A FAUNAL ANALYSIS OF THE WHITING SLOUGH SITE (ElNs-10): AN AVONLEA PROCESSING SITE IN SOUTH-CENTRAL SASKATCHEWAN

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Abstract

The faunal analysis of the Whiting Slough site (ElNs-10) provides a detailed analysis of the faunal assemblage as well as the taphonomic processes that have altered the bone materials at the site. This thesis also examines what procurement strategy took place. Analysis involves (1) calculating skeletal frequencies, (2) identifying the bison herd population structure, (3) pinpointing the seasonality of the bison faunal assemblage, and (4) describing the taphonomic characteristics of the bones.

A quantitative and qualitative research design was employed. This involved the re-examination of the faunal assemblage for accuracy of counts as well as the recognition of any identifiable materials or modifications. Quantitative analysis involved accurate descriptions of bone counts for the species present as well as measuring proximal radii in order to accomplish bivariate analysis. Qualitative analysis included the examination of bison lower tooth rows for age assessment of the herd along with the description of the natural and cultural taphonomic characteristics of the faunal assemblage.

As a result of this study, it is concluded that the Whiting Slough site (ElNs-10) is a late fall or early winter single component Avonlea bison processing site located roughly 35 km southwest of Saskatoon, Saskatchewan. The bone bed has been radiocarbon dated to approximately 1325 years before present. Quantitative analysis indicates that a minimum of 54 bison are present within the assemblage. Bivariate and mandibular dentition analyses reveal a male and female herd with a homogenous age rate of x.6 being harvested. Procurement of this species likely involved the utilization of a pound or other means of containment at a kill site nearby. It is important to note the presence of a potential ceremonial feature containing the remains of a canid that is associated with bison elements many of which are cranial. This

research has provided insight on the processes that underwent prior to the construction of the unique bone features present at the site. The faunal analysis of the Whiting Slough site (ElNs-10) has contributed to the overall understanding of the Avonlea phase in Saskatchewan and the Northern Plains.

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This thesis is dedicated to the memory of my father and brother, Mark and Jim Thomson.

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Chapter 1

Introduction

1.1 Statement of Objectives

The Whiting Slough site (ElNs-10) is an Avonlea site located north of Highway 7, approximately 35 kilometers (km) southwest of Saskatoon, Saskatchewan. Initial testing of the site took place in 2013 by the cultural resource management (CRM) company, Western Heritage, in order to assess the area for significant cultural resources that might be impacted by the future project of twinning Highway 7 by the Saskatchewan Ministry of Highways and Infrastructure. Extensive shovel testing was conducted producing artifacts including an Avonlea projectile point and numerous bone materials. Additional excavations took place in the following years and as a result numerous unusual bone features were discovered. The site was radiocarbon dated to approximately 1325 years before present (BP). In 2017, the University of Saskatchewan (U of S) archaeology field school and graduate students conducted further excavations to provide a greater understanding of the site. A total of 120 square meters were excavated resulting in the recovery of 398,329 artifacts, the vast majority being identified as American bison (*Bison bison*) bone and bone fragments.

The aims of this research are twofold. The first aim of this thesis includes providing a detailed analysis of the faunal assemblage as well as the taphonomic processes that have altered the bone materials at the Whiting Slough site. This in return will assist with the second aim of the project which is to provide a greater understanding of the procurement strategy that took place. There are four objectives for this study which include: (1) calculating skeletal frequencies, (2) identifying the bison herd population structure, (3) pinpointing the seasonality of the bison faunal assemblage, and (4) describing the taphonomic characteristics of the bones.

1.2 Chapter Summary

Chapter 2 provides a site background and biophysical description of the Whiting Slough site. It includes an overview of the previous work completed, the physiography of the region as well as a description of the soils, climate, and hydrology. Contemporary flora and fauna descriptions are listed for the region.

Chapter 3 provides a cultural background of the Avonlea phase on the Northern Plains. It examines the research that has been conducted throughout North America in relation to Avonlea sites. An overview of precontact hunting strategies including bison pounds and jumps are described.

Chapter 4 provides a description of the methodology practiced while surveying, excavating, monitoring, and recording stratigraphy at the Whiting Slough site. It also includes an overview of the methods utilized while cleaning and cataloging the archaeological materials. This chapter concludes with the procedures and analysis involved with the quantitative and qualitative archaeological research that was conducted for this project.

Chapter 5 includes the results of the faunal assemblage quantitative analysis. The chapter provides an overview on the bone counts for the species present as well as weights, burned versus unburned, and the distribution of bison and non-bison elements. A discussion on the quantitative results is described and summarized.

Chapter 6 provides a background on bison population structure and seasonal movement patterns of bison. The chapter explores the quantitative and qualitative analysis involved in sexing and aging the bison population to provide seasonality at the Whiting Slough site. This is completed through bivariate analysis by measuring proximal radii as well as analyzing the

available lower dentition of bison within the collection. The chapter concludes with a discussion on the herd structure and seasonality at the Whiting Slough site.

