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ADAPTATION DURING THE ANTELOPE CREEK PHASE: A DIET BREADTH AND SITE CATCHMENT ANALYSIS OF THE SUBSISTENCE STRATEGY AT THE TWO SISTERS SITE

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in partial fulfillment of the requirements for the

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By

MARJORIE ANN DUNCAN

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OF THE SUBSISTENCE STRATEGY AT THE
TWO SISTERS SITE

A Dissertation APPROVED FOR THE
DEPARTMENT OF ANTHROPOLOGY

BY

Susan Vehik

R. A. Bailey

Lesley Rankin Hill

Don G. Wyckoff

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ABSTRACT

This study examines the subsistence strategies of the inhabitants of the Two Sisters site (34TX32), a Late Prehistoric period homestead of the Antelope Creek phase in the Oklahoma panhandle. Excavations in 1972 and 1973 revealed a four-room stone-slab house superimposed over a single-room adobe structure. Radiocarbon dates for the site are A.D. 1327-1440. By examining the artifact assemblage, which consists of over 99,000 items, in context with the climate, landscape, availability of floral and faunal resources, internal proximity of items to each other, and differentiation among these items, a picture of the daily activities of the inhabitants and their subsistence activities emerges. Site catchment and diet breadth (prey choice) models are used as a theoretical backdrop from which to examine the site. The result of this analysis is the story of a people who practiced limited horticulture that was constrained by an arid environment, forcing them to forage for wild plant foods to supplement their primary subsistence resource of bison. As bison hunters, they initially located their permanent dwelling in an area rich with prey, near water, and with ample wild plant foods. This location provided sufficient resources for some time; however, these people abandoned the central-place strategy and became nomadic bison hunters, probably in response to diminishing floral and faunal resources in the area surrounding the site. Migrating herds, drought, and over-harvesting of floral resources may have contributed to this change in lifestyle.

CHAPTER 1

INTRODUCTION

Archaeology is a scientific method of trying to piece together the story of a group of forgotten people known only by the items that they have left behind. Consequently, we must closely examine the artifacts and debris left by these individuals and try to develop clues about how they may have lived within their environment. Objects intentionally crafted along with evidence of diet and shelter construction point to a lifestyle. We will probably never know the ideological view of these people; however, we can, through extensive analysis of the physical remains, gain some insight into more fundamental aspects of their existence. Each object associated with the patterns of daily behavior tells a part of a larger story. Viewed through the lense of evolutionary ecology, all of the recovered objects coalesce into a story of survival. It is this story that the present study will try to tell.

Many things are involved in survival: food, water, shelter, tools, fire, and a group dynamic that adjusts to external demands of climate, availability of food, and scarcity or plentitude of resources. No single feature of this dynamic interplay will suffice as an explanation. Instead, all of these factors must be examined in relation to the entire spectrum of life within environmental constraints. Human beings do not exist in abstraction but are integrated within their world and, as such, must continually face the demands of that environment. The study of this dynamic relationship can be seen scientifically as subsistence strategy.

In order for a group of people to survive, they must develop a shared understanding of the basic approaches to everyday life. These behavioral patterns become the glue that holds a group together and allows them to work toward the common goal of survival. Without such a group dynamic, these people would not be able to meet the challenge necessary to obtain food, construct shelters, and conduct the necessary activities to stay alive. The kinds of shelters, tools, and floral and faunal remains can be tracked by archaeologists. All are pieces of a larger system that, when analyzed in terms of subsistence strategy and environmental reconstruction, reveal an overall pattern of behavior that can point toward a deeper understanding of human existence within environmental constraints.

The present study is concerned with identifying subsistence and settlement patterns of a Late Prehistoric period site in the Oklahoma panhandle. The site is known as the Two Sisters site (34TX32) and is northeast of Guymon, Oklahoma (Figure 1.1). Occupied about 600 years ago, the inhabitants of this site left clues about their lives and how they changed through time from their initial occupation in the late fourteenth century until they abandoned the site altogether in the early fifteenth century.

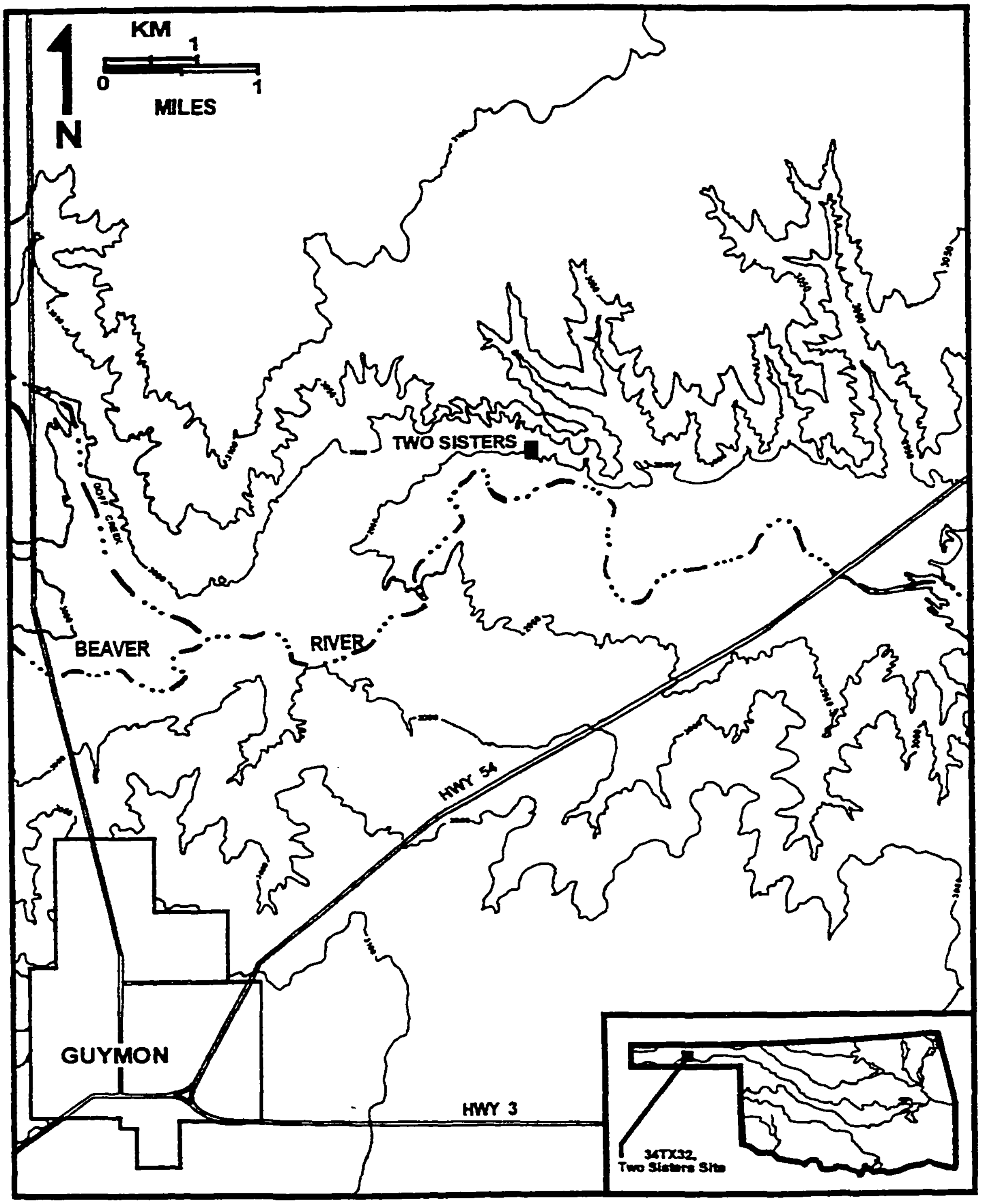


Figure 1.1. Location of the Two Sisters Site, 34TX32.

Collectively, sites in the geographic area of the Oklahoma and Texas panhandles that date between about A.D. 1200 and 1450 are referred to as the Antelope Creek phase. Antelope Creek phase subsistence orientation and material remains are similar to Plains Village tradition complexes. Architecturally, however, houses are more similar to the Southwestern pueblos. The people who comprised the Antelope Creek phase are considered hunter-gatherer-horticulturalists. Unfortunately, few published reports exist about sites on the northern periphery of the Antelope Creek phase in the present-day area of the Oklahoma panhandle.

Previous archaeological excavations and published reports in this area are limited to only a few sites - 34TX1, the Stamper site (Watson 1950), 34TX31, the McGrath site (Lintz 1976), and 34BV14, the Roy Smith site (Schneider 1969). The Stamper site is about 6 km east of the Two Sisters site and is on the southern terrace of the Beaver River. It represents a large village with 18 separate stone slab structures and is roughly contemporaneous with Two Sisters. McGrath is about 0.5 km west and may be part of Two Sisters, although Lintz (1976:2) elected to record them as separate sites. The McGrath site consists of hearths, a storage pit, trash deposits, and cobble concentrations. If a structure was ever present, it was completely removed during construction of the modern county road. About half way between the McGrath and Two Sisters sites, a pit feature was noted eroding out of the south half of the county road. The Roy Smith site is about

48 km east of Two Sisters and is a single, five contiguous room structure dating slightly earlier (about A.D. 1220 to 1260) than Two Sisters.

All of these sites share certain characteristics, leading to the likelihood that there was a connection between the various groups of people who occupied them. First, they are all within the area occupied by the Antelope Creek phase of the Plains Village tradition. Other indications that these sites are related include consistencies in architecture, geographical location, tool types, and floral and faunal remains.

Because there has not been much interpretive analysis of subsistence from these Oklahoma sites, this study will incorporate an evolutionary ecological approach to studying the Two Sisters site. Using diet breadth and site catchment models, hypotheses about behavioral decisions will be tested. According to these models, human interaction with the natural and social environment shapes behavioral decisions about food choices and site locations; consequently, close analysis of the evidence left by the prehistoric site occupants hints at their behavior, beliefs, and adaptations.

In order to address the problem of subsistence and settlement strategies used at the Two Sisters site, I begin by reconstructing the natural environment within which these inhabitants lived. Chapter Two describes the physical landscape including geology, soils, hydrology, and climate. Paleoclimatic reconstructions are presented, providing modeled estimates of precipitation and temperature. Based on this environmental reconstruction, floral and faunal resources that may have been available to prehistoric people are evaluated.

Chapter Three reviews the culture history of the area that outlines the cultural and historical foundation from which the Antelope Creek phase emerged. Prehistoric people have left traces of their lives in this region for the past 12,000 years. Beginning with the Paleoindians and continuing through the Protohistoric period, people have survived in this High Plains environment. How they have used the land and their various adaptations through time are developed.

A theoretical approach based on evolutionary ecology is the subject of Chapter Four. This approach was selected because it combines interaction between the environment, natural selection, and human behavior into a single theoretical model. Explanations about human behavior and human adaptation are measured against two models based on evolutionary ecological theory: diet breadth and site catchment. Diet breadth is used to make inferences about the ranking of prey in resource exploitation. Three site catchment models are constructed to examine horticultural soils, lithic resources, and floral and faunal environments. From these, suggested resource use is hypothesized and inferences about subsistence strategies and landscape use are suggested.

Chapter Five outlines the site history and excavation methodology.

The Two Sisters site was excavated nearly 30 years ago during two summer field schools. Excavations were completed using a variety of archaeological approaches. Some of the site was excavated by room, similar to excavations during the 1970s in the Southwest. Other strategies included excavation by trenches, features, and 1.5 by 1.5 m (5 by 5 ft) test units. Chapter Five summarizes how the site was excavated and defines the various features recorded and their contents.

A full description of the recovered materials is the subject of Chapter Six. A total of 99,182 items were washed and catalogued and are described by category (stone, clay, bone, shell, floral, and historic). The presentation of these data detail the variability of materials used and probable food items consumed by the prehistoric site occupants. These data also provide the basis for inference about human adaptation and environmental stress.

Chapter Seven applies theoretical models of diet breadth and site catchment to the recovered material assemblage. For the diet breadth model, the actual mix of sampled faunal remains and corresponding estimated calories provided are linked with suggested ranking of subsistence prey. Further, hunting tools, floral remains, and horticultural tools are discussed as they relate to this model. In addition, site catchments as outlined in Chapter 4 are applied to the data, resulting in estimated corn yields, targeted lithic resources, and floral and faunal exploitation by habitat type.

Chapter Eight provides a summary of subsistence strategies and settlement decisions used by people at the Two Sisters site. Adaptation to the environment and utilization of the resources available within it are viewed from the perspective of the recovered site assemblage. The inhabitants of the Two Sisters site appear to have changed their subsistence practices and settlement patterns through time in response to changing environmental conditions.

Based on a close examination of diet breadth, site catchment, natural environment, culture history, site history, excavation methodology, analysis of physical remains, and evaluation of this information against the evolutionary ecology model, a closer approximation of the subsistence strategies of the occupants of the Two Sisters site will be proposed. <u>The guiding hypothesis of this study is as follows</u>: If the occupants of the Two Sisters site were "optimal foragers," then (1) the remains found, seen in relation to the basic theoretical model, will describe their subsistence strategy, which (2) will be consistent with the information about the environment, climate, and site location. If this hypothesis proves reasonable, then a more general picture of the occupants of the Two Sisters site can be drawn.

Results from this study can be used in future research to examine peripheral sites for similarities and differences. As a part of the ongoing scientific study of the Antelope Creek phase, the Two Sisters site is paradigmatic of a subsistence strategy that, from the extent of physical remains, was an effective behavioral response to the environment. It is this deeper understanding of a subsistence strategy that can enhance the scientific understanding of this prehistoric period.

CHAPTER 2

ENVIRONMENTAL BACKGROUND

In order to understand the Antelope Creek phase population, and more specifically the Two Sisters site, it is necessary to reconstruct the natural setting within which these people lived. Environmental conditions such as physiography, geology, soils, hydrology, and climate interact and influence the types of plants and animals in an area. These conditions in turn affect human behavioral adaptations. Because the distribution of natural resources directly impacts subsistence and settlement patterns adopted in a region, the environmental setting is critical to our understanding of these people.

Physiography

Physiography is the physical landscape of an area. The Southern High Plains are traditionally divided into two parts: the northern area (north of the Canadian River) and the southern area or Llano Estacado. This physiographic region is part of the Great Plains, as defined by Webb (1931:34), and includes the Texas and Oklahoma panhandles, eastern New Mexico, southeastern Colorado, and parts of western Oklahoma and southwestern Kansas. The northern extent is generally considered to be the Arkansas River in Kansas and the southern boundary the Rio Grande River in south Texas. The Rocky Mountain foothills demarcate the western extent of the Southern High Plains and the eastern margin is marked by the erosional caprock escarpment in the Texas and Oklahoma panhandles. This eastern escarpment grades into the lower prairies of the Osage Plains in western Oklahoma and Texas.

Texas County in the center of the Oklahoma panhandle is in the northern portion of the Southern High Plains. It comprises about 3323 km^2 (Schoff 1939:7). The county is comparatively flat and relatively level with a maximum relief of not more than 60 m between the highest upland and deepest valley. The terrain gradually slopes from west to east with a decrease in elevation from about 1143 to about 823 m above sea level or a slope of about 3.3 m/km (Gould and Lonsdale 1926:8-9). This flat terrain has occasional depressions or playa lake basins that fill with water after heavy rains and a few minor spring-fed tributaries to the east-flowing Beaver River. The Beaver River might more accurately be called a stream because during dry periods it "may dwindle until it is represented by a succession of shallow pools connected by the merest threads of water. During periods of more abundant rainfall, the stream may fill its channel from bank to bank, covering in some instances, a distance of several hundred yards" (Gould and Lonsdale 1926:9). The only permanent tributaries to the Beaver River are Coldwater, Hackberry, and Palo Duro creeks. Intermittent creeks are South Fork, North Fork, Tepee, Goff, and Pony creeks (Schoff 1939:19).

The Beaver and its tributaries only drain one-fourth to one-third of Texas County. The rest of the county is upland flats with no exterior drainage. Precipitation in these areas forms temporary ponds and small lake basins where rainfall accumulates and either evaporates or percolates down into the ground water reservoir (Schoff 1939:20).

Geology

Geologic formations found in Texas County can be broadly associated with four geologic periods: Permian, Triassic, Tertiary, and Quaternary (Branson and Johnson 1972:4). According to Gould and Lonsdale (1926:21), the Permian and Triassic are exposures of red beds while the Tertiary generally consists of unconsolidated sandstone. The Quaternary is represented by wind-blown sand and stream bottom alluvium. The primary formations are Permian Cloud Chief Formation, Pliocene Ogallala Formation, and more recent alluvium and dune sands (Schoff 1939:40-41). These are of sedimentary origin and range in age from the oldest of about 300 million years ago to recent sand dunes and alluvial deposits.

In Texas County, the oldest exposed rocks are Permian Series red beds classified as the Cloud Chief Formation. These deposits consist of red shale or clay with thin lenses of sandstone and minor amounts of gypsum. The only area of the county where the formation outcrops is the southeastern region along Palo Duro, Chiquita, and Hackberry creeks. In this area the formation reaches a maximum thickness of 21 m (Schoff 1939:45-47).

The red bed Triassic age materials are composed of red, yellow, and gray clays and sandstones. Their exposure is limited in Texas County. Outcrops have been recorded west of Guymon on the Beaver River and along Tepee Creek and its tributaries (Schoff 1939:48).

The Ogallala Formation of the late Tertiary age covers most of Texas County. It is composed of unconsolidated calcareous sands, clays, silts, and gravels and is often capped by a layer of caliche or calcium carbonate. The unconsolidated part of the formation below the water table is saturated with water and forms a water reservoir known as the Ogallala aquifer. The Ogallala Formation was deposited about 10 million years ago by fluvial sedimentation from the Rocky Mountains (Kromm and White 1992:15). It ranges in thickness from less than a meter to over 152 m depending on location. Along drainages it has eroded to a thin layer, whereas in uneroded uplands in the northern part of the county, it exceeds 152 m in thickness (Kromm and White 1992:7; Schoff 1939:40, 62-63). Alluvial deposits of Quaternary age are found along the Beaver River and its tributaries. These deposits consist of sands, silts, clays, and gravels in river and stream bottoms and their flood plains. Generally, they are made up of debris from the Ogallala Formation but also include some older sediments. These deposits continue to be moved by streams and to change both through amalgamation and deterioration (Schoff 1939:86).

Dune sands overlay the Ogallala Formation in the eastern and northern parts of Texas County. These eolian deposits consist of "fine- to medium-grained quartz sand heaped by the wind into small but steep hills, and attain a maximum thickness of about 25 feet" (Schoff 1939:88). The sands are derived from alluvial flood plain deposits and are considered of Quaternary age.

Soils

The possibility of horticulture is restricted by the viability of soil. Consequently, an examination of soils in Texas County must be conducted to establish the possibility that the inhabitants of Two Sisters practiced horticulture.

The development and composition of soils and, by extension, their agricultural potential depends on several factors. These factors include characteristics of their parent geological materials, climate of the area, plants and animals living in and on the soil, relief and topography of the area, and length of time that the soil has developed. The active components within soil formation are climate and vegetation. Precipitation, temperature, and air movements impact the vegetative cycle of growth and decay and interact with natural weathering of rock in soil formations. From these interacting factors, combined with relief and time, soils develop (Meinders et al. 1961:44). Soil scientists examining soil and considering these properties classify soils into a hierarchical taxonomic system of orders, suborders, associations, and series.

Mollisols are the primary soil order found in Texas County and are generally dark colored and base-rich soils that support grasslands (Gray and Roozitalab 1976:4-5; Soil Survey Staff 1975:271). Subsurface horizons or layers usually contain high amounts of calcium carbonate and are identified as calcic horizons (Holliday and Goldberg 1992:249; Soil Survey Staff 1975:271). According to Gray and Roozitalab (1976:5), "the presence of high base saturation and abundant calcium indicate that these soils are developed in subhumid to semiarid climatic zones where the leaching of bases is slow or impossible." In areas where Mollisols predominate, moisture, although low, is enough to support perennial grasses (Soil Survey Staff 1975:271). Perennial grasses and an arid climate promote the formation of this soil order.

The Two Sisters site is within the Mansker-Potter-Berthoud soil association that has been described as the "caliche breaks" of Texas County (Meinders et al. 1961: 2-3). The soils in this association vary from clay loam to loam and are often formed over caliche. The Two Sisters site is on the Berthoud soil series of this association. This series is characterized by deep (generally about 30 cm thick), well drained, loamy soils that occur in Texas County along the foot slopes below escarpments. This moderately sloping loamy soil is friable and absorbs water easily. Beneath the 30 cm surface layer, the texture gradually changes to clay loam for the next 25 to 60 cm. The next layer ranges in texture from sandy loam to clay loam (Meinders et al. 1961:8). Berthoud soils are considered to be fairly poor because most of the moisture absorbed by the soil is not available to plants. Generally this soil type supports short grasses such as blue grama (*Bouteloua gracilis*) and buffalo grass (*Buchloe dactyloides*) and is not suitable for cultivation (Meinders et al. 1961:35). These soils are described as calcareous and include numerous small fragments of caliche. They reflect the parent material that is described as calcareous loamy sediments with fragments of rock and caliche. These colluvial "sediments were washed down from the escarpments or were deposited by streams during Tertiary time" (Gray and Galloway 1969:52; Meinders et al. 1961:8).

Adjacent to the Two Sister site and along the Beaver River the soil changes to the deep flood plain soils of the Sweetwater-Lincoln-Spur association. Within this association, the Sweetwater series of soils are poorly drained, dark bottomland soils generally about 15 to 40 cm thick. The surface soil is silty clay loam that grades into a sandy loam to fine sand at about 40 cm. At about a meter below the surface, there is a wet sandy layer. In many places, a layer of black wet clay is below this lens. Meinders et al. (1961:15) indicate that when the soil survey was conducted in Texas County in 1958, the water table was generally within about a meter of the surface in the summer and often at the surface during winter. Because

Sweetwater soils are subirrigated, they are very productive for some grasses, especially switchgrass (*Panicum virgatum*), eastern gama grass (*Tripsacum dactyloides*), and Canadian wild rye (*Elymus canadensis*), but generally not suitable for cultivation (Meinders et al. 1961:22,34).

The only soil near the site that would be desirable for cultivation and farming is the Spur soil found about 1.0 km downstream. Spur soils occur on the flood plains of the Beaver River and are commonly a clay loam to loam in texture. They are deep, dark, friable soils that are fairly level and easy to till. The parent material for these soils is calcareous, fine- and medium-textured, alluvial sediments (Meinders et al. 1961:14-15). If the occupants of the Two Sisters site were farming, Spur soil would have been the soil type used.

Hydrology and Water Distribution

In a semiarid environment, water is an important commodity, having a considerable impact on plants, animals, and human populations. Hydrology and water distribution, therefore, are key variables in human adaptation in the Oklahoma panhandle. Surface water in this area is derived from only a few sources - the Beaver River, seeps and springs that form tributaries to the Beaver River, and rain that is temporarily held in playa lakes.

The Beaver River is a permanent river that originates in the foothills of the Rocky Mountains. It is fed by numerous tributary streams, snow melt, and surface runoff. Although today it is only an ephemeral stream, the width of the river valley affirms that it carried a much greater volume of water in the past. Spring thunderstorms and winter snow melt in the mountains would have affected the volume of water causing drastic seasonal fluctuations in the river.

Probably the most stable source of water in this region is from the spring-producing ground water aquifer. The Ogallala aquifer is an underground lake that is fed or recharged by rainfall and runoff from the Rocky Mountains. Because it is dependent upon precipitation, fluctuations in rain may significantly impact the discharge rate of the aquifer springs. Seeps or springs occur where the aquifer is near the ground surface and excess water is released. During a drought, water discharged from the aquifer springs can vary "depending upon their locations relative to the ground water source (i.e., whether they emerge from the top or bottom of an aquifer)" (Boyd 1997:21). Some springs or seeps in this area may have dried up while others may have continued to flow at the same or at a reduced rate.

In addition to the river and aquifer, other sources of water are water-holding basins called playas. These are shallow, usually circular, basins that are lined with a thick layer of impermeable clay. Because of the clay lining, they are internally drained and may hold water for extended periods of time after rainy seasons (Gustavson et al. 1995; Steiert 1995). According to U.S. Geological Survey topographic maps for the area, 19 small playas are within 5 km of the Two Sisters site. These may have provided a seasonal water source for migratory and mobile prey.

For the occupants of the site, all of these resources - the river and its tributaries, aquifer springs, and playa lakes - were critical factors in settlement location decisions. Building their houses near the Beaver River and several nearby springs indicates that these were their most dependable sources of water. Water must be available not only for the human population, but also for the numerous interdependent species of plants and animals upon which these people subsisted. Water resource areas would, therefore, have been highly exploitable areas for hunting and gathering.

Climate

Understanding the climate during the occupation of the Two Sisters site is a fundamental component that shapes our knowledge of subsistence behavior. Information about precipitation, temperature, evaporation, and the seasonality of these attributes, linked with properties of the wind-field and effective solar radiation, is necessary to interpret the past environment of this region.

The climate in Texas County is semiarid with relatively low precipitation, low humidity, and high evaporation. Three air masses affect the climate: dry air from the Pacific, cool air from the Arctic, and humid air from the Gulf of Mexico. Episodes of cold dry Arctic air from the northern polar jet stream impact winter weather. Seasonally, the region is subject to either hot, dry air from the desert southwest or moist air from the Gulf of Mexico. These conditions depend on the magnitude, location, and strength of atmospheric circulations. In addition, the Rocky Mountains are an important influence on the climate in the Oklahoma panhandle. Because they form a barrier to dominant westerly winds of the upper atmosphere, a trough of low air pressure is formed at lower elevations east of the mountains. This "lee trough" causes southerly surface winds to intensify, reducing the amount of precipitation received from the west (Johnson and Duchon 1995:10). Seasonally, these different air masses converge and result in violent thunderstorms.

On the average, Texas County only receives about 43 cm of rainfall per year (Meinders et al. 1961:54-55; Table 2.1). Most rainfall occurs during May through September. Precipitation often is unpredictable with spring thunderstorms generating high amounts of runoff. It is not uncommon for this area to experience droughts that vary in severity and then be followed by years of greater than normal rainfall (Johnson and Duchon 1995:13-14). The erratic nature and the unpredictable distribution of rain in terms of annual and long-term cycles is of fundamental importance to the human inhabitants.

Temperature is also a fundamental attribute in climatic reconstruction because it sets the boundaries of the growing season for an area. In central Texas County, the mean temperature is 56.6 ° F but ranges from a low mean of 34.3 ° F in January to a high mean of 79.6 ° F in July. These data are somewhat misleading because the absolute extremes range from a low of -19 ° F to a high of 109 ° F (Meinders et al. 1961:55). According to the Hooker weather station (National Climatic Data Center 2000), the average date of the first fall freeze is October twenty-fifth and the average date of the last spring freeze is April seventeenth. The growing season, therefore, currently averages 186 days. The temperature data, however, linked with the low amount and unpredictability of rain suggests that the area is horticulturally marginal.

Table 2.1. Temperature and Precipitation for Texas County.

Month	Daily Maximum Temperature °F (°C)	Daily Minimum Temperature °F (°C)	Mean Monthly Temperature °F (°C)	Mean Monthly Precipitation (mm)
January	83 (28)	-17 (-27)	34.3 (1.3)	8.1
February	86 (30)	-17 (-27)	38.7 (3.7)	13.7
March	93 (34)	-9 (-23)	45.7 (7.6)	20.0
April	98 (37)	8 (-13)	56.9 (13.8)	36.6
May	104 (40)	28 (-2)	64.6 (18.1)	65.3
June	109 (43)	38 (3)	72.4 (22.4)	59.2
July	108 (42)	41 (5)	79.6 (26.4)	59.7
August	109 (43)	41 (5)	77.8 (25.4)	55.1
September	104 (40)	30 (-1)	70.6 (21.4)	46.5
October	100 (38)	11 (-12)	58.3 (14.6)	34.5
November	89 (32)	-1 (-18)	45.2 (7.3)	16.8
December	85 (29)	-19 (-28)	35.5 (1.9)	14.7
Year	109 (43)	-19 (-28)	56.6 (13.7)	430.3

Note: Temperature and Precipitation based on a 45 year record from 1910 through 1955 from Goodwell Station, Texas County (Meinders et al. 1961:55).

Along with precipitation and temperature, evaporation is another critical element of the Southern High Plains climate that impacts horticultural production. In the Oklahoma panhandle, evaporation usually exceeds the mean annual precipitation making the area subject to drought. Lake evaporation is estimated at approximately 173 cm per year reflecting short to occasionally prolonged droughts (Johnson and Duchon 1995). Although there is increased precipitation during the growing season, higher summer temperatures offset the moisture causing the evapotranspiration rate to be extremely high. When this occurs, wild and domestic plants are heat-stressed due to the loss of water and may wither and die (Johnson and Duchon 1995:32).

Wind is also an important factor for climatic reconstruction and subsistence study. Wind data from the Hooker, Oklahoma, weather station (National Climatic Data Center 2000) indicates an average wind speed of 18.5 kph (Table 2.2).

Table 2.2. Wind Speed and Direction for Texas County.

Month	Average Wind Speed kph	Maximum Wind Speed kph	Wind Direction
January	15.9	85.0	NNW
February	19.5	93.3	NNW
March	19.0	73.2	N
April	21.1	84.5	N
May	19.8	87.0	N
June	20.8	127.6	S
July	18.3	106.2	S
August	17.7	68.9	S
September	19.3	82.9	S
October	16.3	76.6	NNW
November	16.1	73.7	SSW
December	18.5	80.3	N
Year	18.5	127.6	

Note: Compiled from Mesonet Climatological Data Summary for Hooker, Oklahoma, National Climatic Data Center (2000). Period of record October 1999 to September 2000.

Wind direction during the year is from the north 33.3%, from the south 33.3%, from the north northwest 25%, and from the south southwest 8.3%. During winter, wind speed impacts humans by making the actual temperature seem lower (wind chill factor). During the growing season, plants also are affected by the wind, because summer winds dry the soil and increase evaporation.

Another climatic factor that impacts plant growth and life is solar radiation. Solar radiation is the only source of atmospheric energy. It is the "ultimate cause of all changes and motions of the atmosphere, and the single most important control of climate" (Trewartha 1968:10). Because the amount of solar radiation absorbed by plants is directly linked with the angle of the rays hitting the earth, the degree of surface slope affects the amount of effective solar radiation. The Two Sisters site is on the north side of the Beaver River with a south-facing slope. Because of the tilt of the earth, south-facing slopes absorb more solar radiation than north-facing ones causing snow to melt faster and soil to warm earlier in the spring (Trewartha 1968:18).

Paleoenvironment

All these climatic factors aid in forming an interpretation of the past environment of the Two Sisters site. Direct paleoenvironmental data, however, is unavailable for Texas County during the fourteenth and fifteenth centuries - the time that Two Sisters was occupied. Because of this lack of information, environmental reconstructions and models must be pieced together and extrapolated from modern climatic data for the region and from paleoecological records preserved in the pollen and faunal remains from other datable prehistoric sites on the southern Plains (Bryson and Bryson 1996:6; Hall 1988; Wendland 1978).

Wendland (1978:281) suggests that, based on archaeological inferences from dietary habits and pollen data for various areas of the Great Plains, a cooler, drying phase begins about A.D. 1200. This phase is called the Pacific climatic episode. Hall (1988:208) agrees that the climate became dryer but believes that it began slightly earlier at about A.D. 1100. Vertebrate remains and soil development are used by Hall (1988:208-209) to infer a peak in arid conditions at A.D. 1500. Lintz (1986:244) suggests that drought conditions occurred during the fifteenth and sixteenth centuries in this area of the Southern High Plains but that it is unclear when the droughts became severe. From these data, researchers have suggested that the southern Plains environment was more arid during the Plains Village occupation than during the preceding Woodland occupation. Arid conditions would have impacted plants and animals as well as human populations.

Because various lines of climatic information have defined an arid climate for the occupation period of the Two Sisters site, understanding seasonal precipitation and temperature are important for making suggestions about plant growth. Domestic and wild plants, and humans and animals relying upon them, are all dependent upon certain climatic conditions. It is, therefore, necessary to introduce a new method of modeling the most likely climate in order to clarify resource composition.

Archaeoclimatic Modeling

Since knowledge about the prehistoric environment and possible drought conditions is critical to our understanding subsistence at the Two Sisters site, a high-resolution, site-specific climatic model, developed by Bryson and Bryson (1995), is applied. Their model takes into account Milankovitch cycles (orbital angles and solar output) and the changes in atmospheric transparency, caused by volcanic aerosols, to calculate glacial ice volume. This is then used to model annual latitudinal temperature gradients. In conjunction with modern atmospheric calibration data and geographic data, the positions of "centers of action," such as jet streams, subtropical high pressure systems, and the inter-tropical convergence zone, are calculated. Proxy data (e.g., palynological data, ash fall dates, glacial core data, oxygen isotope reconstructions, etc.) are incorporated in the model. Comparing these results with modern meteorological data provides estimated monthly mean values of temperature, precipitation, stream discharge, growing seasons, and vegetation potential for the area. Bryson and Bryson (1995) have used this information to devise a method they believe models past climatic conditions. Application of this model provides estimated environmental conditions of annual precipitation, temperature, evaporation, and stream flow rates of the Beaver River for the Two Sisters site.

Mean monthly temperature and precipitation from the Goodwell, Oklahoma, research station was used to suggest the possible water history for the area (Figure 2.1). Goodwell is about 26 km (16 mi) southwest of Two Sisters and the data used in the model are based on a 29 year record from 1961 to 1990. According to the model, between A.D. 1000 and 1400, the annual precipitation dropped from about 480 mm to about 470 mm. At first glance, this drop does not seem too significant. However, when viewed from the perspective of the growing season, the precipitation drops significantly during July and August. Without adequate moisture during those months, crops would have withered and died. In addition, modeled temperature differences between A.D. 1000 and 1400 show a cooling trend with an average annual temperature decrease of about 1°C from about 14°C to 13°C (Figure 2.2).

Modeled annual evaporation rates range from about 2686 mm at A.D. 1000 to about 2537 mm at A.D. 1400. These rates of evaporation significantly reduce effective precipitation for plant development and growth. Surprisingly, as Figure 2.3 shows, evaporation rates are slightly better during the growing season for the later time period. Modeled stream flow of the Beaver River also suggests that more water was flowing and available in A.D. 1400 than 400 years earlier (Figure 2.4).

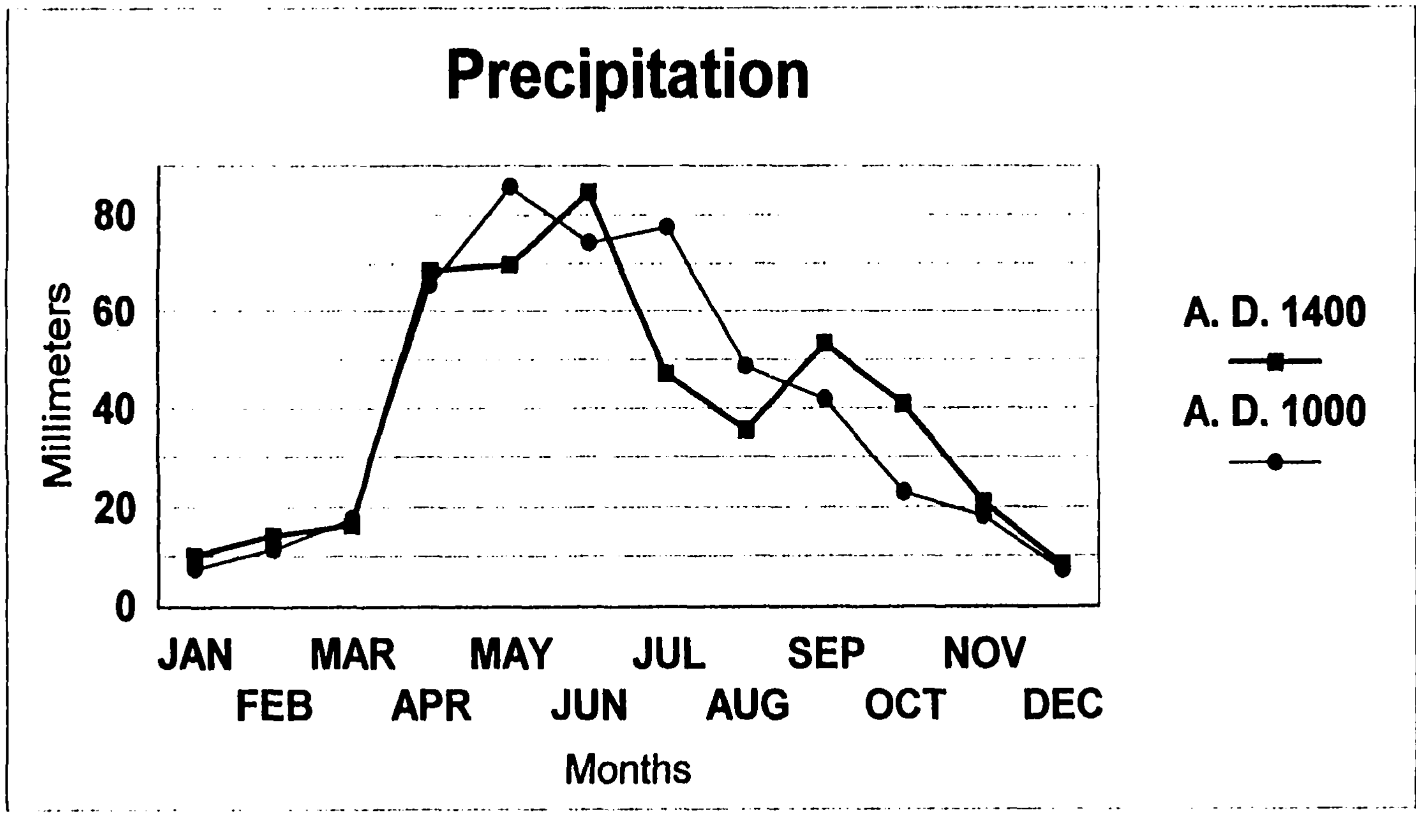


Figure 2.1. Modeled Precipitation at 34TX32.

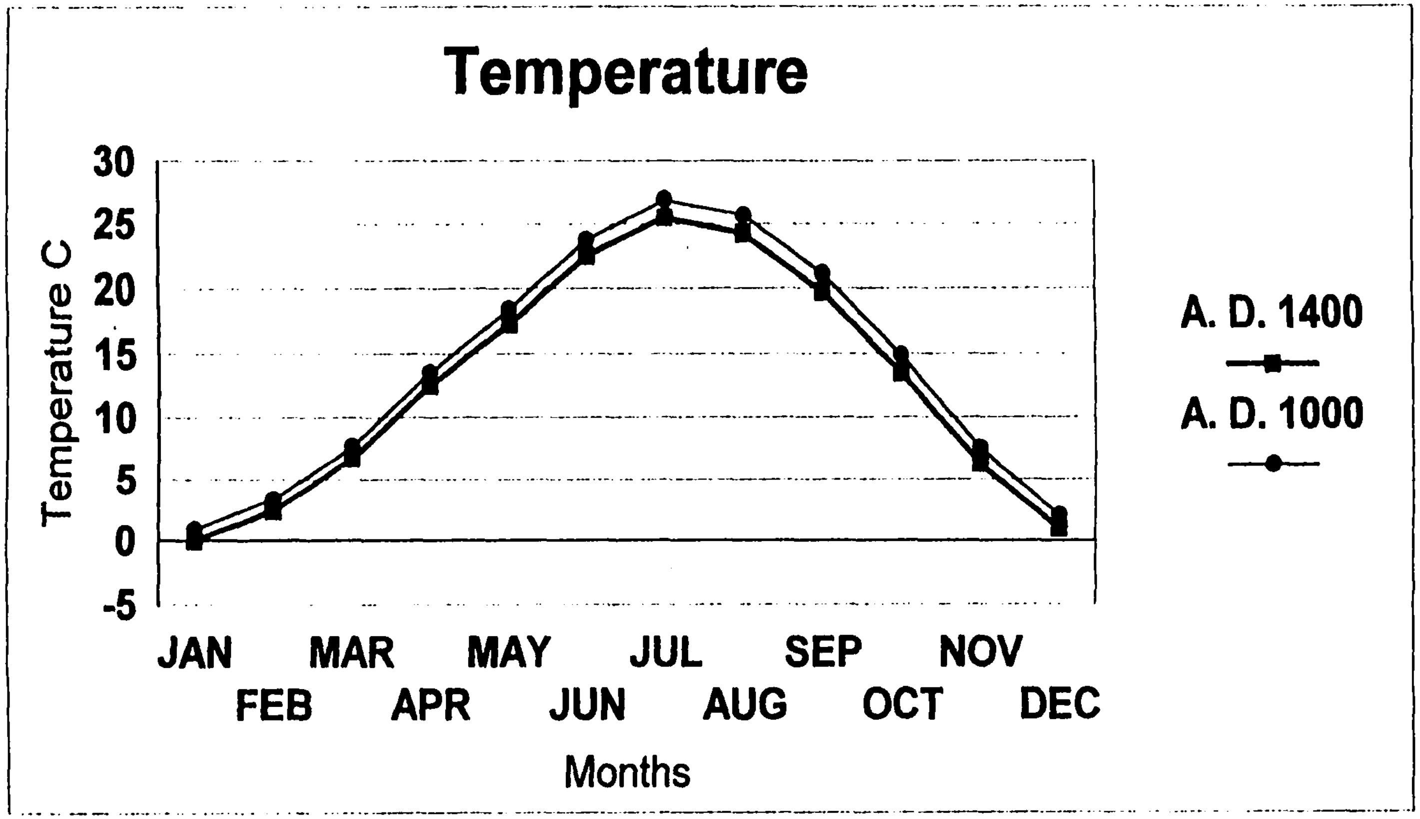


Figure 2.2. Modeled Temperature at 34TX32.

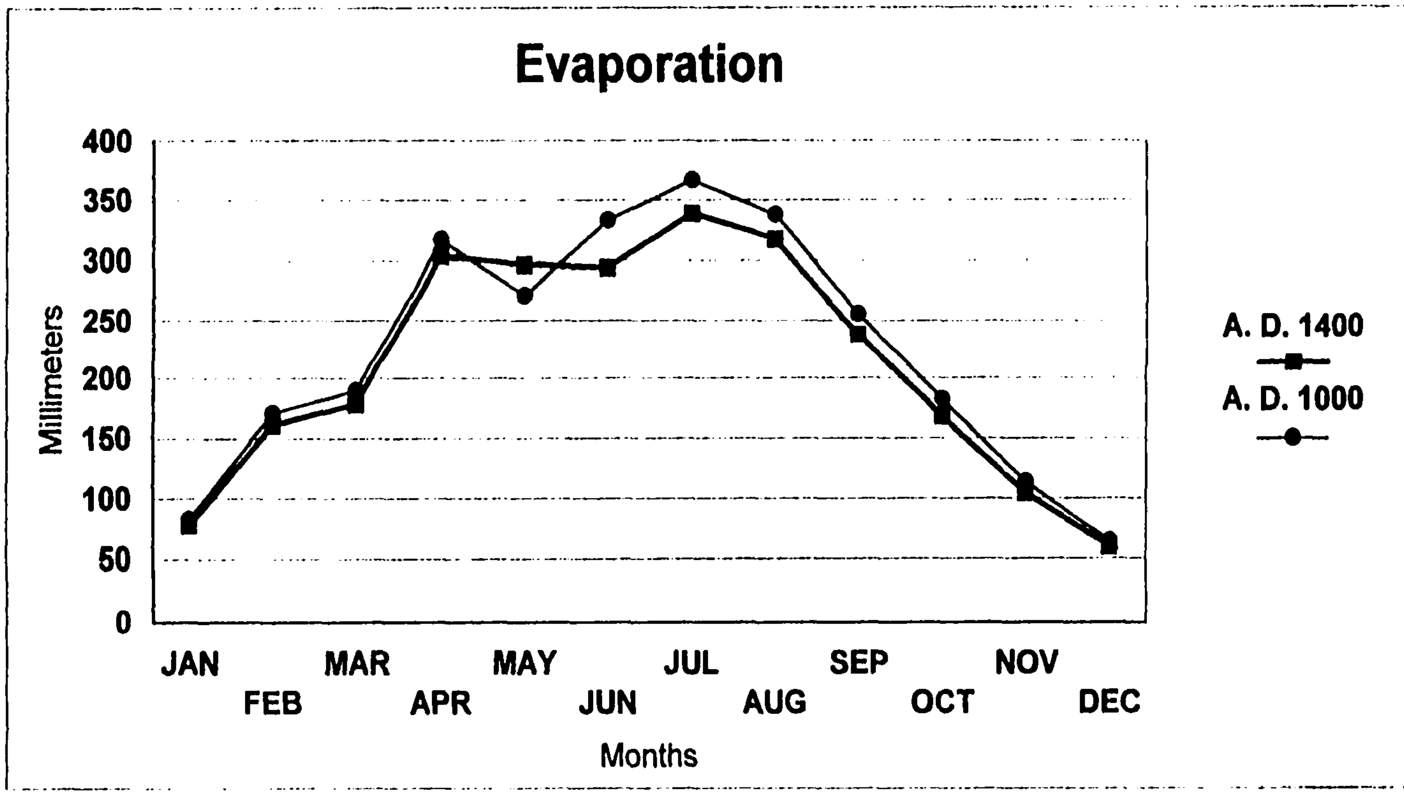


Figure 2.3. Modeled Evaporation at 34TX32.

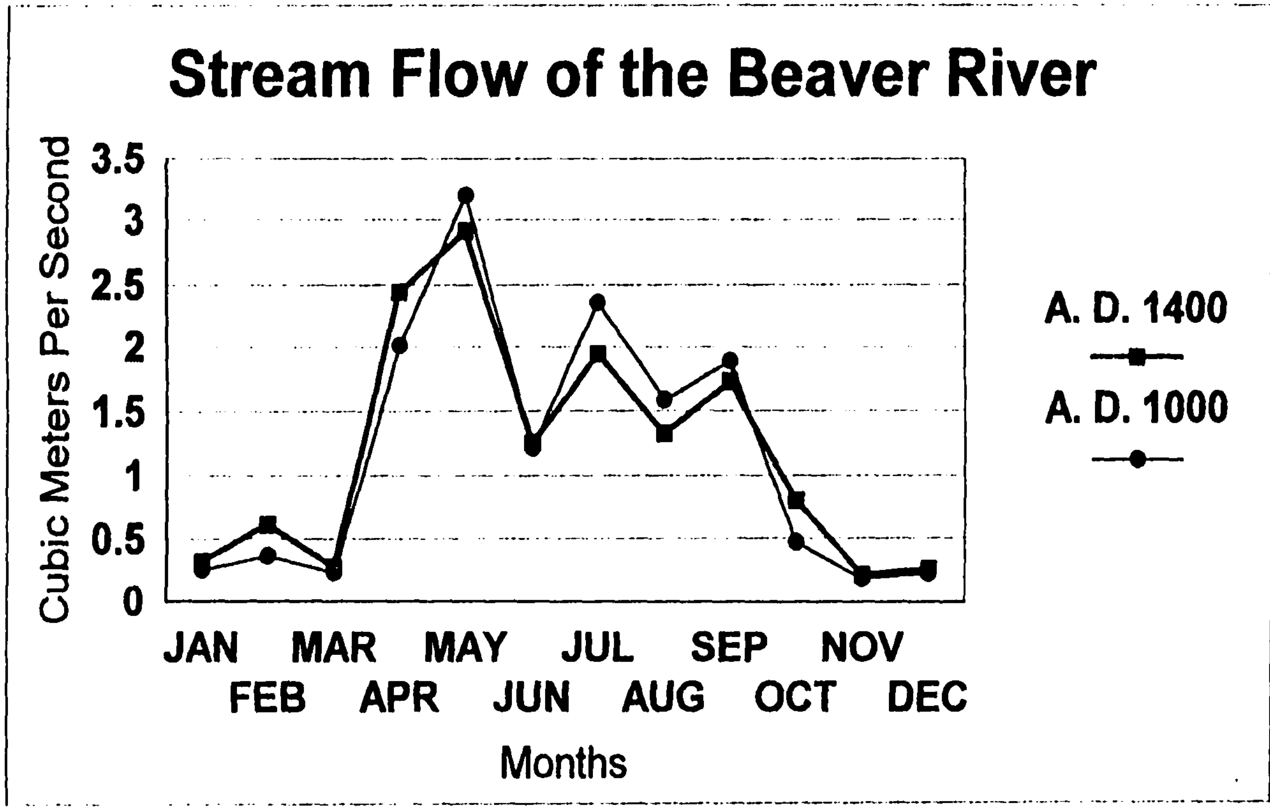


Figure 2.4. Modeled Stream Flow of the Beaver River Near 34TX32.

Each of these modeled variables - precipitation, temperature, evaporation, and stream flow - helps in understanding past climatic conditions at the Two Sisters site. Plant and animal life, not to mention human survival, is intrinsically a part of the environment in which it exists. If the environment was cooler throughout the year and drier during the summer months, vegetation patterns would have been altered to more drought-resistant species and horticulture would have been a less stable subsistence base. Because the modeled precipitation for A.D. 1400 suggests that rainfall was heaviest in April, May, and June, wild plants and grasses that germinate in the spring and early summer most likely out-competed the summer-growing species. According to Albertson and Tomanek (1965:717-720) and Albertson and Weaver (1944:398, 421), these would include western wheat grass (*Agropyron smithii)*, blue grama (*Bouteloua gracilis*), and sand dropseed (*Sporobolus cryptandrus*). Buffalo grass (*Buchloe dactyloides*) is not as drought resistant but increases with moderate grazing (Smith 1940:384-385). Changes in available wild plants and grasses would most likely result in increases of some dependent herbivores, e.g., bison. Because bison primarily eat drought-resistant plants such as blue grama, buffalo grass, and sand dropseed (Peden 1972:6-7), it is likely that bison would have been available. Therefore, by applying Bryson's climatic model to the data, useful information about possible plants and animals is revealed that helps in understanding these early people's subsistence patterns.

Flora and Fauna

An important aspect to consider in trying to model the environment is the availability of floral and faunal resources within a geographic region. In this section, potential plant and animal communities are identified for the prehistoric inhabitants of the area. Various topographic settings for this region of the Southern High Plains are also identified.

The Oklahoma panhandle region of the Southern High Plains is classified as a short-grass prairie and reflects three distinct topographic regions - Uplands, Breaks, and Bottomlands (Lintz 1976:4-7). Most of the area is considered Uplands. Separating the Uplands from the Beaver River and its tributaries (Bottomlands) are the Breaks. Because the modeled prehistoric climate suggests cool, arid conditions, floral and faunal communities, linked to the soils of the various topographic settings and available precipitation, are suggested. Tables 2.3 and 2.4 indicate the diverse matrix of plant and animal resources that prehistoric occupants may have used.

Table 2.3. Plants Potentially Used - Two Sisters Site (Kindscher 1987).

Species	Possible Habitat Type	Use	Season	Found in Archeological context
Allium canadense (Wild Onion)	Bottomlands	Edible bulb high in vitamins A and C, medicinal	Spring to early Summer	Yes
Amaranthus graecizans (Prostrate Pigweed)	Uplands, Breaks, Bottomlands	Edible plants and seeds	Spring, Summer, Fall (seeds)	Yes

Table 2.3 (continued).

Species	Possible Habitat Type	Use	Season	Found in Archeological context
Ambrosia trifida (Giant Ragweed, Buffalo Weed)	Breaks, Bottomlands	Edible seeds, medicinal, stalks for wind-breaks	Fall	Yes
Amorpha canescens (Leadplant, Tea Plant, Prairie Shoe-strings)	Uplands, Breaks	Leaves for tea, medicinal	Late Spring, Summer	No, but abundant across prairie in 1842
Apios americana (Groundnut, Wild potato)	Bottomlands	Edible tubers and seeds	all year	Yes
Astragalus crassicarpus (Ground plum Milkvetch, Buffalo Bean, Buffalo Pea)	Uplands, Breaks	Edible immature pods	Spring	No, but ethnohistoric use by Pawnee, Dakota, Omaha, and Ponca
Atriplex subspicata (Saltbush)	Uplands	Edible greens, shoots, and seeds, ashes of plant for leavening	Spring to Fall	No, but used by Southwest and Great Basin Indians and species extend into the prairies especially the shortgrass prairie
Callirhoe involucrata (Purple Poppy Mallow)	Uplands, Breaks	Edible roots and leaves, medicinal	Early Spring to Fall	Yes, but seeds only; fleshy plants not preserved
Chenopodium berlandieri (Lamb's Quarters, Goosefoot, Indian Spinach)	Breaks, Bottomlands	Edible leaves and seeds high in calcium and vitamins A and C	Spring to early Winter	Yes
Cirsium undulatum (Wavy-leafed Thistle)	Uplands, Breaks	Edible leaves, stalks, flowers, seeds, and roots	All year	No, but ethnohistoric accounts by Kiowa, Comanche, and Apache
Cleome serrulata (Rocky Mountain Bee Plant)	Uplands, Breaks	Edible leaves and seeds	Late Spring to Fall	No, but ethnohistoric accounts from Hopi, Tewa, Zuni, and Navajo

Table 2.3 (continued).

Species	Possible Habitat Type	Use	Season	Found in Archeological context
Comandra umbellata (Bastard Toadflax)	Uplands, Breaks	Edible fruits	Summer	No, but used by Indians in the Western United States
Coryphantha vivipara (Pincushion Cactus)	Uplands, Breaks	Edible fruit, flowers, plant	Summer	Yes
Cucurbita foetidissima (Buffalo Gourd, Wild Pumpkin)	Uplands, Breaks	Edible seeds and roots (roots can weigh up to 88 pounds), medicinal	Late Summer to Winter	No, but ethnohistoric accounts by Omaha, Osage, and Ponca
Dalea candida (White Prairie Clover)	Uplands, Breaks	Edible roots and leaves for tea, medicinal	Summer	No, but ethnohistoric accounts by Omaha, Ponca, Pawnee, Comanche, Lakota, and Kiowa
*Glycyrrhiza lepidota (*American Licorice*)*	Uplands, Breaks, Bottomlands	Edible roots, medicinal	Fall to Winter	No, but ethnohistoric accounts by Pawnee, Dakota, and Cheyenne
Helianthus annuus (Sunflower)	Breaks, Bottomlands	Edible fruits and flower buds, source of oil	Summer to Fall	Yes
*Ipomoea leptophylla (*Bush Morning Glory*)*	Uplands, Breaks, Bottomlands	Edible root (10-100 pounds each), seeds for visions (hallucin-ogenic)	Fall to Winter	No, but ethnohistoric accounts by Pawnee, Cheyenne, Arapaho, and Kiowa
Liatris punctata (Gayfeather)	Uplands, Breaks	Edible roots (extremely drought resistant)	Fall to Winter	No, but ethnohistoric accounts by Kiowa, Omaha, Ponca, and Osage
Lomatium foeniculaceum (Prairie Parsley)	Uplands, Breaks	Edible leaves and roots	Spring, Fall	No, but ethnohistoric accounts by Lakota and possibly Cheyenne

Table 2.3 (continued).

Species	Possible Habitat Type	Use	Season	Found in Archeological context
Opuntia macrorhiza (Prickly Pear)	Uplands, Breaks	Edible ripe fruit, pads, buds, flowers, and seeds	Summer to Fall	Yes
Physalis heterophylla (Ground Cherry)	Bottomlands	Edible ripe fruit	Late Summer to Fall	Yes
Proboscidea louisianica (Devil's Claw)	Bottomlands	Edible green fruit, seeds	Summer to Fall	No, but ethnohistoric accounts by Apache
Prunus americana (Wild Plum)	Bottomlands	Edible ripe fruit, extremely productive	Midsummer to Fall	Yes
Prunus virginiana (Chokecherry)	Bottomlands	Edible ripe fruit, kernels for pemmican, green sticks as skewers, bark for tea	Summer to Fall	Yes
Psoralea esculenta (Prairie Turnip)	Uplands	Edible roots	May to July	Yes
Rhus glabra (Smooth Sumac)	Breaks	Edible berries, roots, and shoots	Spring to Fall	Yes
Ribes odoratum (Buffalo Currant)	Breaks	Edible berries, leaves with meat or for tea; high in vitamin C	Summer	No, but ethnohistoric accounts from Kiowa, Cheyenne, Dakota, Omaha, and Ponca
Rosa arkansana (Wild Rose)	Breaks, Bottomlands	Edible fruit, shoots, leaves, stalks, and flowers; high in vitamin C	Spring, Fall	No, but ethnohistoric accounts by Cheyenne, Dakota, Omaha, and Ponca
Tradescantia occidentalis (Spiderwort)	Bottomlands	Edible stems, leaves and flowers	Spring to Summer	No, but ethnohistoric accounts by Dakota
Yucca glauca (Small Soapweed)	Uplands, Breaks	Edible flower stalk and petals, medicinal	Spring to Summer	Yes

Table 2.4. Fauna Potentially Used by Occupants of the Two Sisters Site.

Species	Possible Habitat Type
Mammals	
Antilocapra americana (Pronghorn)	Uplands, Breaks
Bison bison (Bison)	Uplands, Breaks
Canis latrans (Coyotes)	Uplands, Breaks, Bottomlands
Castor canadensis (Beaver)	Bottomlands
Cervus canadenses (Elk)	Breaks, Bottomlands
Citellus sp (Ground Squirrel)	Breaks, Bottomlands
Cynomys ludovicianus (Black-tailed Prairie Dog)	Uplands, Breaks
Didelphis marsupialis (Opossum)	Bottomlands
Dipodomys ordii (Ord's Kangaroo Rat)	Bottomlands
Erethizon dorsatum (Porcupine)	Breaks
Felis rufa (Bobcat)	Breaks
Felix concolor (Cougar)	Breaks
Geomys bursarius (Plains Pocket Gopher)	Breaks
Lepus californicus (Black-tailed Jackrabbit)	Uplands, Breaks
Mephitis spp. (Skunk)	Breaks
Odocoileus hemionus (Mule Deer)	Breaks
Odocoileus virginianus (White-tailed Deer)	Bottomlands
Ondatra zibethica (Muskrat)	Bottomlands
Procyon lotor (Raccoon)	Uplands, Breaks, Bottomlands
Sciurus niger (Eastern Fox Squirrel)	Bottomlands
Sylvilagus floridanus (Eastern Cottontail)	Breaks, Bottomlands
Taxidea taxus (Badger)	Uplands
Reptiles and Amphibians	
Chelydra serpentina (Snapping Turtle)	Uplands, Breaks, Bottomlands
Kinosternon flavescens flavescens (Yellow Mud Turtle)	Bottomlands
Natrix sipedon (Water Snake)	Bottomlands
Pseudemys scripta elegans (Red-eared Turtle)	Bottomlands
Rana catesbeiano (Bullfrog)	Bottomlands

Table 2.4 (continued).

Species	Possible Habitat Type
Reptiles and Amphibians	
Terrapene ornata (Western Box Turtle)	Uplands, Breaks, Bottomlands
Trionyx spp (Softshell Turtle)	Bottomlands
Fish	
Aplodinotus grunniens (Freshwater Drum)	Bottomlands
Ictalurus melas (Black Bullhead Catfish)	Bottomlands
Micropterus salmoides (Largemouth Bass)	Bottomlands
Birds	
Anas acuta (Pintail)	Upland Playas, Bottomlands
Anas discors (Blue-winged Teal)	Upland Playas, Bottomlands
Anas platyrhynchos (Mallard)	Upland Playas, Bottomlands
Anser albifrons (White-fronted Goose)	Upland Playas, Bottomlands
Aythya americana (Redhead)	Upland Playas, Bottomlands
Aythya collaris (Ring-necked Duck)	Upland Playas, Bottomlands
Aythya valisineria (Canvasback)	Upland Playas, Bottomlands
Branta canadensis (Canada Goose)	Upland Playas, Bottomlands
Bucephala albeola (Bufflehead)	Upland Playas, Bottomlands
Lophodytes cucullatus (Hooded Merganser)	Upland Playas, Bottomlands
Meleagris gallapavo (Wild Turkey)	Bottomlands
Olor buccinator (Trumpeter Swan)	Upland Playas, Bottomlands
Pediocetes phasianellus (Sharp-tailed Grouse)	Upland Playas, Bottomlands
Mussels (species not defined)	Bottomlands

The Upland Plains region covers about two-thirds of Texas County and for the most part has shallow soils overlaying a caliche caprock. Other areas of the Upland region are covered with deep sand dunes (Meinders et al. 1961:3-4). Plants in this topographic setting would have been limited by the availability of water and the shallow soil; therefore, plants that are fairly drought-resistant, should have been common in this type of locality. These would include blue grama (*Bouteloua gracilis*), hairy grama (*Bouteloua hirsuta*), and buffalo grass (*Buchloe dactyloides*). In areas of erosion, mid-grasses, such as western wheat (*Agropyron smithii,* also known as *Pascopyrum smithii*) and vine-mesquite (*Panicum obtusum*), probably occurred along with prickly pear cactus (*Opunta macrorhiza*). Within the Upland region around the playas, switch grass (*Panicum virgatum*), bluestem (*Andropogon gerardi*), sand sage (*Artemesia filifolia*), and yucca (*Yucca glauca*) are found today and may have been available to prehistoric groups (Blair 1950:111; Blair and Hubbell 1938:441; Bruner 1931:148-150; Lintz 1976:9).

Important fauna found in the Upland region during the Late Prehistoric period, according to Duffield (1970) and Lintz (1976:9-10), include bison (*Bison bison*), pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), black-tailed jack rabbit (*Lepus californicus*), coyote (*Canis latrans*), bobcat (*Lynx rufus*), black-tailed prairie dog (*Cynomys ludovicianus*) and western box turtle (*Terrapene ornata*).

Between the Upland and the Bottomland region is an area known as the Breaks. The Breaks are characteristically rough terrain formed by erosion. This unique feature encompasses about one-fourth of Texas County and is dissected by the river and its tributary streams that have cut through the underlying caliche, separating the flat High Plains from the level alluvial flood plains of the Beaver River. The Breaks region ranges from 1.5 km (1 mi) to about 13 km (8 mi) wide and occurs in bands along both sides of the Beaver River and the smaller streams and creeks (Meinders et al. 1961:2-3).

Plant communities within this region today are sparse but fairly uniform. Blue grama and bluestem grasses occur on the steep slopes below the caliche. Near the base of the slopes, the vegetation thickens and includes grasses, shrubs, and forbs. Some of these grasses and plants are blue grama, bluestem, sand sage, yucca, prickly pear cactus, wild sunflower (*Helianthus annus*), and ragweed (*Ambrosia trifida)*. Wind blown sand collects within areas of the breaks, and wild plum thickets (*Prunus americana*) and sage (*Salvia* spp) are important plants for this biotic environment (Blair 1950:110-111; Blair and Hubbell 1938:441; Bruner 1931:148-150; Lintz 1976:11). During the time that the Two Sisters site was occupied, these species were probably present, although in reduced numbers as a result of more arid conditions.

Like plant communities, some animals that occur in the Uplands are also found in the Breaks region. These include bison, antelope, mule deer, jack rabbits, bobcats, prairie dogs, and box turtles (Lintz 1976:11). Other characteristic fauna include elk (*Cervus canadensis*), cottontail rabbit (*Sylvilagus* spp), plains pocket gopher (*Geomys bursarius*), and Ord's kangaroo rat (*Dipodomys ordii*).

The Bottomland region is the riparian aquatic habitat of the river and streams. The alluvial soils forming the wide flood plain, confined oxbow lakes, marshes, and sloughs in this area support a wide variety of trees, shrubs, and grasses and would have provided a valuable source of wood, fruits, and nuts to prehistoric people. Common floral species include cottonwood (*Populus deltoides and P. sargentii*), willow (*Salix* spp), sumac (*Rhus* spp), elm (*Ulmus americana*), hackberry (*Celtis reticulata*), oak (*Quercus* spp), switch grass (*Panicum virgatum*), inland salt grass (*Distichlis stricta*), little bluestem (*Schizachyrium scoparium*), alkali sacaton (*Sporobolus airoides*), and common reed (*Phragmites communis*) (Blair 1950:110-111; Blair and Hubbell 1938:441; Bruner 1931:148-150; Lintz 1976:12, 1986:60-61).

Important mammals found in the Bottomland region include white-tailed deer (*Odocoileus virginiana*), beaver (*Castor canadensis*), coyote (*Canis latrans*), badger (*Taxidea taxus*), cottontail rabbit (*Sylvilagus* spp), muskrat (*Ondatra zibethica*), raccoon (*Procyon lotor*), opossum (*Didelphis marsupialis*), and skunk (*Mephitis mephitis*). In addition, various species of reptiles - box and softshell turtles, water snakes (*Natrix sipedon* spp) and both nonpoisonous and poisonous snakes occur. Within the river and stream area are various fish, bullfrog (*Rana catesbeiano*), mussels, and birds. Migratory waterfowl seasonally visit the Bottomlands and playa lakes because their central migratory flyway is over this region.

Modeled environmental reconstructions of stream flow of the Beaver River (Figure 2.4) indicate more water during the Late Prehistoric period than earlier. Reflecting precipitation, however, modeled stream flow shows a reduction during July and August. Because of the availability of water in the Bottomland area, the plant and animal species indicated above were most likely present and available as resources during occupation of the Two Sisters site.

Summary

In this chapter, an examination was made of information about the natural setting - physiography, geology, soils, hydrology, and climate - of the Oklahoma panhandle. The study also includes a paleoenvironmental analysis that incorporates modeled precipitation, temperature, evaporation, and stream flow to provide clues about past climatic conditions during the occupation of the Two Sisters site. Based on present and past environmental conditions, general floral and faunal resources found in Texas County, Oklahoma are identified. The influence of climate on wild and domesticated resources would have directly affected subsistence and settlement patterns adopted in the area. Because the climate was becoming more arid during the twelfth through fifteenth centuries, the interrelationships between plant, animal, and human populations would have been different from earlier climatic episodes.

The people represented by the Antelope Creek phase are a product of a long culture history. Human adaptation in the region began many generations earlier in different environmental settings and with different technologies. This is the subject of Chapter 3.

CHAPTER 3

ARCHAEOLOGICAL BACKGROUND

Archaeological research in the Oklahoma panhandle has not been very actively pursued. Although archaeological sites and isolated diagnostic artifacts are reported from this area, few sites have been excavated. Our knowledge of the area is based primarily on surface surveys, avocational collections, and the published information from the handful of excavated sites. Most of the recorded sites consist of lithic scatters without an assigned cultural affiliation. The few sites that provide information about regional culture history range from the earliest known occupation, Paleoindian through the Historic period. Using a regional perspective, this chapter summarizes the late part of the prehistoric through the protohistoric archaeological record of the Oklahoma panhandle and adjacent southern Plains. The principal temporal divisions reviewed include the Woodland, Late Prehistoric and Protohistoric periods.

Plains Woodland Period

The Plains Woodland Period, in this region from about A.D. 1/500 to 1100/1200 (Gunnerson 1987:63; J. Hughes 1991:24), is characterized by a shift in technology and subsistence strategies indicative of the adoption of the bow and arrow, ceramics, and possibly limited horticulture. The new tools - small arrow points and thick pottery sherds - mark the beginning of a significant transition from nomadic hunter-gatherers to the later semi-sedentary village horticulturalists. Other than in southeast Colorado, evidence for the shift to horticulture has not been recorded during the Woodland period on the southern High Plains (Boyd 1997:293). The only visible differences from the Archaic period are the appearance of corner- and a few side-notched arrow points, often found in association with the earlier dart points, pit structures, and cordmarked pottery sherds (J. Hughes 1991:24-26).

Lake Creek Complex

Jack Hughes (1962, 1991:25-26), suggests the name Lake Creek complex for the Woodland in the Oklahoma panhandle and the northern part of the Texas panhandle based on surface and excavated materials from the Lake Creek site. The Lake Creek site is in the breaks of the Canadian River. It was tested in 1952. Collections of small corner and side-notched arrow points and corner-notched (Ellis-like) dart points were found in association with cordmarked and plain brownware pottery and ground stone (Hughes 1962). The cordmarked pottery was generally thick-walled and vessels were probably large, pointed-bottom or conoidal pots. The one rim sherd recovered at this site had a slightly everted lip with long incised diagonal lines decorating the area just below the lip. Temper consisted of angular limestone particles and rounded quartz grains. The brownware found at the Lake Creek site closely resembles the brownware of the Pecos River valley sites in eastern New Mexico (Hughes 1962:71-72). These smoothed surface sherds are identified as Alma Plain, a Jornada Mogollon brownware (Baugh 1994:271). Baugh (1994:271) suggests that these sherds represent early interaction between Plains groups and southwestern people. In addition to pottery and lithics at the Lake Creek site, limited faunal remains include bison, deer, jackrabbit, unidentified rodent, and turtle (Hughes 1962:81-82).

J. Hughes (1991:25-26) and Boyd (1997:293) suggest that generalities of the Lake Creek complex include a predominance of local lithic material usage, numerous manos and metates indicative of more intensive plant processing, large cordmarked conoidal vessels tempered with generous quantities of coarse particles of crushed rock and/or bone, and fewer bison remains. The lack of bison in Lake Creek sites follows Dillehay's (1974) suggested "Bison Absence Period II (A.D. 500-1200). Faunal evidence and buried soils indicate that the climate in this region has an apparent increase in effective moisture during this time compared to both the preceding and subsequent centuries (Ferring 1986:75; J. Hughes 1991:27). Another generality of the Lake Creek complex is the type of sites. Site types are usually campsites with two possible village occupations in the Texas panhandle. No rockshelters or bison kill sites have been discovered (Boyd 1997:282).

The two possible residential base camps or "village occupations" are the Greenbelt site (41DY17) and the Duncan Ranch Site 1 (41HC124). Both of these sites have pithouse structures and the Greenbelt site has numerous storage pits. In regard to the Greenbelt site, Boyd (1997:282) interprets the bone tempered sherds, corner-notched arrow points, and two Mogollon brownware sherds as probably representing a Woodland period occupation. The site is multi-component with Plains Woodland and Antelope Creek phase occupations. No radiocarbon dates are available for this site. The other possible residential site, the Duncan Ranch Site 1, has a calibrated radiocarbon date of A.D. 993-1151 from a charcoal sample collected on or near the floor of the pithouse (Boyd 1997:283). In addition to the charcoal sample, fire-cracked quartzite, utilized flakes, a hammerstone, an Ellis dart point , and a Scallorn arrow point were found near the floor of the structure. A Deadman's point and a Jornado Mogollon brownware sherd may suggest interaction with the Palo Duro complex south of the Lake Creek occupations (Boyd 1997:283).

The earliest date for Woodland pottery of the Lake Creek complex comes from the Tascosa Creek site in the Texas panhandle. A thermoluminescence date of A.D. 520 was obtained from a cordmarked sherd from that site (J. Hughes 1991:25). Other Lake Creek sites include the Sandy Ridge site on Palo Duro Creek in Hansford County, Texas (Quigg et al. 1993:117-214) and the Swift Horse (Briscoe 1987) and possibly

Beaver Dam sites (Thurmond 1991) in Roger Mills County, Oklahoma. The early appearance of cordmarked pottery has led Lintz (1986:226) to suggest that the Lake Creek complex is "a likely candidate for the indigenous antecedents to the Antelope Creek phase group."

Although not specifically assigned to the Lake Creek complex, other recorded Woodland sites in Texas County, Oklahoma include Johnson-Cline (Lintz 1978a:131), Muncy (White 1987:82-83), Tuckers Dune Ridge, and Easterwood (Oklahoma Archeological Survey site files). These sites appear to be transitional between Late Archaic to Woodland with the co-occurrence of both corner-notched dart and arrow points.

The Carrizozo Creek Bridge site in Cimarron County, Oklahoma, also produced evidence of Plains Woodland occupations in the Oklahoma panhandle. However, due to its far western location, it is not clear if it is associated with the Lake Creek complex or the Graneros focus of southeastern Colorado (Baugh 1994:269; Saunders 1983).

Graneros Focus

The Graneros focus was originally defined by Withers (1954:3). Geographically it is northwest of the Lake Creek complex in southeast Colorado. Located along the Arkansas River and its tributaries, mostly on the Chaquaqua Plateau, the Graneros focus is dated between about A.D. 450 to 1050 (Gunnerson 1987:60). Plains Woodland materials associated with this focus include cordmarked pottery and corner-notched small to large points. Site types vary from rockshelters to open habitations with circular, horizontally placed slab foundation structures (Campbell 1976:102; Gunnerson 1987:60; Hofman and Brooks 1989:61). These houses generally have a "saucer-shaped" floor and a central hearth. Support posts for the roof are placed near the walls (Gunnerson 1987:60). Wild plants and small and large game form the subsistence base in the early part of the focus (Hofman and Brooks 1989:61). In the later part of the Graneros focus (A.D. 750-1000), "maize entered the area and evidence of horticulture is certain" (Gunnerson 1987:60).

Palo Duro Complex

The other Woodland occupation in the Texas panhandle, the Palo Duro complex, is south of the Lake Creek complex in the upper drainages of the Red and Brazos Rivers. Dating between A.D. 500 and 1100-1200, site assemblages are characterized by corner-notched (Scallorn-like) and basal-notched (Deadman-like) arrow points, Jornada Mogollon brownware pottery, and an abundance of groundstone (Boyd 1997:315-334). Faunal remains suggest an economic focus predominately on deer supplemented with small game, such as rabbits and rodents. Bison are only minimally represented (Boyd 1997:321). Habitation site types range from residential base camps, where people lived in pithouses to open, temporary campsites and rockshelters (Boyd 1997:295). According to Boyd (1997:334), human burials associated with the Palo Duro complex indicate evidence of extensive violence from possible "periodic contact with enemy peoples to the north and east (i.e., Lake Creek or Plains Woodland groups)". The pithouse architecture and the Jornada Mogollon pottery exemplify cultural influences from the western Jornada Mogollon region (Boyd 1997:335).

Late Prehistoric Period

On the southern Plains, the Late Prehistoric period is usually defined as dating A.D. 1100 to 1450 (J. Hughes 1991:29). This time period is primarily associated with the appearance of the Plains Village tradition and differs from the preceding Woodland period in an increased emphasis on horticulture and bison hunting. These two dominant subsistence activities have repercussions on tool assemblages and social structures of Late Prehistoric period populations. Site assemblages are characterized by small triangular arrowpoints without notches (Fresno variety), with side-notches (Washita variety) and occasionally, side- and basally-notched (Harrell variety). Diamond-beveled knives and formalized end scrapers become common, emphasizing the increased importance of bison hunting and processing (Creel 1991). With the increased utilization of bison, regional exchange and social interaction expand. At the same time, groups become more sedentary, aggregating in villages with more permanent houses and increasing their reliance upon horticulture. Cordmarked and smoothed-surface ceramics and bone horticultural tools - digging sticks and hoes - become more common. Plains Village groups maintain a mixed economy based on growing corn, beans, and squash, and hunting bison, deer, and other small mammals. Gathering of wild plants and fresh water mussels continues as a supplement to the diet (Baugh 1994: 272-273; Brooks 1989:75; Drass 1998:415; J. Hughes 1991:29-30; Lintz 1986:25).

The Plains Village tradition is represented by various geographically separated archaeological manifestations (Figure 3.1). On the southern High Plains, Lintz (1986:25-37) has proposed the Upper Canark regional variant for groups living in the Canadian and Arkansas river basins. This variant consists of the Apishapa phase (A.D. 1000-1400) and the Antelope Creek phase (A.D. 1200-1450). The Buried City complex (A.D. 1150-1350) in the northeast area of the Texas panhandle shows some similarities but Bevitt (1999:186-187) has suggested that it is part of a new variant known as the Plains Border variant. East of this area in west-central Oklahoma is a closely related group that seems to have adopted some of the cultural traits of adjacent groups. This group is known as the Zimms complex and dates to A.D. 1265-1425. Plains Village groups in central and western Oklahoma have been defined by Drass (1997:18) as the Redbed Plains variant. Included in this variant are the Paoli, Custer, Washita River, and Turkey Creek phases with occupation ranging between A.D. 800 and A.D. 1450.

