SHELTERS IN SPACE: A STUDY OF HOW ROCK SHELTERS AFFECT SETTLEMENT PATTERNS IN THE BIG BEND REGION OF TEXAS

by

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ABSTRACT

Settlement pattern studies are an important component of archaeological research, yet few studies have been undertaken for the Big Bend region of Texas. None have researched how sites are clustered around fixed geological features, such as rock shelters. This thesis was undertaken in an attempt to address this research issue.

Towards this end, 400 hectares of land in the eastern part of Brewster County were inspected by means of a 100 percent pedestrian survey. Thirty-three prehistoric sites were recorded in the sixteen surveyed quadrats, and 16 are rock shelters, seven are lithic procurement sites, six are open campsites, and four are lithic scatters. The sites, which could be dated using temporally diagnostic projectile points, ranged in age from the Middle Archaic to the Late Prehistoric.

The locational information of these sites was then analyzed using statistical and geospatial methods in order to determine if the location of open sites – lithic procurement sites, lithic scatters, and open campsites – are influenced by the presence of rock shelters. The statistical and geospatial analyses show a strong positive correlation between the location of rock shelters and the location of open sites. While a causal relationship cannot be proven, it is clear that open sites are located near rock shelter sites which are located in fixed geological features. This indicates that the prehistoric hunter-gatherers of the Big Bend chose to position their open sites in areas which were easy to access from a rock shelter.

I. INTRODUCTION

This thesis is concerned with settlement patterns in the Big Bend region of Texas. Settlement patterns studies are a rare research topic in this area, and the available information is limited in scope. The research for this thesis was undertaken in response to this lack of data, more specifically to better understand how the rock shelters, which are ubiquitous throughout the region, affect the locations of other kinds of archaeological sites archaeological sites.

The Big Bend region of Texas is a large expanse that is relatively poorly known archaeologically, especially when compared to surrounding regions in the United States. Most large scale archaeological investigations have focused on Big Bend National Park and Big Bend Ranch State Park, in western and southern Big Bend. The rest of the region, including the area around the research area (Figure 1.1), lacks detailed archaeological data.

Figure 1.1. Map of the Big Bend region showing Big Bend National Park, Big Bend Ranch State Park and survey area.

One of the largest archaeological surveys in the eastern Big Bend region was William Marmaduke's (1978a) Bear Creek survey; the report on this survey contains important information about settlement patterns. Marmaduke noted that site density for each time period seemed to increase throughout time and made the case that the two environmental zones he surveyed, the ridgeline and the valley, experienced alternating periods of utilization.

Other than this inferred increased site density through time, which also has been noted by later researchers (Mallouf 2005:230), little else has been done in terms of settlement patterns. It has been recorded that Late Prehistoric Cielo Complex sites tend to be located on hilltops (Mallouf 2013a:50), and that mountaintops were preferred ritual site locations (Mallouf 2005:235). These mountaintop ritual sites were common in the Late Prehistoric, but their roots may go back to the Late Archaic or even earlier. As for the Late Archaic, it has been recorded that sites of this age tend to be located in rock shelters and near springs and dry basin arroyo systems (Mallouf 2005:230-231). Other researchers have briefly noted that Middle Archaic sites tend to be clustered around springs and occasionally around rock shelters (Ohl 2011:82). Although not strictly a settlement pattern survey, a recent study hypothesized that certain sites were inhabited to take advantage of areas with high ecological variability within a day's forging distance (Riggs 2014:19).

Other inferences can be made by carefully reading survey reports from the Big Bend region. During a survey of a small area of Big Bend Ranch State Park, researchers noticed that open campsites exhibited strong clustering near large drainages (Ohl and Cloud 2001:73-74). Notably, no rock shelters were recorded on this survey. Another survey in Big Bend Ranch State Park, this time focusing on the Upper Fresno Canyon Rim, recorded the vast majority of the sites as being located in the foothills region (Sanchez 1999:43). A large scale survey of Big Bend Ranch State Park described the vast majority of open campsites as being located in the foothill region, less than 300 meters from a water source (Ing et al. 1999:80). The same report also noted that while most occupied rock shelter sites were located near water sources, some were located very far away from water and thus either other ecological resources or the rock shelter itself must have been more important than easy access to water (Ing et al. 1999:85).

The strong tendency for sites to be located near water is unsurprising, given the desert environment. It has been theorized that the hunter-gatherers in the Big Bend practiced mobility patterns which were tied to water sources (Taylor 1964). Other resources which might have tied prehistoric peoples to an area should also be considered. Patch-choice models state that resources are not evenly distributed on the landscape, and hunter-gatherers must balance the energy necessary to reach resource patches with the energy they will gain from exploiting them (Bettinger 1991:87-90). Central place foraging models take this a step further by taking into account the time necessary to reach these patches, exploit the resources, and then to return to the starting point (Bettinger 1991:93-97).

These optimal foraging theories can be considered in light of the previously mentioned data from the Big Bend. The tendency for sites to be located in the foothills, even in areas without easy access to water, can be understood as the inhabitants positioning themselves on the landscape in such a way that they can take advantage of several different resource patches from one central place. Foothills themselves are often areas with high densities of sotol and lechuguilla, important food resources. (Maxwell 1968:94). In the context of this research, rock shelters can be thought of either central places from which to forage, or, being areas of shade and cooler temperatures, as resource patches themselves. Whether rock shelters are convenient central places from which to forage or resources unto themselves, it stands to reason that these sites would have a strong effect on the local hunter-gatherer population.

Current Study

Due to a paucity of reported settlement patterning data in the Big Bend, especially concerned with the role of rock shelters, it was decided that an archaeological survey could help elucidate the spatial patterns in site distribution and provide a greater understanding to this understudied region. The survey was carried out as my MA thesis research project on the Stovall Ranch (Figure 1.2) in eastern Brewster County, a large commercial ranching property.

Figure 1.2. Location of Stovall Ranch Headquarters.

This ranching property was ideal, as several areas with multiple rock shelters and easy access were available to survey. Four hundred hectares, or roughly 988 acres, were surveyed over the course of six weeks in July and August 2015. Thirty-three prehistoric sites were recorded in the surveyed areas. The data from this survey, along with the data from the Marmaduke Bear Creek survey, were analyzed using statistical and geospatial GIS techniques to understand how rock shelters affect where prehistoric hunter-gatherers placed other sites on the landscape.

Organization of the Thesis

Chapter 2 communicates background information about the Big Bend region of Texas. Information about geology, climate, flora, and fauna are all discussed. Chapter 3 details the history of archaeological research, the culture history, and the material remains of the Big Bend. Chapter 4 describes the methodology involved in this research, including pre-field research, field methods, and analysis methods. Chapter 4 details the results of the research, first with a section that describes the sites found on the survey and then with sections on the results of statistical and geospatial analyses. Chapter 5 contains descriptions of the sites which were found on the survey. Chapter 6 details the results of the statistical and geospatial analyses. Chapter 7 is the discussion and conclusion chapter; this chapter discusses the issues and implications of the research related here. Appendix A contains additional information about the sites which were recorded on the survey.

II. GEOLOGY, CLIMATE, FLORA AND FAUNA OF THE BIG BEND

The Big Bend is a unique and complex area of Texas. Geologic processes have shaped a dramatic landscape while creating several resources, such as rock shelters and stone for tools, which are vital for human habitation. Lying within the Chihuahuan Desert, this is a hot, dry climate with little rainfall, generally mild winters, and harsh summers. Despite the desert environment, the area is host to diverse plant and animal species, both terrestrial and riverine. In this chapter, the geology and geoarchaeology of the region are discussed. Information about the climate, flora, and fauna is also summarized.

Geology

Many studies have been carried out in the geologically complex Big Bend region. Large scale geological surveys have been conducted in Big Bend National Park and Big Bend Ranch State Park. Exposed geological formations range in age from the Paleozoic to the Tertiary and from sedimentary to volcanic (Henry 1998; Turner et al. 2011). Faulting, folding, and erosion throughout the region contribute to the intricate geological formations that can be observed. Interbedded layers of hard and soft rock strata that erode at different rates create impressive stepped hillsides, often with hard igneous or limestone caps (Maxwell et al. 1967). This complex geology affects all aspects of life including the distribution of ecological resources, water, and shelter for human inhabitants.

Geologic History

Exposed rocks in the Big Bend region represent more than 500 million years of history (Henry 1998:2-3). Paleozoic features are exposed in several areas in the state and national parks; north of the parks in the Marathon Basin, remnants of the Ouachita

System which extends through Texas, Oklahoma, and Arkansas can be observed (Maxwell 1968:9-10). These deposits are sedimentary in nature and several, such as the Maravillas Formation and Caballos Novaculite, contain chert, an important resource for prehistoric peoples (Henry 1998:19). The late Paleozoic was a time of significant folding and faulting in the area.

There is an absence of Triassic and Jurassic rocks in the Big Bend, an unconformity due to intense erosion (Turner et al. 2011:68). The next major geological event in the Big Bend region was the deposition of massive amounts of Cretaceous age sedimentary rocks, formed while the area was covered by the Mesozoic Sea (Maxwell et al. 1967:28). Most of these Cretaceous formations are limestone, marl, sandstone, and shale. Several of the lithostratigraphic units of this age, such as the Del Carmen and Santa Elena Limestones, contain chert. These limestone formations are also important for their potential to contain caves and rock shelters, which were often used for human habitation.

In the late Cretaceous and the early Tertiary, an episode of folding and faulting called the Laramide orogeny affected most of western North America, including the Trans-Pecos region of Texas (Henry 1998:29). Two belts of folding occurred in this region. One belt runs along the Rio Grande from El Paso to Presidio, and the other runs through Big Bend National Park. This period of folding and faulting created many monoclines in the region, including the Mesa de Anguila and Sierra del Carmen-Santiago Mountains monoclines (Turner et al. 2011:52-56) in Big Bend National Park and the Fresno-Terlingua monocline (Henry 1998:30) in Big Bend Ranch State Park.

During the middle Tertiary, the Big Bend region was an area of volcanic activity. In Big Bend Ranch State Park one of the most impressive geological formations is the

Solitario, an igneous dome formed by uplifting, an eruption, and a caldera collapse (Henry 1998:39-40; Maxwell 1968:30). Also in the state park, the Bofecillos Mountains were entirely formed by at least six different volcanos that deposited basalt lavas, rhyolite lavas, and ash-flow tuffs. In the national park, igneous rocks are abundant in the Chisos Mountains (Maxwell et al. 1967:16), and there is evidence for volcanic eruptions at the Pine Canyon caldera, the Sierra Quemada dome, and Dominguez Mountain (Turner et al. 2011:58-60).

The late Tertiary was a period of basin-and-range faulting. Both the normal north-northwest faults and atypical east-west faults are present in the state park (Henry 1998:55), while most of the faults in the national park are of the normal north-northwest variety (Turner et al. 2011:62-66). Although the area is now considered to be tectonically stable, fault scarps less than one million years old have been found in the area. In addition, the largest recorded earthquake in Texas occurred in the Trans-Pecos in 1931 (Henry 1998:55).

Extensive erosion characterizes the Quaternary period (Turner et al. 2011:48). This erosion contributes to the many alluvial fan deposits which can be seen in the park, as well as the presence of large, multiple event landslides seen in Big Bend National Park; one landslide in the Santiago Mountains covers an area of a few square miles. There are areas of Quaternary sediment deposition, especially along the Rio Grande. These processes of erosion, down-cutting, and occasional aggradation have greatly contributed to the landscape in its current form.

Recent Geology

Unlike bedrock geology, the recent geology of the Big Bend area has not been well studied. While the recent geology is often mentioned, it is rarely a focus of investigations. Some investigations (Maxwell et al.1967; Maxwell 1968) barely touch on recent geology. Others (Turner et al. 2011) do study recent geological depositions in more detail, but still do little in terms of dating or detailed descriptions. Often, post-Tertiary depositions are limited to a few paragraphs of general description.

One early study into the recent geology of the Big Bend area is Kelley, Campbell, and Lehmer's (1940) *Association of Archaeological Materials with Geological Deposits in the Big Bend Region of Texas*. This report is one of the seminal works of the region. While its geoarchaeological importance will be discussed later, it does contain significant information about the Quaternary geology of the area. Kelley et al. (1940) based their observations and descriptions of allostratigraphic units on an article by Claude Albritton and Kirk Bryan about the Quaternary sediments of the Davis Mountains, published in 1939. Although Albritton and Bryan based their descriptions on sediments seen in the Davis Mountains, Kelley et al. (1940) applied the sequence to sediments they observed at buried sites throughout the Big Bend region. A later author (Marmaduke 1978b) stated that he also found these sediment layer identifications to be accurate in his investigations across the region.

Maps of Big Bend National Park and Big Bend Ranch State Park show that most recent Quaternary soils are alluvial soils, deposited near the Rio Grande and along the perennial creeks that crisscross the region (Henry 1998; Turner et al. 2011; United States Department of Agriculture, Natural Resources Conservation Service 2013). The alluvial deposits along river can be massive, with deposits from the last 20 years being over 3 meters in thickness (Turner et al. 2011:9). Colluvial soil deposits are the second most widespread in the area; they can occur as parts of massive landslides. Eolian deposits are much less widespread than the other types of soil and tend to be much thinner (Turner et al. 2011:9). Most Quaternary deposits in Big Bend National Park are older than the Holocene and Late Pleistocene, meaning they pre-date human occupation in the region (Turner et al. 2011:9-12).

Throughout the Big Bend region, basins formed at the end of the Tertiary (Henry 1998:55; Turner et al. 2011:62-66). These basins then filled with graben fill, a mix of sediments from the surrounding areas of higher elevation. These basins tend to fill with sediments during arid time periods (MacLeod 2002:31). In this area, there have been four major dry periods in the last twenty-five million years with the last one lasting from 1.5Ma to the present. In the basins that exist throughout the region, much of the basal sediments date back to the late Tertiary, but they are usually capped by alluvium from the Late Pleistocene to Holocene in age. A well drilled in the town of Alpine, located in the Alpine Basin, encountered a layer of alluvium 15m thick (MacLeod 2002:220).

A benchmark study for soils and sediments in the Big Bend region by Kelley et al. (1940) identified three allostratigraphic sediment and soil layers, separated by periods of erosion (Figure 2.1). The oldest of these layers, the Neville formation, was deposited during a period when the climate was wetter than in the present and contains remains of mammoths and ancient horses. The next oldest layer, the Calamity formation, contains only modern forms of fauna. The youngest layer is the Kokernot formation.

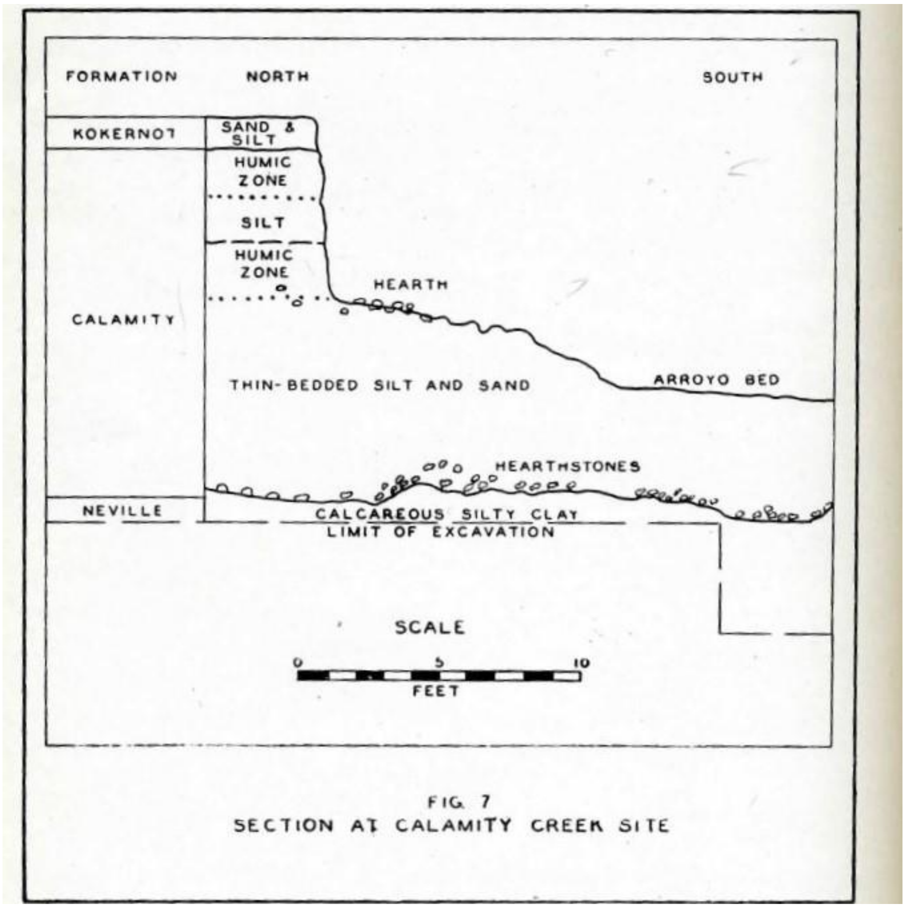

Figure 2.1. Relationship between Neville, Calamity, and Kokernot formations. Figure from Kelley et al. (1940:108)

The Neville formation is a series of discontinuous exposures of densely packed red-brown silt (Marmaduke 1978b:54). This formation has been dated to the Pleistocene based on the presence of megafauna remains (Kelley et al. 1940:51). However, it should be noted that parts of the Neville Formation are thought to date into the Miocene. The Neville lies on top of scoured bedrock and some deposits of this formation are up to six meters in depth (Marmaduke 1978b:56). After deposition of this formation ceased, the Neville formation was partially eroded away and carbonates built up in the sediment.

The Calamity formation is the next allostratigraphic unit and is the major unit of valley fill across the Big Bend region (Kelly et al. 1940:49; Marmaduke 1978b:54). This formation consists of interbedded layers of gravels and silt lenses, with occasional humic-stained silt wedges. While local silt and gravel beds in this formation can display considerable variation over a long distance, there are enough similarities in sediments to classify them as part of the Calamity formation (Marmaduke 1978b:54). Given the lack of megafauna remains in this layer, the beginnings of deposition of this formation date to the early Holocene at the earliest. The youngest layers of the Calamity contain hearths and Langtry dart points, dating the end of the Calamity formation to the Middle Archaic (Marmaduke 1978b:55).

Like the unconformity that exists between the Neville and the Calamity formations, an unconformity between the Calamity and the Kokernot represents a period of erosion. The Kokernot is described as a relatively thin layer when compared to the underlying Calamity (Marmaduke 1978b:55). Kokernot formation consists primarily of unconsolidated gravels and sands. Ensor dart points occur at the base of the Kokernot formation, dating the beginning of this unit to the Late/Transitional Archaic. Late Prehistoric materials occur in the top part of the Kokernot, and in some cases historic ranching debris are also embedded in this layer (Kelley et al. 1940:96). Marmaduke (1978b:64) believed that the Kokernot was the result of slope wash, not of fluvial processes.

Geoarchaeology

Formal geoarchaeological research in the Big Bend region is lacking. Geoarchaeology had a promising start in the area, when J. Charles Kelley, T.N. Campbell, and Donald Lehmer (1940) published a report about the association of archaeological materials with geological sediments. They looked at the three valley fill sediment layers – the Neville, the Calamity, and the Kokernot – identified by Claude Albritton and Kirk Bryan, and associated buried archaeological remains from a number of sites with their place in these allostratigraphic units.

Kelley et al. (1940:91) did not find any archaeological materials associated with the Neville formation, although given that it likely dates to the Pleistocene, it is possible that some early Paleoindian remains could be preserved in the formation. They did describe several sites which were contained in the Calamity formation. Kelley et al. (1940:91) described these sites as related to the Santiago Complex or Pecos River Focus - today they would be described as Middle Archaic sites. As for the Kokernot formation, at at least one site the authors believed that it was associated with an historic ranching complex, as they saw faunal bones embedded in the formation which they believed were from cows (Kelley et al. 1940:96).

The report is considered a seminal work for the area for several reasons. First, the authors were among the first to recognize the potential for deeply buried archaeological sites in the Big Bend. They were not even convinced that this was possible at first, until persistent landowners got them to take a second look at materials eroding from the walls of an arroyo (Kelley et al. 1940:42-43). This work also showed the importance of the cooperation and interest of private landowners is in an area where there is so little public land on which to conduct research. Lastly, looking for cultural material eroding outward from arroyo walls is a method still used to find deeply buried sites, some seventy years later (Mallouf 2005:236).

Another important geoarchaeological contribution of this report is that it can help explain the lack of Paleoindian and Early Archaic sites in the region. While some have taken the lack of these early sites in comparison with the number of Late Archaic and Late Prehistoric sites to mean than there must have been a population explosion in the Middle Archaic (Ing et al. 1996:26), this might not have been the case. If these early sites are contained in the Neville and lower Calamity formations, they are unlikely to be discovered, especially given that the usual survey method in the area is pedestrian surface survey (e.g. Ing et al 1996:73-78; Sanchez 1999:39-40; Ohl and Cloud 2001: 38-39). It is also worth noting that the Neville and Calamity are separated by an erosional unconformity; Paleoindian and Early Archaic sites might have been eroded away.

Importance of Geology and Geoarchaeology

The complex geology of the Big Bend is important for archaeological research in the area for many reasons. Geology can influence the distribution of plants and animals; it can also direct the movement of people through the landscape (Waters 1992:12). Geology also influences the movement and availability of water on the landscape. In an area of interbedded less permeable igneous rocks and more permeable sedimentary rocks, the sedimentary rocks can act as aquifers while the igneous rocks act as aquitards. Where erosion has cut into these interbedded strata, springs are often present in areas where the aquifer layers are exposed. This phenomenon is well documented in the Bofecillos Mountains of Big Bend Ranch State Park (Henry 1998:66). Impermeable rock formations exposed on the surface also dictates the possibility of *tinajas*, pools of standing water left after rainfall.

Geology can also provide direct resources for humans. Several formations, mainly the limestone formations from the Cretaceous and Paleozoic, contain chert which provides varied resources for chipped stone tools (Turner et al. 2011:18-20). A wide ranging archaeological survey of Big Bend Ranch State Park mentions the abundant, if wildly varying in quality, cherts, rhyolite, and agates available in the area (Ing et al. 1996:89); other archaeological reports from the area agree (Ohl and Cloud 2001:48; Sanchez 1999:48). The Ing et al. (1996:84-85) report also points out the abundance of rock shelters in the area, in both sedimentary and volcanic formations. These rock shelters are of course places of shelter and shade in the sweltering Chihuahuan Desert. It has been suggested that Archaic populations in particular utilized rock shelters particularly intensively (Mallouf 1981:137).