Chapter 7 provides a taphonomic analysis of the faunal assemblage through the examination of the natural and cultural modifications that have altered the bones. A detailed discussion on what taphonomy is and why it is important in archaeology is provided. Natural taphonomic agents that are discussed include carnivore and rodent damage and disturbance, root etching, weathering, as well as pathologies and abnormalities. Cultural taphonomic agents that are discussed involve butchering, cooking, and burning. The chapter concludes with a discussion on what natural and cultural factors were involved in the formation of the Whiting Slough site.

Chapter 8 discusses the significance of the terrain surrounding the Whiting Slough site. The chapter compares the Whiting Slough site to five sites throughout central Saskatchewan including Tschetter, Fitzgerald, Gull Lake, Bakken-Wright, and the Estuary site. Historic and ethnographic accounts of pounds are examined. This is followed by a discussion, the limitations of the Whiting Slough site, and a summary.

Chapter 9 summarizes the results of the Whiting Slough site faunal analysis. This is followed by a restatement of the research aims and objectives. Conclusions from this research are provided with interpretations concerning the faunal assemblage of the Whiting Slough site.

Chapter 2

Site Background/Biophysical Resources

2.1 Location of Site

The Whiting Slough site (ElNs-10) is located in the moist mixed grassland ecoregion in the province of Saskatchewan. This ecoregion covers 11 percent of Saskatchewan and spreads from the southeastern corner of the province and diagonally northwest to the lower midsection of the Saskatchewan-Alberta border. The Whiting Slough site is located north of Highway 7, roughly 35 km southwest of Saskatoon, Saskatchewan. It is situated between two towns which include Deslile roughly 8 km to the southwest and Vanscoy around 7 km to the northeast as seen in Figure 2.1.

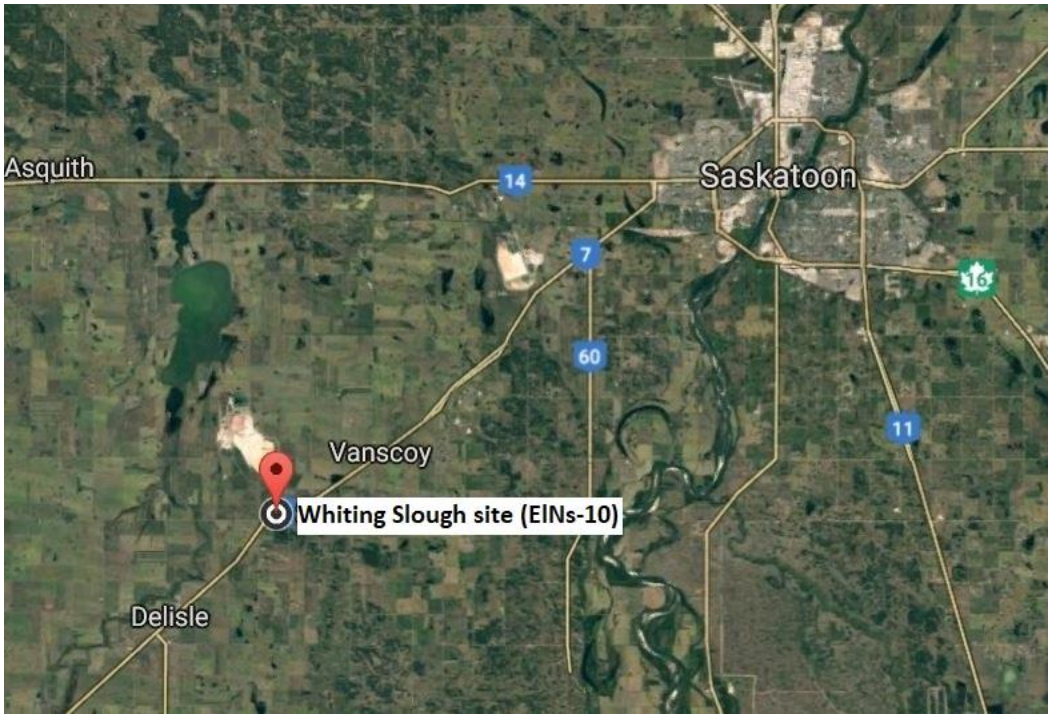

Figure 2.1 Aerial view of the Whiting Slough site in relation to Delisle, Vanscoy, and Saskatoon (Google Maps 2017)

2.2 Previous Work

Initial testing of the Whiting Slough site took place in 2013 by the CRM company, Western Heritage, in order to assess the area for significant cultural resources for the future project of twinning Highway 7 by the Saskatchewan Ministry of Highways and Infrastructure. Archaeological investigation during 2013 consisted of 16 shovel tests with emphasis around Shovel Test #227, which produced faunal material and an Avonlea point (Western Heritage 2015). In 2015, a total of 51 shovel tests were conducted throughout the general area of the site in two parallel 10 meter transects. Excavation in the form of shovel shaving took place in areas of the site where the shovel tests produced significant archaeological materials. Testing the site yielded information of a bone bed at a depth between 45-65 cm in an estimated area of 11 m x 7 m (Western Heritage 2015).

