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24CA37 a Bison Kill in Cascade County, Montana

by
Arrow R. Coyote
M. A., University of Montana--Missoula, 1998

Presented in partial fulfillment of the requirements
for the degree of
Master of Anthropology
University of Montana
1998

Approved by



Chairperson



Dean, Graduate School

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24CA37 a Bison Kill in Cascade County, Montana

Chairperson: Foor, Thomas A. *TAF*

Archeological site 24CA37 in Cascade county, Montana contains evidence of a bison kill from a sample excavation conducted in 1991. From analysis of the artifacts I determine that the bison were procured at the site using a pound. Further, I compare 24CA37 to other well documented bison kills and concluded that it was a Late Prehistoric Avonlea site. Further, I made recommendations as to how this site could be fully excavated and what information this site could provide in understanding prehistoric life on the Plains.

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Acknowledgements

First, I would like to thank the owner of the site Cindy Kitridge. I also want to express special appreciation to the National Bison Range for providing the skeletal remains of a bison bull that died on the range during their seasonal rut. Also thanks to Kim Wingate and Jason Trook for helping me collect the bison from the range. Further, Jason helped refit and label the bison skeleton as a comparative model for analysis. My thanks to Bob Dundas who provided the paleontological terms for the skeletal elements, and Les Davis who shared a collection of projectile points previously collected from the site during uncontrolled digging.

Finally, I would like to thank my thesis committee: Dr. Tom Foor, Dr. Randy Skelton, and Dr. John Donahue.

I. Introduction

Discovery and Location

My thesis on 24CA37 results from field work done by the University of Montana, Anthropology Department during the summer of 1991. Dr. Tom Foor supervised the field and laboratory work.

Volunteer amateur archaeologists and archaeology students from the University of Montana made up the excavation crew members. Materials collected were cleaned, cataloged, bagged by feature, and stored until April of 1997 when I began my analysis.

The site is approximately a half mile above the junction of Bird Creek with the Missouri River, near the town of Cascade (Figure 1). Maynard Shumate in 1949 excavated a portion of the site exposing some of the bonebed. Although no report was written, some projectile points were collected and given to Montana State University. I later examined these points and used this information in my thesis. The site was officially recorded on July 17, 1974 and named "North Bird Creek Pound".

Objectives and Structure of Investigation

My first objective is to determine if 24CA37 is a bison kill and, if so, how prehistoric hunters killed and processed the bison. This research is important for a number of reasons. First, since many sites are recorded but few are excavated, the particular characteristics of this site may help archaeologists identify other bison kills with minimal test excavations. For example, this site contains a number of bones and projectile points, but no cliff to run the bison over and no post molds to indicate an artificial trap. If I can explain how these bison were killed and butchered, based on the analyzed site sample, then this can serve as a basis for interpretation of similar sites.

Second, I will determine the cultural chronology of this site. This will be done by using a relative dating method of projectile point type chronology.

Third, I will attempt to determine whether this site has a primary

depositional context. I will analyze the bones and the topography to determine which sections of the site are likely to be undisturbed. This information can help determine whether this site is a single or multi-component site, or if this site was used more than once.

Fourth, my research will help determine whether 24CA37 offers any further potential information to archaeology. Knowledge gained from this test excavation can help decide where to place future excavation units.

II. Environmental Setting

Northwestern Plains & Cascade County

This site is found in the Northwestern Plains region. The Northwestern Plains according to Frison include,

"all of Wyoming and includes in addition southern Montana, eastern Idaho, southwest North Dakota, western South Dakota and Nebraska, and the area along the northern border of Colorado (Frison 1991:2).

However, I will be concentrating most of my focus on Montana, Wyoming and the area south of the Parkland/Grassland borders of Alberta, Saskatchewan, and Manitoba (Figure 2).

The vegetation consists of mostly temperate, short-grass communities which are periodically destroyed by fires and drought that also prevent the permanent establishment of trees and shrubs. The grasslands extend across the plains except at margins where they merge gradually with forests and deserts (Pratt 1994:130).

Temperatures exhibit seasonal extremes: winters are cold and blizzards frequent; summers are hot and subject to thunderstorms (Hunt 1967:266). There is little record of native corn agriculture west of the 100 frost-free days line which follows the North and South Dakota/Wyoming borders and north of the Canadian border (Wedel 1961:35). Strong winds prevail over the plains and induce high rates of evaporation when combined with summer heat. Moisture varies considerably from year to year. Variability contributes to the absence of trees and makes subterranean habitats advantageous for small animals (Shelford 1972:329,331).

In Cascade county "Chinook" winds are common during the colder months along the Missouri. As a result valley locations generally enjoy mild winters in Montana. Snowfall averages 50-60 inches a year in the valleys. Rain is 12-16 inches per year. Precipitation is heaviest in late spring and early summer and the growing season extends from April through September (Clark et al. 1973:146-7).

River valleys are, in general,

“....broad, steep sided and shallow. Few are deeper than about 150 feet. The valley walls, although not high, generally are too steep to hold soil and are formed by the outcrop of the geological formations. Between the valleys are smooth uplands of nearly flat plains. Trees are largely confined to the valleys, the almost treeless uplands, originally grasslands, now are plowed fields and pastures” (Hunt 1967:222).

Streams flow eastward from the Rockies carrying sediments into the Missouri and Mississippi (Hunt 1967:224). Isolated mountains scattered over the Missouri Plateau include the Black Hills, the Big Snowy, the Little Rockies, the Bear Paw Mountains, and the Sweetgrass and Cypress Hills. Elsewhere, there are rugged ridges, hills, cliffs, and breaks, as well as flat-topped buttes. These valleys and breaks provide water, fuel, and sheltered areas that offer protection from the rigorous winters. Also the presence of well-marked terraces provide humans with safe flood-free living sites (Wedel 1961:27,30).

Cascade county lies in both glaciated and unglaciated parts of the Missouri Plateau. Parent materials consist of sandstone and shale with layers of silts deposited from Glacial Lake Great Falls.

“Glacial Lake Great Falls submerged the area between Cascade and Great Falls to an elevation of about 3900 feet. Water was about 500 feet deep at Cascade and almost 600 feet deep at Great Falls” (Alt and Hyndman 1986:272).

Fauna

There are large raptors who often nest in cottonwood stands- hawks, bald and golden eagles, owls and osprey. Wild geese, ducks and other aquatic birds follow their seasonal migrations down the Missouri flyway (Wedel 1961:43). Because of the limited number of trees away from the river, 53% of birds nest on the ground. Among these birds are: prairie chicken, burrowing owl, sage grouse, bobwhite, sharp-tailed grouse, ruffed grouse, blue grouse, ring-necked pheasant, Hungarian partridge, horned lark, lark sparrow, lark bunting, vesper sparrow, McCowan's longspur, Chestnut collared longspur, Sprague's pipit, Brewers's sparrow, grasshopper sparrow, curlew and western meadowlark (Shelford 1972:332-3).

The main grassland animals include: buffalo, pronghorn, badger, jack rabbit and grasshoppers. Wooded valley bottoms contain: white-tail and mule deer, elk, wolves, coyotes, kit fox, black-footed ferret, skunk, black bear, cougar, wildcat, beaver, muskrat, otter, mink, raccoon and numerous smaller fur-bearing animals. These could be drawn on for food in times of scarcity among the large mammals (Shelford 1972:333; Wedel 1961:43).

Reptiles include: bull snake, gopher snake, rattlesnake, lizards, frogs and toads. Burrowing animals include: badger, ground squirrel, prairie dog, pocket gopher, pocket mice, kangaroo rat, mole, shrew and grasshopper mouse. There are also a number of different fish species in rivers, streams and lakes (Shelford 1972:333,336).

Not only do these animals survive on the grasslands, but they also help to maintain them. Prairie dogs dig 12-15 feet underground and bring enormous amounts of soil material to the surface. Badgers excavate in search of their supply of ground squirrels and other rodents. Digging loosens the soil for plants that often get trampled by large herd animals. Large ungulates, prairie dogs, ground squirrels, grasshoppers and other herbivores eat prairie grasses. Animal droppings fertilize soil and give shelter and substance for insects (Shelford 1972:333-4).

Flora

Plants found in the region include: bluebunch wheatgrass, blue grama wheatgrass, western wheatgrass, pickley pear, needlegrass, Kentucky bluegrass, timber oatgrass, junegrass and fescue. Shrub species include: lupine, balsamroot, sticky geranium, harebell, sugarbowl, shrubby cinquefoil, northern bedstraw, yarrow, fringed sagewood and golden aster. There are fruits of: wild currant, gooseberry, serviceberry, high-bush cranberry, buffalo berry, chokecherry and wild plum. Tree riparian zones include: cottonwoods, willow, aspen, and birch (Wedel 1961:39; Davis and Carroll n.d:15,19).

Many of these plants are well adapted to the plains. For example, western wheatgrass (*gropyron smithii*) is a good soil binder with maximum growth in the early spring.

It is very nutritious and can withstand heavy grazing (Van A Bruggen 1992:11). Blue grama (*Bouteloua gracilis*) withstands drought and during dry periods it provides a major part of the diet for range animals (Van Bruggen 1992:13). Indiangrass (*Sorghastrum avenaceum*) is a very nutritious, warm-season grass. It serves as winter range or prairie hay for winter feeding (Van Bruggen 1992:17). Rubber Rabbitbrush (*Chrysothamnus nauseosus*) serves as a winter browse for pronghorn, deer and elk (Van Bruggen 1992:41). Hood Phlox (*Phlox hoodii*), a low perennial, is resistant to drought because of its deep roots and prefers dry, eroded areas where other plants cannot grow (Van Bruggen 1992:50).

Psoralea esculenta and the *Pomme blanche* are starchy roots eaten fresh or dried for winter use by historic Native Americans. They also gathered plantain, milkweed, purple coneflower, sunflowers and other plants for medicinal purposes. Indian hemp, certain species of milkweed and nettles provided fibers for cord and sewing materials (Wedel 1961:38).

Site Description

The boundaries of 24CA37 are marked by the surface extent of a cluster of weathered bone and chipped stone artifacts. The site is located in a basin with its long axis running north/south and is on the first terrace above and to the east of the Missouri River flood plain. Bird Creek runs just to the west of the site approximately 400 meters away (Figure 1). The southern boundary of the site is a steep bank (Figure 3). The northern boundary is only 3-5 meters above the center of the site. The eastern boundary is a weathered portion of the basin sloping down approximately 5 meters. The western boundary extends from the center of the site uphill (east) to its apex some 20 meters above the center of the basin. The southwestern boundary joins an arroyo that extends southwest approximately 60 meters.

The site seems to have undergone heavy erosion at one time but now is relatively stable because of a heavy grass cover. The extreme eastern portion of the site as well as much of the extreme western periphery has been heavily eroded to expose bedrock. The major concentration of

exfoliated and weathered bone and of chipped surface stones comes from this heavily eroded portion of the site.

The soils of the site are colluvial and poorly drained. The uppermost is a gray clayey loam extending to about 18 centimeters in depth. Underlying this is a gray to light gray clayey loam extending to a depth of 153 centimeters or more. The soil is calcareous below 36 centimeters, low in permeability, and tends to pond surface runoff. Near the top of the southern boundary is an outcrop of sedimentary rock that runs the length of the bank forming a shelf.

