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THE RAVENSCROFT II SITE: A LATE PALEO-INDIAN WINTER BISON KILL EVENT IN THE OKLAHOMA PANHANDLE

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ABSTRACT

The winter kill model combines aspects of optimal foraging theory and animal behavioral ecology to explain large scale bison hunting organization on the North American Great Plains. These same theories are applied to the late Paleo-Indian age Ravenscroft bison kill in the Oklahoma Panhandle. The results show the Ravenscroft II site fits the winter kill model. The site is in close proximity to Bull Creek, a tributary of the Cimarron River, which would have provided ample vegetation for bison consumption. Additionally, tooth eruption patterns show wear associated with an 8 month old calf; the calving season spans from March – May with peaks in April. Finally, the herd targeted during the kill event was composed of mature cows carrying fetuses, this is the single greatest indicator of seasonality.

CHAPTER 1:

INTRODUCTION

Paleo-Indian bison kill sites on the Plains of North America have received considerable investigation over the past century, yet with each new discovery comes new avenues of inquiry. In this thesis, I apply a Winter Kill Model developed to explain bison hunting on the Northern Plains to the Ravenscroft II Late Paleo-Indian site located on the Southern Plains. The Ravenscroft II site is located on the Southern High Plains along the left flank of a first order tributary to Bull Creek in western Beaver County, Oklahoma (Figure 1). Buried within an ancient arroyo are the bones from at least two large scale bison kill events. This thesis presents the analysis of the upper deposits and sets the stage for a similar study of the lower bonebed. A great many Paleo-Indian age sites in the Southern Plains are represented by arroyo bison kills. These sites facilitate investigative research into a variety of topics including what animals were killed, who killed them, when were they killed, and what happened to their butchered carcasses. The analysis of the Ravenscroft II site materials follows the guiding expectations provided by the Winter Kill Model outlined by Malainey and Sherriff (1996), Quigg (1978), Frison (1980), and Arthur (1974).

The Winter Kill Model was developed on the Northern Great Plains to explain why most bison kill sites occurred during the winter. Previous work on the Southern Plains has determined that early Paleo-Indian bison kills primarily occur during the summer, but then shift to winter kills during the subsequent Late Paleo-Indian period. I apply the Winter Kill Model to the Late Paleo-Indian age Ravenscroft II site to help explain why this shift occurred.

Chapter 2 presents the foundational theories that this study is based on. Chapter 3 discusses the physical and environmental context of the study area and Chapter 4 provides a glimpse of the people and cultures who have inhabited the Southern Plains. Chapter 5 begins discussion of the Ravenscroft II site, while Chapter 6 discusses the excavation and analytical methods utilized pre and post excavation. Radiocarbon dating is the subject of Chapter 7. The results of the analysis described in Chapter 6 are presented in Chapter 8, followed in Chapter 9 by a discussion of the butchering practices, parallels to the Olsen-Chubbuck site, transport decisions, and lithic comparisons. The final conclusions are presented in Chapter 10 followed by future investigations.

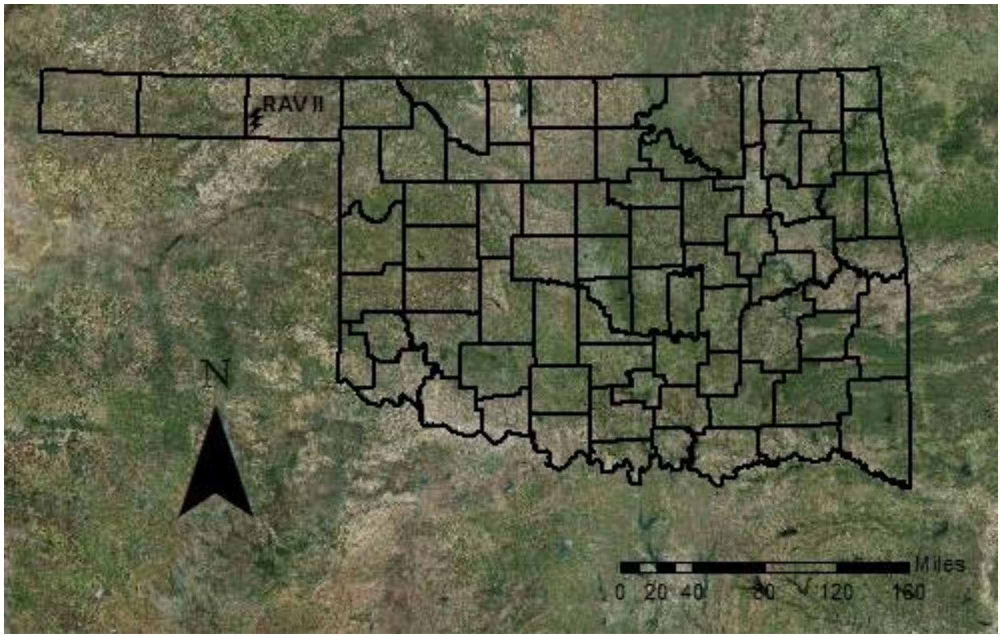


Figure 1. Ravenscroft II geographic location.

CHAPTER 2:

THEORIES OF BEHAVIOR AND PROCUREMENT

The Ravenscroft II site can greatly benefit from evolutionary and ecological theory application. Foraging models such as diet breadth, resource patch choice and decision making can aid in the explanation of pre- and post-kill factors that created the Ravenscroft II site. Evolutionary and ecological theory can also aid in macro analysis, such as Graves' (2008) exploration of the relationship between the characteristics of a region's resources and the land use patterns of its human inhabitants. Applying evolutionary ecological theories to faunal analysis can help predict procurement strategies and aid in interpreting results (Graves 2008).

Behavioral Ecology and Foraging Theory

Human Behavioral Ecology (HBE) began in the mid-1970s with the application of models of optimal foraging (Winterhalder and Smith 2000). The school of thought's early goals were to blend Julian Steward's culture ecology studies of hunter-gatherers with emerging Neo-Darwinian approach to behavior (Winterhalder and Smith 2000). A behavioral ecology explanation would include models of circumstance and mechanism. Models of Circumstance seek the answer to questions such as, how do socioenvironmental factors shape cost/benefit? Models of Mechanism would seek to answer: how does natural selection, sex selection, or kin selection act on those cost/benefits? HBE creates testable hypotheses with mathematical models grounded in principles of evolution by natural selection, a hypothetic-deductive research strategy (Winterhalder and Smith 2000).

An example of behavioral ecology in relation to my research i.e. bone beds, is Winterhalder and Smith's (2000) discussion of distribution and composition of prehistoric faunal assemblages. In short, selective field processing and transport create the uncovered bone bed assemblage (Graves 2008). Central Place Foraging models are used to predict when resources will undergo field processing. Field processing lessens the number of trips (Model of Circumstance), and the load is comprised of high value materials (Model of Mechanism).

Communal hunt kill sites house hundreds of thousands of butchered and field processed specimens. What kind of social relationships had to exist in order to coordinate and organize a successful hunt on such a level? Through the application of behavioral ecology, Winterhalder and Smith (2000) believe that only with the development of exchange based food transfer did it become feasible for individual hunters to target large game, in this instance bison. Predation of meat depends on the organization of humans, the nature of the prey, and external environmental variables (Driver 1990). The effective value of a large mammal to a lone hunter is less than the cost and energy output of pursuit, capture, ad transport. However, once an effective system of exchange networks was created, it offset the cost, making such large prey more likely to enter the diet (Winterhalder and Smith 2000).

Foraging models were created to investigate hunter-gatherer decisions in regards to land use and resource selection. Optimal foraging theory falls under the evolutionary ecology school of thought, which also includes evolutionary genetics, community ecology, animal behavior, and decision theory (Winterhalder and Smith 2000). Optimal foraging theory and strategies provide a generalized yet realistic approach to the analysis of hunter-gatherer behavior. The behaviors of the animal will determine the foraging strategy; mobile but aggregated prey such as bison require a combined group strategy (Graves 2008). These models produce operational hypothesis testing of foraging behaviors expected in different environmental circumstances (Winterhalder 1981). Graves (2008) explores the relationship between the characteristics of a region's resources and the land use patterns of its human inhabitants.

Foraging Models

Models of optimal diet are concerned with the forager's choice of food in any given environment. These models were created to predict the answers to such question as: What food resources will a forager prefer? What food resources will be passed over when encountered? What environmental occurrences will affect diet breadth, and will cause it to expand or tighten? Why did the forager choose this resource over another? Foraging models are used to predict these answers by testing models against observations.

Diet Breadth

Diet breadth is the range and quantity of food resources consumed by a forager in any given environment. Heterogeneous environments have a discontinuous or mosaic resource distribution, and well mixed, similar, and evenly distributed resource environments are uniform (Winterhalder 1981). Foragers are categorized as generalists or specialists (Winterhalder 1981; Binford 196X). Generalists consume a broad range of resources, and inversely specialists target specific food resources. Graves (2008) uses a diet breadth model to conclude bison were abundant and a highly ranked resource exploited by hunter-gatherers.

Graves (2008) utilized a diet breadth model in conjunction with faunal analysis to test hypotheses about the characteristics of subsistence practices at the Protohistoric Crandall site in the Upland Plains region. The first hypothesis stated the inhabitants of the Crandall site had a specialized diet composed of bison meat because bison were abundant and a highly valued resource (Graves 2008). There were numerous other species unearthed at the site including: turtle, deer, coyote, beaver, and mussels (Graves 2008). However, the faunal record supports the hypothesis of bison consumption specialty through sheer quantity. The second hypothesis stated the hunting strategy used by the Crandall inhabitants increased their pursuit cost and subsequently their diet was geared towards the procurement of large quantities of bison (Graves 2008). The faunal record indicates that both high and low utility portions were transported back to the site. This indicates some of the kills occurred closer to camp and it was not necessary to butcher the carcass to such an extent that decisions concerning high or low quality (Graves 2008).

Resource Patch Choice

Optimal foraging theory employs spatial models to predict foraging relative to resource distribution (Winterhalder 1981). There are two strategies to be employed when hunting mobile prey such as bison: sit and wait or forage widely (Winterhalder 1981; Pianka 1978). The sit and wait method is best executed when the prey type is dense, highly mobile, and the predator has a low resting requirement. Foraging widely is best when prey type is sedentary and low density with the predator having a high resting metabolic requirement (Winterhalder 1981). The patch use model described by Winterhalder (1981), ranks patch types from most to least with regards to decreasing yield, i.e. time and energy cost. This foraging model has two phases: hunting time/energy and number of patch types.

The fractal patch model (FPM) predicts the spatial scale at which foragers should notice resource differentiation as well as to predict the relationship between the environmental structure and ratio of patches usable to foragers; it can be viewed as an optimal patch model (Cannon and Meltzer 2008). Fractal patch modeling has several advantages when compared to optimal foraging theory. FPM makes fewer assumptions, it is not simply a model of resource choice but general model of landscape use and it can make subsistence and mobility predictions (Cannon and Meltzer 2008). For example, foragers in a fine-grained environment should travel over a shorter distance as they utilize greater portions of the relatively small resource area of the environment (Cannon and Meltzer 2008). Fine-grained environments are heterogeneous with many small resource patches. Coarse-grained environments are homogenous, containing a few large resources. The most efficient foraging strategy would be to use the few largest patches and ignore the rest (Cannon and Meltzer 2008). This predictive model is facilitated by tradeoffs instead of searching for, and handling resources (Cannon and Meltzer 2008). When large resource patches are available, the cost of time spent traveling between patches is higher than when patches are small (Cannon and Meltzer 2008; Stephens and Krebs 1986). Additionally, low return resources are best exploited only when high return resources are unavailable.

Decision-making

To fully understand foraging behavior, the decision process must be taken into account (Mithen 1989). Mithen (1989) believes there is a need for a complementary approach to foraging behavior models which focus on the decision making process. Optimal foraging theory (OFT) is not wholly perfect. There are theoretical and methodological issues with the concept of optimization. There is little rationale in assuming that humans forage optimally. Mithen (1989) sought to remedy this by substituting meleorizing for optimization. Meleorizing means to improve upon and not to maximize foraging efficiencies (Mithen 1989). OFT models are also static in that the values of prey and patch types do not change over time. When variables such as resource depletion, environmental disturbances, or other random and rare events are included, the model becomes not only more complex but also closer to actual conditions in ecological evolution (Mithen 1989). The importance of discussing the acquisition of environmental knowledge/information and the investment in time and energy in doing so has been neglected, because it is has been unconsciously assumed (Mithen 1989). Additionally, in light of the flexible nature of human behavior it should be expected that individuals will switch between goals, currencies, and constraints that are liable to change shortly, seasonally, with age, or in the protracted future (Mithen 1989).

Mithen's (1989) approach utilizes a decision rule model which explores decision process through the use of computer simulations (Jochim 1983). Mithen (1989) also employs Binford's (1980) notion of encounter foraging, which is on the spectrum of hunter-gatherer settlement patterns. Encounter foragers are characterized as highly mobile with little to no food storage and living in low latitudes. The decision is whether or not to exploit the resource upon encounter. Considering the decision from the individual’s point of view invokes the notion of stalk probabilities. A hunter will choose to stalk an animal if such an activity is likely to increase but not maximize foraging efficiency. Decisions regarding procurement are influenced by long and short term goals, learned experiences, as well as learned knowledge from others (Mithen 1989).

The Ravenscroft II site can greatly benefit from the application of evolutionary and ecological theory. The people responsible for the kill event were living in a dynamic environment with a multitude of subsistence options. Foraging models such as diet breadth, resource patch choice and decision making can aid in the explanation of pre- and post-kill factors that created the Ravenscroft II site. Evolutionary and ecological theory can also aid in macro analysis, such as Grave’s (2008) exploration of the relationship between the characteristics of a region’s resources and the land use patterns of its human inhabitants. In this instance the region’s resources are bison, and the land use pattern present at Ravenscroft II is a natural arroyo trap. Applying evolutionary ecological theories to faunal analysis can help predict procurement strategies and aid in interpreting results (Graves 2008). For the hunters at the Ravenscroft II site, one of the most crucial decision-making choices occurred post kill in the consideration of the method of butchery relative to travel distance. Utilizing the Hadza hunter-gathers of South Africa, Lupo (2006) investigated methods of butchery in relation to travel distance and expectations for the resulting faunal assemblage. Unfortunately, Lupo’s (2006) results showed there was no single guide for determining processing and transport decisions for impala and zebra; however, her data can be useful in formulating assumptions and possible expectation for faunal assemblages.

Bison Procurement Models

Bison procurement strategies of prehistoric peoples on the Great Plains have brought great intrigue and warranted investigation. Models reflecting procurement strategies have been proposed to help explain the organization of procurement and strategies for procurement at specific locations at particular times in the past (Cooper 2008). These models are intended to be utilized at a regional scale and it is important to test models against the known archaeological record to better assess applicability on a broader scale (Cooper 2008). Five models were created to explain bison procurement strategies; however, only two are pertinent to the discussion: the Annual and Fall bison procurement model and the Winter procurement model (Arthur 1978; Brink 2008; Fawcett 1987; Frison 1967b, 1970, 1971; Hamilton et al. 2006; Malainey and Sheriff 1996; Speth 1983; Quigg 1978).

The Annual and Fall bison procurement model (Fawcett 1987), suggests bison procurement occurred on a yearly basis and the timing of the event was dependent upon biological and behavioral patterns of the bison population (Cooper 2008). Bison behavior and herd structure vary throughout the year according to reproductive cycles (Cooper 2008). Communal hunts could only occur during a brief window between the rut when bison behavior was too erratic, and severe winter storms when herds dispersed (Cooper 2008). Communal hunts were organized in the fall to stockpile meat and other byproducts for the lean winter months. Bison are also in prime condition and have the greatest bodily fat stores in the fall. A key element to this model is the assumption that hunters sought fat and scheduled their communal hunts to maximize bison body fat stores (Brink 2008; Cooper 2008; Speth 1983). However, some scholars questioned this model. Using historic ethnography and first-hand observations an alternative model was proposed (Cooper 2008).

Both Walker (1987) and Arthur (1975, 1978) made clear with historic records and first-hand observations via trappers and explorers that communal hunting occurred throughout the winter (Cooper 2008). Initially, it was believed was that the Plains were abandoned by both human and bison populations and that indigenous people experienced a semi-starvation period where they subsisted on pemmican and other food stuffs until winter broke (Quigg 1978; Malainey and Sherriff 1996). However, there is substantial evidence for winter kill and camp sites (Malainey and Sherriff 1996). Arthur (1978) claimed that tribes such as the Blackfoot and Cree used bison jumps and corrals not only in the fall, but in the winter as well.

Arthur (1974) also argued that winter kills are a normal occurrence and that the pattern is reflected in kill site age structure, i.e. kill events occur seasonally. Prey density is a major contributing factor. According to Frison (1980), there would need to be enough bison present to make winter communal kills feasible. Frison (1980) goes on to state that success ratios (kill events) increase significantly above a certain density threshold. During winter buffalo congregate in sheltered wintering areas. Arthur (1978also noted that as bison moved into their winter grounds, they aggregated into large sedentary herds, and that the herd size facilitated the formation of a camp capable of supporting one to two thousand individuals looking to exploit the herd for its resources. According to Malainey and Sherriff (1996) many of winter habitation camps are located along rivers due to the available vegetation. With the presence of fresh water, vegetation, and large bison herds, it wasn’t necessary to abandon the Plains during winter. During winter, bison herds are primarily composed of mature cows carrying fetuses as (the calving season spans from March – May with peaks in April [Arthur 1975]). Fetal bone is identified as small, very porous elements of bone tissue (Quigg 1978). Tooth eruption patterns and the presence of fetal bone are indicators of seasonality at bison kill sites (Malainey and Sherriff 1996; Quigg 1978). Assessing the stage of fetal growth can pinpoint seasonality more accurately (Frison 1980)

Movement of bison is critical to the reconstruction of seasonal activity patterns of hunters dependent upon them (Malainey and Sherriff 1996). Bison life cycle was a key factor in their hunt. Cows and bulls travel together only during the rut; the rest of the year they are split into male/female herds with females caring for the calves (Carlson 2015). Cows carry more fat throughout the year and are therefore primary targets. Bulls carry more fat going into rutting season; however, hormones make the meat undesirable and is only consumed in dire straits (Brink 2008; Carlson 2015; Ewers 1958; Speth 2010).