A total of 95 square meters were excavated. Quarter inch screens were utilized for recovering small artifacts and faunal fragments from the units. These materials were bagged, cleaned, and cataloged into a Microsoft Excel sheet by employees at Western Heritage. From these excavations over 300,000 bone fragments were recovered along with over 150 projectile points. In addition to these artifacts, the excavations revealed numerous bone features that appear to be aligned as well as the presence of a dark grey to black elliptical sand lens in the site's stratigraphy. Six bone samples were sent to the Laval University Radiochronology Laboratory for radiocarbon dating and results range from 1320 to 3700 BP. One of the bone samples did not have enough collagen to fulfill the requirements of dating the material therefore only five dates were produced. These dates include 1320±20 BP (ULA-6043), 1325±15 BP (ULA-6040), 1330±20 BP (ULA-6042), along with two older dates from levels above and below the occupation layer including 3645±20 BP (ULA-6053) and 3700±20 BP (ULA-6052) (see

Appendix A). It should be noted that the radiocarbon dates provided in this thesis are conventional dates with no calibration.

2.3 Physiography

The Whiting Slough site is located in the moist mixed grassland ecoregion of Saskatchewan situated between two landscape areas, K7 Goose Lake Plain and K9 Moose Wood Sand Hills as seen in Figure 2.2 (Saskatchewan Conservation Data Centre 2014; Western Heritage 2015). This ecoregion covers 6.8 million hectares of Saskatchewan and it represents the northernmost portion of the open grasslands. It is a broad plain that slopes downward towards the north and east (Acton et al. 1998). The physical landscape as well as soils of this region were formed due to last glaciation 10,000 years BP (Hammermeister 2001). As a result of the deglaciation event the ecoregion has numerous valleys, hills, sand dunes, ponds, sloughs, lakes, and rivers. The elevation of the ecoregion is between 500 and 600 m above sea level (Acton et al. 1998).

Figure 2.2 Moist mixed grassland ecoregion in light blue (W.P. Fraser Herbarium 2006)

Acton et al. (1998) describes the K7 Goose Lake Plain as a glacial lake plain that covers the area between the North Saskatchewan River west of the town of Borden and the elbow of the South Saskatchewan River. It is a region that is characterized by sand dunes due to sandy and silty glaciolacustrine deposits from the last glacial retreat. Acton et al. (1998) explains that native vegetation including grasses and shrubs are common in valleys and near waterways. Juniper can be found in areas that have less sandy soils, while aspen is found in areas where the water table is close to the surface.

Acton et al. (1998) describes the K9 Moose Wood Sand Hills as the area south of Saskatoon near the South Saskatchewan River. It is a region that is characteristic of sand dunes and it has an average elevation of 520 m above sea level. The area is characterized by sandy Regosolic soils and Dark Brown sandy loam soils. The vegetation and plant distribution is identical to the K7 Goose Lake Plain region.

2.4 Soil

The soils at the Whiting Slough site are characteristic of dark brown clay rich sediment with some sand and gravel (Western Heritage 2015). Acton et al. (1998) explains that the dominant soil in the moist mixed grasslands is a Dark Brown Chernozem due to slow rates of decomposition of organic material in the mixed grasslands. Two other common soil types are Black soil and Brown soil. The Dark Brown soil is characterized by an organic dark layer whose presence varies depending on the physiography of the area. On the tops of slopes this soil layer is thin, however, it increases in thickness lower down on the slopes where vegetation is more prominent. Black soils are high in organic matter and they are present on the lower portions of steep north-facing slopes where grasses and fescues are common. Brown soil zones are prominent in arid regions on south-facing slopes and they are lower in organic matter.

2.5 Climate

The climate in Saskatchewan fluctuates widely between the summer and winter months. The typical climate of this region is semi-arid with summer temperatures averaging around 15.5°C and winter temperatures around -11°C (W.P. Fraser Herbarium 2006). However, Lewry and Ward (2015) explain that during the summer temperatures can reach as high as 41°C. While in the winter months temperatures in Saskatchewan can be as low as -53°C. Winter begins near the end of October and lasts through to the end of March. During these months, the average snowfall is roughly 750 mm (Lewry and Ward 2015). Rainfall from May to September is 240 mm and the mean annual precipitation is 383 mm (Acton et al. 1998).

2.6 Hydrology

Hydrology in the mixed moist grasslands involves numerous bodies of water. They include rivers, streams, ponds, sloughs, and lakes that are sporadically spread across the landscape. The Whiting Slough site is a short distance from a slough which is only a few meters to the northeast. To the northwest of the site is Rice Lake which is approximately 10 km away and approximately 20 km to the east is the South Saskatchewan river which flows into the Hudson Bay. Acton et al. (1998) explain that water drainage in the moist mixed grasslands flows into the South Saskatchewan, Souris, and Qu'Appelle rivers. Glacial aquifers are spread throughout the ecoregion and promote vegetation growth (Acton et al. 1998).

2.7 Flora

Three kinds of vegetation are common in the moist mixed grasslands which are grasslands, shrublands, and woodlands. Acton et al. (1998) explains that the dominant grassland vegetation is comprised of mid-grasses such as spear grass (*Heteropogon contortus*) and wheatgrass (*Agropyron* sp.), combined with other common grasses including blue grama grass

(*Bouteloua gracilis*), Hooker's oat grass (*Avenula hookeri*), June grass (*Koeleria macrantha*), and fescues (*Festuca* sp.). Deciduous shrubs include wolf willow (*Elaeagnus commutata*), snowberry (*Symphoricarpos albus*), buckbrush (*Ceanothus cuneatus*), rose (*Rosa* sp.), chokecherry (*Prunus virginiana*), and saskatoon berry (*Amelanchier alnifolia*) (Saskatchewan Conservation Data Centre 2014; W.P. Fraser Herbarium 2006). The woodland regions are comprised of willow (*Salix* sp.), aspen (*Populus* sp.), box-elder (*Acer negundo*), and cottonwood (*Populus* sp.) (W.P. Fraser Herbarium 2006).