North of the site is a rolling plain approximately 1 mile square. The soils are deep and well drained, since they are formed in alluvium and eolian sands. The soils are dark grayish brown and composed of fine sandy loam with a top layer around 18 centimeters thick. The subsoil is brown to grayish brown fine sandy loam about 38 centimeters thick. There are scattered sandstone fragments on the soil surface and throughout the soil underneath. Permeability is moderately rapid with surface runoff being slow to medium. These soils support good pastures of prairie sandreed, bluebunch wheatgrass, Indian ricegrass, forbs and shrubs (Clark et al. 1973:91-2).

Northeast of the site lies a gradual sloping draw approximately a quarter mile wide and a half mile long. Separating the plain to the north and the draw to the northeast is a hill approximately 200 meters wide. Although the top of the hill rises some 50 meters above the bottom of the draw, the hill side is not sufficient to guide bison down the draw, mainly because of its relatively gentle slope.

Uncontrolled digging at the site has occurred numerous times over the years and the extent of damage is uncertain. The greatest amount of uncontrolled digging has taken place near the southeastern boundary of the site.

III. Bison Behavior and Accounts of Bison Traps

Here I will focus on various procurement strategies using historic and archaeological evidence, and other information about bison herds. First, a brief explanation of the bison "seasonal round" will be discussed in order to understand the movements and behavior of bison on the plains. Next, a description of a bison pound followed by archaeological descriptions of bison kill sites will be discussed.

Bison Behavior

Studies in Yellowstone Park show that bison have readily identifiable familiar areas and seasonal home ranges. The range area size and location appear to depend on the forage needs and the distribution of forage in the region they inhabit (Bamforth 1988:80). Part of the year the bison are in their "over wintering" period which extends from October to May when bison range through their fall, winter and spring habitats. In the past, these range areas concentrated the animals along the western and northern edges of the plains but some herds wintered in prairie mountains such as the Cypress Hills in southeastern Alberta and the Black Hills in South Dakota. These isolated areas were more sheltered; protection was afforded from high winds and extreme cold, and forage was readily available (Reeves 1990:171; Bamforth 1988:80).

Next, the bison move into their "summering" range on the shortgrass plains after calving in May. Most of this time the bison travel in two distinct herds. One is the "nursery herd" composed of cows, yearling, calves and immature bulls. This group ranges in size from 20-30 to several hundred animals. The other herd is the bull herd composed of sexually mature males and ranges in size from 2 to 30 animals (Bamforth 1988:81). The herds concentrated along major rivers as watering holes and streams dried up (Reeves 1990:172).

This aggregation and dispersal of bison seems to coincide with human hunting populations as well. According to the ethnographic accounts, most hunter/gatherer peoples of the plains had a major communal hunt in the summer and then moved to their wintering grounds where they killed

bison for robes and winter meat (Fletcher and LaFlesche 1970:270-1 [1911]).

Historic Accounts

Most of the early historic accounts of bison kills came from explorers and fur trapper journals. Some recorded information important to their business ventures, whereas others recorded information based on a real interest in the activities of the native populations. Later trained ethnographers and scientific archaeological excavation confirmed these accounts.

I found that 24CA37 fits best into the historic accounts of pounds. The following is a historic description of impounding bison by Henry Youle Hind. He witnessed a pound operated by the Cree on the headwaters of the Qu'Appelle River in 1858. Hind's description is given verbatim from Hornaday with an introductory paragraph by Hornaday (Arthur et al. 1975).

"He [Hind] describes the pound he saw as a fence, constructed of the trunks of trees laced together with green withes, and braced on the outside by props, inclosing a circular space about 120 feet in diameter. It was placed in a pretty dell between sand-hills, and leading from it in two diverging rows (like the guiding wings of an elephant pen) were the rows of bushes which the Indians designed "dead men," which serve to guide the buffalo into the pound. The "dead men" extended a distance of 4 miles into the prairie. They were placed about 50 feet apart, and the two rows gradually diverged until at their extremities they were from 1-1/2 to 2 miles apart". "When the skilled hunters are about to bring in a herd of buffalo from the prairie," says Professor Hind, "they direct the course of the gallop of the alarmed animals by confederates stationed in hollows or small depressions, who, when the buffalo appear inclined to take a direction leading from the space marked out by the 'dead men', show themselves for a moment and wave their robes, immediately hiding again. This serves to turn the buffalo slightly in another direction, and when the animals, having arrived between the rows of 'dead men', endeavor to pass through them, Indians stationed here and there behind a 'dead men' go through the same operation, and thus keep the animals within the narrowing limits of the converging lines. At the entrance to the pound there is a strong trunk of a tree placed about one foot from the ground, and on the inner side an excavation is made sufficiently deep to prevent the buffalo from leaping back when once in the pound. As

soon as the animals have taken the fatal spring, they begin to gallop round and round the ring fence, looking for a chance of escape, but with the utmost silence women and children on the outside hold their robes before every orifice until the whole herd is brought in; they then climb to the top of the fence, and, with the hunters who have followed closely in the rear of the buffalo, spear or shoot with bows and arrows or fire-arms at the bewildered animals, rapidly becoming frantic with rage and terror, within the narrow limits of the pound. "A dreadful scene of confusion and slaughter then begins; the oldest and strongest animals crush and toss the weaker; the shouts and screams of the excited Indians rise above the roaring of the bulls, the bellowing of the cows, and the piteous moaning of the calves...." The last scene of the bloody tragedy is thus set forth a week later: "Within a circular fence lay, tossed in every conceivable position, over two hundred dead buffalo. [the exact number was 240.] From old bulls to calves of three months' old, animals of every age were huddled together in all the forced attitudes of violent death. Some lay on their backs, with eyes starting from their heads and tongue thrust out through clotted gore. Others were impaled on the horns of the old and strong bulls. Others again, which had been tossed, were lying with broken backs, two and three deep. One little calf hung suspended on the horns of a bull which had impaled it in the wild race round and round the pound. The Indians looked upon the dreadful and sickening sight with evident delight, and told how such and such a bull or cow had exhibited feats of wonderful strength in the death-struggle. The flesh of many of the cows had been taken from them, and was drying in the sun on stages near the tents. It is needless to say that the odour was overpowering, and millions of large blue flesh flies, humming and buzzing over the putrefying bodies, was not the least disgusting part of the spectacle" (Arthur et al. 1975:54-6).

Archaeology

The following contains archaeological evidence and bison behavior information to explain the use of different types of bison kills.

First, I would like to describe the process of gathering the bison in order to maneuver them into traps. Often the process requires the use of **drive lines** like the ones described by Hind's account which he calls **"dead men"**. I define drive lines as structures made up of rock cairns, brush, "dead men" or other types of material constructed as barriers that maintain animals into a lane of direction. **At Head-Smashed-In** (Figure 4), more than five hundred cairns, about a meter in diameter and a third of a meter high, mark paths as long as eight kilometers in length. Cairns located along stream tributaries provided natural runways

for the stampeding bison. Also, the rows of cairns helped the stampeders to keep bison aimed toward the jump point (Reeves 1983:124).

In bison pounds, drive lines often converge as the lines get closer to the pound, often forming wings that bunch the herd ever closer together and funnel them into the trap. Often the direction of these wings is designed to hide the trap from the animals. For example, Frison describes the funneling process at the Ruby site,

"At a distance of about 40 feet from the enclosure, the drive lane takes a sharp bend which obscured the pound itself from view of the animals until the last possible instant. It is possible that the animals were speared just as they passed the bend that would allow them a view of the trap, before they panicked" (Frison 1991).

One type of bison kill used on the plains is the buffalo jump. The buffalo jump is a natural precipice that is high and steep enough to either kill or seriously injure an animal when it falls over the edge. Jumps are designed to take advantage of a large herd of bison. The bunching instincts and momentum keep the herd together. According to Frison, bison can move rapidly and change their direction quickly.

"A single animal or a small group of bison is almost impossible to drive over a precipice because they can easily perceive the danger and react immediately by swerving or reversing their direction. Stampeding a large herd of bison creates a different situation; in this case, the mass of animals is so great that the leaders cannot change direction and are pushed over the edge followed by many to their rear" (Frison 1991:157).

Head-Smashed-In is a good example of a buffalo jump. It has a vertical drop between 9 and 10 meters, though it was nearly twice as high in the past before part slumped off. Further, this jump was obviously an excellent kill site, as it was used for at least the last 5,600 years, and possibly as long as 9,000 years (Reeves 1983:120).

The Vore is considered a buffalo jump, but it is also a natural pound. The site is a circular sinkhole with surrounding sides that are steep

enough to seriously injure the bison and trap them inside the sinkhole. The sinkhole is about one hundred and twenty-five feet across with steep sides about fifty feet high. The Vore site is multi-event site, with at least twenty-two bone levels that begin about four feet below the surface and continue to a depth of seventeen feet (Reher 1978:27).

Other types of kill sites use the natural topography to entrap bison. These traps stop or impede the progress of the animals. For example, animals can be run onto the ice, into rivers, into snow drifts and into sand dunes. For example, the Casper site is a natural sand trap site located in Wyoming. Frison describes Casper as,

"a perpendicular drop of 2 to 3 feet along the edges of the dune trough where the sand is held in place by deep root growth, being places that make it difficult if not impossible for bison to negotiate. Hunters would only need to move the animals from the pond into the nose of the sand dune where the sand would impede their progress enough that they could be killed. Surrounded by well-armed hunters around the rim of the dune the animals would be forced to move uphill in the soft sand in their effort to escape"(Frison 1991:172).

The Hawkins kill site uses a natural arroyo to trap bison. The sides of the arroyo are thirty-five feet high, too steep for the bison to escape. According to Frison, a group of bison could be herded into the arroyo bottom, then moved upstream until either a headcut, artificial barrier or corral is reached. Hunters could be stationed at critical spots, such as tributary arroyos or places where the banks are not steep enough to contain the animals. The animals could be kept moving steadily up the arroyo in close pursuit by the hunters. Once the lead animal reached some barrier, there would have been confusion as the bison in the rear collided with them. At this point hunters could throw darts or spears into the animals while a fence could be stretched across the arroyo behind the animals to deter escape (Frison et al. 1976:31-2).

Pounds are usually either natural or artificial enclosures or sometimes a combination of the two. The corral structure can be made of fences of logs, brush or piled snow. The idea is to construct the pound

carefully to look solid so that bison can not see "daylight" and try to burst through the fences. Remnant post molds, bone uprights, and decaying wood from posts or fences are sometimes found at the sites.

The Ruby site is a pound that combines some of the techniques of the previous types of traps. It consists of a buffalo pound in an arroyo, part of a drive lane, and an associated ceremonial structure (Frison 1971:77). Fragments of posts were occasionally recovered in the post holes. Many posts were tightened in the hole by forcing bison mandibles, ribs, humeri, other long bones, and flat stones between the posts and sides of the holes. To enclose a circular pound stakes were fixed in the ground and the distance between them filled with logs, dry boughs, masses of stone, or trees laid on one another to the height of about 5 feet. The pound had diverging wings to funnel the animals into the entrance. These were short fences and or rows of bushes or other markers which concealed persons who appeared at the proper moment to keep the animals headed in the correct direction. Once inside the pound, a barrier of some kind could be dropped behind the animals (Frison 1971:80).

