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Faunal Analysis of the Tongue River Bison Kill Site (24RB2135) in Southeastern Montana

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The University of Montana

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FAUNAL ANALYSIS OF THE TONGUE RIVER BISON KILL

(24RB2135) IN SOUTHEASTERN MONTANA

By

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B. A., Pennsylvania State University, State College, PA, 2002

Thesis
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The Faunal Analysis of the Tongue River Bison Kill Site (24RB2135) in Southeastern Montana

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The University of Montana excavated the Tongue River bison kill site (24RB2135) in 2005 on the Northern Cheyenne Reservation. This was the site of a prehistoric bison hunt. Over 20,000 bone fragments and over 1,000 stone tools were recovered during the excavation. This study focuses on the bone material in order to understand past hunting practices at this site.

In order to complete the analyses required to understand the faunal material, specific data was gathered for each bone element. These data points include: the taxon, skeletal element, side, body orientation, portion, color, size, weathering, age, and any natural or cultural modifications. Qualitative observations such as carnivore activity, rodent gnawing, root damage, and beetle drilling, measured natural modifications. Cultural qualitative characteristics include cut marks and excavation damage. Calculations including, bone density, bone utility, butchering practices, and age of the bison, were used to determine the cultural significance of the bones.

The bone bed was not created by environmental factors, but more likely created by human actions. Exposure to the elements, fire, carnivore activity, and rodent damage were minimal. The site was the initial kill site and hunters removed highly nutritious parts for processing. The Tongue River site contains bison from many age classes including at least one fetus. Such an age range indicates that the site was used more than once. There are two different events within the bone bed: one to the east and one to the west. One of the hunts took place on a cow-calf herd during the winter or early spring.
Acknowledgments

I would like to thank Dr. Anna Prentiss for offering this project to me and getting me started. I would also like to thank my committee members, Dr. Dan Pletscher and Dr. Ashley Mckeeown, for their help and patience. I extend a thank you to Blair Logan for her help examining the many bone fragments and to David Clarke for his technical expertise. This work would have been difficult without assistance from Dave Dyer, Ayla Amadio, and Christina Palen. I would also like to thank Lindsay Blackford, Casey Coughlin, Kathryn Dayer, Kelsey Denison, and Sara Hamler in the initial cleaning of the collection. I would especially like to thank the Northern Cheyenne Reservation and the Bureau of Indian Affairs for all of their help and support throughout this project. Most importantly, I appreciate the patience and understanding of my husband and my family.
## Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>ii</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>iii</td>
</tr>
<tr>
<td>List of Tables</td>
<td>vi</td>
</tr>
<tr>
<td>List of Figures</td>
<td>vii</td>
</tr>
<tr>
<td>Chapter 1: Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Theoretical Framework</td>
<td>2</td>
</tr>
<tr>
<td>Chapter 2: Background</td>
<td>6</td>
</tr>
<tr>
<td>Paleoenvironment</td>
<td>6</td>
</tr>
<tr>
<td>Bison History and Behavior</td>
<td>8</td>
</tr>
<tr>
<td>Culture Chronology and Bison Hunting on the Northern Plains</td>
<td>10</td>
</tr>
<tr>
<td>Chapter 3: The Tongue River Site</td>
<td>20</td>
</tr>
<tr>
<td>Lab Methodology</td>
<td>22</td>
</tr>
<tr>
<td>Faunal Remains</td>
<td>24</td>
</tr>
<tr>
<td>Associated Materials</td>
<td>25</td>
</tr>
<tr>
<td>Chapter 4: Taphonomy</td>
<td>27</td>
</tr>
<tr>
<td>Weathering</td>
<td>27</td>
</tr>
<tr>
<td>Natural Modifications</td>
<td>29</td>
</tr>
<tr>
<td>Heat Modifications</td>
<td>30</td>
</tr>
<tr>
<td>Bone Density</td>
<td>31</td>
</tr>
<tr>
<td>Chapter 5: Cultural Factors</td>
<td>36</td>
</tr>
<tr>
<td>Carcass Utility Index</td>
<td>36</td>
</tr>
<tr>
<td>Butchering Methods</td>
<td>40</td>
</tr>
<tr>
<td>Herd Structure and Seasonality</td>
<td>43</td>
</tr>
<tr>
<td>Section</td>
<td>Page</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Multiple Kill Events</td>
<td>45</td>
</tr>
<tr>
<td>Chapter 6: Discussion and Conclusions</td>
<td>51</td>
</tr>
<tr>
<td>References Cited</td>
<td>55</td>
</tr>
<tr>
<td>Appendix A: Faunal Database Key</td>
<td>61</td>
</tr>
</tbody>
</table>
List of Tables

Table 1: Stages of weathering, as described in Behrensmeyer (1978). 28
Table 2: Total bone fragments exhibiting various levels of weathering. 29
Table 3: Total bone fragments exhibiting signs of other natural modifications 29
Table 4: Heat modification characteristics, as described in Lyman (2001) 30
Table 5: Total bone fragments for each stage of heat exposure 31
Table 6: Volume density of B. bison bones taken from Kreutzer (1996). 33
Table 7: Minimum number of animal units (MAU) for the Tongue River Assemblage 35
Table 8: MNE, %MAU, and MGUI values for Eastern units. (Codes listed in Appendix A) 47
Table 9: MNE, %MAU, and MGUI values for Western units. (Codes listed in Appendix A) 47
List of Figures

Figure 1: The Tongue River site bone bed during excavation, facing north. 20
Figure 2: The plotted squares and excavated unit layout in Area 1. 21
Figure 3: Levels of weathering within the Tongue River assemblage. 28
Figure 4: Impact of taphonomic factors on the Tongue River assemblage. 30
Figure 5: The number of bone fragments with heat modification. 31
Figure 6: Scatter plot illustrating correlation tests between bone density and minimum number of elements (MNE). (Codes listed in Appendix A) 33
Figure 7: Modified general utility index (MGUI) against ranking of minimum number of animal units (%MAU). (Codes listed in Appendix A) 39
Figure 8: Locations of cut marks on bison skeleton. (Original diagram from L.C.Todd 2001) 42
Figure 9: Age distribution of the Tongue River assemblage. 44
Figure 10: Reverse utility curve for western kill event. (Codes listed in Appendix A) 46
Figure 11: Reverse utility curve for eastern kill event. (Codes listed in Appendix A) 48
Chapter 1

Introduction

Millions of bison lived in the United States during the prehistoric period, predominately in the western region (Lott 2002). Buffalo hunting was crucial to the survival of people who lived on the Great Plains. A buffalo can provide meat, marrow, grease, and hides. Hunting techniques used for these abundant and useful animals changed through time. Communal bison hunting sites are found throughout the United States. Archaeologists extensively study the techniques used to kill and process the animals (Agenbroad 1978; Anderson and Shutter Jr. 1978; Borresen 2002; Chatters et al 1995; Davis and Zeier 1978; Frison 1970a, 1970b, 1971, 1974, 1976; Forbis 1978; Reeves 1978a, 1978b; Rogers and Martin 1984; and Stanford 1978) but many questions still remain. The Tongue River Buffalo jump, located in southeastern Montana near the Tongue River, offers more clues about the subsistence strategies and hunting techniques of the past inhabitants on the Northwest Plains.

The analysis of the faunal remains at the Tongue River Site (24RB2135) is based on evolutionary ecology, particularly focusing on the idea that hunting techniques are an adaptive behavior (Reher 1978, Shipman 2004). Previous research has shown that Bison species have decreased in size through time (Wilson 1978). Bison bison (the current form of bison) is the smallest yet. Hunting strategies have changed and evolved through time to accommodate the changes in the animals, different environmental pressures, and climatic changes.

The Tongue River site is in southeastern Montana near the Tongue River on the east side of the Northern Cheyenne Indian Reservation. The University of Montana in
conjunction with the Northern Cheyenne tribe and the Bureau of Indian Affairs conducted the excavation. The Tongue River site yielded 20,359 bones and 1,185 stone tools and flakes. Through the information gathered at the site, it is clear that Late Archaic and Late Prehistoric hunters used this site for a minimum of two kill events with at least one kill occurring during the late winter or early spring season. Based on the carcass utility index, butchering processes, and bone density analysis, the Tongue River site was a primary kill site where highly nutritious parts were removed for processing.

Theoretical Framework

Drawing on the logic of optimal foraging theory (Winterhalder 1981), archaeologists often make the assumption that hunters-gatherers will make food decisions in an efficient manner. This is measured in terms of time and energy spent in relation to the prospective energy profit, measured in the amount of calories and fat obtained. On the hunt, hunters do not sit down and “run the numbers,” but they seem to assume the larger the animal the larger the potential return. A strategy that provides large quantities of food with the least amount of energy lost will become the primary behavior. Theoretically, once a successful behavior is found, the hunter will pass the technique on to the next generation (Winterhalder 1981). This hunting strategy will last until a new set of circumstances arises due to changes in herd structure, environment, or human population.

As Reher (1974) points out, bison was one, if not the most, important food resource on the Plains. Bison provided a lot of potential nutritional value as well as several other items, such as bones, hides, and grease. A large communal bison hunt took a lot of planning, preparation, and subsequent processing of animals. To make such an
endeavor practical, a certain number of bison would need to be present in order to
achieve a profitable return on the energy spent.

Modifications within the bison population, to the surrounding environment, and in
the human population can lead to adjustments in the prevailing hunting behavior.
Significant changes within bison herds could result in changes in human hunting tactics
(Reher 1974). During the summer rut, bison groups are larger and consist of males and
females. A mating group could potentially provide the hunter with plenty of meat. During
the winter, groups are smaller and a hunt could be less effective if a lot of time and
energy investment are required.

