UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

THE DEVELOPMENT OF LATE PALEOINDIAN IDENTITY-BASED TERRITORIES ON THE SOUTHERN PLAINS

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

Doctor of Philosophy

By

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Norman, Oklahoma
2007

UMI Number: 3249639

UMI Microform 3249639

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THE DEVELOPMENT OF LATE PALEOINDIAN IDENTITY-BASED TERRITORIES ON THE SOUTHERN PLAINS

A DISSERTATION APPROVED FOR THE
DEPARTMENT OF ANTHROPOLOGY

BY

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Acknowledgments

This dissertation is the result of numerous individuals who have helped me along the way in completing my research. First, I thank Allen and Maggie Sasse who not only put up with me during the excavation of the Howard Gully site, but also opened up their home and family to me. Ray Cleland of the American Gypsum Company gave me access to the Perry Ranch site, and was very supportive of my research efforts. Robert Blasing of the Bureau of Reclamation was instrumental in helping me obtain funding from the Bureau of Reclamation for geoarchaeological research at 34GR4 on the Lake Altus reservoir.

Without the assistance of dedicated avocational archaeologists this dissertation work would not have been possible. I thank Lawrence and Gene LeVick who have been long time stewards of archaeology in southwestern Oklahoma. They were very generous in opening up their collections for research multiple times, and imparting their knowledge on southwestern Oklahoma archaeology. My projectile point analysis was also based upon the collections of Anne Bullard, Jim Cox, Vera McKellips, the late Roy Patterson, Albert Redder, Billy Ross, and Mike Waller. Thank you all.

I am also indebted to Jeff Indeck who provided research space and access to the Rex Rodger materials curated at the Panhandle-Plains Historical museum. I also thank the staffs at the No Man's Land Historical museum, and River Valley Pioneer Museum for letting me examine spear points from the Nall and Horace River sites.

A special thanks to Joe and Christa McGrory who spent many of their nice summer mornings helping me excavate Howard Gully. I also thank Maggie Dew, Jim Dougherty, Luther and Liz Leith, Brian Lizzo, and Lora Moffet for their hard work at Howard Gully, Perry Ranch, and 34GR4. Brian Carter traveled many times from Stillwater to southwestern Oklahoma to help me make sense out of the deposits at Howard Gully. His soil profile descriptions allowed us to put together a fairly complete picture at Howard Gully.

I thank Beau Schriever who has helped me in all of my research projects. He is one of the most energetic archaeologists that I know. Many of my ideas for this project were formed from long hikes and conversations with Beau around Norman. I also thank fellow unsociables Jethro Gaede and Warren Lail of the Diogenes Club. Cheers to keeping each other moving forward and getting done.

Thanks to my committee members Lee Bement, Circe Sturm, Susan Vehik, Don Wyckoff, and May Yuan who helped make this dissertation a more polished product. Lee supported me with many research and job opportunities throughout my graduate career, and provided sage advice and help at Howard Gully, Perry Ranch, and 34GR4. My thoughts on how to examine identity based territories in the archaeological record were formed in Circe's theories of identity class. Throughout graduate school Susan has been there to stimulate my thoughts on archaeological theory even when I stubbornly refuse to do so. May Yuan taught me how to incorporate GIS into my dissertation. I started working with Don when I first stepped onto campus, and he has immeasurably provided me with research positions and support at the Sam Noble Oklahoma Museum of Natural History. A lot of my thoughts and interests in archaeology stem from Don's great field method courses and numerous conversations. I thank you.

My parents Stephen and Anita Hurst have formed the backbone to keep me upright during the difficult process of being a graduate student. Without their unconditional support I would not have made it through. I dedicate this dissertation to you.

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Abstract

Projectile point styles become more diverse across North America during the late Paleoindian period. Researchers have thought this increase in diversity is part of a regionalization process related to environmental change and/or an increase in population density. A decrease in mobility, reduced territory size, widening of diet breadth, and the formation of ethnic groups are potential results of regionalization. Each of these possible changes are interrelated, and are examined from the perspective of identity based territories in this dissertation.

A combination of excavation and analysis of surface collected projectile points from the Southern Plains were used for determining if late Paleoindians were becoming more regionalized. Excavations were conducted at Rattlesnake slough (34GR4), Howard Gully (34GR121), and Perry Ranch (34JK81) sites in southwestern Oklahoma to uncover chronological information, environmental data, and features. A total of 860 spear points from six localities and late Paleoindian sites across the Southern Plains were examined for delineating late Paleoindian territorial boundaries.

Carbon isotopes and pollen from 34GR4 supports previous research that a significant environmental change occurred ca. 11,000 RCYBP. This indirectly suggests an increase in population density more likely explains the development of more circumscribed territories. Excavation at the Howard Gully site uncovered a shallow side-notched point in association with one to two bison dating to ca. 10,200 years ago. This point style had previously not been well dated, and suggests interactions with eastern woodland groups where this point style is more common. Work at the Perry Ranch site uncovered evidence of a large bison kill, and a gully was used for trapping the bison. This provides a

better context for the Perry Ranch site then what was previously known. Projectile point analysis identified possible territorial boundaries during the late Paleoindian period. Also a reduction in territory size during this period was evident. The sum of these results indicates that prior assumptions about the regionalization process during the late Paleoindian period are true. However, these are tentative results and the story will likely become more complex as we make new discoveries.

Chapter 1

Introduction

Understanding how late Paleoindians fit into the picture of populating the New World has been a mystery for over six decades now. The late Paleoindian period dates between 10,200-8,000 radiocarbon years before present (RCYBP), coinciding with the early Holocene, and is a critical time after deglaciation when the environment is undergoing major changes (Guthrie 1984). We have discovered their past activities in the form of bison kills, campsites, and lithic caches, but the places they occupied are rarely uncovered in good context.

Most of our evidence has come from the recovery of late Paleoindian spear points on the modern ground surface. The hallmark characteristic of the late Paleoindian period is the diversity in projectile point styles. Open up a book on projectile point typology, and you will find at least 10 different types (Figure 1.1). In contrast, during the previous Clovis (11,600-10,900 RCYBP) and Folsom (10,900-10,100) time periods (Holliday 2000a), a specific style of spear point was used. There is some variation in Clovis and Folsom point manufacture, but the main general hafting style does not change (Howard 1995). From the inception of late Paleoindian studies, researchers have questioned why forger groups began designing different styles of spear points.

Historically, all late Paleoindian points were first called Yuma points because they were being found together from surface locations in Yuma County, Colorado (Renaud 1931). Their first discovery from a stratified site context was at the Clovis site in New Mexico (Sellards 1952; Sellards and Evans 1960). The 1949-1950 excavations by Sellards, Mead, and Evans at Clovis revealed these points were associated with bison re-

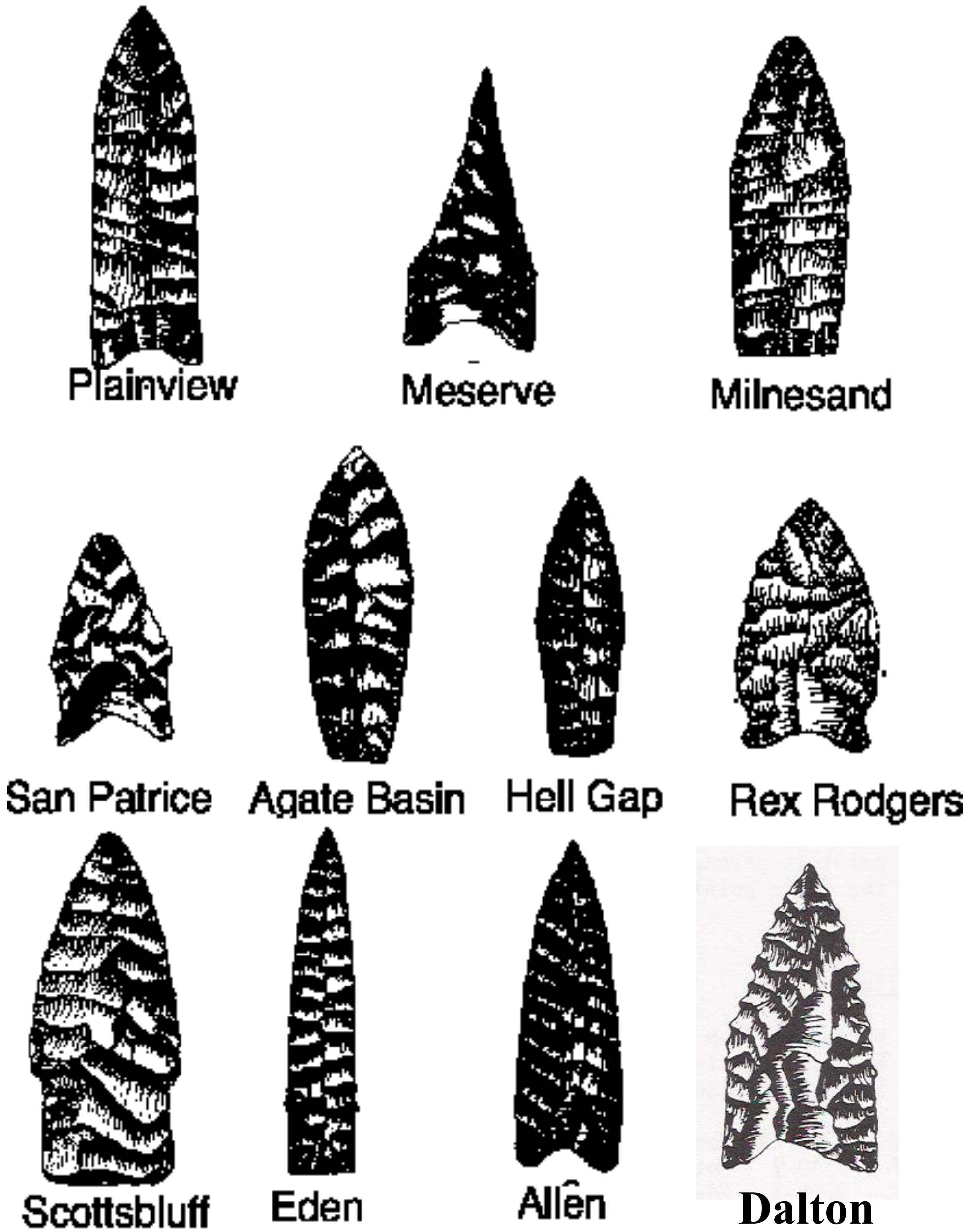


Figure 1.1. Late Paleoindian projectile point types found on the Southern Plains. Adapted from Bell (1958, 1960) and Perino (1968, 1971).

mains, and occurred in Stratum 5, above the earlier Clovis and Folsom Paleoindian levels. The main attribute distinguishing Clovis and Folsom points from late Paleoindian points is their fluting. To Sellards, Evans, and Mead this meant that people using unfluted projectile points came after forager groups that fluted their spear points. In addition, the unfluted points were designed in many different ways compared to the previous Clovis and Folsom technology. They thought these different points were part of the same culture, which they called the Portales complex (Sellards and Evans 1960), since they were found together in the same stratum.

The idea of one cultural group making all these different point styles did not withstand the discovery of single component sites and multiple component sites with better integrity across the Great Plains. Subsequently, other point styles and their chronologies were defined at Agate Basin (Frison and Stanford 1982), Casper (Frison 1974), Hell Gap (Irwin-Williams et al. 1973), Horner (Frison and Todd 1987), James Allen (Mulloy 1959), Plainview (Sellards et al. 1947), and Ray Long (Hannus 1986) sites. In addition, Agogino and Rovner's (1969) investigations at the Clovis site in the 1960s further identified separate cultural horizons for the post-Folsom occupations. They discovered a late Paleoindian cultural sequence of Agate Basin, Cody, and Frederick. Although Plainview and Milnesand spear points were also discovered, there was not a specific stratum for which to provide a context. Agogino and Rovner's work were later confirmed by Johnson and Holliday's (1997) investigation of the site. The late Paleoindian points at Clovis were not made by the same culture, but represent the actions of several groups of people (Johnson and Holliday 1997).

Today, the prevailing theory for the emergence of the late Paleoindian period is that environmental change and/or an increase in population caused forager groups to become more regionalized. The crowding of people on the landscape resulted in them selecting a wider range of food resources within a smaller area rather than focusing just upon large game (LaBelle 2005; Stanford 2000; Walthall and Koldehoff 1998). The formation of smaller territories and perhaps the development of ethnicity during the late Paleoindian period was a result of this regionalization process (Johnson 1989). This pattern of regionalization is apparent for most of North America [e.g. the Northeast (MacCarthy 2003), the Southeast (Carter 2003), the Rocky Mountains (Pitblado 2003), the Great Lakes region (Ruggles 2001), and the Great Plains (Stanford 2000)]. The increase in diversity of projectile point styles is thought to reflect these cultural changes. With culturally different forger groups, there is potentially an increase in spear point styles. My research involves examining these ideas about the late Paleoindian period. In essence, this is a three part question.

First, was there a cause for late Paleoindians to become more regionalized? Was it due to an environmental change or population pressure? Second, did in fact late Paleoindians become less mobile, broaden their diet, and occupy smaller territories? And third, did these forager groups form ethnic identities? I focused my attention on the Southern Plains region for addressing these issues.

The Southern Plains region is characterized by a patchy distribution of resources. Of particular importance is that high quality lithic materials are unevenly distributed (Banks 1990). This makes it possible to examine changes in mobility patterns, and the development of territories through the movement of raw materials. Many of our ideas about Paleoindians have also been developed on the Southern Plains, e.g. Clovis (Cotter 1937), Folsom (Figgins 1927), and Plainview (Sellards et al. 1947). In addition, the large number of collectors with late Paleoindian points and research potential at late Paleoindian sites made the Southern Plains region ideal for furthering our understanding of early Holocene people.

On the Southern Plains today, over 20 late Paleoindian sites have associated radiocarbon dates and contexts (Figure 1.2). From these sites, we have a better understanding of when some of the point styles were being made (Table 1.1 and 1.2). For some of the point styles, there is a considerable age range in their occurrence. Plainview for example, has been difficult to define because of its ubiquitous frequency and wide ranging radiocarbon dates (Holliday et al. 1999). Styles such as Agate Basin, San Patrice, Scottsbluff/

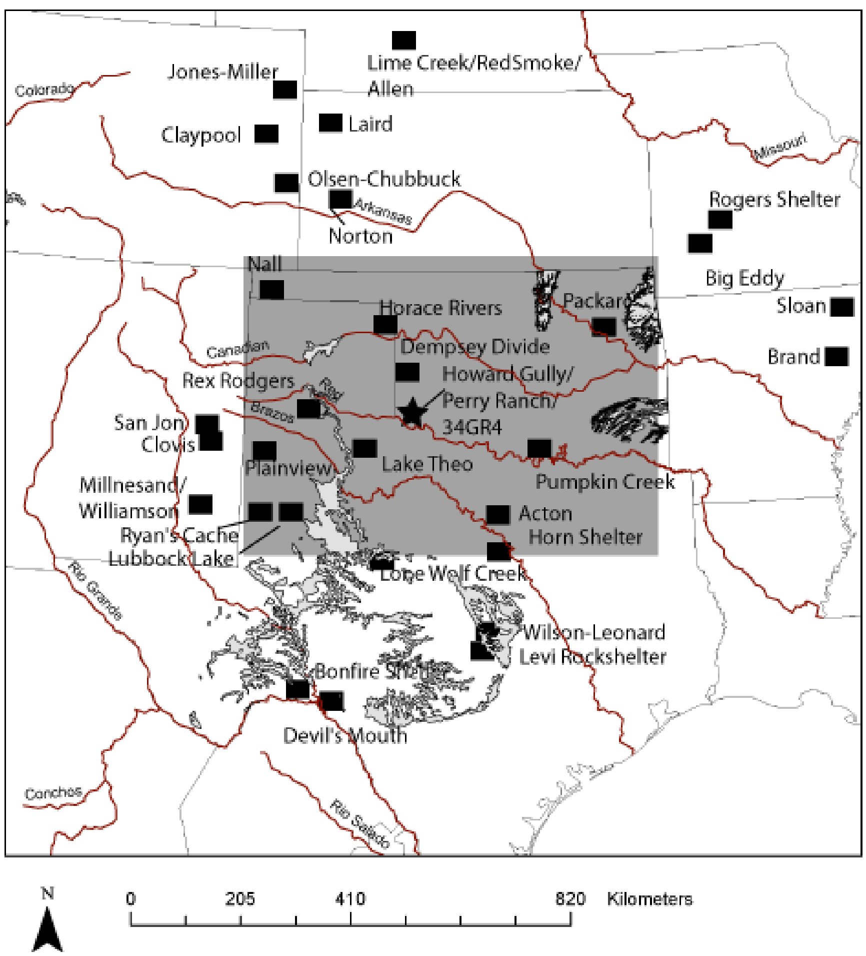


Figure 1.2. Location of key late Paleoindian sites. The grey shaded area denotes study area.

Table 1.1. Dated Late Paleoindian Sites From Study Area on the Southern Plains

Site Name	Projectile Point Types	Site Type	Radiocarbon Dates	Material Dated	References
Horace Rivers	Plainview	Campsite	9,000±70 (Beta-55909) 9,040±70 (Beta 55908) 9,060±(Beta55907) 9,290±80(AA-9397)	Charcoal	Mallouf and Mandel 1997
Horn Shelter	San Patrice/Plainview	Campsite	9,458±300 (SM-761) 9275±-360 (SM689) 8400±110 (TX-1996) 9500±200 (TX-1830) 10,030±130 (TX-1998) 9980±370 (TX1722) 10,310±150 (TX1997)	Charcoal/Snail Shell	Valastro et al. 1979; Watt 1978
Howard Gully	San Patrice?	Bison Kill	10,214±55 NZ (21229)	Petris Collagen	
Lake Theo	Plainview	Bison Kill	9,420±85 (SMU-856) 9,950±110 (SMU-866)	Humates A-horizon	Johnson et al. 1982
Lubbock Lake (FA5-17)	Agate Basin	Bison Kill	9,950±120 SMU-1261	Organic Rich Mud	Knudson et al. 1998
Lubbock Lake (FA6-11)	Plainview	Bison Kill	9,990±100 (SMU-728) 9,960±80 (SMU 275) 10,015±80 (SI-3203)	Soil	Johnson 1987
Nall	Plainview/Frederick-Allen	Campsite	7,740±80 (Beta-121880) 6,870±40 (Beta-141597) 9640±110 (Beta-121881) 9650±(Beta-125446) 9700±80(Beta-138041)	Charcoal/Baker Soil	LaBelle 2003
Packard	Agate Basin, Side-Notched Point, Dalton	Campsite/Work	9,630±100 (AA-3119) (Dalton) 9,416±193 (NZ-478) (Dalton) 9,880±90 (AA-3116) (Agate Basin) 9,830±70 (AA-3117 (Agate Basin) 9,770±80 (AA-3118) (Agate Basin)	Charcoal	Wyckoff 1985, 1989
Perry Ranch	Plainview	Bison Kill	7,030±190 (TX-2190) 8,460±45 (CAMS-95513)	Bone/Petris Collagen	Hurst and Wyckoff 2004; Saunders and Penman 1979
Plainview	Plainview	Bison Kill	9,860±180 (TX-3908) 10,200±400 8,860±110 (SMU-234) 8,790±60 (NSRL-1881 CAMS-16166) 8,790±80 (NSRL-3469 CAMS-38695) 9,110±90 (NSRL-3464 CAMS-38693) 10,170±100 (NSRL-2060 CAMS-35909) 10,660±70 (NSRL-2061 CAMS-35910) 11,440±80 (NSRL-2059 CAMS-35908)	Bone/Collagen	Speer 1990; Holliday et al. 1999
Rex Rodgers	Plainview/San Patrice?	Bison Kill	9,326±83 (SMU-274)	Bone	Speer 1978
Ryan's Site	Plainview	Cache	9,220±220 (SMU-2448) 10,650±120 (SMU-2447)	Soil	Hartwell 1995

Table 1.2. Estimated radiocarbon dates for late Paleoindian point styles on the Southern Plains.

Point Style	Approximate Radio-carbon Date	Sites
Plainview	10,200-9,000	Plainview, Lubbock Lake, Perry Ranch, Horace Rivers, Lake Theo, Ryan's Cache, Horn Shelter No. 2
Agate Basin	9,800	Packard, Lubbock Lake
Dalton	9,600	Packard
Scottsbluff/Eden (Cody)	9,400-8,200	Lubbock Lake
Terminal Paleoindian (Allen, Frederick, Angostura) Oblique Flaking	9,000-8,000	Nall
San Patrice	10,200	Howard Gully, Rex Rodgers

Eden, and Dalton have only been dated at a few sites in the study area. And, for some of the sites we just have approximate soil ages or unreliable bone dates.

My strategy for gathering data is twofold. First, only through further research at late Paleoindian sites can basic chronological information about the relationship between some of the spear points styles be determined. We are still unclear whether a few of the various styles overlap in time, or if they were made by different generations of people (Holliday 2000a). Information gained from excavation can also provide finer resolution for better delineating mobility patterns, the formation of territories, and ethnicity.

There have been some notable studies that use surface collections for determining the amount of mobility and likely territories (Ballenger 2000; Hofman 1991, 2003; Jennings 2006; Taylor-Montoya 2003). However, from excavated contexts, we have the potential to also learn what a particular group(s) was doing at one time and one place. A good example of this is Bement's (1999b) study of the lithic assemblage from the Cooper

Folsom site. He discovered variation in the amount of resharpening and differences in the percentage of lithic raw material represented with each of the three kills. This suggests that the group(s) who made each of the kills might have been coming from different areas, perhaps after spending different amounts of time at other subsistence extraction locations. Clearly, at this fine scale of analysis there is more variation in Folsom mobility patterns and use of territory that can't be discerned with surface finds which masks variability (Bement 1999b).

Excavation of late Paleoindian sites can also lead to a better understanding of the possible development of ethnic groups. It is only at the site level of analysis that we can examine whether one or different cultural groups are responsible for making the artifacts. This is based upon looking at the diversity of material culture at the site in relation to spatial patterning. Discrete clusters with evidence of varying techniques and styles for making artifacts may suggest contrasting ways of manufacture indicative of distinct cultural groups. If only one group of people were present at the site, then it is also important to ascertain their range of acceptable fabricating techniques and styles. This further helps in determining from surface collections how many different groups of people might have participated in making projectile points.

My second research strategy is to examine late Paleoindian projectile points from surface collections. The value of examining surface-found projectile points is their high ubiquity, and widespread distribution across my study region. Because projectile points require many decisions before their completion, they are more likely to convey group differences than a simple flake tool. Projectile points are also useful for elucidating territorial boundaries and mobility patterns. This is based upon examining the distribution of spear points on the landscape in relation to their raw material source.

I was successful in my research in locating three sites in southwestern Oklahoma for excavation. Also, I was able to analyze a total of 860 surface collected points from six different localities across the Southern Plains (Figure 1.3).

Testing of the 34GR4 site at Lake Altus was conducted to assess if there were any contexts from which late Paleoindian materials could be recovered. Lawrence and Gene LeVick have been collecting from the site for numerous years. Several late Paleoindian points from their collection suggested the possibility of an undisturbed site. Backhoe trenching and coring was used to determine if there were any intact soils containing late Paleoindian occupations. From this work, several potential soils were discovered dating to the early Holocene period. At one of the trenches with traces of an early Holocene soil, six 1x1m units were excavated to ascertain if there was any evidence for a late Paleoindian occupation. Associated late Paleoindian artifacts were not found with these soils, but they do merit further investigation. From an excavation wall and core hole, pollen samples were removed for providing important environmental information about climate change for the early Holocene period in southwestern Oklahoma. The results from research at 34GR4 are provided in Chapter 4.

At Howard Gully, excavation revealed the remains of one or two bison associated with shallow side-notched points that have been rarely discovered in dated contexts on the Great Plains. The radiocarbon age of 10,214±55 (NZA-21228) years ago places the

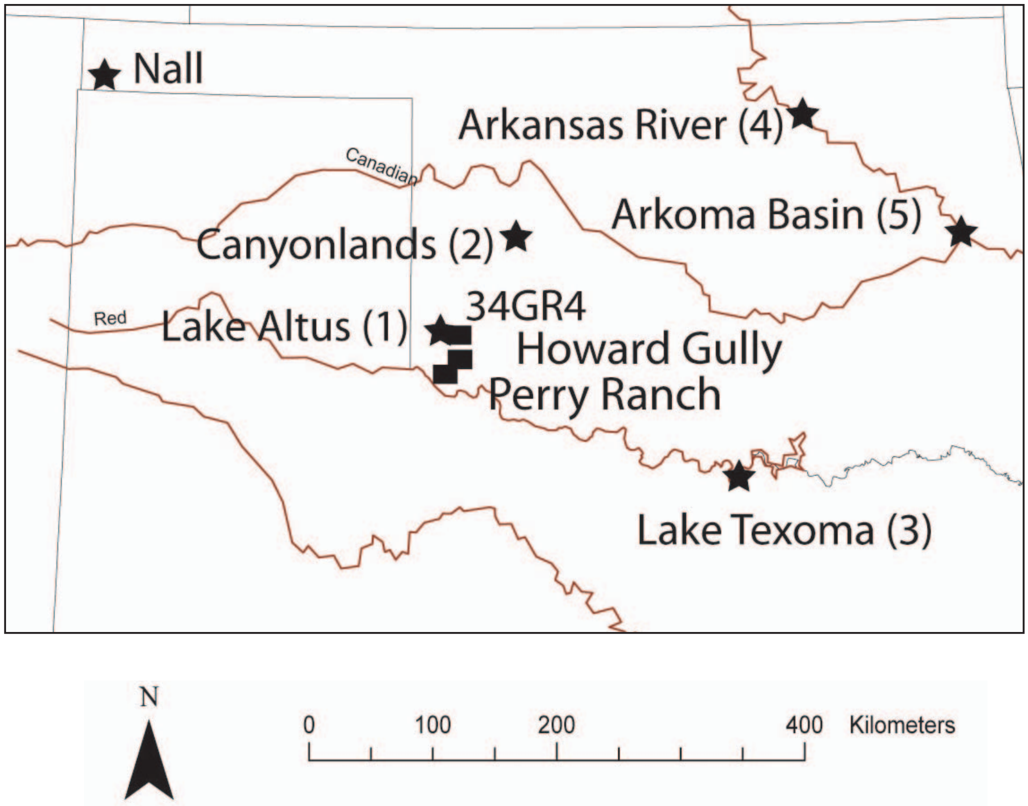


Figure 1.3. Location of investigated sites and localities used in projectile point analysis.

advent of this style earlier than what was previously expected. A discussion of the work at the Howard Gully site is provided in Chapter 5.

The Perry Ranch site was first excavated in the 1970s (Saunders and Penman 1979) and has been considered a small Plainview bison kill. Testing of the site with 1x1m squares and several backhoe trenches uncovered the remains of a large bison kill that has been washed and redeposited within several gully cut and fill events. Unfortunately, besides the recovery of bison bone, no other artifacts were found. Additional work is necessary to derive a further explanation of what happened at Perry Ranch, and how Perry Ranch fits into the late Paleoindian period. The Perry Ranch findings are described in Chapter 6.

A sample of 860 points are from collections located in the Arkoma Basin of eastern Oklahoma, Lake Texoma in south-central Oklahoma, along the Arkansas River in north-central Oklahoma, the canyon lands of western Oklahoma, and from the Lake Altus area in southwestern, Oklahoma. In addition, I examined the Nall site collection at the No Man's Land Museum and the Patterson collection housed at the Oklahoma Archaeological Survey. The results from the projectile point analysis are discussed in Chapter 7.

In Chapter 3, a current synthesis of environmental information from the late Pleistocene to early Holocene is provided for discerning whether there was a significant shift in the availability and distribution of resources that correspond to the regionalization process during the late Paleoindian period. It is also possible that population pressure would result in the reduction of territory size. However, measuring population density is difficult, and only a gross estimate from either surface collected projectile points or data from excavated contexts would be possible. This is something that needs to be addressed in future research, and is not a focus of this dissertation.

The key to my study was identifying the interrelationship between identity and the concept of territory for hunter and gatherer societies. This provides a means for inferring both the development of territory and ethnicity from projectile points. This is further discussed in Chapter 2.

Chapter 2

Identity Based Territories

My research question is determining whether or not late Paleoindians on the Southern Plains were becoming less mobile, occupying smaller territories, selecting a wider range of food resources, and distinguishing themselves by ethnic differences. All of these factors are interrelated. I approach the issue of regionalization from a territorial perspective.

The distribution of resources in relation to a region's forager population density has an effect on territories (Cashdan 1983; Dyson-Hudson and Smith 1978; Kelly 1995:130-132). Therefore, when there is a change in either the resource structure or population density, the size and distribution of territories are affected. When territory size becomes smaller, then mobility is reduced and diet breadth increases within a given environment (Kelly 1995:87).

Forager group identity is also related to a place or territory. I argue ethnicity is correlated to the establishment of territorial boundaries among forager groups. This is the key. Additional discussion focuses on the interrelationship between territory, the environment, and hunter and gatherer identity. Special attention is paid to how identity develops between hunter and gatherer groups. The chapter then ends with an explanation of how artifacts are studied to infer the existence of socially defined territories.

Development of Identity Based Territories

What is of central concern in this dissertation is how ethnicity develops among forager groups. A review of the anthropological and ethnographic literature makes it clear that there are two ways differences between forager groups are created. In the first instance, competition over resources leads to social differentiation. And secondly, social distance between populations results in divergence through time. To further illustrate how ethnicity develops, Madden (1983) formed three models for examining the creation of social boundaries in southern Norway that are discussed below.

In the first model, population density is so low in a given region that sustaining networks between forager groups is vital for maintaining a viable population. A rigid social boundary would disrupt the critical interaction between populations, so instead regional solidarity is promoted. In contrast, in the second model, the distance between groups is too great to continue a social network. Instead, everything one needs to survive is sought within the group. In this case, incestial taboos are relaxed for survival of the group (see Hofman's 1994 argument for Folsom). Material cultural differences between forager groups would be evident, because of a lack of interaction (Sackett 1977). Finally in Madden's third model, the distance between populations is reduced to the point of overlapping territories among foraging groups. This creates competition that results in the development of boundaries to mark one's territory over contested finite resources.

Madden's (1983) models provide a conceptual idea for how ethnicity and social boundaries may develop that are worthy of examining in the archaeological record. The keys to Madden's (1983) models are the factors of social distance and competition. These two variables are discussed further below, expanding upon Madden's models by interrelating with a better understanding of territory.

Tragedy of the Commons

Without some sort of agreement of how to manage resources, humans will use more resources for the benefit of themselves to the downfall of the common good (Hardin 1968; Ostrom 1990). Foragers will also "get in the way of each other" when resources are not evenly distributed, thereby decreasing the foraging efficiency of everybody (Smith 1988:250). Therefore, it is imperative that some sort of management strategy be in place for properly allocating resources between populations of people. It is thus not surprising that we find this behavior in modern hunter and gatherer groups (Barnard 1992; Bhanu 1992; Myers 1982; Williams 1982)

Most foraging groups occupy a definable space on the landscape that is referred to as a territory (Cottrell 1991:11; Kelly 1995:185; Service 1962:52 Wobst 1974:153). The possible exception is an initial colonizing population expanding out over new environments focusing on large game (Beaton 1991:215; Kelly and Todd 1988). Certainly by Folsom times on the Southern Plains, and most likely for Clovis people, the lithic assemblages left behind by these hunter and gatherers does not suggest a transient explorer adaptation, but a consistently occupied home range (Bement 1999a; Hofman 2003). Therefore, for the purpose of this dissertation, the people inhabiting the Southern Plains after 10,200 RCYBP occupied a particular space on the landscape.

Based upon Wilson's (1975:26) definition, Cottrell (1991:9) defines a territory as a "demarcation by a group of a specific area that is defended against trespass from outsiders either through advertisement or overt defense." Population density during the late Paleoindian period was probably too low to warrant warfare in defense of territory boundaries, and necessarily the focus is on how social defenses delineate territories. To further define how territories work and are created, the ecological defense and social boundary defense models are discussed below.

Ecological Defense Model

Dyson-Hudson and Smith (1978) argue that the predictability and relative abundance of resources is critical in ascertaining the development and types of territories. Predictability refers not just to resource concentration in space, but also to resource abundance by season. As an example, Kelly (1995) discusses Thomas' (1981) study in which he found that Reese River Shoshone were more territorial in the winter time in order to process piñon, and less so in the summer time when they were gathering grass seeds. This is due to piñon in the winter being a more dense and predictable resource.

Dyson-Hudson and Smith (1979:26) derived four expectations of territory behavior based upon the predictability and density of resources. In the first case, when resources are unpredictable and dense the resulting adaptation should be high mobility coupled with communication between forager groups in regards to resource locations. In the second case, resources that are both unpredictable and scarce should produce a pattern of high mobility across the landscape and forager groups should be rather dispersed across the landscape. Resources that are both predictable and dense as in the third case will coincide with the development of more rigidly defined territories. And finally, when resources are predictable but scarce, mobility should be reduced with the development of relaxed permeable territories.

Social Boundary Defense Model

In contrast to the ecological defense model, Cashdan's (1983) study determined that strictly defined territories developed when resources were not very dense and predictable among the !Ko, Nharo, G/wi, and Ju/[1]hoansi bushmen groups. Clearly, a critical variable was missing from the ecological defense model that inhibited its explanation of the cultural pattern observed between the bushmen groups. Cashdan (1983) determined that competition between these groups developed because of higher population densities. Territorial boundaries became critical in maintaining the distribution of people in relation to scarce resources. However, instead of an overt perimeter defense of boundaries, reciprocal altruism became more important in the maintenance of boundaries. Reciprocal altruism takes the form of permission granting behaviors between forager groups.

Cashdan (1983:51) deduced the importance of seeking permission to use another group's territory (see also Peterson 1975 and 1979). First, the process of asking permission ensures the continued reciprocity between the groups. Peterson (1975:62) documents the elaborate greeting ceremony that takes place between Australian Aborigine groups upon entry of the guest group. This is critical in an environment when resources are not predictable every year. In a resource poor year, this allows a group to move into another territory (Smith 1988:250). Second, important information about the location of resources in the host's territory are passed to the outsider's group. This is also a way to manage the resources in the host's territory. Cashdan (1992:255) provides an example of a //Gana informant telling her that permission to enter a territory is never denied, but they will tell them "which side to use and which side not to use". It becomes more important to acquire this information in larger territories. The higher cost of moving around in a larger territory, and risking not encountering food or water makes it worth the effort to first ask. Third, it is likely an outsider group without permission would be detected while traversing the host's territory. Even in a large territory, it is more likely that the intruders will spend a corresponding greater amount of time in the territory to acquire resources and thereby increase their risk of detection by the residents (Cashdan 1983:50). And finally, reciprocal access is valuable to both groups.

Myers (1982) ethnographic study of the Pintupi Aborigines from Australia highlights the interworkings of the social boundary defense system. Myers discovered that Pintupi individuals rarely live their entire lives within a single bounded territory. Instead people move back and forth across a permeable social boundary. Permission to enter another group's territory is granted most of the time. The asking for permission is important for the continuation of territorial reciprocity and maintenance of resources. The Pintupi do not view the use of resources as exclusive to any particular group, but the host group must know where the visitors are going to be so they can better plan their foraging strategies (Myers 1982:184). One's own territory among the Pintupi is determined by whether they have to ask or not. Prestige for the Pintupi is tied up in the esoteric ritual and spiritual knowledge of the landscape (Myers 1982:188-189). This is only acquired through the teachings of the elders for a particular territory and creates a social identity to the landscape.

Social boundary defense becomes a way of managing resources when social distances are reduced to the point of increased competition between foraging groups. Competition is created either from a reduction of resources or an increase in population density. And, competition may occur only on a seasonal basis when either population densities increase to procure an abundant and predictable resource or from a seasonal resource decline. This is the mental picture of what may have occurred when competition increased between hunter and gatherer groups at relatively low population densities. These are permeable boundaries where individuals and groups move in and out of territories. However, some social differences become marked to aid in the identification of group membership related to territory (McElreath et al. (2003). The process of how material culture is encoded with particular stylistic elements distinct to different groups is presented below.

Connections Between Identity and Material Culture

Artifacts are not manufactured in isolation, but are made by individuals who are part of their larger social community. Dobres (2000:128) states this eloquently as:

> "From this standpoint, even when single technicians work alone to fabricate, use, and repair material objects for some explicitly functional end, they are still part of their social community – a collectivity within which they develop their technical skills, learn to value them, and within which they display gestural competence and practical knowledge in acceptable or challenging ways."

It is therefore probable that material culture may give archaeologists some insight into the development of social boundaries since artifacts are crafted within cultural contexts.

For most tools there is not one optimal design, but many alternatives that maximize different efficiencies for use (Bettinger et al. 1996:140). It is expected that hunter and gatherer groups may manufacture material goods in culturally specific ways (Close 1978; Sackett 1973; 1977; 1985). Knowledge of how to make tools is acquired from within the foraging band. Therefore, contrasts in constructing material culture is expected among forager groups. This is significant to archaeologists for identifying territories in the past.

Wiessner's (1983) landmark study examined the differences in metal projectile point styles of the Kalahari San in Africa. The Kalahari San are divided into three groups with mutually unintelligible dialects of the !kung, !Xo, and G/wi. However, they share 90% of their material culture (Wiessner 1983:158). She discovered !kung projectile points were smaller than the other two groups. The !Xo and G/wi points were differentiated by differences in their tip, base shape, and body. She did not find significant difference in projectile point styles between the bands within the different language groups. Wiessner (1983) attributed the variation in projectile styles between the !Xo, G/wi, and !kung as purposeful boundary signaling. These were conscious differences in point styles recognized by the different groups.

Sackett (1985) challenged Wiessner's (1983) interpretation of stylistic projectile point variability. Sackett (1985) instead viewed the differences in projectile point styles not as purposeful boundary signaling, but as historically created differences between the groups. The variations in projectile point styles apparent to the three groups were not fashioned for group differentiation, but only vary because of a lack of interaction between the groups. Further, no significant stylistic differences occur in point design within the language groups because of social interaction (Sackett 1985).

In Wiessner's (1985) response to Sackett (1985), she further defined the difference between projectile point attributes that were consciously and unconsciously recognized among the Kalahari San. She discovered that when asking questions over particular aspects of point manufacture that they would become annoyed. Their response to her was that they were simply made that way and it was not important.

There are two important points about the Wiessner and Sackett discussion. First, Wiessner (1985) distinguishes between conscious and unconscious style. Conscious style has symbolic ethnic meaning to individuals in the group while unconscious style is elucidated by the investigator (Clark 2004:43). This implies that some aspects of material culture will be ethnically marked and have meaningful importance to the people. Other aspects of material culture may vary ethnically, but are unrecognizable to individuals within the groups (Jones 1997:122). Although these attributes do not have any ethnic importance, they can still be used to map the distribution of ethnic groups (Carr 1995; Clark 2004:45).

The second important notion is the distinction Sackett and Wiessner make in whether style is historically derived or actively used. Instead, both play an interactive part in defining ethnic relations (Jones 1997:122). In some cultural contexts, point attributes may be noticed as different by the Kalahari San, but are not actively used to denote group differences. In other cultural contexts, the variation in point attributes may take on a more active social significance when the different groups encounter each other.

Ethnographic studies indicate that some aspects of material culture do correlate with the spatial distribution of ethnic groups (Hegmon 1992; Hodder 1985; Larick 1986; Sampson 1988). However, some styles may crosscut social boundaries (Hegmon 1992; Hodder 1985). There are also instances when tools are manufactured but traded across social boundary lines, blurring the existence of ethnic groups (Dietler and Heirbech 1998). Discovering social boundaries in a coarse grained archaeological record is a difficult task that may not always work even when well-defined ethnic distinctions existed. Only in particular defined contexts can we hope to uncover evidence of social boundaries.

Summary

Ethnicity is a consciously recognized difference that identifies group membership in order to coordinate forgers' competition over resources. Ethnicity is not a fixed concept, but is a fluid ever changing culture structure in which individuals engage each other in a preexisting matrix of meaning (Cornell and Hartmann (1998:77). And, different situational contexts determine how identity is used in competition for resources.

A focus of this dissertation is how ethnicity is related to the concept of territories, and how territories developed between low population density forager groups. It is likely that the development of these identity based territories would occur when there is an increase in competition over resources. Prior to an increase in competition, social solidarity may have been promoted to maintain a viable reproducing population. However, if resource predictability and density decrease or populations increase then in order to alleviate competition and conflict identity based territories may have developed. Most likely these would not be actively defended territories, but highly permeable boundaries that serve to manage the distribution of resources in relation to people on the landscape. In Chapter 3, evidence is examined for deciphering whether or not there was an environmental change that would cause an increase in competition between forager groups between the Folsom and Late Paleoindian time periods.

The development of these identity-based territories may be detectable in the archaeological record if there are neutral or non-functional ways in which tools can be manufactured by individuals in these various groups. It is expected some aspects of material culture would vary to signal differences between the groups. Whether these differences were ethnically meaningful or not does not hinder the identification of territories. And, the development of territories is related to the creation of socially meaningful boundary differences.

Conclusion

My research question is to examine if regionalization is responsible for the increased diversity in late Paleoindian projectile point styles. This question can be divided into three parts.

1. Did an environmental change and/or population pressure cause late Paleoin dian forager groups to become more regionalized?
2. Is there evidence for late Paleoindian groups becoming less mobile, and select ing a wider range of food resources within smaller territories?
3. Did late Paleoindian groups develop ethnic identities?

In addressing the first question, evidence of an environmental change may suggest late Paleoindian groups began using smaller territories because of a change in resource distribution. An absence of an environmental shift may indicate population density was more of a factor in foraging groups occupying smaller territories. Unfortunately, there are not enough sites to accurately determine late Paleoindian population density. Measuring population density based just upon projectile points would be a gross estimate and may not be a reliable indicator. This needs to be examined in future research.

In the second question, a comparison is made between the distance of Folsom and late Paleoindian point surface finds from their raw material source. If late Paleoindian points are located not as far as Folsom points from their raw material source, then this would suggest late Paleoindians were occupying smaller territories and were less mobile then Folsom. Directly answering whether or not late Paleoindians were selecting a wider range of food resources compared to Folsom is not possible due to the limited number of late Paleoindian sites. And, my research did not uncover any new late Paleoindian features to add to the discussion. However, it can be argued indirectly that a reduction in territory size likely corresponds to using a wider range of food resources (Kelly 1995).

For the third question, ethnic identity is assessed as a correlation of space, projectile point style, and raw material source. If there are distinct patterns of contemporaneous spatial segregation of projectile point styles, and their raw material sources, then this would suggest that ethnically distinct hunter and gatherer groups were using different territories. This is because, as discussed earlier, territories can be correlated to forager group identity.

Chapter 3

The Southern Plains Environment and Evidence of Environmental Change From 11,500-8,000 RCYBP

In this chapter, environmental data gathered from carbon isotope, geomorphology, phytolith, pollen, and vertebrate studies are used to examine whether there is a marked environmental shift from the late Pleistocene through the early Holocene period on the Southern Plains. These data are used to determine if an environmental shift might have been responsible for a change in the distribution of resources that would cause an increase in competition between hunter and gatherer groups.

The first part of this chapter lays out the physiographic region of the Southern Plains to situate the unfamiliar reader. Then the discussion proceeds to modern ecological studies that inspect the relationship between climate, grass, and bison distributions. An understanding of modern ecological relationships is important for interpreting the impacts of past climatic changes on grasslands and bison behavior.

A focus of this chapter is how an environmental shift may have impacted the distribution of bison. Bison have unquestionably been an important resource to people on the Plains throughout prehistory (Bement and Buehler 1997; Hofman and Todd 2001). From bison, meat, fat, marrow, hides, sinew, organs, blood, bones, and rumen content can be obtained (Hofman and Todd 2001). The prior conception of foragers during the Paleoindian period is that they were solely focused on the procurement of megafauna (Kelly and Todd 1988). Foragers who specialize in bison hunting are highly mobile because of following the herds. And of course, high mobility necessitates the occupation of larger territories (LaBelle 2005; Hofman and Todd 2001). However, it is becoming increasingly clear that not all Paleoindians just focused on bison Instead, they used a wide variety of other resources according to their relative availability on the landscape (LaBelle 2005; Meltzer and Smith 1986).

Hofman and Todd (2001) make the argument that Folsom hunter and gatherers were focused on bison at least on a seasonal basis, and other resources were acquired while pursuing bison. This is evident by the high number of Folsom bison kill sites, and large territories delineated by lithic raw material types and projectile point resharpening patterns (Hofman 1991; Hofman et al. 1990).

Some paleontological data indicate bison were bigger, and more numerous during the Folsom period (Jodry 1999). The higher predictability of bison during Folsom times could have lead Folsom foragers to be extremely mobile, focusing their attention on bison at least during parts of the year (Bamforth 1985; Jodry 1999:12; Hofman and Todd 2001). The current archaeological findings on the Southern Plains seem to corroborate this hypothesis (Hofman and Todd 2001).

In contrast to the Folsom evidence, the current perception of late Paleoindians is that they were less mobile and hunted and gathered a wider range of resources (Bamforth 2002; LaBelle 2005; Mallouf and Mandel 1997). They relied less upon bison then Folsom people. A possible explanation for a shift in mobility and diet is a change in the distribution and number of bison. A decrease in the number and predictability of bison increases the cost of searching for bison following a high mobility strategy in a large territory. Therefore, it becomes efficient to more frequently procure smaller game and other resources in a diminutive territory, and obtain bison when they are available. This issue is further explored below.

Physiographic Description

The Southern Plains are a gently undulating landscape, if you exclude the Wichita and Arbuckle mountains (Figure 3.1). Grasses dominate the region with trees confined to west-east flowing river corridors (Webb 1931). Risser (1985:22) defines a grassland as "biological communities containing few trees and characterized by mixed herbaceous

Figure 3.1. Satellite relief map of major physiographic regions of the Southern Plains and adjoining areas (Adapted from satellite image from www.usgs.gov)

vegetation dominated by grasses." Grasslands occupy areas where there is not enough precipitation for forests, but enough for a perennial herbaceous layer (Risser 1985). The Southern Plains are arbitrarily bounded by the Arkansas River to the north, Rocky Mountains to the west, Edwards Plateau to the south, and a migrating woodland border to the east. The two main physiographic areas of the Southern Plains are the Southern High Plains (Llano Estacado) and the Central Lowlands or Osage Plains (Fenneman 1931).

The Southern High Plains is featureless plateau covered with short grass, with trees occurring at select spots in valleys and along the escarpment (Holliday 2000b). The Southern High Plains is a large plateau marked by the Mescalaro escarpment to the west and the Caprock escarpment to the east. Thirty thousand playas provide a scattered water source in the region (Gustavson et al. 1991). Northwest-southeast trending draws cross-cut the Southern High Plains (Holliday 2000b).

The Southern High Plains are principally underlain by Ogallala gravels that were deposited after the Rocky Mountain orogeny that occurred 80 mya (Gustavson et al. 1991:477). The landscape became stable approximately five million years ago. Wind-blown sediment from the Pecos River valley then covered and cemented the Ogallala gravels. This created the Ogallala Formation. On top of the Ogallala Formation is another wind blown sediment deposit called the Blackwater Draw Formation (Holliday 1997). The Blackwater Draw Formation is the major surface deposit of the Southern High Plains. Within the Blackwater Draw Formation are several soil horizons containing archaeological materials.

The Central Lowlands to the east of the Southern High Plains has a low relief (30 to 100 m) with hilly landforms caused by the differentially resistant bedrock (Ferring 1990). This is broken up by the Wichita and Arbuckle mountains, and the Arkansas, North Canadian, Canadian, Wichita, Red and Brazos rivers (Ferring 1990). The Central Lowlands was partially formed from the erosion of the High Plains. The Caprock escarpment is the current erosional edge of the High Plains, and remnant Ogallala Formation gravels are still found on divides across the Central Lowlands (Madole et al. 1991). The bedrock of the Central Lowlands is the red Permian shale that formed 290 to 250 mya (Madole et al. 1991).

The Effect of Climate on Modern Grasslands

An important aspect of grassland ecology on the Plains is how climate contributes to grassland distributions. This information is useful for understanding past climatic patterns. Annual precipitation across the Southern Plains decreases from east to west and falls predominately in the Spring and Fall seasons (Johnson and Duchon 1995). This rainfall pattern has created three different grassland zones (Risser 1985:22). Short grasses are predominate on the western part of the Plains, including the Southern High Plains, and are associated with lower rainfall amounts. On the eastern boundary of the Plains, higher precipitation favors the growth of tall grasses. Between the short and tall grass zones, a mixed grass prairie composed of both tall and short grass species occurs. There are 7,500 grass species with multiple adaptations filling out microniches across the breadth of the Plains (Risser 1985:22). Within the main grass zones are microzones, where for example, tall grass is found near water sources in the mixed and short grass areas.

Besides the three major grass zones, grasses are also positioned on the landscape according to their photosynthetic pathway. Atmospheric carbon is in the form of CO_2 with an almost constant $^{13}C/^{12}C$ ratio of 1:100 (Chisholm et al. 1986:197). Plants absorb CO_2 into the cytoplasm and mesophyll cells for conversion into energy (Jones 1985). A product from this conversion is either three or four carbon organic acids. Therefore, there is a difference for ^{13}C depletion based upon whether three or four carbon organic acids are produced (Tieszen 1991:229). Plants, and particularly for this study grasses, can be identified whether they are C_3 or C_4.

The difference in the photosynthetic pathway of C_3 and C_4 plants creates advantages and disadvantages in their adaptation to the environment. C_4 grasses use more energy in fixing CO_2, but their advantage over C_3 grasses is their ability to fix CO_2 at higher rates when light energy is more abundant (Tieszen et al. 1997:61). Additionally, C_4 grasses are more efficient in their use of water, and are more prevalent compared to C_3 when there are limits in water supply, higher temperatures, and higher CO_2 concentrations in the atmosphere (Tieszen et al. 1997:61).

Cool weather grasses are C_3 grasses, and warm weather grasses are C_4 grasses. Today, C_4 grasses are the predominate type on the Southern Plains, and they give way to C_3 grasses at the Nebraska-South Dakota border (Figure 3.2) (Epstein et al. 1997:729). This pattern is correlated with mean annual temperature differences from South to North on the Plains (Epstein et al. 1997:729; Terri and Stowe 1976). The distribution of C_4 grasses is also related to mean annual precipitation Epstein et al. (1997). Therefore, the production of C_4 grasses is greatest along the eastern boundary of the Plains (Coffin and Lauenroth 1996).

Sala et al. (1988) discovered a clinal decrease in grass production from west to east (Figure 3.2). Also, variability in production was greatest on the western Plains. Their findings indicate grass production variability is the greatest in the northwest corner of Oklahoma and southwestern Kansas. This irregular grass production has an effect on bison populations.