In many kill sites the butchering consisted of cutting the animals into pieces that could be moved to a processing area away from the kill. These areas were usually found upwind of the kill area (Reeves 1983:130) and may have included tools for butchering and processing and features such as: fire cracked rock, refuse piles, boiling pits, hearths, and post molds from smoking racks.

The archaeological evidence suggests that the bison killing was a communal effort but that the processing was not. The processing areas often consist of a number of similar but separate processing units that, according to Frison, were worked at the family level (Frison 1971:87).

V. Method of Excavation and Analysis at 24CA37

Method of Excavation

The locations of excavation units were selected to salvage the eroding bone from intact deposits. The one exception is Feature 12 that was opened up in the middle of the site where the bones were intact and no erosion had taken place. Unfortunately, this feature was only opened briefly and there was not enough time to excavate it fully.

Excavation of the units proceeded by loosening dirt with trowels, brushes, and other hand tools. Then the unit dirt was sifted through a 1/4 inch screen and all materials bagged and labeled.

Method of Cultural Material Analysis

The projectile points from the site are grouped from the general, Late Prehistoric points, Prairie and Plains, to the specific, Avonlea points. The general characteristics of Late Prehistoric points are that they are small (smaller in size than atlatl points), triangular (as opposed to lanceolate or leaf-shaped), and side-notched (notches on the side of the points with notches taken off at a 90 degree angle, not a 45 degree angle). The points can be separated into Plains points with notches that are rectangular and have the same width at both ends, or Prairie points with notches that are V-shaped or U-shaped at the open end. The points that fit into the Prairie will then be keyed out based on Kehoe's definition of Avonlea points (1966). Kehoe defines Avonlea points by the following characteristics:

"Flaking: well-executed, the flake scars broad and shallow, usually parallel, extending from the blade edge to the mid-point or beyond. Notching: V or U-shaped (never rectangular), fairly wide, shallow, small side-notches, placed very low on the blade. Base: preponderantly concave, corners usually rounded, with ears projecting at about a 65 degree angle to the longitudinal axis of the point. Edge: very regular, frequently serrated with the tip needle sharp". Further, the shape is triangular and the material type varies (Kehoe 1966:829).

Projectile points and other tools that I examined were entered into a database with the following fields: 1) feature unit, 2) artifact type, 3) material type, 4) maximum length, 5) maximum width, 6) neck width, and 7) weight.

I used the following descriptions to identify the types of chipped stone tools found at the site. These descriptions are my own interpretation and modification of definitions from Crabtree (1982) and Whittaker (1994).

Projectile Point: Specimens that are bifacially-worked tools with a hafting element for attaching to a spear or arrow shaft (Crabtree 1982:50).

Bifaces: These have one or more edges with flakes scars on both dorsal and ventral surfaces. These specimens may have been used for scraping, cutting or chopping. This category also includes fragments of projectiles that are too incomplete for more specific identification (Crabtree 1982:32; Whittaker 1994:19).

Unifaces: These have a regular series of flake scars on one surface along one or more edges. This includes tools that may have been used for cutting, scraping and graving (Crabtree 1982:57; Whittaker 1994:19).

Flakes: These are pieces of chipped stone having sharp edges, a bulb of percussion (and/or percussion rings) and/or a platform at the proximal end (Crabtree 1982:36; Whittaker 1994:14).

Thinning Flakes: These are flakes that have four or more flake scars on the dorsal surface. Generally these flakes are removed in order to make the flake thinner (Crabtree 1982:55; Whittaker 1994:185-6).

Debitage: this consists of waste product from making stone tools. This includes flakes and shatter (Crabtree 1982:32; Whittaker 1994:20).

Shatter: This consists of pieces of material that may or may not have flake scars, but are not flakes. Shatter can be culturally or naturally produced (Whittaker 1994:21).

Modified Flake/Modified Chunk: These are flakes or chunks of stone with altered edges that lack the diagnostic attributes of formed

tools. The edges look like they may have small flakes taken off, or chips taken off due to use wear. These may be naturally or culturally modified.

Cobble: These are usually round stones, larger than 25mm, that do not naturally occur in the sediments they are found in. These may be culturally used or not. They may be used for the purpose of lithic reduction or as boiling stones.

Method of Bone Analysis

I used a taphonomic approach in examining the bonebeds. This approach that concerns itself with what happens to an animal including its type of death and the resulting modification of bones in micro-depositional environments (Lyman 1994:3). I chose paleontological terminology for bone element labels (Figure 5).

I gathered the following information during bone analysis. The bone element and species were determined in comparison to a comparative bison skeleton. Bones thought to be from some other species were analyzed against the collection at the Philip L. Wright Zoological Museum or against illustrated manuals (Brown 1978; Olsen 1960). The examination of the bone elements and modification helped explain whether the bone was butchered or gnawed and dispersed by carnivores. Any unusual marks on the bones were compared with materials with known origins of such marks (Binford 1981; Lyman 1994; Shipman 1981). The age was estimated (if possible), against Koch's bison epiphysis fusion rates (Koch 1935:372-3) and bison dental eruption and dental wear from the Agate Basin site (Frison and Stanford 1982:241-250). The attributes of bison bone age, such as dental eruption, dental wear, and epiphysis fusion rates were examined to help determine the season (if possible) in which the killing took place. The season could explain why this particular site was chosen.

I built the database for the bones using ClarisWorks database system. The database is a modification of the Hudson-Meng excavation manual (Todd 1996:21). The fields consist of: 1) unit, which provides the information about what feature the artifact is found in; 2) specimen

number, the number given each artifact; 3) genus; 4) species, coded as a known name or as "UN" for unidentified bone; 5) element, which particular bone is found, such as humerus or "US" for unspecified; 6) the part of the bone element found, or "CO" for complete, or "US"; 7) side, "R" for right and "L" for left or "N" not sided, "UN" for unknown; 8) the proximal fusion of the bone element, 0= unfused, 1= partially fused, 2= fused but line still visible, 3= completely fused, 4= broken cannot be determined, 5= not applicable; 9) the distal fusion of the bone element, with the same coding as proximal; 10) length taken in millimeters along the long axis of the bone; 11) broken, coded as D= dry break, G= green break, N= not broken, Y= broken but not sure how; 12) burned, Y= burned, and N= not burned; 13) modified, C= carnivore damage, B= butchering marks, N= not modified or unknown origin of modification; 14) comment is for information not provided by the fields.

On modified specimens, I tried to determine whether the marks suggested butchering by humans or gnawing by animals or both. In interpreting bone modification there are two categories: biological modification (humans or animals) and chemical or environmental modification.

Non-Human Animal Modification

There are many types of animals potentially able to modify the form or location of bones in an archaeological site. As mentioned earlier, many burrowing animals inhabit the plains and displace soil and, along with it, artifacts. Rodents and lagamorphs have teeth that continually grow. They continually chew on bones to keep their teeth worn down. Predatory animals often scavenge bones, thereby modifying and displacing them.

Often times canids, particularly wolves or dogs, scavenge bison kills after humans have left the site. Lewis and Clark noted that by nightfall, when the natives finished processing the bison, the remains were left to the wolves, "which are in great numbers, always in the neighborhood of the buffalo" (Bergon 1989:82).

Because bone modification is done by canids in particular, I will

briefly describe the types of modification they leave using Binford's carnivore modification (Binford 1981) and first hand observation of a dog chewing a bone.

First, the marks carnivores make on bones are: tooth perforation marks, gnawing and scooping out of cancellous tissue, crunching and splintering, spiral fracturing directed from the epiphyseal ends and partial digestion. The results are certain types of tooth marks such as: punctures, pits, scores and furrows (Binford 1981:39). Punctures are deep holes in the bone and may be one or paired holes resulting from the canine teeth penetrating into soft bone. Pits are similar but are made by shallower penetrations of the canine teeth (Binford 1981:44,46).

"Scoring is the result of either turning the bones against the teeth or dragging the teeth across relatively compact bones. The result is linear marks along the surface". Furrowing is the effect of "repeated jaw action produced on cancellous bones, where the bones usually looks scooped out. Mashed edges can occur when the animal vises down with its teeth while tilting its head in the opposite direction of the bones, thus, allowing the animal to pry off bits of the bone" (Binford 1981:46,48,55).

Human Modification

Other types of modification are derived from human butchering and skinning carcasses. Human marks sometimes mimic those made by animals. However, tooth marks from carnivores are usually "U" shaped, shallower and wider than marks made by human tools. Cut marks made by tools leave a groove that is more "V" shape, narrower and deeper (Lyman 1994:297,305,307). Marks found on the bone collection of 24CA37 are recognizable once the distinction is made, and sometimes a microscope helped to distinguish the type of mark.

Marks that result from skinning the hide are generally made at the carpal and hock joints, around the shaft of the lower leg and phalanges, and on lower margins of the mandible or on the skull (Binford 1981:107). Cutting marks are often found at the proximal and distal ends of bones, on the surface of vertebrae and pelvic parts due to cutting ligaments or muscles (Binford 1981:110-126). Defleshing marks are usually found on

the shafts of major bones. Dismembering marks such as blow marks are depressions in the bones or crushed edges and are usually found at the site of heavy muscle attachments. Split and broken bones usually indicate extraction of marrow or tool-making (Johnson 1978:99).

There are predictable butchering patterns found in the archaeological record, in modern ethnographic cultures, and experimentation. The following is an account based on Paleo-Indian butchering patterns on the Llano Estacado described by Johnson (1978). For butchering of the head and spinal column the following observations were made: for the extraction of the brain, the occipital area was normally broken; for the extraction of the tongue, mandibles showed breakage around the symphyseal plate, the coronoid process was snapped off and cut marks were found on the ascending ramus. In the process of detaching the head, the atlas often has all or part of its dorsal arch removed. For the rest of the spinal column, to loosen the muscles that were attached, there was crushing damage to the transverse process, the spine of the thoracic was broke off near the base and sometimes cut marks appear at the base of the spine (Johnson 1978:100).

The limb bones were often butchered in the following way. The medial tuberosity of the humerus was removed or crushed along the edges and cut marks appeared along the top of the lateral condyle. Defleshing marks were found on the shafts of the radii, tibiae and metapodials. The radius usually had the ulna removed leaving the ulna broken at the shaft and the olecranon was crushed with a blow mark. Metapodials were often crushed and the condyle removed. There was crushing damage on the femur, cut marks or crushing around the condyles of the tibia, and the distal end of the calcaneum was broken or cracked off (Johnson 1978:101).

Removal of the iliac wings freed several muscles and the bones "provided a handle with which to strip these muscles". The same is true for the ischium and pubis areas (Johnson 1978:103).

Weathering

The next consideration of bone modification is the process of weathering. Bone weathering is:

"the process by which the original microscopic organic and inorganic components of bone are separated from each other and destroyed by physical and chemical agents operating on the bone *in situ*, either on the surface or within the soil zone" (Behrensmeyer 1978:153).