As for geoarchaeology, the level of preservation of artifacts within sites can vary greatly across the region. Chipped stone and ground stone artifacts and burned rock are all fairly indestructible and will not decompose at a site within the time frame of human occupation in the Americas, although they can be washed away. Charcoal which might have been associated with burned rock features is more likely to be preserved in a buried context. Rock shelters often have buried deposits which can preserve this important source of radiometric dating and botanical information, but the complexity of rock shelter deposits creates its own problems (Goldburg and Macphail 2006:169). Charcoal can also be preserved at open sites in a buried context, but relatively few open sites have been excavated in the region. As for perishable artifacts such as matting, grass pits, sandals, and wood artifacts, they virtually only survive in rock shelters, and whether they will be preserved in any particular shelter is never a certainty (see Kelly 1963; Kelly and Smith 1963).

The preservation of sites themselves in the Big Bend region is also subject to complex forces. While rock shelter sites seem fairly stable, they should not be thought of as unfailingly pristine. Deposits within the shelters can be washed out. Ancient inhabitants of these spaces damaged or destroyed earlier deposits while making pits and earth ovens. Open sites, if they are not buried, are archaeologically highly visible, but the earlier sites are likely to have been destroyed by processes such as sheet-wash or landslides. Buried sites seems like they would be well preserved, but the formation and expansion of arroyos can destroy even deeply buried sites. It is also important to note that there are two known periods of major erosional activity that could affect the survival of archaeological sites – one between the Neville and Calamity formations, the other between the Calamity and Kokernot formations. These erosional periods can create palimpsest surface sites, which are common in the region.

Climate

Today, most of the Big Bend region is classified as subtropical arid, with a few higher elevation areas classified as mountain climates (Larkin and Bomar 1983:2). Modern temperatures in the Big Bend Region vary little year to year; annual and diurnal temperature ranges are fairly wide (Schmidt 1986:44-45). As is expected for a desert region, rainfall throughout the year is generally low, with most rainfall occurring in the late spring and summer months, with occasional winter snowfalls which are more common at higher elevations. The highest average temperatures are in May and June, while the lowest are in January (Larkin and Bomar 1983). The average annual low ranges from 50-55 degrees F, and the average annual high is over 80 degrees F. The wind blows constantly, with some incredibly strong gusts.

Flora and Fauna

All of the Big Bend region lies within the Chihuahuan Desert, and the flora and fauna of the area are diverse. The plant communities range from various desert scrub communities to montane woodland communities at higher elevations (Henrickson and Johnston 1986:20). These different vegetation communities grade into each other, based on geology and elevation. Of course, the vegetation of an area affects the fauna that are also present in the region.

Flora

The Big Bend has incredibly diverse vegetation. The region contains multiple ecological zones, which can be divided by elevation as well as vegetation (Wauer and Fleming 2002:21-22). At eighteen hundred to four thousand feet in elevation is the River Floodplain – Arroyo Formation. It is related to the Rio Grande and its tributaries. The plants here are mostly broadleaf trees and shrubs, with very thick vegetation. The Shrub Desert Formation lies at eighteen hundred to thirty-five hundred feet in elevation. Vegetation is sparse, with succulents and semi-succulents dominating (Wauer and Fleming 2002:22).

The third major vegetation zone is the Sotol – Grassland Formation, from thirty-two hundred to fifty-five hundred feet in elevation (Wauer and Fleming 2002:24). The plants of the Shrub Desert Formation continue into this zone, now with the addition of grasses. The Woodland Formation occurs at thirty-seven hundred to seventy-eight hundred feet in elevation. This high elevation vegetation zone contains broadleaf and coniferous trees. The rarest vegetation zone is the Moist Chisos Woodland Formation, which lies at a similar elevation to the Woodland Formation (Wauer and Fleming

2002:25). It consists of high elevation canyons with forest edge type vegetation. The Shrub Desert Formation and the Sotol- Grassland Formation, when taken together, comprise the vast majority of the Big Bend region.

Trees and Shrubs. Even in the Chihuahuan Desert, several species of trees flourish. Several Cottonwood species live near sources of water (Wauer and Fleming 2002:26-27). Honey Mesquite (*Prosopis glandulosa*) is widespread throughout the area. At high elevations, pines, junipers, and oaks are abundant (Wauer and Fleming 2002:39-44). Shrubs are also common throughout the region. Creosote Bush (*Larria tridentate*), locally called greasewood and Ocotillo (*Fouquieria splendens*) dot the landscape (Wauer and Fleming 2002:32-33). Various yuccas exist in the area. In historic times, the candelilla plant was used for wax production (Maxwell 1968:95-99). Not only is the plant widely availible throughout the area; the production vats and large mounds of ash that are the remains of these wax production operations are visible throughout the region (Tunnell 1981).

Two prehistorically important food resources that are very widespread in the area are sotol and lechuguilla (Maxwell 1968:94). Lechuguilla (*Agave lechuguilla*) can be found from the lowlands up into the mountains. It even thrives on the southward facing hillslopes, which offer little protection from the summer sun (Wauer and Fleming 2002:30-31). Sotol occurs most frequently in the desert foothills. These two plants can be roasted in earth ovens and consumed, making them widespread and easily accessible food items. Dry rock shelters from the region preserve the remains of these plants in a cultural context, showing their use by the hunter-gatherers in the region (Mallouf 2005:237).

Cacti. Over sixty types of cacti occur in Big Bend National Park alone, with even more occurring in the general Big Bend region (Wauer and Fleming 2002:65). Several species of prickly pear occur throughout the area, including the very common Englemann Prickly Pear (*Opuntia engelmannii*) and Blind Prickly Pear (*Opuntia rufida*), a rare example of a cactus without obvious spines (Wauer and Fleming 2002:67-69). The Strawberry Cactus (*Echinocereus stramineus*), sometimes called pitaya, is prolific in the desert lowlands; the fruit which occasionally grows on this cactus is a desert delicacy (Wauer and Fleming 2002:72). Other cacti in the area include various pitayas, chollas, and the odd Living Rock (*Ariocarpus fissuratus*) which only occurs in Northern Mexico, and north into Texas as far as Alpine.

Fauna

The Big Bend area is home to diverse animal species, ranging from the fish in the Rio Grande to the Carmen Mountains White-Tailed Deer (*Odocoileus virginianus carminis*), a species of deer only seen in the mountain woodlands. The exact animal species which live in the area are in a state of flux, as species which were removed from the area in the 1940s and 1950s are reappearing, either by natural means or though human intervention (Wauer and Fleming 2002:81). Nonnative species which have been introduced by ranchers in the area have also spread through the region.

Mammals. One of the most widespread mammals in the area is the Javelina (*Pecari tajacu*) also called Collared Peccary (Wauer and Fleming 2002:79-80). This animal, although it looks like a pig, is an ungulate. The other ungulates that live in the area are the Carmen Mountains White-tailed Deer, Mule Deer (*Odocoileus hemionus*), Pronghorn (*Antilocarpa americana*), and Desert Bighorn Sheep (*Ovis canadensis*)

(Wauer and Fleming 2002:80-81). There are several carnivores indigenous to this region. The Mountain Lion (*Puma concolor*) is the best known carnivore, with several places in Big Bend National Park named after the panthers (Wauer and Fleming 2002:81-82). Another species of cat which can be found in the region is the Bobcat (*Lynx rufus*). Black Bears (*Ursus americanus*), coyotes (*Canis latrans*), badgers (*Taxadia taxus*) and several species of fox are other carnivores which live in the area (Wauer and Fleming 2002:82-84).

Several species of skunks, rats, and mice make the various ecological zones of the region their home. Porcupines (*Erethizon dorsatum*) are found from the desert lowlands into the mountains (Wauer and Fleming 2002:85). In the lowlands, Black-tailed Jackrabbits (*Lepus californicus*) and the Desert Cottontail (*Sylvilagus audubonii*) are common, while the Eastern Cottontail (*Sylvilagus floridanus*) resides in the mountains (Wauer and Fleming 2002:85). Gophers and ground squirrels can also be found in the desert lowlands. In addition, nineteen species of bats have been recorded in Big Bend National Park.

Reptiles, Amphibians, and Fish. The Big Bend is home to many different reptiles (Wauer and Fleming 2002). Geckos and other lizards are prolific. Snakes are found all over the region, and are incredibly diverse. Most are harmless, but there are six recorded venomous snakes. Five are different species of rattlesnakes; the sixth is the Trans-Pecos Copperhead (*Agkistrodon contortrix pictigaster*) and is found primarily near water (Wauer and Fleming 2002:110-111). Riverine animal species include several species of turtles and fish. Blue catfish (*Ictalurus furcatus*), Channel catfish (*Ictalurus punctatus*), and Flathead catfish (*Pylodictis olivaris*) are the most common large fish species.

Longnose Gar (*Lepisosteus osseus*) are also found in the Rio Grande (Wauer and Fleming 2002:112). Many other small species of fish are also present in the waterways in the area.

Past Climates and Environments

Using information obtained from plant remains preserved in packrat middens, past climate data for the Chihuahuan Desert can be reconstructed (Van Devender 1986). It was determined that the climate of the northern Chihuahuan Desert has shifted from a more mesic environment dominated by pinyon pine, juniper, and oak woodlands to a transitional xeric woodland environment. In the Pleistocene, spruce and pine woodlands were present throughout west Texas; a mean July temperature of 21°C for parts of this region is inferred from the presence of these trees (Bryant 1974:13). Although the Pleistocene climate was certainly cooler and wetter than in the Holocene, there is evidence for certain xerophytic plants, including sotol, existing in the region alongside the woodland plant species (Wells 1974:70-71).

The transition of the Pleistocene to the Holocene was a period were the climate became warmer and drier. These changes are evidenced by plant remains and the presence of carbonates in the Calamity formation that indicate increased evaporation rates after 11,500BP (Marmaduke 1978b:62-63; Van Devender et al. 1974:112-113; Wells 1974:81-82). The middle Holocene was a period of grassland desert-scrub that transitioned to a more xeric environment dominated by desert-scrub within the last four thousand years. Water from springs and seeps was more abundant in the past than it is now; water courses were likely more heavily wooded with more diverse vegetation (Mallouf 1981:132). The desert is at its largest expanse today.

III. ARCHAEOLOGY OF THE BIG BEND REGION

The archaeology of the Big Bend region is explored in several sections of this chapter. First, the history of archaeological work in the area is briefly reviewed. Then the prehistoric culture history of the area is discussed. Next, the material remains, including site types, which can be found in the region, are summarized. Lastly, an overview of archaeological work in the study area is reviewed.

History of Archaeological Research

The recorded archaeology of the Big Bend region remains fairly limited in scope in comparison to other areas of Texas, especially when compared to the two adjoining regions: far west Texas (Miller and Kenmotsu 2004) and the Lower Pecos region (Turpin 2004). Although the history of archaeological exploration in the area dates back to the 1920s, many early excavations focused on rock shelters to the neglect of other types of sites (Bousman and Rohrt 1974:19-20). In addition, early archaeological efforts were not as scientifically controlled or as thoroughly documented and recorded as they would be now (Cook 1932; Seltzer 1935). Thus, while it is usually known from which sites certain artifacts in museums originated from, their exact stratigraphic context has been lost.

One of the first archaeological reports to come out of the Big Bend region was Edwin Coffin's (1932) report on excavations rock shelter, 41BS8, in Bee Cave Canyon in Brewster County. The report does describe the more unusual artifacts, such as the perishable materials and some painted stones, and contains maps with features which were encountered during the excavations. Another early researcher in the area, Seltzer (1935), wrote several pages of detailed artifact descriptions for the perishable artifacts found at another rock shelter in Brewster County and briefly described the lithic and faunal remains.

Some large scale surveys and scientific excavations did take place in the region during these early years of research. An archaeological survey on the land that was to become Big Bend National Park was completed in the 1930s. Unfortunately, many of the artifacts and records were lost in a fire, but one report survives (Cook 1937). 102 open sites, 10 caves, and 28 rock shelters were recorded and described. Unfortunately the descriptions are brief and there are no maps with which those sites can be located today, although an attempt at relocation was later made during another survey of the park (Bousman, personal communication 2016).

During excavation of a rock shelter near Alpine, Victor J. Smith (1938) carefully recorded the depths and positions of artifacts and studied and described all the artifact categories. Victor J. Smith was an archaeologist who worked extensively in the Big Bend region (see Smith 1927, 1928, 1931, 1932, 1933, 1936, 1938, 1940, 1941, 1942). When he was associated with the Museum of the Big Bend in the 1920s and 1930s, he directed several excavations, mostly focused in rock shelter sites (Tunnell 1992). In addition to excavations that were carefully recorded, Smith extensively documented rock art in the region, although the locational information of these sites has been lost (Lowrance 1998:118). Smith was also a mentor to J. Charles Kelley, another archaeologist who worked extensively in the Big Bend. Kelley wrote extensively about the La Junta area (Kelley 1951, 1952, 1953, 1986).

A landmark works for this region, mentioned in the previous chapter, was by Kelley et al. (1940). In this report, the authors describe the regional cultural phases and attempted to correlate these phases with geological deposits. The descriptions for the cultural phases are impressive, with lists of material culture traits and site types for these phases. The names Kelley et al. (1940) used for the cultural periods (e.g. Livermore focus, Bravo Valley aspect, La Junta focus) are still in use to some extent today (Ohl and Cloud 2001:28-32); this report stands as a more scientific and multidisciplinary approach to archaeological research than had been attempted before in the area. This recognition of broad soil types and the ways in which different sites can be related to one another and grouped together makes for a truly impressive report, even by today's standards.

A large, two-season survey was undertaken at Big Bend National Park by Tom Campbell (1970) recording 351 sites, but unfortunately the maps with plotted site locations has been lost (Bousman, personal communication, 2016). Bousman and Rhort (1974) undertook an evaluation of the archaeological work at Big Bend National Park, but most work in the region continued sporadically, with surveys (Mallouf and Tunnell 1977) and small scale excavations (Baskin 1978; Marmaduke 1978a) being the norm. These projects were mostly focused on Big Bend National Park or around various construction projects. The reports from the 1970s and 1980s also vary widely in quality, from the much more thorough (Baskin 1978; Mallouf and Tunnell 1977; Marmaduke 1978a) to reports which are much more limited in scope (McCullough et al. 1993; Warren 1992). This approach changed with the establishment of the Center for Big Bend Studies by Sul Ross State University in 1987.

The Center for Big Bend Studies has conducted most of the large projects in the Big Bend region since its foundation in 1987. One of the largest projects was the partial survey of Big Bend Ranch State Park, completed in 1994 (Ing et al. 1996). The reconnaissance recorded 179 sites. These sites include quarries, rock shelters, and an historic mercury mine. Since the reconnaissance of Big Bend Ranch State Park, the Center for Big Bend studies has completed and reported numerous surveys (Ohl and Cloud 2001; Sanchez 1999) and excavations (Cloud 2001; Cloud and Piehl 2008; Mallouf et al. 2006; Seebach 2007). They are currently finalizing a report on the largest archaeological survey ever conducted in the region, completed in Big Bend National Park (Cason and Keller 2012).

Despite these recent efforts, the Big Bend Region remains a little researched area, especially for certain time periods. When compared to the adjacent El Paso and Lower Pecos regions, the eastern Trans-Pecos region is very poorly understood (Miller and Kenmotsu 2004; Turpin 2004). This is partially due the dearth of recent, large, scientifically controlled excavations. The early excavations focused on rock shelters in order to find museum worthy artifacts, and did not practice rigorous scientific controls. The lack of syntheses of known information for both the region in general and the different time periods specifically has hurt efforts to spread information about the area to other archaeologists (Ohl 2012). Lastly, looting of archaeological sites was and remains a huge problem.

Looting in the region is prolific. Even the early reports from the area note vandalism of sites (Reed 1936:61). More recent reports from the area usually state that the ground surface is remarkably lacking in diagnostic tool types (Carpenter 2001:17; Sanchez 1999:43). Studies that focus on projectile points often have to study private collections in order to gather information on types that are rare in the region, such as Paleoindian points (Gray 2013; Mallouf 2013b). Surface remains are not the only sites vulnerable to looting. Caves and rock shelters are especially susceptible to the nonscientific digging of looters (Piehl 2009:10,16). The museum collections in the region are filled with artifacts, some of them unique perishable artifacts and skeletal remains, which were collected by looters (Mallouf 2005:225-226).

Culture History

The cultural history of the Big Bend is divided into the Paleoindian, Archaic, Late Prehistoric, Protohistoric, and Historic periods. The Paleoindian period is divided into the early and late periods, while the Archaic is divided into early, middle, and late periods. Kelley et al. (1940) did not use these terms, but they did describe several cultural aspects and phases within the Midwestern system of taxonomy (McKern 1939), then called foci. Most of these cultural groups (e.g. Pecos River focus, Livermore focus, La Junta focus) are from the Late Archaic and Late Prehistoric. Although the terms that Kelley et al. (1940) coined are still in use (Cloud and Piehl 2008:17-28) today, many reports from the area use the more generalized terms of Middle Archaic or Late Archaic. While Late Prehistoric sites are often defined by this generalized term, La Junta phase and Cielo Complex sites are often classified by these more specific terms; this is due at least in part to the highly distinctive cultural assemblages that are present at these sites (Mallouf 2013a).

Paleoindian

Paleoindian remains are rare throughout the Big Bend region. Even inspections of projectile points in private collections from the region yield few Paleoindian points and virtually all are from the late Paleoindian period (Gray 2013:15). Few Paleoindian sites have been found, and it is speculated that this is due to the depths these sites are likely to be buried (Mallouf 1986:70). Recently, two late Paleoindian sites have been excavated near Alpine (Cloud 2012; Mallouf 2012; Walter and Cloud 2014). Besides their potential to shed light on a little known time period of the region, these sites are particularly interesting for a different reason. Both the Genevieve Lykes Duncan site and the Searcher site, located within three miles of each other, show evidence for the use of hot rock cooking features, something unusual for the Paleoindian period. The earliest reported date for the Genevieve Lykes Duncan site is 9480±40 B.P. (Walter and Cloud 2014:8). The earliest feature at the Searcher site dates to 7280-7050 B.C. (Mallouf 2012:3). The Genevieve Lykes Duncan site, the oldest recorded site in Brewster County, also reportedly contained metate fragments (Cloud 2012:2). This is also unusual, as the use of ground stone is not typical for the Paleoindian period. These sites are also interesting in that they give evidence for the theory that the eastern Big Bend may have been the site for the earliest transition from Paleoindian to Archaic hunter-gatherer lifestyles in Texas (Mallouf 1981:12). Another site with a Paleoindian component, located in the Chisos Basin in Big Bend National Park, dated to 8890±90 B.P. (Alex 1999:10).

Early Archaic

Like the preceding Paleoindian period, the Early Archaic is not well known in the region. The same studies of projectile points in private collections reveal a similar lack of Early Archaic points (Gray 2013:15). This might indicate that Early Archaic deposits are deeply buried, although the lack of data about this time period has been noted as being unusual (Mallouf 1986:71). In general, the Early Archaic is characterized by an increasing reliance on plant resources that required processing to be edible (Miller and Kenmotsu 2004:221). Thus, there is a corresponding increase in the use of earth ovens and grinding stones. In addition, the Early Archaic also marks the transition from the lanceolate-shaped projectile points to stemmed points. Despite the general lack of information from the Early Archaic, it seems clear that it was during this period the Archaic hunter-gatherer lifestyle for the region was developed. Nine sites from the Big Bend region have been dated to the Early Archaic, with dates ranging from 7750-7580 B.P. to 5290-4850 B.P. (Boren 2012:109).

Middle Archaic

The Middle Archaic is analogous to what Kelley et al. (1940:24-27) called the Pecos River focus of the Big Bend Cave aspect. This time period of the Big Bend region is not well understood; however, it is better represented than the Early Archaic and Paleoindian periods. Despite the general lack of data, it seems to be apparent that the Middle Archaic represents a period of increasing population due to increasing numbers of sites, as well as the exploitation of a wide range of environmental zones (Sanchez 1999:33-34). Although the Middle Archaic groups might have utilized a wide range of environments, there was a definite preference for the foothills (Ohl 2006:15). This is likely related to an increased reliance on desert succulents. Contracting stem dart points are the typical projectile point for this time period.

Three recently investigated sites have shed some light on the Middle Archaic. The Paradise site is an open campsite located in an upland basin at the head of Terlingua Creek in the southern Davis Mountains (Ohl 2006). The site contains the remains of an earth oven which was not heavily used, and a lithic reduction area located adjacent to the earth oven feature. This earth oven dating to 3950 B.P. was used a limited number of times which has suggested that this site was a temporary base camp and that the preparation of succulents was a supplemental activity to hunting.

The Rosillo Peak site is a mountaintop site located in the Rosillos Mountains, utilized in the Early Archaic and then more substantially in the Middle Archaic (Mallouf et al. 2006). The site is located on a flat area at the top of the mountain, near a saddle. The site commands an impressive view of the surrounding area. The view is not the only interesting aspect of the Rosillo Peak site; it lacks features, cooking or otherwise, and the artifact assemblage is dominated by projectile points. The commanding view, lack of features, and the prolific projectile points have been taken as evidence that the Rosillo Peak site was a ritual site (Mallouf et al. 2006:130; Ohl 2011:85). Another Middle Archaic site with possible ritual ties is the Lizard Hill Cache, located in the lowlands of the Chihuahuan Desert (Ohl 2011:85-86). The site consists of a v-shaped alignment of stones and a small cairn on the side of a hill which marked a cache; the cache consisted primarily of contracting stem dart points.

These three sites have added substantially to the understanding of the Middle Archaic in the region. It is clear that the roots of earth oven cooking could stretch back to the Late Paleoindian period in the Big Bend and the Paradise site shows that during the Middle Archaic period the exploitation of dessert succulents was becoming a large-scale strategy (Ohl 2006:15). The Rosillo Peak site and the Lizard Hill Cache also both show the ritual behaviors seen in the Late Prehistoric have their roots in the Middle Archaic (Mallouf et al. 2006:130).

Late Archaic

The Late Archaic is better represented in the archaeological record than the earlier time periods for this region. This time period corresponds with what Kelley et al. (1940:27-29) called the Chisos focus of the Big Bend Cave aspect. Buried deposits from the Late Archaic have been dated from 2500 to 1300 B.P. (Mallouf 2005:226). In general this time period was characterized by increasing population that necessitated the utilization of wide range of economic zones. The climate was characterized by a shift towards more mesic conditions, before a more xeric climate was retrenched during the latter part of the Late Archaic. In terms of projectile points, the contracting stem points of the Middle Archaic are replaced by a wide variety of points, ranging from side-notched to parallel stemmed dart points. Although Late Archaic people certainly exploited desert succulents, the variety and density of Late Archaic dart points suggests that they also heavily focused on hunting (Mallouf 2005:238).

Despite the discovery of Late Archaic sites from rock shelters near the Rio Grande (Mallouf and Tunnell 1977) to the tops of mountains (Mallouf et al. 2006) and the widespread and highly archaeologically visible remains of earth ovens, the Late Archaic remains poorly defined. This seems unusual at first, considering the incredible site density for the region (Mallouf 2005:230). It is more understandable when it is taken into account that Late Archaic people heavily utilized rock shelters. Many of these huge deposits of Late Archaic material were excavated in the early days of archaeological research in the area and the scientific data from these excavations are minimal. In general, the Late Archaic is thought to represent a period of long-lived adaptations to life in the desert, with an increased focus on desert succulents in response to population pressures and the increasingly xeric environment in the latter part of the time period (Ohl and Cloud 2001:27-28).