As far as procurement is concerned, there is no real style difference between winter kills and kills during other seasons i.e. arroyo trap, just adaptations. Hunters drove bison across the grasslands into deep snow drifts that accumulated in the valleys and make the kill while the bison floundered in the deep snow (Catlin 1841; Ewers 1958; Quigg 1978).

Although these models were created to deal with bison procurement, organization, and behavior on the far northern Plains, they can be applied at a regional scale. It is important to test models against the known archaeological record to better assess applicability on a broader scale.

Based on work by Malainey and Sherriff (1996), Quigg (1978), Frison (1980) and Arthur (1974), there are a number of more specific expectations for a winter kill. These include:

1. Bison herd quantity large enough that a communal kill is feasible.
2. Winter kills are patterned and will be reflected in the kill site age structure.
3. There should be fresh water and plentiful vegetation in the surrounding area.
4. The seasonality of kills should be during winter, as indicated by fetal growth and tooth eruption and wear patterns.
5. Butchering patterns should reflect decisions about animal part transport to a secondary processing or base camp.

The environment is the foundation for ecology. The following Chapter, “Environment,” illuminates the climate pre- and post-Holocene on the Southern High Plains. The Chapter also illustrates how climate change can alter established lifeways.

CHAPTER 3:

ENVIRONMENT

Physiography and Geology

The Oklahoma Panhandle encompasses Cimarron, Texas, and Beaver counties (Doerr and Morris 1960). The Panhandle consist of detrital materials such as silt, sand, and gravel laid down via stream activity (Doerr and Morris 1960). The majority of the Panhandle is flat, with the exception of places that erosion has produced irregularities that created ledges and bluffs (Figure 2) (Doerr and Morris 1960; Fenneman 1931). An additional exception is Northwest Cimarron County, at the western margin of the Panhandle. Volcanic activity in the Capulin area of New Mexico created an area where the elevation reaches 1524 meters above sea level (m asl)- at the crest of Black Mesa State Park. The eastern margin of the Panhandle has an elevation of 640 (m asl) (Doerr and Morris 1960).

The western portion of the Southern High Plains annually averages 500 mm of precipitation. However, the climatological records for the Panhandle are both incomplete and irregular (Doerr and Morris 1960; Ferring 1990). During the wet periods, crops flourish and the range land is productive but during dry periods the soil blows, dust fills the air, and economic life suffers (Doerr and Morris 1960). Evidence suggests there is a short term cyclical period of 11 years between peaks and saddles on the precipitation curve (Doerr and Morris 1960). Wind is tied to life on the Plains. The mean velocity on the ranges from 12 to 18 mph, and the strongest winds blow from a westerly direction. However, the most common winds are southwesterly (Doerr and Morris 1960; Webb 1931).

Figure 2. General view from Ravenscroft II; facing North, showing the eroded landscape.

The Bull Creek site (34BV176) in the Oklahoma Panhandle has yielded information necessary for reconstructing the local past environmental conditions. Bull Creek is located approximately 1.2 km west of Ravenscroft. The Bull Creek site and nearby localities produced an environmental reconstruction spanning the Pleistocene – Holocene transition via analysis of soils, sediment size distribution, stable carbon isotopes, pollen, and phytoliths (Bement et al. 2007).

Bull Creek is a tributary of the greater Beaver (Canadian) River, which flows east – west through the Panhandle (Carter and Bement 2004). The lateral migration of the river exposed several profiles for study. Permian age rock such as Dog Creek Shale, Whitehorse Group, Cloud Chief Formation, and Quartermaster Formation lie beneath and line the walls of Bull Creek (Gustavson et al. 1991). Red-pink sandstone and gypsum are present as well as Ogallala; however, it only occurs in certain stratigraphic layers (Bement et al. 2007). Arauza (et al. 2016) describe the three main formations as Permian Cloud Chief, the Doxey Formation, and Neogene Ogallala. The Permian and Doxey formations are described as an extensive collection of Permian red clay, shales, fine sandstones, siltstones, and thin gypsum. This suite of material underlies much of the Texas Panhandle, western Oklahoma, and southwestern Kansas (Gould and Lonsdale 1926; Johnson 1972). The Ogallala formation lies just above the Cloud Chief Formation and contains heterogeneous mixture of lithified fluvial gravels, sand, and mud from the Rocky Mountains during the Neogene (Arauza et al. 2016). The Ogallala Formation outcrops as white, pink, and red gravely sandstone beds in gullies, cut banks, and in the active stream bed. Unconsolidated fluvial and aeolian sediment deposited during the late Pleistocene/Holocene overlay the Cloud Chief and Ogallala Formations (Bement et al. 2007). Aggradation and incisions created by the Bull Creek have created fluvial terraces with cut banks along the modern creek, exposing the valley fill stratigraphy (Bement et al. 2014; Bement et al. 2007; Carter and Bement 2004; Woldeareguay et al. 2012).

Soils

The soils of the Oklahoma Panhandle are pedocal meaning they are rich in calcium carbonate and have low soil organic matter. The top soil has a depth of 30 – 71 cm below the surface. Soils in the western most portion of the Panhandle have depths of 30 – 45 cm before reaching limestone bedrock (Doerr and Morris 1960). The soils' inherent fertility is high with abundant potash and phosphorus; nitrogen is weak (Doerr and Morris 1960). The upland soils are described as loamy with sand dunes present along the northern margins of the Beaver River (Arauza 2016). Stream valley erosion has created rougher terrain laced with caliche, gypsum, and consolidated sediments. Plowing and overgrazing have led to erosion in many places.

Investigation by Bement (et al. 2007) revealed there are three depositional units excluding the Permian sandstone of the Cloud Chief Formation at the base of the Bull Creek profile. The lowest layer just above bedrock is composed of an alluvial deposition of gravels and sand (Unit I). Unit II consists of a shift to colluvium/alluvium of silt loams with gravel and sand stringers. The final upper layer, Unit III consist of wind-deposited silts (Bement et al. 2007). Pedogenesis soil formations occurred in the eolian and colluvium/alluvium deposits, but not in the sand and gravel of the lower alluvium (Bement et al. 2007).

Bement and colleagues (2007) define the surface soil and three buried soils in the wind-blown silt deposits, and an additional five soils in the colluvium/alluvium deposit (Bement et al. 2007). Radiocarbon dating of buried soil A Horizons provided the chronology (Bement et al. 2007). The soil dates ranged from 11,070 +- 60 RCYBP (Beta – 184854) at 231 cm below surface to 6200 +- 90 RCYBP (Beta - 191039) at 50 cm below surface (Bement et al. 2007).

Climate

Generally speaking, the Panhandle experiences mild winters and hot summers. Below freezing temps are common in the winter months and sub-zero days are not unexpected. Temperatures in excess of 90 degrees are quite common during the summer months. Rainfall on the Southern Plains varies greatly, droughts are common (Bomar 1983; Ferring 1990).

Through intensive, long-term study researchers and archaeological investigators have been able to reconstruct the paleo-environment of the Southern High Plains region. Using pollen records, the late glacial period environment from 14,000 – 11,000 B.P. is characterized as being warmer and drier than the former fully glacial environment, which was replaced by full grasslands by 11,000 B.P (Bryant and Holloway 1985). The early portion of the Holocene (11,000 – 8,000 B.P.) saw the extension of grassland to the whole of the Southern Plains (Bryant and Holloway 1985; Bryant 1977). The recession of hardwood forest in the east began during this time; however, vegetation remained that of open prairie with sparse narrow strips of wetlands (Bryant and Holloway 1985). Drought characterized the middle Holocene which spanned from 6,000 – 4,000 B.P. (Ferring 1990). Evidence for drought occurs in faunal and pollen records (Albert 1981; Bryant and Holloway 1985; Graham 1987). The late Holocene (2,000 B.P) to present resembles the modern climate with multiple archaeologically significant fluctuations (Ferring 1990). Fluctuations such as the growth of mixed-oak forest followed the drying period of the middle Holocene (Albert 1981; Hall 1982). Moisture increase during the late Holocene is evident through the study of floodplain stability, mollusk, and increased pine-forest growth in the eastern portion of the

Southern Plains (Albert 1981; Artz 1984; Hall 1982; Holliday 1985a; Reid and Ferring 1986c, d).

Vegetation and Game

The growing season lasts about 190 days in the eastern portion of the Panhandle and 170 days at its western boundary (Doerr and Morris 1960). The Southern High Plains grade from western prairie to eastern woodland. The Oklahoma Panhandle is short grass country (Doerr and Morris 1960). Grassland forms a continuous blanket over the Plains except where human intervention prohibits the growth of grass. Grass height and ground cover in the Panhandle diminishes from east to west. Buffalo Grass (*Buchloedactyloides)* and Blue Grama *(Bouteloua gracilis)* compose the short grass prairie (Clements 1916; Bruner 1931; Weaver and Albertson 1956). Scrub oak *(Quercus gambelli),* cedars *(Junipera),* and pinon *(Pinus edulis)* can be found occasionally in the northwest portion of Cimarron County; where sage *(Artemistiatridenta)* and yucca *(Yucca elata)* occur in drier regions and where overgrazing has damaged the sod cover (Doerr and Morris 1960). The Southern plains has supported game as large as Mammoth and as small as a rabbit. Paleo-Indian's and subsequent cultural groups had a variety of subsistence resources to choose from.

Clovis hunters on the Southern Plains hunted megafauna, primarily mammoth; as evident in numerous kill sites by recovered chipped-stone artifacts (Bement and Carter 2010). However, shortly after 11,000 B.P. bison were the largest mammals on the Plains and became a primary subsistence resource for people (Johnson and Holliday 1987a). There is no clear consensus, but human predation/overkill, climate change, an extra-terrestrial event, or a combination of variables drove the mammoth and other megafauna' species except bison extinct (Firestone et al. 2007; Graham and Lundelius 1984; Grayson 1989; Kennett et al. 2009; Martin 1984; Stanford 1999). The effects of the Pleistocene/Holocene climate change on bison populations is unclear. However, the extinction of other large mammals undoubtedly relaxed competition. This allowed the bison population to increase, which prompted hunters to reorient their techniques to hunt bison more efficiently (Hill et al. 2008; Meltzer 2009: 287). Dillehay (1974) stated there was a period of bison-kill site absence from 6,000-5,000 to 2500 B.P. and from 1500 – 600 B.P. There was a resurgence from 600 B.P. to 300 B.P. that is believed to be a cultural reaction to significant environmental change (Dillehay 1974).

Unfortunately, by 150 B.P. bison populations again began taking a catastrophic plunge (Hamalalainen 2001). Numerous reasons, including peace among indigenous tribes, severe drought, disease, and European disturbance, accounted for the plunge (Hamalalainen 2001). By 1850 the bison population was at a critically low level. Horseback hunting and a shift from subsistence to commercial hunting also played a major role in the bison's demise (Hamalalainen 2001). As many as 3 to 4 bison could be killed by a single hunter on horsesback or up to 300 + bison could be killed by a single hunter getting a stand on a herd (Hamalalainen 2001). In a 50-year period several hundred thousand if not millions of bison had been killed off, eventually forcing traditional hunter-gatherer people to shift to pastoralism (Hamalalainen 2001). To live in such a dynamic geographic region, the inhabitants needed to have a thorough knowledge of the landscape and its resources. Seeing as how the Southern Plains and the Oklahoma Panhandle have been occupied since at least 10,900 B.P. (Domebo site) to present, it is apparent those occupants did indeed possess that knowledge.

CHAPTER 4:

CULTURAL PERIODS

Archaeological investigations on the southern Plains of North America began in the last decade of the 19th Century (Bell 1957). One of the major focuses of this work has been to develop a timeline of human existence in the area. This Chapter outlines the current state of knowledge on the time depth of cultural use of this area and key attributes that mark technological and subsistence adaptations. Beginning with a brief discussion on the earliest evidence for Oklahoma habitation, this Chapter is primarily concerned with the Paleo-Indian and Early Archaic history of the area as these temporal zones are related in age to Ravenscroft II.

Pre-Clovis

The Burnham site is believed by some, to be older than Clovis. The Burnham site is located in western Woods County, northwest Oklahoma. In 1986 when a steep ravine bank was being graded to build the dam of a small pond, snail shells and visible bone were observed protruding out of grey sediment. Stratigraphic and geologic investigation concluded Burnham was a paleontological site: 34WO73 (Wyckoff 2003). The presence of Ice Age remains from extinct fauna such as bison, horse, and mammoth remains has allowed researchers to study the fauna and environment of the Wisconsinan period in this region of the Plains. However, the primary reason for further investigation was the possibility of pre-Clovis activities (Wyckoff 2003).

Buehler (2003) analyzed the potentially flaked stone artifacts associated with the bones of extinct bison at Burnham. Buehler (2003) believes there are two questions that must be answered before confirming or denying a shared relationship. First, are the materials natural or modified by human activity? If they have been impacted by human activity are they temporally associated? Residue sorting identified 52 cryptocrystalline pieces that had potential human alteration. Those pieces were examined under a Bauch and Lomb stereoscopic microscope (10-70X zoom) to determine whether the pieces were cultural or natural (Buehler 2003). The primary stone type identified was Day Creek chert, and the most exotic material was Edwards, which was the only sample of that kind (Buehler 2003). After considering numerous factors and variables associated with lithic analysis, Buehler (2003) concluded that lithic material present at Burnham had been modified by humans and were associated with the processing of a bison carcass (Buehler 2003). The bison bone, flakes, tool frags, and non-cultural chert pieces were acted upon by fluvial forces and redistributed a short distance from their original deposit (Buehler 2003).

Fourteen separate chronological assessments were conducted on snail, hackberry seeds, charcoal frags, sediment, and animal teeth, all of which came back between 40,000 – 30,000 B.P. (Wyckoff and Carter 2003). Additionally, a bulk sediment sample consisting of 10 cm of grey loamy sand containing flakes and bison skull frags was radiocarbon dated to 31,150 +-700 B.P. (Beta-23045) (Wyckoff and Carter 2003). Unfortunately, such dates are contentious because of the redistribution of artifact-bearing deposits. The oldest undisputed cultural complex is Clovis.

Paleoindian period

There has been human activity on the Plains well before the Holocene epoch. The Paleo-Indian period lasted from at least 11,500 – 8,000 radiocarbon years before present (RCYBP). The Southern Plains contains sites spanning this entire period and into the Archaic period.

Clovis

The Llano as defined by Sellers (1952) is a complex steeped in hunting large game as their main subsistence practice, using distinctive fluted lanceolate projectile points (Hofman 1989). The name Clovis is derived from the Blackwater Draw site in Roosevelt County, New Mexico where the fluted Clovis points were unearthed (Hester 1972). The Clovis hunter-gatherers occupied the Plains from 11,050 – 10,800 B.P. (Waters and Stafford 2007). There exist a debate as to whether Clovis hunters were specialist, consuming primarily mammoth and other megafauna as their main form of subsistence (Meltzer 2009; Waguespack and Surovell 2003). There is evidence for the meat caches at the Colby site in Wyoming (Frison 1976, 1978; Frison and Todd 1986). There is no evidence for plant storage but there is evidence for a variety of hunting techniques (Hofman 1989).

The Domebo site is a well-known Clovis complex site, containing Clovis projectile points, megafauna, and dates within the accepted Clovis chronology (Leonhardy 1966). In 1961 portions of mammoth skull, tusk, and vertebrae were discovered at the bottom of a creek gully in southwestern Oklahoma. Further excavation uncovered a Clovis projectile point in a blue-grey silt in close proximity with mammoth vertebrae (Leonhardy 1966). Stratigraphic analysis suggests the mammoth died on solid ground. Shortly after, the remains were partially covered with fine sand and water from the creek. When sediments settled they completely covered and sealed the mammoth remains (Leonhardy 1966). The animal died on its left side with its limbs disarticulated but within close proximity. All major bones groups present. All four molars were recovered, but only one of them was found in situ (Leonhardy 1966). Remains were tested for evidence of butchering. The force of water was not nearly great enough to move bones such as mammoth femurs and the distribution of bones and the placement of a rib underneath a pelvis confirmed human interference (Leonhardy 1966). Culturally, three projectile points were associated directly with the skeletal remains; two complete and one fragment; all defined as Clovis points. Three waste flakes were also unearthed. A fourth projectile point and two flakes are also associated with the bone bed but were displaced via erosion (Leonhardy 1966).

Clovis age people underwent a cultural shift from mammoth hunters to bison hunters. This shift coincides with the extinction of the great mammoth (Bement and Carter 2010). Scholars debate whether overzealous hunters, an extra-terrestrial event, or a combination of the two caused mammoth to go extinct; what cannot be debated are hunters reorienting toward the remaining species (Martin 1984; Firestone et al. 2007; Kennett et al. 2009; Stanford 1999). Evidence from the Jake Bluff site highlights Clovis age people hunting bison using a new technique: arroyo trapping to kill and butcher 22 bison (Bement and Carter 2010). Pleistocene climate change relaxed competition on the grassland facilitating an increasing bison population (Bement and Carter 2010).