Bison Ecology

Bison Characteristics

The behavior of bison at the late Pleistocene/early Holocene transition is extrapolated through studies of modern bison. McHugh (1958, 1972) observed bison require wa-

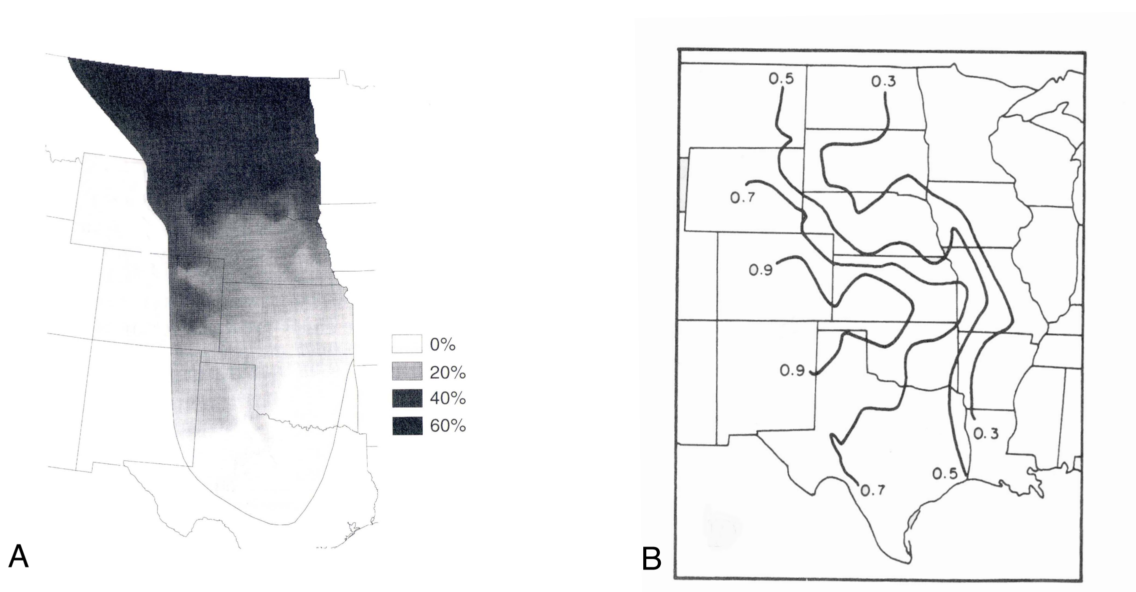


Figure 3.2. Figures depict relative production of grasses across the Plains. A) Relative production percentage of C_3 grasses (Adapted from Epstein et al. 1997). B) Isopleth map showing variability in annual grass production on the Great Plains (Adapted from Sala et al. 1988)

ter at least once per day. Bison will graze more frequently on those grasses closer to watering holes. Bison organize themselves into bull and cow groups. Bull groups are larger during the calving season and smaller during the rut as they separate and join cow groups. Cow groups remain constant in size, except during the rut and its addition of bulls. The rutting season is approximately June through September. From April to the end of May is the calving season. The timing and length of the rut and calving seasons slightly varies in timing and length from south to north on the Plains.

Bison are large ruminant grazers with a predominately grass diet (Coppedge 1998; Peden 1974; Schwartz and Ellis 1981). Sedges are also consumed during their growing season. Forbs and shrubs compose a smaller portion of the annual diet (Knapp 1999; Steuter 1995). Researchers examine the bison's impact on native grasslands, and how to best manage them on rangelands. From these studies, we have learned bison select for cool or warm season grasses during their growing seasons. This is when the grasses are at their most nutritious stage (Knapp 1999; Peden 1974; Plumb 1993; Schwartz and Ellis 1981; Steuter 1995). Bison also crave new growth on burned areas after a recent fire (Biondini 1999). And, since fire has always been an important factor in the maintenance of grasslands (Collins 1990), the bison's attraction to new burned areas likely has its antecedents with the development of the modern Plains grassland.

Bison Distribution

Predicting past bison population densities has been an important debate for Plain's archaeologists (Arthur 1975; Bamforth 1987, 1988; Epp 1988; Hansen 1984; Morgan 1980; Shaw and Lee 1997). The relative abundance of bison across the short, mixed, and tall grass prairies and the seasonal migration and aggregation patterns of bison are the two important issues.

Reeves (1973) imparts an ecological argument to account for bison flourishing on the short grass prairie. While total forage capacity is lower for short grasses compared to tall grass ecotones, short grasses maintain a higher protein to carbohydrate ratio (Johnson 1951). From Sims' et al. (1978) analysis of short grasses, he found a higher root crown mass occurs compared to mixed and tall grass. The higher root crown mass allows short grasses to recover more quickly after drought, grazing, and renewed growth after limited rains. Guthrie (1980, 1984) agrees that the expansion of short grasses is correlated to an increase in bison. It is not until after 11,000 RCYBP that bison become prevalent (Guthrie (1980). This coincides with the expansion of the short grass prairie. Guthrie (1980:68) further argues that C_4 grasses were particularly good for bison since they provide more stored nutrients above ground. From their study of early traveler accounts in the 19th century, Shaw and Lee (1997) found these early explorers document the presence of bison more frequently on short grass than on the tall grass prairie. However, in both prehistoric and historic time periods, there were more indigenous farmers located on the eastern portion of the Plains which might have limited bison populations.

Hansen (1984:105) contends bison were prevalent across all grassland biomes in prehistory. He discounts the evidence Johnson (1951) reports on the higher protein content for short grasses. Instead, rainfall has a more important effect on the percentage of protein within grasses, but grasses lose their nutrition as they mature past the growing season (Rodgers and Box 1967).

Bamforth (1987, 1988) agrees with Hansen's position. Bison population levels should be associated with a higher total forage yield, which coincides with larger rainfall amounts on the eastern periphery of the Plains. Bison should form large dispersed herds on the short grass, but with less overall numbers compared to the eastern tall grass zone. In the tall grass biome, there should be more bison, but dispersed into smaller herds. Bamforth (1987) also agrees with Shaw and Lee's conclusion. Settler's encroachment likely reduced bison population numbers in the east, and the larger bison herds in the west caused early explorers to overestimate their numbers.

Besides the debate of how bison are distributed across the different grass biomes, there is also some disagreement regarding bison migration patterns. Hansen (1984) thinks bison did not follow a predicted migratory round between a summer and winter range. Instead, bison were more evenly distributed throughout the year across all grass types. Therefore, bison moved short distances to acquire local grasses as they become available. Bison conglomerated into larger groups during the rut, but also formed large herds in the winter to feast on the limited forage not deeply covered by snow.

Hansen's (1984) discussion is a critique of Morgan (1980), who concluded bison migrated by season and were dispersed during the summer and formed large herds in the winter. Hansen makes the correct point, larger herds do form in the winter on the Northern Plains because of limited foliage. Bamforth (1988) points out there are probably a multitude of migratory and sedentary bison behaviors on the Plains dependent upon local foraging conditions. Epps (1988), relying upon ungulate studies from the Serengeti, concludes there should be both smaller residential and larger migratory herds. The dispersed smaller residential herds rely on local grasses, whereas the larger migratory herds move across the region taking advantage of when grasses are at their most nutritious growing stage. Preliminary studies of modern bison herd dynamics seems to support Epps' conclusion (Bement 2003).

Environmental Trends 11,500-8,000 RCYBP on the Southern Plains

The Wisconsin glacial period reached its peak around 18,000 RCYBP. After 18,000 RCYBP, the earth's climate began to warm to the present Holocene climate. This warming was interrupted by the Younger Dryas event that dates ca. 11,000 to 10,000 RCYBP (Anderson 1997). The Younger Dryas was a 1,000 year shift to cooler conditions in the northern latitudes caused by the influx of glacial waters into the North Atlantic from the retreating Laurentide ice sheet of North America (Anderson 1997:237). The effects of the Younger Dryas were manifest worldwide, but with widely varied climate responses (Anderson 1997). Another important factor was the relatively abrupt beginning and end of the Younger Dryas period. From Dansgaard et al.'s (1989) study of Greenland ice cores, they document that the climate warmed up by 7 °C coupled with a 50% increase in precipitation within 50 years. The current resolution of climatic data on the Southern Plains does not delineate within 100 year fluctuations, but there is plentiful evidence that demonstrates a climate change ca. 11,000 RCYBP.

Geomorphology Studies

Key geomorphic studies from the Southern High Plains, southwestern Kansas, south-central and north-central Texas, and from southwestern Missouri provide evidence for environmental change from the late Pleistocene to early Holocene period. Based upon geomorphic investigations, Holliday (1997, 2000b) documents that valleys within the Southern High Plains held perennial streams between 11,200-10,900 RCYBP. Holliday (2000b) thinks this period had the largest amount of precipitation during the Paleoindian period when the climate was more equable (see Haynes 1991 for a contrasting view). Between 10,900-10,200 RCYBP, an abrupt shift to the development of lakes and ponds occurred instead of perennial streams in the valleys. In addition, sheet sands accumulated on upland surfaces. Carbon isotope information from soils suggests that C_4 grasses were prevalent during the Younger Dryas period, and then there was a shift back and forth between C_3 and C_4 grasses during the early Holocene period. This suggests that during the late Paleoindian period the environment fluctuated between wetter and drier conditions with an overall drying trend represented for this period.

Farther north in southwestern Kansas, Olson and Porter (2002) document the Brady soil that dates to 9,064±87 RCYBP. Carbon isotope information for the late Pleistocene/early Holocene boundary indicates cool weather grasses were most frequent representing about 55-85% of the grassland. LaBelle et al. (2003:15) working at the Nall site in the panhandle of Oklahoma discovered a stable soil surface dating to 9,645±74 RCYBP. After the development of the Nall soil, a drier episode is denoted by the deposition of wind-blown sands between 9,500-9,000 RCYBP. Soil formation renewed after 9,000 RCYBP, with the formation of the Baker soil. These Nall site findings imply that the climate during the early Holocene was undergoing fluctuations in moisture regimes.

Farther south in south-central Texas, Nordt et al. (2002) correlates changes in Brazos valley alluvial deposition and carbon isotope data with the retreat and exposure of the

St. Lawrence drainage system. During the Younger Dryas period, C_4 grass production was higher, which is associated with the diversion of cooler water from the Gulf of Mexico to the North Atlantic. This had the effect of warming things up in southern Texas. From 10,000-9,000 RCYBP, there is a continuation of the Younger Dryas pattern. Not until 8,000-7,000 RCYBP is there a shift to cooler temperatures, and this may be correlated with changes in oceanic circulation patterns and the final break up of the Laurentide ice sheet.

At the Aubrey Clovis site in north-central Texas, Humphrey and Ferring (1994) uncovered evidence for a rapid alluviation sequence deposited by the Trinity River. Carbon isotope signatures from these sediments suggest the early Holocene period was relatively more humid. Interestingly, the alluvial record correlates with a Clovis drought period at the end of the Pleistocene in support of Haynes (1991) findings.

Carbon isotope analysis at the Big Eddy site in southwestern Missouri confirms the expansion of grasses after 12,700 RCYBP (Lopinot et al. 1999). Prior to 12,700 RCYBP, C_3 plants were the most prevalent. This suggests a forest setting with high precipitation. It is not until 9,400-8,200 RCYBP is there evidence for an increase in precipitation and retreat of grasses farther west.

In summary, these geomorphic studies indicate that major climatic change occurred approximately 11,000 RCYBP with the onset of the Younger Dryas period. This correlates with the end of the Clovis culture and beginning of the Folsom culture. Little geomorphic evidence was found to support a major climatic change at the end of the Younger Dryas period ca. 10,000 years ago. Instead, there was a continuation of the climatic patterns from Folsom times on into the late Paleoindian period on the Southern Plains. There were definitely fluctuations in climate indicated by soil genesis and subsequent burial by sediments during the early Holocene period.

Pollen Studies

Finding places on the Southern Plains to recover pollen for analysis has proven difficult because of poor preservation. However, a few important studies offer insight into environmental change during the early Holocene transition.

In the panhandle of Oklahoma, Bement and Carter (2004) recovered pollen from a profile located along Bull Creek. They discovered that grass pollen was continually present from the late Pleistocene up until 8,500 RCYBP. After this date, increases in sage brush, sunflower, and cheno-ams are characteristic of a change to more xeric conditions of the Altithermal period.

In central and south-central Texas, findings at Hershop and Boriack bogs provides information about climate during the early Holocene period. At Hershop Bog in south-central Texas there is a decline in tree pollen ca. 10,500 RCYBP and an increase in grass pollen (Bousman 1998; Larsen et al. 1972). At ca. 8,600 RCYBP, grass pollen is the majority. Changes in pollen through the early Holocene period at Hershop bog suggest a general warming trend and expansion of the grasslands into a previously wooded area.

In central Texas, spruce pollen is prevalent at 15,000 RCYBP at the Boriack bog (Holloway and Bryant 1984). At 9,000 RCYBP, there is a shift to higher grass pollen frequencies, and a higher percentage of *Asteraceae* implying an open parkland environment. Woodlands were reestablished sometime between 9,000-8,000 RCYBP, and the grassland community comes back to dominate after 8,000 RCYBP with the onset of the Altithermal period.

Along the margins of the eastern Plains in southeastern Oklahoma, analysis of sediments from Ferndale Bog provided important insights to vegetation change during the early Holocene (Albert 1981; Bryant and Holloway 1985). Bryant and Holloway (1985) discovered the vegetation was an open woodland dominated by pine and oak trees with some grasses and composites before 12,000 RCYBP. From 12,000-10,000 RCYBP, there is a shift to a higher frequency of grass pollen. A grassland community continues to be prevalent, but with an increase in forbs that is characteristic of tall grasses today between 10,000-9,000 RCYBP. There is also an increase in oak during this time frame.

These pollen studies also confirm the change to xeric condition ca. 8,000 RCYBP. From a few of the sample locations, there is also evidence for expansion of the grasslands sometime ca. 11,000 RCYBP. After 11,000 RCYBP there appears to be some fluctuations in climate, but there is not a definitive change to signal the end of the Younger Dryas and onset of the early Holocene period. Instead, there is only gradual change with some fluctuations through the early Holocene.

Vertebrate Studies

Besides geomorphic and pollen studies, some researchers also have analyzed changes in the distribution of faunal species as indicators of climate change. I also discuss in this section, research into changes in bison from the late Pleistocene-early Holocene period.

At the Lubbock Lake site in the panhandle of Texas, Johnson (1987:88) documents that major changes in the fauna assemblage occur at 11,000 RCYBP and at 8,500 RCYBP. During the Clovis period, 44% of the fauna species are exotic to the area today (Johnson 1987:97). By Folsom times, this percentage decreased to 30%. At 8,600 RCYBP, only 16% of the fauna recovered from the Firstview occupation were exotic to the area.

Balinsky's (1998) research of microvertebrates at the Wilson-Leonard site in southern Texas also provides some clues to changes in climate on the Southern Plains. Balinsky (1998:1541) found the presence of *Synaptomys cooperi* in sediments dating prior to 12,000 RCYBP. *Synaptomys cooperi* requires cooler and moister conditions than today. The species *Cratogeomys castanops* is an indicator of more xeric conditions and is found in deposits dating to 11,500-11,000 RCYBP. The return to more moist conditions between 9,500-8,700 RCYBP are suggested by the presence of *Oryzonmys palustris* and *Ondatra zibethicus.* And after 8,700 RCYBP, the trend changes to dry conditions correlating with the beginnings of the Altithermal period.

A few bison morphology studies provide important information about bison behavior in correlation with grassland composition. Wilson's (1978) examination of bison horn core tip measurements from the northern Plains, indicates bison were becoming smaller from the late Pleistocene through early Holocene times. Increased dwarfing occurred with the beginning of the Altithermal period sometime after 8,000 years ago. Todd et al. (1992:159-160) studies of bison humeri and radii from Lipscomb, Jones-Miller, Frasca, and Horner sites discerned that bison decrease in size from Folsom into the late Paleoindian periods. In other comparison of distal humerus measurements, Hofman and Todd (2001) found bison were 18-20% larger during Folsom times than modern bison. In contrast, bison were only 9-10% larger than modern bison at Cody (Scottbluff/Eden) sites from the Plains. This implies a greater amount of post-cranial change in bison morphology occurred from Folsom through the late Paleoindian period than indicated from Wilson's horn core tip measurements. Hill (2002:330) finds a similar pattern as Todd et al. (1992) with his study of astragali from the Milnesand site. He found that in comparison with the Lipscomb, Casper, 12 Mile, and Plainview sites that there was a decrease in bison size from Folsom to late Paleoindian.

In a contrasting view, Lewis' (2003) analysis of bison metapodials from the Southern Plains suggests that the only major morphological change occurs around 8,000 RCYBP. Prior to that, bison horn morphology reaches its modern shape sometime between 11,000-10,000 RCYBP. Not until 8,000 RCYBP, in correlation with the transition to a dominance of warm weather grasses, is there a major change in metapodial robusticity and geometry.

Bement's (1999, 2003) examination of bison morphology from the Cooper site provides important insights because it allows a chance to document bison morphology differences from bison herds killed not too far in time from each other. There was significant variation in femur/metatarsal lengths between the kills, and this is likely due to differential use of the landscape. Because of substantial variation in bison herds represented at the Cooper site, this implies that studies of bison morphological changes are problematic and misleading depending on which samples are chosen for analysis. This maybe the depiction of what Epps (1988) determined to be a difference between migratory and residential bison herds. A difference in herd structure and how they move across the landscape would affect the representative nutrition of bison herds, and thus the size and composition of bison herds (Bement 2003).

Conclusion

Most of the current evidence implicates that the major climatic and environmental changes happened ca. 11,000 RCYBP. Prior to 11,000 RCYBP the Plains were grazed by numerous mammalian species that are extinct today. They inhabited a mosaic environment with many patches of different types of grasses and vegetation (Graham and Lundelius 1984; Guthrie 1984). After 11,000 RCYBP, the environment became drastically reoriented into homogenous grassland zones. This obviously had an impact on the extinction of Pleistocene fauna and bison behavior.

Guthrie (1980:67) makes a convincing argument that it is not until after 11,000 RCYBP that bison become prevalent. This likely correlates with the expansion of the grasslands. Prior to the Younger Dryas period, bison were scattered throughout North America, and were adapted to numerous environments (McDonald 1984; Schultz et al. 1969; Webb et al. 1984). However, it is not until after 11,000 RCYBP that they become prevalent and numerous on the Plains. This is reflected by the change to curving bison horns that facilitated the formation of larger herds.

In addition, contrary to other arguments (Bamforth 1988), I think bison were more associated with short grasses farther west than with the tall grass prairies to the east. This does not mean bison were not present on the eastern Plains, but they probably were present in larger overall numbers in the west. They also most likely formed larger herds in the west compared to the eastern Plains. If bison were more populous in the east, then you would expect to find more eastern Folsom bison kills. Instead, Folsom sites are concentrated on the western Plains region.

The current environmental information implies the major shift in resources took place at 11,000 RCYBP. After 11,000 RCYBP, there are fluctuations in climate that would have effected the resource base, but not to the same degree as between the Clovis and Folsom periods. The next major climatic change happens around 8,000 RCYBP. This is the beginning of the drying trend indicative of the Altithermal period. Hofman and Todd (2001) think there is a change in bison size through time. Jodry (1999) argues there might have been more bison present during Folsom times in comparison with the late Paleoindian period. However, based upon the current environmental data, there appears to be no reason for bison to become smaller due to environmental change. Lewis' (2003) study of bison on the Southern Plains documents that bison did not undergo a dramatic dwarfing in size until after 8,000 RCYBP. Even if bison were becoming smaller during the early Holocene, it could coincide with an increase in bison density. Only through further work will we be able to decipher changes in bison evolution during this critical period.

So, it appears that there was not a drastic change in environment from the Folsom to late Paleoindian periods. Therefore, this would suggest the increase in projectile point diversity was not determined by changes in subsistence patterns, but more likely due to increases in human population density. An increase in the number of people would better account for less mobility in a smaller territory to alleviate conflict over resources.

Chapter 4

Geoarchaeological Investigations at the 34GR4 Site

Research at archaeological site 34GR4 was initiated to ascertain whether there were contexts to further our understanding of late Paleoindians. The LeVicks amassed an impressive collection of late Paleoindian points from the site (Figure 4.1). Therefore, Lee Bement and I, with funding from the Bureau of Reclamation and assisted by Bob Blasing, excavated a series of backhoe trenches augmented with coring to provide information on site formation processes and the development of terraces in the site area (Hurst et al. 2006).

We were successful in locating buried soils that date to the late Paleoindian period. However, no late Paleoindian artifacts were found with the soils. We did extract soil samples for pollen analysis to provide further environmental information for the southwestern Oklahoma region. In addition to pollen, the radiocarbon dated buried soils and their carbon isotope signatures furnishes further insight into the environment at the late Pleistocene to early Holocene transition in southwestern Oklahoma.

Geoarchaeological Investigation

Initially, the plan was to cut two long backhoe trenches parallel and perpendicular to the long axis of the site. However, upon field assessment of the locality, it was deemed prudent to excavate short trenches at various intervals on both sides of the slough (Figure 4.2). This change in tactics allowed the investigation of a much larger area and eventually led to the postulation of a terrace sequence in this area.

Figure 4.1. Selected late Paleoindian points collected by the LeVicks from 34GR4.

A total of six backhoe trenches and two soil cores were placed into the site's deposits (Figure 4.3). A profile cut of the high terrace at 34GR8, also known as Beachhaven, was also documented. The trenches were cut into L-shapes to provide a cross-section. A description of each profile was made and samples removed for radiocarbon assay and particle size analysis. Color photographs documented all aspects of the inves-

Figure 4.2. Aerial photograph showing locations of geoarchaeological activities.

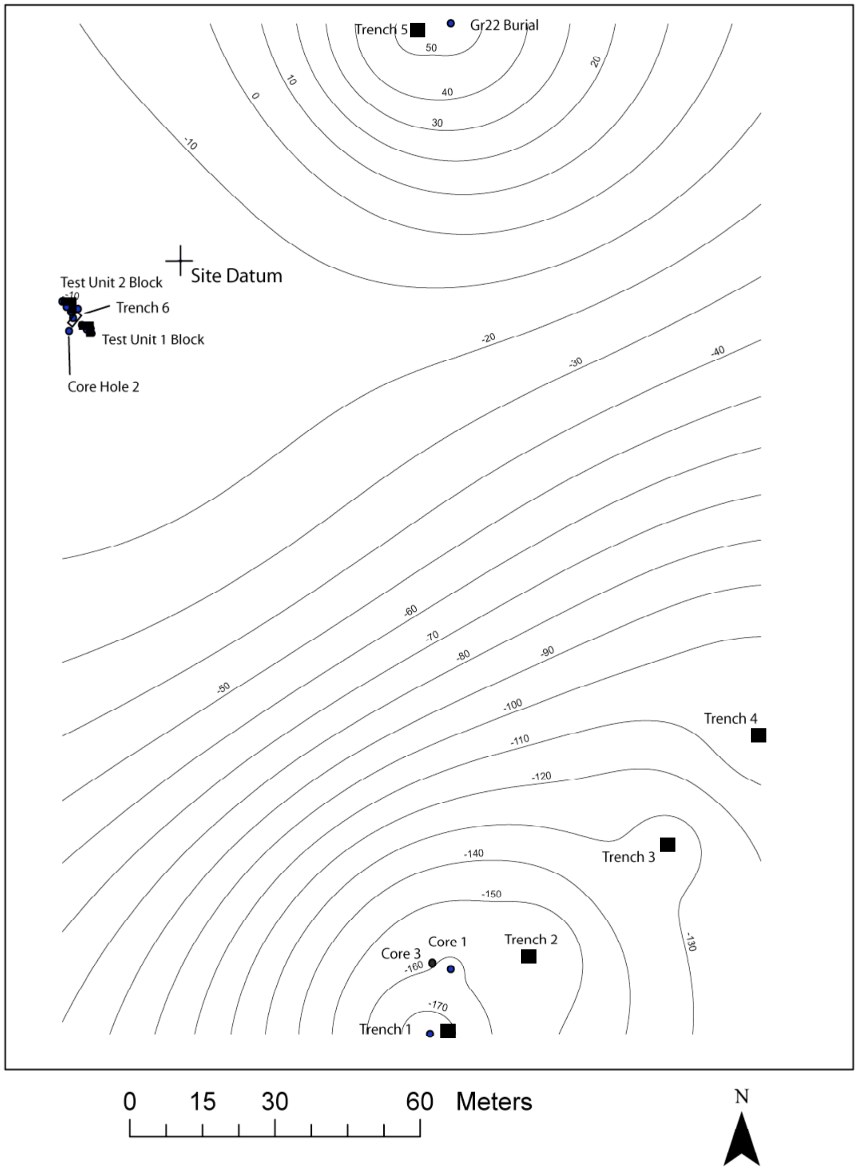


Figure 4.3. Location of trenches from geoarchaeological field work and test units from Trench 6 excavations.

tigation. All trenches and cores were mapped in reference to a iron bar datum set by the Bureau of Reclamation. Each soil profile description is provided. The results of radiocarbon analysis is provided in Table 4.1, and particle size analysis is presented in Table 4.2.

Table 4.1. Results of radiocarbon assays on organic sediment.

Site	Number	Provenience	13C/12C^	Conventional Age
Beachhaven 34GR8				
	BETA-182387*	Profile	-19.5	13,200 +/- 90 RCYBP
Rattlesnake Slough 34GR4				
	BETA-182388*	Trench 1	-20	7,480 +/- 50 RCYBP
	BETA-182389	Trench 2	-16.9	2,970 +/- 100 RCYBP
	BETA-182390*	Trench 5	-18.7	9,070 +/- 50 RCYBP
	BETA-182391	Trench 6	-19.1	6,080 +/- 110 RCYBP
	BETA-182392	Trench 6	-20	8,200 +/- 110 RCYBP
	BETA-182393*	Core 1	-18.9	9,730 +/- 60 RCYBP
	BETA-182394	Trench 4	-16.7	4,080 +/- 100 RCYBP
	^ $^{0}/_{00}$ * AMS Technique			

Table 4.2. Particle size results for soils from 34GR4 investigations.

Sample No.	Depth (cm)	SANDS 2.0-1.0 (v.coarse)	1.0-0.5 (coarse)	0.5-0.25 (medium)	0.25-0.1 (fine)	0.1-0.05 (v.fine)	SILTS 0.05-0.02 (coarse)	0.02-0.005 (medium)	0.005-0.002 (fine)	CLAY <0.0002	Total Silt	Total Sand	TEXTURE Labor-atory
		diameter (mm) %											
Trench 1													
Horizon 2	60-70	6.0	2.0	1.4	2.2	18.4	43.7	9.3	1.1	15.8	54.1	30.0	SiL
		7.9	3.7	2.8	3.2	12.9	37.8	11.7	1.8	18.1	51.3	30.5	SiL
Horizon 3	100-110	8.7	3.1	2.0	2.8	14.6	40.3	10.4	2.6	15.2	53.4	31.2	SiL
		4.7	1.9	1.3	2.3	19.5	44.6	8.9	2.0	14.7	55.5	29.7	SiL
Horizon 4	130-140	4.8	3.6	3.0	3.9	12.8	35.0	13.2	2.7	20.9	50.9	28.1	SiL
		7.0	3.3	2.4	3.2	15.5	38.0	12.0	2.7	15.8	52.8	31.4	SiL
Trench 2													
Horizon 2	30-40	4.1	2.1	1.4	2.2	22.2	45.0	7.7	1.2	14.1	53.8	31.9	SiL
		5.2	2.1	1.3	2.3	21.5	44.8	7.8	1.1	13.8	53.7	32.4	SiL
Horizon 3	64-74	4.9	2.2	1.6	2.5	20.5	44.0	8.2	0.8	15.1	52.9	31.8	SiL
		4.6	2.0	1.3	2.3	22.2	45.0	7.4	0.8	14.3	53.2	32.5	SiL
Horizon 4	90-100	15.0	6.1	3.5	3.8	13.7	32.6	10.0	1.2	13.7	43.9	42.1	L
		11.8	5.0	3.5	4.2	14.8	35.3	9.5	2.4	13.4	47.2	39.2	L
Horizon 5	120-130	8.2	3.0	2.0	3.0	15.0	39.2	12.3	2.3	15.0	53.8	31.2	SiL
		6.1	3.5	2.0	3.0	15.8	40.5	12.3	2.1	14.6	54.9	30.4	SiL
Trench 3													
sample 1 - LB, $, BS	50-60	4.8	1.9	1.3	2.2	21.6	45.2	7.6	0.6	14.7	53.4	31.8	SiL
		3.6	1.6	1.3	2.2	21.5	46.5	8.0	0.9	14.3	55.4	30.2	SiL
sample 2 - LB, $, BS	130-140	9.8	4.0	2.6	3.5	14.5	41.1	8.8	1.6	13.5	51.5	34.4	SiL
		9.4	5.2	3.2	3.9	16.4	36.8	9.1	1.3	14.8	47.2	38.0	L
Trench 4													
Horizon 1	12-21	2.6	1.0	0.9	2.0	24.0	46.2	7.6	0.7	14.6	54.6	30.6	SiL
		1.7	0.9	0.8	2.4	25.8	46.3	7.3	1.3	13.5	54.8	31.6	SiL
Horizon 2	49-59	2.1	0.9	0.8	1.9	23.3	47.1	7.9	0.7	15.2	55.7	28.9	SiL
		2.9	0.9	0.9	1.9	23.9	46.9	7.3	0.8	14.3	55.0	30.6	SiL
Horizon 3	92-101	6.7	2.1	1.5	2.4	18.3	42.0	9.5	2.1	15.3	53.7	30.9	SiL
		4.3	2.0	1.5	2.4	19.7	42.3	9.6	2.0	16.0	53.9	29.9	SiL
Horizon 4	112-120	4.5	1.8	1.3	2.3	19.6	43.3	9.6	1.9	15.4	54.9	29.6	SiL
		5.4	2.1	1.7	2.7	19.1	42.8	9.1	1.9	15.2	53.7	31.0	SiL

Table 4.2 Continued. Particle size results for soils from 34GR4 investigations.

Sample No.	Depth (cm)	SANDS 2.0-1.0 (v.coarse)	1.0-0.5 (coarse)	0.5-0.25 (medium)	0.25-0.1 (fine)	0.1-0.05 (v.fine)	0.05-0.02 (coarse)	SILTS 0.02-0.005 (medium)	0.005-0.002 (fine)	CLAY <0.0002	Total Silt	Total Sand	TEXTURE Labor-atory
		diameter (mm)					%						
Trench 5													
Horizon 1	50-60	0.4	1.3	5.3	6.6	14.3	37.3	11.7	2.5	20.3	51.4	27.8	SiL
		0.2	1.3	5.0	7.1	13.7	37.1	11.9	3.0	20.8	51.9	27.2	SiL
-	100-110	0.6	3.0	15.0	18.0	17.1	23.3	6.8	1.0	15.2	31.0	53.7	SL
		0.5	2.8	15.4	16.9	17.0	25.5	5.8	1.4	14.5	32.6	52.6	SL
Trench 6													
Horizon 1	30-40	0.0	0.1	0.2	1.0	17.2	47.2	11.2	2.4	20.6	60.8	18.5	SiL
		0.0	0.1	0.3	1.0	16.4	47.1	11.5	3.1	20.4	61.7	17.7	SiL
Horizon 2 (top)	100-110	0.0	0.4	1.0	1.9	11.6	41.8	17.8	3.3	22.0	63.0	14.9	SiL
		0.0	0.4	0.8	1.8	10.9	42.7	17.9	3.4	22.0	64.0	13.9	SiL
Horizon 2 (bottom)	150-160	0.3	0.6	1.2	2.2	9.6	39.4	18.3	4.0	24.3	61.7	13.9	SiL
		0.3	1.0	1.5	2.5	10.6	39.0	17.9	4.0	23.0	60.9	16.0	SiL
Beach Heaven - (Profile 1)													
Horizon 2	115-128	0.1	7.6	19.1	31.5	24.4	7.0	1.2	0.2	8.7	8.4	82.7	LFS
		0.2	3.4	12.2	23.6	26.2	16.2	4.3	1.2	12.6	21.7	65.4	SL
Horizon 3	196-214	0.0	1.0	5.4	13.3	24.7	26.4	6.9	1.5	20.7	34.8	44.3	L
		0.0	0.3	3.3	11.8	25.0	27.4	7.2	2.0	22.6	36.6	40.6	L
Horizon 4	253-265	0.0	0.3	2.5	9.6	28.4	30.0	6.5	0.8	21.7	37.3	40.8	L
		0.0	0.2	2.3	9.5	28.9	30.5	6.1	1.8	20.4	38.4	41.1	L
Horizon 5	330-346	0.2	0.4	2.5	13.2	33.0	19.3	4.7	0.0	27.4	24.0	49.4	SCL
		0.0	0.2	2.3	12.5	32.9	20.6	4.0	0.8	26.3	25.5	47.9	SCL
Horizon 6	350-358	0.1	0.2	1.6	11.1	38.6	23.9	4.1	1.1	19.2	29.1	51.6	L
		0.0	0.2	1.6	10.9	38.5	25.2	4.2	0.4	18.8	29.9	51.2	L

Beachhaven Profile

The exposed terrace of the Beachhaven locality was scraped back approximately 10-15 cm in order to view a fresh face for profiling (Figure 4.4). The terrace is 350 cm in depth measured from the modern surface. Described in Table 4.3 are the profile details for geomorphological and soil development for the terrace. Of interest was a former soil that was present throughout the exposed terrace 175 cm below the modern surface. A sample (Beachhaven 01) from this former soil was radiocarbon dated returning a conventional age of 13,200 $\pm$ 90 RCYBP (BETA-182387). This date establishes a minimum time estimate for the development of this terrace location.

Trench 1

An east face of Trench 1 was profiled to a total depth of 1.48 m (Figure 4.5 and Table 4.4). Gradual boundaries separated the horizons evident in the profile. The bottom 2Ab horizon of the profile contained a higher concentration of organics and this increases our chances for acquiring a reliable radiocarbon date. Sample GR4/1 was removed from the bottom 2Ab horizon and yielded a radiocarbon date of 7,480 $\pm$ 50 RCYBP (BETA-182388).

Trench 2

Part of the west wall from Trench 2 was profiled to a depth of 1.50 m (Figure 4.6 and Table 4.5). At this location we discovered another soil potentially located above the one dated from Trench 1. Soil sample GR4/2 dated to an age of 2,970 $\pm$ 100 RCYBP (BETA-182389) confirming our suspicions of a mid - late Holocene soil development.

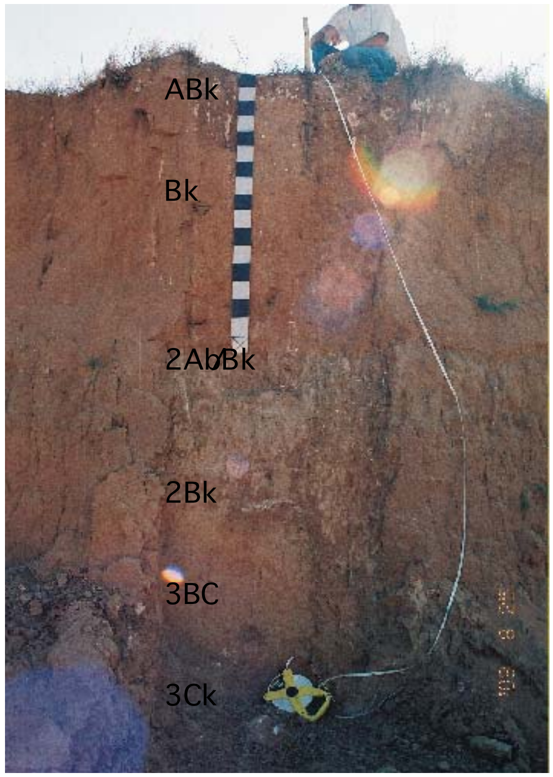


Figure 4.4. Beachhaven locality profile.

Table 4.3. Beachhaven locality profile description.

Depth (cm)	Horizon	Color	Texture	Structure	Boundary	Special Features
0-36	ABk	7.5YR4/4	SCL	sbk	g, s	large CaCo3 nodules, layer of CaCo3 nodules at bottom of horizon
36-180	BK	7.5YR4/6	LFS	b	g, s	rootlets common, large CaCo3 root casts
180-240	2Ab/Bk	7.5YR5/4	L	sbk	g, s	Mn nodues, Fe staining/ 13200±90 RCYBP (BETA-182387)
240-310	2Bk	7.5YR5/8	L	sbk	g, s	CaCo3 nodules and root casts
310-341	3BC	10YR5/6	SCL	sbk	g, s	CaCo3 nodules and root casts
341-366	3C	7.5YR5/6	L	sbk	-	large CaCo3 nodules

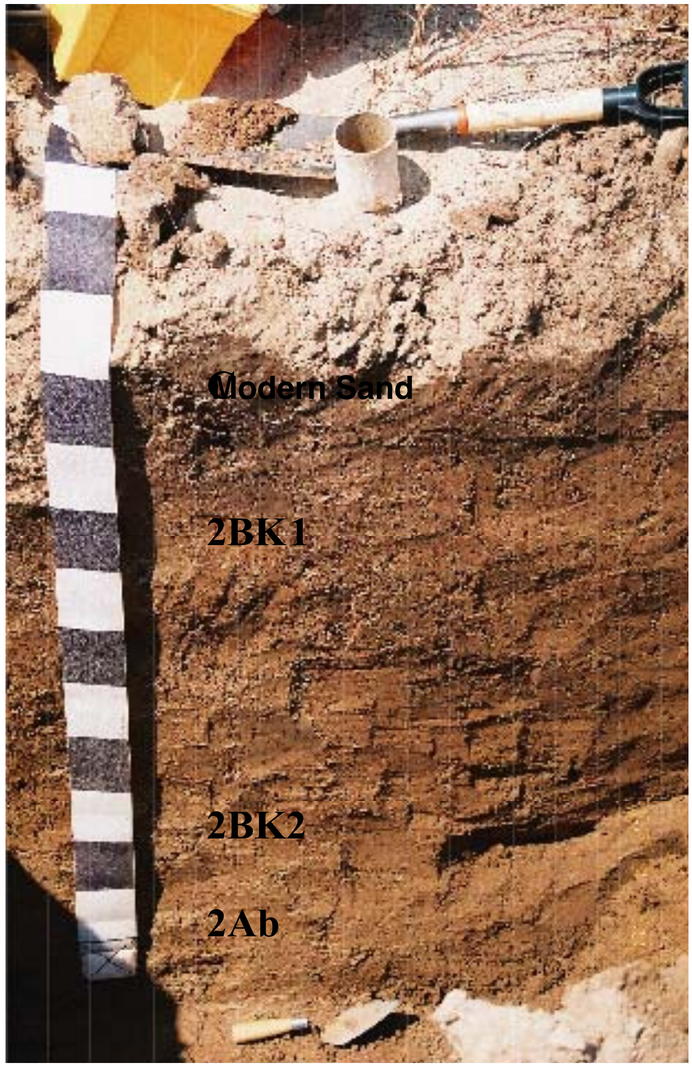


Figure 4.5. Photograph of Trench 1 profile.

Table 4.4. Trench 1 profile description.

Depth (cm)	Color	Horizon	Texture	Structure	Boundary	Special Features
0-20	-	-	-	-	-	modern sand
20-96	7.5YR4/6	2BK1	SiL	sbk	g, s	CaCo3 present
96-120	7.5YR4/3	2BK2	SiL	sbk	g, s	CaCo3 present
120-148	7.5YR4/2	2Ab	SiL	sbk	g, s	CaCo3 present 7,480±50 RCYBP (BETA-182389)

Figure 4.6 Photograph of soil profile from Trench 2.

Table 4.5. Profile description for Trench 2.

Depth (cm)	Horizon	Color	Texture	Structure	Boundary	Special Features
0-17	-	-	-	-	-	modern sand
17-58	A/B1	7.5YR4/6	SiL	sbk	g, s	
58-76	A/B2	7.5YR4/3	SiL	sbk	g, s	2,970±100 RCYBP (BETA-182389)
76-118	Btk	7.5YR5/3	L	sbk	g, s	clay accumulation
118-150	Bk	7.5YR5/3	SiL	sbk	-	carbonates present

Trench 3

A portion of the west wall of Trench 3 was excavated to a depth of 1.40m (Figure 4.7 and Table 4.6). Noticeable from this soil profile description are the few soil horizons. The second soil horizon is a Btk with an above erosional disconformity. The above missing buried A horizon is evident in krotovenas containing darker soils with a Munsell chart reading of 7.5YR3/2. No soil samples were sent for radiocarbon dating.

Trench 4

A west face of trench 4 was excavated and profiled to a depth of 1.32 m (Figure 4.8 and Table 4.7). The bottom of the profile contained the potential lower half of the soil dated from Trench 2. A soil sample (GR4/7) was sent for radiocarbon dating. The result of 4,080 $\pm$ 100 RCYBP (BETA-182394) suggests that this horizon represents a portion of the soil discovered in Trench 2.

Trench 5

The decision on placement of Trenches 5 and 6 was to determine the context for human burials uncovered at the lake shore. One burial was found eroding out of the site area the week before the planned excavations, and the location is plotted on the map. A wall facing northeast was profiled to a depth of 1.40 m (Figure 4.9 and Table 4.8).

Two soil horizons were identified for Trench 5. An abrupt wavy boundary separated the top Bk horizon from the bottom 2Ab horizon. A soil sample (GR4/3) was pulled from the bottom of horizon 2Ab yielding a date of 9,070 $\pm$ 50 RCYBP (BETA-182390).

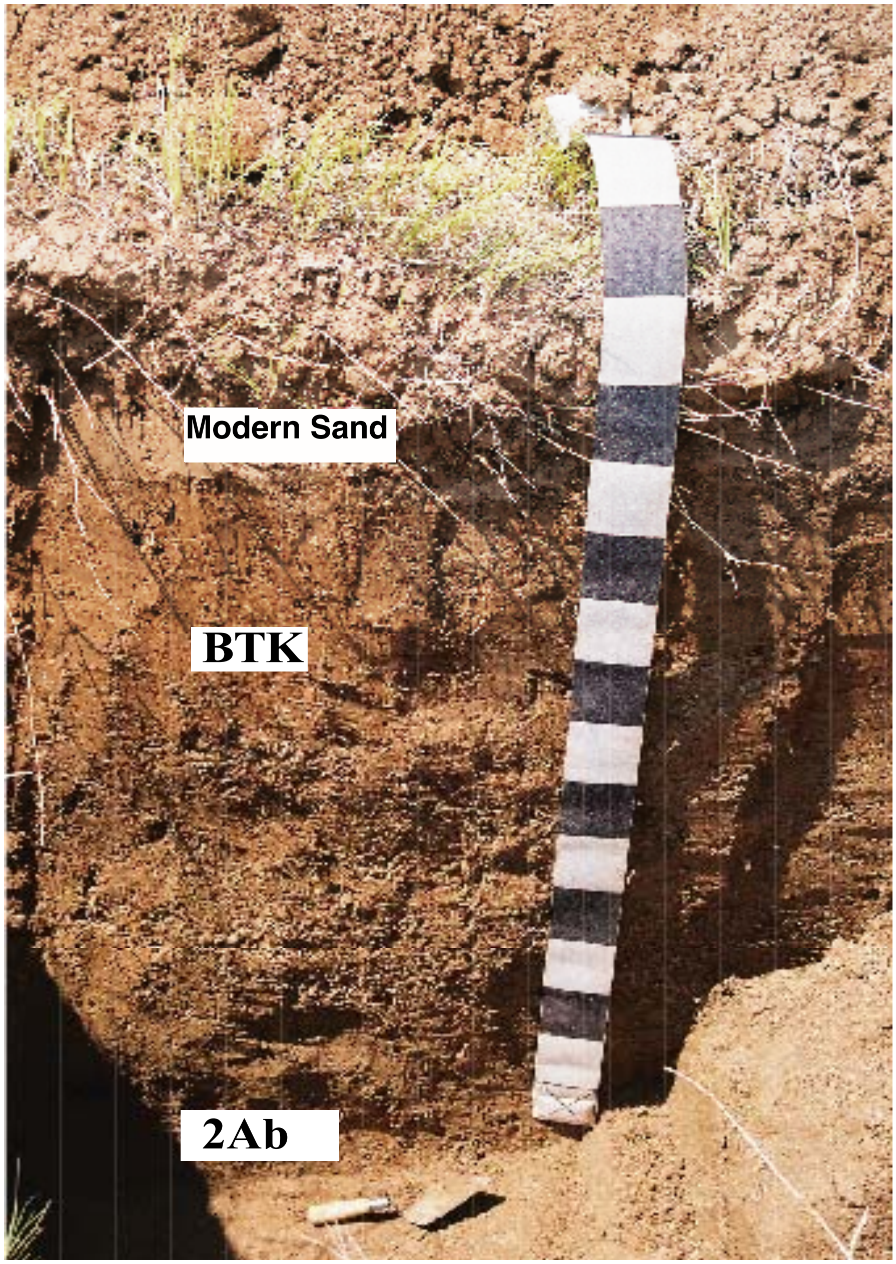


Figure 4.7. Soil profile description of Trench 3.

Table 4.6. Profile description of Trench 3.

Depth (cm)	Horizon	Color	Texture	Structure	Boundary	Special Features
0-10	-	-	-	-	a, s	modern sand
10-120	Btk	7.5YR4/4	SiL	sbk	a, s	missing A horizon is evident in rodent burrows. Color of missing A horizon is 7.5YR3/2.
120-140	2Ab	7.5YR4/3	SiL	sbk	-	CaCo3 present, bits of charcoal.

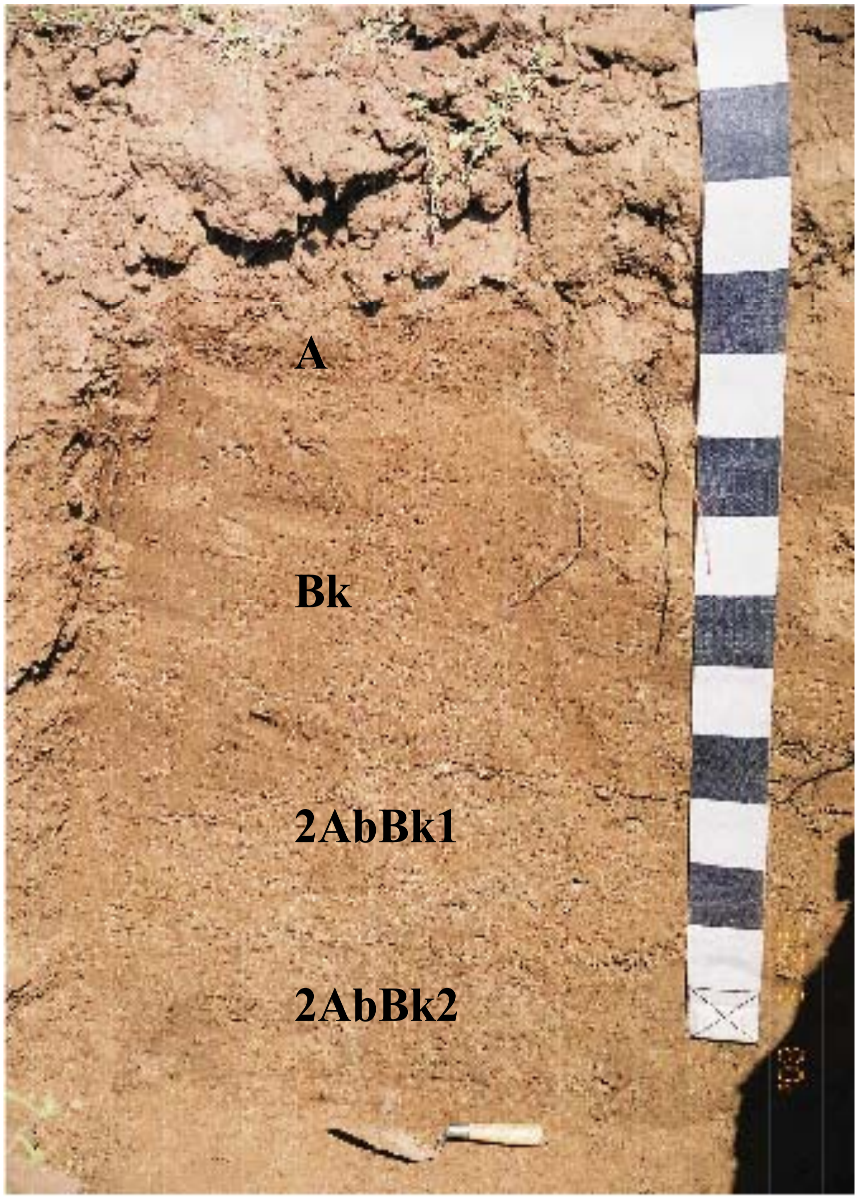


Figure 4.8. Photograph of Trench 4 profile.

Table 4.7. Soil description from Trench 4 profile

Depth (cm)	Horizon	Color	Texture	Structure	Boundary	Special Features
0-32	A	7.5YR3/2	SiL	sbk	g, s	rootlets present
32-93	Bk	7.5YR4/4	SiL	sbk	g, s	CaCo3 present
93-106	2AbBk1	7.5YR4/3	SiL	sbk	g, s	CaCo3 present
106-128	2AbBk2	7.5YR4/3	SiL	sbk	-	CaCo3 nodules more common than Horizon 3./ 4,080±100 RCYBP (BETA-182394)

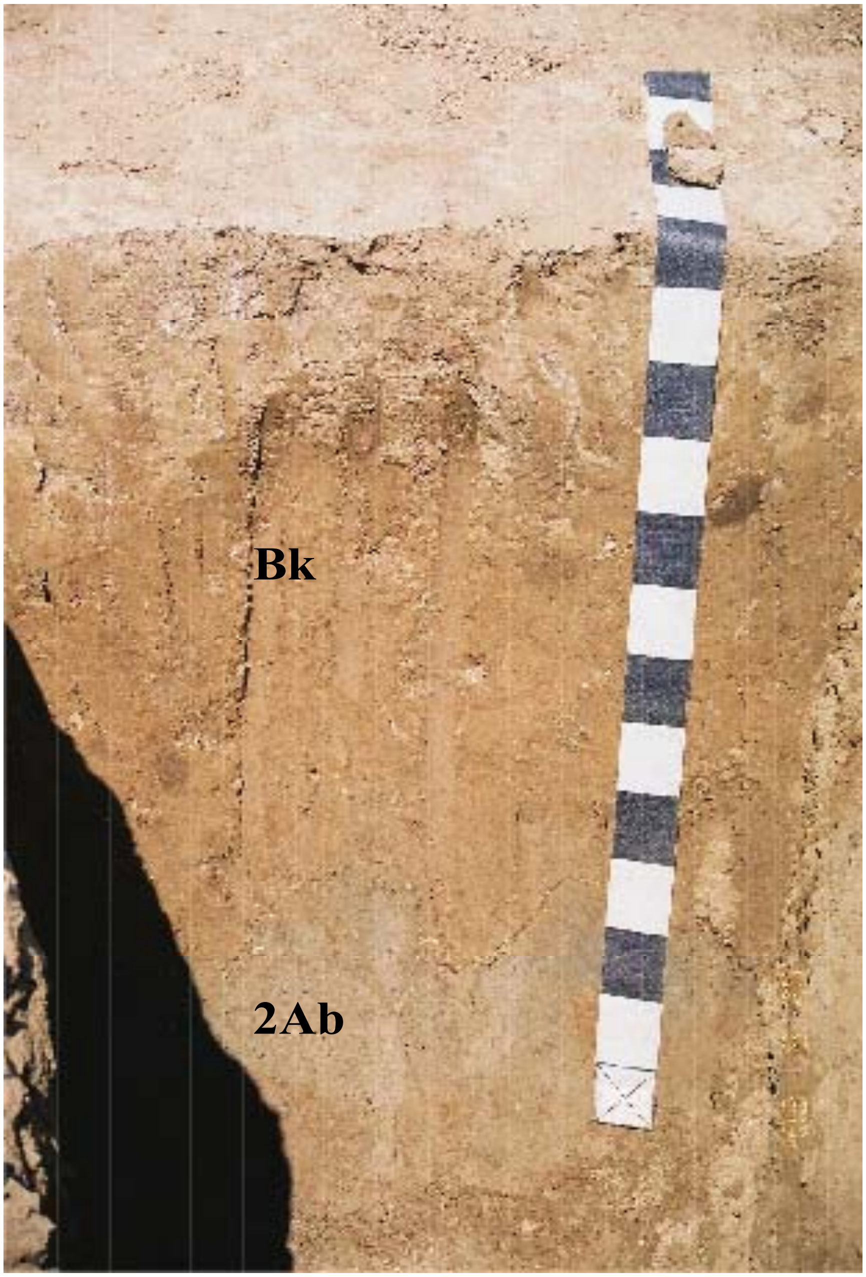


Figure 4.9. Trench 5 profile photograph.