2.8 Fauna

The mixed moist grassland region of Saskatchewan provides a suitable habitat for numerous faunal species. Prior to human induced infrastructure, the number of animals that could be found in the Whiting Slough site region was greater. Today, animal populations are limited due to Highway 7, the towns of Delisle and Vanscoy as well as agricultural development on the surrounding plain. Therefore, the ecosystem has changed and the animals that once inhabited the area are now less common.

2.8.1 Mammalian Fauna

Animals that inhabit ecosystems characteristic of the Whiting Slough region are numerous. They include a wide range of herbivores, carnivores, and omnivores, as described by Banfield (1974) and Gilbert (1990). Ungulates that are characteristic of the mixed moist grassland ecozones include bison (*Bison bison*), pronghorn (*Antilocapra americana*), deer (*Odocoileous* sp.), moose (*Alces alces*), and wapiti (*Cervus canadensis*). Carnivores that could be expected in this region are comprised of fox (*Vulpes* sp.), coyote (*Canis latrans*), wolf (*Canis lupus*), bobcat (*Lynx rufus*), river otter (*Lutra canadensis*), striped skunk (*Mephitis mephitis*), badger (*Taxidea taxus*), wolverine (*Gulo luscus*), mink (*Mustela vison*), raccoon (*Procyon lotor*),

as well as grizzly bears (*Ursus horribilis*), and black bears (*Ursus americanus*). The white-tailed jackrabbit (*Lepus townsendii*) and the snowshoe hare (*Lepus americanus*) can be found in the region. This ecozone also attracts numerous rodents that include porcupine (*Erethizon dorsatum*), beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), western jumping mouse (*Zapus princeps*), northern bog lemming (*Synaptomys borealis*), prairie vole (*Microtus ochrogaster*), meadow vole (*Microtus pennsylvanicus*), heather vole (*Phenacomys intermedius*), gapper's red-backed mouse (*Clethrionomys gapperi*), deer mouse (*Peromyscus maniculatus*), Northern pocket gopher (*Thomomys talpoides*), red squirrel (*Tamiasciurus hudsonicus*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), Richardson's ground squirrel (*Spermophilus richardsonii*), least chipmunk (*Eutamias minimus*), and the woodchuck (*Marmota monax*). The moist mixed grasslands are also home to the big brown bat (*Eptesicus fuscus*) (Acton et al. 1998).

2.8.2 Avian Fauna

The ecology of the region provides a suitable habitat for a diverse group of bird species. There are over 190 birds that can be spotted in the mixed moist grasslands of Saskatchewan (Acton et al. 1998). Of these, only six species have been introduced. The populations of these bird species changes throughout the seasons with the majority being present during the summer (Acton et al. 1998). Some of the birds that are found in the ungrazed, grassland, or sandhill portions of the region consist of sharp-tailed grouse (*Tympanuchus phasianellus*), Sprague's pipit (*Anthus spragueii*), yellow-headed blackbird (*Xanthocephalus xanthocephalus*), Baird's sparrow (*Ammodramus bairdii*), vesper sparrow (*Pooecetes gramineus*), savannah sparrow (*Passerculus sandwichensis*), western meadowlark (*Sturnella neglecta*), horned lark (*Eremophila alpestris*), McCown's longspur (*Rhynchophanes mccownii*), chestnut-collared longspur (*Calcarius*

ornatus), eastern kingbird (*Tyrannus tyrannus*), and the piping plover (*Charadarius melodus*) (Leighton et al. 2002). There are three common owls which include the burrowing owl (*Athene curicularia*), short-eared owl (*Asio flammeus*), and the northern harrier (*Circus cyaneus*) (Acton et al. 1998). Some waterfowl bird species include the Canada goose (*Branta canadensis*), mallard duck (*Anas platyrhynchos*), and the sandhill crane (*Grus canadensis*) (Acton et al. 1998).

2.8.3 Amphibian and Reptilian Fauna

Amphibians and reptiles make up a small number of the biotic species found in the moist mixed grasslands. Acton et al. (1998) describes amphibians and reptilians in this region as the following. There are five species of snakes, two of which include the plains garter snake (*Thamnophis sirtalis*) and the prairie rattlesnake (*Crotalus viridis*). Of the six frogs and toads in the ecoregion the most common include the wood frog (*Lithobates sylvaticus*), boreal chorus frog (*Pseudacris maculata*), northern leopard frog (*Lithobates pipiens*), and the great plains toad (*Anaxyrus cognatus*). There is one common turtle and salamander in the moist mixed grasslands which are the painted turtle (*Chrysemys picta*) and the tiger salamander (*Ambystoma tigrinum*).

