RE-ANALYSIS OF CONEJO SHELTER: A LEGACY ARCHAEOLOGICAL COLLECTION FROM THE AMISTAD RESERVOIR AREA, TEXAS

A Dissertation

by

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ABSTRACT

Although the critical importance and research potential of archaeological collections have long been recognized, care and management of these collections and research within them have not always been at the forefront of the discipline's overall goals. While there have been several successive waves of concern regarding the proper curation (or lack thereof) of archaeological materials, response to these concerns has been limited primarily to improving curatorial facilities and the State laws and regulations that control them. Updates to the physical conditions of archaeological collections are both necessary and valuable, but they are not the only potential solution. This dissertation adds to the growing body of literature regarding current issues within the field of archaeological materials curation and proposes that (1) building research projects using existing archaeological collections is a viable path to mitigating the curation crisis and (2) encouraging this type of research is part of our ethical obligation to protect and preserve archaeological resources. Within this framework, I am examining a collection of archaeological materials from Conejo Shelter, a dry rockshelter in west Texas. Despite the remarkable preservation of perishable artifacts recovered from the site and its significance for understanding the pre-Columbian occupants of the Lower Pecos region of Texas, Conejo Shelter has never been fully reported. Through an analysis of this collection, I examine chronological change and cultural adaptation in the Amistad area, comparing existing knowledge to new information gleaned from the collection. This analysis will focus primarily on a theoretical model of cultural continuity or stasis, which has been broadly applied to the Lower Pecos. This model was developed following observations of limited changes in lithic technology and diet. Researchers of the Lower Pecos typically suggest that the observed technological and dietary stasis is due to the fact that the environment of the Lower Pecos has been fairly consistent throughout the last 6,000 years. Analysis of perishable artifacts has led to the development of another theoretical model, which suggests migration of populations and/or ideas by way of similar styles and manufacturing techniques between the Lower Pecos and Coahuila, on the Mexico side of the Rio Grande.

DEDICATION

For Ed and Judy Jelks, whose legacy I gladly follow.

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CHAPTER I

INTRODUCTION TO THE PROJECT

Despite long-standing recognition of their research value, archaeological collections have often taken a back seat to new excavations in the way they are valued, analyzed, and reported on. This paradox has served as the primary motivation for the body of research presented in this dissertation.

Debates within the field of archaeology regarding how archaeological collections are created and managed, have often focused on what has been called "the Curation Crisis." This crisis refers to situations where archaeological museums and repositories have become overburdened with archaeological collections and associated records to the point where those institutions are no longer able to properly care for the entire inventory. Many repositories and museums were inundated with artifacts and records immediately following the passage of the National Historic Preservation Act (NHPA), which mandated that infrastructure projects that received federal dollars or permits had to complete archaeological testing and mitigation prior to any construction. No one would argue that this Act had a negative impact on archaeology – far from it. The majority of the archaeological investigations that take place in the United States are carried out under the auspices of compliance with Section 106 of the NHPA. However, the NHPA and related acts, executive orders, and federal regulations often lack the legal "teeth" required to ensure that collections (including associated records) are properly documented, processed, analyzed, and stored post-excavation.

While the culture of the discipline is changing slightly, there is still emphasis on completing excavation-based research as the primary component of dissertations in archaeology. This dissertation seeks, in part, to demonstrate that original research can be conducted within existing archaeological collections, particularly through the implementation of innovative technologies and analytical methods.

One of the main goals of this dissertation is to ensure that new data generated from this project are stored in open-access digital repositories, helping to mitigate one of the primary difficulties of conducting research in archaeological collections. It is frequently the case that excavation records are incomplete or otherwise difficult to interpret, either because excavation methodologies were not up to current standards, preservation conditions were not ideal, or some combination of the two. Increasing the accessibility of data in archaeological collections is paramount to encouraging the utilization of previously-excavated collections.

Within the framework of these motivations, promoting collections access and collections-based dissertation research, this dissertation includes several components. Chapter 2 includes an overview of the current state of archaeological curation, an analysis of curation education at the undergraduate and graduate level, and a presentation of potential solutions for improving archaeological curation moving forward. The primary analytical component of this chapter is the presentation of a survey conducted regarding the ways Anthropology departments teach and promote curation topics. A focus on collections based education connects the case study of Conejo Shelter research to the broader themes of mitigating the curation crisis and increasing access to existing collections.

Chapter 3 serves to familiarize the reader with the primary source of the archaeological data presented in this dissertation, Conejo Shelter. This chapter includes an overview of the site setting, focusing on regional and site ecology and how these environments impact the nature of the archaeological record at Conejo. Chapter 2 also delves into previous research in the Lower Pecos region, excavations at Conejo and the site assemblage, the post-excavation history of the collection. The last section of this chapter reviews current research, including conservation work completed as part of this dissertation.

Following the introduction to the site, chapter 4 summarizes the primary theoretical frameworks that have served as the basis for much of the research in the Amistad Reservoir area and introduces the models that frame the interpretation of the Conejo fiber sandal assemblage. The Desert Culture model was applied to the Lower Pecos by Dibble (1964) following a model initially developed by Jennings (1957) for the Great Basin. This theoretical model assigns various cultural traits to adaptations specific to living in desert regions. A derivative model, the cultural stability model, has pervaded much of the research of the Lower Pecos. It posits that since the regional ecology of the Lower Pecos has remained largely unchanged for much of the last 6,000 years, and given the constraints of living in such a marginal environment, cultural adaptations must have stabilized along with the environment. Interpretations of the rock art and perishable industries of the region have been developed in contrast to the stability theory.

Chapter 5 focuses on the ways in which older excavation records can be modernized in order to increase quality, resolution, and access. I address the role of geographic information systems (GIS) in archaeology, particularly focusing on their utility for increasing our understanding of previously excavated archaeological sites. This chapter includes a discussion of some of the issues encountered through the data collection process and presents a more robust radiocarbon chronology developed for the site.

Chapter 6 presents the results of my analysis of the assemblage of perishable plant fiber sandals from Conejo Shelter. This chapter also includes summaries of chronological and regional changes in sandal manufacture based on radiocarbon analyses and GIS mapping. Discussions of cultural transmission from Coahuila, and the role of children and knowledge transmission in the creation of the archaeological record follow in chapter 7.

The data generated for this project are presented, with a data management plan, in the appendices of this work.

CHAPTER II

ARCHAEOLOGICAL CURATION ETHICS: CREATING RESEARCH OPPORTUNITIES FOR STUDENTS USING EXISTING COLLECTIONS

Curation Laws and Practice

Federal Laws and Regulations

Managing cultural resources has been part of the mission of the United States Government since 1800, with the appropriation of $5,000 for the establishment of the Library of Congress. It was not until 1906, however, with the passing of the Antiquities Act, that the federal government specifically protected archaeological resources. This law prohibited the excavation of antiquities from public land without a permit from the Department of the Interior (King, 2008). Between 1906 and 1990, several additional laws concerning archaeological resources were put into place. The majority of these laws were passed in the 1960s and 70s, in association with the National Environmental Policy Act (NEPA). The most significant cultural resource law from that era is the National Historic Preservation Act (NHPA), signed into law by President Lyndon Johnson in 1966. This law and associated legislation laid the groundwork for the emerging branch of Cultural Resource Management (CRM) archaeology. The NHPA mandates that all projects under federal contract or receiving federal funding must include an assessment of potentially impacted cultural resources. Any archaeological material excavated in association with these projects is the property of the federal government and is to be kept and maintained in perpetuity.

Unfortunately, there were no legislative guidelines or standards for curating federal archaeological collections until 1990, with the addition of 36 CFR 79 by the National Park Service (NPS). This regulation, part 79 of title 36, chapter I of the Code of Federal Regulations (CFR) specifically addresses responsibility for federal collections, including procedures to maintain them, establishing criteria for repositories that store federal collections, as well as guidelines for access to and use of those collections. While 36 CFR 79 provides a solid list of goals for curation facilities, the regulation fails to provide a timeline for compliance or any way to enforce implementation of the regulation.

State Laws and Regulations

Texas is one of very few states that have state-level laws and regulations concerning the care of cultural resources and curation. Administrative Code Title 13, Part II, Chapter 29, Management and Care of Artifacts and Collections, amended the Antiquities Code of Texas to give the Texas Historical Commission power to develop rules and regulations for the care of held-in-trust collections. Part 29.6a outlines standards of best practice for archaeological curation facilities in the state and established the Curatorial Facility Certification Program (CFCP). The CFCP provides guidelines and necessary steps toward improving curatorial facilities and bringing them up to current curatorial standards. A significant feature of the legislation was a mandate that all facilities that are responsible for state-owned collections go through the certification process. This mandate ensures that the state's extensive held-in-trust collections are properly cared for. The Texas Historical Commission also has regularly awarded grants, which serve to provide funding to aid curatorial facilities in the certification process and other efforts toward high quality collections care.

Current State of Curation

Over the past several decades there have been waves of increased concern about the future of archaeological collections – sometimes with the result of real, positive changes and policies. A seminal paper by Marquardt et al. (1982) argued for the existence of a crisis in the curation of archaeological collections. That paper was, in many ways, a response to a few previous articles and assessments of the state of archaeological collections management in institutions around the United States (Ford 1977; Lindsay et al. 1980). Marquardt et al. highlight the ethical responsibility to both the public and the archaeological profession to properly curate collections so their future research potential can be realized. These reports, along with a second survey by Lindsay et al. in 1980 characterize the first wave of primary concern about the state of archaeological collections. This wave emerged fairly shortly after the enactment of the National Historic Preservation Act (1966) and other similar laws and regulations, which substantially increased the rate at which archaeological collections accumulated in repositories (Marquardt et al., 1982).

The second wave of curation concern began with the adoption of federal regulation at 36 CFR 79, which provided federal agencies and repositories with a set of curatorial standards to comply with, but offered few solutions to the rising costs of improving curatorial facilities and practices. One of the formative papers for this wave was "The Curation Crisis" published in the National Park Service publication *Common* Ground (Childs 1995). In this paper, Childs highlights the critical nature of the lack of understanding of proper collections management by the archaeological community. In "Primal Fear: Deaccessioning Collections," Sonderman (1996), proposed that archaeologists may be unrealistically attached to curated collections while at the same time reminding archaeologists of their ethical responsibility to care for what they have collected. He suggests deaccessioning redundant artifact categories such as brick fragments, nails, and even in some cases debitage as a possible solution for overcrowding and the increasing backlog of uncataloged objects in curatorial facilities and repositories (Sonderman 1996). Though controversial at the time, Sonderman's approach for certain artifact classes has been adopted by many states. Unfortunately, federal regulations regarding deaccessioning policy and practice have yet to be passed (Childs, personal communication). In 2000, Childs and Corcoran published a comprehensive manual, "Managing Archaeological Collections," for the National Park Service which includes an exhaustive discussion of cultural resource laws, key issues with curation, and ways to properly manage collections (Childs and Corcoran 2000). This manual, along with several other books and articles (Sullivan and Childs 2003; Childs 2004) characterized the third wave.

Adding to the momentum garnered for curation, the discipline earned a significant victory with the passing of H.R. 3114 which provides funding for the U.S. Army Corps of Engineers (COE) Veterans Curation Program (VCP). This pioneering program started at the Missouri curation office of the Corps of Engineers as the brainchild of Dr. Michael (Sonny) Trimble. The VCP, which has three laboratories around the country is a five month program designed to aid veterans in the transition to the mainstream job market after their service has ended. Program participants are trained in archaeological curation methods, including artifact processing, repackaging, photography, cataloging, and managing associated records. This program not only provides temporary employment and job training, but the hard work of the program participants has been instrumental to the COE in alleviating the sizeable backlog of unprocessed archaeological materials. H.R. 3114, signed into law July 6, 2016, is the first law passed in this country that allocates funding specifically for curation.

Curation Education

While the Curation Crisis has long been on the tongues of collections managers and curators, the discipline as a whole is still far from appropriately meeting the challenges presented by the crisis. Progress has been made toward ameliorating the curation crisis. Professional anthropological and archaeological societies are promoting professional development seminars about curation issues and publishing research papers about the state of the discipline as it relates to collections care and management. However, archaeologists are still not being adequately trained and prepared for the reality of the state of curation in the discipline. To better quantify the gravity of the dearth of curation education and training opportunities, especially at the graduate level, I examined 67 universities with prominent anthropology/archaeology programs in the United States, Canada, and England.

Survey Development

The selection process for the universities in the survey was initially by reputation. I selected programs that had historical reputations of having strong anthropology and archaeology programs. I also selected a few universities that I knew had graduate programs in Museum Studies, regardless of their rank among anthropology/archaeology programs. Speakman, et al's (2018) ranking of top tier graduate anthropology programs allowed me to fill out and refine the list to include programs I had missed in my initial selection and to cull a few that did not need to be included. From this list, I included all universities ranked Tier I and Tier II and the first seven ranked at Tier III. There were several programs listed lower in Tier III or in Tiers IV, V, and 0 that I kept. The spreadsheet indicates which programs were on this list and where they ranked. For each university identified, I collected data on: Department Name, Degrees available (including whether Museum Studies – specific degrees/certificates were conferred), whether the Department or University had archaeological collections, whether those collections were available for research, whether the graduate program descriptions encouraged or even mentioned the use of the collections for graduate-level research, and whether courses in Museum Studies, Curation, or Collections management were available at the undergraduate or graduate level. For this final question, I queried each department's course catalog for key words like: museum, data, curation, collection, management. If these words were not identified in course titles or descriptions, the answer to that survey question was marked as "no". If the University had a separate Museum Studies program, this was noted, even in cases where the program was housed in a non-anthropology department. If the Museum Studies program provided links or accepted elective coursework from the anthropology department, this was recorded as a "yes" for the final question.

Results

The results of the survey are presented in Appendix B. I typically spent 20 minutes to an hour collecting data for each university. In some cases, it is possible that I could have found more information with additional digging, but one of the goals of this exercise was to mimic the experience of a potential student or employer searching for a graduate program that would fit their collections/museum-focused goals. I made an effort to select every available tab from the department's home page. In some cases, it did not take very long to find the answers to all of the survey questions, but in others, it took serious digging. Narrative descriptions of the categories of data collected will start with an overview of responses recorded for each question. An overall assessment was made regarding the quality of each program, which was determined with positive responses in each category, including the university/program having Museum Studies degrees, minors, or certificates available at the graduate level. Finally, I will discuss these results in terms of the university rankings as defined by Speakman et al (2018). References to specific universities will be followed by their ranking in parentheses.

Twenty-two of the surveyed universities offered Masters of Arts degrees, Graduate Certificates, or Graduate Minors in Museum Studies, Museology, or other museums/collections-related field. Programs with these kinds of degrees available are highlighted in yellow on the spreadsheet. Of these, seven universities housed Museum Studies in a different, non-anthropology department, or it existed as separate, multidisciplinary entity. This metric was not quantified, but in most cases, any museum studies offerings had to be searched for separately and were not always openly advertised as an offering or even an option in the Anthropology Department websites.

Ten of the surveyed universities did not have in-house archaeological collections in any form (or these were not found). Entries in this category are highlighted in orange. The universities that appeared to not have archaeological collections at all include: Ohio State University (Tier II), Tulane University (Tier III), and Boston University (below Tier III). Those institutions where the presence or absence of collections could not be readily determined were: University of Virginia (Tier II), Rutgers and University of California Riverside (below Tier III), and University of California Irvine and University of Sheffield (both unranked). Two of the universities without specific reference to collections (University of Chicago and University of Massachusetts, Amherst) had potential avenues for exploring collections through connections to local museums (in the case of University of Chicago) or through a departmental CRM firm (in the case of UMass), though neither of these ties were explicit enough to merit a positive answer for the survey. With more extensive digging, I was able to find University of Chicago's Oriental Institute and other laboratories through the UC Archaeological Nexus, located within an Interdisciplinary Studies tab on the Graduate Program page. Because of the potential, but not obvious or readily found availability of collections, these two entries were marked in a lighter orange than the other eight.

Of the 57 universities or Anthropology programs that had affiliated or on-campus collections or museums, eight of these appeared to be exhibit only and/or not available for research. These universities include: University of Pittsburgh (Tier II), McMaster University, Northwestern University, and University of Oregon (all Tier III), Rice University and University of California Santa Cruz (below Tier III), and Emory University and University of Southern California (unranked).

Well over half of the universities surveyed stressed excavation-based field work as an integral component of the graduate program, particularly at the doctoral level. Even at universities with substantial, well-known museums or department collections, doctoral level research was still not promoted to the degree that a prospective student would feel supported and encouraged in a collections-based research project. One program, at Princeton University, did specifically note on their primary doctoral degree program page that "field work" did not necessarily include excavation. Twenty-seven of 67 universities had no opportunities for museum studies or curation coursework in anthropology or related departments. Of the remaining programs that did offer museum studies or curation coursework, eight limited these courses to the undergraduate level. Ten of the programs with museum studies or curation coursework only offered this coursework at the Masters level. Sixteen of the 67 surveyed universities received positive scores for each criterion. Among these, three stood out, based on caliber of the program, collections accessibility, and clear promotion of the collections and curatorial practice: Arizona State University, University of Michigan, and University of New Mexico.

Working Through Solutions

Sixteen programs met my basic criteria for being collections-friendly. Fewer than 25% of the top programs in anthropology in three different countries are actively working with students on a path toward mitigating the curation crisis. Most departments still stress or even require excavation field work as part of the doctoral research program.

Changing the conversation about curation issues from the understandably alarmist “curation crisis” perspective to a systematic restructuring of how archaeology is taught is the best way to ensure that archaeological collections are valued and cared for. The results of the programmatic survey were quite distressing. It becomes difficult to believe that these problems will ever be alleviated if collections management and curatorial work are continuously relegated to the sidelines. Given the widespread nature of the curation crisis, it is unlikely that anthropology graduate students now or in the future will be able to avoid issues that inevitably accompany underfunded and understaffed collections and curatorial facilities. Continuing to award PhDs to students without any experience working with archaeological collections is not sustainable practice moving forward.

Beyond ensuring that students at all programmatic levels are trained in the realities of archaeological curation, it is the responsibility of Department Chairs, University Museum Curators, and Graduate Advisors to advocate for and actively encourage collections-based research. It is vital that students at all levels understand that graduate level research does not require excavation, that data collected from previously excavated materials can be just as informative as data collected from a personally-excavated site. Future students at all levels need to understand that collections-based research is a viable option, it isn't a fallback or safety net for those "incapable" of excavation.

The final step that will be in the hands of the next generation of graduate students and PhDs involves changing how funding agencies perceive collections-based research. The biggest, practical hurdle that collections and curatorial facilities must overcome is inadequate funding. Curatorial facilities are chronically underfunded and storage fees are simply not enough to sustain collections in perpetuity (Terry Childs et al. 2010). Increasing access to grant funding, both for collections care and collections-based research would be an immensely positive move in the right direction.

CHAPTER III

CONEJO SHELTER

Previous Research

The research potential of the archaeology and rock art of the Lower Pecos Canyonlands was first recognized professionally in the 1930s. Expeditions led by researchers from the Texas Memorial Museum and the Witte Museum, among others, involved archaeological testing and documentation of the impressive rock art in the region (Jackson 1938; Kirkland and Newcomb 1967). While several of these forays led to systematic excavations, museum sponsorship meant that the primary directive of this early research was to document and collect exhibit-worthy artifacts.

During the mid-20th century, dams were constructed on nearly every major river in the United States to create reservoirs and to tap into hydroelectric power potential (Jennings 1985). The River Basin Survey (RBS) program was created as a joint task force between the National Park Service and the Smithsonian Institution to conduct salvage archaeological excavations in the inundation areas of these reservoirs (**cite**). Plans for creation of the Amistad Reservoir, initially called the Diablo Reservoir, along the Rio Grande were drawn in 1944 as part of a Water Treaty between the United States and Mexico (Graham and Davis 1958). The Texas Archaeological Salvage Project (TASP), operating from The University of Texas, Austin, implemented the majority of the RBS projects in the State (Jelks 2006). In 1964, the TASP was awarded a National Science Foundation (NSF) grant to carry out ecologically-focused investigations for several Amistad Reservoir sites, including rock shelters. Several pollen and macrobotanical analyses were conducted through this grant. This research resulted in a tightly refined paleoclimate chronology built from numerous pollen profiles and paired with faunal analyses from those shelters (Johnson Jr. 1963; Story and Bryant 1966). Climate chronologies from this period of research guided most of the subsequent analyses of the archeology and material culture of the Lower Pecos.

Regional Paleoenvironments

The earliest deposits at Conejo Shelter date to around 6,500 years BP, well into the early Archaic period, but archaeological evidence suggests human occupation of the Lower Pecos region at least as early as 12,000 years BP (the Paleoindian period). Paleoclimate models for the region were initially developed in the 1960s and 1970s from palynological records. These reconstructions have remained largely the same, with major climatic intervals confirmed and recognized with more modern analyses. Early occupants of the Lower Pecos region would have experienced a relatively mesic climate. Cool, moist environments dominated by pine, spruce, grasses, and other arboreal species associated with open woodlands supported megafauna in this region, evidenced by pollen records and physical remains of some of these species at Bonfire Shelter (41VV218) and Cueva Quebrada (41VV12a) (Turpin 2004). Bryant identified a short warm/dry period in deposits dated around 10,000 years BP, with increased grass and herb pollen and decreased arboreal pollen types (Bryant and Holloway 1985). This shift likely contributed to the retreat of megafauna from the region. Another cool/moist period followed, with pine and grass pollen, as well as gourd pollen dominating the record during Bryant's Medina stage as identified from the lowest strata at the Devil's Mouth site. Faunal remains from Bonfire Shelter Bone Bed 2 confirm the resurgence of cooler environments which could support large populations of bison (Bryant 1969; Dibble and Lorrain 1968).

The end of the Medina stage corresponds to the beginning of the Archaic Period, which is largely characterized by a warmer and drier climate. During the Stockton stage (~9,000 to 4,500 years BP) there was a gradual decrease in the mesic plants that dominated earlier stages, paired with an increase in xeric-adapted species, like *Ephedra*, *Prosopis*, various cacti and succulents (Bryant 1966). By the onset of the Sanderson stage (~4,000 – 2,500 years BP), the climate in the Lower Pecos was hot and dry, with a further proliferation of xeric-adapted plant species and reduction of grasslands. Bryant identified a brief erosional period (evidenced by an erosional break in the stratigraphic sequence at the Devil's Mouth site) between the Stockton and Sanderson stages, named the Ozona interval. This period is marked by a seemingly dramatic change in plant cover on the landscape as climate became warmer. While the exact cause of the period is unknown, corresponding pollen evidence from other shelters supports the supposition of a denuded landscape as a result of the transition from mesic to xeric plants. Different distribution of plant cover, paired with increased seasonal rainfall, could have led to higher-energy flooding during this period.

Some researchers have postulated that the warming and drying which occurred during the Stockton and Sanderson stages are the local manifestation of the Altithermal, first proposed by Antevs (1955). While traces of the Altithermal have been observed in the global archaeological record, the exact nature and timing of this climatic event, particularly in the Lower Pecos, are still debated. Nance (1972) proposes the onset of the Altithermal as the best working hypothesis for the shift in subsistence economy (to more intense use of desert succulents) seen in the Lower Pecos between 6,000 and 5,000 years ago. In a summary paper on climate and diet in the Lower Pecos, Ken Brown (1991) suggests up to three hypsithermal (the term used more commonly by archaeologists in the Midwest) events based on estimations of maximum insolation by Davis (1984). According to Davis (1984), these maximum insolations, where the area would have been exposed to most intense radiation from the sun, occurred in May to June 13,000 years BP, July to August 10,000 years BP, and September to October 5,000 years BP. These estimations are based on global climate data, particularly from COHMAP. The third period of insolation fits the time frame suggested for the Altithermal, which began globally around 5,500 years BP.

The brief return to more mesic conditions during Bryant's Frio Interval corresponds to the timing of the end of the Altithermal, at about 2,500 years BP. This period saw an increase in pine, sedge, and grass pollen in the area. The expansion of the grasslands of the Southern Plains again brought bison to the Lower Pecos, where they were again dispatched of *en masse* at Bonfire Shelter. The continuation of the xeric-adapted subsistence economy evidenced from deposits in most other shelters in the region suggests that the populations exploiting bison may have migrated to this region with bison during the Frio Interval (Bryant 1966; Turpin 2004).

The final climate stage, which Bryant named the Juno stage, is marked by a rapid return to xeric conditions. Pollen records show increases of mesquite, acacia, mimosa, cactus species, and cheno-ams. Conditions of the Juno stage have persisted to the present.

Period	Subperiod	Climatic Period	Radiocarbon Years B.P.
Paleoindian		Medina Stage	<12,000 – 9,000
	Aurora		14,500 – 11,900
	Bonfire		10,700 – 9,800
Late Paleoindian		Stockton Stage	9,400 – 9,000
	Oriente		9,400 – 8,800
Early Archaic			9,00 – 6,000
	Viejo		8,900 – 5,500
Middle Archaic		Sanderson Stage Ozona Erosional (4500 BP)	6,000 – 3,000
	Eagle Nest		5,500 – 4,100
	San Felipe		4,100 – 3,200
Late Archaic		Frio Interval	3,000 – 1,000
	Cibola		3,150 – 2,300
	Flanders	Juno Stage	2,300 – ?
	Blue Hills		2,300 – 1,300
Late Prehistoric			1,000 – 350
	Flecha		1,320 – 450
	Infierno		450 – 250
Historic			350 – 1

Table 1. Cultural and climatic chronology of the Lower Pecos. Table adapted from Turpin (2004) and Bryant (1966).

Site Setting and Ecology

Conejo Shelter (41VV162) is situated in a side canyon just north of the confluence of the Rio Grande and Pecos Rivers (Figure 1). It is 170 feet wide, approximately 50 feet deep, and the overhang is 40 feet high at its highest point (Collins 1969). The location of the shelter is high up the sloping canyon wall, about 150 feet above the canyon bottom. The mouth of the shelter faces roughly southeast. A small overhang adjacent to the shelter, Cueva Quebrada, was designated 41VV162a (see Figure 2). Excavation records reported that during summer months, the overhang of the shelter provided plentiful shade, while during winter months, the angle of sun kept the shelter quite warm (Alexander 1974). Surveys around the shelter indicated that occupants of Conejo Shelter would have been able to access the resources in the upland plateau above the shelter, as well as resources on the canyon slope and the canyon bottom. While the canyon itself would not have been perennially watered, the Rio Grande intersects with the canyon about 200 yards west of the shelter. Initial recording of the site as part of the Amistad Reservoir mitigation noted an extensive midden deposit, bedrock mortars, and metates near the mouth of the shelter (Graham and Davis 1958). Because deposits at Conejo Shelter only date back as far as 6,000 – 6,500 years BP, the shelter would have only been occupied during the climatic stages of the Archaic and later periods: the Stockton stage through the Juno stage. By the time Conejo was first occupied, xeric conditions were relatively stable in the region, with minor fluctuations as described above.

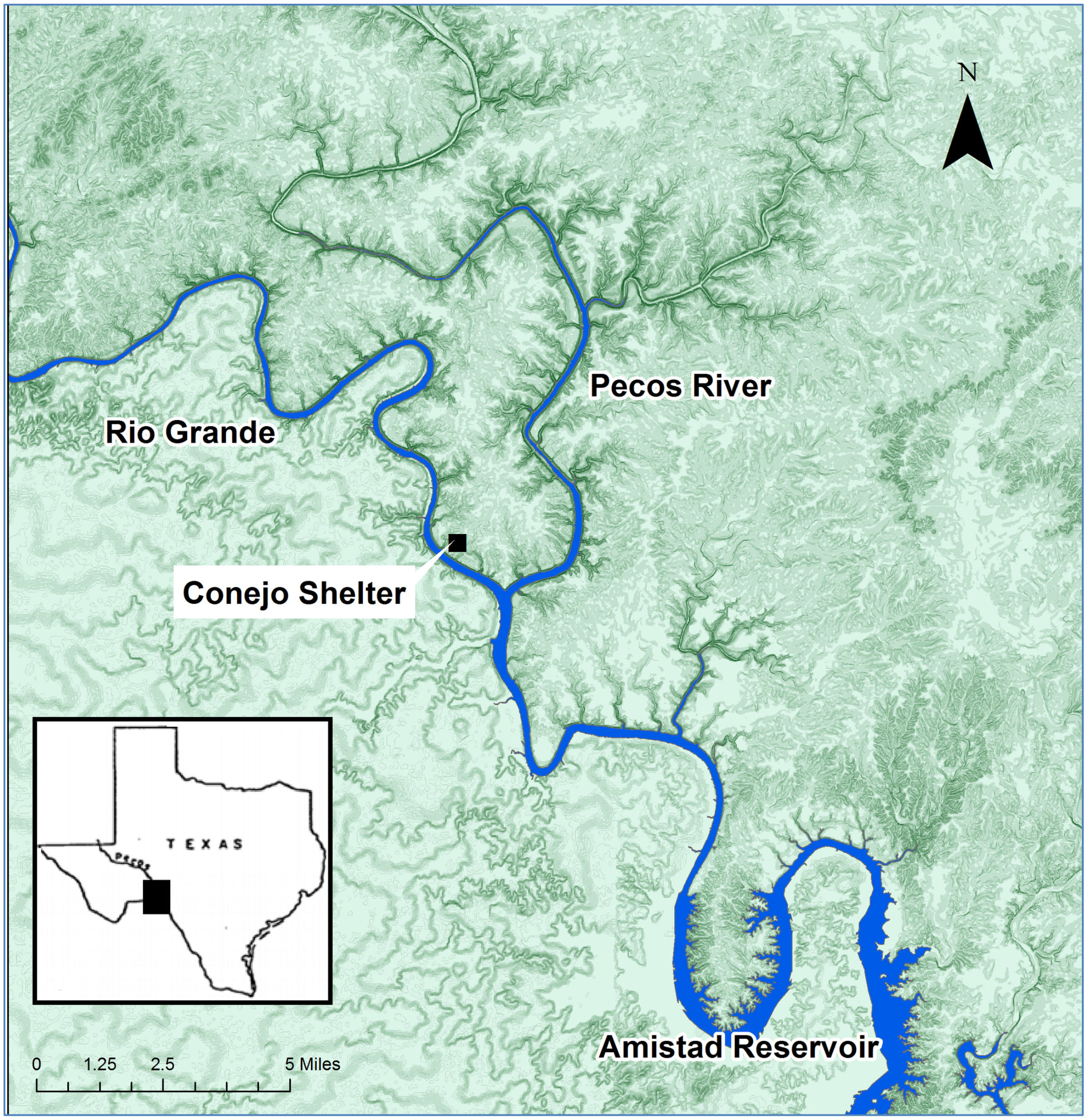


Figure 1. Approximate location of Conejo Shelter. Figure generated in Esri ArcGIS 10.3.

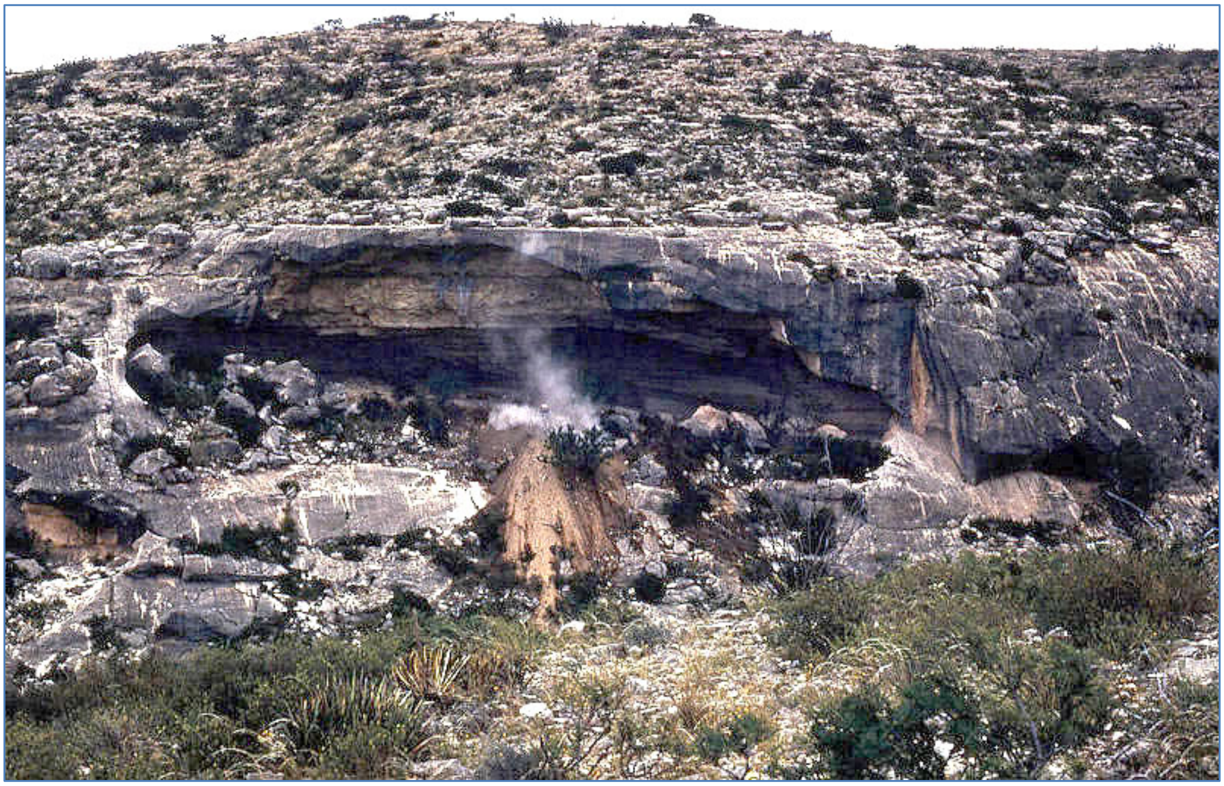


Figure 2. Conejo Shelter during the 1969 excavation. Cueva Quebrada is to the right. Public Domain photograph, original housed in the Amistad Reservoir National Recreation Area archives at the Texas Archeological Research Lab

Excavations at Conejo

Testing and excavation at Conejo Shelter took place in 1967 and 1968, under the auspices of the TASP. Test pits excavated in 1967 focused on rear portions of the midden noted by Graham and Davis (1958). These pits revealed stratified deposits of dust, limestone spalls (from the roof of the shelter), and occupational debris (Collins 1969). Robert Alexander took over the main excavations in the fall of 1967, which became the subject of his dissertation (Alexander 1974). While the initial test pits were excavated in arbitrary six inch levels, the rest of the midden, which extended east, west, and south of the first two test pits, was excavated in natural levels. Figure 3 shows a plan map of the excavations at Conejo Shelter.