Table 4.8. Soil profile description from Trench 5.

Depth (cm)	Horizon	Color	Texture	Structure	Boundary	Special Features
0-104	Bk	7.5YR4/3	SiL	sbk	a, w	KV color 7.5YR3/2 and may represent missing A. CaCo3 present
104-140	2Ab	7.5YR5/1	SL	sbk	-	redox features, CaCo3 present/ 9,070±50 RCYBP (BETA-182390)

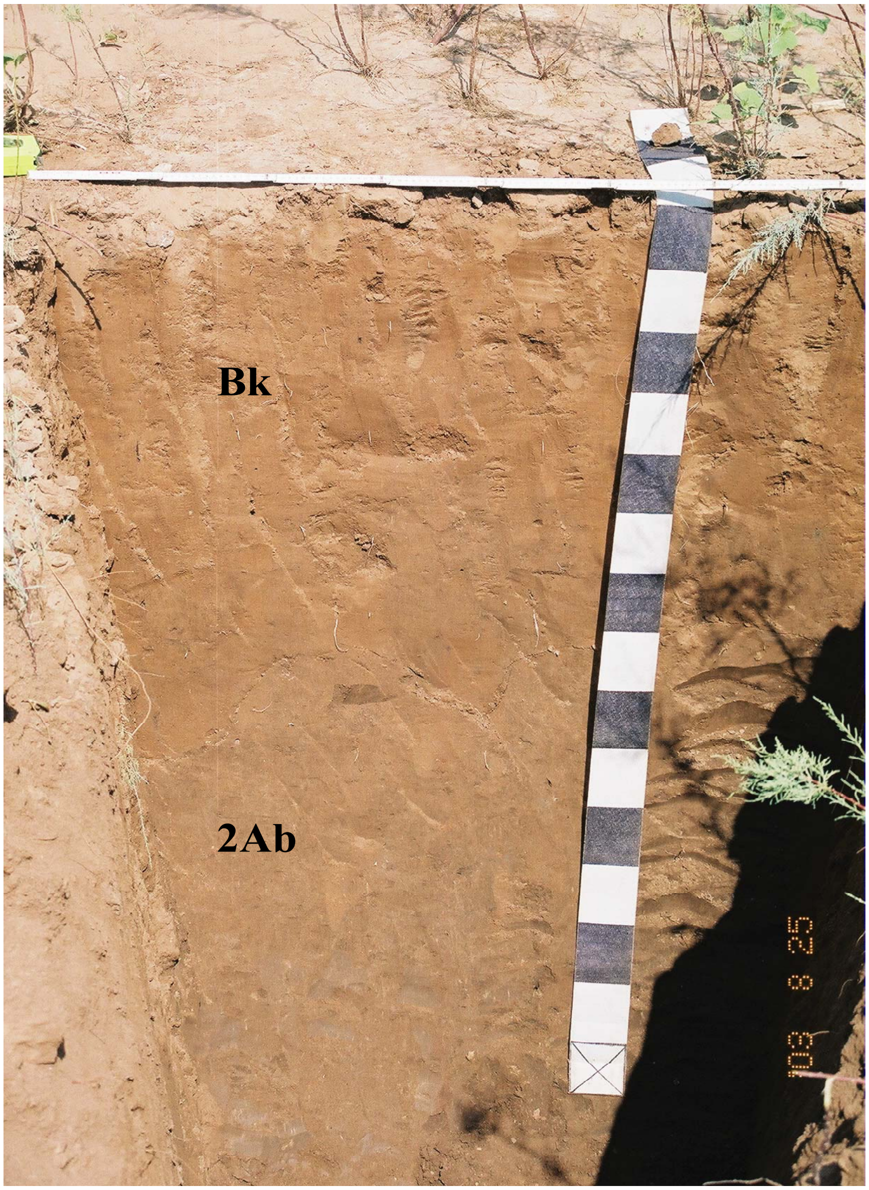


Figure 4.10. Photograph of profile from Trench 6.

Table 4.9. Description of soil profile at Trench 6 location.

Depth (cm)	Horizon	Color	Texture	Structure	Boundary	Special Features
0-98	Bk	7.5YR3/4	SiL	sbk	a, w	CaCo3 present
98-160	2Ab	7.5YR5/2	SiL	sbk	-	CaCo3 present, Clay films on ped surfaces/ Upper date 6,080±110 RCYBP (BETA-182391), Lower date 8,200±110 RCYBP (BETA-182392)

Trench 6

To a depth of 1.60m Trench 6's soil characteristics were described (Figure 4.10 and Table 4.9). A northeast facing wall from Trench 6 was selected for the recording. Similar to Trench 5, an abrupt wavy boundary was identified between .80 to 1.00m below surface. Two samples from top and bottom of horizon 2Ab were selected for dating. The top sample (GR4/4) produced a date of 6,080 $\pm$ 110 RCYBP (BETA-182391). The bottom sample (GR4/5) dated to 8,200 $\pm$ 110 RCYBP (BETA-182392). These two dates bracket a soil development sequence from the early to mid Holocene period.

Core Hole #1

In addition to the backhoe trenching activities, a core sample using the Oklahoma Archaeological Survey's bull probe was used to trace the soil sequences between trenches 1 and 2 (Table 4.10). At a depth between 1.70 to 2.45 m below surface an additional older soil was discovered not found in Trenches 1 and 2. The soil sample GR4/6 produced a radiocarbon date of 9,730 $\pm$ 60 RCYBP (BETA-182393). This date confirms soil development during the early Holocene period.

Table 4.10. Description of Core Hole #1

Depth	Soil Description
0-45 cm	7.5YR4/4, Bk1, subangular blocky, fine sandy loam
45-150 cm	7.5YR4/3, Bk2, friable, clay loam, carbonate nodules and root casts
150-170 cm	7.5YR4/3, 2BC, friable gravel lens, abrupt upper boundary, carbonates
170-245 cm	7.5YR4/1, 3ABk, prismatic structure, carbonates common, lower portion dated to 9730 +/- 60 RCYBP (BETA-182393)
245-255 cm	7.5YR4/4, 3 BC, bottom of hole gravel and clay

Summary of Geoarchaeological Investigations

The effort to discover the geomorphological contexts for archaeological materials at 34GR4 was successful. Soils dating to the early Holocene were discovered in Trenches 1, 5, and 6 and Core Hole 1. Soils developed during the middle and late Holocene period were identified in Trenches 2 and 4. An earlier late Pleistocene deposit was confirmed for the terrace above 34GR4. Figure 4.11 is a cross section from west to east across the site. It provides a means of visualizing the ages and development of soils for the site location. The cross section view suggests the 34GR4 site's cultural deposits occur in segmented portions of river terrace developments by the lateral movement of the North Fork of the Red River to the east (Figure 4.11). The geomorphological analysis indicates soils from the early through late Holocene periods are preserved at the 34GR4 site location. Future excavations at the site focusing on the early Holocene soils holds promise in uncovering the activities of late Paleoindian in southwestern Oklahoma.

Environmental Investigation

Fifteen pollen samples (Table 4.11) were collected from test excavations near Trench 6 and also Core Hole #3 (Table 4.12), which was placed near Core Hole #2. Contiguous 10 cm block samples were removed as a column from a profile wall near the Trench 6 test excavation (Figure 4.12 and Table 4.13). Soil samples removed from Core Hole #3 included soil beneath the dated buried soil, and top and bottom samples from the dated buried soil. The combination of these samples provided a pollen sequence from the late Pleistocene/early Holocene to the mid-Holocene period. The pollen analysis was performed by Linda Scott Cummings, and for more details see Hurst et al. (2006).

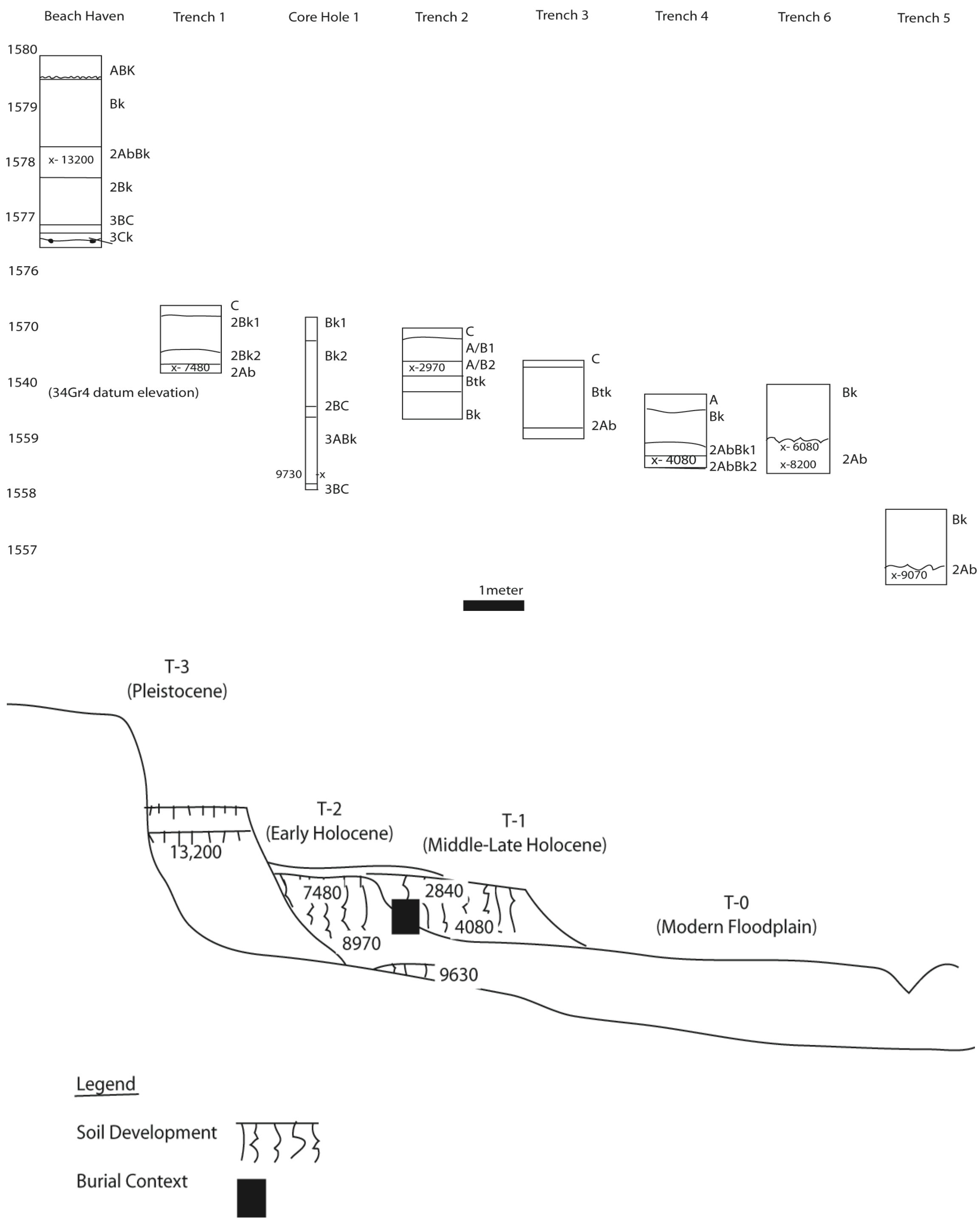


Figure 4.11. Cross-Sectional View of soil profiles from Lake Altus. View is from west to east. Below is a model depicting the development of soils along the western side of the North Fork of the Red River.

Table 4.11. Provenience data for samples from site 34GR4, Oklahoma.

Test Unit/ Core No.	Sample No.	Depth (cmbs)	Provenience/Description	Analysis
Test Unit 2	16		Column sample from top 10 cm of modern surface	Pollen
	9		Top of dated soil (Stratum II) 6,080 ± 110 BP	Pollen
	8		Stratum II, clay loam	Pollen
	7		Stratum II, clay loam	Pollen
	6		Stratum II, clay loam	Pollen
	5		Stratum II, clay loam	Pollen
	4		Stratum II, clay loam	Pollen
	3		Stratum II, clay loam	Pollen
	2		Bottom of dated soil (Stratum II) 8,200 ± 110 BP	Pollen
	1		Below dated soil, Stratum III, Btk, clay calcium carbonate, concreting, blocky	Pollen
Core 3	5	230-235	Top of dated soil	Pollen
	4	275-280	Bottom of dated soil, 9,730 ± 60 BP	Pollen
	3	295-300	Mottled transition layer	Pollen
	2	300-305	Top of gleyed soil	Pollen
	1	342-347	Bottom of gleyed soil	Pollen

Table 4.12. Description of Core #3

Depth	Description
0-10 cm	Bk1, 7.5YR3/2, subangular blocky, Fine Sandy Loam
10-85 cm	Bk2, 7.5YR4/4,subangular blocky, Clay Loam, CaCo3 nodules and root casts
85-165 cm	Bk3, 7.5YR4/4, subangular blocky, Clay Loam, CaCo3 nodules and root casts
165-230 cm	Bk4, 7.5YR4/3, subangular blocky, Clay Loam, CaCo3 nodules
230-280 cm	2Abk, 7.5YR3/1, prismatic, CaCo3 common
280-300 cm	2BC, 7.5YR4/4, prismatic, redoximorphic features
300-347 cm	2C, Gley 1 4/N, subangular blocky, redoximorphic features

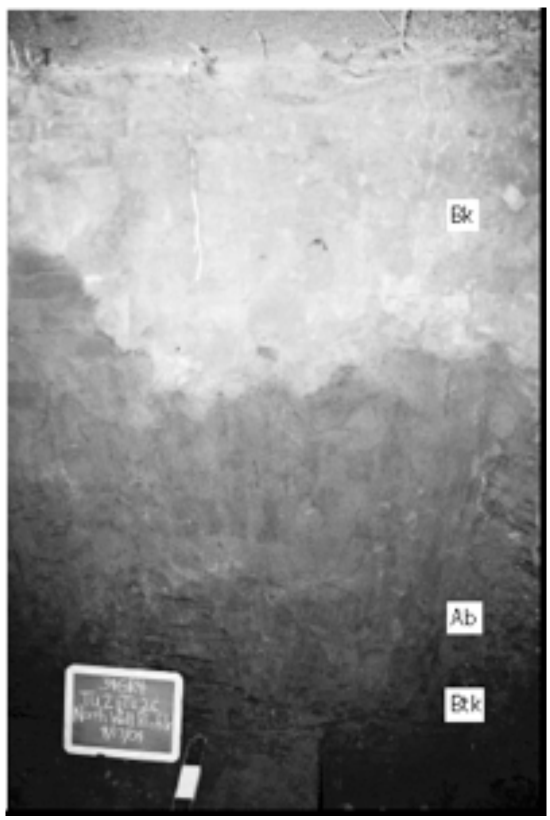


Figure 4.12. Unit 2 and 2B North Wall Profile.

Table 4.13. North wall profile description of test excavation from where pollen samples were removed.

Depth (cm)	Hori-zon	Color	Texture	Structure	Boundary	Special Features
0-86	Bk	7.5YR3/4	SiL	sbk	a, w	krotovinas, CaCO3
86-154	2Ab	7.5YR5/2	SiL	sbk	g, s	krotovinas, CaCo3
154-190	2Btk	7.5YR4/1	CL	b	-	Clay on ped faces, CaCO3 stringers and nodules, krotovinas

The results of the pollen analysis are recorded in a pollen diagram (Figure 4.13). A list of common names is provided in Table 4.14. Before 9,730 ± 60 RCYBP, the North Fork of the Red River was higher up on the landscape creating a wetter riparian zone. Cottonwood tree pollen is more frequent from samples below this dated buried soil. Other species identified from these lower levels are juniper, pine, elm, umbel family, sagebrush, thistle, marsh elder, cocklebur, rabbitbrush, cheno-ams, greasewood, wild buckwheat, legumes, and grasses.

A buried soil dated to 9,730 ± 60 RCYBP holds pollen suggesting a shift in the course of the North Fork of the Red River. Cottonwoods disappear, and sagebrush, marshelder, rabbit brush, cheno-ams, and grasses become more abundant. The pollen from this buried soil marks a vegetation community more typical of a dry terrace setting rather than being apart of an active flood plain.

Drier conditions continue to be the trend leading into the early Holocene between 8,200 ± 110 RCYBP to 6,080 ± 110 RCYBP. As evident from pollen contained in this buried soil, cheno-ams and grasses both decline in abundance. However, the chicory tribe of the sunflower family becomes prevalent during this time.

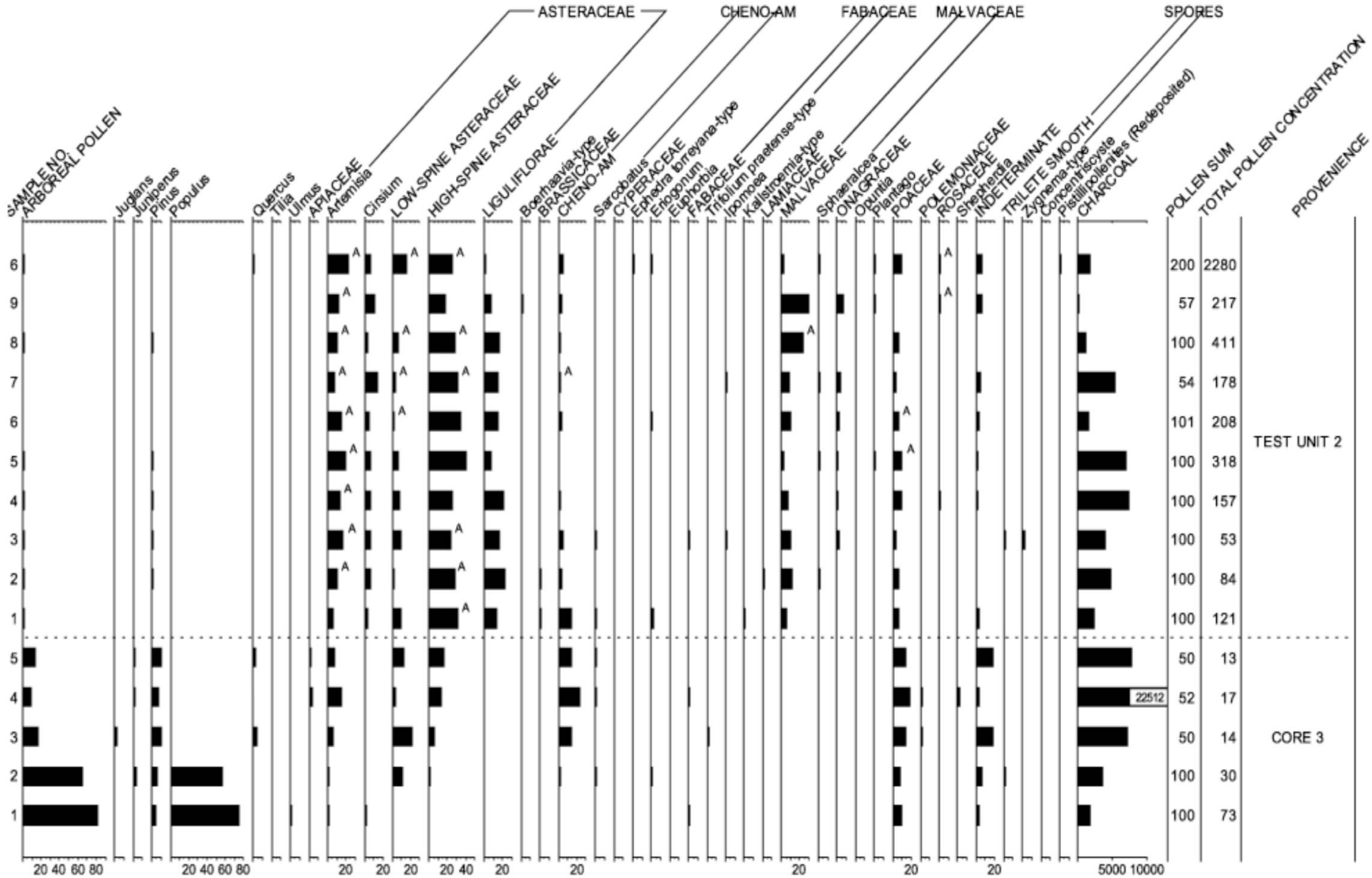


Figure 4.13. Pollen diagram for samples from Core #3 and Test Unit at the 34GR4 site, Oklahoma.

Table 4.14. Pollen types observed in samples from site 34GR4, Oklahoma.

Scientific Name	Common Name
ARBOREAL POLLEN:	
Juglans	Walnut
Juniperus	Juniper
Pinus	Pine
Populus	Poplar
Quercus	Oak
Tilia	Linden, Basswood
Ulmus	Elm
NON-ARBOREAL POLLEN:	
Apiaceae	Parsley/Carrot family
Asteraceae:	Sunflower family
Artemisia	Sagebrush
Cirsium	Thistle
Low-spine	Includes ragweed, cocklebur, sumpweed
High-spine	Includes aster, rabbitbrush, snakeweed, sunflower, etc.
Liguliflorae	Chicory tribe, includes dandelion and chicory
Boerhaavia	Spiderling
Brassicaceae	Mustard family
Cheno-am	Includes the goosefoot family and amaranth
Sarcobatus	Greasewood
Cyperaceae	Sedge family
Ephedra torreyana-type (includes *E. torreyana*, *E. trifurca*, and *E. antisyphilitica*)	Ephedra, Jointfir, Mormon tea
Eriogonum	Wild buckwheat
Euphorbia	Spurge
Fabaceae:	Bean or Legume family
Trifolium pratense	Red clover
Ipomoea	Morning-glory

Table 4.14 Continued. Pollen types observed in samples from site 34GR4, Oklahoma.

Scientific Name	Common Name
Kallstroemia	Kallstroemia
Lamiaceae	Mint family
Malvaceae:	Mallow family
Sphaeralcea	Globe mallow
Onagraceae	Evening primrose family
Opuntia	Prickly pear cactus
Plantago	Plantain
Pluchea sericea	Arrowweed
Poaceae	Grass family
Polemoniaceae:	Phlox family
Rosaceae:	Rose family
Shepherdia	Buffaloberry
Indeterminate	Too badly deteriorated to identify
SPORES:	
Trilete	Fern
ALGAL:	
Zygnema-type	Algal body
OTHER:	
Concentricyste	Indicator of wet, oxidized conditions
Pistillipollenites (Redeposited)	Pollen liberated from geologic deposits and redeposited in Eocene deposits

Basic environmental data was also gathered from the radiocarbon samples in the form of $^{13}C/^{12}C$ ratios (Table 4.1). The organic carbon contained by the soils finds its source in the plants and organisms on the surface during soil development. In general, the $^{13}C/^{12}C$ ratio provides a gross value of the ratio of C_3 and C_4 plants on the landscape. A higher composition of warm xeric adapted C_4 plants would suggest a drier climate than one dominated by relatively higher percentages of cool mesic adapted C_3 plants. In general the site data supports other carbon isotope data discussed in Chapter 3. The values accompanying the early Holocene dated soils indicate the dominance of C_3 grasses and plants (-18.7 to -20.0 $^0/_{00}$). The later periods are less mesic with the driest indicator of -16.7 $^0/_{00}$ occurring at 4080 years ago which is an indicator of the altithermal period (BETA-182394). The carbon isotope data collaborates the pollen diagram. During the early Holocene the $^{13}C/^{12}C$ ratio of -18.7 to -20.0 $^0/_{00}$ indicates a higher frequency of C_3 grasses. However, this changes during the mid-Holocene when C_4 grasses become more frequent during the Altithermal period.

Conclusion

Investigations at 34GR4 were conducted to find late Paleoindian contexts for further investigation. It is only through more excavation of late Paleoindian sites that we can unravel the regionalization process through finer resolution data. The study was successful in uncovering buried soils that date to the late Paleoindian period. More work in this area may uncover late Paleoindian campsites that are critically needed to develop a better picture of the late Paleoindian period. The research was also valuable in providing more environmental information for this poorly understood period. In general, the results confirm the basic sequence of environmental change from the late Pleistocene to mid-Holocene period as discussed in Chapter 3.

Chapter 5

Excavation at 34GR121, The Howard Gully Site

Excavation began in the spring of 2004 at the Howard Gully (Figure 5.1) site in the hopes of uncovering artifacts left from the activities of late Paleoindian foragers. Specifically, an activity feature or a former buried surface from which to recover artifacts together in a dateable context were sought. Paleoindians were known to have used the area based upon a collection of late Paleoindian style points from the site area by the LeVicks. Also, Jack Hofman tested the site in 1987, 1989, and 1991 (Hofman et al. 1991). Their research goals were similar to mine in determining if appropriate age deposits were intact with the potential for preserving Paleoindian artifacts. Because late Paleoindian sites are rare this was an important site to investigate.

Hofman et al. (1991) excavated a trench and ten 1x1 m test units to document the stratigraphic context, and to recover bison bone eroding at the site. Two radiocarbon dates were obtained from a buried "A" horizon along the gully wall. The first date was collected from sediments from a cleaned profile at the head of the gully. The date is 11,060 $\pm$ ^{14}C (Beta-20359/ETH-2934) RCYBP. They also collected another piece of charcoal within 20 cm of the first sample. The AMS date from the charcoal is 10,810 $\pm$ ^{14}C RCYBP (NZA-1461). These two dates provided a maximum age for the bison remains and other recovered fauna since they were above the buried "A" horizon. This also indicates these deposits were not buried by sediment until after 10,800 RCYBP. From their testing efforts they recovered bison mandible fragments, vertebrae, acetabulum, and a humerus. Some of these bone elements are likely part of the same feature that I excavated and report here.

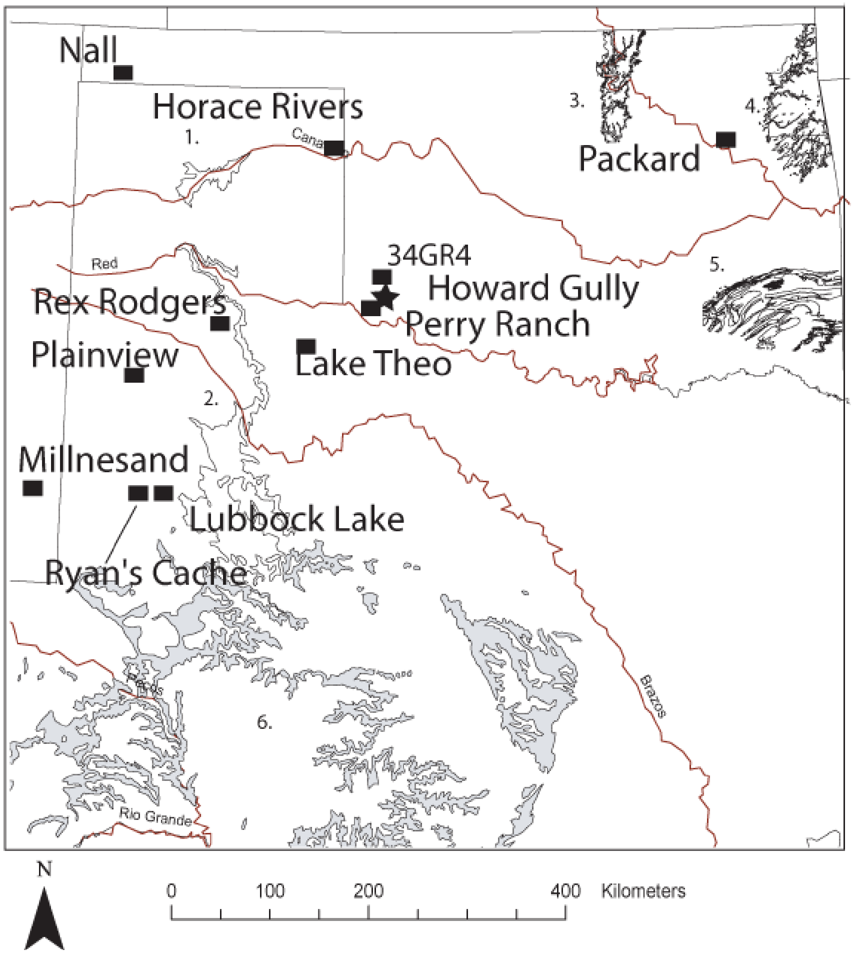


Figure 5.1. Location of Howard Gully site in relation to other late Paleoindian sites and lithic raw material sources on the Southern Plains.

More recently, the current landowner, Allen Sasse, made a discovery while walking over the site after a rain. Allen noticed a spear point eroding out of the earth with many small bone fragments. He finished uncovering the spear point to discover that it was completely intact. When Don Wyckoff and I first met Allen and Maggie Sasse to ascertain the feasibility of conducting excavation at the site, Allen showed us the point, and at the time we recognized it as a style resembling points from the Rex Rodgers (Willey et al. 1978) and Horn Shelter No. 2 (Redder 1985) sites in Texas. This was definitely a lure to work at the Howard Gully site since this style of late Paleoindian projectile point had not been reliably dated on the Southern Plains. In addition, the spear point was made from Edwards chert, a source location over 200 km away in central Texas.

Excavation at Howard Gully began the third week in April of 2004. An initial 3x2 m grid was set up over the area where Allen found the spear point associated with eroding bone fragments. After a few days of excavation, another spear point of a similar style was uncovered in association with bison remains (Figures 5.2, 5.3). In addition, the point was manufactured out of the same raw material as the first projectile point.

Excavation at Howard Gully proceeded to the first week in August. The months of work were necessary to properly document the context of the find, and to discover more artifacts. We also needed to find how the artifacts became situated at their current location on the slope overlooking the main gully below. What we learned from the five months of work at Howard Gully is discussed below.

Methodology of Excavation

An initial 3x2 m block was excavated near Allen Sasse's projectile point discovery and eroding bone fragments (Figure 5.4). We used a laser level to record elevation in relation to the site's datum. The bone feature was excavated first as one level and then each level was removed in 10 cm increments afterwards. The soil matrix was water-screened through a combination 1/8 inch and 1/16 inch mesh. Initially, the research design was to water-screen the northwest quarter of each unit through 1/16 inch mesh. However, the bone was unearthed immediately and all soil from the feature was water-sieved through 1/16 inch. After removing the bison remains, only the northwest corner of each 1 m unit was water-screened with a 1/16" mesh and the rest of the unit was water-screened through 1/8 inch hardwire.

Figure 5.2. Discovery of spear point in association with bison bone feature.

Figure 5.3. Close-up photograph of projectile point in situ.

After the first 3x2 m block was excavated, it was expanded to a 6x4 m block (Figure 5.5). Soil removed from these additional units was dry-screened through 1/4 inch mesh with the northwest corner still being water-screened through 1/16 inch size hard-wire. After the excavation of the expanded block, an 8 m trench was dug west of the block. This was labeled Trench B. This was dug to determine if a portion of the site were upslope and to assess the effects of the slope in washing artifacts across the bone feature. All soil removed from the trench units was dry-screened through 1/4 inch mesh. Twenty centimeter levels were removed within Trench B by shovel skimming and pick-axe when getting close to Stratum 1 (Permian weathered rock).

Each bone element and bone fragment was carefully mapped in situ, and strike and dip was recorded for each bone element with an axis. Bottom elevations were recorded for each end of the bone elements. Excavation techniques for the bone bed follow

Figure 5.4. Set up of initial 3X2m grid over eroding bone fragments prior to excavation.

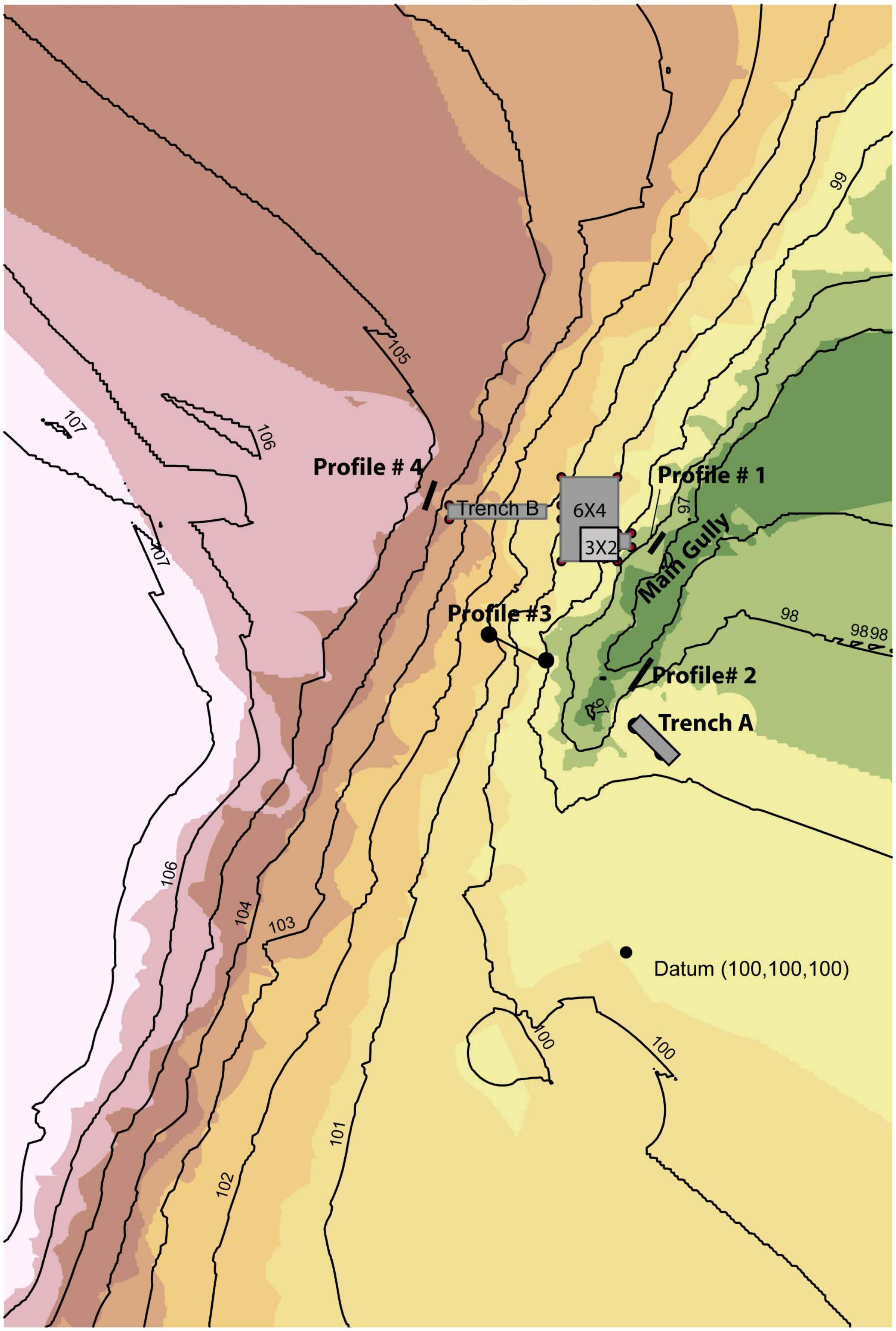


Figure 5.5. Location of excavation units and soil profiles at Howard Gully. Topo lines are also mapped for elevation reference.

the work of Bement (1999) and Todd (1987). Bone was carefully removed in the field and wrapped in aluminum foil for transportation back to the lab. Two sections of the bone feature were removed as blocks for more careful cleaning and analysis in the lab using the foam encasing technique (Bement 1985).

Howard Gully Site Context

The bison kill/processing area is on a 30 degree slope that dips east (Figure 5.6). The site overlooks the main gully that is eroding in a north direction. A significant amount of erosion has occurred in the last 17 years. The change is shown between Hofman's investigation and the present 2004 excavation photos (Figure 5.7). The gully has significantly increased in width and depth at the site. Continued flooding from the dammed pond to the south of the site is the erosional agent.

From the bottom Permian bedrock to the top of the modern surface, the gully exposed a sequence of charcoal lenses within ponded deposits, several alluvial flood events, and an upper eolian (wind-blown) deposit holding evidence of soil development. In the past 10 years, several rills are eroding the western slope perpendicular to the main gully. Two of these rills (Channel A and Channel B) crosscut the bison feature area, and one to the south (Profile #3) provides a cross section of the western slope's deposits (Figure 5.6).

Six depositional units were identified (Table 5.1). The characteristics and distribution of these deposits are provided in Figures 5.8-5.15. Detailed soil description information was collected by Brian Carter and is provided in Tables 5.2-5.6. An underlying red Permian sedimentary rock is Stratum 1. This stratum was mapped throughout the site area and followed the slope of the current landscape trending in a northeastern direction.

A deposit of Ogallala quartzite gravels can be found on top of Stratum 1 at the

Figure 5.6. Overview of excavation area and soil profile locations.

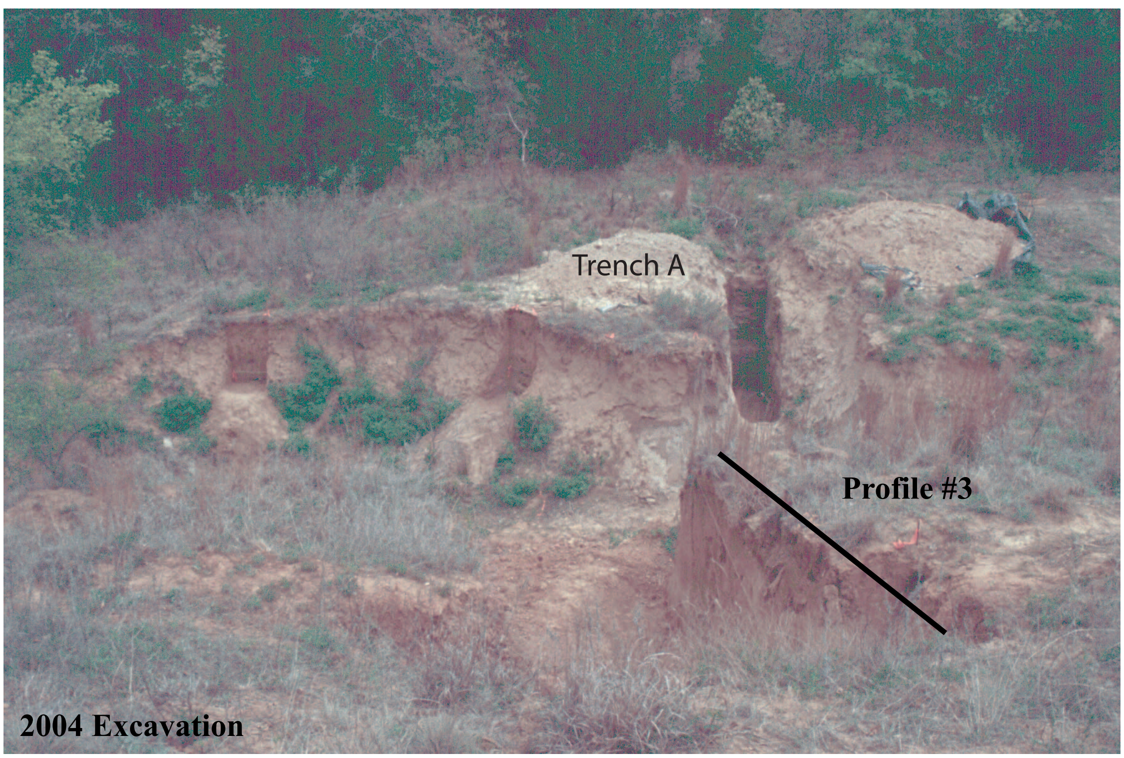


Figure 5.7. Photos from Jack Hofman's 1987 excavation above, and the 2004 dig below. Notice how much additional erosion has occurred in the past 17 years.

Table 5.1. Description of stratigraphic units at the Howard Gully site.

Stratum	Description	Radiocarbon Dates
6	Recent Channel Cut/Fill Deposit	-
5	Eolian Deposit. This stratum contains a well developed buried A horizon underneath the bison bone feature.	Two dates from upper surface of buried A horizon are 10,030±280 (GX-31270) and 11,200±340 RCYBP (GX-31271). Bone feature dates to 10,214±55 RCYBP (AMS collagen petrous bone).
4	Alternating Alluvial Flood Events	-
3	Ponded Deposit with Black Matte Lenses	10,614±40 RCYBP (Charcoal Lens)
2	Ogallala Gravels	-
1	Red Permian Bedrock/Alluvium	-

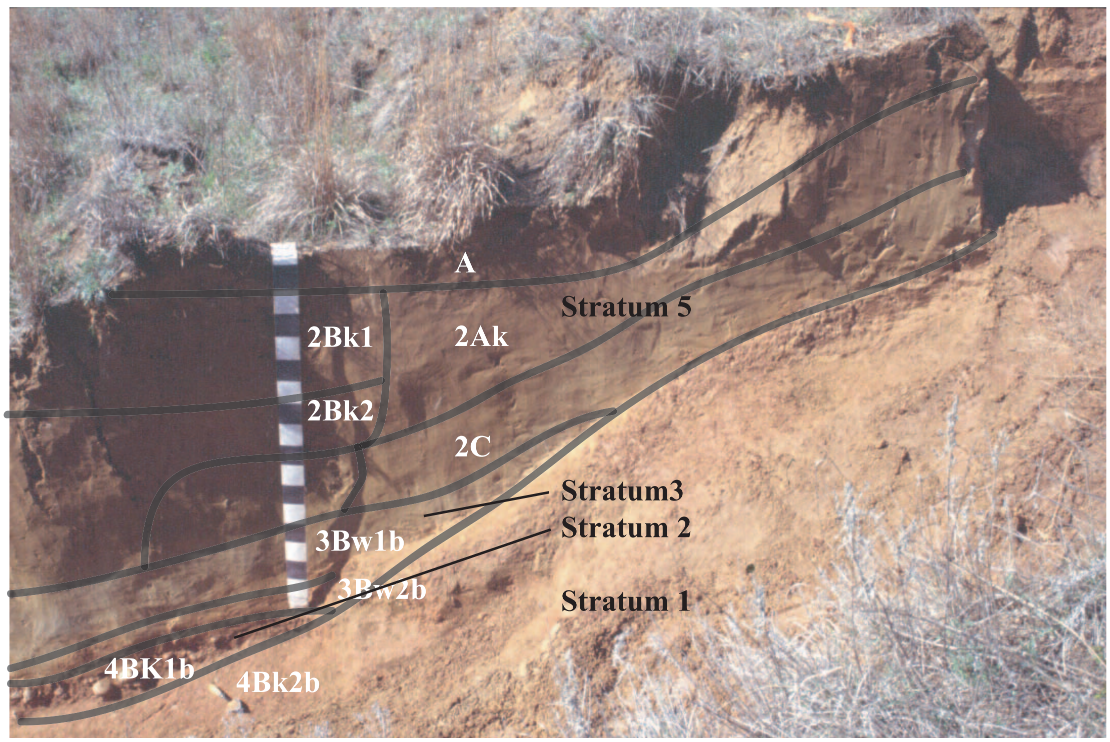


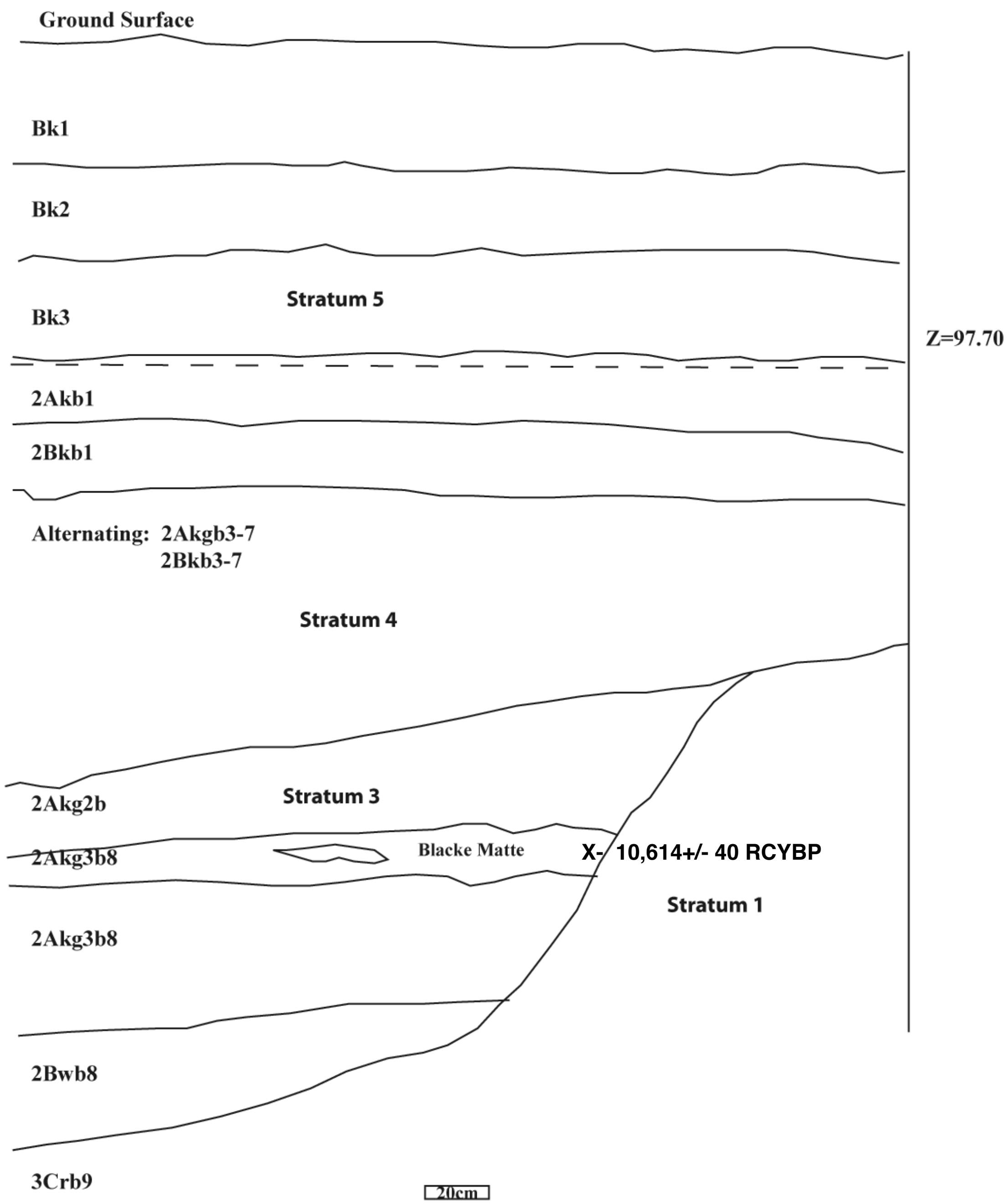
Figure 5.8. A view of profile #3.

Table 5.2. Soil profile description for Howard Gully (34GR121) slope profile #3.

#	Horizon	Depth (cm)	Color moist (Dry)	Structure†	Texture‡	Consistence¶	Boundary§	Effervescence††††	Special Features
1	A	0-21	5YR4/4 (5YR4/3)	1mSBK	SL	slh	gs	se	alluvium-colluvium; many fine + med. roots; few detrital $CaCO_3$ nodules.
2	2Ak	21-55	5YR4/6 (5YR5/6)	1cPR	LS	h	ds	ve	eolian; common fine roots; many $CaCO_3$ softbodies in pores and on ped faces.
3	2Bk1	55-104	5YR4/4 (5YR4/4)	1cPR	LFS	h	gs	ve	eolian; few fine roots; many med. $CaCO_3$ softbodies in pores and on ped faces.
4	2Bk2	104-133	7.5YR5/6 (7.5YR5/6)	1cPR	LFS	h	gs	se	eolian; few fine roots; common fine + med. $CaCO_3$ softbodies in pores and in ped faces; common med. faint redoximorphic acculmulations (5YR5/8).
5	2C	133-152	7.5YR5/4 (7.5YR5/4)	M	LFS	h	cs	se	eolian; few fine roots; few fine + med. $CaCO_3$ softbodies; few fine faint redoximorphic accumulation (5YR5/8).
6	3Bw1b	152-163	7.5YR6/8	1cSBK	FSL	h	cb	-	alluvium; few fine roots; common med. distinct redoximorphic accumulations (5YR4/6).
7	3Bw2b	163-176	7.5YR6/8	1cSBK	FSL	h	as	-	alluvium; common med. distinct redoximorphic accumulations + depletions (5YR4/6).
8	4Bk1b	176-194	2.5YR4/6	1mSBK	LS	h	as	ve	alluvium-colluvium; common fine $CaCO_3$ softbodies on ped faces.
9	4Bk2b	194+	10R4/4	2mSBK	GSiC	h	-	-	colluvium; few $CaCO_3$ softbodies on ped faces; few rounded quartzite gravels; few limestone + granite gravels; few cobbles.

Structure†				Texture‡		Consistency¶		Boundary§		Effervescence††††	
1	weak	SBK	subangular blocky	S	sand	fr	friable	c	clear	sle	slightly effervescent
2	moderate	ABK	angularblocky	Si	silt	fi	firm	s	smooth		
m	medium	PR	prismatic	L	loam	slh	slightly hard	w	wavy		
c	coarse	sg	single grain	C	clay	ex	extremely	g	gradual		
				F	fine						
				G	gravelly						

Figure 5.9. At Trench A profile #2 are a series of alluvial flood events designated as Stratum 3.



Ground Surface
Bk1
Bk2
Stratum 5
Bk3
Z=97.70
2Akb1
2Bkb1
Alternating: 2Akgb3-7
2Bkb3-7
Stratum 4
2Akg2b
Stratum 3
2Akg3b8
Blacke Matte
X- 10,614+/- 40 RCYBP
Stratum 1
2Akg3b8
2Bwb8
3Crb9
20cm

Table 5.3. Soil profile #2 description for Howard Gully (34GR121) site.

#	Horizon	Depth (cm)	Color moist (Dry)	Struc-ture†	Tex-ture‡	Consis-tence¶	Boun-dary§	Effer-vescence††††	Special Features
1	Bk1	0-37	7.5YR4/3 (7.5YR4/3)	1cPR	LS	slh	gs	-	eolian; few fine roots, few $CaCO_3$ softbodies in pores, few, med. faint redoximorphic accumulations (5YR4/4).
2	Bk2	37-69	7.5YR4/3 (7.5YR4/3)	M	LS	slh	gs	-	eolian; few fine roots, common $CaCO_3$ softbodies in pores, common med. + coarse distinct redoximorphic accumulations (5YR4/6).
3	Bk3	69-93	7.5YR4/3 (7.5YR4/3)	M	LS	h	cs	-	eolian; few fine roots; many $CaCO_3$ softbodies in pores, many med. + coarse, distinct redoximorphic accumulations (10.5YR4/8).
4	2Akb1	93-114	7.5YR5/1 (7.5YR5/1)	1cSB	FSL	h	gs	e	alluvium; few fine roots; many fine + med. $CaCO_3$ softbodies in pores; few fine faint redoximorphic depletions (5YR7/1).
5	2Bkb1	114-134	5YR4/4 (5YR4/4)	1cSB	FSL	h	cs	e	alluvium; few fine roots; many fine + med. $CaCO_3$ softbodies in pores, common, distinct med. redoximorphic depletions (10YR4/3).
6	2Akgb2 2Bkb2	134-155							Each horizon consists of two parts; the upper part of each horizon is gray (10YR6/1) and a clay loam to clay. The lower part of each horizon is red (5YR4/6) and a loam to loamy sand. The sequence of horizons 6-11 are a series of stacked flood events containing each a fining-upward sequence. Each flood event (horizons) ends with a gley zone representing reduction of organic matter: from plant roots and debris in a paludal or swampy environment. Many $CaCO_3$ softbodies in pores and voids, especially in the gleyed upper part of each horizon. Few fine roots throughout.