2.9 Summary

The moist mixed grasslands of Saskatchewan are rich in biodiversity with multiple plant and animal species inhabiting the region. The diversity in this region attracts human groups to occupy the area due to the available resources. There have been changes in the physiography and biotic nature of the moist mixed grasslands near the Whiting Slough site due to human involvement and manipulation. Therefore, modern vegetation and animal species are different to what it would have been like 1325 BP.

Chapter 3

Culture Background

3.1 Introduction

The Whiting Slough site (ElNs-10) is an Avonlea site situated in south-central Saskatchewan in the moist mixed grassland ecoregion. Archaeological excavations at the site have produced 226 projectile points that are diagnostic of the Avonlea complex (Diduck 2018). Accompanying the projectile points are 393,161 identifiable and non-identifiable animal bones and bone fragments the vast majority representing American bison (*Bison bison*). Materials such as these relate to bison kills which are common archaeological sites across the Northern Plains. Late Precontact groups including the Avonlea people had several methods in which they could employ to procure bison. This section will provide an overview of the Avonlea complex and the research that has been conducted concerning Late Precontact bison procurement strategies on the Northern Plains.

3.2 Avonlea Complex

The Avonlea complex has a temporal range on the Northern Plains that extends from 1800 to 1150 BP. During this time on the Plains, there were changes in projectile styles reflecting changes in hunting techniques. Avonlea marks a transition from large dart tip projectiles to small bow and arrow points and the addition of large communal hunting strategies. This complex is represented by a small thin delicate triangular side notch projectile point with a concave base, as seen in Figure 3.1 (Diduck 2018). Other characteristics of the Avonlea complex includes the use of a variety of pottery styles. These pottery styles include Avonlea Plain ware, Truman Parallel Grooved ware, Ethridge ware, and Net/Fabric Impressed ware (Meyer and Walde 2009). Features common among Avonlea archaeological sites are basin shaped hearths

filled either with rocks or ash and bone (Meyer and Walde 2009). Avonlea projectile points are frequently associated with bison kill sites (Kehoe and McCorquodale 1961).

Figure 3.1 Avonlea point (Western Heritage 2015)

The complex receives its name from the type site (EaNg-1) located near the town of Avonlea in south-central Saskatchewan (Kehoe and McCorquodale 1961). Initial excavations at the Avonlea site took place in the fall of 1956 by McCorquodale, Swanston, and Hudson and it was revisited in 1984 (Kehoe et al. 1988). The site produced numerous lithic artifacts, pottery, and bison remains. These researchers concluded from the archaeological materials recovered and the characteristics of the geography of the area that EaNg-1 was a single component bison drive kill site. Radiocarbon samples from a hearth feature dated the occupation to 1500±100 BP (S-45) (Kehoe et al. 1988).

3.3 Avonlea Site Distribution

The Avonlea complex is distributed over a significant percent of the Northern Plains, occupying portions of Saskatchewan, Alberta, Manitoba, Wyoming, Montana, North Dakota, and South Dakota, as seen in Figure 3.2. This section will provide an overview of the research completed in these regions.