The degree of weathering can give a relative indication of how long the bones are left exposed on the surface depending on the environmental conditions in which they are found. Behrensmeyer 1978 has a general description of stages of weathering that I used in my analysis.

Stage 0: The surface of the bones shows no sign of cracking or flaking. The bone is still greasy and some flesh may still be attached to the bone.

Stage 1: Bone shows cracking, normally parallel to the fiber structure. Skin tissues may or may not be present.

Stage 2: Bones show some flaking, usually associated with cracks, "in that the bone edges along the cracks tend to separate and flake first. Deeper and more extensive flaking follows, until most of the outermost bone is gone". Further, there may be some flesh remnants still left on the bones (Behrensmeyer 1978:151).

Stage 3: The bone is characterized by rough patches resulting in a fibrous texture.

"Gradually the patches extend to cover the entire bones surface. Weathering does not penetrate deeper than 1.0-1.5 mm at this stage, and the bone fibers are still firmly attached to each other". There is rarely any tissue left at this stage (Behrensmeyer 1978:151).

Stage 4: "The bone surface is coarsely fibrous and rough in texture; large and small splinters occur and may be loose enough to fall away from the bone when it is moved. Weathering penetrates into inner cavities" (Behrensmeyer 1978:151).

Stage 5: Bone is falling apart *in situ* and there are splinters lying around the bone. The bone is fragile and may fall apart when it is moved from its original location (Behrensmeyer 1978:151).

V. Feature Descriptions

Feature 1

Feature 1 is the site itself (Figure 3). The main datum point was located at the northeast boundary along a true north/south line. It was situated so that most of the site can be easily viewed from the datum point. A secondary datum point was established west of the primary datum along a true east/west line. From the secondary datum the arroyo can be viewed more easily. Chipped stone tools and flakes were collected from the surface of this site and assigned to this feature. They consisted of ten projectile points (many of them broken), eight bifaces, four flakes, two thinning flakes and two worked flakes (Table 3).

Feature 2

Feature 2 was identified as the densest concentration of bones in the site. The exact boundaries of the bonebed are uncertain at present. The bones are apparent at the surface, are broken down, and have been moved by erosion or by the activities of uncontrolled digging. Several teeth of large ungulates (bison) are the most discernible skeletal pieces present. Most of the exposed bone pieces are unidentifiable, brittle fragments. A possibly undisturbed section of the bonebed has been trenched by natural runoffs. No bones or chipped stones were assigned from this feature.

Feature 3

Feature 3 is the first excavation unit. It is a 2x2 meter square pit oriented north-south and is located at the upper, northern part of the site. The northern edge of the feature was determined by an eroded bank. The soil is gray silty-clayey loam from the surface into the layer containing bone. Relatively intact bone was first exposed at 47 cm below datum, 131 cm from the NE corner and 162 cm from the SW corner (surface at SW corner). One Late Prehistoric projectile point base was collected from the northeast unit at 28 cm below datum.

At 40 cm below datum two projectile points were located in close

association with bone. The first is white cryptocrystalline silicate (CCS) and the second point made of a poorly consolidated CCS. Both were located within 9 cm of each other. There were four additional points found within Feature 3 along with one biface, five flakes, one piece of shatter, one thinning flake, and one cobble.

At the northern boundary of the site, where this unit is found, the bone is less well preserved than the bonebed at the site's southern boundary. This may suggest that soils were less conducive to preservation along the northern boundary or that perhaps an older bonebed was exposed. Feature 3 is apparently sterile below 60 cm.

Faunal Remains

As recorded in Table 1 there are three bones from the forequarters: one right radius proximal end, one right radius distal end, and one broken right ulna. There are no identifiable rear limb bones, but five pieces of long bone shafts could represent fore or rear leg bones. It is possible that the two radius parts fit together but there is not enough bone shaft between them for refitting. Post-kill modifications include: one radius with carnivore marks, one shaft piece with carnivore marks, and another with butchering and blow marks (Table 2).

All together there are eight carpal and tarsals, one complete left and one broken left calcaneum; one broken left naviculocuboid; two left and one right, nearly complete scaphoids; one broken right magnum; one broken right lunar and one complete left unciform. There are no phalanges but there is one complete sesamoid bone. The only post kill modification consists of one scaphoid with carnivore marks.

The vertebral column consists of one unidentifiable vertebra, eleven broken ribs, one of which is left and two right, and seven unsided ribs. Also there is one scapula broken into two pieces that fit together. Post-kill modifications include one rib with carnivore marks and another with cut marks.

Skull bones include one possibly temporal, ten identifiable teeth, and three pieces of enamel. The teeth consist of four fairly complete and two broken molars, one fairly complete premolar, and one complete

incisor. There is one molar with cut marks on the root, and one very white molar compared to the rest of the teeth. This may indicate that the white molar was intruded into the unit.

In addition, there are over eighty unidentifiable bones ranging from 1-142 mm in length. Post-kill modification of these fragments consist of cut and carnivore marks and a few bits of burned bones. Most of these bones are in weathering stage 1-2 with some in stage 3-4 in that may have been secondarily deposited into the feature.

Feature 4 and Feature 6

Feature 4 is a 2x2 meter trench with the edges oriented to a true north-south line. It is located in an eroding section of the site. The soil consists of weathered bone fragments and silty loam from 0-58 cm below datum. This soil is most likely a secondary deposit because of the heavily weathered concentration for bone fragments uniformly present and running continuous throughout the unit. This probably results from soil movement exposing the bonebed at the upper end of the site (northern to northeastern end) and from runoff moving the soil and weathered bone fragments down slope across the northwestern to southwestern portion of the site. All deposits, except possibly the lowest levels, appear to be secondary deposits.

Feature 6 is a 25x20 cm ridge that lies southwest and is connected to Feature 4. This ridge resulted from the erosion of two small rills that ran through Feature 4. When the ridge was removed it exposed a previously covered bed of relatively unweathered bone and burned bone fragments.

Feature 4 has seventeen projectile points (more than any other feature), one flake, two pieces of shatter and two cobbles. No chipped stone was found in Feature 6.

Faunal Remains

There are sixteen bones from the feet: four nearly complete distal phalanges, two broken and one complete median phalanges, four complete and two broken proximal phalanges, one unidentifiable broken phalanx,

and two sesamoid bones. Evidence of post-kill modification includes: three distal phalanges with carnivore marks and another one burned, one median phalanx with consecutive cut marks in a row on the anterior side, one proximal phalanx with cut marks and two others burned, and one burned unidentifiable phalanx. One of the median phalanges is smaller than the other two and is not fused on the proximal end which may suggest a juvenile animal.

The forelimbs are represented by one broken left radius and one broken right radius, one broken left humerus, one broken left tibia, two proximal femur ends, three femur fusion ends, four long bone shaft pieces, and one unidentifiable long bone end piece. The post kill modification consists of one partially burned radius, one humerus with cut marks, one burned unidentifiable long bone end, one shaft piece with cut marks and two burned shaft pieces.

There are thirteen carpal and tarsals: one complete left astragalus, two broken left and one right astragali, one broken calcaneum, two left and one right lunars, three left and one right unciform, and one right scaphoid. Post-kill modification consists of one burned left astragalus, two burned lunars and another with carnivore marks, one burned scaphoid, and four burned unciform, one with carnivore marks. All together there are seven metapodials consisting of one broken right metacarpal and six distal metapodial fusion ends, three of them burned.

From the vertebral column there are twelve vertebra pieces: one thoracic centrum, four thoracic spines, six identifiable vertebrae centra and one posterior vertebral disc. There are also five rib pieces which consist of one left head and four unsided shafts. No post kill modification was noted on these except that they were all broken, probably in the course of butchering.

The skull bones consist of one unidentifiable piece of skull, one possible temporal, six premolars, eight molars and over twenty-nine pieces of enamel. Most of the skull bones and enamel are burned.

From the bones in Feature 4 and 6 there was at least one mature individual based on the carpal and toes. Also one juvenile, based on the median phalanx that is unfused on the proximal end and is smaller than

the rest of the toe bones.

There are over seven hundred unidentifiable bones ranging from 1-176 mm in length. Some have carnivore and cut marks on them and vary in weathering stages from 1-2 and 3-4. Some are burned white with a few gray pieces, which may indicate that part of the bones were burned at different temperatures.

Feature 5 and Feature 7

Feature 5 is a 2x2 meter trench orientated to a true north-south line. This unit was placed at the western margin of a presumed pot-hunters pit and extended eastward into what is believed to be undisturbed midden area.

The bonebed of Feature 5 is Feature 7. The bonebed was first excavated at the west end of the excavation unit 42 cm below datum. The bones were removed and a rather dense concentration of charcoal was discovered 74.5 cm below datum. It was situated beneath the bonebed.

Of the chipped stone found, there are two projectile points, three flakes, and two pieces of shatter.

Faunal Remains

There are five skull pieces: one possible temporal, two possible frontals and two pieces of alveolar. The teeth consist of thirty-six molars, nine premolars, six incisors, and ten unidentifiable pieces. Most of the teeth are complete or nearly complete and exhibit little weathering. The two pieces of alveolar contains a few teeth but not enough to determine animal age.

The pelvis bones consist of three pieces of bones which, when refitted, connect in the center of the right acetabulum, one piece of the left acetabulum, one part of the left ischium; one piece of an unsided ischium, and two pieces of the coxae fusion parts. The post-kill modification consists of the broken pelvis bones with cut and carnivore marks on them. The pelvis remains from Feature 5 show at least two individuals.

Specimens from the vertebral column include:

- fourteen broken thoracic vertebral centra
- fourteen thoracic vertebral spines
- three complete vertebral discs
- forty-three pieces of vertebral discs
- seven nearly complete caudal bones
- three nearly complete atlases
- one mostly complete axis and half of another axis
- ten mostly complete cervical vertebra; two cervical vertebra pieces
- and fourteen unidentifiable vertebrae.

Post-kill modification include thoracic vertebrae centra with cut marks, thoracic spines with cut and carnivore marks, three atlases with cut and carnivore marks, and some cervical vertebrae with cut and carnivore marks. Many of the cut marks are on the vertebral foramen and all the spinous processes are broken off every thoracic vertebrae, breakage that is a good indication of butchering. Further, there are three distinct atlas parts which suggest at least three individuals were present.

All the ribs are broken and consist of nine left rib heads and three right, two unsided rib heads, six left and four right rib shafts, thirty-four unsided rib shafts, and thirteen plus rib parts. The post-kill modification consists of broken ribs with some cut and carnivore marks.

From the rear limbs are the following: one distal femur end, two femur heads, and one left tibia broken at the ends. For the post-kill modification there is one femur with carnivore marks and femur heads with canid chewing where the teeth punctured and left drag marks across it.

From the fore limbs there are one left radius proximal end, one right radius, one right and one left distal radius fusion ends, two left and one right humeri, and one left proximal ulna end. Post-kill modifications include one radius with cut and carnivore marks, and two right humeri with carnivore and cut marks, many of which are on the olecranon fossa. Also there is one left radius with a clean diagonal

fracture along the shaft and one right radius that is crushed and opened, which may suggest marrow extraction. Further, there are seven unidentifiable long bone pieces that could be from either the hind or fore limbs.