Test pits 1 and 2 were used as a baseline for determining the natural stratification of the different periods of occupation and other debris accumulation at the site. From the profiles of these initial test pits, Alexander identified 22 lenses during the 1967 field season. The lenses were interpreted as individual periods of occupation. Alexander traced each lens identified from test pits 1 and 2 across the midden deposit, which would eventually become the 20 x 25-foot excavation block, though the extent during the 1967 season was only 15 x 20 feet (Figure 4). While some lenses were connected across multiple excavation units, the vertical and horizontal extents of these lenses were highly variable. In some areas, multiple lenses shared the same vertical location, while in other areas, extensive lenses sloped across the deposit, overlapping or undercutting other lenses (Figure 5).

Excavated deposits were screened through ¼ inch mesh to collect artifacts that were not recovered in situ. Unscreened matrix samples were taken from the central portions of each lens to collect materials finer that ¼ inch. Deposit fill types were sorted into four primary categories. The first category was vegetal fill, characterized by preserved vegetal materials, generally in thin lenses. The second category was the fine ash fill – fine grained wood ash and limestone dust. Because of the unstable nature of this fill type, excavation according to natural levels was not possible for these deposits. Burned rock (primarily limestone cobbles) and charcoal comprised the third fill type. Similar to other sites in the region, the burned rock midden deposits were concentrated by the mouth of the shelter, under the drip line. Basal deposits in the shelter, the fourth fill type, were categorized as unstained limestone dust and roof spalls. Alexander determined that these deposits were the only natural deposition in the shelter, and likely derived from the bedrock of the shelter itself. Based on analysis of the fill types, Alexander determined that aeolian deposition was unlikely, while fluvial deposition was certainly impossible given the volume of the canyon and the height of the shelter.

Despite some issues with the exact order of the lenses, the general interpretation of the site chronology, according to time-diagnostic artifacts, is consistent with other sites in the region. Alexander was able to group the lenses according to the chronological periods identified by Story and Bryant (1966) and correlate each group with bulk charcoal radiocarbon dates (Alexander 1974).

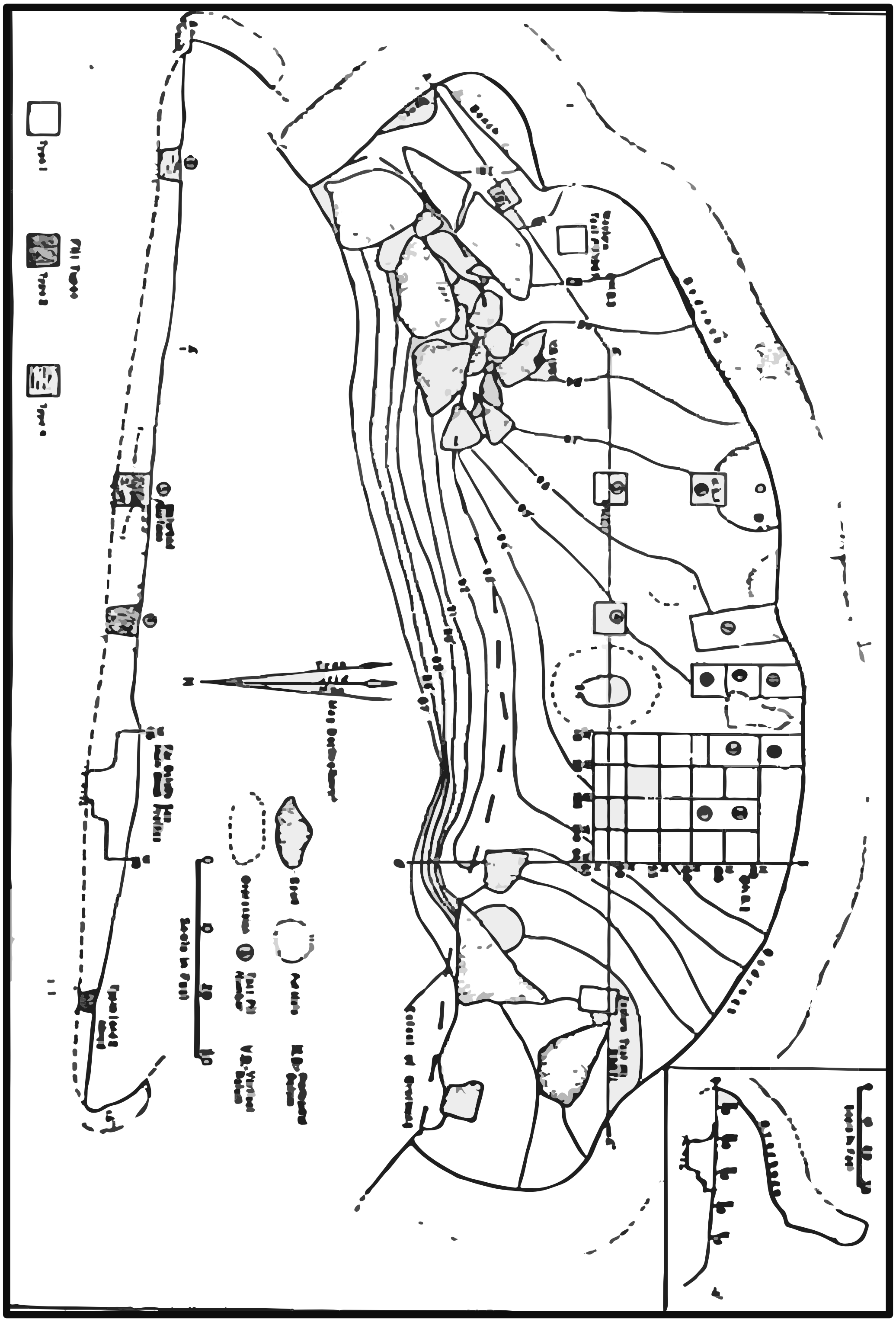


Figure 3. Plan map of Conejo Shelter. Figure adapted from Alexander (1974).

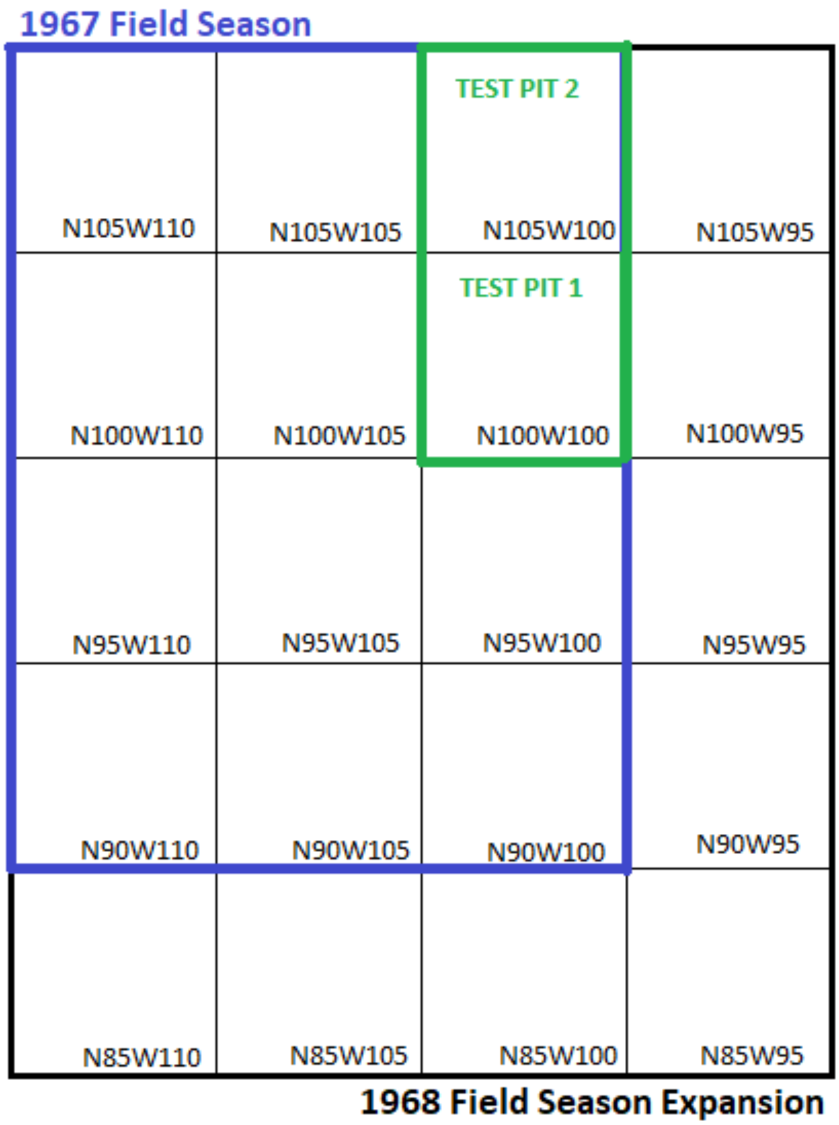


Figure 4. Excavation block at Conejo Shelter.

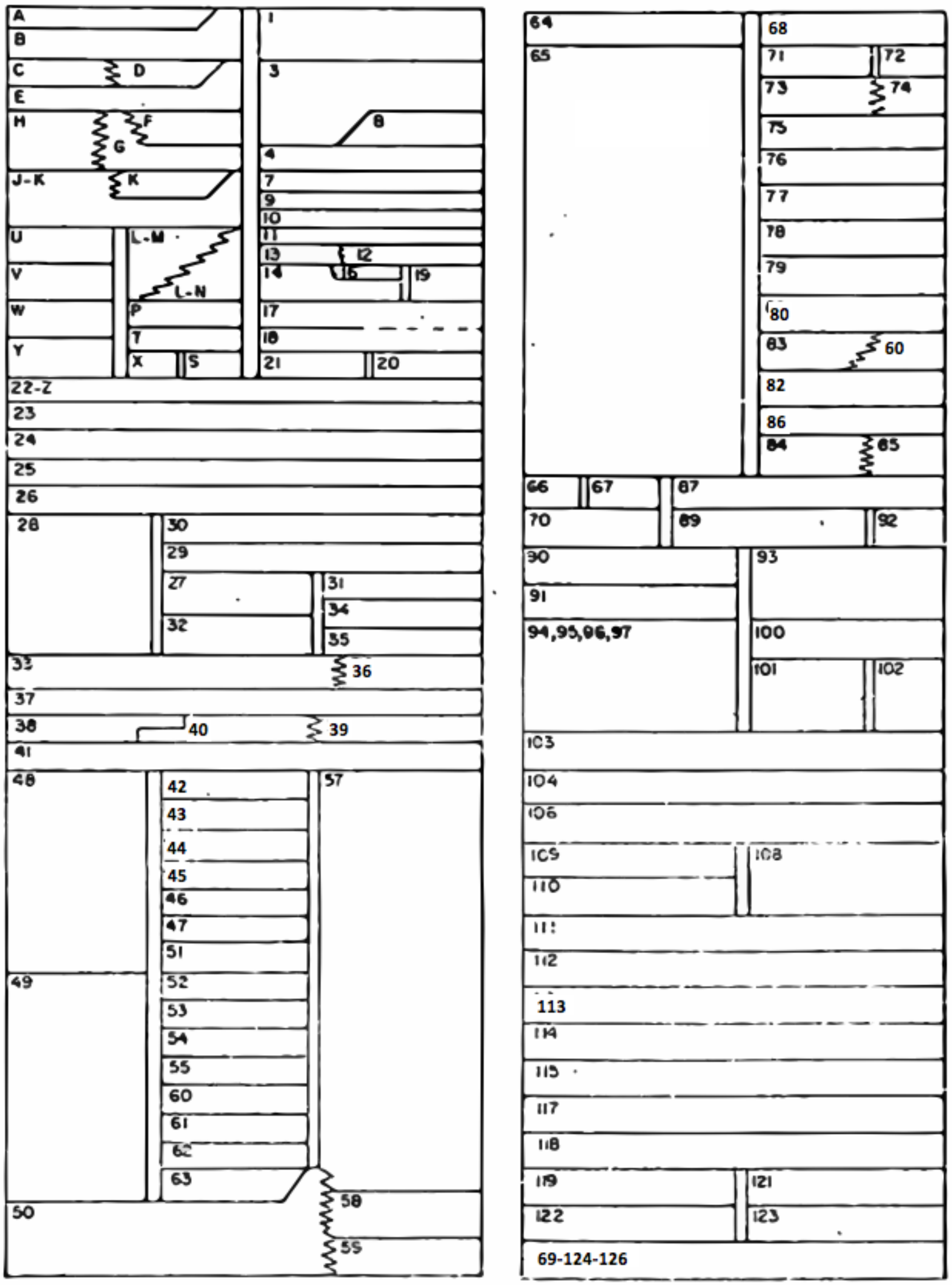


Figure 5. Composite Lens Sequence. Figure adapted from Alexander (1974).

Overview of the Assemblage

Because the primary goal of the Amistad Reservoir mitigation projects was salvage, all artifact types were collected. Diagnostic stone tools were targeted, primarily for their ability to date the site. Food refuse (both floral and faunal), plant artifacts and raw materials, and numerous matrix samples were also collected. Unlike some of the shelter excavations in this region, particularly those conducted earlier in the decade, Alexander made a conscious effort to collect and document coprolites from Conejo Shelter (Bryant 1969, 1974). Bulk charcoal samples and other vegetal refuse were sampled for seven radiocarbon dates.

The fiber artifact assemblage from the Conejo excavations is discussed in depth in Chapter 5. Knotted leaves and cordage were the most numerous fiber artifacts recovered. Matting, basketry, and sandals were also collected. During analysis, fiber artifacts were counted and roughly sorted into groups based on structure and weave type, but no additional analysis or interpretation of these artifacts was completed.

The lithic assemblage of Conejo Shelter served primarily to provide relative age estimates for the occupation layers and situate those layers within cultural periods established by Story and Bryant (1966). Formal tools recovered from the site included diagnostic projectile points (both darts and arrows), bifaces, and a number of ground stone tools, including limestone slab metates. Painted pebbles and ochre pieces, both common to the region, were also recovered.

Alexander's primary goal with the analysis that formed his dissertation was to track proportions of food refuse through time. To this end, all faunal and vegetal food refuse were collected, categorized into resource units, and analyzed to illuminate potential differences in the diversity and intensity of resource exploitation. Food refuse resource units included 26 parts from 14 different plant taxa and faunal contributions from 28 mammal, reptile, and fish species. Based on his diversity/intensity analysis of these different resource units, Alexander determined that diet at Conejo Shelter did, for the most part, remain consistent for much of the period the shelter was occupied.

While drastic changes in the dietary expression of the people of Conejo Shelter are not expected, there are serious equivocations in Alexander's study, simply based on the excavation methodologies. Detailed explanation of the excavations at Conejo is presented in Chapter 4, but the nature of the sampling strategy is pertinent to discuss now, as it relates to the conclusions of Alexander's analysis. As noted above, all vegetal material was put through a ¼ inch screen (bulk sample) and unscreened matrix samples were collected to compare the recovery rate between these two types of samples. During Alexander's analysis, he compared the bulk sample and unscreened matrix for just 15 of the 128 lenses identified during excavation. Since there was little difference between the bulk and unscreened samples for these lenses, Alexander concluded that representation of fine materials from the ¼ inch screen was good. This comparison is not overly thorough, nor does Alexander indicate which lenses were selected for comparison. Given that analysis of perishable artifacts both before and during Amistad Reservoir mitigation suggests early creation and use of parching trays, one would wish that more attention had been given to the recovery of potential evidence for a small seed industry in the region.

Post Excavation History

Just prior to the completion of his dissertation, Alexander brought the entire assemblage with him to his next professional position in the hopes of finishing a formal site report. Unfortunately, a report was never completed, and the materials were returned to the Texas Archeological Research Laboratory for permanent storage in the early 1990s. Beyond intermittent assessments, no other excavations have been conducted at Conejo Shelter. Inundation of the Amistad Reservoir and periodic high-water levels made Conejo, and other shelters in the region, more vulnerable to looting. Conejo Shelter has suffered mightily from this activity; no intact cultural deposits remain at the site. Parts of the assemblage from Conejo Shelter have been analyzed since the material was returned to TARL, namely the recovered human remains, faunal components, and coprolite components.

Current Research

While the adjacent site, Cueva Quebrada, has been revisited by archaeologists multiple times since the inundation of Amistad Reservoir, Conejo Shelter has seen no further formal excavations. Recent assessment of the shelter indicates that the site has been looted significantly. The portions of the shelter's midden deposit that were left intact by Alexander have been leveled and no cultural deposits remain (Elton Prewitt, personal communication). Distressingly, during my own visit to the shelter in February of 2018, I observed relatively fresh looting at the shelter, marked by the disturbed remnants of the burned rock midden noted at the mouth of the shelter. It was clear that a large hole had been dug and back-filled. A few scattered lithic flakes were noted, likely passed up by looters looking for complete projectile points. As future excavations are no longer possible, it is even more important that the collections from Conejo Shelter (and other shelters in the area) be re-analyzed with modern technologies and new theoretical frameworks. The components of this dissertation research, which include artifact conservation, new radiocarbon samples, stratigraphic analysis, and perishable artifact analysis, are the only large-scale projects happening within the Conejo Shelter collections (Sonderman 2016, 2017). Analyses of the mobile art at Conejo (particularly carved and painted pebbles) are ongoing by other researchers (Marybeth Tomka, personal communication).

CHAPTER IV

THEORETICAL FRAMEWORK

Before presenting and interpreting the data collected and generated for this project, it is important to situate this work within the context of the theoretical models which have dominated other research in the region. Early investigations in the area focused on the lithic assemblages of the rockshelters and upland surface sites, typically at the expense of other artifact types. This was primarily a product of the time, when predominately male archaeologists focused on the artifacts traditionally associated with male activities. The focus on lithics was possibly also a function of early archaeologists simply not understanding the biotic portions of the assemblages enough, nor having the technological tools, to study them in depth. Regardless, archaeologists developed typologies and relative chronologies for the different lithic tools, observing little variation in their morphology for the majority of the Archaic period, up until the adoption of bow and arrow technology (Alexander 1974; Turpin 2013). Similarities in lithic technology led these early archaeologists to posit a model of cultural stability due to a lack of cultural stimulation or influence from adjacent regions.

During the Amistad Reservoir mitigation period (1958-1969), archaeologists again encountered the lithic assemblage of the Lower Pecos Archaic. During the mitigation period, however, archaeology had begun to move past culture history; theories from anthropology and other disciplines were being newly applied to the region. This time, interrelated models theoretically grounded in ecological functionalism were employed to promote the idea of stable and unchanging technological and cultural adaptations for the Archaic period in the Lower Pecos (Turpin 2004). This model of static culture emerged as a sort of combination between the "desert culture" or "Desert Archaic" mode originally proposed by Jennings (1957) in the Great Basin and "tethered nomadism" proposed by Taylor (1964) based on research in Coahuila, Mexico. Jennings' Desert Archaic had indigenous peoples barely eking out an existence in an extremely marginal environment where "full exploitation of the environment is required for survival" (Jennings 1957: 284). Taylor's model proposed that occupants of these areas would have been necessarily "tethered" to available water sources, limiting group mobility in terms of settlement patterns.

Desert Archaic

Anthropological interest in the ways humans adapt to their environments, particularly to marginal environments, was established in the United States through the work of Julian Steward. His theory of cultural ecology would serve as the basis for how archaeologists and anthropologists approach the interplay between how humans collect and process food, and how those structures affect social organization and labor (Steward 1936, 1950, 1955).

As discussed above, the concept of the Desert Archaic, as it was applied to the Lower Pecos, was initially formulated for the Great Basin. Jennings (1957) developed the Desert Archaic as a set of adaptations necessitated by the rapid aridification of the Great Basic at the Pleistocene/Holocene transition, between 8,000 and 9,000 years ago. Based on the archaeological record of Danger Cave, Utah, Jennings suggested a shift in the subsistence strategies of the occupants. Faunal and botanical remains from the cave indicated increased exploitation of small game and the development of a small-seed industry, which likely persisted for much of the Archaic period (Jennings 1957; Fry 1980). Beyond the advent of new and diversifying subsistence strategies, the Archaic period in the Great Basin was also marked by the abandonment of certain unifacially and bifacially flaked tool types, notably crescents (Jones and Beck 2012).

The nature of hunter-gatherer adaptations to arid climates is subject to debate in other regions as well. More recently, researchers in the American Southwest and Great Basin (less so in the Lower Pecos) are employing Middle Range Theory, studying modern groups to understand the past (Gould and Watson 1982; Gilman 1987; Elston and Zeanah 2002). The best ethnographic analogies currently available to archaeologists come from hunter-gatherer groups in the deserts of southern Africa and Australia, as hunter-gatherer groups no longer exist in the Great Basin, American Southwest, or the Lower Pecos (Bird et al. 2008; Bird 1997; Bird et al. 2012; Williams and Hunn 1986). Various studies of resource exploitation strategies, from tool creation and use to fire management, help archaeologists refine interpretations of the archaeological record in arid landscapes (Holt 1996; Bird 1997; Picornell Gelabert et al. 2011; Grayson and Cannon 1999; Bettinger 1987; Veth et al. 2008).

Tethered Nomadism

The concept of “tethered nomadism” was initially proposed by Walter Taylor (1964) in an essay about site selection and distribution in Coahuila, Mexico, the region adjacent to the Lower Pecos. The state of Coahuila is on the Mexico side of the Rio

Grande from the Lower Pecos, so the climate is largely the same. Tethered nomadism has both a functional and social basis. From a functional standpoint, since water is relatively scarce in the region and generally limited to rivers and close tributaries, population migrations between resources would likely be limited to areas where water is available. Taylor recognized that "availability" also had a social reality. If one group was already occupying or using a water source and a second group arrived expecting to be able to use that same water source, there is potential for conflict. To mitigate territoriality issues, Taylor proposed that groups might stay within a relatively small range near permanent water sources to maintain continuous access to those water sources. Acquisition of desert succulents, which vary seasonally and geographically in their time of maturation and ideal harvest, necessitated some degree of mobility. Foraging ranges, however, would have been limited by maintaining at least moderate proximity to the claimed water source. Taylor asserts that while hunting and gathering territories may have overlapped or even been intentionally shared by different groups, they would still maintain exclusive access to their central water supply (Hudson 2008).

This concept of "tethered nomadism," while not identical in its parameters, is remarkably similar to the concept of Central Place Foraging (CFP), adapted from behavioral ecology. In archaeological contexts, the CFP model proposes that hunter-gatherer groups would forage along various radii within a given range from a centralized location. Typically, the model involves collecting foodstuffs and raw material and bringing them back to the central place where they are consumed. In most archaeological applications of CFP models, the "central place" is identified as or interpreted as being a home base or campsite that is provisioned from resources in the surrounding areas (Bird 1997). Taylor's tethered nomadism is sort of the inverse of this, where one particular resource, potable water, acts as the central place. Despite the clear correlations between these two theoretical models, few analyses of the Lower Pecos have been framed within Central Place Foraging theory, or any other models grounded in behavioral ecology.

Theoretical Interpretations for the Lower Pecos

As discussed in Chapter 2, the environment of the Lower Pecos began its gradual aridification between 8,000 and 9,000 years ago and stabilized to modern or near-modern conditions by 5,000 to 6,000 years ago (Bryant 1966; Turpin 1984). With the exception of a brief interval of mesic conditions (marked by the return of bison to the region) climatic conditions, and thus biotic communities were largely the same for the majority of the Archaic Period [9000 to 1300 BP]. Environmental stability, together with morphological consistency in lithic tools initially formed the basis of the cultural stability model for the Lower Pecos. Within this model, Alexander explored specific expectations from the archaeological record: 1) absence of substantial environmental change, 2) absence of technological change, and 3) absence of dietary change.

Robert Alexander sought to test the cultural stability model through an examination of the dietary refuse (both faunal and vegetal) at Conejo Shelter. Alexander thought that the presumption of stability required systematic and quantitative testing. He presented an analysis of measures of food resource diversity and intensity in order to test the hypothesis of stability from the perspective of food. The results of this study, and several subsequent analyses of coprolites from Conejo Shelter, Hinds Cave and other rockshelters in the region suggest persistence in the diet of the occupants of the region during the Archaic period (Alexander 1974; Bryant 1974; Riley 2008; Williams-Dean 1978; Stock 1983; Sobolik 1988; Reinhard 1988). Continuity in dietary remains indicates continuity in selection preference or the maintenance of factors controlling their selection (Alexander 1974). Dietary analyses, at least to a certain degree, have corroborated the cultural stability model.

The issue with this model, and indeed a limitation of the ecological functionalism theoretical paradigm, is whether culture can be defined entirely by environmental factors. How much of culture can be defined by diet, resource acquisition, and processing? This question has led to a different interpretation of the cultural system in the Lower Pecos, primarily spearheaded by Solveig Turpin. Through critical theory and analyses of rock art and mortuary practices, Turpin has rejected the static, cultural continuity model in favor of a more dynamic understanding of the cultural system. How is it possible that a population could remain static for 8,000-9,000 years? Turpin notes that the notion of stasis and continuity so permeated the research of the region that observed changes in raw material and food resource selection, and variations in perishable artifacts, settlement patterns and parietal art were simply written off as minor. These fluctuations were ignored for the most part, again in favor of espousing the "amazing persistence of adaptation" (Turpin 2013). She suggests a connection between this viewpoint for the Lower Pecos and commonly held pseudo-utopian interpretations of paleolithic societies. I would push that idea a step further and suggest that these suppositions of stasis may be rooted in racism, albeit unintentional.

Turpin's approach to research in the Lower Pecos would have archaeologists be more diligent about studying the variation we see in the artifact assemblages rather than viewing them as anomalous outliers. She has also strongly suggested incorporation of rock art analysis into interpretations of the region, particularly in terms of Archaic chronology. There are over 200 documented rock art panels in the region and research on them has resulted in recognition of stylistic types that are correlated to distinct time intervals (Turpin 2013). Boyd (2003) recognizes the rock art of the Lower Pecos as "visual by-products of an essential human behavior." While these approaches are not the specific focus of this dissertation, the discussion of alternative approaches and theoretical models is vital to a more complete understanding of hunter-gatherer behavior.

Theoretical Framework for Conejo Shelter

While expanding the theoretical framework employed for research in the Lower Pecos is not the goal of this dissertation, I do think that research in the region could benefit from the application of behavioral ecological models, including Central Place Foraging (CPF) and Optimal Foraging Theory (OFT). Foraging pathways and cost catchments could be explored using both traditional interpretations of CPF, with rockshelters and other habitation sites as the central place, and an adaption of CPF and tethered nomadism, using perennial water sources as central places. Given the harvesting and processing requirements of desert succulents, central place provisioning and transportation analyses could be used to better understand the large accumulations of plant debris in rockshelters in the region. OFT models, which posit that humans tend to collect foods and materials that are low caloric cost, but high caloric gain, would also be useful interpretive guidelines in this region. Optimal Foraging Theory would be particularly salient for understanding decision making processes regarding desert succulent selection. Anecdotal accounts suggest that *Agave lechuguilla* is most calorically dense (and tastes best) in the brief period before flowering (Steve Black, personal communication). Presumably, the edible portions of the other available succulent species would be similar, though season of maturation and bloom differ by species, rainfall, and season. Even at peak caloric density, most desert plants are considered "fallback" foods by most OFT models, since they are less calorie rich than meat and other food sources. Adjusted OFT models could potentially be used to understand the cultural value of these plants beyond their caloric potential, since these plants are also essentially quarry sites for raw material for sandals, baskets, mats, and other materials vital to the lifeways of the Lower Pecos. Additional potential avenues for future research in the Lower Pecos will be explored further in Chapter 8.

In this dissertation, the dichotomous theoretical approaches to the cultural system of the Lower Pecos will again be evaluated through the context of sandal construction. Alexander's original interpretation of Conejo Shelter supports the cultural stability model. Through the course of presenting the data generated for this dissertation, Alexander's claim will be re-evaluated and joined by several theoretical discussions regarding the origins of sandal manufacture in the Lower Pecos, as well as their functions and the behaviors guiding raw material acquisition and processing. I address a hypothesis of cultural transmission from the Coahuila region in Mexico, first proposed by Adovasio (1980), knowledge transmission, and how childhood behaviors can be detected in the archaeological record.

CHAPTER V

DIGITAL RECONSTRUCTION OF CONEJO SHELTER STRATIGRAPHY

GIS in Archaeology

Various features of GIS applications and software have been used with archaeological site data for much of the last 30 years (Kvamme 1990; Johnson et al. 1988). Many of these applications have focused on inter-site analysis and comparisons rather than specific intra-site analyses. Some of the more common applications of GIS, specifically with ArcGIS software, involve geospatial analysis of the landscapes surrounding archaeological sites. Researchers collect data from known sites, identifying environmental, geographic, and geologic factors these sites have in common. Those variables can then be applied to new areas - using interpolation to predict the locations of certain types of sites. GIS applications enable catchment analysis to understand resource availability around a site, cost analyses (both cost-distance and least cost pathways) to measure and predict potential movements and migrations of pre-Columbian peoples, and viewshed analysis to better understand the placement of structures and monuments (Anderson and Gillam 2000; Howey 2007; Kantner and Hobgood 2016; Contreras 2009).

Intra-site analyses within GIS software are less common, at least in the United States (Huggett 2000). Spatial distributions of artifacts, fill types, and other relevant data are well suited for analysis within GIS. One of the primary benefits of using GIS for distribution analysis is the ease it brings to evaluating trends in data. Improved photographic technology (especially photogrammetry) and the ability to drape images over elevation layers in ArcGIS have focused many intra-site applications of GIS on visualization. A number of European teams excavating in Greece, Turkey, and Syria have focused much of their efforts on 3D visualizations of archaeological excavations within GIS software (Katsianis et al. 2008; Tsipidis et al. 2011; Forte et al. 2012; Apollonio et al. 2012). The 3D Analyst and ArcScene ArcGIS extensions, and attachments to photogrammetry-specific software allow researchers to store nearly all excavation data in a digital format, representing excavation units, stratigraphy, features, and artifact locations within ArcGIS.

One of the difficulties and potential impediments of intra-site archaeological analysis with GIS is the need for high resolution data. Many of the projects in the papers cited above would not have been possible without extremely robust data sets, especially those generated by Total Stations. Careful and consistent collection of Global Positioning System (GPS) data, both from general excavation surfaces and point-plotting artifacts is necessary to accurately render excavation data within a GIS.

Excavation methodologies at Conejo Shelter

Methodologies used during initial site testing differed slightly from those used during the full excavations which followed. As was the case for many of the excavations during this salvage period prior to the inundation of Amistad Reservoir, the primary goal was to extract as much archaeological data as possible in a relatively short period. Large concentrations of human refuse were encountered during testing, which led investigators to conduct a full-scale excavation the following field season.

Michael Collins led testing of Conejo Shelter during the 1967 field season (Collins 1969). Alexander joined the work here following testing at Parida Cave (Alexander 1970). Alexander came to Conejo hoping to find the intact and undisturbed midden deposits that were not recovered at Parida. Since Alexander's academic aims for the excavations at Conejo could not have been successful without an established stratigraphy, all Test Pits from the 1967 season were dug in arbitrary 6 inch levels. Test Pits were excavated in the east and west ends of the shelter, and others were placed sporadically between them in order to locate artifact concentrations. Test Pits 1 and 2 were placed adjacently, forming a short trench. This area happened to be the densest midden portion of the shelter. Archaeologists encountered relatively hard packed fiber lenses beneath the overburden of limestone dust from roof erosion and sheep dung left by the local livestock populations. The natural stratigraphy encountered in the profiles of these two units formed the baseline for evaluating stratigraphy for the rest of the excavation.

Excavations later in 1967 began with expanding south and west from Test Pit 1, which had been assigned an arbitrary unit coordinate of N100W100. A 15x20 foot excavation block was dug. Alexander and the field crew at Conejo systematically removed each lens, as they were observed in the profiles of Test Pits 1 and 2. Based on Alexander's assessment that the excavation strategy employed was successful, excavations continued at the shelter in 1968. During this season, the original excavation block was opened by another five feet on both the south and east ends, increasing the total size of the excavation area to 20 x 25 feet. In an effort to alleviate confusion, the lenses in these additional units down to the level achieved during the 1967 field season were assigned letters rather than numbers. Once all units were at the deepest level from the 1967 season (Lens 22), lens designations went back to numeric.

During excavation, the crew occasionally collected elevation data but these data were not collected systematically. Field notes indicate measurements of thickness for each excavated lens, but elevations were not taken at the top and bottom of each lens. Plans of most of the lenses were drawn as they were removed (Figure 6). Based on review of the field notes, Alexander's dissertation, and individual artifact records, the vegetal deposits were placed in ¼ inch screens; artifacts, faunal, and vegetal material were collected from the screen. Though the unit and lens were recorded for each recovered artifact, there does not seem to have been an emphasis on collecting or recording artifacts of any material class *in situ*. Vegetal remains collected from the screen were labeled "bulk sample" and would become a large portion of Alexander's analysis of the diet of Conejo Shelter occupants. Samples of unscreened matrix were collected from each lens to capture materials smaller than ¼ inch. As discussed in Chapter 2, during analysis, Alexander compared the bulk and unscreened matrix samples for 15 lenses, concluding that the two sample types were similar enough to assume that no data were lost due to screen size.