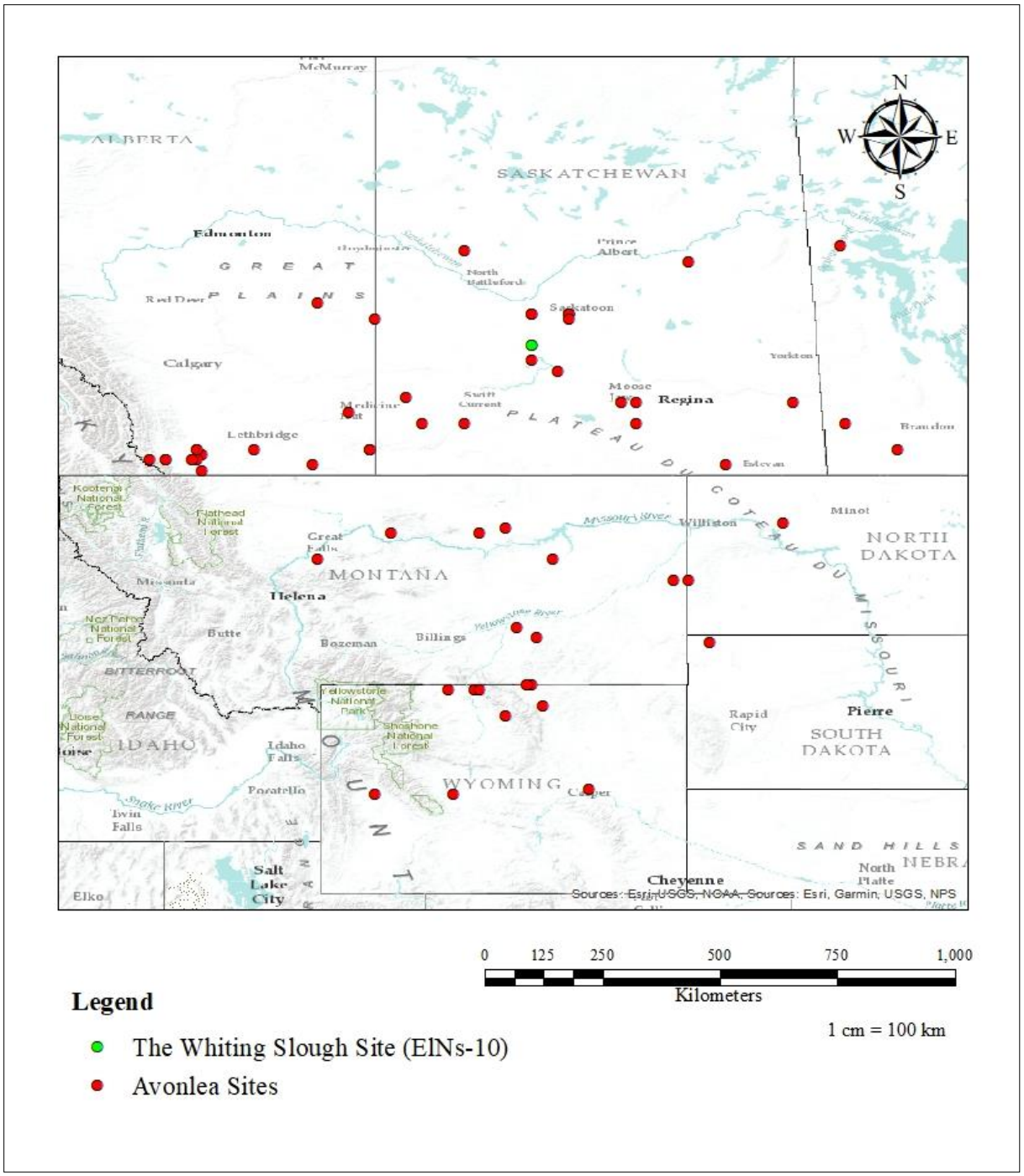

Figure 3.2 Distribution of Avonlea sites across North America discussed in this chapter

3.3.1 Northern Saskatchewan

Avonlea sites are distributed widely throughout Saskatchewan, reaching as far north as the Saskatchewan Forks region in the southern portion of the mixedwood forest ecoregion

(Meyer et al. 1988). The most northern Avonlea site in Saskatchewan is the Yellowsky site, located on the east side of Turtle Lake. This site produced lithic artifacts, pottery, along with bison bones and two dates of 720±135 BP (S-2299) and 420±140 BP (S-2300) (Martindale et al. 2016; Meyer et al. 1988). The Nipawin region of east-central Saskatchewan contains seven sites that produced Avonlea projectile points, including: Mineral Creek, Ens Creek, Lewis, Gravel Pit, Mollberg, Wallington Flat, and the Orviak site (Cloutier 2004; Martindale et al. 2016; Meyer et al. 1988). Of these sites, the only one that has radiocarbon dates is the Gravel Pit site with dates of 425±145 BP (S-2354) and 895±135 BP (S-2355) (Martindale et al. 2016). Fauna recovered from northern Avonlea sites tend to include the remains of fish and migratory spring and summer waterfowl which relate to spring and fall occupations. Meyer et al. (1988) recognize that the pottery recovered from these sites is indicative of warmer-weather occupations since it is difficult to construct pottery vessels in wintering months.

3.3.2 Southern Saskatchewan

In southern Saskatchewan Avonlea sites continue to be common. A total of 24 sites have been recorded which include: the Gull Lake, Bakken-Wright, Rousell, Camp Rayner, Verlo, Cherry Lake, Avonlea, EaOh-23, Newo Asiniak, Long Creek, Lebret, Sjovold, Amisk, Peg, FbNp-1, Garratt, Hartley, Estuary, Goosen Pasture, Klein, Ardath, Kyle, Chamberlain, and Bethune sites (Frison 1978b; Kehoe and McCorquodale 1961; Martindale et al. 2016; Smith and Richards 1987; Smith and Walker 1988). A summary of Avonlea sites with dates in Saskatchewan is shown in Table 3.1.

Table 3.1 Saskatchewan Avonlea sites with dates

Site Name	Date	Reference
Yellowsky (FjOd-22)	720±135 BP (S-2299) 420±140 BP (S-2300)	Martindale et al. 2016; Meyer et al. 1988
Gravel Pit (FhNa-61)	425±145 BP (S-2354) 895±135 BP (S-2355)	Martindale et al. 2016
Gull Lake (EaOd-1)	1740±60 BP (S-255) 1290±60 BP (S-254)	Kehoe 1973
Rousell (FbNs-2)	1185±70 BP (S-670)	Morlan et al. 2002
Camp Rayner (EgNr-2)	1680±110 BP (S-1318)	Martindale et al. 2016
Avonlea (EaNg-1)	1500±100 BP (S-45)	Kehoe et al. 1988
EaOh-23	1170±40 BP (Beta-290600)	Martindale et al. 2016
Newo Asiniak (FbNp-16)	995±75 BP (S-2533)	Martindale et al. 2016
Lebret (EeMw-26)	1260±115 BP (S-2691) 1715±105 BP (S-2797)	Martindale et al. 2016; Smith 1986
Sjovold (EiNs-4)	1460±200 BP (S-1762) 1460±190 BP (S-1763)	Martindale et al. 2016
Amisk (FbNp-17)	560±70 BP (S-2531) 905±155 BP (S-2537)	Martindale et al. 2016
Peg (DiMv-61)	1305±85 BP (S-2968)	Martindale et al. 2016
FbNp-1	1260±60 BP (Beta-70705)	Martindale et al. 2016
Garratt (EcNj-7)	1280±60 BP (S-408)	Martindale et al. 2016
Estuary (EfOk-16)	1190±165 BP (S-641)	Adams 1977
Goosen Pasture (FbNs-19)	1095±110 BP (S-2690)	Smith and Richards 1987
Hartley (FaNp-19)	1200±65 BP (S-3382)	Hanna 2007
Bethune (EeNg-6)	1389±40 BP (S-1575)	Dawson and Walker 1988