Table 5.3 Continued. Soil profile #2 description for Howard Gully (34GR121) site.

#	Horizon	Depth (cm)	Color moist (Dry)	Structure†	Texture‡	Consistence¶	Boundary§	Effervescence††††	Special Features
7	2Akgb3 2Bkb3	155-172							
8	2Akgb4 2Bkb3	172-191							
9	2Akgb5 2Bkb5	191-195							
10	2Akgb6 2Bkb6	195-211							
11	2Akgb7 2Bkb7	211-225							
12	2Akg1b8	225-244	10YR5/1	M	LFS	fr	as	sle	alluvium; many $CaCO_3$ softbodies in pores; few med. $CaCO_3$ nodules; few fine distinct redoximorphic accumulations (10YR5/6) and common fine faint redoximorphic depletions (Gley 1, 6/10Y).
13	2Akg2b8	244-251	Gley 1 6/10Y	M	SL	fr	as	e	alluvium, many fine + med $CaCO_3$ nodules + softbodies; many fine + med. charcoal fragments.
14	2Akg3b8	251-293	Gley 1 5/10Y	M	L	fr	gs	sle	alluvium; few fine $CaCO_3$ softbodies + nodules; few fine + med. charcoal fragments.
15	2Bwb8	293-325	2.5YR5/6	M	SCL	fr	as	-	alluvium; few fine faint redoximorphic depletions.
16	3Crb9	325+	-	-	-	-	-	-	Cr Permian shale residuim.

Structure†				Texture‡		Consistency¶		Boundary§		Effervescence††††	
1	weak	SBK	subangular blocky	S	sand	fr	friable	c	clear	sle	slightly effervescent
2	moderate	ABK	angularblocky	Si	silt	fi	firm	s	smooth		
m	medium	PR	prismatic	L	loam	slh	slightly hard	w	wavy		
c	coarse	sg	single grain	C	clay	ex	extremely	g	gradual		
				F	fine						
				G	gravelly						

Figure 5.11. Discovery of large mammal rib in ponded deposits at base of profile #2.

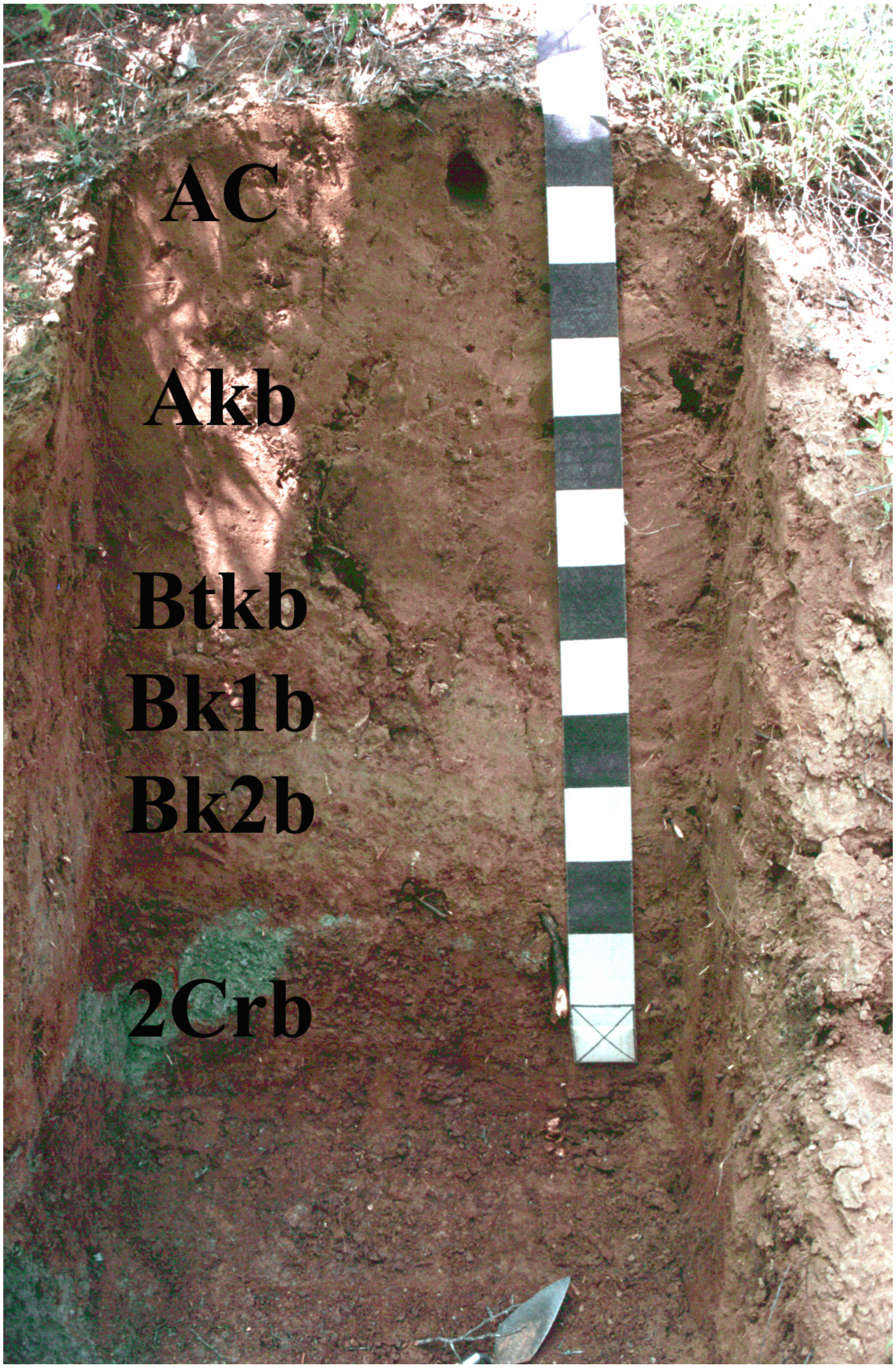


Figure 5.12. Description of profile #1 which is at the base of the excavation area.

Table 5.4. Soil profile description for Howard Gully (34GR121) profile #1.

#	Horizon	Depth (cm)	Color moist (Dry)	Struc-ture†	Tex-ture‡	Consis-tence¶	Boun-dary§	Effer-vescence††††	Special Features
1	AC	0-47	7.5YR4/4	1,m,SBK	LS	fr	cs	sle	many fine and medium roots; common fine and medium $CaCO_3$ softbodies and nodules.
2	Akb	69	5YR4/3	1mSBK	SL	fr	cs	e	many fine and medium roots; common fine $CaCO_3$ softbodies in pores.
3	Btkb	78	2.5-5YR4/4	2mSBK	CL	fr	cs	ste	many fine and medium roots; medium fine and medium $CaCO_3$ softbodies in pores; common medium redoximorphic depletions (2.5YR3/3).
4	Bk1b	91	2.5YR5/3	2mSBK	CL	fi	cs	sle	many fine and medium roots; common fine $CaCO_3$ softbodies in pores; common medium redoximorphic accumulations (2.5YR4/4).
5	Bk2b	102	2.5YR4/6	1mSBK	CL	fi	cs	sle	many fine and medium roots; few fine $CaCO_3$ softbodies in pores; common fine redoximorphic depletions (2.5YR5/3).
6	2Crb	130+	10R4/4	1mSBK	GSiCL	fi	cw	sle	few fine roots; few fine $CaCO_3$ softbodies in pores; large zone of gley (5.6Y5/1) redoximorphic depleted zone; weathered red shale.

Structure†				Texture‡		Consistency¶		Boundary§		Effervescence††††	
1	weak	SBK	subangular blocky	S	sand	fr	friable	c	clear	sle	slightly effervescent
2	moderate	ABK	angularblocky	Si	silt	fi	firm	s	smooth		
m	medium	PR	prismatic	L	loam	slh	slightly hard	w	wavy		
c	coarse	sg	single grain	C	clay			g	gradual		
				F	fine						
				G	gravelly						

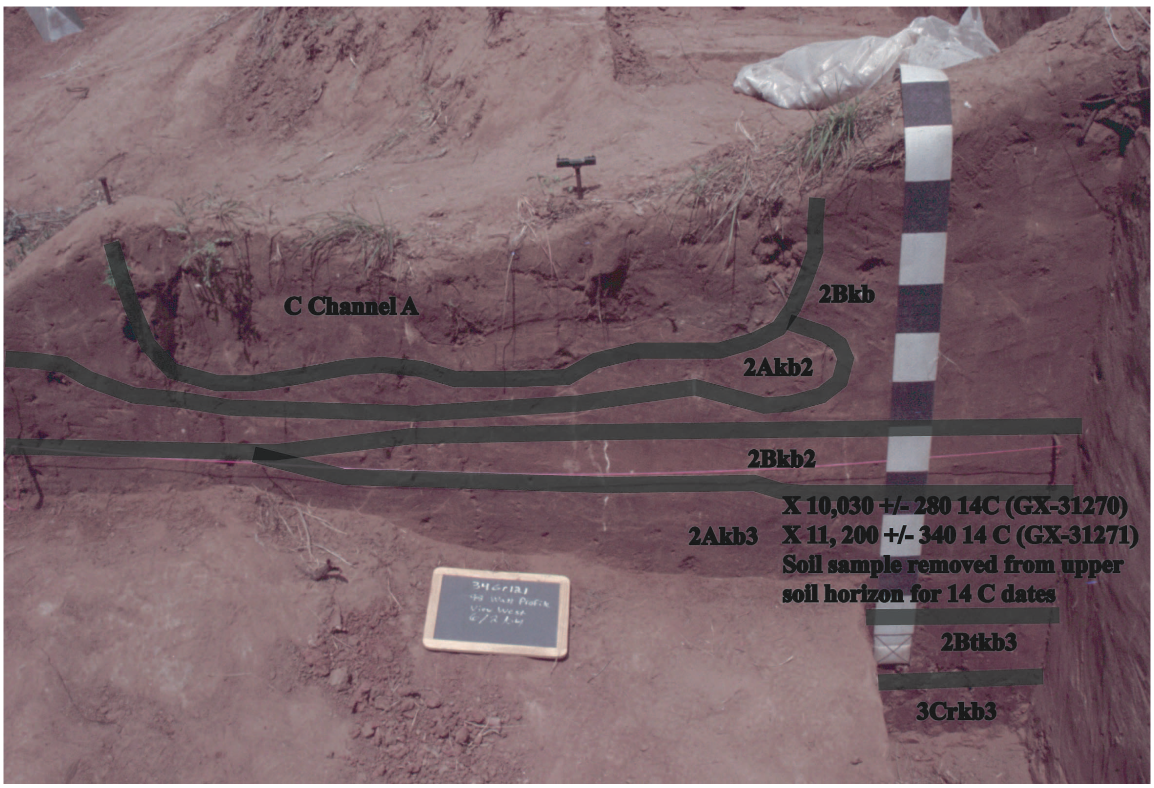


Figure 5.13. West wall profile of 3X2 meter excavation area from were bison remains were removed at 34GR121.

Table 5.5. Soil profile description for Howard Gully (34GR121) profile 98 east wall at N 131.50.

#	Horizon	Depth (cm)	Color moist (Dry)	Structure†	Texture‡	Consistence¶	Boundary§	Effervescence††††	Special Features
1	C	0-19	7.5YR4/4 (7.5YR5/4)	sg	LS	slh	cw	e	alluvium (channel fill); common fine and medium roots; few very fine $CaCO_3$ nodules and softbodies.
2	2Bkb	33	7.5YR4/4 (7.5YR5/4)	1cSBK	LFS	slh	gs	-	fine roots; many fine and medium $CaCO_3$ softbodies in pores and root channels.
3	2Akb2	51	7.5YR4/3-4 (7.5YR5/3)	1cSBK	FSL	h	cs	sle	few fine roots; many fine and medium $CaCO_3$ soft bodies in pores and root channels.
4	2Bkb2	58	7.5YR4/6 (7.5YR5/6)	1cSBK	FSL	h	cs	sle	few fine roots; many fine and medium $CaCO_3$ softbodies in pores and root channels.
5	2Akb3	73	7.5YR3/3 (7.5YR4/3)	1cSBK	L	h (fr)	cs	e	few fine roots; many fine and medium $CaCO_3$ softbodies in pores and root channels; few fine charcoal fragments.
6	2Btkb3	95	5YR4/4 (5YR5/6)	2cPR/ 1cSBK	CL-L	vh (fr)	cs	sle	few fine roots; common fine and medium $CaCO_3$ softbodies in pores; few fine discontinuous clay films on pedfaces; few fine charcoal fragments.
7	3Crkb3	110+	2.5YR3/4 (2.5YR4/4)	1cABK	-	exh	-	sle	few fine roots; common medium $CaCO_3$ softbodies on ped and rock surfaces; many fine continuous clay films on ped and rock surfaces.

Structure†				Texture‡		Consistency¶		Boundary§		Effervescence††††	
1	weak	SBK	subangular blocky	S	sand	fr	friable	c	clear	sle	slightly effervescent
2	moderate	ABK	angularblocky	Si	silt	fi	firm	s	smooth		
m	medium	PR	prismatic	L	loam	slh	slightly hard	w	wavy		
c	coarse	sg	single grain	C	clay	ex	extremely	g	gradual		
				F	fine						
				G	gravelly						

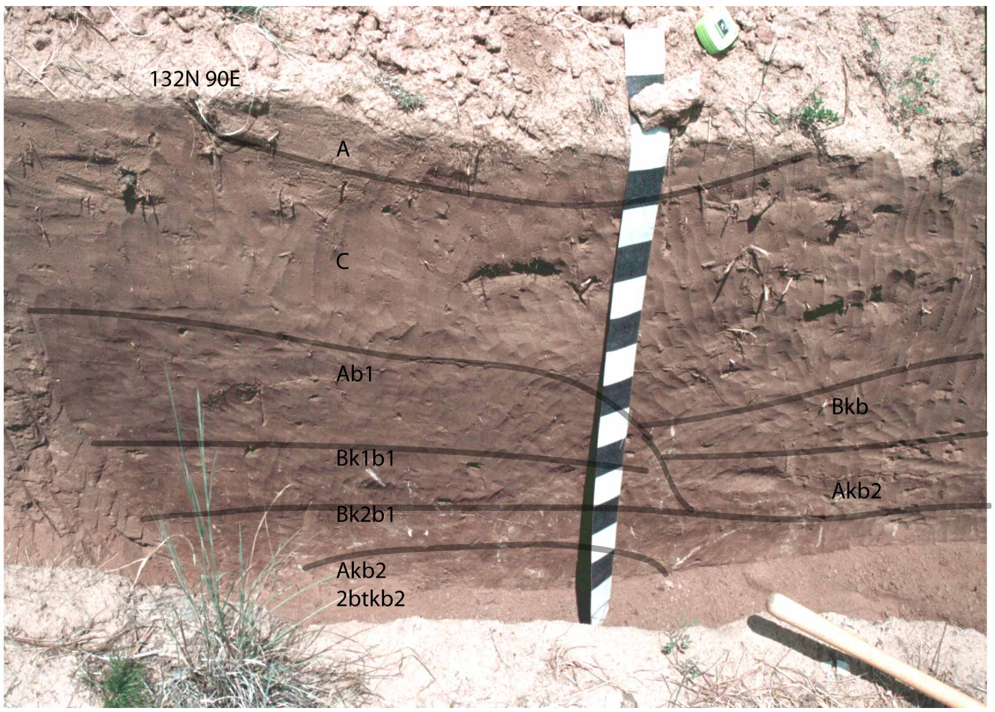


Figure 5.14. Profile view of north wall of Trench B at 34GR121.

Table 5.5. Soil profile description for Howard Gully (34GR121) Trench B north wall.

#	Horizon	Depth (cm)	Color moist (Dry)	Structure[†]	Texture[‡]	Consistence[¶]	Boundary[§]	Effervescence[††††]	Special Features
1	A	0-10	10YR5/4 10YR4/4	1mSBK	LS	l	gb	-	eolian; many fine and med. roots.
2	C	10-76	10YR5/6 10YR4/4	SG	LS	1	gb	-	eolian; many fine and med. roots.
3	Ab1	76-120	10YR4/4 7.5YR4/3	l cSBK	FSL	h	gs	-	eolian; few, fine roots; few calcium, carbonates soft-bodies in root casts.
4	Bk1b1	120-154	7.5YR4/4 7.5YR4/4	l cSBK	FSL	h	gs	ve	eolian; few fine roots; many $CaCO_3$ softbodies in root casts and a ped faces.
5	BK2b1	154-168	7.5YR5/6 7.5YR4/6	lw cSBK	FSL L	h	cs	ve	eolian; many $CaCO_3$ softbodies in root casts and on ped faces.
6	2Akb2	168-180	7.5YR4/4 7.5YR3/4	3m SBK	L	vh	gs	ve	alluvium; many $CaCO_3$ softbodies on ped faces 45 cm in width (remnant A horizon).
7	2Btkb2	180-185	10R3/4 10R3/4	3m ABK	SiC	vh	-	ve	alluvium; many $CaCO_3$ softbodies on ped faces; many continuous clay films on clay faces.

Structure[†]				Texture[‡]		Consistency[¶]		Boundary[§]		Effervescence[††††]	
1	weak	SBK	subangular blocky	S	sand	fr	friable	c	clear	sle	slightly effervescent
2	moderate	ABK	angularblocky	Si	silt	fi	firm	s	smooth		
m	medium	PR	prismatic	L	loam	slh	slightly hard	w	wavy		
c	coarse	sg	single grain	C	clay	ex	extremely	g	gradual		
				F	fine						
				G	gravelly						

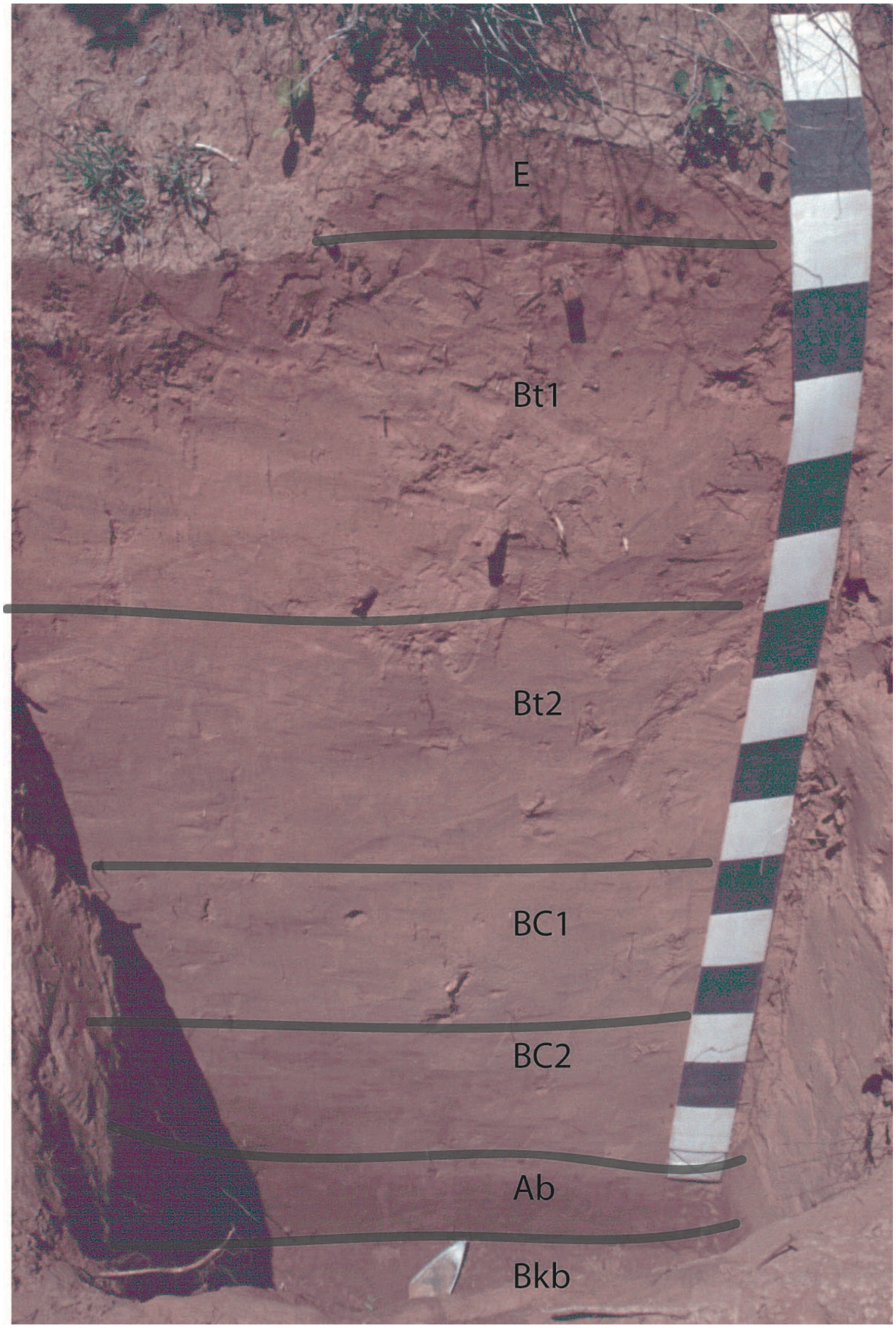


Figure 5.15. View of profile #4 which is west of Trench B at the top of the hill at 34GR121.

Table 5.6. Soil profile description for Howard Gully (34GR121) profile #4.

#	Horizon	Depth (cm)	Color moist (Dry)	Structure†	Texture‡	Consistence¶	Boundary§	Effervescence††††	Special Features
1	E	0-14	5YR4/4	SG	LS	l	cs	-	eolian; many fine + med. roots; few coarse roots.
2	Bt1	14-50	5YR4/6	2m SBK	LS	h	gs	-	eolian; many fine + med. roots; few coarse roots, 3 lamellae – 3-6mm thick, continuous = 10R4/4.
3	Bt2	50-89	5YR5/8	1m SBK	LS	h	gs	-	eolian; many fine + med. roots; few coarse roots.
4	BC1	89-117	5YR4/4	1c SBK	LS	h	ds	-	eolian; common fine + med. roots.
5	BC2	117-182	5YR5/6	1c SBK	LS	h	cs	-	eolian, common fine + med. roots.
6	Ab	182-200	5YR4/3	1m SBK	LS	h	cs	-	eolian; common fine + med. roots.
7	Bkb	200-209+	5YR4/3	1m SBK	L	h	-	ve	eolian; common fine + med. roots common $CaCO_3$ softbodies in root casts.

Structure†				Texture‡		Consistency¶		Boundary§		Effervescence††††	
1	weak	SBK	subangular blocky	S	sand	fr	friable	c	clear	sle	slightly effervescent
2	moderate	ABK	angularblocky	Si	silt	fi	firm	s	smooth		
m	medium	PR	prismatic	L	loam	slh	slightly hard	w	wavy		
c	coarse	sg	single grain	C	clay	ex	extremely	g	gradual		
				F	fine						
				G	gravelly						

bottom of Profile #3 (Figure 5.8 and Table 5.2). Southeast flowing streams deposited Ogallala quartzite gravels during the middle Miocene to late Tertiary/early Quaternary period (Gustavson et al. 1991:477-478). Subsequent erosion of the Rolling Plains has scoured portions of the landscape, leaving behind only scattered remnants on upland divides and within reworked Quaternary alluvial deposits.

Following the Ogallala gravels deposit, ponded sediments (Stratum 3) were laid down that are now exposed at the bottom of the gully (Figures 5.9-5.11 and Table 5.3). The western edge of Stratum 3 is viewed in the cross section of Profile #3 (Figure 5.2). These sediments are documented as Akg horizons with sandy loam and loam texture (Table 5.3). While cleaning off Profile #2 the rib of a large mammal was discovered resting on the Permian and within Stratum 3 (Figure 5.11). A notable feature of Stratum 3 is the occurrence of charcoal lenses. A piece of charcoal was pulled from a lens and AMS dates to 10, 614 ± 40 RCYBP (NZA-21569).

Several alternating alluvial events are apparent after Stratum 3 at the bottom of the main gully and are documented at Trench A and Profile #2 (Figures 5.9, 5.10 and Table 5.3). Within Stratum 4 are a total of six flood horizons that consist of two parts (Figure 5.10). The upper portion of each horizon is a gray (10YR6/1) clay loam to clay. And, the lower portion of each horizon is red (5YR4/6) loam to loamy sand. Each of these flood events ends with gleyed deposits, indicating the reduction of organic matter. This occurs within a paludal or swampy environment.

Stratum 5 is an eolian deposit composed of loamy sand to fine loamy sand texture that blankets the site area. It contains the late Paleoindian bison remains (Figures 5.12-5.14; Tables 5.3-5.6). At Profile #2 a buried soil lies on top of Stratum 4 and is contained within Stratum 5. No samples were pulled to date this paleosol, and are therefore not correlated with the buried “A” horizon dated beneath the bison in the excavation area (Figure 5.13). Within Stratum 5, $CaCO_3$ formed as softbodies in pores and along root channels. The translocation of $CaCO_3$ might have influenced the two radiocarbon dates from the buried “A” horizon below the late Paleoindian bison feature. The buried “A” horizon was discovered in the excavation area, Trench B, and at Profile #4 (Figures 5.13-5.15). Another melanized zone occurs above the buried “A” horizon in the excavation area. But this potential former “A” horizon has indistinct boundaries and is limited in lateral extent (Figure 5.13). Soil samples were removed from the upper portion of the buried “A” horizon at the East 98 wall near the bison bone remains, and were sent in for dating. The dates are 11,200 ± 340 $\delta^{13}C$ -23.3 (GX-31271) and 10,030 ± 280 $\delta^{13}C$ -23.3 (GX-31270) for the organic fraction (Figure 6.13).

The last unit of geological deposition recorded at the site is composed of small cut and fill channels that transect the slope. Channel A is of particular interest because it cuts directly through the bone feature (Figure 5.6, 6513). Channel B most likely removed a significant portion of the site and has flushed artifacts further down the gully (Figure 6.6). This channel is of recent origin as is evident by the discovery of a .22 shell at the bottom of the channel.

The significant variation between the two buried “A” horizon dates is not surprising given the complex nature of the exchange of new and old carbon through time (Birkeland 1999:137) and other possible contaminations (Martin and Johnson 1995). The fomation of $CaCO_3$ throughout Stratum 5 likely indicates movement through the profiles influencing the dating of the buried “A” horizon. However, the two soil dates indicate a late Pleistocene/early Holocene stable surface that existed before the influx of eolian sediments. This suggests a period of landscape stability during the late Pleistocene/early Holocene. There was likely more moisture to stabilize the landscape. After this period, the landscape was not as stable as is indicated by the deposition of wind-blown sediments resulting in Stratum 5. This is a drier period after the formation of the buried “A” horizon. The bone bed from the site occurs above this buried “A” horizon within Stratum 5.

The recent erosion of the Howard Gully site area has left only a small deteriorating island of stability that contains the archaeology of late Paleoindian hunters’ past activities. How much of the site has been removed by erosion is uncertain. Fortunately, the buried “A” horizon in Stratum 5, and the bone area itself provides a context for investigating this little known time period. The crucial piece of evidence is that there was landscape stability sometime during the early Holocene/late Pleistocene time frame as suggested by the radiocarbon dates from the former “A” horizon. The charcoal AMS date from the ponded sediments of 10,614 ± 40 (NZA-21569) suggests ponded water at the bottom of the gully was contemporaneous with the buried “A” horizon on the upper slope (Figure 5.10). A reconstruction of the cross section from the site is presented in Figure 5.16. A three-dimensional plot of the relationship between the bison bone bottom elevations, the buried “A” horizon and the underlying Permian bedrock is presented in Figure 5.17. The bison feature rests above the buried “A” horizon and came into contact with it at the western edge. This indicates the bison kill took place after burial of the “A” horizon, and the location was occupied during the deposition of the eolian sediments from Stratum 5. To more accurately date when this site was occupied, a bone sample was selected for AMS dating.

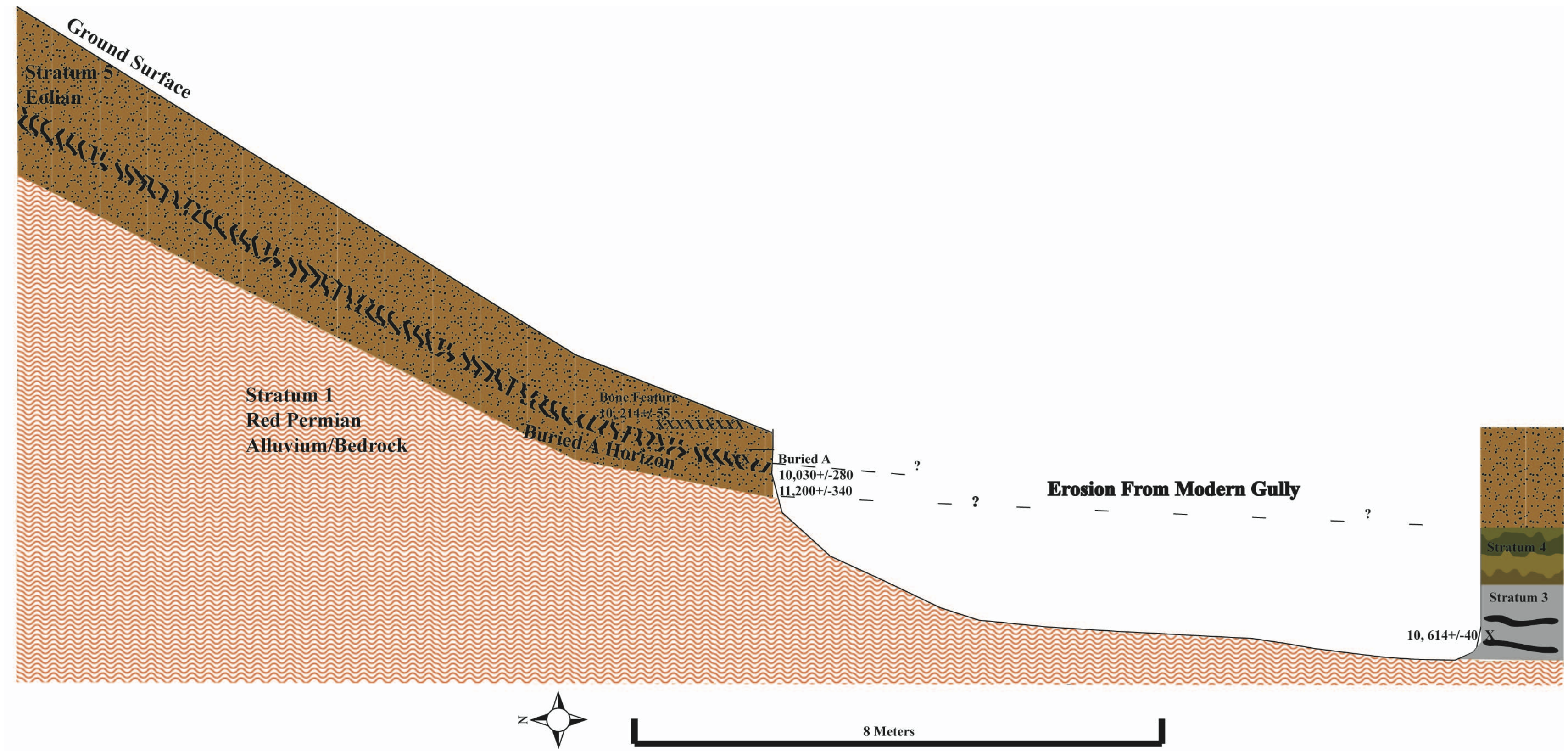


Figure 5.16. North to south cross-section of Howard Gully (34GR121) site.

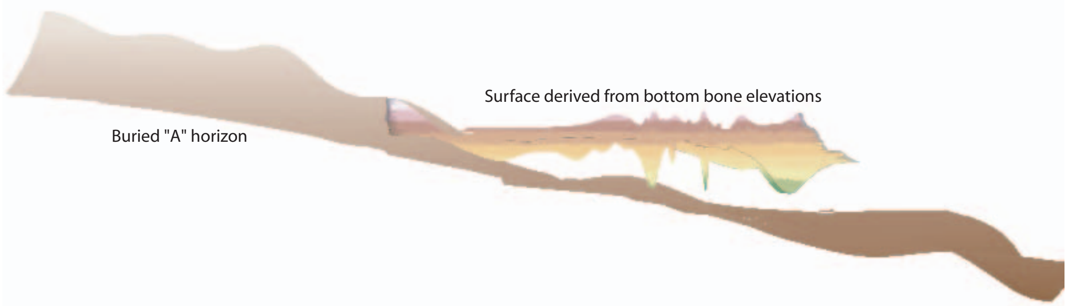


Figure 5.17. Comparison of bottom bone elevation and the top elevations from the buried A horizon mapped at the excavation and trench B areas at 34GR121.

Charcoal is the best material for radiocarbon dating. However, no charcoal was recovered in direct association with the bison bones. Instead, a bone date was the best chance for nailing down an age for the site. A petris (ear bone) from the feature was sent to Rafter Radiocarbon Laboratory Geological and Nuclear Sciences in New Zealand for collagen AMS dating. The petris is the most dense bone of the body and thus less susceptible to degradation and contamination (Bement, personal communication). Collagen from the bone was isolated, and molecular weight separation was used to remove any exogenous humic/fulvic acids.

Nancy Beaven Athfield at Rafter spent extra effort to determine the efficacy of the technique in dating older bone collagen. Four different dates were run to determine the effect of the condition of the collagen, and the size fraction dated for the AMS date. The two samples that were less than 30KD dated to 9,524 ± 50 RCYBP $\delta^{13}C$ -12.11 (NZA-21210) and 9,553 ± 55 RCYBP $\delta^{13}C$ -12.2 (NZA-21211). The first date used the best collagen portion, and the second date used the sludgy residue collagen portion. It appears the relative preservation of the collagen had little effect on the resulting date. This is also the case with the greater than 30KD fraction that was dated. The date that is most acceptable from the petris bone is 10,214 ± 55 RCYPB $\delta^{13}C$ -10.9 (NZA-21229), which was the result from the best collagen fraction. A second date was obtained from the greater than 30KD fraction on the sludgy residue collagen portion with a result of 10,212 ± 45 RCYBP $\delta^{13}C$ -10.69 (NZA-21228). These two AMS results suggests that this method, removing the smaller than 30KD fraction successfully eliminated likely soil contaminates. This eliminated the potential for contaminates to produce a more recent bone date that is typical when dating bone.

Of interest is the different $\delta^{13}C$ values for the buried "A" horizon and the petrous bone. The $\delta^{13}C$ results for the two paleosol dates indicates a grassland community mainly composed of C_3 grasses. In contrast, the $\delta^{13}C$ values for the petrous dates points to a dominance of C_4 grasses. The change from cool to warm weather grasses coincides with a shift from the development of the "A" horizon that had mainly C_3 grasses to the deposition of eolian sediments that buried the bison remains. This makes sense because a warmer climate likely coincides with the deposition of wind-blown sediments.

Because the bison bone bed is near the surface over part of the site, other prehistoric occupants also left behind artifacts after this feature. Notably, in the excavation of units away from the main bison feature was the recovery of deer bone, turtle shell, Ogallala quartzite flakes, Alibates flakes, Edwards chert flakes, and several unidentified chert flakes that were probably left behind by other people besides the ones who were responsible for the bison remains. Therefore, only artifacts directly associated with the bison feature, or at an appropriate level in the other units, are analyzed for the late Paleoindian period.

Bison Feature

Excavation exposed bison remains fairly well concentrated within one stratigraphic position (Figures 5.18, 5.19, and 5.20). Attempts to understand the human behavior behind the feature yielded numerous questions. First, how many bison were slain at this location? Second, was this the kill location or is the bison feature refuse from processing portions of the bison for meat? Third, is human behavior even discernible from this feature or did natural processes have more to do with the feature's patterning? And finally, what season of the year did this kill take place? Unfortunately, this last question could not be addressed because intact teeth were not recovered.

Based upon bone fragments complete enough to identify element and side, and by examining if the diaphysis was fused to the epiphysis, a minimum number of individuals (MNI) total of 1-2 bison was identified (Table 5.7). Although fusion is evident for the calcaneum, which suggests an age over 5.3 years (Bement 1999b:190), the other bone elements are of large size, suggesting a relatively mature individual. It is possible the calcaneum was the first to fuse in this individual with the rest of the elements to be fused within only a few months. An examination of minimum analytical unit (MAU) in comparison with bone density and food utility will determine if the bone feature represents a small kill and/or processing pile.

MAU is an analytical unit defined by Binford (1984) to determine what parts of the animal were being removed from the kill for further processing at another location. MAU is concerned with the portions not the number of animals utilized at the site. MAU

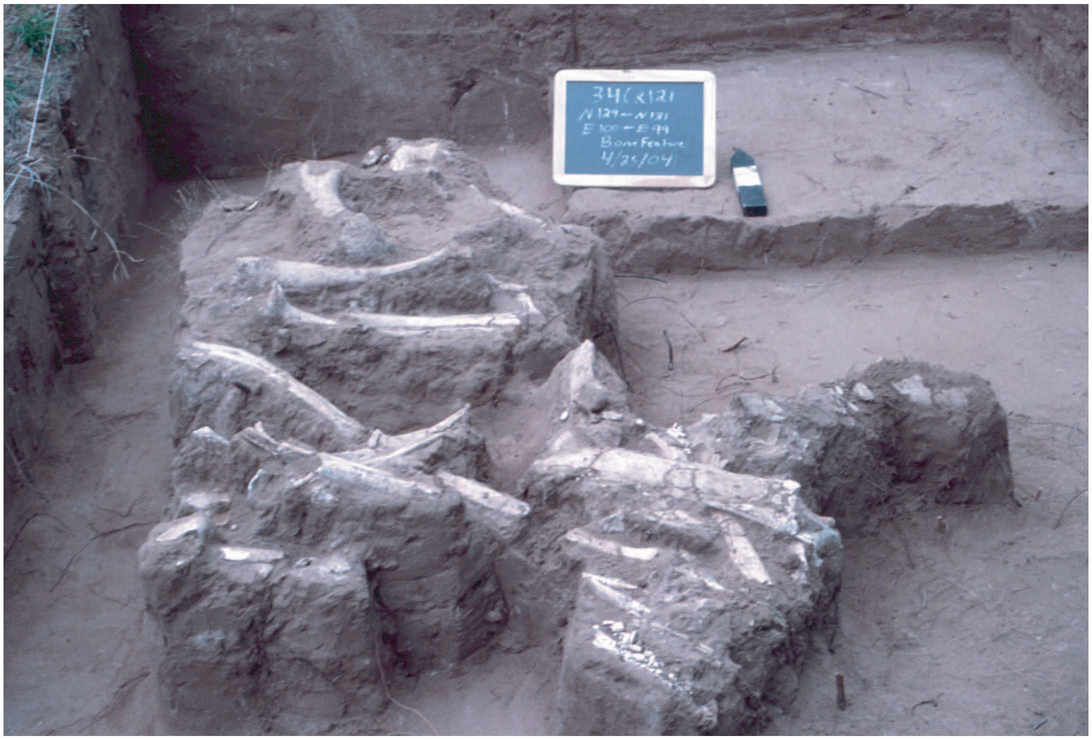


Figure 5.18. View of bison feature looking to the north.

Figure 5.19. Looking to the east over the uncovered bison feature

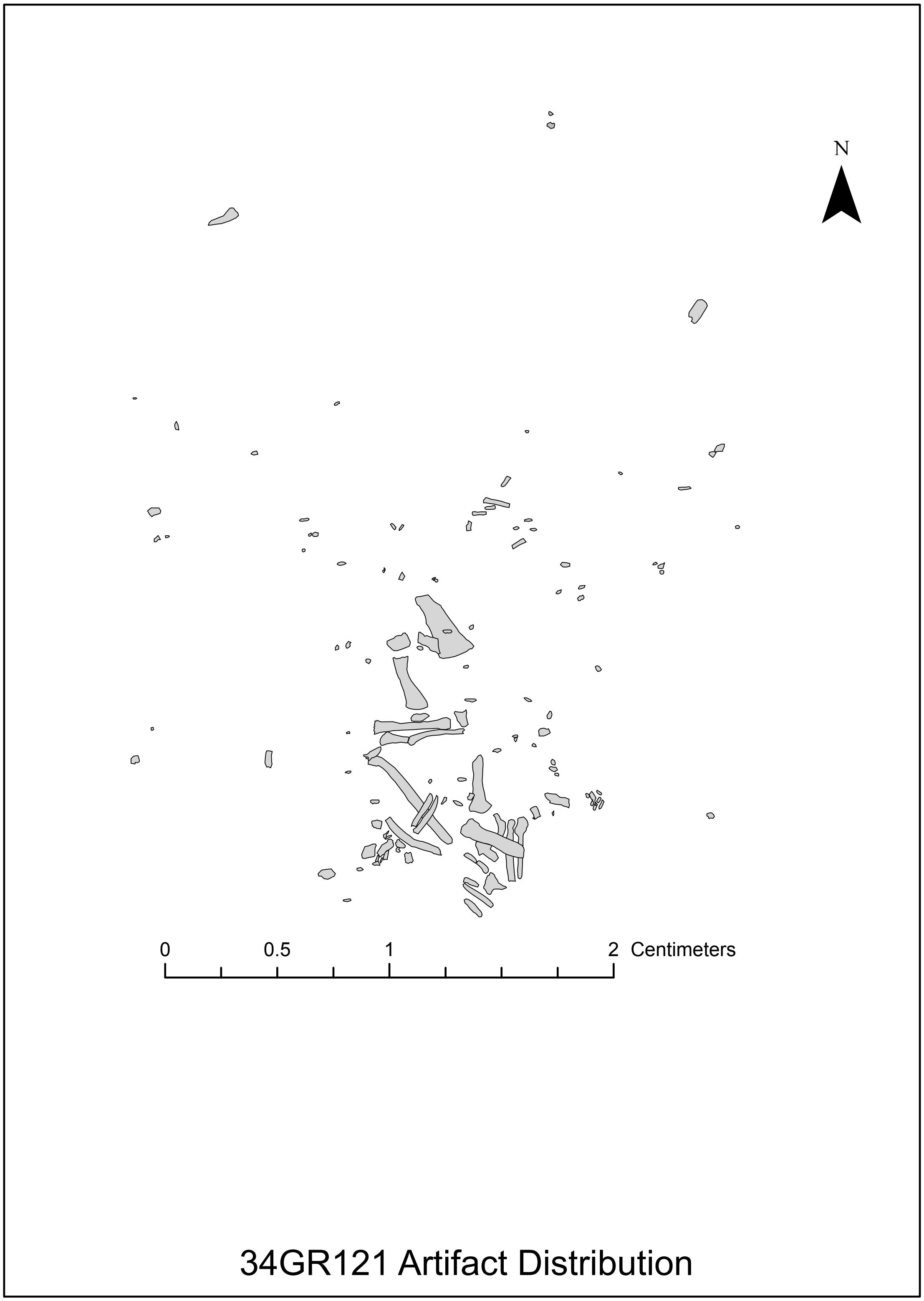


Figure 5.20. Plan view of artifact distribution from bison bone feature.

Table 5.7. MNI determination from elements present and epiphysis fusion rates.

Cat#	Element	Side	Proximal Fusion	Distal Fusion	Age Estimate
46	1st Thoracic	-	-	-	-
56	3rd Cervical	-	-	-	-
62	Scapula	Left	-	-	-
63	Axis	-	-	-	-
64	Humerus	Left	Unfused	Fused	1.3-5.3
65	Radius	Right	Unfused	Fused	1.3-5.3
66	6th Thoracic	-	-	-	-
68	Ulna	Right	Unfused	-	<5.3
76	Atlas	-	-	-	-
137	Scapula	Right	Unfused	-	
161	Calcaneus	Left	Fused	-	>5.3

is calculated by totaling the frequency of an element and dividing that number by the total number of elements represented in the animal (Lyman 1994:106). A MAU% is used to normalize the size of the sample for comparison between sites. The largest number of MAUs is represented as 100%, and the other MAU% is then derived from this total. MAU% is compared to bone density data to determine if differential preservation of bone influenced the survival of bone elements present in the feature (Kreutzer 1992).

The MAU% was also compared to a Food Utility Index created by Emerson (1993:142). The Food Utility Index is useful for determining if high food utility elements were removed from the kill location and then processed, or if the entire bison is represented at the site. This would help indicate a kill location rather than a processing feature. The food utility index takes into account the relative value of meat, marrow, fat, and grease a section of the bison can produce (Emerson 1993). In addition, the bison bone was examined for cut-marks and green spiral fractures indicative of butchering practices.

A multivariate comparison between MAU%, Bone Density, and Food Utility revealed there was no correlation (Table 5.8). A Spearman's Rho value of one would indicate a perfect correlation between the two data sets. This evidence suggests the bison was killed at this location and portions were not removed nor accumulated as in a processing pile. Also, differential bone preservation does not account for the bone elements left at the site.

Cut-marks on bone are evident by their characteristic V-shaped cross section and inclusive striations (Olsen and Shipman 1988). A careful analysis of the Howard Gully bone elements failed to reveal cut-marks. However, many bone elements had striation marks created from gopher and carnivore activity (Figure 5.21, Tables 5.9 and 5.11). Extensive root-etching on most of the bone elements might have been a factor in erasing any cut-marks (Tables 5.10 and 5.11).

Table 5.8. Multivariate comparison of MAU%, Bone Density, and Food Utility.

Element	MNE	MAU	MAU%	Bone Density	Food Utility
Humerus	1	0.5	33	10	28.4
Radius	1	0.5	33	15	19.7
Ulna	1	0.5	33	31	19.7
Scapula	3	1.5	100	20	28.4
Calcaneus	1	0.5	33	33	30
			Spearman's Rho	0	.19

Table 5.9. Classification of striation marks from identified bison bone elements from Howard Gully.

Cat#	Element	Carnivore	Gopher
64	Left Humerus	Present	Absent
65	Right Radius	Present	Absent
62	Left Scapula	Present	Absent
76	Atlast Vert.	Present	Absent
71	Rib Shaft	Absent	Present
55	Rib Shaft	Absent	Present
46	1st Thoracic Vert.	Present	Absent
54	Proximal end of Rib	Absent	Present
60	Flat Bone Fragment	Present	Absent

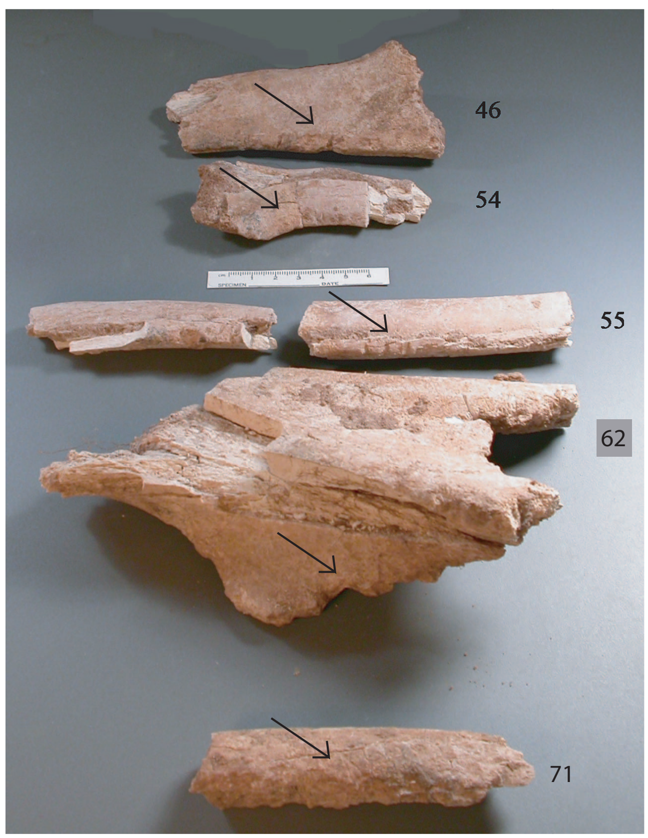


Figure 5.21. Gopher and carnivore damage among select bison bone elements from Howard Gully. Catalog numbers 46 (1st Thoracic Vertebrae) and 62 (Scapula) have puncture marks evident of canine damage. Gophers gnawed ribs 54, 55, and 71.

Table 5.10. Bone from Howard Gully bison feature identified to element.

Cat#	Element	Portion	Segment	Side	Breakage Type	Charring	Weath ering	Root Etching
26	Rib	Diaphysis	-	-	Dry/Step	Unburned	2	Present
28	Maxillary Molar	-	Interior	-	-	Unburned	-	-
29	Maxillary Molar	-	Interior	-	-	Unburned	-	-
42	Thoracic	Dorsal Spinous Process	-	-	Dry/Step	Unburned	2	Present
44	Rib	Diaphysis	-	-	Dry/Step	Unburned	2	Present
45	Rib	Diaphysis	-	-	Dry/Step	Unburned	2	Present
46	1st Thoracic	Centrum and Dorsal Spine	-	-	Dry/Chipped	Unburned	2	Present
47	Scapula	Blade Fragment	-	-	Dry/Step	Unburned	2	Present
50	Rib	Diaphysis	-	-	Dry/Step	Unburned	2	Present
51	Scapula	Blade Fragment	-	-	Dry/Step	Unburned	2	Present
52	Rib	Diaphysis	-	-	Dry/Step	Unburned	2	Present
53	Rib	Diaphysis	-	-	Dry/Step	Unburned	2	Present
54	Rib	Proximal + < 1/2 Shaft	-	-	Dry/Step	Unburned	2	Present
55	Rib	Diaphysis	-	-	Dry/Step	Unburned	2	Present
56	3rd Cervical	Tranverse Spinous Process	-	-	Dry/Step	Unburned	5	Present
58	Rib	Diaphysis	-	-	Dry/Step	Unburned	2	Present
62	Scapula	Glenoid and Blade	-	Left	Dry/Step	Unburned	2 to 3	Present
63	Axis Vertebrae	Body	-	-	-	Unburned	2 to 3	Present
64	Humerus	Complete	-	Left	None	Unburned	2 to 3	Present
65	Radius	Diaphysis	Complete	Right	None	Unburned	2	Present
66	6th Thoracic Vertebrae	Complete	-	-	Dry/Step	Unburned	2	Present
67	Rib	Proximal + <1/2 shaft	-	-	Dry/Step	Unburned	3	Present
68	Ulna	Proximal + < 1/2 Shaft	-	Right	Dry/Step	Unburned	2	Present
69	Atlas Vertebrae	Centrum	Right	-	-	Unburned	2 to 3	Present

Table 5.10 Continued. Bone from Howard Gully bison feature identified to element.