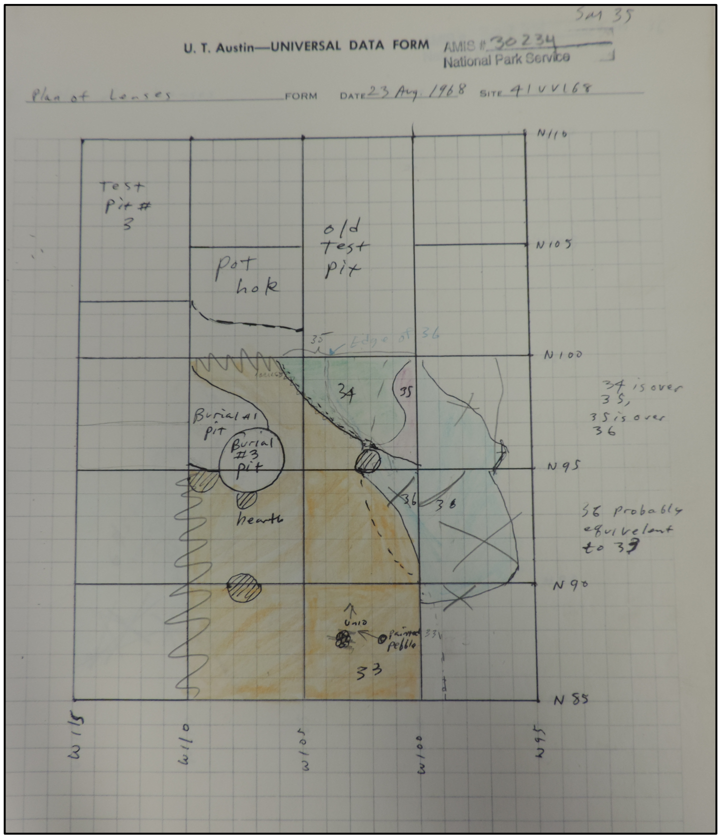


Figure 6. AMIS 30234, drawn lens plan map. Reprinted with permission from Conejo Shelter Field Notes, archived at the Texas Archaeological Research Lab

Although Alexander asserted that the methodology was generally effective at identifying specific lenses, he explains in his dissertation and the field notes that there were some issues defining the extent and boundaries of some lenses. Based on the decision to use the identified lenses as the framework for chronological analysis, one would assume some degree of consistency with how the lenses were created and how and where they terminate. Eight samples for radiocarbon dating were collected and used to establish the chronology of the shelter and tie it to the overall chronology that had been posited for the region by Story (1966). Groups of lenses were assigned to periods

(II through VI) based on the predominant projectile points for those lenses and corresponding radiocarbon dates (Figure 7).

Period (Story)	Age	Diagnostic Artifacts	Lens Groups	C-14 Dates	Lens Dated
VI	200 B.C. – A.D. 1,000	Ensor, Frio	35-A	A.D. 140±70 (TX 1757)	H
V	200 – 1,000 B.C.	Montell, Marcos, Shumla	41-33	740±80 B.C. (TX 1759)	38
IV	1,000 – 2,500 B.C.	Langtry, Val Verde	85-42	1,360±90 B.C. (TX1761)	50
III	2,500 – 4,000 B.C.	Nolan, Pandale	124-66	3,070±80 B.C. (TX1763) 2,640±90 B.C. (TX1762) 3,000±70 B.C. (TX1762) 2,940±80 B.C. (TX1760)	87 103 115
II	4,000 – 7,000 B.C.	Early Barbed	125-128	4,700±110 B.C. (TX1758)	126

Table 2. Chronology of Conejo Shelter, with initial radiocarbon dates. Table adapted from Alexander (1974)

Understanding the site stratigraphy and chronology of Conejo Shelter is the primary requirement for any interpretation of temporal changes within the fiber sandal assemblage of the site. Given that this site was excavated 50 years ago without current standards and technologies, the geospatial data available for this site are relatively low resolution. At the start of the 1968 field season, the crew (re)established the Datum for the site and collected chain length measurements and elevations for the grid corners of the excavation block and other significant areas of the site. These measurements, which were reported as rod elevations in the field notes, were used to extrapolate elevation based on the Datum, arbitrarily set at 100 feet.

Methods – Radiocarbon Analysis and GIS Datasets

Typically, intra-site analysis of an archaeological site is part of a project's research design, which shapes how data are collected. For the reconstructive functions of GIS to work most effectively, GPS data are collected at many points throughout the excavation, through each excavated layer and, often, with diagnostic artifacts plotted individually. As these data are not available for Conejo Shelter, the initial goals for detailed reconstruction of the stratigraphy had to be altered. Rebuilding and understanding the stratigraphy were achieved through collection of 30 samples for radiocarbon analysis and creation of a GIS dataset based on transit data collected during excavations.

Radiocarbon Data

Because Conejo Shelter was excavated before the advent of Accelerator Mass Spectrometry (AMS) Radiocarbon dating, there are several potential issues with the radiocarbon data originally reported for the site. Eight radiocarbon samples were collected during excavation and processed using traditional radiocarbon methods at the laboratory at the University of Texas. Seven of the eight dates were generated from bulk charcoal samples. Traditional radiocarbon methods required a significant quantity of material to generate radiocarbon dates. As was common for the time, all (or most) charcoal material for a given provenience or feature were aggregated and the resulting date would be an average of the dates produced by the individual charcoal pieces. The "old wood" problem is significant in this geographic area. The climate limits tree growth, and trees that do grow tend to be small. The majority of the wood that would have been available to people in the region, particularly during the very dry Archaic period would have been dry dead wood (Elton Prewitt, personal communication). Radiocarbon dates on charcoal at Conejo were dates on the time of the death of the tree, which did not necessarily correspond with the event through which the material was burned.

To test sample types, Alexander also collected a fragment of an *Agave* leaf from Lens 103, which had also been dated using bulk charcoal. The date from the *Agave* leaf was nearly 400 years earlier than that of the charcoal. Alexander notes in his dissertation that future studies would likely be better served by using plant refuse material (like Agave, Yucca, or Dasylirion leaves) rather than charcoal. Despite the recognition that the charcoal data were likely imprecise, the overall trends of the site chronology aligned with the chronology currently understood for the region.

With these limitations in mind, I sought to collect material that would, for the most part, avoid “old wood”, bulk samples, or stratigraphic reversals. In order to capture data on as many lenses as possible I collected plant samples from sandals and coprolites. Several assumptions were involved in the selection of these material types for radiocarbon dating. First, both sandals and coprolites represent events that are much more precise and ephemeral than something like a hearth, which could be dug out and reused many times. Coprolites are obviously the result of a singular event and typically contain no more than a few days’ worth of meals. Initial radiocarbon analysis included sampling vegetal components of both a processed and an unprocessed coprolite from the same lens. The radiocarbon ages returned for these two samples from Lens 9 differed by only 15 years and had overlapping confidence intervals. These results helped demonstrate that standard coprolite processing methods did not have a significant effect on the potential for radiocarbon analysis (Sonderman 2017). Sandals also represent fairly concrete periods because weaving typically requires relatively fresh raw material and the use-life of the sandal was likely not more than a few years. Most of the sandals from the site are also fairly large, especially relative to most charcoal fragments, and are thus less likely to travel significantly through the site post-deposition. Coprolites were sampled by extracting plant fibers embedded in the fecal matter to ensure that the collected samples represented ingested material, and not post-deposition adhesion of the fiber. Most of the coprolites from the site are relatively flat and fiber-dense, so plant materials that could be readily identified (*Opuntia*, *Allium*, *Dasylirion*) were targeted (Figure 8). For the sandals, small fiber fragments that had already broken or fallen off the sandal but remained loose in the artifact bag were selected. This ensured that the selected fibers were related to the sandal being dated without causing further damage to the artifact. The radiocarbon data set consists of 17 sandals and 13 coprolites. All samples were sent to the W. M. Keck Accelerator Mass Spectrometry Laboratory at the University of California, Irvine. Ten of these dates have already been reported (Sonderman 2017) but these data were not released in time to be included in the most recent published inventory of Radiocarbon dates in the Lower Pecos (Turpin and Eling 2017).

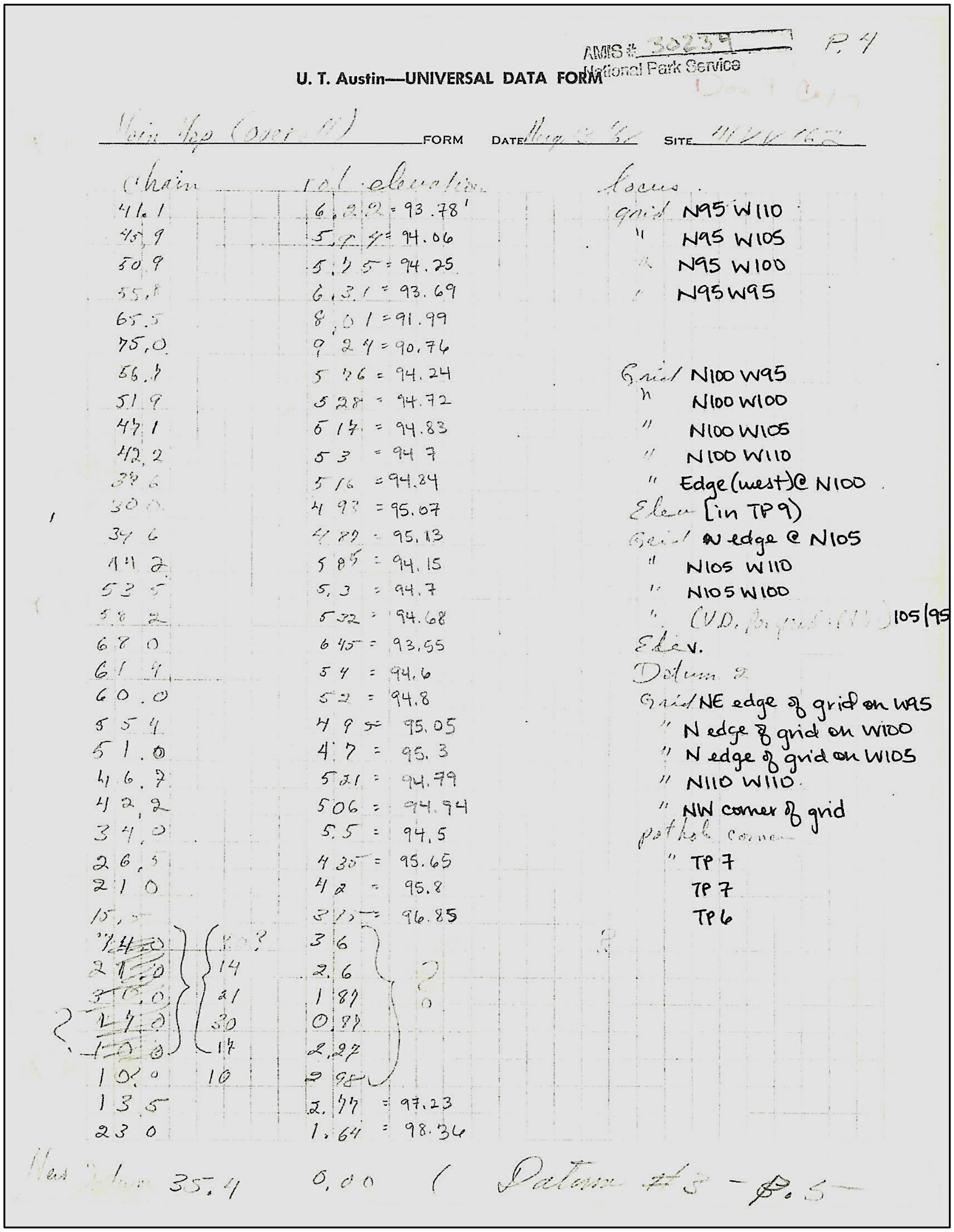
Figure 7. Radiocarbon sample from sandal

Creating the GIS Dataset

In field notes dated to August 12 and 13, 1968, the crew recorded chain length and rod elevation measurements for 142 points in the rock shelter, likely using a standard transit/theodolite (Figure 10). Fortunately, I was able to find a plan map of the shelter, which had drawn points that corresponded to the brief descriptions on a few of the chain/rod measurements in the notes (Figure 9). Using an architects scale and the size of each excavation unit (5x5 ft), I matched 135 of the points on the map with their corresponding measurements in the notes. Next, I determined from the notes that the Datum had been set to read at an arbitrary height of 100 ft. Rod elevation measurements were subtracted from the height of the Datum to get the elevation of each point. None of these elevations correspond to actual coordinate elevations, so they could not be tied into a global map but could be understood in relation to each other.

An image of the plan map of the site was converted to a Raster format and uploaded into an ArcMap document. Next, Point and Line shapefiles were created in ArcCatalog and loaded to the ArcMap document. Using the Editor tool in the Points layer, each of the transit points on the map was digitized (Figures 11 and 12). Elevation data were added to an "Elevation" column that I created in the Attribute Table for the layer. The same process was completed to add elevation data to the contour lines drawn on the map. The elevation data were added in to the Attribute Tables manually, rather than being georeferenced because the Datum was arbitrarily set and the exact location of the shelter cannot be revealed because it is a protected National Park Service locality still threatened by looting.

Figure 8. Plan map of Conejo Shelter, AMIS 48, used with permission from the Conejo Shelter Field Notes archived at the Texas Archeological Research Laboratory.



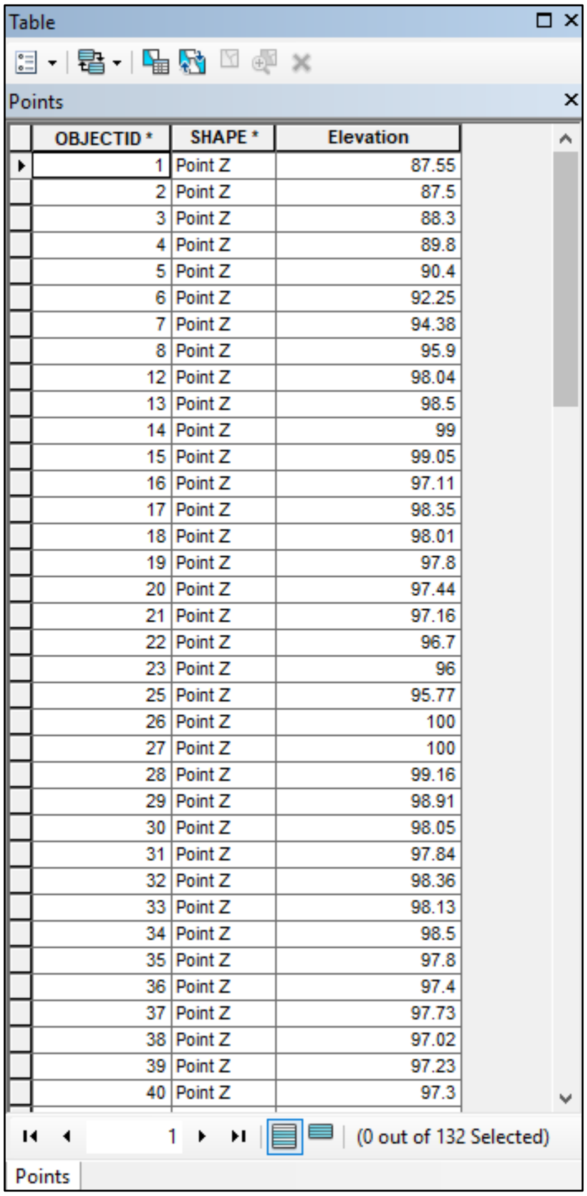
AMIS # 30234 P. 4
National Park Service

U. T. Austin—UNIVERSAL DATA FORM

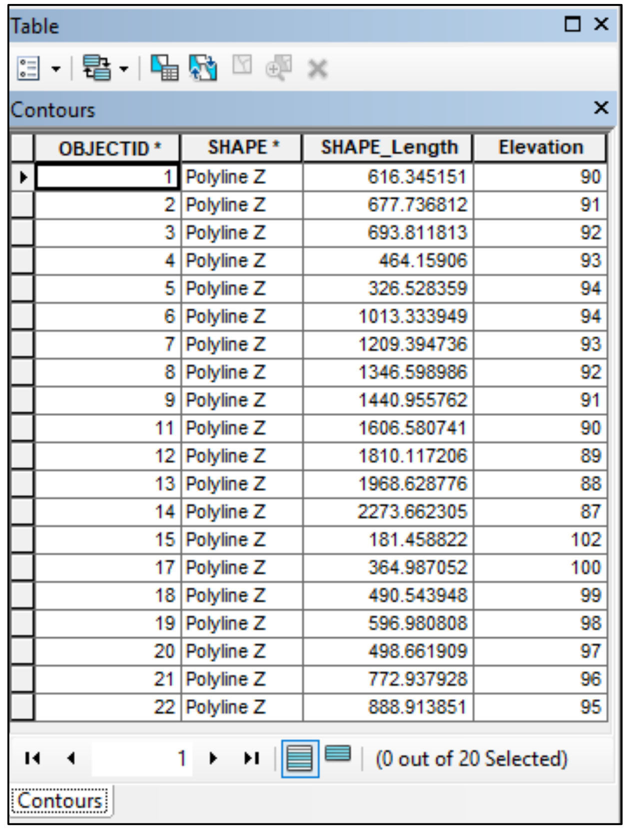
FORM DATE SITE

chain	rod elevation	locus
41.1	6.22 = 93.78'	grid N95 W110
45.9	5.94 = 94.06	" N95 W105
50.9	5.75 = 94.25	" N95 W100
55.8	6.31 = 93.69	" N95 W95
65.5	8.01 = 91.99	
75.0	9.24 = 90.76	
56.1	5.76 = 94.24	Grid N100 W95
51.9	5.28 = 94.72	" N100 W100
47.1	5.17 = 94.83	" N100 W105
42.2	5.3 = 94.7	" N100 W110
38.6	5.16 = 94.84	" Edge (west) @ N100
30.0	4.93 = 95.07	Elev [in TP9)
34.6	4.87 = 95.13	Grid N edge @ N105
44.2	5.85 = 94.15	" N105 W110
53.5	5.3 = 94.7	" N105 W100
58.2	5.32 = 94.68	" (V.D. ...) 105/95
68.0	6.45 = 93.55	Elev.
61.4	5.4 = 94.6	Datum 2
60.0	5.2 = 94.8	Grid NE edge of grid on W95
55.4	4.95 = 95.05	" N edge of grid on W100
51.0	4.7 = 95.3	" N edge of grid on W105
46.7	5.21 = 94.79	" N110 W110
42.2	5.06 = 94.94	" NW corner of grid
34.0	5.5 = 94.5	pothole corner
26.5	4.35 = 95.65	" TP 7
21.0	4.2 = 95.8	TP 7
15.0	3.15 = 96.85	TP 6
24.0 / 8.0?	3.6	
21.0 / 14	2.6	?
31.0 / 21	1.87	
24.0 / 30	0.77	
10.0 / 17	2.27	
10.0 / 10	2.98	
13.5	2.77 = 97.23	
23.0	1.64 = 98.36	
New Datum 35.4	0.00	(Datum #3 - p. 5

Figure 9. Raw transit data, with my notes added, AMIS 30234, used with permission from the Texas Archeological Research Laboratory.



OBJECTID *	SHAPE *	Elevation
1	Point Z	87.55
2	Point Z	87.5
3	Point Z	88.3
4	Point Z	89.8
5	Point Z	90.4
6	Point Z	92.25
7	Point Z	94.38
8	Point Z	95.9
12	Point Z	98.04
13	Point Z	98.5
14	Point Z	99
15	Point Z	99.05
16	Point Z	97.11
17	Point Z	98.35
18	Point Z	98.01
19	Point Z	97.8
20	Point Z	97.44
21	Point Z	97.16
22	Point Z	96.7
23	Point Z	96
25	Point Z	95.77
26	Point Z	100
27	Point Z	100
28	Point Z	99.16
29	Point Z	98.91
30	Point Z	98.05
31	Point Z	97.84
32	Point Z	98.36
33	Point Z	98.13
34	Point Z	98.5
35	Point Z	97.8
36	Point Z	97.4
37	Point Z	97.73
38	Point Z	97.02
39	Point Z	97.23
40	Point Z	97.3



OBJECTID *	SHAPE *	SHAPE_Length	Elevation
1	Polyline Z	616.345151	90
2	Polyline Z	677.736812	91
3	Polyline Z	693.811813	92
4	Polyline Z	464.15906	93
5	Polyline Z	326.528359	94
6	Polyline Z	1013.333949	94
7	Polyline Z	1209.394736	93
8	Polyline Z	1346.598986	92
9	Polyline Z	1440.955762	91
11	Polyline Z	1606.580741	90
12	Polyline Z	1810.117206	89
13	Polyline Z	1968.628776	88
14	Polyline Z	2273.662305	87
15	Polyline Z	181.458822	102
17	Polyline Z	364.987052	100
18	Polyline Z	490.543948	99
19	Polyline Z	596.980808	98
20	Polyline Z	498.661909	97
21	Polyline Z	772.937928	96
22	Polyline Z	888.913851	95

Figure 10. (Left) selection of attribute table for digitized points theodolite data. (Right) attribute table for digitized contour lines. Both attribute tables were generated in Esri ArcGIS 10.3.

Figure 11. Plan map of Conejo Shelter showing digitized theodolite points and elevation contours. Image generated in Esri ArcGIS 10.3.

Interpolated surfaces were generated from the digitized elevation points using three different interpolation methods available in the Raster Interpolation section of the 3D Analyst Toolbox in Esri ArcGIS 10.3. Each interpolation method uses a different set of predictive parameters to generate a continuous surface based on individual points. Kriging, Inverse Distance Weighted, and Natural Neighbor interpolations were all tested.

Results

Radiocarbon Sequence

The lenses selected for radiocarbon analysis are shown in Figure 13. Radiocarbon dates generated during the original analysis of the sites are denoted with squares, while the lenses samples during this dissertation analysis are indicated by triangles. The bracketed lenses show Alexander's original lens grouping by cultural period (as described above in Figure 7). Assignment of the lenses to particular cultural periods was based on diagnostic lithic tools recovered from those or nearby lenses. Table # shows all of the radiocarbon dates available for Conejo Shelter. Those with "AMIS" designations are new dates generated during this dissertation analysis. Dates were calibrated using OxCal. During analysis of the sequence, I sought to explore the validity of several assumptions Alexander made during initial analysis of the site: whether occupations at Conejo shelter were continuous throughout the Archaic period, and whether the periods assigned to the lenses could be validated with a more refined radiocarbon sequence.

During initial analysis of Conejo Shelter, Alexander proposed, based on the quantity and continuity of the cultural deposits, that the site had likely been occupied continuously for much of the Archaic period. He noted that most cultural lenses had very little natural deposition between them. While this observation is valid, it is important to note that very little natural deposition into the shelter would be possible, beyond natural weathering of the limestone of the shelter itself - which was observed between several lenses. Examination of the new radiocarbon sequence shows relatively tight

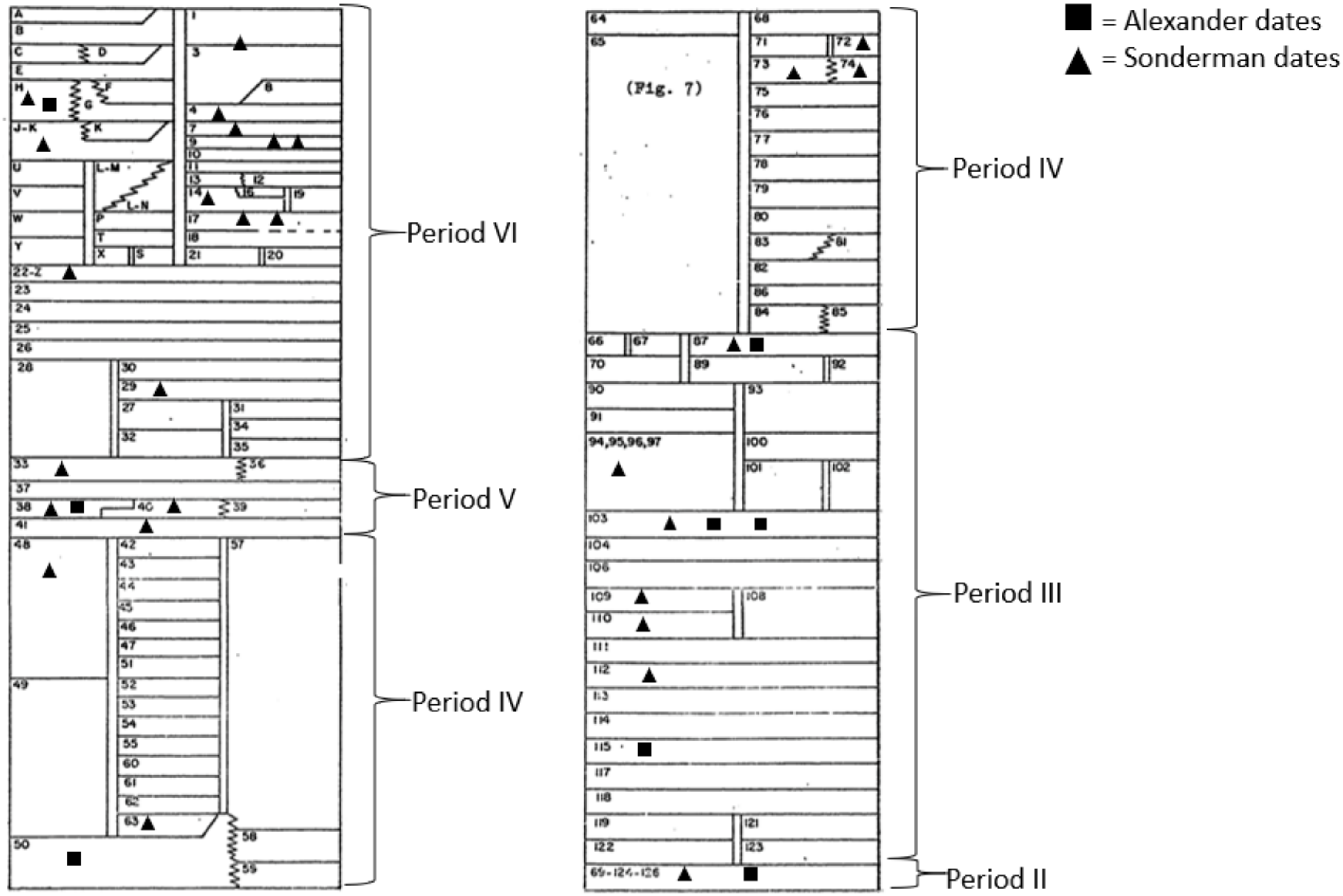


Figure 12. Lenses selected for radiocarbon analysis. Figure adapted from Alexander (1974).

chronological grouping for the entire upper portion of the excavation. As seen in the West 100 profile, 58 individual lenses were identified in the first 30 inches of excavated material.

Alexander's assumption of continuous occupation was likely influenced by the presence of artifacts in every identified cultural lens. Close examination of the radiocarbon sequence, however, shows that many of these cultural lenses represent the same or closely correlated chronological periods. Figure 14 shows plotted radiocarbon dates (not calibrated) with Alexander's original dates in blue and the new dates shown in red. Each date is symbolized with a number that corresponds to the where the sampled lenses fall in Alexander's stages. These plots show distinct periods of occupation, or at least distinct breaks in occupation. These intervals indicate that, despite artifact representation in every lens, this site was likely not occupied continuously during the Archaic.

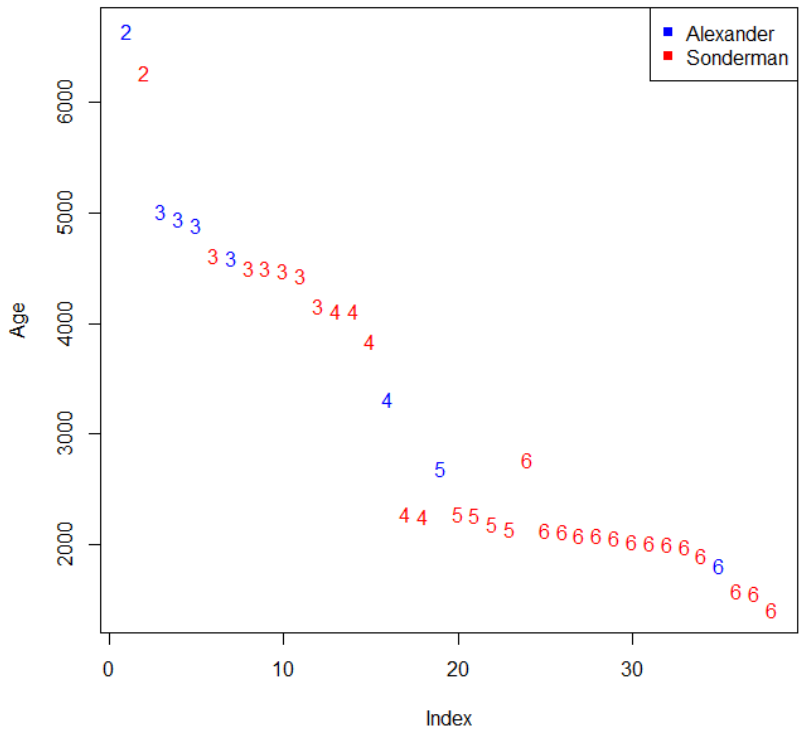


Figure 13. Plotted radiocarbon dates for Conejo Shelter.

UCIAMS	Catalog	Material	Lens	Period	Age	SE	from	to	%	from	to	%	mu	sigma	median
Tx-1758	Tx-1758	charcoal	126	2	6650	110	7595	7435	68.2	7694	7323	95.4	7531	89	7531
192584	AMIS 61686	coprolite	125	2	6275	15	7249	7178	68.2	7252	7170	95.4	7212	25	7213
Tx1763	Tx1763	charcoal	87	3	5020	80	5890	5660	68.2	5912	5608	95.4	5770	89	5768
Tx-1762A	Tx-1762A	charcoal	103	3	4950	70	5745	5600	68.2	5892	5587	95.4	5706	86	5693
Tx-1760	Tx-1760	charcoal	115	3	4890	90	5738	5485	68.1	5892	5334	95.4	5637	115	5636
192582	AMIS 61678	coprolite	112	3	4615	15	5436	5313	68.2	5445	5304	95.4	5385	55	5423
Tx-1762B	Tx-1762B	agave	103	3	4590	90	5461	5057	68.1	5580	4975	95.5	5264	155	5278
192574	AMIS 23882	sandal	96	3	4500	15	5284	5056	68.1	5288	5050	95.4	5167	72	5166
176098	AMIS 23795	sandal	103	3	4500	15	5284	5056	68.1	5288	5050	95.4	5167	72	5166
192579	AMIS 61622	coprolite	109	3	4475	15	5271	5047	68.2	5283	5038	95.3	5174	77	5196
192569	AMIS 23759	sandal	110	3	4440	15	5210	4977	68.2	5262	4967	95.4	5051	86	5014
192585	AMIS 61687	coprolite	87	3	4165	15	4821	4647	68.3	4825	4626	95.4	4717	58	4714
176096	AMIS 23854	sandal	73	4	4120	15	4799	4578	68.2	4809	4550	95.3	4668	81	4639
192571	AMIS 23782	sandal	72	4	4115	15	4797	4572	68.2	4808	4532	95.4	4660	83	4626
192580	AMIS 61667	coprolite	63	4	3835	15	4283	4159	68.2	4294	4154	95.4	4223	46	4226
Tx-1761	Tx-1761	charcoal	50	4	3310	90	3679	3447	68.2	3825	3361	95.5	3553	107	3547
176092	AMIS 22975	sandal	6	6	2765	15	2879	2803	68.2	2921	2794	95.4	2853	31	2856
Tx-1759	Tx-1759	charcoal	38	5	2690	80	2873	2745	68.2	3004	2520	95.4	2817	89	2815
192573	AMIS 23853	sandal	33	5	2275	15	2340	2314	68.2	2347	2188	95.4	2307	45	2324
192581	AMIS 61677	coprolite	74	4	2270	15	2340	2310	68.2	2345	2184	95.4	2296	50	2320
192583	AMIS 61679	coprolite	41	5	2260	15	2336	2208	68.2	2341	2182	95.4	2273	56	2311
192578	AMIS 61621	coprolite	48	4	2255	15	2333	2189	68.1	2339	2180	95.4	2261	57	2237
176091	AMIS 23773	sandal	40	5	2180	20	2301	2147	68.3	2307	2123	95.4	2229	58	2253
192575	AMIS 61605	coprolite	38	5	2135	15	2150	2069	68.2	2292	2056	95.4	2124	47	2125
192572	AMIS 23783	sandal	14	6	2130	15	2147	2068	68.2	2153	2045	95.4	2113	42	2118
176095	AMIS 23757	sandal	29	6	2110	15	2121	2059	68.2	2141	2008	95.4	2083	33	2083
192577	AMIS 61614	coprolite	7	6	2085	15	2105	2004	68.2	2115	2000	95.4	2055	34	2052
192570	AMIS 23762	sandal	22	6	2085	15	2105	2004	68.2	2115	2000	95.4	2055	34	2052
176094	AMIS 23770	sandal	17	6	2055	15	2042	1990	68.2	2107	1950	95.5	2019	32	2018
192576	AMIS 61613	coprolite	4	6	2020	15	1991	1950	68.2	2001	1926	95.4	1967	21	1968
176097	AMIS 23785	sandal	17	6	2015	15	1990	1948	68.2	1999	1925	95.4	1963	21	1965
192567	AMIS 23694	sandal	9	6	2005	15	1987	1934	68.2	1994	1901	95.4	1955	24	1958
176093	AMIS 23857	sandal	1	6	1975	15	1945	1896	68.2	1971	1882	95.4	1921	23	1919
192566	AMIS 23688	sandal	2	6	1900	15	1870	1826	68.2	1883	1820	95.4	1849	19	1849
Tx-1757	Tx-1757	agave	H	6	1810	70	1823	1626	68.2	1884	1566	95.4	1736	85	1739
176090	AMIS 61595	coprolite	9	6	1575	15	1522	1416	68.1	1524	1413	95.4	1468	34	1467
176089	AMIS 61594	coprolite	9	6	1560	15	1519	1410	68.2	1523	1406	95.4	1469	35	1474
192568	AMIS 23699	sandal	4	6	1410	15	1325	1297	68.2	1340	1294	95.4	1313	13	1310

Table 3. Radiocarbon ages for Conejo Shelter

Phase Model

A phase model was generated to better interpret and understand these occupational intervals. A sequence model was created first (Figure 15). To do this, all of the dates (combined Alexander's dates and my new dates) were ordered by lens, since these were generally in stratigraphic order. Next, two outlier models were created, one for charcoal dates and one for short-lived organics. The intent with these models was to recognize the potential for old wood, which would result in an age older than the burning event; and to account for the potential for post depositional disturbance (in the case of short-lived organics), in which case the age may represent an event higher or lower in the sequence. The model identified two outliers, which were removed, five probably outliers which were not removed, and three dates that were contemporaneous and younger than surrounding dates which were moved to the top of the sequence. With the sequence defined, dates were grouped visually, then put through a phase model to identify the beginning and end of each phase. Dates were divided into phases to identify relatively contiguous periods of occupation, independent of the stages Alexander proposed. Tx-1761 is used as an isolated date and not assigned to a phase. The beginning and end dates of each phase, as well as periods of no occupation were estimated. A three phase model was developed to replace Alexander's Stages (Figure 16). Phase 1 includes lenses 125 and 126; Phase 2 includes lenses 115, 112, 110, 109, 96, 87, 73, and 72; Phase 3 includes lenses 48, 41, 38, 22, 17, 14, 9, 7, 6, 5, and 4. There are two ages that are younger than Phase 3 and two ages between Phases 2 and 3 which may represent very brief occupations.