The climate and environment fluctuate; some variations include temperature,
rainfall, river and lake depths, and grass quality. Optimal conditions for bison include
access to quality grass and water (Reher 1978). Inadequate foraging conditions result in
smaller herd size and larger home ranges (Bozell 1995). As habitats change, bison will
travel to find quality food resources and subsequently so will hunters. If bison are not
close to a topographical aid, such as a cliff or arroyo, the hunters need to change their
methods and even their technology. Excess travel uses more energy, possibly limiting the
energy return. Lots of grass and easy access to water will likely produce healthy and
abundant bison herds; less grass and water during a summer drought or harsh winter may
result in depleted groups.

Within the human group, changes in size, culturally important items, and
locations of campsites can alter a successful strategy. The size of a group directly relates
to the number of animals that can be killed and processed. Larger hunting groups can kill
larger animal groups; the fewer the participants, the more restricted the size of the kill.
During processing, hunters may be influenced by cultural significance or economic value to harvest a product with little nutritional value. There are several useful materials that can be harvested from a carcass and many factors can influence the decisions made by prehistoric hunters (Lyman 2001). Items that are culturally important can also change the hunting strategy. For example, bison hides harvested in the fall season make warm winter coats.

Due to travel requirements typically associated with a hunt, the hunter needs to transport the meat or other products back to the living area. It is important to utilize the animal’s most valuable parts while using the least amount of energy. Dragging a several hundred pound animal across miles of landscape is not energy efficient or time effective. The preliminary butchering takes place at or near the site of the kill. The hunter divides up the carcass based on anatomical sections that are more easily transported (Binford 1978). Once moved, the animal units are taken to a secondary site for storage and further processing. These articulated sections are further processed into smaller more useable portions.

The problem of transporting animal parts is a critical factor in energy and time costs. The more meat that is acquired, the more energy used to claim it (Binford 1978). The meat needs to be removed from the carcass and transported. When there are a lot of animals, less valued units will be left behind (Binford 1978). Hunters can be more selective in what they harvest and make the most of their energy spent.

To provide a basis for the following study, I will review the climate history for the northwest Plains, bison evolution and behavior, and changes in cultural groups and hunting techniques. From this foundation, I will describe the Tongue River site field and
lab methods, as well as the faunal and tool materials recovered. The faunal analysis portion is made up of natural factors (taphonomy) and cultural factors. Taphonomic factors addressed in this study include weathering, natural modifications, heat, and bone density. Cultural factors include carcass utility, butchering methods, herd structure and seasonality, and separating the site into multiple kill events.
Chapter 2

Background

The Great Plains region covers a vast expanse of land in North America. It extends from Canada down to Mexico, approximately 2,360 miles, and from the Rocky Mountains to the eastern woodlands, 995 miles (Gray 2002). Due to the wide variation within this geographical area, archaeologists divide the plains into 5 regions: Northwest, Northeast, Central, Middle Missouri, and Southern (Fagan 2000). Based on the location of the Tongue River site, this thesis will focus on the Northwest region. The Northwest region includes eastern Montana, the western Dakotas, and Wyoming. Throughout the plains, summers are hot and winters are cold and harsh. Animals and humans face a battle throughout the year against the summer sun and winter storms. Animals on the Great Plains, specifically Bison, have acclimated to the changing environment. Human hunters have also changed, as seen in their technology and hunting techniques.

Paleoenvironment

The last ice age during the Pleistocene period in North America peaked 20,000 years ago, before any known human habitation (Gray 2002). The animal population during the Pleistocene period was very different than today. Dire wolves, cheetahs, mammoths, lions, and early species of sheep and bison roamed the Great Plains (Gray 2002). As human groups traveled across the land bridge into North America, ice sheets retreated, and warmer weather moved north (Gray 2002). This was a time of change on the Northwest Plains. With less arctic air moving down from Canada, previously glaciated land was turning into conifer and aspen forests as well as prairie grasslands (Gray 2002). Between 12,000 and 10,000 years before present (BP), several known
species disappeared during a great extinction (Pielou 1991). Most species were mega
fauna, weighing over 990 pounds (Dunleavy 2002). The exact cause of the mass
extinction is debated; however, a combination of the changing climate and pressures from
the new human predator are often blamed. Bison were adjusting to the changing
conditions by becoming smaller and, as Gray (2002) suggests, moving in smaller groups.

The early Holocene period coincides with early human groups during the Paleo-
Indian period. As defined by Geologists, the Holocene begins 10,000 years ago (Pielou
1991). The Hypsithermal period, lasting for 3,000 or 4,000 years, brought warm and dry
conditions (Pielou 1991). Fossils found in extreme northern environments indicate
geographical ranges extended far beyond those of today. According to Pielou (1991),
 evidence of beavers on the Seward Peninsula is well outside of their current range. The
warmer and dryer conditions brought drought and fires to the Great Plains (Pielou 1991).
These dry conditions severely affected human and animal groups. Humans and animals
moved to find more hospitable habitats. Animal herds traveled to the edge of the forest
for the wet environment and left the dry open Plains (Pielou 1991). Bison groups stayed
near water in order to find the best vegetation; humans followed their food resources
(Fagan 2000).

After the warm Hypsithermal period the climate became colder and wetter (Pielou
1991). The prairie vegetation changed from desert type plants, such as sagebrush, orache,
and cactuses, to grasses (Pielou 1991). Tree species changed in their range and forests
changed in their composition. Some species retreated due to the colder northern
temperatures, other species continued to spread north (Pielou 1991). The human
population was increasing and large bison kills were taking place (Frison 1991).
Corresponding to the overall trend of warming and cooling periods, this neoglacial period was followed by the Little Climatic Optimum, characterized by warmer temperatures (Pielou 1991). This is the last warm period before the current warming trends. Starting at 1,800 years BP, this period has warm and dry air and frequent forest fires (Pielou 1991). Following the Little Climatic Optimum is the Little Ice Age (Pielou 1991). Lasting between 1350 and 1870 AD, the Little Ice Age falls into historic memory (Pielou 1991). The Little Ice Age is followed by warmer temperatures, our current climatic period. After European contact, the ecosystem of the Plains drastically changed due to human activity not climatic influences. Thousands of European settlers were putting new strains on the resources of the Native Americans; the bison herds drastically declined in numbers due to over-hunting.

**Bison History and Behavior**

Although most bison herds were destroyed by extensive hunting practices of white settlers and Native Americans, some bison still exist today. Ancestors of modern bison came across the land bridge linking Siberia and Alaska (Wilson 1992). The original bison species in America was larger than modern bison. Two earlier forms of buffalo were *Bison antiquus* and *Bison occidentalis*. *B. antiquus* existed in North America between 22,000 and 10,000 years ago (Lott 2002). *B. antiquus* coexisted with *B. occidentalis* (Lott 2002). *B. occidentalis* thrived for 5,000 years before it was replaced by the modern *B. bison* (Lott 2002). It is possible that there were several evolutionary lines, which would allow multiple species to coexist (Wilson 1992). Due to previously described changes in environment and climate on the plains, the buffalo became smaller in size.
Bison behavior and physical qualities are well adapted to life on the Great Plains. Spring is the time for bison to recover from harsh winter months and start preparing for the next winter. While food is plentiful, bison will store up fat to use when food is not abundant during later months (Lott 2002). As the weather warms, the bison shed their thick winter coat (Lott 2002). Bison are able to stay warm during harsh winters because of their thick coats. According to Lott (2002), buffalo skin has 10 times as many hairs in one square inch than that of a standard cow. A buffalo hide during the winter months would have been highly prized by prehistoric Plains hunters. During the winter, bison cut down on their energy output; Lott (2002) shows that modern bison eat less in the winter, even if food is plentiful.

Modern bison social behavior is predictable and well studied. Modern studies (Lott 2002, Schaeffer 1978) and early accounts of bison hunting on the Plains (Crow 1978) provide the extent of information available to archaeologists. It is assumed for this study that bison behavior has remained relatively consistent from prehistoric through historic periods and in modern times. Understanding bison behavior is crucial to understanding methods and motives of early prehistoric hunters.

Mature bull groups remain separate from the larger cow groups for most of the year. Bull groups consist of 4-5 individuals: mostly males, but also barren females (Reeves 1978). Cow-calf groups are made up of cows, young calves, and adolescent bulls (Reeves 1978). These groups come together between mid-June and mid-September to mate. Once the mating season is done, the groups separate again. With a gestation period that ranges from 270 to as much as 285 days, calves are born in early spring, between April and May (Arthur 1935). The predictability of *B. bison* mating and birthing seasons
combined with the aging of bison in the faunal assemblage can help archaeologists reconstruct a prehistoric hunting event. For example, the presence of fetal material indicates the kill took place between the mating and birthing seasons.

Culture Chronology and Bison Hunting on the Northern Plains

Humans lived on the Plains and hunted bison continuously for over 11,000 years (Frison 1991). Studying such a long and critical element of Plains survival can reveal a lot about daily life for prehistoric people. Knowing the context of bison hunting and culture change will help understand where and how the Tongue River kill site fits into Plains prehistory.

Natural topography was essential to bison hunting. Hunters have used several natural aids for killing bison: natural and artificial corrals, sand dunes, snowdrifts, and steep cliffs (Frison 1991). These communal methods resulted in a large number of bison killed at one time. Hunters would drive a herd to a calculated spot where a natural feature or a man made corral would trap the animals. The hunters would surround and kill the bison with their weapons. Other examples of natural traps include sand dunes and snow drifts. Bison would be driven into the dune or drift and get stuck.