Upper Canark Regional Variant

The Upper Canark Regional variant, as defined by Lintz (1986:25-37), extends along and between the Canadian and Arkansas Rivers and their

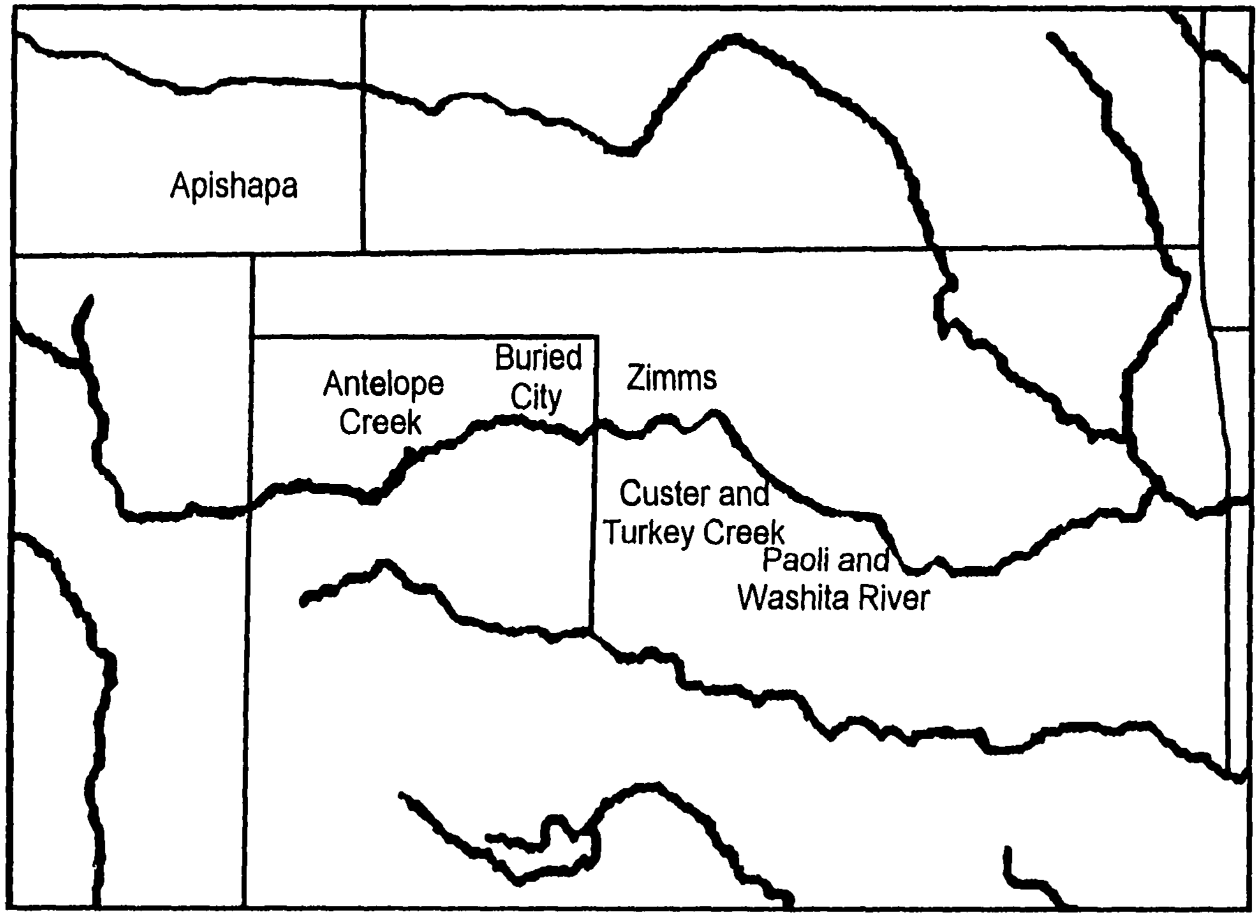


Figure 3.1. Late Prehistoric Period Plains Village Tradition.

tributaries in the High Plains of southeastern Colorado, northeastern New Mexico, and the panhandles of Texas and Oklahoma. According to Lintz (1989:273), the primary characteristics of the variant include "a dual foraging-horticultural economy, predominantly small side-notched and unnotched points, cordmarked pottery, stone masonry architecture used in isolated and contiguous room structures, and the presence of single flexed burials." The primary difference between this variant and other Late Prehistoric complexes to the east is the unique stone architecture and the spatial patterning of houses. Sites included within this variant often consist of single and multi-roomed structures with stone slab foundations (Lintz 1986:25). Lintz (1986:25) initially defines two phases for the Upper Canark variant: the Apishapa phase and the Antelope Creek phase. The Buried City complex in the Texas panhandle was later included in this variant (Brooks 1989:83; D. Hughes 1991; Hughes and Hughes-Jones 1987) but has recently been reclassified as part of the Plains Border variant (Bevitt 1999:186-187).

Apishapa Phase

The Apishapa Phase is an *in situ* cultural development in southeastern Colorado derived from the previous Plains Woodland Graneros phase (Campbell 1976:103; Gunnerson 1987:89). Geographically, the Apishapa phase is found along the Apishapa and Purgatoire rivers and probably extends into the Black Mesa area of the

Oklahoma panhandle (Campbell 1976:103; Drass 1998:422; Gunnerson 1989:2; Lintz 1986:26, 1989:280). Major sites include Snake Blakeslee I, Cramer, Steamboat Island Fort, 5LA875, and 5LA977 (Gunnerson 1989:74-104; Lintz 1986:26). Other significant sites include Avery Ranch, Trinchera Cave, and Medina Rockshelter (Drass 1998:422; Lintz 1986:26).

Sites date between A.D. 1000 and 1400 and consist of rock shelters, temporary camps, and open settlements. Many of the sites are in, or in sight of, defensive places and are aggregated on mesas and in canyonland locations. Defendable locations and fortifications around sites suggest that warfare and conflict may be common (Gunnerson 1989:90). Open sites range from single room sites to "villages" containing up to 60 rooms (Lintz 1986:27). Rooms are usually circular with some oval and semicircular shapes also documented. Square and rectangular shaped rooms are extremely rare (Campbell 1976:103; Gunnerson 1987:89). Vertical slab architecture is normal and houses are constructed on the surface rather than being semisubterranean (Gunnerson 1989:89; Lintz 1986:28). Interior central hearths and roof support features are rare in the smaller rooms and most fire pits are outside the structures. Few houses have identifiable entryways indicating that access may have been through the roof (Lintz 1986:28).

Apishapa subsistence is a mix of hunting and gathering supplemented with minimal horticulture. Remains of small mammals, primarily rabbits, prairie dogs, gophers, and rats, along with larger prey, such as deer and antelope are often recovered from Apishapa sites. Bison, elk, bobcat, and coyote are occasionally recovered (Lintz 1986:28). Wild plant remains consist of "grass seeds, Indian ricegrass, pea family seeds, hackberry seeds, choke cherry pits, wild plum pits, grape, yucca quids, globe mallow seeds, sunflower seeds, hedgehog cactus seeds, and piñon nuts along with pigweed, goosefoot, Juniper berries and purselane [sic]" (Lintz 1989:283). Although bison scapula hoes are not found at Apishapa sites, maize, beans, and gourds were cultivated, probably with wooden digging sticks (Gunnerson 1989:90; Lintz 1989:283).

Apishapa material culture is represented by chipped and ground stone, bone tools, shell artifacts, ceramics and a limited number of trade goods. Utilized lithic materials include primarily local cherts, jaspers, and quartzites (Brooks 1989:83). Stone tools consist of arrow (mostly Fresno and Washita types) and dart points, bifacial and unifacial knives, scrapers, gravers, drills, unifacial choppers, and bifacial axes. Diamond-beveled knives that are so common at other late prehistoric Plains Village sites to the east are absent. Also lacking are pin and T-type drills (Lintz 1989:283). Groundstone includes one-handed manos, metates, and arrowshaft smoothers. "Shell artifacts include locally made pendants, discs, and scrapers while bone working includes abundant bone beads", scrapers, shaft wrenches, and awls (Lintz 1989:283). Apishapa ceramics are globular, grit tempered, cordmarked jars with straight to everted undecorated rims (Campbell 1976:103). The relatively few trade items present indicate at least some contact with other Plains groups and with the northern Pueblos. Alibates chert is a probable trade item from the Antelope Creek phase groups to the east and Santa Fe and Galisteo black-on-white, and Taos Plain sherds represent contact with the Pueblos to the southwest. Olivella and Neogastropodia shell beads, obsidian, and turquoise also suggest southwestern contact (Gunnerson 1987:90).

Antelope Creek Phase

The Antelope Creek phase dates from about A.D. 1200 to A.D. 1500 (Lintz 1991:93). Geographically, the cultural remains are found along the Canadian and Beaver rivers and their tributaries in the Texas and Oklahoma panhandles. The culture is defined by the unique blend of Plains Village tradition artifact assemblages and "puebloan-style" architecture (Krieger 1946; Wedel 1961:144). Apparently, a mixture of hunting and gathering of wild resources was combined with limited horticulture.

Stone slab masonry was used to construct houses that range from single-room structures to contiguous-room villages containing more than 35 rooms (Lintz 1984:327). Large slabs of rectangular-shaped, chipped sandstone, caliche, and dolomite were placed vertically in single or double rows on the bedrock to form structure walls. The slabs were held in place by packed mud. Evidence of central post holes chipped into the bedrock is occasionally found (Lintz 1982:39; Schneider 1969:126,129). Room shape and size varies from small circular huts to large rectangular rooms with narrow, extended eastward entryways (Lintz 1982:38-39). According to Lintz (1982:39), "the most common ... basic unit type is a large rectangular structure with a low extended passageway to the east, a step feature, a shallow depressed floor channel which encompasses nearly one-third of the floor area, a centrally located hearth, two to six roof support posts along the channel margins, and a raised platform or "altar" either recessed into the west wall or protruding into the channel from the west wall." Often, circular rooms are added to each side of the extended entryway and were probably used as food storage and processing areas (Lintz 1982:39,1986:329). Generally, the large contiguous room structures were occupied during an early subphase (A.D. 1200 to 1350) and were adjacent to the Canadian River. After A.D. 1350 (late subphase), settlements were dispersed to the tributaries of the Canadian River valley and there was a predominance of isolated, larger-roomed structures (Lintz 1978b:325, 1991:93).

Storage facilities, pits, cists, and bins are found within structures and as exterior features (Lintz 1984:330). In large, rectangular-room structures that have a floor channel and bench, storage cists or pits are often contained within the floor bench (Lintz 1984:328-329). Structures with extended entryways frequently have small storage rooms on each side of the passageway. Some small circular or rectangular isolated structures appear to have been used exclusively for storage (Lintz 1984:329). Basin and bell-shaped pits sometimes have stone-slab walls and occasionally, a stone floor (Lintz 1984:330).

Recovered hunting and horticultural tools as well as animal and plant remains suggest a subsistence base of both hunting-gathering and horticulture (Duffield 1964:73, 1970:1; Hughes and Hughes-Jones 1987:25-26; Lintz 1986:33, 37, 1991:90). According to Lintz (1986:35, 33), evidence of hunting and gathering consists of stone tools (Washita, Harrell, and Fresno points, diamond-beveled knives, scrapers, and drills) and numerous faunal remains - bison, antelope, deer, small game, amphibians, reptiles, fish, water fowl, and mussels. Bison remains (from the few Antelope Creek sites that have faunal analyses) are often comminuted or pulverized for bone grease (DeMarcay 1986:117-119; Duffield 1970:253), indicating a need for fat in the diet. Wild plant remains include acorn, hackberry, mesquite, buckwheat, cattail stems, plums, persimmons, and prickly pear. Horticultural tools such as bison tibia digging sticks, scapula hoes, basin metates, and one-handed manos are common (Lintz 1986:33, 35). At least two varieties of corn were grown along with squash, pumpkin, and beans (Lintz 1986:33, 242).

Antelope Creek pottery, labeled Borger Cordmarked, is common on most sites. The vessels are usually globular jars with wide mouths and straight rims that are tempered with sand, mica, or crushed quartzite.

Surfaces are textured with a cord-wrapped paddle (cordmarked) prior to firing (Lintz 1984:333-334).

Ample evidence of trade exists at Antelope Creek sites (Lintz 1991). Primarily, the exchange routes are to the Southwest with obsidian from the Jemez mountains, turquoise, and mica found at most sites. Furthermore, marine shell jewelry and 19 different varieties of southwestern pottery are reported, with 12 of these ceramic types originating in the northern pueblos (Lintz 1991:95). The ceramics, in addition to aiding in dating the Antelope Creek phase, reveal contact of one form or another with the Rio Grande and upper Pecos river (northern) pueblos (Lintz 1984:335, 1986:35).

Evidence of exchange with Plains groups is more difficult to identify. Red pipestone (probably from Kansas), Niobrara jasper, and collared-rim cordmarked sherds hint at contact with Central Plains groups (Lintz 1984:335, 1986:35). Recovery of Alibates agatized dolomite from both the central and southern Plains, as well as southwestern pueblo sites, suggests that Alibates was one resource exchanged by Antelope Creek groups for exotic goods (Lintz 1991:94).

Although clear evidence is lacking, bison were probably another resource traded by the Antelope Creek people. Whether they traded meat, robes, or tools is not clear in the archaeological record. Baugh (1984) and Spielmann (1991:7) suggest that bison were traded with the Puebloans at Spanish contact and that possibly these exchange networks had already been established. Bison were probably also traded with people of the Washita River phase to the southeast (Drass and Flynn 1990:188).

Along with social interaction and trade there is evidence of intertribal conflict at Antelope Creek sites. The evidence of violence takes three forms: 1) physical trauma, 2) selectively burned structures, and 3) defensive locations (Lintz 1986:247-252). Physical trauma is suggested at several sites where human bones have been scattered, extra "trophy" skulls are present, and arrowheads are embedded in some human remains (Lintz 1991:93). Burned structures are found at sites, but as Lintz (1986:248) points out, burned structures do not always imply warfare. The only burned structures that may point to tribal raiding are ones found late in time (after A.D.1350) and associated with selective, multiple-burned households at major sites near the Alibates flint quarries. These sites are generally the only ones that appear to have been located in defensive positions. Lintz (1986:251) documents that the majority of defensive structures are located on high mesa tops and appear to provide defense against groups that would have approached the Alibates quarries from the west. Other sites are not in defendable locations. These sites may imply that proximity to the Ogallala aquifer's seeps and springs was more critical to the occupants than defending themselves against outside raiding parties (Lintz 1986:251). It is difficult to determine the degree of conflict and warfare at Antelope Creek sites. Some evidence exists that it occurred, but it does not appear to have been the major source of stress to the population until the late phase (Lintz 1991:93).

Buried City Complex (Plains Border Variant)

Located east of the Antelope Creek phase and sharing some similarities with it, the Buried City complex (part of the Plains Border variant identified by Bevitt in 1999) is primarily along Wolf Creek in the northeast corner of the Texas panhandle. Initial excavations were carried out in this area at what was called "Buried City" (Eyerly 1907). Eyerly reports that 12 mounds (thought to be graves) were recorded, each constructed of vertical stone slabs and rectangular in shape (Hughes and Hughes-Jones 1987:13). Additional excavations throughout the twentieth century have helped to further identify this complex. Hughes and Hughes-Jones (1987) have been the major contributors of information and have identified the primary sites as Buried City or Handley ruins, Moorehead, Courson, Kit Courson, Kirk Courson, and Gould. Dates for the complex range from A.D. 1150 through A.D. 1350 and are "roughly equivalent to what Lintz has defined as the Early Subphase of the Upper Canark Regional Variant in the Antelope Creek area" (Hughes and Hughes-Jones 1987:105).

The architecture of the Buried City complex is similar to the Antelope Creek phase but there are differences. These differences are most notably a reduced number of contiguous rooms at individual sites, use of caliche boulders, and increased site density. Hughes and Hughes-Jones

(1987:101-102) summarize the architecture as consisting mostly of large, single room square to rectangular houses constructed with boulders of caliche as the wall base and four main central roof support posts. Entryways to the east are usually 2-3 m in length. A central cylindrical clay-lined hearth located in a central depressed east-west channel is generally surrounded by plastered caliche-mud floors. Semicircular or D-shaped attached rooms on the southeast corner of the structure are also sometimes present. Exterior cylindrical straight-sided storage pits and burials are also associated with the houses.

The material assemblage of stone tools is similar to Antelope Creek. Washita and Fresno points are common as well as diamond-beveled knives, drills, and scrapers. Lithic materials of these tools suggests that Buried City inhabitants were obtaining local Alibates gravels and not using the higher quality quarried materials.

Buried City pottery provides the most striking material cultural difference from Antelope Creek. Instead of the consistent cordmarked exterior vessels, Buried City ceramics are very diverse and also include smoothed and smoothed-over cordmarked surfaces. Vessels are described as "thick, poorly fired, rounded, globular or sub-conoidal" jars that are typically sand tempered with some bone, shell, or clay added (Hughes and Hughes-Jones 1987:104). Decorations include "single, double, and triple rows of fingernail impressions around the vessel neck, chevron designs, and crenulated rims" (Brooks 1989:84). Appliqued, incised, filleted, gouged, pinched, and fluted rims are characteristic of the ceramic assemblage. Strap handles and corncob and fabric impressed surfaces are also reported (Brooks 1989:84; Drass 1998:425; Drass and Turner 1989:48; Hughes and Hughes-Jones 1987:104). Hughes and Hughes-Jones (1987:78) suggest that these decorations are similar to Geneseo series pottery from the Great Bend aspect sites in central Kansas.

Zimms Complex

The Zimms complex is primarily in what is now Roger Mills County, Oklahoma and dates between A.D. 1265 and A.D. 1425. According to the literature (Brooks 1989:84; Brooks et al. 1992:61; Drass 1998:426; Flynn 1986:138; Moore 1988; Saunders 1973:7), people of the Zimms complex lived between the Antelope Creek phase to the west and Turkey Creek phase to the east, sharing some characteristics of both groups. Only a few sites in western Oklahoma have been recognized as representing the Zimms complex, and, of these, only seven have been excavated and the information published. These include Zimms (Flynn 1986), Hedding (Shaeffer 1965), Pyeatt #4 (Moore 1984:140), Chalfant (Briscoe 1983), Lamb-Miller (Moore 1988), New Smith (Brooks et al. 1992), and Wickham #3 (Wallis 1984). Geographically, the sites are in the mixed-grass prairie transitional zone between short-grass plains to the west and tall-grass prairies to the east (Brooks et al. 1992:63; Flynn 1984:216). The sites, both habitation and burials, are generally on high terraces along tributary streams of the Washita River or North Canadian River and are away from the fertile river floodplains (Brooks et al. 1992:61). Because many sites are small dispersed hamlets and are not directly on the river floodplains, intensive horticulture is not likely the primary subsistence strategy.

The diet and subsistence of the Zimms complex people is believed to come primarily from hunting and gathering, possibly supplemented with some horticulture. Little evidence of horticulture exists, however, and the only domesticated cultigen identified is corn (Brooks 1989:84). To date, no pollen samples from any wild plants (other than unidentified grasses) have been recovered, making the flora reconstruction impossible (Brooks 1989:85; Flynn 1984:272). Faunal remains include deer, rabbit, bison, prairie dogs, box turtles, and birds (Flynn 1984:270-71). The faunal remains support the earlier suggestion that Zimms people were exploiting both of the adjacent biotic zones.

All Zimms complex houses are semi-subterranean with mud plastered walls and stone benches at the ends of the depressed floor channels (Brooks et al. 1992:61). Architectural design elements share characteristics with both the Antelope Creek people to the west and the Turkey Creek groups to the east (Brooks et al. 1992:61; Drass 1998:426; Lintz 1986:89-102). Zimms groups apparently combined the Antelope Creek house floor plan with the Turkey Creek mud wall construction (instead of the typical stone slab masonry used by the Antelope Creek people).

Very few storage facilities have been found at Zimms complex sites, but the few that have been excavated are shallow, round to oval pits, containing faunal, lithic, and ceramic remains (Brooks et al. 1992:73; Flynn 1986:132). Generally, these storage facilities have been subsequently used as trash middens or roasting ovens (Brooks et al. 1992:69). From the scarcity of storage pits and their shallow depth, implications are that the Zimms complex people, although sedentary, did not have surplus agricultural food to store.

A few bison tibia digging sticks and bison scapula hoes have been recovered (Brooks 1989:85; Brooks et al. 1992:71). These indicate that the inhabitants were involved with at least some horticultural activities; however, the small quantity of these tools suggests that they did not rely primarily upon intensive agriculture for subsistence. Several grinding implements were also found in association with the Zimms complex sites. These manos and metates may indicate some processing of agricultural grains, i.e., maize; however, it is only a hypothesis, since they could have also been used to process wild plant foods.

Zimms complex pottery and lithic materials are different from Antelope Creek and Turkey Creek assemblages. Pottery recovered from Zimms sites has a smooth surface and is tempered with fossiliferous shale, shell, or limestone. Although this type is similar to some of the Turkey Creek phase pottery, it is unusual in that cordmarked wares found at Antelope Creek and Turkey Creek phase sites are lacking. According to Drass (1998:427), Turkey Creek ceramic assemblages contain significant amounts (about 28%) of cordmarked sherds in addition to smoothed wares. Another difference between Zimms and Antelope Creek and Turkey Creek is the use of Florence A chert from the Flint Hills of Kansas and Oklahoma. Zimms lithic assemblages include about 5% of this non-local material. Alibates chert from local gravels is the dominant tool resource (Flynn 1984:280), but other non-local resources and trade materials are important. These include Edwards chert from central Texas, obsidian, puebloan pottery, and Olivella shell beads from the Southwest, and Caddoan pottery (Brooks 1989:85; Drass 1998:427).

Redbed Plains Variant

The Redbed Plains variant was defined by Drass (1997:18) and consists of eastern and western variations "along the Washita River and parts of the Canadian River from the Arbuckle Mountains in south-central Oklahoma to the edge of the High Plains in far western Oklahoma". The eastern manifestation includes the Paoli phase dating from about A.D. 900 to 1250. This phase develops into the Washita River phase that lasts until about A.D. 1450. Development in the western geographic area begin with the Custer phase, A.D. 800-1250, and is followed by the Turkey Creek phase, A.D. 1250-1450 (Drass 1998:427-428).

These Late Prehistoric southern Plains societies consisted generally of small, egalitarian, scattered villages. They grew some corn and beans and continued to rely upon gathering wild plants and nuts. According to Drass (1997:114), there is some possible evidence of domestication of sunflower (*Helianthus annuus*), marshelder (*Iva annua macrocarpa*), goosefoot (*Chenopodium*), little barley (*Hordeum pusillum*), maygrass (*Phalaris caroliniana*), and knotweed (*Polygonum*). Hunting strategies were focused on deer, fish, and with some use of bison. Deer were more readily available in the eastern areas and bison were more abundant in the west (Drass 1998:427-434).

Paoli Phase

In central Oklahoma, generally along the Washita River, an early group has been identified by Drass (1997, 1998:428-430) as Paoli phase. Paoli phase people were dependent upon small scale horticulture, fishing, and deer. Bison remains are only occasionally found. Evidence for house structures reveal rectangular, wattle and daub dwellings with four center posts and a central hearth. The small clusters of houses with little differentiation in material remains suggest an egalitarian sociopolitical organization. There is not much evidence of trade with other groups and it appears that local resources were relied upon (Drass 1998:428-430).

Custer Phase

West of the Paoli culture during this same time period, the Custer phase has been defined. Custer phase inhabitants are similar to Paoli in their structures, settlement patterns, and sociopolitical organization. They differ in that they rely more heavily upon bison than deer. In addition, although there is evidence of horticulture, it is not very dependable due to the reduced rainfall in western Oklahoma (Drass 1998:432-434).

Washita River Phase

The Paoli phase was replaced by the Washita River phase at about A.D. 1250. Horticulture was more prominent with a greater reliance upon maize. Through time, fish and deer decreased and bison increased in the faunal assemblages. The number of houses in each village increased and there were villages located up the Washita River about every 2-3 km. Evidence of internal and external storage increases and with it, probably a more stratified social structure. Trade becomes more common especially with the Caddos to the east (Bell 1984:307-324; Drass 1998:430-432).

Turkey Creek Phase

In the western part of Oklahoma between A.D. 1250 and A.D. 1450, the Custer phase is replaced by the Turkey Creek phase. Turkey Creek differs from Washita River in that bison dominate the faunal assemblage. Although horticulture continues, bison become more and more important through time. Structures continue to be built similar to those of the Custer phase, but what is lacking is interior storage pits. Storage may have shifted to arbors for drying and then the food products stored in caches away from the sites. Since part of the year Turkey Creek phase people are hunting bison, hidden storage seems plausible. During this time, trade with the Southwest intensifies. Group conflict increases as evidenced in traumatic injuries from sites such as McLemore. Apparently, Turkey Creek is a group in transition to a more mobile existence (Drass 1998:432-434).

Protohistoric Period

The Protohistoric period for the Texas High Plains and the southern Plains is a time of major changes in settlement patterns, subsistence practices, and social interaction. Beginning about A.D. 1450 and continuing until about A.D. 1750, occupants of the area focus on bison hunting and have a less sedentary existence. Farming groups virtually disappear and archaeological sites become more ephemeral due to the lack of horticultural pursuits. Trade increases, probably because of increased settlement mobility and reduced reliance upon horticulture. Archaeological complexes for this period include Tierra Blanca and Garza complexes in the Texas panhandle and the Wheeler phase in western Oklahoma (Figure 3.2).

Tierra Blanca Complex

The Tierra Blanca complex is poorly defined. No diagnostic artifacts are exclusive to this complex and Boyd (1997:369) suggests that the definition of the complex is primarily based on the geographic location. The complex is mainly centered in the northern Llano Estacado region of the Texas panhandle along the Prairie Dog Town Fork of the Red River. In

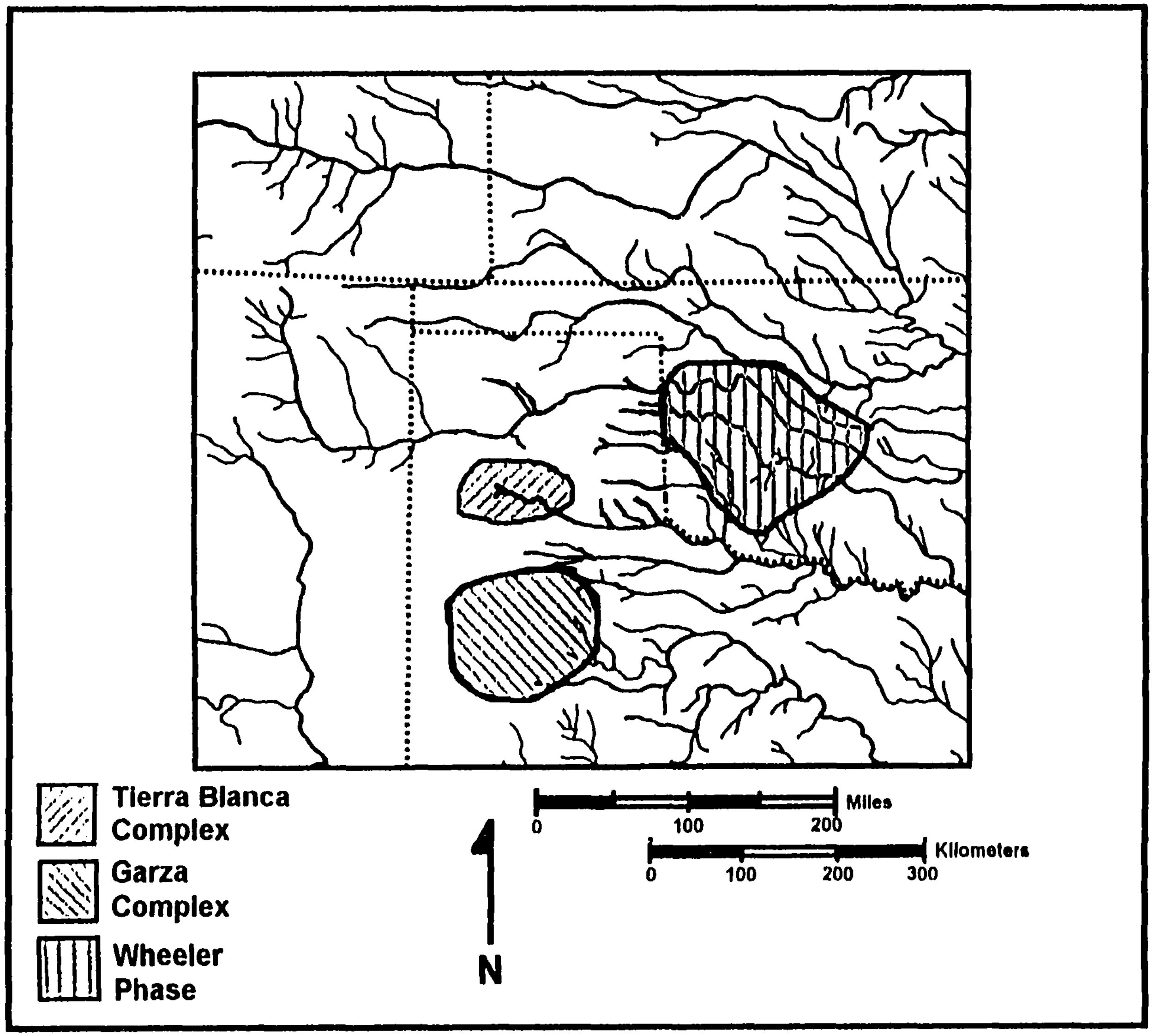


Figure 3.2. Protohistoric Period Culture Complexes and Phases.

addition to this location, Quigg et al. (1993:214-330) and Boyd (1997: 377-380) suggest a possible Tierra Blanca occupation north of the Canadian River on the Palo Duro Creek in Hansford County, Texas. Radiocarbon and thermoluminescence dates indicate occupation between A.D. 1450 and 1650 (Boyd 1997:421-422; Habicht-Mauche 1992:251). These dates are further supported by the recovery of Rio Grande glaze ware sherds from the Intermediate Glaze period in the Southwest that dates to the same time period (Habicht-Mauche 1992:251; J. Hughes 1991:35).

Sites for this complex include the type site of Tierra Blanca (41DF3), as well as Blackburn, Fifth Green, Canyon City Country Club Cave, Cita Mouth, and Tule Mouth sites. These sites range from residential base camps with stone circle tipi rings to bison kill/hunting camps to rockshelter occupations (Boyd 1997:369-380). Lithics reflect intensive hunting and processing of bison with small triangular, notched and unnotched arrow points, scrapers, drills, and diamond-beveled knives (Habicht-Mauche 1992:251-252). The predominant lithic material utilized is Alibates agate (Baugh 1994:284; Boyd 1997:419). Horticultural tools such as bison scapula hoes and digging stick tips are absent (Baugh 1994:284). Utilitarian ceramics (Tierra Blanca Plain) include "thin, dark, plain utility ware in the Southwestern tradition" that were probably made of local clays (Habicht-Mauche 1987:178,184). Trade items of obsidian, turquoise, and *Olivella* shells indicate interaction with the eastern Pueblos (Habicht-Mauche

1992:252-253).

J. Hughes (1991:35) and Habicht-Mauche (1992:254) suggest that the nomadic bison-hunting Tierra Blanca people represent the Querecho Indians that Coronado encountered in the spring of 1541 in the northern Llano Estacado of what is now the Texas panhandle. As to their ethnic identification, "the Querechos are confidently identified as Athapascan speakers who later become known as Apaches" (Boyd 1997:482).

Garza Complex

South of Tierra Blanca in the lower Texas panhandle another group of mobile bison hunters has been identified as the Garza complex. Garza complex sites date between A.D. 1450 and A.D. 1750 and are primarily concentrated around the Brazos River and its tributaries in the vicinity of Lubbock, Texas (Baugh 1994:285; Habicht-Mauche 1992:253). Site types include residential base camps, bison kill and hunting camps, rockshelters, and burials (Boyd 1997:380-419). Garza, Longhorn, Headstream, Montgomery, Floydada Country Club, Staton Dump, Lubbock Lake, Bridwell, and Boren Shelters No. 1 and 2 are some of the sites that comprise the Garza complex (Boyd 1997:383).

Material culture from the Garza complex includes small triangular notched and unnotched points comparable to the Tierra Blanca complex points, but the Garza complex also includes Garza and Lott points that are not found in Tierra Blanca sites (Boyd 1997:419). Numerous scrapers, drills, diamond-beveled knives, and bifacial knives also occur. Unlike Tierra Blanca, Edwards chert from central Texas dominates the assemblage (Baugh 1994:285; Boyd 1997:419). Bone hide processing tools (awls and fleshing tools) are also present and suggest the importance of bison. Ceramics consist of "locally produced Southwestern-style utility wares in association with imported Rio Grande glaze wares. Most of the glazes appear to have been manufactured in the Galisteo Basin" (Habicht-Mauche 1992:253). Differing from the glaze wares found at Tierra Blanca complex sites, Garza sites contain more Late period glaze wares that date between A.D. 1550 and 1700 (Habicht-Mauche 1992:253). Other trade items from the Southwest include obsidian, turquoise beads, and shell objects (Baugh 1994:285). Ties to the Wheeler phase in western Oklahoma are also present with the occurrence of Plains Village tradition pottery, such as Edwards Plain and Little Deer Plain (Habicht-Mauche 1992:253).

If the Tierra Blanca complex represents Coronado's Querechos and their descendants the Plains Apaches, then Habicht-Mauche (1992:255) reasons that the Garza complex that is geographically located south and slightly east, represents the bison hunters that Coronado calls Teyas. Garza complex sites containing chain mail, Spanish bridles, and cross bow dart points in Blanco Canyon indicate contact with Coronado (Word 1994). Coronado's chroniclers document that the Querechos and the Teyas were enemies and some scholars have suggested that these groups probably did not share ethnic ties (Boyd 1997:482-483; Habiche-Mauche 1992:255-256). The ethnic identity, however, of the descendants of the Garza complex is not readily apparent. Some researchers believe that most evidence, including the distinctive Teya trait of facial and body painting, hint at a Teya link with the Plains Caddoan (Baugh 1994:286; Habicht-Mauche 1992:255). Others such as Gunnerson (1987:111) and J. Hughes (1991:36) suggest an Apache affiliation.

Wheeler phase

The Wheeler phase in central and western Oklahoma dates between A.D. 1450 and 1750 (Drass and Baugh 1997:198). Initially, the phase was defined as two separate taxonomic units: Edwards complex dating between A.D. 1500 and 1650 and Wheeler complex dating A.D. 1650 to 1750. Based on similarities in the cultural assemblages, T. Baugh (1986) combined the complexes into one taxonomic unit, the Wheeler phase. Prominent sites as outlined by Drass and Baugh (1997) and T. Baugh (1986:168-169) include Little Deer (34CU10), Duncan (34WA2), Edwards I (34BK2), Scott (34CN2), Taylor (34GR8), Robertson (34GD144), Traders Creek (34WD5), Wilson Springs (34CD6), and Goodwin-Baker (34RM14).

The Wheeler phase probably developed out of the Plains Village tradition Turkey Creek and Washita River phases (Drass and Baugh 1997:201; Hofman 1989:97). Site types range from small seasonal camps to large, fortified, semisedentary villages. Through time, site assemblages include more trade items and less evidence of permanent structures. Storage pits are absent and are either replaced with above ground storage that is not recognized archaeologically or people become more mobile and storage declines (Drass and Baugh 1997:191-192). Like the Garza complex, this society emphasized bison hunting.

Subsistence data for Wheeler phase is limited. Apparently, bison were the primary meat source and were supplemented by smaller game (T. Baugh 1986; Hofman 1989:95,98). Evidence of corn, beans, and wild plants has been reported at some sites including Duncan, Goodwin-Baker, Traders Creek, Robertson, and Little Deer (T. Baugh 1986:173; Drass 2001; Drass and Savage 1992).

Trade intensifies with groups to the west and includes Southwest pottery sherds from the eastern Pueblos, turquoise beads and pendants, Olivella shell beads, and obsidian (Drass and Baugh 1997:189-190). In addition to items from the Southwest, southeastern pottery from Red River Caddoans and red pipestone from northeastern Kansas has been recovered from the Duncan and Goodwin-Baker sites (Drass and Baugh 1997:190).

Local ceramics are predominately dark, thin, sand tempered wares classified as Edwards Plain. These smoothed-surface vessels are occasionally decorated and the decoration is confined to incised lines on the lip (Drass and Baugh 1997:184). The other common pottery type is Little Deer Plain and Decorated. This pottery type has grog or clay temper and the decorated forms have "appliqued strips, brush marks, brushed-punctated impressions, wipe scratches, incised and punctated indentations, trailed lines, and smeared corrugation creating a neck-banding effect" (Drass and Baugh 1997:186). Both Edwards Plain and Little Deer Plain and Decorated were coiled vessels, usually thin-walled jars with a flat circular base. Edwards Plain vessels were smoothed with a paddle-and-anvil technique (T. Baugh 1986:170-172).

Lithic assemblages include small triangular arrow points, primarily unnotched Fresno points, but some notched (Washita, Harrell, and Garza) varieties are also present. Other lithic tools include large planoconvex end and side scrapers that become more prominent through time, diamond-beveled knives, expanding base drills, wedges and ensiform pipe reamers (Drass and Baugh 1997:187). Early in the phase, Alibates agatized dolomite is the primary lithic material used. It is supplemented by Florence A chert from north-central Oklahoma and Edwards chert from central Texas. During the later years of the Wheeler phase, Alibates decreases in prominence and is gradually replaced with significant quantities of Florence A chert.

Bone artifacts, although few, include beads, awls, serrated fleshers, digging stick tips, and bison scapula hoes. Drass and Baugh (1997:195) suggest that based upon the scarcity of bison scapula hoes and tibia digging stick tips, this "may reflect a decrease in horticultural activity" compared to the earlier Washita River and Turkey Creek phases.

Summary

A clear picture of the research area of the Oklahoma panhandle and the surrounding regions provides a context within which the occupation of the Two Sisters site can be analyzed. Trying to understand the site independent from its cultural historical setting is like trying to describe a "piece" of the ocean. While it can be done, much is lacking and the overall picture is flawed. By reviewing subsistence and settlement patterns of prehistoric people through time, various strategies of adaptation to the Southern High Plains environment are evident.

While this chapter has examined the history of human adaptive behavior, it remains to elucidate the theoretical models upon which this information might be interpreted. In the next chapter, I will present a detailed account of the evolutionary ecological model, that will be the underlying theoretical foundation for this study.

CHAPTER 4

THEORETICAL FOUNDATIONS AND ANALYTICAL METHODS

Evolutionary Ecology Theory

Introduction

A fundamental difference exists between science and history. The activity of doing science is a unique approach to understanding the world that attempts to arrive at universal (or at least generalizable) results. In the past, many archaeologists believed that the best method was something akin to an historical description of a site. This type of archaeology avoided theoretical entanglements, presupposing that by doing so it could avoid methodological problems and simply "describe" the site. At least two major difficulties occur with this approach: (1) all "description," particularly when reconstructing a prehistoric behavioral complex from archaeological data, is, in fact, interpretation of some sort (i.e., we cannot avoid theorizing); and, (2) even if it were possible to rely upon a simple descriptive method, the results would be site-specific. Without a general theoretical framework, individual results could not adequately ground scientific inquiry, which, by its very nature, requires a general rather than specific method. For this reason, I will follow an approach that is founded in a scientific understanding of archaeology, presenting a theoretical framework that has been successful in the past and should be useful in obtaining generalizable results from a careful examination of the Two Sisters site. In short, I plan to perform a scientific analysis of this site rather than strictly focus on a particular description. To begin this study, therefore, I will first lay the groundwork of how the theoretical approach, known as evolutionary ecology, became a central method used by some archaeologists.

Throughout its development, archaeology has relied heavily upon biological evolution. Indeed, this cornerstone of modern thought displays the paradigm for explaining not only genetic change, but also emergent variations of human behavior. The nature of these biological roots are perhaps best described by Ernst Mayr (1988:14), who states:

> Living systems are characterized by a remarkably complex organization which endows them with the capacity to respond to external stimuli, to bind or release energy (metabolism), to grow, to differentiate, and to replicate. Biological systems have the further remarkable property that they are open systems, which maintain a steady-state balance in spite of much input and output. This homeostasis is made possible by elaborate feedback mechanisms, unknown in their precision in any inanimate system.

Stated simply, living systems are, as a part of their intrinsic nature, faced with certain environmental conditions. They must adapt to these conditions in order to survive. Consistent with biological evolution, human beings find themselves caught within the interplay of their adaptive phenotypical development as it interfaces with the challenges of their environment. The survival behavior of individuals and groups changes through time, according to environmental conditions; availability of resources for food, water, and shelter; and to the kinds of technology and strategic group cooperation that are available. Clearly, if people fail to adapt to environmental constraints, they will die, just as a fish in a lake will die if it ignores available resources and repeats outmoded survival practices. This is the simple view of what has come to be known as "evolutionary ecology."

Dating back to the 1930s, evolutionary ecology finds its beginnings in mathematical biology, specifically in the works of thinkers such as Lotka, Volterra, Gause, and Hutchinson (Winterhalder and Smith 1992:5). The methods that they used to examine population dynamics, competition, and predation showed a larger connection between the individual, group, and environment. It is this general premise from which the evolutionary ecological model emerges. According to Winterhalder and Smith (1992:5-6), MacArthur, Lack, Levins, and Pianka all developed these ideas further and began applying them in various areas such as ornithology, biogeography, and evolution of mating systems. Their principal concerns were in using these models to develop studies of differing adaptation and foraging strategies and territorial behavior. These early applications laid the foundation for evolutionary ecology as an anthropological paradigm (Winterhalder and Smith 1992:5-6).

Optimal Foraging Theory

Overview

A sub-category of evolutionary ecology that has proved useful for archaeologists is called "optimal foraging theory." Generally, proponents of optimal foraging theory hold that an intrinsic connection exists between the behavior of human beings and their environment (Durham 1981; Foley 1985, 1992; Smith 1987; Smith and Winterhalder 1992; Stephens and Krebs 1986; Winterhalder 1981a, 1981b, 1986, 1987; Yesner 1981). Furthermore, these theorists contend that individuals and groups will tend to adopt a subsistence strategy that optimizes their chances for survival. Of course, prehistoric hunters on the Southern High Plains had fewer options than would a more technologically developed society. But the most important point is that groups of people are continuously engaged in adaptive behaviors, which, if they work, tend to become regular habits that are transmitted to others and passed on to future generations. While the goal of this process is "optimal," mistakes are possible, because of lack of knowledge, limited technology, and conditioned behavioral patterns that no longer work. However, if a group in fact survived, they found some strategy for survival that worked, at least for as long as we can show continuous habitation.

One of the most fruitful ways of analyzing behavioral complexes of prehistoric hunter-gatherer groups has been through use of models of economic organization. Although several prototypes of this approach occurred prior to 1936, the introduction of adaptation strategy theory by Steward (1936, 1955) marked the beginnings of the application of this kind of scientific model to anthropology (Smith 1983:625). However, because Steward's model was not developed enough to be effectively applied to an ever-widening body of empirical research and case studies, newer variations were devised (Smith 1983:625). Within the larger scope of evolutionary ecology, "optimal foraging theory" has emerged as a valuable tool in examining animal behavior and is especially useful in analyses of human behavior. Specifically, optimal foraging theory is useful for archaeologists because it provides a scientific basis upon which to develop some understanding of why a particular group adopted a specific approach to survival.

Smith (1983) has given us a carefully crafted developmental history of optimal foraging theory, which he categorizes into four general features. First, as Smith (1983:626) tells us, "foraging behavior has been 'designed' by natural selection to respond to changing conditions in a way that yields the greatest possible benefit for the individual forager's survival and reproductive success." This means that Darwinian evolutionary theory forms a central component of the underlying sense of optimal foraging analyses. Further, one can envision optimal foraging theory as an improvement of the applicability of Darwinian theory. Smith (1983:626) points out that this feature of the approach brings "costs and benefits" into relief as essential parts of evolution. Spelling out the specific details of cost-benefit analysis in this context, Smith (1983:626) describes its general features as follows: "most foraging models assume that foragers will be selected to behave so as to maximize the *net rate of return* (of energy or nutrients) *per unit of foraging time*". Although this is a reasonable perspective, Smith (1983:626) points out that there are conditions under which this principle is more likely. These conditions include moderate scarcity (of either or both energy or nutrients), spatio-temporal constraints, and emergent dangers inherent to hunting.

The second general feature of optimal foraging theory that Smith (1983:626) outlines is that it brings "optimization analysis" into play. Put simply, this approach presumes (often tacitly) that the behavior of a system (which may include human systems) strives toward optimization. While it is difficult to prove exactly what causes a phenomenon, this approach is clearly teleological, i.e., it holds that there is a continual striving of dynamic systems toward optimal conditions. Although this presumption about the world presents some philosophical problems, a very useful body of empirical research spanning various disciplines has developed that warrants at least a provisional acceptance of optimization theory. However, as Smith (1983:626) cautions, "optimization assumptions should be viewed as potentially useful starting points for building models and generating testable hypotheses rather than as Panglossian conclusions about the operation of the real world." If the principle of optimization is applied to optimal foraging theory, the "model must specify a currency (such as energy), a goal (such as maximizing foraging efficiency), a set of constraints (factors that limit the range of options for the duration of the process studied), and a set of options (choices left open to the actor)" (Smith 1983:626; emphasis added).

The third general feature cataloged as an essential component of optimal foraging theory is the "use of mathematical and graphic representations to reduce the complexity of real-world constraints and options to a limited number of 'sufficient parameters'" (Smith 1983:626). According to this view, mathematization is a manner of standardizing the approach, allowing only certain controlled variables into play, so that there might emerge standardized results across a wide range of empirical samples. The variables included in optimal foraging theory are fairly straightforward quantifications of human and environmental constraints, availability of resources, and energy loss/gain in acquiring resources. Potential problems with attempting to mathematize human behavior; however, are vast. First, the complexity of the life-world, reduced to a "few variables" loses its unique and expressive qualities and becomes only an abstract function exhibiting integration and differentiation. Further, mathematics itself is conceptually limited, as is widely recognized in the literature of theoretical mathematics. This point is made explicit in Gödel's 1931 proof of the formal incompleteness and inconsistency in mathematical systems (Nagel and Newman 1958). However, despite these difficulties, and with a clear recognition of the limitations of mathematizing certain features of human behavior, the practice is useful in standardizing the method of asking questions and comparing results in optimal foraging analyses as well as providing a generalization of the method and results.

The fourth and final general feature of optimal foraging theory is that "optimal foraging theory . . . simplifies its analysis by dividing its subject into discrete choice categories and by focusing on broad strategies" (Smith 1983: 626). Fragmentation of the complex of human behavior into various discrete categories seems reasonable at first; however, this is also a process of abstraction that, in a sense, takes a continuum and breaks it up into convenient parts. The problem with this kind of approach is that reality is a continuity that cannot be fully understood when seen as a collection of discrete parts. Regardless of this conceptual problem, it seems reasonable to view certain "regions" of human behavior as valid areas of theoretical interest. Some such regions, in the field of optimal foraging theory, described as "analytical categories" by Smith (1983:626), are "diet breadth (prey choice), patch (microhabitat) choice, time allocation, foraging-group size, and settlement location --in other words, what to eat, where to forage, how long to forage, with whom, and where to live." Smith (1983:626) also points out that while there may be specific variations among individual case-studies, optimal foraging theory must be a general theory, i.e., it would have little or no value reduced to a historical account of a specific site. Generalization of the theory is what allows archaeologists to practice science rather than an isolated historical description of a particular empirical instance.

Many critiques of optimal foraging theory exist. One of the most challenging is that it represents a sort of "ecological determinism." As Smith (1983:626) puts it, referring to the positions of Boucher and Gould, these opponents charge that the Darwinian aspect of optimal foraging theory is a "loose analogy," when applied to human beings, and "represents a 'fallback position' from stronger forms of genetic determinism and sociobiology." This argument is raised particularly against those who want to view a strong connection between genomic and phenotypic expression as a force that is designing optimal foragers. Proponents of the softer approach argue that predictive behavior emanates from "cultural evolution." Smith (1983:627) cites Boyd and Richerson (1982); Durham (1976, 1978, 1982); Pulliam (1981); Pulliam and Dunford (1980); and Richerson and Boyd (1978, 1992) as theorists who have argued that specific adaptive strategies are products of cultural evolution rather than something strictly reducible to genetic transmission.

The contention between whether optimal foraging behavior might be shaped by adaptation to the point that the phenotype expresses a specific foraging strategy (or always opts for the most optimal foraging strategy) or whether it is the product of cultural evolution represents two diametric polarities that need be neither mutually exclusive nor jointly exhaustive. Evidence for genetic transmission of behavioral patterns is clearly demonstrated in the well known case of the Sphinx wasp, which is born "hard-wired" to find a certain kind of caterpillar, paralyze it, and lay a single egg on it, which will feed on the host and eventually produce another wasp, complete with the behavioral tendency, although never having interacted with the parent. Further, human beings also exhibit genetically transmitted "tendencies." A good example is the linguistic "hard wiring" present at birth, which is then developed through social interaction. What we see in the human example is a combination of genetic propensity coupled with environmental "fleshing out." In all likelihood, this is also the case with adaptive behavior, i.e., that while adaptation and natural selection furthers genetically favorable propensities, cultural indoctrination allows it to develop fully. Human beings may have propensities for survival that are genetically inherent, but each individual is born within a biographical situation, in a context of predecessors, with a preexisting stock of knowledge, normative influences, and existing adaptive strategies. While the phenotype may express a genetic tendency to be adaptive, it is the confrontation of the actual individual with the actual environment that gives rise to specific adaptive behavior.

While these features are problematic in some areas, taken together they constitute a reasonable starting place to conduct a scientific examination of, in this case, human behavior within a limited-agricultural foraging group. Furthermore, application of this scientific approach to the analysis of archaeological sites is consistent with the larger evolutionary approach that is at the foundation of modern biology. Maximizing net rate of energy return, combined with optimization theory, cast into a general mathematical model that relates discrete aspects of human behavior will never succeed in giving us the final answer about why a particular group behaved in a certain manner. However, it represents the most scientific approach to understanding the major components of adaptive survival, without which a group of people would cease to exist. Simply, we are looking at the "lowest common denominator" of group behavior –the fact that they must survive within the context of environmental constraints and, most likely, with the least amount of struggle.

Basic Models

Introduction and Rationale

Evolution, regardless of the form of life involved, is always a struggle for acquisition of resources. This struggle intensifies in direct proportion to the scarcity of resources and becomes lax in relation to abundance. The best analyses of the human struggle for survival occur in situations of moderate scarcity. Simply, there is a greater chance for survival of those who are more successful in obtaining energy-producing resources (various foods) and are, as a result, able to reproduce more often and live more productive lives. Consequently, an essential and, to a great extent, causal relationship exists between available resources, their distribution, and strategies chosen to interface with them. This means that variables from the environment, such as weather, availability of water, available shelter, and available food resources coalesce with that of human limitations for successfully exploiting these resources within the environmental constraints of time, space (especially proximity), and energy (both expended and gained) and can be understood as a subsistence strategy. In other words, the ability of a group of people to *adapt* to their environment, especially in devising effective *strategies* to respond to challenges of environmental constraints, is perhaps the most foundational aspect of their ability to flourish.

The Prey-Choice (Diet Breadth) Model

Kaplan and Hill (1992:168) have experimented with various "evolutionary models" that illustrate the relationship between environmental variables and human limitations. Although larger models can be envisioned, their analyses are best suited to the examination of simple groups that obtain(ed) most of their resources directly from the environment and have not developed extensive trade and symbolic exchange mechanisms. Therefore, they limit their analyses to "hunter-gatherers and forager-horticulturists with little or no market involvement" (Kaplan and Hill

1992:167). The model is also limited according to the technological development that a group has attained, so that the more sophisticated the technology, the more successful the group can be within a limited environment. Both of these features of the model are suitable for an examination of prehistoric groups subsisting on the Plains of North America.

Mathematical Models of Prey-Choice

One important aspect of analyzing a group of people on the basis of their subsistence strategy is determining the ways that they chose what food to eat. This choice, although seemingly simple, involves a host of variables, including: time and energy spent acquiring the resource, time spent processing it, resource abundance (based upon the rate that it is encountered), the return rate of energy from the average encounter, and the probability of successful resource acquisition. From these factors Kaplan and Hill (1992:170) construct a general mathematical representation of the differential relationship of various variables that, when factored together, rank the overall energy gain, thus allowing them to "rank" the various resources in terms of which are optimal (i.e., the net energy gained is highest relative to the net energy expended in acquisition). On the basis of the general analysis of environment (including available resources), available technology, and known patterns of behavior, Kaplan and Hill (1992:167) attempt to illustrate how the general mathematical model can be used to explain what they describe as "variation in diet and food acquisition" and "develop general models of behavioral decision-making."

The basic differential model is as follows:

$$R_{max} = (E/T_f)_{max}$$

In this formula, explained by Kaplan and Hill (1992:170), (R_{max}) refers to the maximal rate of net energy acquisition, which is equal to the total net energy obtained from the resources (E) divided by total foraging time (T_f). This is the simple form of the equation; however, total foraging time (T_f) can be divided into two aspects: (1) time spent searching for resources (T_s) and (2) time spent handling the resources (T_h). Time handling includes all of the things involved in obtaining the resources once they are located; namely, time spent in failed acquisitions and time spent processing the resource once it is obtained.

Although this simple equation determines the relationship of energy acquired and energy expended, many other sub-variables occur that factor into the equation to make it more precise. The extended version of the differential equation is expressed in the following form:

$$R = \frac{\Sigma^{n}_{i=1} T_s \lambda_i p_i e_i - sT_s}{\Sigma^{n}_{i=1} T_s \lambda_i p_i h_i + T_s}$$

Where the rate (R) of net energy acquired during foraging, according to Kaplan and Hill (1992:170),

> is equal to net energy acquired from resource pursuits [the sum of all encounters with all prey types ($T_s\lambda_i$), times the probability that they will

be pursued (p_i), times the expected net energy returns from encounters with each prey type (e_i)], minus the energy expended in search [the energy costs of search multiplied by time spent searching (sT_s)]. Time spent foraging (T_f) is equal to time spent handling resources [the sum of all encounters with all prey types ($T_s\lambda_i$) times the probability that they will be pursued (p_i), times the mean handling time per encounter (h_i)], plus time spent searching for resources (T_s).

From this equation, variables can be replaced with actual values that allow a ranking of resources in terms of their net energy gain. The results indicate which resource is most efficient in terms of acquisition, so that "the set of resources that result in R_{max} are referred to as the *optimal set* or the *optimal diet*. The total number of resources in the diet, counting from the top of the ranked list, is referred to as *diet breadth*" (Kaplan and Hill 1992:171).

Some Problems with this Approach

An analysis of diet breadth includes ranking prey in terms of optimal diet. It is possible that the group does not follow this ranking, although there are indications that it is applicable to both human and other primate groups (Kaplan and Hill 1992: 171). However, in human populations, cultural traditions often preclude optimal diet (e.g. people of Jewish descent often avoid eating pork for religious reasons, even if pork were the most efficient food available to them). While Kaplan and Hill (1992:172-176) supply examples of how the formula works, clearly in prehistoric reconstructions there are indeterminate aspects. In addition, while it is conceivable that cultural practices might skew the results from the analysis of a prehistoric group, it is more likely, however, that while examining the diet breadth of a prehistoric group, the archaeologist is constrained by lack of exact data for certain parts of the equation. It is not possible for the archaeologist to watch the behavior of a group of people to determine the average time spent searching and handling a resource item[1]. Consequently, when working from debris excavated from an archaeological site, the equation must be worked "backwards" (i.e., tools, floral, and faunal remains can be placed in classes that can be supported by the formula). In other words, the remains indicate the strategy that a given group of people adopted and, with knowledge about the environment and resources available at the time, can be used to construct the subsistence strategy of that particular group. Given the reconstructed model, the archaeologist is able to postulate that the optimal strategy would result if the equation were right; however, this postulate must be evaluated in terms of the actual data discovered, as well as information obtained about the surrounding environment and availability of resources (Kaplan and Hill 1992:176).

The Patch-Choice Model

Another aspect of the general model is the notion of "patch choice." Kaplan and Hill (1992:178) explain, "when resource types are clumped together they are said to constitute *patches*." The idea of patches of resources is important since they represent areas that, when recognized by

[1] In fact, Kaplan and Hill (1992:172) clearly state: "In order to perform the strongest test of the prey choice model, it is necessary to measure the values of e, *h*, and λ for every potential resource encountered by a forager."

the foragers, maximize the abundance of environmental resources. Through "patch choice," foragers adopt a strategy of increasing their net energy return through intelligent decisions and behavioral patterns that adjust one variable of the equation, resulting in more efficiency overall in the net return of energy. Kaplan and Hill (1992:178) state that modeling patch exploitation time is similar to their prey choice models, specifically:

> [p]atch choice models use the same choice principle (mean rate maximization) and many of the same constraints as simple prey choice models, but they differ in their assumptions about prey distributions and net energy gain as a function of handling time. The prey choice model is based upon the assumption that search time is shared among all potential prey because they are encountered at random as a function of their abundance. However, if environments are sufficiently patchy, foragers may alter their return rate by spending more time searching specific portions of a habitat.

The main concern is how long a forager can remain in a particular patch before moving to another area (Kaplan and Hill 1992:178). This is the genesis of their attempts to devise a way of modeling patch exploitation time. Basically, they supply us with three general models of "patch exploitation time." Accordingly, (1) a group of foragers might enter a patch and never have to leave, since the resources within that enriched environment continue to exceed demands placed upon the environment by the users and the environment itself is stable enough to support this continual abundance. This type of patch occupation will be called the "steady state model." On the other hand, (2) the patch might be occupied and the resources suddenly diminish. This might be the result of many things; for example, an environmental change such as a river drying up or a herd of animals migrating to another area or a thunderstorm causing a flood in the patch area that prohibits occupation and exploitation of resources. We will call this particular model the "sudden decline model." And finally, (3) resources within a patch may continually decline until the advantage of inhabiting the patch is no longer profitable. We will call this the "steady decline model."

As we might expect, the choice of patch exploitation can be correlated directly with habitation strategies. For example, a group following a herd of animals over long distances might require either many "camps" along the migration route (supposing that it is regular) or portable shelter to remain flexible and maximize the amount of energy gained in terms of shelter. If the "patch exploitation model" is applied to prehistoric archaeological sites, clues can be discovered that may indicate the model that is most appropriate. For example, permanent structures may indicate a "steady state model," semi-permanent structures may indicate a "steady decline model," and evidence of sudden abandonment of a site may indicate a "sudden decline model." However, in archaeological analysis, reductionism to only one aspect of the site might alter the likelihood of a reasonable reconstruction. For this reason, and particularly in archaeology, application of these models are highly speculative and must be evaluated in terms of all other data, including climate reconstructions, floral, and faunal remains (evidence of abundance or scarcity), technology, and other indications of behavioral choices and subsistence strategies.

The Central-Place Foraging Model

In addition to the patch approach to resource exploitation, Kaplan and Hill (1992:184) examine what they call "central-place foraging." According to this model, some groups tend to have a "base camp" or "village" and leave to acquire resources. Kaplan and Hill (1992:184) argue that this practice might occur anywhere along a continuum from a "random search and encounter" to "targeted search and pursuit." They provide examples from the Aché and (perhaps) the !Kung hunters for the first random search and encounter style and cite Binford's (1978) description of the Nunamiut Eskimo men seeking a certain prey as an example of the "targeted search and pursuit" (Kaplan and Hill 1992:184). It is important to note that this is a continuum, and, as omnivores, humans can be expected to take advantage of any easily harvested resources, even while on a targeted hunt.

The central-place foraging model requires a cost in terms of travel to and from the food resources. Carrying time greatly impacts the overall effectiveness of the subsistence strategy (at least according to the mathematics of diet choice and patch exploitation models). The question arises: why would a group of people adopt a strategy that is less efficient than another? Clearly, in the case of prehistoric groups the answer is highly speculative. However, there may be many reasons for this behavioral choice: (1) the group may have established dwellings for greater protection from a hostile environment (which may include other hostile groups); (2) they may find that a more established habitat allows for more efficient processing of the resources; or, (3) the stable environment may be found to support procreation and child rearing more efficiently than a mobile habitation strategy. Clearly resource maximization models (especially when dealing with prehistoric remains of a site) must include many variables and diverse perspectives to gain insight into the probable reasons for a particular strategy.

Within the central-place foraging model, Orians and Pearson (1979) distinguish both single and multiple "prey-loader models." This distinction describes behavior along two fundamental axes: (1) a central-place forager on a resource expedition may wait at a single place, scan for food, and harvest what passes by. Kaplan and Hill (1992:185; emphasis added) observe that, "[t]he model shows that as distance from the central place to the site of encounter *decreases*, diet breadth increases and includes items of both high and low profitability" and "longer distances narrow the diet to include fewer items [but those that are] of high profitability." In contrast to this model, the "single-prey-loader model," described by Orians and Pearson (1979:162) "is designed for choices about which prey to handle when resources are *sequentially encountered* in patches some distance from the central place" (Kaplan and Hill 1992:185). According to this model, "as distance increases . . . foragers should return only with higher-ranked resources, passing by low-ranked items" (Kaplan and Hill 1992:185). Comparing the two models, it is clear that when the distance from the central place and the resources is greater, the maximum energy return for the load carried must necessarily increase. Consequently, the "single-prey-loader model" is most suited for hunters of larger prey.

The Site Catchment Model

Although the "patch-choice" and "central-place" models are concerned with spatial relationships between human beings and their environment, another version of spatial analysis, called "site catchment analysis," is useful in archaeological reconstruction. The development of the site catchment approach has been more along the lines of archaeological research and less following contemporary ethnography. Central to the site-catchment model is the emphasis upon, as Roper (1979:120) puts it, "the primacy of man-land relationships in determining site locations." This is cast in direct contrast to other theories that view competing groups as the fundamental principle in ordering spatial relationships (cf. Hodder 1977; Hodder and Orton 1976; Jochim 1979,1981; Schiffer 1975; Wilmsen 1973). According to Roper (1979:120), the site catchment approach "emphasizes such considerations as the availability, abundance, spacing, and seasonality of plant, animal, and mineral resources as important in determining site location"; and further, "the characteristics of this entire area, not just the immediate locus of the site, are considered in inferring locational processes." A more formal description of site catchment analysis was given by Vita-Finzi and Higgs (1970:5) as "the study of the relationships between technology and those natural resources lying within economic range of individual sites."

A central presupposition of the site catchment model is that distance is equal to energy and that there is a dynamic horizon of resources surrounding a site that are practical to harvest. Beyond that point, the amount of energy required to obtain the resource far exceeds its energy return. Essentially, the basic principles of this model are similar to those contained in the prey-choice and patch-choice models, with the exception that a focus is placed upon the necessary boundary conditions of any site. Thus, we see the actual site as a locus within a usable field defined as the radius of practical resource acquisition activity. The most intense resource exploitation occurs, naturally, in closer proximity to the site, with a differential decrease in the intensity of exploitation corresponding to the increase in distance from the site.

Within this model, choices about prey are made upon the basis of the site radius. For example, while rabbits, fish, and limited horticulture might be easy to obtain close to the site, larger game, such as bison, may require traveling a longer distance from the site, yet the yield of energy might be worth the energy expended in a more intense hunt. Not only will resource choices be intrinsically connected to their spatial relationship to the site, some resources must, by necessity be closer. An example of a highly necessary resource that must be available close to the site is water, which, at eight pounds per gallon, is too heavy and cumbersome to transport over long distances routinely. As Roper (1979:121) puts it: "some resources, such as water, are so basic and so vital that the distance to obtain them must be minimized; others are less immediate, are 'worth' more, and may therefore be gathered from farther away."

Furthermore, the environment plays a larger part in the location of the site and catchment radius. Roper (1979:121) explains: "The biophysical environment is not uniform, however, either spatially or seasonally. The size, shape, and location of an individual site's catchment are therefore largely a function of the zonation, spacing, and seasonal differentials of resource zones exploited from the site." In other words, as the environment inevitably changes due to seasons changing and resources migrating, the catchment may itself need to be relocated on that basis. This means, for example, that some locations may be designed to serve as "winter sites" and others as "summer sites."

What is important about site catchment analysis is the correlation between location and function. Rather than a simple location, the site itself is functional. A direct causal relationship exists between the location of the site and how it works as a locus within which resources may be obtained.

Seen from this perspective, site location (along with its projected radius of effective activity) plays an active role in the effectiveness of the chosen strategy and is directly related to the subsistence behavioral patterns of a group.

Applications of Ethnographic Models to Reconstructive Archaeology

Application of these various models to archaeological studies will require an approach based on extrapolation, especially those proposed by Kaplan and Hill. Namely, because it is not possible to observe and rate various components of subsistence behavior and then plug actual values into the prey-choice equation, and because information is limited about various patches that were available to a prehistoric group, and because we are unable to observe single-prey or multiple-prey loading behavior, this information must be inferred from the remains of a group. The kinds of things that remain are: place in time, shelter structure, technological debris, floral and faunal remains, and the relationship between these features. It is also possible to use climatological data to reconstruct the climate, employ information about the kinds and densities of animals and plants to determine likely choices and relative abundance, and use comparative information from other locations as elements of a comprehensive subsistence strategy evaluation. Consequently, in archaeological analyses, it is not possible to provide exact numerical indications of values for mathematical models.

On the other hand, the fact that mathematical models actually work in ethnographic studies is a good reason to expect that something similar would have been the case for a prehistoric group. While ethnographers can observe mitigating factors such as entrenched culturally transmitted behavioral patterns that sometimes alter the model, this information is usually not present for Plains archaeologists dealing with prehistoric settlements. Therefore, the results of a subsistence-strategy analysis of a prehistoric settlement are more tentative for the archaeologist than for the ethnographer. This does not mean that this kind of study is not valuable; on the contrary, basic survival needs of human beings are relatively constant and must be met in terms of time, space, energy, environment, and technology. These categories relate directly to the manner in which human beings subsist and the strategies they choose in order to survive. Although there may be cultural nuances (and most probably were), there is a breaking point where cultural practices can become outdated and threaten the survival of the group. In these cases, the group either finds new, more effective, strategies or it will cease to exist. The equilibrium of human behavior centers on a group of people finding a workable subsistence strategy. For this reason, subsistence strategy analyses of archaeological sites represent the most basic type of examination that can be done. Since it is foundational, all other discussions about culture and practice must be subsequent to the discussion about survival.

The General Archaeological Model

It is clear that a strong relationship exists between the environment and the strategy employed by a group of people to survive within it; however, various approaches allow examining this relationship, especially in relation to archaeological studies. The models put forth by Kaplan and Hill (1992) can be divided broadly into three categories: (1) diet breadth/prey choice, (2) patch choice, and (3) central-place foraging. Although they and others create various other models, the central variables from these theories provide a useful background for the present study. A general model can be constructed that includes all possible variables from optimal foraging models, which then can be used to study the archaeological remains of the Two Sisters site.

The general model most applicable to archaeological investigations is broadly based upon challenge and response. The most basic challenge is to survive; however, survival itself occurs within a contextual background of the environment. The main needs for survival are food, shelter, and water – and these constitute a relationship between humans and their environment. Decisions about the procurement of these resources are constrained by availability of resources, technology, climate, and energy acquired related to energy expended in acquiring necessities. Factors such as search time, abundance measured by the rate of encounter, probability of success, and average handling time, all enter into the measure of energy gained from available resources. Added to these concerns is a more global analysis of location. Patch-choice models and the possibility of central-place foraging are also necessary for understanding the subsistence strategy of a prehistoric group.

Since archaeologists must work with the remnants of a social group that has long since gone, only the remains can be used to build a plausible model of the most likely subsistence pattern. Such an analysis must first examine the outer variables, particularly climate, availability of floral and faunal resources, location of water, and the relative position of evidence of group activity at a particular place during a particular time. This means that a detailed evaluation of the location in relation to landscape is the starting point. From this it is possible to evaluate all the other data in a context of locale. The relationship between location and other resources, such as water, can be examined through a geological analysis of the location. Furthermore, the location will be more or less distant from usable lithic resources, and material used to construct shelters and other resources, such as timber or its absence, may have an impact upon the kinds of shelter constructed. The soil and rock of the area are also important elements in developing a scientific understanding of what choices were available to a prehistoric group.

Next, it is necessary to use climatological data and reconstruct elements of weather, water availability, likelihood of horticulture as a viable possibility, and kinds of flora and fauna that might subsist within a given radius inhabited. Site catchment theory is based upon the likelihood that an individual can only go so far to obtain resources. Within the most likely radius, therefore, resources can be analyzed in terms of floral history; faunal prevalence and movement patterns; stream, pond, and river proximity; and kinds of shelter that would be necessary to endure the climate of that time. The remains of the site can be examined directly in terms of its spatial orientation to the landscape and evidence of the kinds of materials and style of shelter constructed. Evidence of more detailed shelter construction, particularly in groups, may indicate a more permanent home, and thus be evidence of either central-place foraging, or at least of a steady-state patch choice. Evidence of portable shelter might indicate a more nomadic approach, in which the group followed a herd of animals along a water and food trail (such as a river).

The implements used by inhabitants of a site are valuable clues to their level of technology. For example, spear points might indicate that the users were less technologically advanced than those with arrow points, for example. The available technology is a limiting factor on how close an individual must get to an animal to make a kill and to the accuracy of the attack. Better technology would then indicate a greater chance of success, all else being equal. Furthermore, the presence of processing tools indicates a great deal about subsistence behavior. The prevalence of hide scrapers and absence of large grinding stones likely indicates hunting as the primary subsistence behavior. The locations and extent of fire rings or hearths may indicate whether cooking was performed in a group or individual setting. Tools such as awls may indicate the construction of clothing. Baskets, pottery, and other implements provide further clarification of the approach used by a group of people.

In addition, floral and faunal remains can be analyzed to determine exactly what were the major constituents of the diet of a prehistoric group. One would expect a prevalence of large animal bones for a group whose primary subsistence behavior was hunting; their absence may indicate that they were not primarily hunters. A large amount of cultivated plant remains is, of course, absolute evidence of horticulture. Blends of horticultural indicators and hunting evidence would reveal a mixed approach to subsistence. And, a wide assortment of floral and faunal remains would most likely indicate a certain degree of opportunism, perhaps evidencing a group located at a central point, say a river, where many different animals came to drink and thus were exploitable without great energy expenditure.

Finally, lithic or other evidence that is not indigenous to the location (i.e., in a reasonable range surrounding the site) clearly indicates one of two things: (1) that there was direct exploitation practiced by the group; or, (2) that there was some form of trade between groups. The emergence of trade is especially important, providing clues about the initial formation of a wider culture in which technology and resource harvesting strategies are exchanged. This kind of exchange may lead to rapid developments in the capacities of a group to adopt more efficient subsistence strategies.

While the mathematical precision of Kaplan and Hill (1992) is sacrificed in a more general archaeological account, the central features of behavioral decisions in relation to the environment are clearly evident. Patterns of behavior are not observed directly, but may be inferred from what is left behind by a prehistoric group. The objects and their locations, taken in terms of their relative proximity to each other, and within the constraints of climate, environment, and the availability of resources - all coalesce into a viable model for anthropological research. This method of reconstruction will be employed here.

Specific Considerations in Examining the Two Sisters Site

This section examines some of the particular features of the Two Sisters site from the perspective of theoretical formulations of the optimal foraging theory of evolutionary ecology, particularly focusing on the roles of diet breadth and site catchment analysis. However, first, it is important to examine constraints posed by the climate during the occupation of the site, as well as examine availability of certain resources, in this case bison, which may have affected the subsistence strategy of the occupants of the site.

Late Prehistoric Period Environment

Before an analysis of diet breadth and site catchment can be implemented, environmental conditions and availability of resources during the Late Prehistoric period need to be reviewed. The environment during the Late Prehistoric period was changing and becoming cooler and dryer. Wendland (1978:281) supports the argument for a cooler more arid climate beginning about A.D. 1200 with pollen and faunal data. Hall (1988:208-209), using faunal remains and soil development, argues a similar position with environmental conditions changing initially about A.D. 1100. Application of the site-specific climatic model developed by Bryson and Bryson (1995) suggests that these cool, arid conditions decrease horticultural productivity. This is because precipitation during the growing season most likely dropped significantly during July and August. Plants such as corn, beans, and squash require adequate moisture while they are actively growing to successfully produce an edible crop. If the modeled precipitation is accurate, then horticultural pursuits in the area of the Two Sisters site were probably not a reliable subsistence strategy. Crops would have been planted only to wither and most likely die in August.

The frost-free growing season, estimated to be about 186 days, combined with the reduced precipitation during the summer months is another constraint to horticultural productivity. With such a limited season, most likely only one crop of corn per year could have been produced. Given these climatic conditions - both annually and seasonally - horticulture was probably not a reliable subsistence strategy.

Further, reduced precipitation would impact the wild grasses, causing some species to thrive and others to be forced out or greatly decreased. Species such as little bluestem (*Andropogon scoparius*) and other short-rooted species were most likely eliminated and replaced with more drought tolerant grasses such as blue grama (*Bouteloua gracilis*), side-oats grama (*Bouteloua curtipendula*), western wheat grass (*Agropyron smithii*), and sand dropseed (*Sporobolus cryptandrus*) (Albertson and Tomanek 1965:717-720; Albertson and Weaver 1944:398, 400-403, 421; Coupland 1958:302-303).

Change and expansion of these wild grasses resulted in an increase in the number of dependent herbivores, especially bison (*Bison bison*). Bison, in addition to increasing herd size, expanded their range. According to Dillehay (1974:184-186), bison populations thrived from east-central New Mexico to parts of eastern Oklahoma during the Late Prehistoric period. Creel et al. (1990:64) argue that bison numbers were low from about A.D. 900-1300 and then "in contrast, during the following period, *ca.* A.D. 1300-1650, bison seem to have been present in considerably greater numbers."

Significant increases in bison exploitation are evident in the archaeological record of areas with increased numbers of recovered bison bones and lithic tools used for processing meat and hides (Creel 1991; Creel et al. 1990). Chipped stone endscrapers are common in site assemblages dating after A.D. 1300 and are "widely considered to have been used primarily in processing the hides of such large mammals as bison" (Creel et al. 1990:65). Diamond-beveled knives further support the importance of bison because they become more frequent at this same time period (Creel 1991:44-45). Bison bone quantities recovered from stratified archaeological sites that date after A.D. 1300 also increase (S. Baugh 1986; Boyd 1997:337; Creel et al. 1990:64-65; DeMarcay 1986:133; Dillehay 1974:184-186; J. Hughes 1991:30).

Lintz (1986:242-243) and DeMarcay (1986:133) suggest that the increase in bison populations changed human subsistence strategies. A mixed hunting-gathering-horticultural economy is suggested that is heavily dependent upon bison. Because bison contributed between 79 and 98 percent of the usable meat at most Antelope Creek phase sites, Lintz (1986:242-243) suggests that it is the most important faunal resource. DeMarcay's (1986:113, 115, 125,) research further supports intensive bison hunting and identifies extensive bone grease manufacturing during the Antelope Creek phase. Corn is found at most sites, but its relative importance is unknown (Lintz 1986:242). Other game and wild plants supplement the diet. With bison most likely increasing and expanding their range, humans adapted by decreasing the variety of species hunted and specializing on one particular resource - bison.

Preliminary Expectations of the Ranking of Prey

Because bison numbers are most likely increasing, a preliminary anticipation of ranking of prey at the Two Sisters site, therefore, should show bison as the primary resource with elk, antelope, deer, and other smaller game ranking as secondary resources. Horticulture should also rank below bison because of the suggested reduced precipitation during the growing season.

Furthermore, the prey choice or diet breadth model allows us to predict that, when resources are stable and evenly distributed across the landscape, groups will have a generalized diet and will be small and dispersed across their territory. On the other hand, when resources are clumped and mobile, larger residential groups and territories are expected and the diet will become more specialized (Heffley 1981:128; Winterhalder 1981a:25). Once again, faunal and floral remains should help delineate the selected strategies of the site occupants. Numerous bison bones, coupled with scant horticultural remains, such as corn, may point to a diet shift away from a horticultural-based economy. Lithic tools associated with hunting and horticultural bone tools, therefore, must be quantified to aid in determining diet composition.

Other aspects that need to be considered in establishing the diet breadth model are the time and energy necessary to acquire and benefit from a resource. It is likely, if the basic model is truly indicative of human behavioral patterns, that decisions were most likely made by the inhabitants of this site based upon immediate return rates (i.e., how much energy it took to obtain the food). In addition, if population density accelerated, diet breadth should have increased along with handling costs (Bettinger 1991:84-87; Winterhalder 1981a:25; Yesner 1981:150). If the population density was increasing at Two Sisters, the diet breadth would need to expand to accommodate their subsistence requirements. Initially, this seems to contradict the previous premise that a clumped and mobile resource predicts a shift to a specialized diet. However, if bison numbers are increasing and becoming a more stable subsistence strategy, a shift to a specialized diet is an optimal survival strategy.

Time and energy are constants for this model. In order to maximize energy in a changing environment where bison numbers are increasing, groups had to be more mobile in order to survive and maximize fitness. Smith (1991:41-42) and Winterhalder (1981b:67, 92) argue that humans adapt to receive the highest return rate for the time spent foraging, selecting game for their size, quality, "nutritional value" and "social rewards." For the people at Two Sisters, this may suggest greater dependence on bison.