Carpals and tarsals include one broken left lunar, one complete left scaphoid, one right astragalus, and one left calcaneum with carnivore marks. There are no phalanges present, but there are six complete sesamoid bones.

The metapodials consist of four complete right metacarpals and two complete and one broken left metacarpals; there are some fusion ends that fit the metacarpals; and three other fusion distal ends pieces unidentified if metacarpals or metatarsal. There is one left metacarpal proximal end with cut marks. From the metacarpals there are at least four individuals. Since many of these bones are barely fused or unfused, juvenile animals were present.

The bones in Feature 5 and Feature 7 are in fairly good shape with some flaking and splitting characteristics of stage 1-2. With but one exception, all the bones are broken, many in places that facilitate butchering. Because the bones are not widely scattered, this may suggest that the bison were probably butchered where they were found.

Feature 8 and 9

Feature 8 was opened in the arroyo at the southwestern border of the site. This unit was opened as a salvage project where a small section of a vertebral column and associated charcoal were noted eroding out of the bank. Feature 9 is the bone deposit of Feature 8. The identifiable bone exposed by erosion consists of a burned rib and three unburned vertebrae apparently preserved in their original articulated form. This deposit is probably a result of erosion moving the soil from the hillside above (south) down slope. It is interesting, however, that many sections of vertebral column are still articulated and the charcoal concentration is located directly beneath the three vertebrae. The feature was closed out at 60 cm. No chipped stone artifacts were found in this feature.

Faunal Remains

There is only one femur head and no fore limb bones. There are some carpals and tarsals represented: one left fibula, one right unciform, one right pisiform and one left scaphoid. The only post-kill modification consists of a femur head with carnivore marks.

There are seventeen vertebrae, one nearly complete lumbar, two thoracic pieces, one nearly complete caudal vertebra, four broken vertebral discs and nine unidentifiable vertebral pieces. There are six ribs consisting of three shaft pieces, two right rib heads and one unsided rib head. A few of the vertebrae exhibit cut marks.

From the skull there is one broken mandible with two molars, one incisor, three premolars, nine molars and seven unidentifiable teeth pieces. Further, there are over a hundred unidentifiable bones that range in size from 1-80 mm. Some are broken and some are splinters in the 1-2 stage of weathering. Most of the bones show no post-kill modification.

There seem to be two types of bones represented, some brown and more intact and some white and more weathered. This may suggest that part of the feature was buried before another part, that part of the feature was later exposed, or that some of these weathered bones eroded out and were transported into Feature 9 at a later time.

Feature 10 and 11

Feature 10 is 1x2 meter salvage unit opened at the site. It is located at the southwestern boundary of the basin. Ribs, a vertebrae, and a lower leg bone were eroding out of the north face of the bank. Feature 11 is the bonebed of Feature 10. At 56 cm below datum the bone bed was uncovered and a skull was located 85 cm from the southeast corner and 10 cm from the southern wall. A second skull was located at the northeast corner of the unit at 54.5 cm below datum. The bonebed contains unarticulated jumbled bones. There are no chipped stone artifacts found in this feature.

Faunal Remains

There are a number of feet bones: six proximal phalanges, one proximal phalanx epiphysis end, five complete median phalanges, and three distal phalanges. There are some post-kill modifications that consist of one median phalanx with many cut marks, one median phalanx with carnivore marks, and one distal phalanx with carnivore marks. There are enough toe bones to infer at least two individuals.

There are some carpals and tarsals: one right scaphoid, three left naviculocuboids and five broken calcanei. The post-kill modifications consist of one calcaneus with cut marks as well as a blow mark. This blow mark is typical of butchering patterns where the hock joint is chopped off to separate the upper limb from the lower limb. Further, with five calcanei there are probably at least three individuals present.

The metapodials consist of one left metacarpal, one unsided metacarpal, two left metatarsals and two metapodial epiphysis ends. Post-kill modifications include one metacarpal with cut marks, two metatarsal with some cut and carnivore marks, and one metapodial epiphysis end with cut marks.

Limb bones include two right tibiae, one left tibia, one tibia epiphysis fragment, one left femur, and one broken right humerus. There is some post-kill modification of two tibiae with cut marks and one femur with cut marks. In addition, there is one nearly complete right scapula.

Vertebra and ribs consist of two nearly complete cervical vertebrae, five cervical vertebrae parts, one lumbar vertebra, four thoracic vertebral spines and ten rib fragments. Post-kill modifications include three cervical vertebrae with cut marks, one thoracic vertebral spine with cut marks and two ribs with cut marks. The lack of lumbar vertebrae suggest that this part of the bison was taken out of the site.

The skull has four possible frontal bones, one right part of the occipital with part of the occipital condyle, one part of an eye orbit, two pieces of the occipital basilar part, three possible temporal, three unknown pieces of skull, one unbroken horn core, one horn core broken in

three pieces that fit together, and one horn core still attached to part of the skull. Also, there are one right mandible broken in two parts with three molars and some broken premolars, six molars, and two broken teeth. The skull and tooth fragments suggest at least two individuals.

In addition there are over forty-four unidentifiable bone fragments in stage 1-2 in weathering.

Feature 12 and 13

Feature 12 is a 1x3 meter excavation unit located near the center of the site. This feature was selected to give a better understanding of soil movement at the site as well as to examine the extent of the bonebed. Feature 13 is the bonebed at Feature 12. The bonebed was first exposed 32 cm below datum in the southern quadrant and 38 cm below datum in the northern quadrant. No chipped stone artifacts were found at this feature.

Faunal Remains

Limb bones include one broken right femur, one right humerus, the proximal end of the right ulna, one right radius, and three unidentifiable limb bone shafts. Modifications consist of two femurs with cut marks, one ulna with carnivore and cut marks, and one radius with carnivore marks and defleshing cut marks along the shaft. Further, the right radius and ulna fit together.

There is one left naviculocuboid, one left scaphoid with carnivore and cut marks, and one right metacarpal. There are only two foot bones; one complete proximal phalanx with carnivore marks and one complete median phalanx.

The skull consists of two alveolar mandible sections that fit together, one mandible part with two molars in it, three other alveolar parts, and three additional molars. All of these bones, except for the teeth, have carnivore modification.

The vertebral column includes three thoracic spines, five ribs, and some centrum pieces. There are post-kill carnivore modifications on one of the vertebra centrum pieces, two thoracic spines with carnivore marks, and three ribs with cut and carnivore marks.

The bones from this feature represent at least one individual that was butchered. Further, there are over thirty-five unidentifiable bones ranging in size from 1-125 mm in length, some with canid and cut marks, and one burned. All these bones are in the 1-2 stage of weathering. Some look to be broken from butchering and others from splintering during weathering.

Feature 14

Feature 14 is the flood plain directly northwest of the site, lying approximately 190 meters from the site. A number of chipped stone artifacts were collected on the surface including two projectile points, thirteen bifaces, four unifaces, forty-eight flakes, twenty-three pieces of shatter, two thinning flakes, and one piece of worked material. It is possible that this feature may have been the processing area or the campsite associated with the kill site.

VI. Comparing 24CA37 with other Avonlea Sites

Chronology of the Site

William Mulloy describes some of the Late Prehistoric period projectile point types as small, triangular points had side notches with flat or concave bases. Further, the Late Prehistoric period has a greater variety of material culture including ceramics and an emphasis of hunting larger game, particularly the buffalo (Mulloy 1958:163,213-4). Mulloy puts the time period of the Late Prehistoric as beginning around A.D 500 and ending with the appearance of European trade items (Mulloy 1958:231,222). The beginning of the Late Prehistoric is marked by a change in the projectile point type and size, a change that is believed to result from the introduction of the bow and arrow (Frison 1991:111). Some of the earliest arrow points are Avonlea. Avonlea predates Mulloy's A.D 500, with the earliest dates about A.D 100 and the latest dates about A.D 1100 (Wilcox 1988:276-7).

There is no radiometric date from this site, so I used point types to determine the relative date of the site. Since 24CA37 is a bison kill with Avonlea points, it can be considered an Avonlea site. By comparing 24CA37 to other Avonlea sites, I can address the question of how typical 24CA37 is. The answer may help define the social and cultural boundaries of the Avonlea culture, particularly in Montana.

Avonlea Sites

Most Avonlea sites are bison kills or are associated processing centers or campsites that contain projectile points, processing tools, butchering tools and bison bones. There are, however, artifacts found at some sites that show Avonlea people also procured other types of game and plants for subsistence. Plant processing tools such as manos, grinding slabs, and pottery were found at the Fantasy bison pound and TRJ sites (Tratebas and Johnson 1988:91,94), both located in Montana (Figure 4). Other types of game animals trapped include pronghorn antelope at the Lost Terrace site in Montana (Davis and Fisher 1988:101). Some Avonlea sites have pottery which include parallel-

grooved, net-impressed or plain (no design). Sometimes features are found such as hearths, ceramic centers, hide smoking racks, boiling pits, and tipi rings.

Another characteristic of Avonlea sites are multi-component kills and camp sites located on or near lakes and rivers. This could be interpreted to mean that Avonlea people planned seasonal movements to certain locations following movements of bison and other resources.

Avonlea sites often contain a wide variety of different types of lithic materials, ranging from exotic material to local. The quality of the materials may be associated with the quality of the projectile as Frison suggests,

"The differences in appearance and quality of workmanship of projectile points can not be attributed entirely to change through time as much as to the use of different raw materials" (Frison 1991:116).

It may be that the Avonlea people preferred to use the best knappable material and may have taken preforms of this material with them to other sites or traded for preferred material with other groups. In 24CA37, the best worked points are made from high quality cherts and obsidians not found locally. The least worked points are small, poorly formed, expedient points made from an inferior chert probably of local origin.

Since Avonlea spans a lot of time, Wilcox separates Avonlea into Early (A.D. 100-400), Middle (A. D. 400-750) and Late (A.D 750-1100). Wilcox describes the Early period as being associated with sites such as Head-Smashed-In, Gull Lake, and Lebret. He believes that the Early sites are best represented in the western part of the Northern Plains, have the classic Avonlea projectile point type, and have few associations with pottery and the use of pounds. Further, the Early sites are contemporary with the Middle Woodland and Besant-Sonota sites (Wilcox 1988:276-7).

The Middle period begins with the first appearance of Samatha and other arrow points and ends with the first appearance of the Prairie Side-Notched and Old Women's point type. During this time parallel-

grooved pottery appears along with grinding stones. Also there are variations of the classic Avonlea point types. The Middle is associated with Benson's Butte-Beehive sites. During this time few Avonlea sites are found in Canada (Wilcox 1988:276-7), a finding which may suggest a movement of Avonlea people to the south.

In the Late period, shells are found in site deposits due to a panregional exchange system. Many of these shells were traded through sedimentary villages networks along the Middle Missouri (Wilcox 1988:277).

The eastern Avonlea margin contains some mounds and sedentary sites along the Missouri River. In South Dakota there are only a few sites. Most Avonlea points occur in surface collections. One theory is that the topography of South Dakota did not favor areas for trapping bison with pounds (Hannus and Nowak 1988:188).