Late Prehistoric

The Late Prehistoric period has been more heavily researched and defined than earlier time periods. This is primarily due to the interest in the La Junta region and the Cielo Complex (Ing et al. 1996:26-27). In addition, the Late Prehistoric was a time of cultural change, making it easier to recognize archaeologically without having to utilize temporally diagnostic projectile points. This time period marked the beginnings of agriculture in the region, the introduction of the bow and arrow, and the increased significance of ritual sites (Mallouf 2005:235). While there is some evidence for the origin for several of these traits in the Late Archaic, it is in the Late Prehistoric when these cultural patterns fully developed.

The earliest Late Prehistoric cultural phase is the Livermore phase (900-1200 A.D.) (Seebach 2007:8). Unfortunately, this cultural phase has remained poorly known since it was defined by Kelley et al. (1940:30). This mobile hunter-gatherer group is characterized by several arrow point types, including the Livermore point, and beveled knifes. While it was originally hypothesized (Kelley et al. 1940:162-163) that the Livermore phase originated from outside the Big Bend region, recent opinion is that it could have originated among the people native to the area (Cloud 2001:23). In either case, while the evidence for the Livermore phase is known throughout the Big Bend, it is most heavily represented in the area around the Davis Mountains. This in unsurprising, given that the Livermore Cache which contained over one thousand Livermore arrow points was found on Mt. Livermore in the Davis Mountains (Kelley et al. 1940:30).

The later Late Prehistoric period is characterized by the La Junta phase and the Cielo Complex, two cultural complexes which were roughly contemporaneous and possibly related to each other (Mallouf 2013a:64). The Cielo Complex, one of the rare cultural phases not defined by Kelley et al. (1940), is the archaeological manifestation of a mobile hunter-gatherer group which ranged across the Big Bend. The Cielo Complex is particularly defined by the presence of circular to oval shaped above ground wikiup foundations that typically have narrow entrances (Mallouf 2013a:48-50; Mallouf 1986:75). These features, present at Cielo Complex base camps and short term campsites, are highly archaeologically visible and are distinctive to this complex. These sites tend to be located on elevated areas (Cloud 2013:154) and the stone structures are occasionally found in lowland settings (Lintz 2014).

The La Junta area is located around modern day Presidio, Texas (Cloud and Piehl 2008:5). The La Junta cultural phase was originally defined by Kelley et al. (1940:33-35; Kelley 1951) as the La Junta focus of the Bravo Valley aspect. It was characterized by a semi-sedentary to sedentary population which focused on fishing and agriculture. The cultivation of maize was considered particularly important. The inhabitants of La Junta phase villages lived in small rectangular houses that were constructed by building a *jacal* structure over a pit (Cloud and Piehl 2008:18). This presence of a semi-sedentary, agriculturalist population virtually surrounded by mobile hunter-gatherers was long considered to be an oddity. It has been suggested, partly due to the abundance of El Paso Polychrome ceramic sherds, that this cultural group was an isolated offshoot of the El Paso phase of the Jornada Mogollon. However, due to several key cultural differences, including differences in mortuary practices, others have suggested that this is unlikely

(Mallouf 2013a:64). Instead, it is possible that the La Junta phase had an indigenous origin.

Whatever the origins of the La Junta group, there is evidence of their influence in the Big Bend region beyond their immediate habitation areas. Studies of three rock shelters in northwestern Presidio County revealed evidence for the use of Mogollon ceramics at two of the sites, Tres Metates Rockshelter and Potsherd Rockshelter (Seebach 2007:75,97). Tres Metates Rockshelter even contained the preserved remains of maize in a storage pit (Seebach 2007:32). These remains indicate either trade between the local hunter-gatherers and the La Junta area, or the presence of La Junta people in the rock shelters. Which scenario is more likely depends on whether the La Junta people were sedentary (Kelley et al. 1940:163) or a semi-sedentary (Cloud and Piehl 2008:110-111; Mallouf 2013a:64; Seebach 2007:8) people who periodically moved outside of the La Junta area in order to exploit wild plants and animals to supplement their diet beyond cultigens.

One general trend in the Late Prehistoric is the introduction of the bow and arrow, evidenced by the regional change in projectile point styles from dart points to arrow points. It is important to note that there is evidence of the use of atlatls, and therefore dart points, into the Late Prehistoric (Mallouf 2005:228). This indicates a level of technological continuity despite the innovation of the bow and arrow. The continued use of the atlatl is not the only evidence for cultural continuity in the area. The relative abundance of ritual sites in the Late Prehistoric has roots in the Middle Archaic, with some sites seeing repeated ritual usage (Mallouf et al. 2006:133). However, maize agriculture is considered unique to the Late Prehistoric, as archaeological evidence for maize in the Late Archaic lacks secure context even though it is well documented at that time further west (Mallouf 2005:238; Hard and Roney 1998). The use of ceramics is another aspect in which the Late Prehistoric is sharply divided from the Late Archaic.

Protohistoric

The Concepcion phase stretches from the last part of the Late Prehistoric through the Protohistoric. Defined as the Concepcion focus of the Bravo Valley aspect by Kelley et al. (1940:35-37), it is located in the La Junta area, but is differentiated from the La Junta phase in several ways. Rectangular houses are still common, but they are often much larger than the earlier La Junta phase houses. Another key difference between the La Junta phase and the Concepcion phase are the ceramics. The El Paso phase ceramics from the Southwest are replaced by new wares, likely locally made. The Cielo Complex also lasts into this time period (Mallouf 2013a:48).

It is during the Protohistoric that Europeans first arrived in the area. The Spanish traveled through the region, with Cabeza de Vaca's travels as early as 1528 to 1535, and occasionally raided the area to capture slaves to work in silver mines; however, they did not immediately settle in the area (Ohl and Cloud 2001:33; Kenmotsu and Wade 2002). Another important event that occurred at this time was the migration of Apache groups into the area (Cloud and Piehl 2008:22). These invaders often clashed with the indigenous peoples, and it has been speculated that the tendency for Cielo Complex sites to be located in areas of high elevation was for ease of defense against these Apache groups (Mallouf 2013a:52).

Historic

The establishment of missions in 1683 in the La Junta region is the beginning of the Conchos phase (Kelley et al. 1940:36-37). This cultural phase is characterized by a continued technological tradition from the Concepcion phase, with the addition of Spanish wares. During the Conchos phase the Apaches had an increasing presence in the area. They raided and traded with both the Spanish and the local indigenous population. Comanche groups first moved into the region during this period. The Conchos phase is also characterized by multiple Spanish *entradas*, usually in an attempt to combat the Apache and Comanche groups. These attempts were generally unsuccessful.

One poorly defined phase for the La Junta region is the Alamito phase. Kelley et al. (1940:37-38) characterizes this phase as a time of ethnic mixing and increased acculturation. House and ceramic styles continued virtually unchanged from the previous Conchos phase. Presidios were established in the region in 1760 near present day Ojinaga, Chihuahua to protect against these raids, but they were ultimately abandoned (Cloud and Piehl 2008:25-26). The Texas Revolution occurred during this time period and had very little impacted on the region (Ing et al. 1996:41-43). One major change at this time was the growing importance of trade in the early nineteenth century, with several trade routes running through the Big Bend region.

The Presidio phase is defined by the archaeological manifestation of Spanish and Anglo-American cultural expressions. This can be seen by the remains of adobe structures, ranch houses, and artifacts related to ranching (Kelley et al. 1940:38). Native Americans still lived in the region at the beginning of the Presidio phase, but had been removed by the period’s end. By 1890, the last Native American group in the region, the

Apache, were removed to reservations in Oklahoma and New Mexico (Ohl and Cloud 2001:35; Kenmotsu and Wade 2002). This was the beginning of ranching in the area, which only increased when the railroad came through the region and enabled easier migration into the Big Bend; ranching has persisted through to the present as a major industry for the area. Mining and candelilla wax processing also became important industries at this time (Ing et al. 1996:43-44). When the Mexican Revolution broke out in the early 1900s, the unrest it caused occasionally spilled over into the La Junta area, which necessitated a strong military presence in the area (Cloud and Piehl 2008:27).

Material Culture

Prehistoric Material Culture

Lithic artifacts, both chipped and ground stone, are the most common artifact type in this region. This is due to the long history of prehistoric occupation, as well as to the abundant stone resources in the area (Ing et al. 1996:89). Dart and arrow points are the main formal, temporally diagnostic stone tools. Scrapers, knifes, and assorted other chipped stone artifacts are also common but not necessarily culturally or temporally diagnostic. Manos and metates are commonly found ground stone tools. Prehistoric artifact assemblages are aceramic, at least until the Late Prehistoric (Ing et al. 1996:151). The dry rock shelters of the region can also preserve perishable artifacts. The types of perishable artifacts found in the region are diverse, including sandals, baskets, skins, and cordage (Coffin 1932; Seltzer 1935; Smith 1938). Sandals are particularly interesting as research has suggested that they can be utilized as temporally diagnostic artifacts (Turpin 2003).

Prehistoric features beyond the ubiquitous hearths and burned rock features can be observed in the area (Ing et al. 1996). Bedrock grinding features are not uncommon. Rock cairns can indicate burials or ritualistic markers (Sanchez 1999:50-51). Stacked stone structural foundations are found throughout the area. Although many of these can be related to the Cielo Complex, many others cannot, due to flimsy construction or lack of diagnostic artifacts (Ing et al. 1996:80-81). Nonstructural prehistoric stone alignments have been speculated to serve a ritual purpose; in the case of the Lizard Hill Cache, the apex of a nearby v-shaped petroform seems to point directly at the place where the cache was found (Ohl 2011:85-86).

Historic Material Culture

Historic ceramics are easily distinguishable from prehistoric ceramics, whether they are Spanish or American made wares (Ing et al. 1996:151). Glass artifacts are often the remnants of ranching activities. Metal artifacts range from household wares to spent cartridge casings. Metal cans litter the region (Sanchez 1996:43). Although most historic artifacts are related to the ranching activities that occurred throughout the area, some are related to the military activity that occurred in the area in the early twentieth century. Historic features relating to ranching activities are common. These include house sites, stone walls, and corrals (Ing et al. 1996:89-90; Sanchez 1999:53-55). Historic documents can occasionally provide more information about these sites, including the names of past occupants. Earthen or concrete dams are other features which originated in the ranching period. Rockshelters were occasionally utilized by ranch hands and sheepherders (Sanchez 1999:56). They often also utilized boulders as places of shelter. Features related to candelilla wax processing occur throughout the area, especially in locations near large water sources (Maxwell 1968:95-99). These operations, some of which lasted into the 1940s, leave distinctive features including concrete-lined pits, metal boilers, and large piles of ash and spent candelilla plants.

One of the few types of historic cultural remains that are difficult to distinguish from prehistoric cultural remains are rock cairns. In historic times they were often used as survey markers or fencepost supports (Ohl and Cloud 2001:60-61). Historic rock cairns can sometimes be distinguished from prehistoric ones by the presence of rebar rods in the cairn. Cairns that served as fencepost supports will often occur in a linear fashion across the landscape, separating them from prehistoric cairns which are typically not aligned in this way.

Site Types

The types of sites which can be found in the Big Bend region are diverse. Historic debris litters the area (Ing et al. 1996:89-90; Ohl and Cloud 2001:30). The remains of mines are also present in the region (Ing et al. 1996:205-206). Scattered house ruins, rock walls, and earthen or concrete dams can be seen throughout the area. Intersite historic debris is common, a remnant of the long history of ranching in the area.

Prehistoric sites are present in all areas of the region, from the desert lowlands to mountaintops. Rock shelters, found in both the volcanic and sedimentary geologic deposits of the area, are common throughout the landscape and constituted an important resource for prehistoric people (Mallouf 2005:231). Given the abundant sources of tool stone such as chert, agate, and chalcedony (Ing et al. 1996:89), it is not surprising that quarries and lithic procurement sites can be found in large numbers in the area. Rock art sites are also recorded in the Big Bend region. Village sites with semi-permanent structures are found in the La Junta area (Cloud and Piehl 2008), but not further east.

The majority of sites in the Big Bend are open sites, which vary greatly in types. Isolated cairns can be historic or prehistoric in origin (Sanchez 1999:50-51). Open campsites are defined as containing hearths or, if hearths are not present, as containing significant amount of cultural debris related to habitation such as scrapers, knifes, manos, and metates (Ohl and Cloud 2001:37). Sites with no features and limited tools and lithic debitage are termed lithic scatters (Ohl and Cloud 2001:37). Food processing sites are sites where burned rock middens are present (Ing et al. 1996:80). If limited cultural material is present at the site, then it is considered to solely be a food processing site. If extensive cultural debris is associated with the food processing features, the site is considered to be an open campsite with some food processing activities. Cielo Complex campsites are often easily recognizable, as the remains of the stone foundations for wikiups are highly visible (Ing et al. 1996:84).

Previous Research near Stovall Ranch

Colonel Thomas C. Kelly and Roark Cave

Previous research on the ranch which contains the study area is very limited. In the early 1960s Colonel Thomas C. Kelly and his crew studied several rock shelters in the area, testing some and excavating others much more fully (Kelly and Smith 1963; Kelly 1963). Three of the shelters excavated were assigned site trinomials: 41BS1, 41BS2, 41BS3. Kelly’s work was not part of a systematic survey. He only studied rock shelters, and made no mention of any open sites. He selected which rock shelters to study by consulting with the landowners, Buddy Roark and Buddy Roark, Jr. and investigating the rock shelters they pointed out to him (Kelly and Smith 1963:167). The sites studied by Kelly received varying amounts of investigations. Some of the sites, such as Kelly's Cave Numbers 1 and 2, were only tested as far as a single test pit of unknown size in each shelter (Kelly and Smith 1963:168). Cave Number 4 was more thoroughly excavated and was recorded as 41BS2. This was the only site that Kelly noted had not been disturbed.

Cave Number 3 was recorded as 41BS1 and was partially excavated. 41BS1 lies on the land that is now the Stovall Ranch, and was also located in a quadrat that was surveyed during the course of my research. Temporally diagnostic projectile points found during the excavations at this rock shelter date the use of this site from the Middle Archaic to the Late Prehistoric. Kelly and Smith (1963) did not note any perishable artifacts from these investigations.

The site that is the best reported is Roark Cave, 41BS3 (Kelly 1963). The site contains numerous bedrock grinding features that range from shallow depressions to features 66 centimeters deep. Excavations inside the cave revealed a grass-lined pit, which Kelly speculated was for food storage. Projectile points including Langtry, Ensor, Paisano, Livermore, and Perdiz date the use of the site from the Middle Archaic to the Late Prehistoric.

William Marmaduke and Bear Creek

The closest large scale survey to my research area is located 15 kilometers to the southwest, near Bear Creek on the Pope Ranch (Marmaduke 1978a). William Marmaduke conducted a survey in the area, although his exact methodology – how intensively he surveyed the area or how he determined site boundaries – is not apparent from the report. It is clear that he focused on two major environmental zones, which he refers to as the ridgeline and the valley. He recorded 111 sites, which he classified into five component site types: rock shelters, ring middens, middens, hearths, and casual lithic work area. Marmaduke (1978a:37) notes that many of the sites he recorded contained combinations of these component site types and he classified them based on what seemed to him to be the major component.

In his report, Marmaduke (1978a) refers to site localities, which he describes as significant clusters of individual sites. What exactly he considered a significant cluster was not clearly stated, and this designation seems to have been applied at his own discretion. In all cases, these site localities contain at least one rock shelter.

Marmaduke (1978a) also tested seven sites, mostly the large rock shelters and ring midden sites. During these excavations he found temporally diagnostic projectile points dating from the Late Paleoindian to the Late Prehistoric. He notes that most of the tested sites showed definitive evidence of use from the Middle Archaic through the Late Prehistoric, while Late Paleoindian and Early Archaic age components were encountered much more infrequently.

In addition to survey and testing, Marmaduke (1978a:164-169) makes some general observations about settlement patterns in the Bear Creek survey area. First, he notes that, based on the presence of temporally diagnostic artifacts, the number of sites utilized in each time period increase through time. Second, he notes that the ridgeline and valley sites seemed to have been alternatively utilized. He theorized that the sites in the valley represented occupations where hunting was the major activity, and that the activities at the ridgeline sites were focused on the gathering and processing of lechuguilla and sotol.

IV. SURVEY AND ANALYSIS METHODOLOGY

Stovall Ranch is an 80,000 acre private ranch located in eastern Brewster County and encompasses a range of landscape forms. There have been no archaeological surveys in the ranch, especially when compared to nearby Big Bend National Park and Big Bend Ranch State Park. Despite the lack of large scale archaeological surveys, the archaeological sites on the ranch are well known to the landowner. Previous to this research, three sites have been recorded on Stovall Ranch: one open campsite (41BS987) and two rock shelters (41BS1, 41BS3).

Stovall Ranch was chosen as the location to conduct my research for three main reasons. First, the relatively high frequency of rock shelters on the ranch make it an ideal place to test my hypothesis. Second, the ranch headquarters where the survey team stayed had excellent facilities. Lastly, the landowner was amenable to the research project. After Stovall Ranch was selected as the location of the survey, a reconnaissance trip was made to assess possible survey areas and determine where these would be located.

Reconnaissance and Pre-Field Methodology

During this reconnaissance trip, two areas on the ranch stood out as having both a large number of rock shelters and easy access. The ease of access to these two area was considered to be a vital consideration because of the remoteness of the ranch and the small size of the survey team, in case of any accidents. The locations of the rock shelters found on this reconnaissance survey were recorded with a Trimble Juno 3B GPS unit, but not studied or documented in any detail. The two survey area boundaries were placed in a way such that they encompassed the largest potential number of rock shelters and the greatest variation of terrain types possible. The two survey areas were each divided into 25 500 by 500 meter blocks, resulting in 50 potential survey quadrats, each of which was 25 hectares in area. The survey areas were plotted in ArcMap before being imported into the Trimble GPS unit so that the survey quadrats could be easily located while in the field.

As the entire area could not be surveyed, a 20 percent random sample was deemed appropriate given the available time and crew size and five quadrats in each survey area were selected. As the research question is concerned with rock shelters, it was necessary that some of the randomly selected survey quadrats contain some of the known rock shelters. Thus, one quadrat with a marked rock shelter and four quadrats without marked rock shelters were selected in each survey area.

Within this stratified sampling strategy, the surveyed quadrats needed to be randomly selected to avoid researcher bias. To accomplish this, quadrats without rock shelters located on the preliminary trip were sequentially numbered in each survey area, and four quadrats were randomly selected using a random number generator (random.org). In the northern survey area, quadrats 1-21 were the ones that did not contain a rock shelter marked in the reconnaissance survey. In the southern area, quadrats 1-22 were the quadrats without rock shelters. Then, the remaining quadrats with known rock shelters were also sequentially numbered and one was selected using the same random number generator. Quadrats 22-25 were the rock shelter quadrats in the northern survey area, and quadrats 23-25 were the ones with rockshelters in the southern area. During the course of the survey, quadrats were referred to by their assigned numbers with the prefix N or S depending on whether they were in the northern or southern survey area.

After the original 10 survey quadrats were studied, six additional quadrats were surveyed. This time, three rock shelter and three non-rock shelter quadrats were selected to be surveyed. As the northern survey area had a greater number of quadrats with marked rock shelters, two rock shelter quadrats and one non-rock shelter quadrat were selected using the random selection method previously described. In the southern survey area, two non-rock shelter quadrats and one rock shelter quadrat were randomly selected using the random number generator (Figures 4.1 and 4.2).

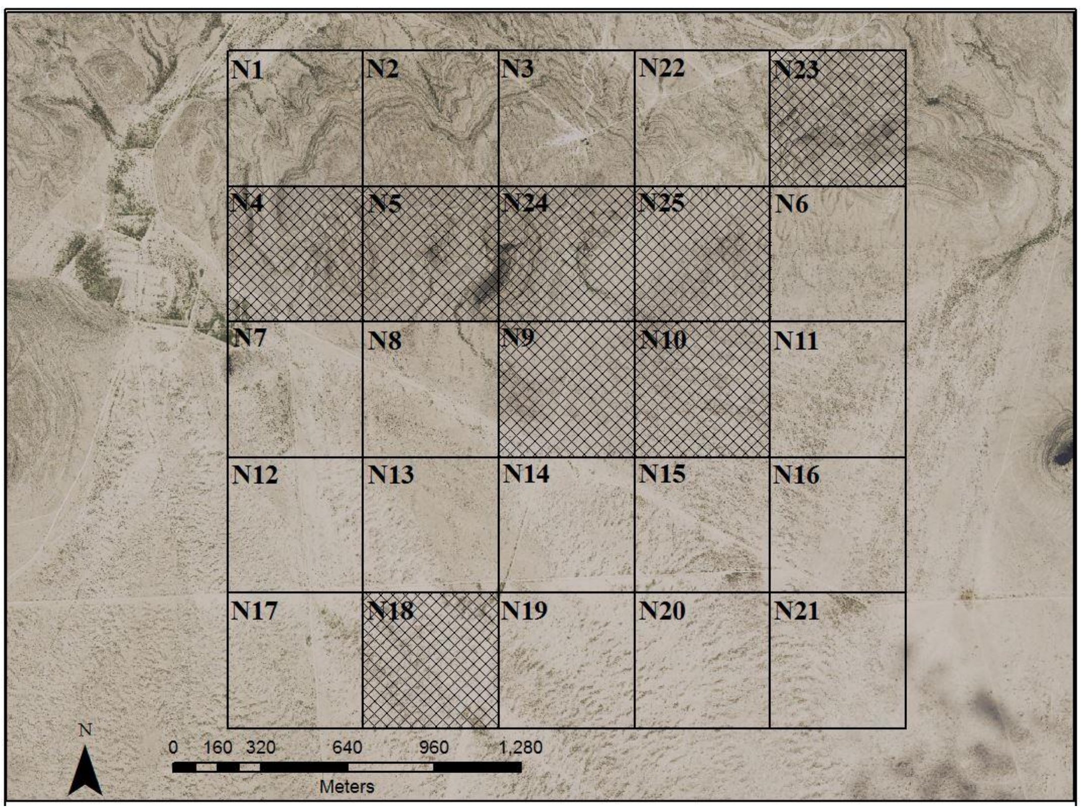

Figure 4.1. Northern survey area – surveyed quadrats are indicated with crosshatching.