Incorporation of a site catchment analysis with the diet breadth model will further our understanding about the resource base and land use strategy of the occupants of the Two Sisters site. Site catchment analysis systematically analyzes resources available in the environment surrounding a site by defining the catchment area or territory and then classifying the possible resources (Hastorf 1980:86-92; Roper 1979; Vita-Finzi and Higgs 1970). Accordingly, catchment analysis stresses the hypothesis that there is a finite distance in land use where travel time outweighs the possible energy received. In addition, neighboring groups and their respective territories probably restrict access to resources.

Previous studies have suggested that agricultural groups only travel about one hour or 5 km from their residential base (Styles 1981:23). Mobile hunter-gatherer groups generally travel within and exploit a territory of two hours or 10 km from their base camp. Since the occupants of the Two Sisters site appear to have had a mixed economy of hunting-gathering and at least some horticulture, a search radius of 5 km (or one hour) will be utilized.

The Two Sisters site catchment of 5 km provides a model of the possible exploitable resources within the environmental setting of the site. Catchment areas are constructed for the soils available for horticulture, the lithic resources, and the habitat types for mapping potential plant and animal resources. The actual recovered materials from the site will be compared to this model in Chapter 7.

Summary

From its roots within the very structure of living organisms and their ability to adapt to environmental constraints, to the twofold causality of living organisms as genetic and phenotypic, and finally to the dynamic feedback processes that characterize life, evolutionary biology has led to the emergence of evolutionary ecology – the study of how life continually adapts to the environment and how this information is passed on to future generations through natural selection. While foundational for the study of all forms of life, evolutionary ecology has been applied to the study of humans, particularly in ethnographic and anthropological circles. The wide application of the fundamental principles of evolutionary ecology has established a large range of sample data, so that many of the principles have been demonstrated to be relevant.

This consistency of behavioral orientation forms the basis of optimal foraging theory, which specifies the kinds of behavior necessary to optimize the potential for survival. We have seen that the basic model of optimal foraging theory involves many "regions" of human activity that interlock to form a way of life that optimizes certain survival behavior. Among these variables are genetic propensities, individual capabilities, group size and potential output, technological development, climate, terrain, availability of resources such as food, water, and shelter, and the proximity of these things to each other. Broadly, these kinds of analyses can be broken down into time, space, and energy components that are related to obtaining resources for survival.

We have also seen the development of mathematical models that allow us to "rank" the optimal prey-choice for a particular group. Even with the problems inherent to mathematizing human behavior, these models are extremely useful. In archaeology, the models are most useful because of how they have been developed and tested in anthropological and ethnographic studies. In archaeological analyses, the model is used backwards, i.e., the premise is: if the optimal model is correct, then we should expect to find certain evidence (which corresponds to the variables of the equation). So, in the case of a particular archaeological site, large amounts of certain items (e.g., bison bones) clearly indicate that the inhabitants of that site ate bison. However, this and more such data that corroborates the usefulness of the model suggest that this diet choice was part of an optimal strategy toward subsistence. We do not "invent" probable variables, but look at that data at hand.

One very useful way to apply optimal foraging analysis to archaeological information is through the following: (1) climatological reconstruction, (2) floral and faunal reconstruction, (3) geological and hydrological analysis, (4) site characterization, (5) site-catchment analysis, and (6) measuring the kinds and quantities of debris left at the site. Although none of these components alone can provide conclusive evidence of a particular foraging strategy, taken as a whole, they form aspects of an emerging recognition of what a group of people did in order to stay alive within a particular environment.

In the present study, we have examined the prevalent environmental conditions, availability of resources, and site characterization of the Two Sisters site. If resources available during the occupation of Two Sisters site can be identified, application of these models will illustrate patterns of subsistence strategies. The environmental reconstruction and an analysis of faunal and floral remains and tools will clarify the characteristics of their mode of subsistence and the relative weight of hunting and gathering to horticulture. By applying models to the Two Sisters site, we should be able to determine how people living at Two Sisters adapted to environmental conditions. Before doing so, however, it is necessary to present information about the site and method of excavation. This is the topic of Chapter 5.

CHAPTER 5

SITE BACKGROUND AND RESEARCH METHODS

This chapter describes the excavation methods used at the Two Sisters site and provides general descriptions of each excavation work area. Information about internal and external features, their locations within the site and content, is presented. In addition, radiocarbon and archaeomagnetic dates for the site are included.

The available data comes from field school excavations conducted in the summers of 1972 and 1973 by students of the University of Oklahoma. The field school excavation for the first summer was initiated at the McGrath site and the Two Sisters site was not discovered and excavations begun until midway through the session. At that time, pipeline construction workers noticed a concentration of vertical stones, flint chips, and pottery and reported this to the directors of the McGrath field school. Since there were only a few remaining weeks for the field school, excavation of the Two Sisters site was primarily done as "salvage" archaeology. Funds for field schools are not guaranteed by the university from year to year and the principle investigators, Richard Pailes and Chris Lintz, believed that if preliminary testing was not done at Two Sisters in 1972, by the time they could return, the site would be completely destroyed and looted by "pot-hunters."

The 1972 excavation began by setting two permanent datums (one at 0-0 and a closer one to the slab structure at 0-S9) to establish a north-south base line for mapping. Initially, nine locations were postulated as possible rooms or areas. According to Lintz (1997a:2), these areas were refined as the excavation proceeded and are as follows (see Figure 5.1):

Area 1: Structure A main room (Room 1A).

Area 2: small room northeast of Room 1A (Room 2A).

Area 3: small room southeast of Room 1A (Room 3A).

Area 4: southwest part of Room 1A (Area 4A).

Area 5: small room northeast of Room 2A (Room 5A).

Area 6: exterior area north of Room 1A between two parallel rows of rock alignments.

Area 7: exterior north of Room 1A between Area 6 and Room 5A.

Area 8: exterior area east of Room 2A.

Area 1A: exterior area north of Room 1A and west of Area 6.

Through the brief 1972 field season, four rooms (Rooms 1A, 2A, 3A, and 5A) were uncovered. During the last week of this excavation, Pailes and Lintz discovered that the stone slab structure was superimposed over an earlier house that lacked a stone foundation. In 1973, this earlier house, as well as numerous exterior squares, was excavated by the second field school. In total, the two field seasons uncovered four rooms in Structure A, all of the

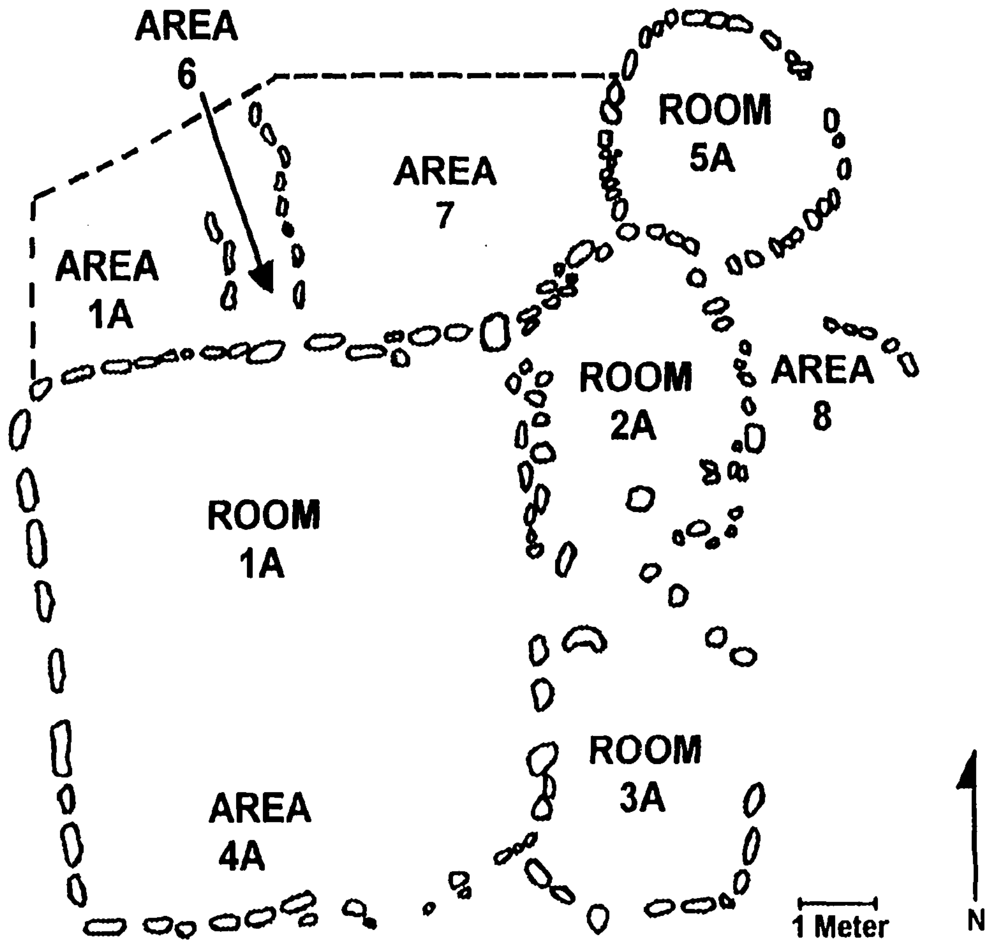


Figure 5.1. 34TX32 Rooms and Areas of 1972 Excavation.

earlier Structure B, and tested 38 additional 1.5 by 1.5 m (5 by 5 ft) extramural squares to the north, south, and east of Structure A (Figure 5.2; Appendix I).

Excavation Methods

Since data collection was done over two years and because it was initiated as "salvage" archaeology, the site was not always dug in standard square units or with a grid-system. Instead, it was dug partially in 1.5 by 1.5 m (5 by 5 ft) squares, partially by room-blocks, and partially by trenches. The depth of each level is also not consistent. Sometimes an arbitrary 10.16 cm (4 inch) level was dug, and at other times, natural levels of up to 40.64 cm (16 inches) were removed. This methodology causes all kinds of problems in data analysis because it is hard to make comparisons.

Structure A was excavated in 1972 using a room or work area approach similar to excavations at the time in the Southwest. Horizontal control was determined by room, and vertical control employed natural levels that were ascertained by sediment colors. The methodology changed for the 1973 field season when a grid system was employed to excavate Structure B and the exterior areas of the site. Structure B was delineated in 22.5 squares, measuring 1.5 by 1.5 m (5 by 5 ft). There were 38 exterior test squares. All sediments were screened through 6.35 mm (1/4 inch) mesh and all measurements were recorded in feet and inches. For this analysis, measurements are converted to the metric system that is common today.

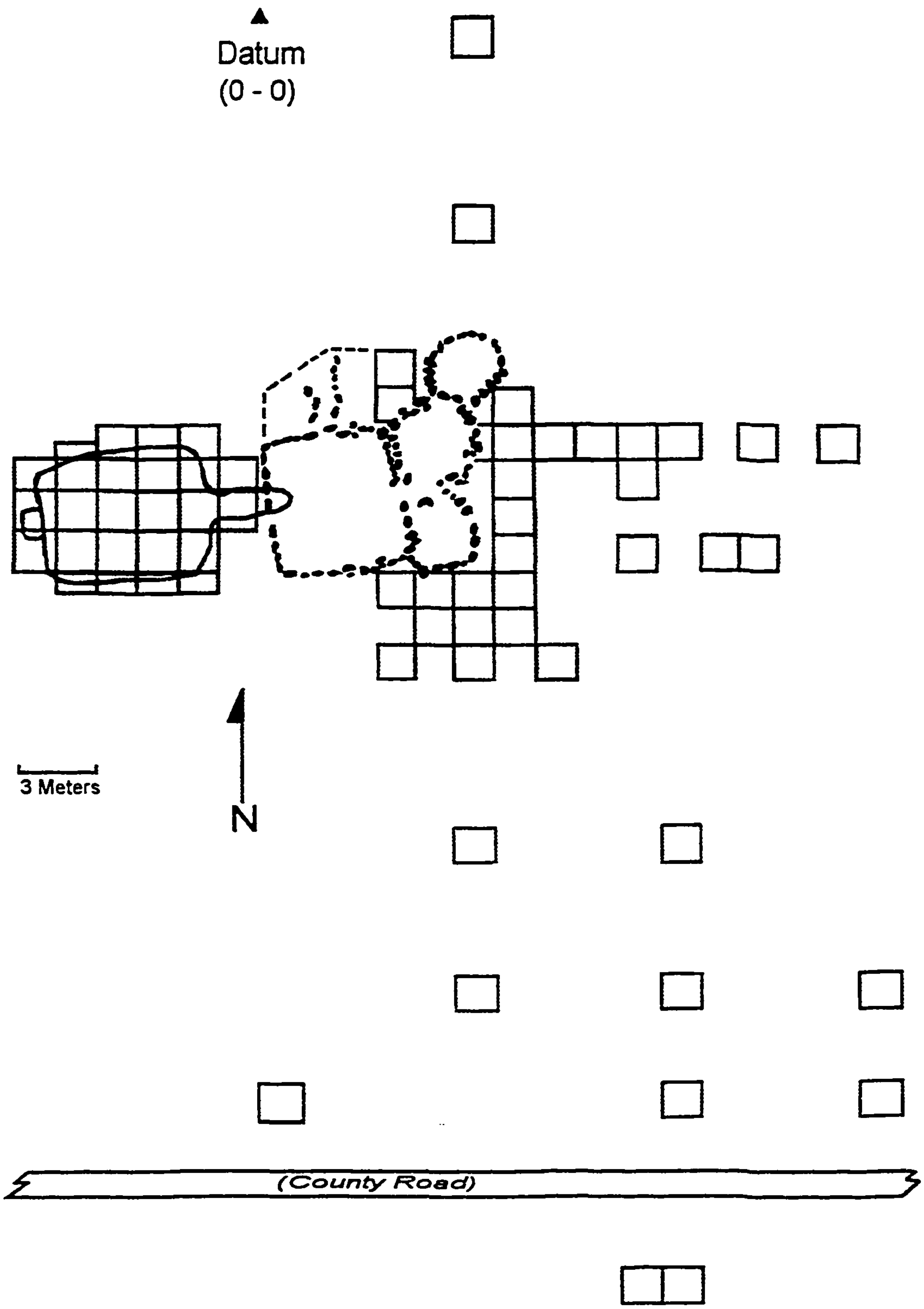


Figure 5.2. All Excavation Areas of 34TX32.

Numerous field maps of the excavations, level and feature forms, and detailed notes kept by Lintz, Pailes, and the students are used in the following descriptions. In addition, a draft of the excavation methodology and a draft of the features by Lintz (1997a, 1997b) and the limited published information on the Two Sisters site (Lintz 1972, 1973, 1979a, 1979b) comprise the majority of the following information.

Structure A

Structure A is the later of the two structures and consists of four contiguous rooms (1A, 2A, 3A, and 5A). Each room is outlined by an approximately 30 cm thick adobe plaster wall facing that encloses a single row of caliche stone slabs. The stone slabs were set vertically into trenches and then encased in adobe mud. Room 1A is the main residential room and it has an eastward extended entrance. Adjoining this entrance on the north and south sides are rooms 2A and 3A. Room 5A is northeast of Room 2A and Lintz (1997b:6) suggests that it represents a secondary building episode after construction of the first three rooms.

Room 1A

This main room of the residence is the largest room at the site. It is roughly square with rounded corners and measures 5.94 by 6.10 m. Since the northwest corner of the room was clearly defined at the outset of the excavation, work began in that corner with an east-west trench-type excavation measuring 1.5 m by 3.96 m. In an effort to determine the stratigraphy of the room, a small preliminary test pit (75 by 75 cm) was dug to a depth of 20 cm in the extreme western corner of this initial excavation area. Information from this test pit indicated that there were two natural levels within this area of the room. Natural level one was about 7.6 cm deep and consisted of a loose eolian loam. Natural level two was marked by a distinctive soil change to a dark, charcoal-stained matrix representing part of the upper roof-fall. This second level measured 7.6 to 12.7 cm below the modern ground surface.

The next step in the excavation was an area along the stone foundations in the southwest corner and along the south wall of Room 1A (1.5 m north-south by 4 m east-west). Initially the field directors believed that this was a separate room and it was designated as area 4A for the first excavation level (0-7.6 cm). After this level was removed, it was apparent that this was part of Room 1A and the 4A designation was dropped. Excavations were extended to cover the distance between the northwest corner and south wall of the room. At this time, the room measured about 6 m north-south by almost 4 m east-west. Because stone slabs had not been encountered on the east side of these initial excavation units, the last area of this room to be excavated was inside the eastern row of exposed stone slabs and extended to the previously excavated western part. This last excavation unit measured 2.1 m east-west by 6.1 m north-south. All excavation units were dug through the first natural level to a depth of about

7.6 cm.

In the northeast corner of this room about 1.82 m south of the wall, a straight, east-west alignment of white caliche gravel was noticed (Figure 5.3). This line of white caliche matrix is interpreted to be an interior partition or wall within the main room (Room 1A). It is in front of and conceals three overlapping storage pits. The storage pits at this point in the excavation, however, had not yet been discovered.

After all of Room 1A was excavated to a depth of 7.6 cm, a second test pit, labeled "Test Pit 1" in the notes, was removed. The pit was removed from the southeast corner of the room and was dug in three natural levels (levels 2-4) in an attempt to locate the floor.

Level two of Room 1A ranged from about 7.6 to 12.7 cm and stopped at an abrupt change in the soil to a fine gravel layer. This gravel layer extended into the room a distance of about 1.22 m. As the rest of the room was excavated, it was determined that this gravel deposit continued around the perimeter of the room, continuously extending in from the wall about 1.22 m and forming a bench around a depressed area. Lintz (1997a:4) suggests that this "gravel zone" represents the adobe wall melt over the floor surface.

With the exception of the center of the room, natural level three (12.7 to 20.3 cm) permeated the wall fall and contained burned patches of fill above the floor. The first cultural materials, tools and concentrations of bone, were in this level in the southeast corner of the room (Feature 5;

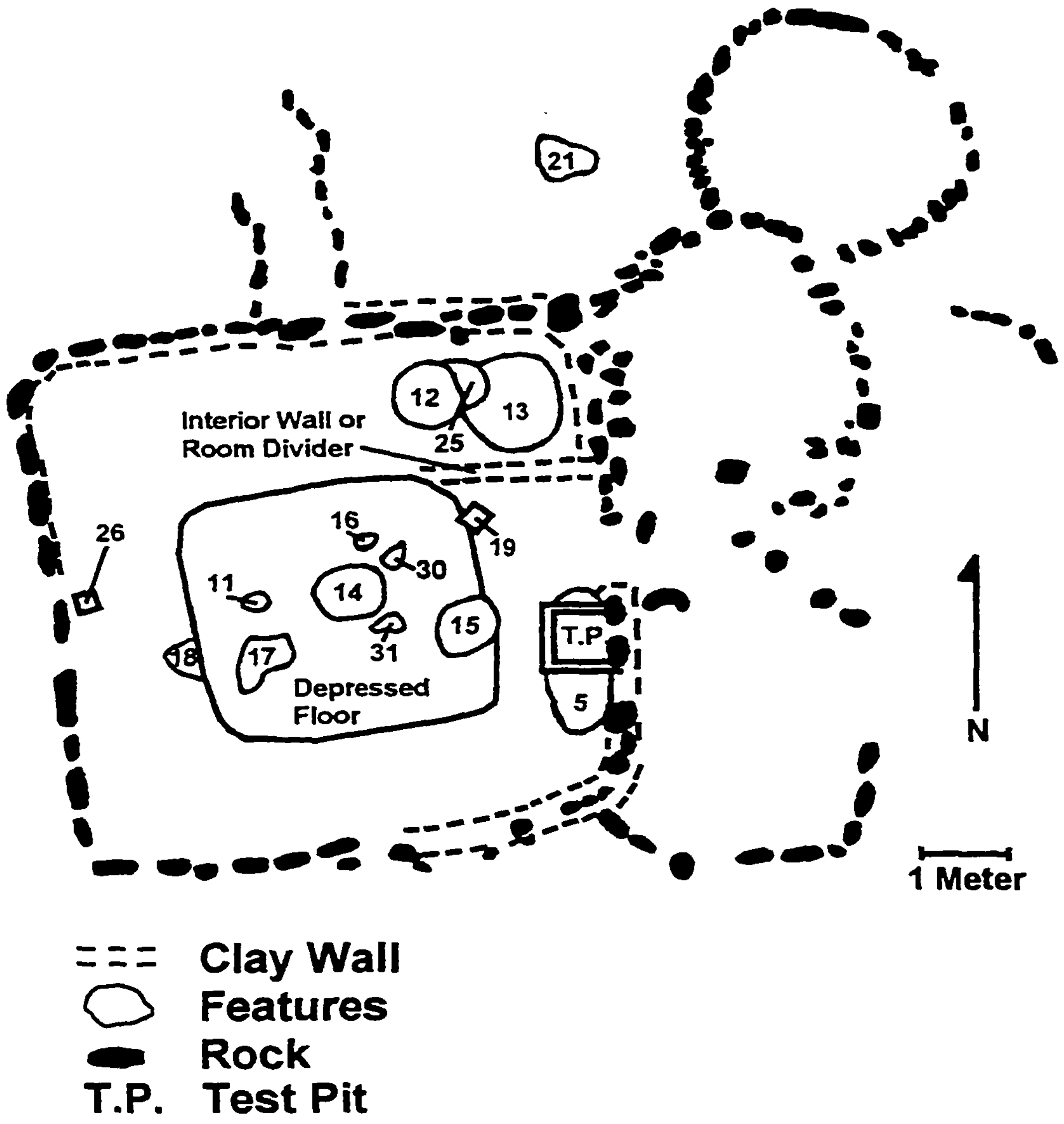


Figure 5.3. Room 1A and North Exerior Area including Features 5, 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 25, 26, 30, and 31.

Figure 5.3). Furthermore, the white caliche partition wall in the northeast corner of the room was better defined as "a thin line of whitish caliche mortar located 1.82 m south of the north wall and extending from the east wall for a distance of 1.98 m" (Lintz 1997a:4).

Natural level four was the last level to be excavated as a "room level" and it ranged from 20.3 to 28 cm below the ground surface. The matrix of this level was a dark ashy material near the exterior walls. The center of the room continued to be a distinct light brown sediment quite different from the 1.22 m area around the wall. At this point in the excavation, Pailes and Lintz did not realize that the center of the room was depressed and its different sediment was simply wind blown non-cultural fill.

A third stratigraphic test pit was dug in the northwest corner of the room. This pit measured 60 by 46 cm and was dug to a depth of 45.7 cm below the surface or an additional 17.7 cm below natural level four. According to the field notes, the pit fill was primarily sterile material.

At this point in the project, the excavation strategy changed from a room excavation to a series of test trenches (Figure 5.4). Primarily, this change in strategy was conducted to determine the location of the floor since it had not yet been encountered in the center of the room. The first trench, designated "Trench A" was a north-south trench that began outside of Room 1A on the north side of the structure. It measured 60 cm in width and extended 122 cm north of the center of the north wall. It continued

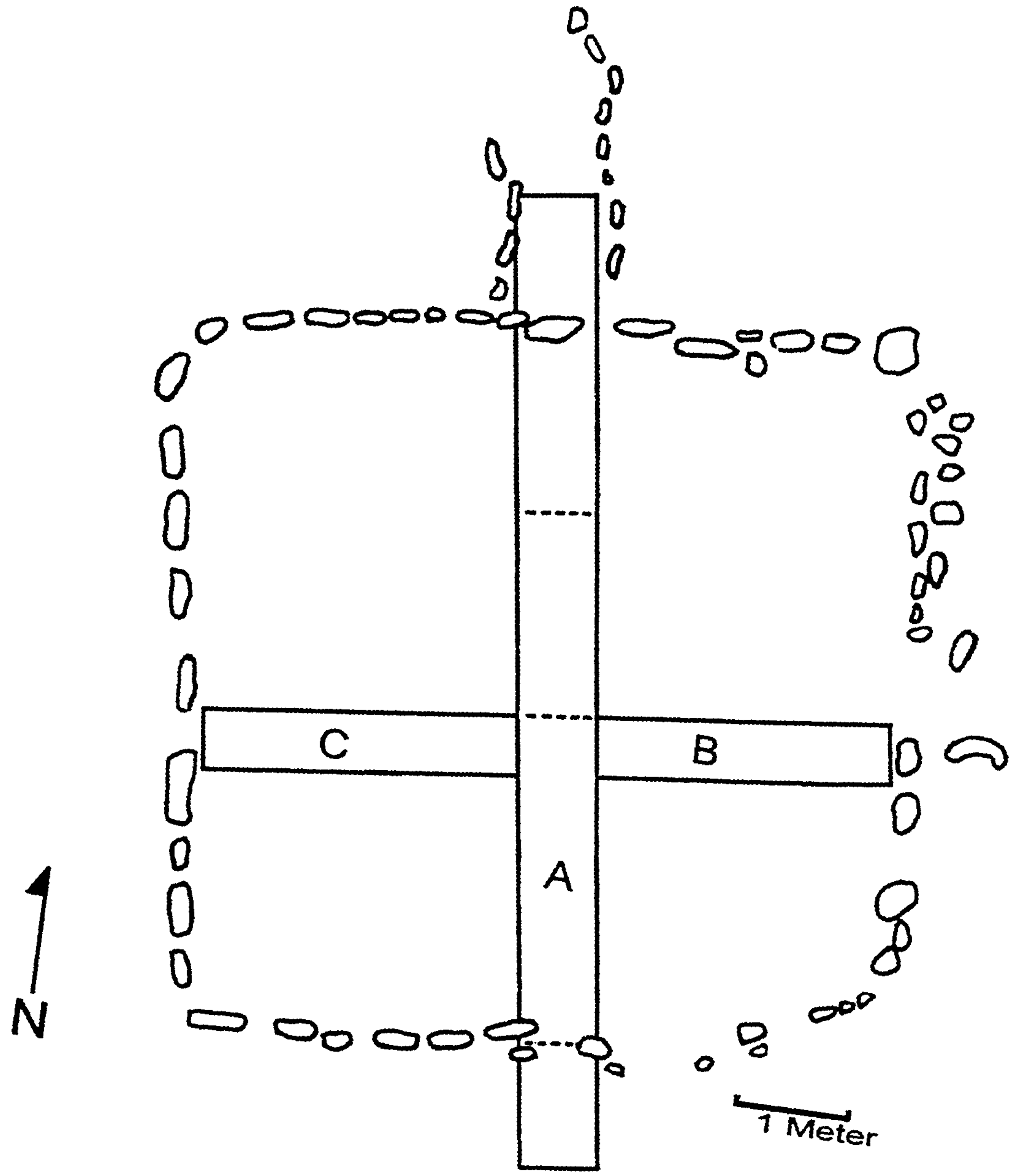


Figure 5.4. 1972 Trenches A (with divisions for excavation segments), B, and C in Room 1A.

south within Room 1A and then extended beyond the center part of the south wall approximately 91 cm outside of the structure. This long north-south trench was then sectioned into segments. In addition to one section north of the room and one section south of the room, three units were designated within the room. The northern part of the trench within the room was divided into two, 1.5 m segments, while the southern part within the room was excavated as one unit. The far north segment within the room was excavated to a depth of 68.6 cm. The next segment on the north side of the room's center was dug to a depth of 58.4 cm, while the south half was only 45.7 cm deep.

Trenches B and C were east-west trenches with B on the east and C on the west sides of Trench A (Figure 5.4). Trench B was 168 cm and Trench C 260 cm long; each ended at the corresponding exterior wall. Both trenches were 60 cm wide and were dug to a depth of 56 cm below ground surface. With these trenches in place, it became apparent that the outer perimeter of the floor (28 cm below ground surface) was level and extended approximately 122 cm from all four walls and then dropped abruptly near the center of the room. Although the base of the excavation was fairly deep in the center of the room, 56 to 58.4 cm, the central floor was still not visible. Instead, an ashy area indicated room fill.

With north-south and east-west trenches sectioning the room into four quadrants, the fill in three of these areas was removed. The three excavations were dug to a depth of approximately 66 cm in the northeastern area, 58.4 cm in the southeast area, and 40.6 cm in the southwest area. The northwest quadrant was not excavated and remained at a depth of 28 cm below the surface.

This work revealed that the central depressed section was about 2.75 m on each side. In all quadrants the excavation matrix was an ashy fill above the floor. The central floor was a plano-convex dish-shaped area that gradually dropped 48 cm to the hearth (76 cm below the surface; Figure 5.5). Probably the most significant fact revealed by the depressed square-shaped floor was that the house did not follow the common Antelope Creek phase pattern of having a centrally depressed floor channel running from the east entry to the west wall.

During the quadrant excavations, pits (Features 12, and 13; Figure 5.6) were discovered in the northeast area of the room, north of the wall partition. These pits overlapped one another and indicate different fill episodes. The earliest, which was sealed with a sterile layer of yellow clay at a depth of 40 cm below the floor surface, is on the east and is labeled Feature 13. The upper part of this feature is labeled 13A and was excavated in 1972. When fill removal reached a sterile yellow clay, excavation stopped and it was presumed that this was the base of the feature. During the 1973 field season, the rest of the pit below the sterile cap was found and excavated as Feature 13B and 13C (Figure 5.7).

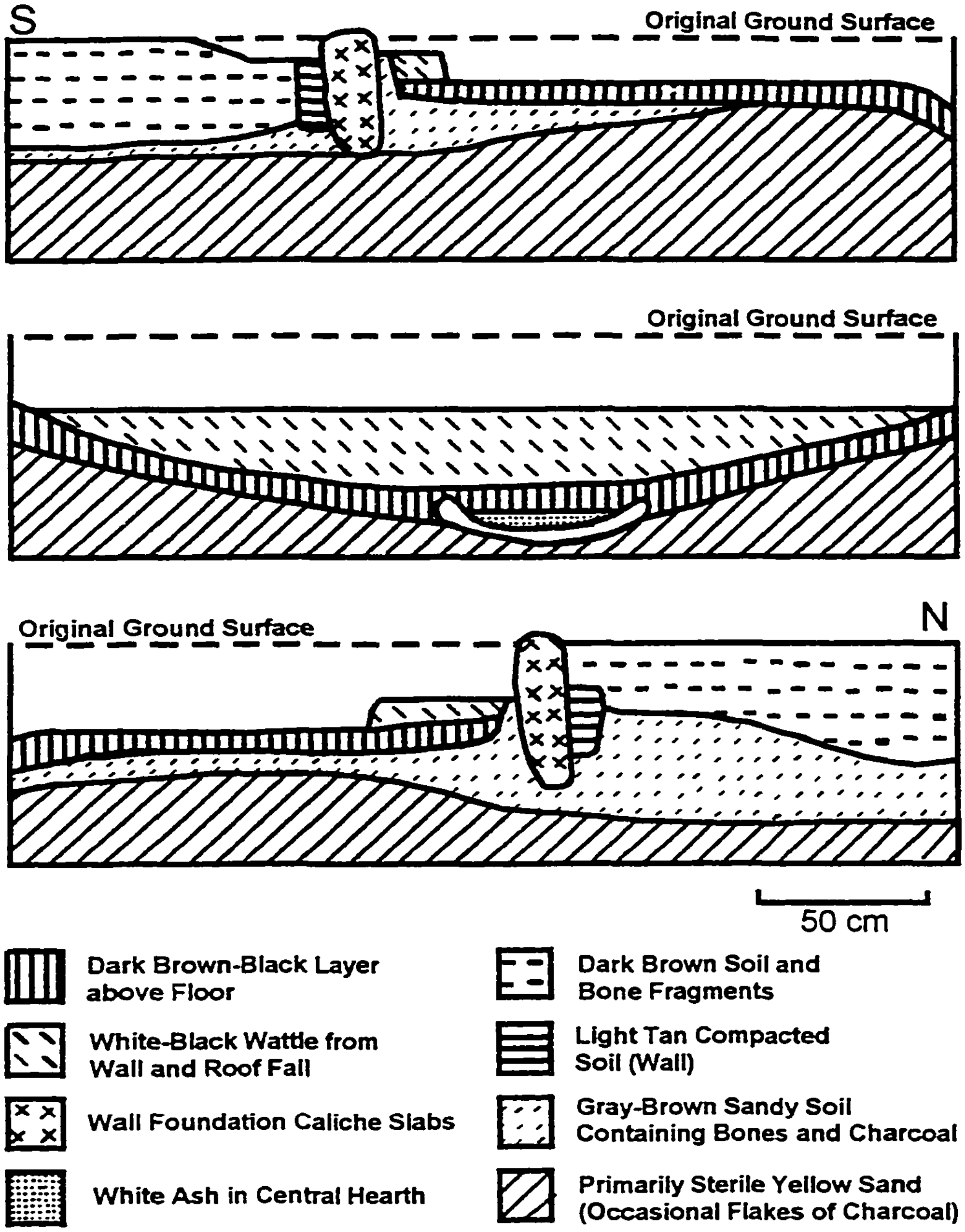


Figure 5.5. Profile Trench A (Depressed Floor).

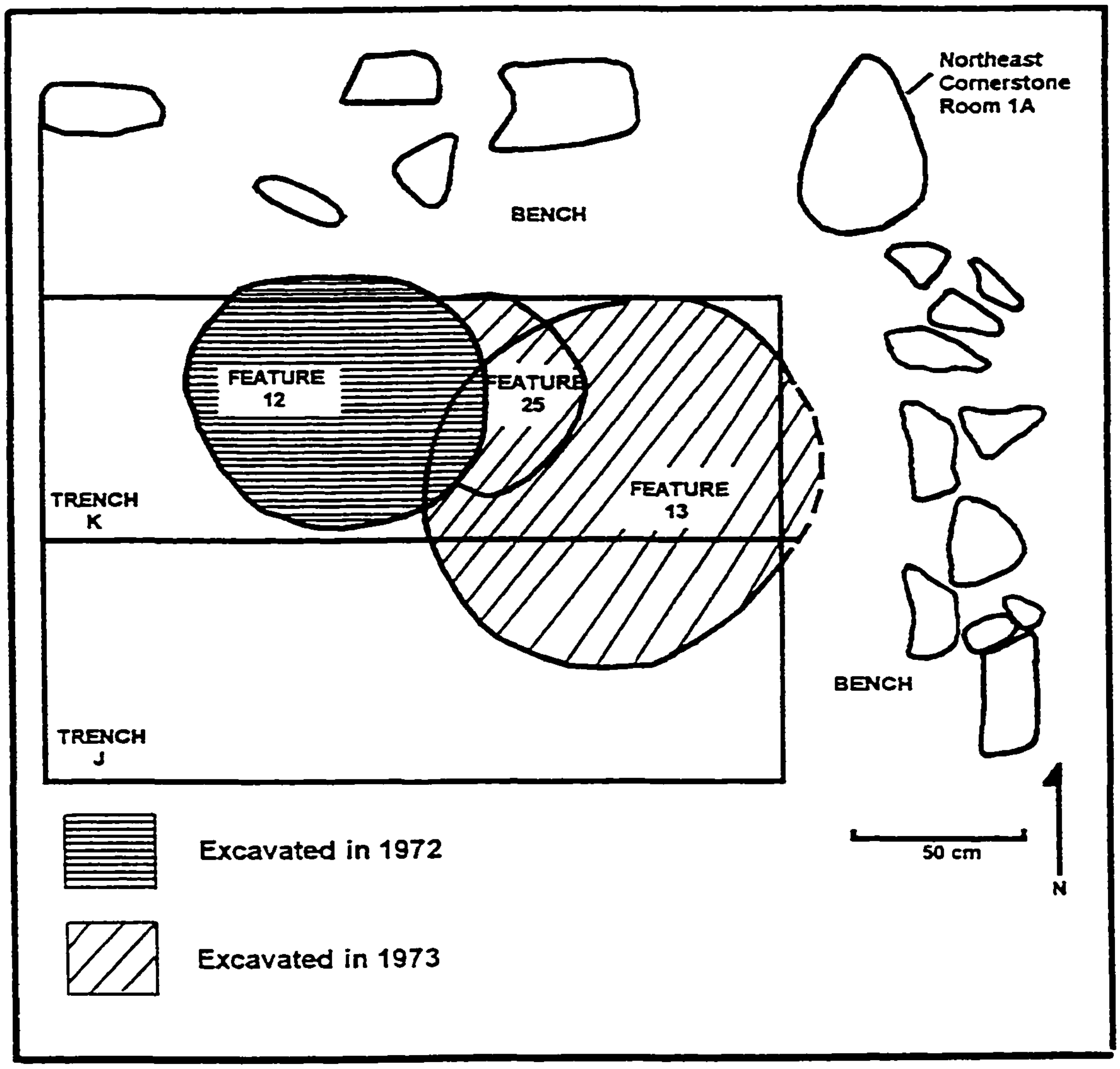


Figure 5.6. Overlapping Pits Features 12, 13, and 25 in Northeast Corner of Room 1A.

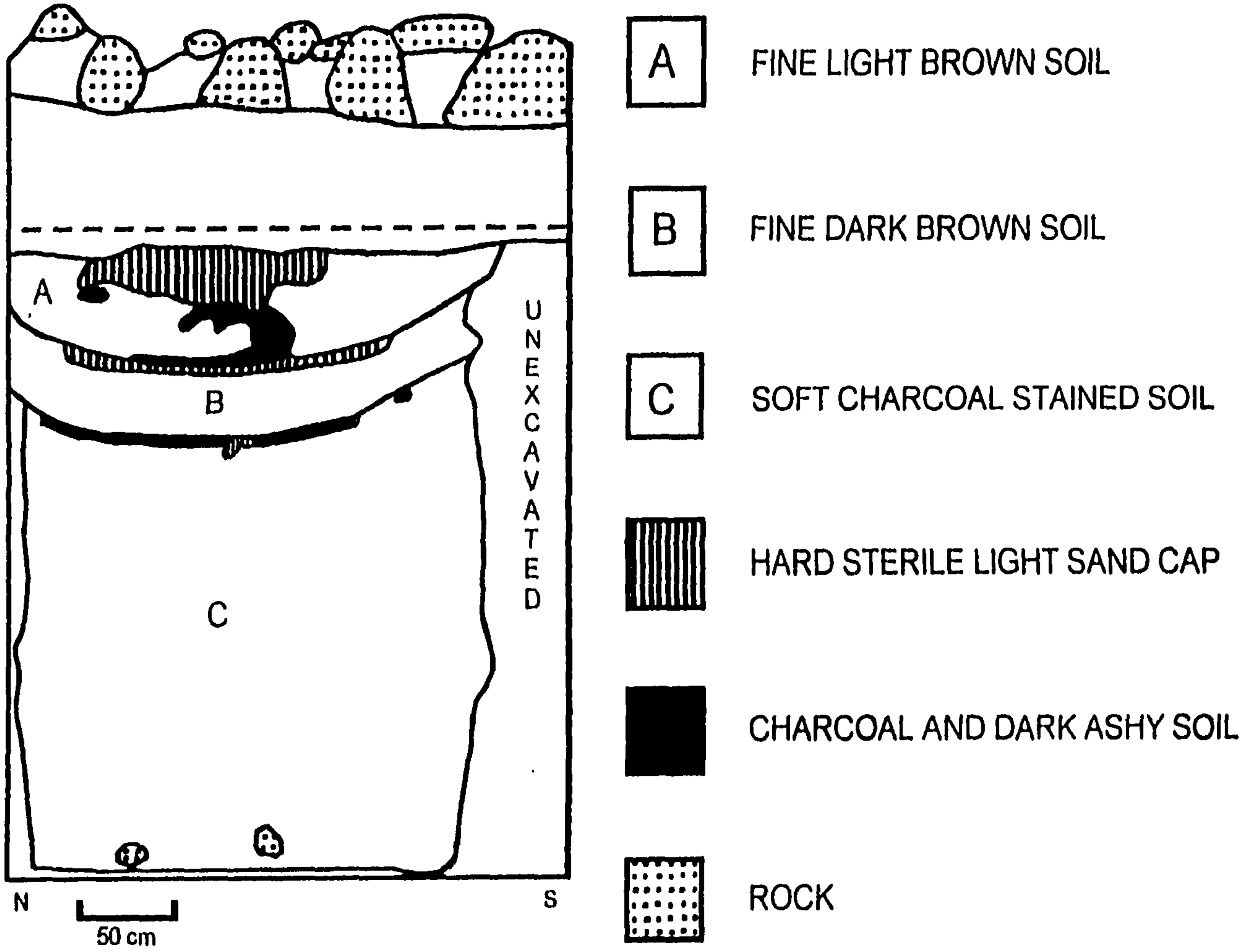


Figure 5.7. Feature 13, Levels A, B, and C.

Feature 13 measures about 1.07 m in diameter and 1.4 m deep and appears to have three separate fill episodes. The most recent pit (Feature 12) was a basin shaped pit 77 cm in diameter and 30 cm deep. Subsequent excavations the following field season revealed a third pit (Feature 25) between the other two both in time and space (Figure 5.6). Feature 25 is slightly below Feature 12. Feature forms indicate its size at 56 cm in diameter and 23 cm deep. Ash, bones, charred floral remains, and some broken tools were recovered in the fill of all three pits (Table 5.1).

Table 5.1. Contents of Features 12, 13, and 25.

Material	Features 12, 13A, and 25 (Assoc. with Late House)	Features 13B, and 13C (Assoc. with Early House)
Washita point		1
Fresno point		4
Unidentified side-notched fragment		2
Point tip fragment	1	3
Biface and fragments	1	14
Scraper and fragments	3	21
Drill		1
Modified flakes		11
Unmodified flakes	20	298
Blocky debris	1	27
Core		1
Hammerstone		8
Sandstone, quartzite, and caliche cobbles	8	69
Mano and fragments	1	7
Metate fragments		6
Abraders		6
Stone pipe fragment		1
Hematite	2	12
Selenite crystals		4
Ceramics		47 (includes 2 shell temp)
Awl		1
Modified bone	4	2
Painted bone	1	
Burned bone	44	937
Unburned bone	1319	6932
Shell scrapers		1
Shell fragments	4	25
Daub	1	15

The final work in this room during the 1972 field season consisted of uncovering the central hearth and the area around it. After removing about 18 cm of additional ash, the hearth was exposed at a total depth of 76 cm below the surface. The shallow (13 cm) basin hearth (Feature 14) had a slightly raised plastered rim around it and measured 91 cm north-south by 79 cm east-west (Table 5.2; Figure 5.8). About 60 cm west of the central hearth, a small bell-shaped, rounded base pit (Feature 11) was uncovered. It was 28 cm deep, with a basal diameter of 43 cm and an orifice diameter of 27.3 cm. Artifacts from these features are itemized in Table 5.2.

Table 5.2. Contents of Features 11 and 14.

Material	Feature 11	Feature 14
Point tip fragment		1
Scrapers and fragments	1	2
Drill	1	
Unmodified flakes	6	18
Sandstone, quartzite, and caliche cobbles	6	6
Hematite	1	
Ceramics		3
Bone awl fragment	1	
Modified bone	1	1
Burned bone	171	106
Unburned bone	41	98
Shell fragments	1	5
Daub		1

The following field season after the backfill was removed, numerous trenches were dug to try to find subfloor features and to determine if there was more than one floor present. Trench A from the 1972 excavation was reopened within Room 1A and divided into four, 60 by 152 cm sections

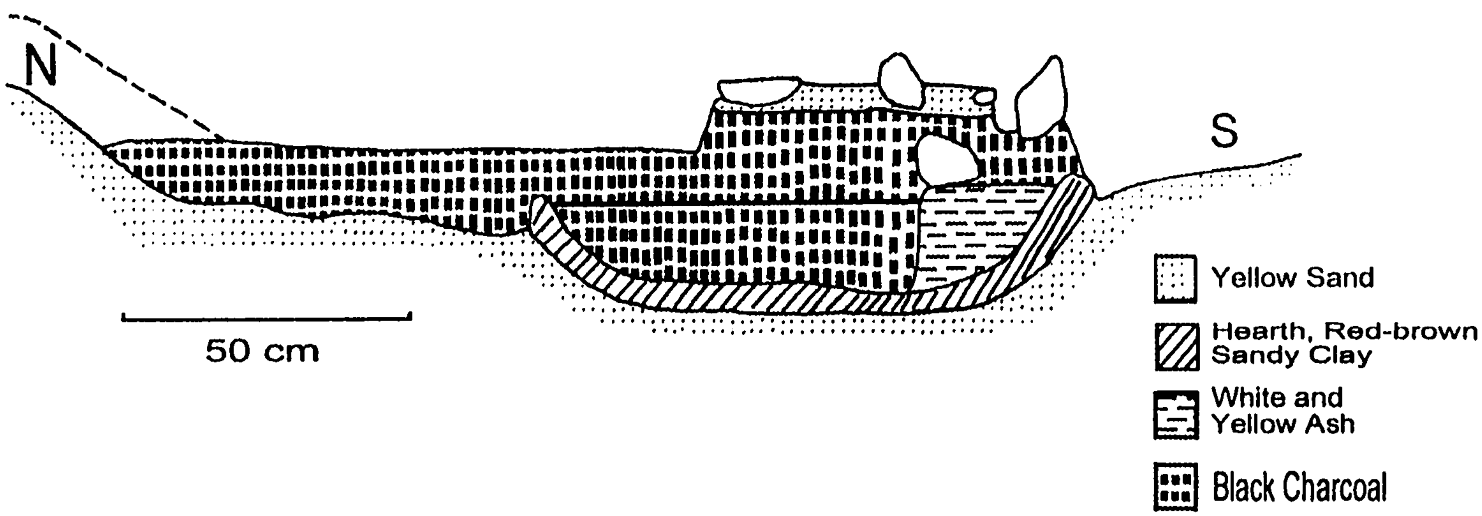


Figure 5.8. Central Hearth Feature 14, Room 1A.

(Figure 5.9). The two exterior areas of Trench A (one on the north and one on the south sides of Room 1A) were also excavated as individual sections. All six of these sections were dug in two additional levels into sterile soil - one 18 cm deep (94 cm below ground surface) and the second 25.4 cm deep (about 120 cm below ground surface).

A series of east-west trenches perpendicular to Trench A was also dug during the 1973 season (Figure 5.9). These trenches were each 60 cm wide and designated from north to south as Trenches K, J, E, I, B, H, F, and G. The system of trench excavations is described as follows:

> Trench segment B corresponds to the location of Trench B/C used during the 1972 field season. The trenches were dug in three segments. A single segment measuring 60 x 152 cm (2 x 5 ft) was dug east of north-south Trench A; these units were designated with the trench number followed by E1 (e.g. segments K-E1, J-E1, E-E1, etc.). The first segments west of Trench A also measured 60 x 152 cm (2 x 5 ft) and were similarly designated by the trench number and W1 (e.g. segments K-W1, J-W1, E-W1, etc.). The third trench segment occurred west of Segment W1; the Trench W2 segments ranged from 91 cm (3 ft) long (in Trench G along the south wall) to 122 cm (4 ft) long (in Trench K near the north wall). Nearly all of these trenches were in subfloor fill, but they successfully delineated a series of soil color anomalies which were regarded as features and excavated as single units [Lintz 1997a:6].

The series of trenches uncovered six additional prehistoric (Table 5.3) and two historic features in the main room of Structure A (Figure 5.3). Within 20 cm of the central hearth, three small, somewhat circular amorphous ash-filled pits (Features 16, 30, 31) were excavated. Situated on the north, northeast, and southeast sides of the hearth, these three "ash

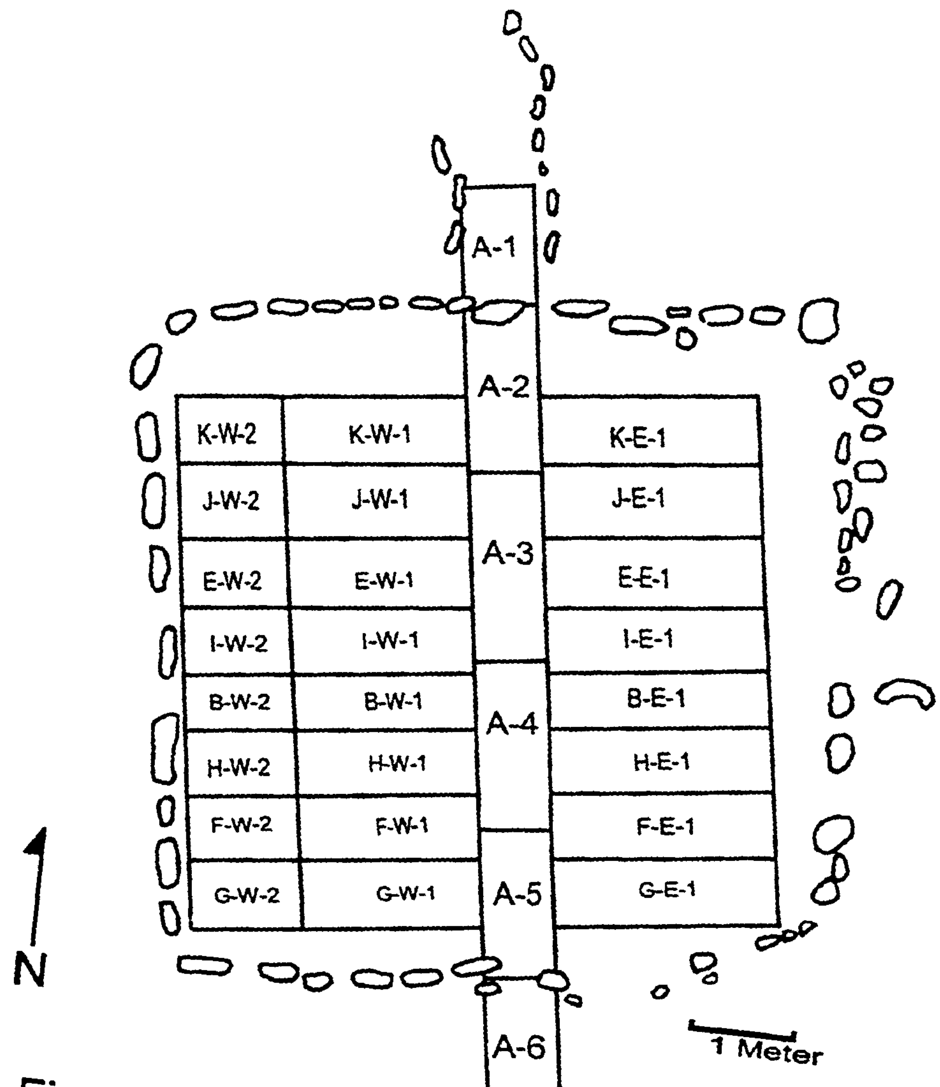


Figure 5.9. 34TX32 Trenches in Room 1A.

concentrations ranged from 28 by 30 cm to 38 by 40 cm in size and from 19 to 22 cm deep, and may have served as 'warming hearths'" (Lintz 1997b:6). Feature 15 is a cylindrical storage pit east southeast of the central hearth. It measured 61 by 53 cm and was about 25 cm deep. Features 17 and 18 were irregularly shaped dark stains west southwest of the central hearth. Feature 17 measured 30 by 61 cm and was about 60 cm deep from the floor level. Although its function is not clear, Feature 17 contained both burned and unburned bone and shell and numerous pieces of charcoal. Feature 18, also recognized as a dark stain was 41 by 51 cm and may be a posthole. The feature consists primarily of charcoal to a depth of 63 cm below the floor with a darker oval stain (post?) within this area measuring 23 by 28 cm.

Table 5.3. Contents of Features 15, 16, 17, 18, 30, and 31.

Material	15	16	17	18	30	31
Washita Point	1					
Scraper Fragments			1	2	1	
Modified Flakes				2		
Unmodified Flakes	4	13	3	9	4	6
Cobbles	2					1
Ceramics (sand tempered)	2					
Decorated Olivella shell bead	1					
Modified bone				1		
Burned bone	25	21	40	74	36	66
Unburned bone	32	45	13	117	234	42
Daub	2		2	1		

The two historic features recorded within Room 1A (Features 19 and 26) are most likely fence posts. Feature 19 was a 21 cm square of dark sediment that is northeast of the central hearth. It had a flat base and extended 69 cm below the ground surface. Under the base of the post were three large caliche cobbles. The other possible fence post, Feature 26, was rectangular (30 by 25 cm) and was near the center of the west wall of Room 1A. It was about 76 cm in depth. Because of the shape of these two features - square and rectangular - and their depth, they are most likely modern intrusions. The posts were placed about 4.4 meters apart.

According to the field notes, the structure burned. Numerous pieces of charcoal and burned bone on the floor surface led to this deduction, although no charred posts were recovered. The only feature that may be a roof support post is Feature 18, and it is not conclusive.

Room 2A

Room 2A is contiguous with the northeast corner of Room 1A north of the extended entrance. A single row of vertically-set stone slabs delineated the room that measured about 3.25 by 2.92 m. The room was excavated as one unit in three arbitrary levels after the surface vegetation of 2.5 cm was cleared. Level one consisted of sediments from 2.5 cm to 12.5 cm, level two ranged from 12.5 to 28 cm, and level three was excavated from 28 to 36 cm. The unplastered floor was uncovered at a depth of about 36 cm where the sediment color changed to a yellow matrix without any ash fill. There were no subfloor features or pits.

Features 1 and 2 were recorded within this room (Figure 5.10). They are both potholes dug by vandals in the southern part of the room. Feature 1 was mapped as 165 by 180 cm with an irregular depth between 25 and 33 cm. Feature 2 was smaller, 63 by 43 cm, and shallower, only 19 cm deep.

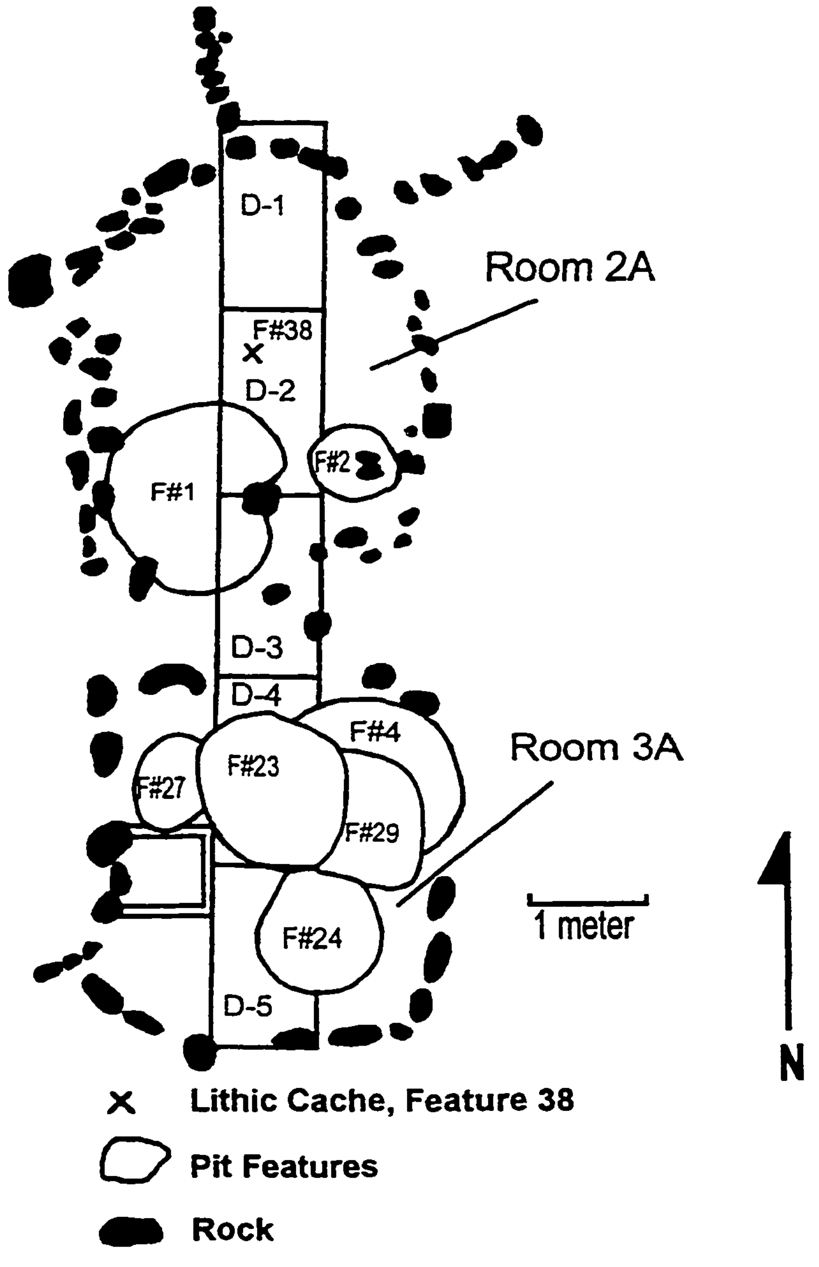


Figure 5.10. Trench D, Room 2A and Room 3A.

The only other feature found in Room 2A was a cache of four side scrapers (Feature 38) found on the floor near the center of the room (Figure 5.10). Based on the lack of subfloor pits and the presence of these scrapers, the function of this room has been interpreted as an interior processing room.

After the room had been excavated to the floor, Lintz (1997b:8) suggested that the walls on the north and west parts of the room may be more than one course high. He based this interpretation on numerous rocks that had fallen into the room. Adobe was recovered from only two sides of the room - the south and west walls. In addition, Lintz (1997b:8) speculated that the entrance to the room was probably through the south wall.

During the 1973 field season, the only work that was done within this room consisted of a north-south trench (Trench D). Trench D was 76 cm wide and extended from the north side of Room 2A to the south side of Room 3A (Figure 5.10). The trench was divided into five, 1.5 m sections and designated from north to south as section 1 through 5. Within this room, five, 10 cm levels were excavated from the floor at 36 cm to a total depth of 86 cm. No subfloor cultural deposits or features were encountered.

Room 3A

Room 3A was south of the entry and adjacent to the east side of Room 1A. Ten centimeters were initially removed from the surface to determine room size. The room, roughly rectangular with rounded corners, measured 3.05 by 2.67 m. A single row of vertically-set caliche slabs outlined the room and included a complete trough metate as part of the wall foundation on the north side. A test pit, 61 cm square, was excavated on the west side of the room to define the stratigraphy of the room. It was dug to a depth of 62 cm, or a total of 72 cm below the surface. On the north side of the room, vandals had recently dug a pothole (Feature 4). It measured 135 by 140 cm and was irregularly dug to a depth of about 53 cm.

North-south Trench D, segments four and five, dissected Room 3A. When this trench was completed at a depth of 71 cm in segment four and 51 cm in segment five, intersecting storage pits were visible. Unfortunately, the boundaries of the pits were difficult to identify because of the overlapping ash and soot matrix in each. Lintz delineated a minimum of four storage pits (Features 23, 24, 27, and 29) based on dissimilar elevations of the bottoms of the overlapping pits (Figure 5.10; Table 5.4). Suggested diameters from the field notes indicate that the pits ranged from 76 to 122 cm and varied in depth from 51 to 69 cm below the estimated floor surface, which was 30 cm below modern ground surface. Accordingly, "the pit fill must be regarded as being mixed from multiple storage episodes spanning an unknown period of time" (Lintz 1997a:8).

The initial function of Room 3A was most likely food storage. Lintz (1973:3) suggests that through time bacteria levels probably forced the occupants to seek other food storage locations. When the pits were no longer usable, they were abandoned and subsequently filled with trash (Lintz 1973:3).

Table 5.4. Contents of Overlapping Pit Features 23, 24, 27, and 29.

Material	Quantity
Washita points	2
Fresno point	1
Point fragments	3
Biface fragment	1
Scraper and fragments	3
Modified flakes	3
Unmodified flakes	122
Mano fragment	1
Cobbles and blocky debris	31
Hematite	5
Ceramics (sand tempered)	7
Burned bone	749
Unburned bone	4053
Shell fragments	9
Daub	5

Room 5A

The fourth room associated with Structure A, designated as Room 5A during the excavation, was a somewhat circular room measuring about 2.95 m in diameter. It shared a common wall with and was northeast of Room 2A. According to Lintz (1973:3), the curvature and wall abutment of this common wall probably indicates it was the last contiguous room built at the site. The wall foundation of Room 5A was a single row of vertical caliche slabs without any gap for an entrance. Lintz (1997b:9) suggests that access to this room was through the common wall from Room 2A.

Room 5A was initially excavated in natural levels to depths ranging from 36 cm on the north to 58 cm on the south side of the structure. When artifact concentrations and caliche cobbles were discovered after these three levels, the excavation strategy was changed and four, 5 cm arbitrary levels were removed. At this point in the excavation, five pits were clearly revealed beneath the floor. Evidently, the floor was missed during the excavation and was probably at the base of the third natural level or at about 45 cm. Therefore, the four arbitrary levels (20 cm) probably "represents the mixed contents from the upper portions of the five interior pits" (Lintz 1997a:9).

The five pits (Features 6, 7, 8, 9, and 10) were originally designated as pits A through E and measurements were taken after the arbitrary levels (20 cm) had been removed (Table 5.5; Figures 5.11 and 5.12). Feature 6 (pit A) was in the center of the room and measured 104 by 107 cm and extended 43 cm below artificial level four (probably about 63 cm below the floor). Feature 7 (pit B) along the east wall was 84 cm in diameter and probably about 50 cm below the floor. Feature 8 (pit C) was one of the larger pits (114 by 130 cm) and was along and possibly partially under the south wall of the room. The depth of this feature was about 71 cm below the floor. Pit D or Feature 9 was slightly bell-shaped and extended under the west wall of the room. It measured about 94 by 112 cm at the top and 122 to 124 cm at the base and was dug to 140 cm below the floor (170 cm below ground surface; Figure 5.13). The bottom 46 cm of Feature 9 contained "unburned chunks of wall daub, some bearing hammerstone percussion marks. Presumably, these unweathered chunks of adobe are wall plaster from the entry hole knocked above the foundation stones in the common wall between Rooms 2A and 5A" (Lintz 1997b:9). The last pit in Room 5A was Feature 10 (pit E). It was along the north wall and measured 86 by 97 cm and extended about 66 cm below the floor.

Table 5.5. Contents of Features 6, 7, 8, 9, and 10.

Material	6	7	8	9	10
Fresno points	1			1	1
Washita points	1		2		
Point fragments	2				2
Diamond-beveled knife	1			1	
Scraper and fragments	6	2	5	7	2
Drill and fragments			1	1	
Biface and fragments	4	1	2	1	
Modified flakes	5	4	2	7	6
Unmodified flakes	120	35	76	135	35
Blocky debris	5		1	9	
Painted stones			1		
Cobbles	7	9	27	7	
Hammerstones	2			2	
Mano and fragments	3	1	1	7	
Metate fragments				2	
Abrader and fragments	1		2	2	
Hematite	1			2	1
Ceramics (sand tempered)	17	14	21*	5	14
Awl and fragments	2		1		1
Tibia digging stick			1	1	
Scapula hoe			1		
Spatula tip			1		1
Shaft straightener				1	
Expedient tool			1		
Flute preform				1	
Modified bone	1	1	3	1	
Burned bone	285	87	244	838	186
Unburned bone	1239	974	1580	5850**	822
Shell bead					1
Shell scraper	2				
Shell fragments	2	3	13	9	
Daub				46	

* In addition to the 21 sherds, a 17.26 liter jar was reconstructed.
** Three fragments of human bone were also recovered from this feature.

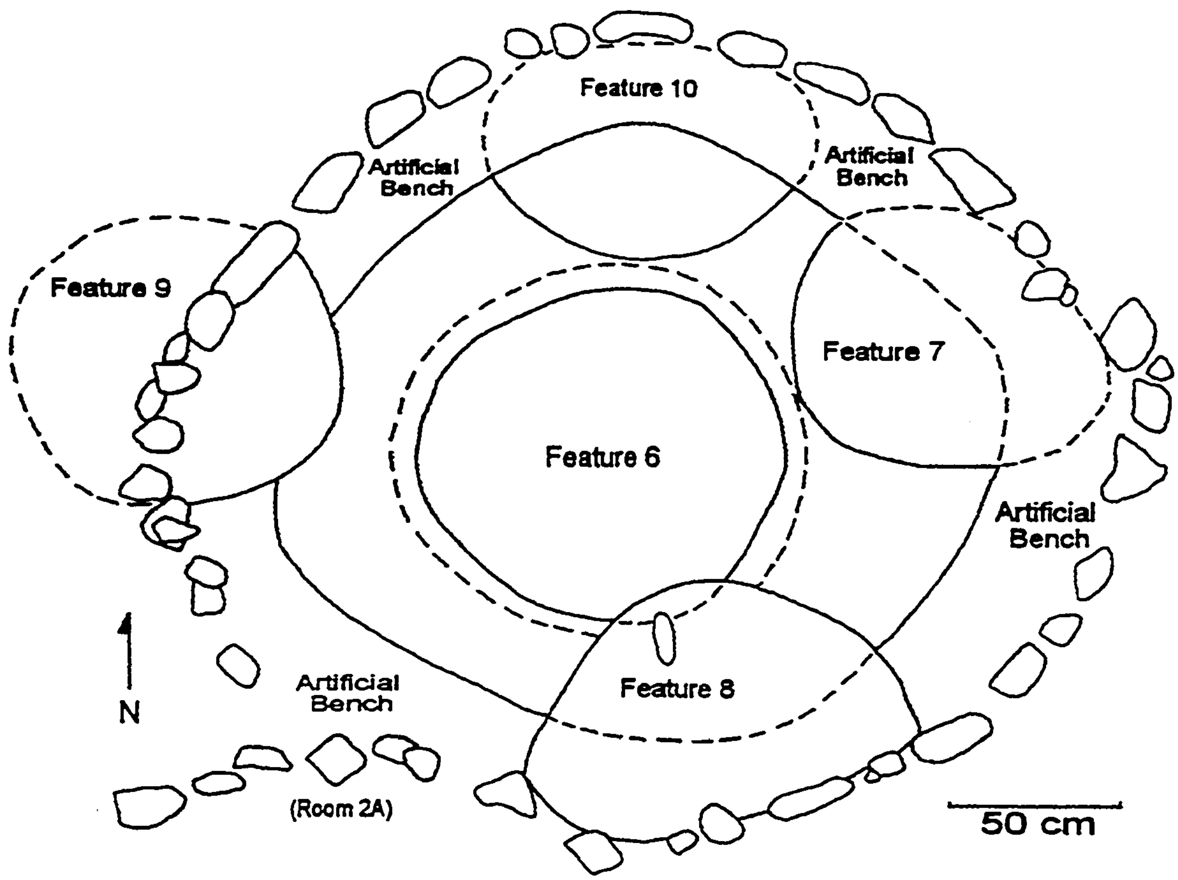


Figure 5.11. Five Storage Pits in Room 5A at 34TX32.

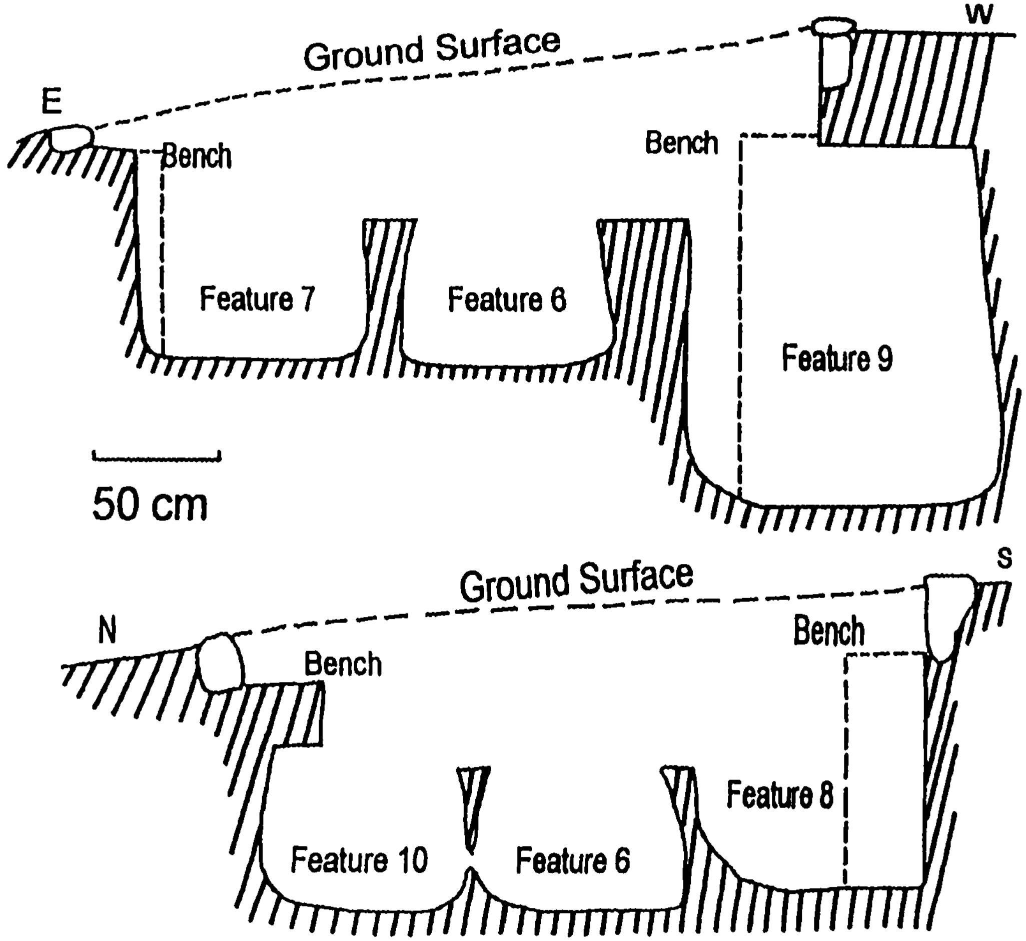


Figure 5.12. Profile of Five Storage Pits in Room 5A at 34TX32.

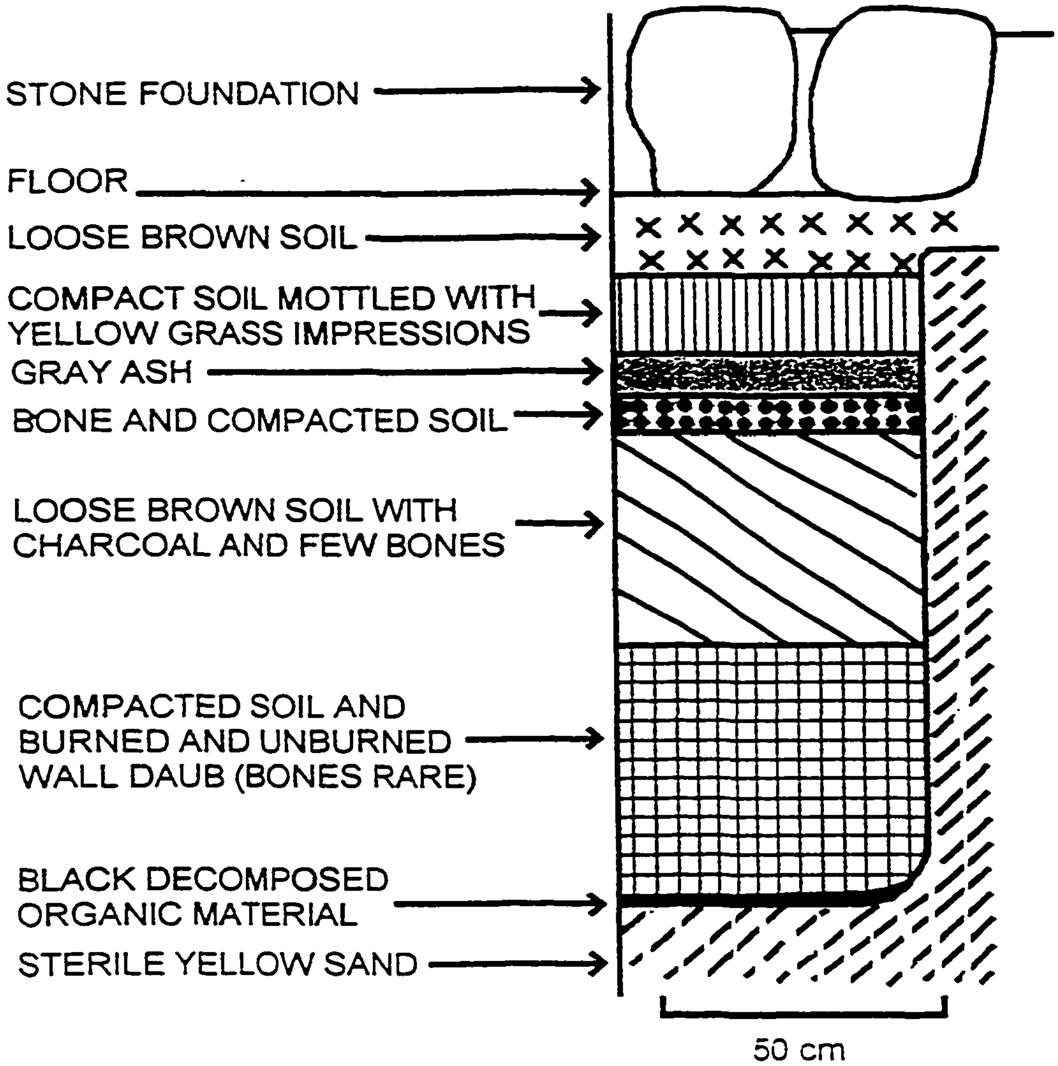


Figure 5.13. Stratigraphy of Feature 9.

Work Areas 6, 7, 8, and Area 1A

When the Two Sisters site was discovered in 1972, the scattered rocks on the surface did not provide a clear picture as to the number of rooms within the structure. Therefore, Pailes and Lintz decided to implement a flexible research strategy that defined work areas for excavation. As the excavation proceeded, some areas were, in fact, rooms while others lacked the characteristic continuous rock alignment of room enclosures. Work areas 6, 7, 8, and Area 1A are places that originally were thought to possibly be rooms, but after testing were determined to be exterior areas and not rooms.

Work area 6 consisted of the area between two roughly parallel series of rocks extending north from the center of the north wall of Room 1A (Figure 5.1). The line of eight rocks that formed the "east wall" was about 2.44 m in length. The other row forming the "west wall" contained only four stones and was about 1.02 m long. The two rows were 79 cm apart at the north end and 92 cm apart on the south side by Room 1A. Originally, Pailes and Lintz thought that these stones may have been an extended entryway to Room 1A. However, as the stones were excavated, it soon became clear that the stones did not come in contact with the main room nor were they supported by adobe wall footings. In addition, the area where the stones indicated a possible entryway was blocked by a solid stone wall foundation for the main room without any possible opening for a doorway. The function of these alignments of stone remains unknown.

Work area 7 was defined as the area east of the stone alignment, north of Room 1A, and west of Room 5A (Figure 5.1). From the surface outline of stone, it was not initially clear if this was an adjoining room to the main structure. This area was excavated in two 10 cm levels during the 1972 field season. At that time, work area 7 was determined to be an exterior area and work ceased until the following year. In 1973, a 1.5 by 1.5 m unit was dug to a depth of 101 cm in this area uncovering Feature 21 (Figure 5.3). Feature 21 was a small irregularly shaped pit that measured 53 by 58 cm and was about 52 cm deep. It contained primarily bone and ash (Table 5.6).

Table 5.6. Contents of Feature 21.

Material	Quantity
Washita point	1
Fresno point	1
Scraper and fragments	5
Unmodified flakes	29
Modified flakes	2
Cobbles and blocky debris	9
Limonite	1
Ceramics	3
Butchered bones	3
Burned bone	176
Unburned bone	1424
Shell scraper	1
Unmodified shell fragments	6
Daub	6

Although work area 8 was assigned at the outset of the excavation, only one natural level of about 10 cm was excavated. The area was defined by an alignment of five rocks that formed a slight arc 1.22 m in length on the east side of Room 2A (Figure 5.1). The work area and possible room designation was dropped when the excavation confirmed that the rocks were not part of a wall.

Area 1A is north of Room 1A and west of the parallel rock alignment (Figure 5.1). Only one level of about 13 cm was excavated and it primarily contained unburned bone fragments. Wall posts, rocks, and soil changes were not found. No additional work was done in this area when indications of a room or structure were not revealed.

Exterior Excavation Units

Thirty-eight exterior excavation units to the north, east, and south were dug during the 1973 field season. Each unit was 1.5 by 1.5 m in size with depths ranging from 10 to 102 cm. These units sampled exterior areas in order to define additional features and activity areas. Of these units, four were tested north of the structure - two in the earlier designated work area 7 and two randomly placed at 7.62 and 9.14 m north of Structure A. Seventeen units were tested east of the structure and nine were tested immediately south of it. Eight additional units were scattered at 10.67 m, 16.76 m, and 21.34 m south of Structure A.