A common method found in all areas of the Great Plains is the bison jump. This technique required moving an entire herd over a cliff or steep drop-off. A stampeding herd of bison could not avoid the impending disaster. The front bison would be driven over the precipice by the following herd (Frison 1991). The jump resulted in many animals being killed, providing an abundance of food for the hunters.

While a successful hunt provided a community with food and other important materials necessary for life, it was a dangerous activity. Pushing a herd toward a specific
spot on the landscape took a lot of planning. Rock piles showed the hunters where to push the bison (Arthur 1974). The unpredictability of bison created a dangerous situation for the drivers. Bison can move rapidly and can quickly change their direction (Frison 1991). A human in the way of a stampeding herd faced severe injury and likely death.

Most large bison hunts took place in the fall. The fall was the time humans and bison were preparing for the winter months. Bison were storing fat to use during the winter and growing their winter hides (Lott 2002). Humans were refilling their dry meat stores to use in the winter (Arthur 1974). According to ethnographic work (Binford 1978, Crow 1978), survival in winter depended on a successful fall hunt. However, not all bison hunts took place in the fall. Hides were the thickest in November, December, and January because it was the peak of the winter season (Arthur 1974); the thickest hides made the warmest robes, a vital commodity of the Plains.

Great Plains Archaeologists divide prehistory into several time periods: Paleo-Indian, Early Archaic, Middle Archaic, Late Archaic, and Late Prehistoric. Archaeologists assign these time frames based on differences seen in the archaeological record. These periods are characterized by differences in stone tool technology and changes in social organization.

The Paleo-Indian period on the Northwest Plains includes several culture complexes. The Paleo-Indian period ranges from 11,500 to 8,000 years BP (Frison 1991). Based on projectile point types, the Paleo-Indian period culture complexes include Clovis, Goshen, Folsom, Midland, Agate Basin, Hell Gap, Alberta, Cody, Frederick, Lusk, and Pryor Stemmed (Frison 1991). It should be noted that these complexes are not thoroughly understood or completely isolated from each other. The relationships between
culture complexes are poorly understood; one complex may be a variation of another, lead to, or result from other complexes. Additional sites and artifact assemblages will provide more information.

The earliest culture complex is Clovis. Evidence for Clovis is widespread; projectile points relating to the Clovis style have been found all over the Plains region. Bifaces have percussion flakes that begin at one margin and stop at the opposite margin (Frison 1991). Some Clovis sites include the Colby site in northern Wyoming, the Lange site in western South Dakota, and the Dent site in Northern Colorado (Frison 1991). Burial and storage sites have been found in Idaho and Montana. These sites contain stone and bone tools, which help link the sites to the Clovis culture (Frison 1991). There is some faunal evidence for mammoth and pronghorn hunting, but the Clovis people did little bison hunting (Frison 1991). At the Colby site, some bison remains were found among the mammoth remains, including a fetal metacarpal (Frison and Todd 1986). The bison represented at the Colby site was likely the earlier form, *B. antiquus* (Frison and Todd 1986).

The Goshen, Folsom, and Midland complexes have similar tool characteristics. The Goshen complex is seen at the Hell Gap site in southeastern Wyoming and at the Mill Iron Site. Bifaces that characterize Goshen use pressure flaking and edge retouching (Frison 1991). Folsom is similar to Goshen, but Folsom are fluted (Frison 1991). Folsom and Midland occurred after Clovis, between 10,900 and 10,200 years ago (Frison 1991). Whether Folsom and Midland can be considered separate culture complexes is still debated.
There is evidence of bison hunting by the Goshen and Folsom people; sites include the Mill Iron and the Agate Basin sites. The Goshen component at the Mill Iron site may be the oldest known Paleoindian communal bison hunt on the Northwestern Plains (Frison et al 1996). This site is likely a primary kill and processing site rather than a secondary butchery site (Kreutzer 1996). The Hanson site, which has a Folsom component, is located in northern Wyoming. This site contains many long bone fragments and some bison teeth, as well as mountain sheep, bobcat, and jackrabbit bones (Frison and Bradley 1980). Radiocarbon dates range from 10,700 to 10,080 years BP (Frison and Bradley 1980). Based on possible lodging locations and potential activity areas this site is not a kill site; however, bones were brought to this location for nutritional or other economic activities. The Agate Basin site also holds a Folsom component. Located south of the Black Hills along the Wyoming and South Dakota border, the Agate Basin site is a communal bison kill that spans many cultural components through the Paleo-Indian period. The Folsom levels of the bone bed were closely associated between the excavation areas (Frison 1982). Interestingly, red ochre and a grinding slab used to pulverize red ochre were found within and throughout the Folsom level (Frison 1982), indicating possible spiritual significance.

The Agate Basin complex is dated to 10,500 to 10,000 years ago (Frison 1991). In sites such as the Agate Basin site, the Brewster site, and the Hell Gap site; Agate Basin points are found above the Folsom stratigraphy. However, Folsom and Agate Basin radiocarbon dates overlap by 300 years. The relationship between these complexes is not clear.
The only bison bone bed attributed to the Agate Basin complex is the Agate Basin site (Frison 1991). Besides having multiple culture complexes present at this site, the Agate Basin complex is obviously named for this location. The Agate Basin component of this site shows a larger kill than those from Folsom which could indicate a more communal setting, better technology, or a combination of the two. Based on locations of articulated bones, the Agate Basin hunters used the site during the winter months and utilized the cold weather for temporary storage (Frison and Stanford 1982).

The Hell Gap projectile point type is believed to have developed from the Agate Basin form (Frison 1991). Tools were frequently reworked and points were used in all stages of production (Frison 1991). These tools were being used to hunt bison. The Jones-Miller site is the largest Hell Gap bison kill known (Frison 1991). Located near Wray, Colorado, the Jones-Miller site contains almost 300 disarticulated *B. antiquus* individuals and represents more than one kill event (Stanford 1978). Over 130 stone tools attributed to the Hell Gap typology were recovered in the bone bed (Stanford 1978). This site is thought to be a pound kill where the hunters possibly drove the bison into snowdrifts, but because snow does not leave any physical record in the stratigraphy, there is little evidence (Stanford 1978). The animals would get stuck in the deep snow allowing the hunters to surround and kill them.

Other bison kill sites from the Hell Gap complex include the Casper site and the Agate Basin site. At the Casper site, at least 74 bison were driven and killed in a sand dune (Frison 1974). Taphonomic differences within the site indicate that either the site was used at several different times or some areas of the bone bed were covered with soil faster than others (Frison 1974). Hunters would reuse a site when the geography or
topography was known to be successful and the animals were nearby. At the Agate Basin site, the Hell Gap bone bed is in situ (Frison 1982); however, the postcranial bones are poorly preserved (Zeimens 1982).

There is some confusion about the relationship between the Alberta complex, the Alberta-Cody complex, and the Cody complex. Alberta points have a large stem and shoulders that allow the point to be hafted (Frison 1991). The Alberta-Cody point is similar to the later Cody complex yet is different from the Alberta point; however, the radiocarbon date does not align with either complex (Frison 1991). The Alberta complex returns dates of 9000 and 9800 BP from the Hudson-Meng site; the Cody complex dates between 9900 to 8800 years BP, based on dates from the Horner site (Frison 1991). There is clearly an interval between the two complexes where a transitional period could have occurred.

Bison hunting throughout the Alberta and Cody complexes show increasing sophistication. The Horner site, the type-site for the Cody complex, shows over 1,000 years of bison procurement (Frison 1991). Located in the Big Horn Basin, the Horner site contains mostly bison remains (Todd 1987). This site has at least 50 animals represented; unfortunately, it is unknown how these animals died (Todd 1987). There is no associated topographical feature. It is possible that a man made or a natural trap such as a corral or a snowdrift may have been employed to contain the animals. No archaeological record of any containment device has been found at the Horner site.

Frederick, Lusk, and Pryor Stemmed complexes are all similar in style. In the Frederick complex, there is a change to a lanceolate style (Frison 1991). Lusk projectile points resemble Frederick, but are more triangular in cross section and the bases are more

Following the many cultural complexes in the Paleo-Indian period, the Early Plains Archaic period lasted between 8000 and 5000 BP (Frison 1991). During this time, the Altithermal climatic period brought dry conditions (Frison 1991). Side, corner, and basal notches are all found in projectile points from this period (Frison 1991). Round or oval pit houses were found from late in the period (Frison 1991). Examples of Early Archaic sites are the Hawken site in Wyoming and Head-Smashed In in Alberta.

Head-Smashed In is a well-used bison jump site. Located in southwestern Alberta, the site consists of the jump site, the campsite, and associated drive lines (Reeves 1978). The kill site includes the cliff and the large bone bed below. The Early Plains Archaic is the beginning of a long tradition of driving bison off the jump at Head-Smashed In (Frison 1991). A sign of the size and importance of this site to the people in the area, there are over 500 stone cairns marking the drive lines to the jump (Reeves 1978).