Cat#	Element	Portion	Segment	Side	Breakage Type	Charring	Weathering	Root Etch-ing
71	Rib	Diaphysis	-	-	Dry/Step	Unburned	2	Present
72	Rib	Diaphysis	-	-	Dry/Step	Unburned	2 to 3	Present
73	Rib	Diaphysis	-	-	Dry/Step	Unburned	2 to 3	Present
74	Thoracic	Dorsal Spinous Process	-	-	-	Unburned	2 to 3	Present
75	Rib	Diaphysis	-	-	-	Unburned	2 to 3	Present
76	Atlas	Centrum	Right	-	-	Unburned	2 to 3	Present
101	Rib	Diaphysis	-	-	Dry/Step	Unburned	2	Present
118	Scapula	Glenoid Portion	-	Left	-	Unburned	2	Absent
137	Scapula	Glenoid Portion	-	Right	Dry/Step	Unburned	2	Present
141	Scapula	Blade Fragment	-	-	Dry/Step	Unburned	2	Present
161	Calcaneus	Complete	-	Left	-	Unburned	2 to 3	Present
162	Maxillary Molar	Complete	-	-	-	Unburned	-	-

Table 5.11. Point provenience unidentifiable bone fragments associated with Howard Gully bison feature.

Cat#	Element	Charring	Weathering	Root Etching	Striations
4	Unidentified Bone Fragment	Carbonized	3	None	None
5	Unidentified Bone Fragment	Unburned	2	Present	Absent
8	Unidentified Bone Fragment	Carbonized	-	-	None
9	Unidentified Bone Fragment	Unburned	2	Present	None
10	Unidentified Bone Fragment	Unburned	2	None	None
12	Unidentified Bone Fragment	Unburned	2	None	None
14	Unidentified Tooth Fragment	Unburned	-	-	None
15	Unidentified Bone Fragment	Unburned	2	None	None
17	Unidentified Bone Fragment	Unburned	2	Present	None
18	Unidentified Bone Fragment	Unburned	2	None	None
19	Unidentified Tooth Fragment	Unburned	-	-	None
20	Unidentified Tooth Fragment	Unburned	-	-	-
22	Unidentified Tooth Fragment	Unburned	-	-	-
23	Unidentified Tooth Fragment	Unburned	2	Present	Absent
24	Unidentified Tooth Fragment	Unburned	2	Absent	Absent
25	Unidentified Bone Fragment	Unburned	3	Present	None
27	Unidentified Long Bone Fragment	Unburned	2	Present	None
30	Unidentified Tooth Fragment	Unburned	1	None	None
31	Unidentified Tooth Fragment	Unburned	2	Absent	Absent
32	Unidentified Tooth Fragment	Unburned	-	-	None
33	Unidentified Tooth Fragment	Unburned	-	-	None
35	Unidentified Bone Fragment	Unburned	2	Present	None
36	Unidentified Long Bone Fragment	Carbonized/ Calcined	2	Present	None
40	Unidentified Bone Fragment	Unburned	3	Absent	Absent
41	Unidentified Long Bone Fragment	Unburned	3	Absent	Absent
43	Unidentified Bone Fragment	Unburned	3	Present	None
48	Unidentified Flat Bone Fragment	Unburned	2	Present	None

Table 5.11 Continued. Point Provenience unidentifiable bone fragments associated with Howard Gully bison feature.

Cat#	Element	Charring	Weathering	Root Etching	Striations
54	Unidentified Long Bone Fragment	Unburned	3	Present	None
57	Unidentified Flat Bone Fragment	Unburned	2	Present	None
59	Unidentified Long Bone Fragment	Unburned	2	Present	None
60	Unidentified Flat Bone Fragment	Unburned	2	Present	Carnivore Along Edge
61	Unidentified Bone Fragment	Unburned	2	Present	None
77	Unidentified Tooth Fragment	Unburned	2	Absent	Absent
78	Unidentified Flat Bone Fragment	Unburned	2	None	None
78	Unidentified Bone Fragment	Unburned	2	Present	None
79	Unidentified Long Bone Fragment	Unburned	3	Absent	Absent
80	Unidentified Flat Bone Fragment	Unburned	3	Present	Absent
99	Unidentified Bone Fragment	Unburned	3	Absent	Absent
100	Unidentified Bone Fragment	Unburned	2	Absent	Absent
102	Unidentified Bone Fragment	Unburned	3	Absent	Absent
103	Unidentified Bone Fragment	Unburned	3	Absent	Absent
104	Unidentified Bone Fragment	Unburned	2	Absent	Absent
105	Unidentified Bone Fragment	Unburned	3	Absent	Absent
106	Unidentified Bone Fragment	Unburned	3	Absent	Absent
107	Unidentified Long Bone Frag	Unburned	3	None	None
111	Unidentified Bone Fragment	Unburned	1	Absent	Absent
127	Unidentified Tooth Fragment	Unburned	2	Absent	Absent
131	Unidentified Bone Fragment	Unburned	2	Absent	Absent
146	Unidentified Bone Fragment	Unburned	3	Absent	Absent
147	Unidentified Bone Fragment	Unburned	3	Absent	Absent
156	Unidentified Bone Fragment	Unburned	3	Absent	Absent
168	Rib Frag. and 64 Bone Fragments	Unburned	3 to 5	Present	Absent

Green spiral fractures are produced when bone is broken while still in a fresh condition. Green spiral fractures can be produced by agents that are non-human (Johnson 1985:175). However, taphonomic studies indicate green spiral fractures are more indicative of human activity then other breakage patterns (Johnson 1985). Green spiral fractures were not the cause of any of the bone breakage at Howard Gully (Table 5.10). This indicates bone breakage occurred while bones were in a dry state after some decomposition.

Burnt bone fragments were present among the contexts associated with the bison feature (Tables 5.10, 5.11, and 5.12). No identified bone elements had evidence of charring (Table 5.10). It is difficult to determine if the charring is natural or cultural. No evidence of a hearth was found near the bison bone bed.

However, a potential hearth was discovered in the original 3x2 m block excavation near the bison feature (Figures 5.22 and 5.23). This possible hearth was bisected in half with all fill being water-screened through a 1/16 inch mesh. The other portion of the feature was bagged and reserved for flotation to possibly recover fauna or botanical remains. Upon first seeing the feature, I thought it could be a burned matrix resulting from an ephemeral hearth (Figure 5.23). After exposing the feature it appears to not be the result of human activity. It did not have the classic bowl shaped cross section common to human-made hearths. It also was developed after Channel A crossed the site, because the feature was contained within Channel A. It is possible the feature is the result of natural fires turning the sediment to a gray color. Or it could be the result of rodent activity. No artifacts were recovered from water-screening the one-half of the gray feature. Some charcoal was recovered.

Table 5.12. Unidentified bone fragments associated with Howard Gully bison feature captured in 1/16 inch water-screen.

Cat#	North	East	Level	Cancel-lous Bone	Corti-cal Bone	Toot Frag	Burnt Bone	Turtle Shell
172	129	98	Bone Feature (99.80-99.40)		53	1		
176	129	99	Bone Feature (99.80-99.40)		407	2	2	1
181	129	100	Channel A Fill	3	90	1	8	
189	130	97	Level 1 (99.90-99.50)		160	4	4	
192	130	97	Channel A Fill	3	6			
193	130	98	Bone Feature (99.70-99.40)	37	625	7	5	
199	130	99	Bone Feature (99.70-99.40)	1	71	10	1	
232	131	97	Channel A Fill	3	13	1	2	
233	131	98	Bone Feature (99.80-99.40)	10	243	14	3	1
239	131	99	Bone Feature (99.80-99.40)	1	71	1	3	
254	**132**	**97**	**Level 11 (99.20-99.10)**				**1**	
264	**132**	**99**	**Level 9 (99.00-98.90)**		**2**			
273	**133**	**96**	**Level 12 (99.70-99.60)**		**5**		**1**	
287	**133**	**98**	**Level 12 (99.10-99.00)**		**1**			
288	**133**	**98**	**Level 13 (99.00-98.90)**				**1**	
291	**133**	**99**	**Level 8 (99.40-99.30)**				**1**	
292	**133**	**99**	**Level 9 (99.30-99.20)**				**1**	
299			Bone Block A (From Lab Analysis)		148			

- Levels in bold indicate only the northwestern 1/4 of the unit was water-screened through 1/16 inch mesh.

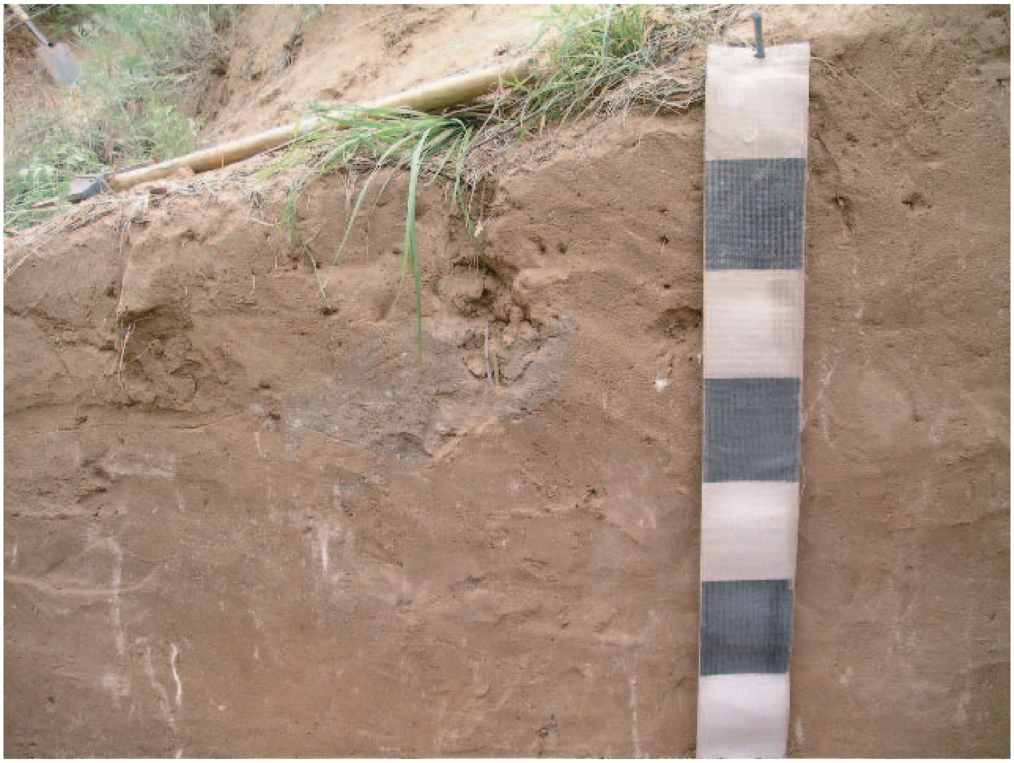


Figure 5.22. Profile of potential hearth looking to the west from original 3x2 m block excavation at Howard Gully.

Figure 5.23. Cross-section of potential hearth after removal of gray soil. View is to the east overlooking the original 3x2 m block excavation at Howard Gully.

Taking into consideration all the evidence, it is more likely that this is a small kill that has been modified by natural processes rather than human agency alone. In addition, the discovery of two projectile points with the bison bones suggests a kill. If only the bases of the spear points were discovered then, it might be more indicative of a retooling after making the kill (Keeley 1982). However, both points still have a significant portion of their blade remaining.

What is puzzling is that the bison was not more fully processed, which is typical of smaller kills (Johnson 1997). The absence of cut-marks and green spiral fractures suggests more of a gourmet butchery strategy than fully processing the bison (Binford 1978). Numerous unidentified bone fragments were discovered in association with the bison bone feature (Table 5.11 and 5.12). The bone fragmentation is more likely due to the bone elements being near the surface and breaking up rather than purposeful processing of bison.

The context of the Howard Gully site has been modified from its original condition due to continued erosion of the landscape. Portions of the bison are missing and probably flushed downstream. The extent of fluvial modification on the positioning of the bone elements in the feature was examined with a rose diagram. Bone elements that have been transported by water tend to orient themselves parallel or perpendicular to stream flow (Kreutzer 1988). Unfortunately, bone orientation is not always a clear indication of the amount of fluvial modification. The original positions of the bone elements and stream morphology have an effect on their position (Hanson 1980). And, a larger sample size is necessary for deriving any meaningful association with the orientation and vertical displacement of bone (Shipman 1981).

Nevertheless, a rose diagram was constructed to assess the natural processes that might have been responsible in creation of the bison bone feature. Evident from the rose diagram (Figure 5.24) is that the bone elements are randomly distributed in orientation and vertical displacement. Although this is a small sample size, it suggests fluvial activity had little to do in sorting out the bone feature. However, erosion of the site from small channels has removed parts of the bison from the site.

Most of the Howard Gully bone elements have weathering stages between 2-3, indicating they were on the surface for a period of time prior to burial (Behrensmeyer 1978). It is therefore not surprising to have carnivore damage on some of the bones. Carnivores do modify and remove bone from the archaeological record (Binford 1981). Carnivores are probably partly responsible for some of the bone elements missing at Howard Gully.

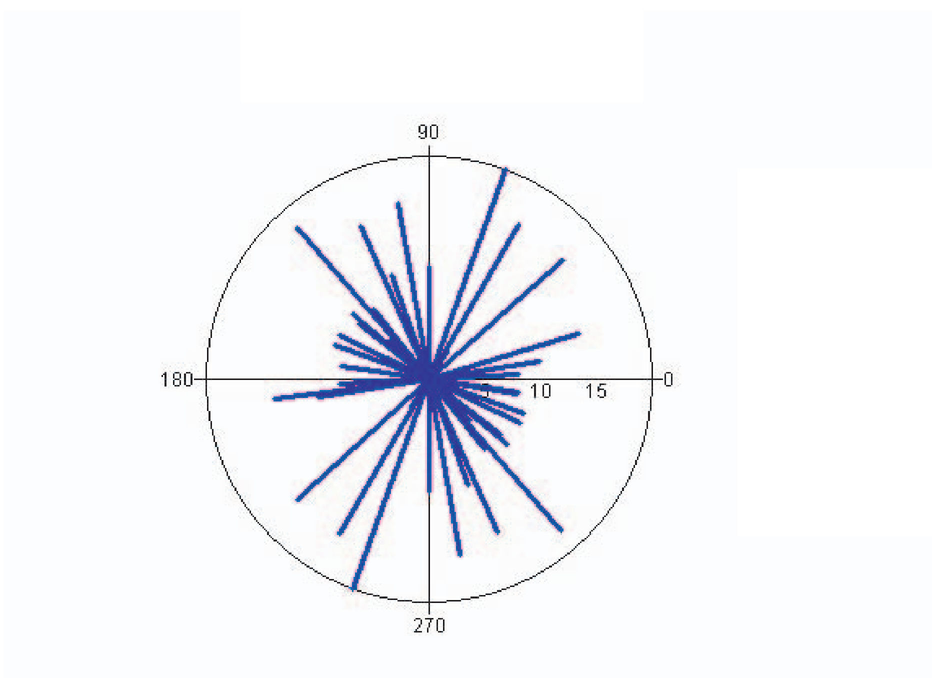


Figure 5.24. Rose diagram illustrating orientation and dip. Lines that extend further out have a greater inclination.

Table 5.13. Fauna recovered from water-screen that is associated with the bison feature at Howard Gully.

Cat#	North	East	Level	Element	Species
181	129	100	Channel A Fill	1 Incisor/3 Unid. Bone Fragments	Unknown
181	129	100	Channel A Fill	6 Unid. Bone Fragments	Unknown
188	130	97	Bone Feature	3 Incisors	Gopher
199	130	99	Bone Feature	Ulna/7 Unid. Bone Fragments	Gopher
199	130	99	Bone Feature	9 Unid. Bone Fragments	Unknown
252	132	97	Level 8 (99.50-99.40)	Unidentified Bone Fragment	Unknown
253	132	97	Level 9 (99.40-99.30)	Molar	Gopher
273	133	96	Level 12 (99.70-99.60)	Incisors and Crania Portion	Gopher
274	133	96	Level 13 (99.60-99.50)	1 Charred Unidentified Bone Fragment	Unknown
291	133	99	Level 8 (99.40-99.30)	2 Charred Unidentified Bone Fragments	Unknown

Table 5.14. Snails identified from analysis of water-screened sediments at Howard Gully.

North	East	Level	Gastropod Species
129	99	Level 5 (99.10-99.00)	1 *Hawaiia minuscula*
129	100	Channel A Fill	14 *Pupoides albiabris*, 2 *Gastrocopta armifera*, 11 *Hawaiia minuscula*, 2 unknown.
130	97	Channel A Fill	3 *Pupoides albilabris*
130	97	Level 2 (99.50-99.40)	2 *Pupoides alibilabris*
130	98	Bone Feature	1 *Pupoides albilabris*, 1 *Hawaiia minuscula*
130	99	Bone Feature	1 *Hawaiia minuscula*, 1 *Heliocodiscus parallelus*
132	97	Level 10 (99.30-99.20)	1 *Pupoides albilabris*
133	98	Level 4 (99.90-99.80)	2 *Pupoides albilabris*

Species other than bison were also recovered during careful water screening (Table 5.13 and 5.14). The only identified vertebrate associated with the bison feature other than bison is gopher. This is not suprising given the tooth marks found on some of the bone elements, and krotovenas encountered while excavating the bison feature. Other animal remains not directly associated with the bison feature were identified as Coyote, Jack Rabbit, Deer, Turtle, and Kangaroo Rat (see Appendix A-F).

Other unidentified bone fragments that were not in direct association with the bison feature were also uncovered (see Appendix A-F). Some of these maybe fragments from the bison feature, but it is unclear from their provenience their definite association. Burnt bone fragments were also recovered from these contexts.

Larger sized snails were also recovered while water-screening through the 1/16 inch mesh (Table 5.14). The presence of snails unfortunately does not give us much information regarding past environments since their contexts are near the surface. It is difficult to determine if they are a recent intrusion or if they are associated with the bison feature. Only AMS dating the snails could determine their age, and this was not attempted.

Lithic Assemblage

Besides the two Edwards chert spear points, lithic debitage was recovered which can give further insights into human behavior at Howard Gully. In this section, the chipped stone is examined to deduce the types of tools used at the site and mobility patterns. It also allows an assessment of the reduction strategies hunters and gatherers employed in manufacturing stone tools. Although this is a small assemblage, it provides

Table 5.15. Lithic debitage associated with bison feature at the Howard Gully site.

Cat#	Raw Material	Lithic Type	Stage of Reduction	Core Type	Context
2	Ogallala Quartzite	Complete Percussion Flake	Secondary	Blocky Multi-Direction	99.84 (Above)
11	Unidentified Quartzite	Complete Percussion Flake	Tertiary	Blocky	99.47 (Below)
13	Ogallala Quartzite	Complete Percussion Flake	Secondary	Blocky	99.78
16	Alibates Chert	Complete Percussion Flake	Secondary	Blocky	99.72
21	Edwards Chert	Shatter Percussion Flake	Tertiary	Unknown	99.66
34	Ogallala Quartzite	Shatter Percussion Flake	Tertiary	Blocky Multi-Direction	99.6
37	Ogallala Quartzite	Complete Percussion Flake	Secondary	Blocky Core	99.55
81	Edwards Chert	Shatter Pressure Flake	Tertiary	Unknown	99.31 Krotovina
84	Unidentified Quartzite	Shatter Percussion Flake	Secondary	Blocky Single-Direction	99.27 (Below)
129	Antlers Silicified Sandstone	Shatter Pressure Flake	Tertiary	Unknown	Channel A Fill 99.71
130	Ogallala Quartzite	Complete Percussion Flake	Secondary	Blocky Multi-Direction	Channel A Fill 99.73
140	Unidentified Black Quartzite	Complete Percussion Flake	Tertiary	Single-Direction	Channel A Fill 99.73
144	Ogallala Quartzite	Shatter Percussion Flake	Primary	-	In Channel A Fill 99.41
145	Unidentified Chert	Shatter Percussion Flake	Tertiary	Multi-Direction	In Channel A Fill 99.36
155	Alibates Chert	Complete Pressure Flake	Tertiary	Unknown	99.095 Probably Late Paleo
166	Ogallala Quartzite	Complete Percussion Flake	Tertiary	Blocky Single-Direction	Channel A Fill 99.96 (Above)
181	Unidentified Chert	Shatter Flake	Tertiary	-	Channel A Fill 1/16 inch Screen
181	Ogallala Quartzite	Shatter Percussion Flake	Secondary	-	Channel A Fill 1/16 inch Screen
181	Unidentified Quartzite	Shatter Percussion Flake	Tertiary	-	Channel A Fill 1/16 inch Screen
181	Unidentified Quartzite	Shatter Percussion Flake	Secondary		Channel A Fill 1/16 inch Screen
193	Unidentified Quartzite	Shatter Flake	Tertiary	-	N130 E98 Bone Feature 1/16" Screen

Table 5.15 Continued. Lithic debitage associated with bison feature at the Howard Gully site.

Cat#	Raw Material	Lithic Type	Stage of Reduction	Core Type	Context
193	Unidentified Quartzite	Shatter Flake	Tertiary	-	N130 E98 Bone Feature 1/16 inch Screen
228	Unidentified Quartzite	Shatter Flake	Primary	Blocky Core	N131 E97 (99.75-99.70) 1/4 inch Screen
228	Ogallala Quartzite	Complete Percussion Flake	Secondary	Blocky Multi-Direction	N131 E97 (99.75-99.70) 1/4 inch Screen
233	Unidentified Quartzite	Complete Percussion Flake	Tertiary	Biface	N131 E98 Bone Feature 1/16 inch Screen
233	Unidentified Chert	Shatter Flake	Tertiary	-	N131 E98 Bone Feature 1/16 inch Screen
239	Edwards Chert	Shatter Flake	Tertiary	-	N131 E99 Bone Feature 1/16 inch Screen
239	Edwards Chert	Shatter Flake	Tertiary	-	N131 E99 Bone Feature 1/16 inch Screen
239	Unidentified Chert	Complete Pressure Flake	Tertiary	Biface	N131 E99 Bone Feature 1/16 inch Screen
254	Alibates Chert	Shatter Pressure Flake	Tertiary	-	N132 E97 (99.20-99.10) 1/16 inch Screen
264	Unidentified Chert	Shatter	Tertiary	-	N132 E99 (99.00-98.90) 1/16 inch Screen
281	Alibates Chert	Shatter	Tertiary	-	N133 E97 (99.30-99.20) 1/4 inch Screen
281	Ogallala Quartzite	Complete Pressure Flake	Tertiary	Biface	N133 E97 (99.30-99.20) 1/4 inch Screen

some answers.

Sixteen point provenience flakes, and 17 flakes recovered from screening of levels and units are associated with the bone feature (Table 5.15). Measurements for the flakes are provided in Appendix A. The point provenience flakes that are likely associated with the bone feature, are listed whether their elevation is above, within, or below the highest and lowest elevation recorded for bone elements from the feature (Table 5.15). The flakes are derived from cores manufactured from Alibates agatized dolomite, Antlers silicified sandstone, Edwards Plateau chert, and Ogallala quartzite sources. A few quartzite and chert flakes were not identified as to their source location (Tables 5.15).

The recovery of primary and secondary Ogallala quartzite percussion flakes produced from blocky multi-directional cores indicates tools were manufactured and used locally from this material (Figure 5.25). The presence of secondary blocky Alibates percussion flakes suggests some unfinished tools or cores that were modified and used at the site (Figure 5.26). Cortex on one of the Alibates flakes is similar to that produced from transportation along a stream bed (Wyckoff 1993). The occurrence of tertiary Alibates pressure flakes shows more formal tools made from Alibates were maintained and used at the site.

Of the four Edwards chert flakes found, three appear to be of a variety very similar to Edwards chert point (#3) uncovered during excavation (Figure 5.27). Unfortunately, no refits were made between the flakes and spear point, but all three flakes lack platforms, hindering attempts at refitting. The other Edwards chert flake is fractured and glossy from being in contact with fire. The flakes were probably detached while resharpening and maintaining Edwards chert tools brought to the site.

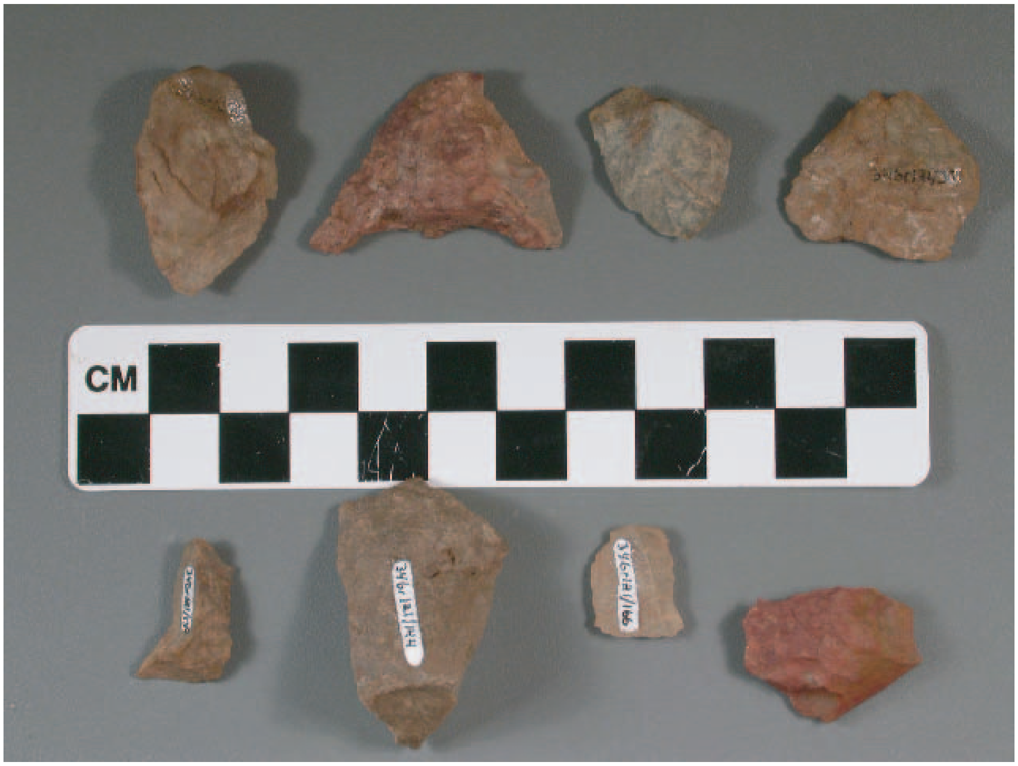


Figure 5.25. Ogallala quartzite flakes from the Howard Gully Site.

Figure 5.26. Alibates flakes from the Howard Gully site.

Figure 5.27. Edwards chert flakes recovered from the Howard Gully site.

A single Antlers silicified sandstone flake was found in association with the bison feature. This is not a commonly documented raw material at Paleoindian sites on the Southern Plains (Wyckoff 2005). This is likely because other investigators not being aware classify it as another type of quartzite rather than Antlers silicified sandstone. The flake fragment from the site most likely came from a finished formal tool.

The unidentified quartzites and chert flakes show the same reduction strategies as outlined by the identified chert materials (Figure 5.28). Several of quartzite flakes were detached from blocky cores. One chert flake (#239) and one quartzite flake (#233) was likely removed to resharpened or thin a biface.

Chipped stone not in association with the bison feature includes Alibates chert, Antlers silicifed sandstone, Ogallala quartzite, petrified wood, and unidentified chert and

Figure 5.28. Unidentified quartzite flakes from the Howard Gully site.

quartzite (Appendix B). Two scrapers made from Alibates and Ogallala quartzite were discovered west of the main excavation block in Trench B. One multi-directional core of petrified wood was north of the bison feature at a higher elevation within Stratum 4. One Alibates late Paleoindian spear point (Figure 5.29) was discovered along a trail created while hauling buckets of dirt to the water-screening area. Unfortunately, the spear point can't be linked to the bison feature.

The distribution of the procurement locations in relation to Howard Gully indicates a mobile settlement pattern across the western Southern Plains (Figure 5.1). The reduction of blocky cores for the production of useable flakes appears to be a common knapping strategy used at Howard Gully. This is a frequent reduction strategy observed during the late Paleoindian period on the Plains (Bamforth and Becker 2000). Mainte-

Figure 5.29. Alibates late Paleoindian projectile point discovered on surface of trail south of the excavation area at Howard Gully Site.

nance of tools and/or manufacture of formal tools, including bifaces are inferred from debitage recovered at Howard Gully.

The presence of Edwards chert flakes may indicate the resharpening of bifacial tools such as the two spear points discovered at the site. Bamforth and Becker (2000) point out that late Paleoindians have been misconstrued as reliant upon a biface technology for the production of useable flakes for tools. Instead, bifacial technology is mainly geared to the production of projectile points, whereas a blocky multi-directional core technology is used to produce their flake tools.

The discovery of the two Edwards chert points (Figures 5.30 and 5.31) in association with a date of 10,214 ± 55 RCYPB (NZA-21229) makes this an important site in further documenting the cultural chronology of the late Paleoindian period. Both points

Figure 5.30. Edwards chert projectile point discovered by Allen Sasse at the Howard Gully site.

Figure 5.31. Edwards chert spear point (Cat #3) discovered associated with bison bone feature at the Howard Gully site.

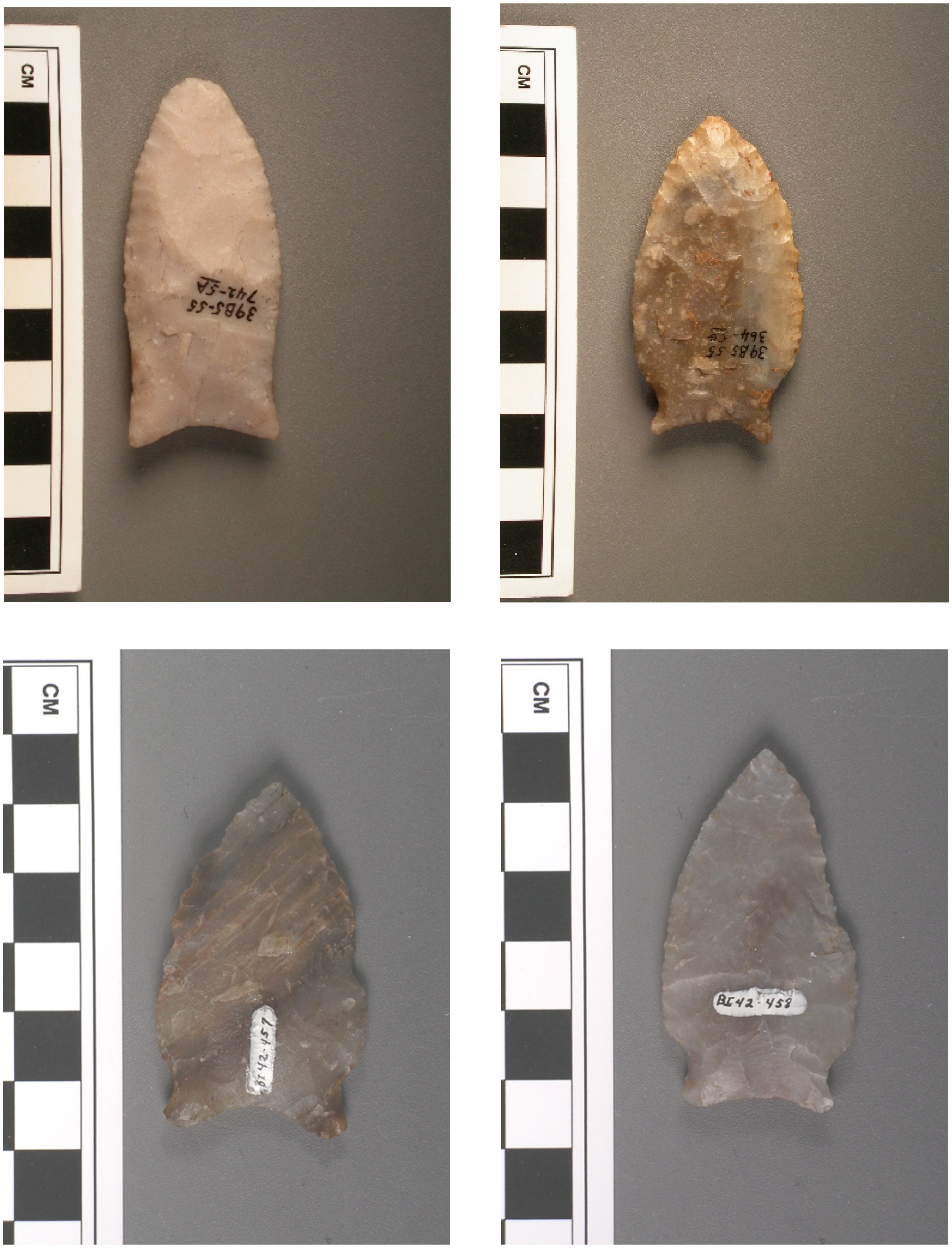


Figure 5.32. Projectile points from Horn Shelter No. 2 (above) and Rex Rodgers (below) are similar to the Howard Gully spear points' style with their shallow side-notching and concave base.

have short bases with shallow-side notching and basal concavity for hafting. This point style has not been reliably dated on the Southern Plains until now. Points of a similar style have been recovered both from the Rex Rodgers bison kill and Horn Shelter No. 2 sites in Texas (5.32). The point style is most similar to San Patrice, which is more commonly found in the eastern Woodlands than on the Plains (Jennings 2006). But, obviously people on the Plains were also manufacturing this point style and using it for hunting bison as well. It is becoming apparent that the San Patrice point style is being found in deposits that date to ca. 10,200 RCYBP (Lopinot et al. 1998).

Conclusion

Excavation at the Howard Gully site uncovered the remains of possibly two bison in probable association with two Edwards chert spear points of late Paleoindian style. Analysis of the bone revealed no evidence for butchering nor the differential occurrence of select bone elements. This indicates the bison feature is most likely a kill location that has been heavily eroded.

The radiocarbon date of 10,214 ± 55 RCYPB (NZA-21229) provides a dateable context for this style of point. This is important because this style has not before been reliably dated on the Southern Plains. This style of point is similar to those discovered at Rex Rodgers and at Horn Shelter No. 2 sites. The lithic debitage left at the Howard Gully site indicates this forager group were a people of the western Southern Plains. The recovery of Alibates and Edwards chert flakes are typical of other late Paleoindian discoveries from this area. In addition, the manufacture of expedient flake tools from local gravels is another common pattern for late Paleoindians that also occur at the Howard Gully site (Bamforth and Becker 2000).

Chapter 6

Excavation at the Perry Ranch (34JK81) Site

In October 2004 and 2005, I continued investigating contexts for late Paleoindians by further testing at the Perry Ranch site (Figure 6.1). My purpose at Perry Ranch was to recover additional information about the site's context. This would improve our understanding of another group of late Paleoindian hunters and gatherers. And, the evidence from the site might further delineate when the kill was made. It was also possible that

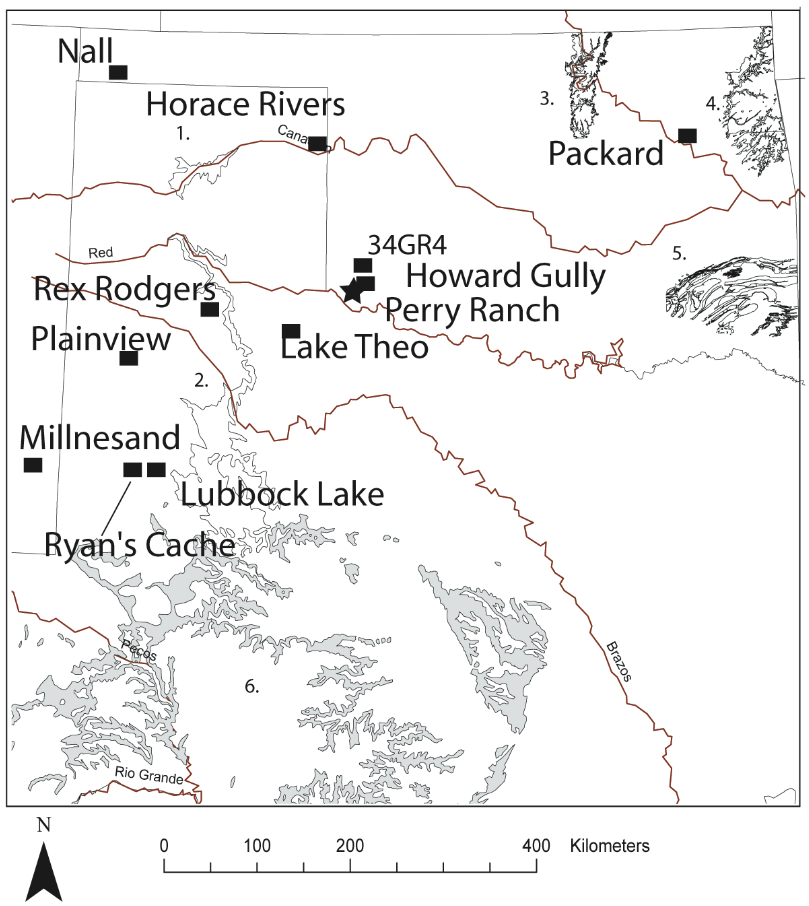


Figure 6.1. The Perry Ranch site is located to the west of Howard Gully in southwestern Oklahoma.

more of the site remained making it valuable for additional study. A preliminary report of findings is presented here.

Previous Research

While scouring the southern Oklahoma landscape for artifacts left behind by indigenous Americans, the amateur archaeologist Elmer Craft found the basal portion of a late Paleoindian Plainview style projectile point in association with bison bone near the town of Duke, Oklahoma (Figure 6.2; Saunders and Penman 1979). Excited by the discovery and recognizing the importance of the find, Elmer confided with Lawrence LeVick, another long time archaeology enthusiast and local farmer, about the site. They then brought the site to the attention of John Penman and Roger Saunders of the Oklahoma Archaeological Survey in Norman, Oklahoma.

Because erosion was destroying a portion of the site, Penman and Saunders proceeded to excavate three 5x5 foot squares to uncover more bison remains and hopefully more evidence for human involvement (Figure 6.3). Under the hot July Oklahoma sun, they found several articulated long bones, a highly fragmented skull, and a complete Plainview style projectile point (Figure 6.2; Saunders and Penman 1979). Recovery of the bison bone was hampered by the highly compact clay soil and considerable deterioration of the bone due to its proximity to the current surface. Fortunately, with the application of a mixture of white glue and water the majority of complete bone specimens were recovered and added to the archaeology collection at the Sam Noble Oklahoma Museum of Natural History for further study.

Figure 6.2. The two Plainview points uncovered at the Perry Ranch site. To the left is the point recovered by Elmer Craft. Note, that this is a cast of the original since it was unavailable to photograph. To the right is the spear point found by Saunders and Penman.

Figure 6.3. The 1974 excavation at the Perry Ranch site. Gene LeVick, family, and friends monitor the progress.

Saunders and Penman (1979) noted that the bison bone had been washed into a narrow shallow erosional gully. Sediments within this gully were a mixture of reworked clay and pieces of local shale. Analysis of the bison bone at the lab in Norman revealed that a minimum of eight bison died at the site. This was based upon estimates of bison age from eruption and wear patterns from teeth.

Ascertaining the age of the kill was important to comprehend how Perry Ranch fit into the emerging picture of Paleoindians in North America. Because charcoal was not recovered, a bison bone sample was submitted. A date of 7,030±190 RCYBP (TX-2190) was returned (Saunders and Penman 1979). This date was more recent than other Plainview finds on the Southern Plains.

The discovery of a bison kill on the flat landscape near Turkey Creek was surprising (Figure 6.4). Figuring out how prehistoric hunters killed bison at this location in southwestern Oklahoma is a complicated task because of the extensive erosion of the landscape. A small approximately 2 m high terrace can be found 300 m to the south of the kill (Figure 6.5). Saunders and Penman (1979) speculated during the past 7,000-10,000 years erosion may have receded the bluff to its current position. Though the bluff is not very high, hunters could have used this natural topographic slope for driving the bison over the bluff into a possible bog or some type of natural trap to give themselves an advantage.

After Saunders and Penman's work, the main unsolved mystery of the Perry Ranch site was the relatively recent date for a Plainview find. Some researchers called into question the Plainview classification of the projectile points (Johnson and Holliday

Figure 6.4. North view of the Perry Ranch site in 2004. Excavation is in progress in the foreground.

Figure 6.5. The small bluff to the south of the Perry Ranch site. View is to the east.

1980). During the summers of 1989 and 1990 Jack Hofman and Lawrence Todd (1997) revisited the site and the museum collection armed with new fauna analysis techniques developed over the last 20 years. They hoped a reinvestigation of the site would aid in solving the unanswered questions at Perry Ranch.

Hofman and Todd first addressed the problematic radiocarbon date. They sent a new bone sample from their limited testing to Thomas Stafford to assess the bone's chemistry and obtain a new date if feasible. Stafford's analysis of the bone sample's chemistry indicated that it was too deteriorated to reliably obtain a radiocarbon date. Therefore, the original date of 7,030±190 RCYBP obtained by Saunders and Penman was in error and likely 2,000 years too recent. Bone dates are notoriously too young when the bone is deteriorated (Holliday et al. 1999).

Besides testing the reliability of the radiocarbon date, Hofman and Todd also reexamined the bison bones using more modern identification techniques. They determined that instead of the eight bison postulated by Saunders and Penman, a minimum of two was more likely. Their examination of the teeth revealed that a young female less than three years old and an immature individual reliably account for the known bison remains. The kill also likely took place during the winter months as suggested by the eruption and wear sequence of the recovered teeth.

Description of 2004 and 2005 Excavations

The site has been puzzling to researchers for over two decades now. Don Wyckoff and I had been trying to relocate the site for three years. We had difficulty because it was recorded in the wrong section. We were finally able to find the site and gain permission from the American Gypsum Company to conduct an investigation. At first glance, the site does not appear to be very much. It is on a flat landscape with little hint that a bison kill took place here over 8,000 years ago (Figures 6.4 and 6.5). This is because of the typological problem created by the recovery of Plainview points and an unreliable radiocarbon date. The results of my research partially solved these questions, but also opened the door to many more.

During the fall of 2004, I set up a 3x3 m grid near the location where Saunders and Penman originally discovered the bison bone (Figure 6.6 and 6.7). An additional 1x1 m unit was dug to the north of the grid. Trowels were used in the excavation as well as bamboo tools for working around bone. All the matrix was dry screened through 1/4 inch mesh. Bone elements were mapped *in situ*, and strike and dip was recorded for each element. A laser level was used to record elevations. Three sections of the discovered bone feature were encased in foam (Bement 1985) and transported back to the lab for more careful analysis.

To ascertain the full extent of the site and its geomorphic setting, five backhoe trenches were dug in the fall of 2005 (Figures 6.6. and 6.7). The trenches were excavated to the top of the buried bone bed. The bone was then documented in place in relation to the alluvial deposits. More bison bone was encountered in Trenches A, B, and C to the north of the previously excavated area. This demonstrates the gully is over 20 m long and holds the remains of a larger bison kill than previously thought. A description of the findings is presented below.

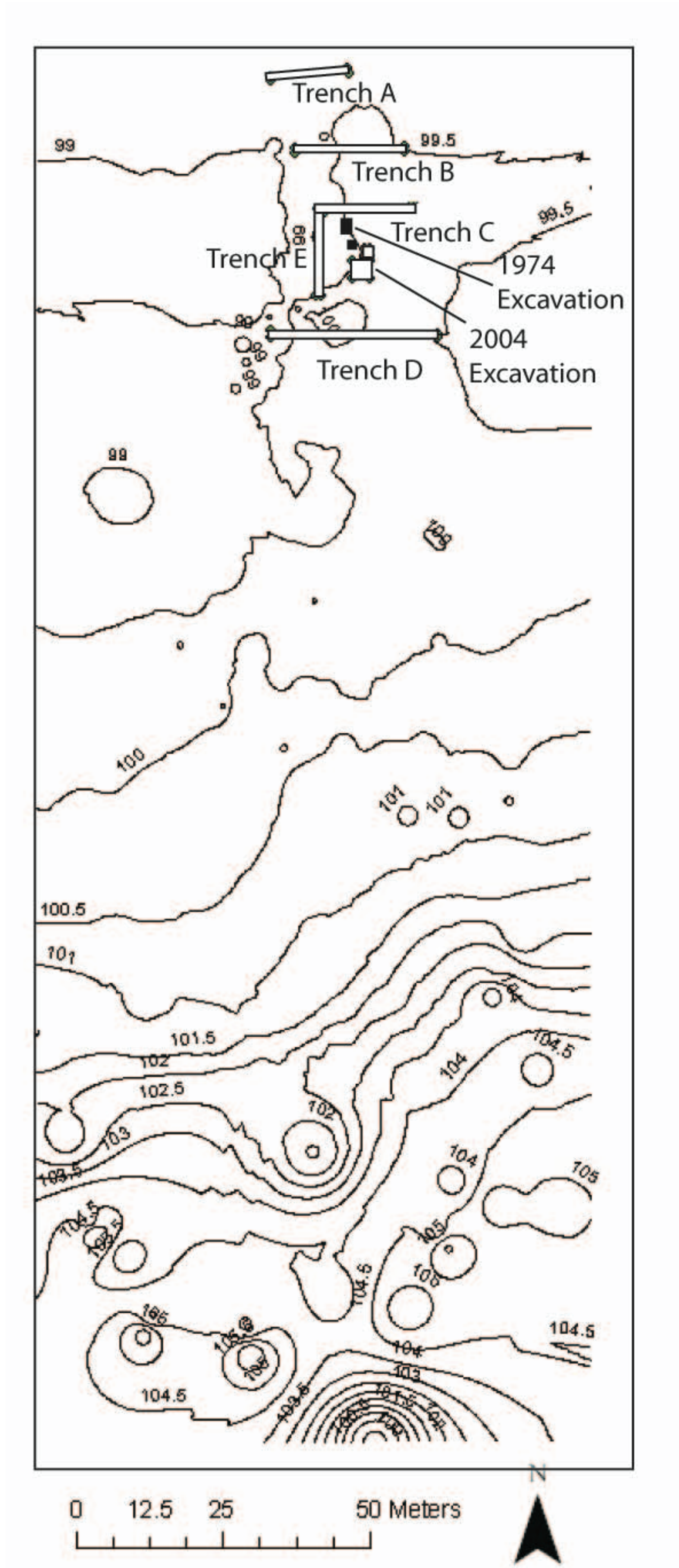


Figure 6.6. Contour map of Perry Ranch site and excavation units.

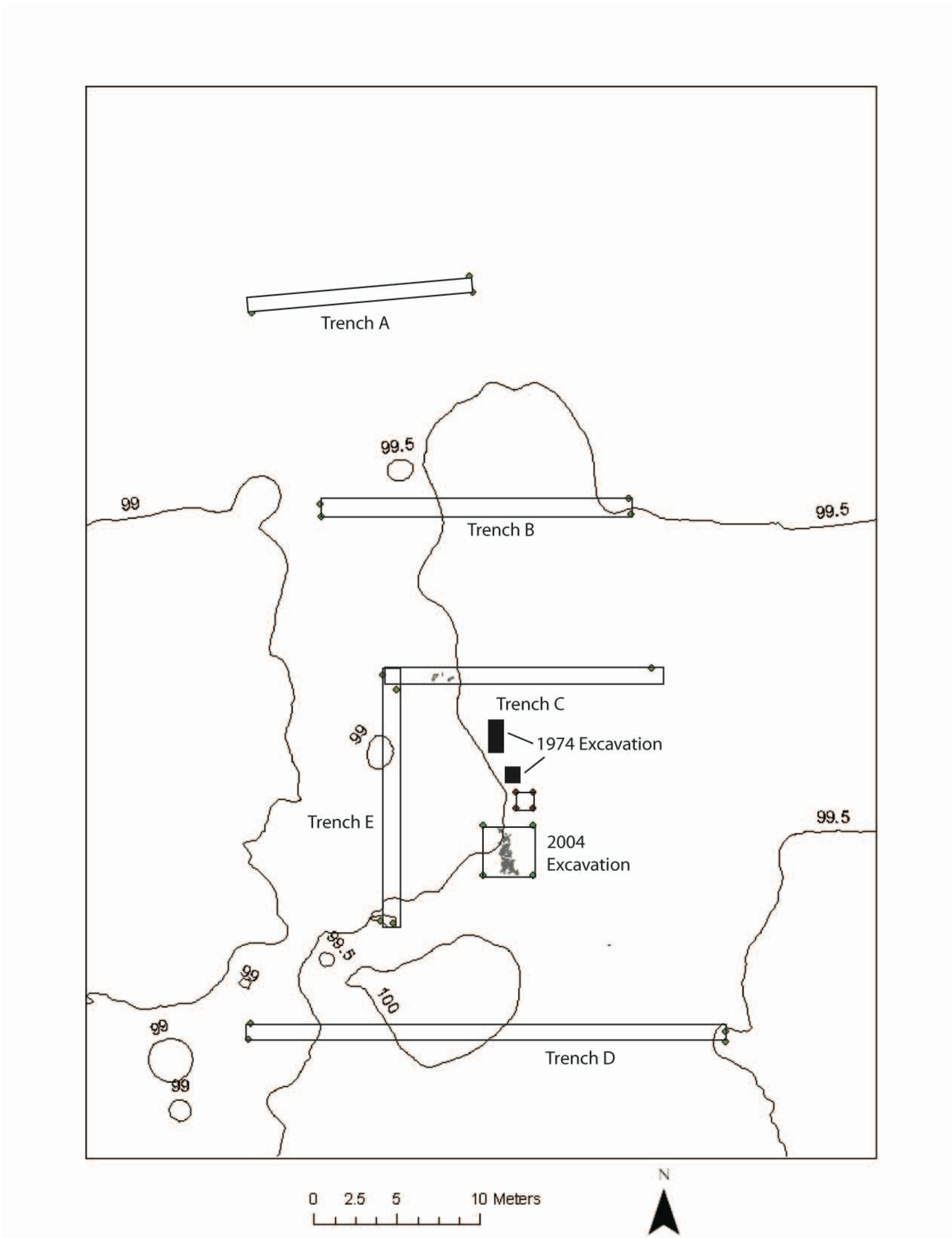


Figure 6.7. Closer view of Perry Ranch site with excavation units.

Figure 6.8. The arrow points to the shallow gully where the bison bone resides at the Perry Ranch site. View is looking south across the 3x3 m excavation of 2004.

Perry Ranch Site Context

The original Saunders and Penman squares and my 3x3 m units were excavated near the likely nick point of a prehistoric gully (Figures 6.6 and 6.7). The excavation of the 3x3 m units revealed a portion of the bison kill in a shallow gully (Figure 6.8). The bottom of the alluvial fill here is only 60 cm below and 80 cm wide in relation to the modern surface. Extensive Holocene erosion may have removed portions of the upper landscape since a 2-3 m high terrace is to the south of the site (Figure 6.4 and 6.6).

The channel containing the bison bone was cut into a prior sequence of alluvial fill strata (Figure 6.8 and Table 6.1). The well-defined structure for the strata indicates some soil development. However, erosion likely removed evidence for part of the soil development sequence. To the south of the 3x3 m excavation, Trench D documents the underlying bedrock and that the gully does not extend too much farther to the south (Figure 7.9 and Table 6.2). Erosion has removed most of the soil, leaving only a thin layer.

To the north of the 3x3 m excavation area, the gully containing the bison kill widens and reaches a depth of 1.7 m in Trench A. The alluvial deposits in the gully are documented in Trenches A, B, and C (Figures 6.10-6.15 and Tables 6.2-6.4). Apparent are the several gully cut-and-fill episodes underlain by the Permian bedrock. The bison bone was found in the first alluvial stratum above the Permian bedrock.