Five additional features (Figure 5.14) were defined within these exterior areas - one pit (Feature 22), two flint caches (Features 28 and 35), one hearth (Feature 36), and one burial (Feature 37). All but the burial were recovered from test squares east of the structure. Feature 22 was an

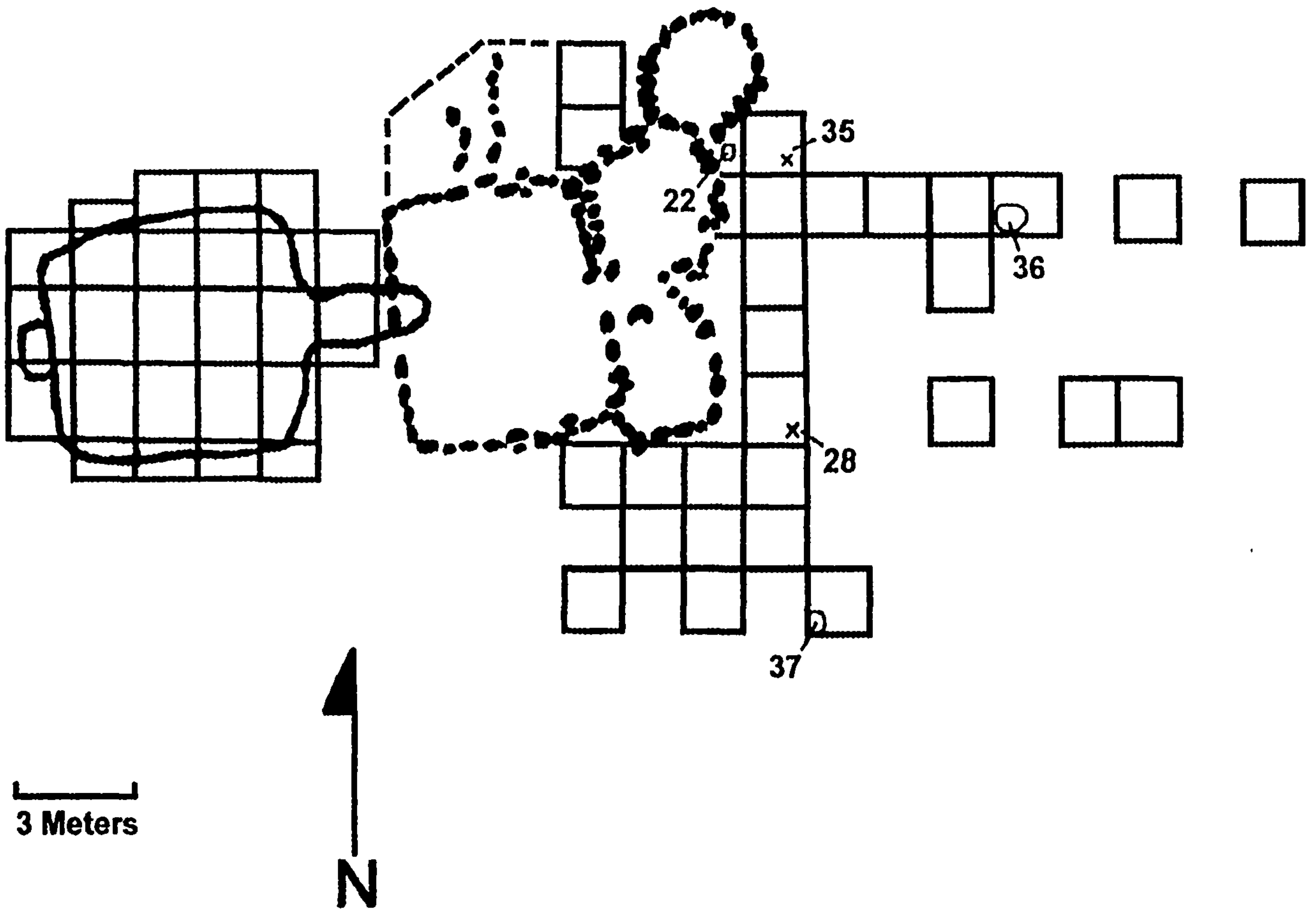


Figure 5.14. Exterior Features 22, 28, 35, 36, and 37.

exterior pit measuring 43 by 37 cm. It was excavated during the 1973 field school to a depth of 30 cm below ground surface and contained three tibia digging stick fragments, six scrapers, several pieces of pottery and flakes, and hundreds of fragments of bone. Feature 28 was a lithic cache east of Room 3A. Buried at a depth of 20 to 24 cm below the modern ground surface, the cache contained 40 items primarily of Alibates. The tools included one diamond-beveled knife, five biface knives, two end scrapers, two side scrapers, six utilized flakes, and 24 unmodified flakes.

The other lithic cache, Feature 35, was east of Room 2A and contained 16 Alibates flakes - five modified and 11 unmodified. The fourth feature recovered east of the structure (Feature 36) was a scattered hearth. Although fairly ephemeral, it was about 60 cm in diameter and approximately 30 cm below the ground surface.

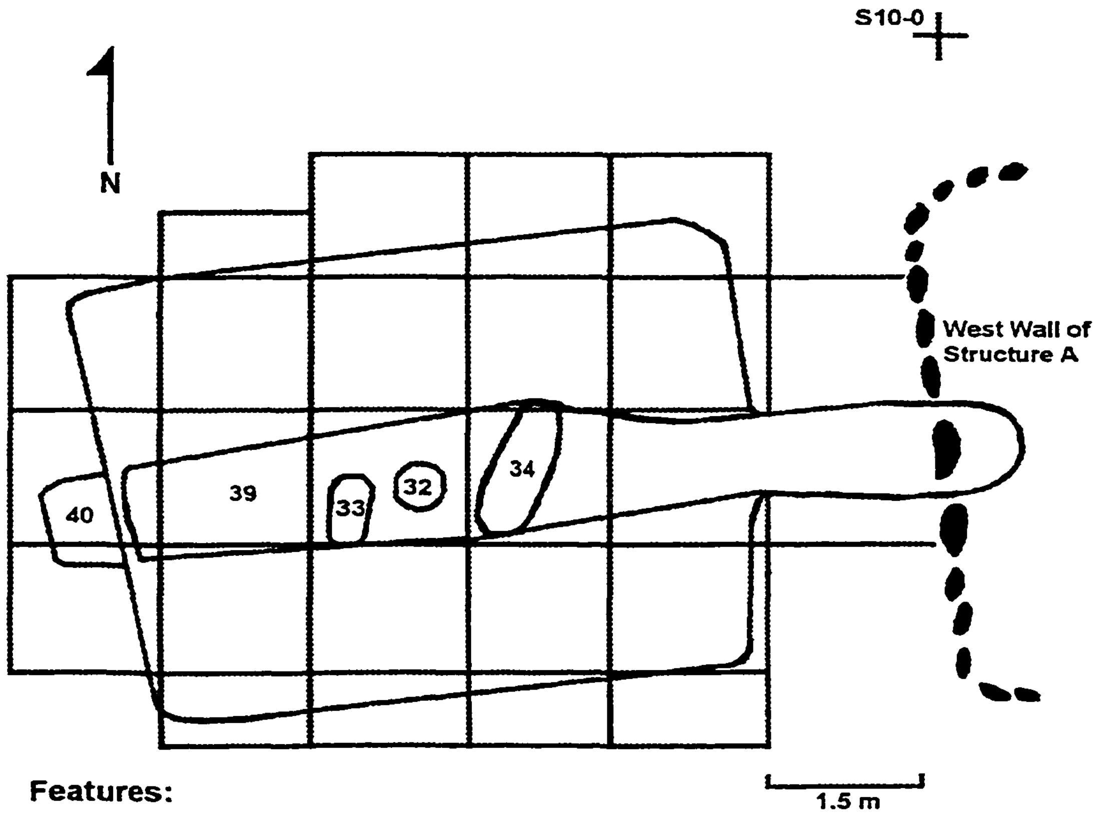
A child burial, Feature 37, was found south of the structure at a depth of 31 cm. The incomplete skeleton was not identified as human during the fieldwork and was only later recognized during laboratory processing of faunal remains (Lintz 1997b:11). Associated funerary items were not present. The limited artifacts within the general area of the burial include a bone pin, a mid-section of a projectile point, two pieces (0.1 g) of egg shell (probably bird), one shell, two pottery sherds, 20 flakes, and 265 fragments of burned and unburned animal bone. Douglas Owsley (personal communication 1999) analyzed the human remains and indicated that the bones are fragmented, but in fair condition. The skeleton is small for gestational age or preterm (late third trimester) and is from a primary interment as indicated by the presence of many small hand bones. Table 5.7 provides a list of the skeletal remains that were recovered.

Table 5.7. Skeletal Inventory (Douglas Owsley, personal communication 1999) of Burial from 34TX32.

Cranial	**Left**	**Right**
Frontal	one-half present	partial fragment
Parietal	partial	partial
Temporal	petrous fragments	petrous fragments
Zygomatic	complete	
Mandible	partial plus ½ of deciduous incisor	
Postcranial	**Left**	**Right**
Innominate	partial	partial ilium
Long Bones	**Left**	**Right**
Humerus	one fragment of proximal metaphysis, side unknown	
Radius	complete, 51 mm in length	
Ulna	complete, 55 mm in length	complete
Femur	complete, 69 mm in length	middle one-third missing
Tibia	complete	
Fibula	middle one-third present	
Ribs	**Left**	**Right**
2nd	2 fragments	
3rd - 10th	8 fragments	7 fragments, including one complete
11th	2 fragments	
12th	2 fragments	
Vertebrae		
C1	one-half of neural arch	
C2 - L5	3 centra; 11 neural arch halves	

Structure B

Structure B is the earlier of the two structures and the extended entry is partially under the west wall of Structure A (Figure 5.15). Excavated in 20 full and five half (150 by 75 cm) units, it is a rectangular semi-subterranean room with rounded corners measuring about 5.23 by 6.71 m. At the time of



Features:
32 - Central Hearth
33 - Shallow Irregularly Shaped Pit
34 - Shallow Irregularly Shaped Pit
39 - Central Floor Channel Defined by Earthen Ridge on Each Side
40 - Altar or Recessed Earthen Alcove

Figure 5.15. 34TX32 Structure B Excavation Map.

occupation, the floor surface was about 51 to 58 cm below the ground surface. The eastern extended entry is 2.44 m long and is 76 cm wide at the east wall of the room. It expands out to a width of 87 cm and then contracts to about 66 cm in width at the eastern entrance. No roof support postholes were found within this structure.

A central floor channel or trough (Feature 39) extends from the west wall to the east entryway and, like the entryway, flares out in the center. The trough measures about 1.00 m at the west wall, expands to roughly 1.35 m in the center of the room, and then contracts to a fairly narrow width of 72 to 80 cm at the entry. A raised earthen ridge about 5 cm high by 15 cm wide flanks each side of the channel. Unlike Structure A, the central channel is not depressed but rather irregularly defined by the earthen ridge with the channel area about the same elevation as the adjacent "floors" to the north and south (Lintz 1997b:4).

On the west end of the channel, Structure B has an altar or rectangular earthen alcove recessed into the wall of the room (Feature 40). Slightly elevated above the floor level, the altar measures 90 cm (north to south) by 62 cm (east to west). Because the room had been cleaned out prior to its burning, the only items found in the altar area were a Washita point, some flakes, and a few pieces of bone.

Within the central channel, Structure B has three other interior features - a central hearth and two shallow pits. The hearth (Feature 32) is an oval shape with fairly straight walls and a level base. It measures 46 cm (north-south) by 61 cm (east-west) and is 44 cm deep. Feature 33 is an irregularly shaped, 33 cm deep depression between the central hearth and the altar. Mapped as a feature, it is 64 cm (north-south) by 48 cm (east-west). No artifacts were associated with it. The other shallow irregularly shaped pit within this room is Feature 34. It is between the hearth and the entry and is fairly long, 183 cm. It is oriented from the northeast to southwest and is 81 cm wide. The depth varies from about 30 to 41 cm. The only artifact found within this feature was a burned flake.

Structure B did not have a stone slab foundation and the material composition of the walls is not clear. No postholes were found either within the room or along its perimeter. Instead, according to Lintz (1997b:5), "a straight, unbroken line of cinders and baked house pit wall facing was noted separating the ashy room fill from the culturally sterile pre-occupation sediments outside of the partially subterranean structure." Wall foundation stones and posts were not salvaged from this room to build the later structure because the burned wall facing had not been disturbed (Lintz 1997b:5). A thick layer of burned clay and charcoal covered the plastered floor.

Although there was no evidence of postholes, the house contained numerous charred beams. Generally, these pieces of charcoal were small, "but 15 specimens measured between 28 and 77.5 cm long. Most specimens (46%) measured between 2.5 and 5 cm in diameter, with another 24% measuring less than 2.5 cm and another 22.5% measuring between 5 and 7.5 cm in diameter" (Lintz 1997b:5). According to Lintz's 1973 field notes, within this room were large sections of fallen daub with small stick or reed impressions. These impressions were oriented east to west while all of the major beams within the room were oriented north to south. In addition, four twigs recovered indicate a woven pattern of two over and one under a perpendicular stick; Lintz (1997b:5) suggested that this woven piece was either from a screen used within the room or part of the roof. Identification of the larger pieces of charcoal demonstrates that cottonwood (*Populus* spp.) was the primary timber used in house construction. Other wood identified includes hickory (*Carya* sp.), oak (*Quercus* spp.), sycamore (*Plantus occidentalis*), elm (*Ulmus* sp.), and hackberry (*Celtis reticulata*).

Structure B was probably intentionally burned because of the small amount of cultural material present in the main room. On or near the floor were 29 flakes, 191 bone fragments, five pottery sherds, three scrapers, two projectile points, one piece of shell, one bone awl, one drill, and one metate fragment. The easternmost part of the extended entry, however, was filled with debris. Deposits of ash, flakes (174), bone fragments (1385), cobbles (33), hammerstones (5), pottery sherds (5), shell (5), knives (4), scrapers (4), a core, a bone rasp, a drill, and a worked bison scapula blade had been dumped to fill the entryway. Above the debris fill, the west stone wall of the later structure, Structure A, was built.

Chronology

Structure A is superimposed over the entrance to Structure B and results from a later occupation. A total of eight carbon samples, seven radiometric and one accelerator mass spectrometry (AMS), from different features and locations within each structure were submitted for radiocarbon dates (Table 5.8). Lintz (1979a:5) provides information about four of the radiocarbon dates and also includes three archaeomagnetic dates. These dates, in addition to three additional wood charcoal and one carbonized corn fragment, provide the basis of an estimated occupation period.

Two of the radiocarbon dates are representative of Structure A. The first is an AMS date on charred corn cupules from the central hearth (Feature 14). The calibrated age at one standard deviation has three intercept points, A.D. 1327, 1346, and 1393 with an age range between A.D. 1302 and 1404 (Beta-156653). The second date is from Feature 6 in Room 5A. This date has an intercept point of A.D. 1420 with a range between A.D. 1400 and 1440 (Tx-3261).

Radiocarbon dates for Structure B should be earlier because of the superposition sequence stratigraphically placing it partially below Structure A. Unfortunately, the sequence of ages do not always agree with the site stratigraphy. Two radiocarbon dates were obtained from wooden support posts in Structure B and have the following intercept points: A.D. 1410

Table 5.8. Radiocarbon Dates from 34TX32.

Lab #	Provenience	Radiocarbon Age B.P.	13C/12C Ratio	Calibrated Ages* (range based on one standard deviation)	Presumed Association	Reference
Tx-3261	Feature 6 Room 5A 11 g wood charcoal	510 ± 50	n/a	A.D. 1420 (1400-1440)	Structure A	Lintz 1979a:5
Beta-156653	Feature 14 Central Hearth 0.27 g corn	600 ± 40	-8.9 o/oo	A.D.1327,1346,1393 (1302-1404)	Structure A	
UGa-2508	S13-W5, floor level, post 25 g wood charcoal	545 ± 55	n/a	A.D. 1410 (1330-1430)	Structure B	Lintz 1979a:5
Beta-146587	S14-W2 post 30 g wood charcoal	520 ± 70	-25.5 o/oo	A.D.1420 (1400-1440)	Structure B	
Beta-142194	Feature 9, 30 g wood charcoal	480 ± 60	-26.6 o/oo	A.D. 1430 (1410-1450)	Structure B	
Uga-2509	Feature 13, Level C, 20 g wood charcoal	600 ± 50	n/a	A.D.1327,1346,1393 (1300-1406)	Structure B	Lintz 1979a:5
Beta-146586	Feature 13, Level C, 30 g wood charcoal	830 ± 50	-21.9 o/oo	A.D.1220 (1180-1260)	Structure B	
Tx-3260	Feature 9, pit fill beneath west wall of Room 5A 15 g wood charcoal	890 ± 50	n/a	A.D. 1161 (1040-1216)	Structure B	Lintz 1979a:5

* Corrections are based on Stuiver et al. 1998

(Uga-2508), and A.D. 1420 (Beta-146587). Four additional dates are from features that appear to be associated with this earlier structure. Two are from the pit beneath the west wall of Room 5A (Feature 9) and two are from below the clay cap in Level C of Feature 13. Each of these two features has one acceptable date, placing utilization within the range of occupation and one anomalous early date. Acceptable dates are A.D. 1430 for Feature 9 (Beta-142194) and either A.D. 1327, 1346, or 1393 (UGa-2509) for Feature 13, Level C. The two unacceptable dates are both too old. Sample TX-3260 from Feature 9 has a calibrated date of A.D. 1161 and the carbon sample from Feature 13, Level C calibrates to A.D. 1220 (Beta-146586). TX-3260 is 166 years older and Beta-146586 is 107 years older than the earliest of the other dates (A.D. 1327). These anomalous early dates are considered unreliable and are not used in this study to indicate occupation age. One likely explanation of these age discrepancies, however, is the prehistoric use of old (dead) wood that was collected and burned by the site occupants. Another is the possibility of carbon samples from interior tree rings of much larger branches or trunks thereby producing an unusually early date.

Three archaeomagnetic dates were also provided by Lintz (1979a:5) that further complicate the estimated occupation period for the two structures (Table 5.9).

Table 5.9. Archaeomagnetic Dates for 34TX32 (Lintz 1979a:5).

Lab #	Provenience	Date A.D.	Alpha
OU-788	Feature 14, Central Hearth, Room 1A	1385	3.4
OU-887*	S16W4, South wall of Room 1B	1420	2.5
OU-888*	Feature 32, Central Hearth, Room 1B	1320	1.0

* Specimens recollected in lab from a single oriented block of baked clay.

The most recent date should be the central hearth of Structure A (sample OU-788). As Table 5.9 indicates, however, this feature produced a date of 1385 with an alpha value (standard deviation) of 3.4. According to Lintz (l997b:13), it is the most reliable of the three magnetic dates because it was collected in the field as eight separate specimens. The two magnetic dates from Structure B have lower alpha values, but are separated by about 100 years. One date is even more recent than the date from Structure A. Lintz collected the specimens in the field and provides an explanation of the inconsistency as follows:

> The large spread of archaeomagnetic dates from Structure B and deviation from that from [sic] Structure A possibly reflects the collection procedure. Due to the lack of the special molds needed to obtain the oriented specimens, segments of burned earth were encased in plaster, marked with dip and strike orientations, and collected en mass. These block samples were subsequently reoriented in the laboratory, the plaster jacket was removed, and specimens of burned earth were collected as oriented cubes for archaeomagnetic processing. Any slight orientation error involved with the sample block collection or reorientation for specimen collection would result in consistent orientation errors and inaccurate paleomagnetic-polar positions for all specimens collected from the block, even though the set could have a tight alpha or standard deviation interval. Since multiple blocks were not collected, there is no way to check on the occurrence of potential collection errors. The magnitude of the collection error would not have to be very large; the 100 year discrepancy in magnetic dates could be accomplished by a

> total deviation of only some four degrees cumulative collection error [Lintz 1997b:13].

Although there are some problems with the radiocarbon and archaeomagnetic dates, the period of occupation is most likely between A.D. 1327 and 1440. Most of the chronometric information suggests that the structures were built and occupied during the later part of this time range, probably around A.D. 1380 to 1420.

Summary

This chapter presents information about the different excavation methods used at the Two Sisters site during the 1972 and 1973 field schools. Eleven weeks of excavation uncovered two superimposed structures of different architectural styles. The earlier structure, Structure B, lacked a stone slab foundation and was restricted to only one room. The later house, Structure A, consisted of four contiguous rooms with vertical stones incorporated into the wall foundations. Thirty-eight 1.5 by 1.5 m exterior test units were completed. In addition, limited data are presented from the features within Structures A and B and from the six exterior features. The 40 features are identified as to type in Table 5.10. The overlap of dates suggests that the two structures were probably occupied by the same group of people. When Structure B became unsuitable for whatever reason, it was cleaned out and burned. Structure A replaced it and was constructed fairly close in time as well as space. The excavation

Table 5.10. Identified Features at 34TX32.

Feature Number	Location	Type
1	Room 2A	Pothole
2	Room 2A	Pothole
3*	Room 5A	Rock Deposits
4	Room 3A	Pothole
5	Room 1A	Concentration of artifacts and ash (SE corner)
6	Room 5A	Pit (center of room)
7	Room 5A	Pit (east side of room)
8	Room 5A	Pit (south side of room)
9	Room 5A	Pit (west side & under wall of room)
10	Room 5A	Pit (north side of room)
11	Room 1A	Bell-shaped pit (west of central hearth)
12	Room 1A	Pit (northeast corner of room)
13	Room 1A	Pit (northeast corner of room)
14	Room 1A	Central fire hearth
15	Room 1A	Pit (east of central hearth)
16	Room 1A	Posthole (north of central hearth)
17	Room 1A	Pit (southwest of central hearth)
18	Room 1A	Pit (west of feature 17)
19	Room 1A	Historic posthole (east side of room)
20**	Room 1A	Clay-lined pit (under west wall)
21	S10-W4	Pit (west of room 5A)
22	S11-E6	Possible pit (southeast of room 5A)
23	Room 3A	Pit (north side of room)
24	Room 3A	Pit (south side of room)
25	Room 1A	Pit (northeast corner of room)
26	Room 1A	Historic posthole (west side of room)
27	Room 3A	Pit (west side of room)
28	S15-E7	Flint cache
29	Room 3A	Pit (east side of room)
30	Room 1A	Pit (adjacent to central hearth)
31	Room 1A	Pit (adjacent to central hearth)
32	Room 1B	Central fire hearth
33	Room 1B	Pit (west of central hearth)
34	Room 1B	Pit (east of central hearth)
35	S11-E7	Flint cache
36	S12-E11	Scattered exterior hearth
37	S18-E8	Child burial
38	Room 2A	Scraper cache
39	Room 1B	Central channel or trough
40	Room 1B	Altar

* Feature 3 was recorded during the 1972 field season, but eliminated as a feature during the analysis.

** Feature 20 was recorded during the 1973 field season and eliminated as a feature during the analysis. Lintz (personal communication 2001) believed that it was only intentional fill of the entryway to the earlier house (1B) and not a feature. The location is where an altar would be if one existed within this later structure.

methods and site chronology provide a general background to this study. In order to understand subsistence and settlement practices at this site, the next chapter will present the available data.

CHAPTER 6

DESCRIPTION OF MATERIALS

In this chapter, a description of the findings will be presented. Because of the large amount of data, careful descriptive information must be presented before it can be interpreted in relation to the theoretical model outlined in Chapter 4.

The two field seasons of excavation at the Two Sisters site recovered 99,182 cataloged items. These include six categories of materials: stone, clay, bone, shell, floral, and historic trash. Primary and secondary sub-groupings for some of the categories were established for ease of identification and description. For example, stone items were classified into chipped stone, ground stone, and miscellaneous stone - each category having numerous sub-categories. Items made of clay were divided by function (ceramics and daub). Bone, the most numerous material recovered, was classified as either modified or unmodified and then further divided according to species, tool form, and condition. Like bone, the shell is grouped into two primary classes: modified and unmodified. Furthermore, throughout the entire analysis, all measurements are in centimeters and all weights are in grams. Floral materials and historic trash are not subdivided. Because the focus of this research is the Late Prehistoric phase occupation, historic materials are summarized in Appendix II.

Chipped Stone

Chipped stone artifacts can be broadly classed as tools and debitage depending on where the item fits in the reductive process of manufacture. For the purpose of this analysis, chipped stone will be divided into numerous taxonomic categories based on form, apparent function, and stage of reduction. Chipped stone includes projectile points, bifaces, knives, scrapers, gravers, drills, cores, and modified and unmodified flake debitage.

Projectile Points

One hundred twenty-six arrowpoints, 1 dart point, 1 large, possibly, ceremonial point, and 93 arrowpoint fragments were recovered at the Two Sisters site. In general, these are triangular, bifacially reduced tools which are similar to previously identified types (Bell 1958, 1960; Perino 1971; Turner and Hester 1985). Measurements are found in Table 6.1 and a summary by lithic material type is presented in Table 6.2.

FRESNO

Sample Size: 63 (19 complete, 44 fragments)

Mean Dimensions: Length 2.61 cm, Width 1.45 cm, Thickness 0.28 cm.

Range of Dimensions: Length 1.51-3.42 cm, Width 0.98-1.92 cm, Thickness 0.15-0.72 cm.

Table 6.1. Metric Dimensions and Material Typesof Projectile Points and Fragments.

Point Type	Cat. #	Material	Length	Width	Thickness	Stem Length	Stem Width	Base Width	Weight
Washita	1	Alibates	1.76	1.28	0.21	0.60	0.80		0.40
Washita	20	Alibates	2.91	1.48	0.28	0.80	0.90		0.87
Washita	21	Unid. chert	1.83	1.35	0.22	0.70	0.62		0.45
Washita	33	Missing-unknown	1.88	1.19	0.20	0.81	0.57		
Washita	33	Tecovas		1.18	0.19	0.72	0.61		0.18
Washita	41	Alibates			0.23	0.69	0.70		0.30
Washita	49	Tecovas		1.64	0.22	0.80	0.91		0.33
Washita	53	Alibates		1.43	0.24	0.68	0.80		0.33
Washita	64	Alibates		1.37	0.23	0.79	0.78		0.51
Washita	65	Alibates	1.18	1.20	0.25	0.59	0.69		0.30
Washita	68	Tecovas			0.26	0.70	0.83		0.52
Washita	70	Alibates	2.35	1.31	0.26	0.75	0.71		0.67
Washita	72	Missing-unknown	3.20	1.28	0.26	0.73	0.63		
Washita	75	Alibates	1.90	1.43	0.23	0.94	0.61		0.56
Washita	77	Alibates		1.23	0.20	0.84	0.62		0.23
Washita	85	Alibates			0.21	0.88	0.50		0.28
Washita	93	Alibates	1.81	1.20	0.19	0.50	0.91		0.34
Washita	95	Missing-unknown	1.80	1.20	0.20	0.63	0.54		
Washita	97	Unid. chert		1.40	0.28	0.77	0.66		0.46
Washita	113	Alibates		1.25	0.29	0.58	0.70		0.58
Washita	113	Unid. chert			0.22	0.63	0.67		0.37
Washita	114	Alibates		1.04	0.19	0.70	0.55		0.29
Washita	139	Alibates	1.90	1.27	0.26	0.65	0.89		0.58
Washita	140	Alibates	2.00	1.16	0.24	0.79	0.65		0.43
Washita	141	Alibates	1.98	1.00	0.21	0.56	0.55		0.35
Washita	148	Tesesquite	2.35	1.40	0.25	0.68	0.65		0.70
Washita	149	Alibates			0.21	0.89	0.68		0.22
Washita	149	Unid. chert		1.27	0.23	0.71	0.68		0.48
Washita	154	Unid. chert		1.42	0.27	0.90	0.83		0.31

Table 6.1 (continued).

Point Type	Cat. #	Material	Length	Width	Thickness	Stem Length	Stem Width	Base Width	Weight
Washita	162	Alibates		1.28	0.22	0.77	0.61		0.53
Washita	168	Alibates			0.28	0.78	0.85		0.67
Washita	177	Missing-unknown	2.96	1.61	0.25	0.80	0.72		
Washita	181	Alibates		1.21	0.19	0.75	0.56		0.22
Washita	200	Unid. chert		1.45	0.24	0.70	0.61		0.63
Washita	276	Alibates	1.60	1.14	0.23	0.63	0.69		0.34
Washita	277	Alibates	1.88	1.24	0.20	0.60	0.61		0.36
Washita	281	Alibates	1.59	1.24	0.18	0.70	0.70		0.25
Washita	281	Alibates	2.20		0.23	0.94	0.55		0.42
Washita	284	Alibates	2.10	1.30	0.22	0.74	0.69		0.50
Washita	286	Day Creek		1.35	0.25	0.77	0.68		0.29
Washita	287	Alibates		1.28	0.26	0.71	0.70		0.49
Washita	289	Alibates		1.30	0.28	0.85	0.71		0.61
Washita	289	Missing-unknown	2.12	1.24	0.27	0.60	0.61		
Washita	311	Alibates	2.37	1.30	0.25	0.81	0.67		0.56
Washita	325	Kenton Opalite	2.27	1.37	0.23	0.81	0.61		0.63
Washita	339	Unid. chert	3.00	1.50	0.30	0.93	0.92		1.03
Washita	394	Missing-unknown	2.50	1.37	0.23	0.89	0.67		
Washita	401	Missing-unknown	3.00	1.15	0.24	0.70	0.61		
Washita	1*	Alibates	2.80	1.50	0.20	0.70	0.60		0.78
Harrell	38	Alibates	2.12	1.19	0.29	0.87	0.71		0.59
Harrell	130	Niobrara	2.37	1.30	0.30	0.89	0.70		0.80
Harrell	244	Tecovas			0.22	0.88	0.67		0.33
Harrell	247	Missing-unknown	3.46	1.40	0.21	0.96	0.68		
Shetley	143	Missing-unknown	3.30	1.36	0.40	1.12	0.62	1.22	
Shetley	162	Missing-unknown	2.63	1.46	0.29	0.90	0.93	1.38	
Scallorn	12	Alibates			0.40	0.78	1.10	1.60	0.47
Scallorn	99	Tesesquite	2.97	1.33	0.27	0.45	0.90	1.15	1.18
Huffaker	58	Unid. chert			0.21				0.50

Table 6.1 (continued).

Point Type	Cat. #	Material	Length	Width	Thickness	Stem Length	Stem Width	Base Width	Weight
Huffaker	60	Missing-unknown		1.70	0.32				
Huffaker	131	Alibates	1.68	1.10	0.18				0.28
Huffaker	159	Alibates	3.35	1.56	0.25				0.98
Huffaker	206	Alibates	2.20	1.38	0.25				0.57
Huffaker	280	Alibates	1.73	1.02	0.26				0.42
Fresno	1	Alibates		1.65	0.30				1.30
Fresno	1	Alibates		1.59	0.29				0.81
Fresno	1	Alibates			0.30				1.37
Fresno	6	Alibates		1.25	0.26				0.28
Fresno	18	Alibates		1.28	0.18				0.37
Fresno	22	Alibates		1.39	0.30				0.71
Fresno	27	Unid. chert		1.78	0.41				1.61
Fresno	41	Kenton Opalite		1.50	0.29				0.86
Fresno	41	Alibates	2.80	1.49	0.27				1.12
Fresno	46	Alibates		1.14	0.23				0.31
Fresno	47	Alibates		0.98	0.18				0.21
Fresno	48	Alibates	2.60	1.52	0.25				0.92
Fresno	50	Alibates		1.37	0.31				0.78
Fresno	51	Alibates		1.56	0.20				0.79
Fresno	53	Alibates		1.19	0.25				0.52
Fresno	53	Alibates			0.28				0.56
Fresno	53	Unid. chert			0.23				0.24
Fresno	55	Kenton Opalite	2.80	1.21	0.31				0.87
Fresno	59	Alibates		1.50	0.20				0.39
Fresno	60	Alibates	2.90	1.31	0.29				0.81
Fresno	64	Alibates	1.62		0.19				0.29
Fresno	65	Alibates		1.20	0.30				1.07
Fresno	75/96	Unid. chert	2.90	1.41	0.22				0.81
Fresno	76	Alibates		1.58	0.15				0.28

Table 6.1 (continued).

Point Type	Cat. #	Material	Length	Width	Thickness	Stem Length	Stem Width	Base Width	Weight
Fresno	76	Alibates		1.41	0.26				0.65
Fresno	76	Alibates		1.39	0.22				0.60
Fresno	77	Kenton Opalite		1.62	0.25				1.04
Fresno	86	Alibates		1.51	0.23				0.35
Fresno	92	Alibates			0.28				0.50
Fresno	97	Alibates		1.51	0.22				0.80
Fresno	98/133	Alibates	3.10	1.31	0.30				0.88
Fresno	98	Alibates	2.69	1.78	0.31				1.39
Fresno	98	Tecovas	2.50	1.32	0.26				0.76
Fresno	114	Unid. chert	3.08	1.81	0.72				3.05
Fresno	120	Alibates	2.00	1.50	0.25				0.76
Fresno	120	Alibates		1.45	0.21				0.63
Fresno	130	Alibates	2.58		0.25				0.66
Fresno	130	Alibates		1.51	0.31				0.92
Fresno	130	Alibates	2.34	1.57	0.32				1.27
Fresno	137	Alibates		1.21	0.23				0.44
Fresno	137	Alibates		1.60	0.28				0.93
Fresno	141	Alibates		1.40	0.18				0.23
Fresno	141/54	Alibates		1.64	0.39				1.62
Fresno	143	Alibates		1.39	0.28				0.76
Fresno	157	Alibates		1.49	0.25				0.50
Fresno	159	Basalt	2.71	1.67	0.40				1.80
Fresno	162/77	Alibates	3.42	1.92	0.65				3.25
Fresno	177	Alibates	2.78	1.89	0.44				1.91
Fresno	177	Niobrara		1.49	0.35				0.93
Fresno	177	Alibates		1.09	0.22				0.44
Fresno	224	Alibates		1.26	0.23				0.51
Fresno	226	Alibates	1.51	1.21	0.19				0.35
Fresno	229	Alibates		1.38	0.31				0.87

Table 6.1 (continued).

Point Type	Cat. #	Material	Length	Width	Thickness	Stem Length	Stem Width	Base Width	Weight
Fresno	238	Alibates		1.20	0.23				0.47
Fresno	260	Alibates		1.78	0.19				0.58
Fresno	275	Alibates		1.31	0.20				0.48
Fresno	282	Alibates	3.00	1.32	0.32				1.31
Fresno	284	Alibates		1.73	0.24				1.43
Fresno	284	Alibates		1.45	0.29				1.22
Fresno	287	Tecovas		1.51	0.20				0.39
Fresno	291	Alibates		1.35	0.32				1.10
Fresno	292	Alibates		1.57	0.27				0.34
Fresno	293	Alibates	2.32		0.27				0.73
Side-notched Fragment	1	Niobrara							0.64
Side-notched Fragment	1	Alibates							0.45
Side-notched Fragment	39	Alibates							0.14
Side-notched Fragment	41	Alibates							0.43
Side-notched Fragment	47	Missing-unknown							
Side-notched Fragment	62	Unid. quartzite							0.45
Side-notched Fragment	65	Alibates							0.33
Side-notched Fragment	112	Missing-unknown							
Side-notched Fragment	121	Alibates							0.28
Side-notched Fragment	139	Alibates							0.57
Side-notched Fragment	140	Unid. chert							0.56
Side-notched Fragment	140	Alibates							0.67
Side-notched Fragment	141	Tecovas							0.55
Side-notched Fragment	141	Alibates							0.48
Side-notched Fragment	141	Alibates							0.50
Side-notched Fragment	144	Unid. chert							0.41
Side-notched Fragment	146	Niobrara							0.29
Side-notched Fragment	177	Tecovas							0.43
Side-notched Fragment	177	Alibates							0.23

Table 6.1 (continued).

Point Type	Cat. #	Material	Length	Width	Thickness	Stem Length	Stem Width	Base Width	Weight
Side-notched Fragment	246	Alibates							0.25
Side-notched Fragment	248	Alibates							0.54
Side-notched Fragment	248	Alibates							0.3
Side-notched Fragment	281	Alibates							0.59
Side-notched Fragment	284	Alibates							0.25
Side-notched Fragment	285	Alibates							0.56
Side-notched Fragment	292	Alibates							0.38
Side-notched Fragment	340	Alibates							0.28
Mid-section Fragment	1	Alibates							0.35
Mid-section Fragment	28	Alibates							0.36
Mid-section Fragment	33	Alibates							0.31
Mid-section Fragment	35	Alibates							0.46
Mid-section Fragment	53	Alibates							0.67
Mid-section Fragment	59	Alibates							0.15
Mid-section Fragment	59	Alibates							0.27
Mid-section Fragment	79	Alibates							0.37
Mid-section Fragment	99	Alibates							0.71
Mid-section Fragment	104	Unid. chert							0.17
Mid-section Fragment	131	Alibates							0.24
Mid-section Fragment	141	Alibates							0.13
Mid-section Fragment	143	Alibates							0.24
Mid-section Fragment	226	Alibates							0.23
Mid-section Fragment	240	Alibates							0.56
Mid-section Fragment	249	Alibates							0.33
Mid-section Fragment	260	Unid. chert							0.38
Mid-section Fragment	270	Unid. chert							0.26
Mid-section Fragment	292	Alibates							0.28
Mid-section Fragment	401	Alibates							0.39
Base Fragment	141	alibates		1.50	0.20				0.40

Table 6.1 (continued).

Point Type	Cat. #	Material	Length	Width	Thickness	Stem Length	Stem Width	Base Width	Weight
Tip Fragment	51	Unid. chert							0.10
Tip Fragment	51	Alibates							0.63
Tip Fragment	51	Alibates							0.42
Tip Fragment	57	Alibates							0.19
Tip Fragment	58	Alibates							1.05
Tip Fragment	64	Alibates							0.72
Tip Fragment	64	Alibates							0.84
Tip Fragment	64	Alibates							0.21
Tip Fragment	64	Alibates							0.21
Tip Fragment	72	Alibates							0.85
Tip Fragment	74	Alibates							0.32
Tip Fragment	83	Alibates							0.28
Tip Fragment	84	Alibates							0.15
Tip Fragment	96	Tecovas							0.38
Tip Fragment	121	Alibates							0.22
Tip Fragment	126	Alibates							0.52
Tip Fragment	130	Alibates							0.23
Tip Fragment	140	Alibates							0.43
Tip Fragment	143	Alibates							0.67
Tip Fragment	143	Alibates							0.16
Tip Fragment	147	Tecovas							0.23
Tip Fragment	149	Alibates							0.54
Tip Fragment	157	Tecovas							0.38
Tip Fragment	163	Unid. chert							1.11
Tip Fragment	164	Day Creek							1.95
Tip Fragment	166	Alibates							1.60
Tip Fragment	171	Unid. chert							0.47
Tip Fragment	173	Tecovas							0.37
Tip Fragment	177	Alibates							0.36

Table 6.1 (continued).

Point Type	Cat. #	Material	Length	Width	Thickness	Stem Length	Stem Width	Base Width	Weight
Tip Fragment	177	Alibates							0.13
Tip Fragment	177	Kenton Opalite							0.36
Tip Fragment	229	Alibates							0.77
Tip Fragment	249	Alibates							0.55
Tip Fragment	249	Kenton Opalite							0.12
Tip Fragment	266	Kenton Opalite							0.13
Tip Fragment	269	Alibates							0.71
Tip Fragment	270	Tecovas							0.26
Tip Fragment	276	Tecovas							0.63
Tip Fragment	281	Alibates							0.56
Tip Fragment	282	Alibates							0.17
Tip Fragment	287	Alibates							0.56
Tip Fragment	287	Kenton Opalite							0.17
Tip Fragment	325	Alibates							0.35
Tip Fragment	383	Alibates							0.75
Tip Fragment	383	Unid. chert							0.56
Corner notched dart point	64	Alibates	2.80	2.20	0.50				3.40

* Found on surface 7-29-98 in vicinity of S18E8

Table 6.2. Projectile Points by Lithic Material Types.

POINT TYPE	Alibates	Niobrara Jasper	Tecovas	Tesesquite Quartzite	Unid. Chert	Opalite	Day Creek	Basalt	Total	Percent
FRESNO	52	1	2		4	3		1	63	29%
WASHITA	34	1	3	1	7	1	1	1	49	22%
HUFFAKER-LIKE	5				1				6	3%
HARRELL	2	1	1						4	2%
SHETLEY	1	1							2	1%
SCALLORN	1			1					2	1%
CORNER-NOTCHED DART POINT	1								1	< 1%
CEREMONIAL POINT		1							1	< 1%
UNIDENTIFIED SIDE-NOTCHED FRAGMENT	18	4	2		2			1	27	12%
TIP FRAGMENT	28		7		4	4	2		45	20%
MID-SECTION FRAGMENT	17				3				20	9%
UNIDENTIFIED BASE FRAGMENT	1								1	< 1%
TOTAL	160	9	15	2	21	8	3	3	221	
PERCENTAGES	72%	4%	7%	1%	10%	4%	1%	1%	100%	

Fresno points are triangular unnotched arrowpoints with straight to slightly convex blade edges (Bell 1960:44-45; Figure 6.1). They are made of various lithic materials with 83% being made out of Alibates. A variety of materials are represented in the remaining 17%.

WASHITA

Sample Size: 49 (27 complete, 22 fragments)

Mean Dimensions: Length 2.19 cm, Width 1.31 cm, Thickness 0.23 cm, Stem Length 0.74 cm, Stem Width 0.69 cm.

Range of Dimensions: Length 1.18-3.20 cm, Width 1.00-1.64 cm, Thickness 0.18-0.30 cm, Stem Length 0.50-0.94 cm, Stem Width 0.50-0.92 cm.

Points of this type are characterized by a triangular form with straight to slightly convex blade edges and a single set of side notches (Bell 1958:98-99). Bases are straight to slightly concave (Figure 6.1). Alibates accounts for 69% of these points. A diversity of materials make up the rest of the assemblage.

HUFFAKER-LIKE (Multiple side-notched)

Sample Size: 6 (4 complete, 2 fragments)

Mean Dimensions: Length 2.24 cm, Width 1.35 cm, Thickness 0.25 cm.

Range of Dimensions: Length 1.68-3.35 cm, Width 1.02-1.70 cm, Thickness 0.18-0.32 cm.

These six specimens are similar to Washita points in shape but have multiple side-notches (Figure 6.1). Based on traditional point typology, they

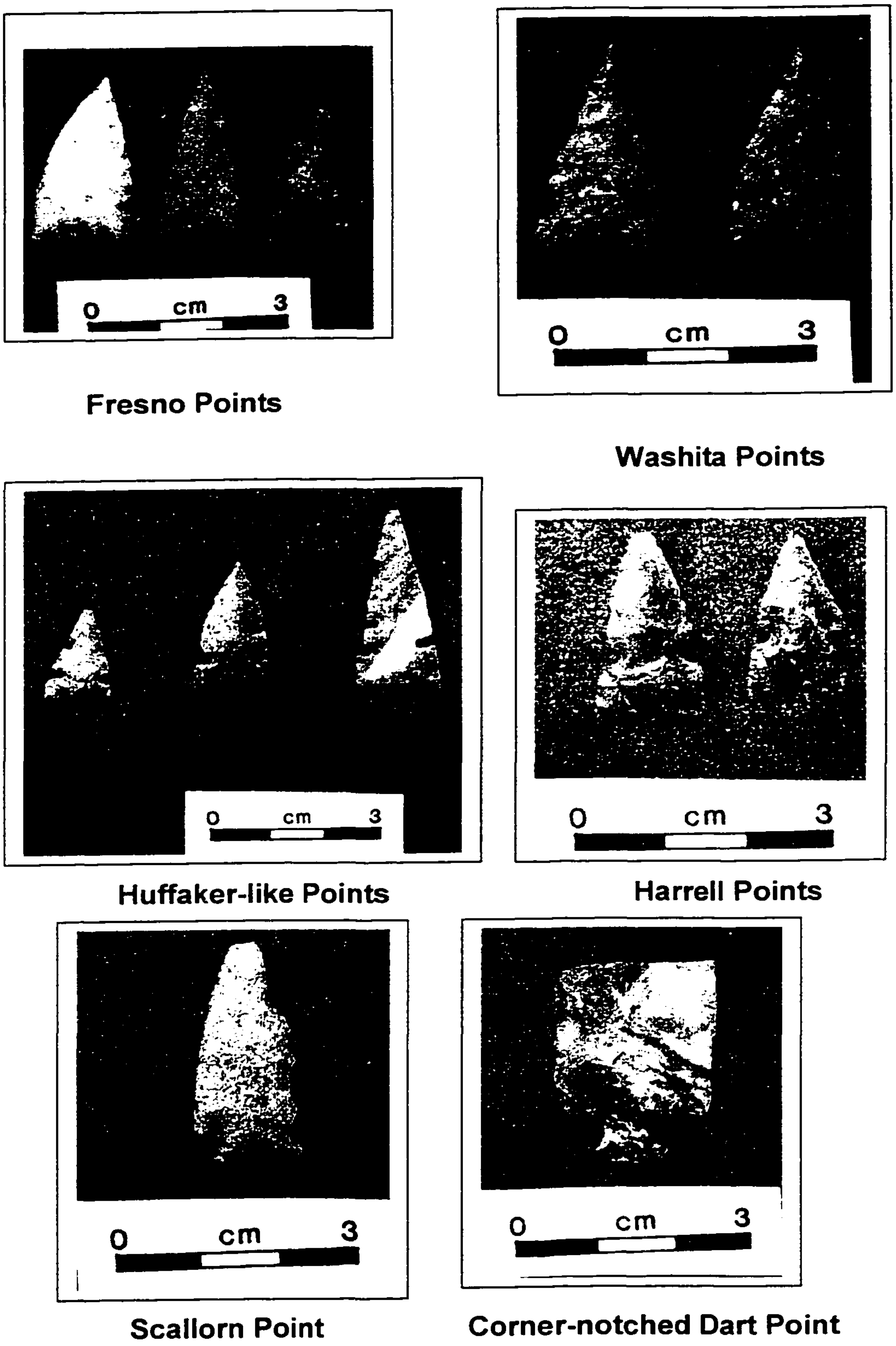


Figure 6.1. Projectile Points (Fresno, Washita, Huffaker-like, Harrell, Scallorn, and Corner-notched Dart Point).

are most similar to Huffaker style points (Bell 1960:58-59). Eighty-three percent are made of Alibates.

HARRELL

Sample Size: 4 (3 complete, 1 fragment)

Mean Dimensions: Length 2.65 cm, Width 1.30 cm, Thickness 0.26 cm, Stem Length 0.90 cm, Stem Width 0.69 cm.

Range of Dimensions: Length 2.12-3.46 cm, Width 1.19-1.40 cm, Thickness 0.21-0.30 cm, Stem Length 0.87-0.96 cm, Stem Width 0.67-0.71 cm.

Harrell points are triangular side-notched points with a notched base (Bell 1958:30-31; Figure 6.1). Alibates accounts for half of these points.

SHETLEY

Sample Size: 2 (2 complete)

Mean Dimensions: Length 2.97 cm, Width 1.41 cm, Thickness 0.35 cm, Stem Length 1.01 cm, Stem Width 0.78 cm, Base Width 1.30 cm.

Range of Dimensions: Length 2.63-3.30 cm, Width 1.36-1.46 cm, Thickness 0.29-0.40 cm, Stem Length 0.90-1.12 cm, Stem Width 0.62-0.93 cm, Base Width 1.22-1.38 cm.

This type of arrowpoint is characterized by long triangular blades with deep narrow side-notches and concave bases (Perino 1971:92-93). Although both points are missing from the collection, Lintz's notes provide the above measurements and identify the material type.

SCALLORN

Sample Size: 2 (1 complete, 1 fragment)

Mean Dimensions: Thickness 0.34 cm, Stem Length 0.62 cm, Stem Width 1.00 cm, Base Width 1.38 cm.

Range of Dimensions: Length broken-2.97 cm, Width broken-1.33 cm, Thickness 0.27-0.40 cm, Stem Length 0.45-0.78 cm, Stem Width 0.90-1.10 cm, Base Width 1.15-1.60 cm.

Scallorn points are corner-notched triangular points with straight to convex lateral edges (Bell 1960:84-85; Figure 6.1). Half are of Alibates.

CORNER-NOTCHED DART POINT

Sample Size: 1 (fragment)

Dimensions: Length 2.8+ cm, Width 2.2 cm, Thickness 0.5 cm.

This corner-notched dart point, made of Alibates, is missing the distal portion and tip area. From the part of the blade that is present, the edges are nearly parallel. The point has a fairly narrow, slightly expanding stem and a straight base (Figure 6.1). It is the only dart point recovered from the site and probably represents either collection by Antelope Creek phase people or deposition by an earlier Archaic group.

LARGE "CEREMONIAL" TYPE POINT

Sample Size: 1 (complete)

Dimensions: Length 9.97 cm, Width 3.55 cm, Thickness 1.07 cm, Stem Length 2.51 cm, Stem Width 2.55 cm, Notch Width 1.50 cm.

Although this point is missing from the collection, Lintz provided the measurements and photograph from his earlier analysis. The point resembles a Washita point in shape although in size it is closer to a dart point (Figure 6.2). It is made of Niobrara Jasper. Lintz (personal communication 2001) described it as having "an acute tip, a long and broad triangular blade with slightly convex blade edges, very broad side notches, a basal portion with edges in line with the blade edge, prominent tangs, and a slightly concave base." In addition, Lintz indicates that it is "extremely well made and has a relatively thin biconvex cross section." The point style is similar to ones described by Wedel (1959:266, Figure 53, Plate 37) and others analyzed by Vehik (2002:54, 57) for sites in south-central Kansas. The point was recovered from the west wall area of Structure 1A. Although no altar was recorded for this structure, had one been present like other Antelope Creek structures, this point would have been in the ceremonial area of the room.

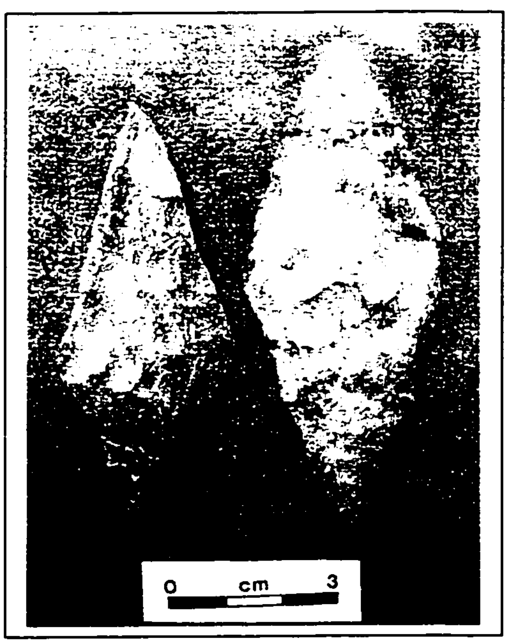
POINT FRAGMENTS

Sample Size: 93

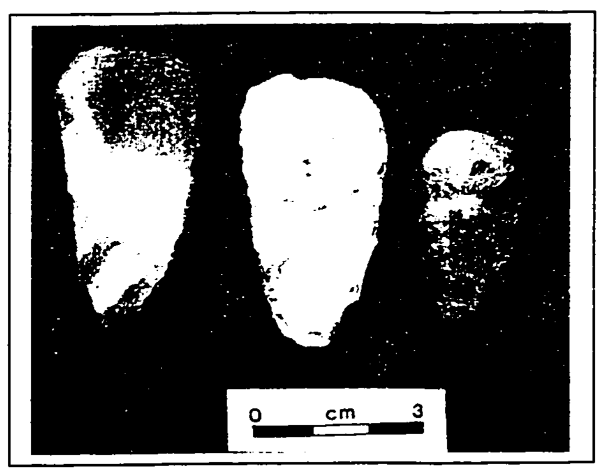
The point fragments consist of tip, mid-section, and base fragments as well as some unidentified side-notched fragments. Like the other projectile points from the site, the primary lithic material is Alibates (64).

Large "Ceremonial" Point

Oval/Ovate Biface



Diamond-beveled Knives



End and Side Scrapers

Figure 6.2. Chipped Stone Tools (Large "Ceremonial" Point, Biface, Diamond-beveled Knives, End and Side Scrapers).

Bifaces

Sample Size: 16

Mean Dimensions: Length 6.34 cm, Width 3.53 cm, Thickness 0.71 cm.

Range of Dimensions: Length 3.04-11.00 cm, Width 2.00-6.20 cm, Thickness 0.51-0.97 cm.

These items are predominately oval to ovate in shape, but also include triangular, a side-notched haftable form, haftable fragments, and a tabular rectangular piece (Table 6.3). Several oval specimens were most likely used as knives. This interpretation is based on small flake scars, on at least one long edge of the biface, that appear to be from sharpening the edge for use (Figure 6.2). The petrified wood biface includes one edge that is beveled. Half of the specimens in this category are of Alibates.

Table 6.3. Metric Dimensions and Material Types of Bifaces and Fragments.

Type	Cat. #	Material	Length	Width	Thickness	Stem Length	Stem Width	Notch Width	Weight
Haftable-Side Notched	177	Alibates	3.04	2.70	0.71	1.27	1.95	0.70	6.50
Haftable Fragment	280	Alibates			0.55	0.88	1.34		2.74
Haftable Fragment	144	Unid.chert	5.68	2.00	0.52				7.20
Haftable Fragment	64	Alibates		2.68	0.60		1.90		8.32
Triangular	63	Day Creek	3.78	2.40	0.65				5.40
Triangular	172	Dakota	6.82	4.53	0.78				26.00
Oval/Ovate	63	Alibates	5.48	2.68	0.94				13.70
Oval/Ovate	63	Petrified Wood	7.18	3.25	0.95				24.70
Oval/Ovate	63	Alibates	6.05	3.60	0.68				16.10
Oval/Ovate	63	Unid.Chert	5.22	1.90	0.50				5.90
Oval/Ovate	302	Alibates	11.00	6.20	0.97				61.06
Oval/Ovate	177	Alibates		2.32	0.51				Missing
Oval/Ovate	141	Alibates	6.61	3.50	0.81				17.93
Oval/Ovate	288	Dakota	7.50	3.21	0.90				26.35
Oval/Ovate	122	Niobrara	3.23	2.41	0.68				5.05
Tabular	173	Niobrara	6.81	5.75	0.77				42.31

Biface Fragments

Sample Size: 85

Biface fragments vary with lateral, end, midsection, and unknown sections present (Table 6.4). Seventy-four percent are of Alibates.

Table 6.4. Biface Fragments.

Cat #	Material	Weight	Section, If known
1	Alibates	3.4	
1	Alibates	5.7	
1	Alibates	1.7	
1	Unidentified Chert	3.2	
1	Unidentified Quartzite	9.3	
12	Dakota Quartzite	8.2	
29	Alibates	2.5	
33	Alibates	2.8	
33	Alibates	1.0	
38	Alibates	0.9	
38	Alibates	1.8	
41	Tesesquite Quartzite	4.7	
50	Alibates	0.8	
51	Unidentified Chert	5.3	
53	Unidentified Chert	10.7	
58	Alibates	6.3	Lateral
60	Opalite	0.6	
64	Alibates	10.4	Lateral
64	Unidentified Chert	3.3	
66	Opalite	23.4	Lateral
67	Tesesquite Quartzite	3.2	
76	Alibates	1.3	
76	Alibates	1.2	
77	Alibates	3.0	
88	Alibates	4.6	
88	Alibates	2.2	
90	Alibates	0.7	Lateral
91	Alibates	2.5	
96	Alibates	1.7	
96	Alibates	3.2	Lateral
96	Opalite	1.2	
99	Alibates	4.4	Midsection
101	Tecovas	8.3	
110	Tecovas	8.3	
116	Alibates	0.7	Lateral
120	Alibates	0.3	
122	Unidentified Chert	3.8	
127	Alibates	1.5	

Table 6.4 (continued).

Cat #	Material	Weight	Section, If known
130	Alibates	0.5	Lateral
130	Opalite	13.0	
131	Alibates	0.6	
131	Alibates	4.2	
134	Alibates	1.2	End and Lateral
135	Alibates	0.3	
135	Alibates	2.3	
137	Alibates	6.3	Lateral
141	Alibates	7.6	
141	Alibates	5.7	
141	Alibates	2.3	
141	Alibates	0.7	
143	Day Creek	4.2	Lateral
144	Alibates	0.6	Lateral
146	Alibates	8.9	Lateral
162	Alibates	10.6	
162	Alibates	0.4	
168	Alibates	9.7	
175	Alibates	6.9	
177	Alibates	6.5	Midsection
177	Alibates	4.8	End
177	Alibates	3.9	
177	Alibates	2.8	
177	Alibates	3.2	
177	Alibates	5.5	
177	Alibates	12.3	
177	Opalite	13.0	
177	Opalite	1.6	
177	Unidentified Chert	14.4	
177	Unidentified Chert	0.3	
212	Unidentified Chert	6.2	
244	Alibates	0.6	
275	Alibates	1.9	
281	Alibates	0.4	
284	Alibates	0.9	
287	Alibates	0.8	
287	Alibates	3.0	
287	Alibates	1.8	
287	Alibates	5.3	Midsection
289	Alibates	2.6	End
289	Alibates	11.7	Midsection
291	Alibates	0.2	
306	Alibates	0.4	
318	Tesesquite Quartzite	0.5	
396	Unidentified Chert	0.5	
401	Alibates	1.0	
161/149	Alibates	10.5	

Diamond-Beveled Knives

Sample Size: 27 (5 complete, 22 fragments)

Mean Dimensions: Length 10.08 cm, Width 3.37 cm, Thickness 0.68 cm.

Range of Dimensions: Length 8.74-12.23 cm, Width 2.82-3.80 cm, Thickness 0.50-0.86 cm.

These knives have a diamond-shaped outline and are beveled on all four edges (Table 6.5; Figure 6.2). Also called "Harahey knives," these tools are commonly associated with bison remains. Creel (1991) suggests that diamond-beveled knives were used in bison-hide processing and indirectly reflect interregional hide trade. Seventy-four percent are of Alibates.

Table 6.5. Metric Dimensions and Material Types of Diamond-Beveled Knives.

Description	Cat. #	Material	Length	Width	Thickness	Weight
Complete	50	Alibates	9.43	2.88	0.64	19.0
Complete	63	Alibates	9.88	2.78	0.75	21.2
Complete	144	Alibates	9.90	3.78	0.70	28.9
Complete	286	Niobrara	8.74	3.20	0.79	19.2
Complete	300	Alibates	12.23	3.40	0.68	26.5
Tip	135/143	Alibates		3.62	0.60	12.9
Tip	154	Alibates		3.49	0.58	18.1
Tip	161/165	Alibates		3.80	0.86	35.1
Tip	287	Tesesquite		2.82	0.73	14.8
Tip	152	Unid.Chert			0.61	5.2
Tip	161/212	Alibates			0.71	24.0
Tip	212	Alibates			0.73	4.7
Tip	305	Alibates			0.84	28.9
Midsection	28	Alibates			0.55	1.0
Midsection	140	Tecovas			0.69	5.0
Midsection	146	Alibates			0.71	5.6
Midsection	148	Alibates			0.79	11.9
Midsection	170	Alibates			0.67	9.9
Midsection	170	Alibates			0.68	4.2
Midsection	247	Alibates			0.60	2.5
Midsection	248	Alibates			0.70	10.1
Midsection	284	Unid.Chert			0.70	5.0
Lateral section	46	Alibates			0.68	2.5
Lateral section	91	Alibates			0.50	1.0
Lateral section	177	Alibates			0.66	0.9
Lateral section	244	Unid.Chert			0.70	1.1
Lateral section	291	Unid.Chert			0.61	0.7

End Scrapers

Sample Size: 46 (29 complete, 17 fragments)

Mean Dimensions: Length 3.93 cm, Width 2.44 cm, Thickness 0.68 cm.

Range of Dimensions: Length 2.00-5.90 cm, Width 1.46-3.52 cm, Thickness 0.30-1.40 cm.

These end scrapers are thick "keeled" or "snub-nosed" varieties with an elliptical to oval shape (Figure 6.2; Table 6.6). The distal end has steep marginal flaking. These tools reflect an important component of a bison-hide processing tool kit (Creel 1991) and support the inference about a primary reliance upon bison. All are made of Alibates with the exception of one Niobrara Jasper fragment.

Guitar Pick Scrapers

Sample Size: 49 (30 complete, 19 fragments)

Mean Dimensions: Length 3.15 cm, Width 1.97 cm, Thickness 0.36 cm.

Range of Dimensions: Length 1.40-4.80 cm, Width 1.30-3.40 cm, Thickness 0.18-.65 cm.

Guitar Pick scrapers are thin triangular scrapers that have been retouched on either the dorsal or ventral surface (Figure 6.2; Table 6.6). Alibates provides the lithic material for 88% of this category.

Endscraper/Gravers

Sample Size: 4 (2 complete, 2 fragments)

Mean Dimensions: Length 3.28 cm, Width 2.43 cm, Thickness 0.77 cm.

Range of Dimensions: Length 3.06-3.49 cm, Width 2.06-2.72 cm, Thickness 0.59-1.06 cm.

Although all of these combination endscraper and graver tools are missing, data sheets from Lintz indicate that they were all made of Alibates and had at least two working edges - one for incising and one for scraping (Table 6.6).

Side Scrapers

Sample Size: 52 (50 complete, 2 fragments)

Mean Dimensions: Length 5.43 cm, Width 2.66 cm, Thickness 0.72 cm.

Range of Dimensions: Length 2.58-9.70 cm, Width 1.18-3.80 cm, Thickness 0.20-1.20 cm.

These scrapers are made from flakes and have had at least one lateral edge modified with unifacial flaking to form a steep working edge (Figure 6.2; Table 6.6). Eighty-three percent are of Alibates.

Miscellaneous Scraper Fragments

Sample Size: 154

These are irregularly shaped scraper fragments. Alibates accounts for 88% of these fragments.

Table 6.6. Metric Dimensions and Material Types of Scrapers.

End Scrapers	Cat. #	Material	Length	Width	Thickness	Weight
Complete	1	Alibates	4.42	2.81	0.67	9.3
Complete	43	Alibates	4.53	2.48	0.64	7.8
Complete	51	Alibates	4.15	3.52	0.63	12.6
Complete	59	Alibates	2.63	1.46	0.51	2.6
Complete	63	Alibates	5.05	3.02	1.00	16.3
Complete	63	Day Creek	4.90	2.43	0.90	12.3
Complete	94	Alibates	3.08	3.04	0.86	8.8
Complete	100	Alibates	3.17	2.42	0.49	4.5
Complete	114	Alibates	5.22	2.63	1.10	17.6
Complete	121	Alibates	4.24	2.59	0.90	11.5
Complete	130	Alibates	2.60	2.09	0.80	5.4
Complete	143	Alibates	3.97	2.40	0.64	6.7
Complete	143	Alibates	4.24	3.10	0.71	10.4
Complete	149	Alibates	3.99	2.40	0.60	8.6
Complete	154	Alibates	3.63	2.08	0.48	5.2
Complete	162	Alibates	3.00	1.88	0.47	2.7
Complete	164	Alibates	3.69	2.66	0.70	8.4
Complete	165	Alibates	4.27	2.06	0.45	5.3
Complete	165	Alibates	4.60	2.37	0.67	8.6
Complete	168	Alibates	5.88	2.60	0.68	13.6
Complete	173	Alibates	4.10	2.60	0.94	8.8
Complete	261	Alibates	3.23	2.50	0.77	6.7
Complete	282	Alibates	4.58	2.35	0.82	8.4
Complete	284	Alibates	3.06	2.31	0.41	4.0
Complete	287	Alibates	2.00	1.82	0.56	2.0
Complete	287	Alibates	3.80	1.90	0.70	6.3
Complete	288	Alibates	3.70	2.60	0.64	7.3
Complete	305	Alibates	4.11	2.10	0.43	5.4
Complete	324	Alibates	4.06	2.54	0.61	6.9
Fragment	1	Alibates	2.80	2.90	1.04	10.0
Fragment	46	Alibates	1.60	2.40	0.50	2.7
Fragment	54	Alibates	1.70	2.80	0.60	3.2
Fragment	54	Alibates	2.40	2.30	0.80	4.8
Fragment	96	Niobrara	1.60	2.50	0.40	1.9
Fragment	96	Alibates	1.60	2.02	0.60	1.9
Fragment	154/275	Alibates	5.00	2.20	0.70	12.8
Fragment	173	Alibates	1.45	2.20	0.30	1.2

Table 6.6 (continued).

End Scrapers	Cat.#	Material	Length	Width	Thickness	Weight
Fragment	176	Alibates	3.93	2.60	0.65	9.1
Fragment	177	Alibates			0.32	0.8
Fragment	227	Alibates	2.00	1.60	0.33	1.1
Fragment	266	Alibates	2.76	2.10	0.60	3.8
Fragment	281	Alibates	3.32	2.90	1.40	14.3
Fragment	283	Alibates	2.46	1.97	0.58	3.4
Fragment	284	Alibates	1.46	2.00	0.50	1.3
Fragment	289	Alibates	2.73	2.88	0.92	10.9
Fragment	308	Alibates	0.91	1.92	0.28	0.6
Endscraper/Gravers						
Complete	44	Alibates*		2.72	1.06	
Complete	60	Alibates*		2.52	0.72	
Complete	174	Alibates*	3.49		0.59	
Complete	177	Alibates*	3.06	2.06	0.7	
Guitar Pick Scrapers						
Dorsal Retouch						
Complete	262/29	Alibates*	3.04	1.70	0.18	
Complete	73	Alibates*	2.95	2.00	0.31	
Fragment	51	Alibates*	1.40	1.42	0.21	
Fragment	107	Alibates*	2.00	1.30	0.24	
Fragment	155	Alibates*	1.50	1.80	0.27	
Fragment	163	Alibates*	2.74	1.45	0.29	
Fragment	383	Alibates*	1.55	1.50	0.20	
Ventral Retouch						
Complete	19	Alibates	3.81	2.09	0.40	3.5
Complete	20	Alibates	3.04	2.20	0.30	2.6
Complete	20	Alibates	3.54	2.30	0.65	5.3
Complete	34	Alibates	3.16	1.80	0.30	2.3
Complete	47	Alibates	4.04	2.20	0.25	3.4
Complete	54	Alibates	4.20	1.80	0.50	3.6
Complete	77	Alibates	2.60	1.70	0.30	1.6
Complete	89	Alibates	3.08	2.05	0.40	3.2
Complete	96	Alibates	2.70	2.10	0.30	1.9
Complete	122	Tesesquite	2.10	1.65	0.30	1.0
Complete	130	Alibates	3.30	2.30	0.25	2.6
Complete	131	Alibates	2.60	1.70	0.50	2.1
Complete	131	Alibates	3.10	1.70	0.25	1.5
Complete	137	Alibates	3.30	1.70	0.60	3.2

Table 6.6 (continued).

Guitar Pick Scrapers	Cat.#	Material	Length	Width	Thickness	Weight
Ventral Retouch						
Complete	141	Alibates	4.80	3.40	0.50	10.7
Complete	141	Alibates	2.95	2.00	0.30	2.0
Complete	144	Alibates	2.85	1.60	0.30	1.4
Complete	170	Alibates	3.90	1.90	0.40	3.2
Complete	177	Tecovas	2.20	1.70	0.45	2.0
Complete	203	Alibates	2.90	1.45	0.40	1.5
Complete	226	Alibates	4.70	2.50	0.50	7.6
Complete	280	Alibates	3.20	2.50	0.55	4.0
Complete	287	Tecovas	3.20	1.70	0.38	2.1
Complete	291	Alibates	4.50	2.55	0.45	5.8
Complete	291	Alibates	3.80	2.15	0.30	2.8
Complete	292	Alibates	3.00	1.60	0.40	2.0
Complete	357	Opalite	4.10	2.05	0.50	5.4
Complete	378	Alibates	4.30	2.50	0.40	5.2
Fragment	43	Alibates			0.30	1.0
Fragment	55	Alibates		1.90	0.40	2.5
Fragment	61	Alibates	3.00		0.40	2.5
Fragment	77	Alibates		2.70	0.30	2.9
Fragment	87	Unid.chert			0.40	1.7
Fragment	91	Alibates		2.05	0.40	1.7
Fragment	102	Opalite			0.40	1.5
Fragment	135	Alibates		1.50	0.25	0.6
Fragment	140	Alibates	3.60	2.50	0.40	4.3
Fragment	141	Alibates			0.30	0.6
Fragment	239	Alibates			0.25	0.5
Fragment	281	Alibates		2.00	0.20	1.1
Fragment	281	Alibates		1.90	0.45	1.8
Fragment	377	Alibates	3.10	1.90	0.40	3.1
Side Scrapers						
Complete	1	Alibates	8.58	2.32	0.82	15.1
Complete	44	Opalite	2.65	2.60	1.00	7.3
Complete	50	Alibates	6.06	3.10	0.86	14.3
Complete	53	Alibates	7.96	3.70	.60	18.8
Complete	55	Alibates	6.28	2.78	.90	16.0
Complete	60	Alibates	2.58	1.80	.70	3.7
Complete	64	Alibates	4.18	2.30	.72	7.6
Complete	66	Alibates	5.10	2.62	1.02	11.3
Complete	66	Alibates	4.10	2.12	.38	3.1

Table 6.6 (continued).

Side Scrapers	Cat. #	Material	Length	Width	Thickness	Weight
Complete	73	Petr.Wood	7.55	2.90	.88	21.4
Complete	76	Alibates	6.10	2.92	.40	8.6
Complete	78	Alibates	2.82	1.60	.40	2.0
Complete	83	Alibates	4.62	2.32	.80	7.9
Complete	100	Alibates	5.50	3.80	.90	12.8
Complete	100	Alibates	5.51	3.10	0.70	13.9
Complete	107	Alibates	6.00	2.68	0.52	9.6
Complete	113	Alibates	4.40	2.18	0.42	3.9
Complete	114	Alibates	5.10	3.34	0.70	8.2
Complete	135	Alibates	4.60	2.00	1.20	10.0
Complete	146	Alibates	4.60	2.70	0.65	6.6
Complete	147	Alibates	3.40	2.32	0.45	5.1
Complete	149	Alibates	5.12	2.10	0.70	7.5
Complete	149	Alibates	5.12	2.50	0.65	9.4
Complete	165	Alibates	5.00	2.70	1.00	10.0
Complete	170	Alibates	5.10	2.94	0.95	20.4
Complete	170	Alibates	3.54	1.18	0.20	1.2
Complete	171	Alibates	9.70	2.38	0.80	22.0
Complete	174	Alibates	3.55	2.25	0.60	5.4
Complete	177	Alibates	4.30	3.05	1.20	17.5
Complete	226	Alibates	6.20	2.72	0.75	14.0
Complete	228	Alibates	6.90	3.02	1.15	25.2
Complete	228	Alibates	6.08	2.82	0.78	13.8
Complete	228	Alibates	7.12	3.10	0.62	14.3
Complete	228	Alibates	6.24	2.52	0.60	9.7
Complete	244	Alibates	5.28	2.95	0.55	11.5
Complete	248	Alibates	5.85	2.64	0.75	11.5
Complete	254	Alibates	7.10	3.10	0.55	11.6
Complete	262	Day Creek	5.50	3.50	0.50	10.4
Complete	267	Alibates	5.08	2.62	0.88	11.4
Complete	281	Alibates	7.42	3.20	0.78	16.5
Complete	285	Alibates	4.78	1.30	0.25	1.7
Complete	286	Day Creek	8.00	3.32	0.95	29.1
Complete	288	Alibates	4.40	2.55	0.45	5.9
Complete	289	Alibates	3.32	2.00	0.60	3.8
Complete	289	Alibates	5.22	3.30	0.54	11.1
Complete	291	Alibates	5.45	2.23	0.40	6.3
Complete	291	Alibates	5.62	3.42	1.20	20.8
Complete	291	Alibates	4.25	2.60	0.60	6.7
Complete	303	Alibates	6.95	2.20	0.90	11.6
Complete	309	Alibates	3.58	2.50	0.90	7.4
Fragment	77	Alibates		2.40	0.82	6.8
Fragment	134	Unid.chert		1.45	0.25	0.6

Table 6.6 (continued).

Miscellaneous	Cat.#	Material	Length	Width	Thickness	Weight
Fragment	1	Alibates	3.70	2.50	1.00	9.5
Fragment	1	Alibates	2.90	2.80	0.80	6.4
Fragment	1	Alibates	3.00	2.40	0.90	7.2
Fragment	1	Alibates	3.50	2.70	0.60	6.8
Fragment	1	Niobrara		1.80	0.60	1.3
Fragment	19	Alibates	2.80	1.90	0.80	5.0
Fragment	22	Opalite		1.70	0.40	1.5
Fragment	28	Alibates		2.00	0.60	1.9
Fragment	29	Alibates	2.00	2.40	0.40	2.9
Fragment	38	Alibates		1.60	0.50	1.1
Fragment	47	Dakota	2.80	2.10	0.60	3.9
Fragment	47	Alibates	2.80	2.30	0.70	5.3
Fragment	48	Tesesquite	3.80	2.40	0.90	7.6
Fragment	55	Alibates	3.80	1.20	0.70	2.7
Fragment	57	Alibates	3.00	1.70	0.50	2.5
Fragment	62	Alibates	2.10	1.10	0.50	1.7
Fragment	64	Alibates	2.20	2.60	0.70	3.5
Fragment	65	Niobrara	2.60	1.00	0.90	1.8
Fragment	67	Alibates	2.90	2.50	0.50	4.3
Fragment	67	Alibates			0.20	0.2
Fragment	68	Alibates	2.50	1.20	0.30	0.9
Fragment	70	Alibates		1.40	0.30	0.5
Fragment	71	Alibates			0.30	0.5
Fragment	73	Alibates	3.30	3.00	1.30	10.3
Fragment	74	Alibates			0.30	0.5
Fragment	75	Alibates		1.90	0.20	0.7
Fragment	76	Alibates			0.20	0.6
Fragment	76	Alibates	2.70	1.30	0.60	1.8
Fragment	76	Alibates	3.90	2.60	0.70	5.9
Fragment	79	Alibates			0.60	1.8
Fragment	88	Alibates			0.20	0.3
Fragment	89	Alibates	2.00	1.50	0.60	1.7
Fragment	90	Alibates	1.80	2.60	0.50	1.9
Fragment	91	Alibates	3.10	1.80	0.30	1.7
Fragment	95	Alibates	1.80	1.10	0.30	0.8
Fragment	96	Alibates	1.80	0.90	0.30	0.6
Fragment	96	Alibates	1.60	1.10	0.50	1.0
Fragment	97	Alibates	3.00	1.40	0.40	1.5
Fragment	97	Alibates	3.50	2.30	1.30	9.9

Table 6.6 (continued).

Miscellaneous	Cat.#	Material	Length	Width	Thickness	Weight
Fragment	99	Alibates	1.60	1.50	0.30	1.2
Fragment	99	Alibates	2.20	1.80	0.60	3.0
Fragment	107	Alibates	2.20	1.60	0.30	1.2
Fragment	111	Unid.chert			0.70	1.1
Fragment	113	Alibates	2.90	1.80	0.30	2.5
Fragment	114	Alibates	3.40	1.30	0.50	2.0
Fragment	114	Alibates			0.20	0.5
Fragment	114	Alibates			0.20	0.2
Fragment	122	Alibates	2.10	2.00	0.40	1.6
Fragment	122	Unid.chert		1.60	0.40	1.0
Fragment	123	Niobrara	2.70	2.50	0.60	5.3
Fragment	127	Alibates	2.70	2.60	0.80	7.6
Fragment	130	Alibates			0.30	0.5
Fragment	130	Alibates	2.60	1.90	0.60	2.4
Fragment	131	Alibates	4.00	3.20	0.80	10.1
Fragment	133	Alibates	3.00	1.00	0.40	1.1
Fragment	134	Alibates	2.30	2.20	0.70	3.0
Fragment	134	Unid.chert			0.40	0.4
Fragment	135	Alibates			0.20	0.2
Fragment	135	Alibates	2.40	2.20	0.70	4.6
Fragment	135	Alibates	2.10	2.10	0.50	2.9
Fragment	136	Alibates	2.40	2.10	0.50	3.2
Fragment	137	Alibates	2.50	1.60	0.60	2.6
Fragment	137	Alibates	2.60	2.00	1.00	6.0
Fragment	137	Alibates	2.20	1.80	0.50	2.8
Fragment	137	Alibates	1.80	1.80	0.90	3.3
Fragment	140	Alibates	1.90	0.80	0.50	0.8
Fragment	140	Alibates	3.60	2.50	0.60	4.9
Fragment	141	Opalite	1.50	1.20	0.40	1.0
Fragment	141	Alibates	2.80	2.80	0.80	8.0
Fragment	141	Alibates	2.50	1.80	0.70	1.9
Fragment	141	Alibates	2.70	1.80	0.70	2.7
Fragment	141	Alibates	1.80	1.70	0.20	1.0
Fragment	143	Unid.chert	2.70	1.50	0.80	3.2
Fragment	143	Alibates	3.50	2.20	0.90	7.5
Fragment	143	Alibates	3.80	2.50	0.70	8.6
Fragment	143	Alibates		2.20	0.30	1.0
Fragment	143	Alibates	2.00	1.80	0.70	2.6
Fragment	143	Alibates	2.20	2.00	0.50	2.4

Table 6.6 (continued).