The Jake Bluff site has both a Folsom and Clovis component. Sandy loamy alluvium separates the deposits (Bement and Carter 2010). Clovis projectile points were found in direct association with bison remains with no cultural mixing (Bement and Carter 2010). Radiocarbon dates obtained from bison bone, tooth, and cranium reveal an average age 10,700 – 10,885 B.P., post-dating the Domebo mammoth kill at 10,900

B.P. A re-evaluation of the duration of dated Clovis sites places the Jake Bluff site at the terminus of Clovis (Waters and Stafford 2007). At Jake Bluff, Clovis artifact are more prevalent than Folsom. Four Clovis projectile points along with one reworked as a drill, a large flake knife, 23 debitage flakes, 12 possible hammerstones, and a possible anvil stone comprise the cultural assemblage (Bement and Carter 2010). Three of the four projectile points are manufactured from Alibates chert, with the fourth projectile point being crafted from a gray quartzite from the Dakota or Morrison formation; all projectile points have a single flute on each face, display evidence of reworking, and are similar to Clovis projectile points found elsewhere on the Southern Plains (Hofman and Wyckoff 1991). The extent of reworking on the larger points is similar to that observed at the Domebo site (Leonhardy 1966). Residue analysis on the four projectile points revealed two with bison remains, one point with no residue present, and the fourth with black bear residue (Yost 2007). All four projectiles were found in the bone bed and the drill bit was found adjacent to the arroyo’s knick point (Bement and Carter 2010).

Faunal analysis determined the minimum number of individuals (MNI) to be 22 *Bison antiquus* and one bear U*rsus americanus* (Bement and Carter 2010). The presence of a bear rib and scapula is believed to be of an opportunistic kill, with the bear apparently attracted to the kill (Bement and Carter 2010). The bison herd was composed of cows, calves, and juveniles. Seasonality is assessed by tooth eruption and wear attributes along with the inferred calving period, which placed the kill in September or October (Bement and Carter 2010). Faunal analysis revealed 15 ribs with spiral fractures (green bone helical), seven bones with cut marks, and five hammerstone- like blows. Expedient bone tools such as a spirally fractured tibia and scapula fragments were also unearthed. Bone tool use is evident from striations observed on the bones (Shipman 1988, 1989; Shipman and Rose 1988). There are two main faunal assemblages present, the main bone bed and the western bench of the site. The assemblage on the west bench was composed of an equal number of front and hind leg elements; however, there were very few axial elements. The main bone bed assemblage had a greater number of limb and axial elements at the site (Bement and Carter 2010). These findings support the notion of selective butchering.

On the Southern Plains, mammoth hunting ceased with the extinction of the mammoths. Clovis hunters turned to bison hunting as represented at the arroyo trap kill at Jake Bluff in northwest Oklahoma (Bement and Carter 2010). The development of the arroyo trap bison kill technique becomes the hallmark of the next Plains Culture: Folsom

Folsom

Again, Jake Bluff supports both a Clovis and Folsom component. It is one of the few sites with clearly stratified deposits; however the nature of the Folsom occupation is unknown (Bement and Carter 2010). Folsom cultural deposits occured one meter above Clovis deposits, and were spread consistently across the arroyo, burying a bison processing pile on the west gully rim. Folsom cultural materials consist of fist-sized cobbles, and a light scatter of highly fractured large bison bones. The Folsom lithic assemblage includes one projectile point and quartzite hammerstone spall. The projectile point was crafted from translucent brown Edwards' chert from central Texas. Morphological analysis suggested the tool went through several episodes of re-sharpening. This is evident from the examination of the shape of the tip and the asymmetry of the base (Bement and Carter 2010). The Folsom point is similar to Folsom points found at the Cooper site, a Folsom age bison kill site located 400 m to the east (Bement 1999; Carter and Bement 2003).

The Cooper site (34HP45) is located on the flood plain margin of the Beaver River in northwest Oklahoma. It is one of the few Folsom age sites in Oklahoma with intact cultural deposits (Bement 1999). Cooper is a three-tiered bison kill site with numerous articulated skeletal remains and a unique painted bison skull, the oldest painted artifact in North America (Bement 1999). Utilizing radiocarbon dating, stratigraphic analysis, diagnostic artifacts, and identifying the bison species helped date the site. The Folsom projectile points diagnostically date the site to at least 10,000 B.P., based on the projectile point from each kill event 10,900 – 10,200 B.P. are the suggested time ranges. Radiocarbon dates on bison bones from each of the three kill episodes date them between to 10,600 and 10,500 radiocarbon years ago (Carlson 2015). The site is located in an ancient gully and because the channel meander, 50 to 75 percent of each bone bed has been eroded away. The upper bone bed is 6 x 4 m, the middle is 5.5 x 4 m, and the lowest level bone bed is 6 x 4 m. Erosion included, estimate (Bement 1999) are that each event contained at least 50 animals. The three kill events produced 27 total projectile points, 13 complete and 14 fragmented/broken points and numerous other tools. Fourteen of the points were crafted from Alibates, seven from Edwards, and six from an Edwards variety known as Owl Creek (Bement 1999).

The Folsom type-site of northeastern New Mexico was the first site that empirically demonstrated the antiquity of humans North America when a projectile point and extinct megafauna were found in association (Cook 1927; Figgins 1927; Meltzer 2006, 2008; Wormington 1957). The Folsom complex spanned 10,800 – 10,200 B.P. (Hofman 1989). The hallmark of Folsom technology is the fluted projectile point, and the production of bifaces is at the center of stone manipulation because of their high portability (Hofman 1989).

Bone technology is also well developed; eyed needles recur at Folsom sites, suggesting that these people made tailored garments. These finds support the view that individuals living during this time possessed a technological prowess comparable to European and Eurasian Upper Paleolithic cultures (Soffer 1985). There are notions, though mostly rejected that Clovis and Folsom technologies derived from these European and Eurasian Upper Paleolithic cultures (Frison and Bradley 1980; Haynes 1982, 1987; Jelinek 1971; Soffer 1985; Klein 1969; Muller-Beck 1966; West 1983). The fluting process may have served as a central point for instruction, the successful transfer of hunting skills and knowledge between generations of hunters whose livelihood depended on an intimate knowledge of animal behavior and hunting tactics (Hofman 1989).

Folsom subsistence economy revolved almost exclusively around bison hunting. There are other faunal remains at Folsom sites and ethnographic studies have shown hunter-gatherers do consume plant material (Meltzer 2006). However, bison meat and remains constitute the vast majority of subsistence-related detritus at Folsom sites (Hofman 1989). Folsom kill sites tend to have a low minimum number individuals (MNI) at sites as well as the consistent occurrence of partially or slectively butchered bison remains (Bement 2003; Hofman and Ingbar 1988). This evidence suggest two things. 1. Gourmet style butchering, this occurs when there are not enough group members to utilize mass numbers of bison before putrification (Todd 1983, 1987). By employing this strategy, family bands would have had greater long-term subsistence security by maintaining a connection with an existing herd, rather than totally depleting the resource (bison) and having to search for another (Bement 2003). The second possibility is that people moved from the kill site, taking with them only select, high quality portions (Bement 2003). In all, the Folsom people were technologically advanced, had a bison hunting subsistence focus, were highly mobile, had an extensive knowledge of bison behavior, and had a social network that aggregated dispersed family groups when necessary (Hofman 1989).

Midland

The Midland complex was defined at the Scharbauer site in Midland, Texas, on the Southern Plains (Wendorf et al. 1955; Wendorf and Krieger 1959). The site contained the remains of Folsom-age human skeletal bone and is the type site for geologic, paleontological, and stratigraphic investigations in a sandy, semi-desert environment (Hofman 1989). The assemblage of projectile points present at the Scharbauer site has been at the center of debates regarding point typology and definitions of cultural complexes through archaeological material (Hofman 1989). Present at the site were fluted Folsom points as well as thin unfluted points morphologically similar to Folsom and termed Midland (Hofman 1989). There are two competing ideas to explain the similarities. First, Midland points are contemporary with Folsom and are of the same technological tradition but are reworked Folsom period points or blanks too thin to be fluted (Judge 1970). This notion is supported by numerous researchers (Frison and Brandy 1980; Bradley 1982; Broilo 1971; Hester 1962, 1972; Irwin et al. 1973; Wilmsen and Roberts 1978). It is worth noting that 25 percent of the projectile points at the Lindenmeier Folsom site were unfluted; however, the unfluted artifacts did not show the degree of controlled lateral thinning that occurs on Midland points (Hofman 1989).

The opposing view argues that Midland and Folsom are distinct complexes and they may represent cultural groups that were closely related in time and shared an economic subsistence strategy (Agogino 1969; Broilo 1971). The argument for distinctness via sites that produce strictly Midland points with Folsom absent only work if it is assumed the full range of points and artifacts utilized by a cultural group are present at the site (Hofman 1989). Evidence for Midland/Folsom temporal overlap is present at the Hell Gap site on the Northern Plains of Wyoming, but with Midland cultural material continuing on post-Folsom (Irwin 1968; Irwin-Williams et al. 1973). There are a number of projectile point types that share attributes with Midland and could represent a transition from Folsom through the Late Paleo-Indian period (Hofman 1989).

Plainview Complex

The Plainview site excavated in 1945 has provided a long lasting contribution to Late Paleo-Indian studies and serves as a primary reference assemblage (Hofman 1989). Plainview is a bison kill site in Hall County, Texas (Sellers et al. 1947). Bone apatite from the original site excavation was dated to 10,200 +- 400 and 9,860 +- 180 B.P. (Tx-3908). These dates are consistent and compare to previously recorded dates on shell. Dates obtained from sediment also support the site’s antiquity (10,000 B.P.) (Holliday

1986). Cultural material determined to be Plainview was found 65 km south at Lubbock Lake, Texas. The site is a small bison kill (6 animals) and processing site that also dates to 10,000 B.P. The site greatly highlights camp life and bison processing (Hofman 1989).

The projectile points were given the type Plainview, and Krieger (1964) suggest they are a possible intermediate between Folsom and Cody. Morphologically Plainview is similar to Clovis and Folsom (Leonhardy 1966; Jennings 1978; Wiley et al. 1978; Wormington 1957). The degree of morphological range of Plainview points in regards to basal and blade outline has created a great deal of confusion when it comes to placing points in a typology. Hofman (1989) has suggested that the problem with projectile types is that they dont recognize variability if they are not well constructed.

Milnesand Complex

Milnesand is an eastern New Mexico bison kill site with distinctive assemblages of projectile points similar to Plainview (Sellards 1955). The Milnesand site has been estimated to be of Plainview age, roughly 10,000 – 9000 B.P. (Hofman 1989). A bison bone bed with both Plainview and Milnesand points at the Lone Wolf Creek site in Colorado City, Texas support arguments for a association between the two (Wormington 1957). However, there are morphological differences in the points such as basal outline and the number and length of thinning flakes (Hofman 1989). Similar to Plainview, Milnesand points display varying morphology typical among Late Paleo-Indian projectile point types.

Agate Basin Complex

Named after the site in eastern Wyoming, the Agate Basin complex has been well-dated by bone assays and stratigraphic evidence to 10,500 – 10,000 B.P., and has been determined to be partially contemporaneous with Folsom and Plainview (Roberts 1961; Frison and Stanford 1982; Irwin-Williams et al. 1973). Agate Basin projectile points display slightly convex blade edges. There is a fair amount of morphological variation in Agate Basin points, resulting from breaking and reworking (Hofman 1989). Agate Basin bison hunters were active on the Southern Plains, though their relationship with Plainview and Folsom peoples is unclear (Hofman 1989). Agate Basin materials overlap with Hell Gap.

Hell Gap

The Hell Gap type-site is located on the Northern Plains and has been radiocarbon dated to 10,000 – 9,000 B.P. (Frison 1974, 1978, 1982b). The Hell Gap site is quite significant in that there is evidence for ritual associated with a bison kill site (Stanford 1975, 1978, 1979). A post mold at the center of the kill, a bird bone whistle and a butchered dog skeleton were uncovered. Ethnographic evidence supports similar item utilization by shamans during bison hunts (Hofman 1989). Hell Gap type projectile points are found on the Southern Plains: however, as of yet no undisturbed sites have been found (Hofman 1989).

Cody and Firstview Complexes

Eden is the type site for the Finley site in Eden, Wyoming (Howard 1943; Moss et al. 1951). Scottsbluff was the term given to points associated with a bison kill site in Scottsbluff, Nebraska (Shultz 1932). The Cody complex is a moniker that includes both the Eden and Scottsbluff point and Cody knives. The name Cody was chosen because of the Horner site near Cody, Wyoming, where a number of Eden and Scottsbluff points were found in situ (Wormington 1957). Temporal length of the Cody complex is undetermined but is estimated at 10,000 B.P – 7,900 (Knell and Muniz 2013). Cody complex lithic assemblages are and include a considerable range of variation in regards to the hafted biface. Cody complex assemblages have been studied from a strictly morphological viewpoint, with no regard to technological methods that account for morphological changes over the course of a tool's "life" (Wheat 1976, 1979; Huckell 1978). Component II at the McHaffie site near Helena, Montana is important to the Cody complex because the manufacture of Scottsbluff points occurred. Investigations of this component led to greater understanding of biface reduction techniques and general campsite activities (Hofman 1989). Some see Firstview as a southern expression of the Portales complex (Bonnichsen and Keyser 1982). Investigations at Lubbock Lake suggest Firstview is roughly 8600 years old (Johnson 1987).

Late Paleo-Indian Cultural Complex

Plano, defined by Jennings (1955), is a cultural complex for unfluted lanceolate projectile points spanning post-Folsom though the Late Paleo-Indian period (Hofman 1989). Plano spans 10,000 – 7,500 B.P. and is defined by a bison hunting economy (Spencer and Jennings 1965; Wedel 1978). Artifacts from sites in this age range that cannot be appropriately typed fall into the Plano classification (Cassells 1983; Brown and Simmons 1987; O'Brian 1984; Krieger 1964).

Allen/Frederick Complex

The James Allen site near Laramie, Wyoming is the type site for Jimmy Allen projectile points. The site is a bison kill that housed projectile points with parallel oblique flaking and concave bases (Hofman 1989). All across the Plains around 8500 B.P. marked the appearance of parallel obliquely-flaked lanceolate points. This period in Plains prehistory is the least documented and understood (Frison 1978). Bone assays place the age of the site at 7,900 +-200 B.P. (Mulloy 1959). Projectile points resembling Jimmy Allen can be found throughout the Plains (Frison 1978; George 1981; Getty 1984; McClung 1979; Wormington and Forbis 1965). This period also marks the last of the classic highly mobile, bison hunting Paleo-Indians (Hofman1989). Climate changes around 8,000 suggest there was a transition and preference for more localized foraging, representing the transition to the Archaic period (Ferring 1995; Hofman 1989). The Southern Plains lacks well documented and recorded sites attributable to the 8,000 – 7,000 B.P. transitional period as it is critical to studies of changing lifeways (Hofman 1989).

The Archaic cultural period on the Southern Plains

The Atlantic climate episode was the driest and warmest period of the Holocene lasting from 8,000 – 5,000 B.P. (Wendland 1978). This episode led to a shift in species diversity and plant community composition as well as extirpation of species with a limited tolerance for seasonally extreme weather. (Albert 1981; Antevs 1955; Baker and Penteado-Orellana 1977; Benedict 1979; Bryant 1977; Bryson et al. 1970; Dillehay 1974; Hughes 1978; Johnson and Holliday 1986; Lundelius et al. 1983; Meltzer and Collins 1986; Neck 1987; Schultz 1978; Stafford 1981; Story 1985; Wright 1970). Archaic hunter-gatherers occupied the Southern Plains from 7,000 – 2,000 B.P.

(Hofman 1989). These peoples have been assigned very general characteristics. Illustrated as band level, egalitarian hunter-gathers employing seasonal strategies to procure food, fuel, shelter, and clothing, as well as strategies for coping with resource shortfall/windfalls cycles (Hofman 1989). Present at Archaic sites are food-grinding equipment, roasting ovens, and rock lined hearths. Speculation that mobility may have become more sedentary is suggested by the intensity of site occupation, use of local resources, and a proliferation of notched and stemmed projectile point types (Hofman 1989).

Geomorphic factors have shaped the archaeological record so soil and geologic information is seminal to studies of Paleo-Indian and Archaic periods on the Southern Plains. According to a report by Reid and Artz (1984), the highest potential for finding an undisturbed Archaic site is to survey along the middle reaches of streams where the slope is level enough to prevent erosion and too gentle enough to facilitate sediment accumulation. Known Archaic age sites on the Southern Plains are located in eroded uplands or buried deeply in alluvial deposits (Hammatt 1976; Johnson and Holliday 1986; Wyckoff 1964, 1986).

The Pumpkin Creek site in Love County is a lithic workshop where hunting equipment was refurbished (Wyckoff and Taylor 1971). Projectile point morphology reflects late Paleo-Indian materials from western Oklahoma and early Archaic types from eastern Oklahoma. There is a lack of subsistence evidence, radiocarbon dates, and stratigraphic information. However this is expected when only surface collections are being studied, and when site deposits are deflated onto a gravel surface. Based on artifacts present at the site it has been estimated the site age is between 9,000 – 7,000 B.P. (Hofman 1989; Wyckoff 1984; Wyckoff and Taylor 1971).

The Gore Pit site is an important in the prehistory of Oklahoma (Hofman 1989). The site is buried in the terrace of Cache Creek (Hofman 1989). Radiocarbon dates place site utilization between 7,000 – 6,000 B.P. (Bastian 1964; Hammatt 1976). The site contained 30 features, several types of tools and grinding stones/basins, and faunal remains, but no bison remains. The site material is indicates of intensive mussel, plant, and small game processing (Bastian 1964; Hammatt 1976). Altithermal hunter-gatherers in western Oklahoma around 6,000 B.P. would have exploited such resources. The intensive use of mussels indicates the presence of perennial water and repeated site occupation, became mussel foraging occurred from late spring through early fall (Cheatum 1976). A single human burial was unearthed, partially destroyed by rodent burrowing. The lower limb elements are missing (Hofman 1989). The body was positioned in a partially flexed position with the head facing toward the northeast. The remains are interpreted as a robust female in the 25 – 35 age range. The cause of death is undetermined; however, a fracture of the right parietal suggests the individual suffered a blow to the cranium.

There was no cultural material present with the remains (Hofman 1989; Keith and Snow 1976).).

Increased seasonality during the Holocene and increased regional population growth explains a greater reliance on plant food and the cyclical nomad strategy, and in some areas tethered nomadism (Mulloy 1954). Cyclical nomadism is the seasonal scheduling of activities (Flannery 1968; Martin and Martin 1984, 1986). Tethered nomadism describes hunter-gatherer groups who are tied to limited water sources in an arid region, and who stray only to locate additional resources and then return to the area (Taylor 1964). Highly mobile game such as bison were fewer in numbers and not reliable enough to continue as a primary subsistence resource.