The Middle Archaic period ranges from 5000 to 3000 years BP. Sites dating to the Middle Archaic period occur more often in open plains, basins, and the foothills (Frison 1991). The Mckean projectile point tradition encompasses several style variations; the most well known is the lancelate point with a convex blade edge and an indented base (Fagan 2000). Archaeologists have found more grinding stones, indicating increasing plant use (Frison 1991). Hunting also increased; evidence of bison, deer, and mountain sheep are found in Middle Archaic sites (Frison 1991). There are several sites with Middle Archaic components such as the Cactus Flower site.
The Cactus Flower site in eastern Alberta contains minimal Pelican Lake occupations and is dominated by the earlier Mckean complex (Brumley 1978). At this site, bison and pronghorn antelope dominate the faunal assemblage (Brumley 1978). Throughout the entire use of this site, there are at least 40 bison present and at least 6 antelope (Brumley 1978). The faunal assemblage shows butchering of the axial elements, front and hindquarters, as well as the thoracic region (Brumley 1978). Based on the Cactus Flower site, the Mckean culture has a long-standing tradition of bison hunting in this region.

The Late Archaic period, lasting between 3000 and 1500 years BP (Frison 1991), has three distinct tool types: Pelican Lake, Yonkee, and Besant. Pelican Lake points have open corner notches that form sharp points at that blade edge (Frison 1991). Some dates for Pelican Lake are as old as 3100 to 3000 BP (Frison 1991). Yonkee points are less widespread and are found mostly in Southeast Montana and Northeast Wyoming (Frison 1991). Yonkee points are found at several kill sites and make use of jumps and arroyo traps (Frison 1991). Besant includes side notched, dart like points and some corner notched points (Frison 1991). These diagnostic tools are found at complex corrals made of logs with deep postholes (Frison 1991). These elaborate structures indicate an investment of time and energy by these hunters and may show the site was intended for reuse. Radiocarbon dates of 1700 BP and 1800 BP were taken from Besant sites such as the Rudy site and the Muddy Creek site (Frison 1991).

Sophisticated bison hunting was common during this time. Communal jumps and arroyos were used. Some sites from this period include the Kobold Buffalo Jump, the Ruby site, and the Muddy Creek site. The Kobold Buffalo Jump is located in southeastern
Montana along the Rosebud creek (Frison 1970b). There are four levels of occupation at
the jump site. Preservation of early levels is poor, but levels 3 and 4 show prolonged
usage and increasing sophistication. Level 3 contains more bison remains than level 2,
while level 4 shows more remains than level 3 (Frison 1970b). Level 4 has evidence of
tongue removal, breaking of ribs, missing hind limb bones, and lack of long bones
(Frison 1970b). Reuse of the site is clear.

The Late Prehistoric period begins approximately 1500 BP and lasts until
European contact (Frison 1991). Bison hunting activities peak between 1200 and 1000
BP (Frison 1991). During this time, there is an increase in the number of animals killed
(Frison 1991). Many large bison kills have been found, which suggests environmental
conditions were often good, promoting healthy and abundant herds (Frison 1991). Early
bifaces are side and corner notched, but through time became basal notched and side
notched (Frison 1991). Changes in projectile point may signify the development and use
of the bow and arrow (Frison 1991). With the development of the arrow, hunters could
kill animals from a greater distance while maintaining their accuracy.

The highest numbers of bison were killed during the Late Prehistoric period
(Frison 1991). Jumps are common, but corrals seem to replace the arroyo traps (Frison
1991). Late Prehistoric people would drive herds over a short cliff or bank into a corral.
The fall was not always intended to kill the animals, but to stun and temporarily trap and
confuse the herd. Projectile points were found within the bone bed to indicate that
surrounding hunters would kill the animals once they were in the trap. According to
Frison (1991), corrals allowed hunters to use lesser topographical features that were more
common than steep cliffs and drop-offs. Examples of sites from this period include the Glenrock Buffalo Jump and the Foss-Thomas site.

The Foss-Thomas site is a corral located in southeastern Montana near the Tongue River (Frison 1991). Sandstone walls and a fence made of stone, wood, and brush created the enclosure (Frison 1991). The corral contained several bison bones and many projectile points (Frison 1991). The Glenrock Buffalo Jump was used for a long period of time (Frison 1970a). Through both excavated layers, tool marks show that butchering practices did not change through time (Frison 1970a). The butchery evidence indicates a similar method of processing the animals as seen at the Tongue River site. Tool marks from the Glenrock Buffalo jump will be compared to the Tongue River site in order to understand how hunters were using the Tongue River site assemblage.
Chapter 3

The Tongue River Site

The Tongue River site was excavated during the summer of 2005. The excavation took four weeks followed by several months in the lab. Excavators included students from the University, members of the Cheyenne community, and representatives from the Bureau of Indian Affairs. The Tongue River site is located in a shallow canyon west of the Tongue River. As shown in Figure 1, areas of elevated terrain surround the site on the north, east, and southern sides. A gentle slope provides access into the valley on the western side.

Figure 1: The Tongue River site bone bed during excavation, facing north.

The site was divided into two areas: Area 1 covered the exposed bone bed and Area 2 covered the elevated plateau overlooking the bone bed. Faunal material in Area 1 was on the ground surface. Figure 2 shows nine squares and 1x1 meter units within each square mapped over the site. Individual units were selected in each square to provide
systematic sampling of the bone bed. Seven of the nine units were excavated in Area 1. The majority of the bone collection and some stone tools were found in this area.

In Area 2, four squares were laid out and a surface collection was completed in each square. A 1x1 meter unit was excavated in each plotted square. Stone tools and flakes were found while little bone material was recovered.

Teams dug 10 cm levels while mapping the artifacts and faunal material in situ and bagging them according to their provenience. Bone fragments were bagged collectively by level. The teams recorded the color and composition of the soil in order to establish site stratigraphy. All of the soil was screened through 1/8-inch wire mesh to recover any small artifact fragments. All artifact bags were inventoried and fragile bones were dipped in a vinac solution to stabilize and protect them. The plan view of each level was mapped before it was excavated.

![Figure 2: The plotted squares and excavated unit layout in Area 1.](image)

Two radiocarbon dates were obtained from bone samples. Sample 5, taken from the bottom of the bone bed in square B, provided a date of 2820+/-160 years before
present (BP); sample 6, taken from the top of the bone bed in square C, produced a date of 900+/-45 years BP. According to these dates, the Tongue River site was used at least twice, once during the Late Archaic period and once during the Late Prehistoric period. These dates suggest the site was used repeatedly over a long period of time, but this raises some questions about stratigraphy and soil erosion. The samples taken for the dates are not separated by large amounts of sediment as would be expected from almost two thousand years of erosion.

Lab Methodology

The faunal analysis was conducted during the summer and fall of 2005 in the archaeology laboratory at the University of Montana in Missoula, MT. Wooden tools and soft brushes were used to remove dirt from the bone fragments. If a bone was broken during transportation from the site to the lab it was repaired with Elmer’s glue. Fragile bones and repaired bones were dipped in a clear coat of vinac to stabilize further destruction. Each bone was labeled with the site number and a specific lab specimen number using clear nail polish and black ink.

Bone identification was facilitated using a comparison collection housed at the University of Montana’s Philip L. Wright Zoological Museum. An adolescent bison skeleton was used as a comparison for the bison material from the Tongue River site. Other mammal and rodent specimens from the Zoological Museum were compared to the Tongue River material in order to help identify the presence of other animals within the faunal assemblage.

In order to complete the quantitative analyses required to understand the faunal material, specific data was gathered for each bone element. As much information was
gathered for each bone element based on the condition and completeness of the specimen being studied. Specific characteristics recorded include: the taxon, skeletal element, side, body orientation, portion, color, size, weathering, age, and any natural or cultural modifications.

Each bone was identified as a particular taxon group to establish the type of animal to which it belonged. The taxon for much of the collection remains unidentifiable due to its fragmentary state. However, where possible a bone was identified as a small mammal, medium mammal, large mammal, or *Bison bison*. A small mammal is defined as a mouse-sized to a rabbit-sized animal; a medium mammal is considered a raccoon-sized to a wolf or dog-sized animal; and a large mammal is defined as deer-sized or larger. An element was assigned to *B. bison* if it matched the characteristics of the comparative skeleton.

An important goal of identifying faunal material is to understand where the bone was located within the body. Skeletal element codes are derived from a list of skeletal parts from L.C. Todd (2001). A bone was identified as a specific element using the comparative samples for *B. bison* and other animals. Then the bone was identified as right or left, if possible. Bone fragmentation, however, did not always allow for a side determination. Directional phrases describe the bone’s orientation within the body and isolate the part of the bone being described. Bone fragments that have specific landmarks or portions are coded to differentiate the fragment from the larger, complete bone. Blair Logan, another graduate student, and I created the portion abbreviations within the lab (Appendix 1). The maximum lengths were recorded in centimeters for each bone using hand calipers. Each measurement was taken in centimeters.
Finally, all modifications were documented. Modifications included any alterations of the bone due to human or natural actions. Human activities included cut marks, burning, or fracturing. Natural modifications included weathering, root marks, rodent gnawing, carnivore teeth marks, and holes from beetle activity. The color and level of weathering for each bone was recorded based on characteristics described in Lyman (2001) and Behrensmeyer (1978). Comparing the Tongue River assemblage to other studies helped to identify natural and cultural modifications.

Faunal Remains

A large amount of faunal material was recovered from the Tongue River site; the total bone count is 20,359. The majority of the assemblage, 60%, cannot be identified as *B. bison*. Bones determined to be *B. bison* make up 12% of the assemblage; large mammal remains, likely *B. bison*, comprise 27%. Medium and small mammal remains make up less than 1% of the assemblage. There are only 390 bones that are classified as complete bone segments; the rest of the assemblage is fragmentary.