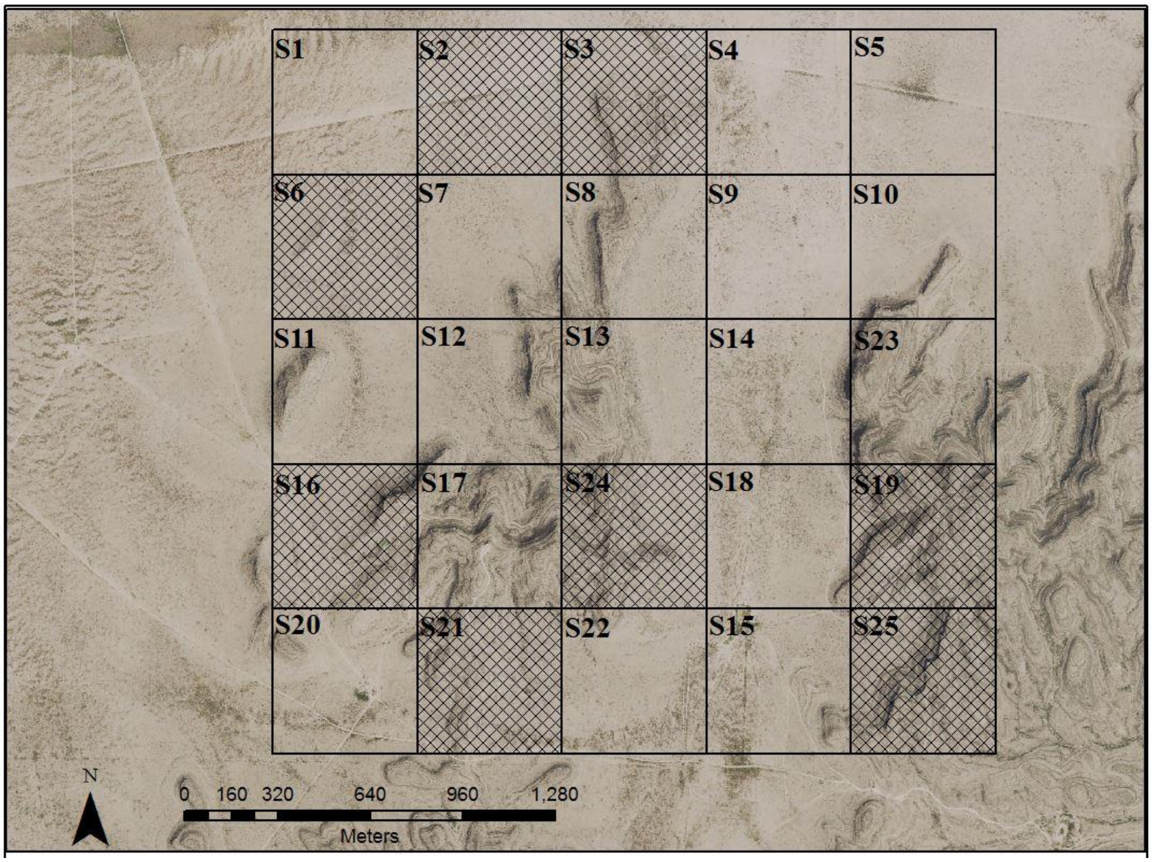

Figure 4.2. Southern survey area – surveyed quadrats are indicated with crosshatching.

Field Work Methodology

The survey grid along with a background map were loaded into a Trimble Juno 3B GPS unit running TerraSync software. When the survey quadrat for the day was selected, the GPS unit was used to locate whichever corner of the survey quadrat was most easily accessible. In areas of flat or relatively easy to walk terrain, the crew surveyed in a north-south pattern, at intervals of 10-15 meters apart. This spacing was appropriate given that the aim of this survey was to locate sites, not isolated finds. Given the steepness of the hillslopes, survey in these areas were concentrated on the areas likely to contain rock shelters, such as just under the hill rim. Hilltops were surveyed by walking with the landscape contours of the hilltop topography, as straight survey transects were often not practical. As only one Trimble unit was available, the person holding the unit was responsible for making sure the entire survey quadrat had been covered. No shovel tests were used in the survey, as is typical for surveys in the area due to good ground surface visibility because of sparse vegetation and the general presence of shallow soils or exposed bedrock (Ing et al 1996:73-78; Sanchez 1999:39-40; Ohl and Cloud 2001: 38-39). In addition, most post-Pleistocene sediment depositions occur near the Rio Grande or large drainages, neither of which are located near the survey area (Turner et al. 2011:9-12).

If fewer than ten artifacts were found in a five by five meter area, it was called an isolated find. Isolated finds were given the prefix IF and then numbered sequentially in the order that they were found. Isolated finds were photographed, marked with a GPS point, and briefly described in the day's survey notes, but were not extensively studied or documented. If any discrete locale with ten or more artifacts in a five by five meter area was found, it was classified as a site. When a site was found it was classified according to site type, as described in Table 4.1. Sites were classified in the field with a prefix which designates the site type, and then sequentially numbered with a temporary field number within the specific group site types. Open campsites were given the abbreviation OC, lithic scatters were LS, procurement/quarry sites were designated LP, rock shelters were RS, and the one historic dam recorded was given the prefix HD. Although two rock shelters did have some examples of rock art, their primary function was not deemed to be as a rock art site, thus those sites were given the standard rock shelter prefix.

Table 4.1. Site definitions.

Open Campsite	Sites containing artifacts and features, such as bedrock grinding features, burned rock middens, or other stone features

Table 4.1. Continued. Site definitions.

Lithic Scatter	Sites which contain lithic artifacts but lack features
Lithic Procurement Site	Sites where activities such as quarrying activities or primary reduction are observed
Rock shelter	A habitable and protected space in bedrock or large boulders that has signs of human utilization, either in the form of artifacts or features
Rock Art Site	Sites with pecked or painted rock art
Historic Site	Any site with historic artifacts or features
Isolated Finds	Any discrete locale with less than 10 artifacts in a 5 meter x 5 meter area

At each site, sketch maps were drawn and photographs were taken. Photographs were taken of the site, of the surrounding area, and of a sample of the artifacts found at each site. Additional photographs were taken of any temporally diagnostic lithic artifacts. Per prior agreement with the landowner, all artifacts were left in place. GPS location information was recorded as well. For rock shelters, a point shapefile was taken at the mouth of the shelter. For open sites, an area shapefile was taken of the site boundary and a point shapefile was taken of the site centroid. Site boundaries were determined by the extent of the visible artifact scatter. Sites were carefully searched in order to locate temporally diagnostic lithic artifacts that might be present and to determine other basic information about the site, such as the artifact density. All relevant information needed to record the site at the Texas Archaeological Research Laboratory and receive a permanent site number was also collected.

Each day, upon returning from the field, the photographs taken that day were downloaded and sorted into folders based on which site or isolated find they documented. In addition, a photo log was completed at the end of each day. Daily field notes about the day's work and additional information about the survey areas were also written up in the evenings. GPS data was downloaded every weekend, although all of the shapefiles were left on the GPS unit until the end of the survey, in case a site had to be revisited or in case of a computer crash. For all newly recorded sites, TexSite forms were filled out using the TexSite 3.0 plugin for Microsoft Access. For any previously recorded sites, revisit forms were filled out using the same software. All field notes and sketch maps were scanned at the completion of fieldwork. The TexSite forms, GPS shapefiles and the original sketch maps were submitted to the Texas Archeological Research Laboratory in order to formally record the sites and obtain trinomial site numbers. Documents and photos from the survey are curated at the Center for Archaeological Studies in San Marcos, Texas.

Analysis Methodology

Statistical Analysis

In order to determine if the number of sites found in rock shelter quadrats was significantly different than the number of sites in quadrats without rock shelters, statistical tests were necessary. As site counts are nominal data, Chi-square tests are the most appropriate tests to determine statistical significance. A Chi-square goodness of fit test was completed to determine whether the difference in the number of sites in quadrats with rock shelters and quadrats without rock shelters was statistically significant. To determine whether different types of open sites are influenced differently by the presence of rockshelters, a Chi-square test of independence was completed. All statistical tests were run in Microsoft Excel using the Real Statistics add-in (www.real-statistics.com/; accessed 9/25/2016).

Geospatial Analysis for Stovall Ranch Sites

To answer the question of how rock shelters affect the location of open sites, a form of geospatial analysis was necessary. Cost distances created in ArcMap were deemed to be the most appropriate geospatial analysis to answer this question. To accomplish this, the locational information for the sites found on the survey were uploaded into ArcMap 10.4, split by survey area and site type. The survey areas were also uploaded into the program.

Several steps are necessary in ArcMap to create cost distances. First, a raster layer containing elevation data is required. The 10-meter Dove Mountain USGS Digital Elevation Model (DEM) quadrangle was downloaded from the US Department of Agriculture's Geospatial Data Gateway; this file was then uploaded into ArcMap. Next, a file containing information about the change in elevation was made. This was done using the Slope tool, located in Spatial Analyst toolbox under Surface tools. The Dove Mountain DEM was the basis for determining the slope; in order to reduce the time necessary to run this analysis, the processing extent was clipped to the north survey area boundaries. Thus, these steps had to be repeated for the south survey area.

Once slope layers for both the north and south survey areas were completed, the next step was to create the cost distance layers. This required the Cost Distance tool, located in the Spatial Analyst toolbox under Distance tools. The input feature class was the point shapefile of the rock shelters, and the input cost raster was the slope raster, created in the previous step. Again, the processing extent was clipped to the survey boundaries. To avoid researcher bias, the default settings of the Cost Distance tool were not changed; the tool created ten cost distance classes at equal intervals. Originally, cost distances were going to be created based off of potential water sources as well, but no permanent or intermittent streams are recorded on the Dove Mountain USGS quad within either survey area.

Geospatial Analysis of Bear Creek Survey Data

Given the limited data set of the Stovall Ranch sample, I decided to compare the geospatial data to another survey which was undertaken in the area. Marmaduke's (1978a) Bear Creek survey was the best candidate for this comparison as it is the closest large survey to the Stovall Ranch, a significant number of rock shelter sites were recorded, and the report on the survey was easily accessible.

To use the Bear Creek survey data it had to be put into a format comparable to my survey results. First, the site descriptions from the report on the survey (Marmaduke 1978a) were thoroughly read. The site numbers mentioned in the report were inputted into a Microsoft Excel spreadsheet, along with information on site type and mapping status. The site descriptions given by Marmaduke were then used to reclassify his results according to the site type descriptions used in this analysis. Open sites that contained hearths, middens, ring middens, or stone features were classified as open campsites. The sites that Marmaduke called "casual lithic work areas" (Marmaduke 1978a:46) were reclassified as lithic scatters. Rock shelters remained classified as rock shelters.

The site locations were plotted on digital maps using data from the Texas Archeological Sites Atlas. The location of the 111 sites were hand plotted in Google Earth by visually comparing the background maps. Fortunately, the landscape around

Bear Creek survey area contains many visually distinct landforms, which provides an acceptable degree of accuracy. After the sites were mapped, they were marked in the Excel sheet; this ensured that all of the sites were plotted. The resulting .kml file was then imported into ArcMap using the .kml to Layer tool. It then became necessary to split this layer containing all the sites into different layers for each site type. This was done using the Select Layer by Attribute tool in the Data Management toolbox, located under Layers and Table Views tools.

Next, DEMs for the Bear Creek survey area had to be imported. Given the survey area's location and size, DEMs for four USGS quads – Yellow House Peak, Hood Spring SE, Bone Spring NE, and Stillwell Mountain – had to be imported into ArcMap. In order to properly use the Slope tool as described above, these four separate DEMs had to be combined into a single file, using the Mosaic to New Raster tool, located in the Data Management toolbox under Raster Dataset tools.

In the last step before Slope and Cost Distance tools could be used as described above, a survey boundary needed to be drawn. Given that it was not clear from either the report on the Bear Creek survey or the Texas Archeological Sites Atlas exactly what areas were surveyed, a rectangle polygon shapefile was drawn around the Bear Creek sites at the discretion of the author to provide a working survey boundary. The survey boundary was used to clip the Slope and Cost Distance surfaces, and the same process as described for the north and south survey areas on the Stovall Ranch was carried out with the Bear Creek survey results to determine the cost distances from rock shelters.

V. SITE DESCRIPTIONS

This chapter first briefly discusses the results of the archaeological survey conducted on the Stovall Ranch in July and August 2015. The prehistoric sites recorded are described, organized by survey areas and survey quadrats.

Northern Survey Area

Eight 500 by 500 meters quadrats were surveyed in the northern survey area. Two of those quadrats – N10 and N18 – did not contain any sites. The other six quadrats – N4, N5, N9, N23, N24, and N25 – each had at least one site. The northern part of this survey area consists of hilltops, with the southern part of the area slopes down into generally flat topography (Figure 5.1). No water sources are mapped in the survey area, and none were noticed during the course of the survey. Twenty-one sites are located in the northern survey area (Figure 5.2). Five are lithic procurement sites, two are lithic scatters, three were defined as open campsites, and eleven are rock shelters. The sites are described by survey quadrat in the following section.

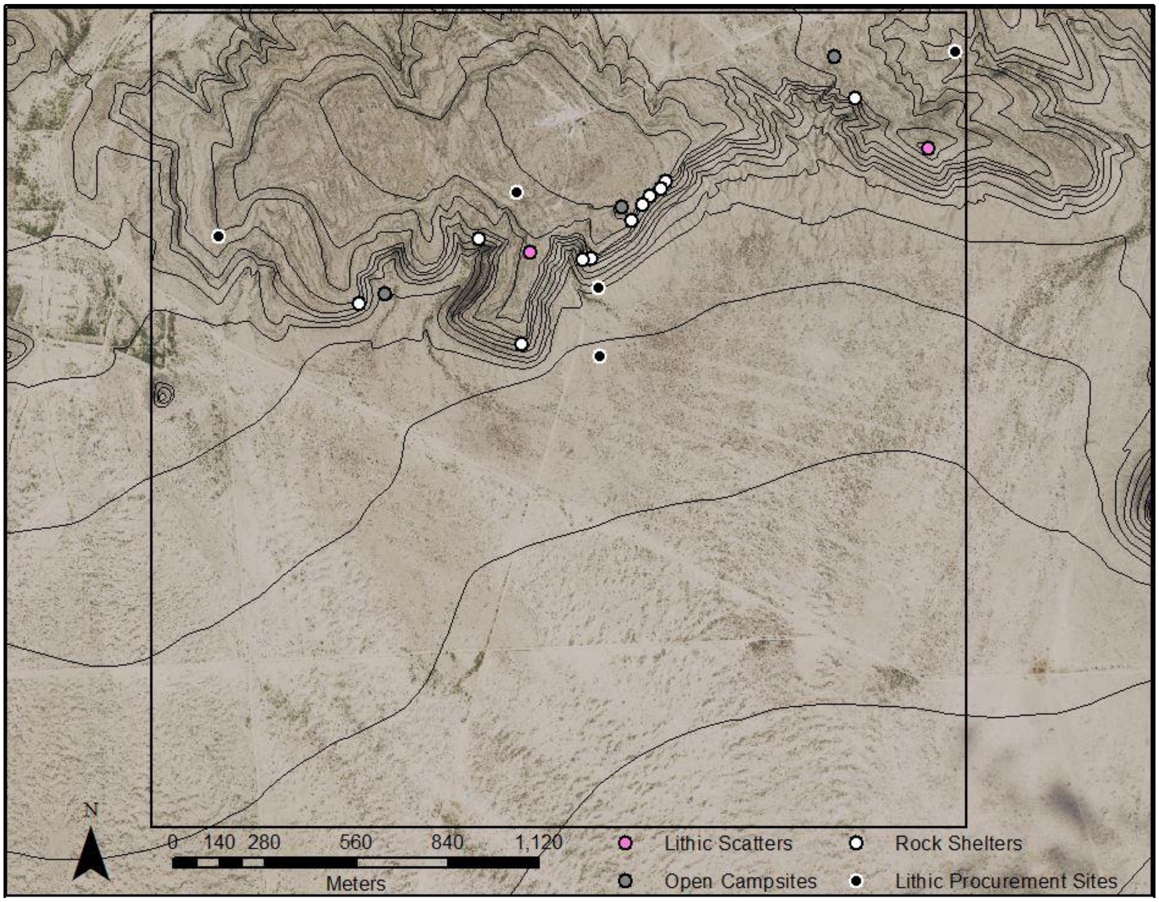

Figure 5.1. North survey area showing sites and topographic lines at 20 feet intervals.

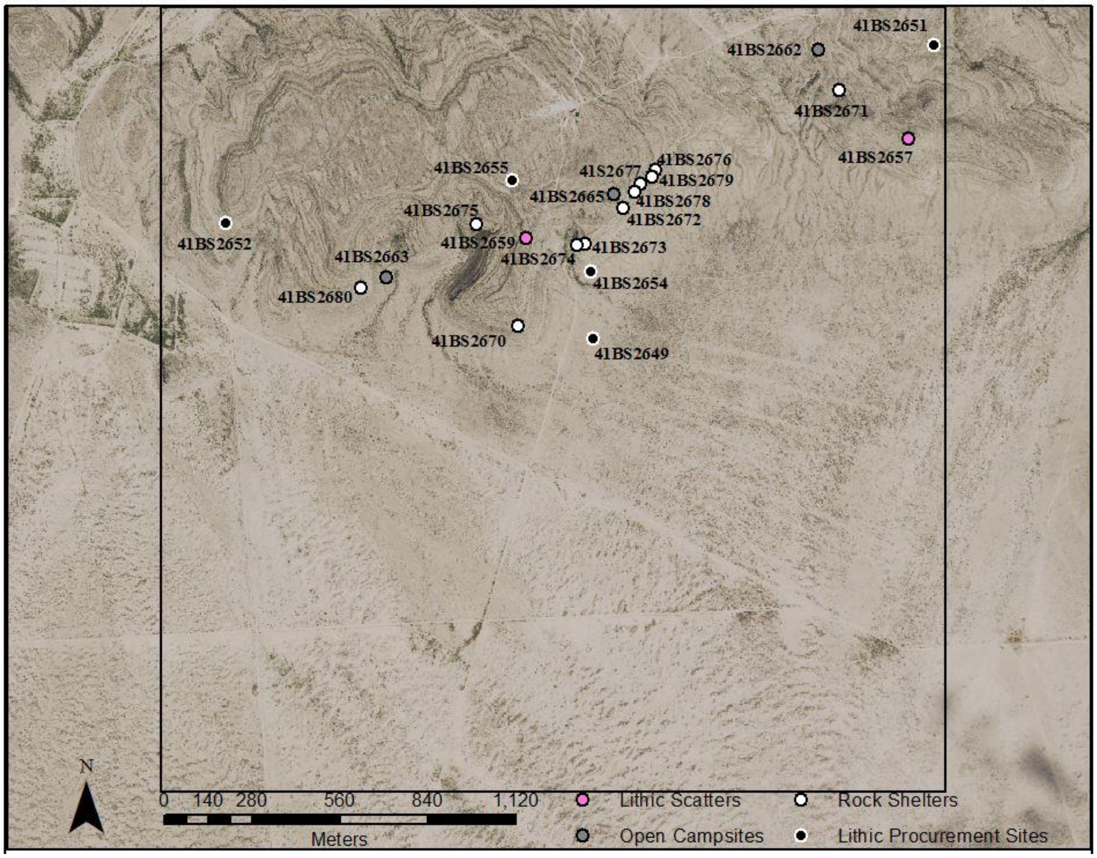

Figure 5.2. Sites recorded in north survey area.

N4 Quadrat

41BS2652 – Lithic Procurement Site. At 1,050 by 1,040 meters, 41BS2652 was by far the largest site found on the survey. The site extends from a hilltop into the flats, which are areas of low topographic relief (Figure App A.1). Most of the site seems to lie in areas of shallow soils. Chert is most available on the western and southern hillside and toeslopes. Cores, primary flakes, and chipping debris are present throughout the site. Two visually distinct chert types appear in this site. The chert available on the hilltop is dark gray in color and is much smaller in raw form. It also appears to have been much less used than the chert available on the hillsides and toeslopes. Most of this chert ranges in color from light tan to light gray, with an orangish-brown cortex (Figure 5.3). Raw material is available in both slab and nodule form. No temporally diagnostic lithic artifacts were found, but the large amount of lithic production debris suggests a long span of use.

Figure 5.3. Chert available on ground surface at 41BS2652.

N5 Quadrat

41BS2663 – Open Campsite. 41BS2663 is located on the eastern edge of 41BS2652. At 70 by 20 meters, 41BS2663 is a relatively small site compared to the other sites found on the survey. It was classified as an open campsite due to the presence of two burned rock scatters in addition to lithic flaking debris (Figure 5.4). The site is located on the toeslope of the hill, near two small drainages. There appears to be some potential for buried deposits, perhaps 20 to 30 centimeters in depth. The burned rock scatters are both roughly 2 meters in diameter. No formal lithic tools or temporally diagnostic artifacts were found during inspection of the site.

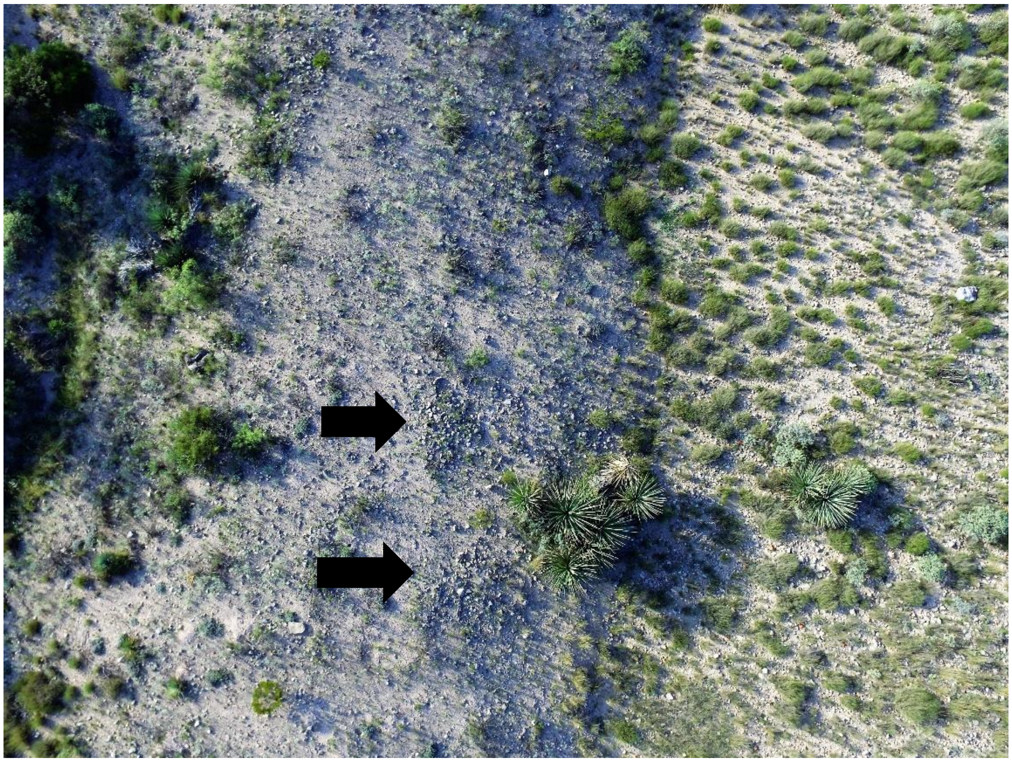

Figure 5.4. Aerial view of 41BS2663. Arrows point at burned rock scatters.