The Southern Plain's water table lowered during this time, creating extensive badlands (Evans 1951; Green 1962; Meltzer and Collins 1987; Smith et al. 1966). These badlands supported xeric plant resources such as fruits, seeds, tubers, and fibers. However, these resources required extensive processing (Hofman 1989). Yucca, cacti, plums, mesquite, and oak were all economically important resources (Hofman 1989). Foragers consumed animal meat such as fish, mussels, deer, and other small mammals. Bison is represented; however, the bone dates are usually 7,000 B.P. and older or 3,000 B.P. and younger (Dillehay 1974). A few mid-Holocene sites indicate a small amount of bison utilization (Johnson and Holliday 1986). Lithic raw material use highlights intensive utilization of local materials. Exotic or non-local materials were reserved for formal tools and bifaces. The Archaic period also saw the first use of heat treatment on lithic material to improve flaking qualities (Hofman 1989). Artifacts with highly controlled and refined bifacial reduction techniques dominate Archaic lithic assemblages. Archaic tool forms occur throughout the Plains, which suggests there were extensive exchange networks and that technological advances were facilitated by diffusion (Hester et al. 1973; Hofman 1977a; Hughes 1976; Ray 1941, 1961; Schmits 1987). Against this backdrop of culture history, the Ravenscroft II site is a kill site of late Paleo-Indian age. The following Chapter: The Ravenscroft II Site, delves into site setting, past investigations, and discusses the history of excavations at the site.

CHAPTER 5:

THE RAVENSCROFT SITE

Site setting

The Ravenscroft site (34BV198) is located in western Beaver County, in the Oklahoma Panhandle. Ravenscroft is situated along the southwest side of a first order drainage to Bull Creek, a south-bank tributary to the Beaver River. The tributary is roughly 400 meters in length from upslope end until its confluence with Bull Creek. Ravenscroft is situated mid-slope, 150 meters from the drainage's confluence with Bull Creek. The soils at the Ravenscroft site are described as the Mansker – Potter complex (Allgood et al. 1962). The soil complex includes Mansker, Potter, and Ulysses soils, on a 3 to 20 % slope on the edges of the High Plains (Allgood et al. 1962). The collective soils are shallow, rocky, and calcareous, and occur contextually with caliche deposits (Allgood et al. 1962). The surface slopes between 5 and 10 percent.

The drainage channel is contained within an arroyo system characterized by two dominant erosional events forming steep head-cuts and steep, high lateral walls. Progression of the most recent head cut extends beyond the site's location, giving the area near the site a benched topography. The lateral extent of erosion along the drainage is bounded in areas by sporadic and limited exposure of the sandstone bedrock of the underlying Permian-age Cloud Chief formation (Arauza et al. 2016; Bement et al. 2012). Concave erosional cuts along the drainage margins identify lateral gully formation in this highly eroded area. Erosion is responsible for the initial exposure of bison bones that led to the discovery of the Ravenscroft site.

Site Discovery and History of Investigation

In 2007 artifact collectors noticed small pieces of bone eroding onto the mid-slope surface along the southwest bank of the upland drainage. After additional exploration and unearthing larger than modern bison bones, the collectors discontinued their investigations and contacted Dr. Leland Bement at the Oklahoma Archaeological Survey, University of Oklahoma, Norman. In 2008, Dr. Bement and a team of survey researchers and volunteer students from the University of Oklahoma conducted the initial site assessment. A profile cut was created at the initial find area to locate the landform from which the faunal material originated. The profile showed that the bones were eroding from a filled arroyo cut perpendicularly into the hillslope. An excavation area 3 meters wide and extending 4 meters into the hill was opened for excavation. Excavations unearthed the partially articulated portions of five bison and a handful of lithic waste flakes. Confirmed bison faunal material was submitted for radiocarbon assay. Results dated the site to around 9000 RCYBP (Bement et al. 2012).

Excavations continued in 2009 as part of the University of Oklahoma's archaeology field school. An excavation area 4 meters wide by 4 meters long probed further into the hill to the arroyo's knick point. The 2009 excavations uncovered the partially articulated remains of an additional five bison and waste flakes. No projectile points were recovered. Included with the bison remains were fragments of at least one fetus. The fetal remains had developed to a size indicating 6 months of growth and development. This suggests the kill occurred in January, if the timing of the rut was similar to contemporary bison ruts in July.

At the close of the 2009 excavation season, excavators noticed that rodent activity 10 meters east of the site had exposed additional bison bone fragments. Exploration via hand augering encountered dense bison bone 70 cm below surface. The utilization of ground penetrating radar by Dr. Alex Simms, then at Oklahoma State University in Stillwater, provided subsurface imaging of the area between the 2009 excavations and the area of the auger hole. The image showed a dip in arroyo deposits at the head of the 2009 excavation area, and a subsequent rising of the bedrock followed by a dip into another arroyo just before the auger location, a distance of approximately 10 meters from the 2009 bone bed (Bement unpublished notes, 2009). This area was named Ravenscroft II, the original arroyo excavation is Ravenscroft I.

Under the continued direction of Dr. Bement, investigations at the newly discovered Ravenscroft II bison bone bed began in 2013 during a University of Oklahoma archaeological field school. The original excavation grid established in 2009 was extended across the new area and a profile trench was staked from N52.5/E62 – N52.5/E67 (Figure 3). This 50 cm wide trench followed the line of the ground penetrating radar (GPR), and included the original auger hole. Prior to establishing a block excavation unit, the 20 x 20 meter area upslope from the original ground penetrating radar imaging was subjected to gradiometer and resistivity imaging. Both geophysical techniques identified an anomaly approximately 5 meters wide and 9 meters in length that extended perpendicularly into the hill slope. Bison bone recovered via hand auger confirmed this (Figure 4). Additionally hand auguring confirmed the presence of bison bone deposits at grid point N45/E62, a little over 10 meters into the hill.

Figure 3. Profile Trench established during the 2013 excavation season.

Figure 4. Auger hole at the southern extent of the buried arroyo

With the known geophysical information, an excavation block was staked with corners at N48/E62, N50/E62, N48/E67, and N50/E67. Excavation in this block opened a 3 x 3 m area (Figure 5) with the additional 5 x 0.5 m extension along the N52.5 trench. The sediments in this arroyo were identical to those encountered in the original arroyo to the east (Ravenscroft I). Particle size analysis of the sediment with the arroyo displayed increased silt and clay casts compared to the more sandy sediments outside the arroyo. By the end of the 2013 season, a total of 500 bison bones had been uncovered, documented, and removed for analysis. The floor of the arroyo was not uncovered during the 2103 excavation.

Figure 5. Initial six excavation unit: 2013 field season

The next excavation season was in 2015 and consisted of a joint field school directed by Dr. Bement at the University of Oklahoma and Dr. Kristen Carlson at Augustana University (Sioux Falls, SD). During the excavation, the Ravenscroft II trench was widened to the south 50 cm and the Ravenscroft II main excavation block was extended 2 meters to the east. The eastward extension ensured that the excavation block provided a complete, observable cross section of the bone-bearing deposits with the arroyo (Figure 6). The 2015 excavation uncovered, documented, and removed an additional 173 bison bones along with a freshwater mussel shell knife, and a complete lanceolate projectile point. The floor of the arroyo still lay buried under bison bones.

Figure 6. Expanded excavation unit: 2015 field season

CHAPTER 6:

METHODS

Excavation Methods

The methods employed in the excavation of the Ravenscroft II bone bed were developed and refined by Dr. Bement during the excavations of the Jake Bluff, Cooper, and Badger Hole Paleo-Indian age arroyo trap bison kills, and along with the Certain and Harrell late-Archaic age bison kill site (Bement 1999; Bement and Carter 2010; Bement et al. 2012; Bement and Buehler 1994; Carlson and Bement 2013). The technique treats the bone bed as a single feature, relying on the exposure of large areas at one time before any materials are removed. This method ensures that associated and articulated animal remains are documented as complete-as-possible animal units.

Specifically, the upper surface of bones was uncovered across excavation area, covering several square meters. Each bone was then uncovered to the surface on which it rested. All uncovered bone was subject to documentation prior to removal. Before any faunal material is removed it was hand mapped onto grid paper that uses five 1 x 1 m inch grid squares to represent the 1 x 1 m excavation unit. The bones were drawn to fit to scale and clearly demonstrate the faunal assemblage arrangement. Once the bone was plotted on the map, the strike and dip of the bone was recorded, along with its elevation below datum. A total station was used for vertical control, and the excavation unit acting as the horizontal control. Digital cameras were used to further document the site. When it came time to remove bone Dr. Bement conducted the removal along with Dr. Carlson. The bone element e.g. (femur) and side (left/right) were recorded into a binder, along with its strike/dip, provenience, date, and elevation. The bone was also assigned a catalogue number for later analysis.

When bone is removed, enough soil should surround the bone to keep it as intact as possible and then wrapped in aluminum foil, The bones is then placed in a clear zip lock bag labeled with the bone number, provenience, date, and initials of the individual(s) responsible for recording the information. At the close of the field season, the remaining faunal material was covered in black plastic and reburied to preserve the feature. Elements such as bison skulls are encased in spray foam for protection and preservation until extraction at a later date (Figure 7).

Figure 7. Skull encased in foam.

Taphonomy

The excavation and recording methods described above provide information on site formation processes, provenience, and bone-bed condition. Analytical methods describe the taphonomic and cultural processes affecting the bone bed. Taphonomy is the study of the chemical and mechanical history of faunal remains as bones move from the biosphere to the lithosphere. In this thesis, taphonomy refers to the post-depositional alteration of bones before, during, and after burial in site deposits. Processes affecting bones prior to burial include weathering, rodent and carnivore gnawing, slope wash movement, sediment abrasion, and inadvertent burning. Post-burial factors include root etching, chemical dissolution, gopher gnawing/scratching/polishing, and sediment crushing. Once the taphonomic factors were identified, further analysis was required to document culturally induced alteration of bones, including butchering damage, cut marks, impact fractures, deliberate burning, and tool manufacture/use.

Additionally, bones were measured for use in reconstructing herd demographics, including age, sex, and size criteria. All of these variables were coded on an Access file form in a database for generating descriptive and qualitative statistics. Standard faunal analytical calculations of Number of Identified Specimens (NISP), minimum number of elements (MNE), minimum number of individuals (MNI), and minimal animal unit (expressed as a percentage; %MAU) were tabulated for use in describing bison-element presence. Once all data were collected and compiled for the 2013 and 2015 excavations of the Ravenscroft II bone bed, the results were compared to the expectations provided by the Fall/Winter Model of bison hunting (Malainey and Sherriff 1996; Quigg 1978).

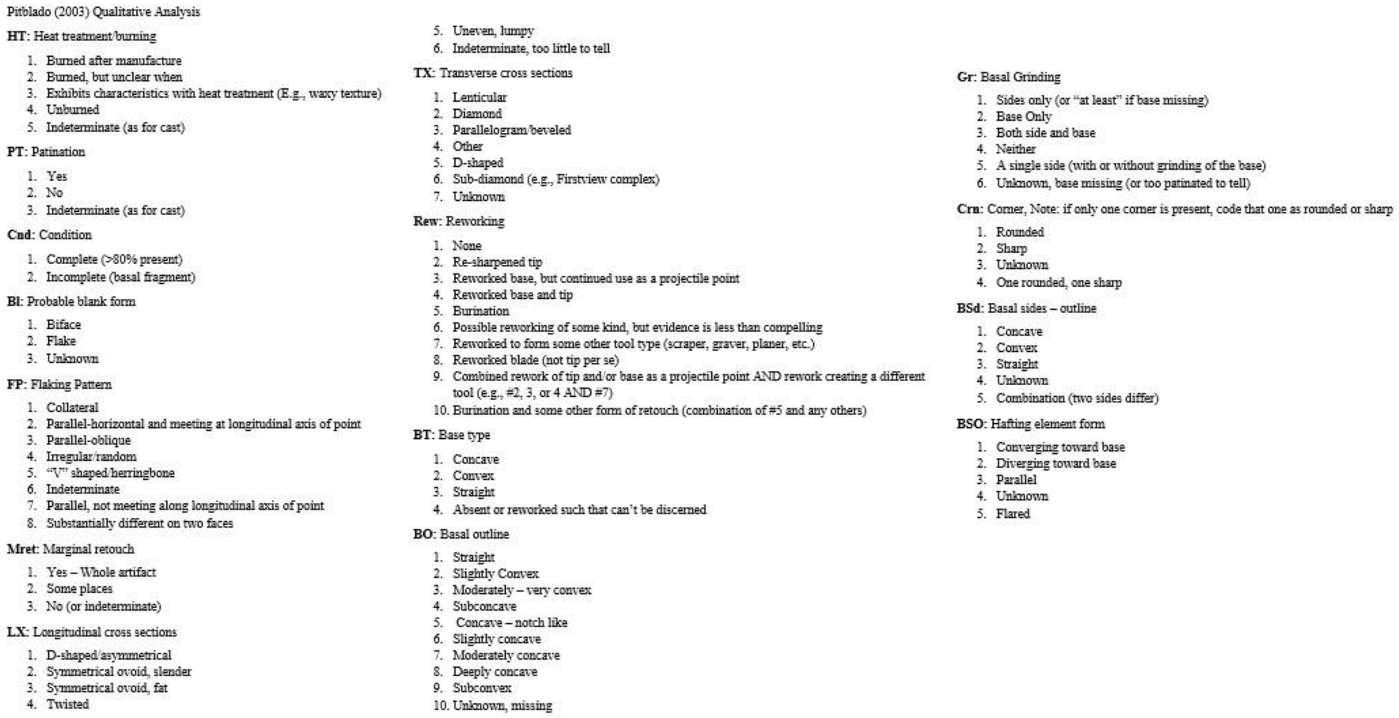
Projectile Point Analysis

A single lanceolate projectile point was recovered from the Ravenscroft II trench unit N52/E64, recorded as number 910 in the catalog. It was located in context with rib bones (Figure 8). I subjected the projectile point to qualitative analysis only because of the limited sample size. The qualitative analysis I employed was developed by Pitblado (2003) (Table 1). Pitblado's (2003) analysis of Late Paleo-Indian points was utilized because the Plains of eastern Colorado were supported large bison aggregates and hunters with similar to identical lithic technologies of hunters on the more southerly Plains. Additionally, Binford (1979) states that for collectors, projectile points should exhibit excellent craftsmanship, hafting, low incidence of re-working, and most importantly, be manufactured from tough raw materials such as quartzite. The Ravenscroft II point is extremely well crafted, has a haft, shows no signs of re-working, and is manufactured from a tough granulated quartzite.

Figure 8. Recovered lanceolate projectile point.

Four flakes were also analyzed. The analysis was to assess the flakes' raw materials and potential utilization as expedient tools. These pieces were examined under a Bauch and Lomb stereoscopic microscope (10-70X zoom).

Table 1. Pitblado (2003) lithic qualitative analysis



Pitblado (2003) Qualitative Analysis

HT: Heat treatment/burning

1. Burned after manufacture
2. Burned, but unclear when
3. Exhibits characteristics with heat treatment (E.g., waxy texture)
4. Unburned
5. Indeterminate (as for cast)

PT: Patination

1. Yes
2. No
3. Indeterminate (as for cast)

Cnd: Condition

1. Complete (>80% present)
2. Incomplete (basal fragment)

Bl: Probable blank form

1. Biface
2. Flake
3. Unknown

FP: Flaking Pattern

1. Collateral
2. Parallel-horizontal and meeting at longitudinal axis of point
3. Parallel-oblique
4. Irregular/random
5. "V" shaped/herringbone
6. Indeterminate
7. Parallel, not meeting along longitudinal axis of point
8. Substantially different on two faces

Mret: Marginal retouch

1. Yes – Whole artifact
2. Some places
3. No (or indeterminate)

LX: Longitudinal cross sections

1. D-shaped/asymmetrical
2. Symmetrical ovoid, slender
3. Symmetrical ovoid, fat
4. Twisted
5. Uneven, lumpy
6. Indeterminate, too little to tell

TX: Transverse cross sections

1. Lenticular
2. Diamond
3. Parallelogram/beveled
4. Other
5. D-shaped
6. Sub-diamond (e.g., Firstview complex)
7. Unknown

Rew: Reworking

1. None
2. Re-sharpened tip
3. Reworked base, but continued use as a projectile point
4. Reworked base and tip
5. Burination
6. Possible reworking of some kind, but evidence is less than compelling
7. Reworked to form some other tool type (scraper, graver, planer, etc.)
8. Reworked blade (not tip per se)
9. Combined rework of tip and/or base as a projectile point AND rework creating a different tool (e.g., #2, 3, or 4 AND #7)
10. Burination and some other form of retouch (combination of #5 and any others)

BT: Base type

1. Concave
2. Convex
3. Straight
4. Absent or reworked such that can't be discerned

BO: Basal outline

1. Straight
2. Slightly Convex
3. Moderately – very convex
4. Subconcave
5. Concave – notch like
6. Slightly concave
7. Moderately concave
8. Deeply concave
9. Subconvex
10. Unknown, missing

Gr: Basal Grinding

1. Sides only (or "at least" if base missing)
2. Base Only
3. Both side and base
4. Neither
5. A single side (with or without grinding of the base)
6. Unknown, base missing (or too patinated to tell)

Crn: Corner, Note: if only one corner is present, code that one as rounded or sharp

1. Rounded
2. Sharp
3. Unknown
4. One rounded, one sharp

BSd: Basal sides – outline

1. Concave
2. Convex
3. Straight
4. Unknown
5. Combination (two sides differ)

BSO: Hafting element form

1. Converging toward base
2. Diverging toward base
3. Parallel
4. Unknown
5. Flared

CHAPTER 7:

RADIOCARBON DATING

Bone samples recovered from Ravenscroft II were selected for radiocarbon dating (C14) by Dr. Leland Bement. Three petrous (inner ear) bone elements returned the following age ranges: 9210 +/- 30 B.P., 9340 +/- 30 B.P., and 9335 +/- 30 B.P. (UCIAMS 136071, UCIAMS 136072, and UCIAMS 136077, respectively); the average being 9300 B.P. (Carlson et al. 2017). The statistical mean was derived by CALIB 6.2. (Table 2). Based on these results, Ravenscroft II is a late Paleo-Indian site, falling between 10,000 RCYBP – 8,000 RCYBP. There are two other sites of similar age in the Oklahoma Panhandle, the Nall and Goff Creek sites (Ballenger 1999). Goff Creek empties into the Beaver River in Texas County, Oklahoma. Site analysis by Brooks and Flynn (1999) revealed it was a bison processing station. An artifact collector recovered 82 projectile points from the associated creek channel; among them, were late Paleo-Indian lanceolate projectiles affiliated with the Plainview, Frederick-Allen, and Midland complexes (Ballenger 1999). The Nall site in Cimarron County, Oklahoma south of the Beaver River is an archaeologically significant site for late Paleo-Indian activity (Ballenger 1999). Projectile point types include Plainview, Firstview and Frederick-Allen, among others (Ballenger 1999).

