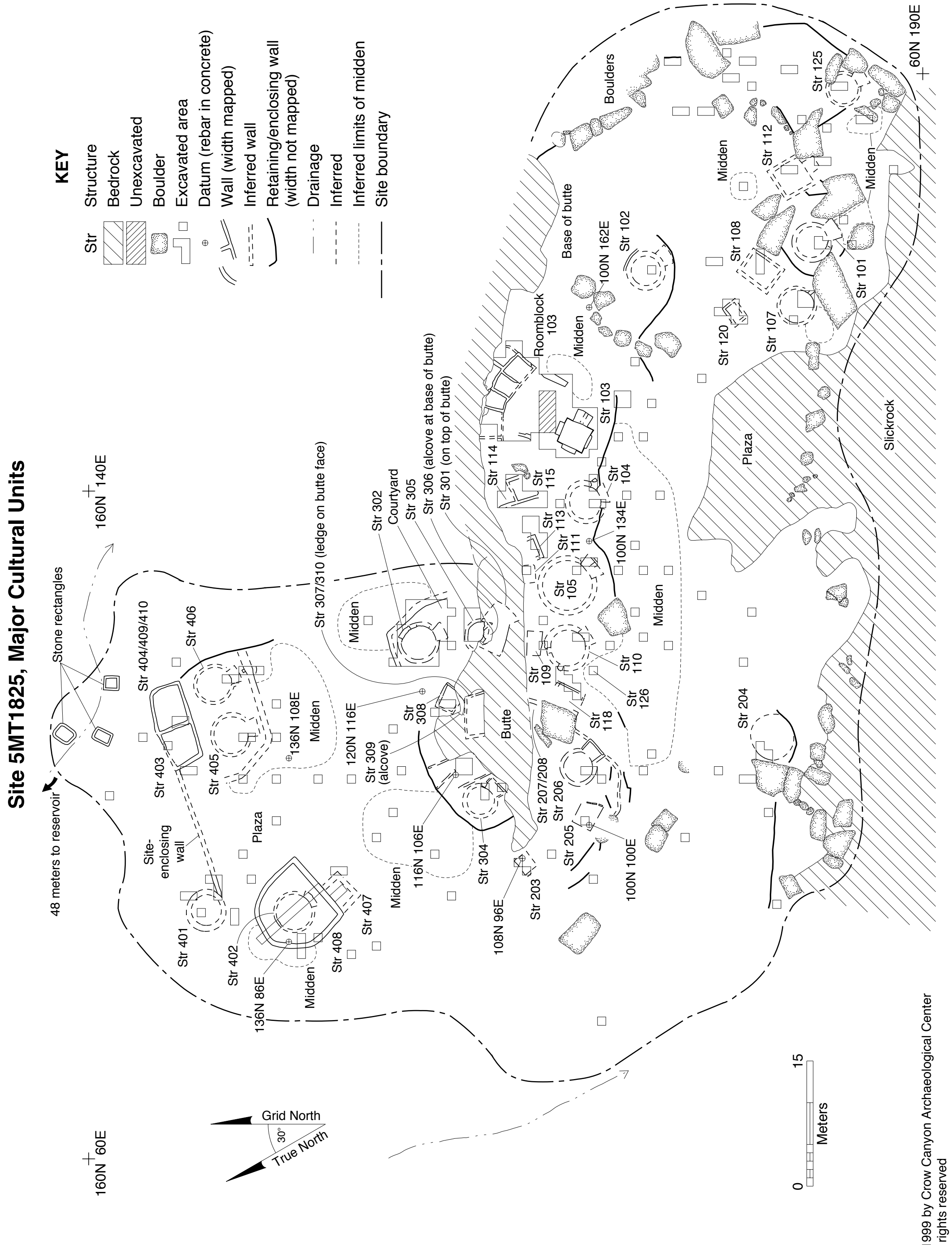

Figure 4. Plan map of Goodman Point Pueblo (courtesy Crow Canyon Archaeological Center).

Figure 5. Three-dimensional reconstruction of Sand Canyon Pueblo superimposed on the actual landscape (reconstruction by Dennis R. Holloway, Architect; aerial photo by Adriel Heisey).

During the dry, cool shift in conditions during the "great drought" (Dean and Van West 2002:Figures 4.1-4.2; Wright 2010:Figure 4.3), which began about A.D. 1276, the farming belt might have been completely eradicated; that is, conditions within the current farming belt became either too dry or too cool for farming, and because conditions were even cooler at higher elevations and even drier at lower elevations, families had nowhere within the region to successfully grow crops. In addition, these environmental conditions coalesced during a time of high population density (Kohler et al. 2007; Varien et al. 2007) in the central portion of the northern San Juan. This "packing" of population reduced opportunities to relocate fields and settlements (Cordell et al. 2007:385-86) and impacted wild plant and animal resources that had already been reduced by over-exploitation and drought. Do the data from our three settlements reveal any societal impacts of this "perfect storm" of conditions?

Acute Subsistence Stress

For a variety of reasons, evidence of subsistence stress and food shortage have historically been problematic to detect in the archeological record. Thus, researching the possibility that families experienced drought-induced famine and the potential ramifications of severe food shortfalls posed significant challenges for researchers in the northern Southwest. Detecting hunger from archeological deposits is difficult, and, as noted by White (1992:363), even death from starvation cannot be reliably identified on human remains. Contributing to this research difficulty in the northern Southwest, until recently, was the lack of robust assemblages of food remains that could be firmly dated to the period in question—the late A.D. 1200s—just before final regional depopulation about A.D. 1280. Fortunately, Crow Canyon's excavations at Sand Canyon, Castle Rock, and Goodman Point

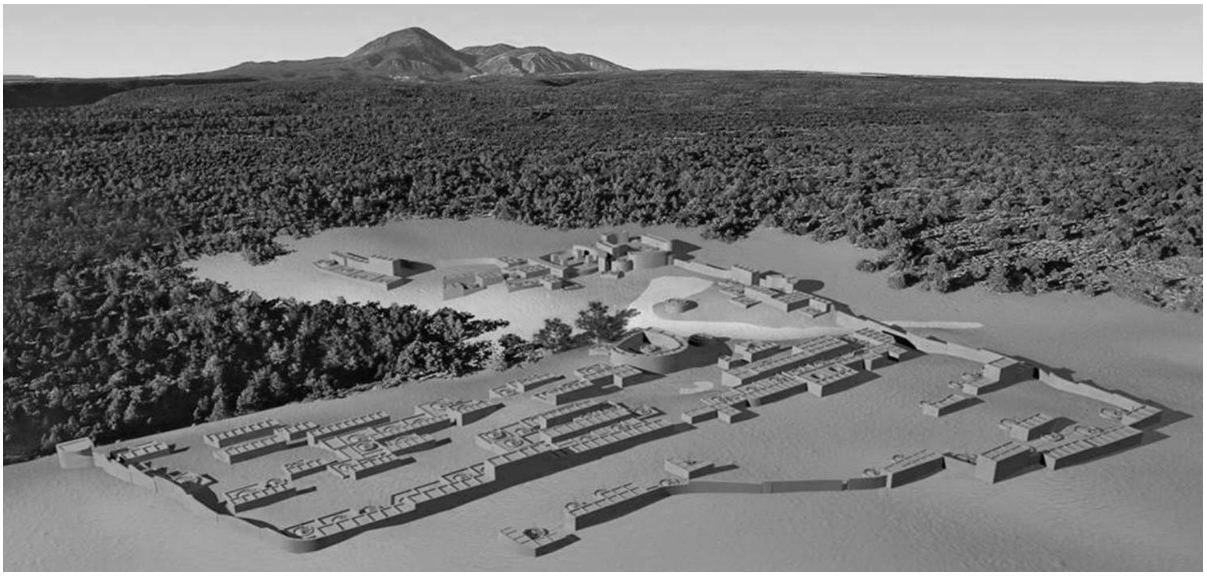

Figure 6. Three-dimensional reconstruction of Goodman Point Pueblo superimposed on the actual landscape (reconstruction by Dennis R. Holloway, Architect; aerial photo by Adriel Heisey).

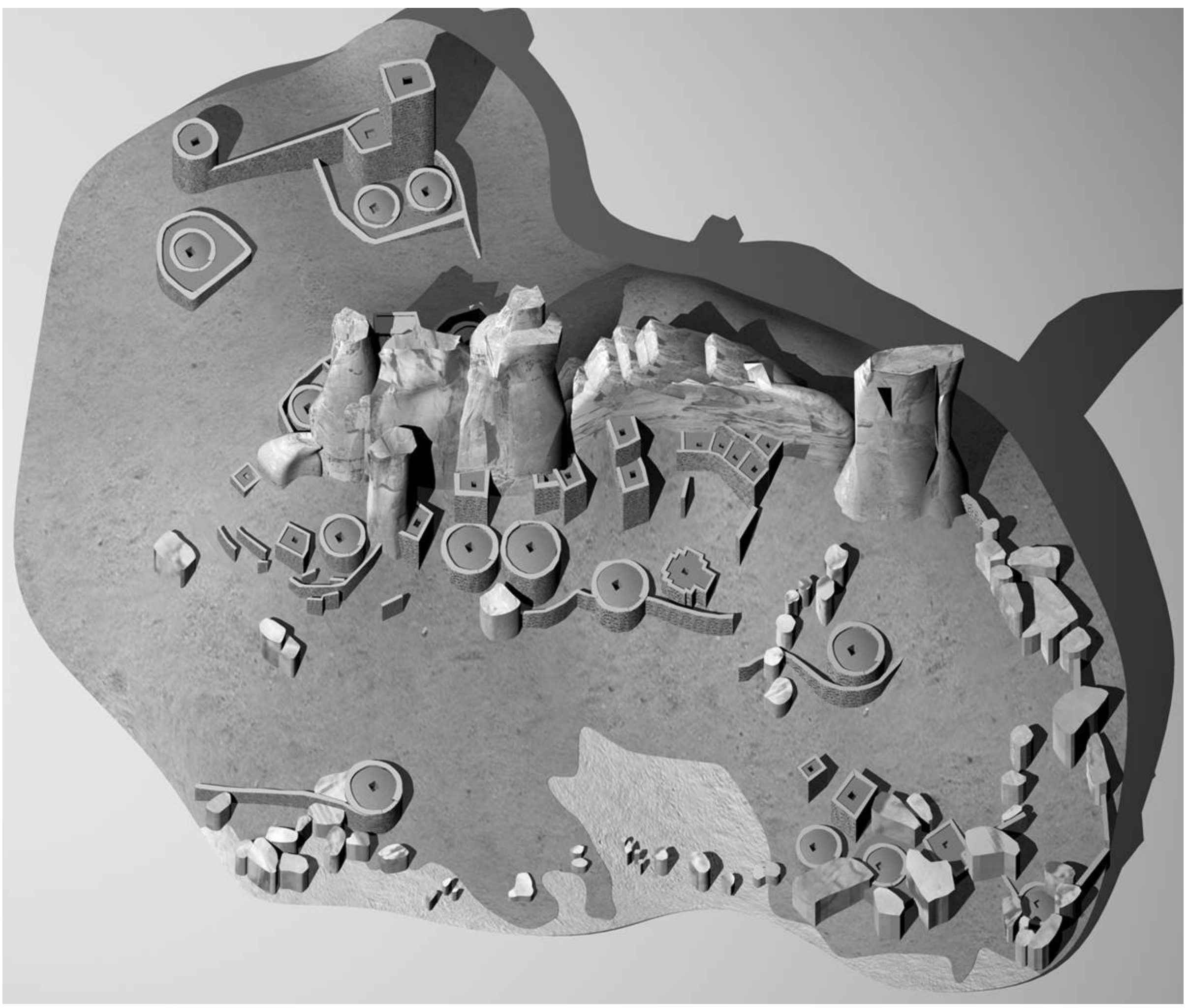

Figure 7. Reconstruction of Castle Rock Pueblo (Computer model by Dennis R. Holloway, courtesy Crow Canyon Archaeological Center).

pueblos yielded abundant archeobotanical and faunal remains that reflect dietary practices near the end of regional occupation.

In a series of recent studies, dietary data for these three single-component settlements were examined for evidence of subsistence stress and famine by comparing the food consumed during most of the time the villages were occupied to the food consumed just before the villages were depopulated (Hoffman et al. 2010; Kuckelman 2008, 2010a, 2010b). Dietary practices of the residents during most of the occupation are reflected in the contents of middens and other deposits of secondary refuse, whereas evidence of the final meals consumed by the villagers was left on living surfaces and in cooking features. Thus, by comparing food refuse in middens to food refuse left on surfaces and in hearths, we were able to detect not only the typical subsistence practices during the 20 to 30 year occupations of these late Pueblo III villages, but we could detect any divergences from that norm that occurred when decisions were being reached to migrate from the area. What did these studies reveal?

Faunal Data

During most of the time that Sand Canyon, Castle Rock, and Goodman Point pueblos were occupied, domesticated turkey and cottontail rabbit constituted the primary sources of animal protein consumed by the residents. However, the faunal assemblages from these three settlements reveal marked shifts in the consumption of key taxa just before regional depopulation (Hoffman et al. 2010; Kuckelman 2010a, 2010b). Consumption of domesticated turkey, for example, clearly a dietary staple during this period, dropped dramatically just before depopulation. Turkey bones comprise between 39 and 55 percent of all identified specimens in midden assemblages from these sites, but only 9 to 19 percent of the identified specimens from abandonment contexts such as floors, roof falls, and thermal features that were still in use when occupation of these villages ended. That is, the final meals consumed by the residents included much less turkey than was typical for their subsistence system. In contrast, consumption of the meat of wild animals increased just before depopulation. Artiodactyls, mostly mule deer, although considered a key resource, actually contributed relatively little to the diet during any part of the occupations of these villages (Hoffman et al. 2010; Kuckelman 2010a, 2010b), probably as a result of excessive procurement in earlier time periods. Muir (2007:Figure 10) found, in a study of the fauna from Sand Canyon Pueblo, a lower than expected richness (variety) of taxa in midden deposits and a greater than expected richness in other contexts, including primarily abandonment contexts. His findings reflect that villagers were overly dependent on turkey during most of the occupation but that, just before depopulation, dietary practices shifted to include an unusually wide variety of wild taxa.

Considered together, these findings in the faunal record for Sand Canyon, Castle Rock, and Goodman Point pueblos reveal that, just before regional depopulation, consumption of the primary source of animal protein—domesticated turkey—decreased dramatically, and the consumption of wild animals increased. Carbon isotope studies indicate that domesticated turkeys were fed maize (Katzenberg 1995; Rawlings and Driver 2010). The faunal data thus indicate that the villagers relied heavily, too heavily, it seems, on maize-fed turkeys for animal protein until nearly the end of occupation, when they were compelled instead to procure and consume the meat of an atypically wide variety of wild game. Further, these wild animals included taxa that were non-local, were difficult to procure, or were non-preferred, including carnivores.

Archeobotanical Data

Although the vagaries of deposition, preservation, sampling, quantification, and analysis of archeobotanical remains render these remains, in general, difficult to interpret with confidence for this type of study, subsistence shifts also appear to be reflected in the assemblages of midden vs. abandonment contexts of plant foods for Sand Canyon Pueblo. Plant data for Castle Rock Pueblo are not robust enough to split along temporal parameters for comparative purposes, and archeobotanical analyses have not yet been completed for Goodman Point Pueblo. At Sand Canyon Pueblo, remains of domesticated plants (maize, gourd, butternut squash, and beans) were found almost exclusively in middens. The ubiquity of maize kernels in secondary refuse (Adams et al. 2007) and the carbon isotope levels in human remains from the site (Katzenberg 1995, 1999) indicate that the predominant domesticate was maize. However, a low incidence of maize kernels in the fills of hearths and on floors suggests that maize was not being prepared widely just before occupation ended. A coincident increase in the overall diversity of wild plant foods from 54 percent in middens to 80 percent in abandonment contexts was noted in the archeobotanical data (Adams et al. 2007); as with the faunal remains, the wider variety of plant taxa included non-local and non-preferred species. These and other data too numerous to present here indicate that domesticated crops, especially maize, composed the bulk of the diet of the villagers during most of the time the settlement was occupied but that, just before regional depopulation, villagers had less access to domesticates and consumed a wider variety of wild plant foods. Thus, dietary data overall reflect excessive dependence on domesticated turkeys and on crop foods, especially maize, during most of the time these villages were occupied and increased dependence on a wide variety of wild-food resources just before regional depopulation.

WARFARE

"*it is certain that the cliff-builders were deeply involved in war*" stated Gustaf Nordenskiöld in 1881 (Diamond and Olson 1991:38).

Indirect and direct indicators of warfare among ancestral Pueblo peoples of the northern Southwest have been documented historically and archeologically, and the assessment of both types of data is crucial for gaining the most comprehensive understanding of outbreaks of unrest and for placing these phenomena within a wider cultural context. Indirect indicators of violence for the latter half of the thirteenth century include defensible settlement locations, defensive architecture, population aggregation, traditional narratives, warfare imagery, and structural burning. Direct evidence of warfare can be obtained from the remains of residents who perished in their villages as the region was undergoing final depopulation by Pueblo peoples.

Indirect Evidence

Evidence of warfare in the northern Southwest in the form of defensive architecture and in the selection of defensible settlement locations has been noted for more than a century (Birdsall 1891; Chapin 1892; Holmes 1878; Jackson 1876; Morley 1908; Morris 1939:43; Newberry 1876; Nordenskiöld 1979 [1893]). As early as 1859, geologist John S. Newberry, U.S. Army Corps of Engineers, observed the following in regard to the ancestral Pueblo sites in the southwestern corner of Colorado: "All of these [ruins] … are admirably located for defense, and would be easily held by a handful of determined men against any number of assailants armed only with the weapons of…warfare" (Newberry 1876:88). Photographer William Henry Jackson (1876:373), after spending the summers of 1874 through1876 surveying the Four Corners area for the U.S. government as part of the geographical and geological Hayden Survey party, wrote of the cliff dwellings, which were last inhabited just before the region was depopulated: "One little house in particular, at the extremity of this ledge…was especially unique in the daring of its site, filling the mind with amazement at the temerity of the builders and the extremity to which they must have been pushed." And William Henry Holmes (1878:384), geologist and cartographer for the Hayden Survey, inferred the following:

> During seasons of invasion and war, families were probably sent to [cliff-houses] for security, while the warriors defended their property or went forth into battle; and one can readily imagine that when the hour of total defeat came, they served as a last resort for a disheartened and desperate people.

Gustaf Nordenskiöld (1979:58 [1893]), a young Swedish scientist who participated in the excavation of numerous cliff dwellings in 1891 in what later became Mesa Verde National Park, observed, "Here as in so many of the ruins already described, it is evident that defence and fortification of the dwelling were uppermost in the mind of its builders." Also, a naturally narrow access route into Balcony House had been constricted into an easily defended crawlway:

> At the south end of the ruin additional precautions have been taken for the strengthening of its defences. A very narrow cleft, which forms the only means of reaching the south part of the ledge, has been walled up to a height of nearly five metres. The lower part of the wall closing the cleft is pierced by a narrow tunnel… Through this tunnel a man may creep on hands and knees (Nordenskiöld 1979:66–67 [1893]).

Tree-ring dating of wood in the tunnel roof indicates that this feature was constructed about A.D. 1278 (Fiero 1998:34; Parks and Dean 1998:17), two years after onset of the "great drought" and only a few years before the region was completely depopulated. In the early 1900s, Harvard archeologist Sylvanus Morley conducted excavations at the site of the terminal Pueblo III village called Cannonball Ruins and observed the following about its canyon-head location:

> This huddling close to the rim insured impregnability from any attack that might have been directed against the settlement from enemies in the canyon itself, while the watchtower was so placed as to give ample warning of invasion from that side and thus afforded an additional element for safety (Morley1908:597–598).

Such impressions of early explorers and scientists are important historically as observations of educated and knowledgeable individuals who had traveled widely. But has subsequent archeological research corroborated these early impressions and produced additional data of a concern with defense among these final Pueblo occupants of the region? In the past 30 years, Crow Canyon's excavations at Sand Canyon, Castle Rock, and Goodman Point pueblos have yielded additional and compelling evidence that residents of the region in the mid-A.D. 1200s invested a great deal of thought and labor in protecting themselves against attack.

About A.D. 1250, many existing communities of dispersed farmsteads aggregated into villages within canyon alcoves, walled canyon-head pueblos, or into settlements in other defensible locations such as the butte at Castle Rock. Some of these villages incorporated one or more springs, and its residents thereby established proprietary access to these precious permanent water sources. Numerous alcoves were defensible by virtue of their naturally difficult access and impregnability from multiple directions; canyon-rim villages such as Sand Canyon and Goodman Point pueblos were protected by massive masonry enclosing walls that were a minimum of one story tall and contained few and constricted entry features.

Additional defensive features have been documented at Sand Canyon Pueblo (Kuckelman 2010b:499) and at numerous cliff dwellings at Mesa Verde (Fiero 1998:124; Palonka 2009; Street 2001:199) and include parapets, tunnels, sealed doorways, and dividing walls that blocked access between different areas of particular cliff dwellings, and angled loopholes through masonry walls that allowed residents to view specific areas of the landscape outside the village from a concealed vantage point. Three access-restrictive constructions at Balcony House that have been interpreted as defensive, including the aforementioned entryway tunnel, were built in A.D 1278 and 1279 (Fiero 1998:48), just before final regional depopulation.

Many multi-story towers were constructed during this time and possess clearly defensive attributes: some were strategically located around the village perimeter and could be accessed only from the interior of the pueblo (see Figures 5-7). In many cliff dwellings, a tower was constructed at each end of the alcove (Fiero 1998:50), which would have been advantageous defensively. Some towers were connected by tunnel to a nearby kiva; this architectural configuration provided a concealed escape route from a subterranean, residential structure with poor defensible prospects to the most defensible location in the settlement: a multi-story structure whose rooftop could have been perpetually stocked with weapons.

The foregoing data include defensive measures taken in response to the concerns of Pueblo residents of the region about being attacked that began about A.D. 1250 and continued until regional depopulation about 1280. Thus, the appearance of a concern for defense by the final Pueblo occupants of the northern Southwest that was first documented more than 100 years ago has been corroborated by modern archeological investigations and documentation at the sites of settlements constructed and inhabited in the final decades of occupation by Pueblo peoples.

The effects of the "great drought" were not experienced until A.D. 1276. What, then, prompted these defensive precautions as early as the 1250s? Evidence suggests that violence was escalating before the onset of the "great drought" (Kuckelman 2010b; Lambert 1999). Street (2001:198), for example, reports that at Long House, in A.D. 1260 or 1261, partial, disarticulated remains of a total of five individuals were sealed beneath burned roof-fall debris in two kivas. Cattanach (1980:145-146) describes the deliberately violent treatment exercised on the remains of one of these individuals. Although the motivations for an elevated concern with defense and a concomitant increase in violence beginning about A.D. 1250 are not yet clear, they could have been stimulated by a combination of factors: deteriorating environmental conditions including cooling temperatures and a disruption of the long-standing bimodal precipitation pattern (Wright 2010), population packing (Kohler et al. 2007; Varien et al. 2007) into a shrinking farming belt, and increasingly depleted natural resources in areas that had been heavily populated for hundreds of years.

Additional indirect evidence of warfare in the northern Southwest includes a traditional Hopi account of a massacre related by John Moss, who served as guide for the Hayden Survey party during their exploration of southwestern Colorado (Jackson 1876). This narrative, attributed to the butte and to the associated archeological site known today as Castle Rock and Castle Rock Pueblo, respectively, recounted a prolonged attack that caused the deaths of many individuals, ended the occupation of the village, and resulted in the migration of the survivors to new homes on the Hopi mesas of northeastern Arizona. The Hayden Survey party promptly dubbed the site "Battle-Rock" (Jackson 1876:Plate V), and a journalist in the party, Ernest Ingersoll, published the account (*New York Tribune*, November 3, 1874) [1]. The data from Crow Canyon's excavations at the site corroborate many details contained in this narrative.

Imagery can also serve as a reflection of important cultural events and developments among non-literate societies. The various non-portable images created in the northern San Juan region rock art during this time included some figures that appear to reflect social upheaval or warfare. Many panels that depict anthropomorphic figures wielding bows with arrows (Cole 1990:Plate 85; Hurst and Pachak 1989:16; Schaafsma 1971:Figures 32-33 and 121 and Plates 14, 16; 1980:Figure 65) may be hunting scenes, but others (Hurst and Pachak 1989:10) present a more violent aspect. Crotty (2001:65) notes, "Militaristic imagery in Anasazi rock art and kiva murals emerges around the mid A.D. 1200s." Images of shields and shield bearers (Castleton 1979:Figures 7.66-7.67 and 7.75; Crotty 2001:69-71; Schaafsma 1980:171), including those in a kiva at Cliff Palace (Crotty 2001:71 and Figure 4.4), are inferred to reference warfare, because such hide or basketry arrow deflectors would have been used as defensive weapons, and unlike spears, hafted axes, and bows and arrows, would not also have been used for hunting or domestic activities. A panel on the south face of the butte at Castle Rock Pueblo features a shield and weapons, and the scene suggests violent human interaction (Kuckelman 2000b:Figure1). This panel depicts three anthropomorphic figures side by side: the center figure appears to train an arrow cocked in a bow on the left figure, who holds a shield in defense while falling away from the threatening figure. The figure on the right holds a bow with an arrow and faces away from the other figures. This scene might have been created as a record of the fatal attack that ended the occupation of that village or as a reflection of the climate of warfare at that time.

Numerous researchers have recognized the presence of burned structure roofs at the sites of various peoples of the Southwest as evidence of warfare both in ancient times (Irwin-Williams 1980:154; LeBlanc 1998, 1999, 2001:28; Mackey and Green 1979; Morris 1939:42; Oliver 2001; Rice and LeBlanc 2001; Tuggle and Reid 2001:93; Turner and Turner 1999; Wilcox and Haas 1994) and historically (Brew 1949:21; James 1974:26, 63; LeBlanc 1998:Table 7.2; Lomatuway'ma et al. 1993:119, 147, 401; Turner and Turner 1999). Data indicate that portions of many kiva roofs burned at Sand Canyon, Castle Rock, and Goodman Point pueblos, and it is likely that these fires were intentional (Kuckelman 2000c:paragraph 3; Kuckelman et al. 2007:paragraph 28). However, it is not likely that most of this burning occurred during attacks on these villages, because kiva roofs, which were constructed mostly of large timbers and thick layers of sediment, would not have been burned quickly or easily (Glennie 1983; Wilshusen 1986). This fact, along with stratigraphic data for these sites, suggests instead that most burned roofs were methodically set afire by the occupants themselves or by considerate others in order to ritually "close" residences being abandoned in preparation for emigration from the area; the concept of ritual "closing" has been explored by several researchers (e.g. Billman et al. 2000:157; Lightfoot 1993:298; Lipe 1995:157; Wilshusen 1986). Some kivas could thus have been closed before the final attack on the village, and others might have been closed after attackers departed. A few exceptions include Kiva 501 at Sand Canyon Pueblo (Kuckelman 2010b:515) and Kiva 101 at Castle Rock Pueblo (Crow Canyon 2001; Kuckelman et al. 2002:494): the roofs of both of these kivas had been burned, and human remains in roof-fall debris and on the floor, respectively, were thermally altered, suggesting that the burning was not a considerate act. In addition, Street

(2001:198-199) inferred that structural burning was associated with a village-wide violent event at the cliff dwelling called Long House.

Direct Evidence

The foregoing data are indirect indicators of violence and warfare. Do any data confirm that warfare actually occurred in the late A.D. 1200s in the northern San Juan region, and that violence played a role in the permanent depopulation of the region by Pueblo peoples? The most direct evidence of violence and warfare in the northern San Juan is contained in the human remains record. These types of data hold special significance; Walker (1997:146) observes that human remains "provide a direct source of evidence regarding patterns of violence in both prehistoric and historically documented societies." Because these data are "free from cultural bias…human remains are extremely valuable sources of evidence for reconstructing what actually happened in the past" (Walker 2008:14-15). Physical remains thus provide an objective and therefore crucially important perspective that constitutes a powerful weapon against individuals of any time or place who would rewrite the past into whatever narrative suits their purposes (Walker 2008:14).

Published observations by early relic hunters in the Mesa Verde cliff dwellings provide unique information regarding the Pueblo depopulation of the region. The latest deposits at these sites were the best preserved record anywhere in the region of the final months, weeks, and even hours of occupation, but were also, unfortunately, the first materials to be disturbed, churned, and depleted by relic enthusiasts in the late 1800s. For example, during an official 1910 excavation of Balcony House, for example, Edward Moore Nusbaum (1910:4) lamented, "the building has been gutted by the Wetherill boys years ago and they left almost nothing." And his son, Jesse Nusbaum (1998:102 [ca. 1910]), stated, "It seems that Balcony House was thoroughly excavated long before our work began… A very small amount of material was found by us, and no trace can be gained of the collections that have been reported as excavated at Balcony House in former years."

Thus, many human remains were discarded, lost, sold to collectors or historical societies, or removed from this country (Diamond and Olson 1991; McNitt 1966; Nordenskiöld 1979 [1893]). The emphasis, at that time, on complete, undamaged specimens worthy of museum display resulted in many human remains found in cliff dwellings being considered "not worth saving" (Nordenskiöld 1979:45, 47 [1893]), even though damaged or incomplete remains on or near the ground surface might well have been the remains of individuals who died as a result of enemy attack. For example, three skeletons were observed in the rubble during the earliest recorded visit of Cliff Palace (McNitt 1966:25); warfare is one of the few types of events or circumstances that would have resulted in three bodies being left on the prehistoric ground surface when occupation of a settlement ended. At Long House, Nordenskiöld (1979:29 [1893]) noted "ribs, vertebrae, etc." strewn about the ruin. On a kiva floor in Ruin 16 were found the remains of a man, partly within the ventilator tunnel, who had "fallen in defence of his hearth and home" (Nordenskiöld 1979:35 [1893]). John Wetherill reported finding five desiccated bodies, all with fractured skulls, on a kiva floor in a cliff dwelling that Earl Morris (1939:42) later dubbed Ruin 6 (see Figure 1). At Spruce Tree House, Fewkes (1909:24) observed: "In clearing the kivas several fragments of human bones and skulls were found by the author. The horizontal passageways, called ventilators, of four of the kivas furnished a single broken skull each, which had not been buried with care." Nordenskiöld's overall impression was that:

> The people of the Mesa Verde finally succumbed to their enemies. The memory of their last struggles is preserved by the numerous human bones found in many places, strewn among the ruined cliff-dwellings. These human remains occur in situations where it is impossible to assume that they have been interred (1979:170 [1893]).

In addition to violent deaths, Fewkes (1911:39-40) described remnants of possible anthropophagous events by stating that calcined human remains were associated with cliff dwellings. Burned and fragmented human remains were reported from a refuse area at the back of Cliff Palace (Fewkes 1909:17; McNitt 1966:41). Fewkes (1911:39) suggested that these charred and fragmentary human remains might have resulted from cremation, although he recognized that Pueblo Indians have no history of cremating their dead.

The foregoing, first-published observations and descriptions of human remains in Mesa Verde cliff dwellings form an important record. It is likely that the remains that were on or near the ground surface at many of these sites held vital information, most of which is now irretrievably lost, regarding violent events associated with the final depopulation of the region. The common and popular belief in the late 1800s that warfare events occurred in the cliff dwellings and played a role in the thirteenth century depopulation of the northern Southwest eventually faded, in the estimation of many archeologists, into "just a theory."

By the early 1990s, the state of knowledge changed abruptly as a result of Crow Canyon's excavations at Castle Rock and Sand Canyon pueblos. These villages, occupied during the final decades of regional occupation, not only revealed a concern for defense in the selection of defensible locations and the construction of defensive architecture, but also yielded multiple types of data in the human remains record that indicate that violence erupted into widespread and lethal warfare in the final years of regional occupation by Pueblo peoples. Later research at Goodman Point Pueblo yielded similar findings. What does the record of human remains at these sites reveal?

When occupation of these villages ended, many human remains were left in abandonment contexts, and some elements display weathering and carnivore damage. Antemortem and perimortem trauma, especially depression fractures of the cranium, are also common on these remains, as are many anthropogenic modifications that reflect a wide variety of violent actions, including trophy taking and anthropophagy. The human remains data for these three sites provide a unique contribution to our understanding of violence in this region in the late A.D. 1200s.

More specifically, at Sand Canyon, Castle Rock, and Goodman Point pueblos, most of the human remains encountered during excavations were located in abandonment contexts; that is, rather than being formally interred, the remains had been left on structure floors, rooftops, or other extramural surfaces, and the deposition of the remains was simultaneous with the end of village occupation. The remains were those of men, women, and children, and were either in articulated but sprawled positions or were disarticulated. Some remains exhibit antemortem trauma, most of which consist of healed or healing depression fractures of the cranium but also include at least one broken nose and a severely infected wound to a tibia (Kuckelman 2010b; Kuckelman et al. 2002). The presence of these lesions indicates that residents of multiple large villages survived one or more non-lethal physical assaults.

More abundant are indicators of lethal-level perimortem trauma that in all likelihood caused death. Most such trauma consisted of depression fractures of the cranium resulting from blunt force trauma that had probably been inflicted by stone axes hafted onto wood handles. Additional anthropogenic modifications include cut marks, chop marks, reaming, spiral fractures, crushing, end polish, thermal alteration, and numerous other modifications (Kuckelman 2012) indicative of scalping and other trophy-taking as well as anthropophagy (Kuckelman 2010b). Evidence of scalping was noted on numerous crania at Sand Canyon and Castle Rock pueblos. This type of trophy taking was practiced by historic Pueblo peoples, and such scalps were considered "rain-senders" (Ellis 1979:444-445; Parsons 1929:138, 1939; see also Allen et al. [1985:31-32]). Scalping—and, by association, warfare—could thus have been culturally sanctioned strategies for promoting increased precipitation in times of severe drought.

The foregoing evidence, along with additional data too numerous to present here but that are presented in detail elsewhere (Kuckelman 2010b, 2012; Kuckelman et al. 2002; Kuckelman and Martin 2007), suggest that near the time of complete depopulation of the Mesa Verde region, these villages were attacked, many of the residents of the settlements were killed, and the attacks ended the occupations of those pueblos. The wide spatial distribution of remains left in abandonment contexts at all three sites suggests that violence occurred in most areas of these villages, which indicates that the settlements were still widely populated at the time of attack. It is reasonable to infer, particularly if the evidence of violence from the cliff dwellings is also considered, that the violence experienced in these villages was perpetrated on the residents of many other settlements across the region as well.

CONCLUSIONS

Numerous aspects of the circumstances that prompted the complete and permanent depopulation of the northern Southwest by Pueblo peoples have been revealed as a result of recent excavations at the sites of three terminal-Pueblo III villages: Sand Canyon, Castle Rock, and Goodman Point pueblos. The architectural, tree-ring, subsistence, and bioarcheological data for these sites, supplemented by observations and descriptions of the earliest visitors of European ancestry to Mesa Verde cliff dwellings and by traditional narrative, fixed imagery, and additional environmental and climatic data from related disciplines, are indicative of previously unknown key aspects of regional depopulation. These abundant and various data suggest that, amidst increasing social unrest and physical violence in the mid-A.D. 1200s, previously dispersed communities aggregated to construct defensive villages in canyon settings on or near their water sources. Population density in the central part of the region peaked, and families were heavily dependent on maize and domesticated turkey for sustenance.

The onset of the "great drought" by A.D. 1276 resulted in crop failure and a reduction of wild resources. The size of turkey flocks declined, probably as the availability of maize for feed dwindled. Farmers turned to a largely hunting and gathering subsistence strategy. As competition for sparse wild resources intensified, violence escalated into warfare as a means to raid concealed food stores and engage in anthropophagy. Countless men, women, and children perished, and the occupation of many villages ended. It is likely that other social, political, economic, environmental, and religious factors also played roles in permanent regional depopulation late in the thirteenth century (Ahlstrom et al. 1995; Benson et al. 2006; Cameron 1995; Cameron and Duff 2008; Cordell 1997:365-397; Cordell et al. 2007; Dean et al. 2000; Dean and Van West 2002; Glowacki 2006, 2010; Kohler 2000, 2010; Kohler et al. 2010; Kohler et al. 2008; Larson et al. 1996; Lipe 1995; Lipe and Varien 1999:339-343; Petersen 1994; Salzer 2000; Van West and Dean 2000; Varien et al. 2007; Wright 2006, 2010). Those who survived this grim chapter in Pueblo prehistory fled southward into what are now New Mexico and Arizona, leaving the northern San Juan region permanently devoid of Pueblo peoples.

Who was responsible for the attacks on Sand Canyon, Castle Rock, and Goodman Point pueblos, as well as on many cliff dwellings? The lack of data to suggest the presence of any culture group other than ancestral Pueblo peoples in the region during the late A.D. 1200s suggests internecine warfare (Kuckelman 2010b:520; Linton 1944; Lipe 1995:161-162; Lipe and Varien 1999:341). Additional data support this conclusion: (1) the villages destroyed by attacks included Sand Canyon and Goodman Point pueblos—the two largest, most populous, and most heavily fortified villages in the northern Southwest—and it is unlikely that a travelling band of non-Pueblo warriors could defeat these settlements; (2) no one, such as victorious warriors and their families, settled in the region after the residents were killed or expelled; and (3) no non-Pueblo remains have been identified in the villages that were attacked. In addition, earlier outbreaks of warfare in the northern San Juan region, during droughts in the initial decades of the A.D. 800s and in the mid-A.D. 1100s, left archeological and bioarcheological signatures similar to those documented at the sites of settlements that were attacked in the late 1200s, and the aggressors in those earlier warfare events were almost certainly Pueblo peoples.

No doubt the depopulation of the northern San Juan region by Pueblo peoples in the late thirteenth century was much more complex than presented here; many additional conditions and circumstances must have also influenced such a major cultural event. However, this application of a wide variety of scientific and historical data toward defining factors that stimulated this depopulation has yielded the most comprehensive picture yet attained of an enigmatic and pivotal juncture in prehistory, when the geographical and cultural landscape of Pueblo peoples changed forever.

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ENDNOTE

1. The full text of Ingersoll's article, as presented by Jackson (1876:380), can be accessed in its entirety online (Kuckelman 2000a).

REFERENCES CITED

Adams, K. R., K. A. Kuckelman, and V. E. Bowyer
2007 Archaeobotanical Remains. In *The Archaeology of Sand Canyon Pueblo: Intensive Excavations at a Late-Thirteenth-Century Village in Southwestern Colorado* [HTML Title], edited by Kristin A. Kuckelman. Available: http://www.crowcanyon.org/sandcanyon. Date of use: 30 October 2013.

Adams, K. R. and K. L. Petersen
1999 Environment. In *Colorado Prehistory: A Context for the Southern Colorado River Basin,* edited by W. D. Lipe, M. D. Varien, and R. R. Wilshusen, pp. 14-50. Colorado Council of Professional Archaeologists, Denver.

Ahlstrom, R. V. N., C. R. Van West, and J. S. Dean
1995 Environmental and Chronological Factors in the Mesa Verde-Northern Rio Grande Migration. *Journal of Anthropological Archaeology* 14:125-142.