The alluvial fill is composed of unsorted angular shale clasts eroded from their nearby exposure in the terrace to the south of the site. Structure is well defined with accumulations of clay and calcium carbonate throughout the alluvial strata. At some of the localities there is the development of an “A” horizon at the upper surface, but it has been

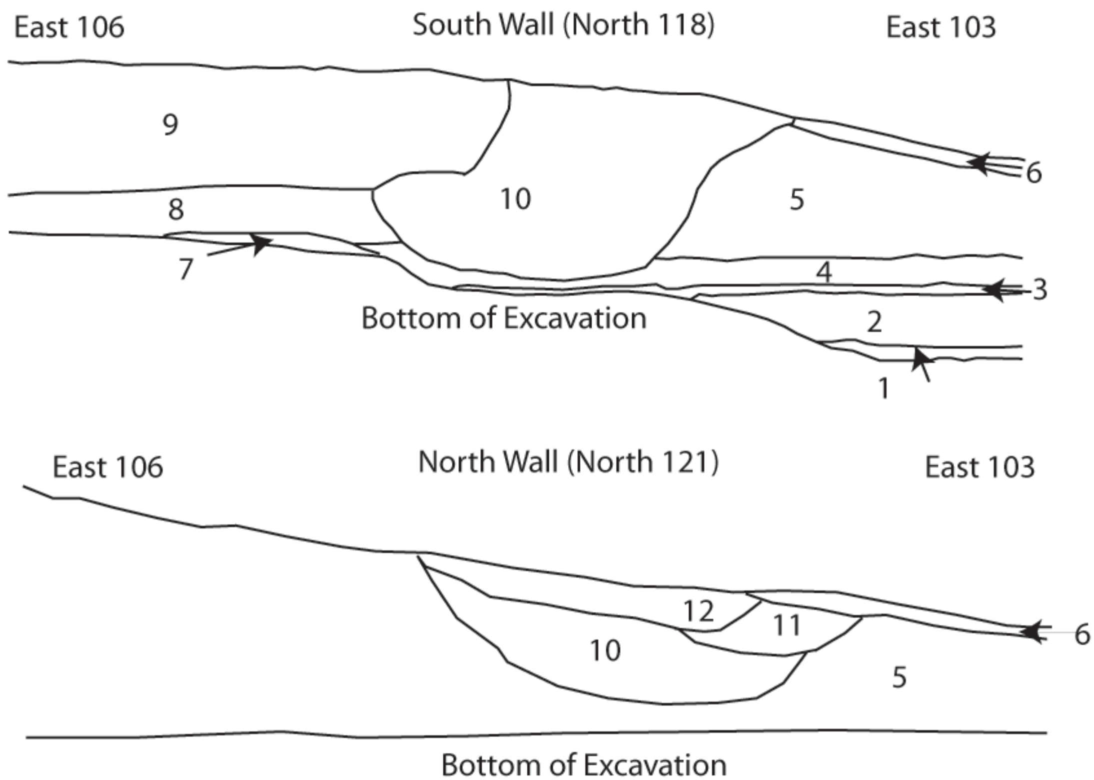


Figure 6.9. Profile illustration of 3x3 m excavation area's north and south wall at Perry Ranch. Description is provided in Table 6.1

Table 6.1. Profile description for north and south wall of 3X3m excavation area.

Stratum	Horizon	Color (Moist)	Structure	Texture	Consistence	Boundary	Effervescence	Special Features
12	C/A	5YR4/4	m,f,sbk	SCL	h	a,s	ste	common fine roots, subangular shale fragments present throughout matrix
11	C/Btk	5YR3/3	m,f,sbk	SCL	h	a,s	ste	common fine roots, subangular shale fragments present throughout matrix
10	C/Btk	5YR4/3	3, f, sbk	SiCL	eh	a,s	ste	common fine roots, subangular shale fragments present throughout matrix
9	C/Btk	2.5YR3/4	3, f, sbk	C	eh	a,s	ste	common fine roots, CaCO3 formed along rootlets
8	C/Btk	2.5YR3/4	3, f, sbk	C	eh	a,s	ste	common fine roots, CaCO3 formed along rootlets
7	C/Btk	5YR4/4	3, f, sbk	SiL	eh	-	ste	common fine roots, subangular shale fragments present throughout matrix
6	C/A	5YR3/3	3, f, sbk	SiC	eh	a,s	ste	common fine roots, subangular shale fragments present throughout matrix
5	C/Btk	5YR3/3	3, f, sbk	C	eh	a,s	ste	common fine roots, subangular shale fragments present throughout matrix
4	C/Btk	10R3/4	3, f, sbk	C	eh	a,s	ste	common fine roots, subangular shale fragments present throughout matrix
3	C/Btk	5YR4/4	1, f, sbk	CL	sh	a,s	ste	Rootlets present, Subangular shale fragments present throughout matrix
2	C/Btk	5YR3/3	3, f, sbk	C	eh	a,s	ste	Rootlets present, Subangular shale fragments predominate the matrix
1	C/Btk	2.5YR3/4	3, f, sbk	C	eh	-	ste	Rootlets present, Subangular shale fragments predominate the matrix

1=weak 2=moderate f=fine m=medium SBK= subangular blocky SCL=Sandy Clay Loam SiL=Silty Loam SC= Sandy Clay h= hard vh= very hard sh=slightly hard g gradual c= clear a=abrupt w=wavy ste=strongly effervescent ve= violently effervescent

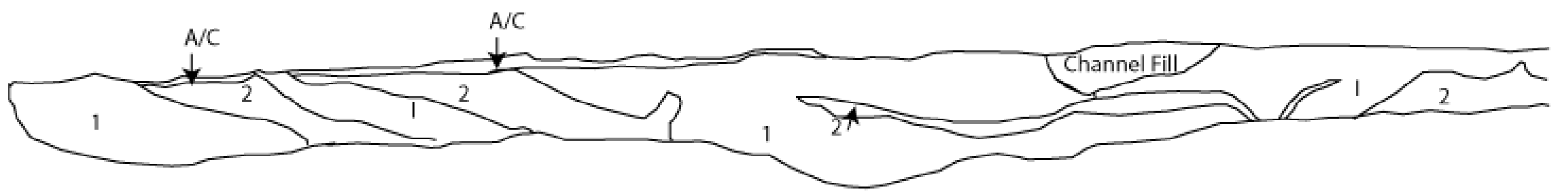


Figure 6.10. Profile Illustration of Trench D at Perry Ranch. This is the south wall of the trench. Soil Description is provided in Table 7.2.

Table 6.2. Profile description of Trench D at Perry Ranch.

Stratum	Horizon	Depth (cm)	Color (Dry)	Structure	Texture	Consistence	Boundary	Reaction	Special Features
3	A/C	0-10	7.5YR5/4	1,f,SBK	SiL	sh	a,w	ste	many fine and very fine roots
3	C	0-20	5YR5/4	2,m,SBK	SC	h	a,w	ste	many fine and very fine roots; 10% gravel
2	R	-	2.5Y6/2	-	-	-	-	ve	-
1	R	-	2.5YR4/6	-	-	-	-	-	zones of gleyed (Gley 5/5BG) redoximorphic depletions

1=weak 2=moderate f=fine m=medium SBK= subangular blocky SCL=Sandy Clay Loam SiL=Silty Loam SC= Sandy Clay h= hard vh= very hard sh=slightly hard g gradual c= clear a=abrupt w=wavy ste=strongly effervescent ve= violently effervescent

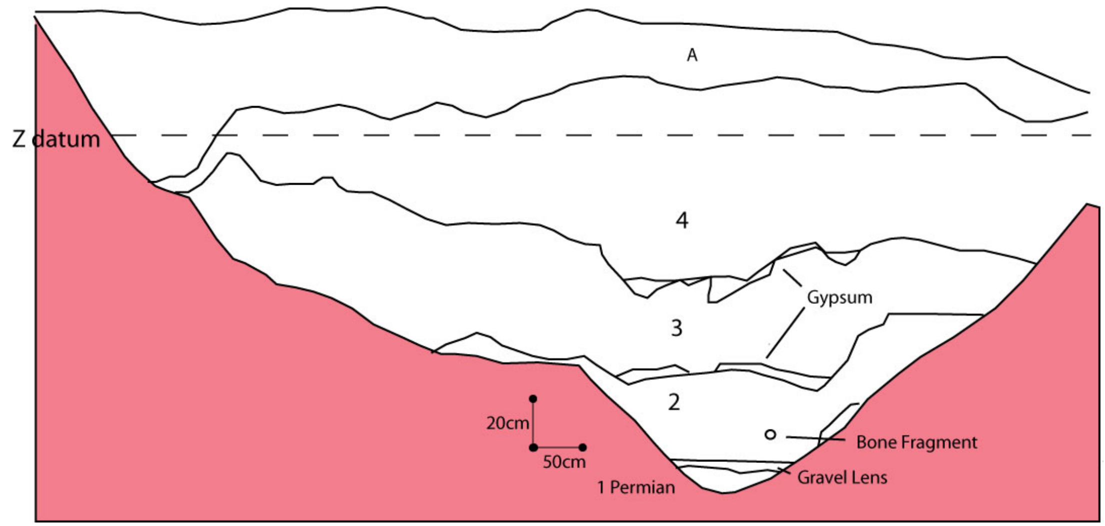


Figure 6.11. Illustration of Trench A's south wall profile at Perry Ranch.

Table 6.3. Description of Perry Ranch Trench A's deposits.

Stratum	Horizon	Depth (cm)	Color (Dry)	Structure	Texture	Consistence	Boundary	Reaction	Special Features
4	A/C	0-24	5YR3/3	2,m,SBK	SCL	h	g,w	ste	many fine and very fine roots, 10% gravel
4	C/Btk	24-110	5YR4/4	2,m,SBK	SC	vh	a,w	ste	few fine roots, CaCO3 formed along roots, 20% gravel;gypsum lens at bottom of stratum
3	C/Btk	110-142	5YR4/4	2,m,SBK	SC	vh	a,w	ste	few fine roots;CaCO3 formed along roots,20% gravel;gypsum lens at bottom of stratum
2	C/Btk	142-182	5YR4/4	2,m,SBK	SC	vh	a,w	ste	few fine roots;CaCO3 formed along roots,20% gravel
1	R	182-	10R4/4	-	-	-	-	-	-

1=weak 2=moderate f=fine m=medium SBK= subangular blocky SCL=Sandy Clay Loam SiL=Silty Loam SC= Sandy Clay h= hard vh= very hard sh=slightly hard g gradual c= clear a=abrupt w=wavy ste=strongly effervescent ve= violently effervescent

Figure 6.12. Photo of Trench A's alluvial deposits as exposed in the 2005 investigations at the Perry Ranch site.

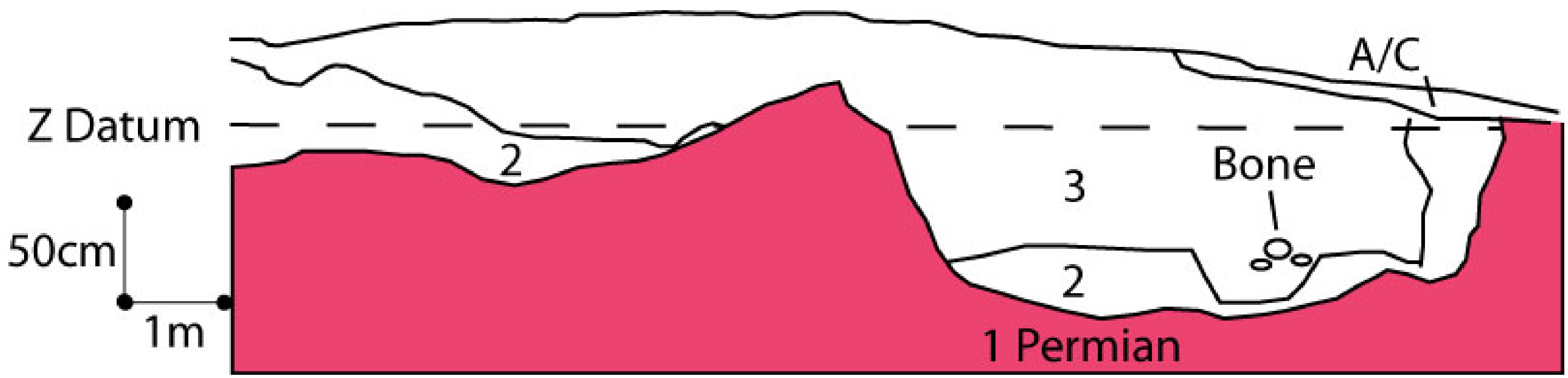


Figure 6.13. Profile illustration of Trench B at Perry Ranch site.

Table 6.4. Description of profile at south wall of Trench B at Perry Ranch site.

Stratum	Horizon	Depth (cm)	Color (Dry)	Structure	Texture	Consistence	Boundary	Reaction	Special Features
3	A/C	0-12	5YR3/2	2 m, SBK	SCL	h	g, s	ste	common fine to very fine roots, clay films on ped facies, 10% gravel; Portions of horizons have eroded away across profile.
3	C/Btk	12-112	5YR4/4	2,m, SBK	SC	vh	c, w	ste	few fine roots; CACO3 formed along roots;10% gravel
2	C/Btk	112-122	5YR4/6	2,m,SBK	SC	vh	a,w	ste	20% gravel
1	R	122-	10R4/4	-	-	-	-	-	-

1=weak 2=moderate f=fine m=medium SBK= subangular blocky SCL=Sandy Clay Loam SiL=Silty Loam SC= Sandy Clay h= hard vh= very hard sh=slightly hard g gradual c= clear a=abrupt w=wavy ste=strongly effervescent ve= violently effervescent

Figure 6.14. Contact between Stratum 2 and Permian Stratum 1 at west end of south wall profile of Trench B at Perry Ranch site.

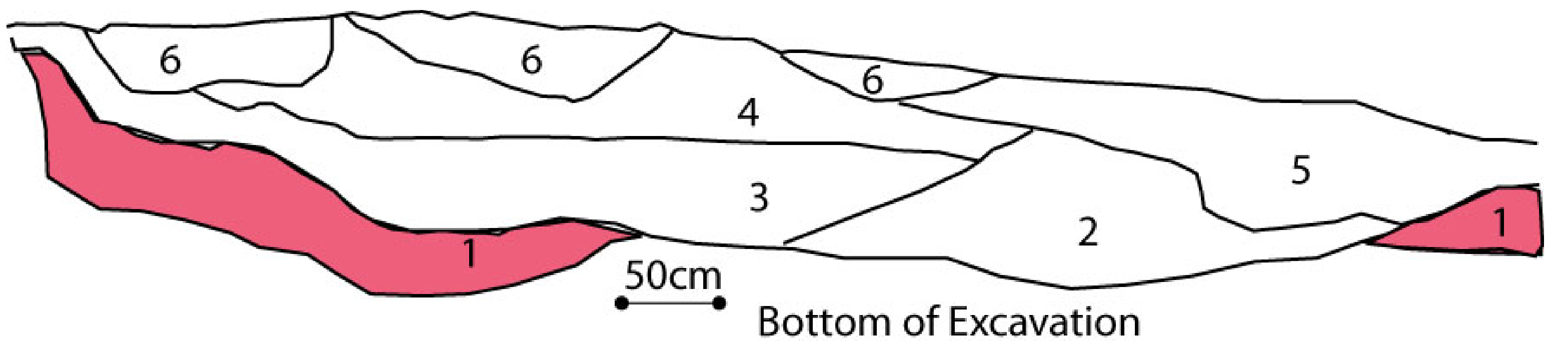


Figure 6.15. Illustration of south wall profile for Trench C at Perry Ranch site.

Table 6.5. Profile description of Trench C's south wall at Perry Ranch site.

Stratum	Horizon	Depth (cm)	Color (Dry)	Structure	Texture	Consistence	Boundary	Reaction	Special Features
6	C/Btk	0-13	5YR4/4	2,m,SBK	SC	vh	a,w	ste	many fine and very fine roots, CaCO3 formed along roots10% gravel; recent cut fills
5	C/Btk	13-27	5YR4/4	2,m,SBK	SC	vh	a,w	ste	many fine and very fine roots, CaCO3 formed along roots;10% gravel;
4	C/Btk	27-53	5YR4/4	2,m,SBK	SC	vh	a,w	ste	few fine roots;CaCO3 formed along rootss,20% gravel
3	C/Btk	53-68	5YR4/4	2,m,SBK	SC	vh	a,w	ste	few fine roots;CaCO3 formed along rootss,20% gravel
2	C/Btk	68-108	5YR4/4	2,m,SBK	SC	vh	a,w	ste	few fine roots;CaCO3 formed along rootss,20% gravel
1	R	108-	10R4/4	-	-	-	-	-	-

1=weak 2=moderate f=fine m=medium SBK= subangular blocky SCL=Sandy Clay Loam SiL=Silty Loam SC= Sandy Clay h= hard vh= very hard sh=slightly hard g gradual c= clear a=abrupt w=wavy ste=strongly effervescent ve= violently effervescent

eroded across most of the landscape. The excavation of Trench E (Figure 6.6) connected the 3x3 m excavation area and Trench C. The trench was dug into the underlying bed-rock with just the top part composed of some soil that had not been eroded.

Unfortunately, nothing was recovered from the alluvial deposits to get a more accurate assessment of the age of the site. Therefore, a petris bone collected by Saunders and Penman was submitted for radiocarbon dating to Thomas Stafford of Stafford Research Laboratories, Inc. The AMS dating of the XAD-Gelatin (KOH-Collagen) chemical fraction resulted in an age of 8,460±45 RCYBP (CAMS-95513) (Hurst and Wyckoff 2004). This age is closer to the acceptable range for Plainview. Another petris bone recovered from my current research from Trench C was submitted to Nancy Beaven Athfield of Rafter Laboratories to confirm the site's age. The same processing technique was used in processing this bone as that performed on the Howard Gully petris bone. An age of 4,259 ± 35 RCYBP (NZA-23546) was the result; obviously, this is a much too recent age for a late Paleoindian age bison kill. Subsequent analysis of carbon and nitrogen preser-

Table 6.6. Radiocarbon age result from petris bone from Trench C Perry Ranch site.

Sample #	δ	Radiocarbon Age	δ14C	δ14C	Percent Modern
NZA (23546)	-14	4259 ± 35 BP	-402.1 ± 2.4 ‰	-415.4 ± 2.4 ‰	58.46 ± 0.24

Table 6.7. Carbon/Nitrogen analysis of petris bone from Trench C Perry Ranch site.

Sample	$\delta^{15}N_{AIR*}$ ‰	Nitrogen %	$\delta^{13}C_{VPDB*}$ ‰	Carbon %	C:N mol ratio
29065-1	10.2	5.7	-13.4	27.4	5.56
	$\delta^{15}N_{AIR*}$ ‰		$\delta^{13}C_{VPDB*}$ ‰		
Control Material(s):	EDTA				
Results for controls (this run):	-0.9±0.03 ‰		-38.3±0.05 ‰		

Note: Due to extremely small sample size CN mol ratio indicates a run that is not optimal. Low % carbon of 27.4% and % nitrogen of 5.7 also indicates poor collagen preservation.

vation in the bone indicates too much deterioration has occurred to obtain a reliable date. This is partially discouraging, but the recovery of more petris bones with better preservation may help confirm the age of the site.

Bison Bone Bed

Only the bone recovered from the 3x3 m grid is discussed here. The artifacts uncovered from the backhoe trenches await analysis. The total number of *in situ* bone fragments and identified elements removed from the 3x3 m grid was 178 (Figure 6.15 and 6.16). Out of these, 117 have been identified to element (Table 6.8). The MNI for the excavated portion of the bison bone bed is four (Table 6.8). This is based upon the four left radii recovered during excavation. Preliminary analysis indicates most of the bone is in either weathering stages 3 or 4. No cut-marks have been observed on the bone. This is not surprising given their highly weathered condition. However, the bone is in better shape at the bottom of the gully. This is where the articulated front legs occur (Figure 6.17).

The discovery of an articulation at the bottom of the gully suggests the bison kill was buried relatively soon after the kill and butchering. Clearly, the articulated bones indicate no destruction by carnivores. In addition, no puncture marks indicative of carnivore activity have been discovered on the bone. As expected the bone uncovered closer to the surface is more highly weathered, and no articulations were documented.

In Trench C, a bison skull, ulna, and several ribs are shown in Figure 6.18. Apparent from the documentation of some of the bone elements in the trenches are their parallel and perpendicular orientation in relation to the channel. I suspect fluvial action has

Table 6.8. Identified Perry Ranch bone elements from 3x3 m excavated block. Elements for which their side can be determined are also separated into right and left categories.

Element	Total NISP	R	L	Element	Total NISP	R	L
1st Phalange	8			Intermediate Carpal	2		
2nd Phalange	11			Lateral Sesamoid	4		
3rd phalange	4			5th Lumbar Vertebrate	1		
Accessory Carpal	1			Medial Sesamoid	6		
Astralagus	1		1	Metacarpal	2	1	1
Cervical Vertebrate #6	1			Metatarsal	6	3	1
Calcaneus	3	2	1	Molars	7		
Caudal	1			Patella	1		1
Distal Sesamoid	1			Pelvis	3	2	1
Femur	4	3		Radial Carpal	3		
Fourth Carpal	1			Radius	5	1	4
Fused 2&3 Carpal	2			Rib	30		
Fused 2&3 Tarsal	3			Thoracic Vertebrate	3		
Fused Central and 4th Tarsal	2			Tibia	1		
Humerus	4	2	1	Ulna	4	1	2
Incisors	2			Ulna Carpal	1		

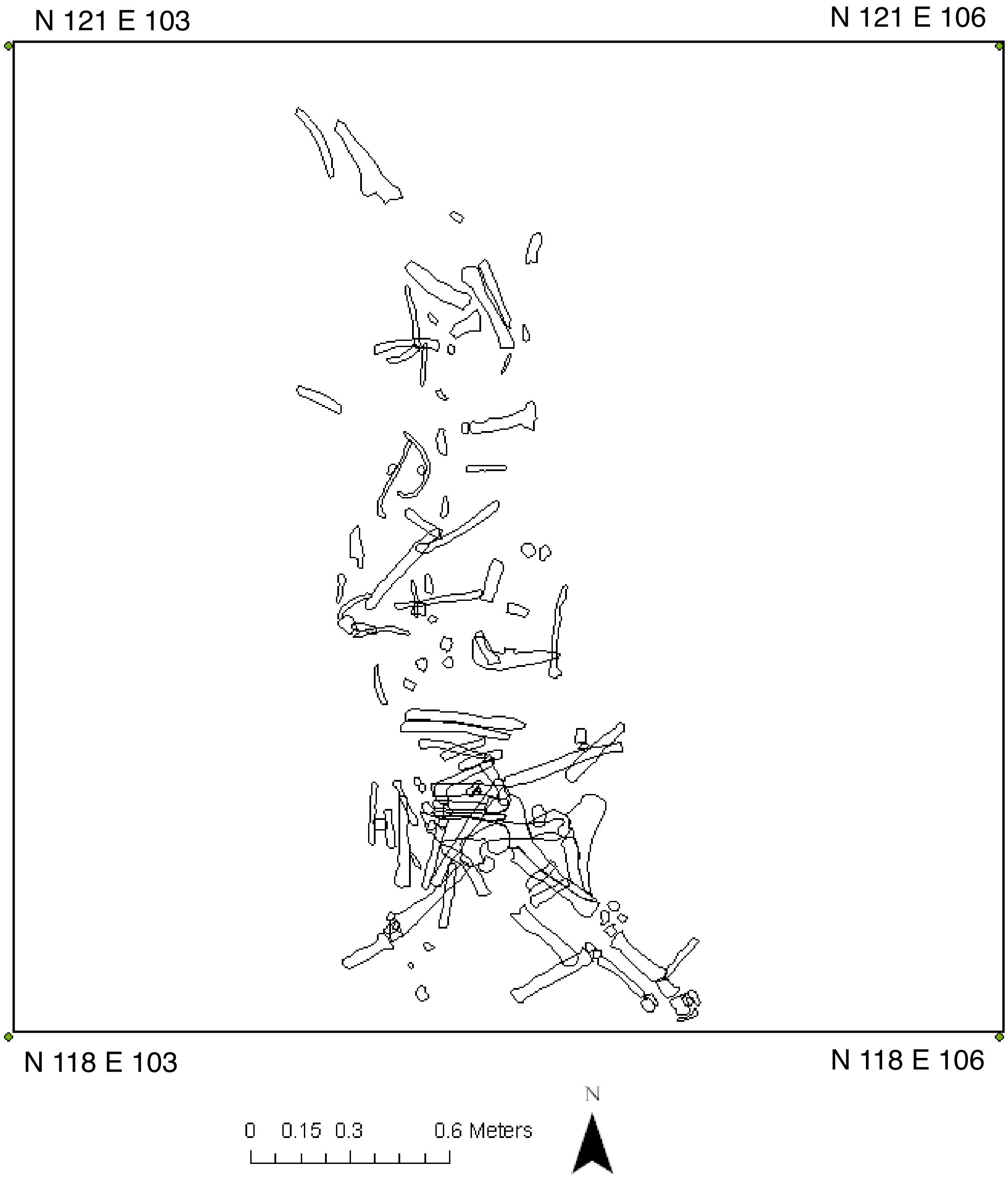


Figure 6.16. Plan map of bison bone distribution in 3x3 m grid dug in 2004 at Perry Ranch site.

Figure 6.17. Articulated front legs of a bison exposed in 2004 at Perry Ranch.

Figure 6.18. Bone bed at the bottom of Trench C as exposed in 2005 at Perry Ranch.

modified the orientation of some of the bone in the gully. Future taphonomic studies are needed to decipher how natural processes are responsible for bone placement within the channel.

Unfortunately, no chipped stone artifact tools were recovered during the site's testing. Only a small unmodified chert nodule was recovered from the channel deposits. Additional field work is needed to learn more about these hunters and gatherers

Conclusion

The purpose of renewed research at Perry Ranch was to uncover more contextual information to better understand late Paleoindian hunter activities, and when they were there. It is now known that the Perry Ranch site is a larger bison kill and better preserved than previously thought. Because no other artifacts were found, additional work is necessary at the site to further uncover the activities of these people. In addition, recovering more petris bone may aid in confirming the 8,460±45 RCYBP (CAMS-95513) age for the site.

Chapter 7

Discovering Identity-Based Foraging Territories on the Southern Plains through Projectile Point Analysis

In Chapter 2, I discussed how territories may have become ethnically marked due to an increase in competition between hunter and gatherer groups. Through an analysis of material culture, some aspects of the past development of identity based territories may be studied. Individuals within a hunter and gatherer band learn how to make things from other members. Therefore, differences in manufacturing techniques and design of artifacts may be apparent between foraging groups. Contrasting material cultural styles between groups may be conscious ethnic differences or unconscious differences that are still useful for mapping territories (Carr 1995; Clark 2004). However, ethnographic studies demonstrate that some styles cross-cut social boundaries because of similar manufacturing techniques or trade between groups (Dietler and Heirbech 1998; Hegmon 1992; Hodder 1985). It is therefore imperative to also examine the types of raw materials artifacts are manufactured from to get a better indication of their origin and subsequent distribution on the landscape.

In this study, I use 860 late Paleoindian projectile points examined from six localities and sites across the Southern Plains. I compare projectile points in terms of their raw materials, base-stem configuration, and measured base attributes for delineating territorial boundaries, the amount of mobility, and possibly ethnicity. But first, spear points from dated site contexts are compared to determine the range in design variability from specific forager groups at one time and place. This allows an assessment of how different late Paleoindian bands were making projectile points at a particular site, and it provides a baseline for comprehending variation in projectile point design from spear points not recovered from site contexts.

Data and Methodology

From six locations across the Southern Plains, a total of 793 spear points with enough of their bases present to determine that they were late Paleoindian style are examined in this study (Figure 7.1). In addition, 67 points from late Paleoindian sites were also analyzed for ascertaining variability in spear point design from known context (Figure 7.2 and Table 7.2). Folsom data collected by Hofman (1991) from Bethel and Cedar Creek locations is compared to the late Paleoindian sample gathered from the same place at location 2 for discerning if there is a reduction in territory size between the Folsom and late Paleoindian period.

Design considerations of projectile points include a sharp point for penetration, sharp blade edges for further perpetuating the wound, a base design that secures the point to the shaft and absorbs the force of the thrust without splitting the shaft, and an overall design that minimizes damage to the point while also considering methods of resharpening the point after use or breakage from either the proximal or distal ends (Musil 1988). My analysis examines the different ways forager groups were solving how to haft the point to the shaft. The base element of the spear point is less likely to be modified during its use life compared to the blade portion (Judge 1974). And, there are many different ways to solve the problem of hafting which can then become culturally specific.

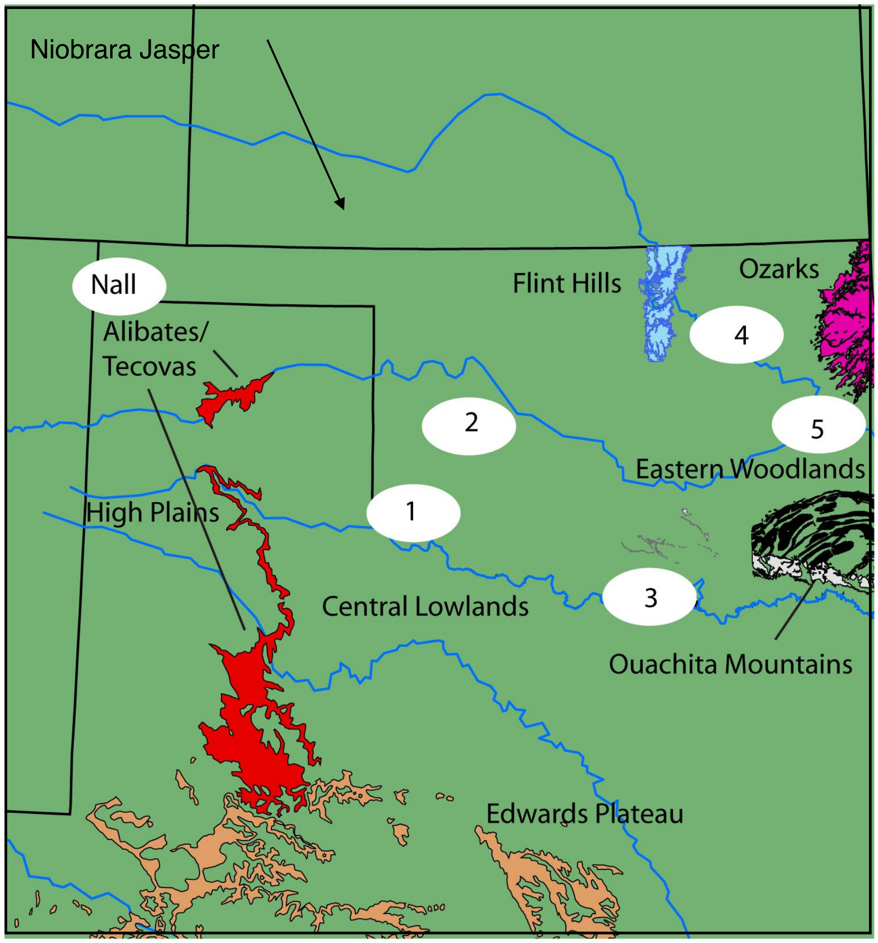


Figure 7.1. Projectile point sample locations and raw material source locations in study area.

The surface collected projectile points were first sorted into five primary base classes (Figure 7.3). Each of these classes may represent different strategies in how to haft projectile points. And, these base classes are defined by hafting styles represented at sites from the study area. Base Class 1 is parallel-sided with a concave base. This hafting style is identified at the Perry Ranch, Plainview, Horace Rivers, Lubbock Lake, and Nall sites (Tables 7.1, 7.2). Base Class 2 differs from Base Class 1 in that its sides extend outwards rather than being parallel. The Dalton component at the Packard site (Table 7.2) defines this hafting style, and one of the Perry Ranch points (Table 7.2) also has a

Table 7.1. Description of projectile point samples used in study.

Location	Collectors	Location	No. of Projectile Points	References
1	Lawrence and Gene LeVick	Southwestern Oklahoma (Howard Gully, Lake Altus)	28	-
2	Jim Cox, Patterson	West-central Oklahoma canyon lands (Cedar Canyon Hydro, Carpenter Canyon, Armstrong Canyon, Farra Canyon, Dead Woman Canyon)	142	Taylor-Montoya 2003
3	Jim Cox, Mike Waller	South-central Oklahoma (Lake Texoma, Pumpkin Creek)	151	-
4	Jim Cox, Anne Bullard	Northeastern Oklahoma (Arkansas River, Keystone Dam)	124	-
5	Jim Cox, Vera McKellips, Billy Ross	Eastern Oklahoma Arkoma Basin (Canadian River, Eufala Dam, 34HS90)	240	Ballenger 2000 Taylor-Montoya 2003
Nall Site	William Baker	Oklahoma Panhandle (Artifacts examined housed at the No Man's Land Historical Museum)	108	Ballenger 1999, Baker et al. 1957, LaBelle 2005

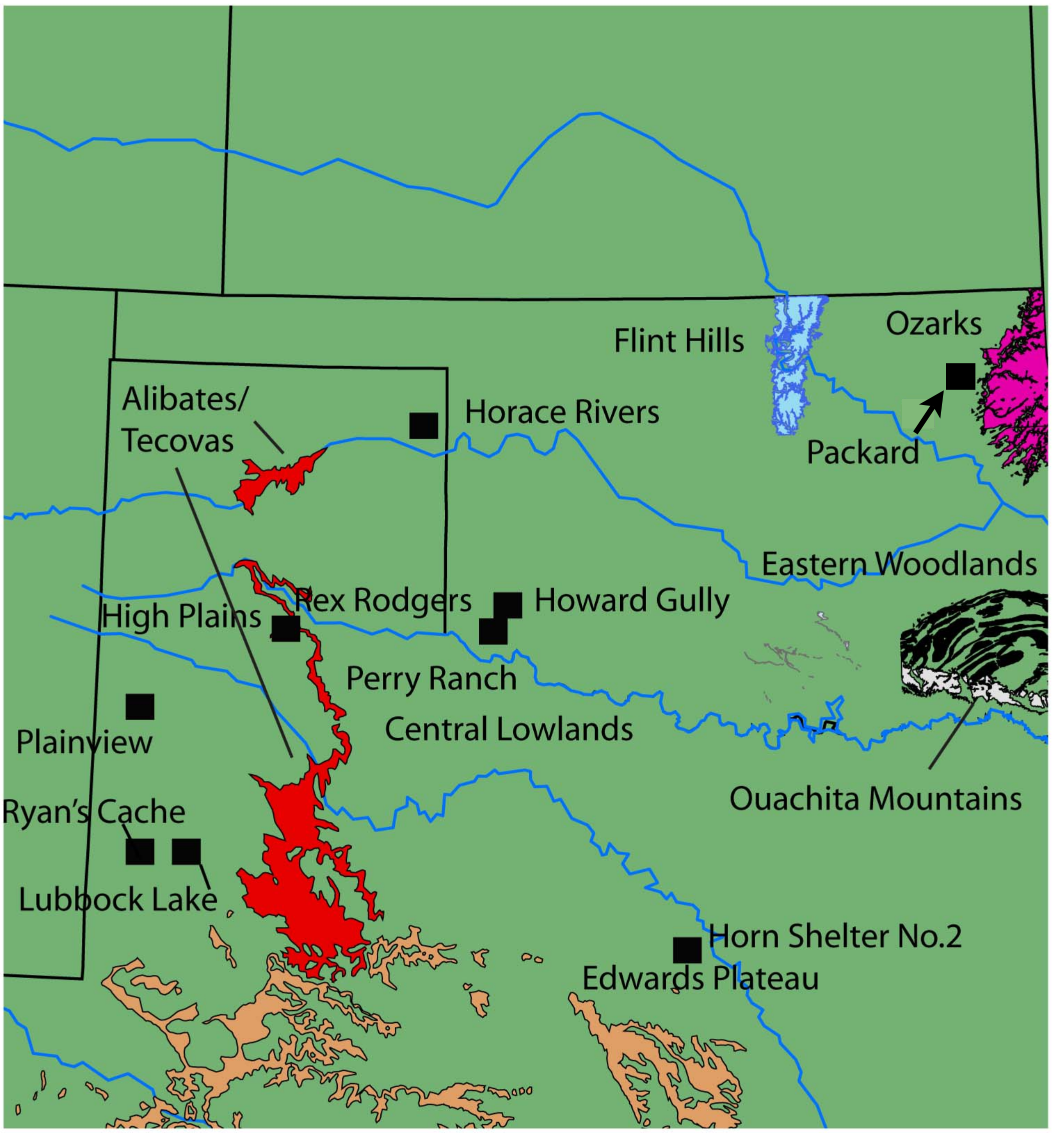


Figure 7.2. Location of late Paleoindian sites with spear points used in analysis.

Table 7.2. Projectile points used in analysis from sites on the Southern Plains.

Site Name	No. of Projectile Points
Horace Rivers	4
Horn Shelter No. 2	13
Howard Gully	2
Lubbock Lake (FA5-17)	4
Lubbock Lake (FA6-11)	1
Packard (Agate Basin)	5
Packard (Dalton)	2
Perry Ranch	2
Plainview	16
Rex Rodgers	4
Ryan's Cache	14

similar configuration. Base Class 3 is parallel-sided with no basal concavity and is found at the Plainview site. This hafting design is also associated with points from the Milnesand site in eastern New Mexico (Sellards 1955), and the Firstview feature at the Lubbock Lake site (Johnson 1987). A constricting stem design is what characterizes Base Class 4. It has been recovered from the Agate Basin component at the Packard site (Wyckoff 1985, 1989) and from feature FA-5-17 at the Lubbock Lake site (Knudson et al. 1998). Base Class 5 is shallow side-notched with a concave base. The Howard Gully, Horn Shelter No. 2, and Rex Rodgers sites have projectile points from this class. Representative samples from each of the localities are illustrated in Figures 8.4-8.9.

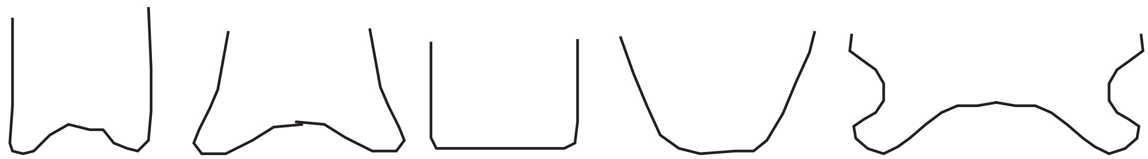
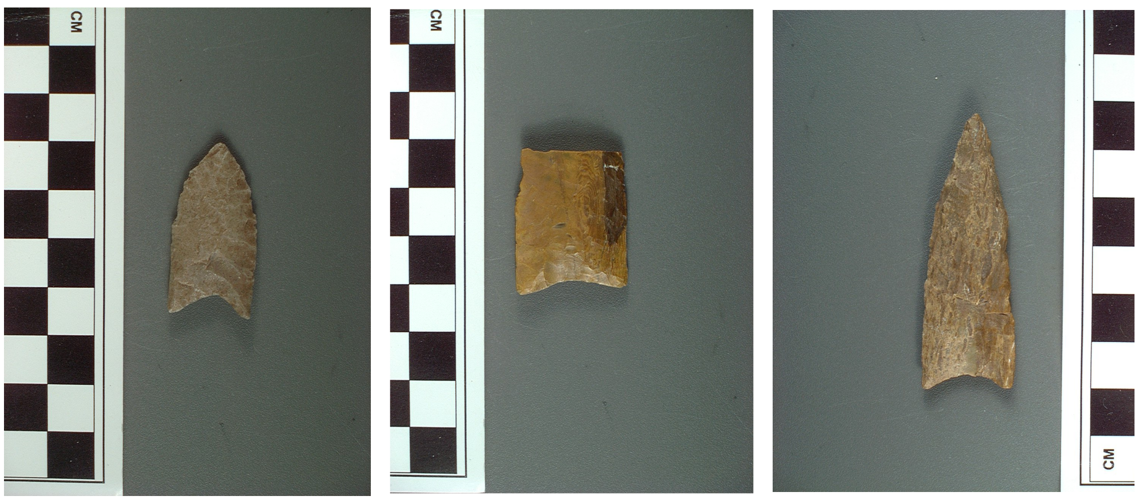


Figure 7.3. Illustration of different base classes used in analysis.

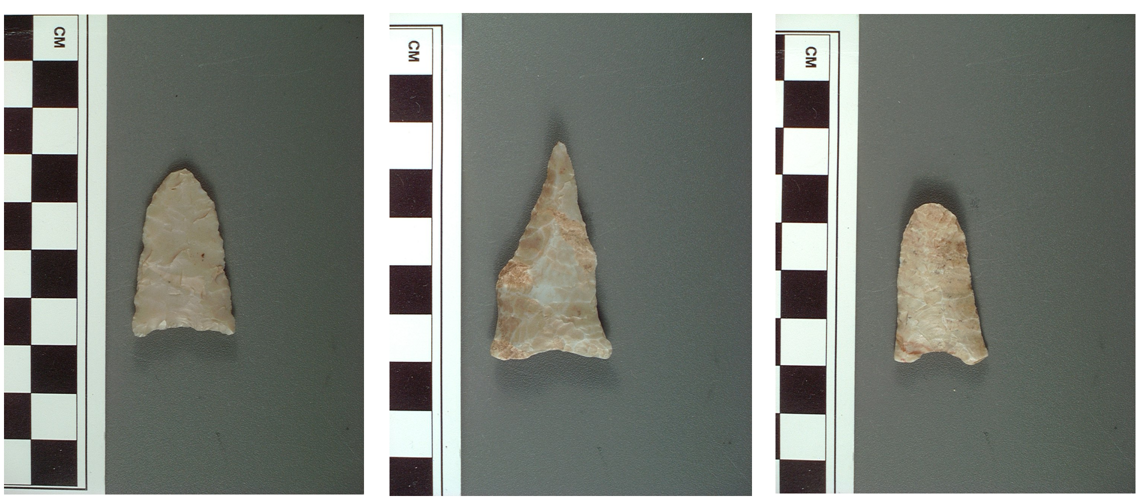
To assess spatial variation within each base class, the following base attributes were measured: Maximum Base Width, Maximum Base Height, Basal Concavity Area, and Maximum Thickness (Figure 8.10). For some incomplete projectile points not all attributes were measured. Each point was photographed and then imported into Madena X version 2.35. Madena was designed as a medical imagery-processing program for mammograms, but this software provides a number of tools to take two-dimensional measurements from photographs. Maximum Thickness was measured with standard calipers to within .01 mm. Because the spear points themselves were not available for analysis, data was collected from the published illustrations and photographs for the Lubbock Lake and Plainview site.

The research area is surrounded by high quality lithic resources that can be used to track the movements of forager groups (Figure 7.1; Banks 1990; Wyckoff 2005). My concentration is on the use and transportation of high quality lithic materials that are indicators of mobility patterns. Besides the primary source location for chipped stone materials, there are also gravels that can be picked up locally which contain quartzites, petrified wood, and small pieces of chert (Banks 1990). In particular, small Alibates cobbles can be obtained along the Canadian and Washita river drainages (Wyckoff 1993). These gravel sources are scattered throughout the region and cannot be used for interpreting

Base Class 1



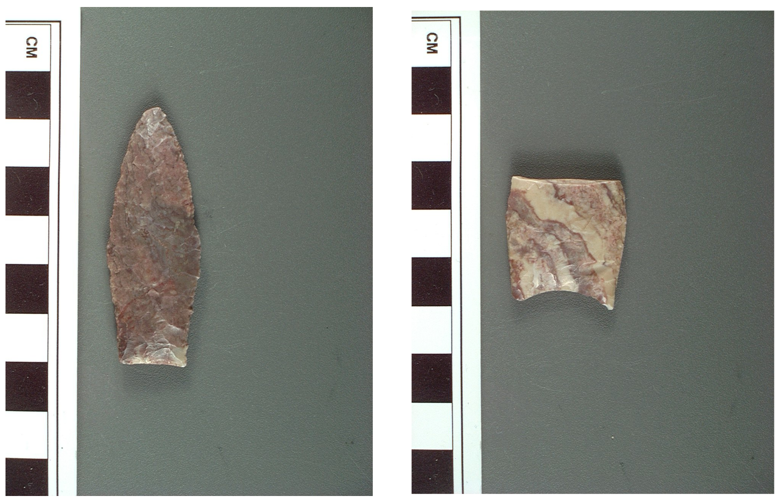
Base Class 1



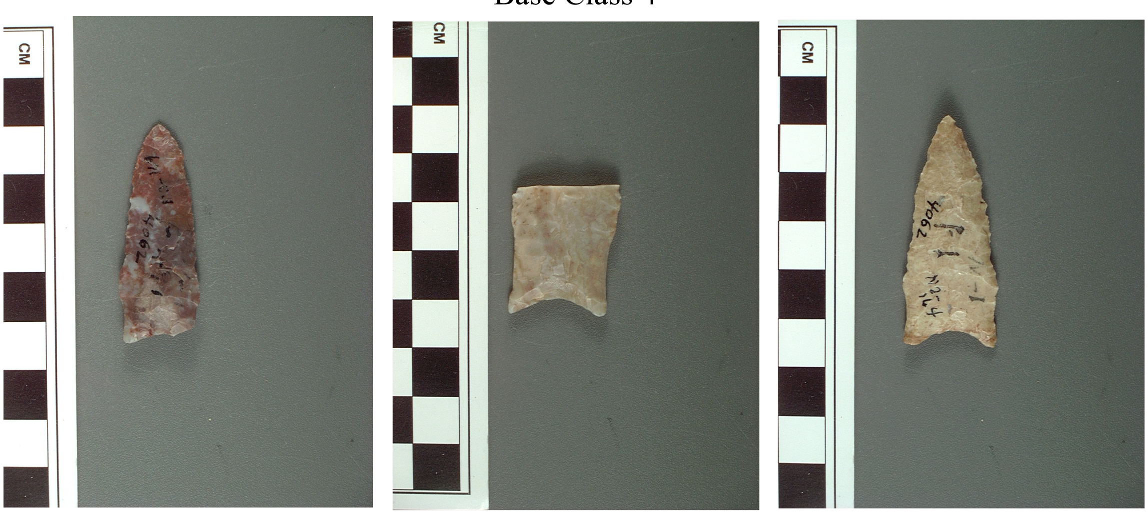
Base Class 2

Figure 7.4. Sample of spear points sorted by base class at the Nall locality.

Base Class 3

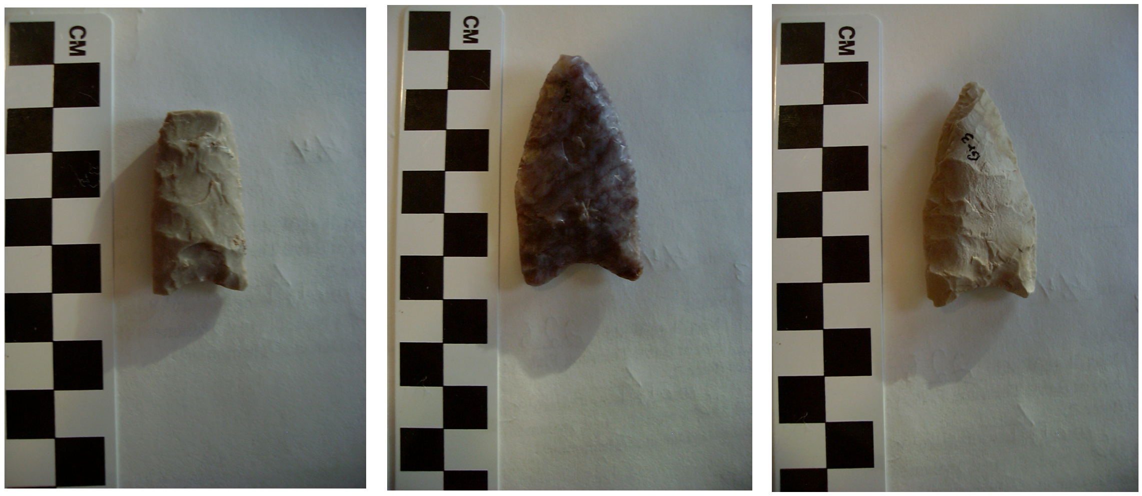


Base Class 4

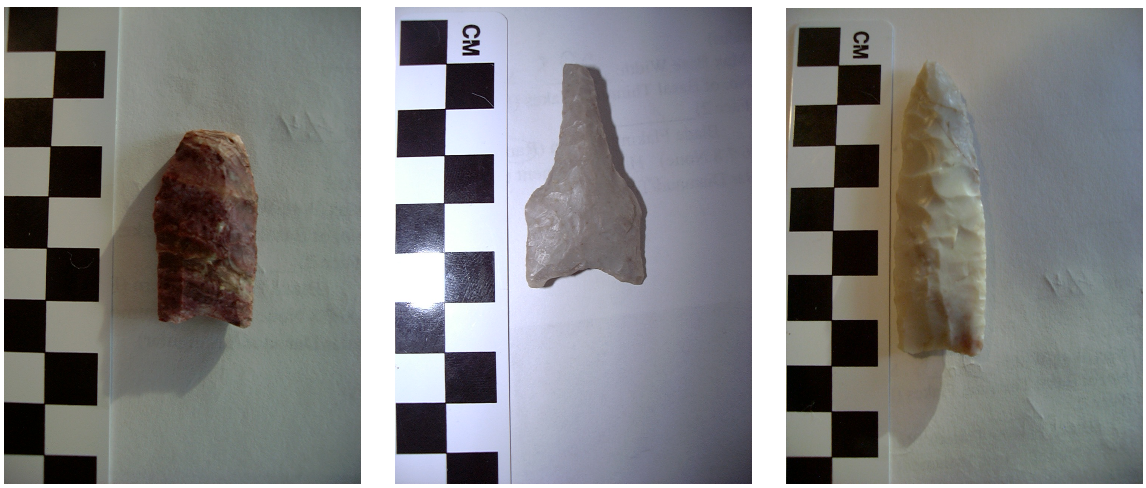


Base Class 5

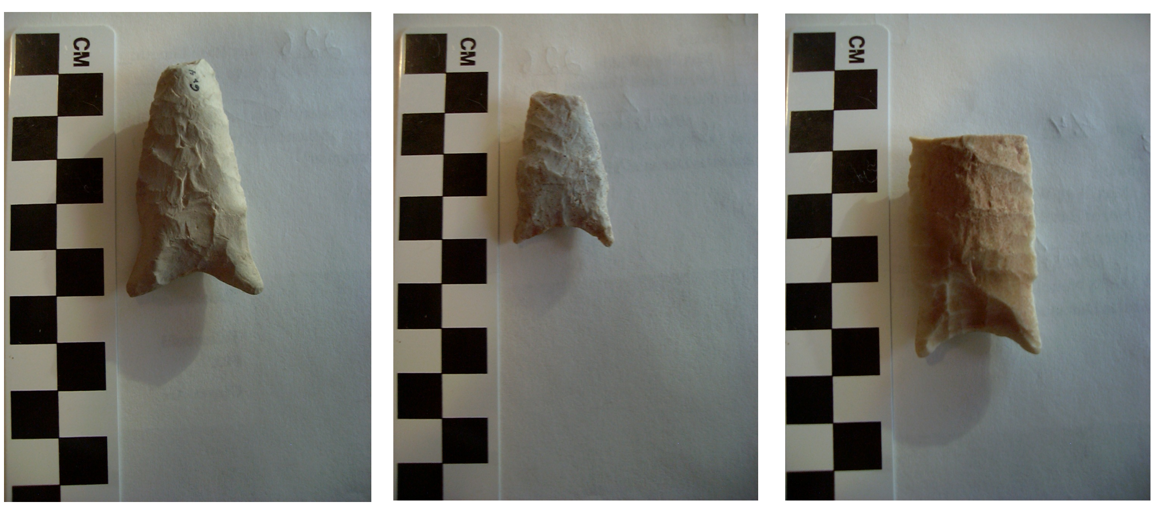
Figure 7.4 Continued. Spear points sorted by base class at the Nall locality.