Table 2. Radiocarbon dates

Site Name	Site Number	Bone Number	Element	UCIAMS	14C	+/-
Ravenscroft II	34BV198	LB628	Petrous	136071	9210	30
Ravenscroft II	34BV198	LB692	Petrous	136072	9340	30
Ravenscroft II	34BV198	LB724	Petrous	136077	9335	30

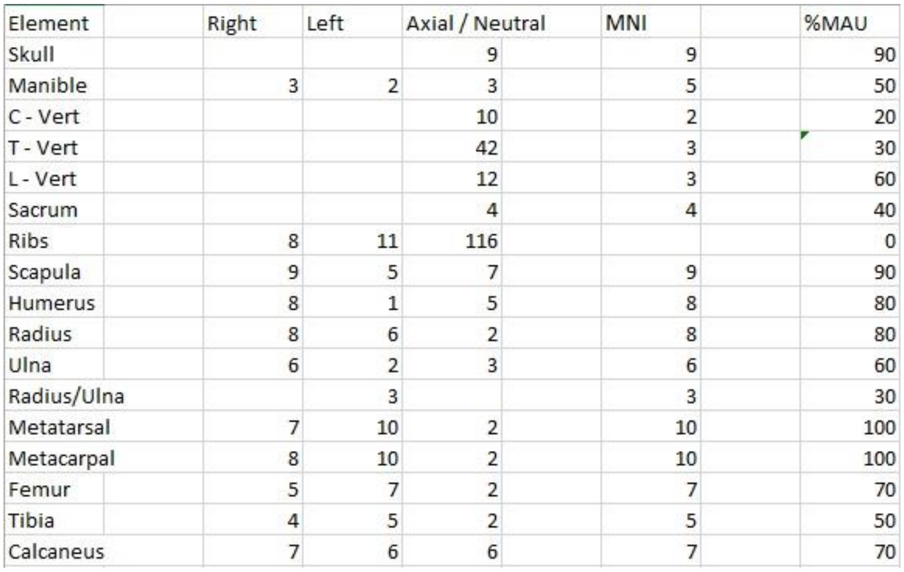
CHAPTER 8:

RESULTS

I analyzed the Ravenscroft site material to address the research question: does the Ravenscroft II site fit the winter kill model? The following results include: taphonomy of the bonebed, accounting of skeletal element frequencies, determination of seasonality, reconstruction of butchering practices, and analysis of the projectile point, all geared towards answering the research question.

The Ravenscroft II bone bed includes 674 bones recovered during the 2013 and 2015 excavations. The current analyzed bone sample provides an MNI of 10 bison. I estimate that less than 10 percent of the site deposits containing bison remains has been excavated and analyzed. Given this estimate and calculating the percent excavated combined with current MNI. I expect that the kill event involved 80 to 100 animals. Additional bones excavated in 2016 and 2017 are not included in this analysis because they are from a previous kill event that has not been dated and is still being cleaned, processed, and identified. Table 3 shows results of element frequency (also see Appendix 1). Table 3 highlight the quantity of each bone element and its side, i.e. left, right or neutral.

Table 3. Bison faunal elements



Element	Right	Left	Axial / Neutral	MNI	%MAU
Skull			9	9	90
Manible	3	2	3	5	50
C - Vert			10	2	20
T - Vert			42	3	30
L - Vert			12	3	60
Sacrum			4	4	40
Ribs	8	11	116		0
Scapula	9	5	7	9	90
Humerus	8	1	5	8	80
Radius	8	6	2	8	80
Ulna	6	2	3	6	60
Radius/Ulna		3		3	30
Metatarsal	7	10	2	10	100
Metacarpal	8	10	2	10	100
Femur	5	7	2	7	70
Tibia	4	5	2	5	50
Calcaneus	7	6	6	7	70

Surface Factors

The next faunal analysis deals with surface factors, including weathering, carnivore chewing, and crushing, that affect bones while they are exposed on the surface.

WEATHERING. Bone removed from the 2013 profile trench as well as the main bone bed feature were unearthed largely intact. Bone surfaces exhibit weathering patterns indicative of rapid burial. Occasionally, highly weathered bones were noted (Figure 9). It is possible that burial across the bone bed was not complete and some specimens were left unburied, were not buried as quickly as others, or that some buried bones were later unearthed by erosion and once again subjected to weathering conditions. Alternatively, it may represent an earlier kill episode at the site.

Figure 9. Weathered bone from a potentially earlier kill event.

CARNIVORE CHEWING. There is no evidence of carnivore chewing.

CRUSHING. There is no evidence of crushing.

Sub-surface Factors

Sub-surface factors are the variables such as root etching, rodent gnawing, and skid marks that affect bone after burial and while it remains buried.

ROOT ETCHING. Root etchings are the vein like impression left on the outside of bone by root activity. Root etching is present on nearly all bone and bone fragments (99.99%)

RODENT GNAWING – Five of the bones showed evidence of rodent gnawing. These bones included two rib fragments, one long bone fragment, one metacarpal, and one eighth thoracic vertebra fragment (Table 4).

Table 4. Spiral fractures, Cut marks, Rodent gnawing and Fetal material

Element	Spiral Fractures	Cut Marks	Rodetn Gnawing	Fetal Material
Skull				
Manible				1
C - Vert				
T - Vert			1	
L - Vert				
Sacrum				
Ribs	2		2	1
Scapula	1			
Humerus	3			
Radius	5			
Ulna				
Radius/Ulna				
Metatarsal	3		1	
Metacarpal	2			
Femur	3			
Tibia	2	1		
Calcaneus				
Long Bone Frag			1	
Pelvis	2			
Fetal Material				2

SKID MARKS. No sediment abrasion, known as skid marks, were present.

Cultural Analysis

Cultural analysis addresses site materials that have been modified or utilized by humans, including cut marks on bone resulting from a cutting action and spiral fractures indicative of marrow acquisition.

CUT MARKS. – I only observed cut marks on one distal tibia. Cut marks are not common at sites because cutting on bone dulls the knife (Johnson and Bement 2009) (Table 4.)

SPIRAL FRACTURES. A total of 25 bones show spiral fracturing. These elements include tibias, scapulas', ribs (heads and shaft fragments,) femurs, humeruses, metacarpals, metatarsals, pelvis and radius fragments (Table 4). Spiral fractures may be the by-products of snacking activity where in people broke open long bones to consume the bone marrow. They may also indicate the creation of expedient tools to aid in the butchering process.

SEASONALITY. Tooth eruption patterns and the presence of fetal bone indicate seasonality at bison kill sites (Malainey and Sherriff 1996; Quigg 1978). Fetal material was recovered from the Ravenscroft II bone bed. The fetal elements include a mandible, rib, and other fragmentary pieces (Table 4). Tooth wear patterns on a mandible (Figure 10) are consistent with a 7 month-old calf (Todd et al. 1996). Figure 11 shows an x-ray of the right and left mandibles, revealing that the deciduous fourth premolar has erupted; the first molar has erupted but is not yet in full use; and the second molar is still buried in the mandible.

Figure 10. Calf mandibles in foam.

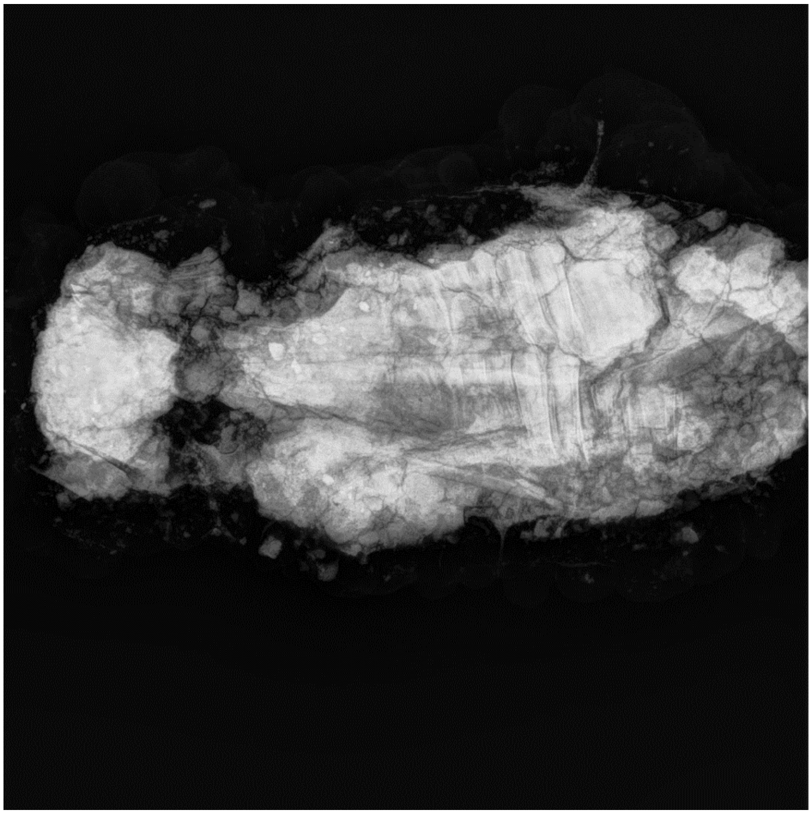


Figure 11. X-ray image of calf mandibles.

Bonebed Analysis

Upon completion of individual element assessment, the analysis focused on describing patterns attributed to the humans who butchered the bison. The analysis followed the steps described in Chapter 5 (Methods), which were designed specifically to yield the data necessary to address the research question "How does the Ravenscroft II kill fit into the Winter Kill model as presented by Malainey and Sherriff (1996), Quigg (1978), Frison (1980), and Arthur (1974).

A profile sketch drafted post-excavation spring 2017 by undergraduate student Dakota Larrick, highlights the west – east boundaries, the arroyo floor, the upper kill event excavated during the 2013 and 2015 seasons, and the lower kill event. [Figure 12 illustrates the north wall, the arroyo is roughly 6 meters west – east. The arroyo floor is exposed at 20 cm below surface at the west end and 25cm below surface on the east end]. The top of the bonebed was exposed by excavation at grid coordinates N49/E65 at 60cm below the surface. The bottom of the upper-kill bonebed was exposed at grid coordinates N49/E66, 1.05 m below the surface. All discussion and analysis focused on this upper kill level.

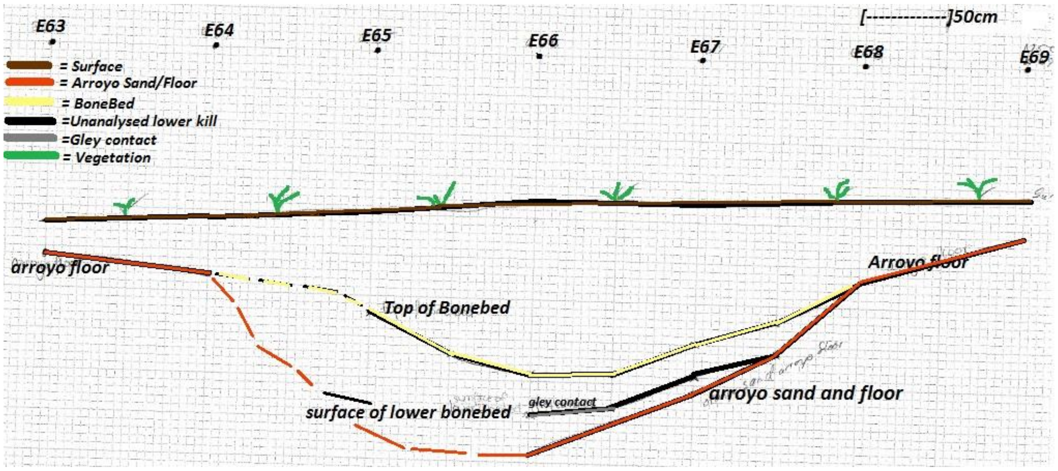


Figure 12. North Wall profile along N50 between E63 and E69.

The bone bed is composed of articulated bison halves, lower limb elements and individual bones. Figure 13 shows a vertebral column articulated to the accompanying pelvis. Ravenscroft II was, without a doubt, the by-product of human predation as confirmed with the recovery of a lanceolate projectile point. However, even without the projectile point, it can still be demonstrated that Ravenscroft II is a cultural by-product by referencing only faunal assemblage attributes. The sheer number of animals in the assemblage suggest human involvement, but natural events can occasionally cause mass deaths. However, the positioning of the bones makes is harder to dismiss, as the result of natural activity. As shown in Figure 14, two bison mandibles are positioned parallel to each other and resting directly atop a humerus, radius-ulna, and metacarpal articulation. This positioning is not normal to a skeleton, suggesting that people manipulated the position of the bones.

Figure 13. Articulated half: vertebral column articulated to the accompanying pelvis.

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Figure 14. Mandibles resting atop limb elements

Figures 15 and 16 show additional examples of articulated halves. Figure 15 depicts a vertebral column with articulated rib bones. Figure 16 shows a similar articulation, except that this animal was laid down on its stomach, this suggest that butchering began on the back of the animal. Figure 17 shows a similar pattern; however, in this instance the vertebral column and thoracic vertebrae are articulated with the front lower limbs. Lower limbs were commonly found articulated with their adjacent bones. In addition to articulated halves, articulated lower limbs were frequently unearthed in the bone bed (Figure 18). Roughly half of the lower limb articulations were two-bone articulations; the other half were full-limb articulations (Figure 19).

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Figure 15. Vertebral column, with articulated rib bones.

Figure 16. Animal laid on its stomach for butchering.

Figure 17. Articulated vertebral column, including thoracic vertebrae and front lower limbs

Figure 18. Partially articulated lower limb

Figure 19. Completed articulated lower limb

Numerous skulls were found in both the profile trench and main excavation unit. The skulls removed from the main excavation unit did not show signs of “bashing” indicating the hunters were not utilizing bison brain material at Ravenscroft II. The main unit also contained skulls with articulated axis units, including cervical and thoracic vertebrae (Figure 20). The largest skull was recovered from the profile trench (Figure 21). No skulls found in the profile trench had their mandibles attached, indicating that hunters did likely remove the tongue (Figure 22).

Figure 20. Skull with articulated axis and vertebrae

Figure 21. Large skull sealed in protective foam exposed in profile trench

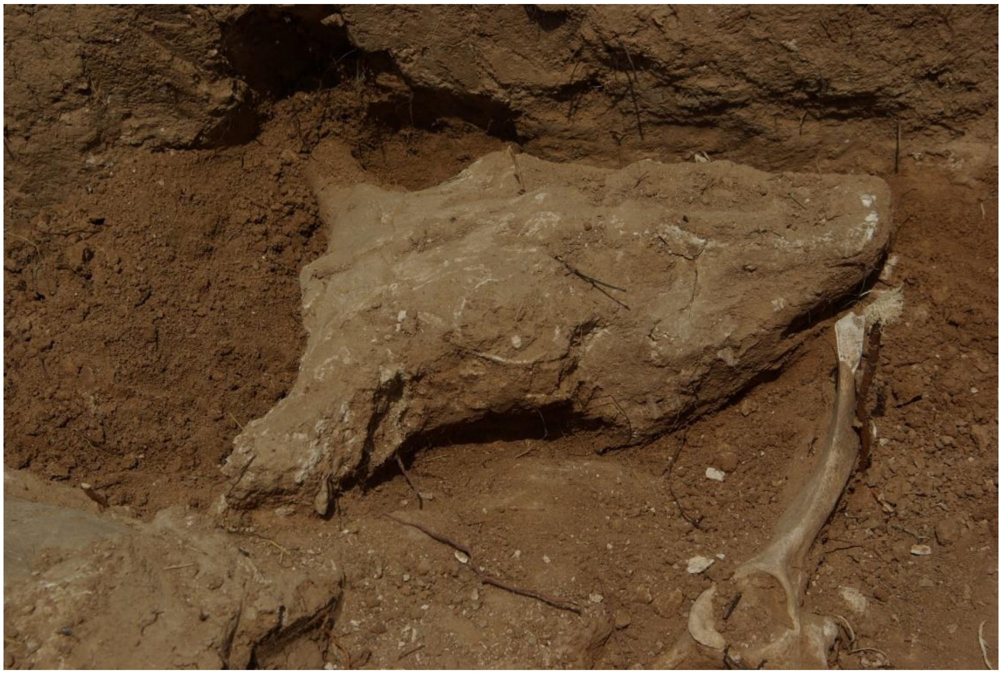

Figure 22. Skull with missing mandible exposed in profile trench

The only other cultural material recovered from the site beside the projectile point is a mussel shell, which appears to have been utilized as a knife (Figure 23 and 24).

Figure 23. Mussel shell tool in situ

Figure 24. Mussel shell tool in situ in the bone bed.