Allen, W. H., C. F. Merbs, and W. H. Birkby
1985 Evidence for Prehistoric Scalping at Nuvakwewtaqa (Chavez Pass) and Grasshopper Ruin, Arizona. In *Health and Disease in the Prehistoric Southwest*, edited by C. F. Merbs and R. J. Miller, pp. 23-42. Anthropological Research Papers No. 34. Arizona State University, Tempe.

Benson, L., K. Petersen, and J. Stein
2006 Anasazi (Pre-Columbian Native-American) Migrations during the Middle-12th and Late-13th Centuries—Were They Drought-Induced? *Climatic Change* DOI:10.1007/s10584-006-9065-y.

Berry, M. S. and L. V. Benson
2010 Tree-Ring Dates and Demographic Change in the Southern Colorado Plateau and Rio Grande Regions. In *Leaving Mesa Verde: Peril and Change in the Thirteenth-Century Southwest,* edited by T. A. Kohler, M. D. Varien, and A. M. Wright, pp. 53-74. University of Arizona Press, Tucson.

Billman, B. R., P. M. Lambert, and B. L. Leonard
2000 Cannibalism, Warfare, and Drought in the Mesa Verde Region During the Twelfth Century A.D. *American Antiquity* 65:145-178.

Birdsall, W. R.
1891 The Cliff Dwellings of the Cañons of the Mesa Verde, *Journal of the American Geographical Society of New York* (23):584-620.

Brew, J. O.
1949 The History of Awatovi. In *Franciscan Awatovi: The Excavation and Conjectural Reconstruction of a 17th-Century Spanish Mission Establishment at a Hopi Indian Town in Northeastern Arizona,* by R. G. Montgomery, W. Smith, and J. O. Brew, pp. 1-43. Papers of the Peabody Museum of American Archaeology and Ethnology Volume 36. Harvard University, Cambridge, Massachusetts.

Cameron, C. M.
1995 Migration and the Movement of Southwestern Peoples. *Journal of Anthropological Archaeology* 14:104-124.

Cameron, C. M. and A. I. Duff
2008 History and Process in Village Formation: Context and Contrasts from the Northern Southwest. *American Antiquity* 73(1):29-57.

Castleton, K. B.
1979 *Petroglyphs and Pictographs of Utah, Volume 2: The South, Central, West, and Northwest*. Utah Museum of Natural History, Salt Lake City.

Cattanach, G. S., Jr.
1980 *Long House, Mesa Verde National Park, Colorado*. Publications in Archeology No. 7H. National Park Service, Washington, D.C.

Chapin, F. R.
1892 *The Land of the Cliff-Dwellers*. Appalachian Mountain Club. University Press, Cambridge.

Cole, S. J.
1990 *Legacy on Stone: Rock Art of the Colorado Plateau and Four Corners Region*. Johnson Books, Boulder, Colorado.

Cordell, L.
1997 *Archaeology of the Southwest*. 2nd Edition. Academic Press, San Diego.

Cordell, L. S., C. R. Van West, J. S. Dean, and D. A. Muenchrath
2007 Mesa Verde Settlement History and Relocation. *Kiva* 72(4):379-405.

Crotty, H. K.
2001 Shields, Shield-Bearers, and Warfare Imagery in Anasazi Art, 1200–1500. In *Deadly Landscapes: Case Studies in Prehistoric Southwestern Warfare,* edited by G. E. Rice and S. A. LeBlanc, pp. 65-83. University of Utah Press, Salt Lake City.

Crow Canyon Archaeological Center
2001 The Castle Rock Pueblo Database [HTML Title]. Available: http://www.crowcanyon.org/castlerockdatabase. Date of use: 8 November 2013.

Dean, J. S., G. J. Gumerman, J. M. Epstein, R. L. Axtell, A. C. Swedlund, M. T. Parker, and S. McCarroll
2000 Understanding Anasazi Culture Change through Agent-Based Modeling. In *Dynamics in Human and Primate Societies: Agent-Based Modeling of Social and Spatial Processes,* edited by T. A. Kohler and G. J. Gumerman, pp. 179-205. Oxford University Press, New York.

Dean, J. S. and C. R. Van West
2002 Environment-Behavior Relationships in Southwestern Colorado. In *Seeking the Center Place: Archaeology and Ancient Communities in the Mesa Verde Region,* edited by M. D. Varien and R. H. Wilshusen, pp. 81-99. University of Utah Press, Salt Lake City.

Diamond, I. L. and D. M. Olson
1991 *Letters of Gustaf Nordenskiöld, Written in the Year 1891 and Articles from the Journals* Ymer *and* Photographic Times. Mesa Verde Museum Association, Mesa Verde National Park, Colorado.

Douglass, A. E.
1929 The Secret of the Southwest Solved by Talkative Tree Rings. *National Geographic* 56(6):737-770.

Ellis, F. H.
1979 Laguna Pueblo. In *Southwest*, edited by A. A. Ortiz, pp. 438-449. Handbook of North American Indians, Vol. 9. Smithsonian Institution, Washington, D.C.

Fewkes, J. W.
1909 *Antiquities of the Mesa Verde National Park: Spruce Tree House*. Bureau of American Ethnology Bulletin No. 41. Smithsonian Institution, Washington, D.C.

1911 *Antiquities of the Mesa Verde National Park: Cliff Palace*. Bureau of American Ethnology Bulletin No. 51. Smithsonian Institution, Washington, D.C.

Fiero, K.
1998 *Balcony House: A History of a Cliff Dwelling, Mesa Verde National Park, Colorado*. Mesa Verde Museum Association, Mesa Verde National Park, Colorado.

Glennie, G. D.
1983 Replication of an A.D. 800 Anasazi Pithouse in Southwestern Colorado. Master's thesis, Department of Anthropology, Washington State University, Pullman.

Glowacki, D. M.
2006 The Social Landscape of Depopulation: The Northern San Juan, A.D. 1150–1300. Ph.D. dissertation, Department of Anthropology, Arizona State University, Tempe.

2010 The Social and Cultural Contexts of the Thirteenth-Century Migrations from the Central Mesa Verde Region. In *Time of Peril, Time of Change: Explaining Thirteenth-Century Pueblo Migration,* edited by T. A. Kohler, M. D. Varien, and A. M. Wright, pp. 200-221. University of Arizona Press, Tucson.

Hoffman, A., K. Kuckelman, L. Nagaoka, and S. Wolverton
2010 Dietary Uses of Animal Resources Prior to the Pueblo III Depopulation of the Mesa Verde Region. Poster presented at the 75th Annual Meeting of the Society for American Archaeology, St. Louis.

Holmes, W. H.
1878 Report on the Ancient Ruins of Southwestern Colorado, Examined During the Summers of 1875 and 1876. In *Tenth Annual Report of the U.S. Geological and Geographical Survey of the Territories for 1876*, pp. 382-408. Geological Survey, Washington, D.C.

Hurst, W. B. and J. Pachak
1989 *Spirit Windows: Native American Rock Art of Southeastern Utah*. Spirit Windows Project, Blanding, Utah.

Irwin-Williams, C.
1980 Investigations at Salmon Ruin: Methodology and Overview. In *Investigations at the Salmon Site: The Structure of Chacoan Society in the Northern Southwest,* Vol. 1, part 2, edited by C. Irwin-Williams and P. H. Shelley, pp. 105-167. Eastern New Mexico University, Portales.

Jackson, W. H.
1876 Ancient Ruins in Southwestern Colorado. In *Annual Report of the United States Geological and Geographical Survey of the Territories, Embracing Colorado and Parts of Adjacent Territories, Being a Report of Progress of the Exploration for the Year 1874*, authored by F. V. Hayden, pp. 367-381. Government Printing Office, Washington, D.C.

James, H. C.
1974 *Pages from Hopi History*. University of Arizona Press, Tucson.

Katzenberg, M. A.
1995 Report on Bone Chemistry Studies from the Sand Canyon Locality. Manuscript on file, Crow Canyon Archaeological Center, Cortez, Colorado.

1999 Human Skeletal Remains. In *The Sand Canyon Archaeological Project: Site Testing,* edited by M. D. Varien, Chapter 19. Available: http://www.crowcanyon.org/sitetesting. Date of use: 30 October 2013.

Kohler, T. A.
2000 The Final 400 Years of Prehispanic Agricultural Society in the Mesa Verde Region. *Kiva* 66:191-204.

2010 A New Paleoproductivity Reconstruction for Southwestern Colorado, and its Implications for Understanding Thirteenth-Century Depopulation. In *Leaving Mesa Verde: Peril and Change in the Thirteenth Century Southwest,* edited by T. A. Kohler, M. D. Varien, and A. M. Wright, pp. 102-127. University of Arizona Press, Tucson.

Kohler, T. A., C. D. Johnson, M. Varien, S. Ortman, R. Reynolds, Z. Kobti, J. Cowan, K. Kolm, S. Smith, and L. Yap
2007 Settlement Ecodynamics in the Prehispanic Central Mesa Verde Region. In *The Model-Based Archaeology of Socionatural Systems,* edited by T. A. Kohler and S. E. van der Leeuw, pp. 61-104. School for Advanced Research Press, Santa Fe.

Kohler, T. A., M. D. Varien, and A. M. Wright (editors)
2010 *Leaving Mesa Verde: Peril and Change in the Thirteenth-Century Southwest*. University of Arizona Press, Tucson.

Kohler, T. A., M. D. Varien, A. M. Wright, and K. A. Kuckelman
2008 Mesa Verde Migrations: New Archaeological Research and Computer Simulation Suggest why Ancestral Puebloans Deserted the Northern Southwest United States. *American Scientist* 96:146-153.

Kuckelman, K. A.
2000a Oral History. In *The Archaeology of Castle Rock Pueblo: A Thirteenth-Century Village in Southwestern Colorado* [HTML Title], edited by K. A. Kuckelman. Available: *http://www.crowcanyon.org/castlerock*. Date of use: 4 November 2013.

2000b Rock Art. In *The Archaeology of Castle Rock Pueblo: A Thirteenth-Century Village in Southwestern Colorado* [HTML Title], edited by K. A. Kuckelman. Available: http://www.crowcanyon.org/castlerock. Date of use: 7 November 2013.

2000c The Final Days of Castle Rock Pueblo. In *The Archaeology of Castle Rock Pueblo: A Thirteenth-Century Village in Southwestern Colorado* [HTML Title], edited by K. A. Kuckelman. Available: http://www.crowcanyon.org/castlerock. Date of use: 7 November 2013.

2008 An Agent-Centered Case Study of the Depopulation of Sand Canyon Pueblo. In *The Social Construction of Communities: Agency, Structure, and Identity in the Prehispanic Southwest,* edited by M. D. Varien and J. M. Potter, pp. 109-121. AltaMira Press, New York.

2010a Catalysts of the Thirteenth-Century Depopulation of Sand Canyon Pueblo and the Central Mesa Verde Region. In *Leaving Mesa Verde: Peril and Change in the Thirteenth-Century Southwest,* edited by T. A. Kohler, M. D. Varien, and A. M. Wright, pp. 180-199. University of Arizona Press, Tucson.

2010b The Depopulation of Sand Canyon Pueblo, a Large Ancestral Pueblo Village in Southwestern Colorado. *American Antiquity* 75(3):497-525.

2012 Bioarchaeological Signatures of Strife in Terminal Pueblo III Settlements in the Northern San Juan. In *The Bioarchaeology of Violence*, edited by D. L. Martin, R. P. Harrod, and V. R. Pérez, pp. 121-138. University Press of Florida, Gainesville.

Kuckelman, K. A., B. A. Bradley, M. J. Churchill, and J. H. Kleidon
2007 A Descriptive and Interpretive Summary of Excavation, by Architectural Block. In *The Archaeology of Sand Canyon Pueblo: Intensive Excavations at a Late-Thirteenth-Century Village in Southwestern Colorado* [HTML Title], edited by K. A. Kuckelman. Available: *http://www.crowcanyon.org/sandcanyon*. Date of use: 8 November 2013.

Kuckelman, K. A., R. R. Lightfoot, and D. L. Martin
2002 The Bioarchaeology and Taphonomy of Violence at Castle Rock and Sand Canyon Pueblos, Southwestern Colorado. *American Antiquity* 67(3):486-513.

Kuckelman, K. A. and D. L. Martin
2007 Human Skeletal Remains. In *The Archaeology of Sand Canyon Pueblo: Intensive Excavations at a Late-Thirteenth-Century Village in Southwestern Colorado* [HTML Title], edited by K. A. Kuckelman. Available: *http://www.crowcanyon.org/sandcanyon*. Date of use: 13 November 2013.

Lambert, P. M.
1999 Human Skeletal Remains. In *The Puebloan Occupation of the Ute Mountain Piedmont,* vol. 5: *Environmental and Bioarchaeological Studies,* edited by B. R. Billman, pp. 111-161. Soil Systems Publications in Archaeology No. 22. Soil Systems, Phoenix.

Larson, D. O., H. Neff, D. A. Graybill, J. Michaelsen, and E. Ambos
1996 Risk, Climatic Variability, and the Study of Southwestern Prehistory: An Evolutionary Perspective. *American Antiquity* 6(2):217-241.

LeBlanc, S. A.
1998 Settlement Consequences of Warfare during the Late Pueblo III and Pueblo IV Periods. In *Migration and Reorganization: The Pueblo IV Period in the American Southwest,* edited by K. A. Spielmann, pp. 115-135. Anthropological Papers No. 51. Arizona State University, Tempe.

1999 *Prehistoric Warfare in the American Southwest*. University of Utah Press, Salt Lake City.

2001 Warfare and Aggregation in the El Morro Valley, New Mexico. In *Deadly Landscapes: Case Studies in Prehistoric Southwestern Warfare,* edited by G. E. Rice and S. A. LeBlanc, pp. 19-49. University of Utah Press, Salt Lake City.

Lightfoot, R. R.
1993 Synthesis. In *The Duckfoot Site, Volume 1: Descriptive Archaeology*, edited by R. R. Lightfoot and M. C. Etzkorn, pp. 297-302. Occasional Papers No. 3. Crow Canyon Archaeological Center, Cortez, Colorado.

Linton, R.
1944 Nomad Raids and Fortified Pueblos. *American Antiquity* 10:28-32.

Lipe, W. D.
1995 The Depopulation of the Northern San Juan: Conditions in the Turbulent 1200s. *Journal of Anthropological Archaeology* 14:143-169.

Lipe, W. D. and M. D. Varien
1999 Pueblo III (A.D. 1150–1300). In *Colorado Prehistory: A Context for the Southern Colorado River Basin*, edited by W. D. Lipe, M. D. Varien, and R. H. Wilshusen, pp. 290–352. Colorado Council of Professional Archaeologists, Denver.

Lomatuway'ma, M., L. Lomatuway'ma, and S. Namingha, Jr.
1993 *Hopi Ruin Legends: Kiqötutuwutsi,* edited by E. Malotki. University of Nebraska Press, Lincoln.

Mackey, J. and R. C. Green
1979 Largo Gallina Towers: An Explanation. *American Antiquity* 44:144-154.

McNitt, F.
1966 *Richard Wetherill: Anasazi*. University of New Mexico Press, Albuquerque.

Morley, S. G.
1908 The Excavation of the Cannonball Ruins in Southwestern Colorado. *American Anthropologist* 10:596-610.

Morris, E. H.
1939 *Archaeological Studies in the La Plata District, Southwestern Colorado and Northwestern New Mexico*. Publication No. 519. Carnegie Institution of Washington, Washington, D.C.

Muir, R, J.
2007 Faunal Remains. In *The Archaeology of Sand Canyon Pueblo: Intensive Excavations at a Late-Thirteenth-Century Village in Southwestern Colorado* [HTML Title], edited by K. A. Kuckelman. Available: *http://www.crowcanyon.org/sandcanyon*. Date of use: 18 July 2013.

Newberry, J. S.
1876 *Report of the Exploring Expedition from Santa Fe, New Mexico, to the Junction of the Grand and Green Rivers of the Great Colorado of the West, in 1859, Under the Command of Capt. J. N. Macomb, Corps of Topographical Engineers; with Geological Report*. Government Printing Office, Washington, D.C.

Nordenkiöld, G.
1979 *The Cliff Dwellers of the Mesa Verde, Southwestern Colorado: Their Pottery and Implements*. Translated by D. L. Morgan. Reprinted by Rio Grande Press, Glorieta, New Mexico. Originally published 1893 by P. A. Norstedt and Söner, Stockholm.

Nusbaum, E. M.
1910 Daily Log of Edward Moore Nusbaum while at Balcony House, 1910. In *Balcony House: A History of a Cliff Dwelling, Mesa Verde National Park*, *Colorado*, by K. Fiero, Appendix A. Mesa Verde Museum Association, Mesa Verde National Park, Colorado.

Nusbaum , J. L.
1998 Report on the Repair and Excavation of Balcony House. In *Balcony House: A History of a Cliff Dwelling, Mesa Verde National Park*, *Colorado*, by K. Fiero, pp. 81-104. Written ca. 1910. Mesa Verde Museum Association, Mesa Verde National Park, Colorado.

Oliver, T. J.
2001 Warfare in the Tonto Basin. In *Deadly Landscapes: Case Studies in Prehistoric Southwestern Warfare,* edited by G. E. Rice and S. A. LeBlanc, pp. 195-217. University of Utah Press, Salt Lake City.

Palonka, R.
2009 Defensive Architecture and the Depopulation of the Mesa Verde Region, Utah-Colorado, USA in the XIII Century A.D. Ph.D. dissertation, Institute of Archaeology, Jagiellonian University, Krakow, Poland.

Parks, J. A. and J. S. Dean
1998 Appendix B: Tree Ring Dating of Balcony House: A Chronological, Architectural, and Social Interpretation. In *Balcony House: A History of a Cliff Dwelling, Mesa Verde National Park*, *Colorado*, by K. Fiero. Mesa Verde Museum Association, Mesa Verde National Park, Colorado.

Parsons, E. C.
1929 *The Social Organization of the Tewa of New Mexico*. Memoirs of the American Anthropological Association No. 36. Menasha, Wisconsin.

1939 *Pueblo Indian Religion*. University of Chicago Press, Chicago.

Petersen, K. L.
1988 *Climate and the Dolores River Anasazi: A Paleoenvironmental Reconstruction from a 10,000 Year Pollen Record, La Plata Mountains, Southwestern Colorado*. Anthropological Papers No. 113. University of Utah, Salt Lake City.
1994 A Warm and Wet Little Climatic Optimum and a Cold and Dry Little Ice Age in the Southern Rocky Mountains, U.S.A. *Climatic Change* 26:243-269.

Rawlings, T. A. and J. C. Driver
2010 Paleodiet of Domestic Turkey, Shields Pueblo (5MT3807), Colorado: Isotopic Analysis and its Implications for Care of a Household Domesticate. *Journal of Archaeological Science* 37(10):2433-2441.

Rice, G. E. and S. A. LeBlanc (editors)
2001 *Deadly Landscapes: Case Studies in Prehistoric Southwestern Warfare*. University of Utah Press, Salt Lake City.

Salzer, M. W.
2000 Temperature Variability and the Northern Anasazi: Possible Implications for Regional Abandonment. *Kiva* 65(4):295-318.

Schaafsma, P.
1971 *The Rock Art of Utah: A Study from the Donald Scott Collection, Peabody Museum, Harvard University*. Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge.
1980 *Indian Rock Art of the Southwest*. School of American Research and University of New Mexico Press, Santa Fe and Albuquerque.

Street, D. J.
2001 The Dendrochronology of Long House, an Anasazi Cliff Dwelling in the Mesa Verde National Park, Colorado, U.S.A. Ph.D. thesis, Department of Archaeology and Prehistory, Research School of Archaeology & Archaeological Science, University of Sheffield, United Kingdom.

Tuggle, H. D. and J. J. Reid
2001 Conflict and Defense in the Grasshopper Region of East-Central Arizona. In *Deadly Landscapes: Case Studies in Prehistoric Southwestern Warfare,* edited by G. E. Rice and S. A. LeBlanc, pp. 85-107. University of Utah Press, Salt Lake City.

Turner, C. G., II and J. A. Turner
1999 *Man Corn: Cannibalism and Violence in the Prehistoric American Southwest*. University of Utah Press, Salt Lake City.

Van West, C. R. and J. S. Dean
2000 Environmental Characteristics of the A.D. 900–1300 Period in the Central Mesa Verde Region. *Kiva* 66:19-44.

Varien, M. D., S. G. Ortman, T. A. Kohler, D. M. Glowacki, and C. D. Johnson
2007 Historical Ecology in the Mesa Verde Region: Results from the Village Ecodynamics Project. *American Antiquity* 72(2):273-299.

Walker, P. L.
1997 Wife Beating, Boxing, and Broken Noses: Skeletal Evidence for the Cultural Patterning of Violence. In *Troubled Times: Violence and Warfare in the Past,* edited by D. L. Martin and D. W. Frayer, pp. 145–179. Gordon and Breach Publishers, Amsterdam.
2008 Bioarchaeological Ethics: A Historical Perspective on the Value of Human Remains. In *Biological Anthropology of the Human Skeleton*, edited by M. A. Katzenberg and S. R. Saunders, pp. 3-40. John Wiley & Sons, Inc., Hoboken, New Jersey.

White, T. D.
1992 *Prehistoric Cannibalism at Mancos 5MTUMR-2346*. Princeton University Press, Princeton, New Jersey.

Wilcox, D. R. and J. Haas
1994 The Scream of the Butterfly: Competition and Conflict in the Prehistoric Southwest. In *Themes in Southwest Prehistory*, edited by G. J. Gumerman, pp. 211-238. School of American Research Press, Santa Fe.

Wilshusen, R. H.
1986 The Relationship Between Abandonment Mode and Ritual Use in Pueblo I Anasazi Protokivas. *Journal of Field Archaeology* 13:245-254.

Wright, A. M.
2006 A Low-Frequency Paleoclimatic Reconstruction from the La Plata Mountains, Colorado, and its Implications for Agricultural Paleoproductivity in the Mesa Verde Region. Master's thesis, Department of Anthropology, Washington State University, Pullman.
2010 The Climate of the Depopulation of the Northern Southwest. In *Leaving Mesa Verde: Peril and Change in the Thirteenth-Century Southwest,* edited by T. A. Kohler, M. D. Varien, and A. M. Wright, pp. 75-101. University of Arizona Press, Tucson.

Defining and Using Households in Archeological Analysis

Ricky R. Lightfoot, Richard H. Wilshusen, and Mark D. Varien

ABSTRACT

Since the 1980s many Southwestern archeologists have used the household as the fundamental unit of social analysis. Evidence from architectural patterns and artifact distributions has been used to identify households. Archeologically defined, households have been used to reconstruct economic activity, infer changes in social organization, and estimate population size. Archeologists have used different architectural correlates to define households, but they have not examined how different correlates affect the larger scale social, economic, and demographic problems being addressed. We reevaluate the archeological household definitions and analytical assumptions, with special focus on the Pueblo I period (A.D. 725–900) in the Mesa Verde region of southwestern Colorado.

OUR INTRODUCTION TO ARCHEOLOGY

Together we participated in our first archeological field experiences in Dee Ann Story's 1976 University of Texas field school at the Deshazo site near Nacogdoches, Texas. Three years later our paths converged in the American Southwest when we began working on the massive Dolores Archaeological Program (DAP) in southwestern Colorado and then at the Crow Canyon Archaeological Center (Figure 1). After excavating in the plow- and rodent-disturbed contexts of the Deshazo site in East Texas, digging in the Southwest seemed entirely straightforward. The visibility of the human element amazed us: structures had well-defined walls, burned roof layers were loaded with charred and datable timbers, and the well prepared floors were often littered with whole pots and complete tools. We were inspired by the clarity of the link between the archeological record and the actual human beings who once lived at the site. In some cases it appeared that the ancestral Pueblo Indian residents had simply walked away and left everything in the structures exactly as they had been when the structures were in use—almost exactly the way we found them some 1000 years later. Since our earliest days in the Southwest, we have shared a common interest in understanding the social groups that occupied those early Pueblo houses.

OUR INTRODUCTION TO HOUSEHOLDS

Anthropologists since the 1950s have distinguished between the family as a kinship group and the household as a coresident group that shares in domestic and economic activities (Bender 1967; Fortes 1958; Murdock 1949), but it was not until the 1980s before the distinction made its way into archeologists' thinking (Ashmore and Wilk 1988; Netting et al. 1984; Wilk 1989; Wilk and Ashmore 1988; Wilk and Rathje 1982). Wilshusen (1988a) connected DAP archeologists with the current thinking around "household archeology," which defined a household as "a group of people who shares in a maximum definable number of activities, including one or more of the following: production, consumption, pooling of resources, reproduction, coresidence, and shared ownership" (Ashmore and Wilk 1988:6). This behaviorally based characterization of the household fit well with the DAP's emphasis on defining activity areas and the rigorous focus on spatial and social systematics. A foundational assumption at the DAP was that architectural patterns could be used to define and interpret social organization. For the early Pueblo period that organization was seen as a nested hierarchy of social groups that included households, inter-household groups, and communities (Kane 1983:11-14, 1986:354-359; Lightfoot 1994:13-15; Wilshusen 1988a:640-645)

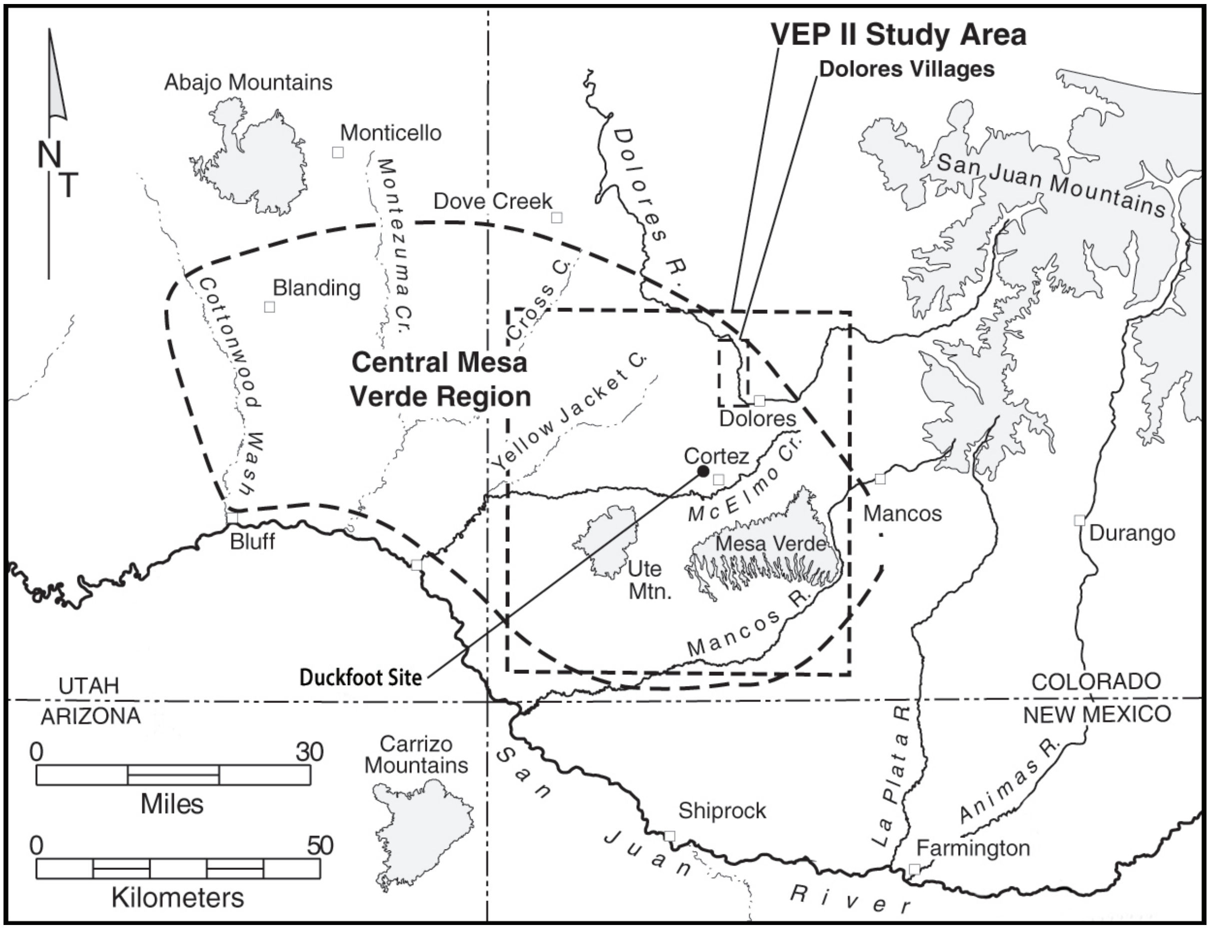

Figure 1. The Four Corners region showing the Central Mesa Verde Region and principal research areas mentioned in text.

In the 1970s at the Deshazo site (Figure 2), we did not talk about households and nested levels of social organization. In those days, we meticulously documented features, and if we were lucky enough to connect post molds to form a complete circle we knew we had a structure. But the words "house" and "household" were almost never used in the two volumes that document the Deshazo site project (Story 1982, 1995). We were far more focused on the history of material culture than we were on the history of social groups.

THE DAP MODEL OF HOUSEHOLD ORGANIZATION

Houses and households were fundamental concepts at the DAP (Kane 1983, 1986). Most of the roughly 1,600 sites in the project area dated between A.D. 650-920, and over most of this period of time there was substantial population growth and inferred changes in social organization. The Mesa Verde region was populated by large numbers of ancestral Pueblo Indian farmers beginning around A.D. 600, and during the period between A.D. 600-720, most of these initial residents lived in scattered settlements that consisted of one or two household compounds, each composed of a single pit structure surrounded by a cluster of isolated storage structures and other extramural features (Brisbin and Varien 1986). Clearly the single pit structure served as the dwelling for a household at these sites.

During the period from A.D. 720 to 880, population grew rapidly (Schlanger 1986) and the architectural and community patterns changed dramatically (Figure 3). Pit structures were excavated much deeper than before, and typically each pit structure was accompanied by a block of contiguous surface rooms consisting of two or more large rooms with domestic features and numerous smaller storage rooms (Wilshusen 1988b). DAP

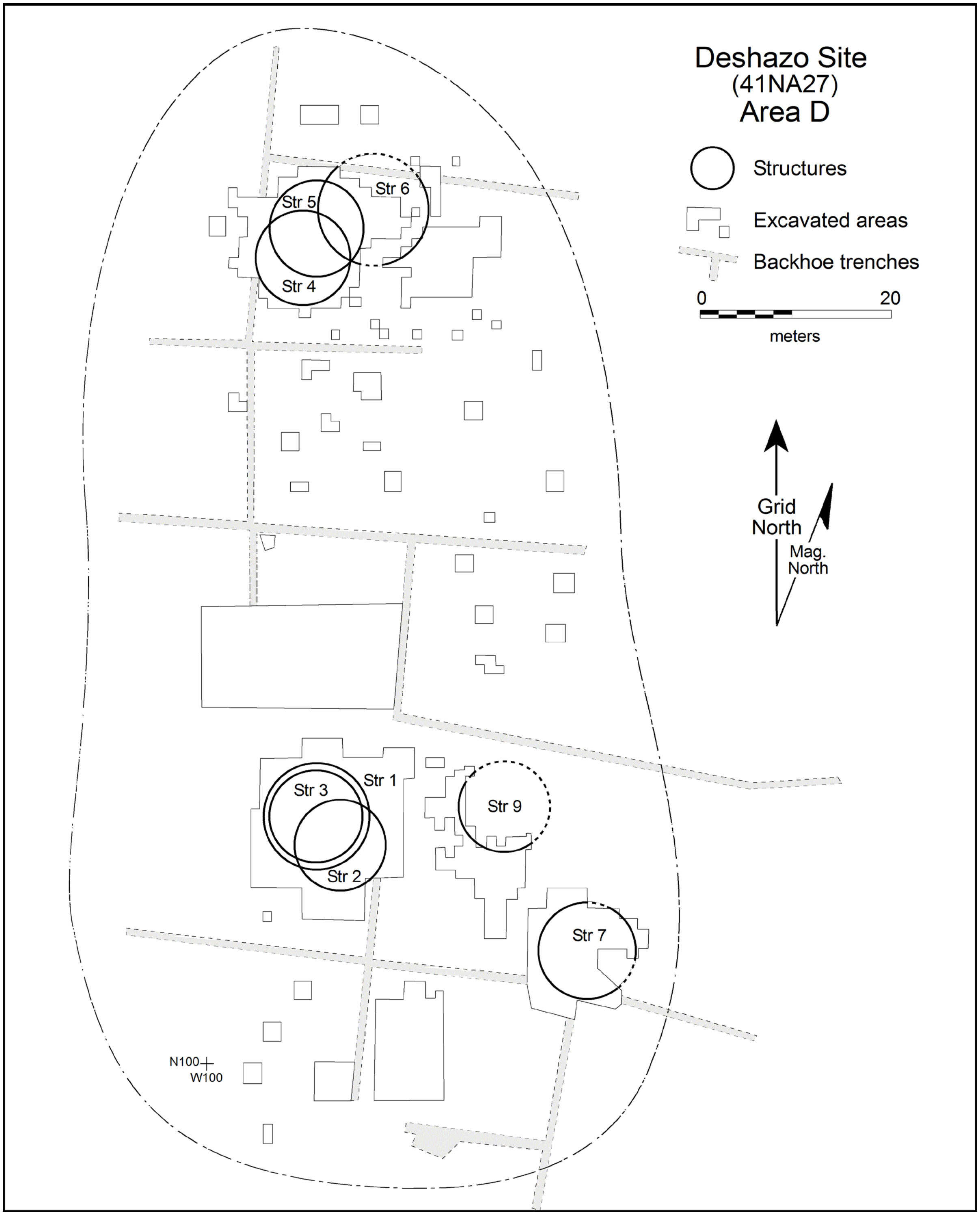

Figure 2. Site plan of the Deshazo site (41NA27), Nacogdoches County, Texas, showing the main cultural units exposed by excavation (adapted from Story 1982:Figure 11).

archeologists interpreted this change in the architectural pattern as representing a shift in household organization. Rather than each pit structure representing the dwelling of a household, a suite of surface rooms consisting of one large domestic room (i.e., a room with the features and sufficient

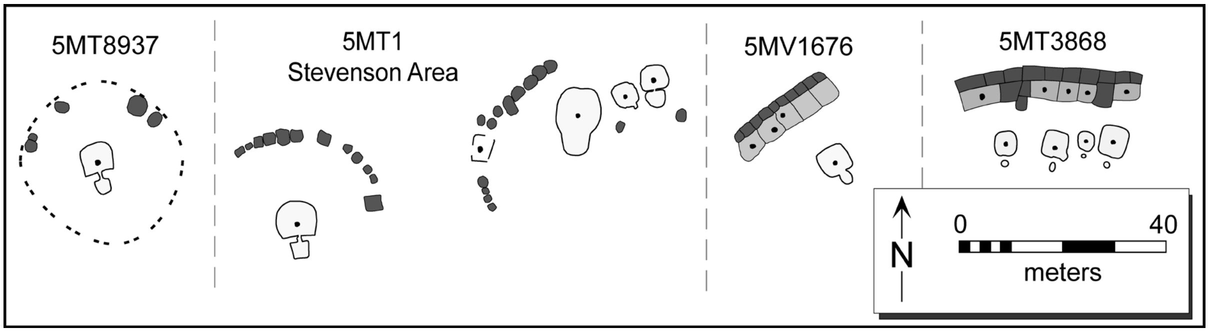

Figure 3. Typical hamlet site plans in the Mesa Verde region showing changes in architecture and site organization, A.D. 650-900. Site plans from left to right are 5MT8937, which dates to the mid-A.D. 600s; 5MT1 (Stevenson Area), which dates to A.D. 675-690; 5MV1676, which dates to A.D. 760-780; and 5MT3868 (Duckfoot site) which dates to A.D. 850-880 (adapted from Wilshusen et al. 2012:Figure 2.5).

space for daily domestic activities such as cooking) and one or more storage rooms was seen as the residence, or dwelling unit, of a household. Following the DAP model for this time period, each pit structure was interpreted as an "inter-household" structure because DAP archeologists inferred that they were shared by multiple households for ritual and domestic activities (Figure 4).

THE DUCKFOOT MODEL OF HOUSEHOLD ORGANIZATION

The DAP architectural model was a logical inference, but the behavioral tests to support it were limited in our investigations at Dolores. After the conclusion of the DAP, the Crow Canyon Archaeological Center conducted intensive excavations at the Duckfoot site, which was located 20 km south of the Dolores River Valley (Lightfoot and Etzkorn 1993). Duckfoot had many structures that burned at the time of their abandonment, which resulted in precise tree-ring dating. There were 375 total tree-ring dates, and 215 of these are cutting dates, which means the exact year that the timber was harvested is known (Lightfoot 1994:28). Seventy percent of the total number of dates cluster between A.D. 850-876; 181 cutting dates, or 84 percent of all cutting dates, occur during this same interval. Based on these dates, Lightfoot (1994:34-36) argued that construction began at Duckfoot at A.D. 850 and the site was occupied less than 30 years and abandoned by 880. Thus, Duckfoot was contemporary with the period of peak population at Dolores, which occurred between A.D. 840-880 (Schlanger 1986:508).

In addition to the precise dating, there was remarkable preservation of floor artifact assemblages, including complete tools made from stone and bone, pottery vessels, and nonutilitarian items such as beads, pendants, bracelets, gaming pieces, and pottery effigies (Lightfoot 1994:57-68). In addition, it appeared that the entire site was depopulated in a very short period of time.

The complete excavation of 20 rooms, four pit structures, extramural areas, and most of the trash midden was used to evaluate the DAP model of household organization (Lightfoot 1994). The analysis of wall construction details confirmed that entire room suites were built in conjunction with each pit structure. Inferred doorway locations showed that there was connectivity between all rooms within room suites associated with each pit structure, but there was no indication of connectivity between architectural suites across the site. Most importantly, floor artifacts and features were used to identify activity areas inside the structures. A complete set of activities was present only when the entire architectural suite—a pit structure and its associated room suite—was considered. The range of activities was complementary within a suite and redundant between architectural suites (Varien and Lightfoot 1989).

Lightfoot (1994:145-162) concluded that the social group that occupied an architectural suite accounted for the construction of the house, the production, storage, and distribution of food, reproduction as represented by ritual activities, and likely the transmission of property. On the basis of these behavioral analyses, it appears that the entire architectural suite is the best correlate of a single household, an interpretation at odds with the DAP model. In contrast to the DAP model, Lightfoot concluded that the individual domestic room suites represented infra-household groups rather than separate households, and that the entire household was comparable to a multigenerational extended family. In essence, the suite of structures interpreted as housing a single household using the Duckfoot model (Figure 5) would have been called an inter-household cluster, inferred as housing two to four households at DAP. Thus, we have two distinctly different models for the architectural correlate of the household in early Mesa Verde region pueblos. It is possible that both models have some applicability in interpreting social organization in early Pueblo settlements, based on the fact that two distinct patterns of village organization emerged in the A.D. 800s.