The majority of Avonlea sites lay east of the Rocky Mountains. There is some evidence on the Columbia Plateau for Avonlea but, it is poorly defined. A few bison kills and many projectile points are classified as "Avonlea-like" points. Benson's Butte/Beehive Butte in southern Montana/northern Wyoming are sites thought to typify the southern Avonlea groups (Frison 1991:113).

The type site for Avonlea is a bison kill on Avonlea Creek in Saskatchewan. Avonlea is best defined at sites in the Northern Plains, particularly in Saskatchewan. Many of the Saskatchewan Avonlea sites are located at the Parkland-Grasslands border. The inhabitants of these sites followed the seasonal movements of the bison when they wintered in parklands and moved onto the grasslands in the spring. In contrast, inhabitants from the Lebret site maintained their campsites and exploited the resources around them. The Lebret site is an early, multi-component habitation site that dates around A.D 690 (Smith and Walker 1988:82). This site, located between two lakes, contains many different types of animal bones beside bison, many of which are fish. Smith and Walker believe that Avonlea people harvested the bison when they wintered in the Parklands, exploited fish during spring spawning runs, and relied on other types of game when the bison were unavailable (Smith

and Walker 1988:86).

The Sjovold Creek site is a Middle period site, located in Parkland-Grasslands zone, on the west bank of the South Saskatchewan River. This is a twenty layer occupation site, the sixth layer being an Avonlea component that dates around A.D 550-750. Bones contained in this site are all bison except for a dog mandible (Dyck and Morlan 1995:253). There are pot sherds of parallel-grooved, cord-impressed and plain. Some of the sherds fit together to form a single pot believed to be part of a ceramic firing feature. Also there is a bison scapula with some clay on it that matches the parallel-grooved impressions of the pottery. This scapula is interpreted to have been used to impress the pot (Dyck and Morlan 1995:262). Another feature area, consisting of a hearth pit with surrounding post molds, is thought to indicate a hide-smoking pit. There is a chipping station which includes hearths, debitage, a chipping hammer, a chipping anvil, and an Avonlea point (Dyck and Morlan 1995:260,271). Lithic material is largely local but some materials are exotic, such as Swan River chert and Knife River flint (Dyck and Morlan 1995:280).

The Larson site, in Alberta, is Middle to Late period that dates to between A.D 500-800 (Milne 1988:43). The site is a multi-component camp probably associated with a bison pound approximately 200 meters away. The camp consisted of roasting and boiling pits, fragmented bison remains, a butchered dog, pottery, and butchering and perforating tools (Milne 1988:52-3).

There are a few Avonlea sites in the Aspen Parkland-Grasslands zones of Manitoba. Most sites show some reliance on bison but also on a number of other mammals, fish, and fowl. Some sites contain burials and trade goods. One example is the Stott site, which has a burial mound with ochre-stained skeletons and dog remains in a log-covered chamber containing bone and shell burial goods (Joyes 1988:230).

Many of the Avonlea sites in Montana date from the Late period. In eastern Montana, the Goheen site contains Avonlea points, bison bones, and parallel-grooved pottery sherds (Fraley 1988:131). The Henry Smith site near Malta dates to A.D 770-1040. This bison kill site has six

drive lines, two anthropomorphic effigies, six rock cairns, twenty-one tipi rings, and a multi-component pound. Artifacts found include Avonlea and Prairie Side-Notched projectile points, butchering tools, and some parallel-grooved pottery sherds (Ruehelmann 1988:191,198,200). The Corey Ranch site in Great Falls is the closest to 24CA37. It dates to A.D 870. This occupation site has at least twenty tipi rings, some stone tools, debitage, fire cracked rock (FCR), bones and pot sherds of parallel-grooved, net-impressed and smooth surface pots (Quigg 1988:145).

* The 24CA37 site fits in well with what is known about Avonlea sites because it is a bison pound, has Avonlea points, has a wide range of lithic materials, and is located close to a main body of water. Also 24CA37 fits into the Late Avonlea period because of the Prairie Side-Notched points. Further, 24CA37 is typical of most other Avonlea sites in Montana which are also Late Avonlea bison kills.

VII. Discussion

First I will interpret how the bison may have been trapped at this site. Next, I will examine the prehistory of the site from the kill and butchering to the present condition of the site. Then I will analyze the area and artifacts around the site to determine what might have happened after the kill.

Site Interpretation

From examining the historic and archaeological evidence, I believe that 24CA37 is a bison pound. The hill on the south side of the site is not high or steep enough to seriously injure the bison, so it could not be used as a buffalo jump. There is an arroyo on the west side that could be used to funnel the bison but there is no headcut to stop them. Therefore, I believe that a pound needed to be constructed to contain the bison. Since no post molds were found to indicate a human-made structure, natural topography and fences of local material probably enclosed the pound. Or if the kill took place in the winter, snow could have been piled up against the basin rims to form an enclosure.

There are no remains of drive lines or stone cairns associated with the site. There may have been no drive lines, or perhaps less durable materials, such as piles of buffalo dung, snow, or brush were used instead. It is also possible that rock piles were removed over time for agricultural purposes. However, there are a couple of possible strategies for herding the bison into the pound.

First, drive lines could be set up above the hillside of the pound on the plains surrounding the site. The animals could be gathered from the plains and herded within 100 meters of the hill then stampeded into the pound. From this direction the pound would not be seen until the animals reached the crest of the hill above the basin. From the momentum of the stampeding herd, the front buffalo would be pushed from behind, over the hill and into the pound before they could turn away from the trap. After the last of the herd was in the pound, a fence of hides guarded by well armed hunters could cover the entrance to prevent the animals from escaping. If the kill took place in the winter, water could be poured

over the hill entrance to form ice too slick for the bison to escape.

Second, drive lines could be established along the Missouri River. The bison would be herded down the drive lines, funneled into the arroyo, and stampeded through the draw into the basin containing the pound. A gate of hides or woven branches would prevent the bison from escaping back down the arroyo. Once the bison were corralled, hunters on the rims could shoot them with arrows as they rushed around in panic.

I believe that the entire kill took place within the bowl-shaped site area. All the eroding bones were found within the basin and a survey outside the basin did not reveal any eroding bone. Evidence from the sample excavation reveal that relatively intact bone was exposed at 47 cm below datum and there are at least two projectile points found 50 cm below datum in Feature 3 and 7 and below 50 cm in Feature 4. There were also some projectile points found on the surface and or just above the bonebed in Features 1,3,4,5, and 7. Though some of the projectile points were not closely associated with the intact bone, I believe that the points can be considered part of the killing process since they are the same type as those found with the bonebeds. In addition there were fifteen projectile points collected from the site with no provenance.

At least some of the butchering took place within the kill site. The best evidence for this is the large number of butchering marks found on the bones and the way some of the bones were broken. Many of the marks are in predictable places for butchering such as cut marks along the shafts of long bones for skinning, blow marks on the astragalus (at the hock joint), snapped off thoracic vertebral spines, broken ribs and cut marks on the atlas for head detachment. Further, flakes, bifaces and unifaces found within the site suggest butchering and processing.

Site Formation

I believe that the key to understanding the primary and secondary deposits of this site has to do with examining the topography and erosional processes. First, I believe sheetwash carried sediments from the sloping basin sides and covered the site. This may have occurred rapidly because the trapped bison in a panic churned up soil and

destroyed vegetation that originally stabilized the slopes. Next, the new layer of sediment and the decaying bison remains helped to regenerated plant growth, thus the site was restabilized and preserved for some time. Then uncontrolled digging disrupted the stabilizing elements of the site. Once again the sheetwash eroded the basin sides and collected in rills.

These rills dissected the site thereby exposing the bonebeds as well as moving some bones farther down into the basin. Bones in these rills have a random orientation that looks as though they slumped into the channels. The exposed bones, subject to constant wetting and drying, weathered rapidly. I believe these bones are in weathering stage 3-4. The bones that remained buried *in situ* are easy to recognize because they are remains in weathering stage 1-2, are not sun bleached, and tend to group into more anatomical order. For example, scapula pieces found in Feature 5 and 7 fit back together because the pieces stayed buried together. Also a large number of phalanges and sesamoid bones were found together where they lay decomposing.

Season of Kill

The season is difficult to determine since there are few intact mandibles with teeth and few of bones from which fusion rates may be estimated. However, there are some metapodials that are not completely fused, some unfused femur caps, and some phalanges that are not completely fused. This would suggest the presence of some juvenile animals in the herd that this was a nursery herd. Also the lack of juvenile bones may result from incomplete destruction by carnivores or the juvenile bones may have weathered more rapidly than adult bones (Behrensmeyer 1978:160). Another possibility is that because the calves are small and easy to move, people may have removed them from the site to be processed elsewhere.

I believe that Feature 14, the flat below the kill site, is the possible processing center or campsite associated with the kill site. This area contains processing tools of flakes, bifaces, unifaces, and only two projectile points. Unfortunately this area was only surveyed

and not excavated, so it has not been fully determined to be the processing area or campsite

VIII. Conclusion

I used information from the historical, ethnographic, and the archaeological records to examine how prehistoric hunters may have constructed buffalo traps and, from this, interpreted 24CA37 as a pound. I described the process of trapping, killing, and processing buffalo through interpreting the artifacts and from comparing 24CA37 to other Avonlea sites.

I defined the cultural chronology by using the relative dates from the projectile points. All the points are identified as Late Prehistoric based on their small, triangular, side-notched shape. Next, I put the points identified as Avonlea into time and space as being part of the Avonlea culture that existed on the Northwestern Plains in the Late period of A.D 750-1000.

I reconstructed the prehistoric pathways of the people who used 24CA37 by comparing it to other bison kill sites. I suggested how these people could use their environment for hunting many different types of animals and for collecting wild foods as well as for trapping bison.

I do not feel that 24CA37 is different from other Avonlea sites or other Northwestern Plains sites. I do, however, believe that 24CA37 fits in well with other Montana sites, which are mostly Late period Avonlea sites used to harvest bison. Further, these sites may represent a trend of the Avonlea culture to become more focused on bison procurement as Avonlea people moved further south from the Parkland-Grasslands regions of Canada.

I determined what are likely to be the primary and secondary contexts of the site based on the weathering patterns on the bones, the erosional processes, and the analysis of the bones elements in each feature. I found it difficult to determine if this site represents a single kill or multi-kills because of erosional damage and because of partial excavation.

To completely understand this site, 24CA37 needs to be excavated in full. A complete excavation could locate the boundaries of the bonebed, show the extent and shape of the pound, and possibly reveal post molds or decaying fences that would indicate a human-made pound. By examining

and counting all the remaining bison bones, it might be determined how many bison were killed at the site. With the additional collection of bones, there may be enough for epiphysis fusion analysis and dental eruption and wear patterns to determine the season of the kill. Also by determining the depth of the site, the bonebed and sediment levels may show if the site was used more than once. Next, it would be interesting to excavate Feature 14 to see if this is a processing site or campsite. There might be pottery, plant-processing tools, and animal remains other than bison that would show broader-based subsistence strategies that are possible in this environment. Also exotic artifacts might be found that connect 24CA37 a larger trade network.