41BS2680 – Rock shelter. A small rock shelter, 41BS2680 is located near the eastern edge of 41BS2652, near 41BS2663. The shelter is 3 meters across at the mouth, 5 meters deep, and 3 meters high at the dripline, with a lower shelf and an upper shelf. This split configuration led to the informal designation of the site as the Double-Decker Rock Shelter (Figure 5.5). The lower shelf contained the majority of the lithic artifacts, including several modified flakes. Lithic artifacts were also present on the upper shelf, as well as part of a metate and a large roof spall block which appeared to have been worn to a polish in some places. There appears to be little potential for buried deposits, with perhaps at most 5 to 10 centimeters of sediment depth in the shelter. The shelter was once larger – the western half is now partially collapsed (Figure App A.2). This is why the site was designated as rock shelter, despite the fact that the current measurements technically make this site a cave. The collapsed half of the shelter was still partially accessible, so it was inspected and no artifacts were found. No temporally diagnostic artifacts were found at this site.

Figure 5.5. 41BS2680.

N9 Quadrat

41BS2649 – Lithic Procurement Site. 41BS2649 is a small site at 40 by 32 meters, and is also a very low density site. It is located in the flats a short distance from the toeslopes of the nearby hills. The site is located in an area of very shallow soils where the bedrock limestone and the chert it contains have eroded outward and are readily available on the surface. Several primary flakes and two bifaces were present at the site (Figure 5.6). No temporally diagnostic artifacts were found at this site.

Figure 5.6. 41BS2649. Red flags mark artifacts.

41BS2670 – Rock shelter. 41BS2670 is a rock shelter which is roughly 6 meters across, 5 meters deep, and 2 meters high at the dripline, although the roof is much lower in most of the shelter. Unlike most of the other rock shelters surveyed, this site has not been heavily collected due to a large rock fall from the hill rim which blocks the shelter from view. Lithic artifacts found consisted of bifaces, unifaces, and flakes. No temporally diagnostic artifacts were found. Considering the limited space within the shelter, 41BS2670 contained a large amount of burned rock and carbon-stained soils (Figure App A.3); the burned rock and lithic debris of the talus extended roughly 20 meters downslope. (Figure 5.7). There appear to be potential for moderate depth of deposits in the shelter – perhaps up to 50 to 100 centimeters in depth. The potential for organic deposits is unknown. The most interesting aspect of this shelter was a grinding slab which was found broken in two – one piece was found near the dripline while the other was found in the back of the shelter. A crew member familiar with ground stone artifacts suggested that this metate might have been ritually ‘killed’.

Figure 5.7. View of 41BS2670 with talus visible.

N23 Quadrat

41BS2651 – Lithic Procurement Site. 41BS2651 is a very small lithic procurement area; the site only covers an area of 9 by 12 meters. The site is located in an area of rough foothills, near a small drainage (Figure 5.8). The area of the natural deposit of low quality chert extends far beyond the boundaries of the site, but the area within

41BS2651 was the only area with evidence of lithic procurement activities. Cores and primary flakes were found at the site. No temporally diagnostic artifacts were found.

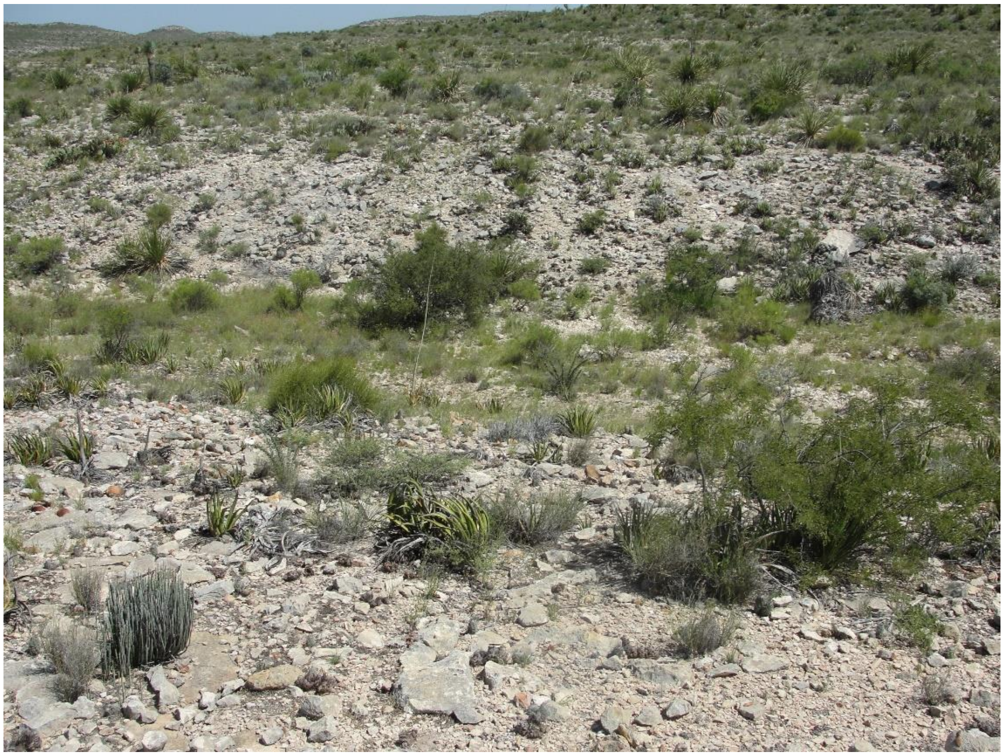

Figure 5.8. 41BS2651 and drainage. Site in foreground.

41BS2657 – Lithic Scatter. 41BS2657 is a lithic scatter located on a hilltop. At 15 by 22 meters, the site encompasses the entire bare rock top of the hill (Figure 5.9). There is no potential for buried deposits at this site. The artifacts consisted of primarily flakes and modified flakes, with a few cores. No temporally diagnostic artifacts were found. Given its location on one of the highest elevations in the immediate area, this site has excellent views of Horseshoe Mesa and Pine Mountain to the northwest and Dove Mountain to the southwest.

Figure 5.9. 41BS2657.

41BS2662 – Open Campsite. 41BS2662 is a site with an area of 120 by 58 meters which extends down three hilltop terraces (Figure 5.10). The site had a moderate artifact density, but an artifact assemblage which was more varied than most of the other open campsites observed during this survey. Bifaces, unifaces, lithic debitage, and cores were all observed. Several dart points which could not be typed were also found at the site (Figure App A.4, Figure App A.5, Figure App A.6, Figure App A.7). The site also contained a burned rock scatter which was roughly 7.5 meters by 5 meters. There is little to no potential for buried deposits at this site.

Figure 5.10. 41BS2662 with Horseshoe Mesa visible in the background.

41BS2671 – Rock shelter. Informally designated Javelina Rock Shelter by the survey crew, 41BS2671 is 7 meters across at the mouth, 6 meters deep, and ranges in height from 2.5 meters to less than a meter (Figure App A.8). The shelter overlooks a small drainage, has a large talus, and seems to have been well used, with large amounts of burned rock and carbon-stained sediments (Figure 5.11). Bifaces, unifaces, lithic debitage, cores, and manos were all found at the site. Two Paisano dart points were found, as well as an untyped arrow point. These projectile points date the use of the use of the shelter from at least the Late Archaic to the Late Prehistoric. It was difficult to locate many artifacts or determine the exact artifact density as much of the shelter floor was covered by javelina feces. The site has suffered some looting, as evidenced by a looter pit, Prince Albert tobacco cans, and the remains of a screen. The looting and animal burrowing revealed organic layers in buried deposits, which might be up to 1.5 meters deep.

Figure 5.11. Overhead view of 41BS2671 with talus visible.

N24 Quadrat

41BS2654 – Lithic Procurement Site. Located on the toeslope directly beneath 41BS2673, this site is a moderately sized lithic procurement site at 80 by 62 meters (Figure 5.12). Tested cobbles, cores, primary flakes, and biface fragments were found during inspection of the site. 41BS2654 is located near a large drainage. No temporally diagnostic artifacts were present. There is little to no potential for buried deposits at this site.

Figure 5.12. View from 41BS2654 upslope to 41BS2673.

41BS2655 – Lithic Procurement Site. 41BS2655 is a hilltop lithic procurement site. At 135 by 95 meters, the site is larger than 41BS2654, but it appears to have been less intensively used (Figure 5.13). No temporally diagnostic artifacts were found, but cores, flakes, unifaces, and bifaces were all present. Lithic materials extend beyond site boundaries where they have eroded down onto lower hilltop terraces. Site is located very near 41BS2659, a lithic scatter, and on the same hilltop terrace as part of 41BS2665, the largest open campsite recorded during the survey. There is no potential for buried deposits at this site.

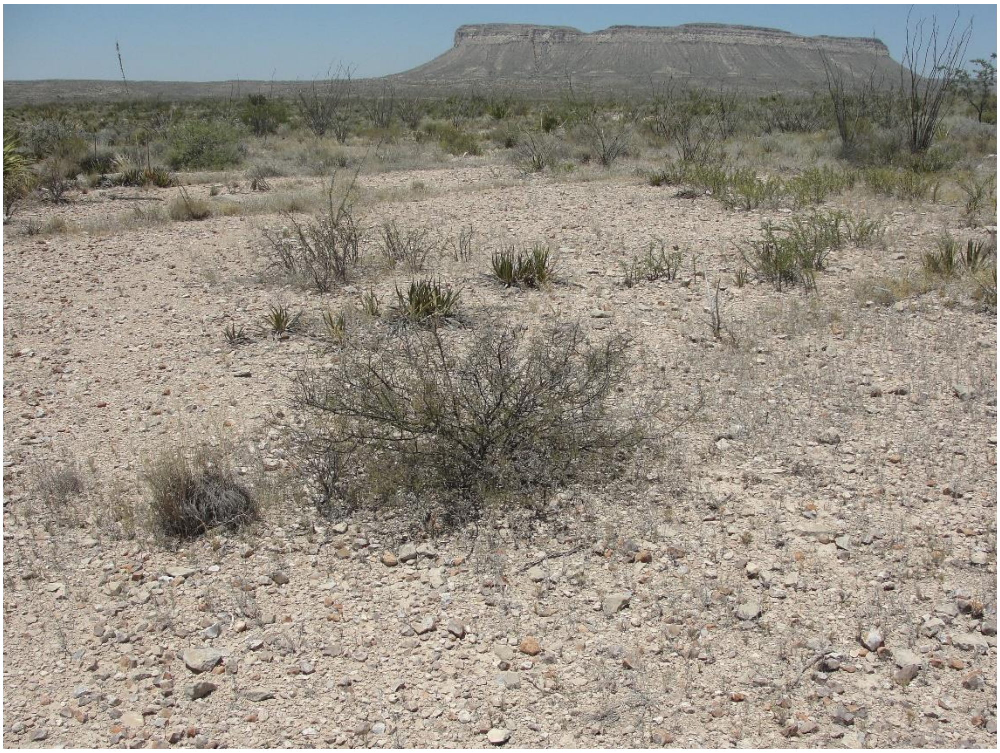

Figure 5.13. 41BS2655 with Horseshoe Mesa in background.

41BS2659 – Lithic Scatter. At 44 by 18 meters, 41BS2659 is the largest lithic scatter recorded during this survey. The site has a low artifact density; cores, unifaces, bifaces, and flakes were all observed at this site. 41BS2659 is located on a hilltop terrace, overlooking a large drainage to the east (Figure 5.14). A mano found on a lower hill terrace might have eroded down from this site, but no groundstone artifacts were found within the site boundaries. No temporally diagnostic artifacts were observed, and there is little to no potential for buried deposits at this site.

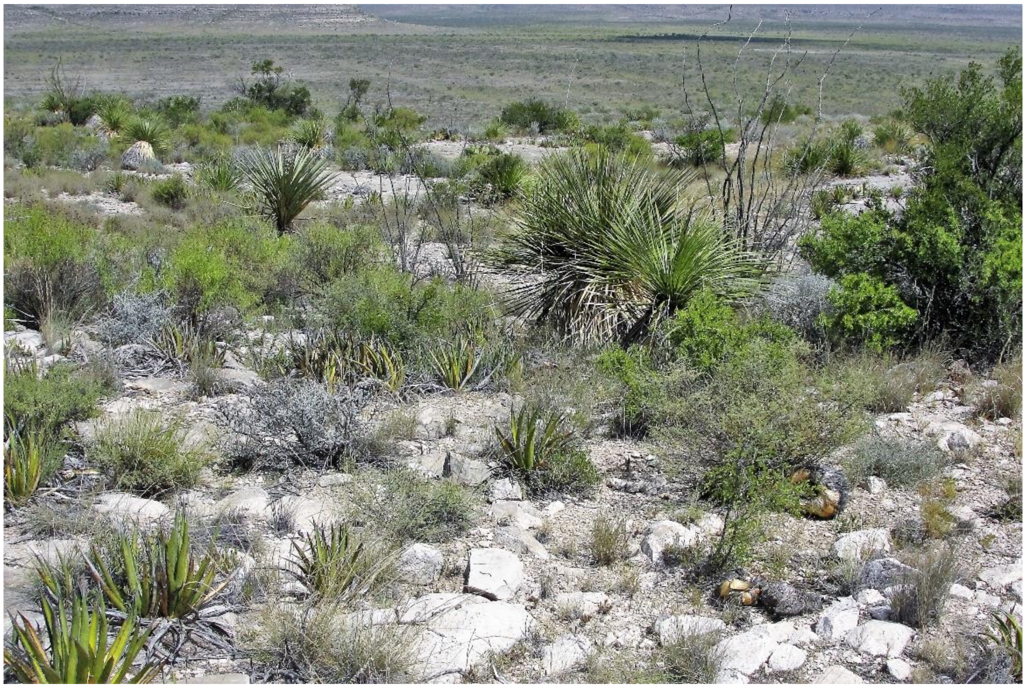

Figure 5.14. 41BS2659.

41BS2665 – Open Campsite. 41BS2665 is the largest open campsite observed during the course of this survey, with a site area of 170 by 90 meters. The site extends over four hilltop terraces. Three bedrock grinding features were observed at the site – they ranged from 30 to 65 centimeters deep (Figure App A.9). Two burned rock features were also observed (Figure 5.15). One burned rock feature is 11 meters in diameter and the other is 8 meters in diameter. The site has a large amount of lithic artifacts including flake tools, bifaces, unifaces, and other lithic debris. Several manos were also observed. One possible dart point was found, but it was too fragmentary to type. A Livermore arrow point was also found, dating the use of the site to at least the Late Prehistoric (Figure 5.16). Given the palimpsest nature of the site, it is difficult to say how many components are present at 41BS2665 without the presence of more temporally diagnostic artifacts. Little to no potential for buried deposits exists at the site.

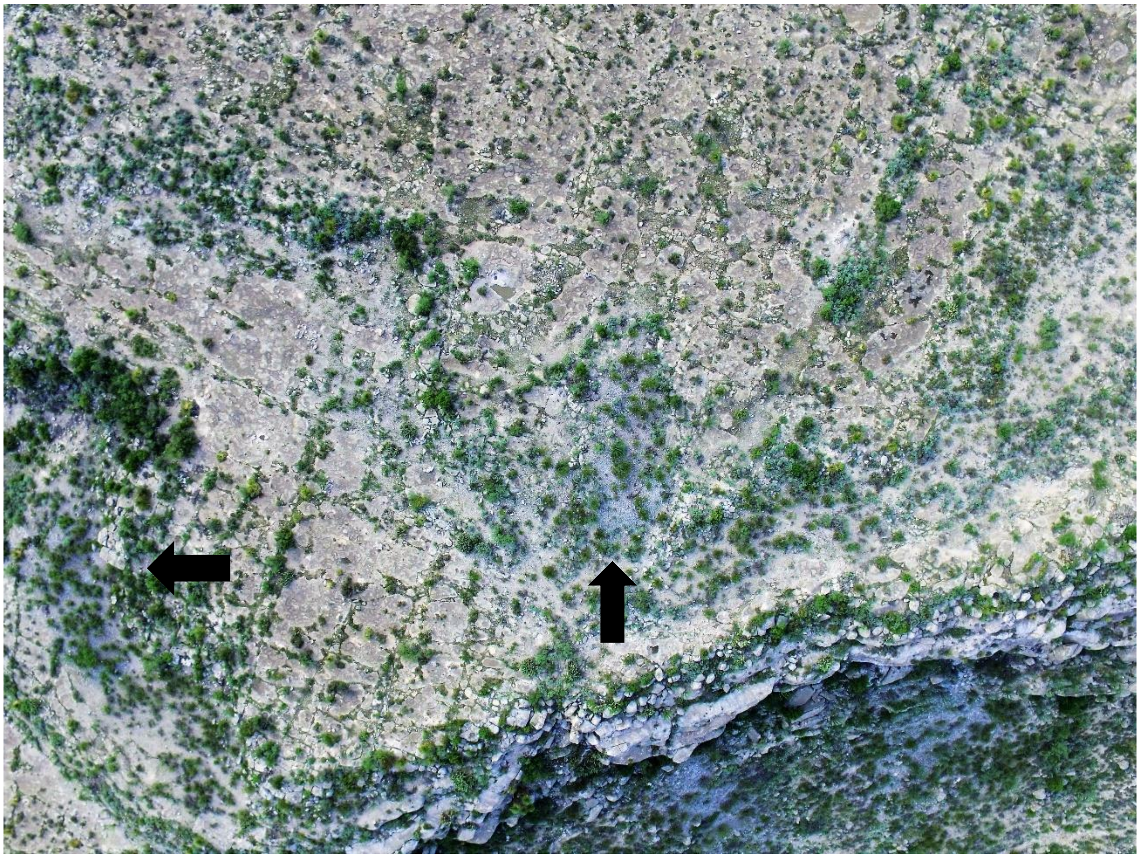

Figure 5.15. View of 41BS2665. Arrows indicate burned rock middens – site covers the entire pictured area of the hilltop.

Figure 5.16. Livermore arrow point.

41BS2672 – Rock shelter. Despite the fair size – 13.5 meters across, 9.5 meters deep, and 1.5 meters high – of the rock shelter, this site appears to have been minimally used. This might be due to the difficulty of access to this site when compared to other rock shelters located along this hill rim; to enter the shelter a short but steep climb up a bare rock surface is required (Figure 5.17). A very small talus consisting of a small amount of burned rock, lithic debris, and two manos is present. Minimal lithic debitage is present inside the shelter. Three shallow bedrock grinding features are located on the west side of the site. No temporally diagnostic artifacts were observed. There is little to no potential for buried deposits at the site.

Figure 5.17. 41BS2672.

41BS2673 – Rock shelter. 41BS2673 is a rock shelter that appears to have been well utilized, based on the large amount of lithic debris present as well as the presence of burned rock and carbon-stained sediments (Figure 5.18). With dimensions of 6.5 meters across, 5 meters deep, and 2.5 meters high at the dripline, it is one of the smaller rock shelters recorded on the survey (Figure App A.10). The depth of deposits in this site are likely less than a meter in depth. The abundant lithic artifacts include cores, flakes, and bifaces, although no temporally diagnostic artifacts were found. The large amount of lithic debris might be explained by the shelters location directly above 41BS2654, a lithic procurement site. A large drainage is located to the southwest at the foot of the hill.

Figure 5.18. Interior of 41BS2673.

41BS2674 – Rock shelter. Located just around the hillside from 41BS2673, 41BS2674 is a wide but shallow rock shelter with dimensions of 9.5 meters across, 3.7 meters deep, and 4 meters high at dripline (Figure 5.19). Unlike 41BS2673, 41BS2674 appears to have been very minimally utilized. No burned rock or carbon-stained sediments were observed and there appears to be little to no potential for buried deposits.

Artifacts consisted of some small pieces of lithic debitage, a small fragment of slightly solarized (purple) glass, and a Perdiz arrow point, dating the use of the shelter to the Late Prehistoric (Figure 5.20). A large drainage is visible directly below the site at the foot of the hill.

Figure 5.19. 41BS2674.

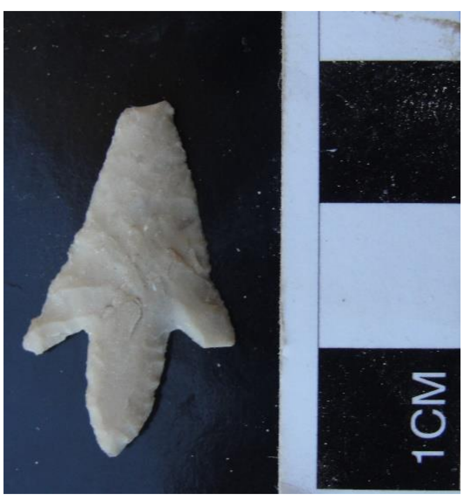

Figure 5.20. Perdiz arrow point from 41BS2674.

41BS2675 – Rock shelter. A small rock shelter with dimensions of 5.5 meters across, 2.5 meters deep, and 3 meters high, 41BS2675 is a low density site with little to no potential for buried deposits (Figure 5.21). No burned rock or carbon-stained sediments were observed at this site. Lithic artifacts consisted solely of flakes and one core fragment; no temporally diagnostic artifacts were observed. A large drainage is located at the foot of the hill below the shelter.

Figure 5.21. Overhead picture of 41BS2675.

N25 Quadrat

41BS2676 – Rock shelter. A rock shelter with good evidence of utilization, 41BS2676 is 8.4 meters across, 5.5 meters deep, and 2.5 meters high at the dripline with a talus that extends roughly 15 meters downslope (App A.11). There is a moderate amount of burned rock and the sediments of the shelter are carbon-stained (Figure 5.22).

Lithic artifacts consisted of flakes and a couple of biface preforms. Several mano fragments and a small grinding slab were also observed. No temporally diagnostic artifacts were found. The depth of deposits in this shelter are likely less than 50 centimeters.

Figure 5.22. Interior of 41BS2676.

41BS2677 – Rock shelter. A wide if not especially deep rock shelter, 41BS2677 is 24 meters across and 5.5 meters deep (Figure App A.12). The large talus extending roughly 20 meters downslope indicates intensive utilization and use as a hot rock cooking facility (Figure 5.23). Burned rock and carbon-stained soils are abundant in both the shelter and on the talus. Lithic flakes and debitage, bifaces, unifaces, and manos were all observed in large numbers at this site. There appears to be significant potential for buried deposits in the shelter. No temporally diagnostic artifacts were found at this site.

Figure 5.23. 41BS2677 and talus.

41BS2678 – Rock shelter. Located along the hill rim just west of 41BS2677, 41BS2678 is a somewhat smaller shelter at 13.3 meters across and 5.6 meters deep, but it appears to have been just as intensively utilized as its neighbor (Figure App A.13). Burned rock and carbon-stained soils are abundant in both the shelter and on the large talus, indicating the use of the site as a hot rock cooking facility. Lithic artifacts are numerous and consist of flakes, cores, bifaces, and one possible Paisano dart point fragment, dating the use of the site to at least the Late Archaic (Figure App A.14). Several manos were also observed. One large roof block on the west side of the shelter has several incised lines, at least six shallow bedrock grinding features, and one grinding feature (bedrock mortar) roughly 40 centimeters deep (Figure 5.24). The presence of historic debris indicates that this site has likely been collected in the past. There appears to be moderate potential for buried deposits, likely less than a meter deep.