THE GROWTH OF VILLAGES AND THE RISE OF COMMUNITY CENTERS

Population in the central Mesa Verde region grew modestly between A.D. 720-800, and then more than tripled between A.D. 800-880 (Varien et al. 2007:284). There were at least 14 large villages by about A.D. 825; in many cases these were built around large (up to 380 m^2) communal structures, known as great kivas that probably served as community centers (Wilshusen et al. 2012b). The residential architecture at these villages was largely aggregates of the room suites joined into long, contiguous room blocks and associated rows of pit structures predominantly to the south of the room blocks (Figure 6). Grass Mesa Village (5MT23) and Morris 25 (5LP2164) are both typical of this village pattern, in which a large great kiva (Lightfoot 1988:253; Lightfoot et al. 1988; Wilshusen et al. 2012a:27) is accompanied by several long rows of rooms and pit structures. Villages such as these could have reasonably housed populations of more than 20 households (Lipe et al. 1988).

After A.D. 820, population continued to grow in the Mesa Verde region, and by A.D. 880 the number of villages increased to at least 25 and possibly as many as 40 (Wilshusen et al. 2012a). Villages like Grass Mesa continued to grow, but the

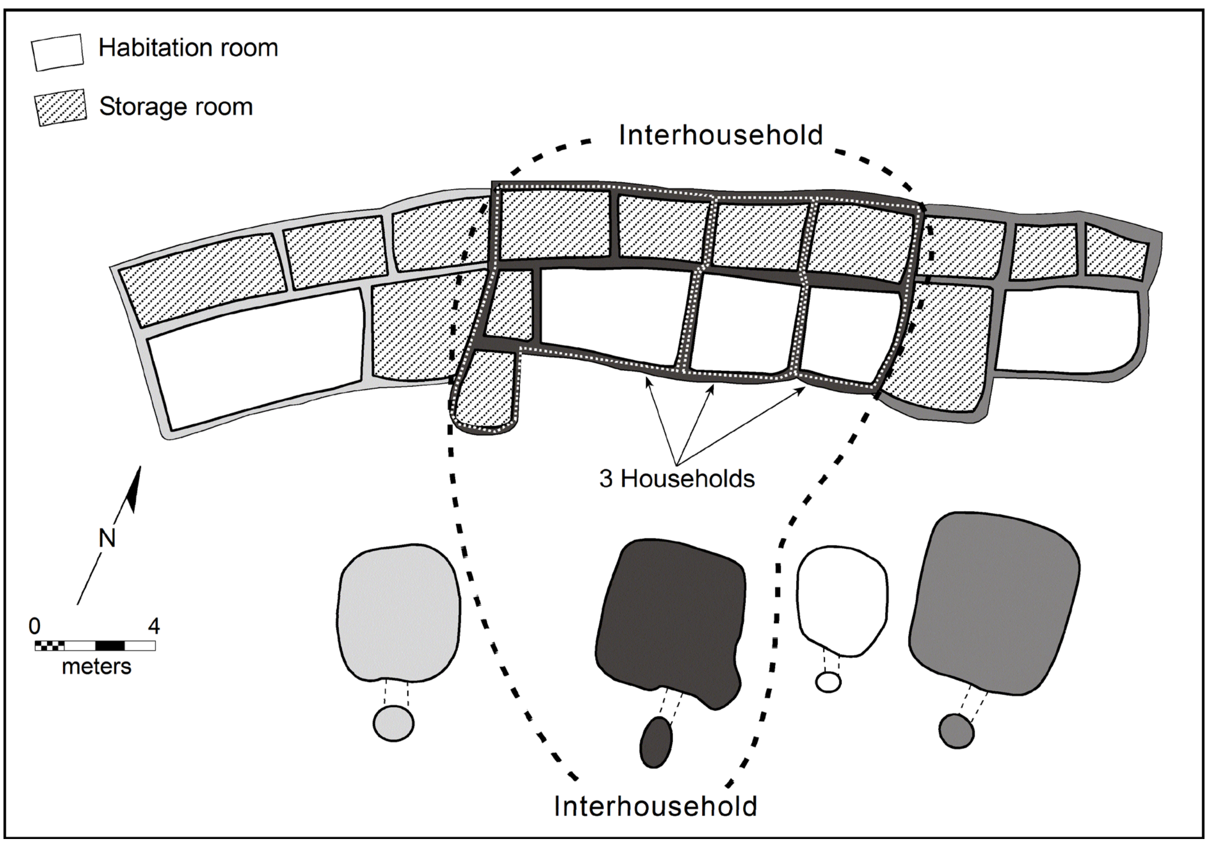

Figure 4. Simplified portrayal of the DAP household model, which identifies the residence of a household as a single room suite, consisting of a habitation room and associated storage rooms (adapted from Kane 1983).

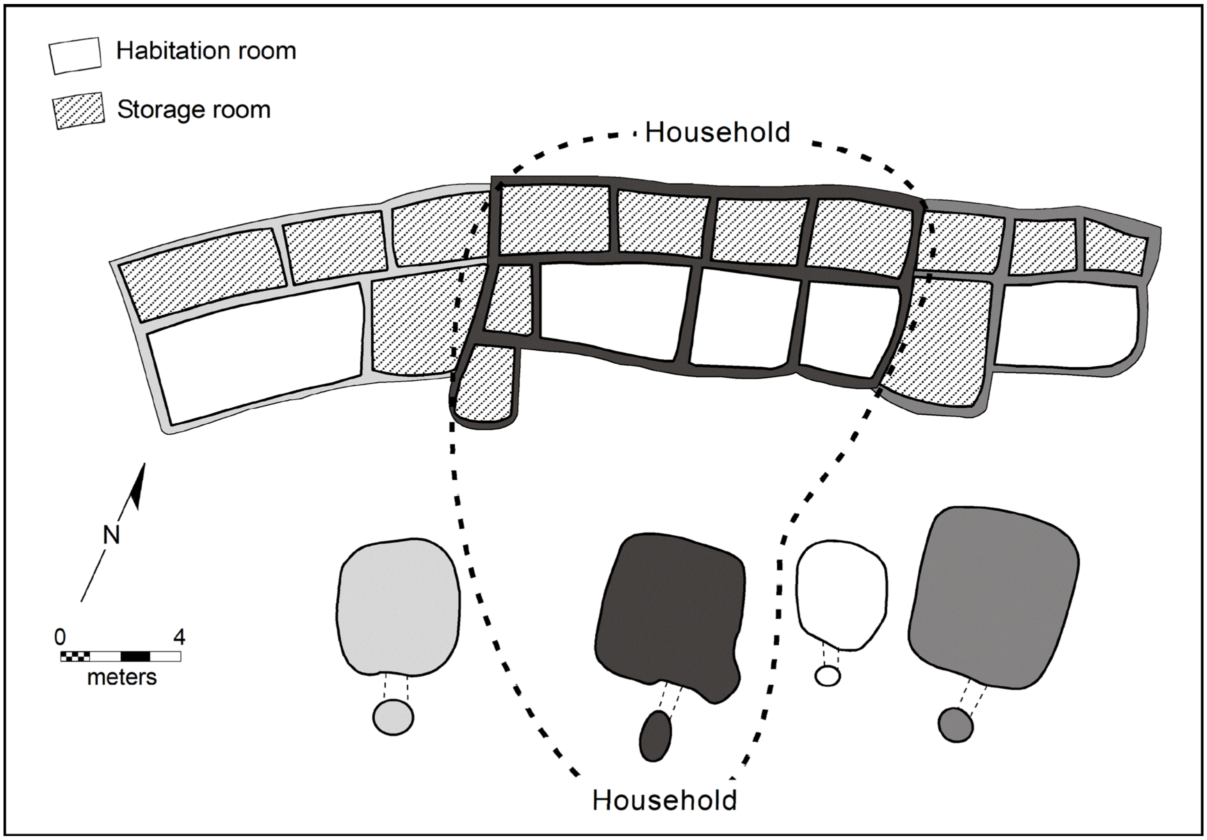

Figure 5. The Duckfoot household model, which identifies the residence of a household as a pit structure and two or more surface room suites, each consisting of a habitation room and associated storage rooms (adapted from Lightfoot 1994).

early great kiva there and great kivas at other early villages fell into disuse by the mid-800s. During the A.D. 840-880 time period, there emerged a second village pattern, as exemplified by McPhee Village, which included one or more large U-shaped room blocks that enclosed plazas into which pit structures were built. Wilshusen and others (Wilshusen and Ortman 1999; Wilshusen et al. 2012a, 2012b; Windes 2004) argue that these U-shaped architectural units were early great houses that served as community centers. Contained within the plazas of these great houses is frequently one oversized pit structure, which was much larger than the typical residential pit structures (e.g., 75 m^2 versus 20 m^2) and contained elaborate ritual features (Wilshusen 1986, 1989). The U-shaped great houses typically have coursed sandstone masonry, which contrasts sharply with the post and adobe walls of the linear room blocks. And, the U-shaped great houses have a substantially larger ratio of rooms to pit structures and a less pronounced spatial association between room suites and pit structures than do the linear room blocks at contemporary villages and hamlets throughout the region. Based on these architectural differences as well as distinctly different patterns in pottery and textiles, Wilshusen and others (Wilshusen and Ortman 1999; Wilshusen et al. 2012b) argue that the population of the Mesa Verde region consisted of at least two and possibly three distinct cultural groups that had different histories and cultural traditions. They further argue that the U-shaped great houses served both as community centers and as the residences of emerging socioreligious elite leaders.

Because the U-shaped great houses are so profoundly different from the otherwise standard layout of the linear room blocks of villages and hamlets, it is not surprising that neither the DAP model nor the Duckfoot model of household organization fit them very well. If the U-shaped great houses are community centers that contain community ritual structures and that also served as elite residences, then they clearly are not organized and used in the same way as the household dwelling units of

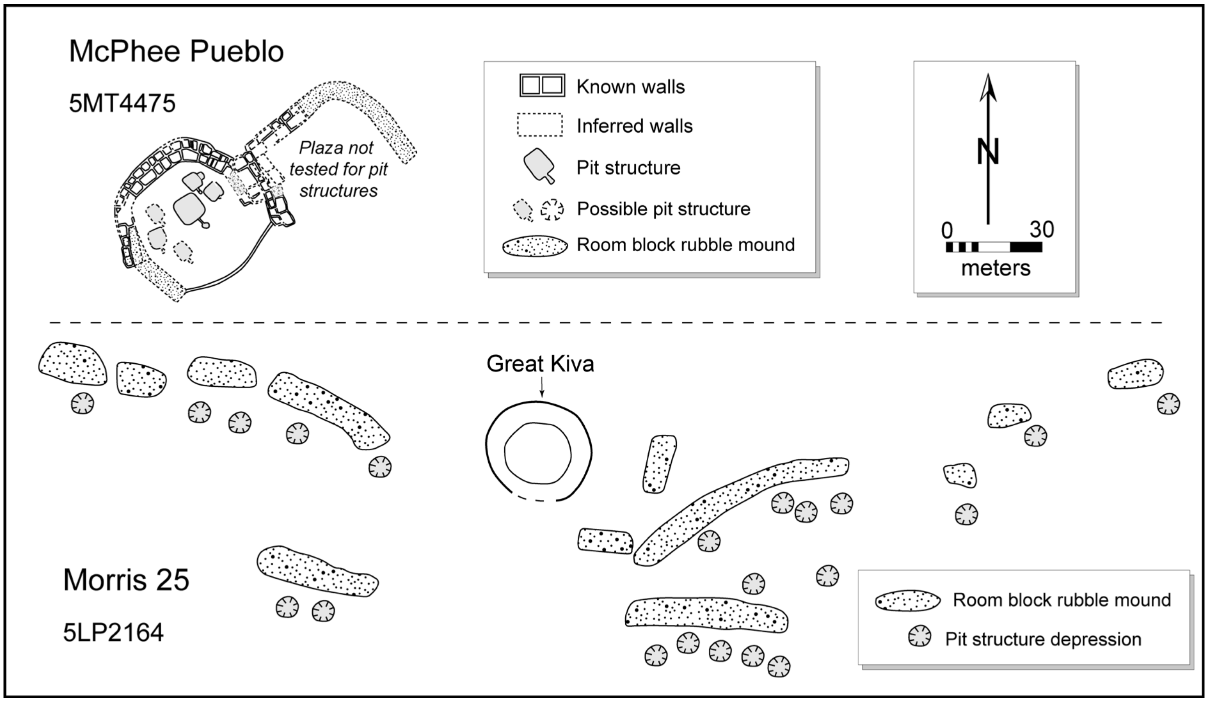

Figure 6. Plan map of two distinct village patterns in the Mesa Verde region: Morris 25 (5LP2164) with linear room blocks, associated pit structures, and a shared great kiva; and McPhee Pueblo (5MT4475) with a U-shaped room block, associated pit structures, and an oversize pit structure in the center of the enclosed plaza (adapted from Wilshusen et al. 2012:Figures 2.6 and 2.7).

the linear room blocks. The higher ratio of rooms to domestic pit structures in the U-shaped great houses probably reflects the elite residents need for and access to a larger number of rooms than a typical household resident. However, domestic pit structures are such an important and consistent component of the household dwelling throughout the eighth and ninth centuries that the number of households living in these U-shaped great houses might be best represented by the number of pit structures rather than by the number of rooms. Thus, the resident population of the U-shaped great houses might be lower than one might expect based on the number of rooms.

USING ARCHITECTURAL CORRELATES OF HOUSEHOLDS TO ESTIMATE SITE AND REGIONAL POPULATION

Family historians have shown that despite differences in family structure and residence rules, average household size has remained fairly constant, with worldwide averages ranging from 4 to 7 (Laslett 1972). Historically, average household sizes in the Southwestern pueblos fall within this range based on census data that have been available since the late nineteenth century (Beaglehole 1935:42; Census Office 1984:183; Eggan 1950; Hillery and Essene 1963:305; Kroeber 1917:124; Li 1937:75). While the averages are very consistent cross-culturally, there can be significant variation in household size within any society. Even in societies that favor large, multigenerational households, there are typically enough small households to bring the overall average back down to this average range. Thus, one would expect the number of rooms in a household suite to vary depending on the size of the resident group and where it is in the multigenerational developmental cycle.

The fact that average household size is consistent through time and across cultures provides a strong basis for using architectural correlates for estimating human population dynamics on a regional scale. But, determining which architectural correlate represents a household could make a significant difference in population estimates. For example, in the late A.D. 800s each pit structure at DAP typically had two to three room suites that consisted of domestic rooms and associated storages rooms per pit structure. Thus, using a pit structure as a proxy for one household, as in the Duckfoot model, versus each room suite as the architectural correlate of a household, as in the DAP model, would produce population estimates that differ by a factor of two or three. Multiplied across thousands of sites in the region, the two formulas would produce significantly different regional population estimates.

Over the last 15 years the Crow Canyon Archaeological Center and Washington State University have partnered with other institutions in a regional research project called the Village Ecodynamics Project or VEP (Kohler and Varien 2012). The VEP has occurred in two phases known as VEP I, which was funded by the National Science Foundation (NSF) between 2001 and 2006, and VEP II, which received NSF funding between 2008 and 2014. VEP researchers compiled environmental and archeological data for a northern study area located in the central Mesa Verde region of southwestern Colorado. This study area is 4,659 km^2 and contains just over 18,000 archeological sites. VEP archeologists reviewed the records for these sites to determine which ones were residential sites. Using a variety of information and following methods developed by Scott Ortman (Ortman et al. 2007), they assigned each component at these residences to one of 14 time periods from A.D. 600 to A.D. 1280.

To estimate population, each recorded pit structure was counted as representing one household of six individuals (Ortman et al. 2007:261). Where pit structure counts were not available, the number of pit structures was estimated using both room block area and site area (Ortman et al. 2007:261-262). Population estimates were adjusted for inferred length of site occupation and other factors to produce a model of momentary population in each of the 14 VEP time periods. The results show that there were two cycles of population increase and decline in the study area, with a population peak between A.D. 840-880 during the first cycle of about 11,000 people and a population peak of about 25,000 people between A.D. 1225-1260 during the second cycle. Working independently, Wilshusen (2002) estimated regional population in the mid-A.D. 800s using room block metrics and survey data and came up with results very comparable to those generated by the VEP.

PATTERN AND VARIATION IN MESA VERDE HOUSEHOLDS

Pit structures persist at residential sites in Mesa Verde region from A.D. 600 to A.D. 1280. While the style of their construction and the nature of their use changed over time, they appear to remain as the focal points of habitations for seven centuries. The architectural suite as defined by a pit structure and its associated rooms is a robust pattern throughout the Pueblo occupation of the region, with the exception of the U-shaped great houses in the ninth century. The Duckfoot case study presents a strong argument that the architectural suite is the correlate of the household and that the household was the building block for larger social groups.

When we look at examples of architectural suites, we see considerable variation, but we do not think this variation undermines the Duckfoot model. Instead, it is consistent with expectations from historical and ethnoarcheological studies of household organization that document the many factors that shape the size and composition of households without affecting the consistency of average household size. There are bachelors, widows, commoners, and leaders. And, there are developmental cycles that households go through as young adults marry and establish new households, expand as they have children, and contract as residents die or move away. In cultures where extended family households are the norm, only a small percentage of households are at a maximum size at any one time. While the consistency of average household size is useful for assessing population dynamics at a broad regional scale, the variation in household size is also interesting and important. Both the pattern and the variation in household size and configuration merit further study and would likely tell us a great deal more about early Pueblo Indian social history.

DEE ANN STORY'S LEGACY

Dee Ann Story was a great inspiration to us as young students who were contemplating careers in archeology. She set the bar high in her expectations of our performance in the field, lab, classroom, and community. Dee Ann showed great confidence in our abilities as young professionals, and she inspired us to be confident in ourselves. She always witnessed great pride in us, as she did in all of her students who pursued professional careers in archeology, and her gift to us as a mentor will continue to shape us for the remainder of our lives.

REFERENCES CITED

Ashmore, W. and R. R. Wilk
1988 Household and Community in the Mesoamerican Past. In *Household and Community in the Mesoamerican Past*, edited by R. R. Wilk and W. Ashmore, pp. 1-27. University of New Mexico Press, Albuquerque.

Beaglehole, P.
1935 Census Data from Two Hopi Villages. *American Anthropologist* 37:41-54.

Bender, D. R.
1967 A Refinement of the Concept of Household: Families, Co-residence, and Domestic Functions. *American Anthropologist* 69:493-504

Brisbin, J. M. and M. D. Varien
1986 Excavations at Tres Bobos Hamlet (Site 5MT4545), a Basketmaker III Habitation. In *Dolores Archaeological Program: Anasazi Communities at Dolores: Early Anasazi Sites in the Sagehen Flats Area*, edited by A. E. Kane and G. T. Gross, pp. 118-210. Bureau of Reclamation, Engineering and Research Center, Denver.

Census Office
1894 *Eleventh Census of the United States: 1890. Report on Indians Taxed and Indians Not Taxed in the United States (Except Alaska)*. House of Representatives Miscellaneous Document 340(15). Department of the Interior, Washington, D.C.

Eggan, F. R.
1950 *Social Organization of the Western Pueblos*. University of Chicago Press, Chicago.

Fortes, M.
1958 Introduction. In *The Developmental Cycle in Domestic Groups*, edited by J. Goody, pp. 1-15. Papers in Social Anthropology No. 1. Cambridge University, Cambridge.

Hillery, G. A., Jr. and F. J. Essene
1963 Navajo Population: An Analysis of the 1960 Census. *Southwestern Journal of Anthropology* 19:297-313.

Kane, A. E.
1983 Introduction to Field Investigations and Analysis. In *Dolores Archaeological Program: Field Investigations and Analysis 1978*, edited by D. A. Breternitz, pp. 1-37. Bureau of Reclamation, Engineering and Research Center, Denver.

1986 Prehistory of the Dolores River Valley. In *Dolores Archaeological Program: Final Synthetic Report*, edited by D. A. Breternitz, C. K. Robinson, and G. T. Gross, pp. 353-435. Bureau of Reclamation, Engineering and Research Center, Denver.

Kohler, T. A. and M. D. Varien (editors)
2012 *Emergence and Collapse of Early Villages: Models of Central Mesa Verde Region Archaeology*. University of California Press, Berkeley.

Kroeber, A. L.
1917 *Zuni Kin and Clan*. Anthropological Papers, Vol. 18, part 2. American Museum of Natural History, New York.

Laslett, P.
1972 Introduction: History of the Family. In *Household and Family in Past Time*, edited by P. Laslett and R. Wall, pp. 1-89. Cambridge University Press, Cambridge.

Li, A. C.
1937 Zuni: Some Observations and Queries. *American Anthropologist* 39:62-76.

Lightfoot, R. R.
1988 Roofing an Early Anasazi Great Kiva: Analysis of an Architectural Model. *Kiva* 53:253-272.
1994 *The Duckfoot Site, Vol. 2: Archaeology of the House and Household*. Occasional Paper No. 4. Crow Canyon Archaeological Center, Cortez, Colorado.

Lightfoot, R. R., A. M. Emerson, and E. Blinman
1988 Excavations in Area 5, Grass Mesa Village (Site 5MT23). In *Dolores Archaeological Program: Anasazi Communities at Dolores: Grass Mesa Village*, edited by W. D. Lipe, J. N. Morris, and T. A. Kohler, pp. 561-766. Bureau of Reclamation, Engineering and Research Center, Denver.

Lightfoot, R. R. and M. C. Etzkorn (editors)
1993 *The Duckfoot Site: Volume 1: Descriptive Archaeology*. Occasional Paper No. 3. Crow Canyon Archaeological Center, Cortez, Colorado.

Lipe, W. D., J. N. Morris, and T. A. Kohler (compilers)
1988 *Dolores Archaeological Program: Anasazi Communities at Dolores: Grass Mesa Village*. U.S. Department of the Interior, Bureau of Reclamation, Engineering and Research Center, Denver.

Murdock, G. P.
1949 *Social Structure*. Macmillan, New York.

Netting, R. M., R. Wilk, and E. J. Arnould
1984 *Households: Comparative and Historical Studies of the Domestic Group*. University of California Press, Berkeley.

Ortman, S. G., M. D. Varien, and T. L. Gripp
2007 Empirical Bayesian Methods for Archaeological Survey Data: An Application from the Mesa Verde Region. *American Antiquity* 72:241-272.

Schlanger, S. H.
1986 Population Studies. In *Dolores Archaeological Program: Final Synthetic Report*, edited by D. A. Breternitz, C. K. Robinson, and G. T. Gross, pp. 493-524. Bureau of Reclamation, Engineering and Research Center, Denver.

Story, D. A. (editor)
1982 *The Deshazo Site, Nacogdoches County, Texas. Volume 1: The Site, Its Setting, Investigation, Cultural Features, Artifacts of Non-Native Manufacture, and Subsistence Remains*. Texas Antiquities Permit Series No. 7. Texas Antiquities Committee, Austin.
1995 *The Deshazo Site, Nacogdoches County, Texas. Volume 2: Artifacts of Native Manufacture*. Studies in Archeology 21. Texas Archeological Research Laboratory, The University of Texas at Austin, Austin.

Varien, M. D. and R. R. Lightfoot
1989 Ritual and Nonritual Activities in Mesa Verde Region Pit Structures. In *The Architecture of Social Integration in Prehistoric Pueblos*, edited by W. D. Lipe and M. Hegmon, pp. 73-87. Occasional Paper No. 1. Crow Canyon Archaeological Center, Cortez, Colorado.

Varien, M. D., S. G. Ortman, T. A. Kohler, D. M. Glowacki, and C. D. Johnson
2007 Historical Ecology in the Mesa Verde Region: Results from the Village Project. *American Antiquity* 72:273-300.

Wilk, R. R.
1989 *The Household Economy: Reconsidering the Domestic Mode of Production*. Westview Press, Boulder, Colorado.

Wilk, R. R. and W. Ashmore (editors)
1988 *Household and Community in the Mesoamerican Past*. University of New Mexico Press, Albuquerque.

Wilk, R. R. and W. L. Rathje
1982 Archaeology of the Household: Building a Prehistory of Domestic Life. *American Behavioral Scientist* 25(6):617-639.

Wilshusen, R. H.
1986 The Relationship between Abandonment Mode and Ritual Use in Pueblo I Anasazi Protokivas. *Journal of Field Archaeology* 13:245-254.
1988a Household Archaeology and Social Systematics. In *Dolores Archaeological Program: Supporting Studies: Additive and Reductive Technologies*, edited by E. Blinman, C. J. Phagan, and R. H. Wilshusen, pp. 635-647. Bureau of Reclamation, Engineering and Research Center, Denver.
1988b Architectural Trends in Prehistoric Anasazi Sites During A.D. 600 to 1200. In *Dolores Archaeological Program: Supporting Studies: Additive and Reductive Technologies*, edited by E. Blinman, C. J. Phagan, and R. H. Wilshusen, pp. 599-633. Bureau of Reclamation, Engineering and Research Center, Denver.
1989 Unstuffing the Estufa: Ritual Floor Features in Anasazi Pit Structures and Pueblo Kivas. In *The Architecture of Social Integration in Prehistoric Pueblos*, edited by W. D. Lipe and M. Hegmon, pp. 89-111. Occasional Paper No. 1. Crow Canyon Archaeological Center, Cortez, Colorado.
2002 Estimating Population in the Central Mesa Verde Region. In *Seeking the Center Place: Archaeology and Ancient Communities in the Mesa Verde Region*, edited by M. D. Varien and R. H. Wilshusen, pp. 101-120. University of Utah Press, Salt Lake City.

Wilshusen, R. H. and S. G. Ortman
1999 Rethinking the Pueblo I Period in the Northern Southwest: Aggregation, Migration, and Cultural Diversity. *Kiva* 64:369-399.

Wilshusen, R. H., S. G. Ortman, S. Diederichs, D. M. Glowacki, and G. Coffey
2012a Heartland of the Early Pueblos: The Central Mesa Verde Region. In *Crucible of Pueblos: The Early Pueblo Period in the Northern Southwest*, edited by R. H. Wilshusen, G. Schachner, and J. R. Allison, pp. 14-34. Monograph 71. Cotsen Institute of Archaeology Press, University of California at Los Angeles.

Wilshusen, R. H., S. G. Ortman, and A. Phillips
2012b Processions, Leaders, and Gathering Places: Changes in Early Pueblo Community Organization as Seen in Architecture, Rock Art, and Language. In *Crucible of Pueblos: The Early Pueblo Period in the Northern Southwest,* edited by R. H. Wilshusen, G. Schachner, and J. R. Allison, pp. 198-218. Monograph 71. Cotsen Institute of Archaeology Press, University of California at Los Angeles.

Windes, T.
2004 The Rise of Early Chacoan Great Houses. In *Search of Chaco: New Approaches to an Archaeological Enigma,* edited by D. G. Noble, pp. 14-21. School of American Research, Santa Fe, New Mexico.

Revisiting the Stylistic Classification of a Charcoal Pictograph in the Lower Pecos

Carolyn E. Boyd, Marvin W. Rowe, and Karen L. Steelman

ABSTRACT

Hyman and Rowe (1997) determined a radiocarbon date of 1280 ± 80 B.P. for a black charcoal drawing of a quadruped at 41VV75. However, when Rowe (2003) reported the date, he mistakenly published a photograph of a red Pecos River style deer from Panther Cave (41VV83) rather than the dated charcoal figure from 41VV75. The description he provided for the dated figure was of the incorrect pictograph. Based on the similarity of the radiocarbon dates for this charcoal figure and a red painting at Cueva Quebrada (41VV162A), Rowe proposed that the black deer image was likely Red Linear style. We correct the mistake in the figure choice, provide an illustration and corrected description for the pictograph that was dated from 41VV75, and reassess its stylistic assignment as an unclassified drawing style. Further, we report the recent identification of a strikingly similar black charcoal quadruped documented at 41VV164 (Kelley Cave).

INTRODUCTION

The purpose of this article is to correct a mistake set forth in Rowe (2003), as well as to re-evaluate the stylistic assignment of a black, dry-applied pictograph (Figure 1). Rowe (2003) reported a radiocarbon date of 1280 ± 80 B.P. (CAMS-29315) for a pictograph from 41VV75 located in Seminole Canyon State Park and Historic Site, Val Verde County, Texas. A radiocarbon date of 1280 ± 80 years B.P. calibrates to A.D. 650-870 (1 sigma) or A.D. 610-950 (2 sigma). This calibration was performed using the Bayesian method of the OxCal computer program version 4.2.3 (Bronk Ramsey 2009, 2013) with IntCal13 curve data from Reimer et al. (2013).

Hyman and Rowe (1997) identified charcoal as the pigment used to produce this drawing based on the disappearance of coloration when the sample was oxidized. Manganese pigment remains black, being unaffected by the oxidizing plasma; whereas charcoal oxidizes to gaseous carbon dioxide. However, when Rowe (2003) wrote a more detailed paper about this figure, he mistakenly chose an image not of the dated black quadruped in 41VV75, but rather a red Pecos River style deer from Panther Cave (41VV83). Unfortunately, Rowe (2003) used the photograph from Panther Cave to write a description for the dated pictograph from 41VV75. He tentatively assigned the image to the Red Linear style based on the date and his description. We herein correct this mistake and reassess Rowe's stylistic assignment of the black charcoal pictograph at 41VV75.

BLACK CHARCOAL PICTOGRAPHS AT 41VV75

Site 41VV75 is a large rockshelter with deep deposits located in Seminole Canyon just north of its confluence with Presa Canyon. Extreme spalling and thick accretions have either destroyed or obscured what at one time would have been one of the most impressive rock art panels in the Lower Pecos. Remnants of Pecos River style rock art extend the length of the shelter. Along the downstream end are numerous small Red Linear pictographs and interspersed throughout are geometric figures resembling Turpin's Bold Line Geometric style (Turpin 1986). Also present are pictographs that do not fit neatly into any of the currently defined styles for the region.

The 41VV75 pigment sample was collected from a poorly preserved, black, dry-applied pictograph of a quadruped located along the back wall near the center of the shelter. The quadruped is associated with at least nine dry-applied, black

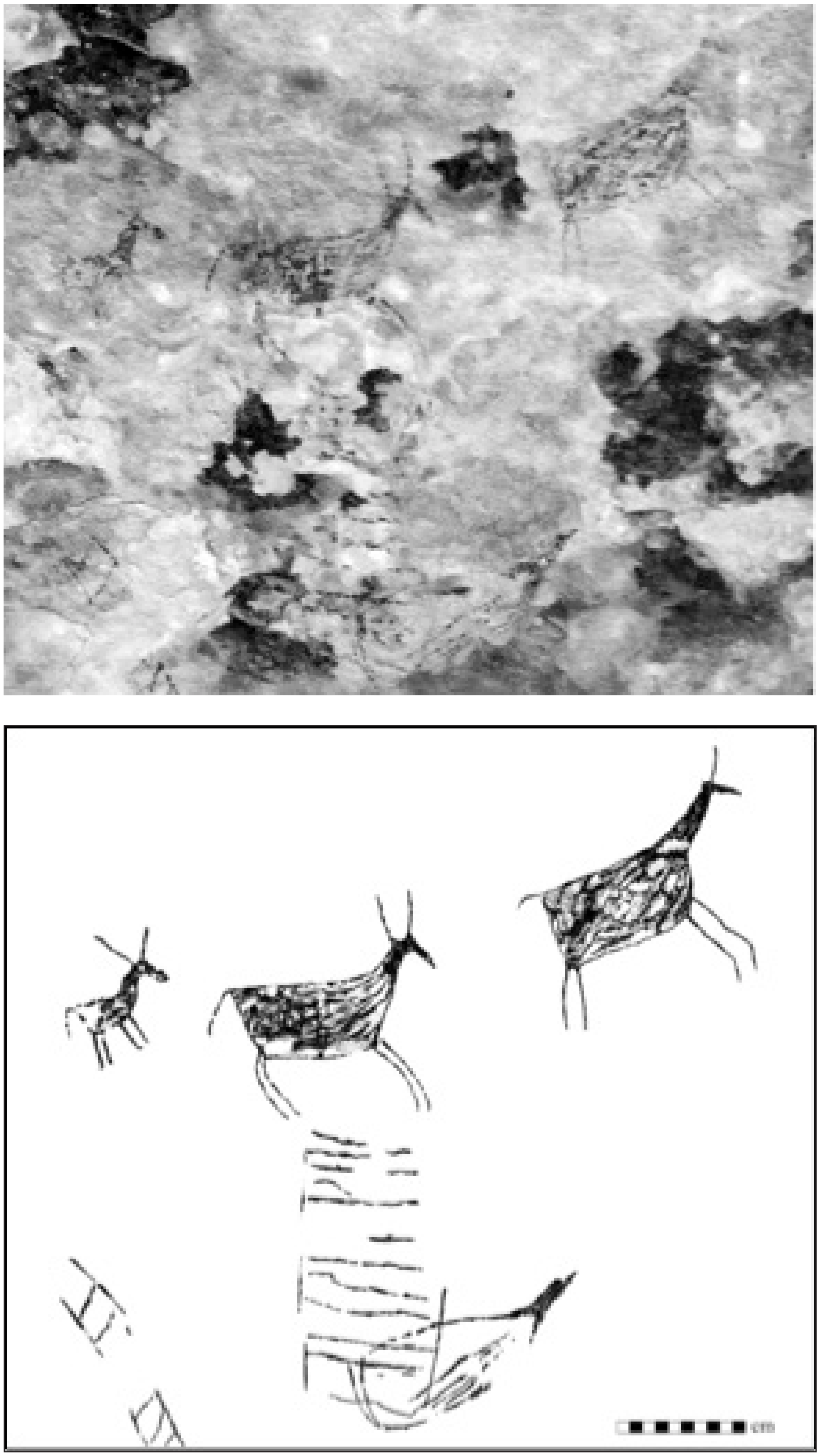

Figure 1. Section from the panel at 41VV75 containing charcoal dry-applied drawings of deer and geometric figures. The dated pictograph is the small quadruped with short legs and a large head located in the upper left corner of the illustration.

figures resembling deer and two black grid- or ladder-like geometric forms that may represent nets (Figure 1). Prior to their execution, this badly spalled section of the panel contained polychromatic Pecos River style paintings. The black figures were drawn onto the wall after the pre-existing figures spalled off. The dated quadruped measures 9 cm in length and stands 4.5 cm in height. It is almost half the size of the other black dry-pigment drawings of deer associated with it. This figure has a rectangular-shaped body, short legs, and a large head with either spike antlers or very tall ears. The remaining figures have rectangular-shaped bodies with tall ears or spikes similar to the dated image. None of the figures are impaled and none are portrayed with hooves or dewclaws.

All of the figures in this composition were recently analyzed in situ using portable X-ray fluorescence (pXRF) (Koenig et al. 2104). The pXRF analysis of the figures demonstrated that the black paint used in their production was not derived from an inorganic (manganese) mineral pigment. Charcoal is assumed as the most likely organic source for the black color. These findings support Hyman and Rowe's (1997) identification of charcoal as the pigment source for the black quadruped. This is the first documented prehistoric pictograph in the Lower Pecos shown to be composed of charcoal. Given that all of the dry-applied drawings in this composition were produced using charcoal pigment and share many of the same attributes, it is likely that they were all produced at the same time and by the same artist. As stated above, when Rowe (2003) assigned the charcoal figure to the Red Linear style, he based his classification on the date obtained for the figure at 41VV75 and a description based on an incorrect photograph. Below we revisit the date for Red Linear style and provide a discussion on the attributes of Red Linear deer according to Boyd et al. (2013).

DISCUSSION

Red Linear is one of four presently defined prehistoric rock art styles in the Lower Pecos Canyonlands of southwest Texas and Coahuila, Mexico: Red Linear, Pecos River, Bold Line Geometric, and Red Monochrome (Turpin 1995). Two experimental radiocarbon assays reported for possible Red Linear imagery have been widely accepted by archeologists as defining the temporal span of Red Linear pictographs. At Cueva Quebrada (41VV162A), a paint sample was collected from one in a series of 13 red-orange oval shapes. The ovals are located directly above four headless quadrupeds identified by Turpin (1984) as Red Linear bison. This paint sample yielded a date of 1280 ± 135 B.P. (AA-10549) (Ilger et al. 1994). The second date was reported by Hyman and Rowe (1997) for the charcoal figure from 41VV75. The radiocarbon assay obtained for the charcoal drawing at 41VV75 (1280 ± 80 B.P.) is virtually identical to the date obtained for a presumed Red Linear figure at 41VV162A, Cueva Quebrada.

It is important to note, however, that although charcoal images, such as the one from 41VV75, can be more reliably radiocarbon dated than pictographs made from an unidentified organic binder, such as the dated red-orange figure from Cueva Quebrada, the date obtained does not indicate the age of the pictograph, but the date for the death of a tree. In arid environments with good preservation, such as the Lower Pecos, charcoal used to produce the paintings may have been made from old wood, a tree that had been dead for many years, perhaps even centuries (Schiffer 1986). Alternatively, old charcoal could be picked up off the floor and used as a pigment by anyone living in or simply passing through the shelter (Bednarik 1994). Hence, radiocarbon dating of charcoal pigments can only produce a *maximum* age for the creation of an image.

Based on the Cueva Quebrada radiocarbon assay and interpretation of Red Linear imagery by Turpin (1984), the style was presumed to have been brought into the region by intrusive bison hunters during the terminal Late Archaic around 1280 B.P. (Turpin 2011). This would place production of the Red Linear style after the large, polychromatic Pecos River style paintings radiocarbon dated to between 4200 and 2750 B.P. (Rowe 2009). However, Boyd et al. (2013) recently completed an analysis of 444 Red Linear figures from 12 sites in the region. Using macro- and microscopic analysis they identified 38 Red Linear figures overlain by presumed older Pecos River style art and no converse examples, thus inverting the relative chronologies for the two styles. They also produced a list of diagnostic attributes for Red Linear anthropomorphs and zoomorphs. The attributes they identified as characteristic of 87 Red Linear deer are used here to reassess Rowe's (2003) assignment of the black charcoal figure to the Red Linear style.

Boyd et al. (2013) classify zoomorphic figures as Red Linear based on the presence of multiple attributes, including size, body shape, presence or absence of physical features, subject, and context—in particular, association with Red Linear style anthropomorphs. Although greater than 60 percent of the documented Red Linear zoomorphs are red, they also are portrayed in yellow, black, and white; and all are wet-applied paintings as opposed to dry-applied drawings (Boyd et al. 2013).

Red Linear deer are typically, but not always, portrayed with crescent and ovoid body shapes. Interestingly, none of the 87 documented Red Linear figures are impaled. They range in size from 1.6 cm to 14.6 cm in height (μ =5.6 cm, σ =2.9 cm) to 2.0 cm to 21.5 cm in length (μ =7.7 cm, σ =3.8 cm). Body proportions tend to be exaggerated, in particular the height to length ratio. Red Linear style deer average 5.6 cm in height and 7.7 cm in length, with a height to length ratio of 73 percent. Hind legs are frequently portrayed even longer than front legs (Figure 2). Red Linear deer are portrayed with or without antlers and with or without hooves. Many are portrayed with protruding lips resembling lip curl or Flehmen response displayed by bucks during rut (Rue III 1997).