Miscellaneous	Cat.#	Material	Length	Width	Thickness	Weight
Fragment	143/170	Alibates	3.10	2.70	0.40	4.6
Fragment	146	Alibates	3.20	1.50	0.60	3.3
Fragment	148/41	Alibates	4.00	1.80	0.70	5.9
Fragment	157	Alibates			0.30	0.2
Fragment	160	Alibates	2.00	1.40	0.50	1.7
Fragment	160	Alibates	2.80	1.30	0.60	1.7
Fragment	162	Alibates	2.20	2.00	0.60	3.5
Fragment	162	Alibates	3.10	2.00	0.50	3.3
Fragment	163	Alibates	2.80	1.80	0.40	2.6
Fragment	164	Opalite	2.90	2.70	0.70	6.2
Fragment	164	Alibates	3.40	1.90	0.60	4.4
Fragment	168	Alibates	2.00	2.70	0.50	3.7
Fragment	170	Alibates	3.50	2.20	0.60	6.2
Fragment	170	Alibates	2.30	1.90	0.60	2.9
Fragment	171	Unid.chert			0.30	0.6
Fragment	172	Alibates	2.20	1.40	0.70	3.1
Fragment	177	Dakota	4.70	4.50	0.70	12.9
Fragment	177	Alibates	5.40	3.10	0.40	5.2
Fragment	177	Alibates	5.00	3.50	1.00	14.1
Fragment	177	Alibates	2.80	2.80	1.00	8.3
Fragment	177	Alibates	2.60	2.40	0.60	4.3
Fragment	177	Alibates	3.20	2.20	0.70	6.0
Fragment	177	Alibates	3.10	2.10	0.50	3.8
Fragment	177	Alibates	2.40	2.40	0.90	5.2
Fragment	177	Alibates	3.10	1.80	0.50	3.0
Fragment	177	Alibates	2.60	1.40	1.00	3.3
Fragment	177	Alibates	2.10	1.90	0.70	2.8
Fragment	177	Alibates	1.80	1.80	0.40	1.4
Fragment	177	Alibates	1.80	1.30	0.60	1.9
Fragment	177	Alibates	1.90	1.20	0.20	0.9
Fragment	177	Alibates	2.00	1.30	0.10	0.4
Fragment	177	Alibates			0.50	0.6
Fragment	184	Alibates	2.20	1.50	0.30	1.3
Fragment	186	Alibates	2.60	2.30	0.60	4.4
Fragment	186	Alibates		2.00	0.50	0.9
Fragment	189	Alibates	1.60	1.00	0.50	1.0
Fragment	212	Alibates	3.60	2.30	0.70	5.2
Fragment	216	Alibates			0.30	0.4
Fragment	226	Unid.chert			0.40	0.3

Table 6.6 (continued).

Miscellaneous	Cat.#	Material	Length	Width	Thickness	Weight
Fragment	226	Alibates	2.40	2.10	0.40	3.3
Fragment	227	Alibates	2.80	2.00	0.60	3.8
Fragment	244	Alibates			0.20	0.5
Fragment	246	Alibates			0.30	0.3
Fragment	248	Alibates	3.40	1.70	0.60	3.9
Fragment	248	Alibates			0.50	0.6
Fragment	248	Alibates	2.00	1.90	0.40	1.7
Fragment	249	Alibates	3.50	2.00	0.60	5.3
Fragment	275	Alibates	3.00	2.00	0.30	3.0
Fragment	276	Alibates	2.40	2.20	0.70	4.0
Fragment	277	Alibates	2.60	1.50	0.50	1.5
Fragment	280	Alibates	4.10	2.80	0.90	11.0
Fragment	280	Alibates	2.60	1.90	0.40	2.1
Fragment	280	Alibates	1.80	1.30	0.30	1.0
Fragment	281	Alibates	2.50	1.20	0.50	1.7
Fragment	282	Alibates	2.90	1.60	0.30	2.5
Fragment	282	Alibates	2.40	1.50	0.40	1.8
Fragment	285	Alibates			0.20	0.5
Fragment	287	Alibates	4.10	4.20	0.50	8.6
Fragment	287	Alibates	3.10	3.00	0.80	9.1
Fragment	287	Alibates	1.80	1.70	0.60	2.1
Fragment	289	Alibates	5.10	3.50	0.80	15.3
Fragment	289	Alibates	3.00	2.20	0.60	4.1
Fragment	291	Alibates	4.00	3.90	0.90	19.3
Fragment	291	Alibates	2.50	1.50	0.80	3.5
Fragment	292	Alibates	1.60	1.40	0.30	0.9
Fragment	292	Unid.chert	4.10	3.00	0.60	7.5
Fragment	293	Alibates	3.50	1.60	0.70	3.7
Fragment	305	Alibates	2.00	1.90	0.50	2.1
Fragment	306	Alibates	2.50	1.50	0.60	2.1
Fragment	326	Unid.chert	2.40	2.20	0.50	2.4
Fragment	347	Alibates			0.60	1.1
Fragment	351	Alibates	3.10	2.50	0.80	4.8
Fragment	360	Alibates	2.40	2.10	0.50	3.4
Fragment	367	Alibates	3.00	2.90	0.80	7.4
Fragment	388	Unid.chert	2.50	1.40	0.40	1.5
Fragment	394	Unid.chert			0.60	0.7

Missing*: Data measurements from Lintz' worksheet; materials missing.

Drills

Sample Size: 38 (15 complete, 23 fragments)

Mean Dimensions: Shank Length 2.15 cm, Shank Width 0.70 cm, Shank Thickness 0.31 cm, Base Length 1.69 cm, Base Width 2.02 cm, Base Thickness 0.45 cm.

Range of Dimensions: Shank Length 0.67-3.39 cm, Shank Width 0.35-1.50 cm, Shank Thickness 0.13-0.47 cm, Base Length 1.01-3.02 cm, Base Width 1.23-4.29 cm, Base Thickness 0.16-0.95 cm.

As Table 6.7 indicates, a variety of drills or perforators were recovered and are all "characterized by a slender, pencil-shaped section representing the point and shaft of the drill" (Bell 1980:13; Figure 6.3). The mounting parts or bases manifest considerable variation.

Table 6.7. Metric Dimensions and Material Types of Drills.

Cat #	Material	Shank			Base			Weight
		Length	Width	Thickness	Length	Width	Thickness	
47	Alibates		0.63	0.32	2.07	1.54	0.37	1.8
99	Alibates		0.64	0.32		2.53	0.65	3.7
122	Alibates	2.98	0.58	0.34	1.07	1.42	0.23	1.2
172	Alibates	1.70	0.50	0.21	1.51	2.24	0.67	2.5
264	Alibates		0.55	0.30	2.11	2.15	0.50	2.4
310	Alibates	2.81	0.65	0.38		1.37	0.46	1.4
324	Alibates	3.39	0.59	0.32	2.17	2.41	0.58	4.5
53	Alibates		0.70	0.47	1.48	1.30	0.63	2.8
143	Unidentified Chert	2.59	0.58	0.33	1.64	1.34	0.71	2.4
38	Tecovas		0.60	0.33	1.41	2.04	0.48	1.5
60	Alibates		0.35	0.23	1.01	1.60	0.40	0.8
73	Edwards		0.91		1.45	2.41	0.70	3.5
86	Alibates		0.54	0.31	1.24	2.27	0.38	1.7
143	Alibates		0.65	0.31	1.28	1.85	0.29	1.2
248	Alibates	2.45	0.69	0.35	1.25	2.07	0.30	2.0

Table 6.7 (continued).

Cat #	Material	Shank			Base			Weight
		Length	Width	Thickness	Length	Width	Thickness	
323	Opalite	3.37	0.98	0.35				1.4
291	Alibates	2.12	0.68	0.47	2.52	2.30	0.47	5.6
65	Alibates	0.67	0.70	0.30	3.02	4.29	0.79	12.6
138	Alibates	1.20	0.90	0.30	1.66	2.83	0.42	2.8
96	Alibates	1.88	1.11	0.32	1.81	1.60	0.42	2.5
319	Alibates	2.00	1.50	0.30	2.32	2.20	0.39	4.1
66	Alibates		0.77	0.29	1.26	1.68	0.27	1.1
141	Alibates		0.80	0.34	2.39	2.00	0.60	3.2
146	Unid. Quartzite	1.01	0.75	0.31	2.35	2.47	0.95	3.9
55	Alibates		0.59	0.19	1.60		0.16	0.7
59	Alibates		0.49	0.13	1.34	2.05	0.33	1.2
76	Alibates	1.99	0.70	0.18	1.16	1.23	0.20	0.9
105	Alibates		0.86	0.21			0.16	0.6
396	Alibates	2.08	0.93	0.21	1.11	1.26	0.16	0.9
52	Alibates		0.61	0.34				0.8
113	Alibates		0.55	0.36				0.4
248	Alibates		0.50	0.32				0.4
289	Alibates		0.50	0.27				0.2
127	Alibates		0.72	0.40				1.1
346	Niobrara		0.89	0.41				0.8
347	Alibates		0.66	0.29				0.4
92	Alibates		0.65	0.34				0.6
177	Alibates		0.70	0.31				0.5

Cores

Sample Size: 13

Mean Weight: 113.14 g.

Cores are cobbles and nodules of chert and quartzite from which several flakes have been removed. The multidirectional specimens from the Two Sisters site consist of 7 Alibates, 1 Ogallala quartzite, 1 Tesesquite Quartzite, 1 Tecovas Jasper, 1 Dakota Quartzite, and 2 unidentified cherts.

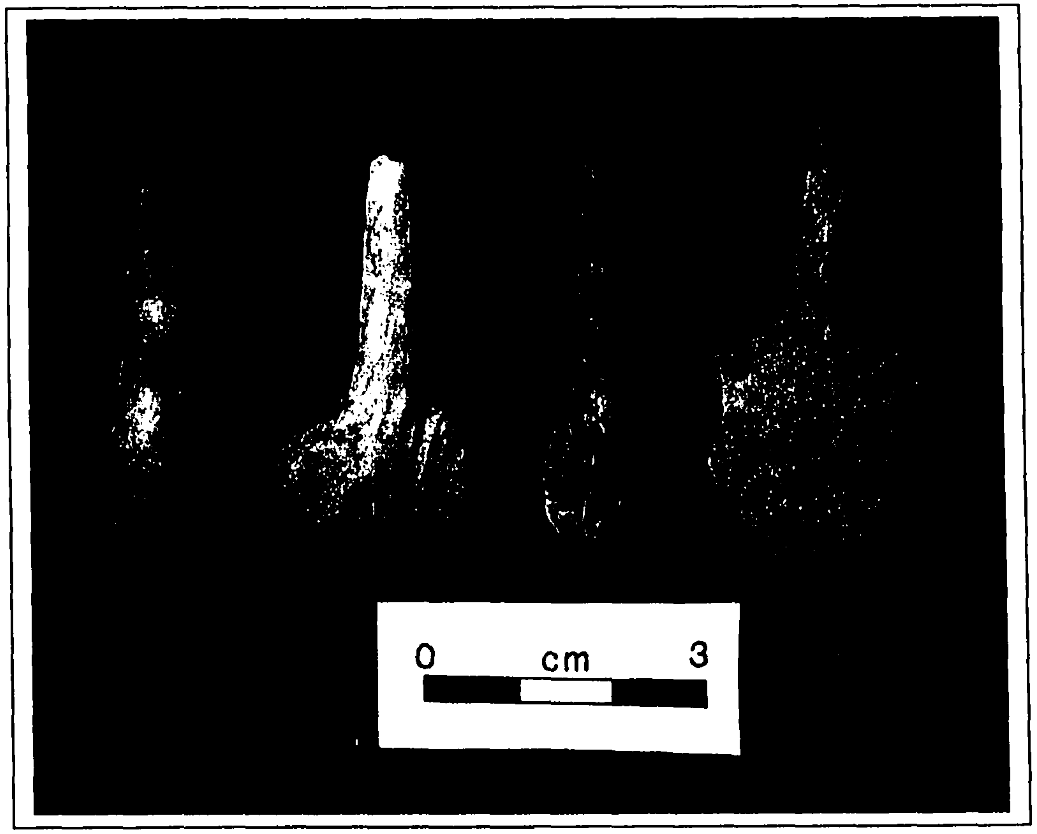


Figure 6.3. Drills from 34TX32.

Modified Flakes

Sample Size: 239

Modified flakes are flakes that have at least one edge that has been intentionally altered for use. The flakes from Two Sisters generally exhibit modification for use as a scraper (a few steep, regular flake scars initiated on one edge) or as a knife (a few flakes removed from both faces in one isolated area of the flake). Seventy-nine percent are of Alibates. Summary data are presented in Appendix III.

Unmodified Flakes

Sample Size: 5,569

Unmodified flakes are the waste debris removed from cobbles, cores, or bifaces during tool manufacture. Three basic methods are used - hard hammer percussion, soft hammer percussion, and pressure flaking. Flakes are initially removed by hard hammer percussion when a hammerstone (usually quartzite) is struck against the tool stone. Soft hammer percussion involves striking the tool stone with a baton, generally made of antler. Pressure flaking involves removal of small flakes by applying pressure, usually with an antler tine, against the tool edge. Pressure flaking is used during the final stage of tool manufacture or when a tool needs to be re-sharpened. Often these techniques can be identified on the flake indicating when the flake was removed from the parent material in the knapping process (Muto 1971).

The unmodified flakes from the Two Sisters site were classified by their stage in the knapping process, i.e. primary decortication flakes, secondary decortication flakes, tertiary flakes, biface thinning flakes, and broken flakes. In addition, the flakes were analyzed and sorted by their material type to determine the distance that the materials had moved across the landscape (Appendix IV). Local materials that most likely could be obtained within 5 km of the site include Ogallala quartzite, Day Creek dolomite, unidentified quartzites and cherts, and petrified wood. The remaining material types are classified as non-local. Summary data is presented in Table 6.8.

Table 6.8. Summary Data of Unmodified Flakes.

Material	Primary	Secondary	Tertiary	Biface Thinning	Broken
Alibates	1	21	265	1738	2214
Niobrara Jasper		13	3	55	46
Tecovas Jasper			3	17	24
Tesesquite Quartzite	11	23	21	108	92
Dakota Quartzite	9	9	8	98	123
Ogallala Quartzite	7	9	6	6	13
Kenton Opalite		1	2	26	38
Unidentified Chert	14	4	22	82	224
Unidentified Quartzite	13	2	10	24	101
Day Creek Dolomite		1	7	36	13
Mosquito Jasper			2	1	1
Petrified Wood			1	1	
Totals	55	83	350	2192	2889

PRIMARY DECORTICATION FLAKES

Sample Size: 55 (34 local materials, 21 non-local materials)

Primary decortication flakes are generally removed with hard hammer percussion to eliminate the natural outside cobble surface or cortex. The shape of the flake is determined by the original cobble shape and generally there is little or no platform preparation. In this analysis, the dorsal flake surface must be covered with cortex (at least 80 percent) to be classified as a primary flake. Because transportation of bulky cobbles intended for stone tool manufacture is labor intensive, it is not surprising to find primarily local materials represented in the primary decortication flake category.

SECONDARY DECORTICATION FLAKES

Sample Size: 83 (16 local materials, 67 non-local materials)

Secondary decortication flakes are produced early in the reduction series and exhibit some cortex (less than 80%) on dorsal surfaces of the flakes. The shape of the flake is controlled by flake scar ridges from previously removed flakes rather than by the cobble shape.

TERTIARY FLAKES

Sample Size: 2542 (195 local materials, 2347 non-local materials)

Tertiary flakes are unmodified flakes removed from a core after the primary and secondary flakes have been removed. Because some are still fairly thick in cross section and some are thin from the final stage in tool manufacture, the category is divided into Tertiary flakes not from bifacial thinning and Tertiary flakes from bifacial thinning. Non-biface thinning flakes, 350 total, are further divided with 46 of local and 304 of non-local materials. Tertiary flakes from biface thinning, 2192 (149 local and 2043 non-local materials) are flakes formed after the tool has been roughly shaped into a bifacial form. They are thin and usually curved, have low platform angles, have no cortex remaining, and usually terminate with a feather termination (Muto 1971:70-71). Alibates, a non-local material, makes up the majority of these thinning flakes indicating that initial reduction occurred away from the site.

BROKEN FLAKES

Sample Size: 2889 (351 local materials, 2538 non-local materials)

The last category is broken flakes. These specimens do not exhibit a platform and cannot be accurately associated with any of the previous classifications.

Blocky Debris

Sample Size: 195

Blocky debris refers to all other stone that cannot be placed in one of the functional categories. Generally, it is irregularly shaped quartzite, chert, and sandstone that does not display any of the characteristics of flakes or cores. The sample consists of unidentified quartzite (83), unidentified chert (49), sandstone (41), caliche (18), and Alibates (4).

Ground Stone

Ground stone items are classified by their function. Categories include manos and mullers, grinding basins or metates, and abraders. The abraders are further classified into three types determined by their apparent function.

Manos and Mullers

Sample Size: 62 (14 complete, 48 fragments)

Mean Dimensions: Length 12.77 cm, Width 8.90 cm, Thickness 4.71 cm.

Range of Dimensions: Length 8.76-16.60 cm, Width 5.82-10.79 cm, Thickness 2.33-8.20 cm.

The manos and mullers from the Two Sisters site are all the one-handed type with either one (21) or two (22) smoothed and ground sides (Table 6.9). Eighteen are fragments and the number of sides utilized could not be determined. Generally, these hand stones are local cobbles that are oval to rectangular and have not been intentionally shaped. One rectangular specimen (pitted mano) has a large shallow depression in the center of one side and may have been used as a small mortar. The majority of the manos are sandstone (46) with the remaining ones (16) made of quartzite and metaquartzite. Thirty-seven manos have been burned possibly from use as cooking or boiling stones or when the structure(s) burned.

Table 6.9. Metric Dimensions (cm) and Materials of Manos and Mullers.

Cat. #	Type	Provenience	Length	Width	Thickness	Material	Burned (y/n)
47*	Uniface	Exterior	15.00	9.38	4.63	Sandstone	n
51	Uniface	Exterior		7.95	3.25	Sandstone	y
53	Uniface	Exterior	13.31	8.80	5.04	Sandstone	n
74	Uniface	Exterior			3.41	Sandstone	n
76	Uniface	Exterior	12.01	7.90	7.40	Quartzite	n
77	Uniface	Exterior		6.62	3.69	Sandstone	n
177	Uniface	Room 1A			3.81	Sandstone	y
177	Uniface	Room 1A	16.45	10.79	8.10	Metaquartzite	y
244	Uniface	Room 3A	10.25	8.30	5.70	Sandstone	n
254	Uniface	Room 2A			5.18	Sandstone	y
281*	Uniface	Room 5A		10.33	8.20	Sandstone	n
288*	Uniface	Room 5A	14.04	8.70	5.41	Sandstone	n
289	Uniface	Room 5A			4.58	Sandstone	y
291	Uniface	Room 5A	12.00	7.60	4.88	Sandstone	y
291	Uniface	Room 5A		9.46	6.71	Sandstone	y
291	Uniface	Room 5A			5.64	Sandstone	y
291	Uniface	Room 5A		7.50	3.31	Sandstone	y
21	Uniface, ends battered	Exterior		9.25	4.28	Sandstone	y
177	Uniface, ends battered	Room 1A			6.52	Quartzite	y
177	Uniface, ends battered	Room 1A			3.97	Quartzite	y
287	Uniface, ends battered	Room 5A	8.76	8.68	6.42	Quartzite	y
1	Biface	Surface			3.80	Sandstone	y
6	Biface	Exterior			3.02	Sandstone	n
44	Biface	Exterior			2.96	Sandstone	n
47	Biface	Exterior			2.83	Sandstone	y
47	Biface	Exterior	13.40	9.90	4.18	Sandstone	n
92	Biface	Exterior		8.91	4.84	Sandstone	y
97	Biface	Exterior			3.90	Sandstone	n
122*	Biface	Exterior	11.14	10.00	3.78	Metaquartzite	n
122	Biface	Exterior			4.36	Metaquartzite	y
123	Biface	Exterior			3.91	Metaquartzite	y
123*	Biface	Exterior	12.70	9.69	3.52	Sandstone	n
148	Biface	Room 1A			6.01	Sandstone	n
173	Biface	Room 1A			4.75	Sandstone	y
223	Biface	Room 2A	16.60	9.63	7.21	Sandstone	n
285	Biface	Room 5A	9.32	8.80	4.32	Metaquartzite	y
291	Biface	Room 5A		10.37	3.77	Sandstone	y
291	Biface	Room 5A			2.33	Sandstone	n
323	Biface	Room 1B			2.94	Sandstone	n
100	Biface, ends battered	Exterior	12.30		4.89	Metaquartzite	y
177	Biface, ends battered	Room 1A	14.60		5.40	Metaquartzite	n
287	Biface, ends battered	Room 5A		5.82	3.86	Sandstone	y
325	Biface, ends battered	Room 1B			4.33	Metaquartzite	y
357*	Pitted Mano	Room 1B	12.38	10.30	5.99	Sandstone	y
20	Unidentified Fragments	Exterior				Sandstone	n
51	Unidentified Fragments	Exterior				Metaquartzite	n

Table 6.9 (continued).

Cat. #	Type	Provenience	Length	Width	Thickness	Material	Burned (y/n)
121	Unidentified Fragments	Exterior				Sandstone	y
123	Unidentified Fragments	Exterior				Sandstone	n
136	Unidentified Fragments	Room 1A				Sandstone	y
139	Unidentified Fragments	Room 1A				Sandstone	y
147	Unidentified Fragments	Exterior				Metaquartzite	y
148	Unidentified Fragments	Room 1A				Sandstone	y
177	Unidentified Fragments	Room 1A				Sandstone	y
177	Unidentified Fragments	Room 1A				Metaquartzite	n
247	Unidentified Fragments	Room 3A				Metaquartzite	y
275	Unidentified Fragments	Room 3A				Sandstone	n
280	Unidentified Fragments	Room 5A				Sandstone	y
281	Unidentified Fragments	Room 5A				Sandstone	y
287	Unidentified Fragments	Room 5A				Sandstone	y
291	Unidentified Fragments	Room 5A				Sandstone	n
293	Unidentified Fragments	Room 3A				Sandstone	y
327	Unidentified Fragments	Room 1B				Sandstone	y

* Missing from collection. Data based on Lintz, 1972, unpublished field notes.

Grinding Basins or Metates

Sample Size: 34 (1 complete, 33 fragments)

These are mostly fragments of basin metates made of orthoquartzite sandstone similar to local outcrops and most likely acquired within 5 km of the site. Other than the grinding basin area, they have not been intentionally shaped or modified. Most of the specimens are small and only one had evidence for use of both faces. Examination of these specimens concurs with the suggestion made by Lintz (personal communication 2001) that due to the similarity of color, size, and partical matrix, the 31 fragments probably represent a total of 19 separate grinding basins. The only complete metate was incorporated into the wall construction of Room 3A. It was standing on end in line with the other foundation stones of the north wall of this room. Table 6.10 outlines the provenience information for all specimens.

Table 6.10. Condition and Provenience of Grinding Basins or Metates.

Catalog #	Type	Provenience	Square/Feature	Depth	Weight
None	Complete	Wall of Room 3A			2234.0
34	Fragment	Exterior	S18-E8	10-20 cm	7.4
46	Fragment	Exterior	S17-E5	0-10 cm	62.8
57	Fragment	Exterior	S16-E4	10-20 cm	17.3
66	Fragment	Exterior	S14-E7	10-20 cm	45.5
77	Fragment	Exterior	S13-E7	20-30 cm	344.0
141	Fragment	Room 1A		13-20 cm	180.8
141	Fragment	Room 1A		13-20 cm	245.0
141	Fragment	Room 1A		13-20 cm	440.5
141	Fragment	Room 1A		13-20 cm	477.3
176	Fragment	Room 1A	Feature 13	Level B	56.6
176	Fragment	Room 1A	Feature 13	Level B	62.0
177	Fragment	Room 1A	Feature 13	Level C	466.2
177	Fragment	Room 1A	Feature 13	Level C	1860.0
177	Fragment	Room 1A	Feature 13	Level C	2122.8
177	Fragment	Room 1A	Feature 13	Level C	1863.4
177	Fragment	Room 1A	Feature 13	Level C	1854.2
223	Fragment	Room 2A		Surface	1566.1
247	Fragment	Room 3A		0-10 cm	81.8
281	Fragment	Room 5A	Natural Level	15-51 cm	327.4
281	Fragment	Room 5A	Natural Level	15-51 cm	1554.5
291	Fragment	Room 5A	Feature 9		450.8
291	Fragment	Room 5A	Feature 9		1322.4
305	Fragment	Room 1B	Entrance-east end	30-51 cm	2948.4
325	Fragment	Room 1B	S15-W1	0-10 cm	14.9
325	Fragment	Room 1B	S15-W1	0-10 cm	5.9
326	Fragment	Room 1B	S15-W1	10-20 cm	26.2
340	Fragment	Room 1B	S14-W2	0-10 cm	3.4
341	Fragment	Room 1B	S14-W2	10-20 cm	7.6
341	Fragment	Room 1B	S14-W2	10-20 cm	69.8
350	Fragment	Room 1B	S16-W2	30-58 cm	1173.4
363	Fragment	Room 1B	S14-W3-floor	41-51 cm	7144.2
400	Fragment	Room 1B	S14-W2-roof fall	30-41 cm	5046.3
401	Fragment	Room 1A		Surface	970.0

Type I Abraders

Sample Size: 5 (1 complete, 4 fragments)

Range of Dimensions: Length of grooves 5.8-7.76 cm, Width of grooves 0.79-1.03 cm, Thickness (depth) of grooves 0.13-0.26 cm.

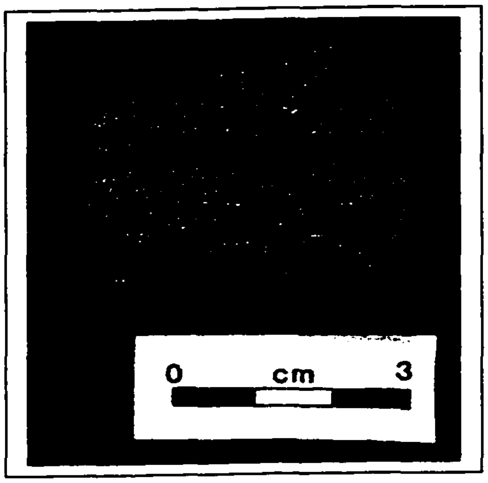
Type I abraders are grooved and shaped oval or rectangular forms of coarse grained sandstone. Each has a single longitudinal groove on one surface that extends the entire length of the specimen cutting through both ends (Figure 6.4). One has a second groove on the opposite face that is oriented at a diagonal to the long axis. The probable function of these abraders is as arrow-shaft smoothers (Flenniken and Ozbun 1988:37-41). Attributes are presented in Table 6.11.

Type II Abraders

Sample Size: 12 (12 complete)

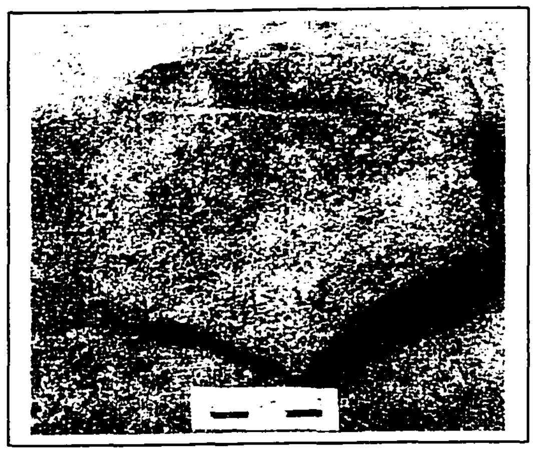
Range of Dimensions: Length of grooves 1.10-7.70 cm, Width of grooves 0.34-1.47 cm, Thickness (depth) of grooves 0.05-0.76 cm.

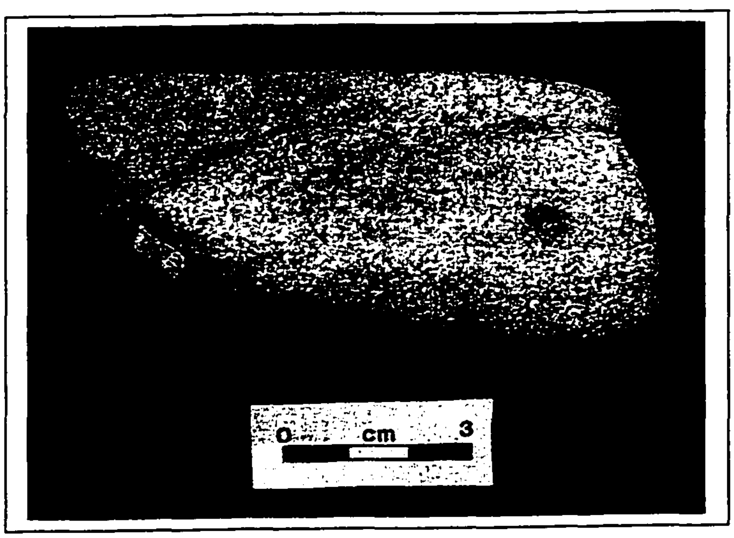
These abraders have one or more irregular grooves on one or more surfaces (Figure 6.4). With the exception of one specimen made of vesicular basalt, they are all made of sandstone. Sizes range from thick bulky blocks to small irregular pieces that have not been intentionally shaped. Nine specimens have only one irregular groove, while the other three have multiple grooves (Table 6.11). These abraders were probably used to sharpen bone awls (Flenniken and Ozbun 1988:49-50).



Type I Abrader

Type II Abrader





Type III Abrader

Figure 6.4. Abraders from the Two Sisters Site.

Table 6.11. Metric Dimensions of Abraders by Classification Type.

Type	Cat.#	Material	Length	Width	Thickness	Groove 1 Length	Groove 1 Width	Groove 1 Thickness	Groove 2 Length	Groove 2 Width	Groove 2 Thickness
Type I	320*	Sandstone	8.34	3.80	1.79	7.76	1.00	0.25	5.80	1.03	0.29
Type I Fragment	92	Sandstone		3.20	2.12		0.80	0.26			
Type I Fragment	95*	Sandstone		2.21	2.00		0.89	0.23			
Type I Fragment	144	Sandstone		2.44	1.43		0.79	0.13			
Type I Fragment	170	Sandstone		3.00	2.39						
Type II	143	Sandstone	2.59	2.09	1.27	1.17	0.80	0.15			
Type II	36	Basalt	1.96	1.40	1.20	1.70	0.70	0.16			
Type II	101	Sandstone	5.30	5.20	1.85	5.34	0.90	0.19			
Type II	141	Sandstone	11.31	9.20	3.07	7.30	0.35	0.16			
Type II	144*	Sandstone	7.80	6.00	4.19	6.40	0.61	0.11			
Type II	249	Sandstone	5.96	4.31	2.57	5.56	0.50	0.10			
Type II	292	Sandstone	8.23	7.25	2.80	4.34	0.50	0.08			
Type II	286	Sandstone	2.40	2.58	2.10	1.74	0.63	0.20			
Type II	289*	Sandstone	9.56	10.91	4.57	4.21	0.48	0.12			
Type II Multiple grooves	1	Sandstone	2.30	2.21	2.00	1.99	1.00	0.18	1.10	0.71	0.08
						1.63	0.49	0.08	1.27	0.75	0.10
Type II Multiple grooves	291*	Sandstone	7.70	6.86	3.47	4.20	0.40	0.30	6.10	0.39	0.06
						6.85	0.34	0.05	2.53	0.40	0.16
Type II Multiple grooves	177*	Sandstone	8.70	7.20	4.40	5.70	1.00	0.43	4.89	1.35	0.62
						3.10	1.47	0.36	3.72	1.00	0.76
						5.26	0.95	0.35	7.70	1.08	0.67
						5.34	1.00	0.31	1.60	0.50	0.12
						2.21	0.60	0.10	3.00	1.45	0.54
Type III	113*	Sandstone	8.05	7.90	3.90	7.00	2.63	0.44			
Type III	122*	Sandstone	7.18	3.34	1.32	3.04	0.39	0.05			
Type III	149*	Sandstone	5.64	5.32	1.96	5.12	0.90	0.16			
Type III	177*	Sandstone	7.97	7.97	2.23	5.41	2.05	0.14			

Table 6.11 (continued).

Type	Cat.#	Material	Length	Width	Thickness	Groove 1 Length	Groove 1 Width	Groove 1 Thickness	Groove 2 Length	Groove 2 Width	Groove 2 Thickness
Type III	177*	Sandstone	5.71	4.06	1.86	4.30	1.79	0.65			
Type III	287	Sandstone	9.53	4.80	1.46	7.51	1.67	0.13			
Type III Fragments	95*	Sandstone									
Type III Fragments	157*	Sandstone									
Type III Fragments	175*	Sandstone									
Type III Fragments	177	Sandstone									
Type III Fragments	177*	Sandstone									
Type III Fragments	289*	Sandstone									
Type III Fragments	291*	Sandstone									
Type III Fragments	339*	Sandstone									

* Missing from collection. Data based on Lintz, 1972, unpublished field notes.

Type III Abraders

Sample Size: 14 (6 complete, 8 fragments)

Range of Dimensions: Length of grooves 3.04-7.51 cm, Width of grooves 0.39-2.63 cm, Thickness (depth) of grooves 0.05-0.65 cm (Table 6.11).

These abraders are thin tabular pieces of coarse sandstone with a fairly wide grinding surface or groove on one face (Figure 6.4). Because of the width of the grinding surface, they may have been used as hones to re-sharpen scapula hoes, digging sticks, squash knives, and other broad bone or wooden tools.

Miscellaneous Stone

Stone Pipes

Sample Size: 2 (2 fragments)

The two stone pipe fragments recovered at the Two Sisters site are both bowl fragments. The larger of the two bowls is fairly complete and sourcing at Wichita State University by James Gundersen (Bement 1998) indicates that it is was ground from a gray siliceous limestone (Figure 6.5). Unfortunately, the material source location could not be determined. This fragment exhibits an incised bulbar upper rim with a maximum diameter of 2.16 cm. It constricts toward the lower bowl and at 1.90 cm from the lip, the diameter is only 1.78 cm. The bowl is cylindrical and the break indicates that the fragment may be from an elbow pipe. Soot residue is present in the bowl which has an interior diameter of 1.20 cm. The pipe fragment was

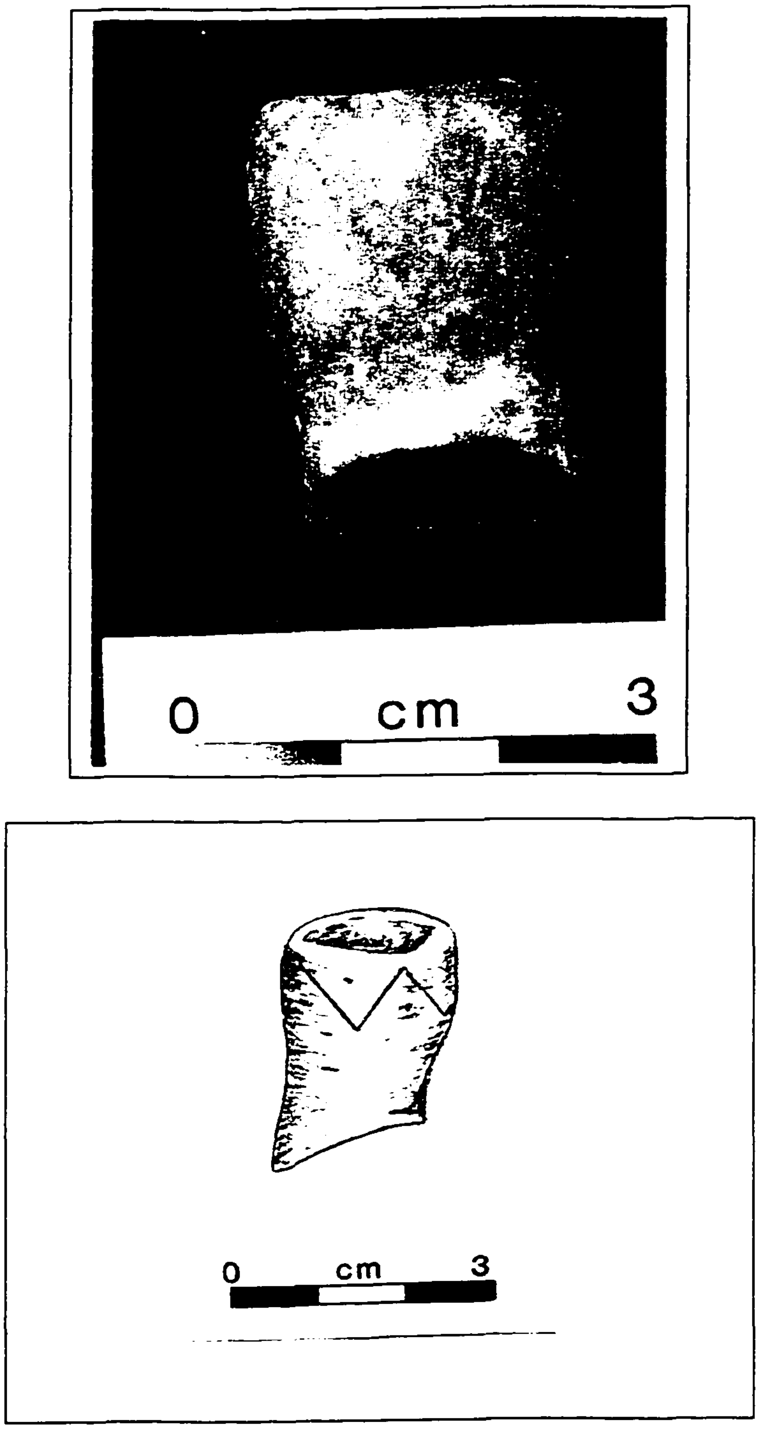


Figure 6.5. Incised Pipe Fragment.

recovered from the large internal pit in Room 1A, Feature 13(C) at a depth between 107 and 140 cm.

The other pipe fragment was recovered outside of Room 1A, directly east of the extended entryway at a depth of 20-30 cm below the ground surface. It is a light tan, slightly siliceous limestone that probably had a maximum exterior bowl diameter of 2.5 cm. The interior diameter is estimated to be 1.5 cm and did not contain any soot or burned residue. The fragment has a rounded lip with sides that gradually constrict until the bowl expands at about 0.43 cm below the lip. Measurements of the bowl indicate that at 1.20 cm from the lip, the bowl has a pronounced shoulder before again constricting to the break at 1.39 cm below the lip. This fragment was also submitted to Gundersen for identification and sourcing, but the material source location could not be identified.

<u>Obsidian</u>

Sample Size: 3

The three obsidian flakes are all small pressure flakes probably resulting from the resharpening of tools. They were recovered at various locations and at various depths within the site. Table 6.12 presents the provenience location of each flake.

Table 6.12. Provenience Data for Obsidian Flakes.

Catalog #	Provenience	Square/Trench	Depth
19	Exterior	S27-E11	10-20 cm
145	Area 6	Trench A, north outside Room 1A	10-56 cm
316	Room 1B	S12-W1 (NE corner of room above floor)	30-41 cm

Painted Stone

Sample Size: 5

These stones have been painted or stained with a red pigment on at least one face of the stone (Figure 6.6). Whether they were intentionally painted or were used to grind pigment is not clear. The stones vary from manos and hammerstones to rough unshaped pieces of caliche (Table 6.13).

Hammerstones

Sample Size: 36

Mean Weight: 306.3 grams

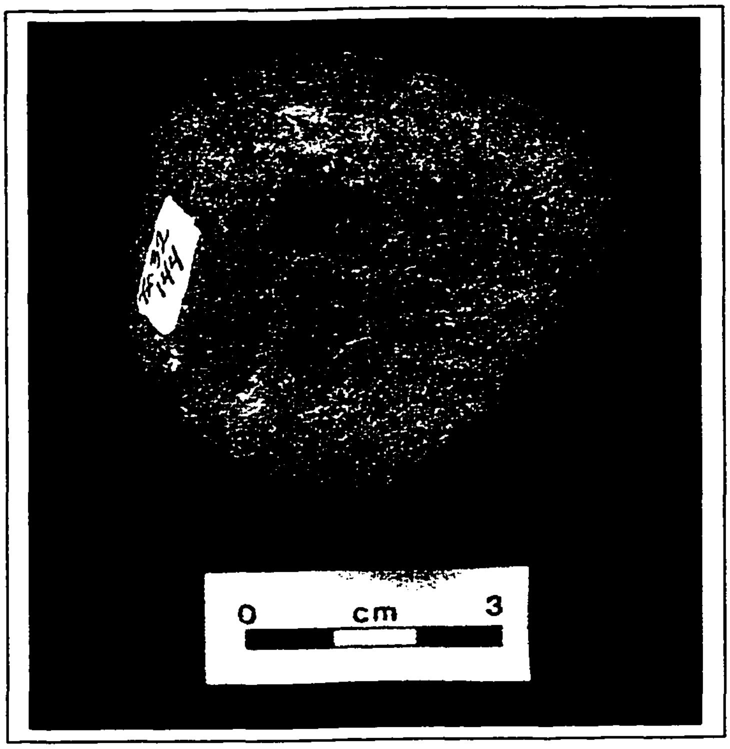
Hammerstones are quartzite (35) and sandstone (1) cobbles used to batter. The pecked surface on these specimens probably occurred during flintknapping or tool manufacture (Table 6.14).

Cobbles/Boiling Stones

Sample Size: 688 (633 burned, 55 unburned)

Total Weight: 40,222 g (35,835.3 g burned, 4,386.7 g unburned)

The burned and unburned cobbles are primarily quartzites (322), but caliche (191), sandstone (163), and other miscellaneous unidentified (12) stones were used (Table 6.15). Suggested use is in cooking, most likely for bone grease processing. However, some may have burned when the houses burned.



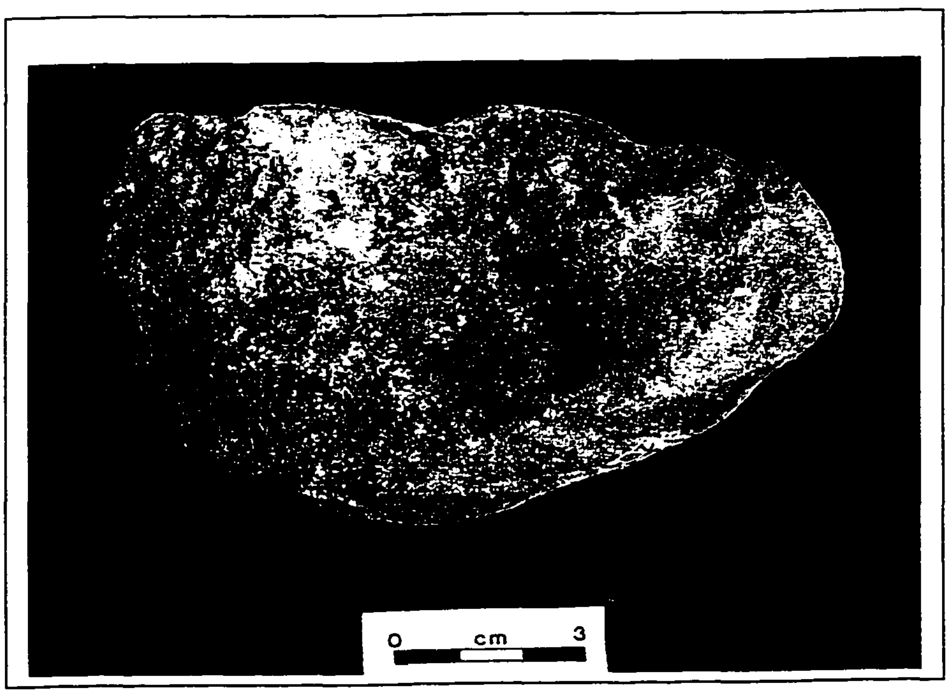


Figure 6.6. Stones Stained with Pigment.

Table 6.13. Painted Stones.

Cat. #	Material	Color	Intensity	Location	Tool	Description	Length	Width	Weight
20	Sandstone	10YR3/6, Dark Red	faint	one face	Yes	Mano fragment	5.80	2.50	136.40
144	Sandstone	10YR3/6, Dark Red	faint	one end	No		3.10	1.70	145.70
280	Caliche	10YR4/6, Red	faint	ridge of one face	No	Faint streak	3.30	3.30	690.00
289	Caliche	10YR3/3, Dusky Red	dense	one face	No	Large Rock	22.40	11.70	566.40
308	Ogallala	10YR3/6, Dark Red	faint	two faces	Yes	Large Hammerstone	5.20	3.70	1207.30

Table 6.14. Hammerstones.

Cat. #	Provenience	Material	Weight	Burned	Comments
1	Surface	Quartzite	289.9	Yes	
19	Exterior	Quartzite	118.7	No	
21	Exterior	Quartzite	231.7	Yes	
33	Exterior	Quartzite	163.8	No	
34	Exterior	Quartzite	372.0	No	
47	Exterior	Quartzite	228.8	No	
55	Exterior	Quartzite	304.6	No	
66	Exterior	Quartzite	680.4	No	
70	Exterior	Quartzite	202.7	Yes	
76	Exterior	Quartzite	793.8	No	
92	Exterior	Quartzite	414.0	Yes	
95	Exterior	Quartzite	160.4	No	
97	Exterior	Quartzite	71.2	No	
122	Exterior	Quartzite	91.3	Yes	
122	Exterior	Quartzite	108.1	Yes	
122	Exterior	Quartzite	55.1	No	
123	Exterior	Quartzite	240.4	Yes	
123	Exterior	Quartzite	283.8	Yes	
123	Exterior	Quartzite	175.3	Yes	
141	Room 1A	Quartzite	180.5	Yes	
141	Room 1A	Quartzite	94.3	Yes	
162	Room 1A	Sandstone	134.8	Yes	
177	Feature 13,Lev.C	Quartzite	199.8	Yes	
177	Feature 13,Lev.C	Quartzite	237.6	No	
177	Feature 13,Lev.C	Quartzite	449.2	Yes	Red paint smear
177	Feature 13,Lev.C	Quartzite	264.1	Yes	
177	Feature 13,Lev.C	Quartzite	76.3	No	
248	Room 3A	Quartzite	251.5	Yes	
287	Feature 6	Quartzite	266.4	No	
291	Feature 9	Quartzite	200.4	Yes	
291	Feature 9	Quartzite	323.5	No	
300	Room 1B	Quartzite	517.0	No	
308	Room 1B	Quartzite	330.6	No	
308	Room 1B	Quartzite	521.8	Yes	
308	Room 1B	Quartzite	1200.0	Yes	
308	Room 1B	Quartzite	793.8	No	
			11027.6		Total Weight
			306.3		Mean Weight

Table 6.15. Burned and Unburned Boiling Stones and Weights.

Cat. #	BURNED						UNBURNED						TOTAL
	Caliche	Sand-stone	Qrtz.	Misc	No.	WT	Caliche	Sand-stone	Qrtz.	Misc	No.	WT	WEIGHT
3								1			1	45.6	45.6
16			1		1	125.8							125.8
19										1	1	73.8	73.8
20								1			1	77.4	77.4
21			2		2	719.2							719.2
28			1	1	2	119.4							119.4
33										1	1	11.5	11.5
38			2		2	18.5							18.5
39								1			1	35.2	35.2
41			3		3	83.5							83.5
43		1			1	280.6							280.6
44		1			1	56.4							56.4
46			1		1	12.1							12.1
47		1	3		4	321.5							321.5
50		1	1		2	86.4							86.4
53									1		1	22.5	22.5
55			1		1	154.5							154.5
58		1	5		6	330.0							330.0
59		1	6		7	454.2							454.2
60	1	1	8		10	811.0							811.0
62			2		2	31.3							31.3
64		1			1	5.5		1			1	10.0	15.5
65			2		2	73.5							73.5
66		1			1	8.9			1		1	73.5	82.4
67			1		1	10.0							10.0
68			2		2	59.9							59.9
69			2		2	40.0							40.0
72			4		4	21.4							21.4
73	9	1	3		13	515.5							515.5
74	2	1	3		6	231.0							231.0
75	1				1	17.1		1			1	23.5	40.6
76	2		4		6	200.9							200.9
77							1	1			2	179.8	179.8
83			3		3	167.7							167.7
84		2	2		4	148.5							148.5
85		1	2		3	151.1							151.1
86	1		5		6	334.4							334.4
87	7		2		9	369.1							369.1
88		1	2		3	121.3							121.3
89		1	1		2	141.5							141.5
90	4	1	3		8	175.1							175.1
92	2	1	5		8	170.7							170.7
95			1		1	47.5			3		3	29.2	76.7
96		2	2	1	5	181.2							181.2
98		1	1		2	80.4							80.4

Table 6.15 (continued).

Cat. #	BURNED						UNBURNED						TOTAL WEIGHT
	Caliche	Sand-stone	Qrtz.	Misc	No.	WT	Caliche	Sand-stone	Qrtz.	Misc	No.	WT	
99	1				1	39.8							39.8
100	1				1	13.2			1		1	264.0	277.2
102	1	2			3	71.6							71.6
104	1		3		4	79.2							79.2
107							1				1	29.5	29.5
108	1				1	5.6							5.6
109			1		1	3.8							3.8
111			2	1	3	52.0							52.0
113	1		2		3	37.5	1	1			2	353.5	391.0
114	1		1		2	5.3							5.3
115	5				5	3.6							3.6
116			1		1	28.0							28.0
117	2				2	53.5							53.5
120	2	2	6		10	84.4							84.4
121	1	3	7		11	654.6							654.6
122	4	1	8		13	506.1							506.1
123	9	3	9		21	2337.7							2337.7
124	6	1	4		11	173.2							173.2
125			2		2	24.8							24.8
126	1		2		3	138.5							138.5
127		1	2		3	310.5							310.5
128	1	1	4		6	133.7							133.7
130	2	2	4		8	199.5							199.5
131			1		1	5.3							5.3
132	2				2	1.9							1.9
133			2		2	69.0							69.0
134	1		4		5	61.2							61.2
135			5		5	87.1							87.1
136	3				3	67.9							67.9
137		1	4		5	236.8							236.8
138		1			1	2.2							2.2
140	4	1	2		7	56.5							56.5
141	1	6	15	2	24	3007.8							3007.8
143	12	6	17		35	1902.0							1902.0
144	6	3	4		13	1986.1							1986.1
146	1	1	2		4	30.8							30.8
147		1			1	10.4							10.4
148	1	2	1		4	760.2							760.2
149		6	2		8	240.4							240.4
150	1		1		2	91.5							91.5
152	1	2	1		4	122.4							122.4
154	2		3		5	149.4							149.4
155			1		1	144.8							144.8
156	1				1	9.7							9.7
157									1		1	2.3	2.3

Table 6.15 (continued).

Cat. #	BURNED						UNBURNED						TOTAL WEIGHT
	Caliche	Sand-stone	Qrtz.	Misc	No.	WT	Caliche	Sand-stone	Qrtz.	Misc	No.	WT	
159								1			1	31.8	31.8
160			1		1	11.8							11.8
161	2	6	3		11	949.0		1			1	429.2	1378.2
162	1		4		5	319.7							319.7
163							1				1	1.2	1.2
165	1	2	1		4	19.0							19.0
167	2	1	2		5	26.4							26.4
168	3	1			4	12.4							12.4
170	6	5	4		15	236.3							236.3
171			3		3	301.0							301.0
172	1	2	3		6	398.2							398.2
173								1		1	2	146.4	146.4
174		2	1		3	101.9							101.9
176	1	2	1		4	6.6	2				2	220.0	226.6
177	5	7	5		17	699.5		2			2	229.0	928.5
179			2		2	697.6							697.6
182	1	1			2	493.3							493.3
188			1		1	98.0							98.0
190							1				1	22.9	22.9
201									1		1	115.2	115.2
212	1		1		2	174.0							174.0
216	1				1	61.0							61.0
224	2	1	1		4	54.9							54.9
225							1				1	28.0	28.0
226								1			1	7.8	7.8
227		1			1	427.8							427.8
230										1	1	95.4	95.4
234			1		1	125.3							125.3
238		1			1	35.6							35.6
244	1		1		2	314.8							314.8
247	1	1	2		4	105.5							105.5
248	1		3		4	150.6							150.6
249		2	1		3	16.4							16.4
250		1	2		3	10.8							10.8
258		1	1		2	4.0							4.0
261		2	1		3	127.9							127.9
264		1			1	11.5							11.5
265		1			1	1.4							1.4
268				1	1	28.4							28.4
270		1	2		3	41.6							41.6
271			1		1	0.7							0.7
272							1				1	26.7	26.7
273								1			1	31.4	31.4
274		1			1	31.1							31.1
275	3		2		5	153.0							153.0

Table 6.15 (continued).

Cat. #	BURNED						UNBURNED						TOTAL WEIGHT
	Caliche	Sand-stone	Qrtz.	Misc	No.	WT	Caliche	Sand-stone	Qrtz.	Misc	No.	WT	
276	4				4	39.4	1		1		2	207.8	247.2
277			1		1	3.9							3.9
280		3	3		6	123.8							123.8
281	3		3		6	447.7							447.7
282		1	1		2	62.6							62.6
284		1	1		2	169.6		1			1	398.5	568.1
285	3	2	1		6	146.4	3	2			5	154.1	300.5
286	1	2	6	1	10	1214.2		2			2	124.7	1338.9
287	3	4	1		8	488.0	2	1			3	216.0	704.0
288		1	7		8	546.5							546.5
289	6	3	7		16	610.0	3				3	158.8	768.8
291	1	3	3		7	1153.0							1153.0
295			1		1	28.7							28.7
296			1		1	3.5							3.5
298		1			1	7.5							7.5
299			1		1	15.4							15.4
300	2				2	426.1	1				1	346.8	772.9
301			1		1	40.3							40.3
305	2		2		4	141.0							141.0
306	2	2	2		6	187.4							187.4
308	1	1	2	1	5	880.7	1	1			2	158.1	1038.8
310		1			1	7.7							7.7
322		2			2	68.9							68.9
330								1			1	5.6	5.6
333		1			1	36.0							36.0
334			1		1	5.5							5.5
340			1		1	6.4							6.4
341	1				1	40.8							40.8
342		1	2		3	186.1							186.1
349		1			1	155.2							155.2
363		1			1	91.0							91.0
378			1		1	89.3							89.3
383			1		1	83.8							83.8
392			1		1	61.1							61.1
395			1		1	43.6							43.6
397	1				1	1.0							1.0
401	3		1		4	424.6							424.6
281/285/286			1		1	554.0							554.0
305/306			1		1	121.5							121.5
Totals	171	141	313	8	633	35835.3	20	22	9	4	55	4386.7	40222.0

Choppers

Sample Size: 2

These specimens are large cobbles that have been chipped and battered on one end. One piece from an exterior square east of the structures is chalcedony and weighs 218.3 g. The other is quartzite weighing 769.8g. It was recovered in the fill material from the entrance to the earlier room, Room 1B.

Hematite and Limonite

Sample Size: 80

These are irrregularly shaped pieces of iron ore that occur in local upland gravel deposits. Hematite is known for its use as red pigment, whereas limonite produces a yellow color. The stained bone and stones found at the Two Sisters site suggest its use by the inhabitants. Provenience data is presented in Table 6.16.

Selenite

Sample Size: 4

Range of Dimensions: Length 1.14-2.30 cm, Width 0.51-1.72 cm, Thickness 0.05-0.18 cm.

Total Weight: 1.8 grams

Selenite, also known as "moon stone" is a variety of gypsum that occurs as transparent crystals. It forms in areas of saline water and most likely these pieces originated from the Great Salt Plains Lake in Alfalfa

Table 6.16. Provenience of Hematite and Limonite.

Provenience	Catalog #	Quantity
Exterior	33	1
Exterior	49	2
Exterior	59	1
Exterior	70	1
Exterior	95	1
Exterior	107	2
Exterior	121	2
Exterior	122	1
Area 7	113	1
Area 7	130	1
Room 1A	137	2
Room 1A	140	2
Room 1A	141	5
Room 1A	143	7
Room 1A	144	1
Room 1A	146	1
Room 1A	152	1
Room 1A	163	1
Room 1A	170	6
Room 1A	172	1
Room 1A	173	1
Room 1A	177	10
Room 1A	212	1
Room 2A	227	1
Room 2A	233	1
Room 2A	254	1
Room 3A	245	1
Room 3A	247	5
Room 3A	250	1
Room 3A	259	1
Room 3A	270	1
Room 3A	271	1
Room 3A	272	1
Room 3A	273	1
Room 3A	275	1
Room 5A	282	1
Room 5A	287	1
Room 5A	291	2
Room 5A	292	1
Room 1B	293	1
Room 1B	296	1
Room 1B	297	1
Room 1B	305	1
Room 1B	310	1
Room 1B	326	1
Room 1B	355	1
Total		80

County in north-central Oklahoma (Gilmore 1996:12). These four samples show no evidence of modification. All four crystals were found in the large pit (Feature 13) in Room 1A.

Fossils

Sample Size: 1

A fossil gastropod was recovered from the area of the east wall of Room 3A. It is 5.96 cm long and 4.67 cm wide.

Ceramics

For the volume of material recovered and the permanence of the structures, ceramic wares were not a large part of the assemblage. Sand and shell tempered sherds, although totaling 1130 pieces, were predominately (over 95% of the sample) smaller than 2.5 cm^2 .

Sand Tempered

Sample Size: 1125 (1063 body sherds, 61 rim sherds, 1 restored vessel)

The sand tempered ceramics vary between unmodified cordmarked (34%) and smoothed cordmarked (39%). The remaining sherds are plain with no evidence of cord impressions (4%), unknown due to a deteriorated and fragmented condition (18%), and rim sherds (5%). Surface finish data is presented in Table 6.17.

Table 6.17. Sand Tempered Pottery.

Catalog #	Provenience	Cordmarked	Smoothed Cordmarked	Plain	Unknown	Rim Sherds
1	Surface	7	7	1	2	
6	Exterior		1			
7	Exterior		1		1	
8	Exterior	1				
11	Exterior	2				
12	Exterior	1				
17	Exterior		1			
18	Exterior		1			
19	Exterior	4	3	3		
20	Exterior	4	6		5	1 (decorated)
21	Exterior	7	9		5	1 (decorated)
22	Exterior	2	2		6	1 (decorated)
23	Exterior	1				
27	Exterior	1	2			
28	Exterior	1	3		2	
29	Exterior	5	1		2	
31	Exterior		3			
32	Exterior		1			
33	Exterior	1	7	1		
34	Exterior		1			
35	Exterior	1				
36	Exterior		1			
38	Exterior	1	2		2	
39	Exterior					1 (decorated)
41	Exterior	5	5	2	1	1
42	Exterior		3		1	1
43	Exterior	1				
44	Exterior		2			1
46	Exterior	2	1		3	
47	Exterior	6	9	1	7	2
48	Exterior		2			
49	Exterior	2	2			
50	Exterior				2	1
51	Exterior	1	2		1	1
52	Exterior	6	7		6	
53	Exterior	14	7		2	
54	Exterior	4	3		1	
55	Exterior	2	8	1		
57	Exterior		2		1	

Table 6.17 (continued).

Catalog #	Provenience	Cordmarked	Smoothed Cordmarked	Plain	Unknown	Rim Sherds
58	Exterior	4	13	3	5	
59	Exterior	13	6	1	7	
60	Exterior	15	10	1	3	2
61	Exterior				5	
62	Exterior	5	3	2	3	1
64	Exterior	7	4		3	
65	Exterior	7	1		2	1
66	Exterior	9	4		1	2
67	Exterior	1				
68	Exterior	2	4		2	
69	Exterior	6	3			
70	Exterior	2	2	1	1	
71	Exterior	3	2		1	
72	Exterior	2		1	4	
73	Exterior	4	6		3	2
74	Exterior	6	6	1	1	2
75	Exterior	4	4		1	
76	Exterior	2	2			1
77	Exterior	4	3			
79	Exterior	2	9	3	2	
80	Exterior				1	
81	Exterior					1
83	Exterior	3	3	1	2	1
84	Exterior	3	8		3	1
85	Exterior	2	10		1	
86	Exterior	4				2 (1 decorated)
87	Exterior	5	5			
88	Exterior	6	6			
89	Exterior	3	3	1	2	
90	Exterior		6			1
91	Exterior	8	5		4	1
92	Exterior	3	3		2	1
93	Exterior		2			
95	Exterior	4	9		2	1
96	Exterior	3	1	1		1
97	Exterior	3	1	1		
98	Exterior		1			
99	Exterior	1	5	1	2	
100	Exterior	1			2	

Table 6.17 (continued).

Catalog #	Provenience	Cordmarked	Smoothed Cordmarked	Plain	Unknown	Rim Sherds
101	Exterior	1				1
102	Exterior			1		
106	Exterior		1			
107	Exterior	1	2			
108	Exterior	1				
109	Area 7				1	
110	Area 7	1				
111	Area 7		2		1	
112	Area 7		1		5	
113	Area 7	1		1	1	
114	Area 7	1	1			1
120	Exterior	2	2			1
121	Exterior	8	8	4	3	
122	Exterior	6	5			1
123	Exterior	2	3		1	
124	Exterior	1	3		1	
125	Exterior	1	2		1	
127	Area 6	1	2		1	
128	Area 6		2			
129	Area 6	1				
130	Area 7	1	8		3	
131	Area 7		6		1	
132	Exterior		1		1	
133	Room 1A				1	
134	Room 1A	2	1			1 (decorated)
135	Room 1A	2	4		3	
137	Room 1A		3		1	
138	Room 1A	2				
140	Room 1A	4	4		2	1
141	Room 1A	6	3	1	3	
143	Room 1A		3		4	
144	Room 1A	1				1 (decorated)
146	Room 1A	2				
148	Room 1A	2	1		1	1
149	Room 1A	1	1			
154	Room 1A		1		1	
156	Room 1A		1			
157	Exterior	2				
159	Room 1A					1

Table 6.17 (continued).

Catalog #	Provenience	Cordmarked	Smoothed Cordmarked	Plain	Unknown	Rim Sherds
160	Room 1A		1			
161	Room 1A				1	
162	Room 1A	3	1	1		
163	Room 1A		1			
170	Room 1A	3	6		2	2
171	Room 1A				1	
177	Room 1A	21	9	1	9	5
179	Room 1A		1		1	
180	Room 1A		1			
181	Room 1A				1	
197	Room 1A	1				
198	Room 1A					1
203	Room 1A		1			
221	Room 1A				1	
222	Room 1A			1		
226	Room 2A		1		2	
227	Room 2A	1	1	1		
232	Room 2A	1	1			
233	Room 2A		1			
235	Room 2A		1			
239	Room 2A				1	
240	Room 2A		1		1	
243	Room 3A		1			
244	Room 3A		2		1	
245	Room 3A		3		1	
246	Room 3A			1		
247	Room 3A	1	3	2	3	
248	Room 3A		1		1	1
249	Room 3A	1	2		2	
250	Room 3A	1	1		1	
253	Room 3A		1			
259	Room 3A				1	
260	Room 3A					1
261	Room 3A			1	1	
262	Room 3A		2			
263	Room 3A					1
264	Room 3A		1			
270	Room 3A		1			
272	Room 3A	2				

Table 6.17 (continued).

Catalog #	Provenience	Cordmarked	Smoothed Cordmarked	Plain	Unknown	Rim Sherds
274	Room 3A	1				
275	Room 3A	1	1			
276	Room 3A		1			
280	Room 5A	2	10		3	
281	Room 5A		1		1	2
282	Room 5A	2	4			1
283	Room 5A	2	3	1		1
284	Room 5A	3	3		1	
285	Room 5A	4	6			
286	Room 5A	4				
287	Room 5A	5	8		2	2 (1 decorated)
288	Room 5A	6	7		1	
289	Room 5A	11	8		1	1
291	Room 5A	3	2			
292	Room 5A	5	5		3	1
293	Room 3A				1	
294	Room 1B			1		
295	Room 1B			1		
299/322	Room 1B	1				
306	Room 1B	1				
310	Room 1B				1	
313	Room 1B		1		1	
314	Room 1B	1			1	
317	Room 1B	1				
321	Room 1B	1				1 (decorated)
323	Room 1B	1			1	
325/326	Room 1B	1				
331	Room 1B	1	1			
341	Room 1B	2		1		
344	Room 1B		1		1	
346	Room 1B		1			
363	Room 1B	1				
373	Room 1B		1			
379	Room 1B		1			
388	Room 1B		1			
379/381/393	Room 1B		1			
401	Room 1A		2			
Totals		377	440	46	200	61

Of the 61 rim sherds, 9 (15%) are decorated. Rim decoration includes two with an incised design of linked triangles (Figure 6.7 a) and three incised with diagonal lines spaced 0.07 cm apart. These diagonal lines from the interior of the vessel, extend from left (interior) to right (exterior) on two sherds (Figure 6.7 c, e) from right to left on the third (Figure 6.7 b). Four rim sherds have a single row of gouged punctates (Figure 6.7 d). In addition, one body sherd had a simple applique.

The temper and form of these sherds are similar to Borger Cordmarked (Suhm and Jelks 1962:15; Suhm et al. 1954:390-392) or Stamper Cordmarked (Watson 1950:30). Temper consists of fine sand to coarse quartz ranging in diameter between less than 0.01 cm and 0.04 cm. Mica and bone are also occasionally present.

Vessel forms were probably globular jars with wall thicknesses ranging from 0.4 to 1.0 cm. Vessel sizes are estimated between 13 and 19 liters from the one restored jar that had a volume of 17.26 liters (Figure 6.8).

<u>Shell Tempered</u>

Sample Size: 30 (28 body sherds, 2 rim sherds)

The shell tempered sherds from the Two Sisters site have a uniform thickness, paste, surface finish, and color. They were recovered from numerous contexts ranging from the general surface to 140 cm below the ground surface (Table 6.18). Paste is fine and compact sand supplemented by some fragmented mussel shell. Exterior surfaces are light brown to gray

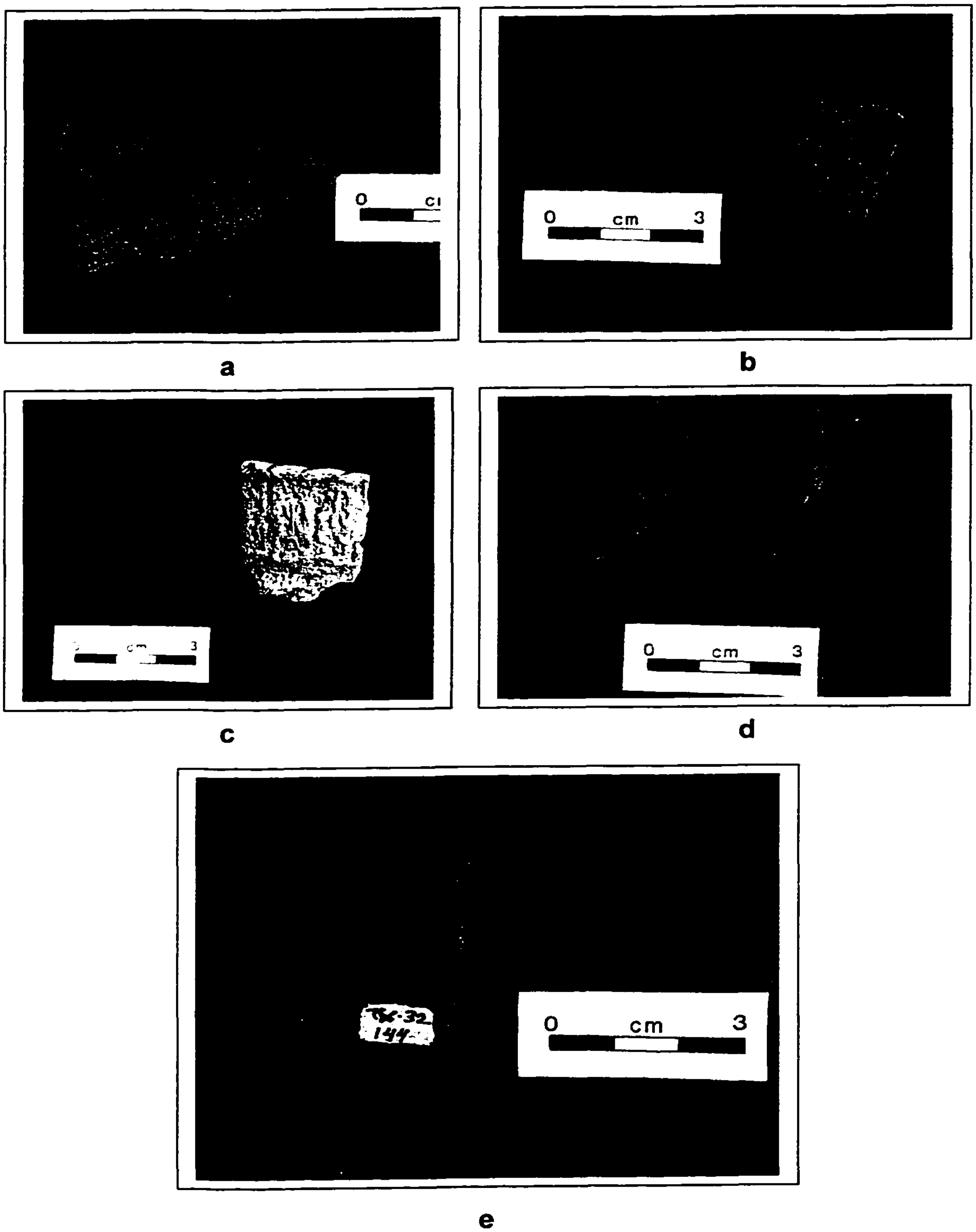


Figure 6.7. Decorated Rim Sherds from the Two Sisters Site.

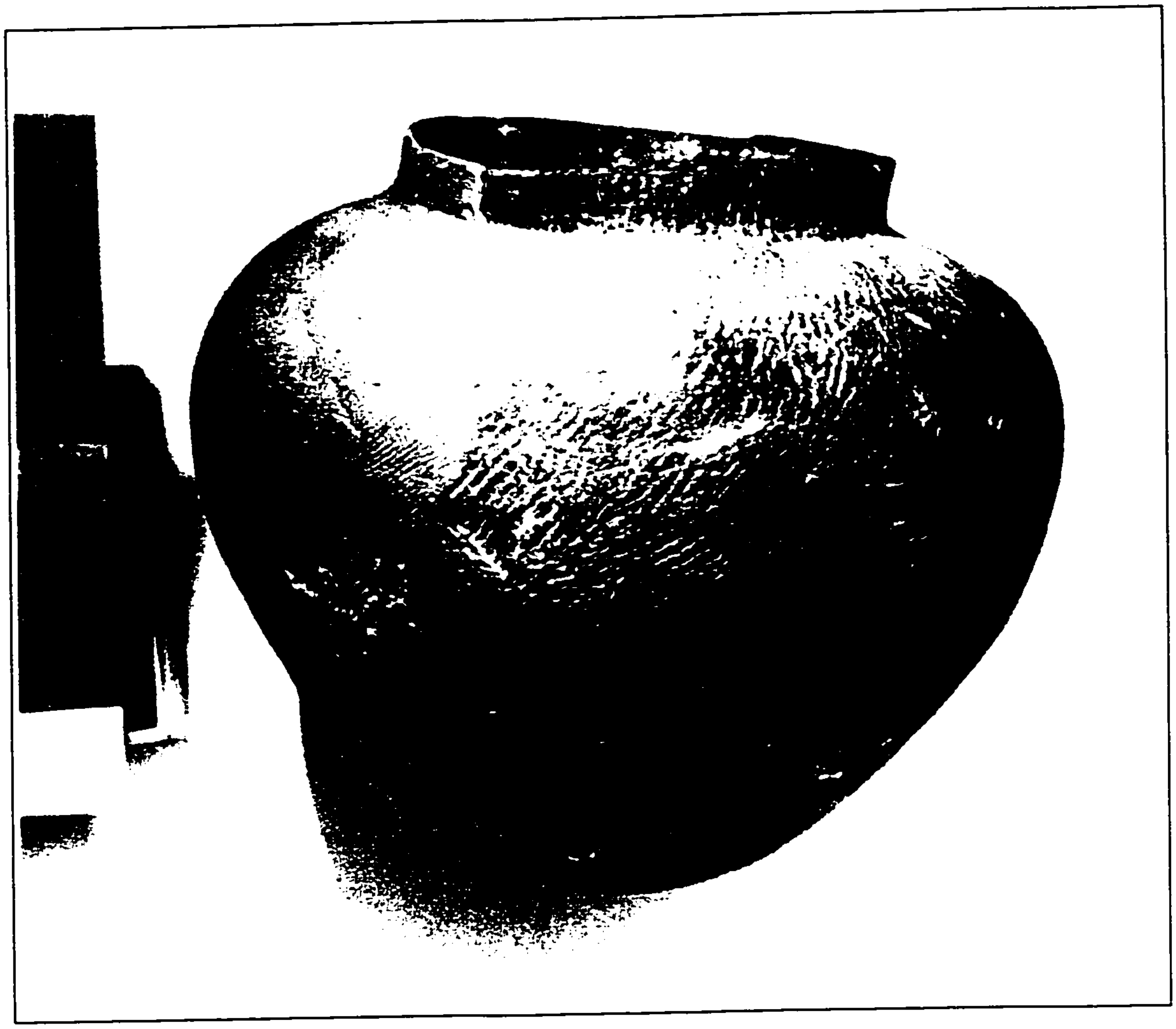


Figure 6.8. Restored Pot from 34TX32.

brown with areas of dark gray where they have been exposed to fire. Surface finishes are smooth and burnished over cordmarking on exteriors and smoothed on the interior. The two rim sherds suggest that one vessel was probably a globular jar with an everted rim. The diameter of the vessel at the lip is estimated to be 12 cm and at the point of maximum neck constriction, it is only 10 cm.

Shell tempered pottery is not common in the Antelope Creek phase of the Oklahoma or Texas panhandles. Because of its rarity, the shell tempered wares may have been traded to the site occupants.

Table 6.18. Shell Tempered Pottery.

Catalog #	Provenience	Square/Room	Level (cm)	Quantity	Rim (Y/N)
1	Surface	N/A	N/A	2	Y (one)
41	Exterior	S18E4	0-10	1	N
46	Exterior	S17E5	0-10	2	N
47	Exterior	S17E5	10-20	3	N
48	Exterior	S17E5	20-30	1	N
49	Exterior	S16E7	0-10	5	N
52	Exterior	S16E6	0-10	3	N
53	Exterior	S16E6	10-20	3	Y (one)
58	Exterior	S15E13	0-10	1	N
62	Exterior	S15E7	10-20	1	N
64	Exterior	S15E7	20-30	3	N
65	Exterior	S14E7	0-10	1	N
139	Room 1A	NW1/4 of Room	8-13	1	N
157	Exterior	South of Room 1A	13-15	1	N
176	Room 1A	Feature 13, Level B	76-107	1	N
47/177/284	47: Exterior 177: Room 1A 284: Room 5A	S17E5 Feature 13,Level C Artificial Level 2	10-20 107-140 ~25	1 refit w/ 47 refit w/ 47	Y
Total				30	(2)

Daub

Burned Daub

Sample Size: 260 pieces

Small to large chunks of burned daub were recovered from the site. These consist of a sand, silt, and caliche matrix used to plaster the walls of all rooms. Most (129 or 50%) were from Room 1A and generally were small pieces. Thirty percent (78 pieces) were from Room 1B and were much larger and provided information about stick and grass impressions. According to Lintz (1997a), 78 specimens had stick impressions and one charcoal impression still had bark on it. Lintz (1997a) describes some of the daub as follows:

> Most of the stick impressions (88%) suggested that the daub was applied to an interior core wall of parallel oriented sticks measuring less than 1.5 cm in diameter. Thin fiber lashings were observed on only five specimens and indicated that a series of three sticks were tied to a larger framing element. Seven specimens had impressions of poles ranging from 4.0 to 5.5 cm in diameter. However, none contained the smaller impressions and it is uncertain whether they were major or minor framing elements. The thickness of the daub specimens measured from the prepared surface to the stick impressions of the core wall usually ranged from 3.5 to 6.7 cm.

The satellite rooms 3A and 5A and the exterior areas and Area 7 all had some daub, although only 20% of the total daub recovered was from these areas (Table 6.19).

Table 6.19. Daub.