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Feature	Skull	Mandible	Teeth	Ribs	Pelvis	Vertabra	Scapula
F-3	1	0	12	11	0	1	1
F-4 & F-6	2	0	43	5	0	12	0
F-5 & F-7	5	2	61	71	6	110	4
F-9	0	1	18	6	0	17	0
F-11	17	1	9	10	0	12	3
F-12&F-13	3	4	3	5	0	6	0

Feature	Fore Limbs	Rear Limbs	Carpals	Tarsals	Feet/Sesam.	Metapodials	Fragments
F-3	3	0	7	3	1	0	80+
F-4 & F-6	3	5	8	5	16	7	700+
F-5 & F-7	8	4	21	2	38	5	280+
F-9	0	1	3	1	0	0	100+
F-11	1	4	1	8	15	6	44+
F-12&F-13	3	1	1	1	2	1	35+

Table 1. Number of bone elements in each feature.

Element	Complete	Broken	Burned	Carnivore	Cut Marks	Blow Marks
Skull	0	34	0	3	0	0
Mandible	0	8	0	0	1	0
Teeth	59	94	10	0	2	0
Ribs	0	107	0	8	15	0
Pelvis	0	15	0	10	4	0
Scapula	0	17	0	9	4	0
Carpals	34	5	7	4	1	0
Tarsals	11	11	2	4	1	1
Meta-carp	8	7	0	3	2	0
Meta-tar	1	1	0	2	1	0
Feet	39	11	7	4	5	0
Atlas	1	2	0	1	2	0
Axis	0	0	0	0	0	0
C-vert	0	23	0	3	7	0
T-vert	0	51	0	7	10	0
L-vert	0	2	0	0	0	0
Caudal	4	0	0	0	0	0
Humerus	2	4	0	2	4	0
Radius	1	8	0	2	2	0
Olna	0	3	0	1	0	0
Femur	1	8	0	3	2	0
Tibia	2	4	0	0	2	0
Sesamoid	20	0	0	1	4	0

Table 2. Modification of bone elements.

Feature	Proj. Point	Biface	Uniface	Flake	Shatter	Cobble	Thin. Flake	Other
F-1	10	8	0	4	0	0	2	2
F-2	0	0	0	0	0	0	0	0
F-3	6	1	0	5	1	1	1	0
F-4 & F-6	17	0	0	1	2	2	0	0
F-5 & F-7	2	0	0	3	2	0	0	0
F-8	0	0	0	0	0	0	0	0
F-9	0	0	0	0	0	0	0	0
F-10	0	0	0	0	0	0	0	0
F-11	0	0	0	0	0	0	0	0
F-12&F-13	0	0	0	0	0	0	0	0
F-14	2	13	4	48	23	0	2	1
Unknown	15	0	0	0	0	0	0	0

Table 3. Number and type of stone artifacts in each feature.

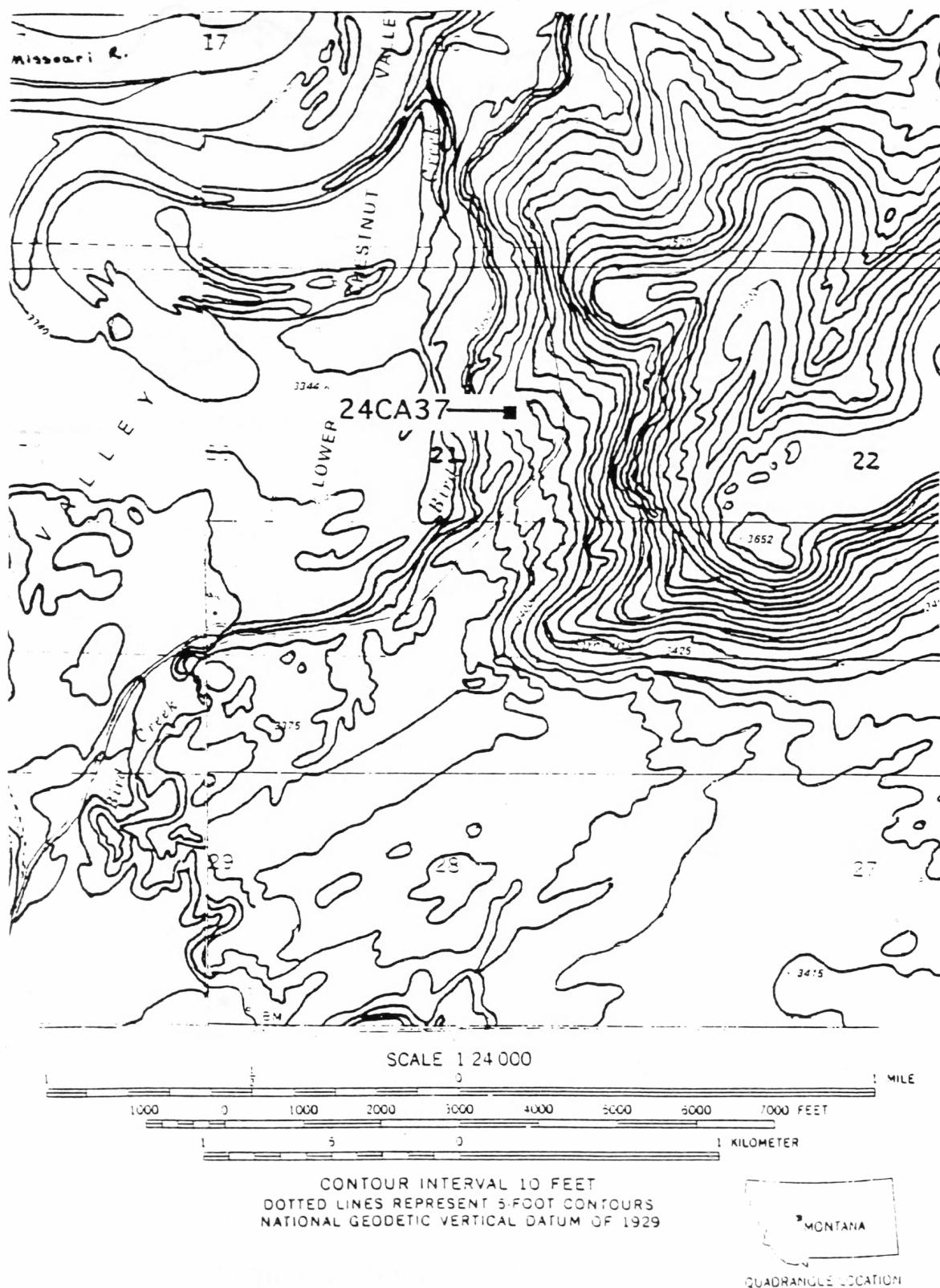


Figure 1. Location of 24CA37.

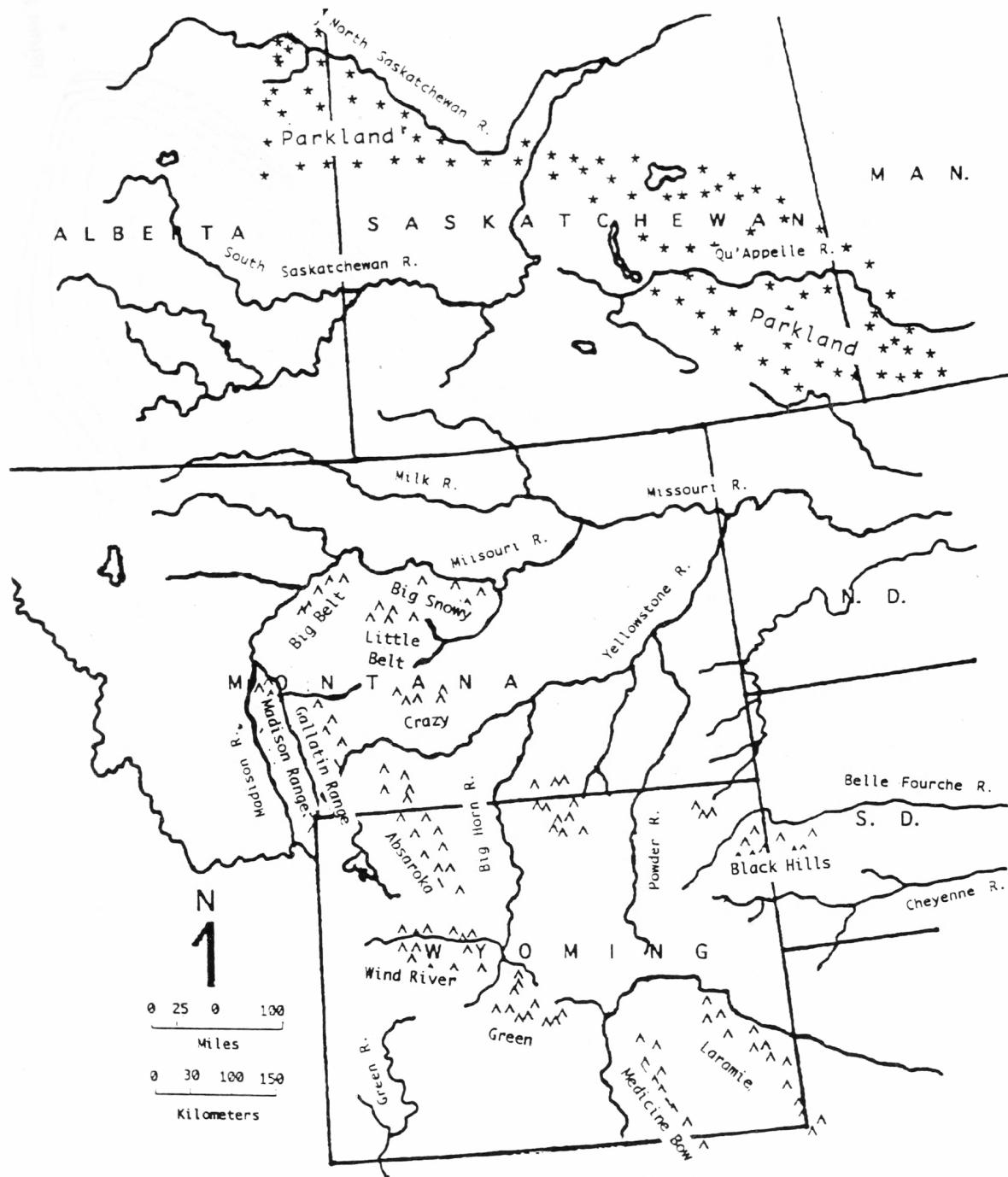
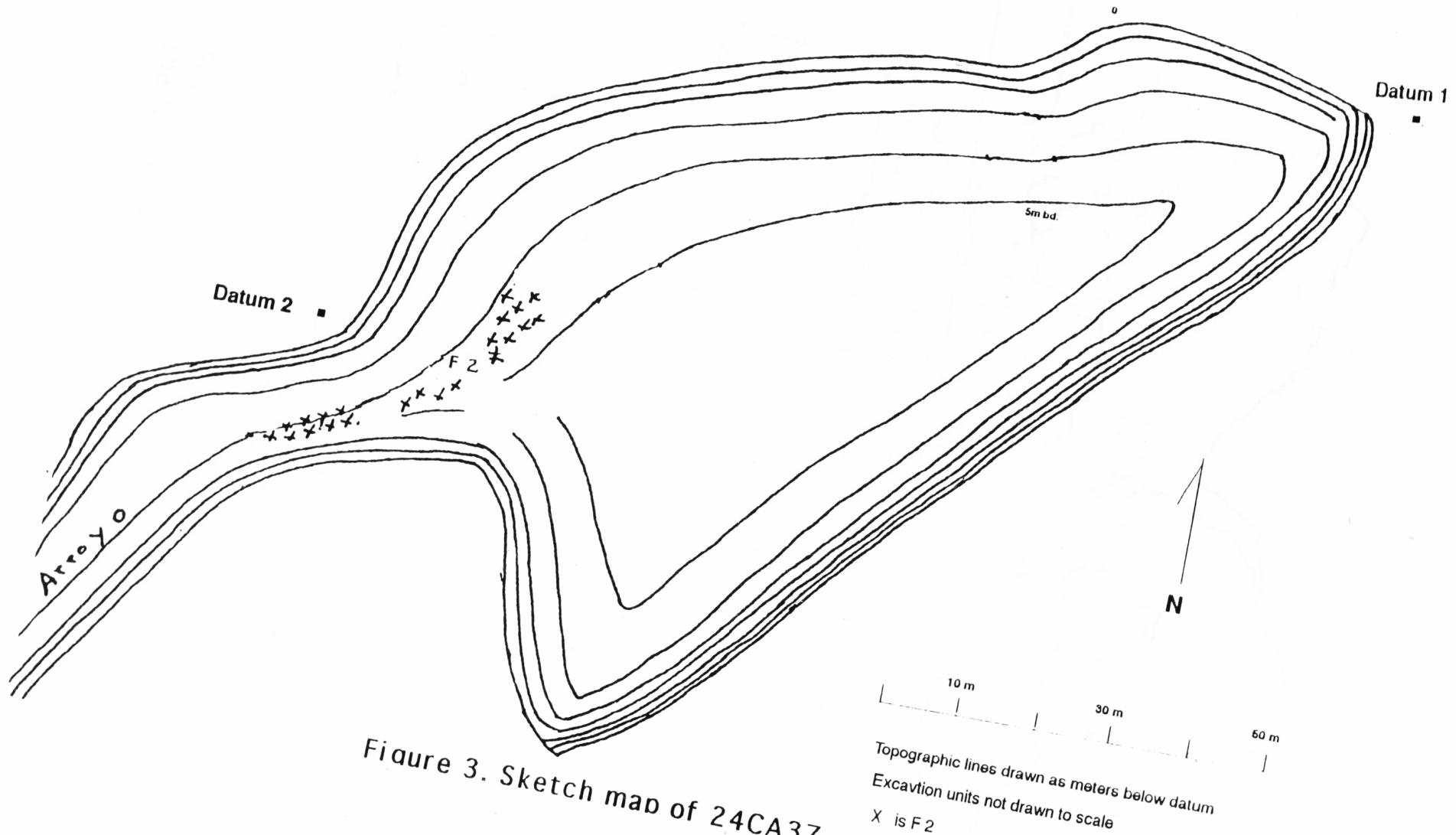