A distinctive geometric form associated with Red Linear artiodactyls is the looped line. This motif, which resembles a loop snare, is formed by a series of connecting looped lines attached along a single straight line. With the exception of looped lines, no other geometric figures are unique to the Red Linear style. Ovals, bars, grids, etc. are found among all rock art styles in the Lower Pecos. Stylistic classification of geometric forms, therefore, is even more ambiguous than zoomorphs and, like zoomorphs, must be based on association with other known Red Linear figures.

Stylistic Analysis of the Charcoal Deer

Classification of zoomorphic figures into stylistic categories is often difficult and this example is no exception. As stated above, classification of zoomorphs into the Red Linear style must be based on the presence of multiple attributes or, in the absence of multiple attributes, association with figures readily recognizable as Red Linear, such as anthropomorphs. The zoomorphs at 41VV75 share only two attributes with documented Red Linear artiodactyls—their size and their lack of spear impalement; neither of these attributes alone

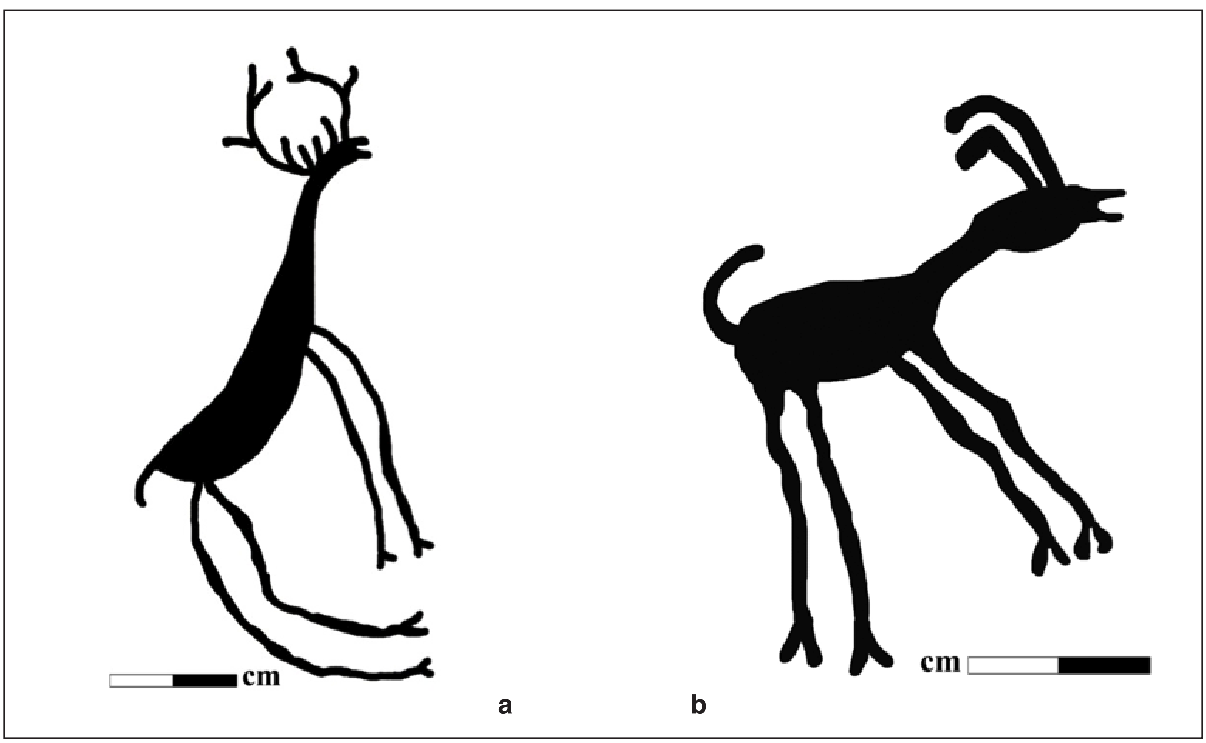

Figure 2. Red Linear artiodactyls from Mystic Shelter portrayed with exaggeratedly long legs and mouths with protruding lips similar to the lip curl or Flehmen response exhibited by bucks during rut.

or in combination can be used to classify them as Red Linear (Table 1). The dated charcoal figures also are dissimilar from Red Linear zoomorphs in their manner of execution—dry-applied versus wet-applied. They lack the exaggerated leg length and distinctive lip curl common to Red Linear artiodactyls. Most importantly, they are not found in association with the distinctive looped lines or with Red Linear anthropomorphs.

Charcoal drawings of deer, however, are not unique to 41VV75. Recently, during the 2013 Eagle Nest Canyon Field School, we recorded a similar dry-applied pictograph at 41VV164 (Kelley Cave) (Figure 3). Kelley Cave is located in Langtry, Texas, approximately 20 miles west of Seminole Canyon. Pecos River style anthropomorphic and enigmatic figures painted in red and yellow are located along the downstream-end of this shelter. No Red Linear style pictographs have been documented at the site; however, preservation of the paintings is very poor and we are left with an incomplete record of the pictograph assemblage. All paintings are heavily obscured by mineral accretions and badly spalled.

A black, dry-applied deer equal in size and morphology to the charcoal deer at 41VV75 is located low on the ceiling toward the back of the shelter. Like the 41VV75 charcoal figures, it was drawn into a pre-existing spall. The deer measures 8.4 cm in height and 17 cm in length. As with those at 41VV75, it has a rectangular-shaped body in-filled with a series of roughly executed black lines, tall ears or spike antlers, and is not impaled. However, in contrast to 41VV75, this lone deer figure is not found in association with any other charcoal imagery.

In November 2013, we conducted an elemental analysis of the dry-applied black deer at Kelley Cave using pXRF. Both the black pigment and adjacent unpainted rock (control) contained similar manganese levels of ≤100 ppm Mn, near the pXRF instrumental limit of detection or "zero-level." As with the black deer at 41VV75, we determined that the black pigment used to produce the Kelley Cave pictograph was not mineral based and, therefore, was derived from an organic substance, such as charcoal.

CONCLUSION

Although the radiocarbon date for the black charcoal deer at 41VV75 is the same as the Cueva Quebrada date for the red-orange oval pictograph, we maintain that the black pictograph cannot be confidently categorized as Red Linear. The figure lacks sufficient diagnostic attributes to classify it as such. The black charcoal deer does not fit neatly into any of the currently defined styles for the region. This leaves us with only one radiocarbon date for Red Linear style—the date from Cueva Quebrada. We caution, however, against relying on this one date to define the temporal span for Red Linear style.

Additional radiocarbon dating of all rock art styles is essential to determine absolute rock art chronologies for the region. This should be coupled with stratigraphic analyses and further descriptions/recordings of rock art assemblages.

ACKNOWLEDGMENTS

We appreciate the support of Texas A&M University at Qatar and the Qatar Foundation for

Table 1. Comparison of Red Linear (RLS) Artiodactyl Attributes to Charcoal Pictographs at 41VV75.

RLS Artiodactyl Attributes (Boyd et al. 2013)	41VV75 Black Artiodactyl Attributes
Height (1.6 cm to 14.6 cm)	Height (4.5 cm to 11.5 cm)
Length (2.0 cm to 21.5 cm)	Length (9 cm to 19.2 cm)
Exaggerated Leg Length	No Exaggerated Leg Length
Wet Applied Paintings	Dry Applied Drawings
Ovoid and Crescent Body Shape	Rectangular Body Shape
Mouth with Lip Curl	No mouth present
Not Spear Impaled	Not Spear Impaled
Looped Line Geometric	Ladder-Like Geometric
Associated with RLS Anthropomorphs	Not Associated with RLS Anthropomorphs

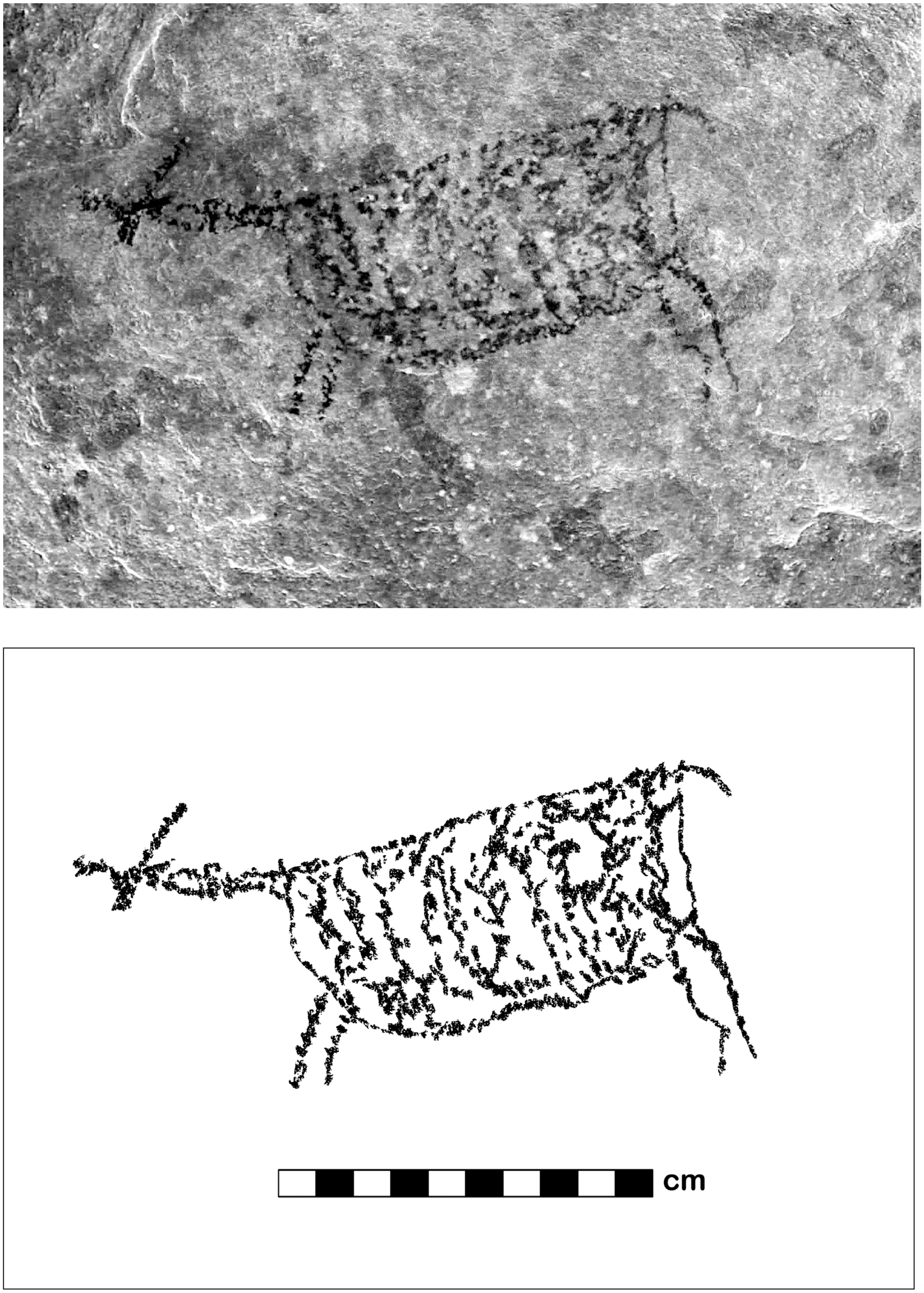

Figure 3. Black, dry-applied charcoal deer from 41VV164 (Kelley Cave).

supplying us with the pXRF analyzer. We received permission from park superintendent Randy Rosales at Seminole Canyon State Park and Historic Site to conduct the in situ pXRF analysis of the black deer. We greatly appreciate the continued support from Texas Parks and Wildlife in our recording and preservation efforts in the Lower Pecos. We also thank the Skiles family for granting Shumla Archaeological Research & Education Center and Texas State University access to Kelley Cave during the 2013 Eagle Nest Canyon Field School.

REFERENCES CITED

Bednarik, R. G.
1994 Conceptual Pitfalls in Dating of Palaeolithic Rock Art. *Préhistoire Anthropologie Méditerranéennes* 3:95-102.

Boyd, C. E., A. M. Castañeda, and C. W. Koenig
2013 A Reassessment of Red Linear Pictographs in the Lower Pecos Canyonlands of Texas. *American Antiquity* 78(3):456-482.

Bronk R., C.
2009 Bayesian analysis of radiocarbon dates. *Radiocarbon* 51:337-360.
2013 On-line *OxCal* version 4.2.3

Hyman, M. and M. W. Rowe
1997 Plasma extraction and AMS ^{14}C dating of rock paintings. *Techne* 5:61-70.

Ilger, W. A., M. Hyman, and M. W. Rowe
1994 Radiocarbon Date for a Red Linear Style Pictograph. *Bulletin of the Texas Archeological Society* 64:337-346.

Koenig, C. W., A. M. Castañeda, C. E. Boyd, M. W. Rowe, and K. L. Steelman
2014 Portable X-Ray Fluorescence Spectroscopy of Pictographs: A Case Study from the Lower Pecos Canyonlands. *Archaeometry*.

Reimer, P. J., Bard, E., Bayliss, A., Beck, J. W., Blackwell, P. G., Bronk Ramsey, C., Grootes, P. M., Guilderson, T. P., Haflidason, H., Hajdas, I., Hatte, C., Heaton, T. J., Hoffmann, D. L., Hogg, A. G., Hughen, K. A., Kaiser, K. F., Kromer, B., Manning, S. W., Niu, M., Reimer, R. W., Richards, D. A., Scott, E. M., Southon, J. R., Staff, R. A., Turney, C. S. M., and van der Plicht, J.
2013 IntCal13 and Marine13 Radiocarbon Age Calibration Curves 0-50,000 Years cal BP. *Radiocarbon* 55:1869-1887.

Schiffer, M. B.
1986 Radiocarbon Dating and the "Old Wood" Problem: The Case of the Hohokam Chronology. *Journal of Archaeological Science* 13:13-30.

Turpin, S. A.
1984 The Red Linear Style Pictographs of the Lower Pecos River Region, Texas. *Plains Anthropologist* 29(105):181-198.
1986 Toward a Definition of a Pictograph Style: The Lower Pecos Bold Line Geometric. *Plains Anthropologist* 31(112): 153-162.
1995 The Lower Pecos River Region of Texas and Northern Mexico. *Bulletin of the Texas Archeological Society* 66:541-560.
2011 Size Matters: The Transition from Religious to Secular Art in the Lower Pecos. In *American Indian Rock Art*, edited by M. Greer, J. Greer, and P. Whitehead, pp. 1-15. American Rock Art Research Association 37.

Rowe, M. W.
2003 Radiocarbon Dating of a Deer Image from the Lower Pecos River Region, Texas. *Bulletin of the Texas Archeological Society* 74:83-88.
2009 Radiocarbon Dating of Ancient Rock Paintings. *Analytical Chemistry* 81(5):1728-1735.

Rue, L. L., III
1997 *The Deer of North America*. Lyons Press, Guilford, Connecticut.

The Knox Biface: An Incised Stone Artifact from Central Texas

James D. Keyser

ABSTRACT

The Knox biface, found in Central Texas in 1961, is a hand-sized biface of Edwards Plateau chert that shows a very complex and detailed pattern of incising in the relatively soft cortical surface covering one side. Probably of Archaic period age, the biface's incised surface shows a complex series of geometric compartments infilled with cross-hatching or parallel lines, and a single plant form with a short barb at the tip of each complete branch. Based on the desire of the artifact's owner, it was donated to the curatorial facility of the Center for Archaeological Studies at Texas State University.

INTRODUCTION

In February 2008, Rich Knox, a member of the Oregon Archaeological Society (OAS), who was enrolled in the OAS-sponsored "Basic Training" class for archeological volunteers, asked if I would be interested in looking at a chipped stone artifact on which there were "Indian carvings." Knowing of my professional interest in rock art and having just attended my lectures in "Law and Ethics for the Volunteer" and "Introduction to Rock Art," Knox felt that the artifact in his possession deserved professional evaluation. He further related that the item was given to him by his grandfather (L. J. Maxwell), who lived for many years in Central Texas, just east of where the artifact was reportedly found. Having been previously shown more than a dozen stones in my long career as a federal archeologist on which interested amateurs claimed to recognize "Indian designs" in what were obviously natural markings, I was not overly hopeful, but agreed to view the artifact at the next class session the following Saturday.

Nevertheless, what Knox brought in is an intricately detailed incised stone. Once he understood the artifact's significance, he readily loaned it to me so I could make detailed photographs and drawings and show the biface to various Texas archeologists with an interest in such artifacts. He then agreed that the results of my examination should be published and that the piece should be donated to a museum repository in Texas, where it can be studied by future archeologists and enjoyed by all. I presented the biface to Wilson "Dub" Crook at the 2013 Texas Archeological Society meeting in Del Rio for curation at Texas State University in the curatorial facility of the Center for Archaeological Studies.

THE KNOX BIFACE

In November 1961, Mr. L. J. Maxwell found a large Edwards Chert biface with an extensive, very intricately engraved cortical surface covering about 65% of one face of the artifact. Found in Kimble County in west central Texas, the artifact was reportedly recovered from a "campsite" (possibly in a cave) which was located near a spring in a canyon between the towns of Junction and Menard (Knox 2008).

Technological Analysis

The large, hand-sized biface (Figure 1) measures just over 14 cm long, 10 cm wide, and almost exactly 1.5 cm thick at its thickest part where a small, crude, reverse-L-shaped "island" of weathered chert cortex rises above the broad percussion flakes that surround it. This cortex island, located on the reverse face (opposite the incising), has a hard, lumpy, heavily weathered, unmodified surface. This "island" survived a knapper's initial

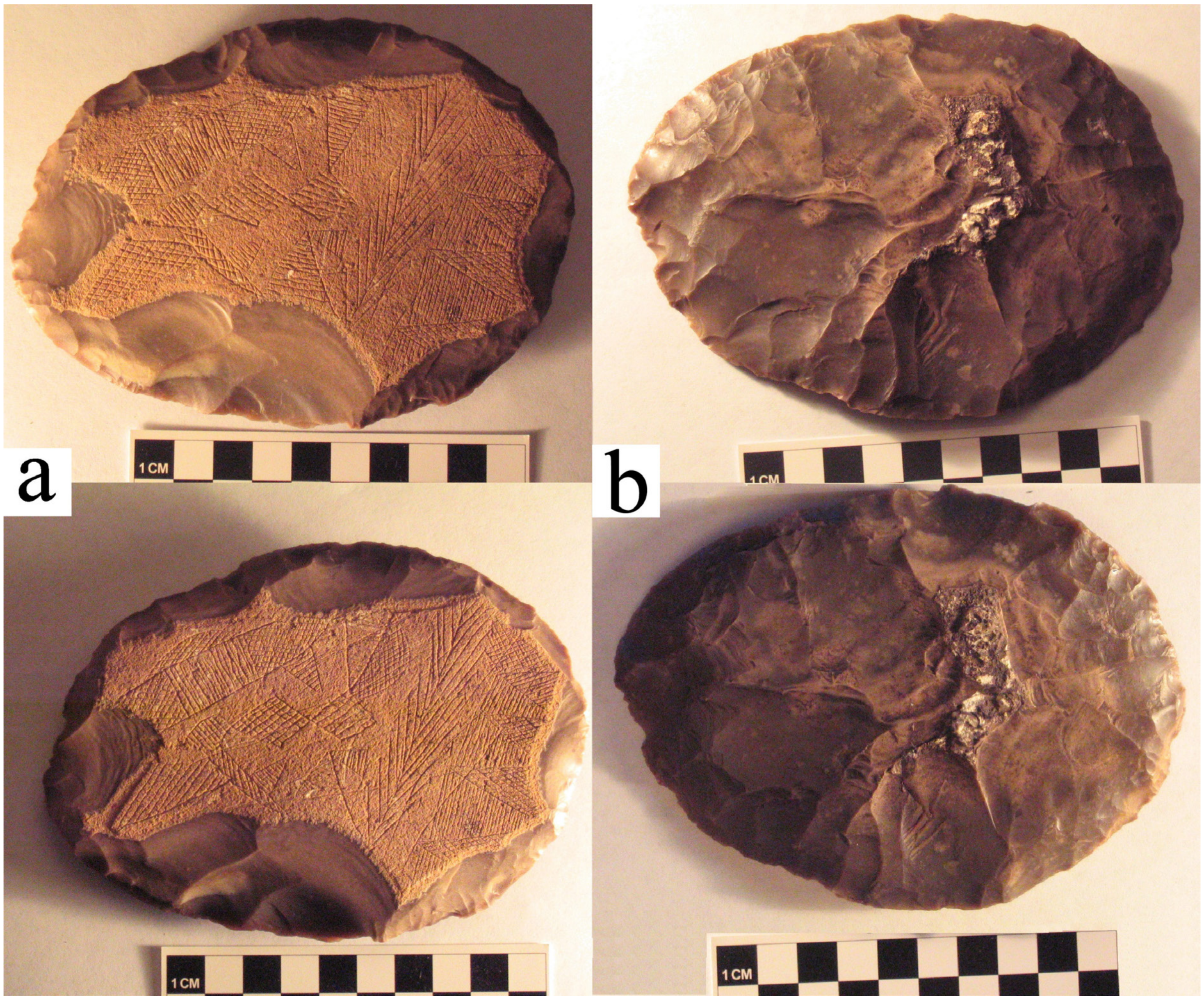

Figure 1. Obverse ("a") and reverse ("b") views of the Knox biface. Note cortex "island" on reverse face and incised pattern on obverse. George Poetschat photographs.

effort to remove it, as evidenced by at least five very broad flake scars that terminate at its edges. But analysis shows that the knapper began a series of small marginal flakes along both edges of the incised, obverse side of the biface (opposite the almost completely flaked surface) that produced two sturdy platforms adequate for the detachment of broad flakes that would have removed this cortex with only minimal additional effort (John Fagan, personal communication 2011).

This remnant-weathered cortex is significantly different from the relatively thick, soft, smoothly weathered, intensively incised, limestone cortex on the obverse side of the artifact. Taken together, however, they indicate that this piece was originally a weathered slab of Edwards Chert before it was picked up and modified by a prehistoric artist and knapper.

The almost completely flaked, reverse face of the artifact has a series of nearly a dozen broad, shallow, percussion flake scars, most of which extend almost to the biface's center. The largest of these extend from 5 cm to almost 7 cm across the biface, but there is no evidence of the outrépassé flaking technique that characterizes Clovis period lithic technology from across the western United States (Mike Collins, personal communication 2009; John Fagan, personal communication 2008). The longest of these scars appears much more weathered at its margins and on the tops of the accentuated ripple marks within it (Figure 2), suggesting that it likely predates the less weathered flaking by some unknown period of time. Following initial percussion removal of several flakes, the reverse face of the artifact was further modified by a series of small, short flakes that appear to be preliminary edge-trimming designed to set up platforms for detachment of flakes from the obverse (incised) face (John Fagan, personal communication 2011).

The incised face is dominated by a large, tan, slightly concave cortical surface that still covers almost 65% of the biface. This cortex was trimmed around the margins by 14 short, broad, shallow percussion flake scars that are considerably different from the percussion flake scars on the reverse face. The short length of the surviving scars is directly attributable to two factors: (1) the flakes on the obverse face did not "carry" any significant distance across the concave surface, and (2) the removal of a significant portion of the biface edge around its entire circumference caused by the detachment of platforms for flakes taken from the reverse side (John Fagan, personal communication 2011).

Figure 2. Close-up of flaking on reverse face shows weathering of margins and ripple marks (arrows) of oldest flake in sequence. Scale in centimeters. George Poetschat photograph.

These foreshortened, marginal flakes created a cortical surface that has a crudely zoomorphic shape (Figure 3b) that may have been recognized by the knapper, although there is no way to verify this. After these broad percussion flakes were removed the knapper further modified this face with a series of edge-trimming flakes that were obviously intended to set up platforms for detachment of additional flakes that would have removed the remnant cortex island on the reverse face (John Fagan, personal communication, 2011). According to Fagan, these platforms have the correct angle already set, and with minimal edge-grinding would be ready for flake detachment.

THE INCISED DECORATION

Much more impressive than any knapping evidence on the biface, however, is the pattern of incising that covers almost its entire remaining cortex. This pattern, consisting of delicate fine lines, shows two phases of production. The initial incisions, clearly superimposed by the later, more structured pattern of lines, are a cluster of about a dozen long, oblique lines extending from lower left to upper right when viewing the biface so that the crude zoomorphic form is in an approximately pronograde position (see Figure 3c). These shallow, carelessly executed lines overlap one another and do not appear to form any recognizable pattern. Likewise, they do not appear to be precursors in any way to the highly patterned and carefully executed lines composing the second phase of incising. Whether these initial scratches were incised millennia or minutes before the second phase cannot be determined, but they certainly seem to have been intentionally, if somewhat haphazardly, produced. It is possible that they are simply the result of the artist's testing the piece to determine how readily it could be incised.

The second phase of incised lines forms a complex series of geometric compartments that include rectangles, triangles, crude diamond shapes, and crude half circles filled with cross-hatching or simple parallel lines (see Figure 3b, d). Interestingly, there are 24 separate compartments evenly divided between cross-hatched and parallel line infill. Cross-hatching is quite uniform

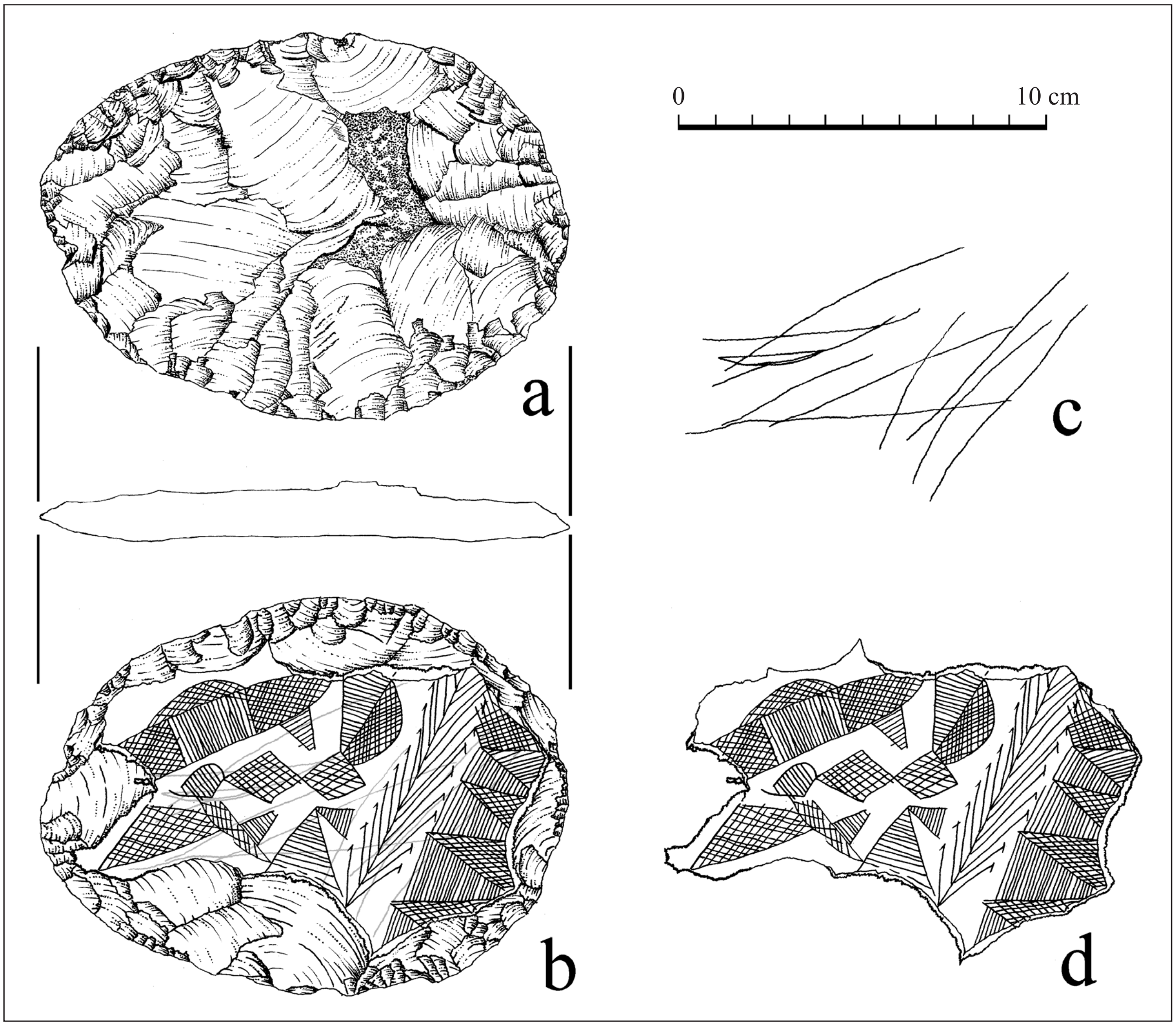

Figure 3. Illustration of the Knox biface and incised pattern: a, flaked reverse surface of biface; b, flaked and incised obverse surface of biface (note earlier scratches are shown in grey); c, earliest scratches; d, later, complex incised pattern. Drawings and tracings by the author.

and consists of patterns of overlapping parallel lines oriented primarily at acute angles with 10 of the 12 ranging from 20 to 33 degrees and the other two being approximately 45 and 90 degrees. In two of the triangular shapes one set of the lines composing the cross-hatching roughly parallels one side of the compartment, but in all others there seems to have been an effort to avoid doing this. The close correspondence of these cross-hatched patterns suggests that they were done by a single hand. All but one of the parallel line patterns are more or less aligned with the inferred base of the triangle or short sides of the rectangle, again suggesting a single artist who had a definite pattern in mind.

These infilled geometric shapes are clearly clustered together rather than randomly scattered across the decorated field. On the left half of this field, triangles abut other shapes and two meet at their apexes. Two diamond shapes are also touching at their ends and three crude rectangles are connected one to the other by their short sides. A crude half circle abuts one side of these connected rectangles and spans all of one and part of another. Cross-hatched lines infilling two of these rectangles and the half circle do not span both compartments, indicating that the infill was done separately for each.

In the right half of the field a series of nine triangles is oriented side by side so that each one shares two sides with neighboring examples. For a sequence of seven of these they alternate between parallel line infill and cross-hatching, with the parallel lines all being aligned with the base of the triangle. The last two disrupt this pattern with one having parallel lines not aligned with any side of the compartment and the last one having cross-hatch infill that is oriented in an opposite direction from the others with cross-hatching.

Separating these two distinctive patterns is a tall, linear, plant-like form consisting of a central line from which extend 12 shorter, obliquely oriented "branches" on each side (Figure 4). In six cases—four of which are on the bottom of the figure—these branch lines are relatively carefully paired so that they meet on opposite sides of the main stem at their point of origin, as if the artist was striving for bilateral symmetry. In the six other cases, however, the placement of these lines is not so obviously precise and they do not meet at the central stem. At the tips of all 17 branches that are still preserved in their entirety—and another that has only its extreme tip removed—there is a short barb produced by carefully incising a short line backward and downward from the branch (Figure 4). Presumably the other six lines, located at the top of the image, also had a similar barb, which is now lost due to flaking that has removed the cortex. This design, especially as evidenced by the terminal barbs on the oblique branches, is as equally carefully crafted, as are the enclosed, infilled geometric forms.

The tiny incisions forming the scratched design on this artifact are carefully controlled, but irregular enough to show they were drawn freehand rather than with the aid of a straight edge of some sort. They are so well done that for more than 350 approximately parallel lines, only two branch or run together, and for nearly 600 places where interior fill lines intersect compartment boundary lines there are fewer than 25 instances where the lines either overshoot or do not quite meet the boundary lines. The same level of accuracy is evident for corners of the diamond and rectilinear shapes. For the 12 obvious triangles only three have marginal lines that do not precisely meet at the apex. In contrast, nearly half of the small barbs on the branches of the plant-like form are less carefully positioned: sometimes exactly pendant from the extreme tip of the branch, but at other times forming a crudely crossed "T." In light of the precision of most lines in the design, this implies that the artist was intentionally imprecise. During my effort to trace these designs I was constantly awed by the exactness and accuracy of these incisions, especially considering that they were drawn freehand with a stone flake using only the naked eye.

The flaking on the incised face was clearly done after the piece was incised. Fourteen geometric compartments are partly truncated along one or sometimes two margins by flake scars (Figure 5). One of these is a broad, very shallow flake scar that terminates in a "hinge fracture" exactly at a straight incised line, demonstrating that the incision served as the hinge fracture point. In addition, remnant incisions from four of the geometric compartments occur at six places within flake scars, where they are preserved in the lowest level of the cortex that was not completely removed by the shallow, feathered edge of the flake. Finally, the tips of seven "branches" and the main stem of the plant-like image end abruptly at flake edges, almost certainly indicating that the top of this design was truncated by the flaking in this area of the biface. In fact, measuring along the margin of the remaining cortex shows that just more than 50% of the edge

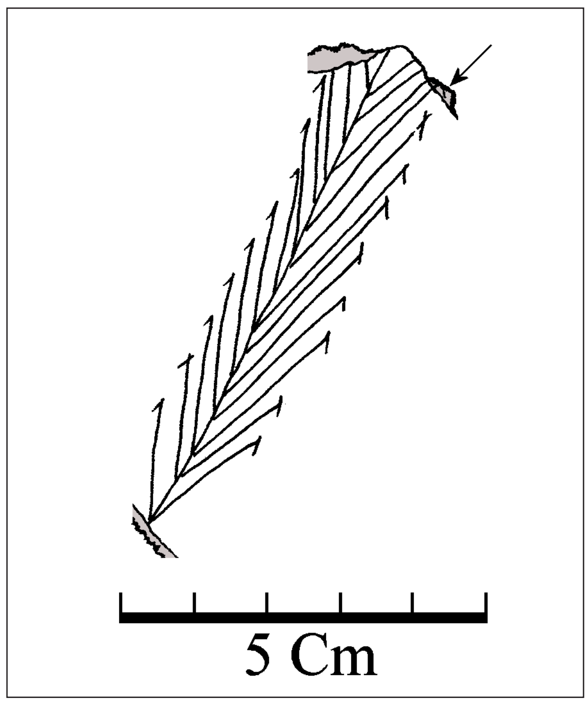

Figure 4. The plant form incised on the Knox biface. Note the small spur at the end of each complete branch and the remnant spur on the partially removed branch at extreme upper right (arrow). Grey areas indicate flake edges where feathering left behind remnant cortex in which incisions are still preserved.

evidences parts of the design that were invaded by the flaking. Taken together, these prove that most of the design was incised before this face was flaked, and strongly suggest that the entire pattern predates the flaking.

INTERPRETATION

Without good provenience it is almost impossible to suggest an ultimate function for the incising on this artifact. Similar incised stones are found throughout the world, both as regoliths of various sizes and (as in this example) flint or chert cores whose design was later completely or partially destroyed by the knapper (Brumm et al. 2006; Fischer 1974; Clark Wernecke, personal communication 2008). Similar items are found throughout North America, especially in Texas, where they date from Clovis to Historic times (Jackson 1938:333; Klimowicz 1988; Reid and Caulk 1986; Clark Wernecke, personal communication 2008; Wernecke and Collins 2010). In Texas, probably the best-known, and most renowned, collection of

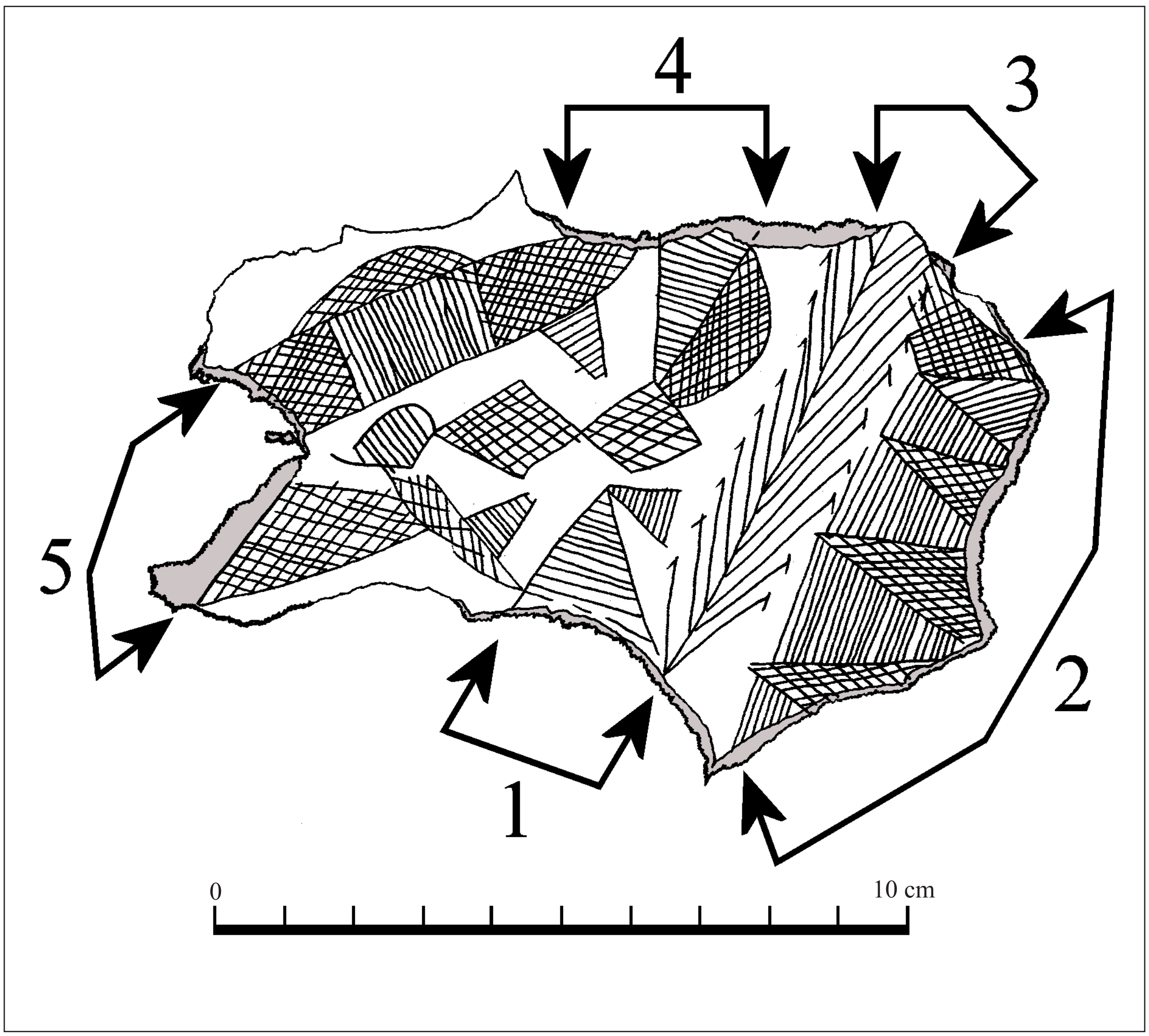

Figure 5. Extent of flaking that has impacted the design incised on the obverse side of the Knox biface. Areas between arrows are where incised lines terminate at flake edges. Grey indicates flake edges where feathering left behind remnant cortex. Note incised lines preserved in this remnant cortex at right arrow in 3 and 4, and just to right of left arrow in 2. Lower portion of area 5 shows where a flake has hinged directly along the incised line of the cross-hatched fill in the triangle.

such artifacts is from the Gault site, where they date from Clovis through Archaic times (Michael Collins, personal communication 2009; Wernecke and Collins 2010).