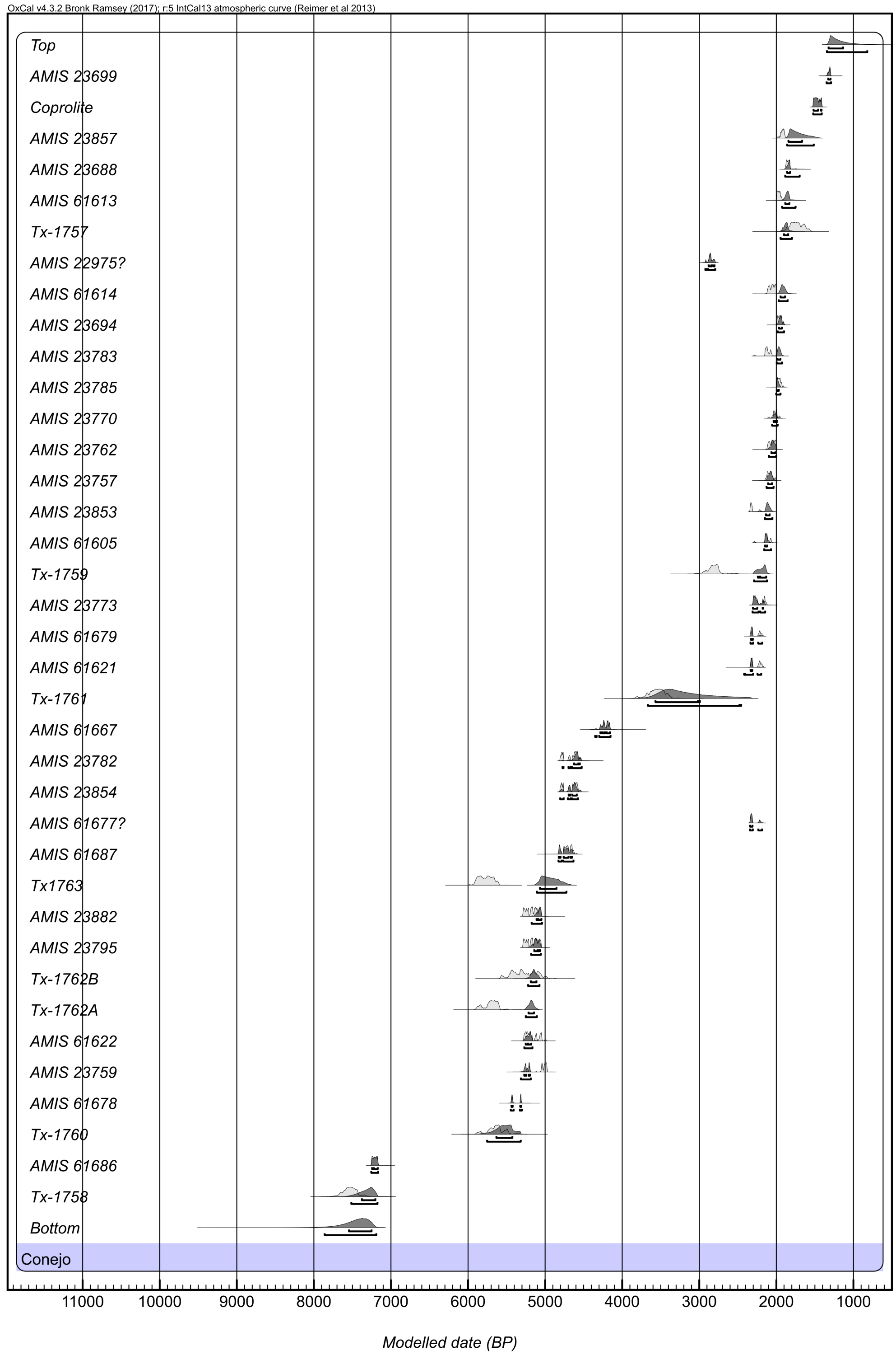


Figure 14. Sequence model for Conejo Shelter radiocarbon ages.

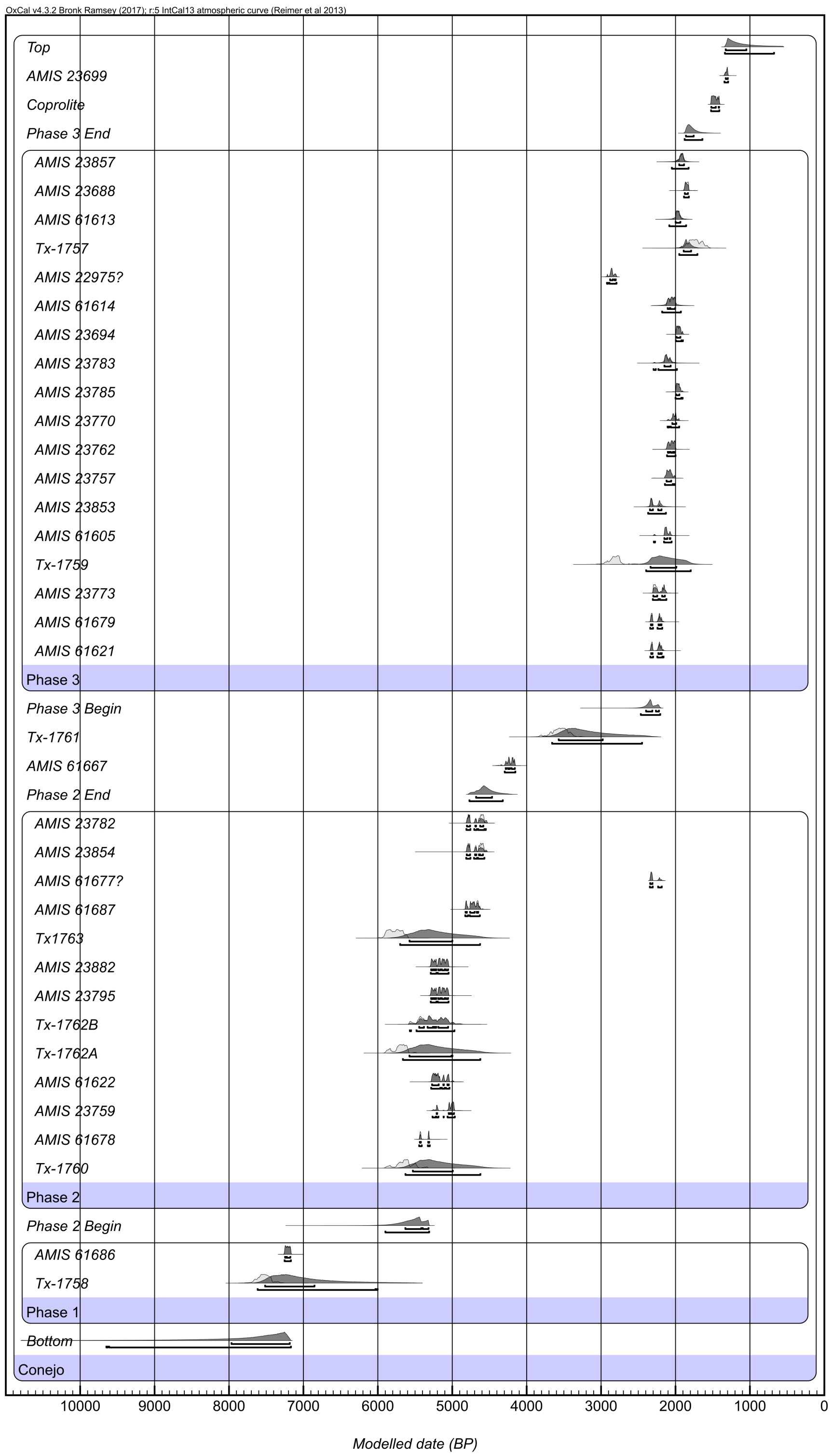


Figure 15. Phase model for Conejo Shelter radiocarbon ages.

Surface Modeling in GIS

Figure 17 shows the results of Kriging interpolation of the rockshelter floor surface. The bands of color represent changing elevations generated from the individual elevation points digitized from the field notes. The slope of the site generally trends to the east side of the shelter. Kriging was selected for this visualization because it showed a surface most likely to be correct. Examination of the IDW-interpolated surface showed that specific low points heavily influenced the predicted surface, often to an extent that did not match the surface described in excavation notes and maps. The output results of Kriging interpolations also allow for additional processing availability, more than IDW or Natural Neighbor interpolation. The results of the Kriging surface could be used in future analyses of the site. Figure 18 shows the Kriging-interpolated surface with the points digitized from the excavation data. This elevation surface represents the same trends as shown in the original drawn plan for the map. Adding gradation and color values to the surface increases the viewer’s ability to perceive and understand the gradual changes in elevation within the rockshelter.

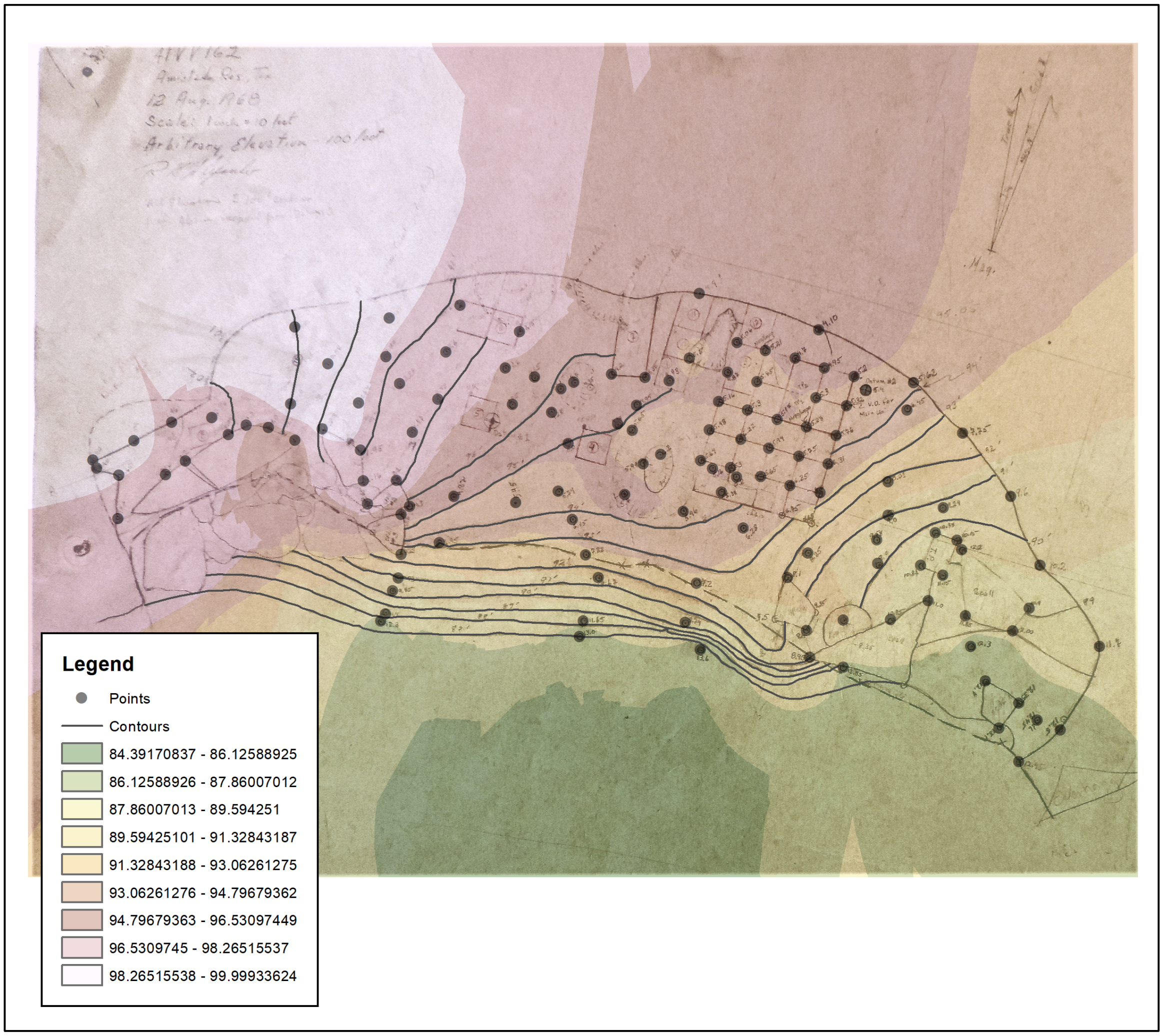


Figure 16. Kriging interpolation layer set at 50% transparency over Conejo Shelter plan map with digitized theodolite points and elevation contours. Figure generated in Esri ArcGIS 10.3.

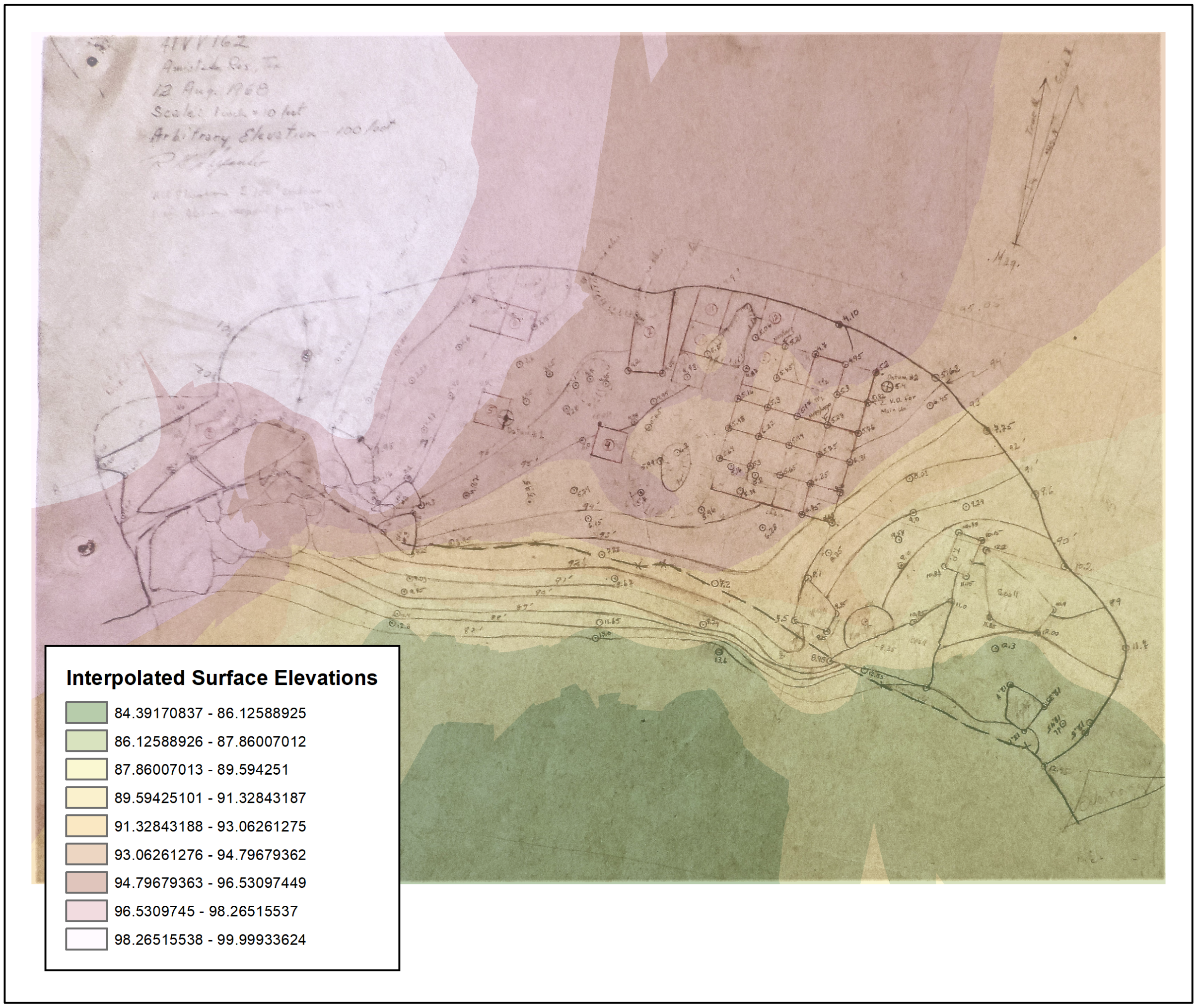


Figure 17. Kriging interpolated surface layer set at 50% transparency with point and contour layers removed. Figure generated in Esri ArcGIS 10.3.

The interpolated surface shown in Figures 17 and 18 is certainly not the only possible end-product for intra-site analysis at Conejo Shelter. With additional time and examination of the field notes, the rendered surface could serve as the starting point for fully digitizing the surfaces of the lenses identified during excavation. While artifacts could not be plotted in their exact coordinates, as this data was not collected during excavation, attributes of the assemblage from each lens could be added to attribute tables generated for each lens.

Kriging surfaces can also be used to create digital elevation models (DEMs), which can be used in a number of other ArcGIS operations. Of interest to archaeological and cultural interpretations of the site are: slope, aspect, viewshed, cost distance and least cost path. DEMs generated for the interior of the shelter and surrounding areas can be combined with aspect analysis (slope direction) to further our understanding of how the occupants of Conejo and other shelter sites in the Lower Pecos could have moved in and out of the shelters and through surrounding areas.

Geospatial Analyses for Conejo Shelter

Cost distance and cost path analyses are powerful tools for aiding archaeologists in answering questions of how human populations move across and exploit various landscapes. These tools use "cost" layers (ie slope, terrain type) to estimate likely pathways through a given area. In an exploration of foraging distance and resource availability in the Archaic Period, I completed a cost distance analysis in ArcGIS. Cost distance, and related least cost path analyses assume that humans are most likely to minimize costs when acquiring various resources (Kelly 1983). Cost distance analyses in ArcGIS require a source data layer, which acts as a starting point, and a cost layer. For this analysis, I used the location of Conejo shelter as the source layer and slope as the cost input. The slope layer was generated from a DEM of the region downloaded from the Texas Natural Resources Information System (TNRIS) website.

In order to limit the cost distance calculations to a reasonable foraging radius from Conejo shelter, I set the processing extent to 10 km – an average maximum foraging radius, based on ethnographic research (Kelly 1995; Morgan 2008). Figure 19 shows the cost distance analysis for a 10 km radius around Conejo shelter. The gradating shades of red represent cost catchments, symbolized as percentages, where the 0-10% range is the least costly area to navigate through from the shelter. Each ring represents a different potential foraging radius from the shelter. The 3.6 km radius represents the distance that could be covered, walking on a +10% gradient at an optimum speed of 1 m/s for one hour (Bastien et al. 2005; Morgan 2008). The 4.7 km radius represents the distance that could be covered, walking on a level surface at an optimum speed of 1.3 m/s for one hour (Bastien et al. 2005; Morgan 2008). The 6 and 10 km radii represent the average range of single day foraging distance (Morgan 2008).

This simple analysis could be expanded to answer a number of other research questions regarding foraging in the Lower Pecos. Vegetation distributions, lithic source material outcrops, and fresh water location layers could all be added to the GIS in order to measure distance and cost to these resources. The locations of other shelters could be added to the GIS, with their own foraging distance buffers as well. Analysis of this data could be used to further our understanding of potential population pressures; how likely different groups were to encounter each other on the landscape.

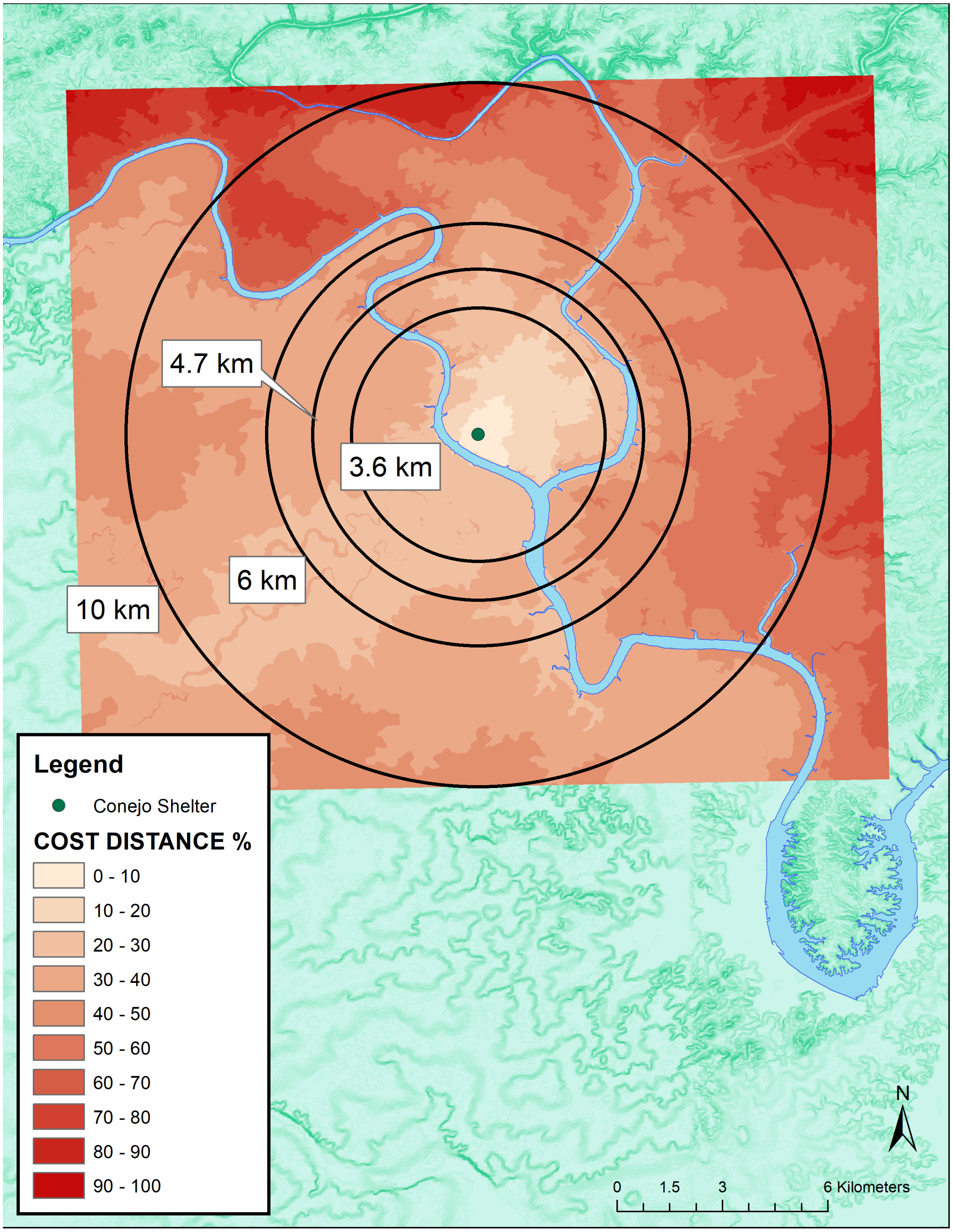


Figure 18. Cost distance analysis for Conejo Shelter. Figure generated in Esri ArcGIS 10.3

Digitizing Plan Maps

Figures 21 and 22 show two profiles digitally rendered based on hand-drawn maps archived with the field notes. The first profile shows the east-west extent of the excavation block along the N95 line. The second profile shows the north-south extent of the excavation block along the W100 line. Figure 20 highlights the selected profiles on a schematic map of the excavation block. Figures 21 and 22 were drawn in Adobe Illustrator, by tracing the lines over an image of the original profiles. Faint lines in the original could be darkened and contact areas between the lenses were made clearer. While the reproduced images here do not include labels for each lens, the digital Illustrator files are labeled in full detail. Images of a sandal and a coprolite represent the type of sample and the lenses that were sampled, plotted within the unit from which the artifact was collected. For example, a coprolite collected from Lens 87 in unit N90W100 is placed in that vertical and horizontal location as represented in the profile.

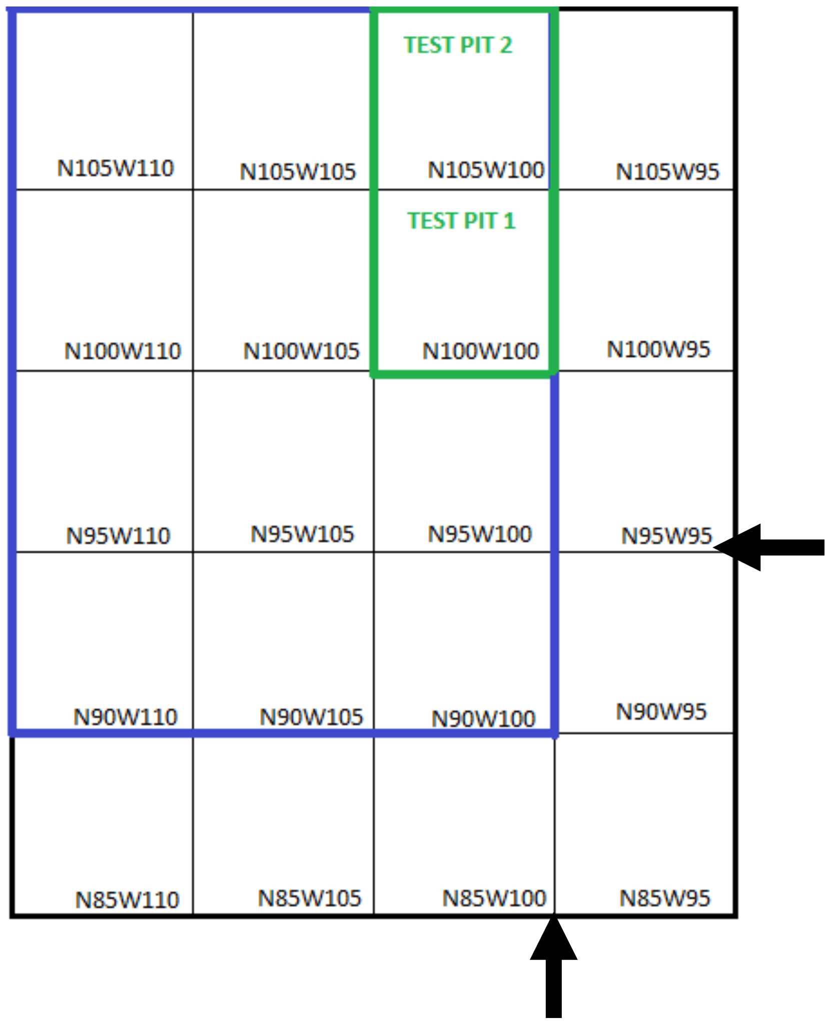


Figure 19. Schematic of Conejo Shelter excavation block, with arrows indicating profiles selected for digitization – N95 Profile; W100 Profile

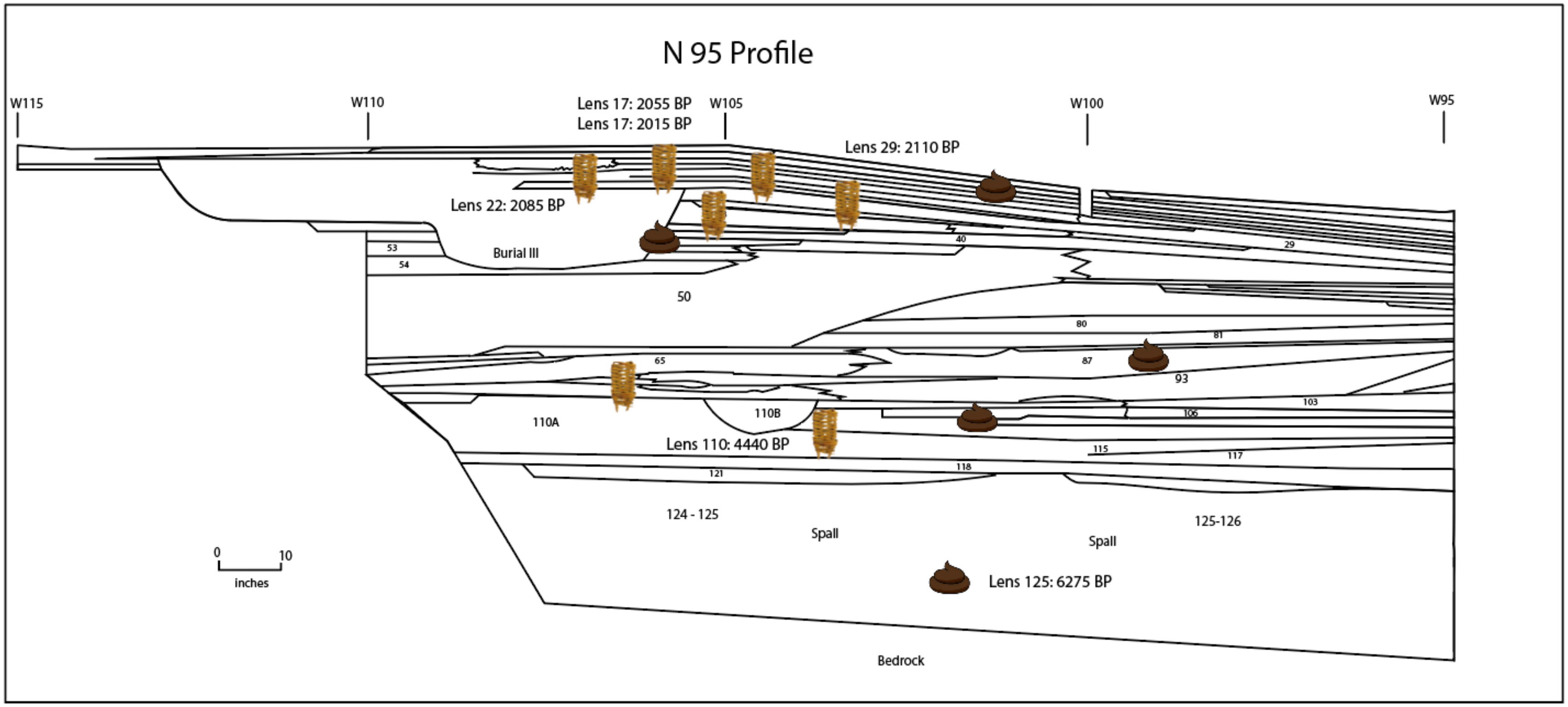


Figure 20. Digitized profile of N95 line.

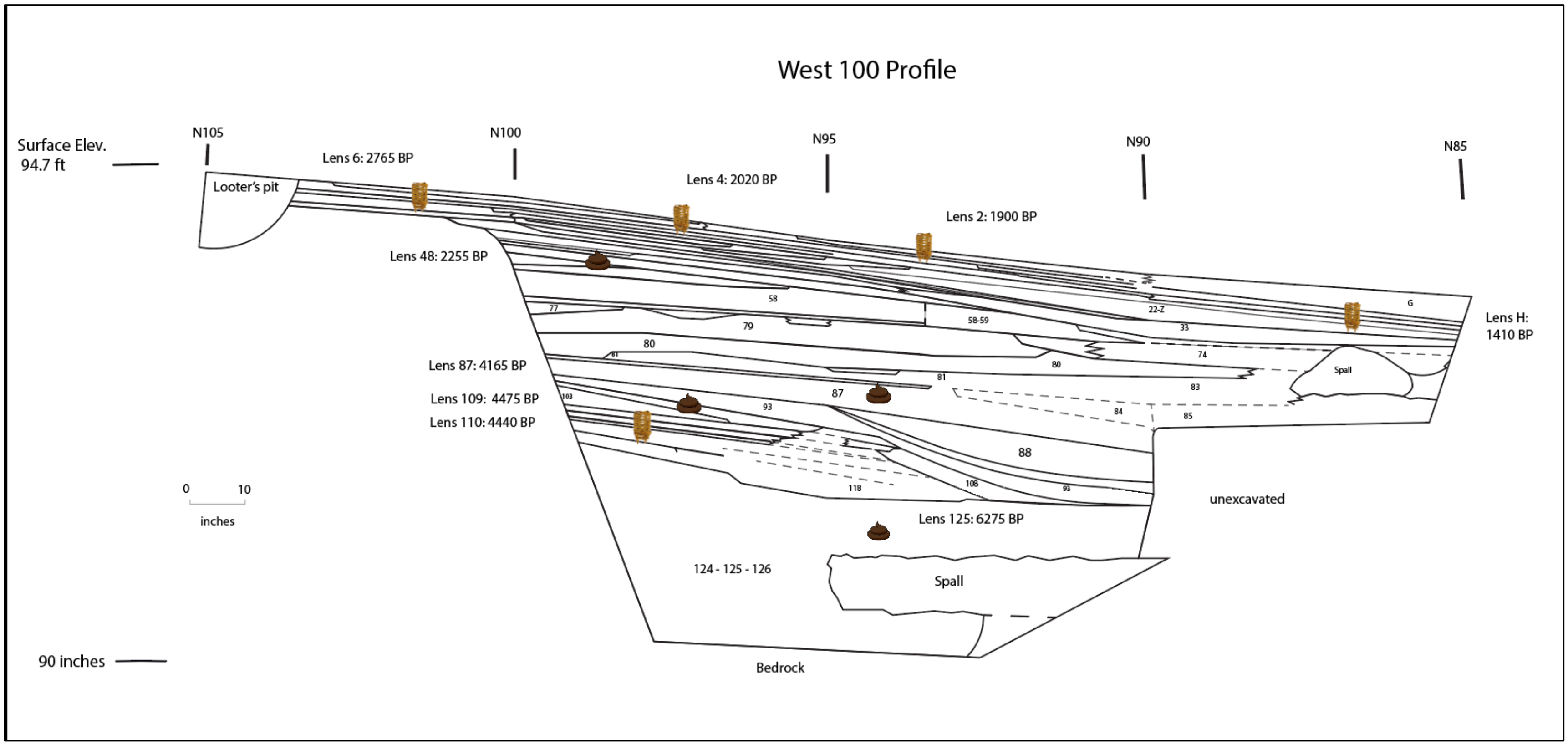


Figure 21. Digitized profile of W100 line.

Conclusions

The primary goal of this aspect of the project was to demonstrate the kinds of analyses and visualizations that can be done with limited datasets from previously-excavated archaeological sites. More robust datasets would have allowed for additional analyses, including spatial analyses of artifact distributions across horizontal and vertical distances within the excavation block.