Lithic Qualitative Analysis

The Ravenscroft point was crafted from a brown quartzite. It is finely crafted and symmetrical, with no evidence for re-working (Figure 25). The point is 9.8 cm long and has an average thickness range from the tip to the base of 1.3 cm to 2.1 cm. The point has lenticular transverse and longitude cross sections. The upper two-thirds is pressure flaked parallel horizontal with transverse flakes that do not cross the midline. The lower one-third of the point has dulled edges with a concave base that have also been thinned on both surfaces by the removal of two basal flakes (Figure 26).

Of the four flakes found at Ravenscroft II, three were crafted from Alibates chert, while the other was made from Dakota formation quartzite. Three of the four flakes were unifacial knife fragments with utilized and worn edges. The latter was a re-sharpening flake. I conclude that these flakes were used during the butchering process. The following Chapter: (Discussion), deals with butchering practices, parallels to the Olsen-Chubbuck kill site, transportation in relation to a winter kill model, and a comparison of lithic technologies.

Figure 25. Recovered projectile point

Figure 26. This view of the projectile point highlights the basal thinning removal of two flakes.

CHAPTER 9:

DISCUSSION

There is no standard butchering practice. Butchering practices are depend on the time of the year, how quickly the meat will be utilized, the distance to camp, and the cultural group completing the task. While there are no strict standards for bison butchering there are some common practices. Ethnographic evidence suggests meat portions are graded according to value (Wheat et al. 1972). These high-value divisions tend to be the side meat, hind quarters, ribs, stomach + content, back, breast, and the forequarters (Wheat et al. 1972). The muscles of the back were removed in one piece, if possible; as they were considered choice portions along with the tongue, thoracic hump, bone marrow, and ribs (Wheat et al. 1972).

On the other hand, the forequarters (front half) has often been viewed as one of the least desirable pieces and is often left at the kill site (Ewers 1955). The neck and vertebrae are left at the kill site along with the pelvis, scapula, and front legs (Wheat et al. 1972; Fletcher and La Flesche 1911). The rear legs were preferred for marrow as the weight at the front legs diminished marrow production and ribs were usually broken away and/ or stripped of meat and discarded (Wheat et al. 1972).

Butchering patterns indicate, as ethnographic evidence shows, that meat portions do reflect choice and transport decisions. The closest camp site to Ravenscroft is the Bull Creek site (34BV176) at the foot of the Bull Creek, a tributary of the greater Beaver River. The distance between Ravenscroft II and Bull Creek is 1200 meters. I have first-hand experience traveling between these sites and can confirm that the distance is not too great to haul select butchered meat portions but evidently not close enough to transport lightly butchered animals. Ethnographic records indicate that during winter, the hide was converted into a blanket of flesh and used to transport selected meat portions by dragging it across the snow. According to Wheat and Colleagues (1972) women are described as the principle butcherers. The faunal assemblage at Ravenscroft II shows at minimum, moderate butchering; cut marks on a tibia suggest people were stripping meat from bone to optimize transportation of high quality portions. Another bison kill site of similar age with similar butchering patterns is the Olsen-Chubbock site in Cheyenne County, Colorado.

The Ravenscroft II bone bed is comparable to the Olsen-Chubbuck bison bone bed in terms of relative age, landform utilization, and butchering patterns. The Olsen-Chubbuck site is an arroyo trap style bison kill with a single radiocarbon date obtained from a bison hoof, dated to of 8200 +-500 RCYBP (Wheat et al. 1972). The vast majority of the faunal material uncovered were articulated halves and limb elements, much like those butchered at Ravenscroft II. In each of the following figures, the Olsen-Chubbuck site example is shown as a drawing and the Ravenscroft II example is a photograph (Figures 27, 28, 29, 30, 31, and 32). Partially butchered animals (Figure 27), vertebral column units (Figure 28), pelvic girdle units (Figure 29), and front and rear limb units were also common at Olsen-Chubbuck (Figure 30, 31, and 32).

Figure 27. Partially butchered animals

Figure 28. Vertebral column units

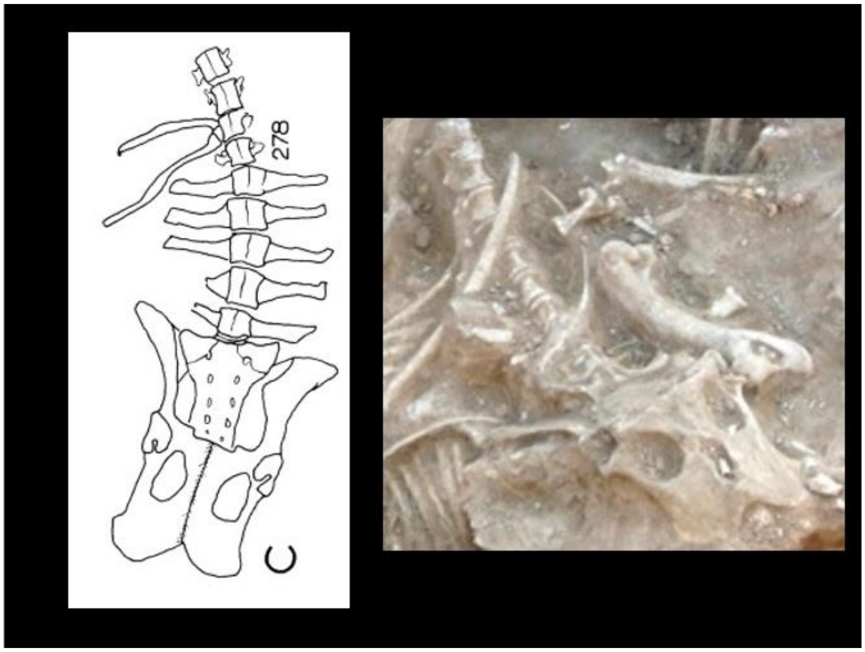

Figure 29. Pelvic girdle units

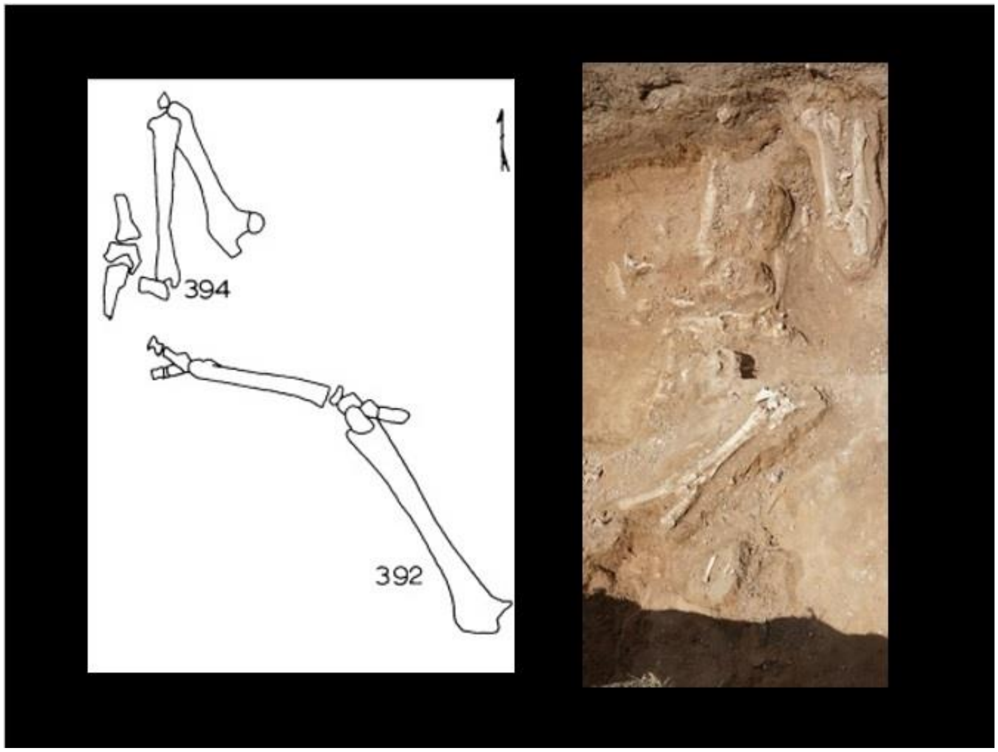

Figure 30. Rear Limb units

Figure 31. Front limb units

Figure 32. Front Limb unit

Earlier I estimated there are 80 – 100 bison involved in the kill event. What types of social networks and how many individuals would be needed to process and consume the meat from the kill event? Gorman (1972) hypothesized that there are two types of bison procurement groups. First, small kin groups making small quantity kills; and large non-kin social groups cooperating to amass large numbers of bison. Gorman (1972) likens the Olsen-Chubbuck kill site to this later group. According to Wheat (et al. 1972) there were about 190 animals involved in the kill event. Wheat (et al. 1972) argued there would have had to have been at least 150 – 200 people to not only consume half to three-fourths of the meat, but to transport the remaining meat to camp for additional processing before it became inedible. Individuals present during the kill event at Ravenscroft II were also large social group. As stated previously, only 10% of the Ravenscroft II site has been excavated and an estimated 80 to 100 animals were involved in the kill. If Wheat (et al. 1972) estimated it took between 150 – 200 people to consume and process 190 bison, I estimate that at least 75 – 100 people were need to consume and process the meat at Ravenscroft II.

The lone culturally diagnostic artifact recovered was a single lanceolate projectile point. It has the potential to illuminate the archaeological cultural groups responsible for the kill event. When the projectile point at Ravenscroft II was initially unearthed, it was assessed by Dr. Bement and Dr. Carlson as belonging to either the Frederick/Allen or Plainview type.

Lithic Analysis

The James Allen (Jimmy Allen) site is also a bison kill and butchering station dating to 7900 +/- 400 B.P (Mulloy 1959). Jimmy Allen points, as they have been termed, have been found in context with *Bison antiquus* as well as *Bison* o*ccidentalis.* *Bison occidentalis* are the species butchered at Ravenscroft II. Morphologically the point recovered from Ravenscroft II is comparable to the type recovered from the Mayhan site in the Oklahoma Panhandle (34CI133). Similar to Ravenscroft II, Mayhan is also a bison kill site with only one projectile point recovered; a James Allen point (Figure 33) (Hofman 2010).

On the High Plains of Texas, a bison kill site was recorded in the 1940s at the Plainview site (Sellards et al. 1947). The species of bison reported at the site is *Bison occidentalis,* the same species present at Ravenscroft II (Sellards et al. 1947). The recovered projectile points bore some resemblance to Folsom, but were ultimately typed as “Plainview” (Sellards et al. 1947) (Figure 34). The projectile recovered from the Plainview site strongly resembles the projectile from Ravenscroft II. Unfortunately, Krieger (1947), who conducted the analysis, could only utilize then known fluted and unfluted Paleo-Indian projectiles to construct his Plainview type (Buchanan et al. 2007). Subsequent point discoveries expanded the Plainview type until it became a “catch all” for unidentifiable Late Paleo projectiles. There are hundreds of points that have been typed Plainview simply because they have a lanceolate blade and a concave base (Wheat et al. 1972). Late Paleo-Indian projectile point typology has negatively benefited from overlapping qualifying attributes and less than careful type assignments (Hofman 1989; Johnson and Holliday 1997; Wheat et al. 1972). The Plainview type illustrates this issue (Buchanan et al. 2007).

I believe that it is best to leave the Ravenscroft II projectile point un-typed. Past typological problems, i.e. Krieger and the Plainview type. In turn, I suggest that the projectile point be placed on a continuum. The continuum would include qualitative, quantitative, temporal, and spatial information readily available for cross comparison.

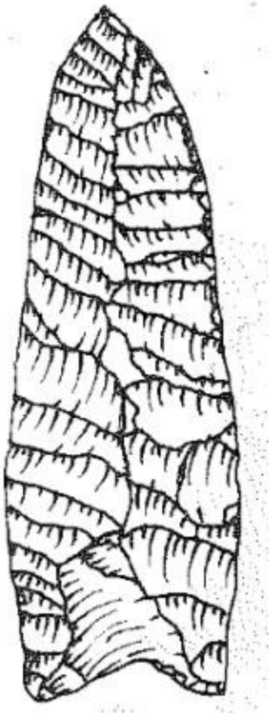

Figure 33. Jimmy Allen point [Mayhan site]

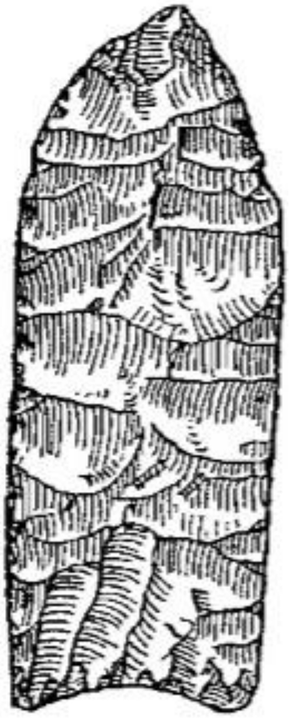

Figure 34. Plainview Point [Plainview site]

CHAPTER 10:

CONCLUSION

It can be stated with a high degree of confidence that Ravenscroft II does fit the model of winter bison hunting. The expectation for a winter time kill by Malainey and Sherriff (1996), Quigg (1978), Frison (1980), and Arthur (1974) which include:

1. Bison herd quantity is large enough that a communal kill is feasible.
2. Winter kills are patterned and will be reflected in the kill site age structure.
3. There should be freshwater and plentiful vegetation in the surrounding area.
4. The seasonality of kills should be during the winter, as indicated by fetal growth and tooth eruption and wear patterns.
5. Butchering patterns should reflect decisions about animal part transport to a secondary processing or base camp.

Is the bison herd quantity large enough that a communal kill could have been responsible? As stated in Chapter 8, (Results), only 10% of the Ravenscroft II site has been excavated. The current MNI indicates that at least 10 bison were killed in the event. Calculating the percent excavated combined with current MNI, we can expect the kill event to have involved at least 80 – 100 animals. When compared to the Olsen-Chubbuck site in Chapter 9, (Discussion), I estimate that 75 to 100 people were needed to process and consume the bison meat. As Paleo-Indians were mobile hunter-gatherers; one of the main motivations for aggregation was communal hunting. I argue the kill at Ravenscroft II was indeed the by-product of communal hunting.

Is there a winter kill pattern and if so, is it reflected in the kill site age structure? Arthur (1974) stated that if bison hunting extended through winter the fact will be reflected in the kill site age structure. The original Ravenscroft excavation of 2008 – 2009 located roughly 10 meters from Ravenscroft II, produced not only an age of 9,000 RCYBP but also fetal material (Bement et al. 2012). The current Ravenscroft II site produced an age of 9,300 RCYBP (Carlson et al. 2017) as well as fetal material. There is also a lower kill present at the Ravenscroft II site. Early excavations have uncovered fetal material. Based on laws of superposition, undisturbed material deposited below another is older than the above material. It would seem as though a winter time bison kill pattern has been established.

Is there fresh water and plentiful vegetation in the surrounding area? According to Malainey and Sherriff (1996) many Paleo-Indian winter camps are located along rivers to take advantage of the available vegetation. With the presence of fresh water, vegetation, and large bison herds it wasn't necessary to abandon the Plains during winter. Bull Creek a tributary of the larger Beaver (Canadian) River, is roughly 1200 meters from Ravenscroft II. Bull Creek, (as evident during a rain storm) (Figure 35) is capable of holding the necessary quantity of water needed to support both man and beast as well as supportive vegetation.

Is the seasonality of the kill winter? Evidence from fetal growth and tooth eruption and wear patterns confirm the season of kill as winter. The evidence is provided in the form of fetal material and the wear patterns of a calf mandible that show a wear pattern indicative of a 7-month old (Todd et al. 1996).

Figure 35. Bull Creek after a heavy rain storm

What do butchering patterns transmit in terms of dealing with part transport decisions to a secondary processing or base camp? The faunal assemblage at Ravenscroft II shows at minimum, moderate butchering. Cut marks on a tibia indicates people were stripping meat from bone to optimize transportation of higher quality portions.

The projectile recovered from Ravenscroft II in 2015 more closely resembles the Jimmy Allen point recovered at the Mayhan site. However, Jimmy Allen, much like other lanceolate projectile points, can be changed quite drastically over the span of its use-life and later be unrecognizable except for minute characteristics. I propose that the Ravenscroft II projectile be left un-typed and placed on a spatio-temporal continuum. Many projectiles were typed during a period of unconscious ignorance. Meaning, individuals such as Krieger (1947) only knew so much about projectile point variation.

By placing the Ravenscroft II point on a continuum, qualitative and quantitative analysis can be referenced and projectiles can also be regionalized, temporally and spatially, and placed in a data base for comparison. This will eliminate issues with type constraints and aid in use-life variation explanations. The method of production, the material, and the morphology can all be cross referenced, to create a better understanding of projectile point distribution.

The vast majority of late Paleo-Indian sites on the Southern Plains and in the Oklahoma Panhandle are kill sites. Environmental conditions and past events such as the Dust Bowl make discovering and investigating habitation sites a rarity. Making inferences based on surface collections are more the norm. The excavation and investigation of Ravenscroft II will allow researchers to broaden our understanding of the lifeways and technology of those Paleo-Indians living on the Southern Plains and in the Oklahoma Panhandle.

Future Investigations

There is still more to be learned about the Ravenscroft II site. Ascribing cultural affiliation can be a complex process. One method used to aid the process is lithic sourcing. The projectile recovered from Ravenscroft II was crafted from a brown granulated quartzite. If it is possible to locate the source material, it could be possible to more closely pinpoint those cultures drawing from the source and their trade networks. Pitblado (2008) seeks to tackle this issue. Pitblado (2008) wanted to develop methods to profile quartzite, and in the long run be able to fingerprint/pinpoint quartzite sources used by Paleo-Indian peoples as well as utilizing the information to reconstruct mobility patterns. In 2013 Pitblado was able to successfully discern quartzite outcrop sources from cobble sources using data obtained from LA-ICP-MS analysis. Pitblado (2013) also states that despite the heterogeneity of some Gunnison Basin cobble sources, their distribution pattern is recognizable, indicating sourcing of quartzite is possible. Pitblado's (2008; 2013) work was based in the Gunnison Basin in southwest Colorado however, it seems quite applicable outside that study area.