Clark Wernecke, Gault Site Project Director, who has devoted more time to studying such artifacts than anyone else, has compiled a list of more than 60 proposed reasons that such artifacts were produced. These range from suggestions that the production of such items could be as simple as the result of doodling, to identifying ownership of a flint nodule, to ritual petitioning for a successful knapping event (Clark Wernecke, personal communication 2008). Unfortunately, Wernecke notes that even with excellent provenience only a few of these possible functions can be ruled out. For the Knox biface we can definitely rule out doodling based on the extreme care evident in precision of line and design. However, with only generic geographic location, and no indication of type of site or specific provenience (e.g., cache, burial, workshop area) within a site, we cannot support or refute any other of the myriad possible functions.

The four archeologists familiar with Texas prehistory who have seen the artifact either in person or in good photographs (Michael Collins, John Greer, Elton Prewitt, and Clark Wernecke), all agree that the biface is probably of Archaic period age, typical of others found commonly in collections throughout west central Texas.

The elements used in the incised design are certainly not unique for this particular artifact, but the overall design is larger and more complex than most found on similar items. Many such designs, especially those that are completely or nearly completely preserved on the larger pieces, are primarily regular cross-hatched images composed of straight lines intersecting at various angles (Jackson 1938:333; Black 2008; Clark Wernecke, personal communication 2008), but occasional examples show designs that may depict plant or animal forms (Wernecke and Collins 2010:3). In contrast, the Knox biface displays an image of a probable plant form combined with carefully drawn geometric elements of at least three different shapes, all of which are infilled with parallel line or cross-hatched patterns. Additionally, one part of this design consists of a very regular pattern of adjacent, repeated, triangular elements while the other part of the geometric design consists of scattered elements, each of which touches at least one other, laid out in no obvious pattern.

Without regard for the incised decoration, the biface is what Fagan (personal communication 2011) terms a "toolkit in transition." The flaking pattern indicates that the biface was the source of large flakes that were then used as, or modified into, smaller tools, rather than a finished bifacial tool itself. Fagan noted that removal of the extant flakes was not done primarily to thin the piece, but instead to obtain flakes suitable for smaller tools. Scars indicate that about a dozen such flakes were already detached from this piece and that at least that many more remained for a knapper of reasonable skill to remove. Finally, Fagan observed that platform preparation and flake detachment for the flakes already taken from the piece removed at least 1-2 cm of material around the entire biface circumference. This is particularly noteworthy on the reverse surface where several of the larger flakes are clearly foreshortened, with their point of origin being as much as 2 cm out from the present biface edge.

Since we know that the knapper started to destroy the design on this biface by flaking around its margins, and prepared platforms for removing two more major flakes from the reverse side, his reason for stopping is unknown. However, it seems plausible that the emergence of the incised cortical surface in the shape of a crude animal form may have given the knapper pause, and this may be why the biface was retained in this form.

In summary, this artifact is a remarkable example of a poorly known class of artifacts for which we have only limited information. Unfortunately this piece has only general provenience, but the sophistication of the incised design makes it worthy of note.

REFERENCES CITED

Black, S.
2008 Clovis Reconsidered. Accessed January 2012, at *http://www.texasbeyondhistory.net/gault/clovis.html*.

Brumm, A., N. Boivin, and R. Fullagar
2006 Signs of Life: Engraved Stone Artifacts from Neolithic South India. *Cambridge Archaeological Journal* 16(2):165-190.

Fischer, A.
1974 An Ornamented Flint-Core from Holmegård V, Zealand, Denmark. *Acta Archaeologica* 45:155-168.

Jackson, A. T.
1938 *Picture-Writing of Texas Indians*. Anthropological Papers Vol. II. University of Texas, Austin.

Klimowicz, J.
1988 A Structural Analysis of Prehistoric Incised stones from Southern Nevada. Master's Thesis, Department of Anthropology, University of Nevada, Reno.

Knox, R.
2008 History of the Artifact. Unpublished Typescript Notes in Possession of Mr. Knox.

Reid, K. and G. Caulk
1986 To Tally or to Dally? An Analysis of Incised Stones from Two Upland Hunting Camps in Wallowa County, Oregon. Paper presented at the 39th Annual Northwest Anthropological Conference, 27-29 March 1986, Moscow, Idaho. Paper abstract printed in *Northwest Anthropological Research Notes* 20(1):60.

Wernecke, D. C. and M. B. Collins
2010 Patterns and Process: Some Thoughts on the Incised Stones from the Gault Site. Central Texas, United States. Acts of the IFRAO Congress on Pleistocene Art of the World, Foix, France. Accessed January 2012, at http://ifrao.sesta.fr/docs/articles/Wernecke_Collins-Amerique.pdf.

Toward an Improved Archaic Radiocarbon Chronology for Central Texas

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ABSTRACT

In this study we present a revised cultural chronology for Central Texas starting with the beginning of the terminus of the Early Archaic, ca. 5800 cal B.P., and ending with the Late Prehistoric, which we argue should consist solely of the Toyah interval at A.D. 1300. Our study is based on a careful review of published radiocarbon dates that are arguably associated with only single point types. We rely on complementary lines of evidence including a high precision chronology of regional bison exploitation, a geoarcheological model of site formation at the Spring Lake site in Hays County, and dietary reconstructions using stable carbon and nitrogen isotope data from the Early Archaic through Toyah to support our interpretations of these data. In addition to relatively precise dates for the Middle Archaic, our model proposes four Late Archaic periods. In addition to increased precision in the regional chronology, our study defines some problematic issues that should be addressed in future work.

INTRODUCTION

Building chronologies, or reconstructing sequences of events, patterns, and periods that occurred in the past, is the "first and often most important step in archaeological research" (Renfrew and Bahn 2012:166). This has been the case for Central Texas since Pearce (1932) described crudely stratified deposits he observed in "kitchen" or burned rock middens. Subsequent research in this region has led to thousands of hours and millions of dollars spent on refining prehistoric events and cultural periods.

Here, we present a revised chronological model for greater Central Texas spanning the end of the Early Archaic to the beginning of the Late Prehistoric Toyah interval, a period encompassing more than 5,000 years. Our model differs from previous ones in that it focuses on reevaluating the existing radiocarbon record to isolate assays that are apparently associated with only a single projectile point style. Additionally, we use direct dates of bison bones and other data to help limit and interpret this revised chronological model. Our reconsideration of the available radiocarbon record highlights the need for greatly improved sample selection and reporting, for additional targeted dating, and for alternative approaches to building and interpreting chronological models.

In terms of associated projectile point types, our model starts with the Calf Creek horizon (including Bell and Andice types), which we consider to represent the terminal Early Archaic, and ends with Scallorn, which we think marks the end of the Archaic era. This study is part of an ongoing effort to understand as precisely as possible the timing of the periods of use of "diagnostic" key index markers (or time markers), most of which are projectile point styles, as well as the timing of sporadic periods of bison hunting and, to a lesser degree, some environmental conditions in the region.

We make no attempt to comprehensively summarize or evaluate previous chronological schemes or models that have been presented for the region; we refer readers to a recent article in the *Bulletin of the Texas Archeological Society* for a useful overview of prior efforts (Carpenter and Houk 2012). Our work builds on a long series of chronological efforts, and we are strongly and positively influenced by these previous studies. Particularly important syntheses were accomplished early by Dee Ann Suhm, Alex Krieger, and Edward Jelks (Suhm et al. 1954; Suhm and Jelks 1962); and subsequently by Frank Weir (1976), Elton Prewitt (1981, 1983), LeRoy Johnson and Glenn Goode (1994), and Michael Collins (1995, 2004). Many recent and useful publications discuss chronology-related semantics and offer detailed treatments of chronology as a research domain in the region (e.g., Carpenter et al. 2013; Carpenter and Houk 2012; Houk et al. 2008, 2009).

Our study is an outgrowth of archeological research in Hays County, especially at Spring Lake, the small impoundment at the headwaters of the San Marcos River that includes State Antiquities Landmarks 41HY147, 41HY160, 41HY161, and 41HY165. Major springs here have attracted humans at least since the Clovis horizon and archeological evidence shows that the immediate area was occupied more or less continuously throughout prehistoric and historic times (Lohse 2013). We have recently compiled a large set of radiocarbon assays on charred plants and on bison bone recovered from archeological deposits at Spring Lake. Our dating program has been aimed at understanding the chronological sequence of the immediate Spring Lake area and relating this chronology to broader patterns of cultural and ecological change through time. We use some of these data here, specifically dates for bison exploitation, environmental modeling for site depositional rates and processes, and isotopic evidence for dietary behavior, to help interpret and contextualize our findings.

Spring Lake, like many major springs (including Comal Springs, Barton Springs, and various San Antonio springs), lies along the Balcones Escarpment on the eastern edge of the Edwards Plateau within what has long been regarded as the Central Texas archeological region, the boundaries of which have been variously defined (e.g., Collins 1995; Ellis et al. 1995; Prewitt 1981; Suhm 1960). Hays County lies within the eastern part of Central Texas in all of these schemes. We have observed that most of the cultural patterns seen at Spring Lake closely parallel those in evidence across most of the region and in immediately adjacent areas as well. Thus, for present purposes we regard our study area as "greater" Central Texas and leave it at that.

CHRONOLOGIES AS TOOLS FOR INTERPRETATION

The purpose of chronologies is to outline a sequence of events, distinctive artifacts, and cultural patterns in their proper temporal order. As models, they are subject to testing and verification, and are useful to varying degrees depending on factors like temporal precision and accuracy, sensitivity to doubt or uncertainty, the lines of evidence on which they are based, and the inclusion of additional lines of information useful for understanding the past. We think that the Archaic (and Paleoindian) cultural chronology for Central Texas will always be somewhat imprecise because it depends so heavily on inferred dates for changes in projectile point styles. Resolving this imprecision to some degree is the main focus of our study. For example, important cultural periods are frequently presented as 500 or more years long, and we argue that such periods were likely to have been in reality much shorter in duration. Another factor is that stone projectile tips cannot be directly dated. Consequently, archeologists working in the region must rely on the quality of the association between a diagnostic time marker and a nearby dateable organic material.

With only a few exceptions, almost all of the time markers used in Central Texas are projectile points. The degree of separation between what is referred to as the "target event" (the precise time when a given point type was made and used) and the "dated event" (the chronometric age of the organic sample submitted for radiocarbon dating) can be misleading, even in the most carefully controlled excavations. Site formation processes (e.g., gradual deposition, bioturbation, and deflation) routinely result in the close physical proximity of materials that are separated in age by centuries or even much longer. Excavators can sometimes but not always detect these processes.

Most prehistoric sites in Central Texas contain mixed-age deposits for the simple reason that they commonly formed on slowly aggrading or non-aggrading stable land surfaces that were periodically subject to periods of erosion (Collins 1995). Human actions, like the digging of pits associated with shallow earth ovens or other features, contribute to this condition. Unfortunately, over the history of archeological research in the region, short-term deposits are often judged as insignificant because they are typically "artifact poor" relative to the rich deposits found in larger sites that routinely formed on stable land surfaces. Even when ideal depositional contexts were encountered and sampled, for budget reasons archeologists have often relied on only a few radiocarbon assays to ascertain the age of the deposits.

Radiocarbon dates can be adversely affected by sample contamination, processing discrepancies among laboratories (e.g., Internal Study Group 1982), sample size, and dating method. In Central Texas, accelerator mass spectrometry (AMS) dating did not become routine until the 1990s; thus most radiocarbon assays were run using conventional radiometric techniques that required at least 10-20 grams of carbonized material. This meant that archeologists pursued radiocarbon dating infrequently because they lacked samples of adequate size; or that they had to submit pooled samples from broad contexts, rather than spot-provenienced samples. In most sites the only carbonized material preserved in such quantities is wood charcoal. Charred wood may come from long-lived species (e.g., live oak) and may well include "old wood" that dates decades or even centuries older than the dated context. AMS dating allows a far better strategy: the dating of charred fragments of short-lived species (e.g., grasses) and plant parts (such as seeds or twigs) from targeted spots.

As a result of many interrelated problems—uncertain associations, mixed-age deposits, insufficient sampling, less-than-ideal material selection, inconsistencies in reporting, and radiocarbon processing issues—the majority of the radiocarbon assays that have been obtained from Central Texas sites over the past half century cannot be regarded as reliable age estimates for the purpose of constructing chronologies with the degree of precision we seek. A key distinction here is between accuracy and precision. We accept that many older assays (those obtained prior to recent decades, especially conventional radiometric assays) remain relatively accurate: that is, the true date of the targeted event falls within the estimated age span. But the spans of time that most such assays represent when calibrated and considered at two standard deviations of confidence (95.4% probability) are very imprecise compared with what can be achieved by contemporary dating methods. Precise dates are those with narrow estimated age spans, and one of our objectives is to present a chronological model that is both accurate and precise. While the overall awareness of factors leading to more precise radiocarbon-based chronologies is improving in archeology, much remains to be done in the region.

In our view, continued attention to refining the cultural chronology of greater Central Texas is worthwhile, and should remain a viable research priority regardless of changes in theoretical orientation across the larger field of anthropological archeology. We concur with recent criticisms of the prioritization of chronology for its own sake (Arnn 2005; Dillehay 2012), insofar as this prioritization precludes adequate attention given to other issues. When appropriate opportunities arise, however, we believe that continued and more rigorous efforts to refine and improve regional chronologies will pay off over time. Chronologies strongly influence the way archeologists understand not only the timing, but also the nature of culture change.

How Chronologies Influence Interpretations

As approaches to absolute dating improve, so too should archeologists' consideration of how chronological schemes can be presented in ways that maximize their effectiveness. For example, chronologies typically portray important time periods as having standard dimensions rounded off to the nearest millennium or century, often shown as a succession of boxes neatly arranged into columns that show no overlap. All archeologists realize that culture change is not as neat as these schemes imply, and that this convention is merely one of convenience. Furthermore, although differences in time periods are said to reflect changes in artifact types and the products of other cultural behaviors (e.g., new technologies, feature types, burial patterns, etc.), most chronologies reveal little or nothing about the nature of the transitions from one period to the next. Were culture changes drawn out or did they happen quickly? Were they local developments or the result of migration or other external cultural influences? Were climatic or ecological changes correlated with the technological changes that chronologies represent?

Another issue for consideration is how chronological models influence expectations concerning site components and acceptable degrees of mixing. Because they are regional syntheses, existing chronological schemes depict the full range of types and time periods in Central Texas with little emphasis on precision. For instance, many archeologists accept the notion that Montell, Castroville, and Marcos points co-occurred during the Late Archaic a little more than 2,000 years ago (see Carpenter et al. 2013; Carpenter and Houk 2012). However, actual ages for each of these types and any degree of separation that might exist are poorly known, and these types are frequently included in the same archeological period as a result. Judging from the groupings of projectile point types portrayed in existing chronologies, the same could be said about many types: they are thought to co-occur over many centuries. Yet very few published sites contain dated components or contexts having only a single point type without others also being found in association. For example, site components having *only* Montell, Castroville, or Marcos points are scarce (see below). Components containing all three appear "robust" in terms of volume and diversity of material content and are often ascribed considerable research value when it comes to allocating money for data recovery. One unfortunate result is that some reconstructed Middle or Late Archaic components span over a thousand years, a length of time with minimal analytical utility for understanding any but the broadest patterns of culture change or social process.

Improvements in how chronologies communicate larger processes involved in culture change can be seen in schemes that also chart complementary lines of evidence, such as climate, at the same temporal scale (e.g., Prewitt 1981). A good example is the model by Johnson and Goode (1994:Figure 2) that depicts the temporal relationship between broad patterns of climate change and equally broad "archeological eras." Their presentation of a generalized climatic model, based on an interpretive synthesis of various lines of published evidence, allows readers to contemplate the co-occurrence of stylistic change with long-term variation in temperature and precipitation.

The integration of additional data, beyond only calendar ages and artifact types, indicates the degree to which researchers intend their chronologies to serve as summaries or even syntheses of time-ordered regional processes. Following Prewitt's (1981) work for Central Texas, perhaps the best regional example is the chronology compiled by Collins (1995, 2004). This complex model builds on and incorporates virtually all of the information presented by Johnson and Goode (1994) and by Prewitt (1981), while also including bison abundance curves (e.g., Dillehay 1974), site components used in the compilation, assessments of the stratigraphic integrity of those components, bog pollen and microfaunal data indicating climate, and regional periods of soil development. This composite graph is large and complex enough that its initial publication in 1995 spanned two pages of the 66th *Bulletin of the Texas Archeological Society*.

Collins' model clearly illustrates several points. First, although he dropped Prewitt's phase names, Collins defined chronological periods by unnamed "style intervals," most of which correspond closely with Prewitt's divisions (12 Archaic style intervals vs. 11 Archaic phases). The effect of this organizational decision was to drop problematic time-space concepts (i.e., stages and phases; cf. Johnson [1986]) while retaining the temporal resolution that those units imply. The Collins chronology also suggests that, in many cases, the "best" data for a given point type, such as Bell and Andice (stylistic variants of basally notched points that mark the Calf Creek horizon), come only from a single site. For other important styles, including Taylor/Early Triangular, Nolan and Travis, and Bulverde, we lack any "high integrity" site components whatsoever. By including stratigraphic integrity as an indication of the degree to which archeologists should rely on or accept the available chronological data, Collins' model brought important attention to how much work remains to be done in terms of refining regional chronologies.

From these previous models and approaches we have learned that more dates are needed that are in reliable association with certain key point types and, ideally, associated with other lines of data such as paleoclimatic proxies, bison abundance, or dietary patterns when they can be reconstructed. Additionally, balance between the level of precision implied by Prewitt and Collins and the accuracy of the gross temporal units (e.g., Middle Archaic, Late Archaic 1, Late Archaic 2) used by Johnson and Goode is needed. Archeologists should continually strive for more-precise chronological control and regional models featuring intervals lasting 1,000 to 2,000 years are simply not very useful. The same concerns also apply to how supporting lines of evidence are developed and then integrated into chronological models. In our view, directly-dated complementary evidence is essential if researchers wish to maintain the highest degrees of chronological precision. Below, we address this issue with respect to bison and also sediment aggradation during the problematic Holocene Climatic Optimum (Meltzer 1999), which likely corresponds with the Edwards Interval defined by Johnson and Goode (1994) as a period of peak aridity. Finally, by analyzing the present state of chronological knowledge and showing where dating gaps exist, we hope to encourage future efforts that will target poorly known intervals, or at least to not place undue emphasis and confidence on a demonstrably uncertain record.

METHODS FOR THE PRESENT STUDY

As we conceive it, a major current obstacle to refining the Central Texas regional chronology is the dearth of reliable radiocarbon dates in clear or unmixed stratigraphic association with diagnostic projectile points. Part of the current predicament results from the uncritical use of radiocarbon dating and the incomplete reporting of the results. Both factors make it difficult or impossible to effectively use or even accept many assays that were run in earlier decades, or even many recent dates. As noted, the reliability of radiocarbon dating has improved dramatically in recent years, especially with the widespread use of AMS, improved processing methods, and the routine identification of the dated materials. Yet it remains the case that many assays that we regard as unreliable still provide the basis for much of our understanding of when certain periods begin and end (see Arnn 2012:63-64, 146).

Our primary objective in this study is to use published radiocarbon and associated contextual data to refine radiocarbon-based understandings of when certain "key" point types occurred in time. Our assumption is that, when cleaned up and viewed with caution, the extant radiocarbon record approximates the age and duration of the archeological periods associated with those types. We interpret this chronological sequence by comparing it against a reliable chronologic record of bison exploitation and by considering independent radiocarbon evidence for rates and patterns of sediment deposition at Spring Lake during certain problematic time periods, specifically the Middle Archaic and early part of the Late Archaic. Human dietary reconstructions based on stable carbon and nitrogen isotope data are also used to help support parts of our chronological model.

Using the library of cultural resource management (CRM) reports in the library at the Center for Archaeological Studies at Texas State University-San Marcos,[1] as well as additional publications from other sources, we searched for radiocarbon assays that were described as being associated with certain point types starting from the beginning of the Middle Archaic to the beginning of the Late Prehistoric, which we limit exclusively to the Toyah horizon. For this study, we tried to review every available archeological publication from Central Texas. We compiled all radiocarbon dates that we could find that were purportedly associated with 16 point types from our period of interest. This period begins with the outset of the Middle Archaic, just under 6,000 years ago and extends until the very end of the Archaic, which we argue did not take place until about 700 years ago. In approximate chronological order from youngest to oldest these types include:

Scallorn
Darl
Frio
Fairland
Ensor
Marcos
Castroville
Montell
Marshall
Kinney
Pedernales
Bulverde
Travis
Nolan
Early Triangular (sometimes called Taylor or Baird)
Bell-Andice-Calf Creek (considered variants of the same basic style)

Not all types that occur in Central Texas during the latter half of the Archaic are included in our study. Some, like Edgewood and Ellis, were omitted because they are less common than other types, like Ensor, from approximately the same time period. Such data gaps remain to be filled. For other types, like Bulverde, Kinney, and Fairland, no dates could be found from unmixed contexts.

The concept of *types* is central to our project, but we do not assume that all projectile point types in the region are completely defined or that further analyses are not necessary for some of them. Indeed, our findings point to a need for typological clarification and we make some suggestions toward that end. Still, for this study we accept the veracity of the published type identifications, as most of the types are commonly encountered in the region and most of the types are well described in available typologies (e.g., Suhm and Jelks 1962; Turner et al. 2011). We also accept the purported associations between the dated samples and projectile point types, although we were somewhat more critical in this regard. In the concluding section of this paper we point to the need for additional reevaluations of both typology and of the stratigraphic integrity of dated contexts.

We started our library research with two assumptions. First, we assume that each projectile point type had its own chronological history: at some point in time a particular design was invented and was emulated over a period of decades or longer before that distinctive way of making a projectile point was abandoned. Secondly, we assume that if more than one type was found in the same site context, there is a greater likelihood that the context represents a lengthy span of time (i.e., it is of mixed age) than if only a single type is present. We do not assume, however, that only a single projectile point type was in use at one point in time in the region or even in one local area or site. We believe it was the case that certain types co-existed during certain intervals of time. Yet, we wanted to examine point type temporal distributions independently. We discuss viable alternative dating strategies at the end of the article.

Revaluating the Radiocarbon Record

Central Texas radiocarbon dates are published in a number of ways, and this variability presents one of the greatest challenges to this study. In an effort to improve this situation, we outline what we consider the minimum radiocarbon and contextual data that must be reported in order to make those data useful to current and future researchers. Given the many ways that dates have been reported, it was necessary to establish protocols for evaluating what constitutes a useful date for our purposes. Our protocols involved addressing three simple questions.

1. Was the radiocarbon assay fully published?

We ruled out assays for which we could not find original publication data with basic critical numeric and contextual data such as lab/sample number, raw reported assay, standard deviation, the material dated, and provenience. In many cases, this information could only be obtained from the journal *Radiocarbon*, where certain labs have published their assays independent from archeological reports. Although we made use of several publications compiling existing radiocarbon data from the region (e.g., Prewitt 1983), in all cases we tried to check the original publications to avoid possible transcription errors. In some cases when the dated material was not clearly specified, we accepted the date if we could safely assume the material was wood charcoal. We also used certain (older) assays for which the $\delta^{13}C$ corrected age was not provided.

2. Is the radiocarbon assay likely to provide a reliable age for the dated material?

With the exception of our own high-precision AMS dates on bison samples, we avoided using radiocarbon dates from bone or shell samples. Pre-treatment processes for non-carbon materials have developed considerably in recent decades (e.g., Stafford et al. 1988, 1991) making most if not all older assays on these materials highly problematic. Another reliability factor is the fact that many radiometric assays from the early decades of radiocarbon dating, when calibrated to one- or two-sigma degrees of confidence, have very large age range estimates. We established an arbitrary rule and eliminated from consideration any assay with a reported standard deviation of more than 100 years, although even this figure is problematic. In truth, most assays obtained prior to the last couple of decades should be viewed with a healthy degree of skepticism. We believe that important contexts that were dated long ago and those that were dated only on the basis of a single radiocarbon assay, merit new dating effort.

3. Is the assay reliably associated with a single projectile point type?

In addition to the lack of precision associated with older assays and the potential inaccuracy of non-carbon dates, most dates that are described in the literature as being associated with a certain point type actually proved to be from contexts containing multiple types. Many published dates were obtained on materials recovered from depositional "zones" that contained multiple projectile point types, and large age ranges are commonly attributed to these zones. While this "zone dating" approach can be useful for some purposes, it does not yield the kind of temporal precision that we sought. Therefore, we only used dates reportedly associated with a single point type. We also rejected assays where excavators recognized obvious contextual problems such as animal burrow disturbances.

Even after meeting these criteria, some seemingly valid dates fell well outside of a given type's plausible age range for reasons we could not identify. For types with less than four reliable assays, we do not feel there is a solid basis for identifying "outliers." But for the types with relatively robust sets of assays (≥4) we imposed an arbitrary "10 percent rule" to identify likely outliers. In some cases, there is no obvious contextual or sample preparation factor that can explain why a date should be excluded, yet probability curves suggest the outliers are likely to be unreliable. Using this rule we reduced the number of dates under consideration for Darl, Scallorn, and Pedernales. The rule did not apply to Marshall or Marcos, which did not meet the threshold of having a suitable number of assays.

Our 10 percent rule works as follows. After compiling all assays for a given type, we measured the difference between the midpoints (corrected date in radiocarbon years before present, or B.P.) of all dates for each type. If the midpoint date was more than 10% younger or older than the next one in the sequence, we excluded the outlying assay and assumed that the more closely overlapping assays represent the "best" (most accurate) age estimates for that type. Admittedly this is not a very satisfying way of verifying radiocarbon data, but it allows us to exclude likely problematic dates without being too capricious. To illustrate this rule, Table 1 shows the 20 assays that appeared based on our initial research to be reliably associated with Darl points; two of these assays were rejected as having standard deviations greater than 100 years and two were rejected as outliers because they exceeded the 10 percent rule.

Central Texas Radiocarbon Sample

After reviewing several hundred radiocarbon assays and applying our evaluation protocols, we identified a total of 67 dates that we consider valid age estimates for 13 projectile point types. These dates come from 28 sites, the approximate locations of which are shown in Figure 1. As can be seen, most of the sites included in our study form a spatial arc along and paralleling the Balcones Escarpment. In addition to these published assays on plant remains, we make use of certain high-precision AMS dates from directly dated bison bones that are part of a bison-use chronological

Table 1. Listing of dates associated with Darl points, showing which assays are excluded from study based on our evaluation protocols.

Sample No.	Radiocarbon Dates (BP)	Standard Deviation
Beta 176630	**710**	**40**
	Difference = 11.3%	
Beta 168468	800	60
Beta 169225	**850**	**110**
Beta 176628	880	40
Beta 176627	890	40
UGA-12493	930	40
UCIAMS-87429	935	20
Beta 195847	940	70
UCIAMS-87430	960	20
Beta 176623	980	40
Beta 176621	1070	40
Beta 175164	1190	40
Beta 175169	1260	40
Beta 102094	1280	40
Beta 182848	1330	40
UGA-12496	1370	40
Beta 176582	1370	40
TX 1767	**1480**	**170**
TX 1927	1480	80
	Difference = 12.1%	
Beta 182829	**1660**	**40**

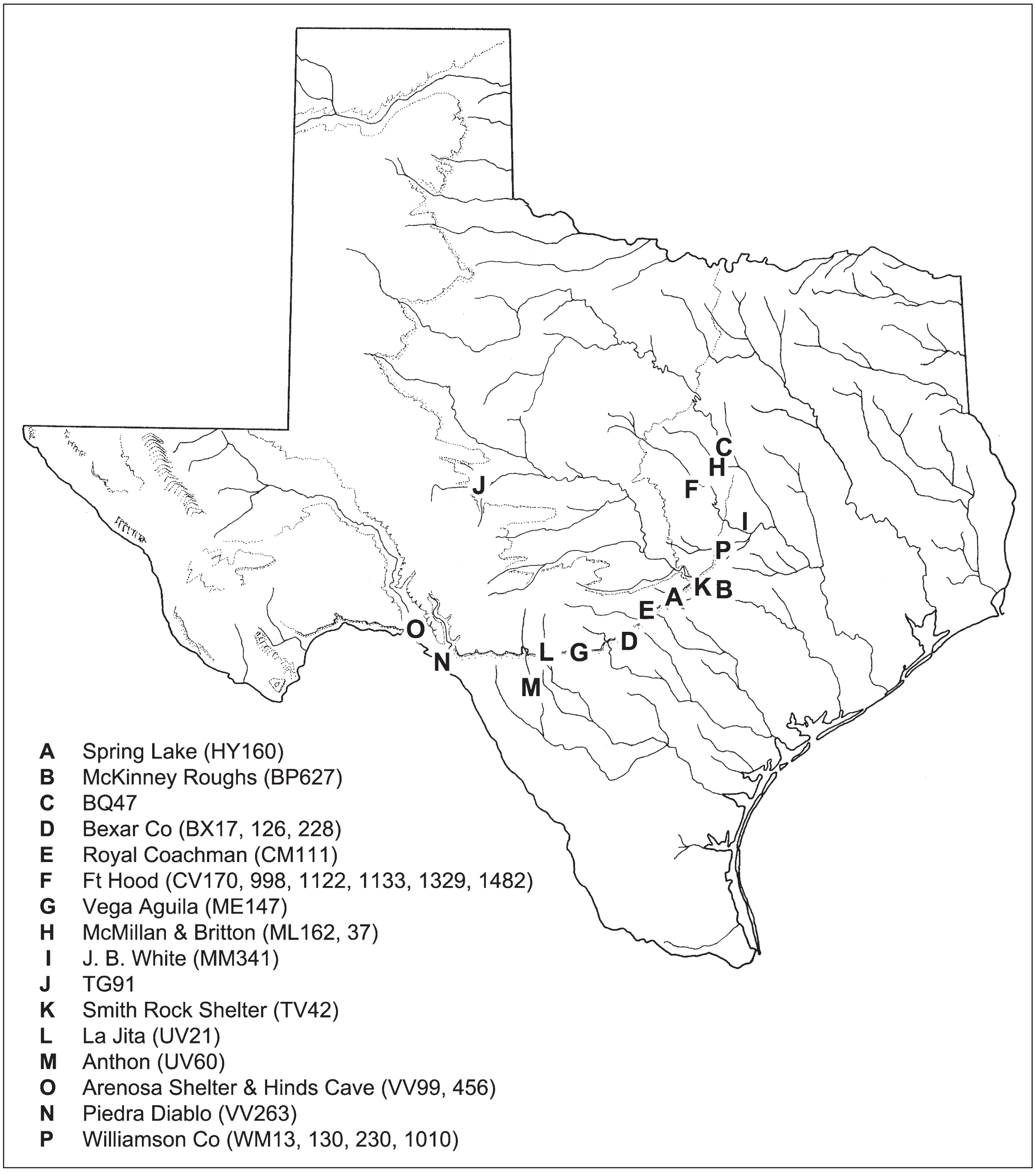

Figure 1. Locations of 28 sites that yielded radiocarbon dates that we consider valid age estimates for 13 projectile point types. Trinomial designations are truncated; all of the sites and are fully expressed by adding the prefix "41" (e.g., 41HY160).

study that currently includes 57 assays, most from Spring Lake and nearby 41HY188. Here we use 12 bison dates from Calf Creek contexts as a way of defining the very end of the Early Archaic, and other bison dates to interpret changes in the Late Archaic part of the sequence. In the next section we discuss the bison dates and justify our use of these.

In addition to these dates, we also use six charred plant assays from a depositional zone at Spring Lake that contains Early Triangular, Nolan, and Travis points in mixed contexts. This exception to our rule is warranted because prior work at Spring Lake helps illustrate what the Middle Archaic deposits at many Central Texas sites look like in terms of stratigraphic condition. Additionally, this temporal unit, which we call Early Triangular-Nolan-Travis (ET-N-T), provides a way to evaluate the published results for Nolan and for Early Triangular points (no valid dates were found for Travis points).

Counting these two exceptions to our rules, the inclusion of Calf Creek bison dates and ET-N-T dates from Middle Archaic deposits at Spring Lake, our study includes 85 radiocarbon dates (Table 2). Several point types in our study are only dated by one, two, or three assays. This fact alone points to the need for additional dating work with an eye to chronological precision.

We calibrated the radiocarbon dates using the online calibration program OxCal (version 4.1.7). We then used OxCal's *sum* function to look at the total or summed probability of a point type's chronometric age, based on the assays associated with that type. This technique is useful for considering all radiocarbon data associated with a particular event, phase, or, in this case, a type that is available from several different contexts or sites. Where a corrected age was available, we used that figure. In many cases, especially for older dates, if no corrected age was listed, we used the measured radiocarbon age. We acknowledge this decision introduces additional error, but $\delta^{13}C$ correction typically results in changes of only a few decades.

In the following discussions, most dates are presented and discussed in calibrated years before present (cal B.P.). For discussion purposes, these dates are discussed at two standard deviations. This convention gives an appropriate combination of precision and confidence in the age assay. In some cases, comparative discussions of other dates not included in our study use uncalibrated radiocarbon years before present (RCYBP). In our discussions below, we are clear about which version of the age estimate we are using.

Bison Dates

As discussed, a useful aspect of some chronologies is that they present time-ordered data along with climatic/environmental inferences. In our effort to understand the Central Texas cultural sequence, we have compiled an extensive record of precisely dated bison remains from archeological contexts at Spring Lake (41HY160 and 41HY165) and at a nearby site, 41HY188 (Bettis 1996), that was excavated by a Southwest Texas State University field school in the late-1980s. Our bison record also includes two dates from 41ME147, the Eagle Bluff site, excavated by the 2010 Texas Archeological Society (TAS) field school (these dates are courtesy of the TAS and Harry Shafer). This record so far includes 57 XAD-purified AMS dates from the Middle to Late Holocene (Lohse et al. n.d.). The XAD purification technique was developed in order to address issues of exogenous carbon leaching into bone collagen from surrounding depositional matrices (Stafford et al. 1988, 1991). The technique allows individual amino acid chains to be isolated and purified prior to dating. This technique permits the most reliable bone radiocarbon dates that can presently be obtained.

Previous chronological models of bison presence in the region have relied on archeological association, and are characterized by varying degrees of precision (Figure 2). Our work on this issue represents the most precise and reliable chronology for bison exploitation yet available for any singe study area in Texas, if not the entire Southern Plains. Although our sample does not cover the full historical range or geographic extent of bison in Central Texas, it provides sound baseline data for the presence of large-bodied herbivores that would have represented the top-ranked prey choice for hunters during times of availability (Figure 3). We use these data as an interpretive framework for our chronology of diagnostic point types.

RESULTS

When the probabilities associated with each point type or period of time are summed and presented together, some patterns are immediately clear (Figure 4). First, some types seem to show a strongly bimodal age distribution; this is true for Darl, Marshall, Nolan, and to a lesser degree for Marcos and Montell. One reason for this may be typological problems that have not yet been resolved. We think this is the case for Darl, which has 16 assays. Another possibility is unrecognized mixing of sediments or deposits that results in the inclusion of poorly-associated assays with each type. We think this is the case for Nolan, considering the apparent stratigraphic placement of that type as at least coeval with and perhaps earlier than Early Triangular. It might also account for the

Table 2. Radiocarbon data for "reliable" assays associated with certain key types used in this study.