Cat.#	Provenience	# without impressions	# with impressions	Sub-total	Number of impressions	Orientation: parallel	oblique	random	N/A	Impression diameter & quantity: <0.5	0.5	1	1.5	2	2.5	>2.5	Thickness
137	Room 1A	4	1	5	1				X	1							
138	Room 1A	1		1													
139	Room 1A	1		1													
140	Room 1A	3		3													
141	Room 1A	18		18													
143	Room 1A	40	8	48	2	X							2				
					2	X						2					
					1				X				1				
					1				X				1				
					1				X				1				
					1				X	1							
					1				X				1				
					1				X				1				7.43
144	Room 1A	1		1													
149	Room 1A	2		2													
159	Room 1A	6	1	7	1				X	1							
162	Room 1A	4		4													
164	Room 1A	1		1													
167	Room 1A	1	1	2	2	X						1	1				
168	Room 1A	1		1													
169	Room 1A	6		6													
170	Room 1A	6		6													
171	Room 1A	1		1													
175	Room 1A	2	1	3	1				X	1							
176	Room 1A	1	2	3	1				X				1				
					1				X		1						
177	Room 1A	8	1	9	2	X					1		1				
182	Room 1A	2		2													

Table 6.19 (continued).

Cat.#	Provenience	# without impressions	# with impressions	Sub-total	Number of impressions	Orientation: parallel	oblique	random	N/A	Impression diameter & quantity: <0.5	0.5	1	1.5	2	2.5	>2.5	Thickness
184	Room 1A	2		2													
186	Room 1A	1		1													
187	Room 1A	1		1													
214	Room 1A		1	1	1				X	1							
		113	**16**	**129**													
244	Room 3A	1		1													
247	Room 3A	1		1													
276	Room 3A	3		3													
293	Room 3A		1	1	1				X			1					
		5	**1**	**6**													
284	Room 5A		1	1	1				X					1			
291	Room 5A	11		11													
		11	**1**	**12**													
294	Room 1B		1	1	19			X		9	9	1					
298	Room 1B		1	1	1				X			1					
300	Room 1B	2		2													
301	Room 1B	1		1													
303	Room 1B		1	1	1				X				1				
305	Room 1B	1		1													
309	Room 1B		3	3	1				X							1	
					1				X							1	
					1				X							1	
312	Room 1B		1	1	1				X							1	
321	Room 1B	8	3	11	1				X							1	
					1				X							1	
					1				X							1	
323	Room 1B	1		1													
325	Room 1B	1		1													

Table 6.19 (continued).

Cat.#	Provenience	# without Impressions	# with Impressions	Sub-total	Number of Impressions	Orientation: parallel	Orientation: oblique	Orientation: random	Orientation: N/A	Impression diameter & quantity: <0.5	0.5	1	1.5	2	2.5	>2.5	Thickness
337	Room 1B		1	1	2	X				1	1						
339	Room 1B	1		1													
341	Room 1B	1		1													
342	Room 1B	2		2													
343	Room 1B	1		1													
344	Room 1B	1	1	2	1				X		1						
346	Room 1B		2	2	3	X				1		2					
					1				X	1							
357	Room 1B	8		8													
359	Room 1B	9		9													
362	Room 1B	2		2													
363	Room 1B	2		2													
364	Room 1B		1	1	1				X		1						3.4
367	Room 1B	4	1	5	1				X		1						
377	Room 1B	4		4													
385	Room 1B	1	1	2	2		X			2							5.5
396	Room 1B	3		3													
1B*	Room 1B		1	1	1				X		1						5.7
1B*	Room 1B		1	1	7	X				7							5.3
1B*	Room 1B		1	1	2	X						1			1		5.2
1B*	Room 1B		1	1	4	X						3	1				5.2
1B*	Room 1B		1	1	4	X					1	3					6.4
1B*	Room 1B		1	1	3	X				3							5.0
1B*	Room 1B		1	1	7	X					4	2		1			5.7
1B*	Room 1B		1	1	6	X					3	2	1				8.1
		53	25	78													
55	Exterior	1		1													
92	Exterior		1	1	3		X			3							

Table 6.19 (continued).

Cat.#	Provenience	# without impressions	# with impressions	Sub-total	Number of impressions	Orientation: parallel	Orientation: oblique	Orientation: random	Orientation: N/A	Impression diameter & quantity: <0.5	0.5	1	1.5	2	2.5	>2.5	Thickness
95	Exterior		1	1	1				X	1							
98	Exterior	3	2	5	4	X				4							
					5	X				5							
99	Exterior	2		2													
122	Exterior	2		2													
123	Exterior	5		5													
125	Exterior	1		1													
132	Exterior	1		1													
		15	**4**	**19**													
113	Area 7	6	2	8	3	X				3							
					2	X				2							
114	Area 7	3		3													
115	Area 7	3		3													
116	Area 7	1		1													
130	Area 7		1	1	1				X		1						
		13	**3**	**16**													

1B*: uncataloged daub from Structure/Room 1B

Note: All data from table created by Lintz.

Unburned Daub

Sample Size: 28 pieces

In the bottom 46 cm of Feature 9, the storage pit under the west wall of Room 5A, there were 28 pieces of unburned daub. None of this daub has grass or stick inclusions and, instead, it consists of a compact matrix of sand and caliche. Pieces range between 2.5 and 9.1 cm in thickness (Table 6.20) and have a total weight of 8127.5 grams. One face of each piece has a smooth surface. Lintz (1997b:12) describes some of the daub chunks as having hammerstone impact marks and proposes that these unburned pieces of daub were the result of creating a wall opening between Room 2A and the new additional room, Room 5A.

Table 6.20. Unburned Daub from the Bottom of Feature 9.

Specimen #	Thickness	Cracked/disjointed	Hammerstone impact marks
1	2.6		
2	2.7		
3	2.8		
4	2.9		
5	3.3		
6	3.4		
7	3.5		
8	3.7		
9	3.8		
10	4.1		
11	4.2		
12	4.3		
13	4.4		
14	4.4		
15	4.7		
16	4.8		
17	4.9		
18	4.9		
19	5.2	X	
20	5.3		
21	5.6		
22	5.7		

Table 6.20 (continued).

Specimen #	Thickness	Cracked/disjointed	Hammerstone impact marks
23	7.1	X	X
24	7.6	X	X
25	7.9	X	
26	8.4	X	
27	8.5	X	
28	9.1	X	

Note: All data from table created by Lintz

Bone

Bone Tools and Modified Bone

A wide variety of bone tools and modified bone were recovered from the Two Sisters site. Based on their form and possible function, bone tools are classified into 21 categories. Data are presented in Table 6.21 (Bison Tibia Digging Sticks) and Table 6.22 (Bone Tools).

BISON TIBIA DIGGING STICKS

Sample Size: 13 (2 complete, 11 fragments)

These tools were made from the distal part of bison tibia by removing the joint end and trimming and grinding the proximal shaft to form a spade-like tool (Figure 6.9). A socket for a wooden handle is created in the distal end by burning and perforating the center of the bone. Although there are only two complete specimens, these items plus the fragments indicate that there are five right tibia present and four left ones. The others are too fragmented to indicate the side. All specimens have at least some polish and six of the 13 have extensive polish over the entire piece. Table 6.21 presents the data for these tools.

Table 6.21. Bison Tibia Digging Sticks.

Cat.#	Provenience	Condition	Length	Width	Hole diam.		Burned	Wt.	Polish	Excav.	Conjoined		Comments
					Length	Width				Dmg	Cat#	Provenience	
1	Surface	Complete	15.70	7.70	4.20	2.10	1(hole)	158.6	3	0			Surface, Unknown provenience
70	S15E10,30-41cm	Complete	18.70	7.00	2.80	2.90	1(hole)	153.0	1	1			
92	S12E9,10-20cm	Broken	20.10	6.10	3.00	2.30	0	171.5	3	0	107	Feature 22	Also with cat.# 289, Feature 8
92	S12E9,10-20cm	Broken	15.90	7.30	2.90	2.30	1(hole)	147.7	1	0			
132	S13E6,0-33cm	Broken	12.40+	5.00+			0	54.9	1	0	254	Rm 2A,36-51cm	
131	Area 7,10-20cm	Broken	8.50+	2.60+			0	25.0	3	0			
107	Feature 22	Broken	10.60+	4.30 +			0	36.2	2	0			
101	S11E7,20-30cm	Broken	9.00+	3.40+			0	32.6	3	0			
33	S18E8,0-10cm	Broken	9.90+	3.90+			0	30.1	1	0			
107	Feature 22	Broken	10.20	3.80			0	21.0	3	0			
289	Feature 8	Broken	12.00+	4.00+			1	46.9	2	0			
93	S12E8,0-10cm	Broken	8.10+	1.60+			0	11.3	2	1			
291	Feature 9	Broken	5.10+	2.40+			0	4.5	3	0			

Polish codes: 0 - None
1 - Localized
2 - moderate, overall
3 - extensive, overall

Excavation Damage Codes: 0 - No
1 - Yes

Burned: 0 - No
1 - Yes

Table 6.22. Bone Tools.

Cat.#	Provenience	Tool Type	Condition	Species	Length	Width	Burned	Wt.	Polish	Excav. Dmg	Conjoined		Comments
											Cat#	Provenience	
289	Rm 5A, Feature 8	Hoe	Broken	Bison	26.6	15.7	0	99.7	0	1			Very fragmentary scapula
143	Rm 1A,floor near walls,center roofall	Hoe	Broken	Bison	3.5+	3.0+	0	3.7	3	1			Steep bevel, striations, polish, small scapula fragment only
60	S15E12, 10-20 cm	Hoe	Broken	Bison	16.3	4.4	0	50.6	1	0			blade tip has steep bevel
138	Rm 1A, Test pit 1	Awl	Complete	Bison	12.7	0.7	0	4.5	1	0	141	Rm 1A, 13-20 cm	Round base,short tip, v-shape cross section
36	S18E8, 30-41 cm	Awl	Complete	Deer/ Antelope	6.6	0.7	0	3.7	2	0			Rounded base,short tip, square cross section
101	S11E7, 20-30 cm	Awl	Complete	Bison or Elk	5.4	1.2	0	2.1	1	0			Rounded base,short tip, rectangular cross section
97	S12E7, 10-20 cm	Awl	Complete	Deer/ Antelope	12.1	0.9	0	5.4	2	0			Fossa in proximal end, long, slender, needle-type use?
47	S17E5, 20-30 cm	Notched awl	Broken	unknown	5.5+	0.7	0	1.2	1	1			Cut with 13 notches spaced between 0.3 and 0.5 cm
110	S11E4, 30-41 cm	Awl fragment	Broken	Deer/ Antelope	11.9+	0.9	0	5.2	2	0	292	Rm 5A, Feature 10	Tip missing, long, slender, quartered metapodial section
267	Rm 3A, east wall	Awl fragment	Broken	Deer/ Antelope	7.5+	1.0	0	3.5	2	0			Fossa in proximal end, Tip missing, long , slender
396	S15W5, 13-30 cm	Awl fragment	Broken	Deer/ Antelope	5.4+	0.9	1	1.8	0	1			Tip missing quartered metapodial section
143	Rm 1A,floor near walls,center roofall	Awl fragment	Broken	Deer/ Antelope	11.5	1.3	1	9.4	2	1			long, broad, split metacarpal half sections

Table 6.22 (continued).

Cat.#	Provenience	Tool Type	Condition	Species	Length	Width	Burned	Wt.	Polish	Excav. Dmg	Conjoined Cat#	Conjoined Provenience	Comments
132	S13E6, 3-33 cm	Awl fragment	Broken	Deer/ Antelope	9.5+	1.0	0	6.7	2	0			medial metacarpal section only, both ends missing
338	S13W2, 51 cm	Awl fragment	Broken	Deer/ Antelope	6.9+	1.0	1	2.7	2	1			missing proximal end u-shaped cross section
341	S14W2, 10-20 cm	Awl fragment	Broken	Deer/ Antelope	6.8+	1.7	0	5.4	1	1	342	S14W2, 20-30 cm	medial section only u-shaped cross section
341	S14W2, 10-20 cm	Awl fragment	Broken	Deer/ Antelope	2.0+	1.2	0	0.7	0	1			very small fragment u-shaped cross section
113	S10E4, 30-41 cm	Awl fragment	Broken	Deer/ Antelope	1.6+	.8+	0	0.3	3	0			small section near tip u-shaped cross section
177	Rm 1A, Feature 13, Level C	Awl fragment	Broken	unknown	7.0+	0.7	1	1.7	3	1	287	Rm 5A, Feature 6	Blunt round tip
104	S11E6, 19 cm	Awl fragment	Broken	Deer/ Antelope	5.3	0.7	0	1.8	2	0			Rounded base,short tip, square cross section
289	Rm 5A, Feature 8	Awl fragment	Broken	Deer/ Antelope	5.2+	0.7	0	1.3	1	0			Rounded base,short tip, square cross section
33	S18E8, 0-10 cm	Awl fragment	Broken	unknown	2.6+	0.4	0	0.1	1	1			Tip section
34	S18E8, 10-20 cm	Awl fragment	Broken	unknown	2.1+	0.5	1	0.2	3	1			Tip section
53	S16E6, 10-20 cm	Awl fragment	Broken	unknown	4.3+	0.9	0	0.7	1	1			Tip section
69	S15E10, 20-30 cm	Awl fragment	Broken	unknown	3.2+	0.7+	0	0.5	1	1			Tip section

Table 6.22 (continued).

Cat.#	Provenience	Tool Type	Condition	Species	Length	Width	Burned	Wt.	Polish	Excav. Dmg	Conjoined		Comments
											Cat#	Provenience	
75	S13E7, 0-10 cm	Awl fragment	Broken	unknown	3.5+	0.7+	0	0.7	3	1			Tip section
76	S13E7, 10-20 cm	Awl fragment	Broken	unknown	4.4+	0.8+	0	0.9	2	0			Near tip
77	S13E7, 20-30 cm	Awl fragment	Broken	unknown	1.9+	0.8+	0	0.7	3	0			Medial section
107	S11E6, Feature 22	Awl fragment	Broken	unknown	1.8+	0.6	0	0.1	2	0			Medial near tip
141	Rm 1A, 13-20 cm	Awl fragment	Broken	unknown	2.0+	0.6+	0	0.1	1	1			Medial near tip
143	Rm 1A,floor near walls,center roofall	Awl fragment	Broken	unknown	2.7+	0.7+	1	0.4	1	0			Medial near tip
247	Rm 3A, 0-10 cm	Awl fragment	Broken	unknown	5.4+	0.9+	0	1.9	1	1			Medial near tip
281	Rm 5A, Natural Level 2, ~ 15-51 cm	Awl fragment	Broken	unknown	2.1+	0.8+	1	0.8	2	0			Mid-section
342	S14W2, 20-30 cm	Awl fragment	Broken	unknown	2.5+	0.7+	0	0.2	1	0			Tip section
265	South 1/2 of Rm 3A, Trench D	Awl mfg. debris	Broken	unknown	10.1+	0.8	0	3.7	2	0			Incised grooves or slotting on both parallel ends
123	S6E6, 30-41 cm	Awl mfg. debris	Broken	unknown	5.0+	0.6	0	1.1	2	0			Incised grooves or slotting on both parallel ends
250	Rm 3A, below floor	Awl mfg. debris	Broken	unknown	1.7+	0.7	0	0.4	3	0			Incised grooves or slotting on both parallel ends

Table 6.22 (continued).

Cat.#	Provenience	Tool Type	Condition	Species	Length	Width	Burned	Wt.	Polish	Excav. Dmg	Conjoined		Comments
											Cat#	Provenience	
287	Rm 5A, Feature 6	Awl mfg. debris	Broken	unknown	2.5+	0.5	0	0.2	3	1			incised grooves or slotting on both parallel ends
60	S15E12, 10-20 cm	Spatula tip	Broken	unknown	2.6+	1.1	0	0.5	1	1			Fragment from awl-like tool
289	Rm 5A, Feature 8	Spatula tip	Broken	unknown	2.0+	1.1	0	0.3	0	1			Fragment from awl-like tool
292	Rm 5A, Feature 10	Spatula tip	Broken	unknown	2.5+	0.7	0	0.2	2	1			Fragment from awl-like tool
177	Rm 1A, Feature 13, Level C	Squash knife	Broken	Bison	13.1	6.7	0	21.4	2	0			Bison scapula fragment
177	Rm 1A, Feature 13, Level C	Squash knife	Broken	Bison	4.6+	2.3+	0	2.3	3	0			Bison scapula fragment
143	Rm 1A,floor near walls,center rooffall	Squash knife	Broken	Bison	17.9	8.6	1	55.8	1	1			Bison scapula (left)
158	Rm 1A west wall ledge, 13-28 cm	Squash knife	Broken	Bison	13.1	6.7	0	47.1	1	1			Bison scapula (right)
300	Rm 1B entrance	Notched rib	Broken	Bison	15.2+	2.5	1	23.2	2	1			17 notches are uniform; spaced 0.5 cm apart
143	Rm 1A,floor near walls,center rooffall	Notched rib	Broken	Bison	14.8+	2.9	0	34.2	1	0			9 notches variously spaced between 0.5 and 0.6 cm apart
143	Rm 1A,floor near walls,center rooffall	Notched rib	Broken	Bison	3.1+	1.1+	1	1.4	1	0			5 notches variously spaced between 0.5 and 0.6 cm apart
143	Rm 1A,floor near walls,center rooffall	Notched rib	Broken	Bison	2.2+	1.0+	1	0.7	2	0			5 notches variously spaced between 0.3 and 0.4 cm apart

Table 6.22 (continued).

Cat.#	Provenience	Tool Type	Condition	Species	Length	Width	Burned	Wt.	Polish	Excav. Dmg	Conjoined Cat#	Conjoined Provenience	Comments
212	Rm 1A, Trench B W-2 bench 58-76cm	Notched rib	Broken	Bison	2.6+	0.7+	1	0.7	3	0			6 notches variously spaced between 0.4 and 0.5 cm apart
144	Rm 1A, Feature 5, 28 cm below floor	Polished rib	Broken	Bison	11.5+	2.9	1	23.7	2	1			Possible rasp preform
285	Rm 5A,artificial level 3, 51-73 cm	Polished rib	Broken	Bison	6.3+	0.9+	0	3.8	2	0			
280	Rm 5A,Natural Level 1, 0-15 cm	Antler handle	Complete	Deer	14.0	3.4	0	106.7	0	0			2 long parallel grooves 1.2 cm apart, one end hollowed
177	Rm 1A, Feature 13, Level C	Antler tine	Complete	Deer	16.7	2.2	0	33.6	2	0			cut on end
177	Rm 1A, Feature 13, Level C	Antler tine	Complete	Deer	13.2	2.1	0	21.6	1	0			
122	S6E6, 20-30 cm	Scapula wedge	Broken	Bison	4.5+	2.8+	0	8.7	1	0			blade tip has steep bevel
291	Rm 5A, Feature 9	Shaft straighten	Complete	Bison	15.3	3.4	0	40.3	3	0			Bison rib; hole diameter 2.6 long by 1.6 cm wide
132	S13E6, 3-33 cm	Shaft straighten	Broken	unknown	3.6+	1.4+	0	1.2	2	0			very small fragment, smoothing along arc on one side
121	S6E6, 10-20 cm	Hide grainer	Complete	Bison or Elk	7.4	4.6	0	43.5	1	0			Possible hide grainer
212	Rm 1A,Trench B-W-2 bench 58-76cm	Expedient tool	Broken	Bison	15.0	3.9	0	70.4	1	0			Long bone with proximal end cut
289	Rm 5A, Feature 8	Expedient tool	Broken	Bison	17.9	2.7	0	43.8	1	0			Long bone fragment

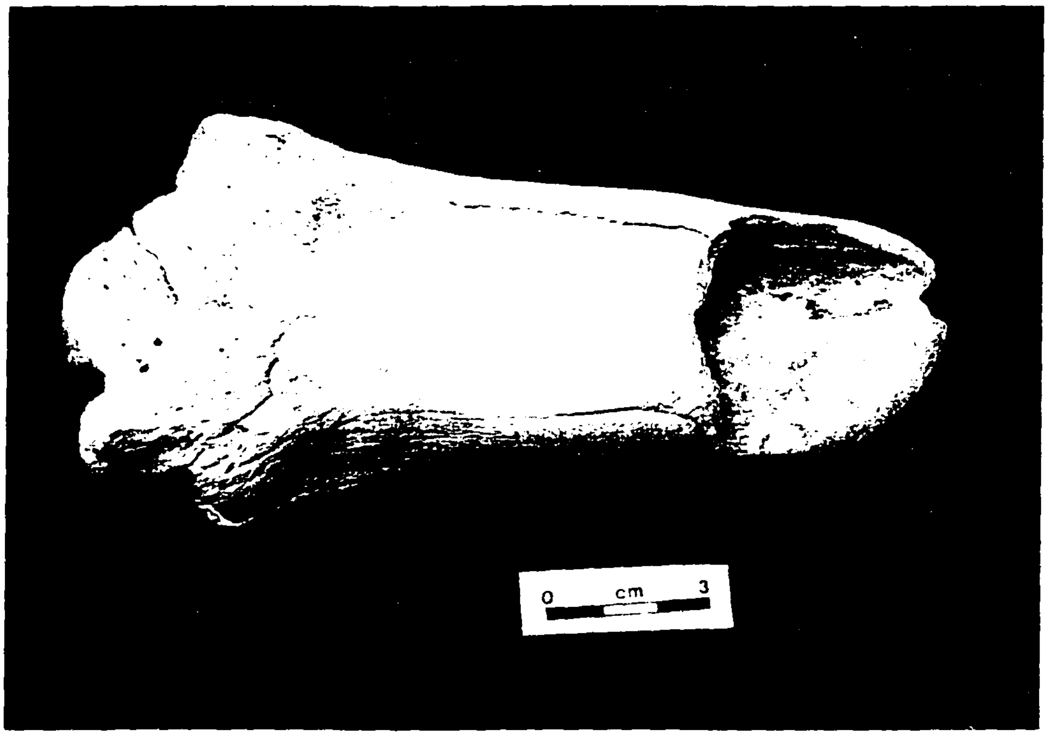
Table 6.22 (continued).

Cat.#	Provenience	Tool Type	Condition	Species	Length	Width	Burned	Wt.	Polish	Excav. Dmg	Conjoined Cat#	Conjoined Provenience	Comments
60	S15E12, 10-20 cm	Tool preform	Broken	Deer	19.7	4.0	0	55.5	0	0			Scored/snapped radius; drill impression 1.1 cm from distal end
289	Rm 5A, Feature 8	Unid. scap. tool	Broken	Bison	9.1+	5.1+	0	31.3	1	0			roughly flaked into shape on 3 sides; one area ground
74	S13E10, 10-20 cm	Drilled bone	Broken	unknown	2.5+	1.6+	0	1.0	0	0			hole: 0.4 cm diameter; 0.4 cm deep
78	S13E7, 20-30 cm	Drilled bone	Broken	Turtle	2.8+	2.1+	0	1.0	0	0			hole: 0.5 cm diameter, along suture line
291	Rm 5A, Feature 9	Unknown	Complete	Antelope	18.6	2.1	0	42.5	2	1			Distal scored/snapped; left metatarsal; hollow proximal end
138	Rm 1A, Test pit 1, east side	Bead	Broken	Bird	5.5	0.7	0	0.8	3	1			two pieces, ends cut, part of medial missing
143	Rm 1A,floor near walls,center rooffall	Bead	Broken	Bird	2.0	0.6	1	0.1	3	0			ends cut

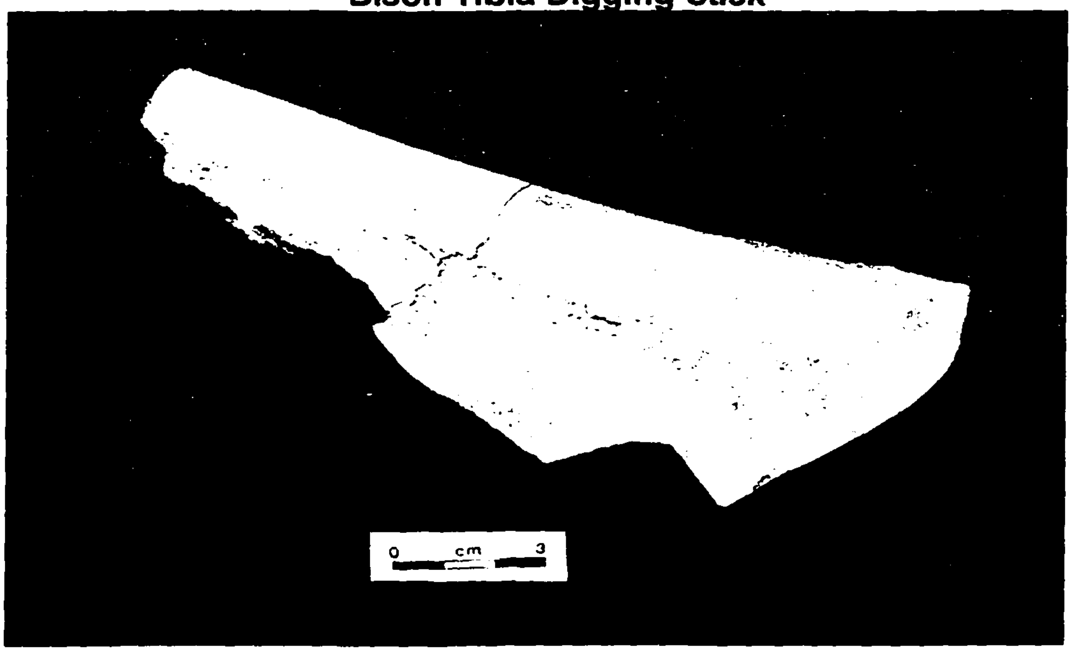
Polish codes: 0 - None
1 - Localized
2 - moderate, overall
3 - extensive overall

Excavation Damage Codes: 0 - No
1 - Yes

Burned: 0 - No
1 - Yes



Bison Tibia Digging Stick



Bison Scapula Hoe Fragment

Figure 6.9. Bison Tibia Digging Stick and Scapula Hoe Fragment.

BISON SCAPULA HOES

Sample Size: 3 (3 fragments)

All three specimens are very fragmentary and only the smaller two are polished. The small specimens are pieces of thick blade sections. The larger piece is part of the left scapula and is missing the distal end (Figure 6.9). The anterior border was reduced by flaking and the spinous process apparently removed by grooving the bone before removal.

AWLS

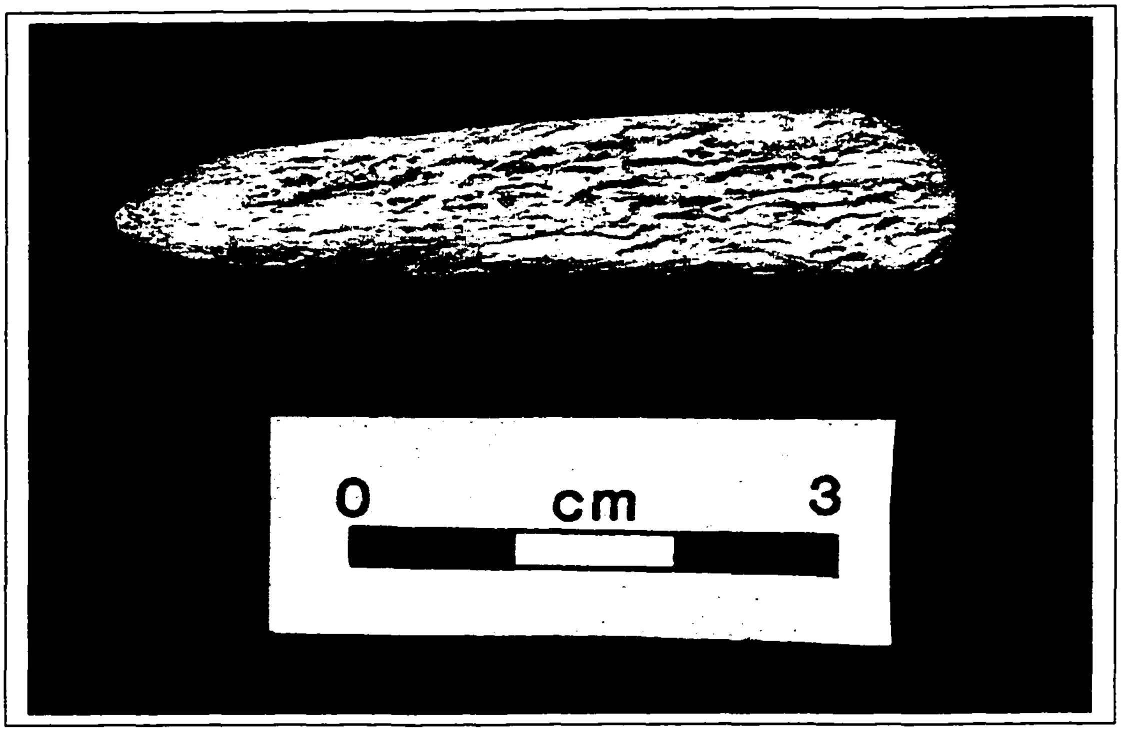
Sample Size: 34 (4 complete, 30 fragments)

Bone awls are round, square, or flat pieces of bone with a sharpened tip or distal end (Figure 6.10). Metatarsal, metacarpal, and other long pieces of mammal bone were split and the distal end abraded into a point. The probable function was to punch holes in leather or for use in making baskets or woven items. One specimen has 13 cut notches spaced between 0.3 and 0.5 cm. The function of these notches is unknown. All of the awls from the Two Sisters site exhibit varying degrees of polish and are described in more detail in Table 6.22.

SPATULA TIP

Sample Size: 3 (3 fragments)

These specimens are fragmentary pieces of bone that have been modified to produce a fairly flat, smooth rounded end. Similar pieces were recovered from the Roy Smith site (34BV14) and Schneider (1969:159)



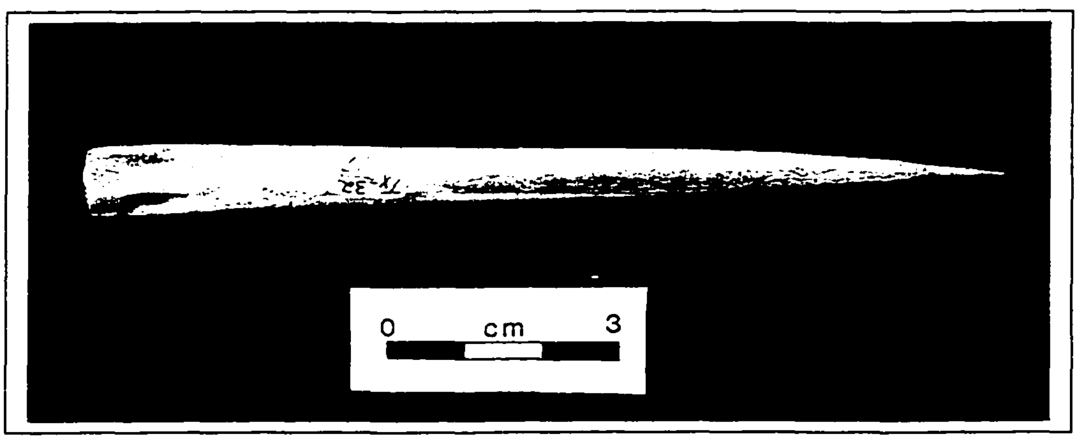


Figure 6.10. Bone Awls from 34TX32.

suggests that due to their shape and localized polish, they may have been used as weaving tools (Figure 6.11).

SQUASH KNIVES

Sample Size: 4 (4 fragments)

These squash knives are fragments of bison scapula that have a thinned anterior border possibly used as a handle and a thin medial blade used for cutting (Figure 6.11). The term "squash knife" has been used to describe similar tools and comes from the likely function of cutting squash and pumpkins into strips to dry (Bell 1980:77; Lintz 1984:333).

NOTCHED RIBS

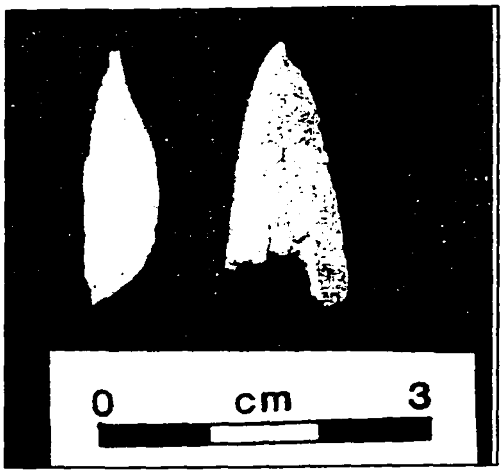
Sample Size: 5 (5 fragments)

Five bison rib sections have been modified with a series of notches along one edge variously spaced between 0.3 and 0.6 cm apart (Figure 6.11). Although the function of these tools is not known, the tool form has been interpreted as a bone rasp because of the notches (Lintz 1984:333; Brooks 1989:81). All five are polished.

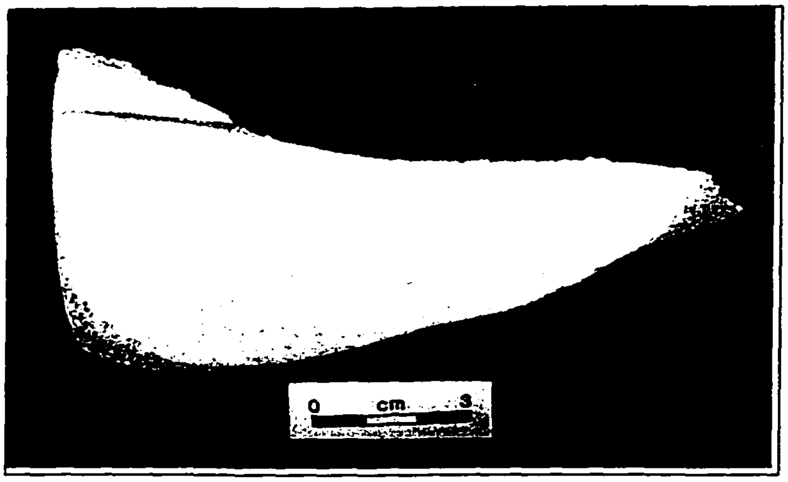
POLISHED RIBS

Sample Size: 2 (2 fragments)

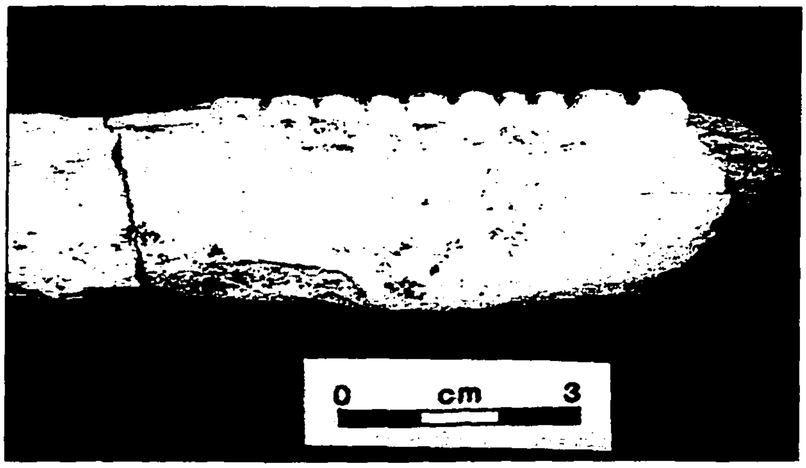
These are bison rib fragments with moderate amounts of polish over the entire fragment.



Spatula Tips



Squash Knife



Notched Rib

Figure 6.11. Spatula Tips, Squash Knife, and Notched Rib.

ANTLER TINES

Sample Size: 2 (2 complete)

These antler tines have smoothed polished tips and may have functioned as pressure flakers. Both appear to have been removed from the antler rack with a groove and snap technique (Figure 6.12).

ANTLER HANDLE

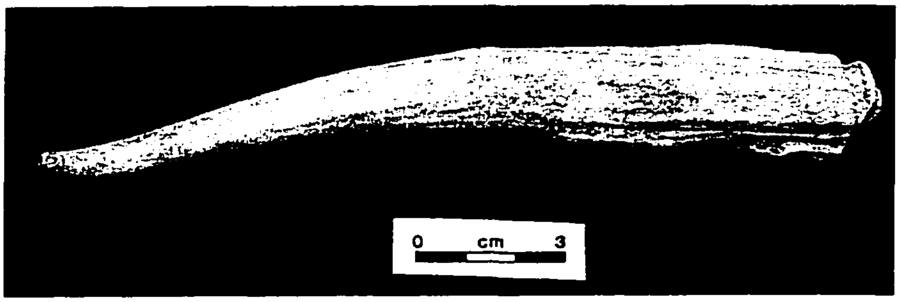
Sample Size: 1 (1 complete)

This specimen is from a deer antler that has been cut on both ends. One end has been hollowed by removing the cancellous tissue to form a socket (Figure 6.12). There are two long parallel grooves cut 1.2 cm apart that extend the entire length of the tool. Similar hollowed-out socketed handles have been described by Wedel (1970:37) from Little River focus sites in central Kansas that date after A.D. 1450.

SHAFT STRAIGHTENERS

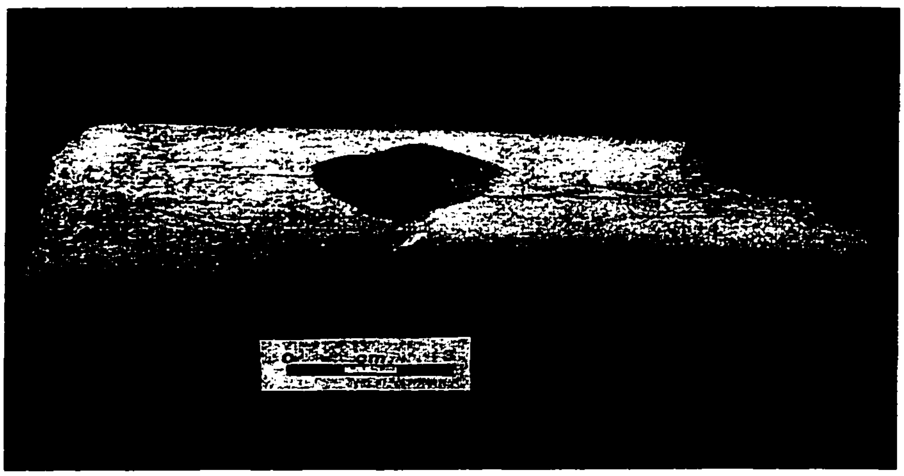
Sample Size: 2 (1 complete, 1 fragment)

The complete specimen is a bison rib section that has been perforated in two places. Only one perforation is complete and it is diamond shaped with beveled and highly polished edges (Figure 6.12). Measurements of the hole diameter are 2.6 cm long by 1.6 cm wide. The other specimen is too fragmented for measurements and only about a third of the working area is present.



Antler Tine

Antler Handle



Shaft Straightener

Figure 6.12. Antler Tine, Antler Handle, and Shaft Straightener.

HIDE GRAINER

Sample Size: 1 (1 complete)

This tool is the faceted left femur head of a bison or elk. Most of the exterior bone has been trimmed or abraded to expose the cancellous portion of the bone (Figure 6.13). Based on Bell's (1980:65) description of similar tools found on proto-historic Wichita sites, this specimen may have been used in hide processing. The abrasive surface of the exposed cancellous bone most likely was used to "smooth out irregularities in the thickness of the hide or to remove hair or fatty tissues during the tanning process" (Bell 1980:65). Sometimes similar tools have been used on the plains as paint applicators (Bell 1980:65). Because this tool did not have any pigment on it, it has been classified as a hide grainer.

EXPEDIENT TOOLS

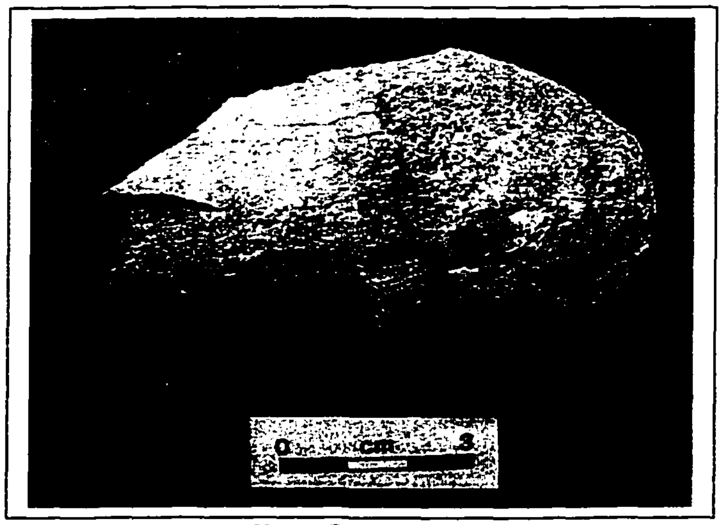
Sample Size: 2 (2 fragments)

The function of these tools is not clear. They are both long bison bone fragments that have localized polish on the rounded or beveled pointed end (Figure 6.13). One specimen was cut on the proximal end.

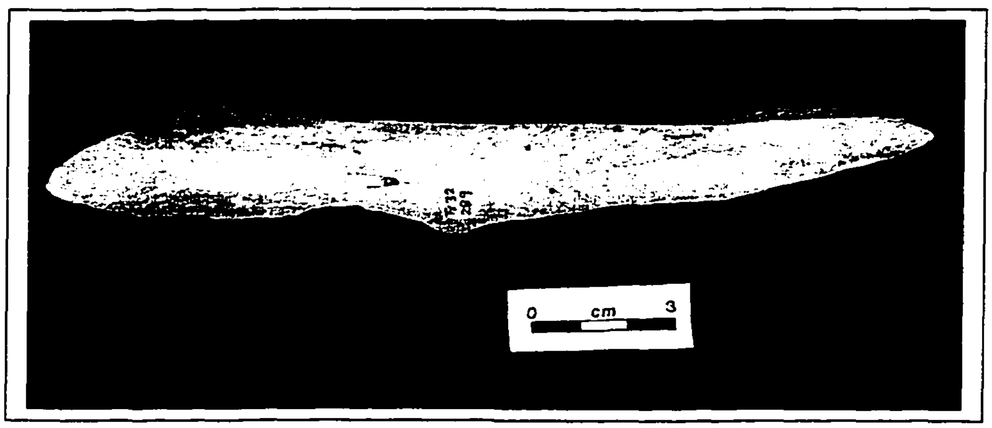
UNIDENTIFIED SCAPULA TOOL

Sample Size: 1 (1 fragment)

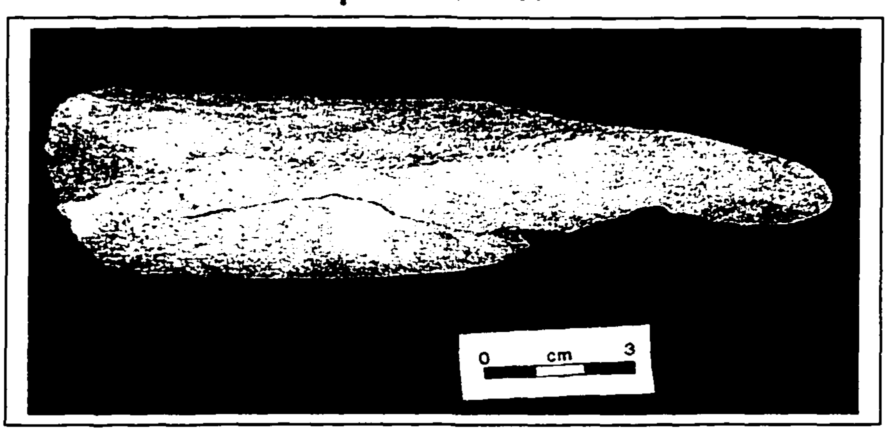
This specimen is a bison scapula tool that has been roughly flaked into a rectangular shape. Three sides have been flaked and the distal part of the proximal posterior border has been abraded. Tool function could not



Hide Grainer



Expedient Tool



Expedient Tool

Figure 6.13. Hide Grainer and Expedient Bone Tools.

be determined.

DRILLED BONE

Sample Size: 3 (3 fragments)

These are fragments of bone that each have a small drill hole. One is a turtle plastron with a .5 cm diameter hole drilled along a suture line (Figure 6.14). Another is an unidentified mammal bone fragment with only a shallow (.4 cm) circular depression .4 cm in diameter. The final specimen is a scored and snapped deer radius that has a small drill impression 1.1 cm from the distal end. The drill impression is shallow and does not penetrate the cancellous tissue. The intended function is unknown.

BONE BEADS

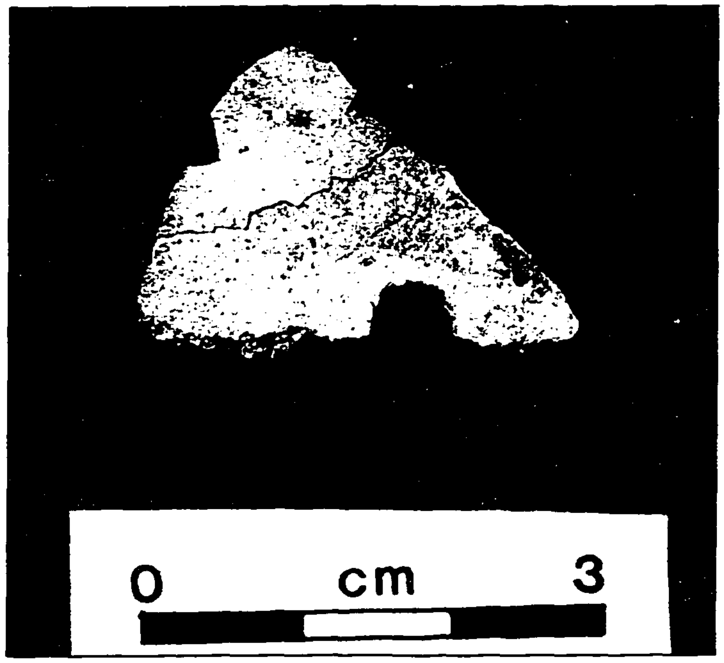
Sample Size: 2 (2 fragments)

Both of these are bird bones that have been modified by cutting and squaring each end (Figure 6.14). Neither are decorated and one is burned.

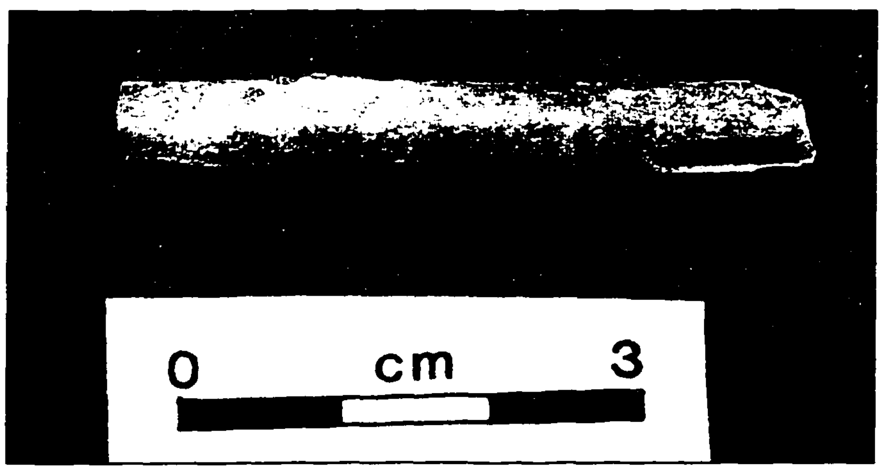
DIGGING STICK PREFORM

Sample Size: 1 (1 fragment)

One broken bison tibia is most likely a preform for a digging stick. Although broken while being manufactured, it has an impact fracture and some evidence of initial burning in the distal end.



Drilled Bone



Bone Bead

Figure 6.14. Drilled Bone and Bone Bead.

MODIFIED BONE

Sample Size: 52

This category refers to bone which has been modified, but for which a specific function could not be determined. Several pieces are scapula fragments from large mammals that have one edge modified. Two are possible bead blanks and two are hollowed-out antelope metatarsals. Additional descriptions of each are presented in Table 6.23.

PAINTED BONE

Sample Size: 5

Five fragments of bone have been stained with a red pigment. These pieces are from various locations at the site and their intended use is unknown (Table 6.24).

<u>Unmodified Bone</u>

Total Sample Size: 89,048 (83,802.0 g)

Number Unburned: 74,484 (73,856.9 g)

Number Burned: 14,564 (9,945.1 g)

By far, the greatest quantity of material recovered from the Two Sisters site is unmodified bone. Most of the faunal debris has been comminuted or pulverized to the point that it cannot be identified as to species. Marrow extraction and bone grease production was probably the cause of the fragmentary nature of the faunal remains. Several species of mammal, reptiles, amphibians, fish, and birds (Table 6.25) have been

Table 6.23. Modified Bone.

Cat. #	Provenience	Species	Burned	Wt.	Polish	Excav. Dmg.	Comments
143	Rm 1A,floor (near walls) and rooffall in center	Lg. mammal	1	1.1	3	0	Scapula edge modified
143	Rm 1A,floor (near walls) and rooffall in center	Lg. mammal	1	3.7	2	1	Scapula edge modified
171	Feature 14, hearth	Lg. mammal	0	1.3	1	0	Scapula edge modified
249	Rm 3A, 20-30 cm	Lg. mammal	0	3.8	0	0	Scapula edge modified
259	Rm 3A,Trench D-4,41-51 cm	Lg. mammal	0	1.1	0	0	Scapula edge modified,cut marks
260	Rm 3A,Trench D-4,51-61 cm	Lg. mammal	0	2.5	0	1	Scapula edge modified
285	Rm 5A, 51-73 cm	Lg. mammal	0	8.4	0	1	Scapula edge modified
288	Rm 5A, Feature 7	Lg. mammal	0	3.8	0	1	Scapula edge modified
289	Rm 5A, Feature 8	Lg. mammal	0	0.9	1	1	Scapula edge modified
307	Rm 1B entrance, 64 cm	Lg. mammal	0	4.1	0	1	Scapula edge modified
1	General Surface	Lg. mammal	0	6.0	1	0	Scapula edge modified
291	Rm 5A, Feature 9	Bison	0	23.2	1	0	Modified metacarpal,proximal end; use unknown
170	Rm 1A,76-81 cm,near hearth	Med.mammal	1	1.0	3	1	Possible awl midshaft fragments (2 fragments)
170	Rm 1A,76-81 cm,near hearth	Lg. mammal	1	1.9	3	0	Smoothed and polished (2 fragments)
170	Rm 1A,76-81 cm,near hearth	Lg. mammal	0	0.3	3	0	Smoothed and polished (2 fragments)
170	Rm 1A,76-81 cm,near hearth	Lg. mammal	1	1.5	1	0	Use unknown, localized polish
173	Rm 1A, Feature 13, level A	Bison	0	0.5	3	0	One edge smoothed, rounded, highly polished
172	Rm 1A, Feature 11	Unknown	1	1.0	3	0	Possible awl midshaft fragment
174	Rm 1A, Feature 13, level A	Bison	1	3.2	2	0	Shaft fragment, use unknown
174	Rm 1A, Feature 13, level A	Unknown	0	0.4	3	0	Possible bead blanks (2 fragments)
333	Rm 1B,S12W2, floor	Unknown	1	0.2	0	0	Possible bead blanks (2 fragments)
289	Rm 5A, Feature 8	Antelope	0	33.4	2	1	Scratched metatarsal (flute preform?)
105	S11E6,Nat'l level 2,13-25 cm	Med.mammal	0	2.2	3	0	Tool shaft fragment; use unknown
105	S11E6,Nat'l level 2,13-25 cm	Med.mammal	0	0.8	2	0	Tool shaft fragment; use unknown
105	S11E6,Nat'l level 2,13-25 cm	Med.mammal	0	0.7	3	0	Tool fragment; use unknown
105	S11E6,Nat'l level 2,13-25 cm	Unknown	0	0.1	3	0	Tool fragment; use unknown;highly polished
132	S13E6, 3-33 cm	Bison	0	167.0	0	0	Modified scapula fragment; use unknown

Table 6.23 (continued).

Cat. #	Provenience	Species	Burned	Wt.	Polish	Excav. Dmg.	Comments
122	S6E6, 20-30 cm	Bison	0	8.7	1	0	Scapula fragment; use unknown
130	Area 7, 0-10 cm	Bison	0	4.2	2	0	Tool fragment; use unknown
141	Rm 1A, 13-20 cm	Unknown	0	0.7	2	0	Tool fragment; use unknown
141	Rm 1A, 13-20 cm	Bison	0	1.5	2	0	Tool fragment; use unknown
141	Rm 1A, 13-20 cm	Unknown	0	0.6	2	0	Tool fragment; use unknown
141	Rm 1A, 13-20 cm	Unknown	0	0.3	2	0	Tool fragment; use unknown
141	Rm 1A, 13-20 cm	Unknown	0	0.2	3	0	Tool fragment; use unknown
141	Rm 1A, 13-20 cm	Unknown	0	0.4	2	0	Tool fragment; use unknown
141	Rm 1A, 13-20 cm	Unknown	1	0.6	3	0	Tool fragment; use unknown
143	Rm 1A,floor (near walls) and rooffall in center	Unknown	0	0.4	2	1	Tool fragment; use unknown
143	Rm 1A,floor (near walls) and rooffall in center	Unknown	0	0.1	2	0	Tool fragment; use unknown
144	Rm 1A,Feature 5,	Unknown	1	0.8	3	0	Highly polished; possible awl fragment
157	S15E4,13-15cm	Unknown	0	0.2	2	0	Tool fragment; use unknown
162	Rm 1A, NE1/4, 48-66 cm	Lg. mammal	0	1.7	2	0	Tool fragment; use unknown
175	Rm 1A, Feature 13, Level B	Unknown	0	0.3	3	0	Tool fragment; use unknown: highly polished
186	Rm 1A,floor near F#18,64 cm	Med.mammal	0	3.1	3	0	Tool fragment; use unknown
249	Rm 3A, 20-30 cm, to floor	Unknown	0	0.2	3	0	Tool fragment; use unknown; highly polished
250	Rm 3A,30-36 cm(below floor)	Lg. mammal	0	1.7	3	0	Tool fragment; use unknown
254	Rm 2A,Trench D-3, 36-51cm	Lg. mammal	0	2.0	2	0	Tool fragment; use unknown
258	Rm 3A,Trench D-4, 30-41 cm	Unknown	0	4.9	2	0	Tool fragment; use unknown
287	Rm 5A, Feature 6	Unknown	0	1.8	3	0	Highly polished; possible awl fragment
345	S14W2,channel fill,51-58 cm	Unknown	0	0.9	3	0	Tool fragment; use unknown
289	Rm 5A, Feature 8	Elk	0	433.6	0	1	Antler tool manufacturing debris

Polish codes: 0 - None
1 - Localized
2 - Moderate, overall
3 - Extensive, overall

Excavation Damage Code: 0 - No
1 - Yes

Burned: 0 - No
1 - Yes

Table 6.24. Painted Bone.

Cat.#	Provenience	Species	Burned	Wt.	Polish	Excav.Dmg.	Comments
173	Rm 1A,Feature 13,level A	Bison	0	5.0	0	1	Red Pigment on Scapula Blade with modified edge
77	S13E7, 20-30 cm	Unknown	0	0.6	3	0	Red Pigment
123	S6E6, 30-41 cm	Unknown	0	0.5	1	0	Red Pigment
118	S10E4, 81-91 cm	Lg.mammal	0	3.7	1	0	Red Pigment
264	Rm 3A,Trench D-5,41-51 cm	Unknown	0	1.8	1	0	Red Pigment

Polish codes: 0 - None
1 - Localized
2 - moderate, overall
3 - extensive, overall

Excavation Damage: 0 - No
1 - Yes

Burned: 0 - No
1 - Yes

Table 6.25. Identified Faunal Species.

Species Identified	Number
Mammals	
Bison (*Bison bison*)	344
Elk (*Cervus canadenses*)	1
Horse (*Equus caballus*)	1
White-tailed Deer (*Odocoileus virginianus*)	75
Pronghorn (*Antilocapra americana*)	109
Coyote (*Canis latrans*)	10
Badger (*Taxidea taxus*)	4
Black-tailed Jack Rabbit (*Lepus californicus*)	26
Eastern Cottontail (*Sylvilagus floridanus*)	15
Desert Cottontail (*Sylvilagus audubonii*)	1
Black-tailed Prairie Dog (*Cynomys ludovicianus*)	35
Plains Pocket Gopher (*Geomys bursarius*)	80
Ord's Kangaroo Rat (*Dipodomys ordii*)	17
Hispid Cotton Rat (*Sigmodon hispidus*)	6
Southern Plains Woodrat (*Neotoma micropus*)	5
Thirteen-lined Ground Squirrel (*Spermophilus tridecemlineatus*)	1
Unidentified Large Mammal	6845
Unidentified Medium Mammal	2337
Unidentified Small Mammal	92
Unidentified Very Small Mammal	145
Mammal Subtotal	10,149
Reptiles	
Western Box Turtle (*Terrapene ornata*)	933
Softshell Turtle (*Trionyx sp?*)	8
Common Snapping Turtle (*Chelydra serpentina*)	91
Yellow Mud Turtle (*Kinosternon flavescens flavescens*)	2
Red-eared Turtle (*Pseudemys scripta elegans*)	27
Unidentified Turtle	25
Water Snake (*Natrix sipedon*)	7
Western Coachwhip (*Masticophis flagellum testaceus*)	5
Prairie Rattlesnake (*Crotalus viridis viridis*)	30
Unidentified Snake	6
Reptile Subtotal	1134

Table 6.25 (continued).

Species Identified	Number
Amphibians	
Bullfrog (*Rana catesbeiano*)	45
Amphibian Subtotal	45
Fish	
Black Bullhead Catfish (*Ictalurus melas*)	89
River Carpsucker (*Carpiodes carpio*)	7
Unidentified Fish	8
Fish Subtotal	104
Birds	
Mallard (*Anas platyrhynchos*)	1
Redhead (*Aythya americana*)	6
Ring-necked Duck (*Aythya collaris*)	1
Canvasback (*Aythya valisineria*)	3
Bufflehead (*Bucephala albeola*)	2
Hooded Merganser (*Lophodytes cucullatus*)	1
Red-tailed Hawk (*Buteo jamaicensis*)	2
Common Snipe (*Gallinago gallinago*)	1
Long-billed Curlew (*Numenius americanus*)	1
Common Nighthawk (*Chordeiles minor*)	3
Belted Kingfisher (*Ceryle alcyon*)	1
Northern Oriole (*Icterus galbula*)	1
Northern Cardinal (*Cardinalis cardinalis*)	1
Perching Birds (*Passeriformes*)	1
Unidentified Birds	76
Bird Subtotal	101
Total Number of Sampled Bones	22,965

Note: Bone Sample from Features 14, 24, and 13, Level A, B, and C.

identified and will be discussed in Chapter 7. The quantities and associated weights are presented by provenience in Appendix IV.

Human Bone

Total Sample Size: 3 (excluding Feature 37)

Three fragments of human bone were recovered from Feature 9, the storage/trash pit located under the wall of Room 5A. They are all fragments from an adult scapula and consist of a piece of the medial border, a small fragment of the acromion, and a portion of the medial and lateral borders at the inferior angle of the bone (Lesley Rankin-Hill, personal communication 2001). They are most likely from one individual.

Shell

Shell Tools

Shell tools and modified shell items were primarily found in the exterior area of the houses and in Room 1A and Room 5A. Modified shell includes scrapers, containers, pendants and beads (Table 6.26). Both freshwater and marine species are represented.

SCRAPERS

Sample Size: 10 (4 complete, 6 fragments)

These shells have been intentionally ground to produce a straight or undulating edge that most likely was used for scraping. The specimens include five with a straight and five with an undulating scraping edge.

Table 6.26. Shell Artifacts and Tools.

Type	Cat. #	Provenience	Square/Feature	Level	Depth	Length	Width	Comments
Olivella shell bead	97	Exterior	S12-E7	2	10-20 cm	1.35	0.60	ground spire
Olivella shell bead	136	Room 1A	"Room 4"	1	0-10 cm	1.30	0.60	ground spire
Olivella shell bead	170	Room 1A	Ash near hearth		76-81 cm	1.20	0.60	ground spire; burned
Olivella shell bead	43	Exterior	S17-E7	2	10-20 cm	1.45	0.70	chipped spire
Olivella shell bead	76	Exterior	S13-E7	2	10-20 cm	1.20	0.50	chipped spire
Olivella shell bead	280	Room 5A	Natural level	1	0-10 cm	1.10	0.50	chipped spire
Olivella shell bead	280	Room 5A		1	0-10 cm	1.20	0.60	chipped spire
Olivella shell bead	182	Room 1A	Feature 15	3	76-84 cm	1.50	0.70	ground spire; decorated
Shell disc bead	1	Surface						
Shell disc bead	113	Area 7	S10-E4	3	30-41 cm			
Shell disc bead	292	Room 5A	Feature 10					
Shell pendant	53	Exterior	S16-E6	2	10-20 cm	1.90	1.80	square; cut
Shell pendant	122	Exterior	S6-E6	3	20-30 cm	1.90	1.00	triangular; drilled
Shell inlay/pendant	212	Room 1A	Trench B-W-2		58-76 cm	4.90	1.90	preform? sides ground
Shell scraper	8	Exterior	S30-E16	2	10-20 cm			straight edge,right valve
Shell scraper	107	Exterior	Feature 22					straight edge,side unknown
Shell scraper	170	Room 1A	Ash near hearth		76-81 cm			straight edge,side unknown
Shell scraper	177	Room 1A	Feature 13	C				straight edge,side unknown
Shell scraper	287	Room 5A	Feature 6					straight edge,right valve
Shell scraper	76	Exterior	S13-E7	2	10-20 cm			undulating edge,right valve
Shell scraper	114	Area 7	Feature 21					undulating edge,right valve
Shell scraper	123	Exterior	S6-E6	4	30-41 cm			undulating edge,side unknown
Shell scraper	287	Room 5A	Feature 6					undulating edge,right valve
Shell scraper	300	Room 1B	Entrance	4	30-51 cm			undulating edge,right valve
Shell container frag.	91/95	Exterior	S12-E9/S12-E8	1 / 2	0-10 cm/10-20 cm			scratched interior
Shell container frag.	127	Area 6	North exterior	1	0-13 cm			scratched interior
Shell container frag.	162	Room 1A	NE1/4 of room		48-66 cm			scratched interior
Shell container frag.	283	Room 5A	Artificial level	1	36-41 cm/58-64 cm			scratched interior
Egg shell	36	S18-E8		4	30-41 cm			
Egg shell	250	Room 3A	below floor	4	30-36 cm			

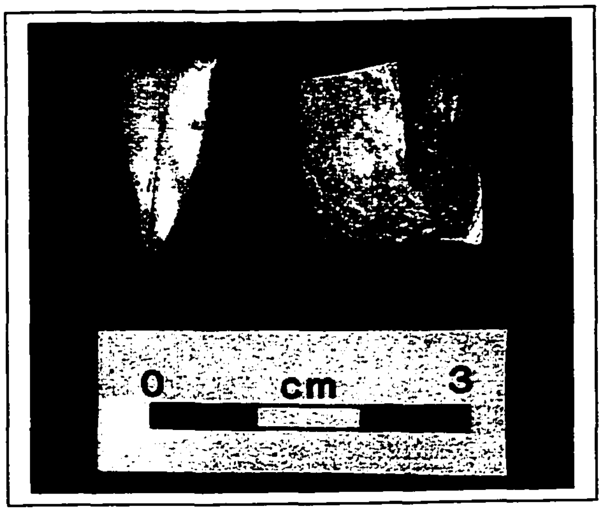
Within the straight edged type, three are the right valves of freshwater mussels. The other two specimens are too fragmentary to determine a side. The undulating edge scrapers are also dominated (four) by right valves. There is not enough remaining of the fifth specimen to identify the side. Four of the scrapers were recovered from exterior squares, two from Room 1A, two from Room 5A, and one each from Room 1B and Area 7.

PENDANTS AND PENDANT PREFORM

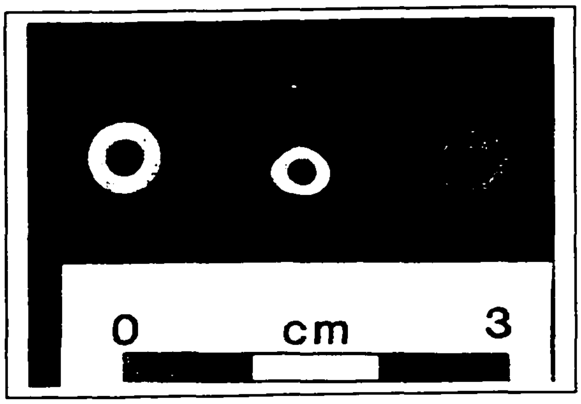
Sample Size: 3 (3 fragments)

Two specimens have been perforated, one with a .3 cm hole drilled through it and the other with a square cut perforation (Figure 6.15). The drilled pendant is triangular and incised with a simple line from the hole to the apex of the triangle. The shape of the triangle (1.9 x 1.0 cm) was formed by one cut edge, one natural edge, and one broken edge. The pendant with the square cut hole is 1.9 by 1.8 cm and has one natural, one cut, and two broken edges.

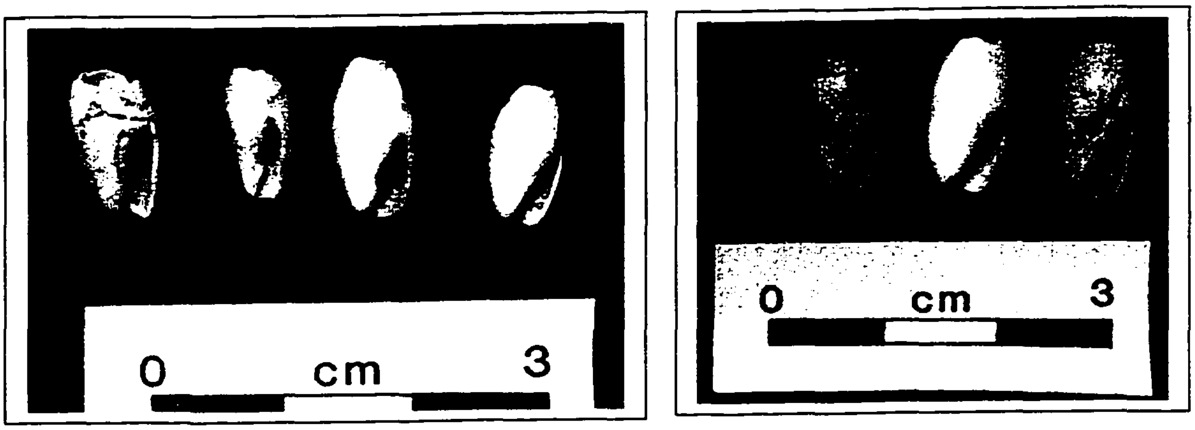
The third specimen is a pendant blank. It is a large rectangular-shaped fragment (4.9 x 1.9 cm) abraded on the exterior face to flatten it and expose the pearl luster of the interior of the shell. Two sides have been cut and ground into a straight edge, one side is the natural edge of the shell that has also been ground to straighten the border, while the fourth side is broken.



Shell Pendants



Shell Disc Beads



***Olivella* Shell Beads**

Figure 6.15. Shell Pendants and Beads from the Two Sisters Site.

POSSIBLE SHELL CONTAINERS

Sample Size: 4 (4 fragments)

Whether these freshwater mussel shell fragments were actually containers is unknown. They all have numerous scratches and cut marks on their interior surfaces that are parallel to the long axis of the shell. They may have functioned as small bowls in which something was cut or mixed.

DISC BEADS

Sample Size: 3 (3 complete)

These beads are small, thin disc beads made from either freshwater or marine shell (Figure 6.15). Measurements are included in Table 6.27.

Table 6.27. Disc Bead Measurements (cm).

Catalog #	**Bead Diameter**	**Hole Diameter**	**Bead Thickness**
1	.60	.30	.13
113	.62	.25	.24
292	.45	.20	.18

OLIVELLA BEADS

Sample Size: 8 (8 complete)

These beads are made from un-fossilized *Olivella* shells that have been chipped (4) and ground (4) to remove their spires and shape into beads (Figure 6.15). Seven specimens are plain and one is decorated. The decorated bead has a series of seven lines engraved on it and has small cuts on each side of the natural opening. Since *Olivella* is a marine snail, these beads may originate from either the Pacific coast or the Gulf of Mexico.

Unmodified Shell

Sample Size: 587 (587 fragments)

These are fragments of freshwater mussel shell for which a specific species could not be determined. They were recovered from all areas of the site.

Egg Shell

Sample Size: 1.2 g

Egg shell was recovered from two locations at the site - one was associated with the neonatal human burial and the other was below the floor in Room 3A. It is highly likely that they represent either bird eggs or reptile eggs. If they are reptile, they may be intrusive and not associated with human occupation of the site.

Floral Remains

Charcoal samples obtained during excavation have been sampled to identify the types of trees available and used, both for construction and for fuel, during the period of site occupation. Results of this analysis indicate the presence of the following: Cottonwood (*Populus deltoides*), Hickory (*Carya* sp.), Sycamore (*Plantus occidentalis*), Oak (*Quercus* sp.), Elm (*Ulmus* sp.), and Hackberry (*Celtis occidentalis*). The most numerous within the sample is Cottonwood which is available in the riparian or bottomland habitat.

The only cultivated plant remains recovered from the Two Sisters site are corn (*Zea mays*) and beans (*Phaseolus vulgaris*). In addition to the charred plant remains removed from the screens during the excavation, soil samples of various volumes were also collected. To standardize the recovery, soil samples of one quart (.95 liter) were taken and poured through a size 30 sieve (.06 cm) into clean water. After the water was agitated and the charred remains floated to the surface, they were skimmed off and placed on cotton sheets to dry. Next, the samples were placed in labeled vials and plastic bags and submitted to Joscelyn Moore for identification. Unfortunately, no wild plants were identified in her analysis. The complete macrobotanical data is presented in Chapter 7.

Summary

This chapter describes the materials recovered from the Two Sisters site. Artifacts, faunal remains, and botanical specimens provide information necessary to investigate the possible subsistence and settlement practices of these prehistoric people. Having outlined these data, the next chapter will apply this information to the theoretical models of diet breadth and site catchment.

CHAPTER 7

THEORETICAL INTERPRETATION OF THE DATA

As a result of excavation at the Two Sisters site, a large collection of material was obtained. Broadly, these data can be classified as bones and bone fragments; floral remains; chipped stones, including projectile points, scrapers, and knives; various horticulture-related implements, including ground stones (manos/metates) and bone tools. This chapter will address the various artifacts, animal bone fragments, and evidence of plant foods from the perspective of the theoretical model described in Chapter 4. Briefly, the central premise is that there is a method of evaluating foraging strategy in terms of what is optimal for a group of individuals under conditions of moderate scarcity. The components of this premise have been expressed in a mathematical formula, which contain variables that influence the outcome of a particular foraging strategy. By observing foraging behavior in terms of these variables, ethnographers and cultural anthropologists have been able to show emergent regularities in foraging strategies used by these kinds of groups. However, while these variables can be derived from direct observation of behavior in ethnographic studies, archaeologists must work backwards. The kinds of things that are found at an archaeological site can be seen as the result of a particular foraging strategy – in other words, we are examining lifestyle, adaptation, and behavior that has been reduced to debris and physical remains.

The major variables involved in understanding foraging behavior can be divided into two areas: (1) "external" variables and, (2) "internal" variables. External variables include climate, environment, site location, and the abundance of prey. Internal variables include the overall technological development (indicated, in this case, by lithic remains), refuse of what the people ate (floral and faunal remains), and site structures (how and from what structures are constructed). Consequently, in this Chapter, I will examine data found at the Two Sisters site and show how it demonstrates a particular foraging strategy and how this strategy changed over time.

Methodology and Hypothesis

Before examining the data itself, it is important to clearly articulate how the data will be analyzed and how it figures into the overall argument of this study. First, the general hypothesis of this study is: If the occupants of the Two Sisters site were "optimal foragers," then (1) the remains found when seen in relation to the basic model will describe the subsistence strategy, which (2) will be consistent with the environment, climate, and site location. If this hypothesis is correct, the occupants of the Two Sisters site will be seen as primarily bison hunters who supplemented their diet with minimal horticulture and foraging. Initially opting for a "central-place" model, they switched to mobile hunting following bison herds and living more nomadically.

The environment and climate parameters have been discussed earlier; therefore, this information can be used as a standard against which the likelihood of the model can be judged. For example, if these data indicate a model that is inconsistent with the conditions, then it is likely that a mistake exists either (1) in the initial picture of the environmental constraints, (2) in the interpretation of the data itself, and/or (3) in the foraging strategy model. On the other hand, compliance of the data with external constraints increases the probability that the interpretation is correct and bolsters the generality of the results.

The data, therefore, will be divided into roughly the various parts of our model from Chapter 4. This includes an analysis of representative samples of the faunal remains, floral remains, chipped and ground stone artifacts, and horticultural artifacts. According to the environmental constraints, the faunal remains should indicate mostly bison bones, although many other kinds of bones may be present. The floral remains should be sparse; however, they might indicate slight reliance upon horticulture as a supplement to the main diet of bison. If the Two Sisters inhabitants were mainly bison hunters, they should have lithic tools consistent with hunting and processing large herbivores. Further, the absence or small quantities of certain items, such as horticultural bone tools and pottery, possibly indicates that these items were not used extensively, which would be more likely in hunting groups than horticultural groups. The same holds true for ground stone implements, which may indicate less grinding as a feature of subsistence. Therefore, the data will be grouped, analyzed, and interpreted in the following categories: (1) specific data that are relevant to diet breadth and (2) specific data related to site catchment analysis. Diet breadth and site catchment, although highly interrelated, can be seen for the purpose of this study as two axes that intersect with the overall theoretical model. The analysis of diet breadth has the goal of determining the various kinds of things that were consumed and their relative importance. Site catchment analysis, on the other hand, will augment this inquiry while, at the same time, discussing the layout of various resources, i.e., their availability in proximity to the site. Consequently, diet breadth related data will be examined first and will include (1) faunal remains, (2) hunting tools, (3) floral remains, and (4) horticultural tools. Data that are more easily understood from the site catchment approach will be examined second and will include (1) horticultural resources based upon soils, (2) lithic resources, (3) biotic resources-floral and (4) biotic resources-faunal. These groups of data will then be related back to the theoretical model for further interpretation.

Data Specifically Indicating Diet Breadth

Faunal Remains

The diet breadth model, as outlined in Chapter Four, provides a framework from which to evaluate decisions about what resources to exploit.

Optimally, these decisions are based on selecting foods that provide the most energy for the least effort. This involves the establishment of a hierarchy of resources based on the number of calories they provide in relation to the amount of energy expended in searching, capturing, and processing.

For the occupants of the Two Sisters site, clues about subsistence are found in the actual mix of recovered faunal remains. Because there are 89,048 pieces of bone (cf. Appendix IV), only a representative sample of the recovered bone is used in this analysis. These samples have been taken from two locations - the earlier and later houses. Analysis of the bones from both locations reveals information about the diet breadth of the occupants (Table 7.1). For the early house (designated as Structure B or Room 1B), Feature 13, Level B and Level C provide the sample. The diet breadth of the occupants of the later house, Structure A, is indicated by the faunal samples from Feature 14, Feature 24, and Feature 13, Level A. All faunal analysis was conducted by Sheila Bobalik Savage.

Although the samples show evidence of a variety of different food sources, the largest number are of bison. If the occupants were constrained in a manner suggested by optimal foraging theory, they were likely using the most efficient food-energy source for subsistence. Bison were the most effective energy source and they were most likely exploited fairly close to the site. This is evident because all elements from the animal are present at the

Table 7.1. Faunal Distribution by Feature at 34TX32.