Base Class 1

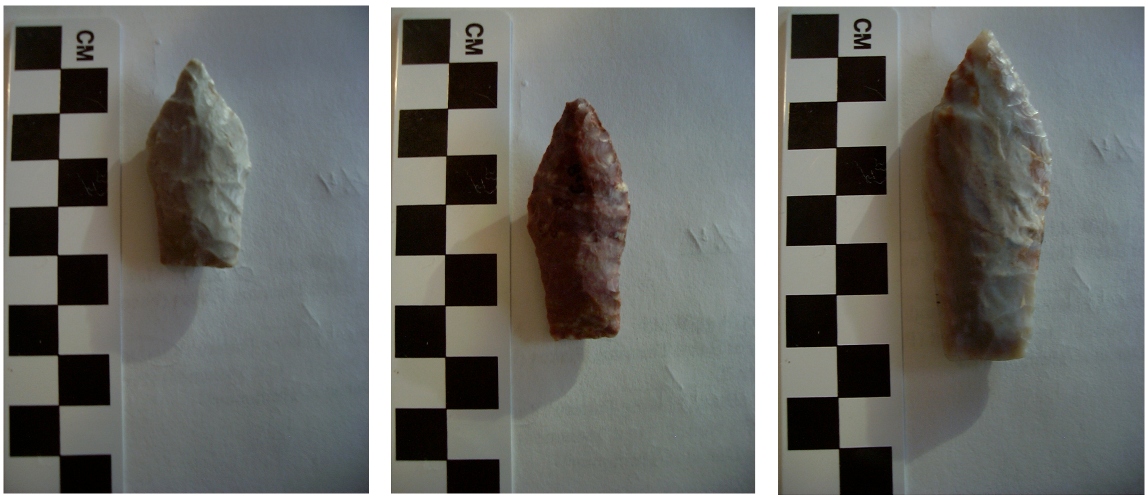


Base Class 1



Base Class 2

Figure 7.5. Sample of spear points sorted by base class at Location 1 (Southwestern Oklahoma).



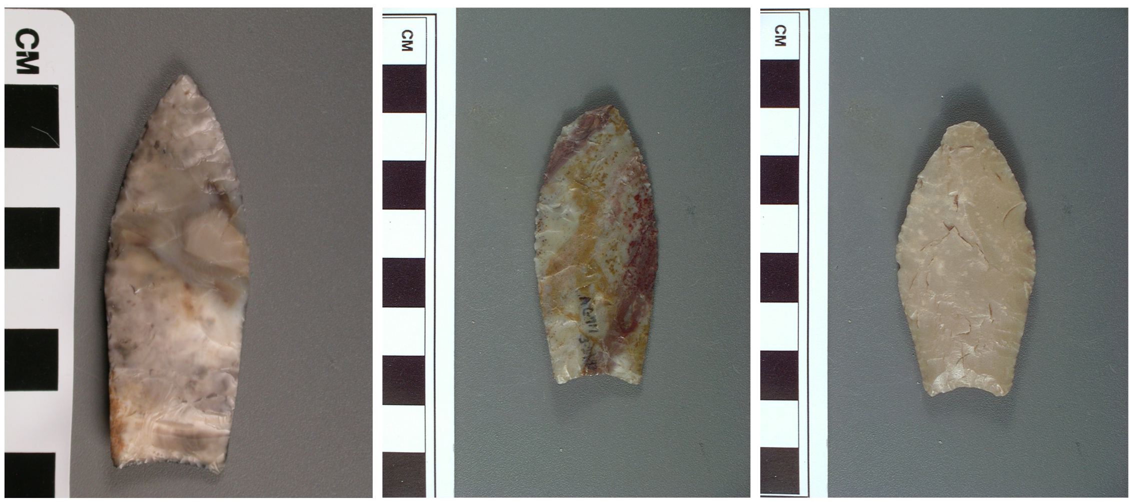
Base Class 4

Base Class 5

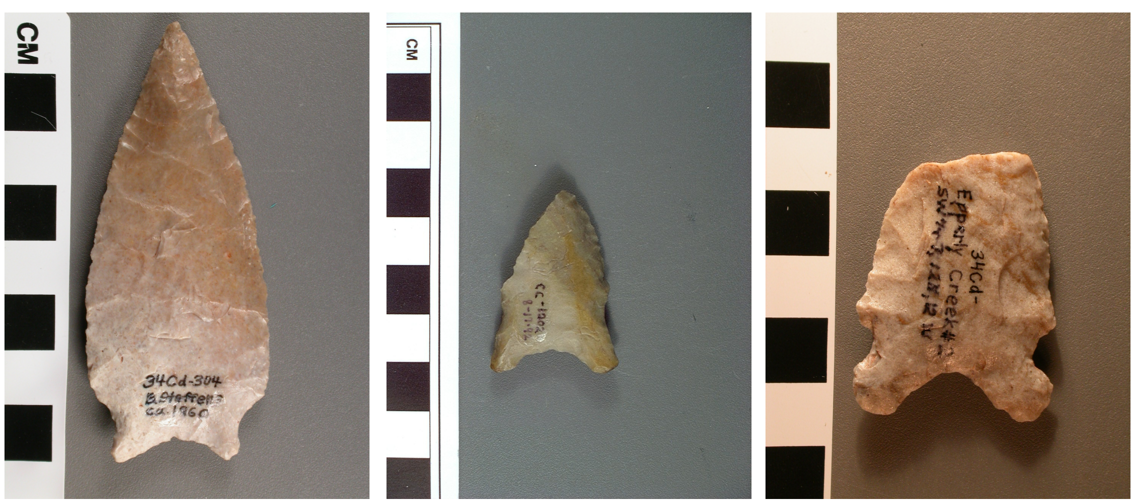
Figure 7.5 Continued. Sample of spear points sorted by base class at Location 1 (Southwestern Oklahoma).

Figure 7.6. Spear points sorted by base class at Location 2 (Canyonlands).

Base Class 3



Base Class 4



Base Class 5

Figure 7.6 Continued. Sample of spear points sorted by base class at Location 2 (Canyonlands).

Base Class 1

Base Class 1

Base Class 2

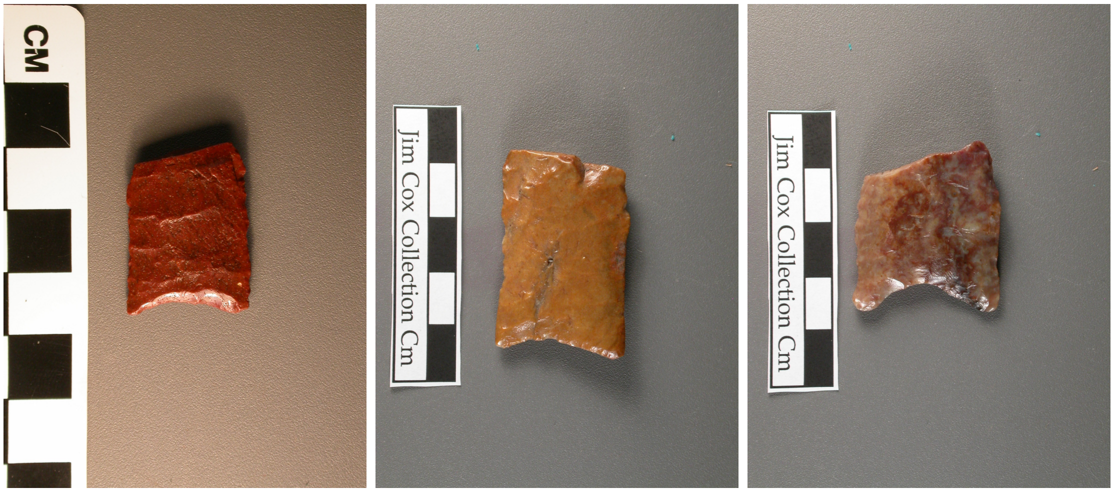
Figure 7.7. Sample of spear points sorted by base class at Location 3 (Lake Texoma).

Base Class 3

Base Class 4

Base Class 5

Figure 7.7 Continued. Sample of spear points sorted by base class at Location 3 (Lake Texoma).

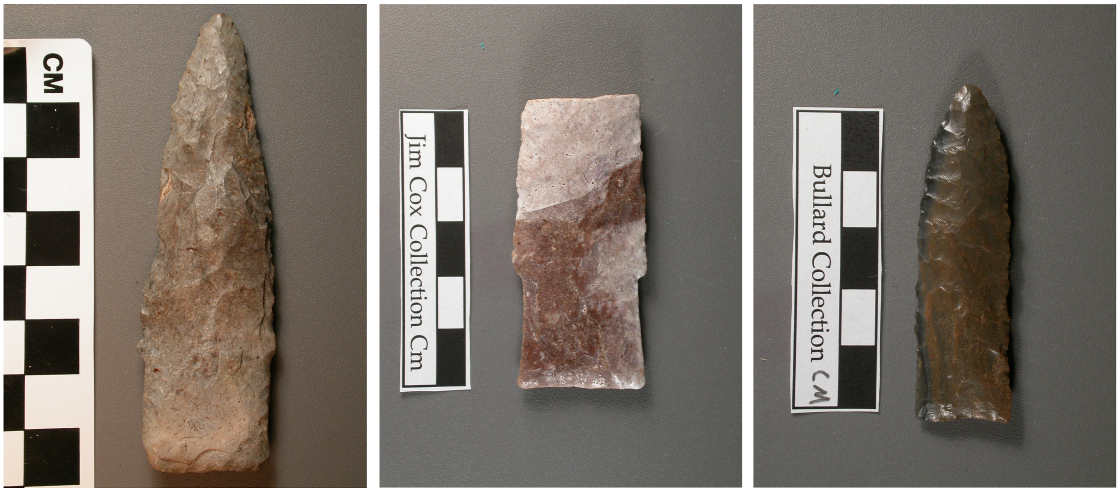


Base Class 1

Base Class 1

Base Class 2

Figure 7.8. Sample of spear points sorted by base class at Location 4 (Arkansas river).



Base Class 3

Base Class 4

Base Class 5

Figure 7.8 Continued. Sample of spear points sorted by base class at Location 4 (Arkansas river).

Figure 7.9. Sample of spear points sorted by base class at Location 5 (Arkoma Basin).

Base Class 3

Base Class 4

Base Class 5

Figure 7.9 Continued. Sample of spear points sorted by base class at Location 5 (Arkoma Basin).

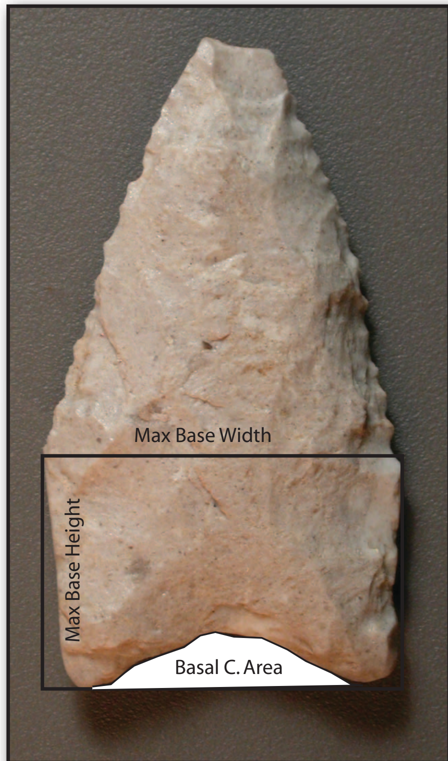


Figure 7.10. Measurements used in quantitative base projectile point analysis.

movements across the study area. Most of these cobbles are too small for the manufacture of late Paleoindian projectile points. For this study, I assume that Alibates was procured from the source location.

Identification of lithic raw materials was made macroscopically through paying attention to color, cortex, fossil inclusions, grain size, and the use of an ultraviolet lamp for more accurate identification of Edwards chert (Hofman et al. 1991). Comparative collections housed at the Sam Noble Oklahoma Museum of Natural History and Oklahoma Archaeological Survey aided in the identification of lithic raw materials. Several different chert bearing formations are known within the Flint Hills, Ozark Plateau and Ouachita Mountain regions (Banks 1990). At this scale of analysis, it was decided to identify the source material to geomorphic province rather than to the specific geological formation.

Alibates and Tecovas Jasper bearing formations were also combined to increase its sample size, and reduce the potential error of misidentifying their source locations. For a number of spear points, I was unable to identify the parent material. I chose to err on the side of caution in source identification rather than mistakenly assign an incorrect source to the projectile point.

Results of Analysis

Projectile Point Analysis from Late Paleoindian Sites

Spear point stylistic variation from late Paleoindian sites was measured for determining the amount of diversity. The frequency of different base classes by site and the coefficient of variation for point attributes within base classes were examined. This is important for ascertaining how different projectile points were made by one group of people. It is possible that more than one group of foragers are represented. Also, some of the sites may be multicomponent rather than representing the actions of hunters and gatherers at one time.

Only one base class is represented at most of the sites (Table 7.3). At Horn Shelter No. 2, Perry Ranch, Plainview, and Rex Rodgers sites more than one base class are present. The occurrence of Base Classes 1, 4, and 5 together at Horn Shelter No. 2 may be due to the difficulty in separating out the stratigraphic levels in the rockshelter (Redder 1985). Therefore, it is unclear if these different base classes are contemporaneous or left behind by different groups of people who visited the site at different times.

The presence of Base Classes 1 and 2 at Perry Ranch is intriguing. This site is a single component bison kill, which suggests these two different base classes were crafted by the same group of people. In addition, both of the points are made from Alibates chert, which somewhat strengthens the argument that both points were made by the same people. Further excavation at the site may provide more evidence for deciphering the variation in point styles there. Attempts at defining the Plainview type for the Southern Plains have been difficult because of the diversity in manufacturing techniques used in making Plainview points (Knudson 1983). At the Plainview site, an overwhelming majority of the points are Base Class 1. There is only one point that is Base Class 3. The presence of only one different base class indicates this may represent a minor variation in the production of points by this group of people. But it has been suggested that the Plainview site may be multicomponent rather than just the result of one kill (Holliday 1997). Attempts at dating the Plainview site have resulted in an array of radiocarbon ages (Holliday et al. 1999). Additional work at the site is necessary to resolve this issue.

Understanding why Base Classes 1 and 5 are associated together at the Rex Rodgers site has been difficult to resolve. In addition, dating the highly weathered bone has produced problematic results (Speer 1978). Matt E. Hill's (personnel communication) recent reanalysis of the site suggests the possibility the bone bed is the result of two separate kills rather than just one. This issue needs clarification for determining if the two different base classes are contemporaneous. If they are, then there is the possibility that these two different styles were made by the same people, or two different groups of people participated in the bison kills at Rex Rodgers.

Overall, the current sample of late Paleoindian sites with defined context indicates little variation in the number of different base classes present. Sites that do have multiple

Table 7.3. Distribution of base classes and raw material by site.

Site Name	Base Class (No.)	Raw Material (No.)
Horace Rivers	Base Class 1 (4)	Alibates (2) Edwards (1) Unidentified Chert (1)
Horn Shelter No. 2	Base Class 1 (5) Base Class 4 (1) Base Class 5 (7)	**Base Class 1** Edwards (5) **Base Class 4** Edwards (1) **Base Class 5** Edwards (4) Unidentified Chert (3)
Howard Gully	Base Class 5 (2)	Edwards (2)
Lubbock Lake (FA5-17)	Base Class 4 (4)	Alibates (1) Edwards (1) Pedernal Chert (2)
Lubbock Lake (FA6-11)	Base Class 1 (1)	Alibates (1)
*Packard (Agate Basin)	Base Class 4 (5)	Ozark Chert (5)
*Packard (Dalton)	Base Class 2 (2)	Ozark Chert (2)
Perry Ranch	Base Class 1 (1) Base Class 2 (1)	Alibates (2)
Plainview	Base Class 1 (15) Base Class 3 (1)	**Base Class 1** Alibates (5) Edwards (9) Petrified Wood (1) **Base Class 3** Edwards (1)
Rex Rodgers	Base Class 1 (2) Base Class 5 (2)	**Base Class 1** Edwards (2) **Base Class 5** Alibates (1) Petrified Wood (1)
Ryan's Cache	Base Class 1 (14)	Alibates (6) Edwards (7) Unknown (1)

* There are two separate stratified occupations defined at the Packard Site (Wyckoff 1985).

base classes, such as Horn Shelter No. 2, Plainview, and Rex Rodgers, may not be the actions of one or more groups of people at one time, but rather traces left by one or more groups at different times. Currently, Perry Ranch appears to be a single component kill with two different base classes. However, a sample of only two points from the site is too small to suggest whether one of the base classes was more frequently manufactured as what appears to have happened at the Plainview site.

Associated with the Agate Basin level at the Packard site is a side-notched point (Wyckoff 1985). This is one of the earliest dated occurrences of side-notching on the Southern Plains. Recent work at the Wilson-Leonard site also documents the presence of side-notching during the late Paleoindian period in southern Texas (Collins 1998). My sample of projectile points used in this analysis does not include side-notched forms because of the difficulty in separating Archaic age points from the late Paleoindian period. However, this is clearly a different base class that needs to be examined in future studies.

Coefficient of Variation percentages for Maximum Base Height, Maximum Base Width, Basal Concavity Area, and Maximum Thickness are presented by base class and site in Tables 8.4-8.6. Only sites with more than two points per base class were examined. Percentages closer to 1.7 indicates standardization attainable by humans without the aid of measurement instruments (Eerkens and Bettinger 2001). Percentages closer to 57.7 are considered random, indicating the artifacts were not manufactured in a standard fashion (Eerkens and Bettinger 2001).

For most of the Base Class 1 points, it appears that they were made to a fairly set standard that limited variation in hafting design (Table 7.4). There was more variation in Maximum Base Height for Base Class 4 (Table 7.5). However, Maximum Base Width and Maximum Thickness exhibits less variation for Base Class 4. Basal Concavity Area was not measurable because none of these points were indented along the base. For Base Class 5, only the Horn Shelter No. 2 site had a large enough sample to measure variation. For Maximum Base Height and Basal Concavity there was very little standardization for Base Class 5. Maximum Base Width and Maximum Thickness demonstrates less variation for Base Class 5, but is still less standardized compared to the other base classes measured from the other sites.

This analysis tentatively finds that different base designs were made to a particular norm for hafting. However, for Base Class 5 there appears to be less standardization, but the sample is only from one site location. Future work with larger sample sizes from known site contexts is needed to further understand the variability in projectile point production.

Territorial Boundaries

Many different aspects of culture, i.e. language and dress, not preserved in the archaeological record are probably better indicators of territorial distributions. For the Paleoindian period, projectile points are useful for detecting territories because of their ubiquitous distribution, and they are complex to make, requiring multiple decisions. Artifacts that require more thought process into their manufacture are more likely to express cultural differences between groups (Binford 1989).

Territorial boundaries should be detectable by examining the distribution of raw materials and projectile point styles across the landscape. A predominate projectile point style manufactured from an area's particular lithic material is a potential indicator of a territory. However, visiting groups will also be bringing in exotic materials that are made

Table 7.4. Coefficient of Variation percents for Base Class 1 attributes.

Site Name	Base Height (CV%)	Base Width (CV%)	Basal Concavity (CV%)	Maximum Thickness (CV%)
Horace Rivers	4.76	9.73	15.2	7.28
Horn Shelter No. 2	11.04	4.70	4.70	11.26
Plainview	24.38	6.18	6.18	13.50
Ryan's Cache	19.00	8.36	8.36	12.14

Table 7.5. Coefficient of Variation percents for Base Class 4 attributes.

Site Name	Base Height (CV%)	Base Width (CV%)	Basal Concavity (CV%)	Maximum Thickness (CV%)
Lubbock Lake (FA5-17)	48.45	14.62	-	4.09
Packard (Agate Basin)	40.77	8.9	-	11.23

Table 7.6. Coefficient of Variation percents for Base Class 5 attributes.

Site Name	Base Height (CV%)	Base Width (CV%)	Basal Concavity (CV%)	Maximum Thickness (CV%)
Horn Shelter No. 2	48.78	12.68	81.29	19.44

differently in comparison with the host group. These should be present as a smaller percentage in comparison with the material culture left behind by the host group. There should also be places on the landscape that fall between territorial boundaries that serve as buffer zones (Eerkens 1999). These areas would contain comparable amounts of different projectile point styles manufactured from lithic materials from regionally different sources.

The frequencies of projectile points by raw material and base class is presented in Figures 7.11 and 7.12 and Tables 7.7 and 7.8. Apparent from Figure 8.11 is the prevalence of Alibates at the Nall site, and at Location 2 (Canyonlands). A small percentage of Alibates is present at Locations 3 (Lake Texoma) and 4 (Arkansas River). Edwards chert is the common material at Locations 1 (Southwestern Oklahoma) and 3 (Lake Texoma). It occurs as a smaller percentage at Location 4 (Arkansas River) and at the Nall site. Flint Hills chert is most frequent closer to its source at Location 4 (Arkansas River). It is present as a smaller percentage at Location 3 (Lake Texoma) and only two spear points of this material occur at Location 5 (Arkoma basin). Ozark cherts are represented as the highest percentage at both Locations 4 (Arkansas River) and 5 (Arkoma basin), and is present in lower percentages at Locations 2 (Canyonlands) and 3 (Lake Texoma). At Location 5 (Arkoma basin), Ouachita Mountain cherts are represented at their highest frequency, although Ozark materials are still the most prevalent material used. Ouachita Mountain cherts are also distributed in low numbers at Locations 2 (Canyonlands), 3 (Lake Texoma), and 4 (Arkansas River).

Base Class 1 is frequent across the entire study area (Figure 7.12). All of the base classes occur as smaller percentages at Locations 1 (Southwestern Oklahoma), 2 (Canyonlands), and 3 (Lake Texoma). However, at Locations 4 (Arkansas River) and 5 (Arkoma basin) in the eastern portion of the study area, Base Class 2 is present as a higher percentage compared to its frequency at western locations. Base Class 5 is more com-

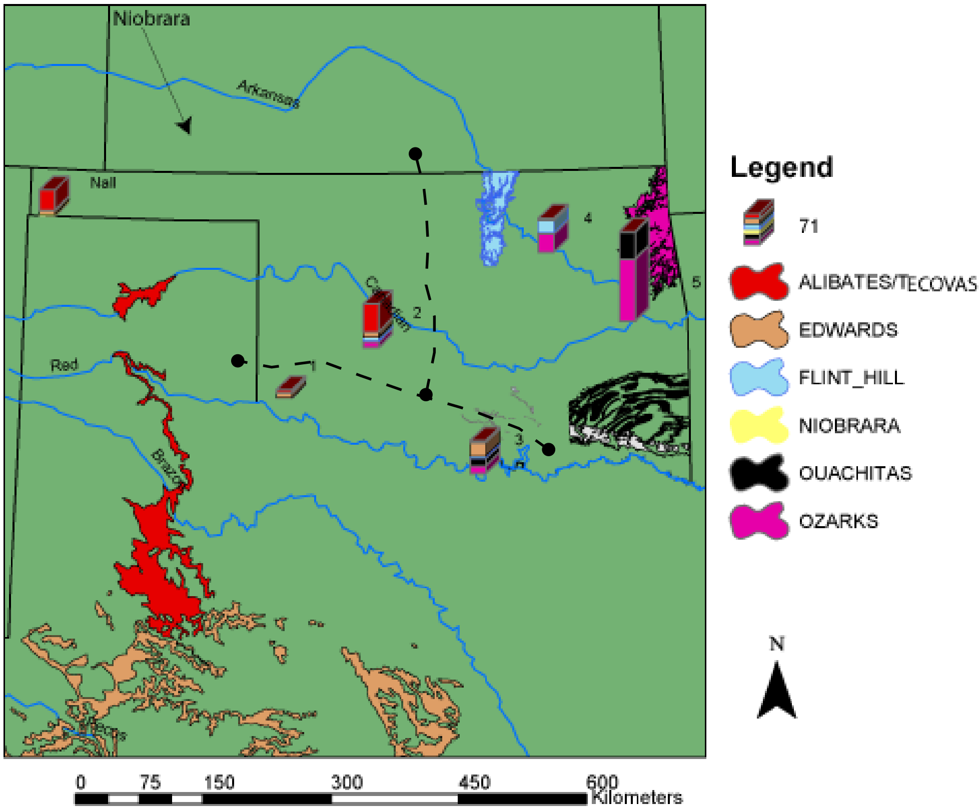


Figure 7.11. Distribution of raw material across the study area. Dotted lines denote possible territorial boundaries.

Table 7.7. Counts of late Paleoindian points by raw material source for each location.

Site	Alibates	Edwards	Flint Hills	Niobrara	Ouachitas	Ozarks
Nall	46	9	0	4	0	0
1 Southwestern Oklahoma	7	11	0	0	0	0
2 Canyonlands	63	13	8	0	2	13
3 Lake Texoma	4	31	4	1	17	18
4 Arkansas river	5	1	26	1	3	41
5 Arkoma basin	0	0	1	1	61	141

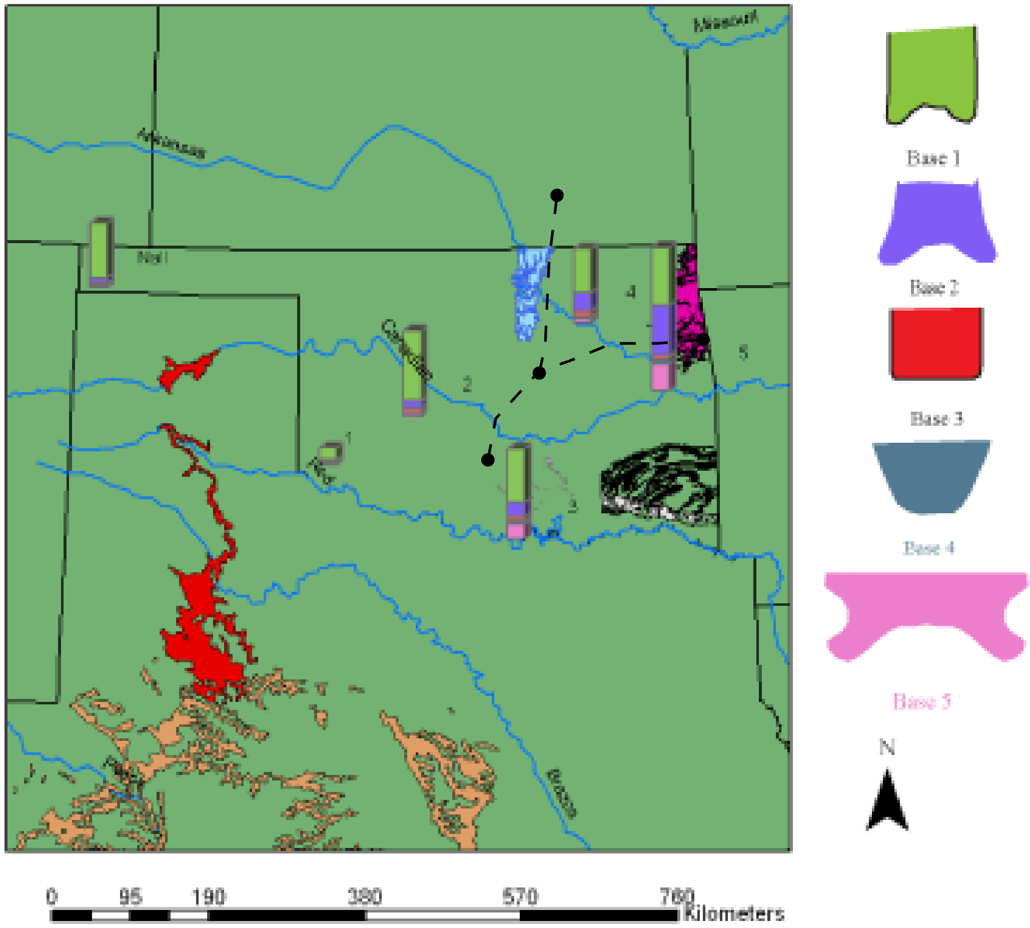


Figure 7.12. Frequency of base classes by location for study area. Dotted lines denote possible territorial boundaries.

Table 7.8. Frequency of base classes by location.

Location	Base 1	Base 2	Base 3	Base 4	Base 5
Nall	92	9	2	1	4
1 Southwestern Oklahoma	19	4	0	4	1
2 Canyonlands	117	13	7	2	4
3 Lake Texoma	89	24	7	6	25
4 Arkansas river	73	31	8	5	7
5 Arkoma basin	97	84	6	7	46

mon at Location 5 (Arkoma basin), and occurs as a higher percentage at Location 3 (Lake Texoma). Base Classes 3 and 4 exists in small number across the entire study area.

The results of this analysis suggest a possible territorial boundary existed between the eastern and western samples (Figures 7.11 and 7.12). Location 3 (Lake Texoma) appears to be on this dividing line with a higher diversity of raw materials and base classes present. This location may represent a buffer zone between overlapping territories. Location 2 (Canyonlands) is interesting in that Alibates is the most common lithic material, but Flint Hills, Ouachita, and Ozark cherts and quartzites were also brought from the east. In contrast, Alibates/Tecovas and Edwards chert occur in very low numbers in the eastern locations. Another possible boundary might have existed between western groups procured Edwards chert to the south and western groups to the north that depended on Alibates (Figure 7.6). This is indicated by the lower percentage of Edwards chert found at Location 2 (Canyonlands), and at the Nall site. Base Class 5 occurs as a higher percentage at both Locations 3 (Lake Texoma and 5 (Arkoma basin). This may be a proxy for a possible territory for people using this base design.

To further examine these possible boundaries, there should be a correlation between raw material and base class. This would indicate that individuals from these different locations were procuring raw material from within their territory and were manufacturing points according to their cultural norms. Figure 7.13 shows results of a contingency analysis between raw material source and base class. As indicated earlier, a strong correlation appears between Base Classes 2 and 5 with Ouachita and Ozark materials. Flint Hills cherts are more associated with Base Class 1, which is a different pattern when compared to Ouachita and Ozark lithics. Base Class 1 is prevalent for all of the raw material source locations.

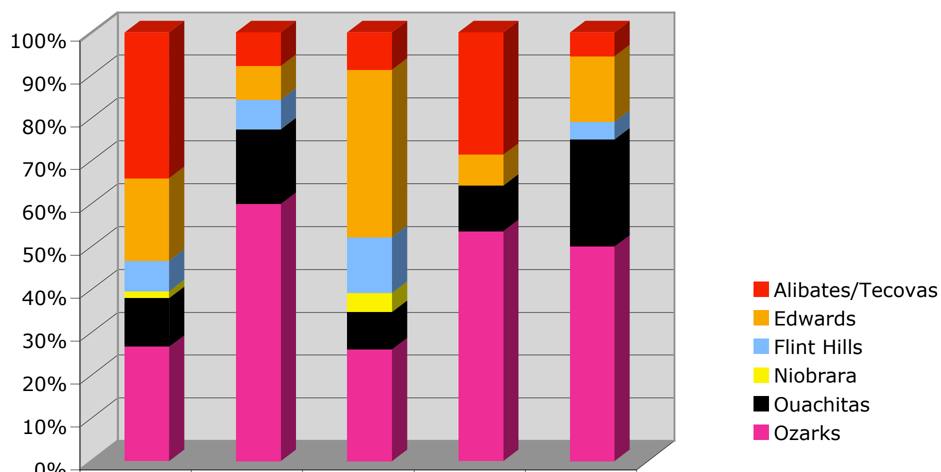
Because Base Class 1 is common, I decided to explore whether differences existed in the way this base class was being manufactured across the study area and whether this variation would correspond with the patterns manifest in Figures 7.11-7.13. I examined only Base Class 1 because of its large sample size and wide distribution. Projectile point attributes Maximum Base Height, Maximum Base Width, Basal Concavity Area, and Maximum Thickness were compared using a one-way analysis of variance.

The statistical program used for the creation of the graphs is JMP version 5 (SAS Institute Inc. 2002). In the one-way analysis, graphs are presented of each measured data point along with their mean and 95% confidence interval. To the right is a series of comparison circle plots which compare means using the student's t test examined at the 95% confidence interval. Significant differences exist when comparison circles do not intersect another circle or when they intersect at less than 90 degrees. When comparison circles intersect at angles equal to 90 degrees, then it is borderline significantly different. At angles greater than 90 degrees there is not a significant difference. At the bottom of each graph is the result from the analysis of variance.

No significant differences in terms of Base Height occur across the study area (Figure 7.14). However, Maximum Base Width, Basal Concavity Area, and Maximum Thickness produced some interesting results (Figures 7.15-7.17). Projectile points from the Nall site are clearly distinguishable from the rest of the locations. In addition, a significant difference occurs between points from Location 4 (Arkansas River) and the other locations based upon Basal Concavity Area. The analysis of Maximum Thickness produced the greatest differences between the locations. Significantly, spear points from Location 5 (Arkoma basin) are thicker than those made at the Nall site.

Next, I compared the distribution of projectile point attributes by raw material (Figures 7.18-7.21). Only Maximum Thickness was significantly different by raw material type (Figure 7.21). It is interesting that projectile points made from Flint Hills, Ozark, and Ouachita sources are thicker in comparison to those of western lithic materials.

From this analysis, it appears that when there is variation in the way Base Class 1 is manufactured, it follows the same raw material and base class distribution patterns high-



	Base Class 1	Base Class 2	Base Class 3	Base Class 4	Base Class 5
Alibates/Tecovas	120	9	2	8	4
Edwards	68	9	9	2	11
Flint Hills	25	8	3	0	3
Niobrara	6	0	1	0	0
Ouachitas	40	20	2	3	18
Ozarks	94	69	6	15	36

Source	DF	Test	ChiSquare	Prob>ChiSq
Model	24	Likelihood Ratio	119.223	<.0001
Error	584	Pearson	109.275	<.0001
C. Total	608			
N	612			

Warning: 20% of cells have expected count less than 5, ChiSquare suspect

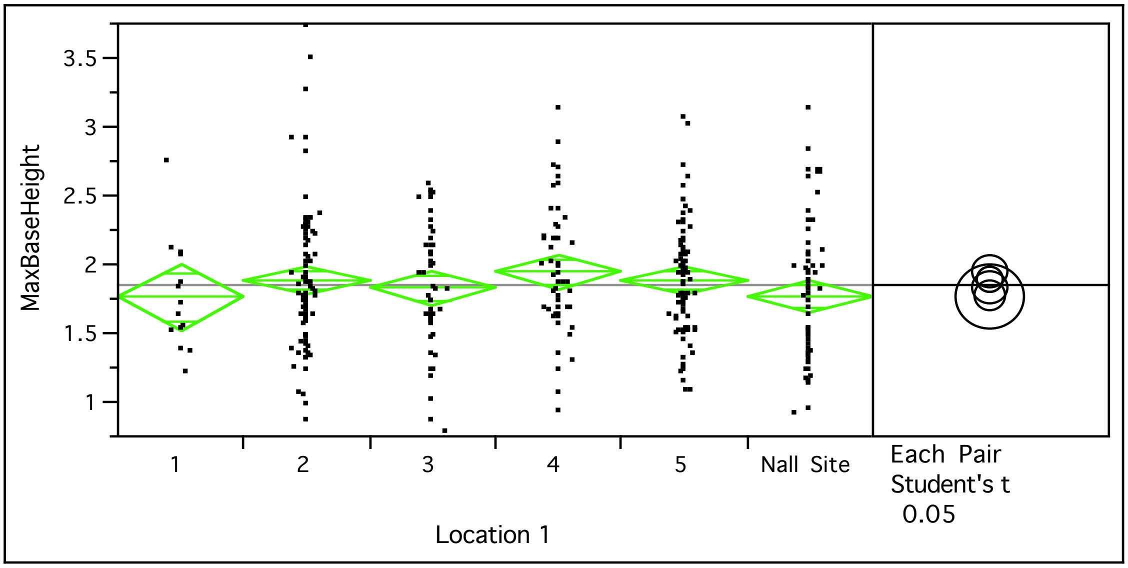
Figure 7.13. Distribution of lithic raw material by base class.

lighted in Figures 7.11 and 7.12. Particularly, Locations 4 (Arkansas River) and 5 (Arkoma basin) deviate the most from the Nall site. In contrast, there is very little difference indicated from the measured attributes between Locations 1 (Southwestern Oklahoma), 2 (Canyonlands), and 3 (Lake Texoma). Locations 4 (Arkansas River) and 5 (Arkoma basin) further deviate from each other when comparing Maximum Thickness and Basal Concavity Area. Further analysis is needed to examine the significance of the differences between these two areas.

Territory Size and Mobility

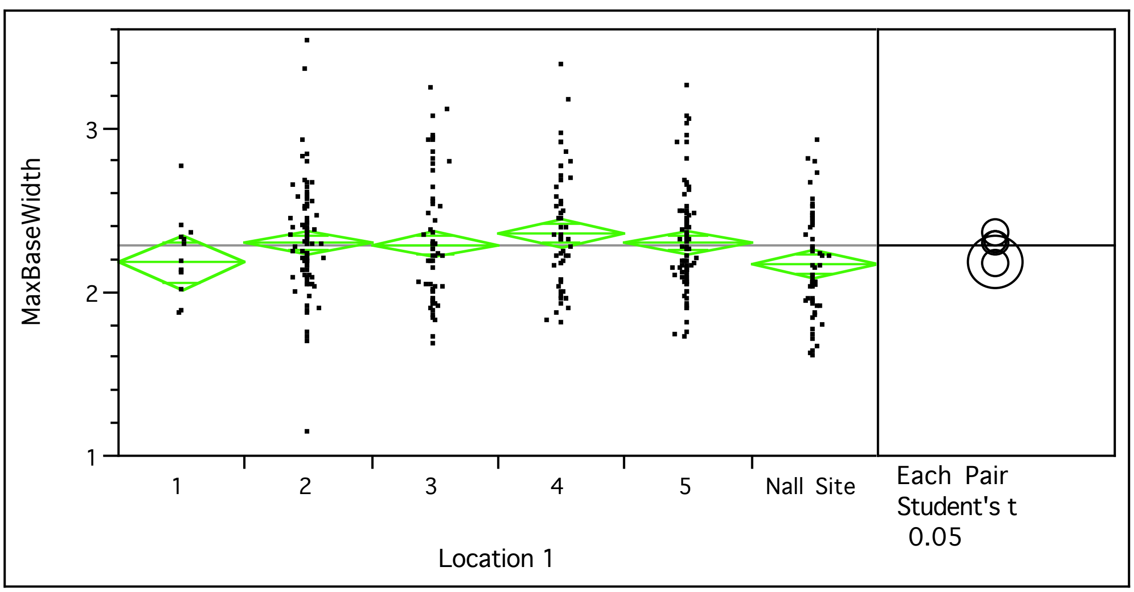
Raw material data for the Folsom projectile points on the Southern Plains is summarized in Table 7.9 and Figure 7.22. As Hofman (1991) notes, there is a clear pattern of Folsom groups carrying Edwards chert great distances across the Southern Plains in relation to other raw materials. They appear to have inhabited an area farther west, but with a territorial boundary that exists between them and an eastern group that may be Dalton's predecessors.

To determine if there was a reduction in total mobility due to a decrease in territory size, I made a comparison between the Folsom data from Cedar Canyon and Bethel localities and late Paleoindian data from Location 2 (Canyonlands) (Figure 7.23). Both data sets are large enough and are derived from comparable locations. The findings suggests there was a reduction in mobility, indicated by the switch from a predominance of Edwards to Alibates/Tecovas chert. This corresponds to a reduction of approximately 100 km in distance.



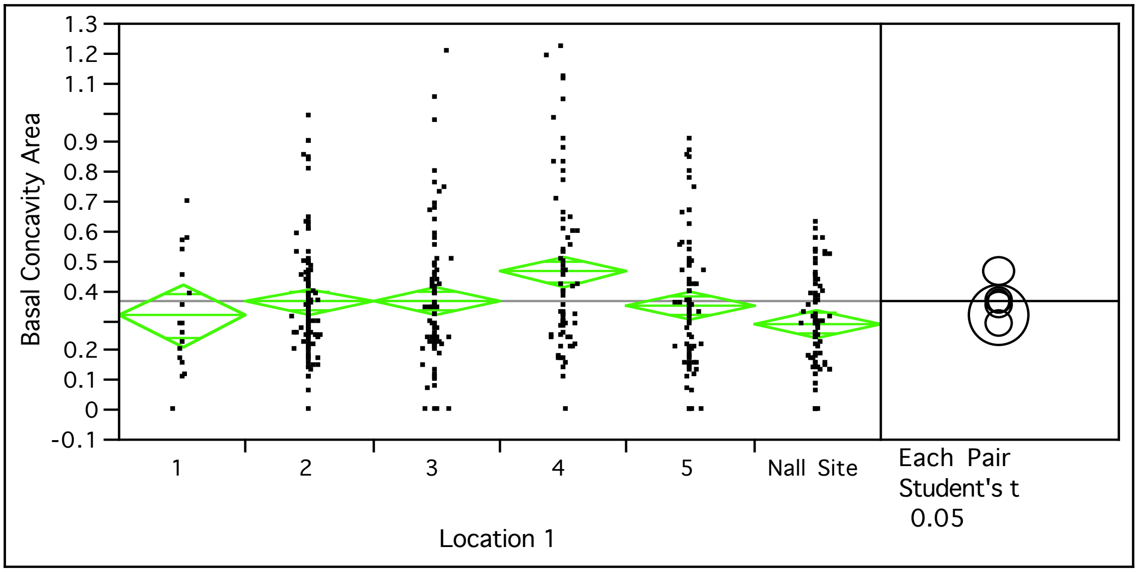
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Location 1	5	1.105175	0.221035	1.0381	0.3950
Error	345	73.458468	0.212923		
C. Total	350	74.563643			

Figure 7.14. One-Way analysis of Maximum Base Height by location for Base Class 1.



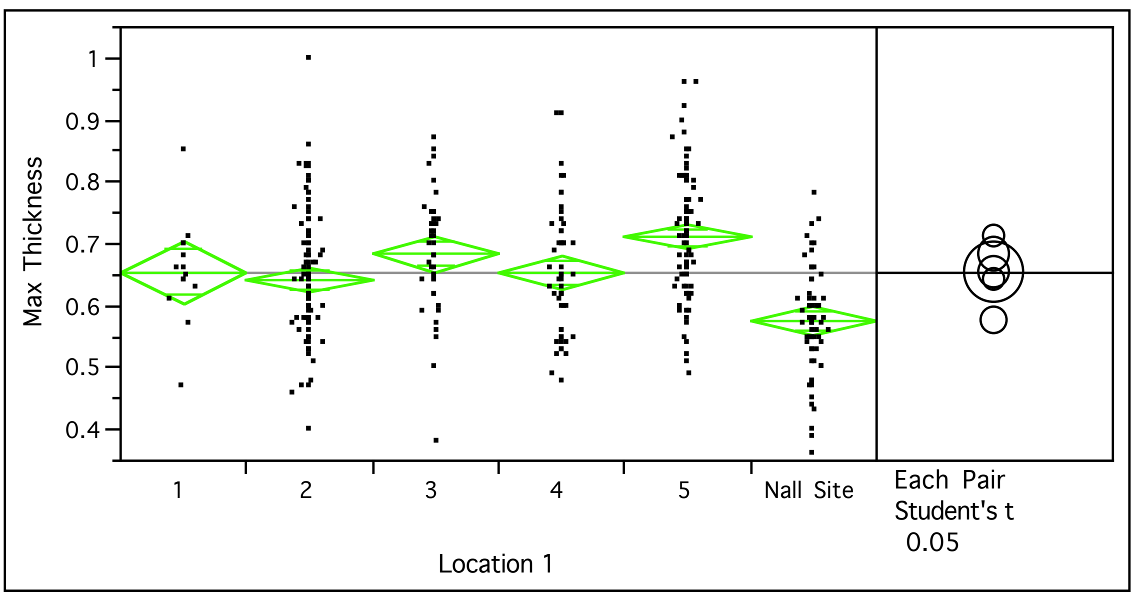
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Location 1	5	1.322878	0.264576	2.4267	0.0350
Error	370	40.340284	0.109028		
C. Total	375	41.663161			

Figure 7.15. One-Way analysis of Maximum Base Width by location for Base Class 1.



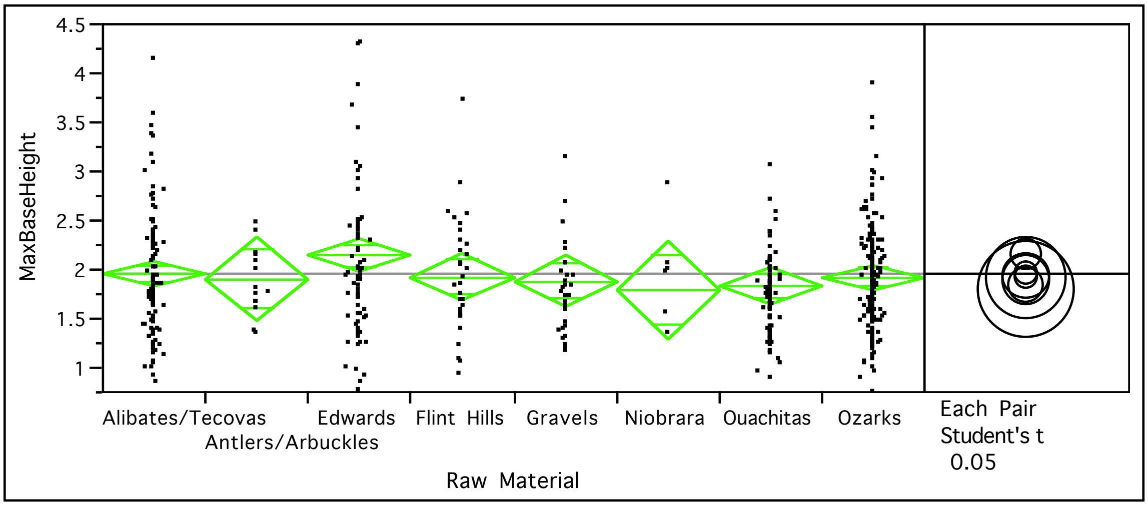
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Location 1	5	1.196200	0.239240	5.0834	0.0002
Error	435	20.472532	0.047063		
C. Total	440	21.668732			

Figure 7.16. One-Way analysis of Basal Concavity Area by location.



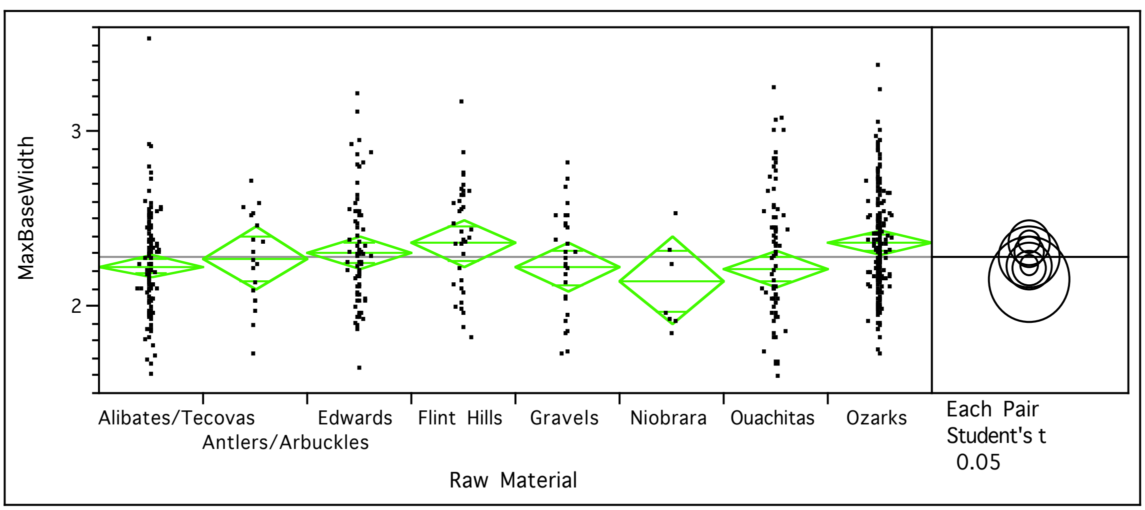
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Location 1	5	0.7254697	0.145094	15.7249	<.0001
Error	350	3.2294548	0.009227		
C. Total	355	3.9549244			

Figure 7.17. One-Way analysis of Maximum Thickness for location.



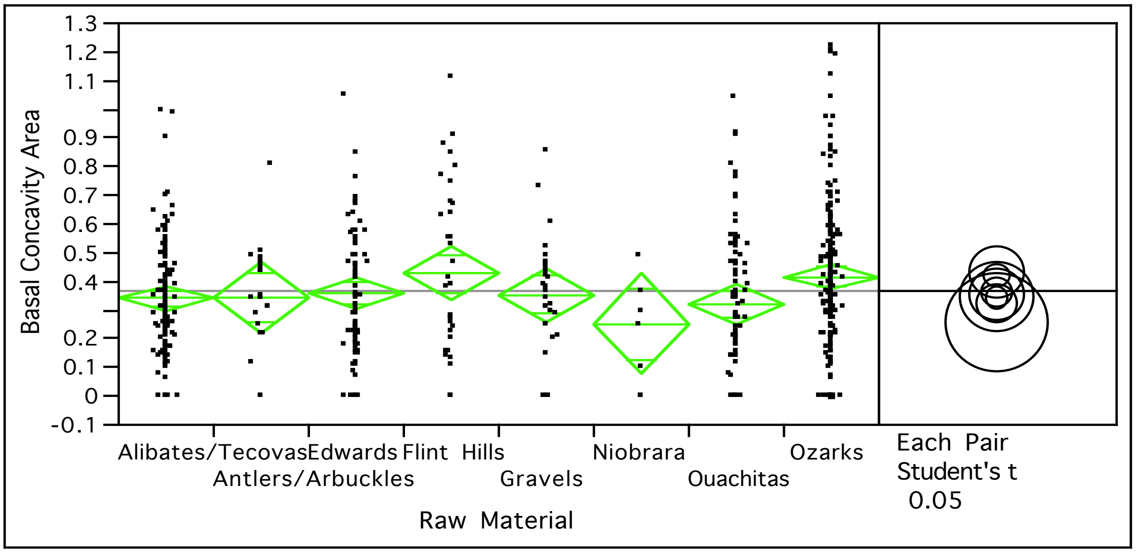
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Raw Material	7	2.488412	0.355487	1.1098	0.3568
Error	293	93.856109	0.320328		
C. Total	300	96.344520			

Figure 7.18. One-Way analysis of Maximum Base height by raw material.