Figure 2. Northwestern Plains regional area.

F 14

24CA37



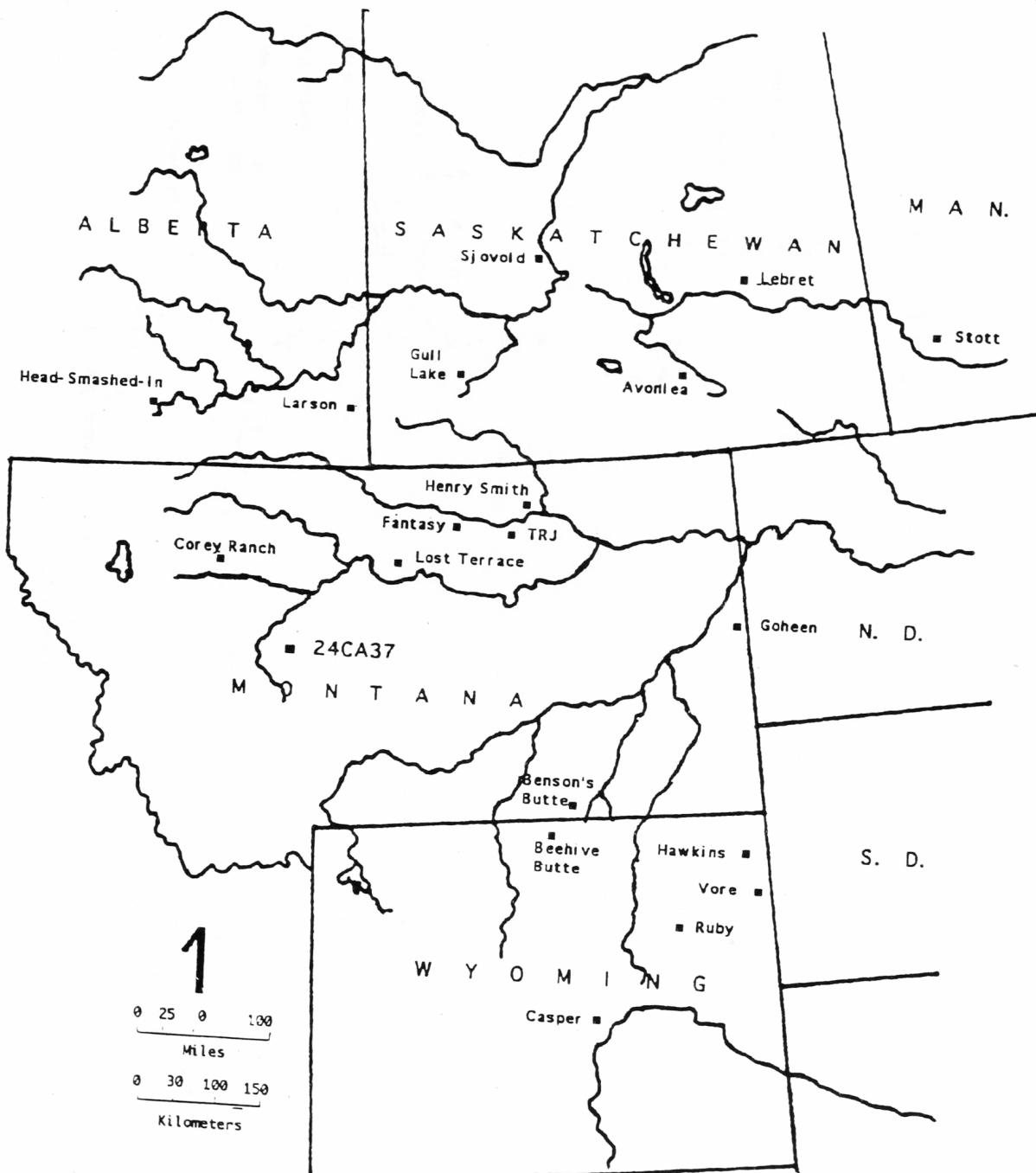


Figure 4. Archaeological sites on the Northwestern Plains.

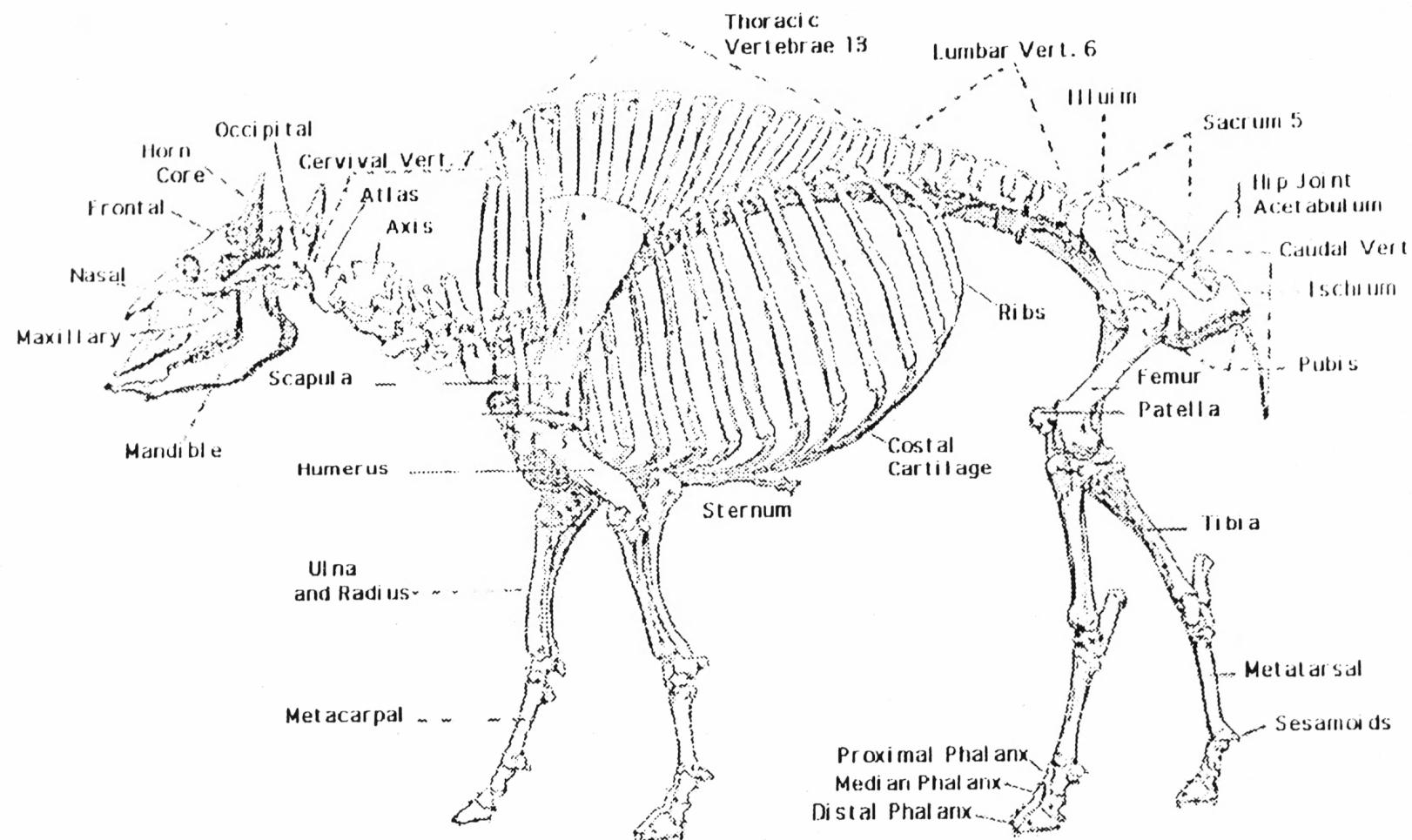


Figure 5. Adult Skeleton of an American Bison.
(Adapted from Hornaday 1914)