	Feature 14			Feature 24			Feature 13, Lev.A			Feature 13, Lev.B & C		
	#	Wt.	MNI	#	Wt.	MNI	#	Wt.	MNI	#	Wt.	MNI
Mammals												
Bison (*Bison bison*)	23	200.2	2	44	304.6	2	85	527.4	2	192	3200.8	4
Horse (*Equus caballus)*				1	9.8	1						
White-tailed Deer (*Odocoileus virginianus*)	4	11.1	1	17	32.3	1	8	63.6	1	46	226.1	2
Pronghorn (*Antilocapra americana*)	3	9.5	1	8	11.8	1	3	14.9	1	95	260.6	7
Coyote (Canis latrans)										10	33.8	2
Badger (Taxidea taxus)										4	15.1	1
Black-tailed Jack Rabbit (*Lepus californicus*)	1	1.9	1	11	3.7	1				14	9.1	2
Eastern Cottontail (*Sylvilagus floridanus*)				11	5.2	1	2	1.5	1	2	0.6	1
Desert Cottontail (*Sylvilagus audubonii*)										1	1.9	1
Black-tailed Prairie Dog (*Cynomys ludovicianus*)	12	5.3	2	1	0.6	1				22	11.8	3
Plains Pocket Gopher (*Geomys bursarius)*	10	4.7	2	11	5.3	2				59	28.7	6
Ord's Kangaroo Rat (*Dipodomys ordii)*	2	0.7	1	1	0.6	1	4	0.9	2	10	1.9	2
Hispid Cotton Rat (*Sigmodon hispidus)*										6	1.2	3
Southern Plains Woodrat (*Neotoma micropus)*										5	1.3	1
Thirteen-lined Ground Squirrel										1	0.1	1
Unidentified Large Mammal	559	416.9		807	557.9		975	612.7		4504	3135.6	
Unidentifed Medium Mammal	263	85.1		216	51.5		100	26.3		1758	684.4	
Unidentified Small Mammal	33	8.4		14	3.5					45	9.8	
Unidentified Very Small Mammal	11	2.9		19	2.5		12	2.1		103	12.8	
Mammal Subtotal	921	746.7	10	1161	989.3	11	1189	1249.4	7	6877	7635.6	36
Reptiles												
Western Box Turtle (*Terrapene ornata)*	143	55.6	6	113	49.6	1	44	30.9	3	633	408.8	12
Softshell Turtle (*Trionyx sp?)*	2	0.7	1	2	0.6	1				4	10.4	2
Common Snapping Turtle (*Chelydra serpentine*)	5	2.2	1	6	2.1	1	31	26.1	1	49	19.5	2
Yellow Mud Turtle (*Kinosternon flavescens flavescens*)	1	0.6	1							1	1.1	1
Red-eared Turtle (*Pseudemys scripta elegans*)	3	1.8	1	11	4	1	6	3.1	1	7	3.6	1
Unidentified Turtle	3	0.6		3	0.8		5	0.8		14	3.5	
Water Snake (*Natrix sipedon)*	1	0.3	1							6	1.1	1
Western Coachwhip (*Masticophis flagellum testaceus*)										5	0.6	1
Prairie Rattlesnake (*Crotalus viridis viridis*)	18	2.5	1							12	2.1	2
Unidentified Snake							1	0.4		5	0.5	
Reptile Subtotal	176	64.3	12	135	57.1	4	87	61.3	5	736	451.2	22

Table 7.1 (continued).

	Feature 14			Feature 24			Feature 13, Lev.A			Feature 13, Lev.B & C		
	#	Wt.	MNI	#	Wt.	MNI	#	Wt.	MNI	#	Wt.	MNI
Amphibians												
Bullfrog (*Rana catesbeiano)*	2	0.7	1							43	7.8	12
Amphibian Subtotal	2	0.7	1							43	7.8	12
Fish												
Black Bullhead Catfish (*Ictalurus melas)*	4	1.2	2							85	17.1	5
River Carpsucker (*Carpiodes carpio*)										7	1.5	1
Unidentified Fish	1	0.2								7	0.7	
Fish Subtotal	5	1.4	2							99	19.3	6
Birds												
Mallard (*Anas platyrhynchos)*				1	0.9	1						
Redhead (*Aythya americana*)										6	2.2	2
Ring-necked Duck (*Aythya collaris*)										1	0.5	1
Canvasback (*Aythya valisineria*)										3	1.4	1
Bufflehead (*Bucephala albeola*)										2	0.9	1
Hooded Merganser (*Lophodytes cucullatus*)							1	0.4	1			
Red-tailed Hawk (*Buteo jamaicensis*)										2	0.2	1
Common Snipe (*Gallinago gallinago*)										1	0.1	1
Long-billed Curlew (*Numenius americanus*)										1	0.7	1
Common Nighthawk (*Chordeiles minor*)										3	0.7	1
Belted Kingfisher (*Ceryle alcyon*)										1	0.1	1
Northern Oriole (*Icterus galbula*)										1	0.1	1
Northern Cardinal (Cardinalis cardinalis)										1	0.1	1
Perching Birds (*Passeriformes*)										1	0.1	1
Unidentified Bird	5	1.6	1	4	0.8		3	0.7		64	9.1	
Bird Subtotal	5	1.6	1	5	1.7	1	4	1.1	1	87	16.2	13
Total	1109	814.7	26	1301	1048.1	16	1280	1311.8	13	7842	8130.1	89
Mussels												
Unidentified Mussel	15	9.1	1	1	0.3	1				30	31.3	1
Mussel Subtotal	15	9.1	1	1	0.3	1				30	31.3	1

site. If the animals were killed a significant distance away, only the highest quality elements of the carcass would have been brought back to camp. Selective butchering is not apparent in the bone sample; everything was brought back and used.

In addition to bison, a variety of game are evident in both the early and late houses at Two Sisters. Major differences between these occupations are an increased number of birds at the early house. This may indicate less standing water for the later occupation. Because the site is near the river, the broad assortment of faunal remains most likely reveals opportunistic encounters that did not require excessive energy. Travel and search time would be minimal resulting in a greater net energy gain and, therefore, inclusion in the diet. The amount of usable meat, however, for these smaller species combined with the reduced quantities evident in the sample suggests that they were supplemental to the diet base of bison. Further, because energy and calories are fundamental to the diet breadth model, Table 7.2 suggests the usable meat weights per species. The table breaks the various components of diet breadth into a ranking based upon the energy potential that can be obtained from a particular food source.

Table 7.2. Usable Meat Quantities and Habitats for Identifiable Possible Prey (White 1953:397-398; Duffield 1970; Caire et al. 1989; Webb 1970).

Prey	Usable Meat-kg (lbs)	Habitat	Early, Late, or Both Houses
Bison Bison (Bison)	408 kg (900) [male] 181 kg (400) [female]	Uplands, Breaks	Both
Cervus canadensis (Elk)	159 kg (350)	Breaks	Late
Odocoileus virginianus (White-tailed Deer)	45 kg (100)	Bottomlands	Both
Antilocapra americana (Pronghorn)	25 kg (55)	Uplands, Breaks	Both
Canis latrans (Coyote)	6 kg (12.5)	Uplands, Breaks, Bottomlands	Early
Taxidea taxus (Badger)	6 kg (12.5)	Uplands, Breaks	Early
Lepus californicus (Black-tailed Jackrabbit)	1.4 kg (3)	Uplands, Breaks	Both
Aythya valisineria (Canvasback)	.86 kg (1.9)	Upland Playas, Bottomlands	Early
Sylvilagus floridanus (Eastern Cottontail)	.8 kg (1.75)	Breaks, Bottomlands	Both
Sylvilagus audubonii (Desert Cottontail)	.8 kg (1.75)	Uplands, Breaks	Early
Anas platyrhynchos (Mallard)	.8 kg (1.75)	Upland Playas, Bottomlands	Late
Aythya americana (Redhead)	.77 kg (1.70)	Upland Playas, Bottomlands	Early
Cynomys ludovicianus (Black-tailed Prairie Dog)	.7 kg (1.5)	Uplands, Breaks	Both
Aythya collaris (Ring-necked Duck)	.57 kg (1.25)	Upland Playas, Bottomlands	Early
Lophodytes cucullatus (Hooded Merganser)	.45 kg (1.0)	Upland Playas, Bottomlands	Late
Bucephala albeola (Bufflehead)	.45 kg (1.0)	Upland Playas, Bottomlands	Early
Numenius americanus (Long-billed Curlew	.45 kg (1.0) (estimate)	Upland Playas, Bottomlands	Early
Ictalurus melas (Black Bullhead Catfish)	.45 kg (1.0)	Bottomlands	Both
Geomys bursarius (Plains Pocket Gopher)	.32 kg (.7)	Breaks, Bottomlands	Both
Gallinago gallinago (Common Snipe)	.32 kg (.7) (estimate)	Upland Playas, Bottomlands	Early
Dipodomys ordii (Ord's Kangaroo Rat)	.23 kg (.5) (estimate)	Uplands, Breaks, Bottomlands	Both
Sigmodon hispidus (Hispid Cotton Rat)	.23 kg (.5) (estimate)	Uplands, Breaks, Bottomlands	Early
Neotoma micropus (Southern Plains Woodrat)	.23 kg (.5) (estimate)	Uplands, Breaks, Bottomlands	Early
Tarrapene ornata (Western Box Turtle)	.23 kg (.5) (estimate)	Uplands, Breaks, Bottomlands	Both
Trionyx sp. (Softshell Turtle)	.23 kg (.5) (estimate)	Bottomlands	Both
Chelydra serpentina (Common Snapping Turtle)	.23 kg (.5) (estimate)	Breaks, Bottomlands	Both
Kinosternon flavescens (Yellow Mud Turtle)	.23 kg (.5) (estimate)	Bottomlands	Both
Pseudemys scripta elegans (Red-eared Turtle)	.23 kg (.5) (estimate)	Bottomlands	Both

Table 7.2 (continued).

Prey	Usable Meat-kg (lbs)	Habitat	Early, Late, or Both Houses
Carpiodes carpio (River Carpsucker)	.23 kg (.5)(estimate)	Bottomlands	Early
Natrix sipedon (Water Snake)	unknown	Bottomlands	Both
Masticophis flagellum testaceus (Western Coachwhip)	unknown	Breaks, Bottomlands	Early
Crotalus viridis viridis (Prairie Rattlesnake)	unknown	Uplands, Breaks Bottomlands	Both
Rana catesbeiano (Bullfrog)	unknown	Bottomlands	Both

An interesting feature of the faunal remains is that most of the bones appear to be intentionally broken. The fragmented condition of the bones and their extremely small size likely indicates that the occupants of both the early and late houses were breaking and smashing most bones, either to boil for bone grease or for marrow extraction. This process is consistent with the optimal foraging premise of maximizing the energy-gain from a particular resource. For example, bone grease manufacture has been documented by Leechman (1951:355) for the Loucheux people of Old Crow in the northern Yukon and she describes the process as follows:

> The bones to be broken are placed on the anvil stone and are smashed into little pieces, 'as big as finger nails,' with the back of an axe. In the old days stone hammers were used for this. The broken bones are then put in a kettle with a little cold water and placed on the fire. As soon as the water comes to a boil, cold water is added...so as to keep the water simmering rather than boiling violently. The purpose of this is to allow the oil and grease rendered out of the bone to float on the top....The grease is skimmed off and put in a separate vessel, usually the small inner part of a caribou's stomach. Here it will keep quite well for as much as two or three years.

Ethnographically, bone grease has been used as a food, similar to butter or oil, and for cooking (DeMarcay 1986:67-72; Leechman 1951:355). It has also been used with dried pulverized meat and berries to make pemmican -

"a high calorie food that remains edible for months" (Quigg 1997:158).

Refuse after bone grease processing by the Nunamiut, according to Binford (1978:159), left a large pile of small unburned bones - some as small as bone meal - piles of ash, and large amounts of burned rock. These descriptions are similar to what is found at the Two Sisters site. Furthermore, Vehik (1977:172-173) identifies primary evidence for bone grease manufacturing as including numerous small pieces of unburned bone and an absence of vertebrae, ribs, legs, and feet. Secondary evidence includes hammerstones, anvil stones, fire pits, and burned or unburned boiling stones. The Two Sisters site includes, in addition to bone fragments, all the secondary evidence. Boiling stones, both burned and unburned are numerous (692) and have a total weight of 40,331 g. This quantity of boiling stones, linked with the number of small unidentifiable bone fragments, strongly suggests intensive bone grease processing. In addition, an impact scar on a right bison phalanx in Feature 13, level C indicates an attempt at smashing the animals feet, quite probably for bone grease.

Bone grease is a highly preservable, concentrated source of energy (Quigg 1997:158). It is important in subsistence reconstruction because bone grease is essentially fat. Fat provides vitamins A, D, E, and K in addition to having the "highest caloric density of any food and is the single most concentrated source of energy in the human diet" (Vehik 1977:172).

Highly fragmented bones at the Two Sisters site and at other

Antelope Creek phase sites also may indicate that these groups were experiencing nutritional stress (Speth and Spielmann 1983:19; DeMarcay 1986:99). Climate reconstruction reveals an environment with marginal horticultural conditions and suggests a long-term reduction in available carbohydrates from corn. At the same time, bison were increasing and would have been an optimal source of energy. However, if the diet of the occupants of the Two Sisters site was primarily dependant upon bison (protein), the need for fats and carbohydrates would be critical. Therefore, supplementing the calories from meat by smashing bones to make bone grease would be one way of alleviating some of the nutritional stress (Speth 1983:158).

Hunting Tools

The reliance upon hunting is further documented by the quantity and quality of hunting tools. Two hundred nineteen arrowpoints and point fragments were recovered from the site and attest to an emphasis upon hunting. Furthermore, bison exploitation and efficiency in processing is demonstrated in the presence of diamond-beveled knives (26), and scraper and scraper fragments (305). Creel (1991) argues that the occurrence of diamond-beveled knives and scrapers increases after A.D. 1300 when bison hide processing becomes important. These tools provide an efficient implement for reducing processing time, thereby increasing the net energy gain per animal. The hunting tools supplement the faunal remains and further reflect the emphasis upon bison as an important aspect of subsistence.

Floral Remains

Even though the primary energy source appears to be bison, evidence exists of limited horticulture as a component of the overall diet breadth. This evidence is remnants of corn (*Zea* mays) and beans (*Phaseolus vulgaris*), which would have supplemented the protein and fat components of the diet with a carbohydrate component. Eleven corncob fragments were recovered with samples of 8, 10, 12, and 14 row cobs (Table 7.3). The majority (5) have 10 rows; counting the number of alignments of cupules and multiplying the sum by two determine the rows. Because there are two kernels in each cupule and each kernel is attached to the cupule socket by the germ, 8 through 14 row cobs have 4 through 7 alignments of cupules respectively. Cobs were oval (60%) and circular (10%) in cross section and cob diameters ranged from .5 cm to 1.1 cm (Table 7.4).

Numerous cupules and kernels (both with the germ attached and with the germ missing - degermed), as well as cupule and kernel fragments are present. Cupules ranged from .35 cm to .90 cm wide and from .20 cm to .40 cm high with the mean being .60 cm and .32 cm respectively (Table 7.5). Metric dimensions of the 28 kernels (Table 7.6) produced the following means: width .79 cm, thickness .52 cm, and height .68 cm.

Table 7.3. Macrobotanical Specimens.

Room	Provenience	Bean (*phaseolus vulgaris*)	Corn (*Zea mays*)						
			cob fragments	germs	cupules	cupule fragments	kernels	kernel fragments	stalk
1A	NW 1/4, Level 4	1							
1A	SE 1/4, Level 5						1		
1A	Trench B						1		
1A	Trench C, west edge							1	
1A	Trench C							1	
1A	Burned floor near hearth			1		1	3	23	
1A	Feature 14, fire hearth			3	2		2	44	
1A	Ash area assoc. w/ hearth				3			9	
1A	Feature 11, pit west of hearth				8		3	64	
1A	Feature 13, Level B		1 (10 row)						
1A	Feature 13, Level C						1	7	
1A	Feature 13, Level C					1		1	
1A	Feature 13, Level C		1 (10 row)			10	2	2	
1A	Feature 13, Level C						1	6	
1A	Feature 13, Level C				5				
1A	Room center, Level 3,flotation					1		2	
2A	Level 2, 13-28 cm		1 (14 row)						
3A	Level 1, 0-10 cm						1		
3A	Trench D, Level 5, 41-51 cm							3	
5A	Artificial Level 4, 58-65 cm				1		1		
5A	Feature 6 (center pit)			1			2	9	
5A	Feature 7 (east pit)		1 (8 row)					6	
5A	Feature 8 (south pit)		1 (14 row)				1	1	
5A	Feature 8 (south pit) flotation							1	

Table 7.3 (continued).

Room	Provenience	Bean (*phaseolus vulgaris*)	Corn (*Zea mays*)						
			cob fragments	germs	cupules	cupule fragments	kernels	kernel fragments	stalk
5A	Feature 9 (west pit under wall)		2 (10 row)		1			7	1
5A	Feature 9 (west pit under wall)				10 (8 row)				
5A	Feature 9 (west pit under wall)		1 (10 row)						
5A	Feature 9 (west pit under wall)		1 (12 row)						
5A	Feature 10 (north pit)				1		3	1	
1B	S16W4, 51-58 cm and floor		2		10	9		12	
1B	Eastern 1/3 of room at floor						3	20	
1B	Eastern 1/3 of room at floor							1	
1B	Above floor						1	10	
Area 7	S10E4, Level 4, 30-41 cm						1		
	Totals	1	11	5	41	22	27	231	1

Table 7.4. Metric Dimensions of Corn Cob Fragments.

Room	Provenience	No. rows	Cob length	Cob diameter	Cross section	Cupules per cm	Cob part
1A	Feature 13, Level B	10	1.70	.8-1.0	oval	4.02	mid-sect.
1A	Feature 13, Level C	10	1.30	.8-1.0	oval	3.0	near tip
2A	Level 2, 13-28 cm	14	1.20	.75-.9	oval	3.5	tip
5A	Feature 7 (east pit)	8		.5	circular		tip-tiller
5A	Feature 8 (south pit)	14	1.00	.75-1.0	oval	3.75	tip
5A	Feature 9 (west pit)	10		.8-1.0	oval	2.84	mid-sect.
5A	Feature 9 (west pit)	10		.55-.6	circular	2.86	tip-tiller
5A	Feature 9 (west pit)	8		.65-.7	circular	4.0	tiller
5A	Feature 9 (west pit)	10	2.60	1.1	oval	3.25	tip-tiller
5A	Feature 9 (west pit)	12	2.45	.8	circular	4.5	tiller?
1B	S16W4,51-15 cm and floor	*	*	*	unknown	*	*

* no data available.

Table 7.5. Metric Dimensions of Cupule Segments.

Room	Provenience	Cupule width	Cupule height
1A	Ash area assoc. w/ hearth	0.60	0.30
1A	Ash area assoc. w/ hearth	0.60	0.30
1A	Ash area assoc. w/ hearth	0.60	0.30
1A	Feature 13, Level B	0.60	0.30
1A	Feature 13, Level C	0.80	0.40
1A	Feature 13, Level C	0.90	0.40
1A	Feature 13, Level C	0.70	0.40
1A	Feature 13, Level C	0.60	0.30
1A	Feature 13, Level C	0.70	0.30
1A	Feature 13, Level C	0.60	0.30
2A	Level 2, 13-28 cm	0.40	0.20
5A	Artificial Level 4, 58-65 cm	0.50	0.30
5A	Feature 7 (east pit)	0.40	0.20
5A	Feature 9 (west pit under wall)	0.50	0.40
5A	Feature 9 (west pit under wall)	0.40	0.30
5A	Feature 9 (west pit under wall)	0.80	0.40
5A	Feature 9 (west pit under wall)	0.35	0.20
5A	Feature 9 (west pit under wall)	0.50	0.30
5A	Feature 9 (west pit under wall)	0.40	0.30
5A	Feature 9 (west pit under wall)	0.60	0.40
5A	Feature 9 (west pit under wall)	0.50	0.20
5A	Feature 9 (west pit under wall)	0.70	0.30
5A	Feature 9 (west pit under wall)	0.40	0.25
5A	Feature 10 (north pit)	0.70	0.40
1B	S16W4, 51-58 cm and floor	0.80	0.35
1B	S16W4, 51-58 cm and floor	0.90	0.40
	Mean dimension	0.60	0.32

Table 7.6. Metric Dimensions of Kernels.

Room	Provenience	Kernel Type	Width	Thickness	Height	Comments
1A	SE 1/4, Level 5	degermed	.8	.4	.7	
1A	Trench B	degermed	.8	.6	.7	fused
1A	Burned floor near hearth	degermed	.9	.6	.8	undented
1A	Burned floor near hearth	degermed	.7	.4	.7	undented
1A	Burned floor near hearth	degermed	.7	.5	.6	undented
1A	Feature 14, fire hearth	degermed	.8	.6	.7	
1A	Feature 14, fire hearth	degermed	.75	.5	.7	
1A	Feature 11, pit west of hearth	degermed	.8	.5	.6	
1A	Feature 11, pit west of hearth	degermed	.7	.5	.4	
1A	Feature 11, pit west of hearth	whole	.8	.6	.8	warped
1A	Feature 13, Level C	degermed	.83	.5	.76	
1A	Feature 13, Level C	whole	.9	.5	.7	undented
1A	Feature 13, Level C	whole	.8	.5	.8	undented
1A	Feature 13, Level C	degermed	.8	.5	.7	
3A	Level 1, 0-10 cm	degermed	.6	.55	.6	undented
5A	Artificial Level 4, 58-65 cm	degermed		.6	.5	nearly whole
5A	Feature 6 (center pit)	degermed	.9	.5	.7	
5A	Feature 6 (center pit)	degermed	.6	.5	.7	
5A	Feature 8 (south pit)	degermed	1.0	.5	.7	undented
5A	Feature 10 (north pit)	degermed	.8	.5	.7	
5A	Feature 10 (north pit)	degermed	1.0	.5	.9	
5A	Feature 10 (north pit)	degermed	.7	.5		
1B	Eastern 1/3 of room at floor	degermed	.75	.5	.85	undented
1B	Eastern 1/3 of room at floor	degermed	.95	.65	.6	undented
1B	Eastern 1/3 of room at floor	degermed	.75	.65	.6	undented
1B	Above floor	degermed	.8	.4	.7	
Area 7	S10E4, Level 4, 30-41 cm	degermed	.7	.4	.5	
			.79	.52	.68	Mean dimensions

Corn is associated with both the early and late houses. Different types or varieties are present as indicated by the 8 to 14 row cob samples; however, no clear pattern is evident between the two houses. All varieties are present in the rooms and features from each occupation period. Although the species or variety is not known, cob, cupule, and kernel data imply that corn cultivation was being practiced at least some of the time by these people.

In addition to corn, one bean cotyledon was recovered from a depth of 20 to 28 cm in the northwest corner of Room 1A. Unfortunately, the site was not excavated with a focus on ethnobotanical results, and the analyzed samples do not reveal any other carbonized domesticates or wild plants. For plant materials to be preserved as carbon, 250 to 500°C temperatures with low oxygen are required for carbonization (Hard et al. 1996:270). Because corncobs were sometimes used for fuel after the edible portions had been removed, they are often preserved. Squash (*Cucurbita* sp.), on the other hand, has a high moisture content and is not useful as a fuel and is less likely to be preserved. Although it was not recovered at Two Sisters, Green (1986:94) mentions the presence of squash at other Antelope Creek phase sites in the Texas panhandle. Other wild plants, such as amaranth (*Amaranthus graecizans*) and prickly pear (*Opuntia macrorhiza*), were probably used, but were either not preserved or not collected in sediment samples during the excavation. According to Lintz (1997b:14), "only on rare occasions were sediment samples collected, and usually these were mostly not sampled for the potential to recover plant remains." Because of the lack of data about wild plants, the use of specific non-domesticates can only be speculated for the Two Sisters site.

Horticultural Tools

Indirect evidence of horticulture and the suggested level of maize dependence can be estimated by the size of the recovered grinding stones or manos. The relative size of mano grinding surfaces provides a means of assessing the level of horticulture because it has a direct correlation with the amount of time and energy necessary to successfully grind corn. The larger the mano area, the less time needed to process corn (Hard et al. 1996:263-264). Hard and others (1996:259) use ethnographic data and correlates mano area with agricultural dependence and suggest that groups with little or no agriculture had mano areas with a mean of 107.4 cm^2. Moderate levels of horticulture produced mano surface areas of 142 cm^2, while high levels of agricultural dependence had mean mano areas of 192.1 cm^2. Studies in the Southwest indicate that as agricultural dependence increased, mano size also increased (Hard 1990:147).

Hard and others (1996:280-281, 284) compared macrobotanical remains, stable carbon isotope, and mano data for Antelope Creek phase sites and suggested that because the mano size was small and maize ubiquity (proportion of all sediment samples that contained maize) was low, maize dependence was minor. Using this methodology for mano length and area and applying it to the Two Sisters site data enables inferences to be made concerning the level of farming. The mean area for the 14 complete manos is 117.23 cm^2 and the mean length is 12.67 cm. The proportion of large manos (over 15 cm) to the total number recovered is low (21%). If the correlation between mano area and length and level of horticultural dependence is reliable, then the occupants of the Two Sisters site had only a minor level of maize use. Their primary mode of subsistence was probably hunting and gathering.

Horticultural bone tool quantities also hint at a low reliance upon horticulture. Only 3 fragmented bison scapula hoes and 2 complete and 11 fragments of bison tibia digging sticks were recovered. These tools represent less than 2% of the total tools recovered. Apparently, either the horticultural tools were left in the field and not brought back to the site or the dependence upon horticulture was not as great as that of hunting and gathering.

Data Related to Site Catchment Analysis

A site catchment analysis was conducted by examining the available resources within a 5 km radius from the site location. Within this radius, which represents the area of greatest activity for the inhabitants of the site, most resource exploitation was conducted. Rather than a limit, this area is most effectively seen as a locus, within which most site-related activity occurred.

The model includes data related to horticultural resources based on soil type, available lithic resources, and resources from the various biotic habitats. By applying the model, actual resources exploited are mapped onto the proposed 5 km catchment area to delineate the resource base and land use strategy.

Horticultural Constraints based on Available Soils

The most suitable soil available for horticulture is limited to the Spur soil along the Beaver River. Within the 5 km radius of the Two Sisters site, there are about 206 ha (510 acres) of this soil type available (Figure 7.1). As discussed in Chapter 4, this is generally seen as the maximum radius beyond which a horticultural strategy would not be cost effective. It is likely, however, that due to the time and energy involved in dry-farming production - tilling, planting, weeding, harvesting, transportation, and processing - a core area within 1 km of the site is a more cost effective estimate. Six ha (15 acres) of Spur soil occur within 1 km of Two Sisters. Will and Hyde (1917, cited in Dallman 1983:43) provide information about yields of native Indian corn for the Upper Missouri tribes during the years 1867-1878. During this time, the average yield was 20 to 30 bushels per acre. If the average yield on the northern Plains is 20 bushels of corn per acre, the estimated yield for the Oklahoma panhandle in an environment that is becoming consistently cooler and drier should be significantly lower. In fact, Schroeder (1999:510; 2001:518) argues that yields for groups without plows for subsistence consumption were probably closer to 10 bushels per acre.

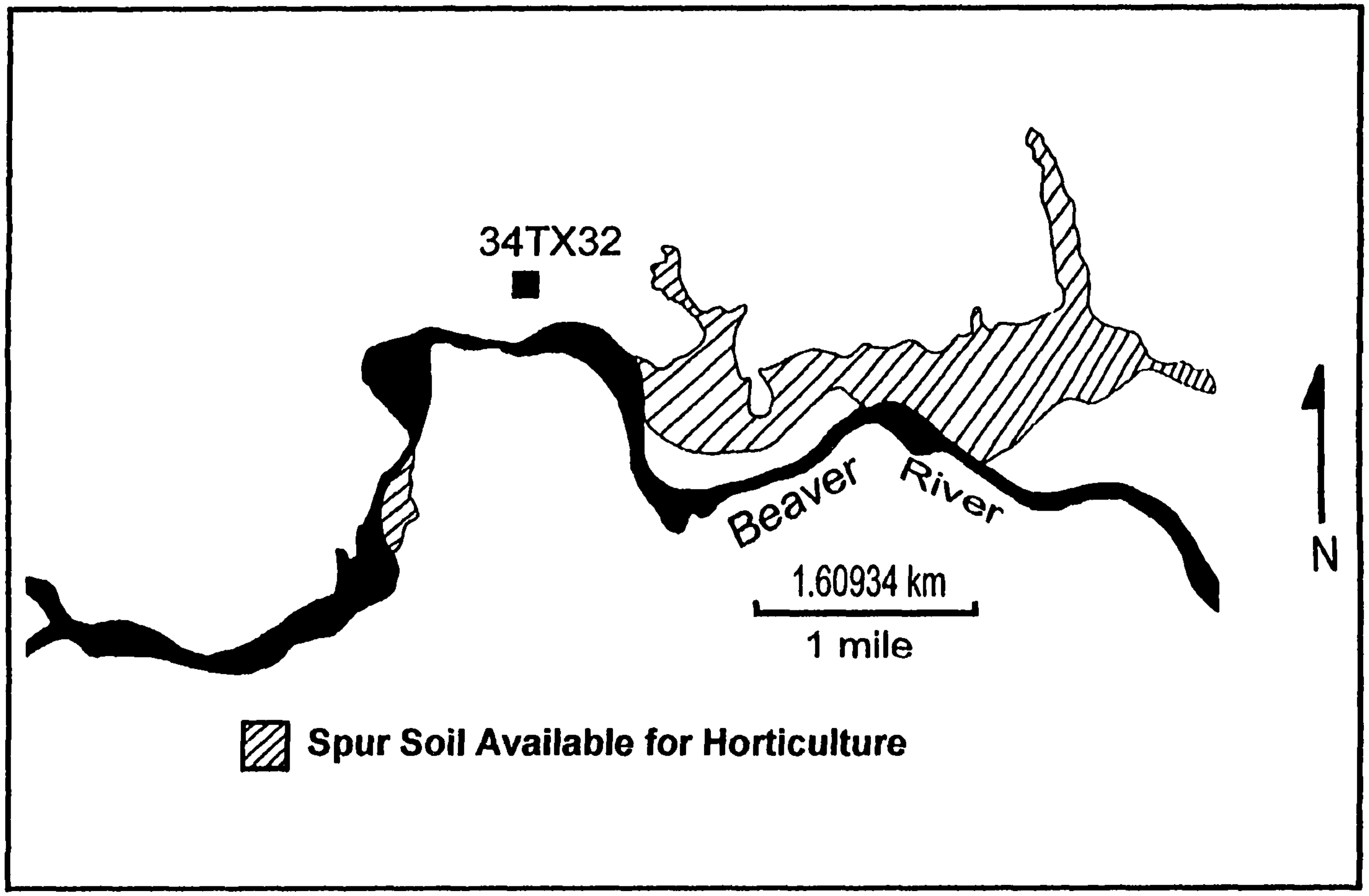


Figure 7.1. Spur Soil Within Five Kilometers of 34TX32.

Therefore, for purpose of this analysis, a highly conservative estimate of 10 bushels of corn per acre is used. Schroeder (1999:510) has calculated that the maximum workable size garden is about .24 ha (.59 acres) per four to five individuals in groups without plows. If the number of calories provided by a bushel of corn is estimated at 88.6 kcal (Watt and Merrill 1963), .24 ha (.59 acres) of suitable soil, producing 10 bushels of corn per acre per year, should yield approximately 523 kcal.

However, in order to calculate the number of calories needed and the area of probable cultivation, population estimates must be determined. One method of calculating population is based on house size. Wedel (1979:94) argues that population approximations for the Central Plains Tradition should be estimated at one individual per 5 m^2 of floor space. Dallman (1983:30) estimated the population of a Plains Village site in Iowa by using Brose's calculation of one person per 3 m^2 of floor space (Brose 1970:38-39). If Brose's figure is used for the houses at Two Sisters, which have a main room size of 36.23 m^2 (Room 1A - late house) and 35.09 m^2 (Room 1B - early house), then the population is estimated to have been 12 individuals for each house. Calculations using Wedel's figures would be only seven individuals per house; a number that seems too low for Two Sisters. No additional structures are associated with this isolated homestead and the two structures were not occupied simultaneously, so for this analysis, the estimate of 12 applies to either occupation.

Having estimated the population as 12 inhabitants, the number of calories needed to sustain them can be calculated. For a Plains Village population with a mixed economy of hunting and gathering supplemented by horticulture, Dallman (1983:29) estimates an average of 2,400 calories per person. This figure is based on 3,000 calories for each male, 2,400 calories for each female, and 2,000 calories for each child. If there are 12 individuals living at Two Sisters and each requires 2,400 calories per day, then the daily minimum caloric requirement is 28,800 calories or 28.8 kcal. The annual subsistence requirement would be 10,512 kcal.

Before calculating the number of calories obtained from corn, a brief analysis of the human diet and its constraints must be considered. Humans require a mix of carbohydrates, fats, and protein in order to survive. Earlier, it was demonstrated through analysis of diet breadth that the occupants of the Two Sisters site subsisted on a diet high in animal products. Habicht-Mauche et al. (1994:299) point out that the upper limit of meat intake at times of scarcity of other food resources is between 20 and 40 percent. Higher percentages of meat, such as those over 50 percent, eventually result in death from protein poisoning.

Stable carbon isotope analysis of human bones from other Antelope Creek phase sites, indicate that 85% to 90% of the diet consisted of maize, bison meat, prickly pear cactus, and amaranth (Habicht-Mauche et al. 1994:300). Because all of these have a C_4 signature in bone, the relative weights of each need to be estimated. If 70% of the total caloric intake is from plants (7358 kcal) and 30% (the mean between the maximum of 40% and the minimum of 20%) is from meat (3154 kcal), then the amount of food other than meat in the diet can be estimated.

If, for example, 50% of the plant food consumed at Two Sisters is from corn, then about 3679 kcal of corn would be needed each year. The required acreage to produce this quantity of corn (about 42 bushels) is approximately 1.2 ha (3 acres). Using Schroeder's (1999:510) estimate of four to five people tilling a maximum workable size garden of .24 ha (.59 acres) and given that the number of individuals at Two Sisters was most likely 12 (a probable extended family), the total estimated garden size necessary to support them would be .72 ha (1.77 acres) or about half of the 1.2 ha (3 acres) needed. Therefore, while a sufficient amount of Spur alluvial soil was present to produce the needed corn, there were not enough people to do the labor.

In addition, environmental conditions may have been too dry for dependable yields of corn. As pointed out in Chapter 2, climatic reconstructions indicate drought conditions during part of the growing season. Required amounts of precipitation at the right time of the year for horticultural pursuits most likely were not available. Wild resources would have been needed to complete the diet.

Lithic Resources

Lithic materials comprise a large percent of the artifacts from the Two Sisters site. Approximately 7,600 specimens were analyzed for material type and distance from their source area. These figures were then compared with the site catchment area for percentages of local versus non-local procurement. Fifteen different kinds of lithic material were used to produce the 6,516 chipped stone specimens (Table 7.7). The 1159 ground stone items consist of at least eight different material types (Table 7.8).

Non-local Tool Stone

The chipped stone assemblage comes from a much larger catchment area than the modeled 5 km (Figure 7.2). Almost 90 percent of the specimens (89.5%) are of non-local origin. The majority of these (76.6%) are Alibates Agatized Dolomite. The primary source of Alibates is about 135 km south of the Two Sisters site (Banks 1990:91). Antelope Creek phase groups occupying and controlling the Alibates source area are probably related to the groups in the Oklahoma panhandle. This relationship, in addition to the high quality material, may be the reason for such a high percentage.

Acquisition of this chert may have been through trade or by organized task groups engaging in direct procurement. Binford (1983:344) contends that small groups leave residential sites with the purpose of acquiring resources, such as tool stone, and transporting them back to the residential

Table 7.7. Chipped Stone Source Materials at the Two Sisters Site.

	Alibates	Nio-brara	Tesesquite Qrtz.	Tecovas	Unid. Chert	Unid. Qrtz.	Edwards	Opalite	Day Crk	Dakota Qrtz.	Ogallala Qrtz.	Basalt	Mosquito Jasper	Obsidian	Petri. Wood	Total
Projectile Points (all)	160	9	2	15	21			8	3			3				221
Diamond Beveled Knives	20	1	1	1	4											27
Bifaces	8	2			2				1	2					1	16
Misc Biface Frags	63		3	1	9	1		6	1	1						85
Drills/Borers	32	1		1	1	1	1	1								38
Side Scrapers	47				1			1	2						1	52
Guitar Pick Scrapers	43		1	2	1			2								49
End Scrapers	44	1							1							46
End Scraper/ Graver	4															4
Scraper Fragments	135	3	1		10			3		2						154
Cores	7		1	1	2					1	1					13
Modified Flakes	189	8	4	8	16			4	7	1	1		1			239
Unmodified Flakes	4239	117	255	44	346	150		67	57	247	41		4	3	2	5572
Total lithics	4991	142	268	73	413	152	1	92	72	254	43	3	5	3	4	6516
Total lithics by percent	76.6	2.2	4.1	1.1	6.3	2.3	0.02	1.4	1.1	3.9	0.7	0.05	0.08	0.05	0.06	100.0
Rounded Percentages	77	2	4	1	6	2	<1	1	1	4	1	<1	<1	<1	<1	99

Table 7.8. Ground Stone and Boiling Stone Source Materials at the Two Sisters Site.

	Sandstone	Quartzite	Caliche	Basalt	Limestone	Hematite/Limonite	Misc.	Selenite	Totals
Manos	46	14							60
Metates			32						32
Abraders	30			1					31
Pipes					2				2
Painted Stone	3	1	3						7
Hammerstones	1	35							36
Boiling Stones	175	305	163	3			46		692
Cobbles		17							17
Pigment						80			80
Crystals								4	4
Anvils/Battered Stones	1	2							3
Blocky Debris	41	83	18				53		195
Totals	297	457	216	4	2	80	99	4	1159
Source	Local	Local	Local	Non-Local	Local	Local	Local	Unknown	

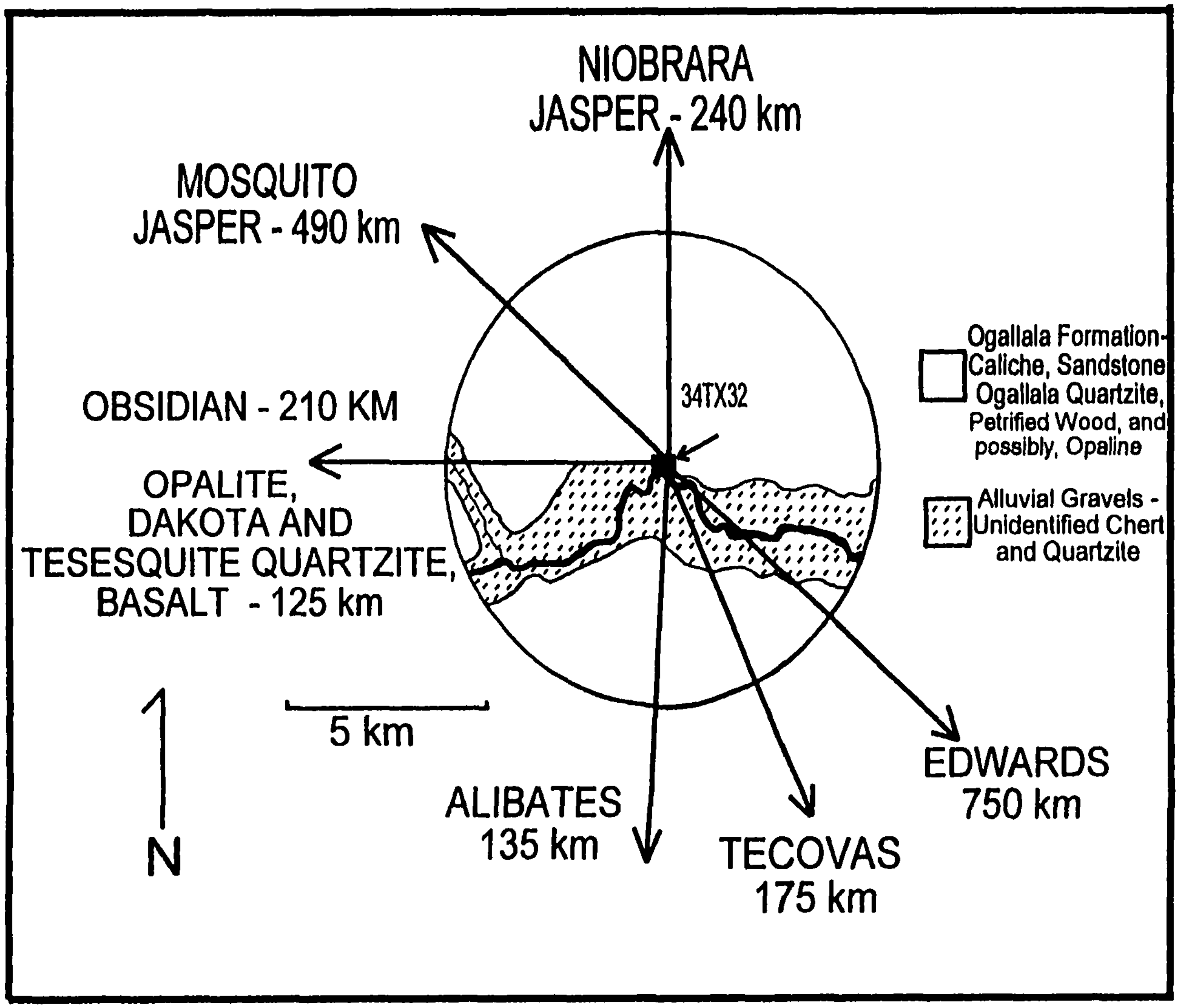


Figure 7.2. Geologic Catchment Area for 5 km Radius.

camp. Stone acquisition may also be included in excursions to procure other resources. Due to the high percentage of Alibates, people from the Two Sisters site were likely traveling south with the primary goal of tool stone acquisition. Bison hunting or procurement of other resources, however, may have been an embedded strategy with tool stone acquisition.

The presence of other non-local lithic materials suggests ties to the west. Approximately 9.5% of the chipped stone is from the Black Mesa area 125 km west of Two Sisters. Materials from this area are primarily quartzites, Tesesquite and Dakota, from either the Morrison or Dakota formations (Banks 1990:94). The Kenton Opalite and Pliocene basalt are also probably from this area (Banks 1984:72), although Banks (1984:71-72) mentions an Opaline chert from the Ogallala Formation outcropping east of Guymon. What has been identified as "Kenton Opalite," from comparative lithic samples in this analysis, may actually be Opaline and occur locally. Opalite, however, only comprises 1.4 percent of the chipped stone assemblage.

Additional non-local chipped stone specimens at Two Sisters are Niobrara jasper, also known as Smoky Hill jasper. The principal area of the chert-bearing Smoky Hill Member of the Niobrara Formation is in Kansas north of the Great Bend of the Arkansas River. Other outcrops are found in western Kansas and Nebraska and eastern Colorado and Wyoming. According to Banks (1990:96), the chert is found "where the Ogallala

Formation overlies and is in direct contact with the Smoky Hill" Member of the formation. Banks (1990:96) describes the chert formation process as similar to Alibates with the chert resulting "from silica replacement of chalk in the uppermost levels of the formation" or in other words, silicified chalk. The Niobrara jasper materials hint at ties to the north-northeast because the prime material source is 240 km from Two Sisters. Several tools and numerous flakes are of Niobrara jasper and this material type makes up 2.2 percent of the chipped stone assemblage.

Tecovas jasper occurs fairly infrequently at Two Sisters, making up only 1.1 percent of the chipped stone. Based on the comparative lithic collection at the Oklahoma Archeological Survey, the source is 175 km south of the site in the Texas panhandle. Banks (1984:72) mentions the possibility of small outcrops in the central part of Texas County, Oklahoma. Because of this possibility, Tecovas at the site may be of local origin.

Mosquito jasper is a northwestern source that outcrops in Chaffee County in central Colorado about 490 km from Two Sisters. Under magnification, the five specimens from Two Sisters appear to be identical to samples in the comparative collection at the Oklahoma Archeological Survey. However, due to the extreme distance and lack of anything but small flakes, this material is of questionable origin.

Only one tool is manufactured from the central Texas Edwards chert source at Georgetown, the most distant lithic source utilized at Two Sisters.

It is an oval based drill fragment that was recovered from the first level of a test unit east of the structure near an external hearth. The Georgetown variety of Edwards chert occurs 750 km southeast of the Two Sisters site. This tool most likely arrives through trade; however it may be a recycled tool from an older site as this material was highly prized by Folsom and other Paleoindian groups frequenting the southern Plains (Hofman 1991:343).

The only lithic ties to the Southwest are three small biface thinning flakes of obsidian. Although the specific origin has not been identified, the suggested source of obsidian or volcanic glass is 210 km west in the Jemez Mountains of New Mexico (Banks 1990:66-70). This material probably originates from trade.

Local Tool Stone

Local chipped stone use consists of Ogallala quartzite, Day Creek Dolomite, unidentified chert and quartzite, and petrified wood. These materials make up only 10.46% of the chipped stone assemblage and occur within the 5 km catchment radius. Clearly, the source areas of the chipped stone materials verify a much larger catchment area.

Sources of ground stone tools (including boiling stones) at the Two Sisters site make up 13% of the total lithic assemblage. Unlike the chipped stone, this category's potential sources have a greater concurrence with the modeled catchment area. Over 99% of the recovered ground stone and boiling stones are of local origin and, most likely, were only transported about 1 to 2 km. The only exceptions are the igneous basalt pieces that probably came from the Black Mesa area (Banks 1984:72) about 125 km west of Two Sisters. There are four pieces of basalt - one abrader and three boiling stones. As Table 7.8 indicates, the majority of the recovered materials in this category are natural cobbles used as boiling stones. It is not unexpected that these would be primarily of local origin.

Although not removed from the site, the other important stone utilized by the occupants of Two Sisters is caliche. According to Lintz (1972, unpublished field notes), all of the stone slabs used for the structural foundation are caliche. Caliche or "caprock" is a mixture primarily of calcium carbonate that has cemented or hardened through time as a result of soil formation processes (Boyd 1997:9-11). Outcrops of caliche occur within 1 km of the site and were probably an important consideration in settlement location decisions.

Application of the lithic resources to the site catchment model shows that although many local resources were utilized, the primary lithic materials were acquired from more distant sources. Caliche was probably the most important geologic resource near the site and Alibates the most important non-local resource.

Biotic Resources – Floral

Site catchment analysis of the biotic resources within the three identified habitats (Bottomlands, Breaks, and Uplands) includes the actual plants and animals utilized by the inhabitants of the Two Sisters site. Unfortunately, economically useful wild plant remains were not recovered and plant use is restricted to the domesticates of corn and beans discussed earlier. If the modern edible wild plants for this biotic zone were present in the late fourteenth and early fifteenth century, then the catchment area of 5 km would include 31 different species. Based on Table 2.3, 26% would occur in the Bottomland, 41% in the Breaks, and 33% in the Uplands. Although speculative, it is likely that the occupants of the Two Sisters site were relying on at least a few of these species.

Analysis of recovered wood charcoal indicates that local trees were used for building materials and fuel for fires. Species identified are Cottonwood (*Populus deltoides*), Hickory (*Carya* sp.), Sycamore (*Plantus occidentalis*), Oak (*Quercus* sp.), Elm (*Ulmus* sp.), and Hackberry (*Celtis occidentalis*). These species occur locally (within 5 km) as part of the Bottomland biotic zone.

Biotic Resources - Faunal

Faunal remains from the Two Sisters site demonstrate the use of numerous species of animals from all three biotic zones (Figure 7.3). As Table 7.1 indicates, bone from the analyzed features was speciated when possible and further classified into categories of mammals, reptiles, amphibians, fish, birds, and mussels. The majority of the bone (90 to 94%) was extremely fragmented and could not be identified beyond

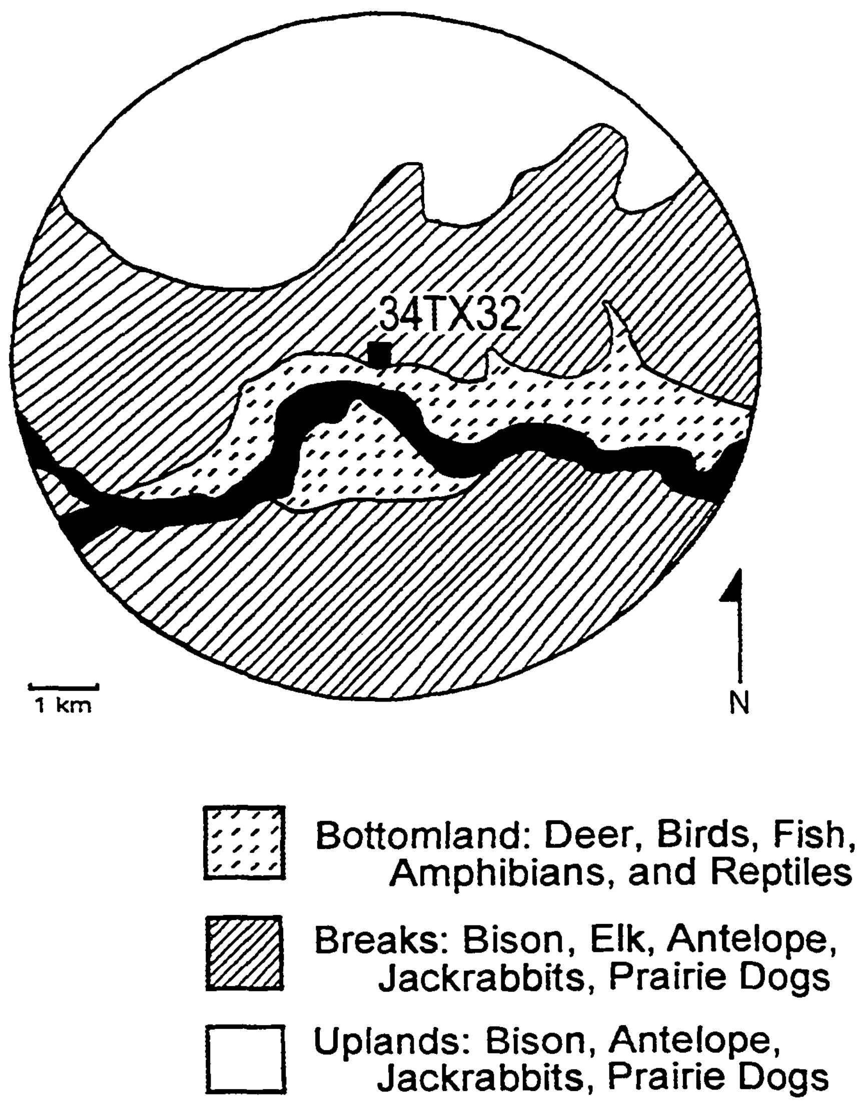


Figure 7.3. Biotic Resource Catchment for 5 km Radius.

differing sizes of mammal. The unidentified mammal category was sub-divided into large (bison-, elk-, bear-, and horse-size animals) weighing between about 900 kg (2000 lbs) and 90 kg (200 lbs), medium (deer-, pronghorn-, mountain lion-, and human-size animals) weighing between about 136 kg (300 lbs) and 36 kg (80 lbs), small (gray wolf-, coyote-, dog-, beaver-, badger-, and raccoon-size animals) weighing between 45 kg (100 lbs) and 3 kg (7 lbs), and very small mammals (skunk-, rabbit-, prairie dog-, gopher-, rat-, and mouse-size animals) weighing less than 4 kg (8 lbs). Most of the bone from the site falls into these categories.

A small percentage of bone was identifiable by element and side and from these, a minimum number of individuals (MNI) by species was calculated. The element, side, and part of the bone that occurred with the highest frequency was used to determine the MNI. When possible, age was also used for MNI. Table 7.1 provides the MNI per feature analyzed and Table 7.9 presents the total MNI for the site.

Although the majority of the bone is fragmented and unidentifiable, the site assemblage contains a wide variety of animals. In total, the analyzed features contained 40 different species that represent all three different biotic habitats. The habitats most important for hunting were the Uplands and Breaks. Bison, pronghorn, jackrabbits, and prairie dogs subsist in the short grasses of these two biotic regions. Elk are an additional prey from the Breaks region. The riparian Bottomland habitat is the most diverse.

Table 7.9. Total Minimum Number of Individuals (MNI) for the Site.

	Number	Weight	(MNI)
Mammals			
Bison (*Bison bison*)	344	4233.0	5
Horse (*Equus caballus*)[1]	1	9.8	1
White-tailed Deer (*Odocoileus virginianus*)[2]	75	333.1	2
Pronghorn (*Antilocapra americana*)	109	296.8	7
Coyote (*Canis latrans*)	10	33.8	2
Badger (*Taxidea taxus*)	4	15.1	1
Black-tailed Jack Rabbit (*Lepus californicus*)	26	14.7	2
Eastern Cottontail (*Sylvilagus floridanus*)	15	7.3	3
Desert Cottontail (*Sylvilagus audubonii*)	1	1.9	1
Black-tailed Prairie Dog (*Cynomys ludovicianus*)	35	17.7	3
Plains Pocket Gopher (*Geomys bursarius*)	80	38.7	8
Ord's Kangaroo Rat (*Dipodomys ordii*)	17	4.1	3
Hispid Cotton Rat (*Sigmodon hispidus*)	6	1.2	3
Southern Plains Woodrat (*Neotoma micropus*)	5	1.3	1
Thirteen-lined Ground Squirrel (*Spermophilus tridecemlineatus*)	1	0.1	1
Unidentified Large Mammal	6845	4723.1	-
Unidentified Medium Mammal	2337	847.3	-
Unidentified Small Mammal	92	21.7	-
Unidentified Very Small Mammal	145	25.7	-
Mammal Subtotal	10,148	10,626.4	43
Reptiles			
Western Box Turtle (*Terrapene ornata*)	933	544.9	18
Softshell Turtle (*Trionyx sp?*)	8	11.7	2
Common Snapping Turtle (*Chelydra serpentina*)	91	49.9	2
Yellow Mud Turtle (*Kinosternon flavescens flavescens*)	2	1.7	1
Red-eared Turtle (*Pseudemys scripta elegans*)	27	12.5	2
Unidentified Turtle	25	5.7	-
Water Snake (*Natrix sipedon*)	7	1.4	2
Western Coachwhip (*Masticophis flagellum testaceus*)	5	0.6	1
Prairie Rattlesnake (*Crotalus viridis viridis*)	30	4.6	2
Unidentified Snake	6	0.9	-
Reptile Subtotal	1134	633.9	30

Table 7.9 (continued).

	Number	Weight	(MNI)
Amphibians			
Bullfrog (*Rana catesbeiano*)	45	8.5	12
Amphibian Subtotal	45	8.5	12
Fish			
Black Bullhead Catfish (*Ictalurus melas*)	89	18.3	6
River Carpsucker (*Carpiodes carpio*)	7	1.5	1
Unidentified Fish	8	0.9	-
Fish Subtotal	104	20.7	7
Birds			
Mallard (*Anas platyrhynchos*)	1	0.9	1
Redhead (*Aythya americana*)	6	2.2	2
Ring-necked Duck (*Aythya collaris*)	1	0.5	1
Canvasback (*Aythya valisineria*)	3	1.4	1
Bufflehead (*Bucephala albeola*)	2	0.9	1
Hooded Merganser (*Lophodytes cucullatus*)	1	0.4	1
Red-tailed Hawk (*Buteo jamaicensis*)	2	0.2	1
Common Snipe (*Gallinago gallinago*)	1	0.1	1
Long-billed Curlew (*Numenius americanus*)	1	0.7	1
Common Nighthawk (*Chordeiles minor*)	3	0.7	1
Belted Kingfisher (*Ceryle alcyon*)	1	0.1	1
Northern Oriole (*Icterus galbula*)	1	0.1	1
Northern Cardinal (*Cardinalis cardinalis*)	1	0.1	1
Perching Birds (*Passeriformes*)	1	0.1	1
Unidentified Birds	76	12.2	-
Bird Subtotal	101	20.6	15
Bone Total	11,532	11,310.1	107
Mussels			
Unidentified Mussels	46	40.7	1
Mussel Subtotal	46	40.7	1

[1] Anomalous from Pleistocene or from historic occupation.
[2] Possibly Mule Deer (*Odocoileus hemionus*), however bone not robust.

White-tailed deer are the primary prey, but birds, fish, amphibians, and some reptiles were also important. Western box turtles could have been collected from any of the three areas. Migratory ducks - Mallard, Hooded Merganser, Redhead, Canvasback, Ring-necked Duck, and Bufflehead - most likely were hunted in the Bottomland but could also have been visitors to the Upland playas. In short, the Uplands provided the highest ranked prey by usable meat weight, but the other two regions also supplied important animal resources.

Within the mammal category, bison are the most numerous species with an MNI of about two animals per feature. Bison are the highest ranked species in terms of usable meat, and they subsist on the short grasses of the Upland and Breaks habitat. Elk, another highly ranked species from the Breaks habitat, are only represented by specimens of antler. It is possible that the antler was collected as shed pieces and brought back to the residence to make tools, but some of the large unidentifiable mammal bone may also be elk. Pronghorn, the other fairly significant Upland and Breaks inhabitant, are manifest in every feature. The last important mammal that is also found in every feature is the white-tailed deer. Because none of the bone was robust, it is classified as white-tailed deer rather than mule deer. This does not mean that mule deer are not present, only that the analyzed bone is more similar to white-tailed deer. Deer occupy the Bottomland habitat and would require a different hunting strategy than bison or pronghorn. Organized hunting groups are usually needed for bison procurement and pronghorn traps, while individual hunters are more successful with deer and smaller prey.

The faunal remains have a few anomalies that need to be addressed. Feature 24 contained one horse (*Equus caballus*) bone. Since horses were not in North America at this time, the bone is either from a Pleistocene mammal or an historic occupation. Either is possible because the site is on an old Pleistocene terrace and the feature had some disturbance by gopher activity. It could also be historic and be associated with the square fence posts (Features 19 and 26) and fence staples that are found near the surface. Again, gopher activity would have been responsible for the movement into the feature.

The other exception within the faunal collection is the small mammals that may be in features due to natural causes. These include burrowing types like gophers. Whether these animals were collected for food or whether they burrowed into the site and died is unknown.

In addition to information about habitat exploitation, a few of the species identified provide information about seasonality. Several of the identified birds, the Hooded Merganser, Redhead, Canvasback, Ring-necked-Duck, and Bufflehead, are transient and are only winter residents of the region. They generally arrive in the Oklahoma panhandle sometime in October to mid-November and return north the middle of March to the middle of May (Wood and Schnell 1984; Sutton 1967). Their presence in the faunal debris indicates a winter occupation of both structures. The Hooded

Merganser was in Feature 13, Level A. This feature is associated with the later occupation, Structure A. The Redhead is from the same feature but was recovered from Level B. The Canvasback, Ring-necked Duck, and Bufflehead are from Feature 13, Level C. Level B and C are below the clay cap and are most likely associated with the earlier Structure B. All are recognized as "diving ducks" (Peterson 1969:46-57) suggesting deep enough water in the Beaver River and upland playas to encourage their habitation.

Furthermore, a suggested spring occupation for both structures is evidenced in the bones of a newborn bison (Feature 13, Level A and C) and three fetal pronghorn (Feature 13, Level B and C). Horticultural crops provide additional information about seasonal occupation. Associated tasks related to horticulture occur from the spring through the fall.

Summer occupation is indicated by the presence of two migratory species of bird - the Common Nighthawk and the Northern Oriole (Wood and Schnell 1984). Both of these specimens are from Feature 13, Level C and are most likely associated with the earlier of the two structures, Structure B.

Based on the combined faunal evidence, the site was occupied year-round. The migratory waterfowl are winter residents, suggesting available prey between October and May. The newborn bison and fetal pronghorn indicate a spring occupation, the horticultural evidence reflects spring and fall activities, and the reptiles, amphibians, fish, and two species of migratory birds demonstrate a summer occupation.

Theoretical Results

A thorough analysis of the data from the Two Sisters site in terms of evidence of diet breadth and site catchment has revealed various components that are essential to the more general theoretical model. From these, the following observations can be made about the subsistence strategy of the inhabitants of the Two Sisters site.

First, from all data collected - including the site catchment and environmental data - it is evident that the inhabitants of the Two Sisters site were heavily dependent upon bison. The majority of faunal remains are bison and bison were probably in close proximity to the site. The site is in a location favorable for bison foraging. The tool inventory emphasizes bison hunting and processing. Furthermore, the absence of highly developed horticulture is obvious from the lack of tools and also because of environmental constraints. Because of caloric intake constraints, it is probable that the inhabitants of the site subsisted by supplementing bison primarily with wild plants and roots.

The fact that the site appears to have been occupied year round indicates that the inhabitants chose a central place foraging style, i.e., they constructed long-term shelter and foraged within relatively close proximity to that shelter. This strategy could only have continued if there was an abundance of resources, which, in turn, indicates a "steady state" patch model. On the other hand, the fact that the site appears to have been abandoned probably indicates that while early on there was an abundance of food, the foragers were required to travel farther and expend increasing amounts of energy, thus finally leading to a critical point at which the subsistence strategy changed. The nature of this change is unknown; however, it could be either a simple move to another patch or a complete change of strategy to a more nomadic form of life. Because no clear indications exist of the simple patch changing strategy, it is most likely that the inhabitants of the Two Sisters site began following bison as their food diminished, eventually leaving the central place behind.

From the perspective of the theoretical model, therefore, the inhabitants of the Two sisters site existed in an environment of moderate scarcity, ideal for the application of the prey-ranking approach to understanding what kinds of behavior most effectively addressed survival. Since bison were the predominate energy source, they would have developed a style of life based upon the rituals and practices of bison hunting. In addition, because of the necessity of obtaining carbohydrates, coupled with the sparse effectiveness of horticulture during the time of the occupation, they also would have practiced gathering. From these data, it is probable that the inhabitants had some social stock of knowledge through which this information was communicated through successive generations. Furthermore, the evidence of limited horticulture indicates that these individuals had some understanding of its practice, but chose, probably because of the nature of the environment, not to make it a central feature of their subsistence strategy.

If evidence from other Antelope Creek sites is considered, it is likely that the inhabitants relied upon horticulture early on in the occupation of the site and, probably because of declining precipitation, modified their subsistence strategy to rely less upon it. Lintz (1991:102; emphasis in original) believes that the Early Subphase had a stronger reliance upon horticulture than the Late Subphase and that the Late Subphase marks the "*beginning* of a decline in local production of cultigens and an increase in hunting." He bases this argument on the decline in bone horticultural tool densities in late Antelope Creek phase sites in the Texas panhandle. This reduction in horticulture may also provide a clue about why the Late Antelope Creek subphase inhabitants initially constructed more permanent structures, which would have been suitable for horticulturists and less so for hunter-gatherers. As the environment became less conducive to horticulture, the Two Sisters site occupants relied more on hunting and wild plants, which, because of the migratory nature of bison and the eventual depletion of natural resources, led to abandonment of the site in favor of a different subsistence strategy.

CHAPTER 8

SUMMARY AND CONCLUSIONS

The purpose of this study was to examine the subsistence and settlement strategies of a prehistoric group that lived in the Oklahoma panhandle about 600 years ago. The central hypothesis has been that if the occupants of the Two Sisters site were, in fact, "optimal foragers," then (1) the remains found, observed in relation to the basic model, will provide a reasonably accurate description of their subsistence strategy, which (2) will be consistent with the environment, climate, and site location. This hypothesis has been tested against the data throughout this work, from both the diet breadth and site catchment perspectives, and the evidence points to a story of a group of people who occupied this area in the Southern High Plains for perhaps 50-100 years.

These inhabitants initially adopted a "central place" foraging style; that is, they built fairly substantial dwellings and foraged around a central locus for food. Using what horticulture that the cool and arid environment would allow, they were forced to find and utilize wild plants to supplement their main food source –bison. In fact, as the environment around their dwellings became less abundant, they probably struggled to go farther and bring back necessary subsistence; however, at some point they abandoned their homes and became nomads, following the herds of bison across the plains.

This conclusion has been arrived at by careful examination of the artifacts, faunal, and floral remains recovered from the Two Sisters site. During this examination, characteristic patterns were discerned that showed evidence of a people's comprehensive approach to subsistence. Understanding this pattern has been the key to deciphering the behavior of an otherwise forgotten people. Like any study of incomplete data, scientific inferences necessitate a problematic approach and this study is by no means complete. Instead, through the lens of theory, evidentiary remains point toward probable paths of human existence — this is the domain of probability and inference that underscores the practice of archaeology.

I began this study by carefully analyzing the data in terms of anthropological models. The most viable model involves examining data from the perspective of the most basic human elements: those patterns of human behavior that are necessary for survival and tend to shape the emergence of social existence. The strength of this approach is that it relates the objective remains (archaeological data) to the lives of human beings who worked to live in their environment, reiterating the fact that human life does not exist in abstraction, but is inextricably interwoven as a creative process within the constraints and possibilities inherent in the surrounding world. As such, the enduring message of this study is one of environmental compatibility, i.e., only by living within the viable possibilities of an environment can a group of people (or a civilization for that matter) survive. Inhabitants of the Two Sisters site survived until the demands of the environment likely forced them to adopt a new subsistence strategy and move away.

The first piece of this puzzle was a careful and comprehensive analysis of the environment. As Chapter Two explains, the Oklahoma panhandle has a comparably flat terrain with topographical deviation found in the eroded rivers and tributaries. These rivers and tributaries, combined with seeps and springs from the Ogallala aquifer along with rain, produced the only water available to the occupants. Rain showers filled the inland lakes or playas that slowly drained into the soil or evaporated. The availability of water was a critical element in this arid environment.

Paleoclimatic reconstructions suggest that during the occupation of the Two Sisters site, the annual precipitation continued to decrease from a high of about 580 mm to a low of about 420 mm. Evapotranspiration rates ranged from about 810 mm to 760 mm and basically eliminated any effective precipitation. Temperatures were on a downward trend, resulting in a cool and dry climate. The various climatic models, outlined in Chapter 2, all indicate that beginning about A.D. 1000 to 1100 the entire panhandle area began to experience a cooler and drier climate with the peak in aridity at about A.D. 1500.

This environmental reconstruction has been critical to understanding subsistence strategies of the Two Sisters site occupants. Temperature and precipitation impacted not only the plants, whether domesticated or wild species, but also the fauna that depend upon them. What is available as a subsistence resource is integrally dependent upon the landscape and the climate. Small changes in the environment can mean the difference between whether a species thrives, merely subsists, or dies out.

Placement of these people on the landscape and within a reconstructed environment is only one piece of the puzzle. Another important foundational piece is their culture history. The culture history, as outlined in Chapter Three, details the human background of the area and the subsistence and settlement practices of the direct ancestors of Two Sisters site occupants, the Woodland phase occupation. By outlining this history, it is clear that the people known as the Antelope Creek phase did not just appear, but rather had a deep-rooted cultural history that was most likely laden with practices and knowledge about subsistence.

In addition to the people before them, consideration has been given to the archaeological remains of people who came after them. Since nomadic hunters and gatherers are the predominate occupants after the abandonment of the stone structures, it is likely that the inhabitants of the Two Sisters site changed their subsistence strategy to a nomadic existence. Perhaps they were pushed south by Athapaskan speakers (Baugh

1994:285) and became part of the Garza complex.

Given the environmental and cultural background, it was necessary to consider the site from a scientific perspective, which entailed finding a firm theoretical foundation. In Chapter Four, the evolutionary ecological approach was selected and an optimal foraging model developed that incorporated analyses of many variables from the perspective of diet breadth and site catchment. The diet breadth model provided a base for hypotheses about behavioral decisions to maximize fitness and shape subsistence behaviors. The strength of this model is that it incorporates the dynamic interaction of environmental factors with technology and social organization, as evidenced in recorded material remains, and provides clues about the ranking of prey and the choice of subsistence strategy. A site catchment analysis was included to emphasize the connection of individuals to their environment, because the "site" is not just lithics and bones, but also the surrounding landscape within which inhabitants face scarcity or abundance and within which viable choices about subsistence are made. By identifying the resource base and delineating land use strategy, information about what was available within a reasonable distance of the Two Sisters site was examined. Comparing the available resources with what was actually used gives insight into the foraging behavior of the Two Sisters site occupants.

In Chapter 5, a thorough description of the site excavation was given. While this site was excavated in 1972 and 1973, operations were conducted without the benefit of the excavators knowing some of the theoretical concerns that are used in the present study. Consequently much evidence, such as biotic-floral remains, may have been overlooked. On the other hand, the methods used to excavate the Two Sisters site were standard archaeological methods and provided valuable faunal remains and sufficient information to apply the current theoretical approach to its analysis.

Having established the environmental setting, culture history, theoretical framework, and the excavation methodology, the materials collected were described in Chapter Six. While the majority of the roughly 99,000 items were bone fragments (89,048), the remainder consisted of chipped and ground stone, daub, modified bone and shell, unmodified shell, human remains, and botanical remains (Table 8.1). Each of these was analyzed separately by category. Categories consisted of stone, clay, bone, shell, floral and historic items. As Table 8.1 indicates, Structure A (Rooms 1A, 2A, 3A, and 5A) clearly contained a much greater percentage of the total recovered material from the site than did Structure B (Room 1B). Structure A apparently was not cleaned out prior to burning and abandonment. Structure B was basically empty. The exterior excavation units, especially those to the north of the structure, also had an abundance of discarded trash and abandoned materials.

Table 8.1. Provenience of Artifacts to Areas.

MATERIAL	Rm 1A	Rm 2A	Rm 3A	Rm 5A	Rm 1B	Area 6	Area 7	Surface	Exterior	Total
CHIPPED STONE										
Points										
Fresno	10	4	3	6			4	3	33	63
Washita	13		2	7	4		3	2	18	49
Harrell			2				1		1	4
Huffaker-like	2			1			1		2	6
Scallorn									2	2
Shetley	2									2
Corner notched Dart									1	1
Ceremonial Point	1									1
Fragments	26	3	11	9	4	1	3	3	33	93
Bifaces	6			2	1				7	16
Biface Fragments	29		2	9	3	1	6	5	30	85
Beveled Knives	1			1	1				2	5
Fragments	12		3	3	1				3	22
Scrapers										
End	10		1	5	2		2	1	8	29
Guitar	7	1	1	5	2		3		11	30
Side	10	6	4	9	2		2	1	16	50
Fragments	68	5	12	22	12	1	8	6	58	192
Endscraper/Graver	2								2	4
Drills	4		1	1	5				4	15
Fragments	3		2	1	2	1	1		13	23
Cores	5			2	1				5	13
Modified Flakes	68	4	16	34	18	1	16	2	80	239
Unmodified Flakes	1376	121	491	632	503	49	211	19	2170	5572
Blocky Debris	81	1	18	27	10	3	15		40	195

Table 8.1 (continued).

MATERIAL	Rm 1A	Rm 2A	Rm 3A	Rm 5A	Rm 1B	Area 6	Area 7	Surface	Exterior	Total
GROUNDSTONE										
Mano	12	2	4	16	4			1	23	62
Metate	12	1	2	4	10				5	34
Abraders	12		1	7	2		1	1	7	31
Stone Pipe	1								1	2
Obsidian					1	1			1	3
Painted Stone	1		1				1		2	5
Hammerstones	8		1	3	5			1	18	36
Cobbles/Boiling Stones	230	10	43	86	44	12	28		235	688
Choppers					1				1	2
Hematite/Limonite	39	3	13	5	7		2		11	80
Selenite Crystals/Fossils	4		1							5
Ceramics										
Sand tempered	144	13	46	126	28	7	36	17	708	1125
Shell tempered	2			1				2	25	30
DAUB	129		6	40	78		16		19	288
MODIFIED BONE										
Tibia Digging Stick				2			1	1	9	13
Scapula Hoe	2			1						3
Awl	5		4	3	5		2		15	34
Rib Rasps	4				1					5
Miscellaneous Tools	7			7					9	23
Beads	2									2
Miscellaneous Modified Bone	25	1	6	8	3		1	1	5	50
Painted Bone	1		1				1		2	5
UNMODIFIED BONE	19775	2111	13241	19590	2771	833	5698	2	25027	89048

Table 8.1 (continued).

MATERIAL	Rm 1A	Rm 2A	Rm 3A	Rm 5A	Rm 1B	Area 6	Area 7	Surface	Exterior	Total
MODIFIED SHELL										
Scrapers	2			2	1		1		4	10
Pendants	1								2	3
Containers (?)	1			1		1			1	4
Disc Bead				1			1	1		3
Olivella Bead	2			3					3	8
UNMODIFIED SHELL										
Unid.Fragments	112	20	38	91	24	2	44		256	587
Identifiable Frags.										
HUMAN REMAINS (indiv)				1					1	2
PLANT REMAINS	212	1	4	53	68		1			339

In addition to more debris, Structure A had a different architectural style than Structure B. Stone slabs of caliche were placed vertically and covered with daub forming a foundation for the walls in the later structure, Structure A. Structure A also contained four separate contiguous rooms - one living area, two storage areas, and one processing area. An eastward extended entry separated two of the satellite rooms. The earlier structure, Structure B, was not constructed with a stone foundation. Apparently, it had adobe walls with a timber and grass-thatch roof. The predominant item found in Structure B was charcoal from the burned timbers of the roof and possibly wall supports. Artifacts were scarce, indicating that the occupants had intentionally cleaned it out prior to burning it. Structure B also had an eastward extended entry that continued under the west wall of Structure A, demonstrating earlier occupation. Unlike the later house, Structure B contained only one room.

Chapter Seven contains the theoretical results of this study. Broadly, application of the theoretical model linked with environmental reconstruction, indicates that short grasses in the study area evidently thrived during this climatic episode and with them, bison --the primary subsistence species. All indications point to increasing numbers of bison on the southern Plains at this time. Living in the Uplands and the Breaks topographic regions around the Two Sisters site, bison ranged fairly close to the site and faunal remains indicate that all or almost all parts of the animal were brought back to the site for processing.

The Two Sisters site was in a prime location to support a diverse diet. Situated on the Breaks, the site is close to the Beaver River and had soils suitable for limited cultivation of corn, beans, and probably squash. The riparian habitat supported deer, fish, birds, reptiles, and amphibians — all of which were utilized and are recorded in the faunal remains from the site. Because of the dry farming methods and the increasing aridity of the area, reliance upon horticultural crops probably decreased through time. Crop failures most likely increased and subsistence efforts included more and more hunting and gathering. Bone grease processing evidence at Two Sisters suggests a stressed existence with labor consumed in processing bone for fat and vitamins. Clearly, the environmental changes impacted and shaped subsistence practices, finally to the point of changing strategies altogether.

In addition to evincing evidence about subsistence food strategies, the location of the Two Sisters site provides clues about settlement decisions. The site not only provided easy access to water and the species found in an aquatic habitat, but also to trees and shrubs used for fuel and building materials. Furthermore, outcrops of caliche are within an easy, transportable distance and were used for the house foundation and some of the groundstone. The Two Sisters site occupants were able to exploit materials and floral and faunal resources from all of the adjacent habitats.

Site catchments were constructed for three different types of resources. The first was an analysis of the available soils conducive to dry farming horticultural practices. Modern soil surveys indicate that only the Spur series soils would have been productive. A site catchment was constructed for soils within 5 km and then reduced to a 1 km radius. The results showed that there would have been enough of this type soil within 1 km of the site for minimal horticultural pursuits of a small extended family with about 12 individuals. Because the amount and type of soil required is within the catchment area, environmental considerations and too few people were the probable limiting factors. The increasingly dry climatic conditions as suggested by Bryson's paleoclimatological models, probably resulted in marginal, undependable corn yields.

The second site catchment constructed was for lithic resources within 5 km of the site. Application of the model showed that the majority of the lithic resources were obtained from outside the catchment area. The only lithic resources utilized from within the catchment area were a small percentage of local cherts and quartzites used for chipped stone and almost all of the ground stone. In addition, all of the building stone, caliche, was from within the catchment area.

The last catchment model dealt with biotic resources. This was probably the most informative of the three in relation to subsistence strategies. The probable floral and faunal resources were mapped onto the catchment area of 5 km. The actual recovered materials from the site were then compared with the modeled ones. Actual floral remains included only corn and beans, yet, because of the dietary requirements for carbohydrate consumption, it is probable that the inhabitants used wild plants. Faunal remains were more informative. The model delineated probable species, and with the exception of low numbers of carnivores and small mammals, the recovered faunal remains closely parallel what the model described. Bison were the primary prey, followed by pronghorn and deer. The Two Sisters site inhabitants utilized all three topographic zones and their associated prey, yet maintained a fairly broad diet. However, their food acquisition emphasis remained clearly on bison. In addition to possible hunts at distances greater than 5 km, at least some bison were hunted near the site. The evidence for this can be seen in all parts of the animal being brought back to the site (long transportation is usually characterized by bringing back only the most valuable parts of the animal). Emphasis on bison exploitation is not surprising given the arid environmental conditions and the risk involved with horticultural production.

Inter-regional Site Comparisons

Other excavated Antelope Creek phase sites in Oklahoma have assemblages that also seem to emphasize bison hunting. These include McGrath, 34TX31 (Lintz 1976), Stamper, 34TX1 (Johnston 1933, 1934; Watson 1950), and Roy Smith, 34BV14 (Schneider 1969). The McGrath site is about 0.5 km west of Two Sisters and consists of several hearths, a storage pit, a trash-filled depression, and a cobble concentration (Lintz 1976). No structure was found. The Stamper site is a large village with at least 18 structures. It is about 6 km east of Two Sisters and is also on the Beaver River. Stamper was excavated in 1933 and 1934 by C. Stuart Johnston and analyzed and published by Virginia Watson in 1950. Because it was excavated in the 1930s, usually only identifiable tools and bones were kept allowing only generalities about quantities to be reported. The only other Antelope Creek site that has been excavated is the Roy Smith site. It is about 48 km east of Two Sisters and is on Sharps Creek, a tributary to the Beaver River. Roy Smith has a single contiguous room structure with five main rooms, three storage rooms, and one "activity area" (Schneider 1969). Excavation was primarily within the structure with some exterior excavations adjoining the structure on the east. Other areas of the site were tested and uncovered two trash areas, two storage pits, a possible isolated dwelling, and a large historic corral (Schneider 1969).