CHAPTER VI

ANALYSIS OF PERISHABLES

Perishable Analysis

Perishable artifacts are items of a groups' material culture which are created from materials that do not survive the preservation conditions typical to many archaeological sites. Generally, these material types include plant and animal byproducts. These organic remains degrade more readily and generally only preserve in perennially cold, dry, or waterlogged conditions. Before discussing the perishable artifact assemblage at Conejo Shelter, I will summarize perishable artifact research and specific contributions to the analysis of the perishable materials from the Lower Pecos region. These summaries will focus exclusively on fiber perishable artifact analysis, i.e., objects made from plants.

Extensive fiber perishable research in the United States has been necessarily confined to regions where these materials preserve. For the most part, this includes regions that are perennially wet (i.e., bogs, see: Adovasio et al. 2001) or dry (i.e., desert rockshelters, see: Schuetz 1956; McGregor 1992; Andrews et al. 1980). Burned basketry and impressions of basketry (both intentional impression on pottery and depositional impressions in sediment) can also be recovered from a variety of site types (Adovasio 2010; Hurley 1979). There is a high concentration of sites with preservation of these types of materials in the Great Basin, the American Southwest, and the Lower Pecos. These regions are characterized by arid climates and numerous caves and rockshelters.

The climates in these areas allow for plant-based artifacts (and other organic materials) to slowly desiccate, much like mummification.

How Are Perishable Artifacts Analyzed?

While exact methods of data collection of perishable artifacts vary by analyst, artifact type, and region, there seem to be general consistencies in the way these materials are examined (Adovasio 1977; Schuetz 1956; McBrinn 2005; McGregor 1992; Turpin 2003). Early analyses of perishables in the Lower Pecos focused on raw material type, preparation or treatment, size measurements and construction method (Schuetz 1956; Alexander 1974). Adovasio (1977) developed a guide for standardizing analysis of basketry materials based on construction attributes. These techniques and guidelines were based on his own research on basketry materials recovered from archaeological sites around the country. Many subsequent analyses of archaeologically recovered perishable artifacts (including this one) have used and adapted Adovasio's manual. Adovasio (1977, 2010) uses major and minor construction attributes to guide analysts through different metric and non-metric techniques of defining and classifying basketry. The primary categorization is by the fundamental ways of creating basketry: coiling, twining, and plaiting. Beyond that, these categories are subdivided by various attributes of the raw material preparation (cordage spin direction, whole or split leaves, sizes of warps and wefts and other elements), weaving design and pattern (twill plaiting, overlay twining, decorative stitching), and size and shape of the product (e.g., mat, sandal, container). The manual presents descriptions, drawings, and artifactual examples of many variations on the primary themes of coiling, twining, and plaiting. Other perishable artifact studies and regional paleoethnobotanical research provide guidelines for raw material identification (Schaffer 1981; McGregor 1992).

Are Sandals Different from Other Woven Materials?

Analyses of sandals are particularly salient to understanding human cultural behavior because of the personal and intimate nature of these objects. These items were likely made for specific individuals, perhaps even made by the individual who wore them (McBrinn 2005). In terms of basic construction, sandals most closely resemble woven mats. They are flat objects, rather than containers like baskets or nets. Just like mats, sandals are typically made in one of the three primary construction categories: twining, coiling, or plaiting as described by Adovasio (1977). Whether sandals are twined, coiled, or plaited is highly dependent on the region (and perhaps also the time period) in which they were made (Connolly and Barker 2004, 2008; Taylor et al. 2003; Adovasio 2005; Turpin 2003; Williams-Dean). Most sandals in the Lower Pecos are created through some variation of plaiting (Turpin 2003). Adovasio defines plaiting as "a sub-class of basket weaves in which all elements are active" (1977). Unlike twined materials, which have stationary warps and wefts that move between them, there are no formalized warps or wefts in plaiting. While the techniques are essentially the same for different types of plaited materials, the appearance of the end product can differ significantly based on how the elements are formed and at what interval they cross each other (Adovasio 1977; Turpin 2003).

Perishables Research in the Lower Pecos

While there are numerous discussions of perishable artifacts from the Lower Pecos and adjacent regions, few have focused specifically on sandals (Turpin 2003, 2012; Taylor et al. 2003; Adovasio 1980; Andrews et al. 1980; Adovasio 2005; McGregor 1992; Hamilton 2001; Woltz 1998; Williams-Dean). These studies and others, however, barely begin to scratch the surface of what is available from the Lower Pecos. The massive sandal assemblages from rockshelter sites all over the region would suggest, at least to me, that much can be done with these materials. Below, I briefly summarize four contributions to the corpus of literature on fiber perishable technologies in the Lower Pecos. They are not presented in any order and I am not assigning value to these over others, they are simply good representations of perishable research in the Lower Pecos and have been useful to me through the research and writing of this volume.

One of the earliest, formal analyses of sandals in the Lower Pecos was completed by Mardith Scheutz in a serial examination of artifacts housed at the Witte Museum in San Antonio, Texas (Schuetz 1956). For the first part of this series, Schuetz analyzed 171 sandal specimens from Shumla Cave. These materials had been excavated during expeditions in the Lower Pecos sponsored by the Witte Museum from 1933 to 1936. Based on this assemblage, Schuetz identified four sandal types, based on frame construction, and three tie types (Figure 23). Type A, biparallel warp frame, was represented by 51 sandals. Type B, bent warp frame, was represented by 35 sandals. Type C, a double frame, is represented by six sandals. Finally, Type D, the opposed warp frame is represented by 66 sandals. These frame types, as they related to the Conejo

Shelter assemblage will be elaborated on below. Schuetz also identified three sandal tie types, also labeled A, B, and C.

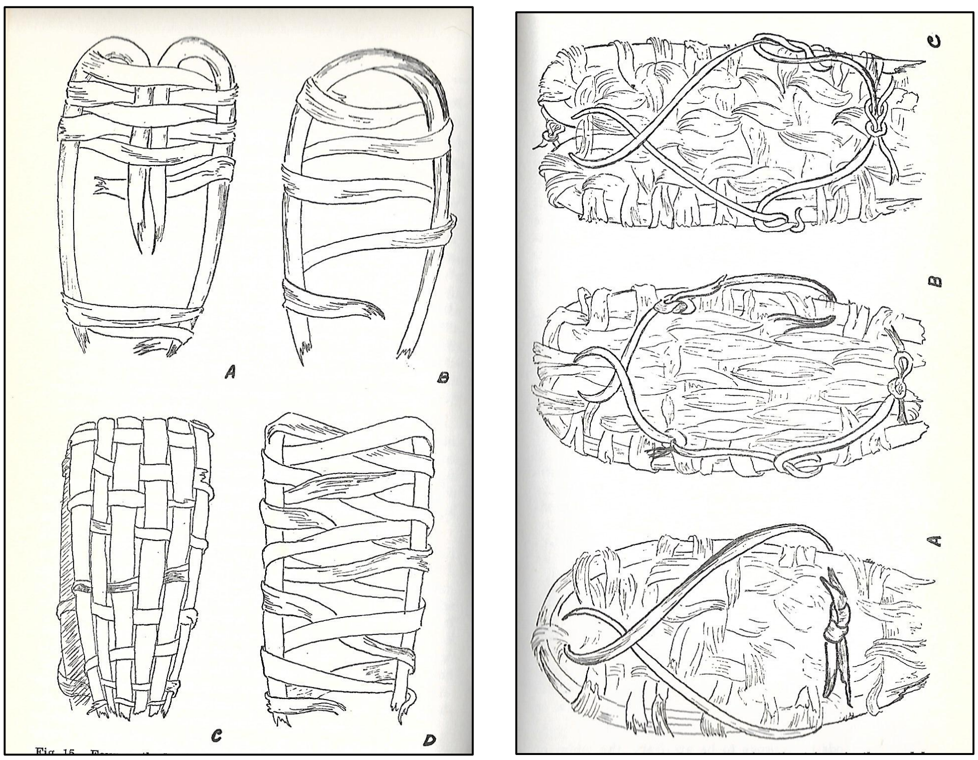


Figure 22. (Left) Sandal frame types and (Right) tie types. Reprinted from Schuetz (1956) Analysis of Val Verde County Cave Material. *Bulletin of the Texas Archaeological Society*, 27: 129-160.

Taylor et al (2003) presents a posthumous summary of the archaeological investigations Walter Taylor conducted in Coahuila, Mexico in the 1930s and 1940s. His analysis includes hundreds of sandals from at least 16 sites surveyed or excavated in

Coahuila, including Frightful Cave, from which nearly 1,000 sandals were recovered. Taylor estimates that during the Frightful Cave excavations, just over 130 square meters of cultural deposit were removed. This means that the sandal density at the shelter was approximately seven sandals per cubic meter (in comparison, the sandal density at Conejo Shelter was just over 1 sandal per cubic meter for 106 cubic meters of excavation). During this research, I have not come across a report of more sandals recovered from a single site anywhere else in the region. Primarily on the basis of the sandals collected during his time in Coahuila, Taylor proposed that the same sociocultural group had persisted in the region for the majority of the Holocene and that members of this population were ancestors of modern Coahuiltecan groups. In this same volume, Adovasio described research conducted in the early 1970s which corroborated Taylor's proposition through his analysis of the basketry. This research was also the primary impetus for the development of Adovasio's hypothesized (and likely correct) cultural connection between the peoples of Coahuila and the Lower Pecos (Taylor et al. 2003).

Fiber perishable artifacts also preserve well in the Rustler Hills, another arid region adjacent to the Lower Pecos to the northwest. Excavations in caves and rockshelters in this region have produced a unique assemblage of perishable artifacts, some of which are similar to those found in the Lower Pecos. The sandals in this region, however, are quite different and are almost exclusively created in the fishtail style, (Hamilton and Bratten 2001). Interestingly, these sandals bear very close resemblance to sandals recovered from excavations in the westernmost part of Coahuila and more easterly regions of the Southwest (Turpin 2003; McBrinn 2005). This stylistic affinity could indicate that Archaic period populations in the Rustler Hills retained closer cultural affinity with groups to the west rather than to the Lower Pecos to the southeast.

The Conejo Shelter Perishables Assemblage

Alexander (1974) provides a fairly cursory assessment of the fiber perishable artifacts from Conejo Shelter. It was his intention to complete more in depth analyses of these materials to be published in a site report. Unfortunately, Alexander never completed a site report for Conejo Shelter. As mentioned above, the counts reported for sandals were incorrect, or at least did not match the inventory at TARL, so it is possible that counts presented of other fiber perishable artifact types are also incorrect.

Mats and Baskets

Alexander identified 40 basketry specimens, and 70 matting fragments, most of these examples are highly fragmentary. Baskets were coiled or twined and occurred primarily on the surface and upper deposits. It remains unclear whether the limited distribution of baskets was a function of preservation bias, previous looting, or a relic of archaeological behavior. Matting fragments were primarily constructed using simple- and twill-plaiting techniques. Both baskets and mats were made with *Agave* spp, *Yucca* spp, or *Dasylirion* leaves. Alexander (1974) notes that most baskets were constructed with *Agave* or *Yucca*, while most of the matting was made with *Dasylirion*. *Nolina* spp is also used in construction of some of the mats. Alexander (1974) does not discuss exact numbers represented by each raw material type, not does he address potential reasons for differential raw material usage between the two artifact types. One potential reason for the more frequent use of *Agave lechuguilla* in basket construction is the quality of the fibrous interior of these plants. *A. lechuguilla*, while difficult to process, has high-quality internal fibers that are well suited for use in sewing and the production of cordage (Tull 2013). Alternatively, both Yucca and Dasylirion can be woven without processing, either with a complete or split leaf.

Cordage and Knotted Fiber

Alexander identified 400 specimens of cordage in the Conejo Shelter assemblage. Cordage was classified by twist direction (S or Z), both for individual plies and spun elements. Most cordage is made of agave, which is consistent with findings from the Hinds Cave perishable assemblage (Andrews et al. 1980). Most cordage pieces were small fragments of only a few centimeters in length. Alexander noted that the longest piece of cordage was 501 cm (p. 133 Alexander 1974). Miscellaneous fragments of knotted fiber were also plentiful in the Conejo assemblage; 581 specimens are described in the initial analysis, representing half of those that were excavated from the site (p. 133 Alexander 1974). These specimens were grouped by conventional knot nomenclature into eight categories.

Sandals

For his initial assessment of the sandal assemblage at Conejo, Alexander determined frame types according to categories defined by Schuetz (1956). Forty-eight sandal specimens are identified in the text. It is unclear whether this is a count of complete sandals, as this number differs from the count presented in the table reproduced below (Figure 24). Alexander identified *Agave lechuguilla* and *Yucca torreyi* as the primary raw materials for sandals.

	Basketry				**Matting**			**Sandals**				**Cordage**						
Period	C	S	D	Total	DP	SP	Total	A	O	I	Total	S	SZ	ZSZ	ZS	Z	Total	Total
VI	8	3		11	3	11	14	16	13	11	40	1	112	2	4	1	120	185
V								4	2	5	11		29		1		30	41
IV					5	1	6		3	4	7		33	2	5		40	53
III	1	1		2		6	6		3	4	7		35	1			36	50
II					1		1						1				1	2
Total	8	4	1	13	9	18	27	21	22	21	64	1	210	5	10	1	227	331
Test Pits	2			2	3	7	10		5	1	6	5	52	6	6		69	87
Total	10	4	1	15	12	25	37	21	27	22	70	6	262	11	16	1	296	418

Table 4. Vegetal artifact distribution by period. Table adapted from Alexander (1974).

Methods and Materials

While Alexander collected general data regarding sandal typologies and their overall temporal distribution, these data were not based on any direct dates on sandals nor do they include information regarding tie types, manufacturing methods, or trends in sizes. Additionally, the sandal counts in Alexander's dissertation narrative do not align with sandal counts reported in tables presented elsewhere in the dissertation. During the course of my research on Conejo Shelter, I have documented 122 sandals from the shelter, a great deal more than either the 48 sandals documented in Vegetal Artifact summary in Chapter # or in Table B9 of the Appendix which lists lens information for 87 sandals. The origins and causes of these discrepancies are unknown. The 122 sandals studied throughout my graduate research represent the entirety of the sandal assemblage of Conejo Shelter, inventoried and housed at the Texas Archaeological Research Laboratory (TARL).

Following a basic assessment of the inventoried specimens at TARL, ten sandals were selected to be part of an experimental conservation project. Nine of these ten sandals showed signs of having been previously consolidated, most likely with an overly viscous solution of polyvinyl acetate (PVA). The treated sandals appeared dark and glossy, some with large clumps of consolidant present on the surface of the sandal. The sandals were retreated by rinsing them with acetone and then soaking them in a very dilute solution of acetone and PVA. More complete descriptions of these conservation methodologies and results can be found in a published report (Sonderman 2017). Seven of the ten conserved sandals had no associated provenience so they were excluded from the chronological analysis.

For the main component of the analysis, each of the remaining sandals (not including those selected for conservation) was assessed and documented. Data sheets that I generated were completed for each artifact (Figure 25). The data sheet format was designed to capture as much information as possible. Basic provenience information, condition information, metric data, and non-metric attribute data were collected for each sandal. Parts of the data sheet were modified during analysis to simplify data collection in some areas and augment in others. At the outset, a single width measurement was proposed, but it was determined that this measure was not sufficient to account for variation in overall sandal size and shape. The single width measurement became three width measurements at specific landmarks of the sandal. Width measurements were collected at the midpoint of the sandal. This landmark was determined by halving the total length of the sandal, and taking a width measurement at that half-way mark. The second and third landmarks were at the toe and heel of the sandal. Based on examination of the assemblage, I established a “cut-off point” of 25 mm from distal (toe) and proximal (heel) ends of each sandal. This determination was somewhat arbitrary but was required to standardize where the toe and heel were on the sandal and thus standardize the way the data were collected. For the sake of consistency, sandal frame types were determined according to the types and terminology defined by Schuetz (1956), because Alexander’s initial overview of the sandal assemblage used this reference. Each sandal was also photographed on each side, with detailed images of significant characteristics (e.g., diagnostic attributes for sandal frames, knot structures, unusual features). Following the completion of the physical data sheet, the data were digitized into an excel spreadsheet. The excel spreadsheet does not include everything completed on the data sheets, which also include sketches of the sandals. Statistical analyses were completed in the R Project for Statistical Computing (R). The general analysis spreadsheet was divided into two .csv files (one for the “regular-sized” or adult sandals and the other for the miniature sandals) and loaded into R to create two data frames, ASandal and MSandal. A third data frame called Chronology was created to group each lens defined by Alexander into broader time periods (II, III, IV, V, and VI from earliest to latest). Analyses were targeted at understanding a few major questions: What are the size ranges of each class of sandals? What is the vertical (chronological) distribution of sandals by type and size? What is the variance shown in each sandal type and is that variance similar between adult sandals and miniature sandals? Can statistical operations be used to determine what the miniature sandals are? Specific descriptions of each statistical test and operation used will be described with the presentation of the results from that test.

SANDAL ANALYSIS DATA FORM – CONEJO SHELTER (41VV162)

DATE:__________

RECORDED BY:__________________

AMIS__________

UNIT ____________________ LENS ____________________

OTHER PROVENIENCE INFO

CONDITION

PHOTO TAKEN (Y/N)_____________ SAMPLED FOR C-14 (Y/N) DATE________________

LENGTH _________________ WIDTH ______________ THICKNESS _________________

AVG WIDTH OF LEAF PARTS _________________

FRAME TYPE

NUMBER OF WARPS/WEFTS

PADDING TYPE

TIES PRESENT (Y/N) TYPE

SELVAGE TYPE

MATERIALS: FRAME______________; PADDING________________; TIES_______________

WEAR PATTERNS

NOTES

Figure 23. Blank Sandal Data Form.

Figure 24. (Left) Adult sandal, AMIS 23695 (Right) Miniature sandal, AMIS 22976.

Results

Qualitative Data

Three primary sandal frame construction techniques were observed at Conejo Shelter: Biparallel Warp, Bent Warp, and Opposed Warp. For sandals in the region, the weaving process is essentially the same, with minor variations in the initial frame shape, how new weft pieces are added, what materials are used for padding, and how ties are made. The basic framework for the sandal is woven first, using one of frame construction methods. A secondary set of wefts is then woven perpendicular to the wefts created as part of the frame. After the base of the sandal is woven and secured, stripped leaves of *Yucca* or *Dasylirion* are tucked between the wefts to pad the sandals. I was able to examine a rabbit-fur padded sandal from a private collection during an ancillary component of my research on perishables in the region. It is the only example of this padding type I've seen or read about in the course of this research. Ties are added last and seem to be the most variable part of the construction. Tie variability at Conejo corresponds well to that observed in other studies of sandals in this and adjacent regions (Turpin 2003; McBrinn 2005).

The Opposed Warp frame was the most common construction type observed in the Conejo Shelter sandal assemblage. Thirty of the 82 sandals in the combined dataset were made with this frame – 14 adult sandals and 16 miniature sandals. The opposed warp was by far the most common frame type used on the miniature sandals (72%), while this frame type was the second-most common frame type for the adult sandal assemblage (~23%). In this frame construction (see figure 27), the warps (stationary portions) become the wefts. The opposed warp was constructed by laying two leaves (split or whole) parallel to each other to make the warps, bending the fibers in toward each other to form the toe and criss-crossing the fibers back and forth until the end of the leaf (wefts). New fibers are simply tucked in until the crossing weft structure is complete. Once the basic frame is finished, a second set of wefts are woven perpendicular to the first set of wefts.

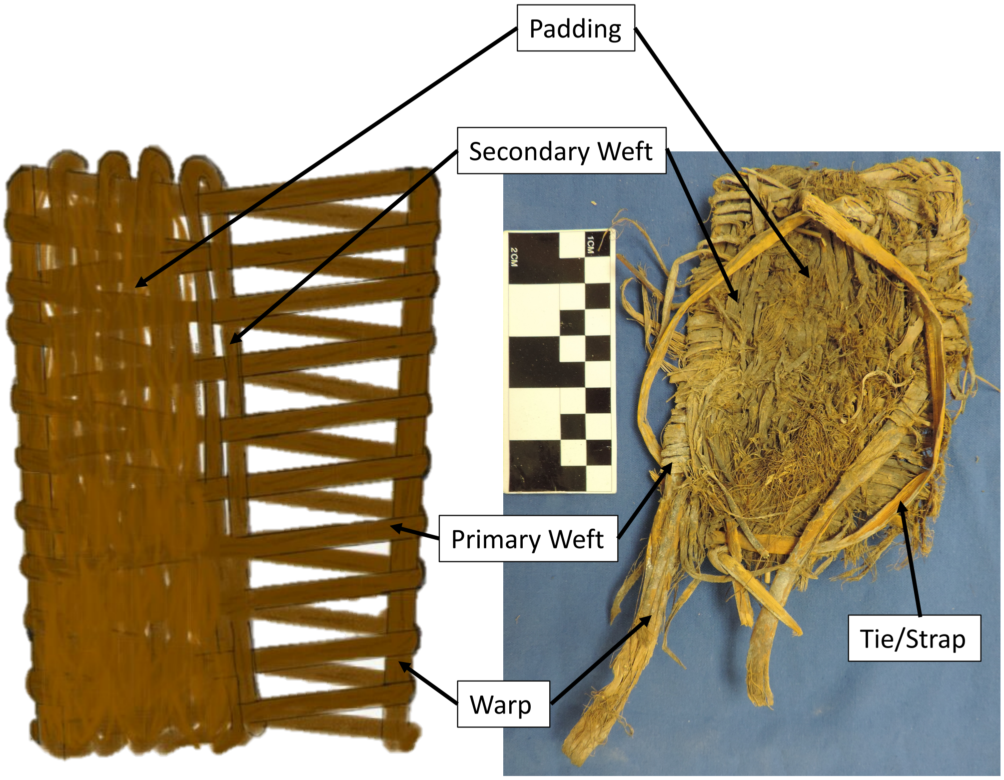


Figure 25. Schematic and photograph of opposed warp sandal.

The second most common frame type overall, but most common frame type for the adult sandals, was the biparallel warp. This frame type represented 28% (n=23) of the total sandal assemblage, with 22 examples in the adult sandal group and one example in the miniature sandal group. The Biparallel Warp frame structure involved splitting a single leaf (commonly *Yucca* spp. due to leaf width) in half up to two to three inches from the base of the leaf, leaving this last portion unsplit. The unsplit portion becomes the central warp while the two halves of the leaf are bent in opposite directions, then pulled down, forming a M shape at the toe of the sandal. A second, separate leaf (the weft) is woven between the three warps. As with the opposed warp sandals, once the basic frame is complete, a second set of wefts is woven in perpendicular to the first set, after which padding is added (Figure 28).

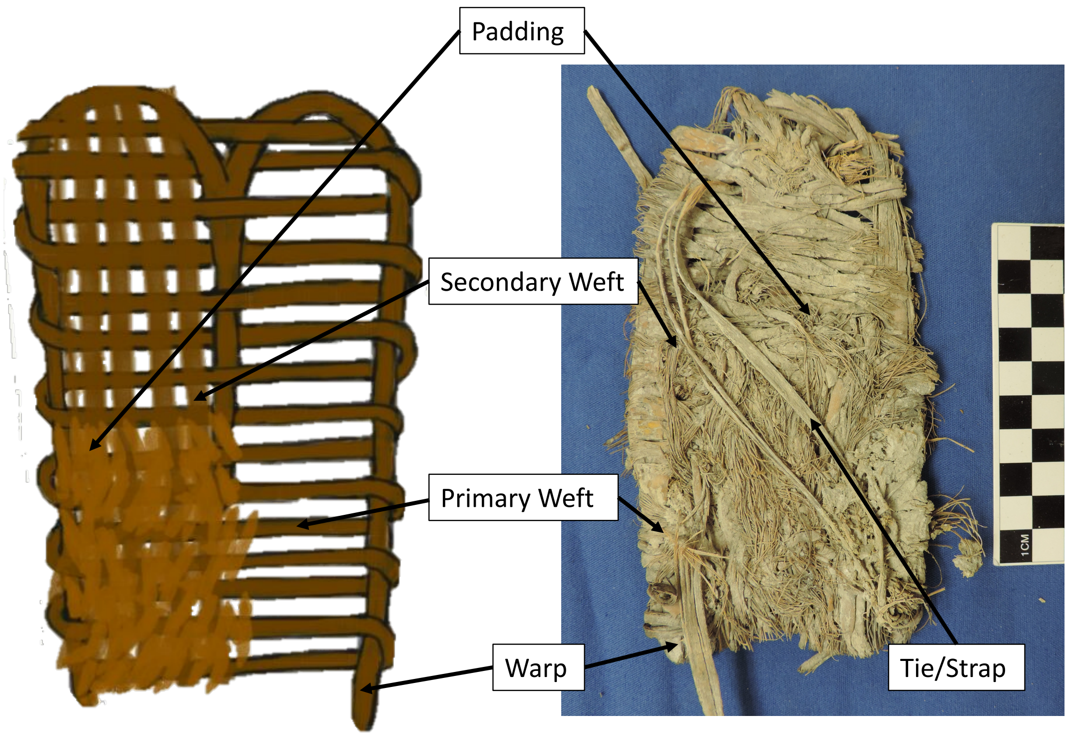


Figure 26. Schematic and photograph of biparallel warp sandal.

The Bent Warp frame construction was the least common type in the Conejo assemblage. Alexander identified bent and double bent warp constructions in his analysis. Give the paucity of this type and the difficult of distinguishing between the two, these categories were combined, following more closely to Schuetz (1956) who only identified single bent warp frames. Two miniature and four adult sandals exhibited this frame type. To construct this sandal frame, one (two in the case of the double bent warp) leaf (split or whole) is bent into a U-shape, where the curved base of the U forms the toe portion of the warp. As with the biparallel warp, a second, separate leaf is woven between the warps, occasionally adding in new weft pieces as needed. Next, a second set of wefts is woven perpendicular to the first set. Padding, and then ties are added last.

One object cataloged and identified as a miniature sandal was twined – a sandal construction type not seen anywhere else in the region (Figure 29). I classified the object as simple, open twining – as defined in Adovasio (Adovasio 1977, 2010). Because this construction has never been identified in a sandal from this region, and due to its size and rather rudimentary execution, I propose that this object has been misclassified and is not actually a sandal.

Figure 27. Photograph of twined miniature sandal, AMIS 23888.

As mentioned above, sandal ties are quite variable, primarily in shape and the number and type of knots used to secure them. In some regions, the constructions of ties are so idiosyncratic, that some scholars propose the idea that tie types are representative of individual stylistic identity (McBrinn 2005). In the Lower Pecos, most ties have a few elements in common, namely the placement of the toe loop in the center or near center of the toe portion of the sandal and that the toe loop is produced by crossing two sections of fiber over each other. The placement of the loop suggests that the second or third toe would have been held there. Other elements of the tie types co-occur with enough frequency that a few primary types have been identified (Schuetz 1956; Taylor et al. 2003; Turpin 2003). For this analysis, tie types identified by Schuetz (1956) were used for comparison. Very few sandals in the assemblage had intact or partially intact ties.

None of the miniature sandals had ties. Twenty-four of the adult sandals had ties; among these, four tie types were observed, nine tie specimens were too fragmentary for identification. The first three types correspond to Schuetz' types A, B, and C. In the following discussion of tie construction, I'll be using foot bed to describe the "top" of the sandal (where the foot makes contact with the sandal) and sole to describe the "bottom" of the sandal (where it makes contact with the ground). Figure 30 shows the Schuetz tie typology again. Each tie description and any significant variations are accompanied by a photograph of an exemplar of that type in the Conejo Shelter assemblage.

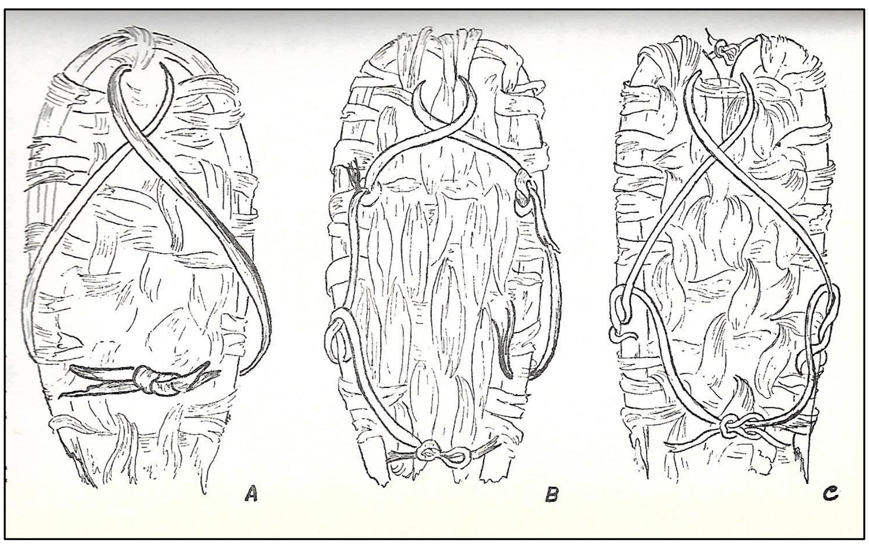


Figure 28. Tie string types. Reprinted from Scheutz (1956) Analysis of Val Verde County Cave Material. *Bulletin of the Texas Archeological Society*, 27: 129-160.

Type A tie strings are relatively simple; usually one leaf (whole or split) is threaded through the middle, toe-portion of the frame and back up through, creating a small stitch on the sole which acts as the base for the toe loop. In two-leaf variants of this type, two leaves are knotted on the end and passed up through the sandal (toward the foot bed) so that the knotted ends catch at the sole and form the base of the toe loop. The two ends of the stitch (or the separate leaves) are then crossed forming the toe loop on the foot bed, then each end is looped over the outside of the warp and threaded back up (from sole to foot bed) around the other side of that same warp. Finally, the two strings are knotted together at the heel, typically with a square knot.

Figure 29. Example of Type A tie.

Type B tie strings are the most complex, at least in terms of number of knots and leaf elements. The toe loops are created in one of the methods used for type A sandals – either a one-leaf stitch or two leaves knotted at the sole. After the elements are crossed, a second set of leaf elements is tied in at approximately one quarter of the length of the sandal, about where the base of the toes and the ball of foot are. The second elements are then looped around and tied to a third set of elements around the warps at approximately three quarters of the length of the sandal, near the heel. The third set of elements is knotted at the heel, again, typically with a square knot.

Figure 30. Example of Type B tie.

Type C ties are similar in form to type B, but usually contain fewer elements. In type C sandal ties, the portion of the tie which passes over the top of the foot is made of a single element, as in type A, as opposed to two elements as in type B. In type C, the second set of elements is knotted in at the warps, where they meet the first set approximately three quarters of the length of the sandal. The second elements form the heel portion of the tie, which is knotted at the back. The most exemplary sandal of this tie type is of particular interest as it is the only example in the assemblage of ties made with bundles of fully stripped leaves.

Figure 31. Example of Type C tie. The heel portion of the tie is folded up toward the toe portion, bending at the knot where the two segments are connected.

A fourth sandal type was observed in the Conejo Shelter assemblage. This type is very similar to Schuetz Type A, but the tie does not cross under the warps at any point in the construction. The tie is knotted to the sandal frame at the toe loop, as with the other types. There is a knot at the heel to complete the tie, but the heel portion of the tie is not anchored to the sides of the sandal. It is possible (and likely) that these ties are simply variations of Type A or broken Type A ties. Three of the sandals exhibited this tie structure (AMIS 23773; AMIS 23776; AMIS 23851). This new type, or variation/broken Type A tie has not been identified in literature examined during this research.

Figure 32. AMIS 23773. Tie type not identified in other research.

Descriptive Statistics and Correlations

I collected descriptive statistics for each data frame in R to look for initial trends in the data. These data included minimum and maximum, median, and average values for each size category (Length, Width at Toe, Width at Midline, and Width at Heel) for both adult and miniature sandals. Tables 3 and 4 summarize the size measurements for both the miniature and adult sandals, all values are in millimeters. The largest sandal in the entire assemblage, AMIS 23695 is 284 millimeters in length, which roughly corresponds to a US Men's shoe size of 11.5, while the smallest sandal in the assemblage, AMIS 23877 is 28.7 millimeters, which is significantly smaller than the smallest US infant shoe size (79 millimeters). These two examples are the extremes of the assemblage. The average length of the miniature sandals is 63 millimeters, also smaller than the smallest US infant shoe size. The average length of the adult sandals is 186 millimeters, which corresponds with US Children's shoe size 12 – and doesn't register on either the US Women's or Men's shoe size scale. These correlations are only meant to provide the ready with a more readily understood visualization of the size of the sandals in the assemblage. Modern US shoe size are likely not completely accurate representations of average foot sizes of the indigenous people of the Lower Pecos, especially considering other sandal studies from this and adjacent regions which suggest that the toes or part of them would have extended beyond the front edge of the sandal (Hamilton 2001).

	Length	Width at Toe	Width at Midline	Width at Heel
Min	28.7	11.4	18.8	12.8
Median	73.3	26	33.2	31.3
Mean	63	26.8	39.1	33.8
Max	142	47.5	66.3	59.3

Table 5. Summary statistics for miniature sandals. N=22

	Length	Width at Toe	Width at Midline	Width at Heel
Min	102	46.7	63.8	55.0
Median	187	77.7	94.7	84.5
Mean	186	78.3	92.7	83.1
Max	284	116.7	111.5	114.4

Table 6. Summary statistics for adult sandals. N=60

A histogram of the adult sandals checked for potential bimodality of the adult sandals by length (as a potential test of clear differences in size by sex). For consistency, I created a histogram of length for the miniature sandal dataset as well. I also generated correlation matrices for adult and miniature sandals to determine the degree to which the difference size measurements correlated with each other. These plots are presented below.

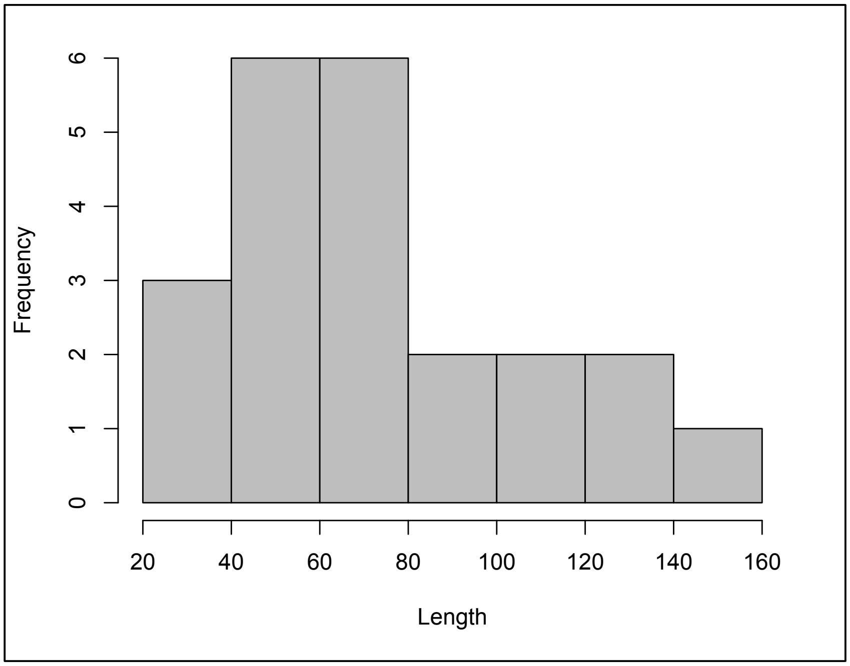


Figure 33. Histogram of Miniature Sandal dataset showing frequency of various lengths (mm).