Further analysis is needed. Excavations have continued on into 2016 and as recently as spring 2017. During the spring 2017 excavation the floor of the arroyo was reached in the eastern portion of the site from E66 – E69. Weathering and gley context association indicates a very likely earlier kill event at the site. The Ravenscroft II site is also 1200 meters from the Bull Creek camp site (34BV176). Preliminary dates on bison bone recovered from the site reveal an age of 9,300 RCYBP. The proximity to Ravenscroft II, the species of bison and similar age of both sites heightens the notion of a shared relationship.

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APPENDIX 1

RAVENSCROFT BISON BONE ANALYSIS TALLY

Provenience	Bone .		Element	Side	Age Group
N49 E64	659	3	1st & 3rd Phalanges Frags	Left	2+
N49 E65	659	5	1st Phalanx	Left	2+
N52.5 E62	691	4	1st Phalanx	Left	2+
	901	A1	1st Phalanx	Left	
N48 E67	1023	4	1st Phalanx	Left	
N48 E66	1067	1	1st Phalanx	Left	= 5
n48 E67	1022	11	1st Phalanx	Right	3-5
N53 E64	501		1st Phalanx		2+
N48 E64	548		1st Phalanx		2+
N52.5 E 63	601		1st Phalanx		2+
N52.5 E63	642		1st Phalanx		2+
N49 E65	658	1	1st Phalanx		2+
N49 E65	658	2	1st Phalanx		2+
N52.5 E62	683		1st Phalanx		2+
N48 E64	695		1st Phalanx		2+
N48 E64	696		1st Phalanx		2+
N52.5 E62	715		1st Phalanx		2+
N48 E67	1066	1	1st Phalanx		= 5
N52.5 E63	613	3	1st Phalanx frag		2+
N52.5 E62	691	5	1st Phalanx Frags	Left	2+
N48 E65	555		1st Phalanx Frags		2+
N49 E64	680	3	1st Phalanx Frags		2+
N48 E64	699	1	1st Phalanx Frags		2+
N49 E64	557	8	1st Rib Frags		<7
N48 E64	558		1st Rib Frags		
N48 E65	710	2	1st Rib Frags		
N52.5 E63	615	1-3	1st-3rd Phalange Frags	Right	2+
N52.5 E63	614	1-3	1st-3rd Phalanx Frags	Right	2+
N49 E65	659	6	2nd Phalanx	Left	1+
N49 E65	659	7	2nd Phalanx	Left	1+
N52.5 E62	691	2	2nd Phalanx	Left	1+
N52.5 E62	691	3	2nd Phalanx	Left	1+
N 52 E 64	901	A2	2nd Phalanx	Left	

N48 E67	1023	4B	2nd Phalanx	Left	
N48 E67	1064	1(B)	2nd Phalanx	Right	= 5
N53 E64	502		2nd Phalanx		1+
N49 E64	508		2nd Phalanx		1+
N52.5 E64	534		2nd Phalanx		1+
N49 E64	547		2nd Phalanx		1+
N48 E64	553	1	2nd Phalanx		1+
N48 E65	554		2nd Phalanx		1+
N52.5 E63	596		2nd Phalanx		1+
N49 E65	658	3	2nd Phalanx		1+
N49 E65	658	4	2nd Phalanx		1+
N52.5 E62	684		2nd Phalanx		1+
N48 E64	729	1	2nd Phalanx		1+
N52.5 E62	815		2nd Phalanx		1+
N48 E67	1022	11B	2nd Phalanx		3-5
N49 E67	1025	2	2nd Phalanx		
N49 E67	1069	1	2nd Phalanx		2 +
N48 E64	700		2nd Phalanx Frags		
N48 E64	730	1	2nd Phalanx Frags		1+
N49 E64	753	2	2nd Phalanx Frags		1+
N48 E64	559		2nd Rib Frags		
N52.5 E63	529		3rd Phalanx		
N52.5 E64	531		3rd Phalanx		
N49 E64	545		3rd Phalanx		
N49 E64	546		3rd Phalanx		
N48 E64	553	2	3rd Phalanx		
N48 E64	648		3rd Phalanx		
N49 E65	658	5	3rd Phalanx		
N49 E65	658	6	3rd Phalanx		
N52.5 E62	685		3rd Phalanx		
N52.5 E62	686		3rd Phalanx		
N48 E64	729	2	3rd Phalanx		
N48 E64	730	2	3rd Phalanx		
N49 E67	1024		3rd Phalanx		
N49 E64	659	8	3rd Phalanx Frags	Left	
N52.5 E62	691	1	3rd Phalanx Frags	Left	
N49 E64	672	1	3rd Phalanx Frags		
N49 E64	680	5	3rd Phalanx Frags		
N52 E64	914		5th Metatarsal		
N52.5 E64	533		Accessory Carpal	Left	
N48 E64	698	2	Accessory Carpal	Right	
N53 E60	819		Accessory Carpal	Right	
N52 E63	952		Accessory Carpal	Right	

N53 E64	503		Astragalus	Left	
N52 E64	901	D	Astragalus	Left	
N48 E67	976	5	Astragalus	Left	3 +
N49 E67	988	5	Astragalus	Left	5 +
N48 E67	1022	1 B	Astragalus	Left	< 3
N48 E67	1023	5	Astragalus	Left	
N52.5 E64	530		Astragalus	Right	
N52.5 E62	719	4	Astragalus	Right	
N52.5 E63	738		Astragalus	Right	
N49 E67/68	969	5	Astragalus	Right	
N48 E67	1022	15	Astragalus	Right	3-5
N48 E67	1064	3(C)	Astragalus	Right	= 5
N48 E66	1066	3(B)	Astragalus	Right	= 5
N49 E67	990	B	Astragalus		< 5
N49 E67	1069	3(B)	Astragalus		2-5
N52.5 E62	724	7	Astragalus Frag	Left	
N52.5 E63	594		Atlas		
N52.5 E63	605		Atlas		<7
N49 E65	1017		Atlas Vert		
N52 E64	907		Axis	N/A	
N49 E65	750		Axis Frags		
N52 E63	964		Axis Vert		
N52 E63	1042		Axis Vert		< 7
N48 E64	557	12	C2-5 Frags		<7
N48 E64	557	11	C6 Frags		<7
N48 E64	557	10	C7 Frags		<7
N52 E62	935		Calcaneous		
N52.5 E62	733		Calcaneus	Left	
N52 E64	901	E	Calcaneus	Left	
N48 E67	1023	2	Calcaneus	Left	
N48 E67	976	4	Calcaneus Frags	Left	3 + (< 5)
N48 E67	1022	1 A	Calcaneus Frags	Left	< 3
N48 E66	1067	3	Calcaneus Frags	Left	= 5
N49 E64	671	2	Calcaneus Frags	Right	
N52.5 E62	719	1	Calcaneus Frags	Right	
N52.5 E63	737		Calcaneus Frags	Right	
N51 E63	1008		Calcaneus Frags	Right	5 +
N48 E67	1022	8	Calcaneus Frags	Right	3-5
N48 E67	1064	3(A)	Calcaneus Frags	Right	= 5
N48 E66	1066	3	Calcaneus Frags	Right	= 5
N49 E67/68	969	4	Calcaneus Frags		
N49 E66	986	3	Calcaneus Frags		5 +

N49 E67	988	4	Calcaneus Frags		
N49 E67	990	A	Calcaneus Frags		< 5
N49 E67	1069	3	Calcaneus Frags		2-5
N49 E65	664		Calf C-Vert Frags		<1
N49 E64	666	10	Calf Teeth Frags		
N48 E66	980		Carpal 2 + 3	Left	
N52 E63	1036		Carpal 2 + 3	Left	
N52 E63	963		Carpal 2 + 3	Right	
N52.5 E64	532		Carpal 2+3	Left	
N48 E64	633		Carpal Frags	Right	
N48 E64	634	2	Carpal Frags	Right	
N49 E64	666	8	Carpal Frags	Right	
N52 E64	947		Carpal Ulnar		
N49 E64	659	1	Carpals	Left	
N52.5 E62	691	8	Carpals	Left	
N52.5 E63	614	5	carpals	Right	
N48 E64	703		Carpals	Right	
N52 E64	920	2	Carpals	Right	<5
N49 E67	989	3	Carpals		
N49 E64	753	3	Carpals Frags	Left	
N52.5 E63	615	5	Carpals Frags		
N48 E66	1030		Carplal 2+3		
N52.5 E63	608	2	Caudal Vert		
N52.5 E63	809		Caudal Vert		
N48 E64	699	3	Caudal Vert Frags		<7
N48 E64	701	2	Caudal Vert Frags		<7
N49 E67	968		Caudal Vert Frags		
N49 E67	970		Caudal Vert Frags		
N49 E67	1065		Caudal Vert Frags		
N52.5 E63	806		Caudal Verts		
N53 E65-61, PROFILE TRENCH	820		CaUDal Verts		
N52.5 E62	692	3	Cuboid	Right	
N52.5 E62	719	6	Cuboid	Right	
N48 E64	699	2	Cuboid		
N52.5 E63	810		Cuboid		
N49 E65	758		C-Vert Epiphyseal Plate Frags		<7
N52.5 E63	617		C-Vert Frags		
N48 E64	630	3	C-Vert Frags		<7
N48 E64	704		C-Vert Frags		7+
N52.5 E62	718		C-Vert Frags		<7
N49 E65	757		C-Vert Frags		<7

N48 E65	787		C-Vert Frags		7+
N49 E65	789	1	C-Vert Frags		
N49 E65	1018	1	C-Vert Frags		
N52 E63	1043		C-Vert Frags		
N52 E62	937	2	Distal Femur	Left	
N52 E64	921		Distal Femur		
N49 E67	1068		Distal Radius		< 5
	901		Distal Tibia	Left	
N48 E67	1023	1	Distal Tibia	Left	
N52 E62	931		Distal Tibia		
N52.5 E63	591		Epiphyseal Plate from Vert		<7
N52.5 E63	561		Epiphysial Plates from Verts		<7
N48 E64	701	1	Femur	Left	<5
N52 E63	906		Femur Ball		< 5
N48 E64	506		Femur Frags	Left	<5
N52.5 E64	538	1	Femur Frags	Left	5+
N48 E67	976	7	Femur Frags	Left	3 +
N48 E67	979		Femur Frags	Left	= 5
N49 E67	988	7	Femur Frags	Left	5 +
N48 E67	1022	3	Femur Frags	Left	< 3
N52.5 E64	526	3	Femur Frags	Right	5+
N52.5 E63	528		Femur Frags	Right	5+
N49 E67	971		Femur Frags	Right	
N48 E67	1022	7	Femur Frags	Right	< 3
N52 E64	1002		Femur Frags		
N48 E67	1022	7 A	Femur Head	Right	< 3
N49 E64	804		Fetal Frag		
N49 E64	628	3	Fetal Mandible Frags		
N48 E64	505		Fetal Material		
N49 E64	753	5	Fetal Rib Frags		
N48 E65	556		Horn Core		
N48 E65	705		Horn Core		
N52 E62	927		Horncore		
N52.5 E63	604		Humerus Frags	Left	<5
N48 E64	507		Humerus Frags	Right	
N48 E64	557	21	Humerus Frags	Right	<5
N48 E64	728	24	Humerus Frags	Right	
N49 E64	751	1	Humerus Frags	Right	5+
N49 E65	789	2	Humerus Frags	Right	
N52 E64	913		Humerus Frags	Right	1+
N49 E65	1021		Humerus Frags	Right	1 +
N48 E65	1058	1	Humerus Frags	Right	1-5
N52.5 E62	689		Humerus Frags		<5

N48 E64	711		Humerus Frags		
N48 E64	779		Humerus Frags		<5
N49 E65	1009		Humerus Frags		
N52 E63	1040		Humerus Frags		< 5
N52 E63	926		Hyoid		
N52 E63	1039		Hyoid		
N48 E65	1050		Hyoid		
N48 E64	646		Hyoid Frags	Left	
N48 E64	645		Hyoid Frags	Right	
N52.5 E62	692	4	Hyoid Frags	Right	
N49 E64	666	4	Hyoid Frags		
N49 E64	802		Hyoid Frags		
N48 E65	709	2	Incisor	LEFT?	
N49 E64	672	2	Incisor	Right	
N52 E63	1040	B	Incisor		
N49 E64	800		Incisor Frag		
N52.5 E63	616	2	Intermediate Carpal	Left	
N52 E61	900		Jack Rabbit		
N48 E64	728	15	L9, T14-9 Frags		<7
N48 E67	966		Long Bone Frag		
N49 E67	967		Long Bone Frag		
N48 E 67	977		Long Bone Frag		
N52.5 E63	607		L-Vert		<7
N52.5 E63	527	1	L-Vert Frags		<7
N52.5 E63	527	2	L-Vert Frags		<7
N52.5 E63	597		L-Vert Frags		<7
N52.5 E63	598		L-Vert Frags		<7
N48 E64	630	2	L-Vert Frags		<7
N52.5 E63	641		L-Vert Frags		<7
N49 E65	661		L-Vert Frags		<7
N52.5 E62	723		L-Vert Frags		<7
N49 E67	991		L-Vert Frags		
N48 E67	1022	12	L-Vert Frags		
N52 E62	1046		L-Vert Frags		
N52.5 E63	637	2	Malleolus	Left	
N53 E64	539		Malleolus	Right	
N52.5 E62	719	2	Malleolus	Right	
N52.5 E62	724	4B	Mandible	Left	
N52.5 E62	724	4A	MANdible	Right	
N52 E65	909		Mandible	Right	
N48 E65	655		Mandible & Teeth Frags	Right	
N48 E65	665		Mandible & Teeth Frags		

N49 E65	667		Mandible & Teeth Frags		
N48 E65	656	2	MANdible Frag	Left	
N49 E65	1010		Mandible Frags		
N52.5 E63	606		Metacarpal	Left	3+
N52.5 E62	691	7	Metacarpal	Left	3+
N52.5 E63	614	4	metacarpal	Right	3+
N52.5 E63	615	4	Metacarpal	Right	<3
N48 E64	631		Metacarpal	Right	<3
N52 E64	920	3	Metacarpal	Right	<5
N49 E67	1025	1	Metacarpal		
N49 E64	801		Metacarpal 5	Left	
N48 E64	823		Metacarpal 5	Left	
N52.5 E62	814		Metacarpal 5	Right	
N52.5 E63	595		Metacarpal Frags	Left	3+
N48 E64	634	1	Metacarpal Frags	Left	3+
N49 E64	659	2	Metacarpal Frags	Left	3+
N48 E66	981		Metacarpal Frags	Left	
N49 E67	989	2	Metacarpal Frags	Left	< 3
N52 E62	1045		Metacarpal Frags	Left	3 +
N52.5 E62	714		Metacarpal Frags	Right	3+
N48 E65	788	1	Metacarpal Frags	Right	3+
N49 E65	1016		Metacarpal Frags	Right	
N48 E65	1059		Metacarpal Frags		< 3
N49 E64	679	1	metatarsal	Left	3+
N52 E64	901	B	Metatarsal	Left	
N48 E67	1023	3	Metatarsal	Left	
N52.5 E62	682		Metatarsal	Right	3+
N52.5 E62	690		Metatarsal	Right	5+
N48 E67	1022	10	Metatarsal	Right	3-5
N52.5 E62	724	6	Metatarsal 2	Left	
N52.5 E63	589		Metatarsal Frags	Left	3+
N52.5 E62	731		Metatarsal Frags	Left	3+
N48 E67	976	2	Metatarsal Frags	Left	3 +
N49 E67	988	2	Metatarsal Frags	Left	5 +
N48 E67	1022	4	Metatarsal Frags	Left	< 3
N48 E66	1067	2	Metatarsal Frags	Left	= 5
N49 E67/68	969	2	Metatarsal Frags	Right	
N49 E66	986	1	Metatarsal Frags	Right	5 +
N48 E67	1064	2	Metatarsal Frags	Right	= 5
N48 E66	1066	2	Metatarsal Frags	Right	= 5
N48 E64	552	1	Metatarsal Frags		<3
N48 E67	1063	2	Metatarsal Frags		3+
N52.5 E62	692	5	Miscellaneous Frags		

N48 E65	1048		Nasal		
N52.5 E63	636		Naviculo-Cuboid	Left	
N52 E64	901	C	Naviculo-Cuboid	Left	
N48 E67	976	3	Naviculo-Cuboid	Left	3 +
N49 E67	988	3	Naviculo-Cuboid	Left	5 +
N48 E67	1022	1 C	Naviculo-Cuboid	Left	< 3
N48 E67	1023	6	Naviculo-Cuboid	Left	
N52.5 E62	720		Naviculo-Cuboid	Right	
N49 E67/68	969	3	Naviculo-Cuboid	Right	
N49 E66	986	2	Naviculo-Cuboid	Right	5 +
N48 E67	1022	14	Naviculo-Cuboid	Right	3-5
N48 E67	1064	3(B)	Naviculo-Cuboid	Right	= 5
N48 E66	1066	3(C)	Naviculo-Cuboid	Right	= 5
N49 E67	990	C	Naviculo-Cuboid		< 5
N49 E67	1069	3(C)	Naviculo-Cuboid		2-5
N52.5 E62	719	3	Naviculo-Cuboid Frag	Right	
N52.5 E62	727		Organic Soil		
N52 E63	941		Patela		
N52 E63	942		Patela Frags		
N52 E62	937	3	Patella	Left	
N48 E67	1022	13	Patella	Left	3-5
N52.5 E64	526	2	Patella	Right	5+
N52.5 E63	618		Patella	Right	
N52.5 E64	538	2	Patella Frags	Left	
N52 E62	928		Pelvis		
N48 E64	627		Pelvis Frags	Left	
N52.5 E63	740		Pelvis Frags	Left	
N52.5 E63	612		Pelvis Frags	Right	
N49 E66	987		Pelvis Frags	Right	
N49 E67	1026	1	Pelvis Frags	Right	
N52.5 E63	616	1	Pelvis Frags		
N48 E64	698	1	Pelvis Frags		
N52.5 E63	735		Pelvis Frags		
N48 E66	983		Pelvis Frags		
N49 E65	1011		Pelvis Frags		
N49 E66	1060		Pelvis Frags		
N48 E67	1022	6	Pelvis w/ Sacrum		< 3
N49 E64	628	2	Petrous	Left	
N49 E64	666	2	Petrous	Left	
N52.5 E62	724	3	Petrous	Left	
N49 E64	666	3	Petrous	Right	
N52.5 E62	724	2	Petrous	Right	