Figure 5.24. Large roof block with numerous bedrock grinding features.

41BS2679 – Rock shelter. A shallow rock shelter located under a limestone shelf partially down the hillslope from the hill rim, 41BS2679 is 12 meters across and 4 meters deep and seems to have little potential for buried deposits (Figure 5.25). No burned rock and very few lithic flakes were observed. No temporally diagnostic lithic artifacts were found. Historic debris were also present, at a rate that seemed higher than many of the nearby shelters. Some incisions were present on large blocks of roof spall. The site did contain two pictographs, both linear geometric designs in red pigment; this is one of only two sites with observed rock art in the survey area (Figure App A.15).

Figure 5.25. Interior of 41BS2679.

Southern Survey Area

Eight 500 by 500 meter quadrats were surveyed in the southern survey area. Four quadrats – S2, S6, S19, and S21 – did not contain any sites and the other four quadrats – S3, S16, S24, and S25 – each had at least one site. The survey area contains two areas of high topographic relief with flats in the middle and in the west part of the survey area. There are no mapped permanent or intermittent water sources in the survey area and none were observed during the course of the survey (Figure 5.26). Twelve sites are located in the south survey area, including two lithic procurement sites, two lithic scatters, three open campsites, and five rock shelters (Figure 5.27). The sites are described by survey quadrat in the following section.

Figure 5.26. South survey area showing sites and topographic lines at 20 feet intervals.

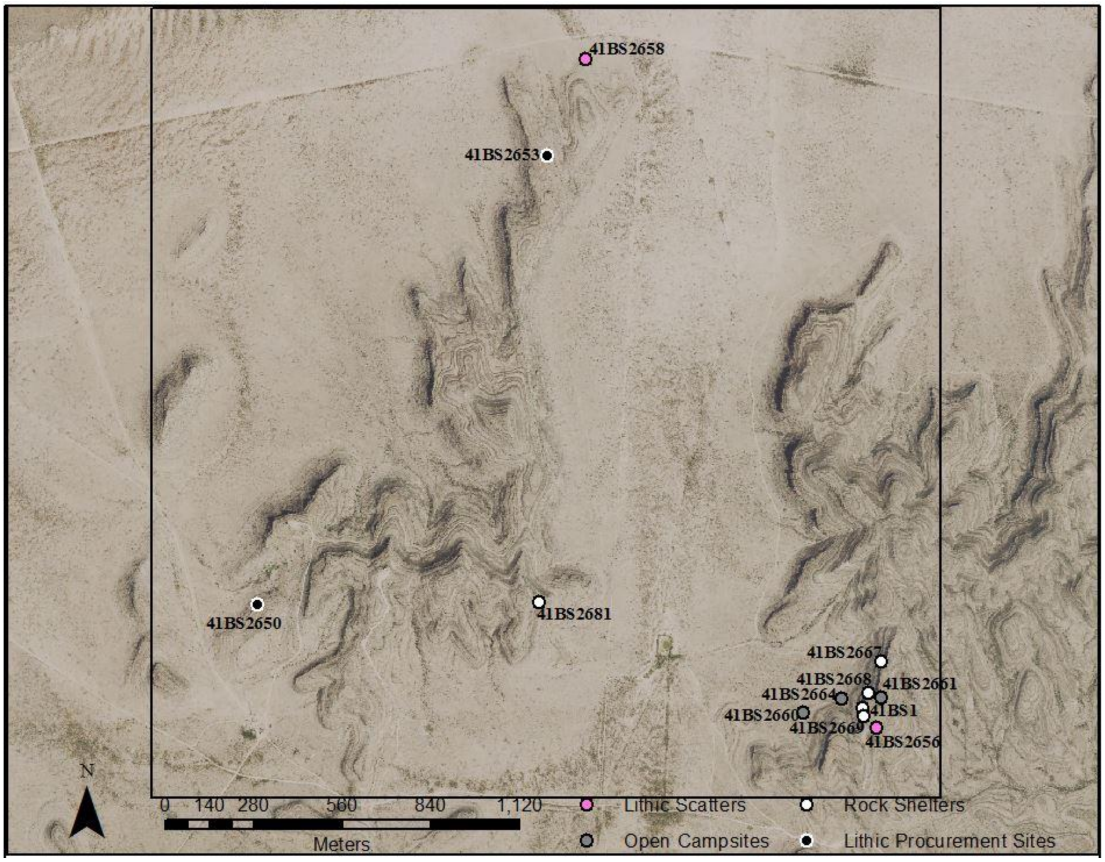

Figure 5.27. Sites recorded in south survey area.

S3 Quadrat

41BS2653 – Lithic Procurement Site. A non-dense lithic procurement site located on a hilltop terrace, 41BS2653 is 18 by 18 meters in area. Chert is easily available where it is eroding out from the limestone bedrock at the south end of the site (Figure 5.28). Flakes, cores, and other lithic debitage is present at the site. An Arenosa dart point was found at the site, dating the use of the site to at least the Middle Archaic (Figure App A.16). There is little to no potential for buried deposits at the site.

Figure 5.28. 41BS2653.

41BS2658 – Lithic Scatter. Site 41BS2658 is a small, non-dense lithic scatter, measuring 23 by 15 meters. Located at the toeslope of a hill, the site rests on bare rock and shallow soils with little to no potential for buried deposits (Figure 5.29). Artifacts found include flakes, a core, and a biface. No temporally diagnostic artifacts were observed.

Figure 5.29. Exposed bedrock and shallow soils at 41BS2658.

S16 Quadrat

41BS2650 – Lithic Procurement Site. 41BS2650 is a small lithic procurement site, with an area of 13 by 30 meters (Figure 5.30). Located on a narrow hill side terrace, chert can be found eroding out from the limestone bedrock. There is no potential for buried deposits at the site. Lithic procurement activities can be inferred through the presence of primary flakes, cores, and other lithic debitage. No temporally diagnostic artifacts were observed. Site is unusual in that the chert at 41BS2650 appears identical to chert widely available along the rest of the hill side, but this site is the only area where evidence of human exploitation can be seen. Site overlooks a small drainage to the northwest where a historic dam, 41BS2648, is located.

Figure 5.30. 41BS2650.

S24 Quadrat

41BS2681 – Rock shelter. A medium-sized rock shelter, 41BS2681 is 9.7 meters across, 6.1 meters deep, with a low roof that ranges from 1.8 meters at the dripline to 60 centimeters in the back of the shelter. The depth of deposits is unknown, but is likely less than a meter. Human utilization and the use of the shelter as a hot rock cooking facility is evident from the burned rock and carbon-stained sediments present in both the shelter and on the moderately sized talus (Figure 5.31). A fair number of lithic artifacts were observed at the site, including flakes and bifaces. One dart point made of black hornfels or fine-grained basalt was found and typed as a possible Castroville (Figure App A.17). This projectile point dates the use of the site to at least the Late Archaic.

Figure 5.31. 41BS2681.

S25 Quadrat

41BS2656 – Lithic Scatter. At 35 by 20 meters, 41BS2656 is a small, non-dense lithic scatter. The site is located along a narrow hilltop terrace with little to no potential for buried deposits (Figure 5.32). Cores, bifaces, modified flakes, and lithic debitage were observed at the site. No temporally diagnostic artifacts were found.

Figure 5.32. 41BS2656.

41BS2660 – Open Campsite. 41BS2660 is a non-dense open campsite that is 38 by 46 meters in area. The site is located near the toeslope of a hill (Figure 5.33). 41BS2660 contains two light burned rock scatters, lithic debitage, and one grinding stone. No temporally diagnostic artifacts were found. There is evidence that the site has been heavily disturbed, as a historic two-track road cuts through the site and historic debris litters the area (Figure App A.18). There seems to be little potential for buried deposits.

Figure 5.33. View of 41BS2660 with 41BS1 visible in background.

41BS2661 – Open Campsite. 41BS2661 is an open campsite which is located on a hilltop terrace above 41BS2668, a rockshelter. At 26 by 16 meters, it is a small site; a small amount of lithic debitage is present at the site. 41BS2661 also contains the only stone alignments found at a site during this survey (Figure 5.34). The northern stone alignment is roughly circular, with a diameter of 2.5 meters. Another possible stone alignment is located 2 meters west of this one. The southern stone alignment is roughly rectangular in shape, about 4 meters long on the longest side and about 2 meters long on the shortest side (Figure App A.19). They are dissimilar to the typical Late Prehistoric Cielo Complex stone features found in the region, as the stone alignments at 41BS2661 are not circular. Given their shape, it is unlikely that the stone alignments at this site were the bases for wikiup-type structures, although they might have acted as bases for windbreaks or as fence post supports. No temporally diagnostic artifacts were found at this site.

Figure 5.34. Arrow pointing at southern stone alignment at 41BS2661.

41BS2664 – Open Campsite. Located on a toeslope directly beneath 41BS1, 41BS2664 is an open campsite that is 60 by 10 meters in area (Figure 5.35). The site contains a burned rock scatter and some carbon-stained sediments on the east side. There is some potential for buried deposits at the site, perhaps 20 to 30 centimeters deep. Lithic debitage, modified flakes, cores, and a mano fragment were all observed during inspection of the site. One dart point was also found, but it was not able to be typed (Figure App A.20). A historic two-track road runs through the west end of the site, so it has likely been heavily collected.

Figure 5.35. View of 41BS2664 with 41BS1 visible.

41BS2667 – Rock shelter. A small shelter, 41BS2667 is 6 meters across and 2.5 meters deep (Figure 3.36). The sites appears to have been minimally utilized, with minimal amounts of burned rock and carbon-stained sediments. The depth of deposits in this shelter is likely less than 20 centimeters. There were few lithic artifacts, mostly flakes; no temporally diagnostic artifacts were observed.

Figure 5.36. View of 41BS2667.

41BS2668 – Rock shelter. Located on the hill rim just north of 41BS1, 41BS2668 is a wide and shallow rock shelter at 12 meters across and 5 meters deep (Figure 5.37). A small talus slope contained burned rock, carbon-stained sediments, and lithic artifacts. The inside of the shelter contained some burned rock and lithic artifacts, although the potential for buried deposits seems minimal. Nine shallow bedrock grinding features were also observed at the site. When the talus slope was closely inspected, a possible arrow point preform made on a flake was found (Figure App A.21). This projectile point dates the use of the shelter to at least the Late Prehistoric.

Figure 5.37. 41BS2668.

41BS1 – Rock shelter. Informally designated Crow Cave by the survey crew, 41BS1 (Figure 5.38) was the only previously recorded site (Kelly and Smith 1963) in the survey area. 41BS1 is 11 meters across and 6.5 meters deep with an extensive talus. Buried deposits in the shelter range from 75 centimeters to 1.2 meters in depth (Kelly and Smith 1963: 169). Burned rock and carbon-stained sediments cover both the shelter floor and the talus, indicating intensive use of this shelter as a hot rock cooking facility. Lithic artifacts occur at a high density; flakes, unifaces, cores, and bifaces are all common. No temporally diagnostic artifacts were found in the course of this survey, but Kelly and Smith (1963: 170-172, 187) reported Langtry, Paisano, Livermore, Toyah, and Perdiz points from the testing at the site. These projectile points date the use of this site from the Middle Archaic through the Late Prehistoric. The shelter contained linear geometric pictographs made with black pigment, which were not mentioned in the original report (Figure App A.22). The site also contains historic graffiti as well as evidence of extensive collecting.

Figure 5.38. View of 41BS1 and extensive talus.

41BS2669 – Rock shelter. 41BS2669 is a rock shelter that is 8 meters across and 2 meters deep, located under the hill rims just south of 41BS1. The rock shelter is almost hidden from view when standing downslope due to vegetation and rock fall in front of the entrance (Figure 5.39). The shelter has a minimal talus. Artifacts consist only of lithic debitage; no temporally diagnostic artifacts were found. A small amount of burned rock and a shallow bedrock grinding feature were present in the shelter (Figure App A.23). Buried deposits in the shelter are likely less than 50 centimeters in depth. Overall, 41BS2669 appears to have been moderately used.

Figure 5.39. View of 41BS2669.

VI. RESULTS

Statistical Analysis

Chi-Square Goodness of Fit

To determine if site frequency recorded in quadrats with rock shelters was significantly different than site frequency recorded in quadrats without rock shelters, a Chi-Square Goodness of Fit test was conducted. The null hypothesis (H0) was that there is no difference in the frequency of sites between these two categories. The alternate hypothesis (H1) was that there was a significant difference in the frequency of sites between quads with rock shelters and those without. The number of survey quadrats was used to estimate the expected number of sites in each category, e.g. expected number of sites in quadrats with rockshelters = 7/16*33. The Chi-Square Goodness of Fit (Table 6.1) resulted in a value of 26.113, degrees of freedom=1, p value = .0000003. This indicates, with a very high degree of statistical certainty, that these samples are significantly different; the null hypothesis can be rejected and the alternate hypothesis can be accepted.

Table 6.1. Chi-Square Goodness of Fit test.

	Number of Quadrats	Number of Sites Observed	Number of Sites Expected
Quads with Rock shelters	7	29	14.4
Quads without Rock shelters	9	4	18.6
Totals	16	33	

Chi-Square Test of Independence

After the Chi-Square Goodness of Fit test determined that there was a significant difference between the numbers of sites in quadrat with and without rock shelter quadrats, the question arose of how different site types are located across the landscape and how they are distributed within these two categories. In order to determine this, a Chi-Square Test of Independence (Table 6.2) was calculated. Lithic procurement sites, lithic scatters, and open campsites were all considered in this test. To have a statistically significant data set, rock shelters were included as either lithic scatters or open campsites based on which site description they better fit. The null hypothesis (H0) was that there is no difference in the number of sites based on site type between quadrats with and without rock shelters. The alternate hypothesis (H1) was that there is a difference in site numbers based on site type between quadrats with and without rock shelters.

Table 6.2. Observed and expected values for Chi-Square Test of Independence.

	Quadrats without Rock shelters	Quadrats with Rock shelters	Totals
Lithic Scatter	1/1.21	9/8.79	10
Lithic Procurement	3/0.85	4/6.15	7
Open Campsite	0/1.94	16/14.06	16
Totals	4	29	33

$\chi^2 = 8.457$, df = 2, p value = 0.015.

When the Test of Independence was calculated (Table 6.2), it resulted in a p-value of 0.015 (χ^2 values of 8.457, df = 2). This indicates a significant difference in the number of sites in quadrats with and without rock shelters based on site type and the Cramer's V= 0.506 indicates it is a moderate, not a strong, pattern. However, this does not indicate which types of sites are significant. To determine that, adjusted residuals must be determined. A value of either above 1.96 or below -1.96 is considered to be significant. After adjusted residuals were determined for this data set (Table 6.3), it became clear that the values for two site types influence the significant result in the Test of Independence. There are significantly more lithic procurement sites found in quadrats without rock shelters and significantly more open campsites found in quadrats with rock shelters than would be expected if the distributions were even.

Table 6.3. Adjusted residuals for Chi-Square Test of Independence.

	Quadrats without rock shelters	Quadrats with rock shelters
Lithic Scatter	-0.25	0.25
Lithic Procurement	2.81	-2.81
Open Campsite	-2.07	2.07

Geospatial Analysis

In addition to the statistical analyses described, a form of geospatial analysis was desired. As the driving research question behind this survey was how rock shelters affect where other sites are located on the landscape, a method analyzing the distances between rock shelters and other sites was necessary. Since the topography of an area influences how people move on a landscape and how much effort it takes them to move from one location to another, a method that takes into account the changes in elevation along these distances was vital. Thus, it was decided to analyze the sites in the survey areas using cost distances from rock shelters. Cost distances from water sources were not calculated, as the Dove Mountain USGS topographic quad does not contain any marked permanent or intermittent streams within either survey areas.

Stovall Ranch Geospatial Analysis

North Survey Area. When the northern survey area is analyzed using cost distances from rock shelters, the results are striking (Figure 6.1). The cost distances are represented on a gradational scale with the blues indicating low cost distances, the greens are medium cost distances, and orange and red indicate increasingly higher cost distances. Eight of the ten open sites fall into the lowest four cost distance categories from rock shelters. Two of the three open campsites, including the largest open campsite recorded during the survey, lie within the second cost distance from the rock shelters. The pattern continues to hold true when the actual pattern of the survey, the light gray crosshatched areas, is taken into consideration. Several areas of high cost distance were surveyed, with no sites being found in these areas. If lithic procurement sites are excluded from the analysis, using the logic that their location is more a function of geology than of human choices, the results become even more striking (Figure 6.2). All of the lithic scatters and open campsites lie within the lowest four of ten cost distances from rock shelters.

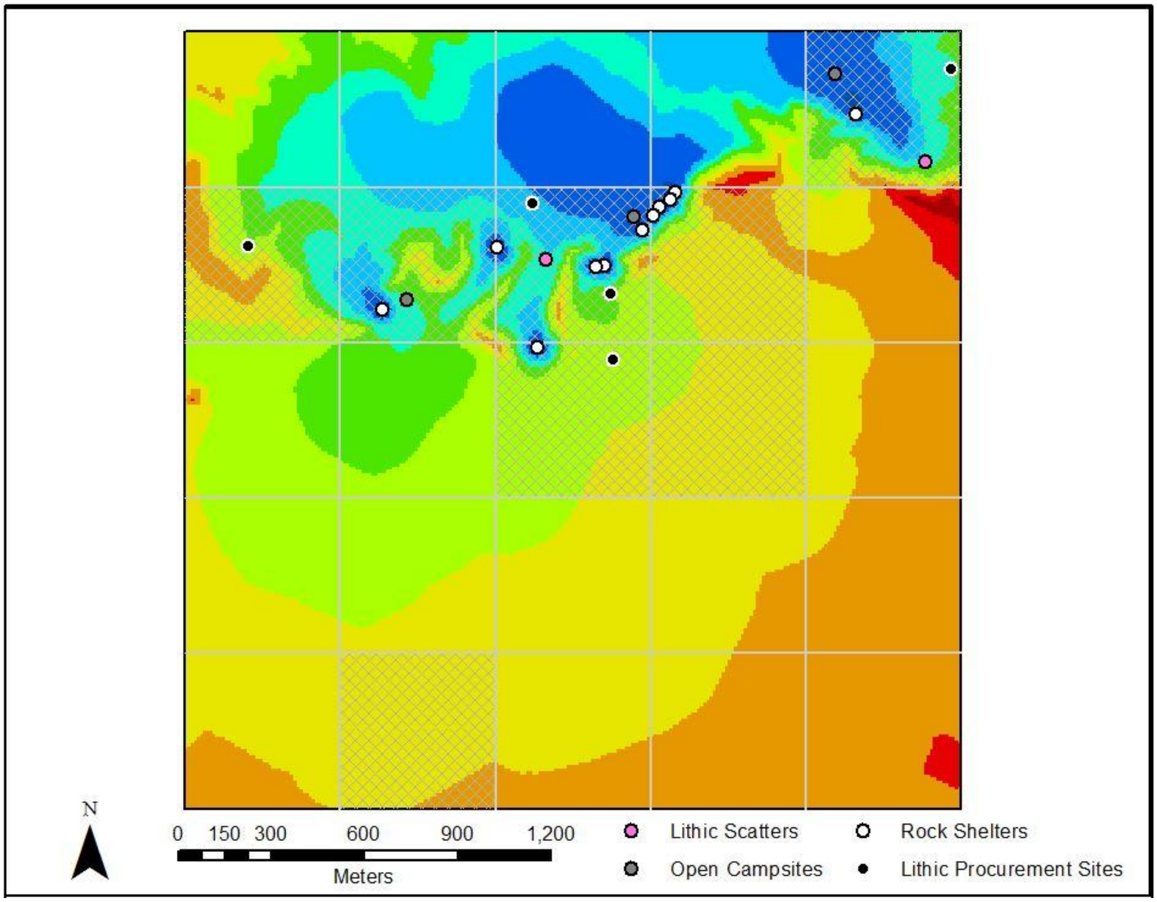

Figure 6.1. Cost distances from rock shelters in the north survey area – surveyed areas indicated with crosshatching.

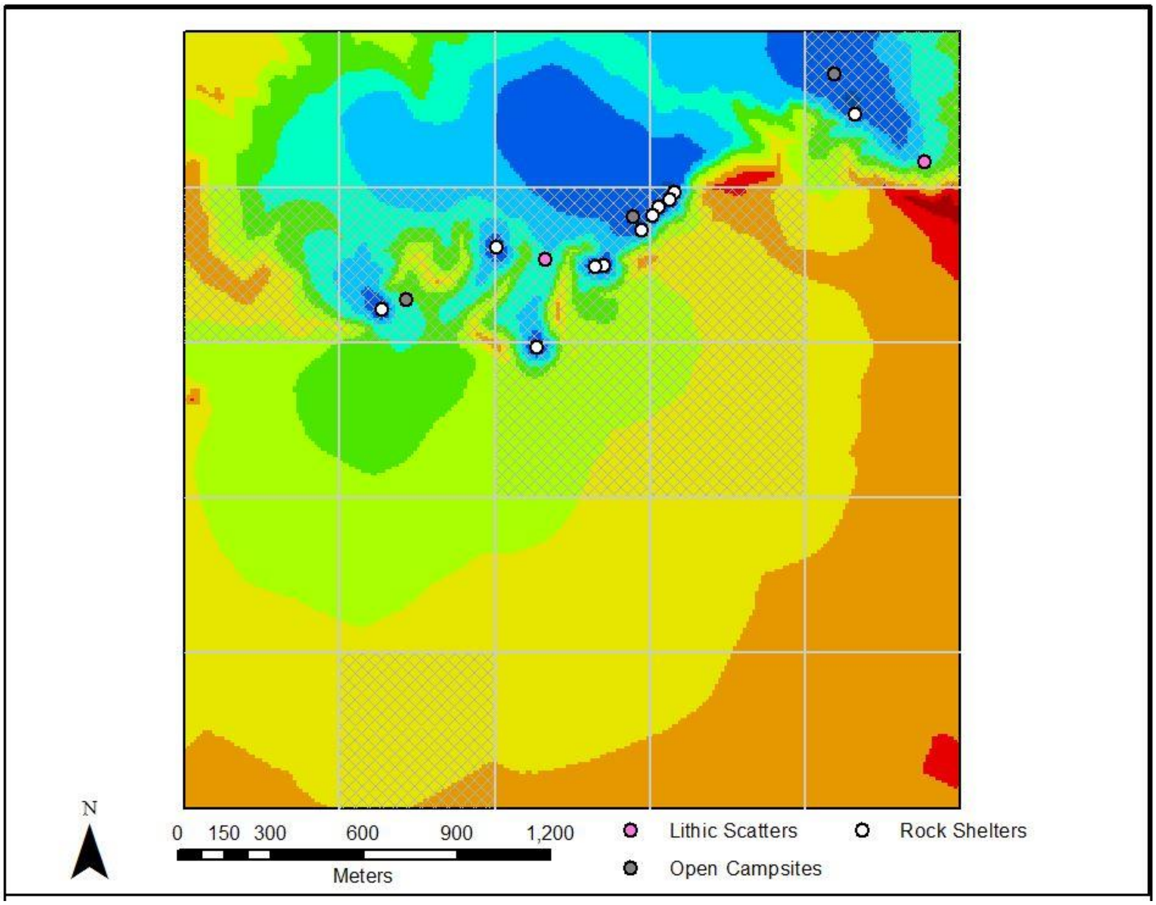

Figure 6.2. Cost distances of lithic scatters and open campsites from rock shelters – surveyed areas indicated with crosshatching.