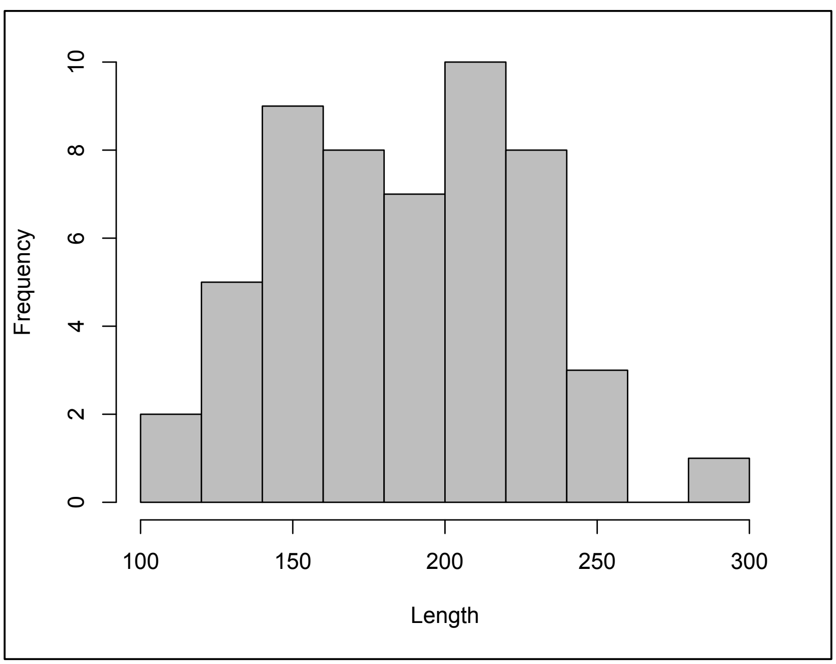


Figure 34. Histogram of Adult Sandal dataset showing frequency of various lengths (mm). There was no apparent bimodality in this dataset for length.

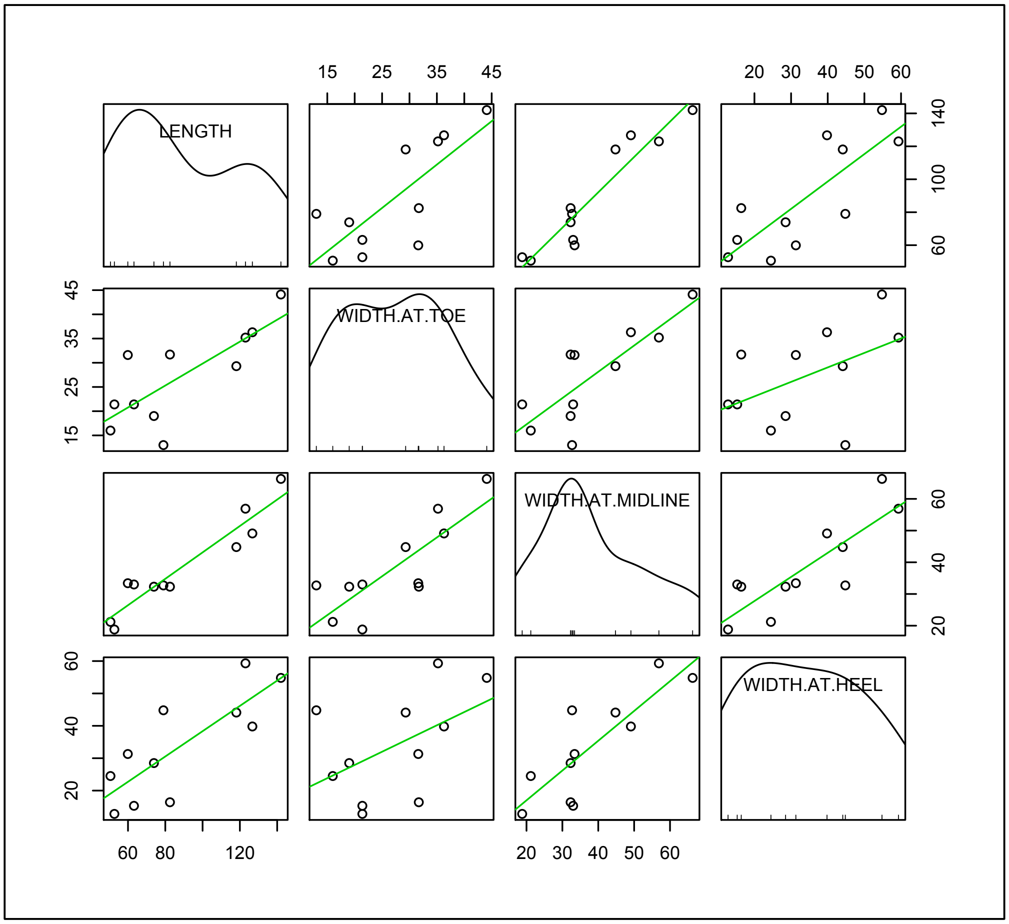


Figure 35. Scatterplot matrix showing correlations between each size measurement in the Miniature Sandal dataset.

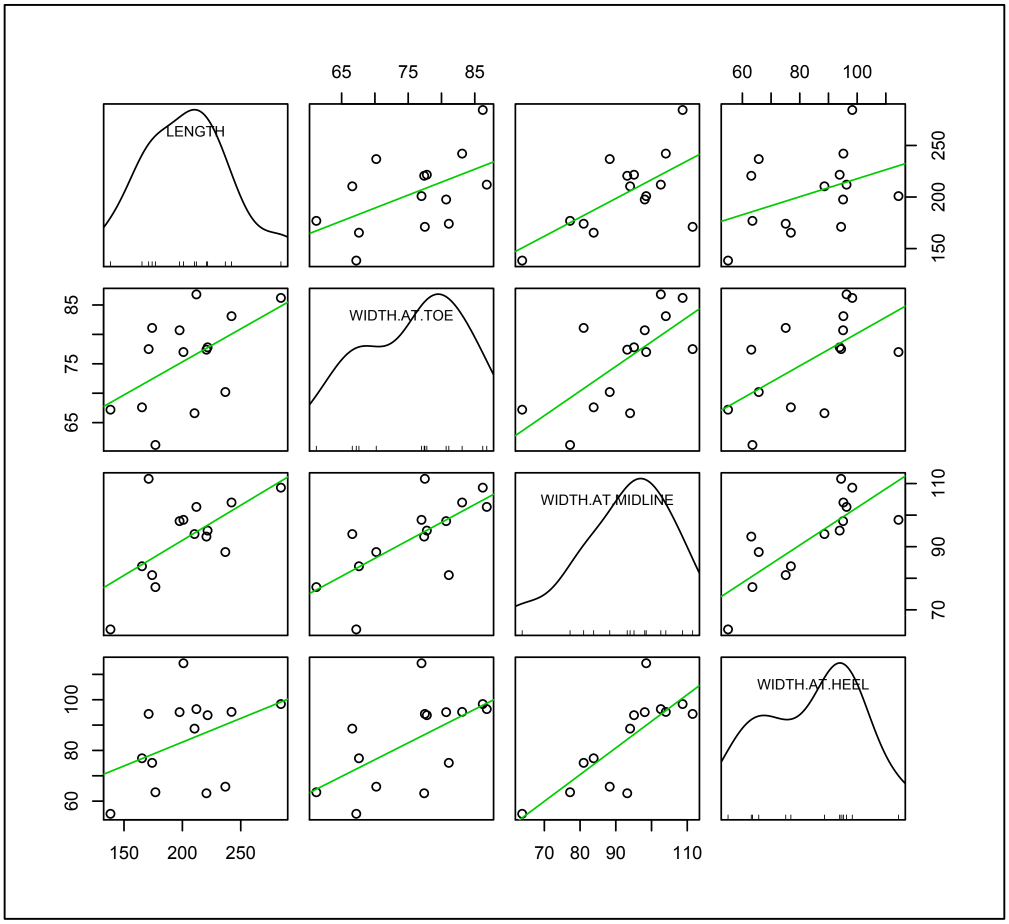


Figure 36. Scatterplot matrix showing correlations between each size measurement in the Adult Sandal dataset.

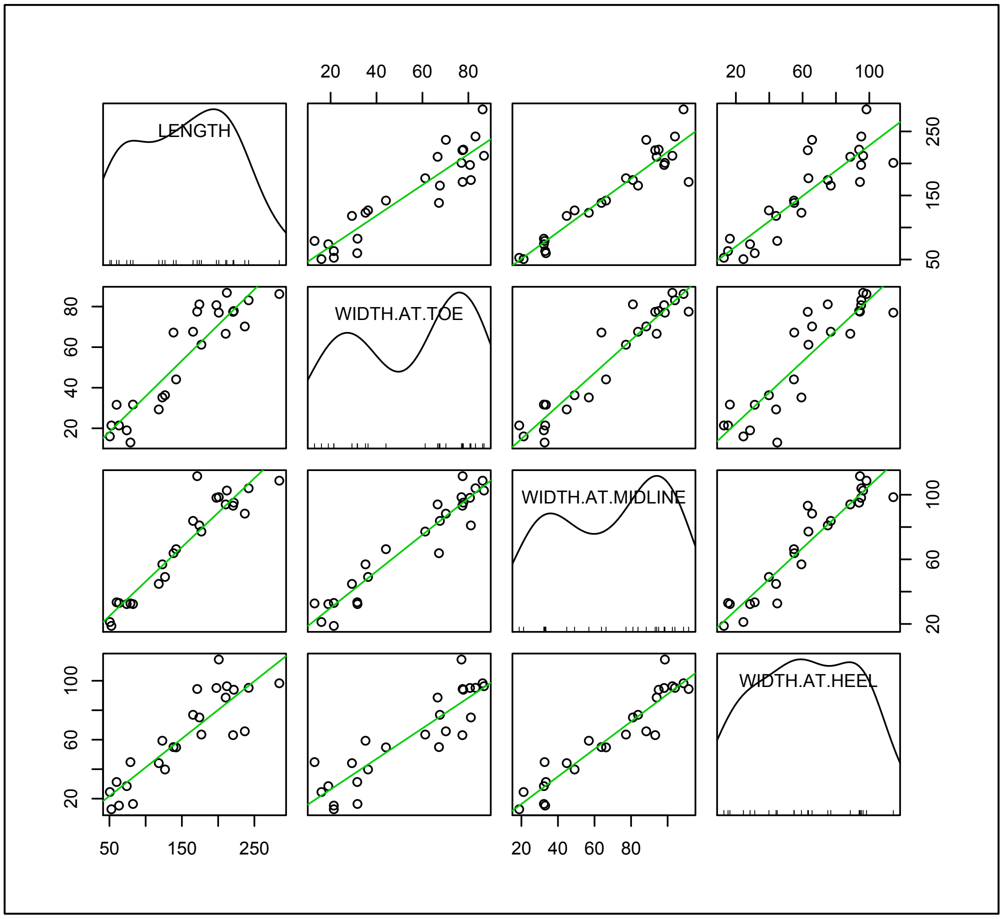


Figure 37. Scatterplot matrix showing correlations between each size measurement in the Total Sandal dataset.

Histograms of the miniature and adult sandal dataset did not show any clear indicators of bimodality. This result was somewhat unexpected for the adult sandal dataset, but potentially shows that sexual dimorphism was modest for populations living in the Lower Pecos, at least during the Archaic Period.

Scatterplot matrices show a high degree of correlation between all of the measurements in the total sandal dataset and potential bimodality in the kernel density plots shown on the left-right diagonal in the center of the figure. Correlations are less clear for the other datasets, potentially due to reduced sample size upon splitting the total dataset.

Strip charts were employed to plot whether specific sandal frame types necessitated larger or smaller sizes, or if any preference could be determined along age or gender lines within the sandal dataset. The three following strip charts show length plotted by frame type for the miniature, adult, and total datasets.

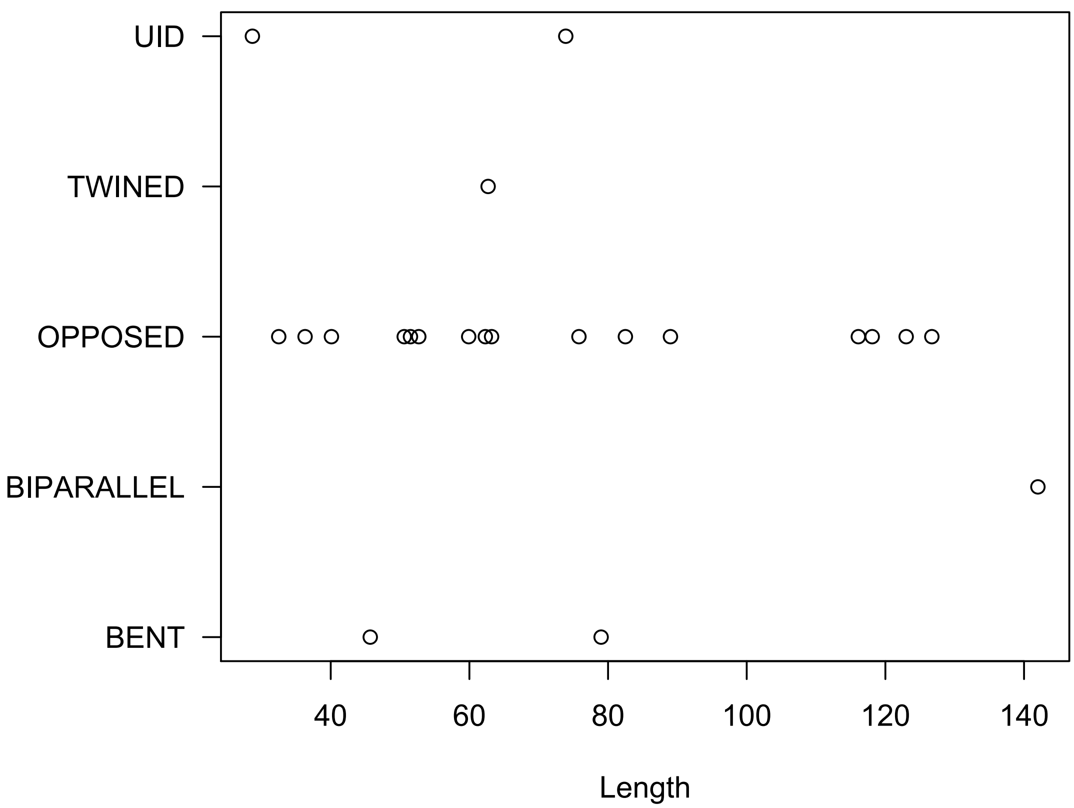


Figure 38. Strip chart showing Length (mm) by Frame Type for the miniature sandal dataset.

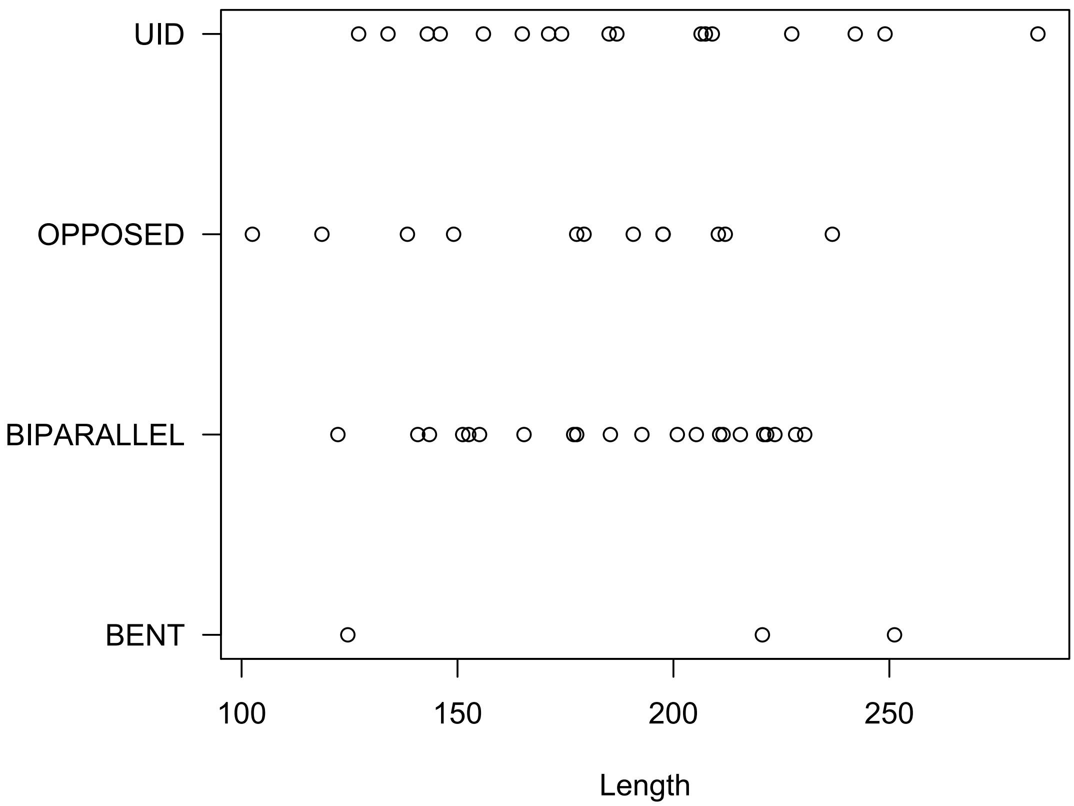


Figure 39. Strip chart showing Length (mm) by Frame Type for the Adult sandal dataset.

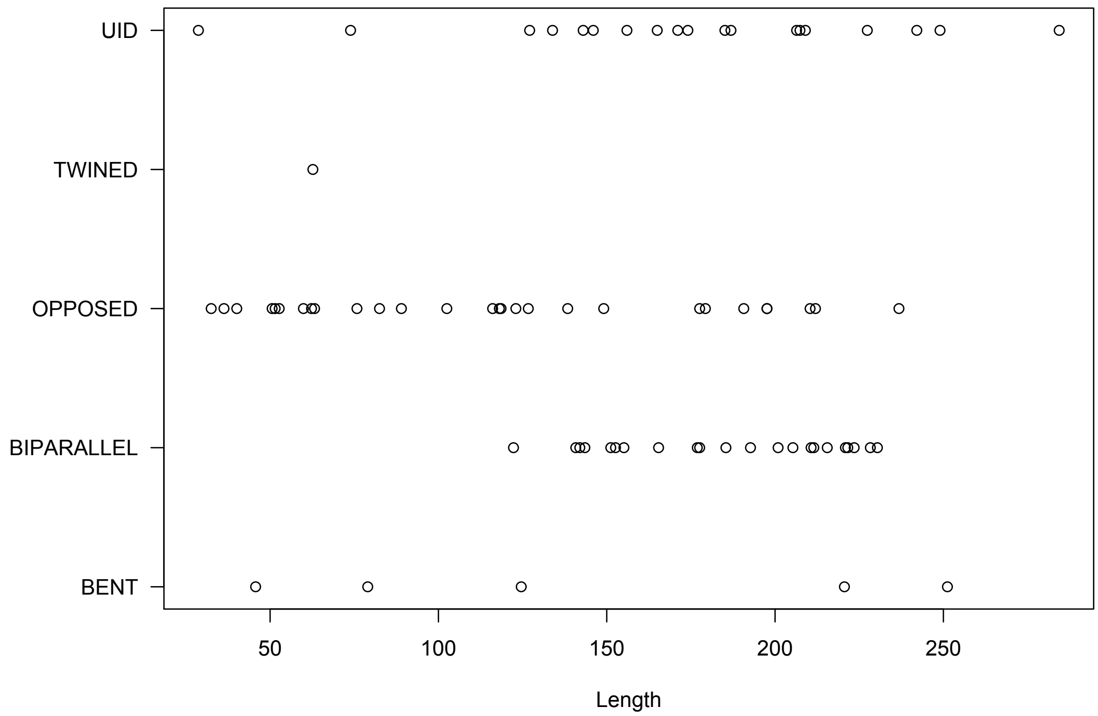


Figure 40. Strip chart showing Length (mm) by Frame Type for the total sandal dataset.

Comparing Adult and Miniature Sandals

After creating plots and summary statistics for each group (MSandal, ASandal, CSandal), it was necessary to complete direct statistical comparisons between the two sandal types. A third histogram of length for the entire dataset was generated to verify bimodality in length by the sandal types. Length to mid-width ratios were also calculated and plotted for sandal dataset, codifying the two groups with A (adult) and M (miniature). A boxplot of the ratios for adult and miniature sandals is shown in Figure 44. The box plot shows that the miniature sandals are slightly more variable that the adult sandals. Further, higher ratio values for the miniature sandals suggests that they tend to be narrower than the adult sandals. The scatterplot showing length and mid-width by sandal group show this same results in a different visualization. Principal Components Analysis (PCA) was completed to test for possible variation in the size and shape of the sandals at Conejo Shelter. For this analysis, Lenth, Width at Toe and Width at Midline were used. Heel widths were excluded primarily due to the degree of wear at this portion – very few heel portions were intact enough to accurate measurements. Additionally, it was determined that enough overall variation could be explained with Toe and Mid widths that the addition of the heel data would not lead to significant differences in the results of the PCA. The first principal component was size. This was expected. There is clear separation in the biplot (Figure 46) between the adult sandals (characterized by A's) and the miniature sandals (characterized by M). The second and third principal components represent shape. As is the case with PCA, the exact meaning of each component is not revealed by the results of the analysis, so which aspects of shape PC 2 and 3 represent are unknown. The two groups overlap considerably on these two components (Figure 47). Lack of clear separation on these components suggests that the sandals are similarly variable in shape. There is one outlier visible in this plot; the point represents AMIS 23780. Re-examination of the sandal and its datasheet indicate that the sandal is possibly incomplete, skewing the measurements collected from the specimen.

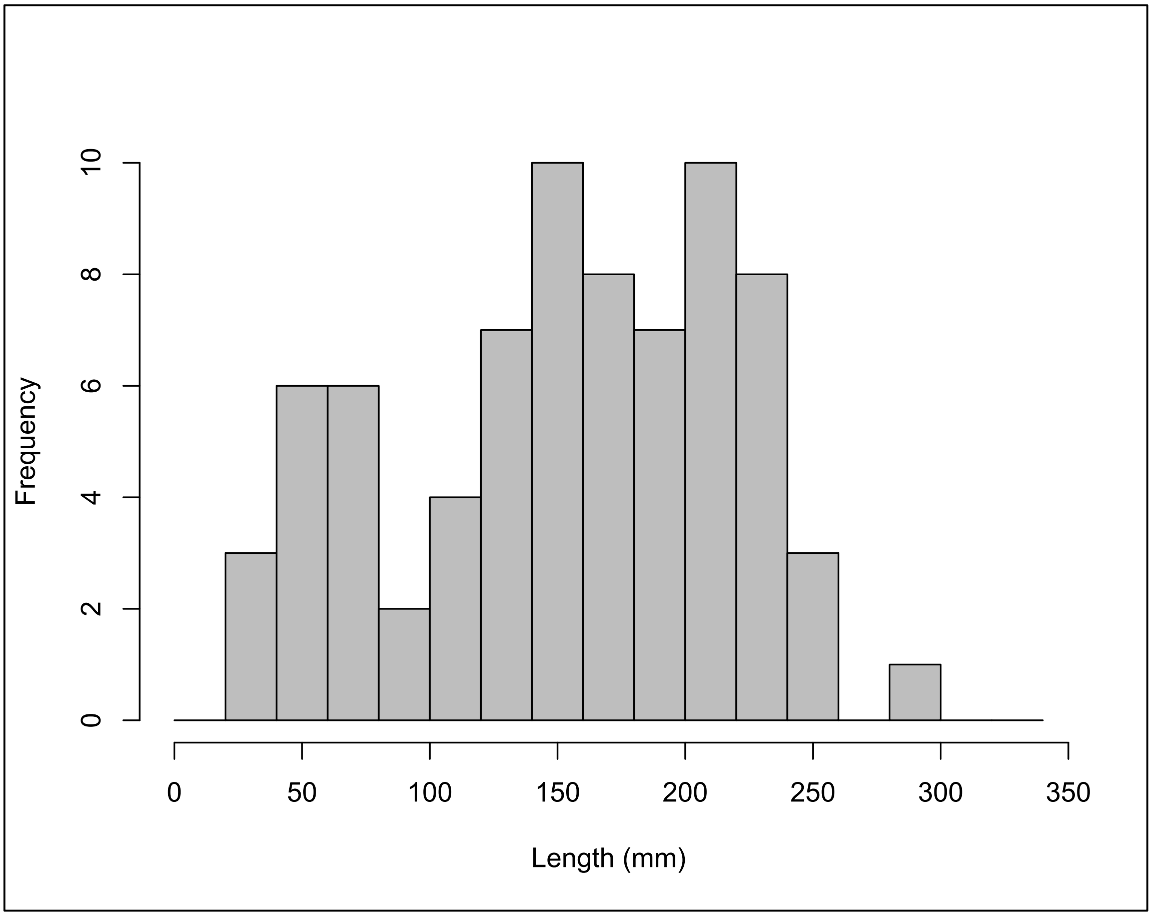


Figure 41. Histogram of the total sandal data set showing frequency of length measurements. While the bimodal separation is not exact, there are clear grouping of the miniature sandals (the two peaks between 40 and 80 mm).

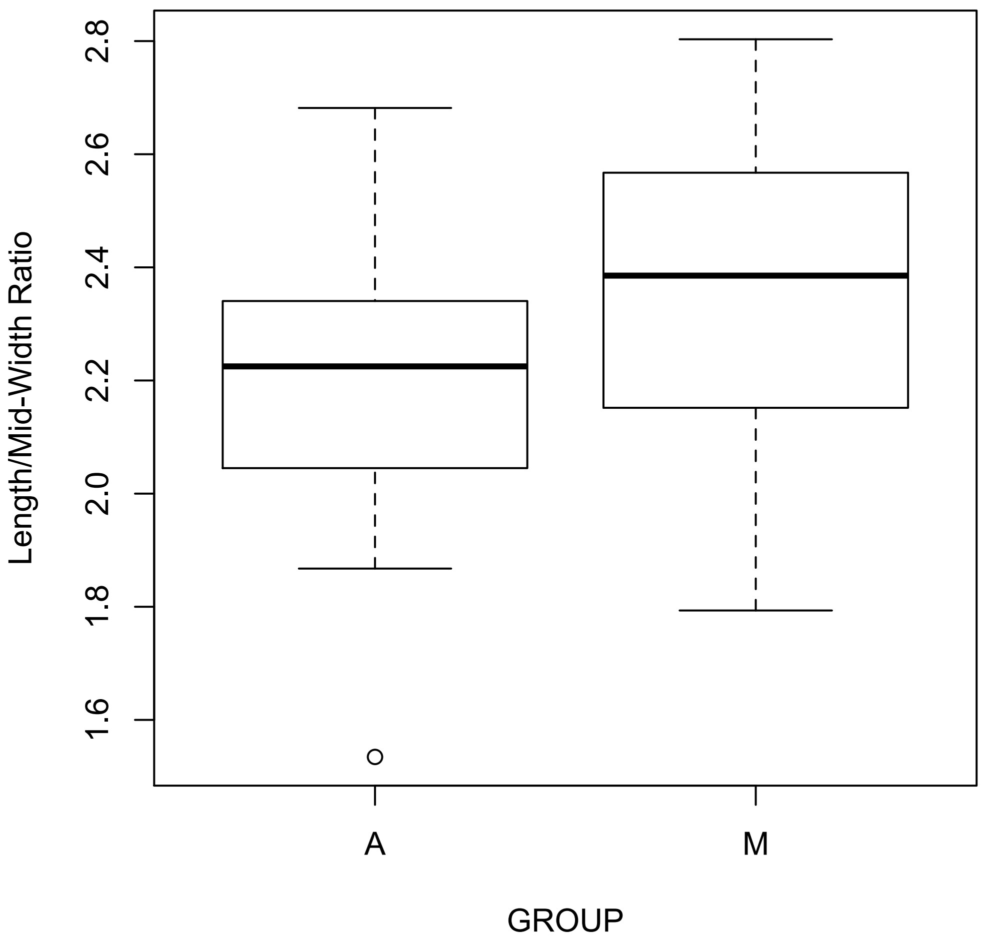


Figure 42. Boxplot of Length to Mid-Width Ratio by Group. A = Adult sandals, M = miniature sandals.

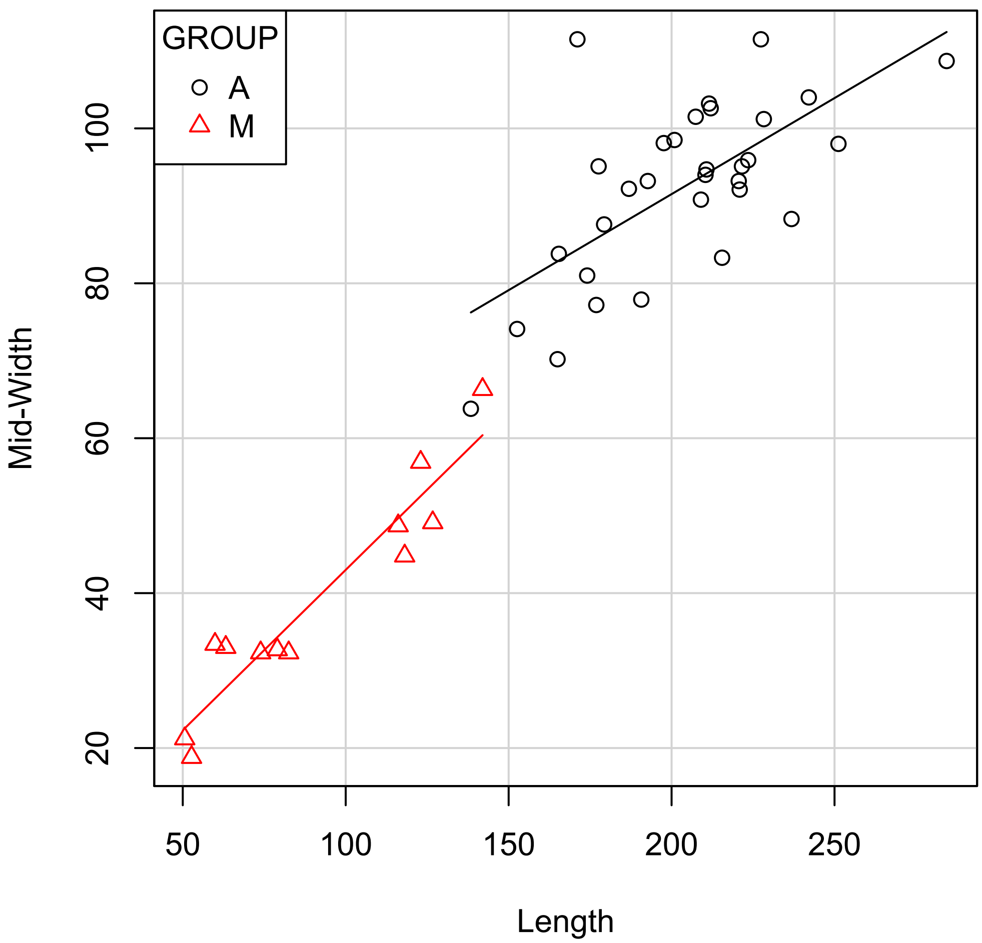


Figure 43. Scatterplot of Length and Mid-Width (mm) for Adult and Miniature sandals.

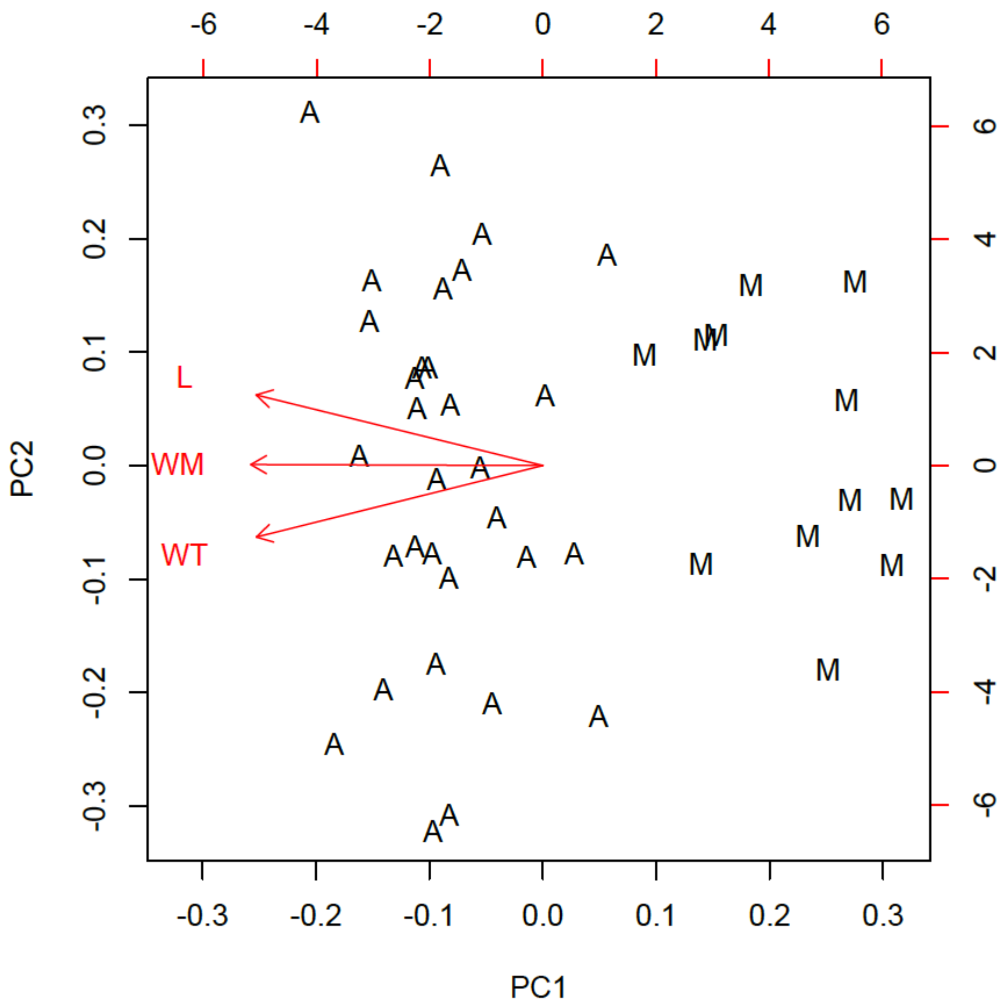


Figure 44. Biplot of Principal Components 1 and 2. A = Adult Sandals, M = Miniature Sandals. Red arrows symbolize the direction of variance as influenced by each variable where L=Length, WT=Width at Toe, and WM=Width at Midline.