Sample No.	Reported age in Radiocarbon Years	Corrected Date (RCYBP)	Site No.	Published References
			Scallorn (n=13)	
TX 687	660±70	N/A	41UV29	Hester (1971), Valastro and Davis (1970a:634)
TX 26	705±95	N/A	41TV42	Tamers et al. (1964:164)
Beta 176631	740±40	740±40	41MM341	Gadus et al. (2006:59, 76, 320, 333)
Beta 176622	760±40	770±40	41MM341	Gadus et al. (2006:59, 76, 320, 333)
TX 2729	800±70	N/A	41WM130	Bond (1978:78, 122), Valastro et al. (1979:265)
Beta 176629	850±40	850±40	41MM341	Gadus et al. (2006:60, 76, 320, 333)
TX 1925	870±60	N/A	41WM230	Prewitt (1974:22-24), Valastro et al. (1977:302)
TX 1923	940±60	N/A	41WM230	Prewitt (1974:22-24), Valastro et al. (1977:302)
Beta 169079	960±40	980±40	41WM1010	Dixon and Rogers (2006:44, 67, 73, Appendices A and C)
TX 3854	1030±70	N/A	41BX228	Black and McGraw (1985:237)
TX 1764	1080±60	N/A	41WM230	Prewitt (1974:22-24), Valastro et al. (1977:302)
Beta 175172	1130±40	1140±40	41WM1010	Dixon and Rogers (2006:44, 57, 73, Appendices A and C)
Beta 168245	1160±40	1150±40	41WM1010	Dixon and Rogers (2006:44, 67-68, Appendices A and C)
			Darl (n=16)	
Beta 168468	800±60	800±60	41WM1010	Dixon and Rogers (2006:44, 51, 83, Appendix A, Appendix C)
Beta 176628	880±40	880±40	41MM341	Gadus et al. (2006:59, 76, 324, 338)
Beta 176627	890±40	890±40	41MM341	Gadus et al. (2006:59, 76, 324, 337)
UGA 12493	930±40	860±40	41MM341	Gadus et al. (2006:57, 324, 335)
UCIAMS 87429	935±20	N/A	41HY160	On file at CAS
Beta 195847	940±70	950±70	41BP627	Carpenter et al. (2006:86, 98, Appendix C)
UCIAMS 87430	960±20	N/A	41HY160	On file at CAS
Beta 176623	980±40	970±40	41MM341	Gadus et al. (2006:57, 76, 324, 334)
Beta 176621	1070±40	1070±40	41MM341	Gadus et al. (2006:57, 76, 324, 333)
Beta 175164	1190±40	1220±40	41WM1010	Dixon and Rogers (2006:44, 51, 99, Appendices A and C)
Beta 175169	1260±40	1240±40	41WM1010	Dixon and Rogers (2006:44, 51, 93, 95, Appendices A and C)
Beta 102094	1280±40	N/A	41CV998	Kleinbach et al. (1999:77, Appendix A)

Table 2. *(Continued)*

Sample No.	Reported age in Radiocarbon Years	Corrected Date (RCYBP)	Site No.	Published References
Beta 182848	1330±40	N/A	41ML162	Mehalchick and Kibler (2008: 193, 430)
UGA 12496	1370±40	1390±40	41MM341	Gadus et al. (2006:59, 76, 324, 336)
Beta 176582	1370±40	1380±40	41WM1010	Dixon and Rogers (2006:44, 120, Appendices A and C)
TX 1927	1480±80	N/A	41WM230	Valastro et al. (1977:302)
		Frio (n=2)		
TX 686	1460±80	N/A	41UV21	Valastro and Davis (1970a:635)
TX 2378	1580±60	N/A	41UV60	Goode (2002:197, 200), Valastro et al. (1977:306)
		Fairland – no dates available		
		Ensor (n=14)		
TX 2384	1640±60	N/A	41UV60	Goode (2002: 197, 200)
TX 2733	1820±70	N/A	41VV456	Valastro et al. (1979:266)
Beta 195849	1840±40	1830±40	41BP627	Carpenter et al. (2006: 86, 99-100, Appendix C)
Beta 87650	1880±70	N/A	41CV1482	Mehalchick et al. (1999:138, 140-141)
Beta 119142	1950±60	N/A	41CV1329	Mehalchick et al. (2000:146, 280)
Beta 182859	1960±60	N/A	41ML37	Mehalchick and Kibler (2008:133, 431)
Beta 275736	1990±40	N/A	41BX17	Munoz et al. (2011:64, 66, 259)
Beta 182874	2020±40	N/A	41ML37	Mehalchick and Kibler (2008:133, 431)
Beta 182842	2030±40	N/A	41ML162	Mehalchick and Kibler (2008:232, 430)
Beta 182876	2040±40	N/A	41ML37	Mehalchick and Kibler (2008:133, 431)
Beta 182861	2050±60	N/A	41ML37	Mehalchick and Kibler (2008:119, 133, 431)
Beta 182883	2050±50	N/A	41ML37	Mehalchick and Kibler (2008:124)
Beta 169226	2080±40	2060±40	41BP627	Carpenter et al. (2006:86, 96, Appendix C)
Beta 182841	2080±40	N/A	41ML162	Mehalchick and Kibler (2008:232, 430)

Table 2. *(Continued)*

Sample No.	Reported age in Radiocarbon Years	Corrected Date (RCYBP)	Site No.	Published References
		Marcos (n=4)		
TX 1999	2330±60	N/A	41BQ47	Valastro et al. (1979:264), Watt (1978:121-122)
TX 4758	2370±70	N/A	41TG91	Creel (1990:40-43)
TX 4761	2480±60	N/A	41TG91	Creel (1990:40-43)
TX 4763	2800±60	N/A	41TG91	Creel (1990:40-43)
		Castroville (n=1)		
Beta 102143	2560±50	N/A	41CV170	Kleinbach et al. (1999:208-209, Appendix A)
		Montell (n=3)		
TX 1977	2520±50	N/A	41VV99	Valastro et al. (1977:308)
NSRL-3520	2700±50	N/A	41BX126	Nickels et al. (2001:105, 108-109)
NSRL-3519	2780±50	N/A	41BX126	Nickels et al. (2001:105, 108-109)
		Kinney – no dates available		
		Pedernales (n=6)		
Beta 102116	3060±40	N/A	41CV1122	Kleinbach et al. (1999:277, 442, Appendix A)
Beta 94006	3240±60	3250±60	41WM13	Johnson (2000:68, 79-83)
Beta 94007	3270±60	3230±60	41WM13	Johnson (2000:68, 79-83)
UCIAMS 87433	3275±25	N/A	41HY160	On file at CAS
Beta 102121	3280±40	N/A	41CV1133	Kleinbach et al. (1999:284, 288, 442, Appendix A)
Beta 94005	3300±50	3240±50	41WM13	Johnson (2000:68, 79-83)
		Marshall (n=3)		
Tx 663	3080±90	N/A	41VV263	Valastro and Davis (1970b (1):271)
Beta 215739	3620±40	N/A	41BX17	Munoz et al. (2011:63, 64, 259)
Beta 215738	3800±40	N/A	41BX17	Munoz et al. (2011:63, 64, 259)
		Bulverde – no dates available		

Table 2. *(Continued)*

Sample No.	Reported age in Radiocarbon Years	Corrected Date (RCYBP)	Site No.	Published References
		Nolan (n=2)		
NSRL 3698	4630±40	N/A	41BX126	Nickels et al. (2001:108, 113-115)
NSRL 3697	4940±50	N/A	41BX126	Nickels et al. (2001:108, 113-115)
		Early Triangular (n=3)		
Beta 166718	4780±40	N/A	41CM111	Mahoney et al. (2003:61-63, Appendix B)
Beta 166715	4820±40	N/A	41CM111	Mahoney et al. (2003:61-63, Appendix B)
Beta 166719	4840±40	N/A	41CM111	Mahoney et al. (2003:61-63, Appendix B)
		Early Triangular-Nolan-Travis at Spring Lake (n=6)		
UCIAMS 87172	3855±15	N/A	41HY160	On file at CAS
UCIAMS 87173	3865±15	N/A	41HY160	On file at CAS
UCIAMS 87174	4140±15	N/A	41HY160	On file at CAS
UCIAMS 87175	4520±20	N/A	41HY160	On file at CAS
UCIAMS 87171	4615±20	N/A	41HY160	On file at CAS
UCIAMS 87170	4880±15	N/A	41HY160	On file at CAS
		Calf Creek (n=12)		
UCIAMS 80999	5060±40	N/A	41HY160	On file at CAS
UCIAMS 95717	5110±15	N/A	41HY160	On file at CAS
UCIAMS 80139	5115±20	N/A	41HY160	On file at CAS
UCIAMS 80136	5120±20	N/A	41HY160	On file at CAS
UCIAMS 80998	5120±20	N/A	41HY160	On file at CAS
UCIAMS 106473	5140±20	N/A	41HY160	On file at CAS
UCIAMS 106468	5140±20	N/A	41HY160	On file at CAS
UCIAMS 106469	5145±20	N/A	41HY160	On file at CAS
UCIAMS 81000	5155±15	N/A	41HY160	On file at CAS
UCIAMS 81001	5165±15	N/A	41HY160	On file at CAS
UCIAMS 80997	5180±15	N/A	41HY160	On file at CAS
UCIAMS-111182	5205±20	N/A	41ME147	On file at CAS

CAS=Center for Archaeological Studies, Texas State University

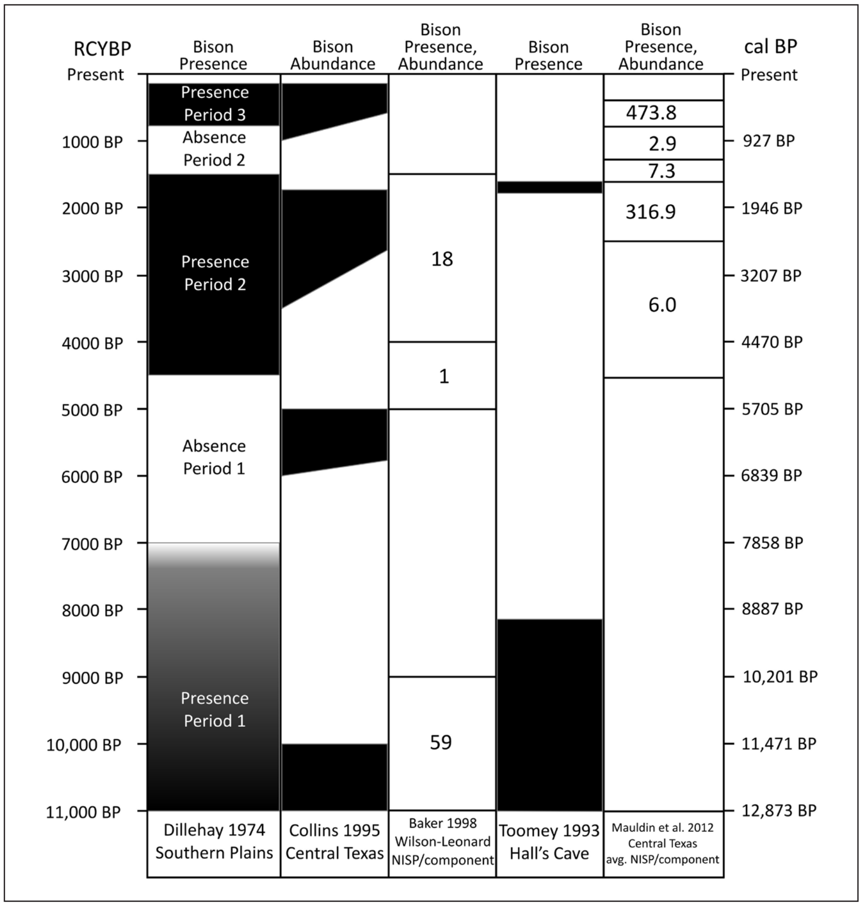

Figure 2. Existing models for the presence of bison by time period in Central Texas. Each relies on archeological association with independently dated deposits to identify periods when bison occur in archeological assemblages. Each also incorporates a different study area, lending to differences in terms of apparent presence or abundance.

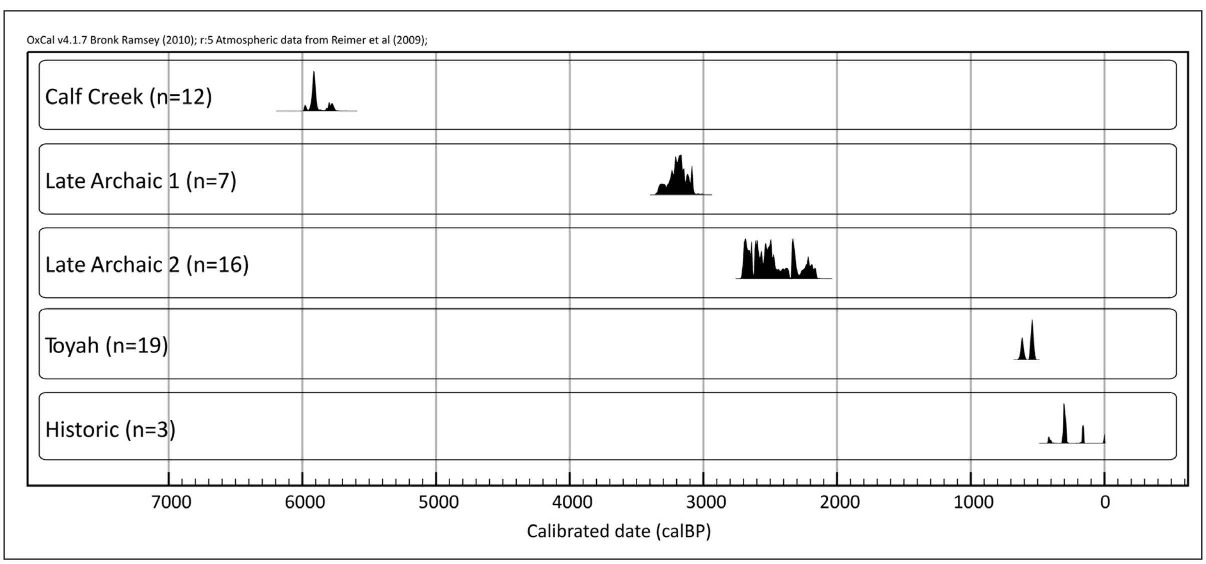

Figure 3. Summed probabilities of 57 XAD-purified AMS dates on bison from Archaic archeological contexts. One Toyah and one Calf Creek date are from 41ME147 and all others are from three sites, 41HY160, 41HY161, and 41HY188, in the San Marcos area of Central Texas.

placement of Marshall before Pedernales; all previous chronologies for Central Texas show Marshall coming after Pedernales and Bulverde, and we are skeptical of this particular aspect of our findings. Alternatively, the types with very few dates that appear bimodal may simply be inadequately dated.

Another issue involves diffuse probability distributions. This problem characterizes Montell, Marcos, and Scallorn. Some of this pattern can be attributed to the shape of the calibration curve at these times; the "shape" of the curve depends partly on the amount of atmospheric carbon that is present, and this varies significantly over time. As a result, some parts of the calibration curve appear relatively flat while other parts include brief reversals. Dates falling along these parts of the calibration curve will simply be difficult to calibrate with precision, as calibrated probabilities "stack up" along flat parts of the curve and present extended age ranges (see our discussion of Late Archaic 2, below). For older dates (see Table 2), calibrated probabilities are extended simply as a result of the

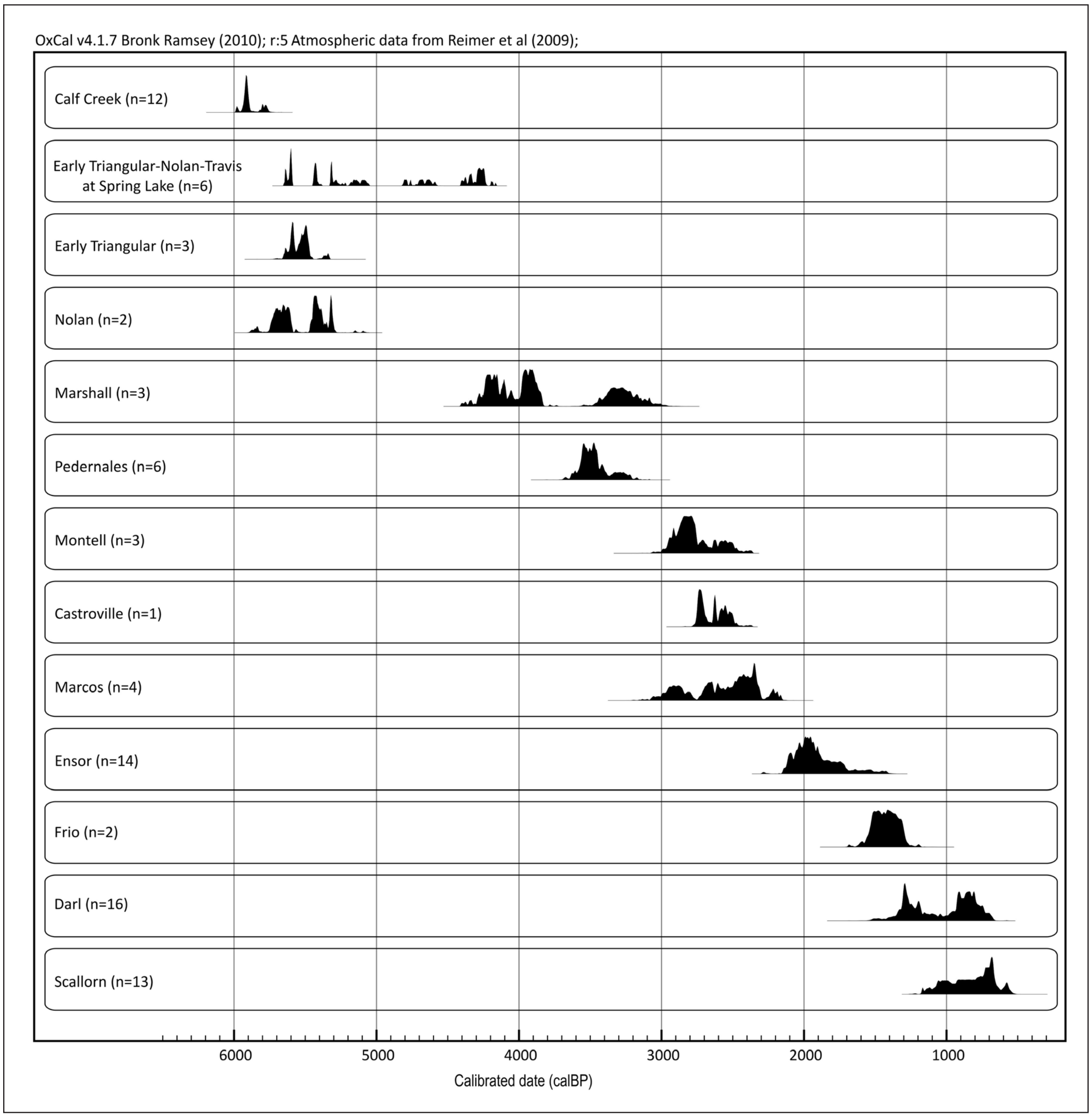

Figure 4. Summed radiocarbon probabilities of all point types included in this study. Clearly, the sample size of what we consider reliable radiocarbon dates for most types is inadequate.

large standard deviations. In both cases, this lack of precision does not improve the understanding of Central Texas prehistory and underscores how older assays and large standard deviations, as well as the systematics of calibration procedures, potentially skew chronologies. Another factor that can contribute to this pattern is that dates are included in our sample that, while meeting our criteria do not necessarily reflect the primary period of use for that type. That is, while our 10% rule was intended to identify assays that do not accurately reflect the target event (the chief period of use), it is likely that not all such dates were successfully filtered out.

In spite of these issues, once these radiocarbon results are compiled and compared against additional lines of evidence, such as the bison dates and the record of sedimentation at Spring Lake, both of which cover almost exactly the same period of time as our study, a working regional chronology starting with the end of the Early Archaic can be proposed (Figure 5).

Calf Creek Horizon: ca. 5955-5815 cal B.P. (Terminal Early Archaic)

Many Central Texas chronologies place Calf Creek in the Middle Archaic, while others show it at the end of the Early Archaic. This issue is more than semantic, as the criteria defining how major periods begin and end should be closely linked with one or more lines of sound, empirical data. We use the sharply defined period of bison exploitation and the lack of confident association between Calf Creek-related points (Bell, Andice) with typical Middle Archaic types like Travis, Nolan, and Early Triangular to define the end of the Early Archaic (Lohse et al. n.d.). Recent excavations at Spring Lake (Lohse et al. 2013; Yelacic et al. 2011) extended through a well-constrained deposit containing bison remains along with Bell/Andice material. Other relatively late Early Archaic types like Bandy, Martindale, and Merrell were recovered immediately below, and in some cases overlapping with Spring Lake's Calf Creek component. Based on the stratigraphic proximity of these types with the bison remains and the clear disjunction with the ensuing Middle Archaic deposits, we consider the Calf Creek horizon (cf. Thurmond and Wyckoff 1999) to represent the terminal Early Archaic

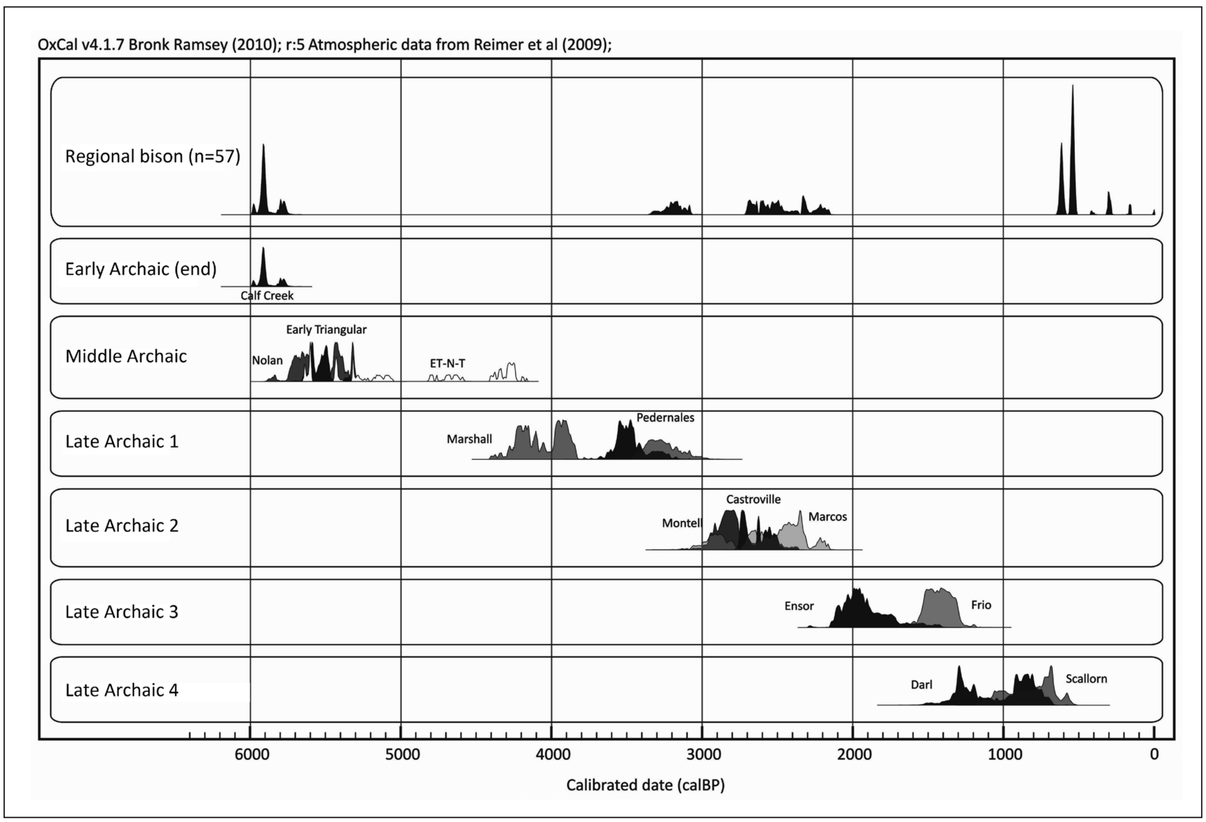

Figure 5. Proposed radiocarbon-based chronology for certain key point types, plus bison exploitation, for the Central Texas cultural chronology from the terminal Early Archaic through the end of Late Archaic 4.

period in Central Texas.

Like Wyckoff (1994; Thurmond and Wyckoff 1999), we use the term "horizon" in the sense of Willey and Phillips (1958:31-33), who describe widespread, short-term occurrences of a broadly shared style or artifact type. Given that all but one of our 12 Calf Creek dates are from Spring Lake, it remains possible that this widely occurring, but seemingly brief period of bison presence may have begun earlier or lasted later elsewhere in the region. However, a bison skull with an embedded Calf Creek point recovered from a gravel bar near Tulsa, Oklahoma has been AMS dated to 5120 ± 25 RCYBP (Bement et al. 2005), exactly within the span we document at Spring Lake. Even considering the current limitations on dating Calf Creek, we do not believe that this horizon extended much beyond 200 calendar years, and it may have been even shorter. Importantly, the presence of bison at this time is in sharp contrast with the ensuing Middle Archaic period. In our view, this distinction is marked enough that it can be used to delineate the end of the Early Archaic.

Middle Archaic: 5800–4200/4100 cal B.P.

The Middle Archaic begins at the end of the Calf Creek horizon, dated by the 12 available AMS dates on bison at about 5815 cal B.P.; we simplify this date by rounding down to 5800 B.P. Dating the end of the Middle Archaic, however, is problematic because of a lack of appropriate radiocarbon dates, which we see as linked to climatic and depositional circumstances. Additionally, the time-ordering of diagnostic types within this period is poorly known, a problem that our data cannot address. This is clearly illustrated in the broad distribution of radiocarbon probabilities from the Spring Lake Early Triangular-Nolan-Travis zone (see Figure 4).

Where these three Middle Archaic point types co-occur (e.g., Spring Lake), Early Triangular tends to be found below Nolan and Travis, indicating that the results of our review placing Nolan coeval with and perhaps before Early Triangular are inaccurate. For example, an isolated Early Triangular component has recently been identified at the Eagle Bluff site (Vega Aquila, 41ME147) beneath a zone with Nolan points during excavations by the TAS field school in 2010 and 2011 (Osburn 2011). Unfortunately, dates from this component have not yet been obtained. In the adjacent Coastal Plains, Early Triangular points in the West Slope at Buckeye Knoll (41VT98) occur in a zone dated to ca. 5100-3800 cal B.P. (Ricklis 2012). Closer to the coast, Ricklis has reported associated dates of 5900-5300 and 4870-4630 cal B.P. from excavated contexts on Nueces Bay and a probable association of 5630-5330 cal B.P. from the Means site (41NU184), although this date is on excavated *Rangia flexuosa,* while the Early Triangular points at that site were collected from the surface (see Ricklis 2007 for summary).

Very few securely associated radiocarbon dates are available for Nolan points (n=2) and none for Travis points. Based on the stratigraphic relationship observed at some sites and on the span of time unrepresented in our model (see Figure 5), we think that these styles occur late in the Middle Archaic sequence. Our work at Spring Lake suggests that such contexts will be hard to find as a result of environmental perturbations associated with the Mid-Holocene Climatic Optimum (Meltzer 1999). Elsewhere, Johnson and Goode (1994) identified what they called the Edward's Interval, at approximately 4200-2800 cal B.P. Global precipitation data (Haug et al. 2001) suggest that northern hemisphere rainfall patterns during this period were characterized by increased amplitude between periods of intense and reduced precipitation. These periods may have been only a few decades in length, and would be difficult to discern in most open alluvial sites in Central Texas. Rather than a uniformly hot, dry period, we see the Middle Archaic as the beginning of a period in which rainfall fluctuation patterns became more extreme; this process culminated in the early Late Archaic. Overall climate may indeed have warmed, as Johnson and Goode argued, but the effect of these climate changes on archeological site formation would have been one of relative instability in landscape surfaces rather than one of uniform erosion. Human responses to overall warmer, drier climatic conditions, in the form of increased use of earth ovens involving shallow pits and fire-heated rocks, probably exacerbated the climatic effects on archeological deposits. Indirect evidence of the more frequent use of shallow earth ovens comes from recent isotopic analyses of prehistoric burials from the region (Mauldin et al. 2013), showing increasing reliance on C_3 plants consistent with the increased consumption of geophytes that require extended cooking. (We return briefly to this issue below in our discussion of the end of the Archaic and beginning of the Late Prehistoric.)

The effects of climatic fluctuation and human activity on regional soils are illustrated in an age-depth model from Spring Lake (Figure 6). This age-depth model shows calibrated radiocarbon dates by depth, and can be used to demonstrate changes in sedimentation rates, as well as depositional processes that characterize certain parts of a cultural deposit. The model is based on 20 calibrated AMS dates on both bison and charred plant material, and clearly illustrates three "phases" of sedimentation at the site. The earliest of these, which extends until approximately 4200 cal B.P., includes both the end of the Early Archaic and the entire Middle Archaic. The next phase, which dates from about 4200-2800 cal B.P., is characterized by dates that are out of stratigraphic order. In addition to climatic fluctuation, another important cause of this mixing is the digging of shallow pits for earth ovens, which is indicated by the increase in frequency in fire-cracked rock. Although this period begins around 4200 cal B.P., many of the dates involved are Middle Archaic in age, suggesting that human activity was responsible for dislocating carbonized remains upwards in stratigraphic columns. We use this model to confirm our ending date for the Middle Archaic, and to argue that the combined effects of increased climatic variation along with the cultural response of increased usage of hot rock cooking technology (cf. Thoms 2008, 2009) disturbed archeological sediments dating to Middle Archaic times.

Based on available data, including bison dates, a meager sample of suitable radiocarbon dates for Middle Archaic diagnostics, and the depositional model from Spring Lake, the Middle Archaic begins at the end of Calf Creek, ca. 5800 cal B.P., and concludes sometime around 4200-4100 cal B.P. Calculating a more precise ending date in the future for the Middle Archaic will require obtaining good dates for Nolan and Travis points. Secure dates for early Late Archaic types like Bulverde, also currently lacking, would also provide evidence allowing archeologists to precisely date the end of the Middle Archaic, as well as the beginning of the complex Late Archaic chronological sequence.

Late Archaic 1: 4200/4100–3100 cal B.P.

Based on the results of our library research, together with our bison dates and additional evidence that includes human dietary patterns based on isotopic analyses, we divide the Late Archaic into four parts. This sequence deviates significantly from most previously published chronologies that recognize two or three general periods within the Late Archaic. Dating the early part of the Late Archaic is as problematic, since there are relatively few radiocarbon dates securely associated with specific projectile point types over a span of ~1700 years, between roughly 5200-3500 cal B.P. As noted, we surmise that Nolan and Travis points were no longer made by about 4200-4100 cal B.P., which we consider the approximate beginning of the Late Archaic 1. Although dating of the Spring Lake ET-N-T zone is poorly resolved, it clearly does not extend beyond this time.

Of the three most common projectile point types assigned to the Late Archaic 1, Bulverde, Pedernales, and Marshall, only Pedernales points are represented by more than three dates in our study. Less common but morphologically related styles including Evant also probably fit into the Late Archaic 1 sequence in ways that are not yet clear. Although we did not identify any valid dates for the Bulverde type, we think it spans the transition from the end of the Middle Archaic into the first half of Late Archaic I. A reasonable estimate of the ending date for Bulverde, based on the probabilities for Pedernales, might be around 3600 cal B.P. Nonetheless, the age span of Bulverde is poorly known and, given that these two types are often found together, they probably overlap in age.

The dating of Pedernales points is particularly important given that it seems to be the most common point type for any prehistoric period in Central Texas. We are intrigued that most of the radiocarbon age probability curve for the six valid dates for the Pedernales type is constrained to a four-century span, from 3600-3200 cal B.P. The possibility that Pedernales points were only in use across the region over such a short period would make this one of the most dynamic intervals in Central Texas.

In most chronological models, Pedernales is followed immediately by Marshall. We found only three dates for Marshall and their probability curve appears bimodal in nature. Although one of the three assays for Marshall fits neatly into the temporal space following Pedernales, the other two dates fall equally neatly immediately before Pedernales (see Figure 4). We think Marshall's bimodal pattern can be attributed to the inadequate number of available dates. Given that Marshall and Pedernales points are often recovered from the same deposits, we suspect that their distributions overlap in time.

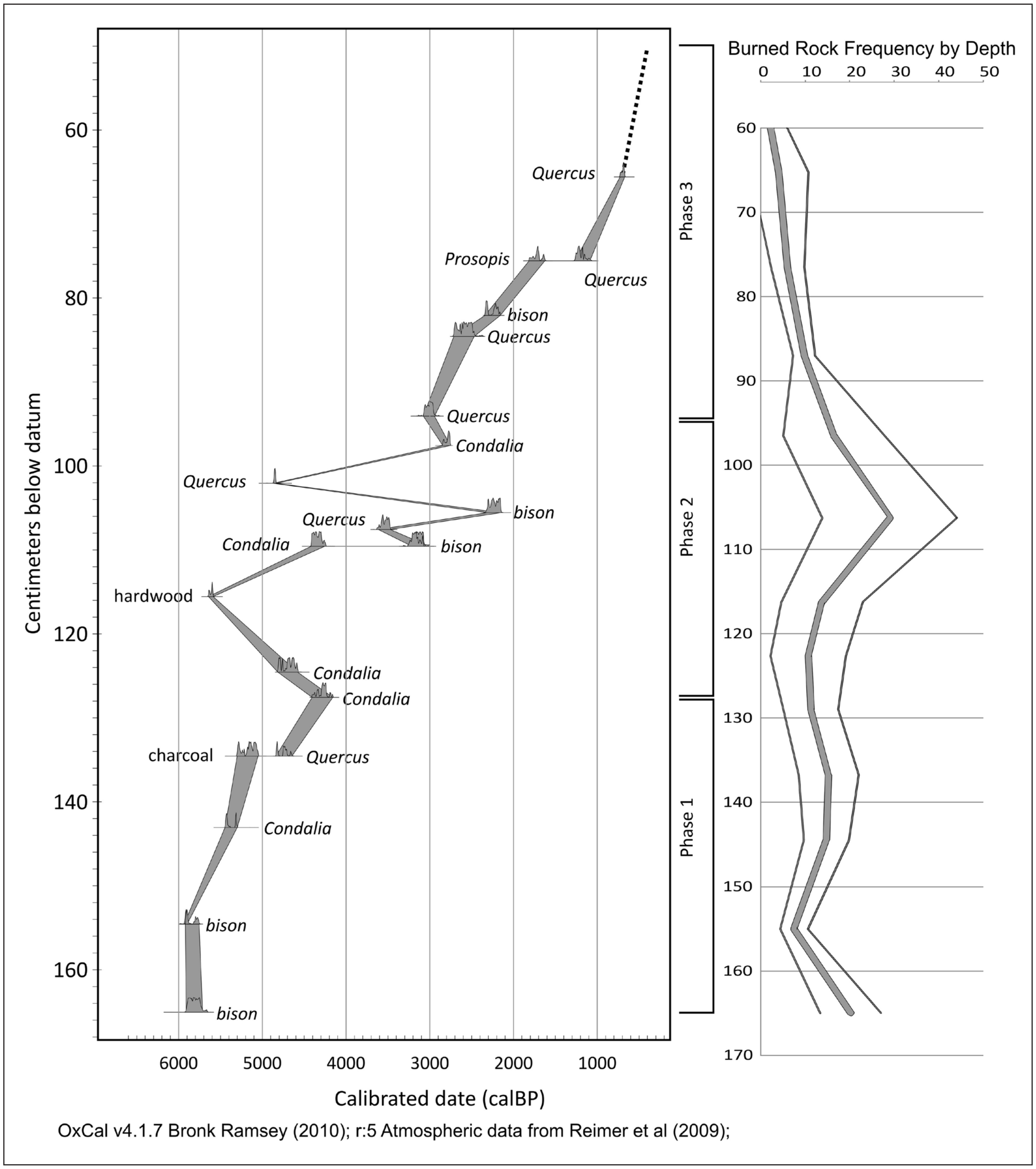

Figure 6. Age-depth model based on 20 AMS dates from Spring Lake showing depositional "phases;" Phase 2 is characterized by severe intrusions, age reversals, and mixed sediments. This phase also corresponds with a sharp increase in the frequency of fire-cracked rock. Although Phase 2 is dated from approximately 4200-2800 cal B.P., many Middle Archaic assays occur here as a result of deposit mixing through cultural and environmental processes (graphic by David M. Yelacic).

We do not argue that Marshall points preceded the Pedernales style in time; they probably followed Pedernales, although this remains to be resolved.

In our model, the latter part of the Late Archaic 1 saw a relatively brief period of bison exploitation, dating to approximately 3295-3130 cal B.P. This is the first of two Late Archaic bison pulses, and was followed by a hiatus that lasted at least 400 years and that heretofore has not been recognized (Lohse et al. n.d.). Unfortunately, it is not clear which point type is most closely associated with Late Archaic 1 bison hunting. Based on the preponderance of the available dates, the Pedernales type should be considered the best candidate. That said, the prevailing wisdom that Marshall points date immediately after Pedernales may still be correct and we note that the last of the three Marshall-associated dates overlaps very well with the Late Archaic 1 bison dates. A conservative hypothesis based on available data is that the latter part of the Pedernales use-period co-occurred with bison and that Marshall points were also used to hunt bison during Late Archaic 1. Considerably more effort should be devoted to sampling and dating discrete Late Archaic 1 deposits, particularly those with single-point associations and those with bison remains. In terms of environmental conditions, this period appears to have been characterized by the extreme wet-dry fluctuations discussed above.

Late Archaic 2: 3100–2150 cal B.P.

The Late Archaic 2 began with a hiatus in bison exploitation, which started at ca. 3130 cal B.P. and lasted at least until 2700 cal B.P. We define the Late Archaic 2 by this hiatus (beginning about 3100 cal B.P. for simplicity) and the following period of bison exploitation, which is closely associated with Montell, Castroville, and Marcos points. Bison hunting appears again as early as 2700 cal B.P. and lasts until 2150 cal B.P. What appears to be a brief hiatus around 2400-2330 cal B.P. is most likely the result of the shape of the calibration curve at this period (see Lohse et al. n.d.).

The dating of the three predominant Late Archaic 2 projectile point styles is difficult as they are often found together. While the periods of use for these three types almost certainly overlapped, they are not always found together and we assume that each type had independent use histories. Yet, we found only a total of eight secure dates for all three types (four Montell assays, three for Marcos, and only one for Castroville). This time period also includes a particularly problematic area on the radiocarbon calibration curve, defined by a relatively flat span of time, or "plateau" that is bracketed by two reversals (Figure 7). Nonetheless, based on our study we infer that Montell is probably the earliest of the three, followed by Castroville and then Marcos.

The probable beginning of Montell is around 3100 cal B.P. and the type may have been in use until about 2650 cal B.P. The type is not tightly dated and may not have been in use as long as the probability data indicate. Montell may have been followed quickly by Castroville, for which we could only find one useful date, about 2770-2450 cal B.P. The four Marcos dates seem to show a bimodal distribution, but we are not confident that this reflects reality. Three of these dates are from 41TG91 (Creel 1990) where a Marcos component containing bison bone was dated by pooling samples of wood charcoal from multiple contexts to obtain conventional radiometric assays. As noted, this technique can skew age estimates through the inclusion of mixed-age wood. Rather than accept the bimodal distribution of Marcos, we choose to discount the early part of the probability distribution for the purposes of dating this type, and suggest that Marcos follows Montell and Castroville in rapid sequence. The end of Marcos corresponds closely with the final Archaic bison pulse, ending at 2150 cal B.P. Much of the imprecision in Late Archaic 2 chronology is the result of the plateau in the calibration curve at this time. Until a larger sample of valid assays is obtained, the precise ages of these types and the timing from one to the next will remain poorly known.

Bone Bed 3 at Bonfire Shelter, immediately adjacent to the Central Texas region, characterizes the Late Archaic 2 period with its associations and problems with respect to dating (Dibble and Lorrain 1968). Castroville, Montell, and Marcos were all found in this massive accumulation of bison remains, but little internal order could be identified during the 1963-1964 excavations, and the reported dates characterize the entire deposit rather than individual episodes that might have taken place. Dating other sites that contain any or all three of these point types in well-stratified deposits or in secure contexts associated with short-lived organic material will be necessary in order to improve the resolution of this interval.

Late Archaic 3: 2150–1270 cal B.P.