South Survey Area. When the cost distances from rock shelters in the south survey area are analyzed, the results are almost as striking (Figure 6.3) as those of the north survey area. Four of the seven open sites are located in the lowest three of ten cost distance categories from rock shelters. All of the open campsites are located in areas of low cost distances. Like the north survey area, the pattern remains striking when the surveyed areas, the crosshatched areas, only are considered. When lithic procurement sites are not considered (Figure 6.4) in the analysis, four of the five sites are located in the lowest three cost distance categories. A small lithic scatter is the only site that lies at a much higher cost distance.

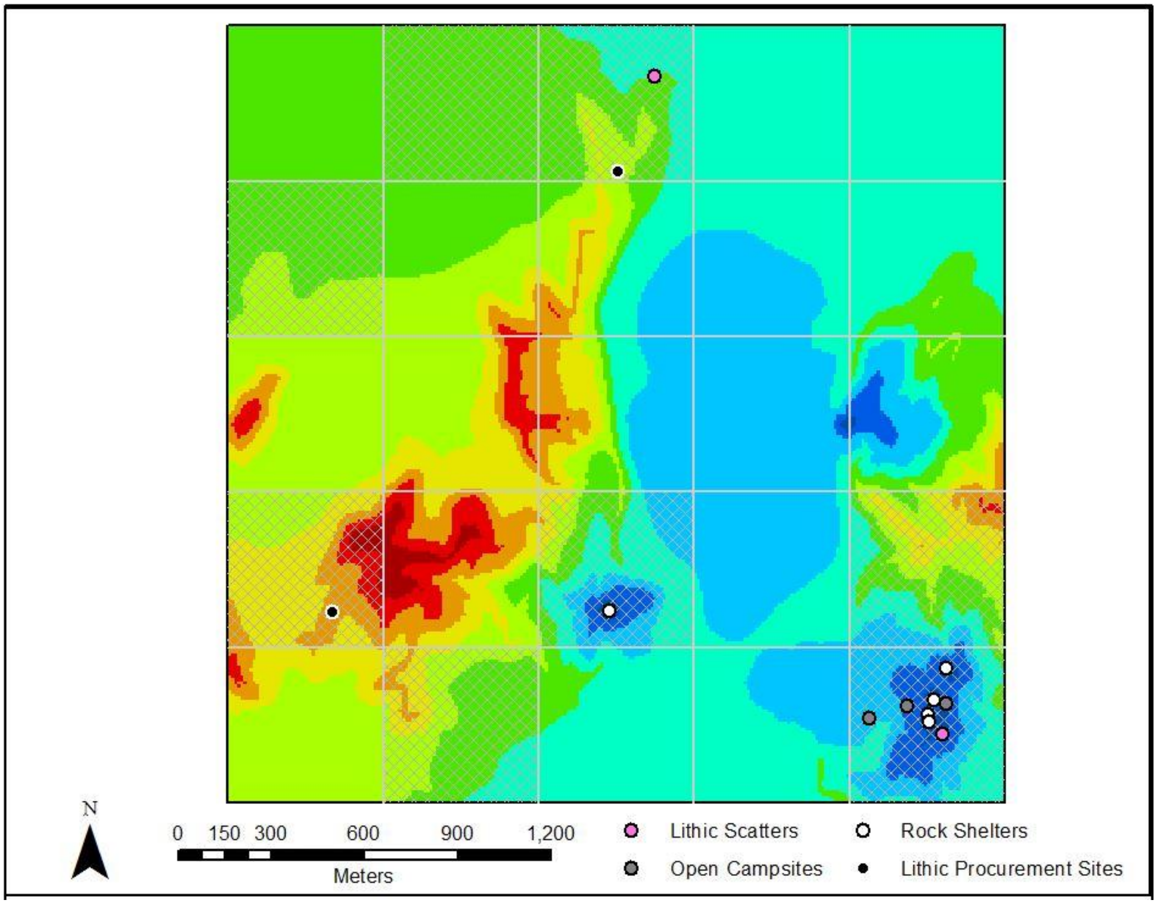

Figure 6.3. South survey area cost distances from rock shelters – surveyed areas are indicated with crosshatching.

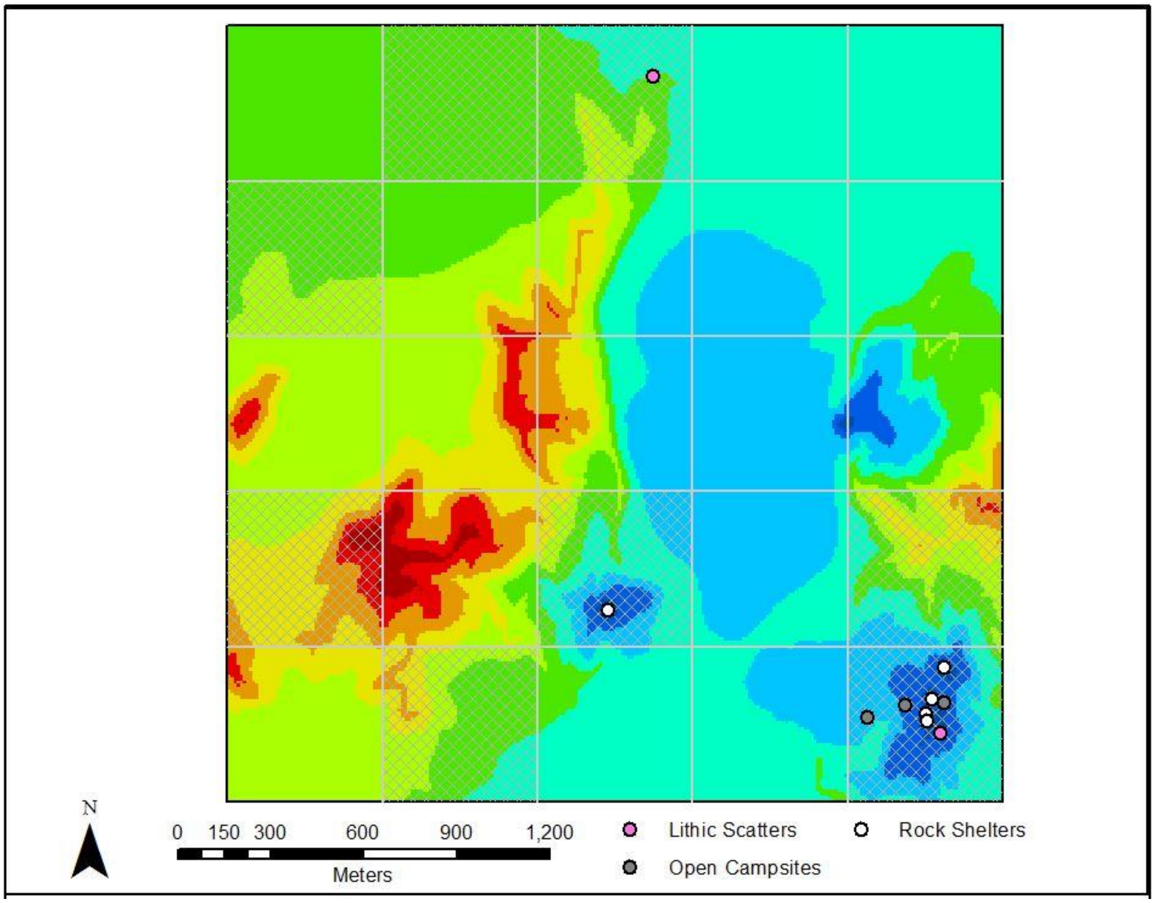

Figure 6.4. Cost distances of open campsites and lithic scatters from rock shelters – surveyed areas are indicated with crosshatching.

Marmaduke's Bear Creek Survey Geospatial Analysis

The results of Marmaduke's survey of Bear Creek also display striking results (Figure 6.5) when the cost distances from rock shelters in comparison to the locations of open sites are analyzed. Only two sites out of the sixty-seven that are classified as open campsites according to my definitions fall outside of these three lowest cost distances. Of all the open sites, 19.8% fall within the lowest cost distance category from rock shelters. When the two lowest categories are combined, that percentage climbs to 55.6%. If the three lowest cost distances from rock shelters are considered together, 80.3% of open sites, both open campsites and lithic scatters, are within this area. It is important to remember that it is likely that not all of the area shown in Figure 6.5 was surveyed by Marmaduke. The actual area he surveyed were not recorded in his report (Marmaduke 1978a) or on the Texas Archeological Sites Atlas.

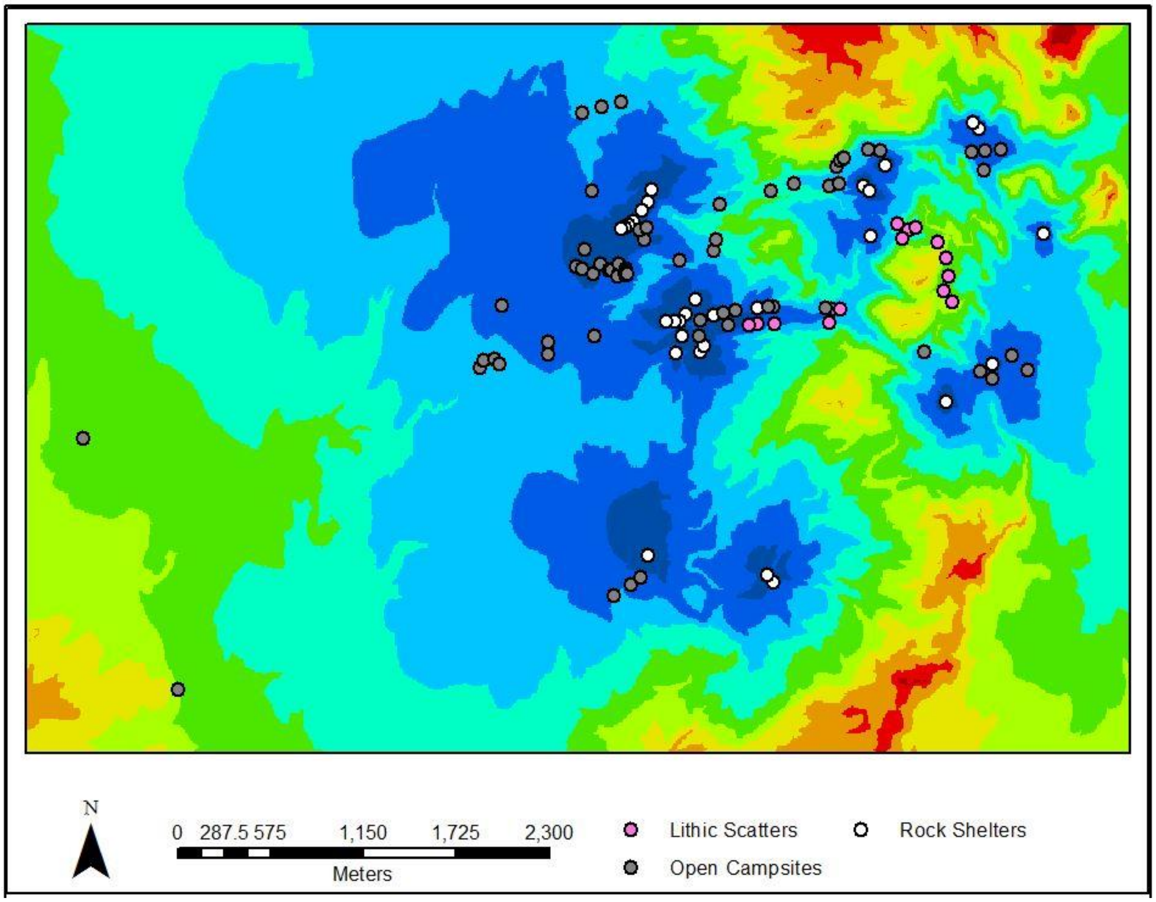

Figure 6.5. Cost distances from rock shelters in the Bear Creek survey area.

VII. DISCUSSION AND CONCLUSION

Settlement Patterns in the Big Bend

Previous Research

As stated in Chapter 1, information about settlement patterns in the Big Bend area of Texas is lacking. The dearth of large scale surveys and excavations in the region means that the data from which settlement pattern studies can be investigated are lacking, although this should change with the forthcoming publication of the Center for Big Bend Studies' large scale archaeological survey of Big Bend National Park (Cason and Keller 2012). The general lack of geoarchaeological data for the region also makes it difficult to determine how issues of site preservation affect the evidence for settlement patterns which can be observed today.

Some information about settlement patterns in the Big Bend region is available. It is clear that population density in the landscape increased through time (Marmaduke 1978a:164-169), and that the population density in the Late Archaic was particularly high (Mallouf 2005:230). It is also apparent that the Late Prehistoric Cielo Complex peoples favored hilltop locations for their sites and that the Late Prehistoric use of mountaintops as ritual spaces has its roots in the Late Archaic (Mallouf 2005, 2013a). In addition, survey reports from the area make it clear that open sites tend to be located near large drainages (Ohl and Cloud 2001:73-74). Other reports note the tendency for sites to be located in the foothills region (Ing et al. 1999:80; Sanchez 1999:43). In general, the hunter-gatherers of the Big Bend can be thought of as having a mobility pattern tethered around water, as well as central places from which they can exploit resource patches (Bettinger 1991:87-90, 93-97; Taylor 1968).

Current Study

In Chapter 6, results of statistical and geospatial analyses of the possible effect of rock shelters on open sites in eastern Brewster County were reported. Statistical analysis showed that there was a significant difference in the number of sites between survey quadrats that contained rock shelters and those that did not. Other statistical analyses showed that there was a significant lack of open campsites in quadrats which did not contain rock shelters. As for the geospatial analysis, cost distances on the Stovall Ranch north and south survey areas showed a strong tendency for open sites, especially open campsites and lithic scatters, to be located at low cost distances from rock shelters. This pattern held true when the sites recorded during Marmaduke's (1978a) survey of Bear Creek were analyzed.

The statistical and geospatial analyses are promising and do suggest a strong correlation between the locations of rock shelters and open sites, especially open campsites and lithic scatters. This indicates that prehistoric hunter-gatherers in the Big Bend tended to locate their open sites near rock shelters. This tendency could either be because the rock shelters acted as convenient central foraging places, or because the rock shelters were themselves important resources of shade and cooler temperatures. However, the case for a causal relationship between these variables should not be forced. That being said, a positive correlation could be used as the basis for a predictive model in the future.

Considerations for the Current Study

Like all studies, there are some issues which must be taken into account when considering this research. The Stovall Ranch survey conducted by the author should be seen as a preliminary survey. The area surveyed was a little under 1,000 acres and by necessity focused on areas which had large numbers of rock shelters within a couple of kilometers. While this means that the influence of the rock shelters' locations was strongly felt, it also means that how sites at distances far from rock shelters are patterned was not studied. The small survey area also meant that only 33 sites were recorded; this small sample size makes it difficult to say anything with statistical certainty and the discerned patterns may not be robust. In addition, the question of how these patterns change through time was not able to be determined, as the ages of only a few sites could be determined.

For the Bear Creek survey which was completed by Marmaduke (1978a) and geospatially analyzed in the previous chapter, there are also some issues that must be mentioned. While Marmaduke (1978a) was able to interpret more about changes to settlement patterns through time than I, a fair number of his sites could not be assigned to a culture phase due to the absence of temporally diagnostic artifacts.

The largest issue with the Bear Creek survey data was that it was impossible to determine the areas that Marmaduke actually surveyed. He states in his report (Marmaduke 1978a) that he surveyed a number of areas in both the ridgeline and valley environments, but it is not reported exactly which area he surveyed or even if he surveyed equal proportions of both. This makes it impossible to say if the lack of recorded sites in the high cost distance areas from rock shelters are a result of actual settlement patterns or simply of a lack of survey data. In future surveys, the boundaries should be clearly indicated as the absence of information can be as informative as the presence of information.

Avenues for Future Research

This thesis can be treated like a preliminary investigation in that it is promising, but much more work should be done on this topic. First, much more survey is needed. Second, more cost distance from rock shelter analyses can be run in different portions of the Big Bend region to see if this is a trend that holds for the entire region. In addition, areas of high cost distances from rock shelters should be investigated in order to determine how sites in these areas might be located and patterned. With more surveys and testing of the geospatial data, it is possible that a predictive model can be made which would increase the efficiency of archaeological surveys in an area that has had all too little work done. Additionally the instigation of systematic sample survey methods may well lead to a much fuller and comprehensive understanding of prehistoric settlement patterns through time.

APPENDIX SECTION

APPENDIX A: ADDITIONAL SITE INFORMATION

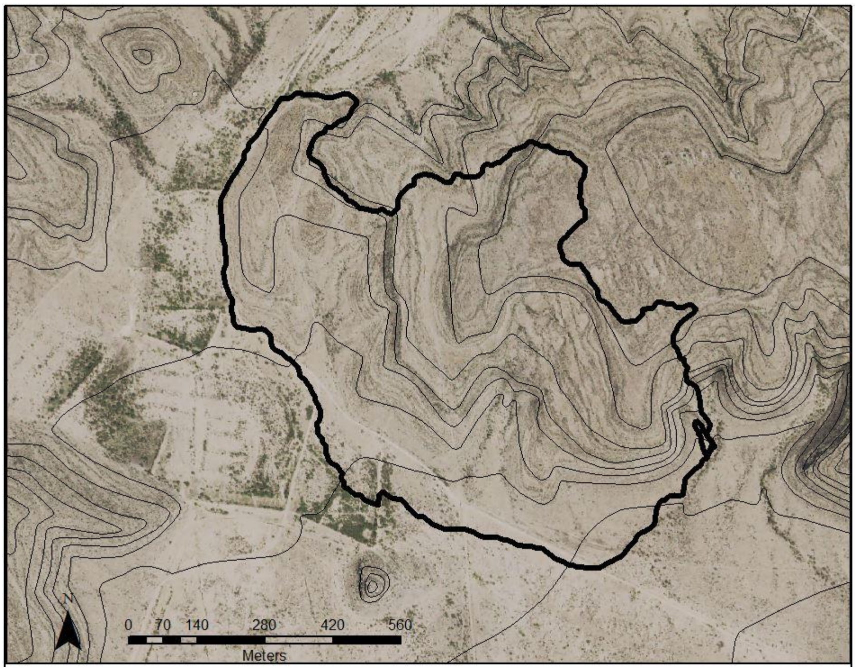

Figure App A.1. Site boundaries of 41BS2652 and 20 feet interval topographic lines.

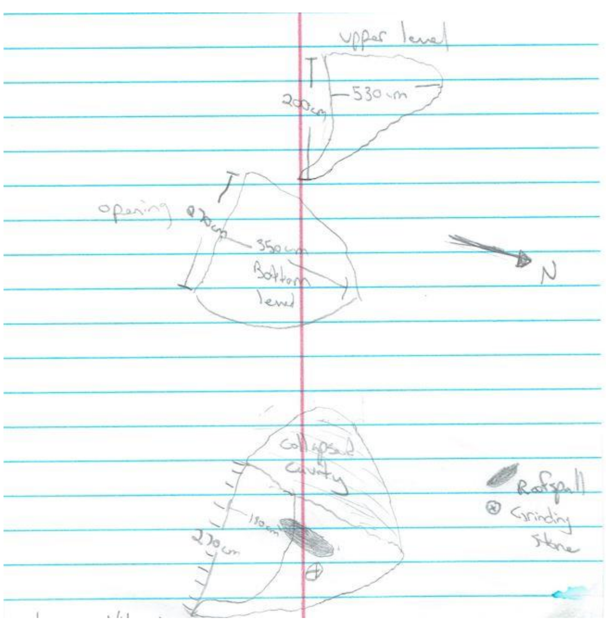

Figure App A.2. Sketch map of 41BS2680.

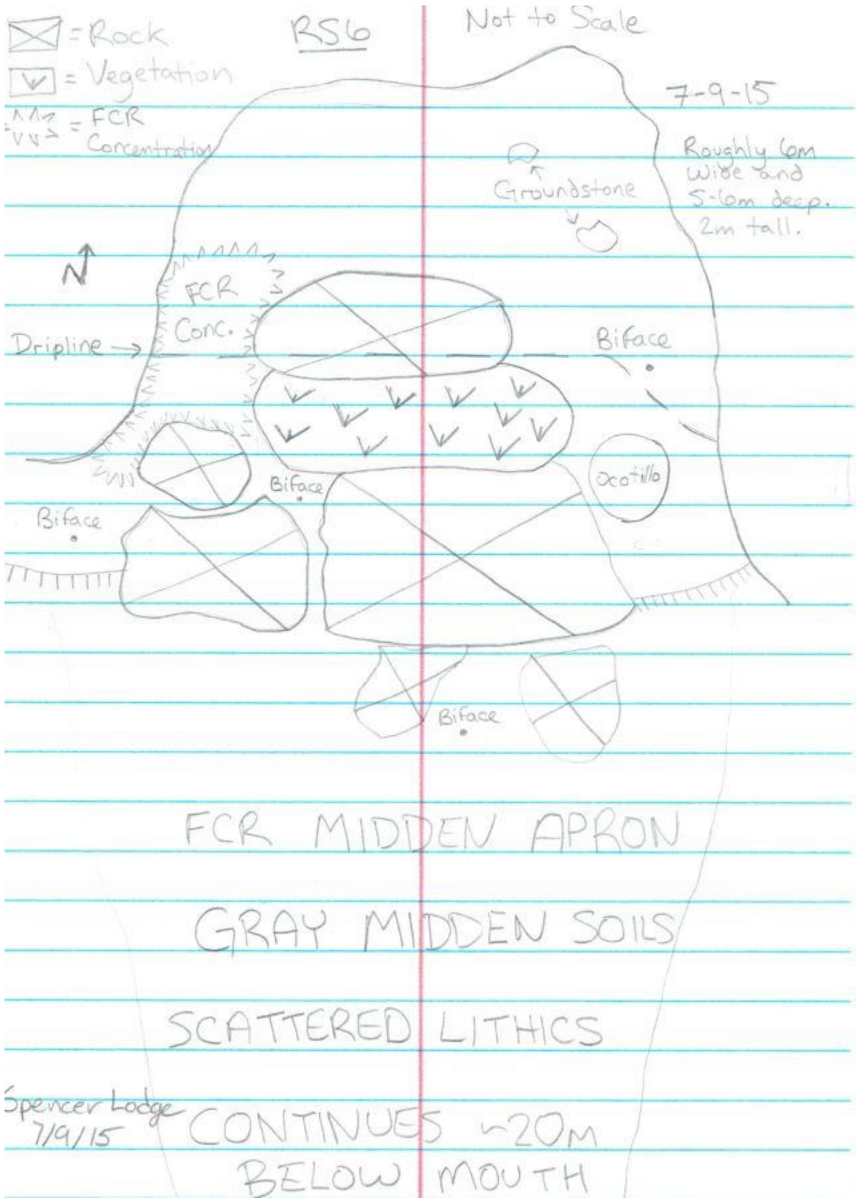

Figure App A.3. Sketch map of 41BS2670.