In Area 1 of the site, the bone bed measured approximately 20 cm wide in some units. The depth of the bone bed differed from unit to unit. The bone bed in units D and F, the western portion of the area, were buried farther in the ground. Based on the topography and soil erosion, this trend is expected. In units on the eastern side of the site, the bone bed is shallower.

The minimum number of individuals (MNI) was calculated to determine the minimum number of animals required to create our faunal assemblage. This number is not an accurate account of the total number of animals killed, but allows a relative number for comparison purposes. The actual population was likely much smaller than the
MNI. Based on this calculation we can determine the relative size of the hunting party, the amount of meat obtained, and possible procurement strategies. To obtain the MNI, the highest number of any one element was used. In this study the right radial carpal was used. The resulting MNI for the Tongue River site is 6 individual bison.

**Associated Materials**

Many stone tools and debitage were found. Tool use and manufacturing processes can aid in understanding the means of utilizing the faunal assemblage. The Tongue River site yielded 1,114 pieces of debitage and 71 tools (Hamilton and Prentiss 2006). In Area 1, there were a total of 31 stone tools found in surface and subsurface contexts (Hamilton and Prentiss 2006). In Area 2, there were a total of 40 stone tools found (Hamilton and Prentiss 2006).

Lithic material type is important to understanding the Tongue River site. As Hamilton and Prentiss (2006: 37) explain, the projectile points are made from a “wide range of raw material.” The raw material was collected locally and from distant locations. Shaped tools, such as projectile points, were made from distant material such as Madison chert and obsidian (Hamilton and Prentiss 2006). According to Hamilton and Prentiss (2006), these data indicate a highly mobile group; Madison chert and obsidian are found as far away as northern Wyoming. This indicates that the groups that used the Tongue River site were familiar with the demands of hunting and butchering bison and were able to obtain the proper tools required (Hamilton and Prentiss 2006). Tools made from distant material were purposely shaped, while tools made from local material were used on an as needed basis. On site tool production created tools important to bison processing. At the site, the hunters were taking flakes from already used small nodules.
made of local raw material (Hamilton and Prentiss 2006). In order to maintain the tools needed to complete the processing of the animals, sharp flakes were removed from small nodules. These flakes were being used for cutting and scraping activities (Hamilton and Prentiss 2006). People that used the Tongue River site were experienced bison hunters that were well prepared for the kill as illustrated by the complete tool kit they used.
Chapter 4

Taphonomy

Taphonomy is the study of the transition of organic material into the geological record (Lyman 2001). In other words, taphonomic studies emphasize the processes that create the excavated bone bed. The forces and consequences that impact the bones during and after death are important because it can determine the information we are able to retrieve from the bones. Understanding the prehistoric environment and human behaviors that created the fossil record are goals of studying taphonomy (Lyman 2001). The natural processes studied on the Tongue River assemblage include weathering, natural modifications, heat modifications, and bone density. Cultural processes are discussed in Chapter 5.

Weathering

Understanding weathering processes inflicted on bone can provide clues to the history of the bone bed. The fossilization of a bone depends on the rate and intensity of physical and chemical agents in the environment (Behrensmeyer 1978). Bone condition can define the extent of weathering for an individual bone. Five criteria were used in this study as presented in Behrensmeyer (1978). Table 1 shows the five stages of weathering and the corresponding conditions.
Table 1: Stages of weathering, as described in Behrensmeyer (1978).

<table>
<thead>
<tr>
<th>Stage</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>The bone surface shows no cracking or flaking.</td>
</tr>
<tr>
<td>1</td>
<td>The bone surface shows cracking, usually parallel to the orientation of collagen fibers, longitudinal in long bones.</td>
</tr>
<tr>
<td>2</td>
<td>Bone surfaces show deeper and more extensive flaking. Crack edges are angular, with no rounding.</td>
</tr>
<tr>
<td>3</td>
<td>Bone surfaces show roughened patches resulting in a fibrous texture, but only to a depth of 1.0-1.5 mm. Crack edges are typically rounded.</td>
</tr>
<tr>
<td>4</td>
<td>Bone surfaces are rough, with loose splinters. Cracks are open, with rounded or actively splintered edges.</td>
</tr>
<tr>
<td>5</td>
<td>The bone is disintegrating into splinters, and the original shape may be difficult to determine. Cancellous bone exposed.</td>
</tr>
</tbody>
</table>

The majority of the assemblage, 54%, shows no signs of flaking or cracking. As shown in table 2 and figure 3, 13% of the weathered bones are within the first 2 stages. Figure 3 illustrates an increase in the number of fragments in the third and fourth stage of weathering. Excavated units in squares G and D contain 59% of stage 3 fragments. Units within squares A, G, and D contain 80% of the stage 4 fragments. These units are the most peripheral in Area 1 and may indicate these units were exposed longer.

Figure 3: Levels of Weathering within the Tongue River Assemblage
Table 2: Total bone fragments exhibiting various levels of weathering.

Natural Modifications

Other taphonomic factors affected the Tongue River bone bed, including root etching, beetle activity, and rodent activity. Figure 4 illustrates the frequency of the various taphonomic factors on bone fragments; actual totals are given in table 3. Approximately 36% of the bone bed has root etching. As shown in figure 4, beetle activity and rodent activity did not significantly impact the assemblage; only 2.6% of the assemblage shows insect or rodent damage. Interestingly, there was no evidence of carnivore activity on the bones. With little rodent and insect activity and no carnivore evidence, the Tongue River assemblage experienced little natural disturbance once deposited. Based on this information, the bone bed was likely quickly covered with sediment and thus protected from further destruction. Rodents and insects were still able to get to the buried bone resulting in the small number of fragments exhibiting rodent and beetle damage.

<table>
<thead>
<tr>
<th>Modification</th>
<th>Number of Fragments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root etching</td>
<td>7461</td>
</tr>
<tr>
<td>Cut marks</td>
<td>444</td>
</tr>
<tr>
<td>Beetle activity</td>
<td>184</td>
</tr>
<tr>
<td>Rodent activity</td>
<td>34</td>
</tr>
</tbody>
</table>

Table 3: Total bone fragments exhibiting signs of other natural modifications.
Heat Modification

The color of bone can indicate the presence of and severity of heat modification. Based on Lyman’s (2001) scale, the bones in the Tongue River assemblage were rated on a continuum of 0-5. Table 4 shows the stages of color change and the corresponding temperature requirements. Approximately 56% (actual numbers shown in table 5) of the assemblage was not exposed to heat. As shown in Figure 5, 40% of the bones show yellowish or red-brown coloration. These temperatures indicate a grass fire or campfire (Lyman 2001). Very little of the faunal material was exposed to hot temperatures.

<table>
<thead>
<tr>
<th>Stage of Burning</th>
<th>Temperature (Degrees Celcuis)</th>
<th>Characteristics of Bone Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>None</td>
<td>No heat modification</td>
</tr>
<tr>
<td>1</td>
<td>&lt;400</td>
<td>Yellowish color</td>
</tr>
<tr>
<td>2</td>
<td>300 to 500</td>
<td>Red-brown color</td>
</tr>
<tr>
<td>3</td>
<td>500 to 700</td>
<td>Black color</td>
</tr>
<tr>
<td>4</td>
<td>700 to 900</td>
<td>Grey-white color</td>
</tr>
<tr>
<td>5</td>
<td>&gt;900</td>
<td>White color</td>
</tr>
</tbody>
</table>

Table 4: Heat Modification Characteristics, as described in Lyman (2001)
Bone Density

Bone density tests can reveal differences of decomposition based on the density of individual bones. Various environmental conditions affect bones differently. The probability that a bone will last against taphonomic processes depends on the bone’s structural density (Lyman 2001). Structural composition varies from bone to bone (Lyman 2001). For example, dense bones can hold up to prolonged weathering, more delicate bones fade earlier. This can have major implications for the archaeologist looking at what is left at a site. Since many conclusions are based on the presence or absence of bones, it is important to rule out differential preservation as a cause for the composition of the assemblage (Lyman 2001).
To determine if differences in bone density created the Tongue River assemblage, I used Spearman’s rho to test the linear relationship of bone density to element frequencies within the faunal assemblage. Bone density values were taken from Kreutzer (1996) who compiled bone mineral density data for modern bison bone elements. Kreutzer (1996) compiled data from many sites on each bone. I took the highest value for each bone because the faunal assemblage did not contain the exact scan sites listed by Kreutzer (1996). The values from her data used in this study are listed in table 6. Comparing the density of a bone to the frequency of that bone at the site will show if there is a correlation between density and frequency.

To determine the frequency of a bone I calculated the minimum number of elements (MNE) based on the number of identified specimens (NISP) for this assemblage. The MNE counts are found in table 3. The MNE is the number of elements represented by the fragmentary remains based on overlapping landmarks (Reitz and Wing 1999). For example, I looked at all 26 of the patella (PT) fragments and concluded there are at least 8 complete patella in the assemblage based on portion and side of the fragments. My goal is to determine how many individual bones of one type are present in the collection (Todd et al 2001).