In our model, Late Archaic 3 includes Ensor and Frio point types; we also include Fairland in this period although no suitable dates could be found for that type. Other types thought to occur during this period include Ellis and Edgewood. We date the beginning of this period at 2150 cal B.P. with the end of Marcos and the conclusion of Late Archaic bison hunting. Ensor is one of the best-dated types in Central Texas. Our group of

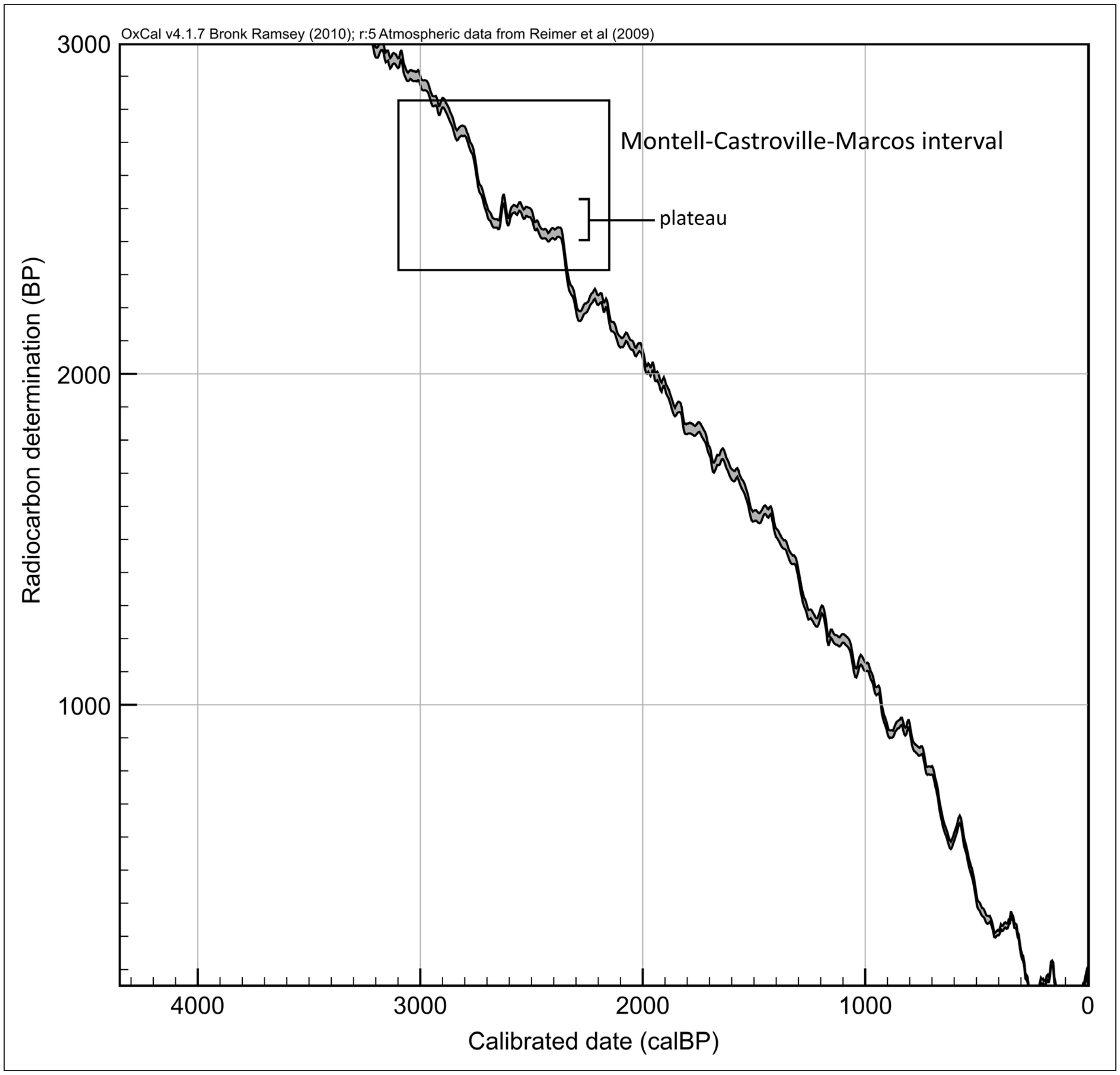

Figure 7. The location of the Late Archaic 2 interval on the radiocarbon calibration curve. The plateau, or relatively flat area of the curve, presents problems for refining this interval with future dates. Dates that define this interval are presented in Table 1.

14 assays shows a robust cluster from about 2150-1750 cal B.P. Soon after Ensor drops off, Frio picks up and extends from 1550-1270 cal B.P., although this span is based on only two dates. This seems to leaves time between Ensor and Frio for some of the types (e.g., Fairland, Edgewood) that were either not included in our study or that could not be dated.

In our view, this period warrants its own designation as Late Archaic 3 because of the typological and technological similarities between the projectile points in this series, because it is clearly distinguished from the previous period by the absence of bison, and because of the technological differences between these types and those that follow, particularly Darl.

Late Archaic 4: 1270–650 BP cal B.P.

The final period in our model is the Late Archaic 4. This period includes a portion of what some refer to as the Transitional Archaic as well as the Austin phase or period. We acknowledge that proposing a new term for this period may be confusing to those familiar with traditional labels.

Nevertheless, for reasons discussed below, we include this period and its key diagnostic markers (Darl and Scallorn) in our discussion of the Archaic. Moreover, we do not see strong evidence for any meaningful "transition" out of this period into the subsequent Late Prehistoric. Rather, our review of available data indicates that this period has far more in common with those that preceded it than with what followed.

Traditionally, the appearance of the bow and arrow, visible in the record with the introduction of Scallorn points, is said to mark the beginning of the Late Prehistoric period and is known as the Austin phase (see recent summary by Arnn [2012:167-168]). For this division to be most useful, however, the Austin phase should be understood as a distinct cultural pattern involving more than the appearance of expanding stem arrow points. Many archeologists have discussed the cultural continuities with the latest Archaic interval (e.g., Black and Creel 1997, 1998; Collins 1994; Johnson and Goode 1994; Prewitt 1981, 1983; Shafer 1977). Examples of behavioral continuity from earlier times are seen in a broad-spectrum diet, the absence of bison, continued plant baking, continued reliance on bifacial stone tool technologies, mortuary practices, and site distribution and settlement patterning.

For this period in particular, bison data play an important role in helping to contextualize and define our temporal units. A recent paper (Dickens and Weiderhold 2003) has speculated that the introduction of bow and arrow technology at the beginning of Austin times resulted in a change in hunting practices, involving more isolated hunters or small parties than in previous times. This change is said to have led to less bison, or less bison *bone*, being returned to residential camps, where it can be encountered in the archeological record. However, based on our sample of bison dates, we suggest that a more direct explanation for the paucity of bison remains in Austin times is that bison were mostly absent from the Central Texas landscape in the centuries prior to Toyah. In light of the record of absolute dates, it is likely that any bison materials that are reported in Austin components, such as those indicated by Mauldin et al. (2012; see Figure 2), represent mixed deposits that were not recognized as such in those original excavations. Based on our data, not only were bison absent from the Central Texas landscape in Austin times, none were present at all for approximately 1,500 years prior to Toyah.

Additional evidence that supports defining the end of the Archaic at A.D. 1300 comes from recent dietary reconstructions based on stable isotope analyses of human remains from Central Texas (Mauldin et al. 2013). Maudlin and his colleagues compile previously reported stable carbon and nitrogen isotope data for the region and add new data from the Coleman site (41BX568), a Toyah cemetery. One important contribution of this study is that it compiles dietary information for most major time periods dating back to the Early Archaic. Another is that it adds new Toyah period data to this record, thereby presenting a model of dietary behavior from the Early Archaic until the end of the Late Prehistoric (Figure 8). When viewed over time, a pronounced trend toward increased reliance on C3 plants can be seen starting in Early Archaic times and continuing through the Austin period. The Toyah sample, however, diverges sharply from this pattern and shows a clear and dramatic change in dietary behavior. Stable carbon and nitrogen isotope data directly reflect what foods were selected throughout the Archaic. From changes in these consumption patterns, archeologists can surmise that associated procurement and processing technologies as well as social norms and rules that accompany food consumption were also markedly different between the general Archaic trend and the Toyah period. As such, these data provide an opportunity to evaluate cultural continuity versus abrupt change relating to diet and associated cultural behaviors.

With respect to the Late Archaic 4 radiocarbon record, we looked at two projectile point types, Darl (n=16) and Scallorn (n=13). As mentioned above, the probability distribution for Darl-associated dates has a bimodal shape with peaks at 1350-1150 cal B.P. and 900-700 cal B.P. As seen in Table 1, the same projects have published results that cover the span of time ascribed to this type. The lengthy bimodal age distribution therefore does not seem to be an issue of geographic range, nor does it seem to be an issue of old or imprecise dates. Unlike Marshall, there is no obvious reason to discount the earlier or the later ends of Darl's age. Instead, the bimodal patterns suggest to us that more than one "type" may be indicated and that more detailed typological analysis of the Darl type is warranted.

The later Darl age distribution falls squarely in the middle of the Scallorn probability distribution, which begins at about 1200 cal B.P. and falls

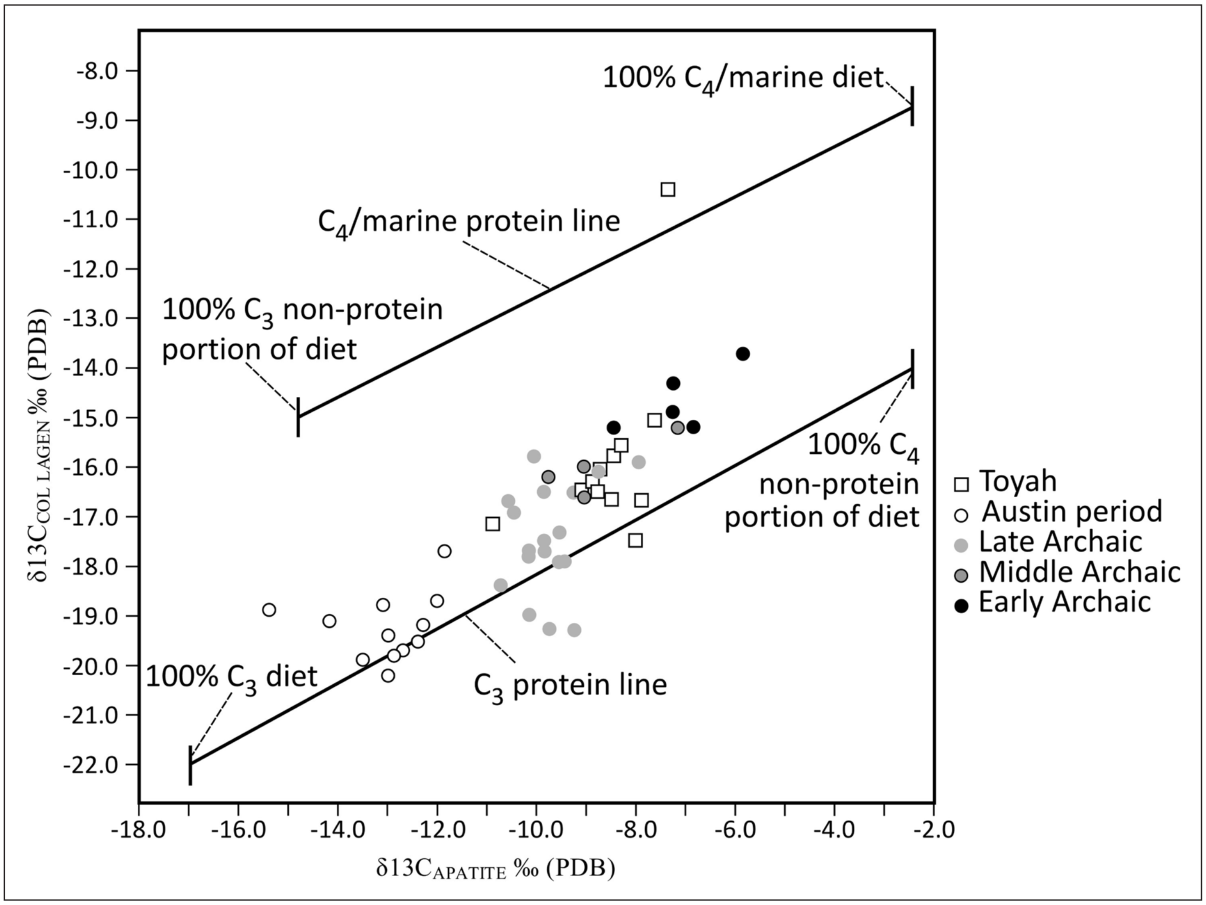

Figure 8. Stable carbon and nitrogen isotope data for Central Texas burials showing a steady trend from the Early Archaic to Austin period of increasing reliance on a C3 diet. Toyah data from the Coleman site (41BX568) and Spring Lake show a dramatic shift in dietary behavior that helps define the Late Prehistoric as beginning after Austin times (redrawn from Mauldin et al. 2013).

off abruptly at about 650 cal B.P. (or A.D. 1300). This 550-year spread is one of the longest for any single point type in our sequence and the overlap with Darl suggests that the technological shift from atlatl and dart to the bow and arrow was a lengthy process. Based on their recent work at the Siren site, Galindo et al. (2013) suggest this transition may have lasted 300 years or longer. Importantly, there is virtually no overlap between Scallorn and the beginning of Toyah phase bison exploitation at 650 cal B.P. For us the return of bison to the region after a 1,500 year absence marks the end of the Archaic and signals a major behavioral, subsistence, and economic shift. We regard the Toyah phase/interval/horizon as the only true Late Prehistoric cultural manifestation in Central Texas.

Taken together, the social, technological, and dietary implications of big game hunting involving bison are significant enough that the introduction of the bow and arrow alone does not, in our view, warrant designating a post-Archaic (Late Prehistoric) period in the regional chronology prior to Toyah. Rather, our review of available data suggest that Darl and Scallorn together, along with their associated cultural patterns, comprise a meaningful temporal period, which we designate Late Archaic 4.

CONCLUSIONS AND SUGGESTIONS FOR FUTURE CHRONOLOGY WORK

Although this study relies on earlier work and previously recorded radiocarbon data, it enhances the precision of that body of knowledge in terms of dating, the chronological sequence of some important projectile point types, and certain technological and stylistic changes. Supplementary data that inform our model include high-precision AMS radiocarbon dates on bison bone, an environmental model of Middle and Late Archaic site formation at Spring Lake, and isotopic data concerning diet behavior spanning the Early Archaic to Toyah periods. We define the end of the Archaic not with the introduction of expanding stem arrow points (Scallorn) during the Austin interval, but rather by the return of bison to the landscape and the significant cultural patterns that were associated with that return. Our study illustrates how little is actually known about some time periods and the dating of the time-diagnostic artifacts that help define them. The early facet of the Late Archaic, with poorly dated Bulverde and other types, is but one example.

In very broad terms the revised chronology presented here emphasizes the need for greatly improved sample selection and reporting, for additional targeted dating, and for complementary approaches to building and interpreting models. Our study also highlights unanswered questions about the timing and nature of some major periods and transitions. For instance, how can archeologists resolve the poorly dated Middle Archaic? Geomorphologically-informed investigations seem essential to this issue. Were Pedernales points really restricted to a narrow time interval as our model suggests? If so, this period would have been one of the most dynamic ever in prehistoric Central Texas. What other social or technological changes accompanied the distinct bison-use periods in Late Archaic 2? What factors explain the bimodal distribution of Darl dates? Was the transition from atlatl to bow and arrow really as drawn out as suggested by our Late Archaic 4 Scallorn and Darl dates? Some of these issues may be resolved through future excavation and analysis, but also by revisiting and redating older collections. From a regulatory perspective, any site capable of addressing any of these issues should be considered eligible for inclusion in the National Register of Historic Places or worthy of designation as a State Antiquities Landmark and should receive due attention.

In the future, archeologists can contribute to this effort by properly publishing *all* of the technical, contextual, and associational information for their radiocarbon assays. On the technical side, at a minimum, archeologists should identify the material that is dated, specify whether conventional radiometric or AMS methods were used, give the uncorrected raw reporting date, and provide the measured $\delta^{13}C$ isotopic value (correction factor). In terms of context and association, researchers must give precise provenience, specify whether the sample is point-plotted or from pooled or screen-recovered context, and carefully describe the stratigraphic position of the dated sample and precise spatial relationships with any potentially associated time-diagnostic artifacts.

Researchers should not be satisfied with only one or two dates for a stratigraphically discrete component, but rather should submit as many assays as budgets allow. However, samples should be selected carefully; prioritizing those with close associations between datable materials and diagnostic artifacts will help clarify the age ranges for key types. It is ironic that today Texas archeologists are in the position of having both too much and too little radiocarbon data. That is to say that while there are a great many assays that we consider essentially useless for reasons we have explained, there are not nearly enough thoroughly reported assays from discrete stratigraphic contexts in good association with diagnostic artifacts. Our study also shows many of the most useful data for some key point types come from only one or two sites. In other words, the geographic coverage is very uneven and mainly concentrated in the curving arc along and paralleling the Balcones Escarpment (see Figure 1), similar to what Johnson (1991) dubbed the “Crescent” (also McKinney 1981).

We are optimistic that as dating work continues, the expanded record of useful, valid assays will allow us to refine chronological models. We hope our study helps point the way, but we know it needs testing through future research. Archeologists should question the notions that prehistoric cultures only changed slowly, and that chronological precision is unattainable. Based on our work, we see periods of both rapid *and* slow culture change. Periods of rapid change, such as Calf Creek and the end of Late Archaic 4 may be defined at some ideal sites by ephemeral, short-term occupation or activity deposits. These kinds of components should be studied using the most rigorous standards in terms of excavation, dating, and analysis. Radiocarbon processing methods are continually improving and developing, as are the statistical models for working with sound radiocarbon data. With these suggestions in mind, we look forward to seeing a lot of important chronology work in the next decade.

The strategy taken in this study is not the only viable approach to more precisely dating the chronology of the long-lived Archaic era. We opted to consider only those radiocarbon assays that appear to have been associated with a single projectile point style, a limited number of XAD-purified AMS dates on bison bone, and a small number of samples from the Middle Archaic ET-N-T zone at Spring Lake. Radiocarbon assays from discrete "sealed" deposits that can be shown by geoarcheological investigation and robust dating to have formed over a brief interval of time can and should be used to understand the use periods of the associated projectile points, even when more than one style is present. We think that by combining explicitly critical revaluations of extant data with new finds from well-designed investigations, archeologists will be able to construct more precise chronologies for Central Texas that shed light on the small-scale human societies that flourished across the region for over 500 generations.

ENDNOTE

1. The research library at CAS and the main Alkek Library at Texas State University have benefited enormously from generous donations of archeological publications from individual scholars, especially Dee Ann Story, and from organizations, especially the Texas Historical Commission. The CAS library is organized by region and county, making it relatively easy to systematically search for the present endeavor.

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REFERENCES CITED

Arnn, J. W. III
2005 Chronology, Technology, and Subsistence: Is That All There Is? *CTA Newsletter* 29:17-28.

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

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, A. C., Jr.
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. and D. G. Creel
1997 Central Texas Burned Rock Midden Reconsidered. In *Hot Rock Cooking on the Greater Edwards Plateau: Four Burned Rock Midden Sites in West Central Texas* by S. L. Black, L. W. Ellis, D. G. Creel, and G. T. Goode, pp. 269-305. Studies in Archeology 22. Texas Archeological Research Laboratory, University of Texas at Austin.

Black, S. L. and D. G. Creel
1998 Making the Most Out of Clashing Mind-Sets. *CRM News and Views*, February: 30-36. Texas Historical Commission, Austin.

Black, S. L. and J. A. McGraw
1985 *The Panther Springs Creek Site: Cultural Change and Continuity within the Upper Salado Creek Watershed, South-Central Texas*. Archaeological Survey Report No 100. Center for Archaeological Research, The University of Texas at San Antonio.

Bond, C. L.
1978 *Three Archeological Sites at Hoxie Bridge, Williamson County, Texas*. Report No. 43. Laboratory, Texas A&M University, College Station.

Carpenter, S. M., M. Chavez, K. Miller, and K. Lawrence
2006 *The McKinney Roughs Site 41BP627: A Stratified late Archaic II Site on the Colorado River Terraces Bastrop County, Texas*. SWCA Cultural Resources Report No. 02-313. SWCA Environmental Consultants, Austin.

Carpenter, S. M., and B. A. Houk
2012 Siren Site Chronology: A Reconsideration of the Late Archaic to Late Prehistoric Temporal Sequence of Eastern Central Texas. *Bulletin of the Texas Archeological Society* 83:99-128.

Carpenter, S. M., K. A. Miller, M. J. Galindo, B. A. Houk, C. Frederick, M. C. Cody, J. Lowe, K. Lawrence, K. Hanselka, and A. Peyton

2013 *The Siren Site: the Long Transition from Archaic to Late Prehistoric Lifeways on the Eastern Edwards Plateau of Central Texas*. SWCA Environmental Consultants Cultural Resources Report 12-93 and Archeological Studies Program Report No. 142, Texas Department of Transportation, Austin.

Collins, M. B.

1994 Cultural Background. 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. 157-166. Studies in Archeology 19, Texas Archeological Research Laboratory, The University of Texas at Austin.

1995 Forty Years of Archaeology 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.

Creel, D. G.

1990 *Excavations at 41TG91, Tom Green County, Texas 1978*. Publications in Archaeology Report No. 38. Texas State Department of Highways and Public Transportation, Highway Design Division, Austin.

Dibble, D. S. and D. 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.

Dickens, W. A. and J. E. Weiderhold

2003 Some Notes on Bison, the Texas Post Oak Savanna, and the Late Prehistoric Period of Texas. *Bulletin of the Texas Archeological Society* 74:31-54.

Dillehay, T. D.

1974 Late Quaternary Bison Population Changes on the Southern Plains. *Plains Anthropologist* 19:180–196.

2012 Foreword. In *Land of the Tejas: Native American Identity and Interaction in Texas, A.D. 1300 to 1700*, by J. W. Arnn, III, pp. ix-xviii. University of Texas Press, Austin.

Dixon, B. and R. Rogers

2006 *Prehistoric Encampments at the Sheperd Site: Testing and Data Recovery at 41WM1010 Williamson County, Texas*. PBS&J, Austin.

Ellis, L. W., G. L. Ellis, and C. D. Frederick

1995 Implications of Environmental Diversity in the Central Texas Archeological Region. *Bulletin of the Texas Archeological Society* 66:401-423.

Gadus, E. Frances, R. C. Fields, and K. W. Kibler

2006 *Data Recovery Excavations at the J.B White Site (41MM341), Milam County, Texas*. Prewitt and Associates, Inc., Austin.

Galindo, M. J., K. A. Miller, and S. M. Carpenter

2013 Metric Discrimination of Projectile Points from 41WM1126. In *The Siren Site: the Long Transition from Archaic to Late Prehistoric Lifeways on the Eastern Edwards Plateau of Central Texas*, pp. 323-338. SWCA Environmental Consultants Cultural Resources Report 12-93 and Archeological Studies Program Report No. 142, Texas Department of Transportation, Austin.

Goode, G. T.

2002 *The Anthon Site: A Prehistoric Encampment in Southern Uvalde County, Texas*. Archaeological Studies Program Report 38. Texas Department of Transportation, Environmental Affairs Division, Austin.

Haug, G. H., K. A. Hughen, D. M. Sigman, L. C. Peterson, and U. Röhl

2001 Southward Migration of the Intertropical Convergence Zone Through the Holocene. *Science* 293:1304-1308.

Hester, T. R.

1971 Archeological Investigations at the La Jita Site, Uvalde County, Texas. *Bulletin of the Texas Archeological Society* 42:51-148.

Houk, B. A., K. A. Miller, and E. R. Oksanen

2008 *The Gatlin Site (41KR621): Investigating Archaic Lifeways on the Southern Edwards Plateau of Central Texas*. SWCA Cultural Resources Report No. 149 and Archeological Studies Program Report No. 108, Texas Department of Transportation, Austin.

2009 The Gatlin Site and the Early-to-Middle Archaic Chronology of the Southern Edwards Plateau. *Bulletin of the Texas Archeological Society* 80:51-75.

International Study Group

1982 An Inter-Laboratory Comparison of Radiocarbon Measurements in Tree Rings. *Nature* 298:619-623.

Johnson, L. Jr.

1986 A Plague of Phases. *Bulletin of the Texas Archeological Society* 57:1-26.

1981 *Early Archaic Life at the Sleeper Archaeological Site, 41BC65, of the Texas Hill Country, Blanco County, Texas*. Publications in Archaeology 39, Texas State Department of Highways and Public Transportation, Highway Design Division, Austin.

2000 *Life and Death as Seen at the Bessie Kruze Site (41WM13) on the Blackland Prairie of Williamson County, Texas*. Archaeological Studies Program, Report 22. Environmental Affairs Division, Texas Department of Transportation, Austin.

Johnson, L. Jr. and G. T. Goode
1994 A New Try at Dating and Characterizing Holocene Climates, as Well as Archeological Periods, on the Eastern Edwards Plateau. *Bulletin of the Texas Archeological Society* 65:1-51.

Kleinbach, K., G. Mehalchick, D. K. Boyd, and K. W. Kibler
1999 *National Register Testing of 42 Prehistoric Archeological Sites on Fort Hood, Texas*. United States Army Fort Hood Archeological Resource Management Series, Research Report No. 38. Prewitt and Associates, Inc., Austin.

Lohse, J. C., B. J. Culleton, D. J. Kennett, and S. L. Black
n.d. A High Precision Chronology for Middle to Late Holocene Bison in Central Texas. *Journal of Texas Archeology and History*, manuscript in review.

Lohse, J. C., D. J. Kennett, B. J. Culleton, and C. L. Timperley
2012 Middle-to-Late Holocene Bison Chronology and Ecology in the South-Central United States. Paper presented at the 77th Annual Meeting of the Society for American Archaeology, Memphis.

Lohse, J. C., A. E. Reid, D. M. Yelacic, and C. L. Timperley
2013 *Data Recovery and Analysis at the Texas State University Ticket Kiosk Project, Located at 41HY160, Spring Lake, Hays County, Texas*. Archaeological Studies Report No. 32. Center for Archaeological Studies, Texas State University-San Marcos.

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.

McKinney, W. W.
1981 Early Holocene Adaptations in Central and Southwest Texas: The Problem of the Paleoindian-Archaic Transition. *Bulletin of the Texas Archeological Society* 52:91-120.

Mahoney, R. B., H. J. Shafer, S. A. Tomka, L. C. Nordt, and R. P. Mauldin
2003 *Royal Coachman (41CM111): An Early Archaic Site along Cordova Creek in Comal County, Texas*. Archeological Studies Program Report 49, Texas Department of Transportation and Archaeological Survey Report 332, Center for Archaeological Research, University of Texas at San Antonio.

Mauldin, R., 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. P., J. Thompson, and L. Kemp
2012 Reconsidering the Role of Bison in the Terminal Late Prehistoric (Toyah) Period in 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.

Mehalchick. G. and K. W. Kibler
2008 *Hunters and Gathers of the North Bosque River Valley: Excavations of the Baylor, Britton, and Higginbotham Sites, Waco Lake, McLennan County, Texas*. Reports of Investigations, No. 156. Prewitt and Associates, Inc., Austin.

Mehalchick, G., T. Myers, K. W. Kibler, and D. K. Boyd
1999 *Val Verde on the Sunny Rio Grande, Geoarcheological and Historical Investigations at San Felipe Springs, Val Verde County, Texas*. Reports of Investigations, No. 22. Prewitt and Associates, Inc., Austin.

Mehalchick, G., K. Kleinbach, D. K. Boyd, and K. W. Kibler
2000 *Geoarcheological Investigations and National Register Testing of 52 Prehistoric Archeological Sites on Fort Hood, Texas: The 1997 Season*. United States Army Fort Hood Archeological Resource Management Series Research Report No. 39. Prewitt and Associates, Inc., Austin.

Meltzer, D. J.
1999 Human Responses to Middle Holocene (Altithermal) Climates on the North American Great Plains. *Quaternary Research* 52:404-416.

Munoz, C. M., R. P. Mauldin, J. L. Thompson, and S. C. Caran
2011 *Archeological Significance Testing at 41BX17/271, the Granberg Site: A Multi-Component Site Along the Salado Creek in Bexar County, Texas*. Texas Department of Transportation, Environmental Affairs Division, Archeological Studies Program, Report No. 140, Austin, and Archaeological Report No. 393, Center for Archaeological Research, The University of Texas at San Antonio.

Nickels, D. .L., C. B. Bousman, J. D. Leach, and D. A. Cargill
2001 *Test Excavations at the Culebra Creek Site, 41BX126, Bexar County, Texas*. Center for Archaeological Research, and The University of Texas at San Antonio. Archaeological Survey Report, No. 265, Archeological Studies Program, Report 3. Environmental Affairs Division, Texas Department of Transportation.

Osburn, T.
2011 Area 1: A Summary of the 2011 Texas Archeological Society Field School. *Newsletter of the Texas Archeological Society* 55(4):3.

Pearce, J. E.
1932 The Present Status of Texas Archeology. *Bulletin of the Texas Archeological and Paleontological Society* 4:44-54.

Prewitt, E. R.
1974 *Archeological Investigations at the Loeve-Fox Site, Williamson County, Texas*. Research Report No. 49. Texas Archeological Survey. The University of Texas at Austin.
1981 Cultural Chronology in Central Texas. *Bulletin of the Texas Archeological Society* 52:65-89.
1983 From Circleville to Toyah: Comments on Central Texas Chronology. *Bulletin of the Texas Archeological Society* 54:201-238.

Renfrew, C., and P. Bahn
2012 *Archaeology: Theories, Methods, and Practice*. Sixth edition. Thames and Hudson, New York.

Ricklis, R. A.
2012 Chronology at Buckeye Knoll. In *Archaeology and Bioarchaeology of the Buckeye Knoll Site (41VT98), Victoria County, Texas, Volume 1*, edited by R. A. Ricklis, R. A. Weinstein, and D. C. Wells, pp. 147-161. Coastal Environments, Inc., Corpus Christi.

Ricklis, R. A. (editor)
2007 *Archaeology and Bioarchaeology of the Buckeye Knoll Site, 41VT98: A Major Locus of Hunter-Gatherer Occupation and an Early Archaic Cemetery near the Lower Guadalupe River, Victoria County, Texas*. 5 vols. Coastal Environments, Inc., Corpus Christi. Draft report submitted to Galveston District, U.S. Army Corps of Engineers.

Shafer, H. J.
1977 Late Prehistory of Central Texas, 500 B.C.–1700 A.D. *Bulletin of the South Plains Archeological Society* 3:18-27.

Stafford, T. W., Jr., K. Brendel, and R. 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.

Suhm, D. A.
1960 A Review of Central Texas Archeology. *Bulletin of the Texas Archeological* Society 29:63-107.

Suhm, D. A., and E. B. Jelks (editors)
1962 *Handbook of Texas Archeology: Type Descriptions*. *Texas Archeological Society*, Special Publication No. 1, Texas Archeological Society and Bulletin No. 4, Texas Memorial Museum, Austin.

Suhm, D. A., A. D. Krieger, and E. B. Jelks
1954 An Introductory Handbook of Texas Archeology. *Bulletin of the Texas Archeological Society* 25:1-562.

Tamers, M. A., F. J. Pearson Jr., and E. M. Davis
1964 University of Texas Radiocarbon Dates II. *Radiocarbon* 6:138-159.

Thoms, A. V.
2008 Ancient Savannah Roots of the Carbohydrate Revolution in South-Central North America. *Plains Anthropologist* 53:121-136.
2009 Rocks of Ages: Propagation of Hot-Rock Cookery in Western North America. *Journal of Archaeological Science* 36:573-591.

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

Toomey, R. S., III
1993 Late Pleistocene and Holocene Faunal and Environmental Changes at Hall's Cave, Kerr County, Texas. Ph.D. dissertation, Department of Geography, University of Texas at Austin.

Turner, E. S., T. R. Hester, and R. L. McReynolds
2011 *Stone Artifacts of Texas Indians*, 3rd Edition. Taylor Trade Publishing, Lanham, Maryland.

Valastro, S., Jr. and E. M. Davis
1970a University of Texas at Austin Radiocarbon Dates VIII. *Radiocarbon* 12(2):617-639.
1970b University of Texas at Austin Radiocarbon Dates VIII. *Radiocarbon* 12(1):249-280.

Valastro, S., Jr., E. M. Davis, and A. G. Varela
1977 University of Texas at Austin Radiocarbon Dates XI. *Radiocarbon* 19(2):280-325.
1979 University of Texas at Austin Radiocarbon Dates XIII. *Radiocarbon* 21(2):257-273.

Watt, F. H.
1978 Radiocarbon Chronology of Sites in the Central Brazos Valley. *Bulletin of the Texas Archeological Society* 49:111-138.

Weir, F. A.
1976 The Central Texas Archaic. Ph.D. dissertation, Department of Anthropology, Washington State University, Pullman.

Willey, G. R. and P. Phillips
1958 *Method and Theory in American Archaeology*, University of Chicago Press, Chicago.

Wyckoff, D. G.
1994 Introduction to the 1991 Bulletin. *Bulletin of the Oklahoma Anthropological Society* 60:1-8.

Yelacic, D. M., A. E. Benton, and J. C. Lohse
2011 New Terrestrial Excavations at Spring Lake, 41HY160, San Marcos, Texas. Paper presented at the 82nd Annual Meeting of the Texas Archeological Society, Fort Worth.

Yelacic, D. M. and J. C. Lohse
2011 Methods and Proveniences. *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. 77-89. Archaeological Studies Report No. 18. Center for Archaeological Studies, Texas State University-San Marcos.

Chemical Characterization of Two Primary Igneous Metamorphic Glass Sources from the Big Bend Ranch State Park, Presidio County, Texas

Christopher Lintz, Richard E. Hughes, and Tim Roberts

ABSTRACT

Recent studies at Big Bend Ranch State Park (BBRSP) located bedrock exposures of black glassy materials some 40 km apart in the Cienega and Rancherias Creek drainages. Although resembling obsidian, the rocks are welded volcanic ash compressed and remelted into glass by subsequent hot lava flows over ash/tuff deposits. The BBRSP materials contain micro-fissures and break into rough, splintery, or blocky chunks. Some Cienega Creek samples form 2-4 cm diameter spherical marekanite (Apache tear) nodules. Adjacent lithic workshops indicate prehistoric attempts to use these poor quality tool stone materials. Geochemical characterization on 12 samples using energy dispersive x-ray fluorescence delineated two geochemical varieties. Geochemical Variant 1 encompasses samples from both BBRSP source areas, whereas Geochemical Variant 2 is restricted to the Rancherias Creek exposure. Although the summed elemental intensities of zirconium (Zr), rubidium (Rb), and strontium (Sr) from both BBRSP sources are virtually indistinguishable from chemical percentages in common obsidian tool stones from the Jemez Mountains and Rio Grande terraces in New Mexico, the igneous glasses from BBRSP and the Jemez Mountains are readily distinguished by percentages of Zr and yttrium (Y).

INTRODUCTION

Despite the occurrence of ancient tectonic geological features paralleling the Balcones escarpment along the eastern and southern edges of the Edwards Plateau of Central Texas and the volcanoes and cinder cones of Big Bend and Trans-Pecos regions in far western Texas, obsidian source studies have neglected chemical characterization of primary igneous glassy outcrops in Texas (Church 2000; Shackley 1988, 2005). The Balcones fault zone between Travis and Uvalde counties contains more than 200 volcanic cones as undersea domes and rare islands protruding from the Cretaceous seas and dating around 84 million years ago (mya) (Spearing 1998; Swanson 1995). No obsidian deposits are known from these ancient Central Texas tectonic events, and it is unlikely that any would remain, even if they did exist, due to the instability of natural glass and their tremendous antiquity (Lonsdale 1927; Shackley 2005:18).

Other porcelain-like and non-igneous glassy nodules occur along the Eocene age Gulf coastal plain about 160 km inland from the Gulf of Mexico in Southeast Texas. Manning fused glass is a volcanic ash or tuff fall-out deposit from West Texas that, on rare occasions, came in contact with burning lignite from the Whitsett and Wellborn Formations within an area between Trinity and Fayette counties and fused into a bubbly form of glass ranging in color from light bluish gray, to burnt sienna with streaks of gray, red, or black and white (Banks 1990:53-54; Barnes 1974; Brown 1976). Another glassy form is found eroding from the Wellborn Formation between Polk and Karnes counties. These glassy black, dark brown to green, pea-to-pebble size nodules generally less than 2.5 cm in diameter are bediasite tektites that represent melted ejected debris probably from the 35 mya Chesapeake Bay meteorite impact crater (Barnes 1951, 1990; Bouska 1993; McCall 2001:20; Vand 1965:47). The colors and bubbles in Manning fused glass make this material distinct from obsidian. It was sought and used for knapping by prehistoric people from the Archaic through Late Prehistoric periods (Brown 1976). Although bediasite tektites macroscopically resemble obsidian, they are structurally and chemically different and most are generally too small to be flintknapped. No prehistorically-worked samples have been recognized yet in Texas archeological sites.

Recently, black glassy cobbles measuring up to 12 cm in diameter have been found by Bill Foster in the Guadalupe River gravels near Cuero, Texas. At least four unworked cobbles contain the distinctive lechatelierite (detrital) structures of tektites but they are of a distinctly different age, size, and ovate to spherical form from those from the Chesapeake Bay impact event (Shackley 2006; Charles Frederick, personal communications 2008). Argon40-argon39 dating of one specimen indicates that it is ca. 2.0 mya, which is consistent with the Pliocene age of the Willis Formation where the cobbles were recovered. As yet they are not attributed to any specific impact events. Attempts to knap one nodule revealed it to be tenaciously harder than obsidian. No known examples of this material have been recognized in South Texas archeological sites, although several geochemical samples from the Texas Obsidian Project cannot be tied to known obsidian sources.

NATURAL GLASSES AND THE TECTONIC ZONES OF WEST TEXAS

The tectonic events in West Texas are part of the mid-Tertiary age subduction of the Farallon plate beneath the North American plate that created a volcanic arch extending from the Cascade Range of the western United States to the Cordilleran range of western Mexico (Henry 1998:33). In the Big Bend Ranch State Park (BBRSP), most volcanism relates to three active pulses from (1) tectonic events forming the Solatario dome around 47 and 34 mya, (2) volcanism from the Chinati and Cienega Mountains around 35 to 32 mya, and (3) tectonic activities associated with the Bofecillos Mountains around 30 to 27 mya (Henry 1998:35, 44; Walton 1985). Minor volcanic activities in far West Texas persisted during the Miocene with the addition of igneous materials dating as recently as 18 mya (Henry 1998:32-34, 44, west map; Swanson 1995). Henry (personal communications 2008) is not aware of true obsidian sources in far West Texas, but he does acknowledge the existence of black glassy materials that represent indurated tuff buried by very hot basaltic lava whose heat and weight softened, compacted, and baked or welded the rhyolite tuff-ash shards that then cooled into hard glassy rocks that look like obsidian. The lithological distinctions between true obsidians and glassy welded tuffs are more of a concern for tectonic geologists than to aboriginal flint knappers who attempted to use the materials for making tools (Deal 1976:34).

Obsidian is a glassy igneous material derived from magma that has cooled so rapidly that it has an aphanetic or non-crystalline structure. Obsidian is chemically unstable and hydrates or absorbs water from the surrounding environment. With sufficient time and hydration, obsidian and other glassy substances transform into chemically stable perlite. Another form of glassy igneous material is pitchstone, which is a glassy obsidian-like material with slightly higher water content and minute fracture plane structures that affect breakage (Shackley 2005:14). Both obsidian and pitchstone are derived from relatively discrete flows and as such, the geochemistry of individual flows tends to have relatively unique and location-specific trace element compositions. In contrast, another form of glassy igneous substance is welded tuff that forms either when super-hot magma flows over beds of volcanic tuff or pumice ash shards, or when ash beds are breeched by intrusive hot lava dikes. The extreme heat and weight of the flowing magma melts and compresses the underlying ash shards into a dense glassy material. Unlike vent-specific magma flows, volcanic ash beds can cover hundreds to thousands of hectares and, if derived from compound cooling units, the chemical signatures of these volcanic glasses can be quite variable (Hughes and Smith 1993).

Several primary contexts of welded tuff are known to occur in the BBRSP. Samples from two of these primary sources are herein named Cienega Creek, related to the Chinati/Cienega Mountain events, and Rancherias Creek, associated with the Bofecillos events (Figure 1). A third variety, also related to the Bofecillos event, is reportedly present in Tapado Canyon (McKnight 1968:50-53; Deal 1976:34). McKnight identifies one source exposure of "black perlitic obsidian" about 30 cm thick along lower Tapado Creek at the southwest end of Tapado dome. No recent samples have been collected or chemically characterized from this locale.