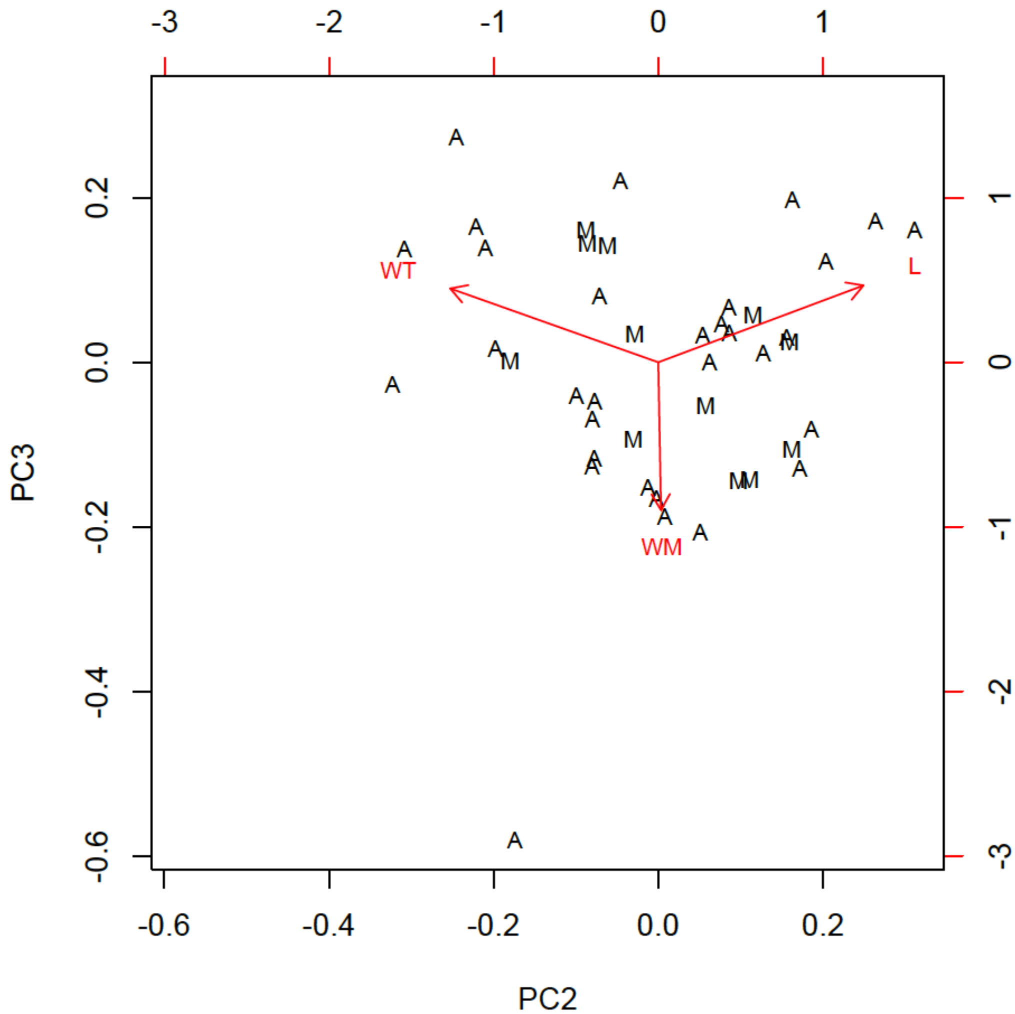


Figure 45. Biplot of Principle Components 2 and 3, showing variation in shape. A = Adult Sandals, M = Miniature Sandals. Red arrows symbolize the direction of variance as influenced by each variable where L=Length, WT=Width at Toe, and WM=Width at Midline.

Temporal Changes in the Dataset

After grouping and characterizing the lenses by Period, there was little temporal variation in the dataset, which is in part due to the small sizes for most periods. Maintaining these groupings, however, served the dataset well for the purposes and goals of this dissertation. Future work will explore more refined chronological changes at Conejo Shelter. The strip chart shown below (Figure 48) plots size against chronological period to test whether significant changes in sandal size (and body size) occurred during the Archaic Period. A small chart was generated to determine any potential changes in the frequency of certain sandal frame types over time (Table 5).

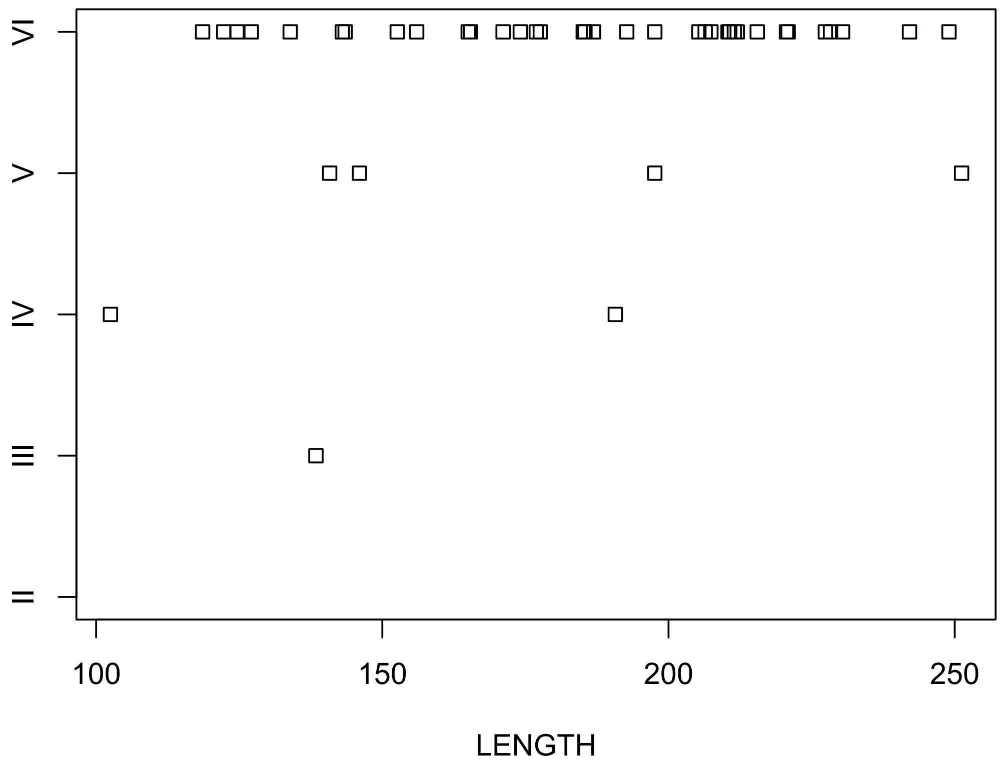


Figure 46. Strip chart showing Length (mm) by Chronological Period.

	Period				
Frame Type	II	III	IV	V	VI
Bent	0	0	0	1	3
Biparallet	0	0	0	1	15
Opposed	0	1	2	1	7
UID	0	0	0	1	15

Table 7. Counts of sandal frame types present in lenses grouped by period.

CHAPTER VII

DISCUSSION

Sandal Typologies

The arid climates of the Lower Pecos and adjacent eco-cultural regions to the south (Coahuila), west (Big Bend) and north (Rustler Hills) allow for a relatively robust assemblage of fiber sandals and other perishable artifacts. Decades of private avocational and scientific collecting have amassed a huge database of sandals from these regions, stored at many curatorial facilities and museums. Despite the quantity of sandals available from the Lower Pecos and nearby regions, there have only been a few attempts at regional synthesis and the development of a sandal chronology. Several factors make intra-and inter-regional synthesis difficult for sandal typologies and chronologies. First, because the sandal assemblages from these areas are stored in so many places, concurrent data collection and analysis of the data are nearly impossible. Site-specific perishable analyses tend to align the fiber artifacts within the overall chronological framework understood for the site and region, but few of the perishable analyses have developed chronologies based on directly dated perishable artifacts. A second difficulty, also related to scattered collections, is the lack of consistent sandal type names or definitions of the types. This chapter addresses these difficulties, with suggestions for improved future analyses, and situates the Conejo Shelter sandal assemblage described in Chapter 5 within the most complete chronologic and cultural frameworks suggested for the region.

Archaeologists are notorious for their desire to discover and describe new artifact types (see….). In the realm of lithic analysis, archaeologists and lithicists tend to describe themselves as lumpers or splitters. Generally, the difference between them rests in how stringently the archaeologist defines a tool type and how much chronological and morphological variation can exist within that type. Some archaeologists have recognized the use-life continuum with lithic tools which can often take the shape and appearance of other types after re-sharpening or re-hafting (Flenniken and Raymond 1986). Some archaeologists have focused more on metric-based tool typologies, which are intended to reduce typological distinctions based on subjective, and qualitative attributes.

Such attempts have not yet been made for perishable materials – probably rightly so, given the degree of individualism that can be inferred from them. Some standardization in the way sandals in particular are described is necessary, however. For the other fiber perishable artifact types like basketry, mats, nets, and cordage, qualitative attribute analysis is well described and largely sufficient for adaptation to different regions. The extensive works of Adovasio have established well-defined attributes and types for the broad structures and manufacturing techniques observed in perishable technologies (see: Adovasio 1977, 1980; Taylor et al. 2003; Adovasio et al. 2001; Adovasio 2005; Adovasio and Gunn 1975; Andrews et al. 1980). In his 1977 manual, *Basketry Technology: A Guide to Identification and Analysis*, Adovasio develops analytical nomenclature based on measureable attributes and manufacturing techniques as a way to standardize how perishable technologies are described. While the original printing of *Basketry Technology* (1977) did not address sandals, Adovasio's updated version (2010) notes that, with some variation, most sandal types seen in the archaeological record of North America follow the same manufacturing techniques seen in basketry (i.e., coiling, twining, plaiting). Despite the availability of such a thorough guide with standardized nomenclature, many perishable analysts still choose to create their own schema for perishable artifact types (Turpin 2003).

For the Lower Pecos and Coahuila, some of the seminal research on sandals was completed before Adovasio's manual was published and, thus rely on codes and nomenclature developed by the individual researcher (Schuetz 1956; Taylor et al. 2003). In one of the first syntheses of sandals in the region, Turpin (2003) attempts to rectify the diverse nomenclature used for sandals in the Lower Pecos and adjacent regions. Through analysis of existing literature and sandal collections from excavated sites in Coahuila (Cuatro Cienegas), Big Bend and the Lower Pecos, Turpin presents a new, more generalized terminology and correlates her terms to those already established by previous research from Smith (1933) in the Big Bend, Schuetz (1956) in the Lower Pecos, and Taylor (1966; 2003) in Coahuila. All of the types present at Conejo Shelter (Schuetz' types A, B, and D) are subsumed under Plaited Sandals. This type is by far the most common in the region. As Taylor (1966, 2003) did with his sandal analyses, Turpin classifies the different warp structures (bent, biparallel, opposed) into sub-categories of the plaited type, rather than classifying them as separate types, as Schuetz (1956) did. In Taylor's typology, plaited sandals were coded as F1a with subtypes F1ai (two warp sandals) and F1aii (three warp sandals). Types included in other typologies, but not present at Conejo Shelter include: Checkerpad, Braided, and V-Weft. Checkerpad sandals, (Schuetz' Type C, as shown in Figure 23) are woven in a style more similar to that employed in mats from the region, and are documented in both plain and twill plaited styles. Only six braided sandals (Taylor's Type F1b) were documented as part of Taylor's analysis and have not been encountered in any sandal assemblages in the Lower Pecos. The V-weft sandal type is quite similar to the fishtail sandals that are ubiquitous in the Rustler Hills and farther west toward El Paso; this type is generally not seen in the Lower Pecos, despite its presence in surrounding regions. While it is valuable to differentiate between the types, even Turpin's simplified terminology is flawed. The primary flaw with these type names is that every one of these types and subtypes are plaited. As mentioned previously, plaiting simply means that all elements used in the weaving are active at the same time. Differentiating "plaited" from "checker weave" is misleading, given that the checker weave sandals are essentially identical in construction and appearance to mats classified as plain and twill plaited. Despite the availability to easily applied terminology, weaving in checkerpad sandals is referred to as either straight or diagonal. It would be simpler and more correct to refer to these weaving patterns in nomenclature conventions outlined in Adovasio (1977, 2010) and call them simple plaited (instead of straight checkerpad) and twill plaited (instead of diagonal checkerpad). Turpin suggests that a broad typology for sandal terminology is a higher priority than developing more metric and detailed description based as suggest by Taylor (1988) or Williams-Dean (n.d.).

Sandal Chronologies

Despite issues with nomenclature, Turpin (2003) developed a preliminary chronology for sandals in the Lower Pecos and Coahuila. Unfortunately, some of the dates reported in the text are not calibrated dates, so comparisons across temporal and spatial ranges are difficult. The chronology is overwhelmingly dominated by plaited sandals (both two warp and three warp subtypes). The opposed warp sandal style was temporally ubiquitous during the archaic period. While Taylor noted that the biparallel warp sandal style was a more recent invention, data resolution is not yet refined enough to corroborate this for the Lower Pecos. Turpin's combined plaited group, which includes all the sandal types recovered at Conejo Shelter, spans 5000 years, from 6,200 radiocarbon years BP to 1,600 radiocarbon years before present (both uncalibrated). The earliest sandals in the proposed chronology are the V-weft variation. Six examples were collected at Cueva Encantada in Coahuila; three examples were collected from Wroe Ranch, on the northwestern edge of the Lower Pecos. These latter specimens were not directly dated but were collected from a feature radiocarbon dated to 6,490 – 7,270 radiocarbon years BP. No sandals of this type were observed in the Conejo Shelter assemblage. The checkerpad sandals (also not observed at Conejo Shelter) appear much later in the record, at least in southern Coahuila, where most of Turpin's dated specimens were collected. Her chronology assigns this sandal type to an age range of approximately 1,200 – 1,800 radiocarbon years before present. Braided sandals, which are not well documented on the Texas side of the Lower Pecos, but are seen in Coahuila, overlap in age with the checkerpad sandals. Examples of this type, or the contexts from which they were excavated have generated dates of 1,170 – 1,660 radiocarbon years before present. Recognizing that this chronology is intended to be preliminary, I must note that, while it provides a framework for the region, it does very little toward guiding the realization of any temporal changes in the Conejo Shelter assemblage. Prevailing issues with terminology and the lumping together of all "plaited" sandals dissolves any potential temporal variation among subtypes within this broader category.

The earliest sandal date collected from the Conejo Shelter assemblage was 4500 ± 15 radiocarbon years BP (AMIS 23795/UCIAMS 176098). The sample was collected from a highly fragmentary, likely biparallel warp sandal collected from Lens 103. Interestingly, the same bag had a smaller, opposed warp sandal collected from the same provenience. These two specimens were labeled in the field as "a pair of sandals", which must have simply indicated that there were two sandals, because they are drastically different sizes and different frame constructions. It is very unlikely that they were worn by the same person. A sample of a degraded sandal of unknown frame construction collected from Lens 96 also returned a radiocarbon age of 4500 ± 15 years (AMIS 23882/ UCIAMS 192574). A second, heavily degraded, but possibly biparallel sandal from Lens 110 was dated to 4440 ± 15 radiocarbon years BP (AMIS 23759/UCIAMS 192569). The most recent radiocarbon age of 1410 ± 15 radiocarbon years BP came from a sandal specimen from Lens H (AMIS 23699/UCIAMS 192568). The sandal is plaited like the rest but a missing portion at the toe made it impossible to determine whether it had a bent, biparallel, or opposed warp frame. Most of the other radiocarbon dates from the sandals are in the range 1,885 – 4,135 radiocarbon years BP. There are no apparent temporal trends in the frame types of the dated sandal specimens. Only one bent frame sandal was sampled; the resulting radiocarbon age was 2765 ± 15 (AMIS 22975/UCIAMS 176082). The remaining sandals sampled were either primarily biparallel or opposed; there were three other dated sandals of unidentified frame type. Based on these dates, the Conejo Shelter sandal assemblage corresponds to the chronology proposed by Turpin (2003). While the corpus of dates generated from this assemblage do add significantly to the existing database of direct radiocarbon dates on sandals, more dates are necessary to refine this chronology, especially in terms of potential variation within the plaited sandal category.

Cultural Affinity Across the Rio Grande

While it is possible that the Rio Grande could have acted as a physical boundary, limiting travel of hunter-gatherer groups living in the Lower Pecos and Coahuila, similarities in the artifacts these groups made and used have been recognized for several decades. Taylor (1966, 2003) posited a potential cultural affiliation between the occupants of these regions based on extensive excavations and analysis of sandals from the region. Following examination of the basketry from Taylor's excavations in Coahuila, Adovasio corroborated Taylor's suggestions of cultural affinity between groups on either side of the Rio Grande. Based on similar construction techniques and the frequency with which certain techniques were used, Adovasio posited that occupants of the Lower Pecos were likely the same cultural group, or at least descendent of the same group (Taylor et al. 2003). Additional research in Coahuila and the Lower Pecos has continuously supported this hypothesis of cultural connection (Hyland and Adovasio 2000; Adovasio 2005, 1980). While more recent explorations of this connection have not explicitly included sandals, the initial hypothesis from Taylor was based on analysis of the vast sandal dataset he generated through excavations in Coahuila.

McBrinn (2005) analyzed sandal structure and manufacture to answer questions about inter- and intra-group social identity. In her research on sandal style in the American Southwest, she suggests that different aspects of sandal construction signal different levels of group identity. McBrinn employs theoretical and ethnographic research on style to develop a framework for determining which features of sandal construction reveal stylistic choices, why those choices would be made, and how they would be recognized by others within and without the community (McBrinn 2005; Wobst 1977; Sackett 1986; Wiessner 1983, 1985; Macdonald 1990). The research focuses on iconological style, that which is visible and interpretable by casual viewers, and isochrestic style, that which is hidden and thus, more personal. McBrinn (2005) attributes sandal toe and heel silhouettes (essentially indicators of basic frame structure) as contributors to a group's iconological style. Sandal silhouettes (thus frame types) are readily perceived by members of an outgroup. To this end, McBrinn posits that indigenous occupants of the southwest signaled economic network affinities through these silhouettes. In times of economic stress, groups within the economic network might call upon one another for assistance. Affinity with that network would be identified through iconological style attributes of the sandals and signal to each group that they are both members of the same economic network, even if they were not members of the same family or marriage network.

Defining the Miniature Sandals

The miniature sandals at Conejo Shelter represent approximately 20% of the total sandal assemblage of the site. My own observations and anecdotal accounts confirm that this type of artifact is not limited to Conejo Shelter (Harry Shafer, personal communication). The scope of this research did not allow for systematic analysis or comparison of miniature sandals from other sites. These materials have, however, been noted in assemblages from the Skiles family collection of materials from Eagle Nest Canyon as well as in the assemblage from Hinds Cave (41VV456).

Statistical analyses, particularly Principle Components Analysis, lend credence to the hypothesis that the initial identification of the miniature sandals is indeed correct. As described in Chapter 5, the adult and miniature sandals showed clear separation on Principle Component 1, size. This was unsurprising given that the difference between the average length of the two types was over 100 mm (186 mm for adult sandals, and 73.3 mm for the miniature sandals). There was almost no separation between the two sandal types on Principle Components 2 and 3 – indicators of shape. This result suggests that, while the sandals were clearly different in size, they are less different in shape. Overlap between the adult and miniature sandals on these components shows that the shape of the miniature sandals closely mirrors that of the adult sandals. Assuming that archaeological interpretations of the adult sandals are correct, it follows that the objects identified as miniature sandals intentionally follow the shape parameters of the adult sandals and differ only in size. Had there been a more discernible difference between adult and miniature sandals in the shape components, it would be more difficult to make this connection definitively. Since the current interpretation of these objects has been quantitatively corroborated, we can continue the discussion with the assumption that the objects were at least intended to *look* like sandals, regardless of whether they were made to function as sandals.

Explaining the Miniature Sandals

Children in the Archaeological Record

The role of children in the creation of the archaeological record has largely been ignored in the discipline. Their impact is seemingly invisible, though this is likely due primarily to lack of recognition of or focus on collecting objects specifically related to children (Kamp 2001a). Kamp (2001) argues further that, since most American archaeologists were raised with a modern, western understanding of childhood and children, it is more difficult to interpret the role of children in society as one that would make a clear mark in the archaeological record. Because we generally perceive children as not-yet adults, they are relegated to the private, closed realm of the home. Just like women, children are seen as parts of a social group that do not contribute to the public aspects of society (Kamp 2001a). Children and childhood have been the subject of a fairly sizeable corpus of research from archaeology and bioarchaeology, and ethnography, particularly in the last two decades (see: (Perry 2005; Schwartzman 2005; Menon and Varma 2010; Halcrow and Tayles 2011; Högberg 2008; Moore and Scott

1997; Baxter 2005; Thomas 2005). Much of this research has focused on craft learning and ways to detect novice artifact production in the archaeological record (Kamp 2001b, 2001a; Kamp and Whittaker 2002; Crown 2014; Menon and Varma 2010; Högberg 2008; Assaf et al. 2016). Since much of this research suggests that miniature objects are made as part of the learning process for various technologies, the miniature sandals will be explored further with an added interpretation as learning tools or toys.

Knowledge Transmission and Training

Learning is an integral feature of the experience of childhood – a period marked by both biological and cultural development. Perceptions of the stages of childhood vary greatly across social groups. Most groups recognize, however, that there are stages of childhood development that involve cultural learning and initiation rites (Kamp 2001a). Craft learning can begin as early as two or three years old, but commences much later, into the teen years in some cultures. In her analyses of ceramic craft learning, Kamp (2001b, 2001a) makes clear that detection of novice craftsmanship is not necessarily synonymous with detection of child craftsmanship. As we do not know the enculturation process or timeline for the Archaic period occupants of the Lower Pecos, I will not assume that learning and craft training is exclusively for children (as they are defined biologically). As learning can happen both through formal instruction and play, it would also not be correct to limit the nature of the miniature sandals to one of these categories (Crown 2014). Analyses of crafts learning of ceramics suggest many steps in the learning process. Some of these are limited simply by motor skill ability; children under the age of 5 typically do not have the requisite fine motor skills to create complex objects out of clay (Crown 2014). This is likely also the case for the construction of sandals. While the weaving techniques used for sandals are certainly not as complex as some types of coiled or twined materials, some level of motor skill development would be required to properly fold the leaves and tie selvage knots. Archaeologists, particularly in the Southwest, have argued that poorly formed ceramic vessels are made by unskilled potters, possibly children (Kamp 2001b). During the learning process, children (or other learners) are expected to move through each step of the learning process, mastering a new skill before taking on the next step (Crown 2014; Kamp 2001b). If the miniature sandals at Conejo Shelter can be understood as representing this process, learning weaving on a miniature scale and mastering the technique could explain the variation in weaving quality seen in the sandals.

Conclusions

The data resolution did allow for a robust temporal analysis of the sandals from Conejo Shelter. It is difficult to conclude whether the concentration of sandals in the upper levels of the shelter deposits is a result of preservation bias or behavior of the occupants. With the exception of cordage, which exists in similar concentrations throughout the excavation block, other woven fiber artifacts (baskets, mats, and sandals) are more prevalent in the upper lenses. Given the quantity of faunal, vegetal and coprolitic debris in the lower levels of the shelter, it seems unlikely that preservation bias is the only answer. The breaks in the chronological sequence as described in chapter 6, are particularly interesting within the context of the concentration of other perishable refuse (faunal and vegetal) which is largely unchanging throughout the entire stratigraphic sequence. Extensive, inter-site analysis and data synthesis is required to gain a full understanding of the differential accumulations of sandals across the Lower Pecos and Coahuila. Because the Conejo Shelter sandal assemblage lacked sufficient temporal depth, and due to the exclusive use of "plaited" sandal frame types, little can be said about the chronological variation in sandals from this site. Additional research and collection of more radiocarbon dates will help refine the chronology, particularly in terms of deciphering any temporal variation in the plaited materials that Turpin (2003) grouped in her analysis.

Cultural affinity between the Lower Pecos and Coahuila is logical and well supported by the perishable artifact evidence and overall suite of lifeways and adaptations. Given the pervasiveness of the plaited sandals types in both the Lower Pecos and Coahuila, cultural affinity could be established on the basis of these objects alone. Taking McBrinn's findings into account, it is very possible that sandal attributes, especially frame structures signaled group affinity in this region as well. While this dissertation did not target style signals during data collection, re-examination of sandal attribute data and comparison with other sites could potentially detect these signals.

Miniature sandals as features of the crafts learning process is the best-fitting interpretation given the available data. While correlations of craft learning were primarily based on ceramics, the stages of the learning process are general and logical enough to apply them across other artifact types. Systematic analysis and comparison of miniature sandals from other sites in the Lower Pecos would make these conclusions more robust.

CHAPTER VIII

PROJECT CONCLUSIONS

This dissertation research has been an immensely difficult, but rewarding process. The nature of collections-based research is inherently challenging. Facing issues involving not-current excavation methodologies, inconsistent data collection, and preservation problems all come with the territory of collections-based research. Overcoming these problems makes the end result that much more satisfying. It is my goal that this work serve as a guide of sorts, demonstrating that collections-based research is a viable and valuable path for graduate study. While there were limitations to the scope of the project and aspects of the research plan had to be altered to account for these limitations, I was able to demonstrate that developing research questions around incomplete analyses of previously excavated material is possible, and that those research questions can be addressed, if not fully answered.

The data resolution did allow for a robust temporal analysis of the sandals from Conejo Shelter. It is difficult to conclude whether the concentration of sandals in the upper levels of the shelter deposits is a result of preservation bias or behavior of the occupants. Given the amount of vegetal and coprolitic debris in the lower levels of the shelter, it seems unlikely that preservation bias is the only answer. Extensive, inter-site analysis and data synthesis is required to gain a full understanding of the differential accumulations of sandals across the Lower Pecos and Coahuila. Because the Conejo Shelter sandal assemblage lacked sufficient temporal depth, and due to the exclusive use of "plaited" sandal frame types, little can be said about the chronological variation in sandals from this site. Additional research and collection of more radiocarbon dates will help refine the chronology, particularly in terms of deciphering any temporal variation in the plaited materials that Turpin (2003) grouped in her analysis.

Cultural affinity between the Lower Pecos and Coahuila is logical and well supported by the perishable artifact evidence and overall suite of lifeways and adaptations. Given the pervasiveness of the plaited sandal types in both the Lower Pecos and Coahuila, cultural affinity could be established on the basis of these objects alone. Taking McBrinn's findings into account, it is very possible that sandal attributes, especially frame structures, signaled group affinity in this region as well. While this dissertation did not target style signals during data collection, re-examination of sandal attribute data and comparison with other sites could potentially detect these signals.

Identifying miniature sandals as features of the crafts learning process is the best-fitting interpretation given the available data. While correlations of craft learning were primarily based on ceramics, the stages of the learning process are general and logical enough to apply them across other artifact types.

The next steps of this research include building a more robust sandal dataset, to compare the assemblage of adult and miniature sandals from Conejo Shelter to those from other excavated sites in the region. The miniature sandals are still a source of particular interest, and comparison of these peculiar artifacts from other archaeological contexts could help prove or disprove the interpretations of them presented in this dissertation. Refining the sandal chronology is also within reach. Methods presented here demonstrate that sandals can be reliably, directly dated, without damaging the intact portions of the objects. The dates presented here significantly increase the number of directly dated sandals from the region. The minute sample requirements of AMS radiocarbon dating and the inevitable breakage of fiber perishable artifacts ensure the great potential for the creation of a massive database of directly dated sandals and other fiber artifacts.

Changing the conversation about curation issues from the understandably alarmist “curation crisis” perspective to a systematic restructuring of how archaeology is taught is the best way to ensure that archaeological collections are valued and cared for. The results of the programmatic survey were quite distressing. It becomes difficult to believe that these problems will ever be alleviated if collections management and curatorial work are continuously relegated to the sidelines. Given the widespread nature of the curation crisis, it is unlikely that anthropology graduate students now or in the future will be able to avoid issues that inevitably accompany underfunded and understaffed collections and curatorial facilities. Continuing to award PhDs to students without any experience working with archaeological collections is not sustainable practice moving forward.

It is vital to the future of the discipline to recognize the validity of collections-based research, like that completed for this dissertation. Increasing collections and data accessibility is the first major step required to move Archaeology into the future. Encouraging students of all levels to engage in collections-based research projects and availing museum studies and curation coursework to them will ensure that the next generation of academics values these materials in the way that fulfills their ethical obligations.