There are six Avonlea bison kill sites in southern Saskatchewan: Gull Lake, Bakken-Wright, Rousell, Verlo, Cherry Lake, and the Avonlea site (Frison 1978b; Kehoe 1973; Kehoe and McCorquodale 1961). The Gull Lake site in southwestern Saskatchewan is a communal bison drive kill site with dates of 1740±60 BP (S-255) and 1290±60 (S-254) (Frison 1978b; Kehoe 1973). Animals were directed into a steep naturally formed slumped area where they became trapped and dispatched by hunters (Frison 1978b). The Bakken-Wright site is a bison drive which has no accompanying dates and is located near Bracken, Saskatchewan in the Frenchman's River valley (Kehoe and McCorquodale 1961). The Rousell site is situated in the Dunfermline Sand Hills and has a date of 1185±70 BP (S-670) (Dyck 1972; Morlan et al. 2002).

Dyck (1972) suggests, due to the types of faunal materials recovered, that this site was once a bison pound. Both the Verlo and Cherry Lake sites are bison kills, however, they lack radiocarbon dates. The Avonlea site as previously discussed is a bison drive kill site and dates to 1500±100 BP (S-45).

There are 11 multicomponent, Avonlea habitation sites and they include: Long Creek, Lebret, Newo Asiniak, Camp Rayner, Hartley, Sjovold, Amisk, Peg, FbNp-1, Garratt, and the Estuary site (Hanna 2007; Martindale et al. 2016; Smith and Walker 1988). The Long Creek site level 2 produced two Avonlea projectile points, although, there is no corresponding radiocarbon date. Smith and Walker (1988) describe the Lebret site as a spring or fall site dating around 1260±115 BP (S-2691) and 1715±105 BP (S-2797) (Martindale et al. 2016; Smith 1986). The Avonlea occupation is comprised of projectile points, lithics, fire-cracked rock (FCR), pottery, and faunal remains. Faunal remains include waterfowl, fish, bison, deer, river otter, and lagomorphs. The diversity of wild game at this site indicates that in the Parkland region during seasonal rounds these people did not entirely rely on bison herds for subsistence, but somewhat surprisingly also incorporated fish into their diet (Smith and Walker 1988). There are two multicomponent bison processing sites in southern Saskatchewan and they are EaOh-23 and Newo Asiniak. EaOh-23 has a date of 1170±40 BP (Beta-290600) and the Newo Asiniak site which produced an Avonlea projectile point has a date of 995±75 BP (S-2533) (Martindale et al. 2016). The Camp Rayner site is a multicomponent camp and bison kill site that has an Avonlea occupation that dates to 1680±110 BP (S-1318) (Martindale et al. 2016). The Hartley site is a multicomponent bison kill and habitation site that dates to 1200±65 BP (S-3382) (Hanna 2007). The remaining multicomponent sites are Sjovold, Amisk, Peg, FbNp-1, Garratt, and the Estuary site as shown in Table 3.1 (Adams 1977; Martindale et al. 2016).

The Goosen Pasture site is a single component Avonlea site in southern Saskatchewan. Smith and Richards (1987) have provided a radiocarbon date of 1095±110 BP (S-2690) for the Goosen Pasture site. They explain that the faunal materials from this site are predominantly bison with a few small unidentifiable rodent remains that may not be intrusive. Also, sherds from a net-impressed ceramic vessel were recovered along with a few lithic tools and debitage, including scrapers and unifaces.

Of the 24 Avonlea sites in southern Saskatchewan there is one burial which is the Bethune site. The Bethune burial has been dated to 1389±40 BP (S-1575) and it involves several individuals and one Avonlea projectile point (Dawson and Walker 1988).

Sites that produced Avonlea style projectile points which lack radiocarbon dates include Klein, Ardath, Kyle, and Chamberlain (Kehoe and McCorquodale 1961).

3.3.3 Alberta

In Alberta, Avonlea sites extend as far west as the Alberta foothills and the Kootenay Trench region (Cloutier 2004; Reeves 1983a, 1983b). There are 18 sites which include: Head-Smashed-In, Upper Kill, Hardisty Bison Pound, Ross Creek, Ramillies, Larson, Manyfingers, DjOu-81, Morkin, Trout Creek, Kenney, Crowsnest Dance Hall, DjPm-100, DjPl-11, DjPm-44, DjPm-115, DgPl-85, and EcOs-41 sites (Milne 1988; Tratebas and Johnson 1988). Sites with dates are shown in Table 3.2.