Each of these sites have numerous bison represented in the faunal sample and the faunal remains are comparable to Two Sisters. As Table 8.2 indicates, all of these sites also include white-tailed deer and pronghorn as part of their subsistence base. Rabbits, prairie dogs, turtles, and mussels are also present at all sites. Primary differences are the absence of fish at Stamper and McGrath and of ducks at Roy Smith and McGrath.

Table 8.2. Comparison of Excavated Antelope Creek Sites in Oklahoma (Johnston 1933, 1934; Lintz 1976; Schneider 1969; Watson 1950).

	34TX32	34TX31	34BV14	34TX1
Date Ranges	A.D. 1302-1440	A.D.1300-1375	A.D. 1220-1260	A.D. 1325-1375
Structures	contiguous & isolated 2 main, 3 storage	none	contiguous & isolated 5 main, 3 storage	contiguous & isolated 12 houses, 6 storage
Room size (m)	2.4x2.4 to 6x6	none	2x2.4 to 4.2x6	2.4x3 to 9.8x11.6
Hearth	central & exterior	exterior	exterior only	central & exterior
Depressed floor channel	present	n/a	absent	present
Storage pits	many	1	few (shallow)	few
Material construction	Caliche	n/a	Sandstone	Caliche
Type construction	stone slab & adobe	n/a	stone slab & adobe	stone slab & adobe
Location	Beaver River	Beaver River	Sharps Crk,Beaver Trib.	Beaver River
Subsistence - Horticulture				
Corn	present	absent	absent	present
Bean	present	absent	absent	absent
Subsistence - Faunal MNI				
Bison	5	2	12	present
White-tailed deer	2	1	3	present
Pronghorn	7	1	1	present
Coyote or dog	2	absent	absent	3
Jack Rabbit	2	1	1	present
Cottontail rabbit	4	1	1	present
Prairie dog	3	1	1	present
Western harvest mouse	0	absent	1	unknown
Canyon mouse	0	absent	1	unknown
Land tortoise	20	2	12	present
Mussels	present	present	present	present
Birds	numerous, incl. ducks	present	3 fragments- no ducks	present, incl. ducks
Fish	7	absent	3 fragments only	absent
Chipped Stone				
dart points	1	3	38	2
Fresno	63	24	209	43
Washita	49	11	142	48
Harrell	4	11	18	4
Huffaker-like	6	1	7	0
Shetley	2	0	0	0
Perdiz	0	0	3	0
Clifton	0	0	1	0
Scallorn	2	1	31	1
Misc. arrowpoints & frags	93	21	580	12
Bifaces and Fragments	101	47	50	15+
Beveled knife	27	2	27	28
Scrapers and Fragments	305	125	484	45+
Drills	38	6	39	18
Gravers	4 (incl w/ scrapers)	9	0	0
Cores	13	28	4	unknown
Modified & Unmod.flakes	5811	1946	8742	unknown

Table 8.2 (continued).

	34TX32	34TX31	34BV14	34TX1
Groundstone				
Mano	62	23	35	3*
Metate	34	10	7	6*
Abrader	31	33	11	12
Pipe	2	0	1	4
Hematite/Limonite	80	0	33	present
Ceramics				
Sand temper	1125	105	1237	1827
Shell temper	30	11	0	0
Bone temper	0	17	0	0
Bone				
Tibia digging sticks	13	1	3	17
Scapula hoe	3	0	3	5
Awl	34	6	19	32
Rib rasps	5	0	12	2
Beads	2	0	3	0
Unmodified (g)	83,802 (185 lbs)	5,540(20 lbs)	171,000 (377 lbs)	unknown
Shell				
Scrapers	10	3	10	several
Pendants	3	0	8	2
Containers	4	0	0	0
Beads	3	1	3	5
Basketry/Woven items	0	0	0	several
Burials	1	0	0	7
Trade items				
Southwest pottery	0	1 *black-on-white*	0	4 Rowe black-on white
Obsidian	3	11	9	9
Olivella beads	8	0	2	10
Greenstone celt	0	0	0	1
Microcline(Amazonstone)**	0	0	0	2
Ceremonial				
Point	present	absent	absent	absent
Bison skull	absent	absent	absent	present
Altar	present	absent	absent	present

*fragments most likely not collected and not included.

**similar in appearance to turquoise. The mineral occurs in granite in Colorado.

Because these are the only four excavated Antelope Creek phase sites in Oklahoma, other similarities and differences are noteworthy (Table 8.2). First, the sites differ in time. The Roy Smith site is associated with the early phase (A.D. 1200 to 1350) and numerous radiocarbon dates place occupation at A.D. 1220 to 1260. The other three sites are late phase sites dating to the latter part of the fourteenth and early part of the fifteenth centuries.

Architecturally, with the exception of the McGrath site which has no structures, sites have contiguous and isolated rooms. Smaller rooms most likely functioned as storage or processing areas. Main room size is larger in the two later sites, Two Sisters and Stamper, than at the earlier Roy Smith site. Walls consist of vertically placed slabs of caliche at Two Sisters and Stamper and sandstone at Roy Smith. All three sites have at least one room that was constructed without stone using adobe and probably wall posts. Stamper has some construction with adobe bricks or blocks. All have a broken metate used as part of wall construction. In addition, the later sites (Two Sisters and Stamper) have at least one room with a depressed floor channel and altar. The Roy Smith site does not have these features nor does it have interior central hearths.

Storage pits are larger and more numerous at Two Sisters than at the other sites. Interior and exterior pits were recovered at Two Sisters and at Stamper. Conversely, the few known pits from Roy Smith and the one from

McGrath are exterior.

Horticultural evidence includes corn and beans from Two Sisters and corn from Stamper. No domestic plant remains were recovered from Roy Smith or McGrath. All sites have bone horticultural tools, but fewer were recovered from Roy Smith than from Two Sisters or Stamper.

Chipped stone tools are similar in type but differ in quantities. Table 8.3 presents a comparison of the chipped stone occurring at all four sites. Projectile points are numerous and make up a high percentage of the chipped stone at Roy Smith. Scrapers are more frequent within the assemblages from Two Sisters and McGrath. While Stamper has a lower percentage of scrapers, diamond-beveled knives occur with greater frequency than at the other sites.

Trade items are found at all sites. Obsidian occurs at all, *Olivella* beads at the three sites with structures, and Southwest pottery at McGrath and Stamper. In addition, the Stamper artifact assemblage includes two pieces of Microcline from Colorado (similar in appearance to turquoise) and a greenstone celt (origin unknown).

The comparison between these sites and the Two Sisters site reveals slight differences in subsistence. Roy Smith does not have as many horticultural tools or any direct evidence of corn or beans. However, because excavations concentrated on areas within the structure, additional tools and domesticated plant remains might be present in untested exterior

Table 8.3. Comparison of Chipped Stone by Site.

	Two Sisters 34TX32		McGrath 34TX31		Roy Smith 34BV14		Stamper 34TX1	
	#	%	#	%	#	%	#	%
Dart points	1	<1	3	1	38	2	2	1
Fresno	63	9	24	9	209	13	43	20
Washita	49	7	11	4	142	9	48	22
Harrell	4	1	11	4	18	1	4	2
Huffaker-like	6	1	1	1	7	<1	0	0
Shetley	2	<1	0	0	0	0	0	0
Perdiz	0	0	0	0	3	<1	0	0
Clifton	0	0	0	0	1	<1	0	0
Scallorn	2	<1	1	1	31	2	1	<1
Misc. arrowpoints & frags	93	13	21	8	580	36	12	6
Bifaces and Fragments	101	15	47	18	50	3	15	7
Beveled knives	27	4	2	1	27	2	28	13
Scrapers and Fragments	301	44	125	48	484	30	45	21
Drills	38	5	6	2	39	2	18	8
Gravers	4	1	9	3	0	0	0	0
Total	691	100	261	100	1629	100	216	100
Projectile Point Subtotal	*220*	*32%*	*72*	*28%*	*1029*	*63%*	*110*	*51%*

areas and hearths. Faunal remains are similar at all sites with the primary large mammal being bison, supplemented by deer, pronghorn and other smaller game. Because of the numerous similarities, it is likely that these sites are related and that they practiced similar subsistence strategies.

Conclusion

The Two Sisters site occupants lived at a time of environmental change that eventually resulted in adjustments to their subsistence strategies. Although their stone slab structures were constructed in an area where they could easily exploit all three environmental zones, with time this location became unsuitable and was abandoned. Fluctuating climatic conditions interacting with an established technology and social structure resulted in adaptations through time to a more specialized subsistence strategy. When a sedentary lifestyle in the Oklahoma panhandle could no longer support them, they abandoned this life and probably became mobile bison hunters. The lives of these individuals were fluid and, as predicted by the hypothetical model of optimal foraging theory, they apparently responded to changing environmental conditions by adopting a mobile subsistence strategy.

The scientific value of this study, taken in view of the developed model, lies in the fact that the archaeological data support the optimal foraging approach to understanding hunter-gatherers living under conditions of moderate scarcity. While this corroboration does not "prove" the truth of optimal foraging theory, it does illustrate that this approach is a very useful and common-sensical way of understanding how these prehistoric inhabitants responded to environmental challenges. Extending the Darwinian notion of adaptation, organisms at every level either adapt to change or become extinct. In this case the organism was a group of human beings living on the Southern High Plains, who, when faced with a changing environment, reacted in such a manner that they were most likely able to survive. This is an example of evolutionary ecology and the story of a people –it is the intersection between science <u>and</u> prehistory.

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APPENDIX I
Provenience Designations by Catalog Number

Catalog No.	Provenience	Depth	Room / Area
1	General Surface		
2	S57E10, Historic Dugout	0-10 cm	Exterior
3	S57E11, Historic Dugout	0-10 cm	Exterior
4	S57E10, NW Trench	0-10 cm	Exterior
5	S57E11, NE Trench	0-10 cm	Exterior
6	S35E16-18, Profile N. Road Cut	profile	Exterior
7	S30E16	0-10 cm	Exterior
8	S30E16	10-20 cm	Exterior
9	S30E16	20-30 cm	Exterior
10	S30E16	30-41 cm	Exterior
11	S30E11	0-10 cm	Exterior
12	S30E11	10-20 cm	Exterior
13	S30E1	0-10 cm	Exterior
14	S30E1	10-20 cm	Exterior
15	S30E1	20-30 cm	Exterior
16	S27E16	0-10 cm	Exterior
17	S27E16	10-20 cm	Exterior
18	S27E11	0-10 cm	Exterior
19	S27E11	10-20 cm	Exterior
20	S27E11	20-30 cm	Exterior
21	S27E11	30-41 cm	Exterior
22	S27E11	41-51 cm	Exterior
23	S27E11	51-61 cm	Exterior
24	S27E6	0-10 cm	Exterior
25	S27E6	10-20 cm	Exterior
26	S27E6	20-30 cm	Exterior
27	S23E11	0-10 cm	Exterior
28	S23E11	10-20 cm	Exterior
29	S23E11	20-30 cm	Exterior
30	S23E6	0-10 cm	Exterior
31	S23E6	10-20 cm	Exterior
32	S23E6	20-30 cm	Exterior
33	S18E8	0-10 cm	Exterior
34	S18E8	10-20 cm	Exterior
35	S18E8	20-30 cm	Exterior
36	S18E8	30-41 cm	Exterior
37	S18E8, Feature 37		Exterior
38	S18E6	0-10 cm	Exterior
39	S18E6	10-20 cm	Exterior
40	S18E6	20-30 cm	Exterior
41	S18E4	0-10 cm	Exterior
42	S17E7	0-10 cm	Exterior
43	S17E7	10-20 cm	Exterior
44	S17E7	20-30 cm	Exterior
45	S17E7	30-41 cm	Exterior

APPENDIX I
(continued).

Catalog No.	Provenience	Depth	Room / Area
46	S17E5	0-10 cm	Exterior
47	S17E5	10-20 cm	Exterior
48	S17E5	20-30 cm	Exterior
49	S16E7	0-10 cm	Exterior
50	S16E7	10-20 cm	Exterior
51	S16E6	0-10 cm	Exterior
52	S16E6	0-10 cm	Exterior
53	S16E6	10-20 cm	Exterior
54	S16E5	0-10 cm	Exterior
55	S16E5	10-20 cm	Exterior
56	S16E4	0-10 cm	Exterior
57	S16E4	10-20 cm	Exterior
58	S15E13	0-10 cm	Exterior
59	S15E12	0-10 cm	Exterior
60	S15E12	10-20 cm	Exterior
61	S15E7	0-10 cm	Exterior
62	S15E7	10-20 cm	Exterior
63	Feature 28		Exterior
64	S15E7	20-30 cm	Exterior
65	S14E7	0-10 cm	Exterior
66	S14E7	10-20 cm	Exterior
67	S15E10	0-10 cm	Exterior
68	S15E10	10-20 cm	Exterior
69	S15E10	20-30 cm	Exterior
70	S15E10	30-41 cm	Exterior
71	S14E10	0-10 cm	Exterior
72	S14E10	10-20 cm	Exterior
73	S13E10	0-10 cm	Exterior
74	S13E10	10-20 cm	Exterior
75	S13E7	0-10 cm	Exterior
76	S13E7	10-20 cm	Exterior
77	S13E7	20-30 cm	Exterior
78	S13E7, bone concentration	20-30 cm	Exterior
79	S12E15	0-10 cm	Exterior
80	S12E15	10-20 cm	Exterior
81	S12E15	20-30 cm	Exterior
82	S12E15	30-41 cm	Exterior
83	S12E13	0-10 cm	Exterior
84	S12E11	0-10 cm	Exterior
85	S12E11	10-20 cm	Exterior
86	S12E11, Feature 36	20-30 cm	Exterior
87	S12E10	0-10 cm	Exterior
88	S12E10	10-20 cm	Exterior
89	S12E10	20-30 cm	Exterior
90	S12E10	30-41 cm	Exterior

APPENDIX I
(continued).

Catalog No.	Provenience	Depth	Room / Area
91	S12E9	0-10 cm	Exterior
92	S12E9	10-20 cm	Exterior
93	S12E8	0-10 cm	Exterior
94	S12E8	0-20 cm	Exterior
95	S12E8	10-20 cm	Exterior
96	S12E7 / S13E7, Area 8	0-10 cm	Exterior
97	S12E7	10-20 cm	Exterior
98	S12E7	20-30 cm	Exterior
99	S11E7	0-10 cm	Exterior
100	S11E7	10-20 cm	Exterior
101	S11E7	20-30 cm	Exterior
102	S11E7	30-41 cm	Exterior
103	S11E7, Feature 35		Exterior
104	S11E6	1 natural	Exterior
105	S11E6	2 natural	Exterior
106	S11E6	2 natural	Exterior
107	S11E6, Feature 22		Exterior
108	S11E6	3 natural	Exterior
109	S11E4	1 natural	Area 7
110	S11E4	2 natural	Area 7
111	S10E4	10-20 cm	Area 7
112	S10E4	20-30 cm	Area 7
113	S10E4	30-41 cm	Area 7
114	S10E4, Feature 21	41-51 cm	Area 7
115	S10E4, Feature 21	51-61 cm	Area 7
116	S10E4	41-51 cm	Area 7
117	S10E4	51-61 cm	Area 7
118	S10E4	61-71 cm	Area 7
119	S10E4	71-102 cm	Area 7
120	S6E6	0-10 cm	Exterior
121	S6E6	10-20 cm	Exterior
122	S6E6	20-30 cm	Exterior
123	S6E6	30-41 cm	Exterior
124	S1E6	0-10 cm	Exterior
125	S1E6	10-20 cm	Exterior
126	N.exterior & Area 6	Surface	Area 6
127	N.exterior	0-13 cm	Area 6
128	Area 6	0-13 cm	Area 6
129	Area 6	1972 backdirt	Area 6
130	Area 7	0-10 cm	Area 7
131	Area 7	10-20 cm	Area 7
132	Exterior entrance Rm 1A	3-33 cm	Exterior
133	Area A1-a	0-8 cm	Room 1A
134	Area A1-b	0-8 cm	Room 1A
135	Area A1-c	0-8 cm	Room 1A

APPENDIX I
(continued).

Catalog No.	Provenience	Depth	Room / Area
136	Room 4	0-8 cm	Room 1A
137	Room 1A	0-8 cm	Room 1A
138	Room 1A Test Pit 1		Room 1A
139	Area A1-a	8-13 cm	Room 1A
140	Room 1A	8-13 cm	Room 1A
141	Room 1A	13-20 cm	Room 1A
142	Room 1A Test Pit 2		Room 1A
143	Room 1A	20-28 cm	Room 1A
144	Feature 5, below floor	28 cm	Room 1A
145	Test Trench A, N. outside Rm 1A	10-56 cm	Area 6
146	Test Trench A, Interior Rm 1A	28-56 cm	Room 1A
147	Test Trench A, S. outside Rm 1A	0-46 cm	Exterior
148	Trench B	28-56 cm	Room 1A
149	Trench C	28-58 cm	Room 1A
150	Ledge NE comer Rm 1A,E.of Trench A	13-28 cm	Room 1A
151	Ledge NE comer Rm 1A,NE comer interior	13-28 cm	Room 1A
152	Ledge E.wall N. of entrance	13-28 cm	Room 1A
153	Ledge E.wall entrance	13-28 cm	Room 1A
154	Ledge E. wall S. of entrance	13-28 cm	Room 1A
155	Ledge test pit East side	1972 backdirt	Room 1A
156	Ledge SE comer Rm 1A	13-28 cm	Room 1A
157	South outside Rm 1A,btwn Rm 3A & 1A	13-15 cm	Exterior
158	Ledge west wall Rm 1A	13-28 cm	Room 1A
159	Ledge NW comer Rm 1A	13-28 cm	Room 1A
160	Ledge SW comer Rm 1A	13-28 cm	Room 1A
161	NE 1/4 Room 1A	28-48 cm	Room 1A
162	NE 1/4 Room 1A	48-66 cm	Room 1A
163	SE 1/4 Room 1A	28-58 cm	Room 1A
164	SW 1/4 Room 1A	41-56 cm	Room 1A
165	West 1/2 Room 1A	28-66 cm	Room 1A
166	NW 1/4 slope Room 1A,Pit ~ 1 ft. inside wall	28-66 cm	Room 1A
167	extension of test trench along west wall Rm 1A		Room 1A
168	Fill above floor, center of Room 1A	58-81 cm	Room 1A
169	Near west wall of Room 1A ash above floor		Room 1A
170	Bumed ashy area near Room 1A hearth	76-81 cm	Room 1A
171	Bumed ashy area near Room 1A hearth	81-84 cm	Room 1A
172	Feature 11		Room 1A
173	Feature 13, Level A	28-66 cm	Room 1A
174	Feature 13, Level A	66-76 cm	Room 1A
175	Feature 13, Level B west	76-107 cm	Room 1A
176	Feature 13, Level B east	76-107 cm	Room 1A
177	Feature 13, Level C	107-140 cm	Room 1A
178	Profile cut Feature 13	profile	Room 1A
179	Feature 14	76-81 cm	Room 1A
180	Feature 15	56-66 cm	Room 1A

APPENDIX I
(continued).

Catalog No.	Provenience	Depth	Room / Area
181	Feature 15	66-76 cm	Room 1A
182	Feature 15	76-84 cm	Room 1A
183	Feature 16	58 + cm	Room 1A
184	Feature 17	58 + cm	Room 1A
185	Feature 18	58 + cm	Room 1A
186	Near Feature 18, floor level	64 cm	Room 1A
187	Feature 25	58 + cm	Room 1A
188	Feature 26	58 + cm	Room 1A
189	Feature 30	76 + cm	Room 1A
190	Feature 31	76 + cm	Room 1A
191	Feature 19	58 + cm	Room 1A
192	Trench A North	58-76 cm	Room 1A
193	Trench A South	58-76 cm	Room 1A
194	Trench A North and South	58-76 cm	Room 1A
195	Trench A, Section 2	76-102 cm	Room 1A
196	Trench A, Section 3	76-86 cm	Room 1A
197	Trench A, Section 3	86-97 cm	Room 1A
198	Trench A, Section 4	76-86 cm	Room 1A
199	Trench A, Section5	76-86 cm	Room 1A
200	Trench A, Section 6	46-76 cm	Room 1A
201	Trench A, Section 6	76-86 cm	Room 1A
202	Trench G-W-1	58-76 cm	Room 1A
203	Trench G-E-1	58-76 cm	Room 1A
204	Trench G-W-2	58-76 cm	Room 1A
205	Trench F-W-1	58-76 cm	Room 1A
206	Trench F-E-1	58-76 cm	Room 1A
207	Trench F-W-2	58-76 cm	Room 1A
208	Trench H-W-2	58-76 cm	Room 1A
209	Trench H-W-1	58-76 cm	Room 1A
210	Trench H-E-1	58-76 cm	Room 1A
211	Trench B-W-2 wall	58 cm	Room 1A
212	Trench B-W-2 bench	58-76 cm	Room 1A
213	Trench B-W-2	58-76 cm	Room 1A
214	Trench B-W-1	58-76 cm	Room 1A
215	Trench B-E-1	58-76 cm	Room 1A
216	Trench I-W-2	58-76 cm	Room 1A
217	Trench I-W-1	58-76 cm	Room 1A
218	Trench I-E-1	58-76 cm	Room 1A
219	Trench E-W-2	58-76 cm	Room 1A
220	Trench E-W-1	58-76 cm	Room 1A
221	Trench E-E-1	58-76 cm	Room 1A
222	Trenches J and K	28-76 cm	Room 1A
223	Room 2A Surface		Room 2A
224	Feature 1		Room 2A
225	Feature 2		Room 2A

APPENDIX I
(continued).

Catalog No.	Provenience	Depth	Room / Area
226	Room 2A	0-13 cm	Room 2A
227	Room 2A	13-28 cm	Room 2A
228	Feature 38, below floor	28 cm	Room 2A
229	Room 2A, floor level	28-36 cm	Room 2A
230	Room 2A, Trench D, Section 1	36-66 cm	Room 2A
231	Room 2A, Trench D, Section 2	10-46 cm	Room 2A
232	Room 2A, Trench D, Section 2	46-56 cm	Room 2A
233	Room 2A, Trench D, Section 2	56-66 cm	Room 2A
234	Room 2A, Trench D, Section 2	66-76 cm	Room 2A
235	Room 2A, Trench D, Section 2	76-86 cm	Room 2A
236	Room 2A, Trench D, Section 3, baulk	13-36 cm	Room 2A
237	Room 2A, S11E6	36-66 cm	Room 2A
238	Room 2A, S12E6	36-46 cm	Room 2A
239	Room 2A, S12E6	46-56 cm	Room 2A
240	Room 2A, S12E6	56-66 cm	Room 2A
241	Room 2A, S13E5	36-46 cm	Room 2A
242	Room 2A, S13E5	336-46 cm	Room 2A
243	Room 3A Surface	Surface	Room 3A
244	Feature 4	0-10 cm	Room 3A
245	Feature 4	10-30 cm	Room 3A
246	Room 3A, Test Pit 3	10-76 cm	Room 3A
247	Room 3A	0-10 cm	Room 3A
248	Room 3A	10-20 cm	Room 3A
249	Room 3A	20-30 cm	Room 3A
250	Room 3A	30-36 cm	Room 3A
251	S14E6, Exterior East of Room 3A	0-15 cm	Exterior
252	Room 3A	1972 backdirt	Room 3A
253	Room 3A, shelf east of Feature 4	30 cm	Room 3A
254	Room 2A and entry to Room 1A, Trench D-3	36-51 cm	Room 2A
255	Room 2A and entry to Room 1A, Trench D-3	51-61 cm	Room 2A
256	Room 2A and entry to Room 1A, Trench D-3	61-66 cm	Room 2A
257	Room 2A and entry to Room 1A, Trench D-3	66-76 cm	Room 2A
258	Room 3A, Trench D, Section 4	30-41cm	Room 3A
259	Room 3A, Trench D, Section 4	41-51 cm	Room 3A
260	Room 3A, Trench D, Section 4	51-61 cm	Room 3A
261	Room 3A, Trench D, Section 4	61-71 cm	Room 3A
262	Room 3A, Trench D, Section 5	20-30 cm	Room 3A
263	Room 3A, Trench D, Section 5	30-41cm	Room 3A
264	Room 3A, Trench D, Section 5	41-51 cm	Room 3A
265	Room 3A, Trench D, Sections 3,4,& 5 profile	30-66 cm	Room 3A
266	Room 3A, Trench D, Section 5		Room 3A
267	Room 3A, east wall bench (S15E6)		Room 3A
268	Room 3A, northwest corner near entry		Room 3A
269	Exterior east of Room 2A & Room 3A	30 cm	Exterior
270	Feature 23		Room 3A

APPENDIX I
(continued).

Catalog No.	Provenience	Depth	Room / Area
271	Feature 23		Room 3A
272	Feature 24		Room 3A
273	Feature 24		Room 3A
274	Feature 27		Room 3A
275	Feature 29		Room 3A
276	Features 23, 24, & 29,east wall Trench D fill		Room 3A
277	Features 23, 24, & 29, upper fill		Room 3A
278	Features 24 and 29, upper fill, S15E6		Room 3A
279	Room 3A, bench west wall near Trench D-4		Room 3A
280	Room 5A	1 natural	Room 5A
281	Room 5A	2 natural	Room 5A
282	Room 5A	3 natural	Room 5A
283	Room 5A	I artificial	Room 5A
284	Room 5A	2 artificial	Room 5A
285	Room 5A	3 artificial	Room 5A
286	Room 5A	4 artificial	Room 5A
287	Feature 6		Room 5A
288	Feature 7		Room 5A
289	Feature 8		Room 5A
290	Baulk between Features 6 and 8		Room 5A
291	Feature 9		Room 5A
292	Feature 10		Room 5A
293	Room 3A, west pit profile S15E6 & S14E6		Room 3A
294	S13-0, above entrance to Room 1B	0-10 cm	Room 1B
295	S13-0, above entrance to Room 1B	10-20 cm	Room 1B
296	S13-0, above entrance to Room 1B	20-30 cm	Room 1B
297	S14-0, above entrance to Room 1B	0-10 cm	Room 1B
298	S14-0, above entrance to Room 1B	10-20 cm	Room 1B
299	S14-0, above entrance to Room 1B	20-30 cm	Room 1B
300	Room 1B Entrance	30-51 cm	Room 1B
301	Room 1B Entrance	30-51 cm	Room 1B
302	Room 1B Entrance	30-51 cm	Room 1B
303	Room 1B Entrance		Room 1B
304	Room 1B Entrance		Room 1B
305	Room 1B Entrance	30-51 cm	Room 1B
306	Room 1B Entrance	30-51 cm	Room 1B
307	Room 1B Entrance	64 cm	Room 1B
308	Room 1B Entrance	30-51 cm	Room 1B
309	Room 1B Entrance	30-51 cm	Room 1B
310	Room 1B Entrance	51-58 cm	Room 1B
311	S13W1	69 cm	Room 1B
312	Room 1B, main room floor level, square unknown	58-69 cm	Room 1B
313	S12W1	0-10 cm	Room 1B
314	S12W1	10-20 cm	Room 1B
315	S12W1	20-30 cm	Room 1B

APPENDIX I
(continued).

Catalog No.	Provenience	Depth	Room / Area
316	S12W1	30-41cm	Room 1B
317	S12W1	41 cm to floor	Room 1B
318	S13W1	0-10 cm	Room 1B
319	S13W1	10-20 cm	Room 1B
320	S13W1	20-30 cm	Room 1B
321	S13W1	30-58 cm	Room 1B
322	S14W1	0-10 cm	Room 1B
323	S14W1	10-20 cm	Room 1B
324	S14W1	20-30 cm	Room 1B
325	S15W1	0-10 cm	Room 1B
326	S15W1	10-20 cm	Room 1B
327	S15W1	20-30 cm	Room 1B
328	N 1/2 S16W1	0-30 cm	Room 1B
329	N 1/2 S16W1	30-58 cm	Room 1B
330	S12W2	0-30 cm	Room 1B
331	S12W2	30-41cm	Room 1B
332	S12W2	41 cm to floor	Room 1B
333	S12W2, floor	51-58 cm	Room 1B
334	S13W2	0-10 cm	Room 1B
335	S13W2	10-20 cm	Room 1B
336	S13W2	20-30 cm	Room 1B
337	S13W2	30-51 cm	Room 1B
338	S13W2	51 cm	Room 1B
339	S13W2 and S13W3, floor	51-58 cm	Room 1B
340	S14W2	0-10 cm	Room 1B
341	S14W2	10-20 cm	Room 1B
342	S14W2	20-30 cm	Room 1B
343	S14W2	30-43 cm	Room 1B
344	S14W2, floor	51-58 cm	Room 1B
345	S14W2, trough fill	58 + cm	Room 1B
346	S15W2	0-30 cm	Room 1B
347	S15W2	30-58 cm	Room 1B
348	S15W2, floor	51-58 cm	Room 1B
349	S16W2	0-30 cm	Room 1B
350	S16W2	30-58 cm	Room 1B
351	S16W2, floor	51-58 cm	Room 1B
352	S12W3	0-30 cm	Room 1B
353	S12W3	30-41cm	Room 1B
354	S13W3	0-10 cm	Room 1B
355	S13W3	10-20 cm	Room 1B
356	S13W3	20-30 cm	Room 1B
357	S13W3	30-41cm	Room 1B
358	S13W3	41-51 cm	Room 1B
359	S14W3	0-10 cm	Room 1B
360	S14W3	10-20 cm	Room 1B

APPENDIX I
(continued).

Catalog No.	Provenience	Depth	Room / Area
361	S14W3	20-30 cm	Room 1B
362	S14W3	30-41cm	Room 1B
363	S14W3, floor	41-51 cm	Room 1B
364	S14W3, below floor	51 + cm	Room 1B
365	S15W3	0-30 cm	Room 1B
366	S15W3	30-51 cm	Room 1B
367	S15W3, floor	51-58 cm	Room 1B
368	S16W3	0-30 cm	Room 1B
369	S16W3	30-51 cm	Room 1B
370	S16W3, floor	51-58 cm	Room 1B
371	S12W4	0-30 cm	Room 1B
372	S12W4	30-41cm	Room 1B
373	S13W4	0-10 cm	Room 1B
374	S13W4	10-20 cm	Room 1B
375	S13W4	20-30 cm	Room 1B
376	S13W4	30-41cm	Room 1B
377	S13W4	41-51 cm	Room 1B
378	S14W4	0-30 cm	Room 1B
379	S14W4	30-41 cm	Room 1B
380	S14W4	41-51 cm	Room 1B
381	S14W4	51-58 cm	Room 1B
382	S14W4, trough fill	58 + cm	Room 1B
383	S15W4	0-30 cm	Room 1B
384	S15W4	30- 51 cm	Room 1B
385	S15W4, floor	51-58 cm	Room 1B
386	S16W4	0-30 cm	Room 1B
387	S16W4	30-51 cm	Room 1B
388	S16W4, floor	51-58 cm	Room 1B
389	S13W5	0-30 cm	Room 1B
390	S13W5	30-51 cm	Room 1B
391	S13W5, floor	51-58 cm	Room 1B
392	S14W5	0-30 cm	Room 1B
393	S14W5	30-58 cm	Room 1B
394	S14W5, trough fill	58 + cm	Room 1B
395	S15W5	0-30 cm	Room 1B
396	S15W5	30 + cm	Room 1B
397	S16W5	0-58 cm	Room 1B
398	Feature 32, S14W3	58 cm	Room 1B
399	Feature 34, S14W2	58 cm	Room 1B
400	S14W2	30-41cm	Room 1B
401	Unknown, Room 1A or Room 5A		Unknown

APPENDIX II
Historic Materials

Quantity	Cat.#	Provenience	Depth (cm)	Room/Area
Window Glass (14)				
10	2	S57E10	0-10	Historic Dugout south of Road
4	5	S57E11,NE Trench	0-10	South of Road
Purple Bottle Glass (1)				
1	1	Surface	Surface	Exterior
Clear Bottle Glass (42)				
31	6	S35E16-18	Profile	North of Road
1	96	S12E7/S13E7	0-10	Exterior
1	118	S10E4	61-71	Area 7
1	121	S6E6	10-20	Exterior
1	135	Area A1-C	0-8	Room 1A
1	136	Room 4	0-8	Room 1A
1	226	Room 2A	0-13	Room 2A
2	227	Room 2A	13-28	Room 2A
3	280	Room 5A	1 natural	Room 5A
Earthenware Crockery (1)				
1	135	Area A1-C	0-8	Room 1A
Straight Wire (2)				
1	13	S30E1	0-10	Exterior
1	134	Area A1-b	0-8	Room 1A
Barbed Wire (3)				
1	3	S57E11	0-10	Historic Dugout south of Road
2	5	S57E11,NE Trench	0-10	South of Road
Square Nail (1)				
1	5	S57E11,NE Trench	0-10	South of Road
Round Nail (3)				
1	2	S57E10	0-10	Historic Dugout south of Road
1	5	S57E11,NE Trench	0-10	South of Road
1	325	S15W1	0-10	Room 1B
Fence Staples (7)				
1	4	S57E10,NW Trench	0-10	South of Road
3	127	North Exterior	0-13	Area 6
1	325	S15W1	0-10	Room 1B
1	334	S13W2	0-10	Room 1B
1	336	S13W2	20-30	Room 1B
Flat-head Thumb Tack (1)				
1	130	Area 7	0-10	Area 7
.22 Caliber Cartridges (5)				
1	126	N.Exterior & Area 6	Surface	Area 6
3	130	Area 7	0-10	Area 7
1	133	Area A1-a	0-8	Room 1A

APPENDIX II
(continued).

Quantity	Cat.#	Provenience	Depth (cm)	Room/Area
Lead Shot (3)				
1	126	N.Exterior & Area 6	Surface	Area 6
1	127	North Exterior	0-13	Area 6
1	137	Room 1A	0-8	Room 1A
Lead Scrap (1)				
1	280	Room 5A	1 natural	Room 5A
Iron Scrap (15)				
2	5	S57E11,NE Trench	0-10	South of Road
2	6	S35E16-18	Profile	North of Road
1	16	S27E16	0-10	Exterior
1	17	S27E16	10-20	Exterior
2	54	S16E5	0-10	Exterior
1	61	S15E7	0-10	Exterior
1	64	S15E7	20-30	Exterior
1	128	Area 6	0-13	Area 6
1	134	Area A1-b	0-8	Room 1A
3	325	S15W1	0-10	Room 1B
Belt Buckle (1)				
1	383	S15W4	0-30	Room 1B
Washer (1)				
1	226	Room 2A	0-13	Room 2A
Bottle Cap (1)				
1	224	Feature 1		Room 2A
Rubber Sheet Fragment (1)				
1	226	Room 2A	0-13	Room 2A

APPENDIX III
Modified Flakes

Cat #	Alibates	Niobrara	Tecovas	Tesequite	Dakota	Ogallala	Unid.Chert	Opalite	Day Creek	Mosquito Jasper	Total
1								1	1		2
16							1				1
41	1										1
46	3										3
47	1		1		1						3
50	1										1
51	1										1
52	1										1
53	3						1			1	5
54	1										1
55	2										2
57	1										1
59	6										6
60	2	1									3
62	1										1
63	5						1				6
65	1										1
73	2						1				3
74	1								1		2
75							1				1
76	1										1
77	1	1									2
85	1										1
86	1										1
92	1						1				2
93		1									1
95							1				1
96	3										3
97	1										1

APPENDIX III
(continued).

Cat #	Alibates	Niobrara	Tecovas	Tesequite	Dakota	Ogallala	Unid.Chert	Opalite	Day Creek	Mosquito Jasper	Total
98	1										1
99	1										1
100	2										2
102	1										1
103	5										5
104	1										1
107	4										4
113	2			1			1				4
114	1			1							2
120	1										1
121		1		1			1				3
122	2										2
123	1	1						1			3
127	1										1
130	6			1			1				8
131	2										2
133	1										1
134	2										2
135	4										4
137	2								1		3
141	10		2				1				13
143	5								1		6
146	2										2
148	2										2
149	1										1
152	2										2
153	1										1
155	1										1
156	1										1

APPENDIX III
(continued).

Cat #	Alibates	Niobrara	Tecovas	Tesequite	Dakota	Ogallala	Unid.Chert	Opalite	Day Creek	Mosquito Jasper	Total
161	2										2
162	3		1								4
163	1										1
164	1										1
165							1				1
167	1										1
170	3		1								4
175	3										3
177	5	1						1	1		8
186	2										2
212	1										1
227	1										1
229	2										2
237	1										1
248	1	1									2
249	3										3
250	1										1
260	1										1
261			1								1
262	1										1
264	1										1
266	1										1
267	1										1
272	1										1
275	1										1
276			1								1
280							2				2
282	1	1									2
284	3								1		4

APPENDIX III
(continued).

Cat #	Alibates	Niobrara	Tecovas	Tesequite	Dakota	Ogallala	Unid.Chert	Opalite	Day Creek	Mosquito Jasper	Total
285	1										1
286	1										1
287	5										5
288	3		1								4
289	2										2
291	6								1		7
292	4						1	1			6
293	1										1
297	1										1
298	1										1
305	1										1
306	1										1
319	1										1
322	1										1
326	1										1
333	1										1
334	1										1
347						1					1
352	1										1
355	1										1
357	1										1
358	1										1
365							1				1
382	1										1
394	1										1
399	1										1
401	1										1
Totals	189	8	8	4	1	1	16	4	7	1	239

APPENDIX IV
Unmodified Flakes

Cat.#	Alibates					Niobrara				Tecovas			Tesesquite					Dakota Quartzite					Ogallala Quartzite				
	P	S	T	BT	Brk	S	T	BT	Brk	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk
1		1		4	6	1		1			2	1															
5					1																						
6			2	8	13				1			1							1		1	1					
7					2				1													2					
8				3	8																	2					
9				2	1																	1					
10					1																1						
11				1																	1						
13				2																							
14				2	1																	1					
15				1	1																	1					
16					1																						
17				2	1				1																		
18				3											1	1					1	1					
19				7	8											2					1	4					
20			1	7	9			1	1						1	4	1										
21				4	3											2	3				1						
22				5	2										1		1										
23				1	3																			1			
24																											
26			1																								
27				5	4																						
28				4	5																						
29				7	4										1	1											
31				2	4										1												
32			1	2	2											1											
33			2	8	9		1	1													1						
34				11	3										1	1											
35				2	2																1						
36			1	4	3											1								1			
38			6	9	14																	1					
39			3	10	7																						
40				3	2															1							
41			4	11	26											1	2		1			1	1				

APPENDIX IV
(continued).

Cat.#	Alibates					Niobrara				Tecovas			Tesesquite					Dakota Quartzite					Ogallala Quartzite				
	P	S	T	BT	Brk	S	T	BT	Brk	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk
42			1	5	0																						
43			1	5	11																						
44				14	16																					1	
46			3	7	12												3										
47			5	12	29																						
48			2	2	7																						
49			1	1	7												1					1					
50				3	5																						
51			2	3	14												1										
52			5	10	18							1					1				1	1					
53			1	22	25				1								2										1
54			2	11	8																	1					1
55				8	22				1													3					2
56				1	3																						
57			1	2	12																						
58			3	14	16						1	1		1	2	1	1				2	3					
59			5	16	21				1												4	4	2			1	3
60			1	9	14				1													4					
61					4				1																		
62		1		6	12			1	1						1	1	1		1		1	3					
63			4	7	4						2																
64		1	4	19	29				2							1					1	2					
65			1	9	18			1							1	1		1				2					
66			2	6	8			1								1	1										
67			1	3	10			1	1		1						1		1								
68			2	2	3																						
69				5	2																1	1					
70				4	3	1																					
71				4	8			1								3						1					
72			1	8	10											1					1	2					
73				7	8			1													1	1					2
74				13	16											1	1	1			2	1					
75				6	9			1								1	1										
76			2	13	15									1							1	3					

APPENDIX IV
(continued).

Cat.#	Alibates					Niobrara				Tecovas			Tesesquite					Dakota Quartzite					Ogallala Quartzite				
	P	S	T	BT	Brk	S	T	BT	Brk	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk
77			1	15	7			2														4					
78				2																							
79				2	3											1	1				2						
80				1	1																						
81				1	1																						
82					1																						
83			1	8	5				2																		
84			2	7	17			1												1							
85				11	3											1	1										
86				4	4																2						
87				5	20			1	1	1		3				1											
88			1	10	17			1								1						1					
89				4	7			1								2											
90				2	2			1													1						
91			1	10	15			1								1					2	1					
92			2	6	19				1	1																	
93			3	6	8				1			2				1						1					
95			3	18	28			5	3			3				3					3	3					
96			2	23	24			1	1						1		1				2	1					
97			1	23	19			2	1																1		
98				12	13			1										1			2						
99			2	9	8				1								1										
100				12	11			1			1						1										
101				7	7			1								1											
102				4	7																						
103		1	1	9																							
104				4	2																						
105				6	3												1										
106			1		1																						
107				7	1									1		1					1					1	
108				1																							
110				2	1																						
111				4	3																						
112				4																							

APPENDIX IV
(continued).

Cat.#	Alibates					Niobrara				Tecovas			Tesesquite					Dakota Quartzite					Ogallala Quartzite				
	P	S	T	BT	Brk	S	T	BT	Brk	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk
113			1	10	15											2	1		1		1	2					
114		1		10	11												1										
115					1																						
116					1																						
118				1	1																						
119					1																						
120			1	2	7				1												1	1					1
121		2	2	8	20			3	1					1	1		2		1	2	4	3				1	
122			3	13	18									2			3		1								
123				9	20			2	1									2	1		1	4		1			
124				4	3											1					1	1	1				
125				1																		1					
126					2																						
127			2	12	16																1						
128				4	4																	1					
129				1	1																						
130			5	23	43				2						1	1	1				1	1					
131			1	23	12			1													1						
132			1	3	4													1			1						
133				3	3																	1					
134			1	22	34											1	1				2	2	1				
135			3	20	44				1								3				1	1		1			
136				2	4																						
137			5	14	30											3					3				1		
138				3	5																						
139				6	4																						
140			2	17	21			1	1					1							2						
141		3	10	48	47							1			1	5	1				3	2		1			
142				1																							
143	1	2	13	46	54			1					2			2	2					2					
144			2	2	9														1								
146			2	8	17											1											
147			3	5	9																	1			1		
148			2	3	8		1		1							1											

APPENDIX IV
(continued).

Cat.#	Alibates					Niobrara				Tecovas			Tesesquite					Dakota Quartzite					Ogallala Quartzite				
	P	S	T	BT	Brk	S	T	BT	Brk	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk
149			3	12	17																						
150				1																							
151					1																						
152			1	1	2																						
153																											
154			3	8	2						1																
155			1	1																							
156			1	3	2																1						
157			1	1	2					1						1											
159				1	1																						
160				1	2																						
161		1	1	7	9																						
162			3	15	16									1								1					
163			1	8																							
164				2	2				1							2											
165				3	3																						
166		1		3	1																						
167			2	6	4																						
168		1	1	2	3				1																		
169			1	1																							
170			4	28	42											4	1										
171			1	6	5																						
172			3		2																						
173			1	5	1																						
174				3	4																						
175			1	10	2									1	2	2	2					1					
176				1												1											
177			10	70	83			2	3				5	5	1	13	18			2	7	10			2		2
179			1	2	3																						
180					1												1										
182					1										1												
183				2	7								1	2													
184				1	1																						
185					1								1				1										

APPENDIX IV
(continued).

Cat.#	Alibates					Niobrara				Tecovas			Tesesquite					Dakota Quartzite					Ogallala Quartzite				
	P	S	T	BT	Brk	S	T	BT	Brk	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk
186			1	3													2										
187				2	1								1														
188					1																						
189			1		2											1											
190				1	5																						
192				1																							
193					2																						
104					1																						
105					1																						
196																											
198					3																						
200					1																						
202					2																						
203					1																						
208				1																							
209				1																							
212		1		8	10			1			1					1					1						
213					1																						
214				2	1																	1					
215					2																1						
216					1																						
218				1																							
220					2																						
221												1										1					
222				1																		1					
224				9	8						1	2															
225					1																						
226				14	13							1															
227				4	13						1					1											
229				6	7			1													1	1					
230					2																						
232				1	1																						
233				3	1																						
234			1		1																						

APPENDIX IV
(continued).

Cat.#	Alibates					Niobrara				Tecovas			Tesesquite					Dakota Quartzite					Ogallala Quartzite				
	P	S	T	BT	Brk	S	T	BT	Brk	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk
235					1																						
236				1	4																						
237					1																						
238				2																							
239					2							1										1					
240					1			1																			
242				2	3																						
243				1	3							1										1					
244			2	10	18			1	1		1					2	1										
245			2	12	10											1											
246				2	9						1										1						
247			2	17	30			2							1						1	1					
248			4	18	17											2					1						
249			2	21	34			2								1					3						
250			2	8	15												1										
251				2	8													1									
253				2																							
255					1																						
257			1	1																							
258				1	1																						
259				3	4									1		1						1					
260				3	3													1									
261				1	9																	1					
262				2	2								1														
263					1																						
264				2																							
265					2																						
266					1																						
267				2	2																						
268				2	1												1										
270			3	7	14			1									2						1				
271			1														1										
272		1		7	9												1					1					
273																											

APPENDIX IV
(continued).

Cat.#	Alibates					Niobrara				Tecovas			Tesesquite					Dakota Quartzite					Ogallala Quartzite				
	P	S	T	BT	Brk	S	T	BT	Brk	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk
274			1	2	4				1																		
275			2	5	10											2	1				1	1					
276			2	7	7						2					1						2					
277					1																						
280			3	14	19												3						1		1	1	
281					9	10																					
282		1		2	16		1	1				1										4		2			
283				4	10																3						
284				16	9											3	2				5	1					
285			1	4	17							1		1						1	1						
286			1	3	8											2					1						
287			2	32	37				3					3			7	1			4	3					1
288			2	6	17												1										
289			3	28	21			2								2	1				2	1					
290					1																						
291			6	49	46			1						1		2	1				1	2		1			
292			4	14	10			1	1																		
293				2	1												1										
294				5	3																						
295					1																						
296					2											1											
297				3	7				1												1						
298				2	3												1										
299				1	1																						
300				1	4							1															
303					2											2											
304				1	1																						
305		1	3	19	11																						
306		1	8	30	13											2											
308			1	1	3																						
309				3	4																						
310				6	4																	1					
313																											
314				2	4																						

APPENDIX IV
(continued).

Cat.#	Alibates					Niobrara				Tecovas			Tesesquite					Dakota Quartzite					Ogallala Quartzite				
	P	S	T	BT	Brk	S	T	BT	Brk	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk
315				1																							
316				2	2																						
317																1											
318				1	1							1															
319			2		3																						
321																											
322			1	2	3																						
323				1	1																						
324					1																						
325				4	4																						
326				1	3																						
327				1	1																						
328					3																						
330				1	4			1	1													1					
331				1	2																						
333				2	1																						
335				1	1																						
336				1	1															1							
337				1																							
339				1	1			1																			
340			2		3																						
341				1	2										1							1					
342					2											1					1						
343			1		1																						
344				1	1																						
345																											
346			2	2	3																						
347				1		1						1															
349					2																						
352				2	2																						
354					1																						
355			1	1	1									1													
356				1	1																						
357					2																						

APPENDIX IV

(continued).

Cat.#	Alibates					Niobrara				Tecovas			Tesesquite					Dakota Quartzite					Ogallala Quartzite				
	P	S	T	BT	Brk	S	T	BT	Brk	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk
359				4	2																						
360				13	1																						
361				1																							
362			1	1																							
365			1	1																							
368				1	1																	1					
370																											
371				2	3																						
372				1	2																			1			
373				1											1												
374				1					1																		
377					1																						
378				10	5						1															1	
379					2						1																
382			1																								
383				1	4																						
384				1	1																						
385					1																						
386				1																							
388					5																						
389		1			4																						
390				1																							
391				1																							
392					4																						
393				1	2																						
394				3	4																						
395					4																						
398				7	1																						
399				51	15																						
401			1	2	2											1						1					
	1	21	265	1738	2214	13	3	55	46	3	17	24	11	23	21	108	92	9	9	8	98	123	7	9	6	6	13

Flake Type: P - Primary S - Secondary T - Tertiary non-biface thinning BT - Tertiary biface thinning Brk - Broken

APPENDIX IV
(continued).

Cat.#	Kenton Opalite				Unidentified Chert					Unidentified Quartzite					Day Creek				Mosquito Jasper			Petrified Wood		Total
	S	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk	S	T	BT	Brk	T	BT	Brk	T	BT	
1							1		2															19
5																								1
6						1	1	1						1										32
7																								5
8																								13
9														1										5
10																								2
11																								2
13																								2
14									1															5
15																								3
16																								1
17																								4
18																								7
19														1										23
20																								25
21							1																	14
22									1															10
23																								5
24									1															1
26																								1
27														1										10
28									1															10
29									1			1												15
31													1											8
32																								6
33									2				1											25
34									1				1											18
35																								5
36							1					1		1										13
38								1						1										32
39																								20
40														1										7
41									1					1										49

APPENDIX IV
(continued).

Cat.#	Kenton Opalite				Unidentified Chert					Unidentified Quartzite					Day Creek				Mosquito Jasper			Petrified Wood		Total
	S	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk	S	T	BT	Brk	T	BT	Brk	T	BT	
42							1		1															17
43																								17
44																								31
46														1										26
47							1	2																49
48							1					1												13
49							1	1				1												14
50																			1					9
51									2															22
52									1					2										40
53				3					1															56
54																								23
55			2	2										1										41
56																								4
57				1					1					1										18
58			1	1										1								1		49
59			1																					58
60									2															31
61				1																				6
62		1	1	1	1				1	1														35
63			1	1												1	1							21
64			1	1																				61
65				1	1					1														37
66									2															21
67									1					1										21
68			1						3					1										12
69																								9
70																								8
71									1															18
72								1						1										25
73									1					1										22
74				2					4				1	2										44
75									1															19
76									5				1	2										43

APPENDIX IV
(continued).

Cat.#	Kenton Opalite				Unidentified Chert					Unidentified Quartzite					Day Creek				Mosquito Jasper			Petrified Wood		Total
	S	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk	S	T	BT	Brk	T	BT	Brk	T	BT	
77					1	1			2															33
78																								2
79					2				1	1														13
80																								2
81																								2
82																								1
83									2															18
84									2															30
85									1															17
86				1					2															13
87	1								3															36
88												1		2										34
89									1															15
90																								6
91									1					2										34
92					1				2				1	3										36
93																								22
95			1				1	1	3				1	1										77
96									2					2										60
97									3					1										51
98														1										30
99								1	1															23
100									1								1							28
101																								16
102														1										12
103																								11
104																	2							8
105																								10
106																								2
107																	1							13
108																								1
110																								3
111								1	1															9
112								1	1															6

APPENDIX IV
(continued).

Cat.#	Kenton Opalite				Unidentified Chert					Unidentified Quartzite					Day Creek				Mosquito Jasper			Petrified Wood		Total
	S	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk	S	T	BT	Brk	T	BT	Brk	T	BT	
113									1	1			1	1										37
114						1																		24
115																								1
116																								1
118																								2
119																								1
120									1															15
121									2					1										54
122					3			1	1					4			1							50
123								1	1								1							44
124								1	1															13
125																								2
126																								2
127							1		1					1		1								35
128																								9
129																								2
130								1	2					2				2						85
131					1				1					1					1					42
132														1										11
133								1																8
134								2	1															67
135								1	2	1				1										79
136																								6
137								2	2			1		1										62
138								1																9
139								1	1															12
140									4					2			1							52
141					1	1	1	8	8	1		1		3	1		2	2						151
142																								1
143								1	2					2			1	1						132
144																	1							15
146									1				1											30
147																								19
148								1				1	1											19

APPENDIX IV
(continued).

Cat.#	Kenton Opalite				Unidentified Chert					Unidentified Quartzite					Day Creek				Mosquito Jasper			Petrified Wood		Total
	S	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk	S	T	BT	Brk	T	BT	Brk	T	BT	
149								2	4					2										40
150																								1
151																								1
152																								4
153									1															1
154							1																	15
155																								2
156								1																8
157																								6
159																								2
160																								3
161								1	2															21
162				2				2	1															41
163									1															10
164																								7
165								1	1															8
166																								5
167																								12
168								1																9
169								1																3
170								3	7											1				90
171																								12
172														1										6
173																								7
174								1						1										9
175									1															22
176									1															3
177		1					3	5	3	2			10	16										273
179																								6
180																								2
182																								2
183														1										13
184													1											3
185																								3

APPENDIX IV
(continued).

Cat.#	Kenton Opalite				Unidentified Chert					Unidentified Quartzite					Day Creek				Mosquito Jasper			Petrified Wood		Total
	S	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk	S	T	BT	Brk	T	BT	Brk	T	BT	
186																								6
187																								4
188																								1
189																								4
190																								6
192																								1
193																								2
194																								1
195																								1
196													1											1
198														1			1							5
200																								1
202																								2
203																								1
208																								1
209																								1
212												1												24
213								1																2
214																								4
215														1										4
216																								1
218																								1
220																								2
221									1															3
222																								2
224																								20
225																								1
226				1										1										30
227																								19
229																								16
230									1															3
232																								2
233																								4
234																								2

APPENDIX IV
(continued).

Cat.#	Kenton Opalite				Unidentified Chert					Unidentified Quartzite					Day Creek				Mosquito Jasper			Petrified Wood		Total
	S	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk	S	T	BT	Brk	T	BT	Brk	T	BT	
235																								1
236																								5
237																								1
238																								2
239																								4
240																								2
242			1																					6
243			1					1	1					1										10
244									1															37
245								2	2															29
246													1											14
247				1				1	2				1	2										61
248									3					3										48
249			1	1				1	3															69
250														1										27
251																								11
253																								2
255																								1
257																								2
258				1																				3
259																								10
260									1															8
261																								11
262																								5
263									1															2
264																								2
265																								2
266														1										2
267														1										5
268																								4
270								1	2															31
271				2																				4
272									1					2										22
273				1																				1

APPENDIX IV
(continued).

Cat.#	Kenton Opalite				Unidentified Chert					Unidentified Quartzite					Day Creek				Mosquito Jasper			Petrified Wood		Total
	S	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk	S	T	BT	Brk	T	BT	Brk	T	BT	
274																								8
275				2				1	4	1														30
276			2					1						1										25
277																								1
280			2				1		7					1										53
281				1					3	4														27
282				1					1															30
283								1	5															23
284								2	2															40
285			1						8		1													36
286			1				1	1	3														1	22
287								2	11					2		2	4	6						120
288				1			1	1	4					2										35
289			2	2				2			1			1		1	5							74
290			1																					2
291			1	1					8			1				1	12	1						135
292					1		1		1					1			1							35
293			1					1	1															7
294								1	1							1								11
295																								1
296									1															4
297							1		1															14
298																								6
299								1																3
300																	1							7
303			1					2	1															8
304																								2
305			1																					35
306								4	1															59
308																								5
309							1																	8
310																								11
313									1															1
314																								6

APPENDIX IV
(*continued*).

Cat.#	Kenton Opalite				Unidentified Chert					Unidentified Quartzite					Day Creek				Mosquito Jasper			Petrified Wood		Total
	S	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk	S	T	BT	Brk	T	BT	Brk	T	BT	
315																								1
316									1															5
317																								1
318																								3
319																								5
321																		1						1
322																								6
323																								2
324									1															2
325				1					1															10
326									1					1										6
327																								2
328																								3
330																								8
331									2															5
333																								3
335																								2
336																								3
337																								1
339								1	1															5
340								1	1															7
341																								5
342																								4
343																								2
344																								2
345														1							1			2
346					1			2						1										11
347																								3
349																								2
352				1																				5
354									1															2
355			1	3					1															9
356																								2
357																								2

APPENDIX IV
(continued).

Cat.#	Kenton Opalite				Unidentified Chert					Unidentified Quartzite					Day Creek				Mosquito Jasper			Petrified Wood		Total
	S	T	BT	Brk	P	S	T	BT	Brk	P	S	T	BT	Brk	S	T	BT	Brk	T	BT	Brk	T	BT	
359																								6
360									1															15
361																								1
362																								2
365									1															3
368																								3
370									1															1
371							1																	6
372																								4
373																								2
374									1															3
377																								1
378																								17
379																								3
382									1															2
383																								5
384																								2
385																								1
386																								1
388									1															6
389																								5
390									1															2
391																								1
392																								4
393																								3
394									1															8
395					1																			5
398								1	2															11
399																								66
401				1																				8
	1	2	26	38	14	4	22	82	224	13	2	10	24	101	1	7	36	13	2	1	1	1	1	5569

Flake Type: P - Primary S - Secondary T - Tertiary non-biface thinning BT - Tertiary biface thinning Brk - Broken

APPENDIX V
Unmodified Bone Quantities and Weight (g)

Cat. #	Provenience	Burned	Burned Wt.	Unburned	Unburned Wt.
1	Surface			2	32.3
6	S35E16/18	22	11.0	69	70.0
8	S30,E16			11	6.0
9	S30,E16			10	8.0
10	S30,E16			1	3.0
12	S30,E11	5	2.0	1	1.0
17	S27,E16	1	1.0	3	17.0
18	S27,E11	2	1.0	8	2.4
19	S27,E11	20	9.0	90	36.0
20	S27,E11	55	30.1	307	178.0
21	S27,E11	52	25.0	287	269.0
22	S27,E11	24	11.5	135	160.5
23	S27,E11	6	3.0	25	30.5
27	S23,E11	3	1.0	13	13.0
28	S23,E11	34	12.0	81	33.5
29	S23,E11	11	10.0	78	37.0
31	S23,E6	4	1.0	13	18.5
32	S23,E6	3	2.0	97	74.5
33	S18,E8	28	11.0	130	57.5
34	S18,E8	41	22.0	268	212.5
35	S18,E8	18	9.0	115	59.0
36	S18,E8	35	13.0	103	55.5
38	S18,E6	13	8.0	90	74.5
39	S18,E6	16	5.0	174	122.5
40	S18,E6	7	4.0	29	15.0
41	S18,E4	64	41.0	536	297.0
42	S17,E7	7	3.0	160	117.0
43	S17,E7	16	6.0	222	155.5
44	S17,E7	16	10.0	260	162.0
45	S17,E7			69	59.0
46	S17,E5	58	26.0	213	104.5
47	S17,E5	82	52.0	646	546.5
48	S17,E5	46	24.5	448	468.0
49	S16,E7	18	13.5	80	61.0
50	S16,E7	12	5.0	81	54.0
51	S16,E6	55	31.0	420	339.5
52	S16,E6	63	40.5	152	127.5
53	S16,E6	126	72.0	774	892.5
54	S16,E5	10	3.0	181	91.0
55	S16,E5	67	41.4	666	531.0
56	S16,E4			22	10.0
57	S16,E4	66	37.0	980	854.0
58	S15,E13	76	28.5	258	382.0
59	S15,E12	129	61.0	274	189.0

APPENDIX V
(continued).

Cat. #	Provenience	Burned	Burned Wt.	Unburned	Unburned Wt.
60	S15,E12	143	100.0	763	612.5
61	S15,E7	9	4.0	50	41.0
62	S15,E7	55	36.5	227	138.0
64	S15,E7	79	49.0	502	359.0
65	S14,E7	87	33.0	208	137.0
66	S14,E7	61	20.5	352	260.0
67	S15,E10	8	3.0	28	12.0
68	S15,E10	16	6.0	55	35.5
69	S15,E10	41	21.5	143	84.0
70	S15,E10	48	20.0	154	151.5
71	S14,E10	15	10.0	22	10.5
72	S14,E10	47	24.0	153	82.5
73	S13,E10	53	28.5	84	53.0
74	S13,E10	132	73.5	257	276.0
75	S13,E7	24	11.0	120	61.5
76	S13,E7	79	44.0	547	409.0
77	S13,E7	73	49.5	863	708.5
78	S13,E7			200	143.5
79	S12,E15	17	17.0	19	18.0
80	S12,E15	22	6.0	35	29.0
81	S12,E15	4	2.0	22	28.0
82	S12,E15			1	1.0
83	S12,E13	28	10.0	41	23.0
84	S12,E11	89	77.7	167	136.5
85	S12,E11	115	63.0	225	150.0
86	F#36	90	57.0	141	138.0
87	S12,E10	54	63.0	68	41.0
88	S12,E10	287	201.0	289	314.0
89	S12,E10	122	73.5	215	174.0
90	S12,E10	46	31.5	87	89.5
91	S12,E9	38	16.0	113	45.5
92	S12,E9	145	85.0	374	359.7
93	S12,E8	15	12.5	56	46.0
95	S12,E8	261	152.5	457	361.5
96	S12,E7	25	12.0	274	262.5
97	S12,E7	64	54.0	312	340.5
98	S12,E7	58	28.0	397	330.5
99	S11,E7	32	10.5	162	91.0
100	S11,E7	29	22.0	351	232.0
101	S11,E7	40	18.5	308	170.5
102	S11,E7	35	21.5	126	112.5
104	S11,E6	18	6.0	120	69.0
105	S11,E6	26	10.5	127	97.5
106	F#22	3	3.0	32	35.5
107	F#22	8	9.5	201	574.8

APPENDIX V
(continued).

Cat. #	Provenience	Burned	Burned Wt.	Unburned	Unburned Wt.
108	S11,E6	29	11.0	176	156.0
120	S6,E6	16	6.0	51	24.0
121	S6,E6	72	43.5	213	109.0
122	S6,E6	122	64.0	442	317.5
123	S6,E6	95	73.0	566	846.5
124	S1,E6	6	3.0	23	11.0
125	S1,E6	5	3.0	35	16.0
132	Entrance Rm 1A	23	15.5	284	595.0
147	Test Trench A, S. outside Rm 1A	21	9.0	628	506.0
157	South outside Rm 1A, btwn Rm 3A & 1A	25	17.0	189	144.5
269	Exterior east of Room 2A & Room 3A	1	2.5	25	219.0
Exterior	**Subtotal**	**4367**	**2531.7**	**20660**	**17785.9**
109	S11,E4	5	1.0	11	4.0
110	S11,E4	8	2.0	50	25.5
111	S10,E4	9	2.0	19	6.0
112	S10,E4	15	5.0	96	37.5
113	S10,E4	220	122.5	1754	1794.1
114	S10,E4	150	92.0	1374	1662.0
115	F#21	25	12.0	56	167.5
116	S10,E4	10	6.0	77	65.0
117	S10,E4	1	0.3	9	4.5
118	S10,E4	2	1.0	16	7.0
119	S10,E4			2	0.2
130	Area 7	78	37.5	510	361.5
131	Area 7	74	31.5	1127	717.5
Area 7	**Subtotal**	**597**	**312.8**	**5101**	**4852.3**
126	N.exterior & Area 6	2	0.5	16	4.0
127	N.exterior	13	7.0	421	245.0
128	Area 6	28	14.5	294	220.0
129	Area 6			10	14.5
145	Test Trench A, N. outside Rm 1A	2	0.4	47	135.5
Area 6	**Subtotal**	**45**	**22.4**	**788**	**619.0**
133	Area A1-a	11	5.0	20	8.0
134	Area A1-b	74	31.0	168	125.0
135	Area A1-c	58	42.5	110	77.5
136	Room 4	1	6.0	25	12.0
137	Room 1A	97	56.5	482	441.5
138	Room 1A Test Pit 1	53	30.0	79	62.5

APPENDIX V
(continued).

Cat. #	Provenience	Burned	Burned Wt.	Unburned	Unburned Wt.
139	Area A1-a	19	11.0	77	56.0
140	Room 1A	88	68.0	327	283.0
141	Room 1A	369	373.5	1261	1377.0
142	Room 1A Test Pit 2	1	0.2	30	15.0
143	Room 1A	426	433.2	615	810.5
144	Feature 5, below floor	296	896.3	121	142.0
146	Test Trench A, Interior Rm 1A	153	133.5	412	352.5
148	Trench B	56	28.2	120	75.0
149	Trench C	60	37.0	203	211.0
150	Ledge NE Rm 1A	5	8.0	44	22.0
151	Ledge NE Rm 1A	12	12.0	30	14.0
152	Ledge N. of entrance	1	0.5	7	177.0
153	Ledge E.wall entrance	7	4.5	19	7.5
154	Ledge S. of entrance	18	17.0	84	313.5
155	Ledge test pit E side			5	29.0
156	Ledge SE corner Rm 1A	34	18.0	51	28.5
158	Ledge W wall Rm 1A			2	11.5
159	Ledge NW corner Rm 1A	9	4.5	31	44.5
160	Ledge SW corner Rm 1A	21	53.0	42	35.0
161	NE 1/4 Room 1A	55	70.5	217	209.5
162	NE 1/4 Room 1A	113	253.5	695	539.5
163	SE 1/4 Room 1A	16	8.5	57	58.5
164	SW 1/4 Room 1A	23	24.5	82	63.5
165	West 1/2 Room 1A	31	22.0	50	72.0
166	NW 1/4 Rm 1A,Pit	1	0.3	4	62.5
167	trench west wall Rm 1A	17	7.0	20	10.0
168	Center of Room 1A	26	13.0	49	137.0
169	W wall of Rm 1A ash	2	0.5	12	74.5
170	Ash Room 1A near hearth	427	241.0	473	447.0
171	Ash Room 1A near hearth	58	21.5	103	48.5
172	Feature 11	157	64.5	53	19.5
173	Feature 13, Level A	24	8.0	1136	1219.5
174	Feature 13, Level A	16	37.0	96	39.5
175	Feature 13, Level B west	50	29.0	480	271.5
176	Feature 13, Level B east	13	5.0	108	65.0
177	Feature 13, Level C	880	449.0	6451	6286.9
178	Profile cut Feature 13	5	2.0	9	4.0
179	Feature 14	39	16.0	3	5.0
180	Feature 15	17	29.0	9	7.0
181	Feature 15	7	2.5	13	6.5
182	Feature 15	1	0.4	10	5.3
183	Feature 16	21	5.5	45	11.0
184	Feature 17	40	24.0	13	6.1
185	Feature 18	41	11.5	56	55.5

APPENDIX V
(continued).

Cat. #	Provenience	Burned	Burned Wt.	Unburned	Unburned Wt.
186	Near Feature 18, floor level	33	10.9	61	31.0
187	Feature 25	7	3.0	80	115.0
188	Feature 26	1	0.5	4	1.3
189	Feature 30	36	17.5	234	95.0
190	Feature 31	66	39.5	42	37.5
192	Trench A North	2	0.3	8	3.5
193	Trench A South	3	2.0	16	7.0
194	Trench A North and South	4	1.0	4	1.0
195	Trench A, Section 2			7	1.5
196	Trench A, Section 3	15	6.0	11	4.0
197	Trench A, Section 3	5	3.5	12	57.5
198	Trench A, Section 4	34	9.5	5	3.0
199	Trench A, Section5			2	0.5
200	Trench A, Section 6	4	2.0	38	16.0
201	Trench A, Section 6	1	0.5	20	12.0
202	Trench G-W-1			15	50.0
203	Trench G-E-1	1	0.5	6	7.0
206	Trench F-E-1			5	3.5
209	Trench H-W-1			7	4.5
210	Trench H-E-1	3	1.5	1	0.5
212	Trench B-W-2 bench	22	10.0	135	396.0
213	Trench B-W-2	2	1.0	3	1.5
214	Trench B-W-1	23	15.0	27	8.0
215	Trench B-E-1	5	4.0	9	4.0
216	Trench I-W-2	12	4.5	18	14.5
217	Trench I-W-1	6	1.5	5	3.0
218	Trench I-E-1			1	0.5
219	Trench E-W-2	3	0.5	8	1.5
220	Trench E-W-1	3	1.5	4	1.0
221	Trench E-E-1	3	0.5	20	8.5
222	Trenches J and K	7	1.5	53	16.5
401	Unknown	5	13.0	50	58.5
Room 1A	**Subtotal**	**4255**	**3766.3**	**15520**	**15420.6**
224	Feature 1	11	10.5	190	114.5
225	Feature 2	6	1.0	20	7.0
226	Room 2A	41	15.5	240	113.5
227	Room 2A	51	27.5	425	240.0
229	Room 2A, floor level	19	7.5	353	379.0
230	S11,E5	5	1.0	45	14.0
231	S12,E5	1	0.5	8	4.5
232	S12,E5	3	0.5	36	20.5
233	S12,E5	6	2.0	61	34.5
234	S12-E5	8	5.0	87	54.0
235	S12-E5			6	24.0

APPENDIX V
(continued).

Cat. #	Provenience	Burned	Burned Wt.	Unburned	Unburned Wt.
236	S13,E5	3	1.0	39	23.0
237	S11,E6	3	1.0	11	5.5
238	S12,E6	3	1.0	34	20.0
239	S12,E6	14	6.0	39	20.5
240	S12,E6	10	4.5	33	22.0
241	S13,E6			6	3.0
242	S13,E5	3	1.0	96	62.5
254	Trench D-3	8	2.0	106	121.5
255	Trench D-3	4	4.5	35	20.0
256	Trench D-3	1	1.5	28	22.5
257	Trench D-3	1	0.5	12	14.0
Room 2A	**Subtotal**	**201**	**94.0**	**1910**	**1340.0**
243	Rm 3A Surface	11	3.0	7	2.0
244	Feature 4	166	79.5	594	463.0
245	Feature 4	184	79.5	725	586.0
246	Room 3A, Test Pit 3	34	8.5	151	128.5
247	Room 3A	142	49.5	445	358.5
248	Room 3A	158	88.0	690	546.0
249	Room 3A	148	66.5	1164	1392.5
250	Room 3A	69	36.0	541	442.0
251	S14E6	19	7.0	118	47.0
252	Room 3A			16	10.5
253	Room 3A,E of Feature 4	2	1.0	22	24.0
258	Rm 3A,Trench D,Sec 4	15	8.5	120	67.5
259	Rm 3A,Trench D,Sec 4	29	24.0	189	188.0
260	Rm 3A,Trench D,Sec 4	43	33.0	350	328.5
261	Rm 3A,Trench D,Sec 4	76	42.5	471	673.5
262	Rm 3A,Trench D,Sec 5	24	10.0	87	22.5
263	Rm 3A,Trench D,Sec 5	17	4.5	87	85.0
264	Rm 3A,Trench D,Sec 5	34	9.0	141	99.5
265	Room 3A, Trench D, Sections 3,4,& 5 profile	3	1.0	43	31.0
266	Rm 3A,Trench D,Sec 5			27	21.0
267	Room 3A, E bench	7	8.0	183	139.5
268	Room 3A,NW corner	4	1.5	34	65.0
270	Feature 23	208	126.0	983	1070.0
271	Feature 23	39	24.0	219	171.0
272	Feature 24	184	99.5	1053	923.5
273	Feature 24	9	2.5	49	20.0
274	Feature 27	61	31.5	228	384.0
275	Feature 29	90	76.0	577	624.5
276	Features 23, 24, & 29, east wall Trench D fill	144	76.5	854	931.5
277	Features 23,24,& 29,upper fill	12	9.0	76	59.0

APPENDIX V
(continued).

Cat. #	Provenience	Burned	Burned Wt.	Unburned	Unburned Wt.
278	Features 24 and 29, upper fill, S15E6	2	0.5	14	19.0
279	Room 3A, bench west wall near Trench D-4	7	3.5	34	29.5
293	Room 3A, west pit profile S15E6 & S14E6	186	125.5	822	891.5
Room 3A	**Subtotal**	**2127**	**1135.0**	**11114**	**10844.5**
280	Room 5A	131	75.5	492	891.0
281	Room 5A	109	54.5	886	580.7
282	Room 5A	111	60.5	614	500.5
283	Room 5A	103	61.5	616	593.0
284	Room 5A	249	98.0	2050	1891.5
285	Room 5A	176	96.5	1241	1327.5
286	Room 5A	76	71.5	529	671.0
287	Feature 6	285	206.0	1239	1390.0
288	Feature 7	87	47.0	974	1338.5
289	Feature 8	244	173.4	1580	2484.5
290	Baulk btwn. F# 6 & 8	28	14.0	74	47.5
291	Feature 9	838	560.0	5850	6752.5
292	Feature 10	186	125.5	822	891.5
Room 5A	**Subtotal**	**2623**	**1643.9**	**16967**	**19359.7**
294	S13,E0			52	56.5
295	S13,E0	1	0.5	58	25.5
296	S13,E0			25	65.5
297	S14,E0	6	4.0	39	76.5
298	S14,E0	5	2.0	98	154.5
299	S14,E0	6	1.5	122	260.0
300	Room 1B Entrance	19	25.0	193	450.0
301	Room 1B Entrance	1	0.5	52	66.5
303	Room 1B Entrance	13	6.0	52	164.0
304	Room 1B Entrance			5	4.0
305	Room 1B Entrance	140	279.5	236	724.0
306	Room 1B Entrance	30	14.0	96	262.0
309	Room 1B Entrance	11	15.0	52	65.5
310	Room 1B Entrance	20	15.5	53	48.5
312	Room 1B, main room floor level, square unknown			3	12.0
313	S12,W1	2	1.0	2	1.0
314	S12,W1	1	0.5	19	4.5
315	S12,W1			27	20.5
316	S12,W1	1	0.5	8	2.5
317	S12,W1			3	3.5
318	S13,W1	1	0.5	5	26.0

APPENDIX V
(continued).

Cat. #	Provenience	Burned	Burned Wt.	Unburned	Unburned Wt.
319	S13,W1	3	0.5	35	16.0
320	S13,W1	1	0.5	19	8.8
321	S13,W1	2	0.5	63	56.5
322	S14,W1	9	8.0	40	13.5
323	S14,W1	3	7.0	60	69.0
324	S14,W1	4	1.0	49	26.0
325	S15,W1	8	2.5	29	20.0
326	S15,W1	7	3.5	149	69.0
327	S15,W1	7	12.0	148	183.5
328	S16,W1			6	2.0
329	S16,W1	1	0.5	3	0.5
330	S12,W2	4	1.0	16	4.0
331	S12,W2			8	4.5
333	S12,W2	2	0.5	1	0.5
334	S13,W2	4	1.5	1	0.5
335	S13,W2			11	4.0
336	S13,W2	2	4.5	9	48.5
337	S13,W2			18	6.5
339	S13,W2	1	0.5	6	1.0
340	S14,W2	2	0.5	21	20.0
341	S14,W2	2	1.5	40	17.0
342	S14,W2	3	4.5	85	113.0
343	S14,W2			10	5.5
344	S14,W2			5	1.0
345	S14,W2	4	3.0	1	1.5
346	S15,W2	2	0.5	55	29.5
347	S15,W2	1	0.5	85	98.5
348	S15,W2			2	39.5
349	S16,W2			4	1.5
352	S12,W3			7	3.5
353	S12,W3			7	2.0
354	S13,W3			1	0.5
355	S13,W3	1	0.5	5	3.5
356	S13,W3	2	3.0	12	5.0
357	S13,W3			9	5.5
358	S13,W3			8	5.0
359	S14,W3			1	0.5
360	S14,W3			12	2.5
361	S14,W3	2	5.5	19	11.0
362	S14,W3	3	1.0	25	19.0
363	S14,W3			13	9.0
364	S14,W3			24	47.5
365	S15,W3			5	3.0
366	S15,W3			5	2.5
367	S15,W3			3	3.0

APPENDIX V
(continued).

Cat. #	Provenience	Burned	Burned Wt.	Unburned	Unburned Wt.
368	S16,W3			2	0.8
371	S12,W4			3	1.0
372	S12,W4			2	0.5
373	S13,W4	2	1.0	1	0.5
374	S13,W4	1	1.0	6	30.0
375	S13,W4			2	0.5
377	S13,W4			3	4.5
378	S14,W4	2	1.0	5	3.0
379	S14,W4	1	0.5	5	16.5
381	S14,W4	1	0.5	1	1.0
382	S14,W4			18	6.0
383	S15,W4	1	1.0	3	3.5
384	S15,W4	1	1.5	8	4.5
385	S15,W4	1	0.5	4	4.5
386	S16,W4			8	15.5
392	S14,W5			3	10.5
394	S14,W5	1	1.0	1	17.5
395	S15,W5			9	4.5
396	S15,W5	1	0.5	3	0.5
Room 1B	**Subtotal**	**349**	**439.0**	**2422**	**3602.6**
Total		**14564**	**9945.1**	**74484**	**73856.9**