N52 E64	920	5	Phalange	Rght	<5
N52 E64	920	4	Phalanges	Right	<5
N48 E67	1022	5	Phalanges		< 3
N48 E67	976	1	Phalanx	Left	3 +
N48 E67	976	1 B	Phalanx	Left	3 +
N49 E67	988	1 A	Phalanx	Left	5 +
N49 E67	988	1 B	Phalanx	Left	5 +
N49 E67	988	1 C	Phalanx	Left	5 +
N49 E67	989	1 B	Phalanx	Left	< 3
N49 E67	989	1 C	Phalanx	Left	< 3
N52 E64	948		Phalanx	Right	
N49 E67/68	969	1 A	Phalanx	Right	
N49 E67/68	969	1 B	Phalanx	Right	
N48 E67	1064	1	Phalanx	Right	= 5
N52 E63	954	1	Phalanx		
N49 E67	974		Phalanx		
N49 E67	975		Phalanx		
N48 E67	976	1 C	Phalanx		3 +
N48 E67	978		Phalanx		
N49 E67	989	1 A	Phalanx		< 3
N48 E66	1034		Phalanx		2 +
N52 E63	1035		Phalanx		
N52 E63	1047		Phalanx		2 +
N48 E65	1054		Phalanx		2 +
N48 E65	1054	B	Phalanx		2 +
N48 E67	1063	1	Phalanx		2 +
N52.5 E62	504		Possible Flake		
N48 E67	965		Proximal Rib	Right	
N52 E62	937	1	Proximal Tibia	Left	
N52 E63	995	1	Radaius Frags	Right	< 5
N52.5 E63	590		Radial Carpal	Left	
N52.5 E62	692	6	Radial Carpal	Right	
N52 E64	919		Radius	Left	
N52 E64	920	1	Radius	Right	<5
N48 E65	1058	2	Radius and Ulna	Right	1-5
N52.5 E63	574		Radius Frags	Left	5+
N52.5 E63	610	1	Radius Frags	Left	5+
N52.5 E63	613	4	Radius Frags	Left	1+
N49 E64	619		Radius Frags	Left	5+
N52.5 E62	732		Radius Frags	Left	<5
N48 E64	509		Radius Frags	Right	
N52.5 E63	610	2	Radius Frags	Right	
N52.5 E63	615	6	Radius Frags	Right	<5

N48 E64	632	1	Radius Frags	Right	5+
N49 E64	666	5	Radius Frags	Right	5+
N48 E64	784	1	Radius Frags	Right	<1
N48 E64	693		Radius Frags		
N48 E66	1033		Radius Frags		
N49 E64	751	2	Radius/Ulna Frags	Right	5+
N48 E65	763		Radius/Ulna Frags	Right	
N48 E66	1028		Rib	Left	
N52.5 E63	639		Rib		
N49 E65	670		Rib		
N49 E65	673		Rib		
N48 E66	1029		Rib		
N48 E64	728	1	Rib 1 Frags		
N48 E64	728	10	Rib 10 Frags		
N48 E64	728	11	Rib 11 Frags		
N48 E64	728	12	Rib 12 Frags		
N48 E64	728	13	Rib 13 Frags		
N48 E64	728	14	Rib 14 Frags		
N48 E64	728	2	Rib 2 Frags		
N48 E64	728	3	Rib 3 Frags		
N48 E64	728	4	Rib 4 Frags		
N48 E64	728	5	Rib 5 Frags		
N48 E64	728	6	Rib 6 Frags		
N48 E64	728	7	Rib 7 Frags		
N48 E64	728	8	Rib 8 Frags		
N48 E64	728	9	Rib 9 Frags		
N52.5 E63	567		Rib Frag		
N49 E66	984		Rib Frags	Left	
N49 E66	985		Rib Frags	Left	
N52 E63	996	1	Rib Frags	Left	
N52 E63	997		Rib Frags	Left	
N52 E63	998		Rib Frags	Left	
N49 E65	1015		Rib Frags	Left	
N49 E65	1018	2 B	Rib Frags	Left	
N49 E65	1020		Rib Frags	Left	
N52 E63	1041		Rib Frags	Left	
N49 E66	1061		Rib Frags	Left	
N48 E65	1055		Rib Frags	Left and Right	
N52 E64	915		Rib Frags	Right	
N52 E63/64	916		Rib Frags	Right	
N52 E63	917		Rib Frags	Right	
N 52 E64	918		Rib Frags	Right	
N52 E63	923		Rib Frags	Right	

N48 E65	1049		Rib Frags	Right	
N48 E65	1052		Rib Frags	Right	
N48 E64	510		Rib Frags		
N52.5 E64	536		Rib Frags		
N52.5 E64	537		Rib Frags		
N49 E64	542		Rib Frags		
N49 E64	543		Rib Frags		
N49 E64	544		Rib Frags		
N48 E64	550		Rib Frags		
N48 E64	551		Rib Frags		
N49 E64	557	13	Rib Frags		<7
N49 E64	557	14	Rib Frags		<7
N49 E64	557	15	Rib Frags		<7
N49 E64	557	16	Rib Frags		<7
N49 E64	557	17	Rib Frags		<7
N49 E64	557	18	Rib Frags		<7
N52.5 E63	560		Rib Frags		
N52.5 E63	562		Rib Frags		
N52.5 E63	563		Rib Frags		
N52.5 E63	564		Rib Frags		
N52.5 E63	565		Rib Frags		
N52.5 E63	566		Rib Frags		
N52.5 E63	568		Rib Frags		
N52.5 E63	569		Rib Frags		
N52.5 E63	571		Rib Frags		
N52.5 E63	572		Rib Frags		
N52.5 E63	573		Rib Frags		
N52.5 E63	575		Rib Frags		
N52.5 E63	592		Rib Frags		
N52.5 E63	593		Rib Frags		
N52.5 E63	600		Rib Frags		
N52.5 E63	603		Rib Frags		
N52.5 E63	609		Rib Frags		
N52.5 E63	613	1	Rib Frags		
N49 E64	620		Rib Frags		
N49 E64	621		Rib Frags		
N49 E64	623		Rib Frags		
N49 E64	624		Rib Frags		
N48 E64	630	4	Rib Frags		
N52.5 E63	638		Rib Frags		
N48 E65	647		Rib Frags		
N48 E65	649	2	Rib Frags		
N48 E65	651		Rib Frags		

N49 E65	654	3	Rib Frags
N49 E65	657		Rib Frags
N49 E65	663		Rib Frags
N49 E64	666	7	Rib Frags
N49 E65	668		Rib Frags
N49 E65	669		Rib Frags
N49 E65	674		Rib Frags
N49 E65	675	1	Rib Frags
N49 E65	677	2	Rib Frags
N49 E65	678	1	Rib Frags
N49 E64	680	1	Rib Frags
N52.5 E62	688		Rib Frags
N48 E64	697		Rib Frags
N48 E65	706		Rib Frags
N48 E65	707		Rib Frags
N48 E65	709	1	Rib Frags
N48 E64	712		Rib Frags
N52.5 E62	722		Rib Frags
N52.5 E62	724	5	Rib Frags
N52.5 E63	734		Rib Frags
N52.5 E63	736		Rib Frags
N52.5 E63	739		Rib Frags
N49 E64	742		Rib Frags
N49 E64	744		Rib Frags
N49 E64	745		Rib Frags
N49 E65	746		Rib Frags
N49 E65	747		Rib Frags
N49 E65	748		Rib Frags
N49 E65	749		Rib Frags
N49 E65	756		Rib Frags
N48 E65	759		Rib Frags
N48 E65	760	2	Rib Frags
N49 E65	761		Rib Frags
N48 E65	764		Rib Frags
N48 E65	766		Rib Frags
N48 E65	768		Rib Frags
N48 E65	770		Rib Frags
N49 E65	772	2	Rib Frags
N48 E64	774		Rib Frags
N48 E65	775		Rib Frags
N48 E64	776		Rib Frags
N48 E64	777		Rib Frags
N48 E64	778		Rib Frags

N48 E64	780		Rib Frags		
N48 E64	781		Rib Frags		
N48 E64	782		Rib Frags		
N48 E64	783		Rib Frags		
N48 E64	785	1	Rib Frags		
N48 E65	786	1	Rib Frags		
N49 E64	803		Rib Frags		
N52.5 E62	817		Rib Frags		
N52 E64	903		Rib Frags		
N52 E64	912		Rib Frags		
N52 E63	924		Rib Frags		
N50 E63	925	1	Rib Frags		
N52 E63	930		Rib Frags		
N52 E64	932		Rib Frags		
N52 E63	944		Rib Frags		
N52 E63/64	959		Rib Frags		
N52 E63/64	960		Rib Frags		
N52 E64	961		Rib Frags		
N52 E64	962		Rib Frags		
N52 E64	1003		Rib Frags		
N52 E64	1004		Rib Frags		
N48 E66	1027		Rib Frags		
N48 E66	1032		Rib Frags		
N48 E66	1062		Rib Frags		
N48 E65	762		Rib Head		
N49 E65	659	9	Rib Head Frag		
N49 E64	622		Rib Head Frags		
N52 E64	904		Rock		
N52.5 E63	527	3	Sacrum Frags		
N48 E64	630	1	Sacrum Frags		
N52.5 E63	640		Sacrum Frags		
N52 E(?)	1006		Sacrum Frags		1 +
N48 E65	650		Scapula	Right	
N52 E63	939		Scapula	Right	
N52 E64/65	908		Scapula		
N52 E 62	934		Scapula		
N52 E63	943		Scapula		
N49 E65	755		Scapula - Glenoid Cavity	Left	
N49 E65	677	1	Scapula Frags	Left	
N48 E65	710	1	Scapula Frags	Left	
N48 E64	728	21	Scapula Frags	Left	
N52.5 E63	741		Scapula Frags	Left	

N48 E64	557	20	Scapula Frags	Right	
N49 E65	654	2	Scapula Frags	Right	
N48 E65	656	1	Scapula Frags	Right	
N49 E65	662		Scapula Frags	Right	
N52.5 E62	681		Scapula Frags	Right	
N48 E64	728	22	Scapula Frags	Right	
N52 E63	1000		Scapula Frags	Right	
N49 E65	675	2	Scapula Frags		
N48 E65	765		Scapula Frags		
N49 E65	1012		Scapula Frags		
N52 E62	1044		Scapula Frags		
N48 E64	552	2	Sesamoid		
N52.5 E63	613	2	Sesamoid		
N53 E65-61, PROFILE TRENCH	821		Sesamoid		
N48 E64	822		Sesamoid		
N49 E65	659	4	Sesamoids	Left	
N48 E64	549		Sesamoids		
N48 E64	553	3	Sesamoids		
N52.5 E63	608	1	Sesamoids		
N48 E64	632	2	Sesamoids		
N48 E64	635		Sesamoids		
N49 E65	658	7	Sesamoids		
N49 E64	680	4	Sesamoids		
N52.5 E62	691	6	Sesamoids		
N52.5 E62	721	2	Sesamoids		
N52.5 E62	724	8	Sesamoids		
N49 E64	751	3	Sesamoids		5+
N48 E64	773		Sesamoids		
N48 E65	788	2	Sesamoids		
N49 E65	799		Sesamoids		
N52.5 E63	805		Sesamoids		
N52.5 E63	808		Sesamoids		
N52.5 E62	812		Sesamoids		
N52.5 E62	813		Sesamoids		
N52.5 E62	818		Sesamoids		
N52.5 E63	611		Skull		
N52.5 E63	644		Skull		
N52.5 E62	725		Skull		
N49 E64	628	1	Skull Frags		
N49 E64	666	1	Skull Frags		
N52.5 E62	692	1	Skull Frags		

N52.5 E62	724	1	Skull Frags		
N52.5 E62	726		Skull Frags		
N48 E66	1031		Skull Frags		
N49 E65	659	10	Sternal Rib Frag		
N52.5 E64	535		Sternal Rib Frags		
N49 E64	629		Sternal Rib Frags		
N48 E65	708		Sternal Rib Frags		
N48 E65	709	3	Sternal Rib Frags		
N48 E64	713		Sternal Rib Frags		
N49 E64	753	1	Sternal Rib Frags		
N52 E64	1005		Sternal Rib Frags		
N48 E65	1058	2(B)	Sternal Rib Frags		1-5
N49 E64	660	1	Sternum & Sternal Rib Frags		
N48 E64	557	9	T1 Frags		<7
N49 E64	557	7	T2 Frags		<7
N49 E64	557	6	T3 Frags		<7
N49 E64	557	5	T4 Frags		<7
N48 E64	728	20	T4 Frags		
N49 E64	557	4	T5 Frags		<7
N48 E64	728	19	T5 Frags		
N49 E64	557	3	T6 Frags		<7
N48 E64	728	18	T6 Frags		
N49 E64	557	2	T7 Frags		<7
N48 E64	728	17	T7 Frags		
N49 E64	557	1	T8 Frags		<7
N48 E64	728	16	T8 Frags		
N49 E64	679	2	Tarsal 2+3	Left	
N52.5 E62	719	5	Tarsal 2+3	Right	
N52.5 E62	692	2	TEETH		
N52.5 E64	526	1	Tibia	Right	5+
N52.5 E63	570		Tibia	Right	5+
N48 E67	1022	9	Tibia	Right	3-5
N48 E64	626		Tibia Frags	Left	<5
N52.5 E63	637	1	Tibia Frags	Left	3-5
N48 E67	976	6	Tibia Frags	Left	3 +
N49 E67	988	6	Tibia Frags	Left	5 +
N48 E67	1022	2	Tibia Frags	Left	< 3
N48 E67	1064	4	Tibia Frags	Right	= 5
N52.5 E63	652		Tibia Frags	Unknown	
N49 E67/68	969	6	Tibia Frags		
N52.5 E62	811		Tooth		
N52.5 E62	816		Tooth		
N48 E65	769		T-Vert		<7

N48 E65	771		T-Vert		<7
N50 E63	925	2	T-Vert		
N52 E64	929		T-Vert		
N52 E63	996	2	T-Vert Frags	N/A	
N48 E64	602		T-Vert Frags		
N52.5 E63	643		T-Vert Frags		<7
N49 E65	653		T-Vert Frags		<7
N49 E65	654	1	T-Vert Frags		
N49 E64	680	2	T-Vert Frags		<7
N52.5 E62	716		T-Vert Frags		
N52.5 E62	717		T-Vert Frags		<7
N52.5 E62	721	1	T-Vert Frags		<7
N48 E64	728	23	T-Vert Frags		
N49 E65	754		T-Vert Frags		
N48 E65	760	1	T-Vert Frags		<7
N52 E63	940		T-Vert Frags		
N52 E64	950		T-Vert Frags		
N52 E64	951		T-Vert Frags		
N52 E63	956		T-Vert Frags		< 7
N52 E63	958		T-Vert Frags		
N52 E63	999		T-Vert Frags		
N52 E63	1001		T-Vert Frags		< 7
N49 E65	1018	2	T-Vert Frags		
N 52 E65	1037		T-Vert Frags		< 7
N52 E63	1038		T-Vert Frags		< 7
N48 E65	1055	B	T-Vert Frags		
N48 E64	557	19	T-Vert Spine		<7
N48 E65	767		T-Vert Spine Frag		
N52.5 E63	599		Ulna Frags	Left	<5
N48 E64	694		Ulna Frags	Left	5+
N48 E64	625		Ulna Frags	Right	<5
N52.5 E62	687		Ulna Frags	Right	5+
N48 E64	784	2	Ulna Frags	Right	<5
N48 E65	786	2	Ulna Frags	Right	
N52 E63	995	2	Ulna Frags	Right	< 5
N49 E65	1019		Ulna Frags	Right	5 +
N49 E64	666	6	Ulna Frags		
N48 E66	982		Ulna Frags		< 5
N52 E63	1007		Ulna Frags		< 5
N52 E63	955		Ulnar Carpal	Left	
N53 E62	500		Unidentified Frag		
N48 E65	649	1	Unidentified Frags		
N52 E64	902		Unidentified Frags		

N52 E64	905		Unidentified Frags		
N52 E64	922		Unidentified Frags		
N52 E62	936		Unidentified Frags		
N52 E64	946	1	Vert		
N52 E64	946	2	Vert		
N52 E64	946	3	Vert & Rib	Right	
N52 E63	938		Vert Disk		
N52 E64	949		Vert Disk		
N52 E63	953		Vert Disk		
N52.5 E63	807		Vert Epiphyseal Plate		<7
N49 E64	660	2	Vert Epiphyseal Plate Frags		<7
N49 E64	666	9	Vert Epiphyseal Plate Frags		<7
N49 E65	676		Vert Epiphyseal Plate Frags		<7
N49 E65	678	2	Vert Epiphyseal Plate Frags		<7
N48 E64	702		Vert Epiphyseal Plate Frags		<7
N49 E65	752		Vert Epiphyseal Plate Frags		<7
N49 E64	753	4	Vert Epiphyseal Plate Frags		<7
N49 E64	671	1	Vert Frags		
N49 E65	675	3	Vert Frags		
N49 E64	743		Vert Frags		<7
N49 E65	772	1	Vert Frags		<7
N48 E64	785	2	Vert Frags		
N49 E65	1013		Vert Frags		< 7
N48 E65	1051		Vertebrae Frags		
N48 E65	1053		Vertebrae Frags		< 7
	576				
	577				
	992				
	993				
	994				
	1014				