Looking at the MNE and bone density values, we find there is no correlation between the bone density and the number of elements present at the site ($r = -0.109; N = 30; p = .565$). As shown in figure 6, there is no linear relationship between bone density and MNE for any of the elements tested.
According to Lyman (2001), it is important to study how many bones survived from the original carcass, not just how many bones there are. The minimal number of
animal units (MAU) is a proportion of the bones within a carcass that survived. I calculated the MAU by dividing the MNE by the number of that element in a living skeleton, as shown in table 7. Then, the highest MAU value is used as a standard and all values are divided by that number to calculate a ratio, %MAU, of that bone as a percentage of the highest MAU within this assemblage (Reitz and Wing 1999). The %MAU value is a way of ranking the MAU values for the assemblage (See table 7). In this case, distal metatarsals have the highest MAU value. All other %MAU values were calculated from the distal metatarsals. When bone density was plotted against %MAU values, I calculated an r = -0.133; n = 30; p = .485. This shows a weak negative linear correlation indicating that density did not alter the frequency of bone elements at the site. According to these results, the density of a particular bone did not determine the abundance of that bone in the assemblage; variation is more likely due to human actions. These data shows there was little rodent or carnivore damage on the bone. Bones were covered quickly and not exposed for an extended period of time. Based on this analysis, environmental or natural influences had little impact on the structure of the faunal material from the Tongue River site.
<table>
<thead>
<tr>
<th>Element</th>
<th>NISP</th>
<th>MNE</th>
<th>MAU</th>
<th>%MAU</th>
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</thead>
<tbody>
<tr>
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<td>1</td>
<td>1</td>
<td>13.3</td>
</tr>
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<tr>
<td>HY</td>
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<td>1</td>
<td>13.3</td>
</tr>
<tr>
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<td>2</td>
<td>26.6</td>
</tr>
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<td>24</td>
</tr>
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<td>16</td>
</tr>
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Table 7: Minimum number of Animal Units for Tongue River Assemblage
Chapter 5

Cultural Factors

Faunal material is a valuable source of information about past human subsistence behavior. Natural processes have been determined as not significantly affecting the assemblage composition at the site; therefore, patterns of human behavior can be inferred from the faunal material. To reconstruct subsistence behaviors, I looked at carcass utility, butchery evidence, herd structure and seasonality, and the possibility of multiple kill events.

Carcass Utility Index

A utility index refers to the usefulness of animal parts for their food value (Reitz and Wing 2004). The usefulness of specific parts of an animal may impact butchering and transporting strategies. For example, there is more meat on the femur than on the radius. A hunter may take the femur with meat to camp, but leave the radius at the kill site because it is not as significant. Binford (1978) developed a method of measuring utility in bone assemblages during his research with the Nunamiut, Eskimo of northern Alaska, called the modified general utility index (MGUI). The MGUI values are based on muscle, marrow, and bone grease that an anatomical unit can provide. Meat is an obvious product of a hunt, but marrow and bone grease are sought after and can influence the decision of what parts of an animal to transport or harvest. Marrow and bone grease have nutritional value, but can also be used for functional purposes (Binford 1978). Binford’s (1978) generalizations on utility are based on caribou remains as well as hunting and butchering strategies of the Nunamiut.
A useful way to predict element utility and explain the assemblage in terms of butchery and transport behavior at a site is to use the MGUI. To determine the MGUI value, Binford (1978) first calculates the general utility index (GUI). He divided each skeletal element into the meat, marrow, and grease yield and calculated the proportion of weight given by each part. In order to standardize the GUI he added the meat, marrow, and grease index for each individual bone element then divided the sum by the total utility for the entire carcass (Binford 1978). The GUI allows for a comparison between high utility and low utility parts in one carcass. For the caribou calculation, the highest GUI is the distal femur. As Binford (1978) points out, this index is not useful to understand butchering practices because it accounts for bones as independent rather than as a transportable unit.

The MGUI index is more useful in determining human behavior from the presence or absence of faunal material (Binford 1978). The MGUI was developed from the general utility ranking, but accounts for butchering in terms of anatomical units not as an individual bone. Specific parts of an animal that are desired by the hunters may be removed from a kill site for later butchering and processing. However, a single bone is not cut from the animal and moved separately. Hunters often cut anatomical sections from an animal to make them easily transported. The MGUI accounts for parts of low utility, what Binford calls “riders,” that accompany high utility parts within a transportable unit (1978:74). The MGUI is the probability that a low utility part will be associated with a high utility element (Binford 1978). This index is useful in providing a model to compare the Tongue River assemblage to the expected butchering techniques used to process high value elements.
Archaeologists can use MGUI values to infer human behavior by plotting bone frequencies from a site against the utility value. The result is a curve that can reflect the type of site being studied. For example, bones with higher utility may have a lower frequency at a kill site, but a higher frequency at a processing site (Binford 1978). Based on the generalization that hunters remove parts based on their high economic value, a primary kill site would consist of low utility parts that the hunters left behind. A processing site would have high utility parts that were removed from the kill site and very few low utility parts. A different curve is created for each site type. Different bone frequencies could reflect human activity or indicate differential environmental preservation. However, our previous bone density study shows natural effects were not a factor on this assemblage.

To understand the Tongue River material in terms of the activities that took place, the MAU and frequencies of each bone type were assessed. As shown in table 3, the MNE, the MAU, and the %MAU were all calculated. The MAU is a measure of the number of bones that have survived within a carcass and the %MAU provides a way to rank parts within the Tongue River assemblage. By comparing %MAU (frequency) values to the MGUI (utility) values, we can see if there is a relationship between frequency and utility. Based on these ideas, figure 7 shows that the Tongue River site was a typical kill site because high utility parts are less numerous. Figure 7 provides an example of a reverse utility curve (Kreutzer 1996) suggesting that hunters transported high utility anatomical units to another site for processing and left behind the low utility units.
Bone elements that have the highest frequencies are the proximal and distal ends of the metacarpal, sacrum, patella, accessory carpal, radial carpal, and the fused 2nd and 3rd tarsal. The distal metacarpal is the most frequent bone in this assemblage with the highest MAU value. Many of these bones are from the lower portions of limbs, are of low utility, and thus they fit the primary kill hypothesis. Furthermore, low frequencies of femurs and humeri are expected with the kill site hypothesis. For the Tongue River site, femuri and humeri are not numerous, falling below 50% as a %MAU value. Other bone elements that have a low %MAU value are cranial and mandible fragments, cervical,
thoracic, and lumbar vertebrae, proximal and distal sesamoids, proximal tibia ends, and distal radii ends. Some of these bones are associated with choice pieces of meat or products such as the hide. For example, the vertebrae would be associated with the hump meat. The low %MAU values for the sesamoids and the distal radii end are unusual and may be due to cultural importance or variations in butchering techniques.

Butchering Methods

It is unknown exactly how the animals were corralled or trapped at the kill site, but evidence for how the hunters used the animals is available. Studying butchering practices of the hunters based on cut marks left at the site can show what activities the hunters were carrying out on the carcass. There are 444 bones within the Tongue River assemblage that have cut marks. Of those, 79 are B. bison, 336 are large mammal (likely bison), 2 are medium mammal, and 27 are of an unidentified taxon. Of interest here and the main focus of this aspect of the study are B. bison and large mammal remains. The Glenrock Buffalo jump has material with butchery evidence that was tied to actual butchering processes by Frison (1970a). In comparing the Tongue River assemblage to the Glenrock Buffalo jump, we find several similarities.

Evidence for human activity within the Tongue River assemblage can be found on four categories of remains: the remaining limb bones, pelvis, skull fragments, and ribs and vertebrae, as illustrated in figure 8. Butchery of limb bones is obvious at Tongue River. There are four scapula fragments with cut marks, and two of those are along the spine. According to Frison (1970a), removing meat from the scapula can result in marks made along the supraspinous and infraspinous fosse. These landmarks are alongside the spine of the scapula where the cut marks are found in the Tongue River assemblage.
These marks could have been made when the hunters removed meat from this portion. There is a cut mark on the proximal end of a radius, at the articulation with the humerus, suggesting removal of the meaty upper limb bone. A fifth metacarpal and a radial carpal bear cut marks. Skinning activities can result in a cut on the radial carpal (Frison 1970a). Marks on the front limb show the hunters were harvesting meat from large bones, such as the scapula and humerus, as well as activities relating to skinning the animal.

Several bones from the hind limb also show cut marks. As shown in figure 8, the distal end of a femur shows a cut mark on the articulating surface while another femur fragment has a cut mark on the lateral condyle. According to Frison (1970a) these marks may show the final separation of the femur and the tibia. Three complete patellas have cut marks, thus providing more evidence for the removal of the femur. These data coincide with evidence from the Glenrock Buffalo jump where 2 of 8 patellas have cut marks (Frison 1970a). Other evidence for the removal of the femur comes from the pelvis. Four fragments of the pelvis show evidence of human modification. Three are acetabulum fragments and 1 is an ischium fragment. These marks may have been made when removing the femur from the pelvis (Frison 1970a). This is further evidence that large meat bones, in this case the femur, were being separated from low utility parts to remove from the site. In addition to the femur fragments and patellas, other leg bones also have cut marks. They include: the distal end of a tibia, 2 fused central and 4th tarsals, and a complete right talus. Interestingly, 2 complete proximal sesamoids, 1 complete distal sesamoid, and a 2nd phalange have cut marks. Bones from the ankle and foot may be culturally significant and not desired for nutritional value.
Eight cranial, mandible, or teeth fragments exhibit cut marks. One cranial bone is a medial fragment, 1 fragment is from the occipital bone, and another is from the right zygomatic bone along the eye orbit. There are 2 unidentified tooth fragments and 1 lower, right 3\textsuperscript{rd} molar fragment with cut marks. There are 2 mandible fragments with cut marks: a medial fragment and the coronoid process. According to Frison (1970a), marks on the mandible could result from skinning or from removing the tongue.