Two "obsidian" cobbles were obtained by Texas Parks and Wildlife Department biologist Raymond Neck from reworked or secondary stream gravels northeast of Tapado dome in the upper portions of Tapado Canyon near Oso Springs (Caran 1989). The outcrop of materials from this locale is upstream from that described by McKnight and probably represents materials

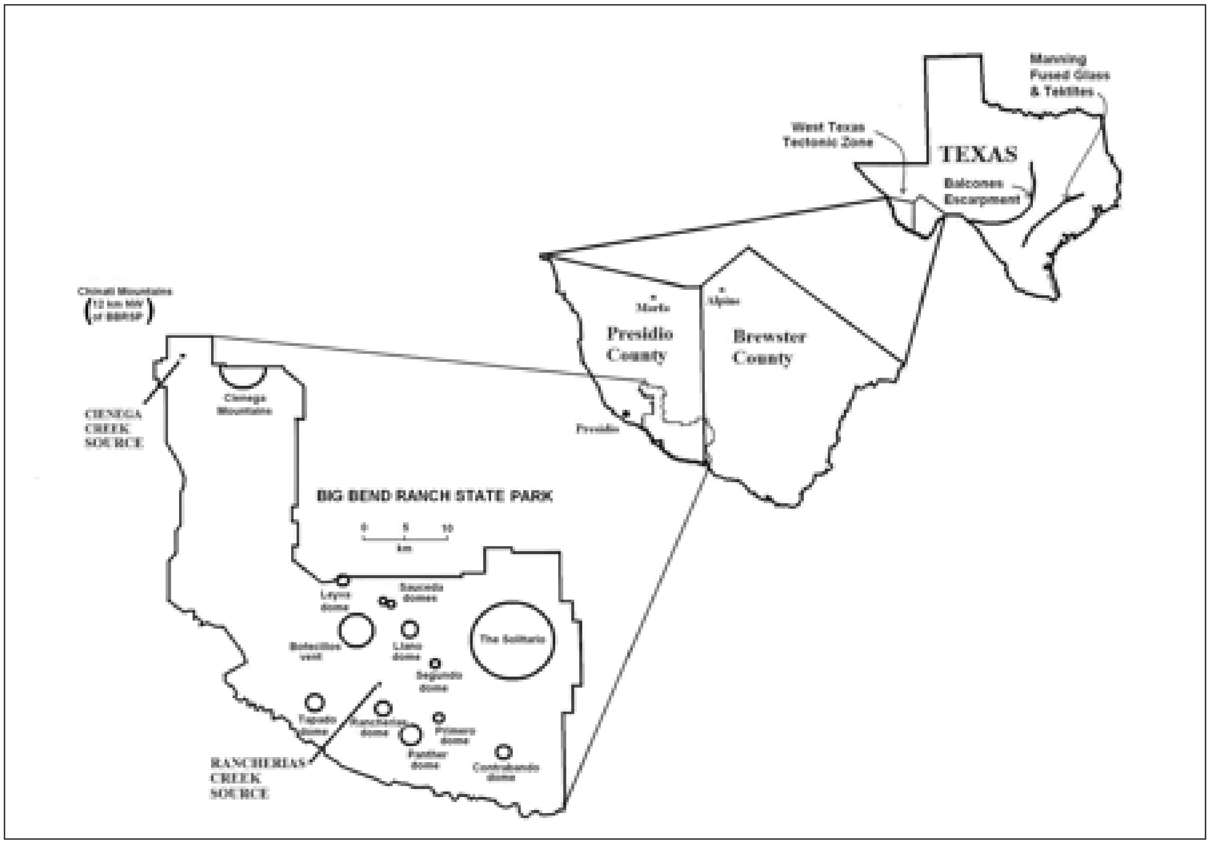

Figure 1. Tectonic/glass-yielding areas in Texas, showing locations of volcanoes and sampled volcanic glasses within Big Bend Ranch State Park, Texas.

from a fourth distinctly different primary bedrock exposure which has yet to be located. The two Tapado Canyon cobbles were reportedly obtained from stream gravels some 4.75 km west of the Rancherias Creek welded tuff source discussed herein. One cobble fragment was submitted to the Lawrence Livermore Laboratory, University of Berkeley, for geochemical characterization as part of the Texas Obsidian Project (Table 1). Further efforts are required to locate and sample the probable volcanic glass sources within the Tapado Creek basin.

The present study describes and presents the geochemical characterization of two primary outcrops of nodules, or boulders, embedded in ash and/or flow exposures beneath lava flows. They are the Cienega Creek and Rancherias Creek welded tuff sources, but the inclusion of the term creek in their names simply denotes the drainage basin for the two sources, and does not imply that the samples are from reworked secondary gravel sources. This article describes the general locations and settings; the form, condition, and potential knappability of the samples; and the chemical compositions for these two glassy welded tuff sources outcropping in far West Texas.

CIENEGA CREEK WELDED TUFF SOURCE

This source is about 28.6 km north-northeast of Presidio, Texas, near the northern panhandle portion of the BBRSP. The Cienega Creek source occurs as black glassy nodules embedded within ashy matrix near the head of a lateral tributary west of Cienega Creek. The exposure is about 1.9 km from the unnamed creek's confluence with Cienega Creek and about 1 km south of an air strip located west-northwest of Cienega Mountain.

The rhyolitic welded tuff is exposed within the Morita Ranch Formation of the early Oligocene Epoch. Barnes (1979) recognizes four members of Morita Ranch Formation consisting of olivine basalt, ash-flow tuff, rhyolite, and basalt porphyry, but he does not map their individual distributions.

Table 1. Geochemical results from Texas Obsidian Project sample #125 (TOP #125), the "obsidian" cobble collected from Tapado Canyon gravels near Oso Springs.

Element		Abundances (ppm)		Element		Abundances (ppm)	
Manganese	Mn	981	± 24	Barium	Ba	134	± 11
Iron	Fe (%)	1.09	*	Potassium	K (%)	2.18	± 0.07
Gallium	Ga	70	± 2	Rubidium	Rb	777	*
Yttrium	Y	124	*	Lead	Pb	57.6	± 1.7
Zirconium	Zr	470	*	Calcium	Ca (%)	1.03	± 0.04
Niobium	Nb	303	*	Strontium	Sr	92	*

Abundances and errors provided as parts per million (ppm) unless otherwise indicated after chemical symbol.
Listed errors are the larger of the estimated precisions or the counting errors.
Errors not listed (*) have counting errors of less than 1 percent.
Data provided by Thomas R. Hester.

Undoubtedly the glassy material represents one of the successions of rhyolite flows mixed with tuff breccia and conglomerates that have a measured thickness up to 91 m. Within this formation, the rhyolite ranges from banded flows to globular spherulites. Recent taxonomic revisions to the geological formations in the BBRSP retain the Morita Ranch Formation terminology for the bedrock source exposure (Henry 1998:North Map).

The glassy welded tuff from the Cienega Creek source occurs near the top of bedded ash deposits where cobbles (12 x 6 cm in size) are embedded in ash; blocky boulders (ca. 40 x 30 x 15 cm) protrude on the hill side and remnants of glassy flow layers ca. 20 cm thick are preserved under more durable basaltic rock layers (Figure 2). The welded tuff exposure is traceable laterally for more than 100 m. Although this formation is undated, potassium-argon dating of the overlying Chinati Mountain group yielded an age of 31.9 ± 0.7 mya, which must be considered a minimum age for the Morita Ranch Formation (Barnes 1979). Other age estimates for the Morita Ranch Formation are dated to 32.7 mya.

Grab samples collected from the Cienega Creek source tend to contain numerous, small (2 to 4 cm diameter), spherical globular bodies within a black glassy matrix that shatters into blocky chunks (Figure 3). Two of three samples described below are semi-spherical nodules usually with one naturally broken surface that measure 4.0-4.5 cm in diameter and 2.5-3.0 cm perpendicular to the broken surface. One semi-spherical nodule has whitish carbonate or perlite splotches on the outside and on some facets of the broken surface. The second semi-spherical nodule has a relatively flat fracture plane with radiating striations from a pressure point, but no bulb of percussion or ripple marks. The fracture surface is extremely rough and uneven, and shows several fractures running through the glassy material.

A third nodule from the Cienega source has a roughly prismatic form with a yellow weathered rind on a conchoidal facet. It measures 6.0 x 4.7 x 2.6 cm thick. This old conchoidal surface is pocked

Figure 2. Cienega Creek welded ash bed (next to person's knee) under lava flow.

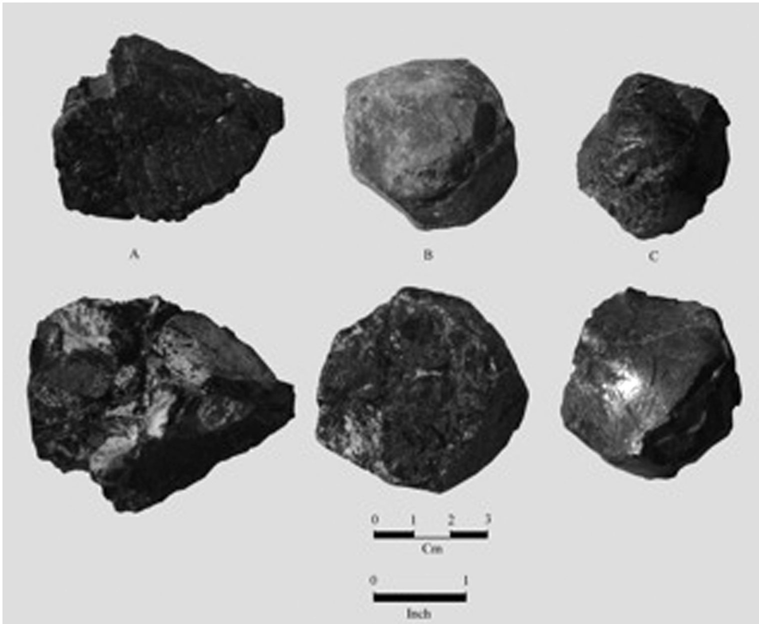

Figure 3. Glassy nodules from the Cienega Creek source.

with fissures and depressions where blocky spalls have broken free from the smooth surface. The opposite face has relatively recent breaks along a block surface. Several old fissures are evident in the stone and many of the broken surfaces have white carbonate or perlite along the facets. Tiny blocky splinters readily spall from this specimen.

The collected samples would be difficult to fashion into stone tools due to their small size and blocky structure with micro-fissures. Flint knapping efforts proved to be difficult as the knapping spalls consist of blocky shatter, rather than controlled flake debris. The range of structural variability along the length of the exposure has not been assessed. Because the source materials tend to erode in small semi-spherical nodules, flint knapping strategies would likely involve split-pebble or bipolar techniques, similar to the methods used for working marekanite (Apache tear) nodules.

RANCHERIAS CREEK WELDED TUFF SOURCE

The Rancherias Creek source area is about 39.5 km east-southeast of Presidio Texas. Revisions to the BBRSP geological formations attribute the Rancherias Creek source to the Leyva Canyon Member of the Rawls Formation (Henry 1998). Potassium-argon dating of the Leyva Canyon Member ranges from 27.04 $\pm$ 0.09 to 27.3 $\pm$ 0.10 mya. The outcrop occurs southeast of La Iglesia dome in geological units mapped as rhyolite lava originating from the Bofecillo vent (Henry 1998). Specifically the linear exposure occurs along the lower hill slopes below a prominent volcanic dike, which would be intrusive and date more recent than the Leyva Canyon Member (Figure 4). A grab sample of glassy welded tuff was collected from an exposed alignment of obsidian boulders.

The collected grab samples from the Rancherias Creek source consist of blocky, sub-angular and sub-rounded nodules. The largest nodule measured 14.8 x 9.5 x 5.5 cm and weighed 797.2 g. None exhibited the small, sub-rounded spheres that readily erode into marekanite nodules that are common in the Cienega Springs locale (Figure 5). Weathered cortical surfaces range from splintery with stepped edges, to moderately smooth with rare fissures and splintery spalls. Several specimens show pre-existing fracture planes. The surface colors tend to be dull brown.

The Rancherias Creek samples are of a marginally better knapping quality than the Cienega Creek materials due to the availability of cobble-to-boulder size chunks. The source area around the exposure showed some efforts at prehistoric acquisition and knapping, but those efforts mostly resulted in shattered fragments and blocky debris. Some samples collected from the Rancherias Creek source have rudimentary impact bulbs of percussions and platform attributes (Crabtree 1982). No flakes with classic dorsal, ventral, or platform attributes, or recognizable finished tools, were observed during the brief visit to the source area.

Modern attempts to knap Rancherias Creek nodules resulted in the production of blocky chunks with shiny, opaque black, irregular surfaces that tended to break along fracture planes and shiny, opaque black, erratic splintery spalls. The sub-rounded nodules show a perlitic weathering rind next to the cortex. In contrast, the specimens with blocky fractures have perlite formed on old fractured surfaces. Attempts to percussion-flake cobbles produced only blocky debris chunks and failed to yield flakes with distinctive dorsal or ventral attributes. Perhaps knapping areas are associated with better quality exposures elsewhere along the Rancherias Creek outcrop.

Figure 4. Rancherias Creek welded tuff bed exposed on lower slope.

Energy Dispersive X-Ray Fluorescence (EDXRF) Analyses

Twelve glassy welded tuff samples from the BBRSP were analyzed by Richard E. Hughes using EDXRF source analyses. The samples were processed using a QuanX-EC™ (Thermo Electron Corporation) edxrf spectrometer equipped with a silver (Ag) x-ray tube, a 50 kV x-ray generator, digital pulse processor with automated energy calibration, and a Peltier cooled solid state detector with 145 eV resolution (FWHM) at 5.9 keV. The specific techniques used for processing these samples and applying a matrix correction algorithm to compensate for inter-elemental absorption and enhancement effects are discussed elsewhere (Hughes 1988, 1994, 2008). In this case analyses were conducted for the elements rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), niobium (Nb), barium (Ba), titanium (Ti), manganese (Mn), and iron (as Fe_2O_3) and to generate iron/manganese ratios (Fe/Mn). The specimens were analyzed as whole-rock samples (not powdered) and suitably flat, cortex-free areas of each specimen were selected as excitation surfaces.

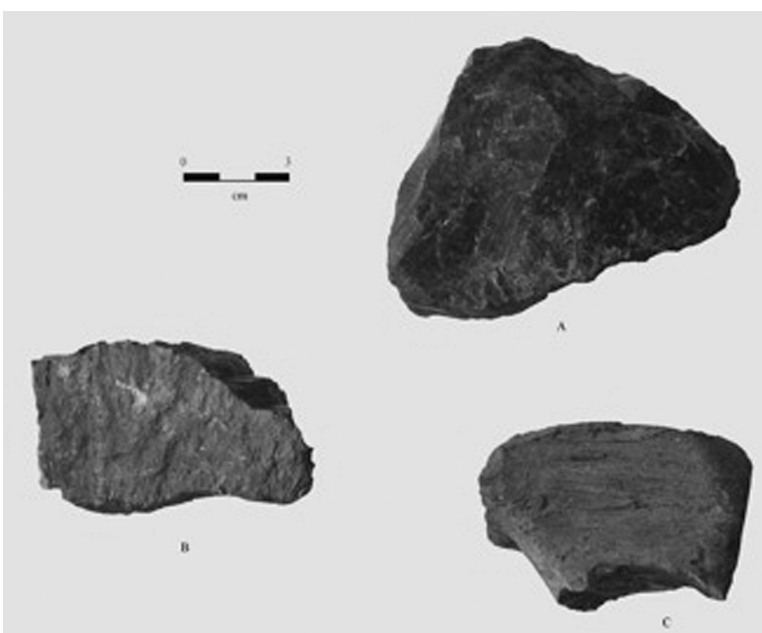

Figure 5. Glassy nodules from the Rancherias Creek source.

The resulting trace element measurements were expressed in quantitative units (i.e., parts per million [ppm] by weight). Comparisons between trace element data generated for the Cienega Creek and Rancherias Creek samples and known obsidian chemical groups were made on the basis of correspondences (at the 2 sigma level) in diagnostic trace element concentration values (in this case, ppm values for Rb, Sr, Y, Zr, Nb, Ba, Ti, Mn, and Fe_2O_3) that appear in Anderson et al. (1986), Baugh and Nelson (1987, 1988), Glascock et al. (1999), Hughes (1984, 2005a), Hughes and Nelson (1987), Jack (1971), Nelson (1984), Shackley (1995, 1998, 2005), and unpublished data on New Mexico obsidians (e.g., Hughes 2005b).

RESULTS AND DISCUSSION

The EDXRF results of 12 samples from BBRSP yielded two geochemical clusters that do not completely coincide with the two collection source areas. Two compositional varieties of glass (termed Variant #1 and Variant #2) were identified at the Rancherias Creek source, but Variant #1 also included all of the specimens from the Cienega Creek source locality. These geochemical varieties can be distinguished on the basis of macroscopic and trace element properties (Table 2 and Figure 6). Variant #1 is the more aphyric or non-crystalline of the two, although pronounced cracks indicative of great age can be seen in these samples under low power magnification. Water analysis would be required to confirm it, but these samples appear greatly hydrated, suggesting that they are perlitic, or nearly so, in composition. Macroscopic and trace element examination of Variant #2 samples also suggest that they represent a *very* extensively hydrated glass; these may be a pitchstone, but water analysis would be required for verification.

While the first variant possesses comparatively uniform trace element composition, the second variety is much more variable, with significantly elevated amounts of Rb, Zr, and Nb composition relative to Variant #1. In both cases elevated Nb values suggest glasses of peralkaline composition. Figure 6 illustrates the contrast between these two chemical variants using Y versus Zr composition, but Table 2 also shows that these glasses also possess contrasting Rb compositions. Although more exhaustive field reconnaissance would be required to make a secure determination, the widespread areal occurrence of geochemical Variant #1 from two sources separated by more than 40 km, suggest that the deposits were probably emplaced as a result of ash flow of finely suspended particles with enough liquid to form a pasty mass (as opposed to a dome/flow eruption) and that the glass was formed through welding of ash in the tuffs (cf. Hughes and Smith 1993:85-89). If so, the textural differences observed are a likely consequence of hydration/glass decomposition processes operating within a compositionally zoned ash-flow tuff sheet.

Some important observations can be made with respect to the archeological implications of these trace element results. Based on the macroscopic and physical properties of both chemical variants, it would appear that only one of these (Variant #1) is nearly aphyric enough to have possibly served as a tool stone medium. Variant #2 contains phenocrysts and *very* few aphyric glass domains, which would probably have rendered it completely unsuitable for use in manufacturing a chipped stone artifact. Even the "best" samples (from an artifact manufacturing standpoint) of Variant #1 glass are extensively hydrated, making them of marginal utility for artifact manufacture. This said, it is possible that better quality volcanic glass may exist in other places within this geologic unit; and, if so, this hypothetically higher quality material could have been used to manufacture artifacts. Limited evidence of knapping debris from areas proximate to one of the collection localities suggests at least some attempts were made by prehistoric people to use the material (Hughes 2008). But the great age of the geologic material (as inferred from the extensive hydration/crack network evident in even the best Variant #1 specimens, and the potassium-argon dating of the formations) suggests that glassy materials from these localities would have been hard to shape and would not have been a major prehistoric tool stone source.

The chemical makeup of the BBRSP glasses may carry an archeological significance that supersedes its physical characteristics. Most obsidian artifacts found in Texas archeological sites that have been sourced have trace elements attributed to volcanic glasses derived from the Jemez Volcanic field of northern New Mexico (Baugh and Nelson 1987; Brosowske 2004; Hester 1991, 1993; Kibler 2005). Some of this Jemez Mountains obsidian has been redeposited into the Rio Grande gravels, where river-transported cobbles were exploited prehistorically far from their primary source (Church 2000). In this regard it is perhaps noteworthy that the Rb, Sr, Zr, and Nb trace element signature of BBRSP Variant #1 volcanic glass—the best of the material analyzed here—is superficially similar to the chemical signature of Obsidian Ridge (also called Cerro Toledo Rhyolite) volcanic glass from the Jemez Mountains (Shackley 2005:Table A.5; Hughes 2005b). In fact, if only the normalized percentages of Rb/Sr/Zr are considered (as was a primary basis for comparison in the very early days of xrf obsidian sourcing studies [Baugh and Nelson 1987:Figure 2]), Variant #1 material would be indistinguishable from two of the most extensively utilized obsidian sources (Cerro del Medio and Obsidian Ridge) from the Jemez Mountains (Figure 7).

Table 2. Quantitative Composition Estimates for Volcanic Glass Samples from Big Bend Ranch State Park, Texas.

Cat.	Trace Element Concentrations										Ratio		Obsidian Source
Number	Zn	Ga	Rb	Sr	Y	Zr	Nb	Ba	Ti	Mn	Fe_2O_3	Fe/Mn	(Chemical Type)
TC-1	nm	nm	243 ±4	13 ±3	81 ±3	203 ±4	125 ±3	35 ±13	325 ±20	548 ±10	1.16 ±.02	21	Variant # 1
TC-3	nm	nm	237 ±4	13 ±3	79 ±3	189 ±4	119 ±3	nm	328 ±25	507 ±12	1.15 ±.02	11	Variant # 1
TC-4	nm	nm	241 ±4	12 ±3	78 ±3	197 ±4	127 ±3	26 ±13	327 ±20	577 ±10	1.14 ±.02	20	Variant # 1
TC-6b	nm	nm	456 ±4	46 ±3	121 ±3	454 ±4	287 ±3	99 ±10	697 ±14	1227 ±10	1.80 ±.02	14	Variant # 2
TC-8b	nm	nm	547 ±4	40 ±3	122 ±3	456 ±4	295 ±3	nm	nm	nm	nm	nm	Variant # 2
TC-9a	nm	nm	495 ±4	60 ±3	123 ±3	440 ±4	286 ±3	105 ±10	528 ±14	873 ±10	1.60 ±.02	18	Variant # 2
TC-9b	nm	nm	475 ±4	39 ±3	113 ±3	412 ±4	264 ±3	101 ±12	906 ±30	729 ±10	1.51 ±.02	19	Variant # 2
TC-10g	nm	nm	691 ±4	42 ±3	123 ±3	442 ±4	283 ±3	119 ±13	469 ±24	798 ±10	1.49 ±.02	17	Variant # 2
CS-1	nm	nm	232 ±4	17 ±3	81 ±3	201 ±4	126 ±3	29 ±10	644 ±12	585 ±10	1.51 ±.02	23	Variant # 1

Table 2. *(Continued)*

Cat. Number	Zn	Ga	Rb	Sr	Y	Zr	Nb	Ba	Ti	Mn	Fe_2O_3	Fe/Mn	Obsidian Source (Chemical Type)
	Trace Element Concentrations											Ratio	
CS-2	nm	nm	240	17	82	205	124	6	478	485	1.10	21	Variant # 1
			±4	±3	±3	±4	±3	±10	±14	±10	±.02		
CS-100	nm	nm	251	15	84	205	126	0	362	701	1.18	15	Variant # 1
			±4	±3	±3	±4	±3	±12	±22	±10	±.02		
CS-101	nm	nm	252	15	81	201	127	37	310	589	1.16	20	Variant # 1
			±4	±3	±3	±4	±3	±12	±20	±10	±.02		
U.S. Geological Survey Comparative Reference Standard													
RGM-1 (measured)	nm	nm	146	108	25	220	7	802	1619	286	1.85	62	Glass Mtn., CA
			±4	±3	±3	±4	±3	±14	±23	±10	±.02		
RGM-1 (recommended)	32	15	149	108	25	219	9	807	1600	279	1.86	nr	Glass Mtn., CA

Values in ppm except total iron [in weight %] and Fe/Mn intensity ratios; ± =x-ray counting uncertainty and regression fitting error at 120-360 seconds lifetime. nm=not measured. nr=not reported. TC=Rancherias Creek; CS=Cienega Creek.

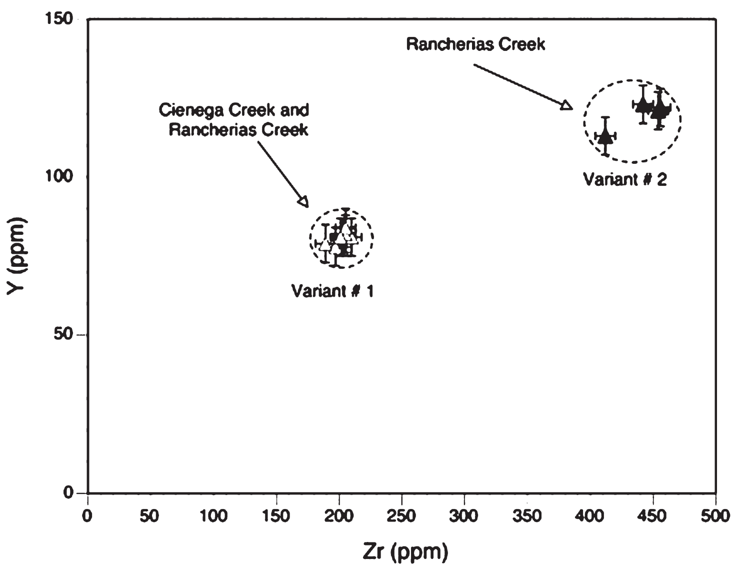

Figure 6. Yttrium versus Zirconium composition of volcanic glasses from Big Bend Ranch State Park, Texas. Dashed lines represent range of variation measured in geologic obsidian source samples. Error bars are two-sigma (95 percent confidence interval) estimates for individual samples from Table 2.

in the Southwest tend to be from sources dating less than 20 mya (Shackley 2005:18). Insofar as the BBRSP welded tuff sources are from formations that date between 27-32.7 mya, their quality as tool stones would be expected to be of marginal quality. Nevertheless, despite the abundance of high quality jaspers and cherts found throughout the BBRSP, possible prehistoric workshops near the two glassy material exposures show that prehistoric people tried to use these marginal-grade materials. Their success in making usable chipped stone artifacts is unknown.

The trace element data generated for specimens from Cienega Creek and Rancherias Creek comprise multi-element chemical signatures that can be compared directly with published values for other volcanic glasses, and can be used to help identify the geologic source for volcanic glass artifacts found within BBRSP and vicinity. In this regard, the single secondary deposited "obsidian

Fortunately, however, the quantitative trace element composition data generated here are sufficiently precise to allow ready separation of the Big Bend Ranch volcanic glasses from Jemez Mountains obsidians (Figure 8). Y versus Zr ppm composition effectively shows this chemical separation, but Nb contrasts also could have been used to distinguish between the BBRSP and Jemez Mountains sources.

SUMMARY AND CONCLUSIONS

The identification and chemical characterization of two welded tuff/ash glassy outcrops from far West Texas expands the documented range of glassy igneous materials into Texas. The knapping quality of material obtained from both of these sources is relatively poor, most likely due to higher levels of perlite in the materials. Indeed, the most common obsidians used by prehistoric people

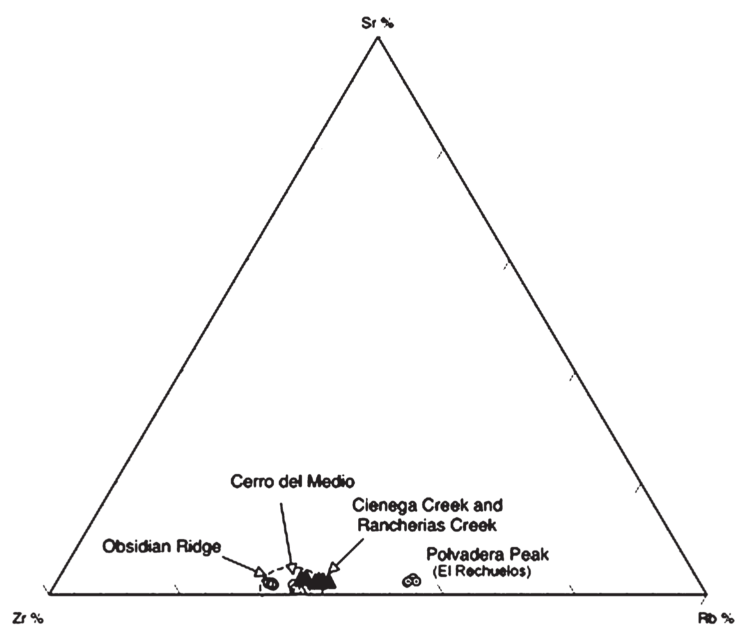

Figure 7. Normalized Rb/Sr/Zr composition of Big Bend Ranch State Park samples in relation to geologic samples from the Jemez Mountains, New Mexico. Dashed lines represent range of variation measured in geologic obsidian source samples. Filled triangles represent the plots for samples from Cienega Creek and Rancherias Creek, Big Bend Ranch State Park.

cobble" collected from the Tapado Creek coincides with geochemical Variant #2 of the present study based on the ppm values of Y and Zr. The geochemical results also provide information useful to assessing the origin of volcanic glass artifacts with superficially similar Rb/Sr/Zr profiles that might have been mistakenly attributed in early x-ray fluorescence studies to Jemez Mountains obsidians rather than to local glass occurrences. The chemical characterization of these sources contributes to the growing body of source data from North American glassy materials, and expands the comparative chemical basis for determining whether these obsidians and welded tuffs were used on a local or regional basis.

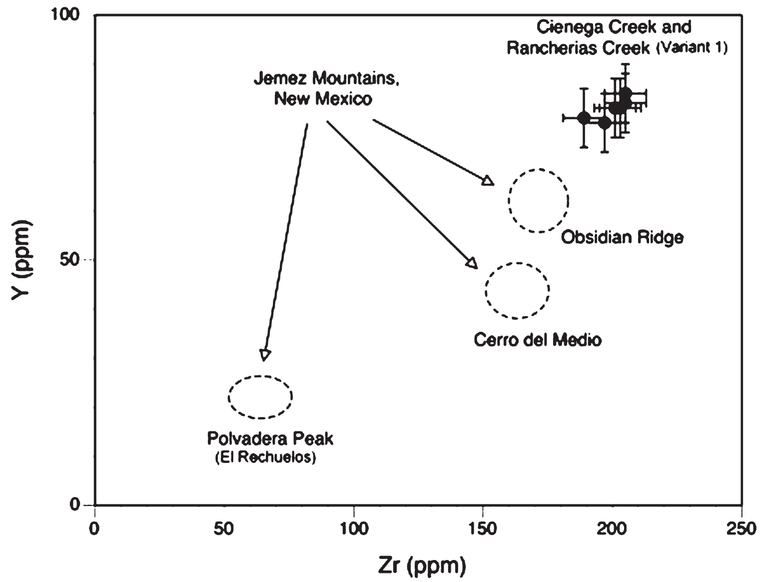

Figure 8. Composition of volcanic glasses from Big Bend Ranch State Park Variant #1 in relation to geologic samples from the Jemez Mountains, New Mexico. Dashed lines represent range of variation measured in geologic obsidian source samples. Black dots represent the plots for samples from Cienega Creek and Rancherias Creek (Variant #1), Big Bend Ranch State Park. Error bars are two-sigma (95 percent confidence interval) estimates for Variant #1 sample results from Table 2.

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REFERENCES CITED

Anderson, D. C., J. A. Tiffany, and F. W. Nelson

1986 Recent Research on Obsidian from Iowa Archaeological Sites. *American Antiquity* 51:837-852.

Banks, L.

1990 *From Mountain Peaks to Alligator Stomachs: A Review of Lithic Resources in the Trans-Mississippi South, the Southern Plains and Adjacent Southwest*. Memoir 4. Oklahoma Anthropological Society, Norman.

Barnes, V.

1951 Tektite Area in Texas. Abstracts of Papers submitted to the November Meeting Detroit, Michigan, November 8-11, 1951. Geological Society of America.

1974 *Geological Atlas of Texas, Seguin Sheet: 1:250,000*. Bureau of Economic Geology. University of Texas, Austin.

1979 *Geological Atlas of Texas, Emory Peak-Presidio Sheet: 1:250,000*. Bureau of Economic Geology. University of Texas, Austin.

1990 Tektite Research 1936 to 1990. *Meteoritic* 25:149-159.

Baugh, T. G. and F. W. Nelson

1987 New Mexico Obsidian Sources and Exchange on the Southern Plains. *Journal of Field Archaeology* 14:313-329.

1988 Archaeological Obsidian Recovered from Selected North Dakota Sites and Its Relationship to Changing Exchange Systems in the Plains. *Journal of the North Dakota Archaeological Association* 3:74-94.

Bouska, V.
1993 Tektites. In. *Natural Glasses*, edited by V. Bouska, pp. 186-247. Ellis Horwood Ltd., New York.

Brosowske, S. D.
2004 Obsidian Procurement and Distribution during the Middle Ceramic Period of the Southern High Plains: Evidence for the Emergence of Regional Trade Centers. *Council of Texas Archeologists Newsletter* 28(2):16-28.

Brown, K. M.
1976 Fused Volcanic Glass from the Manning Formation. *Bulletin of the Texas Archeological Society* 47:189-208.

Caran, C.
1989 Obsidian at Big Bend Ranch State Natural Area, Presidio County, Texas. Manuscript on file at the Texas Archeological Research Laboratory, University of Texas at Austin.

Church, T.
2000 Distribution and Sources of Obsidian in the Rio Grande Gravels of New Mexico. *Geoarchaeology* 15:649-678.

Crabtree, D.
1982 *Introduction to Flintworking*. Occasional Papers 28. Idaho Museum of Natural History, Pocatello.

Deal, D.
1976 The Geological Environment of the Bofecillos Mountains, Southeastern Presidio County, Texas. In *Bofecillos Mountains: A Natural Area Survey*, assembled by D. Kennard, pp. 17-98. Natural Area Survey Report 12. Lyndon B. Johnson School of Public Affairs, University of Texas, Austin.

Glascock, M. D., R. Kunselman, and D. Wolfman
1999 Intrasource Chemical Differentiation of Obsidian in the Jemez Mountains and Taos Plateau, New Mexico. *Journal of Archaeological Science* 26:861-868.

Henry, C. D.
1998 *Geology of the Big Bend Ranch State Park*. Guidebook 27. Bureau of Economic Geology, The University of Texas at Austin. Texas Parks and Wildlife Press, Austin.

Hester, T. R.
1991 Notes on South Texas Archaeology: 1991-1: An Overview of the Results of the Texas Obsidian Project. *La Tierra* 18(1):4-7.

1993 Obsidian in Texas: Geological Sources and Archaeological Interpretations. Paper presented at the 58th annual meeting of the Society for American Archaeology, St. Louis

Hughes, R. E.
1984 Obsidian Sourcing Studies in the Great Basin: Problems and Prospects. In *Obsidian Studies in the Great Basin*, edited by R. E. Hughes, pp. 1-19. Contributions No. 45. University of California Archaeological Research Facility, Berkeley.

1988 The Coso Volcanic Field Reexamined: Implications for Obsidian Sourcing and Hydration Dating Research. *Geoarchaeology* 3:253-265.

1994 Intrasource Chemical Variability of Artefact-Quality Obsidians from the Casa Diablo Area, California. *Journal of Archaeological Science* 21:263-271.

2005a Determination of the Geologic Sources for Obsidian Artifacts from Camels Back Cave, and Trace Element Analysis of Some Western Utah and Eastern Nevada Volcanic Glasses. In *Camels Back Cave*, edited by D. N. Schmitt and D. B. Madsen, pp. 249-256. Anthropological Papers No. 125, University of Utah, Salt Lake City.

2005b Appendix D. ED-XRF Analyses: Original Letter Reports and Data from R. E. Hughes, Geochemical Research Laboratory. In The Dome Fire Obsidian Study: Investigating the Interaction of Heat, Hydration, and Glass Chemistry, by A. Steffen, pp. 333-350. Ph.D. Dissertation, Department of Anthropology, University of New Mexico, Albuquerque.

2008 *Energy Dispersive X-ray Fluorescence Analysis of Volcanic Glass from Two Localities in Big Bend Ranch State Park, Presidio County, Texas*. Letter Report 2008-73. Geochemical Research Laboratory, Portola, California.

Hughes, R. E. and F. W. Nelson
1987 New Findings on Obsidian Source Utilization in Iowa. *Plains Anthropologist* 32(117):313-316.

Hughes, R. E. and R. L. Smith
1993 Archaeology, Geology, and Geochemistry in Obsidian Provenance Studies. In *Effects of Scale on Archaeological and Geoscientific Perspectives*, edited by J. K. Stein and A. R. Linse, pp. 79-91. Special Paper 283. Geological Society of America.

Jack, R. N.
1971 Source of Obsidian Artifacts in Northern Arizona. *Plateau* 43:103-114.

Kibler, K.
2005 Broader Continental Connections through the Gulf Coastal Plain of Texas. In *Gulf Coast Archaeology: The Southeastern United States and Mexico*, edited by N. M. White, pp. 197-204. University Press of Florida, Gainesville.

Lonsdale, J. H.
1927 Igneo*us Rocks of the Balcones Fault Region of Texas*. Bulletin 2744. University of Texas, Austin.

McCall, G. J.
2001 *Tektites in the Geological Record: Showers of Glass from the Sky*. The Geological Society of London, London.

McKnight, J. F.
1968 Geology of Bofecillos Mountain Area, Trans-Pecos Texas. Ph.D. dissertation, The University of Texas, Austin.

Nelson, F. W., Jr.
1984 X-ray Fluorescence Analysis of Some Western North American Obsidians. In *Obsidian Studies in the Great Basin*, edited by R. E. Hughes, pp. 27-62. Contributions No. 45. University of California Archaeological Research Facility, Berkeley.

Shackley, M. S.
1988 Sources of Archaeological Obsidian in the Southwest: An Archaeological, Petrological and Geo-Chemical Study. *American Antiquity* 53(4):752-772.
1995 Sources of Archaeological Obsidian in the Greater American Southwest: An Update and Quantitative Analysis. *American Antiquity* 60:531-551.
1998 Geochemical Differentiation and Prehistoric Procurement of Obsidian in the Mount Taylor Volcanic Field, Northwest New Mexico. *Journal of Archaeological Science* 25:1073-1082.
2005 *Obsidian: Geology and Archaeology in the North American Southwest*. University of Arizona Press, Tucson.
2006 An Energy-Dispersive X-Ray Fluorescence Analysis of Probable Tektites from South-Central Texas. Berkeley Archaeological Laboratory XRF Lab Letter Report, Berkeley, California.

Spearing, D.
1998 *Roadside Geology of Texas*. Mountain Press Publishing, Missoula.

Swanson, E. R.
1995 *Geo-Texas: A Guide to the Earth Sciences*. Texas A&M University Press, College Station.

Vand, V.
1965 Astrogeology: Terrestrial Meteoritic Craters and the Origins of Tektites. In *Advances in Geophysics II*, edited by H. E. Landsberg and J. Van Mieghem, pp. 2-115. Academic Press, New York.

Walton, A. W.
1985 Volcaniclastic-Sedimentary Record of the Chinati Volcanic Center: The Buck Hill and Vieja Groups. In *Igneous Geology of the Trans-Pecos Texas*, edited by J. G. Price, C. Henry, D. F. Parker, and D. S. Barker, pp. 251-265. Guidebook 23. Bureau of Economic Geology, The University of Texas, Austin.

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