Figure App A.4. Untyped dart point from 41BS2662.

Figure App A.5. Untyped dart point from 41BS2662.

Figure App A.6. Untyped dart point from 41BS2662.

Figure App A.7. Untyped dart point from 41BS2662.

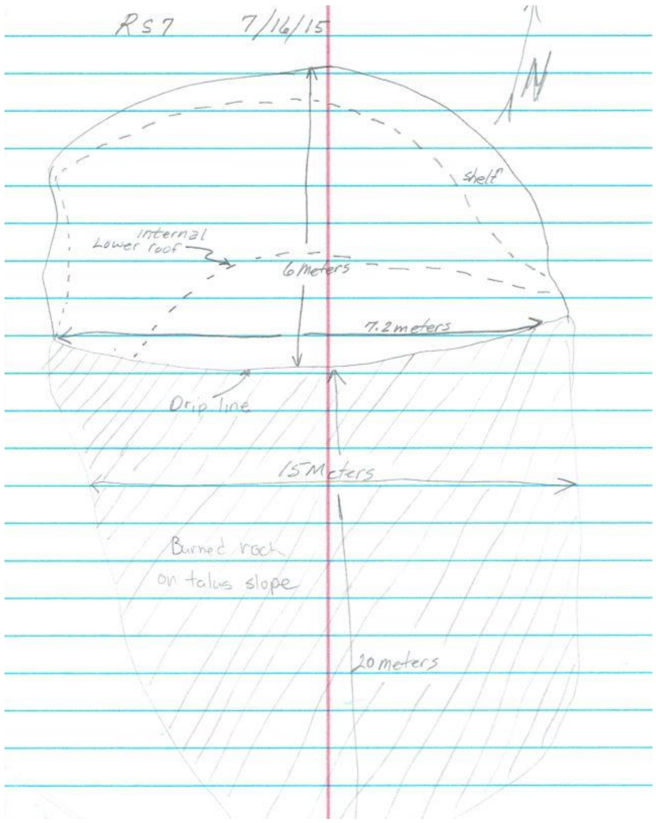

Figure App A.8. Sketch Map of 41BS2671.

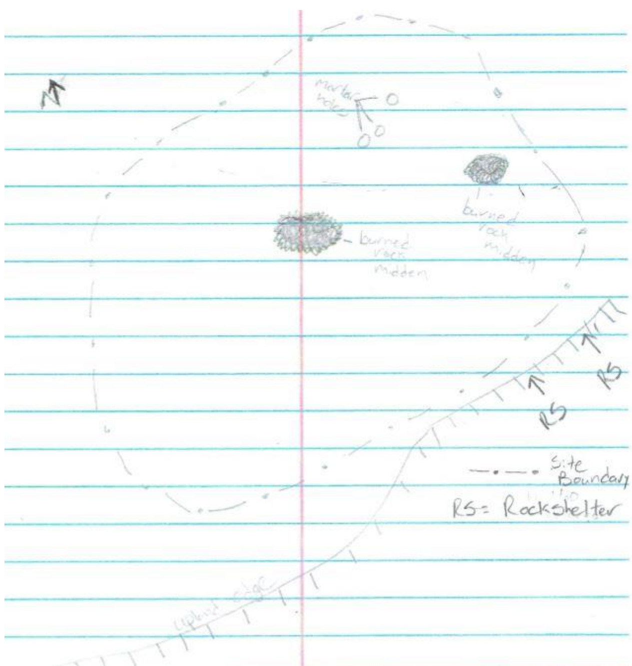

Figure App A.9. Sketch map of 41BS2665.

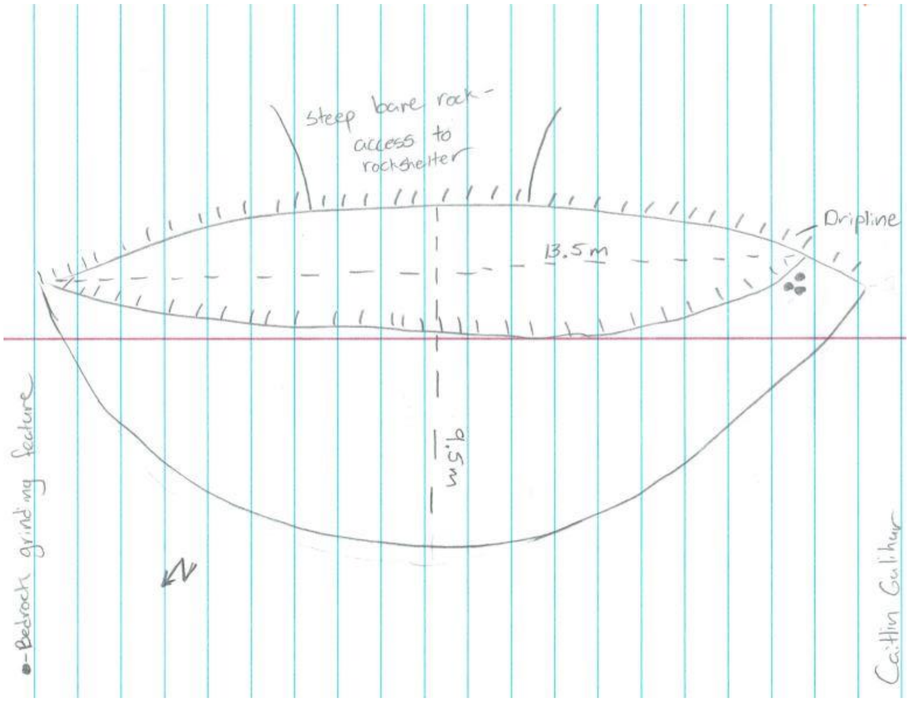

Figure App A.10. Sketch map of 41BS2672.

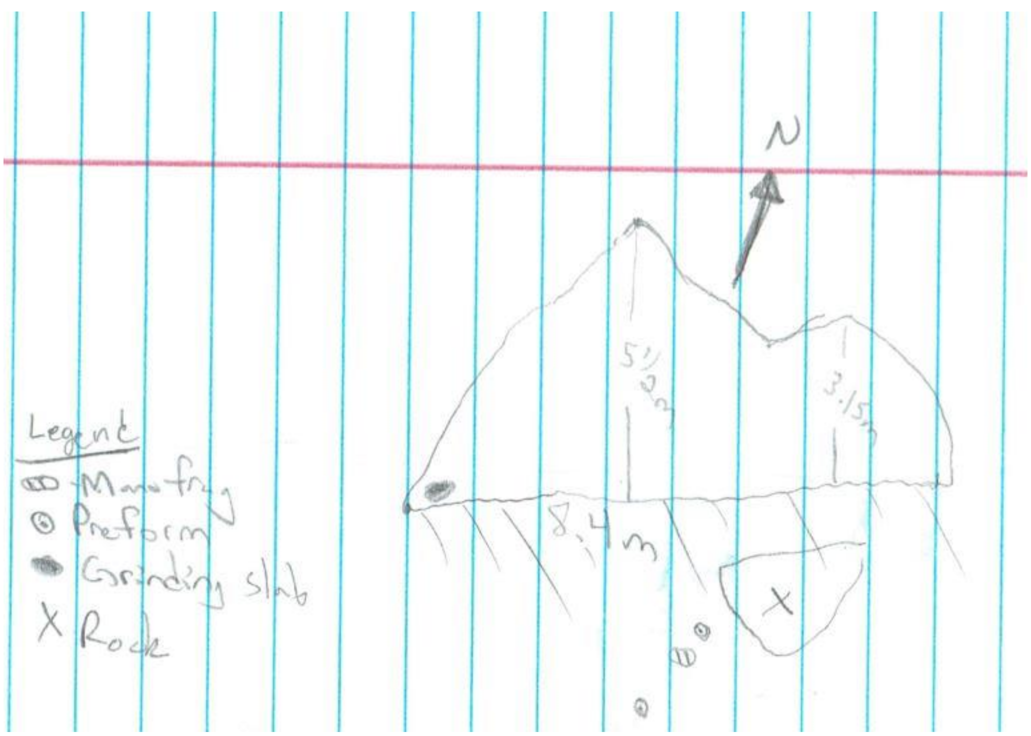

Figure App A.11. Sketch map of 41BS2676.

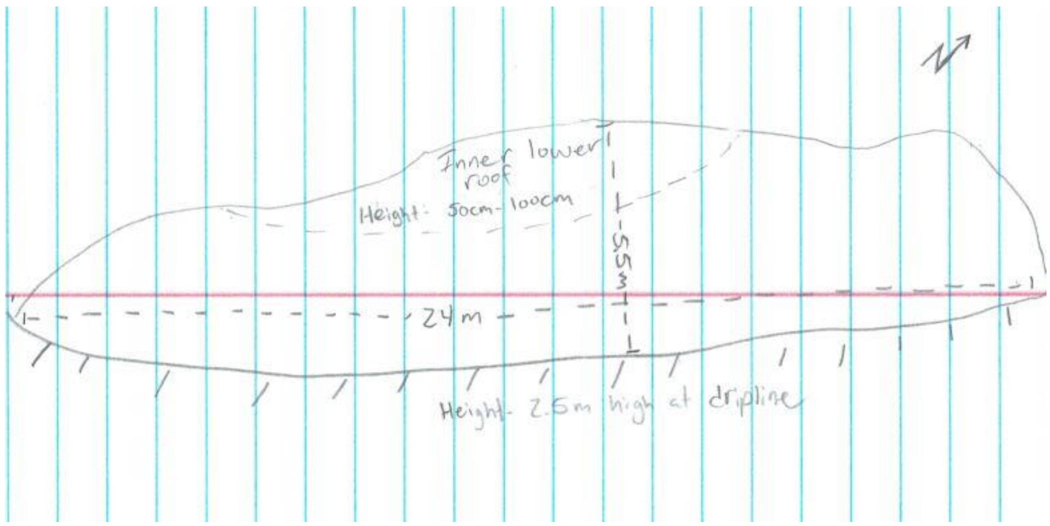

Figure App A.12. Sketch map of 41BS2677.

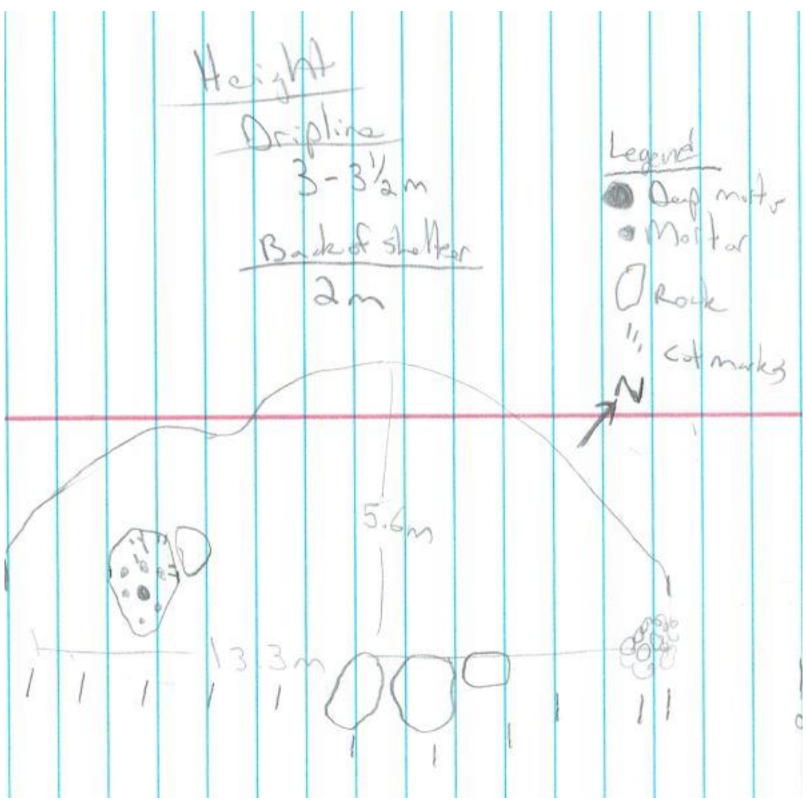

Figure App A.13. Sketch map of 41BS2678.

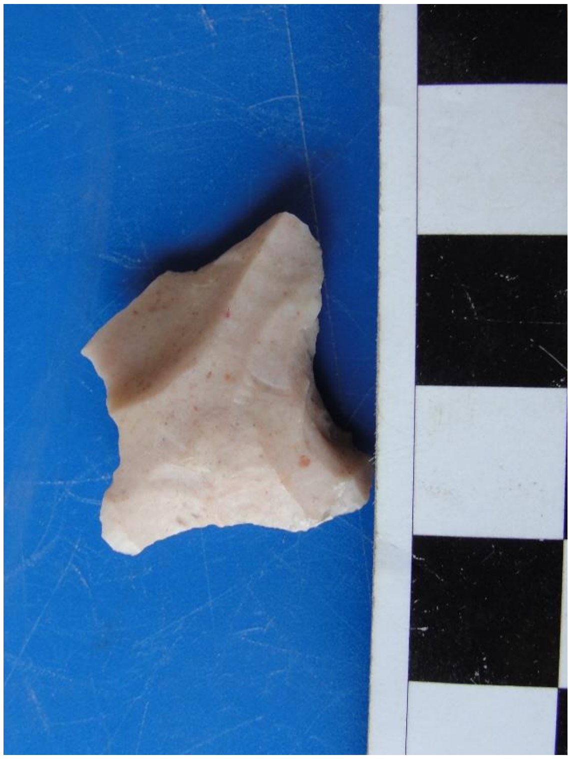

Figure App A.14. Possible Paisano dart point from 41BS2678.

Figure App A.15. Rock art from 41BS2679.

Figure App A.16. Arenosa dart point from 41BS2653.

Figure App A.17. Possible Castroville dart point from 41BS2681.

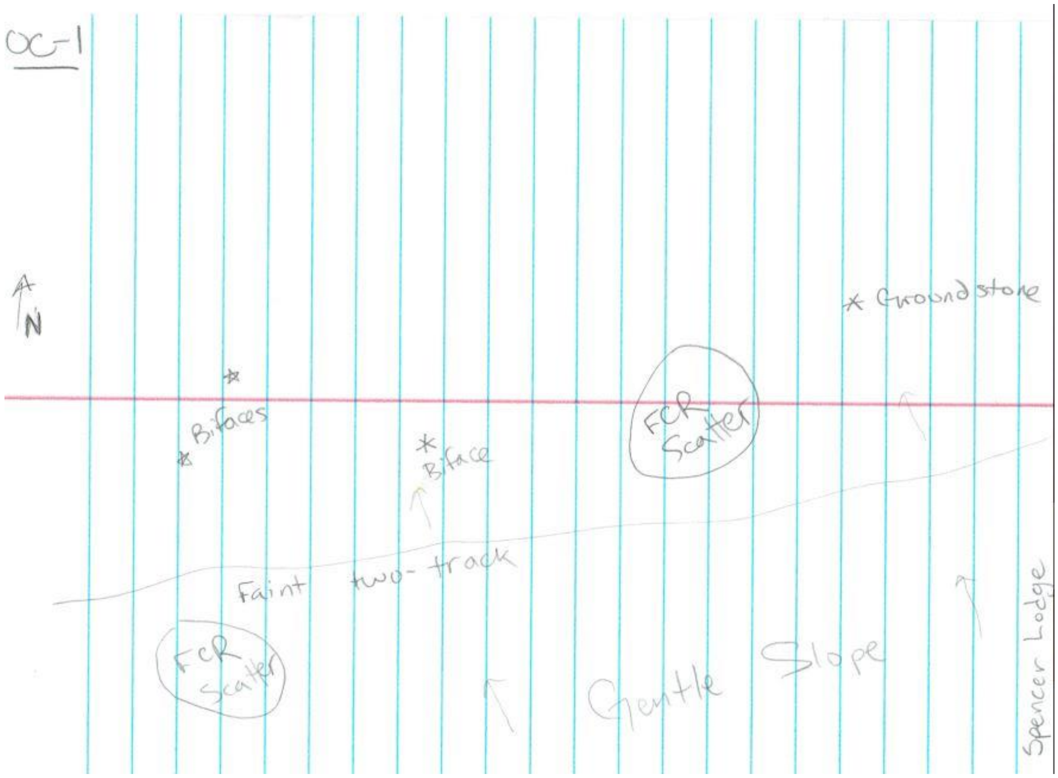

Figure App A.18. Sketch map of 41BS2660.

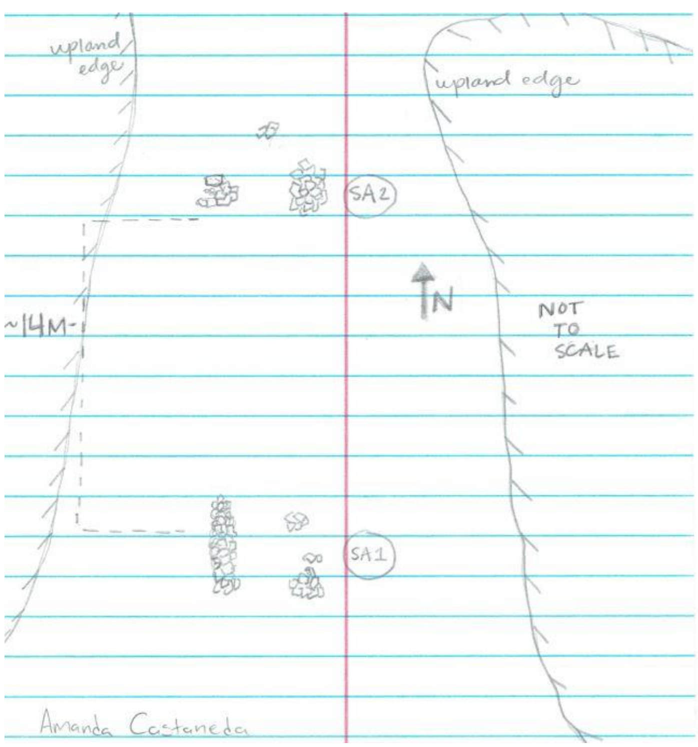

Figure App A.19. Sketch map of 41BS2661.

Figure App A.20. Untyped dart point from 41BS2664.

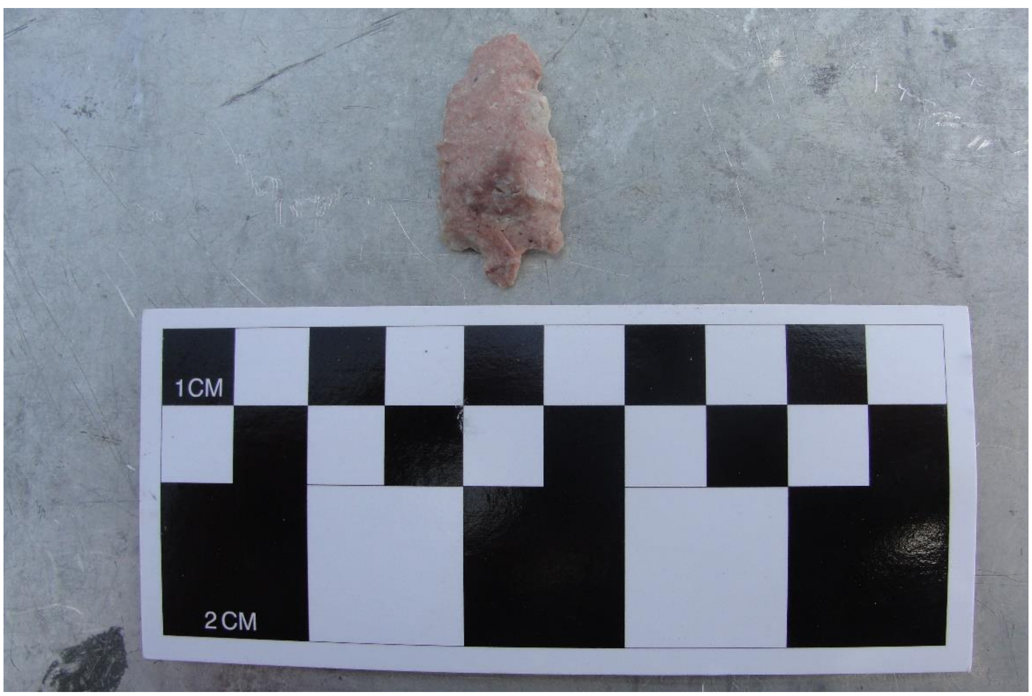

Figure App A.21. Possible Perdiz preform from 41BS2668.

Figure App A.22. Rock art from 41BS1.

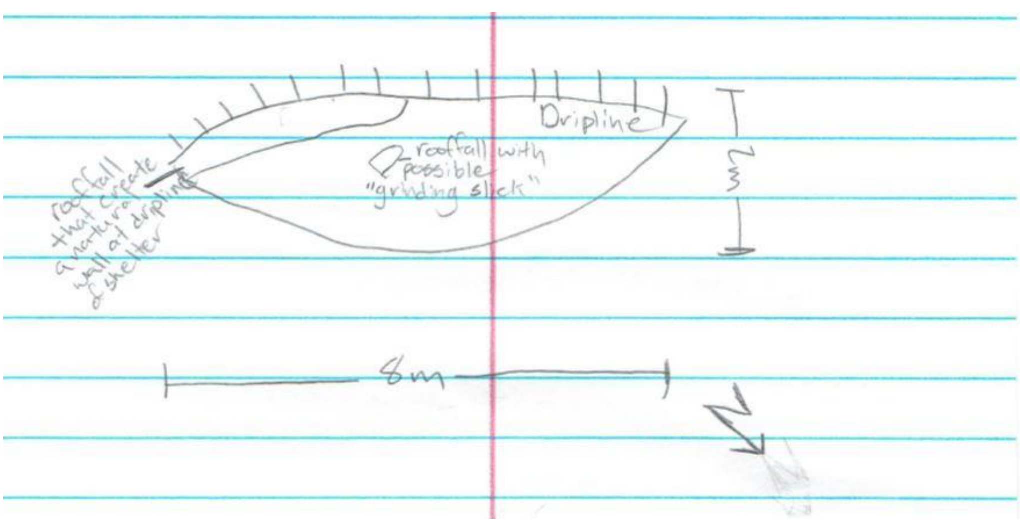

Figure App A.23. Sketch map of 41BS2669.

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