![Figure 8: Locations of cut marks on bison skeleton. (Original diagram from L.C.Todd 2001)](image)

A total of 44 rib and vertebra fragments contain cut marks: 24 rib fragments, 3 cervical vertebra, 7 thoracic vertebra, 4 lumbar vertebra, 4 unidentified vertebra, 1 sacrum fragment, and 1 epiphysis. Most of the rib marks occur on medial surfaces, but 1 does appear on the ventral end. This mark may have resulted in removing the costal cartilage and sternum from the carcass (Frison 1970a). Cervical vertebrae have marks on 2 centraums and 1 transverse process. Cut marks are on the spinous process on 4 of the 7 thoracic vertebrae possibly reflect attempts to obtain the hump meat (Frison 1970a). Two thoracic centraums and 1 epiphysis have cut marks. These marks would follow activities.
separating vertebra into sections. As Frison (1970a) points out, the vertebral column was divided into several areas. Several cases at the Glenrock Buffalo jump show a separation within the thoracic region. Three of the lumbar vertebrae have marks on centra. One fragment has a cut mark on the lateral end of a transverse process. The sacrum fragment has several cut marks along the ventral surface. Frison (1970a) suggests that portions of the sacrum and caudal vertebrae were broken off and left with the hide. Marks on the sacrum could be associated with this activity. Two unidentified centra, 1 spinous process, and 1 epiphysis have cut marks that could result from any of the activities already described.

Herd Structure and Seasonality

The predictability of *B. bison* mating and birthing seasons can help archaeologists reconstruct a prehistoric hunting event based on ages of animals within the kill herd. Many faunal studies (Reher 1974; Frison 1982; Todd, Rapson, and Hofman 1996) of bison kills use known tooth eruption and wear rates of teeth to establish individual age. Unfortunately, the Tongue River site yielded few complete mandibles or teeth. For this study, age of individual bones within this assemblage was determined using un-fused bone epiphyses and comparing them to known ages of fusion (Duffield 1973). The result gave us the maximum age for that individual specimen. In the Tongue River assemblage, there are 33 unfused bones or sub-adult bones and 12 fetal bones. Of the fetal bones, only 1 is classified as *B. bison*; the rest are large mammals or an unidentified taxon. Using the presence of fetal bones and known rates of fusion, age categories can be defined.

As shown in figure 9, the faunal material encompasses a wide age range with multiple age peaks. This may show that the Tongue River site was used multiple times
and the faunal material covers more than one kill. As Speth (1984) points out, bimodality in the age structure may be the result of combining a cow-calf herd with mature males. These groups are only typically together during the summer mating season. However, the Tongue River material contains a large amount of fetal remains that would place the kill sometime between the mating season and the birthing season, approximately between the fall and early spring. Since bull groups and cow groups are not together during this time, it is possible that the faunal material represents multiple kill events. The fetal material suggests at least one kill took place in the late winter and early spring. Cows are in poor condition in the early spring due to birthing and supporting their new calves. A hard winter season can also be taxing on cows and bulls. This time of year would not be optimal for hunting female bison. Cows and bulls are in their prime nutritional state in the fall and early winter, after building up reserves for the winter months and spring calving season (Speth 1984).

![Figure 9: Age distribution of Tongue River assemblage.](image-url)
Multiple Kill Events

Based on dating information and age peaks of the bison, it is likely that the Tongue River site was used more than once. Looking at the age distribution, there is a possible separation of kill events. All of the fetal bones are found in the western units (squares D, F, G, and C). The eastern units (squares A, B, and E) have individuals that range from one year to seven years. This could illustrate two kill events: a kill of a cow-calf herd in the west, and a kill of another herd in the east. The cow-calf herd would need to be harvested during the winter or spring in order to account for the fetal material present. The other herd is possibly a bull group because of the lack of young calves and the large age range.

In order to confirm the distinction between the kill events, carcass utility was compared to see if the bone beds were used differently and cut mark locations to identify differences in butchering techniques. As shown in table 8 and table 9, the MNE, MAU, and %MAU was calculated for each event. Comparing the MGUI to the %MAU values, no clear differences were found between the possible events. Both sides contained low utility parts characteristic of a primary kill site. Figures 10 and 11 show the reverse utility curve for each possible kill event.
Figure 10: Reverse utility curve for western unit kill event. (Codes listed in Appendix A)
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Table 8: MNE, %MAU, and MGUI values for Eastern units. (Codes listed in Appendix A)

Table 9: MNE, %MAU, and MGUI values for the Western units. (Codes listed in Appendix A)
By taking each side of the site as a different kill event, I still need to look at MNI. The MNI for the eastern side is 5 individuals based on the right radial carpal. On the western side the MNI is 3 based on the left fused central and fourth tarsal as well as the right fused second and third tarsal. These numbers do not accurately show the total number of individuals, but the minimum required to produce the assemblage. When the first event took place, a minimum number of animals were required to create the assemblage. This is also true for the second kill event. Assuming these sites were used at different times, the total MNI for the excavated area can be found by adding the MNI for each portion of the site; the total MNI then is 8 bison. Due to differences in the timing of
each event, this MNI is different than the initial MNI of 6 because each kill was isolated from the other.

By looking at cut marks on the bones from each event, differences in butchering practices through time were identified. Bones with cut marks were divided into eastern and western units. In the western units, there is evidence that hunters removed meaty sections of the carcass. Two cut marks along the scapula and along the spinous process of 2 thoracic vertebrae indicate removal of meat. A patella and 2 distal femur fragments show the hind leg being divided, possibly to remove the femur for later processing. Marks on the proximal end of the radius-ulna indicate removal from the humerus. Considering the 42 ribs fragments and 7 cranial fragments, hunters were utilizing all parts of the animals.

In the eastern units, butchering marks are found on all parts of the animal. Proximal and distal sesamoids, as well as the fifth metacarpal, and the fused central and fourth carpal show separation of the lower limbs and support removal of the hide, usually done in the fall and early winter. Six cranial and mandible fragments and 3 tooth fragments support use of the skull and soft tissues within. Vertebrae with butchery evidence include 3 cervicals, 5 thoracics, 4 lumbar, and 1 sacrum fragment. Marks on vertebrae can indicate meat removal and fragmenting the spine. The sacrum fragment may also signify skinning activities.

Interestingly, unit E contained 280 bones (from all taxon groups) with cut marks, over 4 times as many as the next highest unit. Forty are *B. bison*, 222 are large mammals, and 18 are unidentified. All of the large mammal bones are flat bones or long bones, but a
more accurate identification was not possible. This area of the bone bed may have been a secondary processing area where bones were brought before transporting from the site.

There are no significant differences in butchering methods between the kill events. However, the eastern side contains more evidence for skinning than the western assemblage. Based on ethnographic and butchering evidence, the eastern kill may have occurred in the fall in order to obtain warm, thick hides for the winter. The Crow (Crow 1978) and the Blackfeet (Schaeffer 1978) would hunt bison in the fall in order to secure the thick winter coats of the bison. During this time of year the weather was cooler which allowed the hunters to process the meat with less risk of spoiling (Schaeffer 1978).

The Tongue River site may have a late winter/early spring hunt as well as a fall hunt. The western kill contains fetal material indicating the hunters killed the cow-calf herd in late winter or early spring. The eastern kill has more evidence of removing the hides and no young bison remains, possibly a bull herd that was killed in the fall.
Chapter 6

Discussion and Conclusions

Understanding the taphonomic history of the Tongue River site has allowed the analysis of cultural impacts on the assemblage. Weathering and animal activity caused little damage to the bones. In this chapter I outline generalizations and conclusions about the composition of the bone bed and the implications for site use. Late Archaic and Late Prehistoric hunters used this site at least twice with one kill occurring during the late winter or early spring and the other kill occurring in the fall. The Tongue River site was a primary kill site where highly nutritious parts were removed for processing.

The Tongue River site contains individuals from many age classes including at least one fetus. Such an age range would require a cow-calf herd and a mature bull herd to be together, but the presence of fetal material suggests that would not have been likely. This would indicate multiple kill events. By combining the presence of fetal remains with known calving seasons, I can conclude that the cow-calf kill occurred in the late winter to early spring. A hunt during the late winter or early spring contains bison that are not in prime nutritional health, but rather bison with depleted fat reserves due to hard winter months and birthing stresses. A hunt during this period may be a result of circumstance, a hunting party happening along a bison herd, or winter hardship. The kill of the bull herd on the east side of the site occurred before the kill on the western side. Based on evidence of hide removal in the eastern bone bed, it is possible that the bull group was harvested in the fall.

The radiocarbon dates correspond to the separation of the kill events. The earlier date of 2820 BP was taken from the bottom of square B. This unit is located on the
eastern side of the site. The later date of 900 BP was taken from square C, which is located on the western side of the site. Taken together, the eastern portion of the site was used during the Late Archaic period, followed by the kill of the cow-calf herd approximately 1,920 years later during the Late Prehistoric period. Stone tool evidence corroborates the dates; a Pelican Lake point was found on the surface in area 1 (Hamilton and Prentiss 2006).

Based on element frequencies, I conclude that articulated units or long bones were removed from the site for later processing. Comparing the MGUI values developed by Binford (1978) to %MAU values from Tongue River, low utility units were left behind. Butchery evidence supports this hypothesis. Long bones were removed from the carcass leaving cut mark evidence on the surrounding bone. Cut marks left on the remaining bones indicate that the femur, humerus, and hump meat were removed from the site.

The lithic material shows the Tongue River hunters were experienced in the needs and demands of bison hunting and butchering. The groups acquired materials and created the tools needed (Hamilton and Prentiss 2006). Other important tools used for cutting and scraping activities vital in processing the material from the animals were made from local material. Evidently the hunters were familiar with the location and functionality of the local raw material. This may indicate reuse of the site, as suggested by the faunal material.