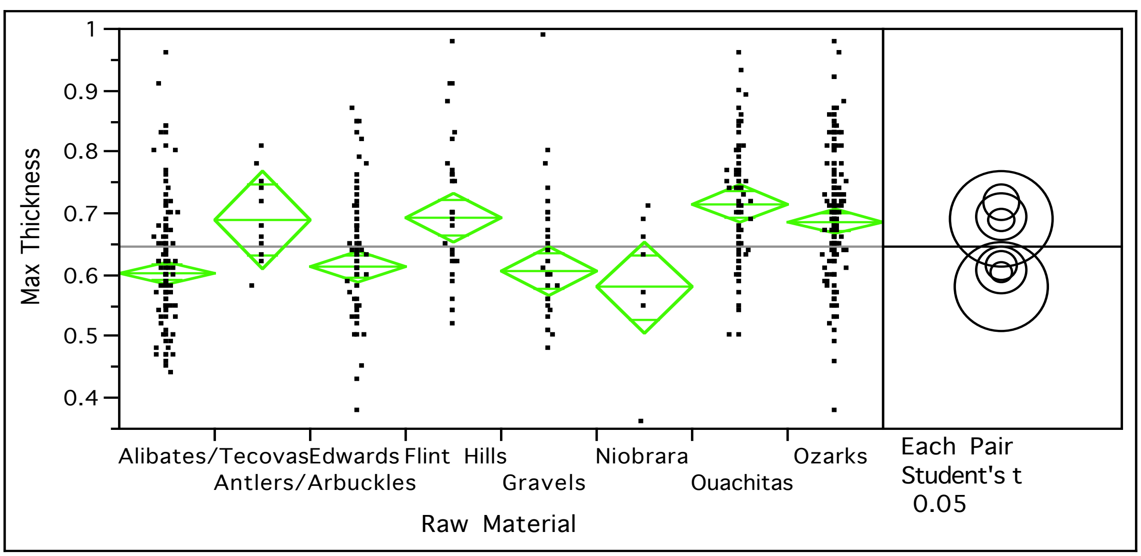
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Raw Material	7	1.355400	0.193629	2.0208	0.0522
Error	308	29.512598	0.095820		
C. Total	315	30.867998			

Figure 7.19. One-Way analysis of Maximum Base Width for raw material.



Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Raw Material	7	0.550654	0.078665	1.6819	0.1123
Error	348	16.276839	0.046773		
C. Total	355	16.827493			

Figure 7.20. One-Way analysis of Basal Concavity area by raw material for Base Class 1.



Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Raw Material	7	0.6374679	0.091067	10.9389	<.0001
Error	300	2.4975201	0.008325		
C. Total	307	3.1349880			

Figure 7.21. One-Way analysis of Maximum Thickness by raw material for Base Class 1.

In addition, materials from the Flint Hills and Ouachitas are closer than either the Edwards or Alibates/Tecovas source, and they occur in higher numbers for the late Paleoindian period compared to the Folsom period. Although a rough measure of territory size, the findings from this location support the idea of a decrease in territory size and corresponding reduction in mobility from Folsom to the late Paleoindian period. The findings also suggest a shift in territorial boundaries, which is indicated by the decreasing amounts of Edwards chert that is carried past the present day Oklahoma/Texas border onto the Central Lowlands during the late Paleoindian period.

Conclusions

When examining Folsom data on the Southern Plains, it appears that territories were more of a construction of social distance rather than for alleviating competition. It is likely population densities were low enough that to maintain a viable population, cultural conformity was promoted to ensure solidarity. This fits well with the Folsom pattern of high mobility and production of similar spear point styles (Hofman and Todd 2001).

The late Paleoindian data presented here indicates a reduction in territory size which corresponds to a decrease of mobility in comparison with Folsom groups on the Southern Plains. Although Base Class 1 is prevalent across the entire study area, there is an increase in stylistic diversity in projectile point manufacture that implies social conformity was no longer as important as it was during the Folsom period. This may indicate a shift to territories becoming socially defended as described in Chapter 4. The social boundaries between forager groups are expected to be permeable, but there should

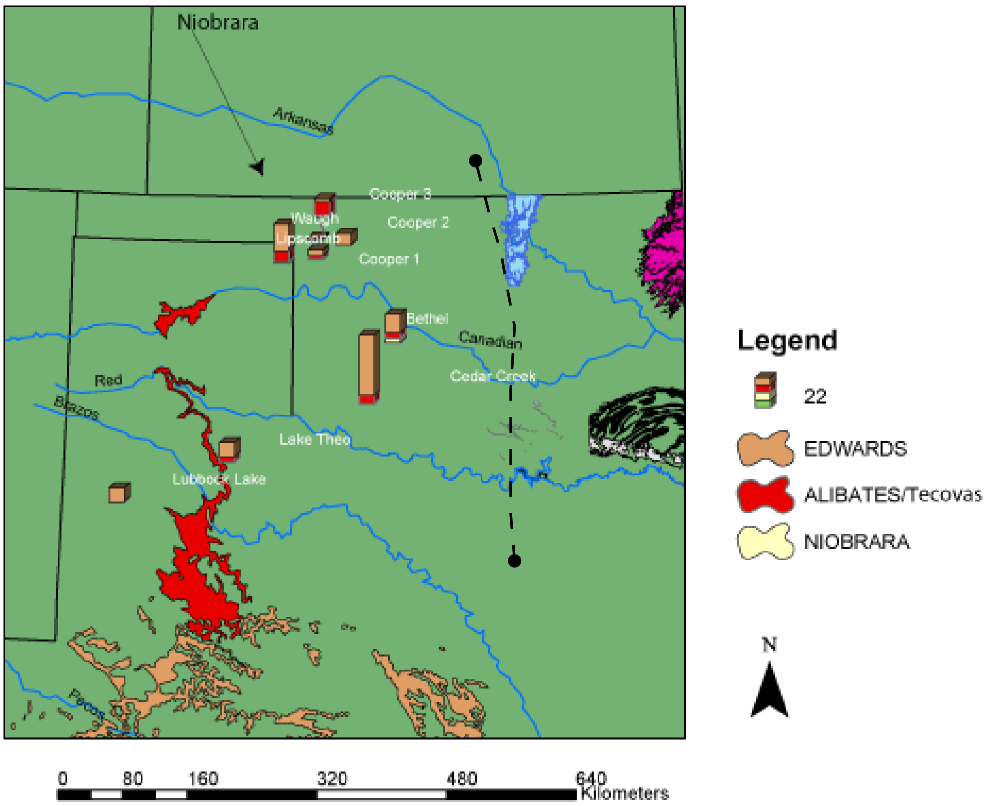


Figure 7.22. Distribution of Folsom projectile points by raw material on the Southern Plains.

Table 7.9. Counts of Folsom/Midland points by raw materials from Folsom sites on the Southern Plains.

Site Name	Edwards	Alibates/ Tecovas	Niobrara	Site Type	References
Cooper 1 (Lower Kill)	4	3	0	Bison Kill	Bement 1999
Cooper 2 (Middle Kill)	8	0	0	Bison Kill	Bement 1999
Cooper 3 (Upper Kill)	2	10	1	Bison Kill	Bement 1999
Waugh	1	1	0	Bison Kill/ Campsite	Hofman 1999
Lipscomb	19	8	1	Bison Kill	Todd et al. 1992
Cedar Creek	43	6	0	Collection Locality	Hofman 1991
Bethel	13	4	3	Collection Locality	Hofman 1991
Lubbock Lake	10	0	0	Bison Kill	Johnson 1987
Lake Theo	10	4	0	Bison Kill	Harrison and Killen 1978

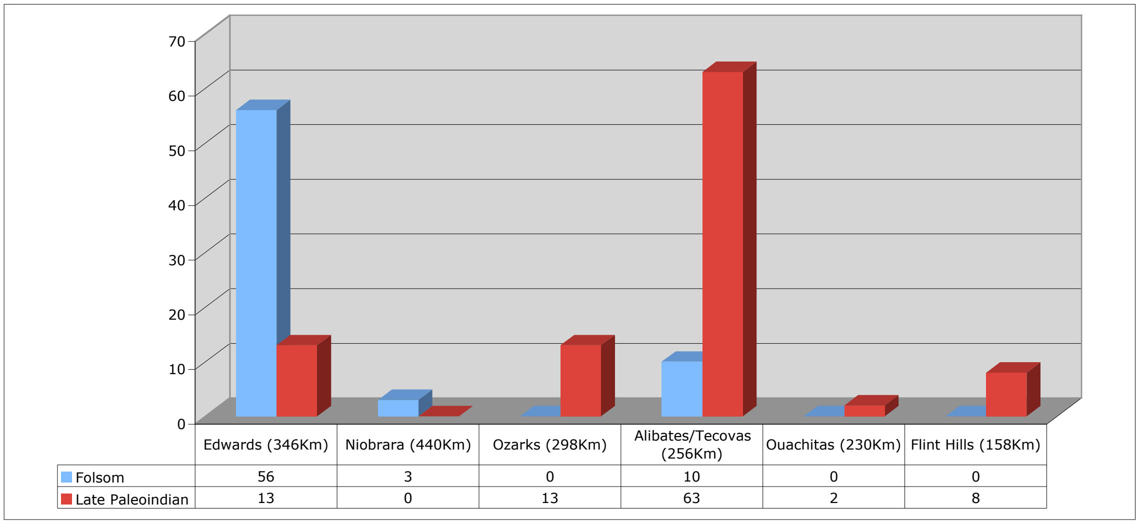


Figure 7.23. A comparison between Folsom and late Paleoindian in frequency of raw material in relation to distance from source. Data is derived from Bethel and Cedar Canyon locations for Folsom (Hofman 1991), and Location 2 for late Paleoindian.

also be some cultural differences that become marked to recognize differences between hunter-gatherer groups.

The projectile point data from this study indicates territorial boundaries may have developed between the west and the east, north and south on the western plains, and forager groups making Base Class 5 points appear to be concentrated in the southern and eastern portion of the study area. At this broad scale of analysis, it is difficult to demonstrate whether these differences in projectile point attributes were ethnically meaningful, or were enculturated unconscious differences between hunter and gatherer groups.

The ubiquity of Base Class 1 indicates there was not a distinct difference between forager groups in how they made projectile points. Therefore, the higher concentration of Base Classes 2 and 5 in the eastern portion of the study area may reflect more enculturated differences in how forager groups made points rather than conscious ethnically meaningful differences. I think the findings imply identity-based territories that were socially defended, but other aspects of culture might have been more ethnically meaningful. However, only by using evidence from sites with good contexts can social boundaries be further defined. Then, the degree to which ethnicity was an important factor in hunter and gatherer interactions can be determined.

Chapter 8

Discussion and Conclusions

The increase in the number of different styles of projectile points has been thought to reflect the regionalization process during the late Paleoindian period (Hayden 1982; Walthall and Koldehoff 1998). Either an increase in population density or environmental changes caused forager groups to occupy smaller territories. The results of using smaller territories was a reduction in mobility and use of a wider range of food resources (Kelly and Todd 1988). Also, part of this process may have been the culturally important formation of ethnic identities (Johnson 1989). The goal of this dissertation was to examine the possibility of regionalization during the early Holocene period by answering three questions.

1. Did an environmental change and/or population pressure cause late Paleoindian forager groups to become more regionalized?
2. Is there evidence for late Paleoindian groups becoming less mobile, and selecting a wider range of food resources within smaller territories?
3. Did late Paleoindian groups develop ethnic identities?

Approaching these questions from a territorial aspect encapsulates the major issues that needed to be addressed in attempting to find answers. Territories are defined by forager groups in consideration of the distribution of resources in relation to the regional forager population density (Cashdan 1983; Dyson-Hudson and Smith 1978; Kelly 1995:130-132). Therefore, an increase in population density and/or a change in resource structure due to environmental changes will have an effect on hunter and gatherer territories. If there was an environmental shift, then late Paleoindian groups may have begun using smaller territories. If an environmental change is not evident, then an increase in population density may have been a more important factor in forcing hunter and gatherer groups into smaller territories. In this study, a lack of evidence for environmental change was taken to indicate that the important factor was more likely population density.

In order to answer point two it was noted that changes in territorial boundaries is correlated with shifts in mobility patterns and food selection (Dyson-Hudson and Smith 1978; Kelly 1983, 1995:131). Occupying smaller territories requires diet breadth to increase and a reduction in mobility within a given environment (Kelly 1995:87). In this dissertation, a change in mobility patterns was directly measured by comparing the distribution of Folsom and late Paleoindian points in relation to their raw material sources. If late Paleoindian points are located not as far as Folsom points from their raw material source, then this would suggest late Paleoindians were occupying smaller territories and were less mobile then Folsom. Unfortunately, examining whether late Paleoindians were using a wider range of food resources was not directly investigated. It is not possible at this time because of the limited number of late Paleoindian sites that can contribute subsistence information.

Point three depended on the idea that, ethnic identity is also likely to coincide with the development of territories in forager societies. Hunter and gatherer identity is based upon their rights and relationships to a place on the landscape (Myers 1982). Competition between hunter and gatherer groups from either a reduction in resources or an increase in the number of people causes a spatial management problem. According to

Cashdan's (1983) social boundary defense model, socially defined territories become important to manage the distribution of forager groups in relation to resources. When the overall population density of a region is low, then permeable social territorial boundaries are likely for negotiating the spacing of hunters and gatherers (Cashdan 1983). Disparities in material culture may become marked to delineate the differences between forager groups (McElreath et al. 2003). If there are distinct patterns of contemporaneous spatial segregation of projectile point styles, and their raw material sources, then this would suggest that ethnically distinct hunter and gatherer groups were using different territories.

In southwestern Oklahoma, 34GR4, Howard Gully, and Perry Ranch sites were investigated for obtaining chronological, environmental, and material cultural information to address the three main research questions. A total of 860 spear points were examined from six surface localities and late Paleoindian sites across the Southern Plains study area. The raw materials from which they were made and the spear point's hafting styles were spatially examined as indications of their range of manufacture, mobility patterns, and territorial boundaries. A summary of what was learned is presented below.

Analysis

34GR4

Pollen from 34GR4 reveals that prior to the early Holocene period, before 9,730 ± 60 RCYBP, the North Fork of the Red River was higher on the landscape, creating a wetter riparian zone. This is suggested by the high frequency of cottonwood trees. Also present was juniper, pine, elm, umbel family, sagebrush, thistle, marsh elder, cocklebur, rabbitbrush, cheno-ams, greasewood, wild buckwheat, legumes, and grasses.

A buried soil dated to 9730 ± 60 RCYBP holds pollen indicating a shift in the course of the North Fork of the Red River. Cottonwoods disappear, and sagebrush, marshelder, rabbitbrush, Cheno-ams, and grasses become more abundant. This vegetation community is more typical of a dry terrace setting overlooking the river rather than being apart of an active flood plain.

Drier conditions continue to be the trend leading into the early Holocene between 8,200 ± 110 RCYBP to 6,080 ± 110 RCYBP. As evident from pollen from this buried soil, Cheno-ams and grasses began to decline in abundance. However, the chicory tribe of the sunflower family becomes prevalent during this time.

Carbon isotope data obtained from the radiocarbon processing corroborates the pollen diagram. During the early Holocene the $^{13}C/^{12}C$ ratio of -18.7 to -20.0 ‰ indicates a higher frequency of C_3 grasses. However, this changes during the mid-Holocene when C_4 grasses become more frequent during the Altithermal period.

Howard Gully

Excavation of Howard Gully successfully recovered a shallow side-notched point associated with 1-2 bison dating to 10,214 ± 55 RCYBP (NZA-21229). This point style had been previously found with Plainview points at Horn Shelter No. 2 (Valastro et al. 1979, Watt 1978) and Rex Rodgers site (Willey et al. 1978). However, attempts at dating bison bone at Rex Rodgers produced unreliable results (Speer 1978), and charcoal dating at Horn Shelter No. 2 yielded a wide range of results between 9,500 to 10,000 RCYBP (Holliday 1997). The Howard Gully site is important for demonstrating that this point style is being used during the Folsom to late Paleoindian transitional period.

The exotic raw materials depleted in making the stone tools left at Howard Gully are Alibates and Edwards chert. This indicates a mobile settlement pattern across the western Southern Plains, but the occurrence of this style of point, referred to as Base Class 5 in Chapter 7, is more frequently found in the southern and eastern portions of the study area. The presence of Alibates at the site suggests a more western extent for their territorial boundary. It may be true that for most forager groups that used Base Class 5 spear points did not travel as far to the west, but people from Howard Gully did. Only from excavated contexts would we gain insights to the mobility patterns of one group of people. Also, the Alibates used at the site is in the form of non diagnostic flakes. Both of the Howard Gully spear points are made from Edwards chert. Therefore, only from the excavated context with the association of these artifacts together can we get a fuller picture of their territory not possible through surface collections alone.

Two radiocarbon ages of 11,200±340 (GX-31271) and 10,030±280 (GX- 31270) provide an estimate of the age of a buried soil beneath the bison feature at Howard Gully. Interestingly, the $^{13}C/^{12}C$ ratio for the two buried soils is -23.3 ‰. This indicates a plant community dominated by C_3 vegetation. In contrast, the $^{13}C/^{12}C$ ratio for the dated bison petris bone is -10.9 ‰. Accounting for the 5 ‰ change from the fractionation effect of bone (Chisholm et al. 1986), the bison were consuming mainly C_4 grasses. A shift in the grassland composition from C_3 to C_4 is suggested at the late Pleistocene/early Holocene boundary. The bison feature was also buried by eolian sediments, further indicating a drier period. The timing of the Howard Gully kill may coincide with part of the Younger Dryas period (Anderson 1997).

Perry Ranch

Previously, the Perry Ranch site was regarded as a small Plainview kill with an MNI of two bison (Hofman and Todd 1997). The age of the kill was unclear because of unreliable bone dating (Hofman and Todd 1997). Their technique for cornering the bison was also uncertain, but Saunders and Penman (1979) speculated that the small bluff to the south of the site may have acted as a small jump for herding the bison into a bog or trap. My excavations discovered that the Perry Ranch site is a large bison kill, and a gully was used for trapping the bison.

Unfortunately, the age of the site is still debatable. One AMS date of a petris bone produced a result of 8,460±45 RCYBP (CAMS-95513). Another date of 4,259±35 RCYBP (NZA-23546) was obtained from another petris bone, but had poor collagen preservation. Perry Ranch may date to approximately 8,500 RCYBP, but more AMS dates from better preserved bone are needed for confirmation.

Spear Point Analysis

The current sample of late Paleoindian sites with projectile points from good context indicates that there is little variation in the number of different base classes represented. This insinuates that single hunter and gatherer groups did not make a wide diversity of different types of spear points. Additional support for this conclusion is that there is not much metric disparity within most of the base classes. The main exception is Base Class 5. Although there was only one site with a large enough sample size for comparison.

From an analysis of 860 spear points, a potential territorial boundary was found that separates the east from the west portion of the study area. This is constructed from the spatial distribution of raw material and the different types of bases for projectile points. Another possible territorial boundary that separates a northern from a southern foraging territory was found for the western part of the study area. Shallow side-notched points, similar to those at Howard Gully and classified as Base Class 5 in this analysis, were concentrated in the southern and eastern sections of the study area. This may represent the territorial boundaries for people using this type of spear point.

Points with parallel sides and concave bases, referred to as Base Class 1, are the most frequent. Variation in the metric attributes of Maximum Thickness and Basal Concavity Area of Base Class 1 projectile points demonstrates a difference between the east and west samples. This follows a similar potential territorial boundary as defined by the spatial distribution of raw material and base classes for the study area.

Territory size is smaller during the late Paleoindian period when compared to the Folsom period. Folsom and late Paleoindian points from the western canyon lands of Oklahoma were employed in the analysis. This conclusion is based upon a comparison of the frequency of the different types of raw materials used in making spear points in relation to the distance from their source. In this area, late Paleoindian groups were more frequently acquiring chipped stone from the Alibates/Tecovas source rather than Edwards chert from central Texas. This is a 100 km reduction in distance. In addition, Flint Hill and Ouachita Mountain cherts and quartzites are used more often in this area, which is a closer source then either the Edwards or Alibates/Tecovas source.

Discussion

In this section, I discuss the results of the research in terms of what was learned in addressing the questions of late Paleoindian regionalization. Also, suggestions for future research are provided.

1. Did an environmental change and/or population pressure cause late Paleoindian forager groups to become more regionalized?

As explored in Chapter 3, the major environmental changes occurred at the Clovis to Folsom transitional period at ca. 11,000 RCYBP. There is no indication that a major shift in the environment caused a drastic change in the resource structure between the Folsom and late Paleoindian period. Some resource fluctuations during the 2,000 year late Paleoindian period likely took place, but nothing like what happened at 11,000 RCYBP. The new information obtained from pollen and carbon isotopes from Lake Altus supports this conclusion.

By process of elimination, I think an increase in population density was the important factor in the regionalization process during the late Paleoindian period. Unfortunately, there is not a large enough late Paleoindian site database in the study area to estimate population density change. It is tempting to use projectile points as an estimate of population, but these measures can not be reliably used in this manner. The relationship between the number of discarded points per individual is unknown, and would only be a wild guess at this time.

2. Is there evidence for late Paleoindian groups becoming less mobile and selecting a wider range of food resources within smaller territories?

I found that territories, as represented by projectile point style distributions, became smaller during the late Paleoindian period compared to Folsom. Because the results indicate territories are becoming smaller, then it is likely mobility is reduced, and forager groups are widening their food choices. However at this time, we can only infer that they are less mobile and were using a wider range of food resources because these behaviors are correlated to territory size (Kelly 1995). We know late Paleoindians were hunting bison, because of the relative high number of bison kill sites that we have from the study area. Unfortunately, the only campsite that we have is Horace Rivers. And, this site's findings have yet to be reported in full. At this site, the diversity in fauna remains suggests a broad spectrum diet (Mallouf and Mandel 1997). Only by finding and excavating other late Paleoindian sites other than bison kills will we find direct evidence for whether or not subsistence was becoming more broad-based compared to the earlier Folsom period.

3. Did late Paleoindian groups develop ethnic identities?

Probably. The results of my projectile study suggests possible territorial boundaries that formed during the late Paleoindian period. As discussed in Chapter 2, ethnic identification is related to a place on the landscape or territory. Projectile points may actively symbolize ethnic distinctions (Wiessner 1983), or they may be unconscious passive differences (Carr 2004). Resolving the social importance of projectile points requires a lot more excavation of site contexts that provide detailed information about activity areas. Whatever the case may be, territories are likely markers of ethnic identity. And, the discovery of potential territorial boundaries demarcates the distribution of ethnic groups.

Territories are also identifiable for the Folsom period. But in contrast to the late Paleoindian period, the use of a larger territory, and the production of the same spear point style suggests territories were more defined by social distance rather than through competition. It is likely differences between these groups were minimized to promote social homogeneity. This was important because of a lower population density and the need to maintain a social exchange network.

In contrast, during the late Paleoindian period, an increase in population density would have created more competition between groups in their use of space. Therefore, territories become more socially defended. The creation of differences between forager groups becomes important for laying a claim on the landscape. This is how ethnic identity develops amidst hunters and gatherers.

Conclusion

In this dissertation, I examined whether or not a regionalization process occurred during the late Paleoindian period on the Southern Plains. I discovered that yes, late Paleoindians were probably using smaller territories, reducing their mobility, and incorporating ethnic identity with territory. A territorial perspective was used for investigating the regionalization process. This allowed inferences about mobility, subsistence, and ethnic identity not possible with the present information alone. However, my results are tentative. More data is needed to confirm these results. It is only through a continued regional and site context perspective will we be able to further flesh out the story of the early Holocene period.

Investigating whether or not hunter and gatherer groups were becoming more territorial during the late Paleoindian period required a broad theoretical framework. This is because the process of regionalization encompasses changes in all aspects of forager group culture. Previous studies have focused on how mobility and adaptation to the environment is reflective in projectile point design (Pitblado 2003:24). Thus, variation in point styles equates to divergent adaptations in different environments (Newby et al. 2005). Whether or not variation in material culture is representative of a functional adaptation to different environments, reflects identity based cultural differences has long been debated in archaeology (Binford 1971, 1989; Bordes 1970; Sackett 1973; Wiessner 1983). However, seemingly functional characteristics of culture are also done in culturally specific ways (Bettinger et al. 1996). For example, why does everybody not drive on the right side of the road? And, what many investigators have deemed as purely symbolic differences also has important functions. For example, why are there so many different languages and regional dialects in the world (Bettinger et al. 1996)? If language was meant to be purely functional and efficient, then why do mutually unintelligible dialects arise within a few hundred years (Bettinger et al. 1996)? Why are the French so French? Bettinger et al. (1996) argue that language differences are due partially to broadcasting dissimilarities between groups. It is a symbolic way to sort out group membership, which has a very important adaptive function. So, what I am saying is that we can not continue to ignore the importance that identity differences has in the archaeological record. It is likely that these identity differences play an important part in the variation of material culture. We need to develop models to explain the archaeological record that incorporates both a functional and cultural perspective.

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Appendix A. Description and measurements of lithic materials associated with bison feature.

Cat	Raw Material	Lithic Type	Stage	Core Type	Context	L	W	T	PW	PD	EPA	PP	T	BP
2	OG	C Percussion Flake	S	Blocky Multi-Direction	99.84 (Above)	30.9	20.4	8.4	-	8.1	90	Absent	Feather	D
11	Unid.Quartzite	C Percussion Flake	T	Blocky	99.47 (Below)	14.6	20.5	3.9	13.2	4.1	90	Absent	Step	D
13	OG	C Percussion Flake	S	Blocky	99.78	28.7	34.8	10	3.7	1.3	75	Absent	Step	D
16	Alibates Chert	C Percussion Flake	S	Blocky	99.72	40.6	33.9	6.4	11.7	3	50	Absent	Step	P
21	Edwards Chert	S Percussion Flake	T	Unknown	99.66	13	12.7	4.3	-	-	-	-	-	-
34	OG	S Percussion Flake	T	Blocky Multi-Direction	99.6	23.5	17.5	4.2	8.5	3.8	90	Absent	Feather	D
37	OG	S Percussion Flake	S	Blocky Core	99.55	25.1	24.7	6.9	6.5	2.2	71	Absent	Step	P
81	Edwards Chert	S Pressure Flake	T	Unknown	99.31 Krotovina	7.5	4.4	0.8	-	-	-	-	Step	-
84	Unid Quartzite	S Percussion Flake	S	Blocky Single-Direction	99.27 (Below)	38.6	49	12.5	-	-	84	Absent	Feather	D
129	A SI	S Pressure Flake	T	Unknown	Channel A Fill 99.71	5	5.1	1.1	-	-	-	-	Feather	-
130	OG Q	C Percussion Flake	S	Blocky Multi-Direction	Channel A Fill 99.73	21	12.9	4.5	7.7	3.8	64	Absent	Feather	D
140	Unid. Black Quartzite	C Percussion Flake	T	Single-Direction	Channel A Fill 99.73	22.7	12.8	2.9	3.8	1.2	72	Grinding	Feather	D
144	OG	S Percussion Flake	P	-	Channel A Fill 99.41	37.9	24.9	16.4	-	-	-	-	-	-
145	Unid. Chert	S Percussion Flake	T	Multi-Direction	Channel A Fill 99.36	9.8	11.9	2.1	-	-	-	-	Feather	-
155	Alibates Chert	C Pressure Flake	T	Unknown	99.095	8.1	8.6	1.2	2.6	0.8	60	Absent	Feather	D
166	OG	C Percussion Flake	T	Blocky Single-Direction	Channel A Fill 99.96 (Above)	16.2	12.5	4.1	7.7	3.2	75	Absent	Step	D

Raw Material: OG= Ogallala Quartzite, A= Antlers, SI= Silicified Sandstone, **Lithic Type:** C= Complete S= Shatter **Stage:** P= Primary, S= Secondary, T= Tertiary. **L**= Length, **W**= Width, **T**= Thickness, **PW**= Platform Width, **PD**=Platform Depth, **EPA**= Exterior Platform Angle, **PP**= Platform Preparation, **T**= Termination, **BP**= Bulb of Percussion: D= Diffuse, P= Prominent

Appendix A. Description and measurements of lithic materials associated with bison feature.

Cat	Raw Material	Lithic Type	S	Core Type	Context	L	W	T	PW	PD	EPA	PP	T	BP
181	Unid. Chert	S Flake	T	-	Channel A Fill 1/16" Screen	3.8	3.5	1.6	-	-	-	-	-	-
181	OG	S Percussion Flake	S	-	Channel A Fill 1/16" Screen	1.1	13.2	3.3	-	-	-	-	Feather	-
181	Unid. Quartzite	S Percussion Flake	T	-	Channel A Fill 1/16" Screen	13.9	17.6	2.8	-	-	-	-	-	-
181	Unid. Quartzite	S Percussion Flake	S		Channel A Fill 1/16" Screen	4.8	15.1	3.8	-	-	-	-	-	-
193	Unid. Quartzite	S Flake	T	-	N130 E98 Bone Feature 1/16" Screen	4.2	2.8	0.8	-	-	-	-	-	-
193	Unid. Quartzite	S Flake	T	-	N130 E98 Bone Feature 1/16" Screen	3.8	3	0.7	-	-	-	-	-	-
228	Unid. Quartzite	S Flake	P	Blocky Core	N131 E97 (99.75-99.70) 1/4" Screen	6.4	14.8	4.3	-	-	-	-	-	-
228	OG	C Percussion Flake	S	Blocky Multi-Direction	N131 E97 (99.75-99.70) 1/4" Screen	17.4	25.1	7.4	22	5.4	56	Absent	Feather	D
233	Unid. Quartzite	C Percussion Flake	T	Biface	N131 E98 Bone Feature 1/16" Screen	14.9	16.4	2.5	6.9	1.6	46	Absent	Step	D
233	Unid. Chert	S Flake	T	-	N131 E98 Bone Feature 1/16" Screen	3.8	2.7	0.6	-	-	-	-	-	-
239	Edwards Chert	S Flake	T	-	N131 E99 Bone Feature 1/16" Screen	5.5	5.3	1.2	-	-	-	-	-	-
239	Edwards Chert	S Flake	T	-	N131 E99 Bone Feature 1/16" Screen	3.6	4.6	1.3	-	-	-	-	-	-
239	Unid. Chert	C Pressure Flake	T	Biface	N131 E99 Bone Feature 1/16" Screen	5.5	3.6	0.4	1.4	0.2	-	-	Feather	-
254	Alibates Chert	S Pressure Flake	T	-	N132 E97 (99.20-99.10) 1/16" Screen	9.3	8.2	1.2	-	-	-	-	Step	D
264	Unid. Chert	S	T	-	N132 E99 (99.00-98.90) 1/16" Screen	4.3	5.2	1.3	-	-	-	-	-	-
281	Alibates Chert	S	T	-	N133 E97 (99.30-99.20) 1/4" Screen	6.3	14.1	1.4	-	-	-	-	-	-
281	OG	C Pressure Flake	T	Biface	N133 E97 (99.30-99.20) 1/4" Screen	7.6	8.6	1.5	4.2	1.1	47	Absent	Step	P

Raw Material: OG= Ogallala Quartzite, A= Antlers, SI= Silicified Sandstone, **Lithic Type:** C= Complete S= Shatter **Stage:** P= Primary, S= Secondary, T= Tertiary. **L**= Length, **W**= Width, **T**= Thickness, **PW**= Platform Width, **PD**=Platform Depth, **EPA**= Exterior Platform Angle, **PP**= Platform Preparation, **T**= Termination, **BP**= Bulb of Percussion: D= Diffuse, P= Prominent

Appendix B: Description of lithic materials not associated with bison feature.

Cat#	Raw Material	Context	Artifact Type
115	Alibates Chert	N133.48 E98.20 Z100.36	Flake
117	Ogallala Quartzite	N133.53 E96.65 Z101.13	Flake
120	Petrified Wood	N133.88 E96.02 Z100.68	Flake
125	Petrified Wood	N133.03 E96.27 Z100.50	Core
133	Ogallala Quartzite	N133.85 E97.08 Z100.80	Flake
143	Alibates Chert	N131.94 E97.29 Z99.48	Flake
149	Unidentified Chert	Channel B Fill	Flake
151	Ogallala Quartzite	Channel B Fill	Flake
152	Ogallala Quartzite	Channel B Fill	Flake
163	Alibates Chert	N131.90 E91.14 Z101.434	Scraper
164	Ogallala Quartzite	N131.71 E91.13 Z101.434	Scraper
165	Alibates Chert	Surface	Spear Point
170/171	Unidentified Chert	Channel B Fill 1/8"	Shatter
170/171	Alibates Chert	Channel B Fill 1/8"	Flake
170/171	Alibates Chert	Channel B Fill 1/8"	Flake
170/171	Alibates Chert	Channel B Fill 1/8"	Flake
170/171	Alibates Chert	Channel B Fill 1/8"	Flake
179	Ogallala Quartzite	N129 E99 (99.20-99.10) 1/16"	Flake
182	Ogallala Quartzite	N130 E96 (100.70-99.90) 1/8"	Flake
184	Unidentified Chert	N130 E96 (99.90-99.80) 1/16"	Shatter
184	Unidentified Chert	N130 E96 (99.90-99.80) 1/16"	Shatter
190	Unidentified Chert	N130 E97 (99.50-99.40) 1/16"	Shatter
190	Ogallala Quartzite	N130 E97 (99.50-99.40) 1/16"	Flake
196	Alibates Chert	N130 E98 (99.20-99.10) 1/16"	Flake

Appendix B Continued: Description of lithic materials not associated with bison feature.

Cat#	Raw Material	Context	Artifact Type
196	Ogallala Quartzite	N130 E98 (99.20-99.10) 1/16"	Flake
196	Antlers Silicified Sandstone	N130 E98 (99.20-99.10) 1/16"	Flake
198	Unidentified Chert	N130 E98 (99.00-98.90) 1/16"	Shatter
201	Unidentified Chert	N130 E99 (99.20-99.10) 1/16"	Shatter
202	Antlers Silicified Sandstone	N130 E99 (99.10-99.00) 1/16"	Flake
204	Ogallala Quartzite	N130 E99 (98.60-98.50) 1/16"	Flake
205	Unidentified Chert	N130 E99 (98.80-98.70) 1/16"	Flake
205	Unidentified Chert	N130 E99 (98.80-98.70) 1/16"	Flake
206	Ogallala Quartzite	N131 E88 (103.11-102.91) 1/4"	Flake
209	Ogallala Quartzite	N131 E90 (102.81-102.61) 1/4"	Flake
210	Alibates Chert	N131 E90 (102.61-102.41) 1/4"	Flake
210	Unidentified Chert	N131 E90 (102.61-102.41) 1/4"	Flake
211	Unidentified Chert	N131 E91 (102.50-101.80) 1/4"	Flake
212	Ogallala Quartzite	N131 E91 (101.60-101.40) 1/4"	Flake
213	Unidentified Chert	N131 E91 (101.20-101.00) 1/4"	Flake
214	Ogallala Quartzite	N131 E92 (102.30-101.40) 1/4"	Flake
214	Alibates Chert	N131 E92 (102.30-101.40) 1/4"	Flake
215	Unidentified Chert	N131 E92 (101.40-101.20) 1/4"	Flake
217	Alibates Chert	N131 E93 (101.59-101.39) 1/4"	Flake
220	Ogallala Quartzite	N131 E94 (100.96-100.76) 1/4"	Flake
224	Ogallala Quartzite	N131 E96 (100.20-100.10) 1/8"	Flake
234	Alibates Chert	N131 E98 (99.40-99.30) 1/16"	Flake
235	Unidentified Chert	N131 E98 (99.20-99.10) 1/16"	Shatter
235	Unidentified Chert	N131 E98 (99.20-99.10) 1/16"	Shatter
237	Unidentified Chert	N131 E98 (99.00-98.90) 1/16"	Shatter

Appendix B Continued: Description of lithic materials not associated with bison feature.

Cat#	Raw Material	Context	Artifact Type
237	Unidentified Quartzite	N131 E98 (99.00-98.90) 1/16"	Shatter
238	Alibates Chert	N131 E98 (98.90-98.80) 1/16"	Flake
241	Unidentified Chert	N131 E99 (99.30-99.20) 1/16"	Shatter
244	Unidentified Chert	N131 E99 (99.00-98.90) 1/16"	Shatter
250	**Alibates Chert**	**N132 E96 (100.20-100.10) 1/16"**	**Flake**
255	Ogallala Quartzite	N132 E98 (99.50-99.0) 1/4"	Flake
257	**Unidentified Quartzite**	**N132 E98 (99.60-99.50) 1/16"**	**Shatter**
258	Alibates Chert	N132 E98 (99.50-99.40) 1/4"	Flake
259	**Ogallala Quartzite**	**N132 E98 (99.20-99.10) 1/4"**	**Flake**
259	**Ogallala Quartzite**	**N132 E98 (99.20-99.10) 1/16"**	**Flake**
259	**Ogallala Quartzite**	**N132 E98 (99.20-99.10) 1/16"**	**Flake**
268	**Alibates Chert**	**N133 E96 (100.70-100.60) 1/16"**	**Flake**
269	**Unidentified Chert**	**N133 E96 (100.60-100.50) 1/16"**	**Flake**
269	**Alibates Chert**	**N133 E96 (100.60-100.50) 1/16"**	**Flake**
272	Ogallala Quartzite	N133 E96 (99.90-99.80) 1/8"	Flake
272	Unidentified Chert	N133 E96 (99.90-99.80) 1/8"	Shatter
275	Ogallala Quartzite	N133 E97 (100.70-100.50) 1/8"	Flake
275	Ogallala Quartzite	N133 E97 (100.70-100.50) 1/8"	Flake
276	Unidentified Chert	N133 E97 (100.50-100.40) 1/4"	Flake
279	**Unidentified Chert**	**N133 E97 (99.80-99.70) 1/16"**	**Flake**
280	**Unidentified Quartzite**	**N133 E97 (99.40-99.30) 1/16"**	**Shatter**
282	**Unidentified Chert**	**N133 E98 (100.50-100.10) 1/16"**	**Flake**
283	Alibates Chert	N133 E98 (100.10-100.00) 1/8"	Flake

- Rows that are bold indicate that only a 1/4 of the unit was screened through 1/16" mesh.

Appendix C: Fauna material recovered from 1/4" screen

Cat	N	E	Level	Cancellous Bone	Cortical Bone	Tooth Fragment	Burnt Bone	Turtle Shell
207	131	89	Level 1 (103.067-102.567)				4	
208	131	89	Level 2 (102.567-367)		1		1	
210	131	90	Level 2 (102.612-102.412)		1			
211	131	91	Level 1 (102.50-101.80)		3		3	
212	131	91	Level 3 (101.60-101.40)		3		1	1
214	131	92	Level 1 (102.296-101.396)		2		1	
215	131	92	Level 2 (101.396-101.196)		4		2	
216	131	92	Level 4 (100.996-100.796)		3			
217	131	93	Level 2 (101.593-101.393)		1			
218	131	93	Level 5 (100.993-100.793)		1		2	
219	131	93	Level 1 (100.793-100.593)		1		2	
220	131	94	Level 3 (100.964-100.764)		1			
226	131	96	Level 8 (99.80-99.70)		5			
229	131	97	Level 2 (99.70-99.60)		4		1	
259	132	98	Level 8 (99.20-99.10)					1
260	132	99	Level 1 (99.80-99.70)		1	1		
261	132	99	Level 2 (99.70-99.60)		2	2		
262	132	99	Level 3 (99.60-99.50)					1
265	132	99	Level 10 (98.90-98.80)		1			
278	133	97	Level 8 (99.90-99.80)			1		
291	**133**	**99**	**Level 8 (99.40-99.30)**		**1**			
293	133	99	Level 11 (99.10-99.00)		1			

- Level in bold indicates the level has a provenience in common with the bison feature.

Appendix D: Fauna and historic material recovered from 1/8" screen

Cat#	N	E	Level	Cancellous Bone	Cortical Bone	Tooth Frag	Burnt Bone	Turtle Shell	22. Bul-let Shell
170/ 171	Ch.B	Ch.B	Channel Fill	1	35	2	2	2	1
182	130	96	Level 1 (100.70-99.90)		2				
183	130	96	Level 2 (100.00-99.90)		3	1	1		
187	130	96	Level 6 (99.60-99.20)		5				
221	131	96	Level 1 (100.70-100.40)		2				
223	131	96	Level 3 (100.30-100.20)		4				
224	131	96	Level 4 (100.20-100.10)						
225	131	96	Level 7 (99.90-99.80)		1				
228	**131**	**97**	**Level 1 (99.75-99.70)**		**1**		**1**		
230	131	97	Level 4 (99.50-99.40)				1		
231	131	97	Level 5 (99.40-99.30)		1				
248	132	96	Level 1 (100.90-100.40)		1			1	
267	133	96	Level 1 (101.50-100.70)		10		2	3	
268	133	96	Level 2 (100.70-100.60)		6		1		
269	133	96	Level 3 (100.60-100.50)		4				
270	133	96	Level 8 (100.10-100.00)		1				
275	133	97	Level 1 (100.70-100.50)		3		2		
284	133	98	Level 3 (100.00-99.90)				1		
289	133	99	Level 1 (100.60-100.00)					1	
294	129	99	Level 7 (98.90-98.80)		2				
295	129	99	Level 8 (99.80-99.70)		1		1		
296	129	99	Level 9 (99.70-99.60)		1				
298	133	98	Level 10 (99.30-99.20)		1				

- Level in bold indicates the level has a provenience in common with the bison feature.

Appendix E: Unidentified fauna materials recovered from 1/16" screen not associated with bison

Cat	N	E	Level	Cancellous Bone	Cortical Bone	Tooth Frag	Burnt Bone	Turtle Shell
173	129	98	Level 2 (99.40-99.30)		31			
174	129	98	Level 3 (99.30-99.20)		108		1	
175	129	98	Level 4 (99.20-99.10)		54			
177	129	99	Level 2 (99.40-99.30)		5			
178	129	99	Level 3 (99.30-99.20)	1	26			
179	129	99	Level 4 (99.20-99.10)		17	1		
180	129	98	Level 5 (99.10-99.00)		17			
184	130	96	Level 3 (99.90-99.80)		5			
185	130	96	Level 4 (99.80-99.70)		3			
186	130	96	Level 5 (99.70-99.60)		1			
190	130	97	Level 2 (99.50-99.40)	2	10		3	
191	130	97	Level 3 (99.40-99.30)				1	
194	130	98	Level 2 (99.40-99.30)	1	24		2	
195	130	98	Level 3 (99.30-99.20)		32			
196	130	98	Level 4 (99.20-99.10)	2	13			
197	130	98	Level 5 (99.10-99.00)		9			
198	130	98	Level 6 (99.00-98.90)	1	9			
200	130	99	Level 2 (99.40-99.30)		5	3		
201	130	99	Level 4 (99.20-99.10)		1			
202	130	99	Level 5 (99.10-99.00)				1	
205	130	99	Level 8 (98.80-98.70)		2			
204	130	99	Level 9 (98.60-98.50)					
223	**131**	**96**	**Level 3(100.30-100.20)**		**1**			
226	**131**	**96**	**Level 8 (99.80-99.70)**		**4**			

- Rows that are bold indicate only the northwest 1/4 of the unit was water-screened through 1/16" mesh.

Appendix E Continued : Unidentified fauna materials recovered from 1/16" screen not associated with bison feature.

Cat	N	E	Level	Cancellous Bone	Cortical Bone	Tooth Frag	Burnt Bone	Turtle Shell
227	131	96	Level 9 (99.70-99.40)		3			
229	131	97	Level 2 (99.70-99.60)		4		1	
234	131	98	Level 2 (99.40-99.30)		2		2	
236	131	98	Level 5 (99.10-99.00)		3			
237	131	98	Level 6 (99.00-98.90)		3			
238	131	98	Level 7 (98.90-98.80)		7			
240	131	99	Level 2 (99.40-99.30)	2	4		1	
241	131	99	Level 3 (99.30-99.20)		1		1	
242	131	99	Level 4 (99.20-99.10)		17			
243	131	99	Level 5 (99.10-99.00)		3		1	
244	131	99	Level 6 (99.00-98.90)		2			
246	131	99	Level 8 (98.80-98.70)		25		1	
247	131	99	Level 9 (98.70-98.50)		3		1	
249	**132**	**96**	**Level 4 (100.30-100.20)**				**1**	
252	**132**	**97**	**Level 8 (99.50-99.40)**				**1**	
256	**132**	**98**	**Level 2 (99.80-99.70)**				**3**	
258	**132**	**98**	**Level 5 (99.50-99.40)**				**1**	
259	**132**	**98**	**Level 8 (99.20-99.10)**		**1**	**1**	**7**	
261	**132**	**99**	**Level 2 (99.70-99.60)**		**1**			
266	**132**	**99**	**Level 11(98.80-98.70)**				**2**	
267	**133**	**96**	**Level 1 (101.50-100.70)**		**2**			
268	**133**	**96**	**Level 2 (100.70-100.60)**		**5**		**1**	
269	**133**	**96**	**Level 3 (100.60-100.50)**					
270	**133**	**96**	**Level 8 (100.10-100.00)**		**2**			

- Rows that are bold indicate only the northwest 1/4 of the unit was water-screened through 1/16" mesh.

Appendix E Continued: Unidentified Fauna materials recovered from 1/16" screen not associated with bison feature.

Cat	N	E	Level	Cancellous Bone	Cortical Bone	Tooth Frag	Burnt Bone	Turtle Shell
271	**133**	**96**	**Level 9 (100.00-99.90)**		**1**			
273	**133**	**96**	**Level 12 (99.70-99.60)**		**5**		**1**	
277	**133**	**97**	**Level 4 (100.30-100.20)**				**1**	
282	133	98	Level 1 (100.50-100.10)		3		1	
286	**133**	**98**	**Level 8 (99.50-99.40)**				**1**	
290	**133**	**99**	**Level 3 (99.90-99.80)**					**5**
292	**133**	**99**	**Level 9 (99.30-99.20)**				**1**	
297	129	99	Level 5 (99.10-99.00)		86			

- Rows that are bold indicate only the northwest 1/4 of the unit was water-screened through 1/16" mesh.

Appendix F: Identified fauna materials not associated with bison feature.

Cat	N	E	Level	Element	Species
82	131.1	98.05	99.37	1 Unid. Long Bone Fragment	Unknown
118	133.573	96.655	101.08	1 Left Scapula (Glenoid Portion)	Jack Rabbit
121	133.16	96.2	100.67	Fused Central/Fourth Carpal	Deer
122	133.35	96.02	100.73	1 Unid. Long Bone Fragment	Unknown
126	133.36	96.02	100.75	4 Unid. Bone Fragments	Unknown
134	133.18	97.35	100	1 Unid. Long Bone Fragment	Unknown
153	133.94	98.53	99.59	1 Unid. Long Bone Fragment	Unknown
157	133.5	99.7	99.38	1 Unid. Bone Fragment	Unknown
160	133.39	99.4	99.4	1 Charred Left Humerus	Turtle
175	129	98	Level 4 (99.20-99.10)	1 Femur/1 Unid. Bone Fragment	Gopher
180	129	98	Level 5 (99.10-99.00)	Unid. Long Bone Fragment	Unknown
183	130	96	Level 2 (100.00-99.90)	Unid. Vertebrae	Unknown
190	130	97	Level 2 (99.50-99.40)	3 Unid. Bone Fragments	Unknown
195	130	98	Level 3 (99.30-99.20)	1 Molar/1 Mandible/1 Unid. Bone Fragments	Coyote/ Jack Rabbit
196	130	98	Level 4 (99.20-99.10)	1 Vert. 2 Unid. Long Bone Fragments	Unknown
197	130	98	Level 5 (99.10-99.00)	Humerus/Ulna/7 Unid. Bone Fragments	Gopher
198	130	98	Level 6 (99.00-98.90)	1 Mandible/7 Unid. Bone Fragments	Gopher
198	130	98	Level 6 (99.00-98.90)	1 Unid. Incisor/1 Vert./15 Unid. Bone Fragments	Gopher
198	130	98	Level 6 (99.00-98.90)	1 Incisor, 7 Unid. Bone Fragments, 1 Mandible	Jack Rabbit
204	130	99	Level 9 (98.60-98.50)	24 Unid. Bone Fragments	Unknown
205	130	99	Level 8 (98.80-98.70)	Metapodial/Unid. Bone Fragment	Gopher
205	130	99	Level 8 (98.80-98.70)	Metopodial/5 Unide. Bone Fragment	Gopher
205	130	99	Level 8 (98.80-98.70)	Metapodial/2 Unid. Bone Fragments	Gopher
205	130	99	Level 8 (98.80-98.70)	Epiphysis Femur/1 Incisor/2 Unid. Bone Fragments	Jack Rabbit/ Gopher

Appendix F Continued: Identified fauna materials not associated with bison feature.

Cat	N	E	Level	Element	Species
205	130	99	Level 8 (98.80-98.70)	1 Unid. Vertebrae	Unknown
205	130	99	Level 8 (98.80-98.70)	2 Unid. Bone Fragments	Unknown
216	131	92	Level 4 (100.996-100.796)	1st Phalange	Deer
218	131	93	Level 5 (100.993-100.793)	1 first phalange	Coyote
220	131	94	Level 3 (100.964-100.764)	1 Premolar/, 1 Unid. Bone Fragment	Deer
222	131	96	Level 2 (100.40-100.30)	1 Mandible/1 Unid. Burnt Bone	Gopher
223	131	96	Level 3 (100.30-100.20)	2 Incisors	Unid.
227	131	96	Level 9 (99.70-99.30)	Epiphysis Thoracic Vert./2 Unid. Bone Fragments	Deer
227	131	96	Level 9 (99.70-99.30)	3 Incisors/1 Vert. Fragment	Gopher
234	131	98	Level 2 (99.40-99.30)	3 Incisors/4 Unid. Bone Fragments	Gopher
235	131	98	Level 4 (99.20-99.10)	1 Unid. Bone Fragment	Unknown
236	131	98	Level 5 (99.10-99.00)	1 Vert. Fragment/1 Unid. Bone Fragment	Unknown
237	131	98	Level 6 (99.00-98.90)	1 Unid. Bone Fragment	Unknown
238	131	98	Level 7 (98.90-98.80)	1 Mandible	Kangaroo Rat
240	131	99	Level 2 (99.40-99.30)	3 Incisors/4 Unid. Bone Fragments	Gopher
241	131	99	Level 3 (99.30-99.20)	5 Incisors, 4 Unid. Bone Fragments, 2 Mandibls	Gopher
245	131	99	Level 7 (98.90-98.80)	1 Incisor	Unknown
247	131	99	Level 9 (98.70-98.50)	1 Incisor/1 Unid. Bone Fragment	Unknown
247	131	99	Level 9 (98.70-98.50)	2 Incisors/1 Vert. Fragment/4 Unid. Bone Fragments	Gopher
248	132	96	Level 1 (100.90-100.40)	1 Burnt Ulna/4 Unid. Bone Fragments	Jack Rabbit
251	132	97	Level 7 (99.60-99.50)	Mandible Tooth Row	Gopher
263	132	99	Level 7 (99.20-99.10)	1 Unid. Vertebrae Fragment	Unknown
275	133	97	Level 1 (101.10-100.50)	1 Unid. Molar/1 Unid. Bone Fragment	Deer
281	133	97	Level 14 (99.30-99.20)	1 Unid. Long Bone Fragment	unknown
282	133	98	Level 1 (100.20-100.10)	1 Unid. Incisor/1 Unid. Bone Fragment	Unknown
283	133	98	Level 2 (100.10-100.00)	1 Unid. Long Bone Fragment	Unknown
284	133	98	Level 3 (100.00-99.90)	1 Burnt Unid. Bone Fragment	Unknown
285	133	98	Level 6 (99.70-99.60)	3 Unid. Long Bone Fragments	Unknown