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APPENDIX A

DATA MANAGEMENT PLAN

Researcher: Elanor M Sonderman
Project Title: Re-analysis of Conejo Shelter: A Legacy Archaeological Collection from the Amistad Reservoir Area, Texas
Project Duration: 2016 – 2018
Project Context: This project was completed as part of dissertation research on Conejo Shelter Texas. Data collection, analysis, and processing took place primarily in the Anthropology Department at Texas A&M University, College Station. Other research loci were the Texas Archeological Research Laboratory, University of Texas, Austin (TARL); the Anthropology Research Collections at Texas A&M University (ARC). The material studied during this project are owned by the National Park Service, Amistad National Recreation Area (NPS-ANRA) and curated at the Texas Archeological Research Laboratory at the University of Texas. Initial excavations were completed under the auspices of the Texas Archeological Salvage Program.
Data: Physical (object and archival) data studied as part of this project include woven fiber sandals and other fiber objects excavated from Conejo Shelter as well as photographs, field notes, and maps created during excavation (1967-1969). All of this material is curated and archived at TARL on behalf of NPS-ANRA. Physical data was created in the form of individual hard copy description sheets for each sandal analyzed as part of this project Digital data was created in the form of spreadsheets (.csv), digitized description sheets (.pdf), photographs (.tiff), Adobe Illustrator drawings (.ai), and ArcGIS shapefiles (.shp) Storage volume is approximately:
Documentation and Description of Data: Recording of the data follows standard nomenclature for archaeology Metadata was collected for all data types in accordance with standard practice and specific guidelines set forth by the Texas Data Repository. Metadata for each data type will be retained using a combination of within file documentation and as separate metadata text document.
File Structure and Naming: To maintain compatibility with naming requirements across all file types, camel case was used for all file names. Each file name begins with CS (Conejo Shelter) to maintain consistency of identification through each level of the file structure. Within the project folder, there are subfolders for “GISData”, “SandalAnalysis” and

"RadiocarbonAnalysis". All data will be assigned a file name that includes a shortened version of the subfolder name, a brief description of the subject, and where relevant, the date.
Deposition of Data: Most of the data generated for this project will be deposited into the Texas Data Repository. This repository was selected because it is free and open access. Digitized archival materials owned by NPS-ANRA and TARL will not be included with the original data generated for this project.
Data Sharing and Access: A two-year embargo period has been set for the completed dissertation document and all data. Once the embargo is lifted, all deposited data will be accessible from the Texas Data Repository
Date Finalized: May 28, 2018

APPENDIX B

CURATION EDUCATION DATA

University	Department Name	Degrees available	Does the University have archaeological collections?	Are collections accessible to researchers?	Does the program promote graduate study within collections?	Does the program offer courses in museum studies, curation or collections managment
Arizona State University	School of Human Evolution and Social Change	BA, BA, PhD in Anthropology; MA in Museum Studies	yes, Center for Archaeology and Society	yes	yes, only throught the Museum Studies MA and Graduate Certificate. PhD curriculum does not suggest CM or Cur. courses	yes- through the museum studies MA; nothing in BA or BS curriculum to encourage CM courses. Only one undergrad course mentions lab component (ASM 365)
Boston University	Anthropology	BA in Anth; MS in Applied, Forensic and Medical;	no, but provides links to other museums (Peabody)	n/a	no, the program is more bio and cultural focused	no
Brown University	Anthropology; Joukowsky Institute for Archaeology and the Ancient World	BA in Anth (with arch focus option); PhD in Anth Archaeo.	yes, Haffenreffer Museum of Anthropology and Collections Research Center	Stress original fieldwork at undergrad and grad level	Unclear, but there are student internship opportunities at the museum	no
Cambridge	Department of Archaeology	Undergrad and Grad archaeology	yes, Museum of Archaeology and Anthropology	yes	yes	yes - MPhils and PhD option to focus on Archaeological Heritage and Museums
College of William and Mary	Anthropology	BA, MA, PhD (with hist arch focus)	yes	yes	no	Woody Internship in Museum Studies, no indication in undergrad or grad coursework to stress museum studies or coll man in archaeo.
Columbia University	Anthropology; Art History and Archaeology	BA, MA, MPhil, and PhD. MA in Museum Anthropology	yes	yes	only with the Museum Anth degree	yes- museum anth, these courses are available to phd students
Cornell University	Anthropology	MA in Archaeology, PhD, BA	Cornell University Museum and Anthropology Collections	yes	sort of	adjacent: heritage management in Ethics course and Museums and Anthropology course (stacked classes
Duke University	Archaeology and Visual Studies in the Classics Dept	PhD and MA in classics	Classics dept is connected to Nasher Museum of Art	only in classics	no	no
Emory University	Anthropology	BA, PhD	Michael C Carlson Museum, Department Labs	collections at the museum seem to not be available for research	no degree in archaeology	no
Florida State University	Department of Anthropology	MA in Anth (arch focus); Grad Certificate in Museum Studies; MA in Museum Studies through the College of Fine Arts; Specialized Study in Museum Studies for MA and PhD students	Ties to SEAC	yes	n/a	yes, primarily through other departments within the museum studies consortium

University	Department Name	Degrees available	Does the University have archaeological collections?	Are collections accessible to researchers?	Does the program promote graduate study within collections?	Does the program offer courses in museum studies, curation or collections managment
George Washington University	Columbian College of Arts and Sciences	MA in Museum Studies, Grad certificates	yes- partner w/ smithsonian	yes	yes	yes, with entire concentration on coll. mgmt
Harvard University		Grad Certificate or MA in Museum Studies through Harvard Extension School	Peabody is there but isn't advertised as part of the MA	through Arch PhD, field work is required/stressed	the Peabody promotes it, but the anth webpage does not	yes, only through MA
Indiana University, Bloomington	Anthropology	BA, PhD	yes, Mathers Museum of World Cultures	yes	the museum promotes student research	Graduate Museum Practicum
John's Hopkins University	Krieger School of Arts and Sciences	BA in Anth; MA in Museum Studies	yes- Johns Hopkins Archaeological Museum	yes	yes, through MA	yes
McMaster University	Anthropology	BA, MA, PhD	seems like the various labs may have collections	unclear	no	no
New York University	Arts and Sciences/Anthropology, Program in Museum Studies	Undergrad and Grad in anth (arch focus); Grad Certificate or MA in Museum Studies	partnerships with NY museums, but there are not in-house collections	n/a	n/a	yes-museum studies program
Northwestern University	Northwestern School of Professional Studies	Online Certificate program in Museum Studies	Teaching Collections in the Archaeology Training	for class instruction	n/a	within the online Museum Studies certification program
Ohio State University	Multi	Certificates in Museum Studies available at undergrad and grad level	no	n/a	n/a	yes, through the certificate program
Oxford	School of Anthropology and Museum Ethnography	MPhil and MSc in Visual, Material and Museum Anth	yes, association with Pitt Rivers Museum	yes	yes	yes
Pennsylvania State University	School of Humanities/American Studies; Anthropology	Museum Studies Concentration; Grad Certificate in Museum Practice	yes, Matson Museum of Anthropology	yes	yes	yes, through the certificate program, practical application through work-study at the
Princeton University	Anthropology; Art and Archaeology	undergrad and grad degrees	yes, Art Museum	yes	yes	no
Rice University	Anthropology, Museums and Cultural Heritage; Art History Department	undergrad minor in Museums and Cultural Heritage; the Art History Department has a Museum Practice Cert and a Museum Professionals track for PhDs	Moody Arts Center, Rice Gallery, collaboration with locl musuems	n/a	n/a	yes, through museum studies minor. 2 additional graduate courses, Museums:Theory and Practice and Heritage Management
Rutgers University		Curatorial Studies Certificate in the Art History Dept	unclear	n/a	n/a	adjacent topics at the undergrad level
Southern Methodist University	Anthropology	BA/BS, PhD	yes	yes	no	no
Stanford University	Stanford Archaeology Center	PhD, BA	Yes, Standford University Archaeology Collections	Yes	Fieldwork, but not lab work is required for the undergrad major	heritage courses in Anth curriculum, museum courses and internships at SUAC

University	Department Name	Degrees available	Does the University have archaeological collections?	Are collections accessible to researchers?	Does the program promote graduate study within collections?	Does the program offer courses in museum studies, curation or collections managment
Stony Brook University	Anthropology	BA, MA, PhD (with hist arch focus)	Yes, Teaching collections	Yes, through course work	Yes	No
Texas A&M University	Anthropology	BA, PhD, Grad Certificate in Historic Preservation	Yes, ARC	Yes	No	Museum Studies minor coursework, only available for
Tulane University	Anthropology	BA, PhD	no	n/a	no	no
University College - London	Archaeology Department	BA, MA, MS	Yes	Yes	No	Grad and undergrad coursework in museums studies, management, conservation, heritage, curatorship, exhibition, public
University of Arizona	Anthropology	BA, MA, PhD	Yes, in house labs and ASM	Yes	no	Grad certificate in museum studies through Fine Arts - not advertized on Anth page or ASM
University of Birmingham		MA, PhD in Cultural Heritage	yes, Research and Cultural Collections	yes	no	only through cultural heritage degrees
University of Calgary	Anthropology and Archaeology	BA, BS, MA, PhD	yes, access to labs/field school data	yes	No	courses in Museum and Heritage studies through Art Dept
University of California, Berkeley	Anthropology	BA and PhD in arch	yes, several arch labs in the ANTH department	yes	no	no
University of California, Davis	Anthropology	BA and PhD	yes, UC Davis Anth Museum, Center for Archaeological Research	yes	no	undergrad level courses (like 2)
University of California,	Anthropology	BA, MA, PhD	not readily found	n/a	n/a	no
University of California, LA	Anthropology/Archaeology	BA, PhD	Fowler Museum/Cotsen Institute	yes	unclear	no
University of California, Riverside	Anthropology	BA, BS, MA, PhD	unclear	n/a	n/a	no
University of California, San Diego	Anthropology	BA, PhD	Collections from field projects housed in 4 arch labs	yes	yes	no
University of California, Santa Barbara	Anthropology	BA, PhD	Repository for Archaeological and Ethnographic Collections	yes	unclear	yes, undergraduate internships
University of California, Santa Cruz	Anthropology	BA, PhD	Archaeology Research Center	unclear	unclear	no
University of Chicago	Anthropology	BA, PhD	local museums	surely	no	no
University of Colorado - Boulder	Anthropology/Museum of Natural History	MS in Museum and Field Studies (with Collections in arch track)	UC Museum of Natural History (2 faculty curators for arch and anth)	yes	yes for MFS but not really for ANTH	yes
University of Florida	Anthropology/Florida Museum of Natural History	BA, MA, PhD	yes, at FLMNH and LSA	yes	encouraged through the FLMNH webpage	yes, Intro to Natural History Museums, Anthropological Museology

University	Department Name	Degrees available	Does the University have archaeological collections?	Are collections accessible to researchers?	Does the program promote graduate study within collections?	Does the program offer courses in museum studies, curation or collections managment
University of Georgia	N/A, Interdisciplinary Certificate Program in Museum Studies	Available to grad and undergrad students in any dept.	Laboratory of Archaeology, Natural History Museum	yes	unclear, the Museum Studies certificate is not advertized on the ANTH department	yes, primarily through the internship portion of the Certificate
University of Illinois	Anthropology/Archaeology	BA, MA, PhD	yes, primarily at Spurlock Museum	yes	the collections are mentioned in the general description of the program so that seems like a yes	Sort of - lab methods and heritage management
University of Massachusetts - Amherst	Anthropology	BA, PhD	possibly opportunities through Archaeological Services (CRM)	not clear	no	no
University of Michigan	Anthropology/Museum Studies Program	BA/Minor in Mu St.; PhD/Certificate in Mus. St.	Museum of Anthropological Archaeology/Labs; Kelsey Museum of Archaeology	yes	yes	Yes, so many through Museum Studies Certificate (multiple departments), practicums/internships with museums all over the country
University of Missouri	Anthropology and Art History and Archaeology	BA/MA/PhD; Graduate minor in Museum Studies through AHA	Archaeological Collections at the Museum of Anthropology/Museum Support Center; Museum of Art and Archaeology	yes	Museum of Anthropology promoted in the "Research" section on the opening page of the Anth department website;	yes through AHA
University of Nevada - Reno	Anthropology	BA, MA, PhD, Museum Studies Minor	Anthropology Research Museum; Department labs	yes	yes	yes
University of New Mexico	Museum Studies (Interdiscplinary)	Undergad minor, certificate; Professional Certificate, Grad minor, MA, MS	Maxwell Museum of Anthropology	yes	Museum Studies does	yes
University of North Carolina - Chapel Hill	Anthropology/Curriculum in Archaeology	BA, MA, PhD	Research Labs in Archaeology	yes	sort of	no
University of Oklahoma	Anthropology/Museum Studies	BA, MA, PhD; MA in Museum Studies	Sam Noble Museum	yes	sort of	only through museum studies MA
University of Oregon	Anthropology	BA, MA/MS (non terminal), PhD	Museum of Natural and Cultural History	unclear	unclear	one course at the grad level
University of Pennsylvania	Anthropology	BA, MA (non terminal), PhD	Penn Museum of Archaeology and Anthropology	yes	seemingly not	2 at undergrad level
University of Pittsburg	Anthropology	BA, MA, PhD	Center for Comparative Archaeology	unclear	no	no
University of Sheffield	Archaeology	Undergrad and Graduate	unclear	unclear	no	no
University of Southern California	Anthropology	BA, PhD	Archaeological Research Center	unclear	unclear	no

University	Department Name	Degrees available	Does the University have archaeological collections?	Are collections accessible to researchers?	Does the program promote graduate study within collections?	Does the program offer courses in museum studies, curation or collections managment
University of Tennessee	Anthropology	BA. PhD	McClung Musuem, Archaeological Research Laboratory	yes	no	yes
University of Texas	Anthropology	BA, MA, PhD	Texas Archeological Research Lab	yes	yes	only at the undergrad level
University of Utah	Anthropology	BA, MA, MS, PhD	Natural History Museum of Utah	yes	no	no
University of Virginia	Anthropology	BA, MA, PhD	unclear	unclear	unclear	yes
University of Washington	Anthropology; Museology	BA, PhD; MA in Museology	Burke Museum	yes	not in Anth/yes in	in both ANTH and Museology
University of West Florida	Anthropology	BA, MA	Archaeology Institute	yes	no	no
University of Wisconsin - Madison	Anthropology	BA, PhD	Department Collections	yes	yes	yes
Washington State University	Anthropology	BA, MA, PhD	Museum of Anthropology/Archaeological Repository	yes	yes	no
Yale University	Anthropology	BA, MA, PhD	Peabody Museum of Natural History, Anthropology Division	yes	unclear	only one at the undergrad level

APPENDIX C

SANDAL DATA

AMIS #	UNIT	LENS	LENGTH (mm)	WIDTH AT TOE (mm)	WIDTH AT MIDLINE	WIDTH AT HEEL	FRAME TYPE	PADDING	TIES	SELVAGE	CONDITION
174	SURFACE		179.30	90.90	87.60	ND	OPPOSED?	STRIPPED LEAVES	N	N	FAIR; INCOMPLETE, WEFTS DETERIORATED
22975	N100 W100	6	220.60	77.40	93.20	63.10	BENT	LONGITUDINAL FIBERS THROUGH WEFTS	Y, TIED TOE PORTION, CROSSED ON TOP, NEW BUNDLES TIED IN AND KNOTTED AT ~36 mm FROM HEEL ON BOTH SIDES, KNOTTED TOGETHER TO CREATE HEEL LOOP	SELF	GOOD; MOSTLY COMPLETE
22976	N105 W105	55.4	82.50	31.70	32.30	16.40	OPPOSED	N	N	N	FAIR/GOOD, POWDERY RESIDUE PRESENT
22977	N90 W105	18	126.70	36.30	49.10	39.80	OPPOSED	N	N, ONE LOOSE FIBER LOOPED BUT NOT TIED NEAR TOE END	SELF	FAIR/GOOD; SOME WHITE RESIDUE ADHERED
23609			200.90	77.00	98.50	114.40	BIPARALLEL	MINIMAL, AT TOE PORTION	N		
23687	GEN PROV		209.00	75.10	90.80	ND	OPPOSED OR F	LONGITUDINAL FIBERS THROUGH WEFTS	N	SELF	FAIR; INCOMPLETE, MISSING HEEL PORTION
23688	N90 W100	2.1	215.50	66.10	83.30	ND	BIPARALLEL	LONGITUDINAL FIBERS THROUGH WEFTS	N	SELF	FAIR; INCOMPLETE, MISSING SECTION AT BALL OF FOOT, MISSING WEFTS AT HEEL
23689	N85 W100	38.8	140.80	ND	ND	94.90	BIPARALLEL?	LONGITUDINAL FIBERS THROUGH WEFTS	N	SELF	FAIR; INCOMPLETE, MISSING TOE PORTION
23690	N90 W105 &	4.6	124.60	116.70	ND	ND	BENT?	LONGITUDINAL FIBERS THROUGH WEFTS	N	SELF	FAIR; INCOMPLETE
23692	GEN PROV		190.70	75.20	77.90	ND	OPPOSED	LONGITUDINAL FIBERS THROUGH WEFTS	Y, INCOMPLETE	SELF	FAIR; QUITE COMPRESSED, MISSING HEEL PORTION
23693	N90 W105	37.6	251.20	84.00	98.00	ND	BENT	LONGITUDINAL FIBERS THROUGH WEFTS	N	SELF	FAIR, INCOMPLET; WORN AWAY AT THE MIDLINE AND HEEL, ADHERED DIRT
23694	N100 W95	J.4	223.50	79.30	95.90	ND	BIPARALLEL	LONGITUDINAL FIBERS THROUGH WEFTS	Y, SINCLE LEAF PIECE, LOOPED THROUGH AND CROSSED AT TOE, KNOTTED ON ONE SIDE. TIED W/ SQUARE KNOT AT HEEL	SELF	FAIR, INCOMPLETE; WORN AWAY AT HEEL END

AMIS #	UNIT	LENS	LENGTH (mm)	WIDTH AT TOE (mm)	WIDTH AT MIDLINE	WIDTH AT HEEL	FRAME TYPE	PADDING	TIES	SELVAGE	CONDITION
23695	GEN PROV		284.40	86.20	108.70	98.30	OPPOSED OR E	LONGITUDINAL FIBER W/O CORTEX	Y, TOE LOOP AT ~31 MM FROM EDGE, ONE LEAF LOOPED UNDER WEFTS, ENDS CROSSED TO MAKE LOOP, 2ND LEAF KNOTTED IN ON BOTH SIDES, TIED TO WARPS AT ~76 MM FROM HEEL EDGE. 3RD LEAF TIED IN AND KNOTTED AT THE BACK	SELF	FAIR; V DIRTY, WORN AWAY AT HEEL END
23696		T.4	143.50	78.00	ND	ND	BIPARALLEL?	LONGITUDINAL FIBERS THROUGH WEFTS (OPUNTIA FIBERS PRESENT)	N	SELF	FAIR; INCOMPLETE; MATRIX ADHERED TO ONE SURFACE, HOLDING IN ROCKS, PUPAE
23697			165.40	67.60	83.80	76.90	BIPARALLEL	LONGITUDINAL FIBERS W AND W/O CORTEX	Y, SINGLE LEAF FOR EACH SIDE. KNOT FOR TOE LOOP ON UNDERSIDE, LOOPS 28.1 MM FROM TOE END, CROSSED DIAGONALLY TO OPPOSITE SIDE AND TIED TO WARP AT 12 MM FROM HEEL END	SELF	FAIR/POOR; WHITE/GRAY RESIDUE AND MATRIX ADHERED, V DIRTY, POTENTIAL INSECT DAMAGE
23698			176.90	61.20	77.20	63.50	BIPARALLEL	N	N	SELF	FAIR; DIRTY, SOME INSECT DAMAGE
23699	N85 W100	H.6	174.10	81.10	81.00	75.10	UID	LONGITUDINAL FIBERS W AND W/O CORTEX	N	SELF	POOR, INCOMPLETE; V DIRTY, TERMITE DAMAGE, MISSING PORTION OF TOE SECTION
23750	N110 W110		118.60	ND	ND	ND	OPPOSED	LONGITUDINAL FIBERS THROUGH WEFTS	N	SELF	FAIR; INCOMPLETE, DIRTY, MISSING PORTION OF SIDE AND HEEL
23752	N100 W95	SURFACE	149.10	72.50	ND	ND	OPPOSED?	LONGITUDINAL FIBERS THROUGH WEFTS	REMNANT OF TOE LOOP AND KNOT	SELF	FAIR, INCOMPLETE; HEEL PORTION MISSING, VERY WORN ON BOTH SURFACES

AMIS #	UNIT	LENS	LENGTH (mm)	WIDTH AT TOE (mm)	WIDTH AT MIDLINE	WIDTH AT HEEL	FRAME TYPE	PADDING	TIES	SELVAGE	CONDITION
23753			143.00	ND	95.90	ND	UID	LONGITUDINAL FIBERS THROUGH WEFTS	N	SELF	POOR, INCOMPLETE; ONLY MIDDLE SECTION PRESENT, TERMITE DAMAGE
23754	N95 W105	17&18	197.60	90.30	ND	ND	OPPOSED	LONGITUDINAL FIBERS THROUGH WEFTS	Y, TOE LOOP PRESENT ON UNDERSIDE OF SANDAL, SMALL PORTION OF ONE SIDE ON TOP	SELF	FAIR, INCOMPLETE; TOE PORTION INTACT BUT MIDSECTION AND HEEL WORN AWAY
23755		W.2	156.00	ND	100.70	ND	UID (POSSIBLY BIPARRALEL)	LONGITUDINAL FIBERS THROUGH WEFTS	N	SELF	FAIR, INCOMPLETE; MATRIX ADHERED, MISSING TOE AND HEEL PORTIONS
23756	N90 W110	25.2	185.10	ND	87.60	ND	UID	LONGITUDINAL FIBERS THROUGH WEFTS	N	SELF	POOR, INCOMPLETE; MISSING PORTIONS ON SIDE AND HEEL END, TERMITE DAMAGE
23757	N95 W100	29.5	192.70	80.30	93.20	ND	BIPARALLEL	LONGITUDINAL FIBERS THROUGH WEFTS	ONE KNOT IN ASSOC. BUT NOT ATTACHED TO SANDAL	SELF	POOR, INCOMPLETE; MISSING PORTIONS OF HEEL
23758			122.30	ND	ND	80.40	BIPARALLEL ?	LONGITUDINAL FIBERS THROUGH WEFTS	N	UID	FAIR, INCOMPLETE; ORANGE RESIDUE ON ONE SIDE, MISSING HEEL AND TOE PORTIONS
23759	N95 W100		ND	ND	ND	ND	BIPARALLEL ?	N	N	SELF	POOR, FRAGMENTARY; MISSING LARGE SECTIONS
23762	N95 W105	22.17	228.30	106.20	101.20	ND	BIPARALLEL ?	LONGITUDINAL FIBERS W/O CORTEX	N	SELF	POOR, INCOMPLETE; MISSING PORTIONS AT HEEL AND TOE, TERMITE DAMAGE
23763	N95 W95	26.12	206.40	ND	98.70	ND	UID (POSSIBLY BENT OR OPPOSED)	LONGITUDINAL FIBERS W/O CORTEX	Y BUT NOT ATTACHED	SELF	FAIR, INCOMPLETE; LARGEPORTIONS OF HEEL AND TOE MISSING

AMIS #	UNIT	LENS	LENGTH (mm)	WIDTH AT TOE (mm)	WIDTH AT MIDLINE	WIDTH AT HEEL	FRAME TYPE	PADDING	TIES	SELVAGE	CONDITION
23765	N100 W95	B	205.30	79.00	ND	ND	BIPARALLEL	UID	SIMPLE OVERHAND KNOTS, SQUARE KNOT AT HEEL		POOR, INCOMPLETE; ONLY TOE PORTION REMAINS, PART OF WARPS AND TIES
23766	N95 W105	17&18	186.90	70.40	92.20	ND	UID	LONGITUDINAL FIBERS THROUGH WEFTS	Y, FRAG AT HEEL, NO KNOTS	SELF	FAIR, INCOMPLETE; MATRIX ATTACHED, BROKEN AT TOE, MISSING WEFTS AT HEEL
23767	GEN PROV		236.80	70.20	88.30	65.70	OPPOSED	LONGITUDINAL FIBERS W AND W/O CORTEX	Y, SM FRAG ON SIDE, LOOPED BUT NO KNOT, SEVERAL HOLES ALONE SIDE AND MIDLINE AT TOE		FAIR, INCOMPLETE; SMALL PORTION OF TOE MISSING
23770	N95 W100	17&18	210.70	85.50	94.70	ND	BIPARALLEL	LONGITUDINAL FIBERS W AND W/O CORTEX	Y, OVERHAND KNOT AT HEEL, BUT NOT TIED TO SANDAL	SEFL	FAIR, INCOMPLETE; SOME MATRIX ATTACHED, TERMITE DAMAGE
23771	GEN PROV		177.60	91.40	95.10	ND	BIPARALLEL	LONGITUDINAL STRIPPED FIBERS THROUGH WEFTS	N	SELF	FAIR, INCOMPLETE; MISSING HEEL END, SOME WHITE POWDERY RESIDUE
23772	N95 W100	22	242.10	83.10	104.00	95.20	BENT OR OPPOSED	LONGITUDINAL STRIPPED FIBERS THROUGH WEFTS	Y, TOE LOOP IS A SINGLE FIBER THREADED THROUGH WEFTS AT 19.7 MM FROM TOE END, CROSSED TO FORM LOOP, LEAVES LOOPED UNDER WARPS ON EACH SIDE (OVER/UNDER) AND TIED AT THE BACK	SELF	GOOD, COMPLETE
23773			197.60	80.70	98.10	95.10	OPPOSED?	LONGITUDINAL STRIPPED FIBERS THROUGH WEFTS	Y, TOE LOOP TIED ON UNDERSIDE WITH AN OVERHAND KNOT AT 23.4 MM FROM TOE END, CROSSED, THEN TIED WITH A SQUARE KNOT AT HEEL	SELF	FAIR, COMPLETE; ONE TOE LOOP BROKEN, SOME WHITE RESIDUE, INSECT DAMAGE
23774		H.22	ND	77.40	ND	ND	BIPARALLEL	VERY LITTLE PRESENT	N	SELF	POOR, INCOMPLETE: TERMITE DAMAGE, FRAGMENTED

AMIS #	UNIT	LENS	LENGTH (mm)	WIDTH AT TOE (mm)	WIDTH AT MIDLINE	WIDTH AT HEEL	FRAME TYPE	PADDING	TIES	SELVAGE	CONDITION
23775	N105 W100	3.8	ND	80.80	ND	ND	BENT? ONE WARP MISSING	LONGITUDINAL FIBERS THROUGH WEFTS	N	SELF	POOR, INCOMPLETE; ONLY TOE PORTION REMAINS
23776			212.00	86.80	102.60	96.30	OPPOSED	LONGITUDINAL STRIPPED FIBERS THROUGH WEFTS	Y, TOE LOOP B/W WEFTS AT 20 MM FROM TOE END, CROSSED AND TIED AT THE BACK WITH OVERHAND KNOT	SELF	FAIR, INCOMPLETE; HEEL PORTION MISSING, RIGHT WARP BROKEN FROM WEFTS, MATRIX RESIDUE
23777	N100 W100	SURFACE	151.20	87.10	ND	ND	BIPARALLEL	LONGITUDINAL FIBERS THROUGH WEFTS	Y, JUST TOE STRAP, LOOPED AROUND CENTRAL WARP FROM UNDERSIDE AND TIED WITH A SQUARE KNOT ON UPPER	SELF	FAIR, MISSING HEEL PORTION
23778	N95 W100	17	210.40	66.60	94.00	88.60	OPPOSED	LONGITUDINAL STRIPPED FIBERS THROUGH WEFTS	Y, SINGLE LEAF THREADED UNDER WARPS ON BOTH SIDES NEAR HEEL, BROUGHT AROUND SIDES TOWARD TOE, CROSSED, THREADED THROUGH AND TIED UNDERNEATH AT TOE END	SELF	GOOD, COMPLTE; SOME FRAYED FIBERS AT HEEL, RESIDUE AND DISCOLORATION
23779	N85 W110	Y.9	249.00	75.10	ND	ND	BIPARALLEL OR OPPOSED	LONGITUDINAL FIBERS W AND W/O CORTEX	N	SELF	FAIR, INCOMPLETE
23780	N100 W115	1.1	171.10	77.50	111.50	94.40	UID	LONGITUDINAL FIBERS W AND W/O CORTEX	N	SELF	POOR, INCOMPLETE?; V DIRTY, MATRIX ADHERED
23782	N90 W95	72.2	102.50	68.50	ND	ND	OPPOSED	LONGITUDINAL FIBERS W AND W/O CORTEX	REMNANT OF TOE LOOP, NO KNOTS	SELF	POOR, INCOMPLETE, ONLY TOE PORTION REMAINS
23785	N95 W100	17	185.40	ND	ND	ND	BIPARALLEL	LONGITUDINAL FIBERS W AND W/O CORTEX, SOME LEAF BASES INCLUDED	N	SELF	POOR, INCOMPLETE, TERMITE DAMAGE, WORN AT TOE, MISSING HEEL
23786	N90 W105	3.1	220.90	72.10	92.10	ND	BIPARALLEL	LONGITUDINAL FIBERS W AND W/O CORTEX	N	SELF	POOR, INCOMPLETE; TERMITE DAMAGE
23792	N90 W105	3.1	230.40	ND	ND	ND	BIPARALLEL	LONGITUDINAL FIBERS W/O CORTEX	N	SELF	POOR, INCOMPLETE
23795	N90 W95	103	138.40	67.20	63.80	55.00	OPPOSED	LONGITUDINAL FIBERS THROUGH WEFTS	N	SELF + SM KNOT AT HEEL CORNER	POOR, FRAGILE; TERMITE DAMAGE

AMIS #	UNIT	LENS	LENGTH (mm)	WIDTH AT TOE (mm)	WIDTH AT MIDLINE	WIDTH AT HEEL	FRAME TYPE	PADDING	TIES	SELVAGE	CONDITION
23775	N105 W100	3.8	ND	80.80	ND	ND	BENT? ONE WARP MISSING	LONGITUDINAL FIBERS THROUGH WEFTS	N	SELF	POOR, INCOMPLETE; ONLY TOE PORTION REMAINS
23776			212.00	86.80	102.60	96.30	OPPOSED	LONGITUDINAL STRIPPED FIBERS THROUGH WEFTS	Y, TOE LOOP B/W WEFTS AT 20 MM FROM TOE END, CROSSED AND TIED AT THE BACK WITH OVERHAND KNOT	SELF	FAIR, INCOMPLETE; HEEL PORTION MISSING, RIGHT WARP BROKEN FROM WEFTS, MATRIX RESIDUE
23777	N100 W100	SURFACE	151.20	87.10	ND	ND	BIPARALLEL	LONGITUDINAL FIBERS THROUGH WEFTS	Y, JUST TOE STRAP, LOOPED AROUND CENTRAL WARP FROM UNDERSIDE AND TIED WITH A SQUARE KNOT ON UPPER	SELF	FAIR, MISSING HEEL PORTION
23778	N95 W100	17	210.40	66.60	94.00	88.60	OPPOSED	LONGITUDINAL STRIPPED FIBERS THROUGH WEFTS	Y, SINGLE LEAF THREADED UNDER WARPS ON BOTH SIDES NEAR HEEL, BROUGHT AROUND SIDES TOWARD TOE, CROSSED, THREADED THROUGH AND TIED UNDERNEATH AT TOE END	SELF	GOOD, COMPLTE; SOME FRAYED FIBERS AT HEEL, RESIDUE AND DISCOLORATION
23779	N85 W110	Y.9	249.00	75.10	ND	ND	BIPARALLEL OR OPPOSED	LONGITUDINAL FIBERS W AND W/O CORTEX	N	SELF	FAIR, INCOMPLETE
23780	N100 W115	1.1	171.10	77.50	111.50	94.40	UID	LONGITUDINAL FIBERS W AND W/O CORTEX	N	SELF	POOR, INCOMPLETE?; V DIRTY, MATRIX ADHERED
23782	N90 W95	72.2	102.50	68.50	ND	ND	OPPOSED	LONGITUDINAL FIBERS W AND W/O CORTEX	REMNANT OF TOE LOOP, NO KNOTS	SELF	POOR, INCOMPLETE, ONLY TOE PORTION REMAINS
23785	N95 W100	17	185.40	ND	ND	ND	BIPARALLEL	LONGITUDINAL FIBERS W AND W/O CORTEX, SOME LEAF BASES INCLUDED	N	SELF	POOR, INCOMPLETE, TERMITE DAMAGE, WORN AT TOE, MISSING HEEL
23786	N90 W105	3.1	220.90	72.10	92.10	ND	BIPARALLEL	LONGITUDINAL FIBERS W AND W/O CORTEX	N	SELF	POOR, INCOMPLETE; TERMITE DAMAGE
23792	N90 W105	3.1	230.40	ND	ND	ND	BIPARALLEL	LONGITUDINAL FIBERS W/O CORTEX	N	SELF	POOR, INCOMPLETE
23795	N90 W95	103	138.40	67.20	63.80	55.00	OPPOSED	LONGITUDINAL FIBERS THROUGH WEFTS	N	SELF + SM KNOT AT HEEL CORNER	POOR, FRAGILE; TERMITE DAMAGE

AMIS #	UNIT	LENS	LENGTH (mm)	WIDTH AT TOE (mm)	WIDTH AT MIDLINE	WIDTH AT HEEL	FRAME TYPE	PADDING	TIES	SELVAGE	CONDITION
23870		G.23	36.30	26.00	ND	ND	opposed	N	N	self	FAIR/POOR, INCOMPLETE. BROWN RESIDUE ON WEFTS, WARP ON ONE SIDE MISSING, SOME INSECT DAMAGE
23871	N85 W95	33.9	73.9/57.2	19.00	32.30	28.50	OPPOSED OR BENT	N	N	WEFT STABILIZED WITH LONG. FIBERS ACROSS MIDLINE AND TIED WITH AN OVERHAND KNOT	FAIR/GOOD, MATRIX ADHERED, INSECT DAMAGE RESIDUE, SOME BREAKAGE OF FIBERS
23872		G.1	89.00	21.10	ND	ND	OPPOSED	N	N	N	FAIR/GOOD, INCOMPLETE; SOME DARK RESIDUE, FRAYED EDGES
23874	TP 12	1.7	116.10	47.50	48.70	ND	OPPOSED	N	N	UID	FAIR; SOME MATRIX RESIDUE, FRAYED EDGES
23875			59.90	31.60	33.40	31.30	OPPOSED	N	N	SELF	FAIR/POOR, INSECT DAMAGE ON ONE SIDE
23876	N105 W100	44A	32.50	ND	ND	ND	Opposed	N	N	N	FAIR, INCOMPLETE. WARPS MISSING.
23877		87.9	28.70	14.60	ND	ND	OPPOSED OR BENT	N	N	Self	POOR, INCOMPLETE. UNABLE TO DISCERN B/W WARP AND WEFT
23878	N105 W100	3	75.8/47.6	ND	ND	ND	Opposed	N	N	N	FAIR. SOME POWDERY RESIDUE, TOE END BROKEN OFF
23879	N90 W105	17&18	79/184.3	13.00	32.70	44.80	BENT	N	N	N	FAIR, SOME POWDERY RESIDUE, FIBER CORTEX BREAKING IN SOME PLACES
23880	N90 W105	26.3	118.10	29.30	44.80	44.10	OPPOSED	N	N	N	FAIR; MATRIX, DARK RESIDUE ON ONE SURFACE
23882	N95 W105	96.3	ND	ND	ND	ND	UID				V POOR, FRAGILE

AMIS #	UNIT	LENS	LENGTH (mm)	WIDTH AT TOE (mm)	WIDTH AT MIDLINE	WIDTH AT HEEL	FRAME TYPE	PADDING	TIES	SELVAGE	CONDITION
23883	NO PROV		40.10	23.70	ND	ND	OPPOSED	N	N	N	VERY FRAGILE, INCOMPLETE
23885	N105 W100		45.70	11.40	ND	ND	Bent	N	N	N	FAIR; POWDERY RESIDUE, FRAYED FIBERS AT HEEL END
23885	n105 W100		62.30	28.90	ND	ND	opposed	N	N	N	GOOD, INCOMPLETE; FIBERS BROKEN AT HEEL END
23888	N100 W100		62.70	ND	ND	ND	TWINED	N	N	Simple knot at heel	FAIR, FIBERS BROKEN AT TOE END
23894	N100 W100	9	ND	63.10	ND	ND	OPPOSED	LONGITUDINAL FIBERS	N	SELF	FAIR; INCOMPLETE
23954	GEN PROV		ND	ND	ND	ND	UID	LONGITUDINAL FIBERS W/O CORTEX	N	SELF	POOR; INCOMPLETE, WHITE RESIDUE, POSSIBLE INSECT DAMAGE
28861	GEN PROV		ND	ND	ND	ND	UID	LONGITUDINAL FIBERS W AND W/O CORTEX	N	SELF	POOR; INCOMPLETE, SPIDER WEBS ADHERED, BLACK RESIDUE ON SOME FIBERS
28862	N90 W105	1	ND	ND	ND	ND	UID	LONGITUDINAL FIBERS W AND W/O CORTEX	N	SELF	POOR; INCOMPLETE, MISSING BOTH ENDS, V DIRTY
28863			221.60	77.80	95.10	93.90	BIPARALLEL	LONGITUDINAL STRIPPED LEAVES	N	SELF	FAIR/POOR; WORN OUT HEEL, SLIGHTLY WORN AT TOE END, LOTS OF ADHERED MATRIX
38074	N90 W100	17	133.90	ND	ND	70.3?	UID	LONGITUDINAL FIBERS	Y, HEEL TIES: TWO SIMPLE KNOTS ON EITHER SIDE OF HEEL	SELF ON SIDES BUT MISSING AT HEEL AND TOE	FAIR; INCOMPLETE HEEL AND TOE PORTIONS MISSING
38105	N95 W100	3	49.00	23.90			opposed	N	N	Self	FAIR. WHITE RESIDUE ON SOME FIBERS
38105	N95 W100	3	50.60	16.00	21.20	24.50	OPPOSED	N	N	N	FAIR, WHITE RESIDUE ON SOME FIBERS

AMIS #	UNIT	LENS	LENGTH (mm)	WIDTH AT TOE (mm)	WIDTH AT MIDLINE	WIDTH AT HEEL	FRAME TYPE	PADDING	TIES	SELVAGE	CONDITION
38131	N90 W100	12	227.40	86.40	111.50	ND	OPPOSED OR BENT	LONGITUDINAL FIBERS	Y, TOE LOOP AT MIDLINE, SECURED W OVERHAND KNOT ON UNDERSIDE, SIDES TUCKED INTO WARPS THEN SECURED WITH SQUARE KNOT AT HEEL	SELF	FAIR; BROKEN HEEL
38133	N95 W105	4.1	123.00	35.20	56.90	59.30	OPPOSED	LONGITUDINAL FIBERS	N	SELF	GOOD/FAIR; ADHERED MATRIX, POWDERY RESIDUE, POSSIBLE INSECT DAMGE
38135	N95 W150 (1	2	142.00	44.10	66.30	54.80	BIPARALLEL	N	N	N	GOOD/FAIR; UNFINISHED, SOME POWDERY RESIDUE, FRAYED LEAF EDGES
48331	N105 W150 (105?)		243.10	ND	102.70	74.10	UID	LONGITUDINAL FIBER W/O CORTEX	N	N	FAIR; PADDING IS COMPRESSED