The eastern and western portions of the site hold several differences in seasonality, and herd structure, but are similar in the butchering techniques. The western portion of the site contains a cow-calf herd killed during the winter or early spring. The eastern side of the site contains a bull group that was killed in the fall. High utility parts
are missing and low utility bones are left behind indicating a primary kill site in both sections of the bone bed.

The Tongue River site is similar to other Late Archaic and Late Prehistoric sites, such as the Kobold buffalo jump and the Glenrock buffalo jump. All three sites have evidence of multiple kill events, indicating hunters of this time were using locations that were successful in the past. Butchering evidence is also similar at all sites; articulated units were missing from the bone bed. At Kobold, Frison (1970b) states that the hindquarters were removed entirely. The tibia, femur, and metatarsals were absent (Frison 1970b). At Glenrock, hunters removed large, meaty bones and there is evidence for skinning activities (Frison 1970a). Articulated segments and hides were removed at the Tongue River site.

As shown in the site comparisons, the classic bison hunting strategies seen at other Late Archaic and Late Prehistoric sites is evident at Tongue River. The tradition of driving a herd over a cliff or into a trap and removing high value pieces was practiced at the Tongue River bison kill. Revisiting and reusing a successful hunting area is seen at many Late Archaic and Late Prehistoric sites (Kobold, Glenrock, Foss-Thomas), as well as the Tongue River kill.

Many bison kills of this time relied on large numbers of animals and a deep bone bed is evidence of the large herd. However, at Tongue River we do not see a deep bone bed or a large MNI. This may show different circumstances leading up to kill: fewer hunters available, smaller herds available, or a different strategy altogether. According to Frison (1991), a large herd is easier to drive than a small herd. This would make a jump unlikely, but not impossible, at the Tongue River site.
Hunters at Tongue River were adapting to changes in the environment and herd conditions in order to be successful at hunting bison. As shown by element frequencies and ethnographic information, articulated, high utility parts were removed from the site. This practice maximized their return on the time and energy spent planning, killing, and processing the animal. Parts with the most economic or most nutritional value in terms of meat, marrow, and grease were removed to a secondary processing site.

The Tongue River bison kill shows Late Archaic and Late Prehistoric hunters reusing successful techniques to enhance their survival. By comparing the Tongue River site to other Late Archaic and Late Prehistoric sites in the northwest Plains, the trend of communal hunts, utilizing high utility parts, and reusing successful locations is apparent. Southeastern Montana contains several kill sites and there are many more as yet undiscovered. More investigations will lead to more answers and more questions about the prehistoric bison hunting practices on the northwest plains.
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Lyman, R. Lee  

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Todd, Lawrence C., David J. Rapson, and Jack L. Hofman

Wilson, Michael


Winterhalder, Bruce

Zeimens, George M.
Appendix A: Faunal Database Key

<table>
<thead>
<tr>
<th>Orientation</th>
<th>Taxon</th>
<th>Modifications</th>
</tr>
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<tbody>
<tr>
<td>CX- cranial medial</td>
<td>BB- Bison bison</td>
<td>0- none</td>
</tr>
<tr>
<td>UP- upper</td>
<td>LM- large mammal</td>
<td>1- cut marks</td>
</tr>
<tr>
<td>MD- medial</td>
<td>MM- medium mammal</td>
<td>2- A-wear</td>
</tr>
<tr>
<td>LR- lateral</td>
<td>SM- small mammal</td>
<td>3- Roots</td>
</tr>
<tr>
<td>DR- dorsal</td>
<td>UN- unknown</td>
<td>4- Rodent gnawing</td>
</tr>
<tr>
<td>VT- ventral</td>
<td></td>
<td>5- carnivore teeth</td>
</tr>
<tr>
<td>PX- proximal</td>
<td></td>
<td>6- holes due to beetles</td>
</tr>
<tr>
<td>DS- distal</td>
<td></td>
<td>7- A-wear and roots</td>
</tr>
<tr>
<td>CR- cranial</td>
<td></td>
<td>8- cut mark &amp; A-wear</td>
</tr>
<tr>
<td>CA- caudal</td>
<td></td>
<td>9- cut marks and roots</td>
</tr>
<tr>
<td>CM- caudal medial</td>
<td></td>
<td>10- A-wear &amp; beetles</td>
</tr>
<tr>
<td>IN- interior</td>
<td></td>
<td>11- indentations</td>
</tr>
<tr>
<td>MDF- medial fore</td>
<td></td>
<td>12- A-wear, cutmarks,</td>
</tr>
<tr>
<td>MDR- medial rear</td>
<td></td>
<td>and roots</td>
</tr>
<tr>
<td>LW- lower</td>
<td></td>
<td>13- cutmarks &amp; holes</td>
</tr>
<tr>
<td>LRF- lateral fore</td>
<td></td>
<td>14- beetle hole &amp; roots</td>
</tr>
<tr>
<td>LRR- lateral rear</td>
<td></td>
<td>15- cutmarks, Awear, beetles</td>
</tr>
<tr>
<td>VTCR- ventral, cranial</td>
<td></td>
<td>16- holes &amp; roots</td>
</tr>
<tr>
<td>CRDS- cranial, distal</td>
<td></td>
<td>17- coal markings</td>
</tr>
<tr>
<td>DRM- Dorsal, medial</td>
<td></td>
<td>18- Awear, beetles, roots</td>
</tr>
<tr>
<td>PXMD- Proximal, medial</td>
<td></td>
<td>19- Awear and rodents</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20- roots and rodents</td>
</tr>
<tr>
<td></td>
<td></td>
<td>21- flaking</td>
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</table>

<table>
<thead>
<tr>
<th>Segment</th>
<th>Provenience</th>
<th>Side</th>
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<tbody>
<tr>
<td>FG- fragment</td>
<td>1- SQ A subsq 24 N444 E513</td>
<td>RT-</td>
</tr>
<tr>
<td>EG- edge fragment</td>
<td>2- SQ B subsq 21 N439 E495</td>
<td>LF-</td>
</tr>
<tr>
<td>CO- complete</td>
<td>3- SQ E subsq 21 N444 E495</td>
<td></td>
</tr>
<tr>
<td>END- end</td>
<td>4- SQ G subsq 5 N450 E 479</td>
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<tr>
<td></td>
<td>5- SQ C subsq 5 N435 E 479</td>
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<td>6- SQ F subsq 22 N429 E 456</td>
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<td>7- SQ D subsq 19 N423 E431</td>
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<td>8- Area 2 SQ B subsq 5 N496 E 587</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9- Area 2 SQ D</td>
<td></td>
</tr>
</tbody>
</table>
### Strike
- SE- south east
- SW- southwest
- EW- east to west
- S- South
- NS- north to south

### Age
- UNF- unfused
- SA- subadult
- SM- small
- W- worn
- FT- fetal

### Portion
- EP- epiphysis
- IL- ilium
- CN- centrum
- WG- wing
- SP- spinous process
- TSP- transverse process
- HD- head
- AC- acetabulum
- IS- Ischium
- MA- Malleolus
- TB- tubercle
- RT- root
- LRC- lateral condyle
- TCS- Tibal crest
- OCC- occipital bone
- OLE- olecranon
- ORB- orbital
- OF- Obturator Foramen
- AX- axial
- AST- Astragalus
- CNL- unidentified canal
- MDCEP- medial crest epiphysis
- CNTSP- centrum and transverse processes of vertebra
- HDEP- unfused head epiphysis
- ILCB- unfused bone from ilium

### Elements
- IC- incisor
- CRN- Cranium
- MR- Mandible
- HY- Hyoid
- TFR- Unidentified tooth fragment
- SC- Scapula
- HM- Humerus
- IC- incisor
- ML- unidentified Molar
- CRN- Cranium
- IM- os coxae
- MR- Mandible
- FM- femur
- HY- Hyoid
- TA- tibia
- TFR- Unidentified tooth fragment
- PT- patella
- SC- Scapula
- AS- talus
- HM- Humerus
- CL- calcaneus
RD- Radius
RDU- radius-ulna
CPU- ulna carpal
CPI- Intermediate carpal
CPR- radial carpal
CPS- fused 2\textsuperscript{nd} and 3\textsuperscript{rd} carpal
CPF- fourth carpal
CPA- accessory carpal
CP- unidentified carpal
MC- metacarpal
MCF- fifth metacarpal
SED- distal sesmoid
AX- axis
CE3-7- specific cervical vertebra
TH1-14- specific thoracic vertebra
LM1-5- specific lumbar vertebra
CA- caudal vertebra
MN- manubrium
RB1-14- specific rib
LB- unidentified long bone
CB- cancellous fragment
TOOL- tool
PM- premolar
M1-3- specific molar
TRC- fused central and 4\textsuperscript{th} carpal
TRS- fused 2\textsuperscript{nd} and 3\textsuperscript{rd} tarsal
TRF- first tarsal
MTS- second metatarsal
MT- metatarsal
MP- unidentified metapodial
PHF- first phalanx
PHS- second phalanx
PHT- third phalanx
PH- unidentified phalanx
SEP- proximal sesmoid
AT- atlas
CE- unidentified cervical vertebra
TH- unidentified thoracic vertebra
LM- unidentified lumbar vertebra
SAC- sacrum
CS- costal cartilage
RB- unidentified rib
VT- unidentified vertebra
FB- unidentified flat bone
US- totally unidentifiable
IC- incisor
P2-4- specific premolar
CAN- canine