Table 3.2 Alberta Avonlea sites with dates

Site Name	Date	Reference
Head-Smashed-In (DkPj-1)	1860±120 BP (GaK-1475) 1000±110 BP (RL-256)	Peck 2011
Upper Kill (DlPd-1)	935±30 BP (GX-2295)	Byrne 1973; Martindale et al. 2016
Hardisty Bison Pound (FdOt-31)	1170±40 BP (Beta-272350) 1090±40 BP (Beta-272351) 1100±40 BP (Beta-272352) 956±40 BP (BGS-2915)	Martindale et al. 2016
Ross Creek (DlOn-2)	1180±140 BP (GSC-1296)	Milne 1988
Ramillies (EcOr-35)	1045±65 BP (S-1015)	Martindale et al. 2016
Larson (DlOn-3)	1270±80 BP (AECV-298C) 1210±80 BP (AECV-299C) 1420±150 BP (GX-9395A) 1140±90 BP (AECV-300C) 1165±125 BP (GX-9396G)	Milne 1988
Manyfingers (DhPj-31)	1180±85 BP (S-865) 1155±90 BP (S-866)	Martindale et al. 2016; Quigg 1988
DjOu-81	1450±90 BP (Beta-19806)	Martindale et al. 2016
Morkin (DlPk-2)	1270±130 BP (GX-2294) 640±210 BP (GX-2058) 1285±90 BP (GX-2057)	Byrne 1973; Martindale et al. 2016
Trout Creek (DlPk-3)	1405±120 BP (GX-1190)	Martindale et al. 2016
Kenney (DjPk-1)	1460±110 BP (GaK-1354) 700±60 BP (S-271)	Martindale et al. 2016
Crowsnest Dancehall (DjPp-3)	250±110 BP (RL-360)	Martindale et al. 2016
DjPm-100	1070±90 BP (AECV-1188C) 310±120 BP (AECV-1194C) 810±90 BP (AECV-1364C)	Martindale et al. 2016
DjPl-11	1530±90 BP (AECV-1365C)	Martindale et al. 2016
DjPm-44	1630±480 BP (AECV-735C)	Martindale et al. 2016

Bison kill sites include Head-Smashed-In, Upper Kill, Hardisty Bison Pound, Ross Creek, and the Ramillies site. Head-Smashed-In is a multicomponent communal bison jump with an Avonlea occupation that has dates of 1860±120 BP (GaK-1475) and 1000±110 BP (RL-256) (Brink 2008; Peck 2011; Reeves 1983a, 1983b). The Upper Kill site is a bison kill site that has a date of 935±30 BP (GX-2295) (Byrne 1973; Martindale et al. 2016). The Hardisty Bison Pound site is an Avonlea bison pound with crushed bone pits, bone uprights, and a bison skull burial at

the entrance of the pound (Moors 2017). It has dates of 1170±40 BP (Beta-272350), 1090±40 BP (Beta-272351), 1100±40 BP (Beta-272352), and 956±40 BP (BGS-2915) (Martindale et al. 2016). Currently there is no other published information on this site. The Ross Creek site is a bison kill site that dates to 1180±140 BP (GSC-1296) and the Ramillies is a multicomponent bison kill campsite with a date of 1045±65 BP (S-1015) (Martindale et al. 2016; Milne 1988).

Single component Avonlea sites include: Larson, Manyfingers, and the DjOu-81 site. The Larson site is a single component late winter Avonlea campsite situated on a terrace in the valley of Ross Creek with dates of 1270±80 BP (AECV-298C), 1210±80 BP (AECV-299C), 1420±150 BP (GX-9395A), 1140±90 BP (AECV-300C), and 1165±125 BP (GX-9396G) (Milne 1988). It was excavated in 1982 and produced materials such as stone boiling pits, roasting pits, an unprepared hearth, FCR, projectile points, lithic tools, lithic debitage, and the remains of bison, canid, mustelid, swift fox, and duck (Milne 1988). The Manyfingers site is a processing campsite situated in the Belly River Valley and has dates of 1180±85 BP (S-865) and 1155±90 BP (S-866) (Martindale et al. 2016; Quigg 1988). This site produced projectile points, lithic tools, FCR, bison remains, and pottery (Quigg 1988). Another single occupation Avonlea campsite is DjOu-81 and it has a date of 1450±90 BP (Beta-19806) (Martindale et al. 2016).

Multicomponent Avonlea sites include: the Morkin, Trout Creek, Kenney, Crowsnest Dance Hall, DjPm-100, DjPl-11, and DjPm-44 site. The Morkin site is a multicomponent campsite that has dates of 1270±130 BP (GX-2294), 640±210 BP (GX-2058), and 1285±90 BP (GX-2057) (Byrne 1973; Martindale et al. 2016). On the opposite side of the creek to the north from the Morkin site is the Trout Creek site with a date of 1405±120 BP (GX-1190) (Martindale et al. 2016). The Kenney site produced two Avonlea points along with 26 Besant points and it has dates of 1460±110 BP (GaK-1354) and 700±60 BP (S-271) (Martindale et al. 2016).

Crowsnest Dance Hall site is a multicomponent site that has an Avonlea occupation with a date of 250±110 BP (RL-360) (Martindale et al. 2016). The remaining multicomponent campsites are DjPm-100, DjPl-11, and DjPm-44 as presented in Table 3.2 (Martindale et al. 2016).

Sites that have Avonlea projectile points however lack accurate dates include: DjPm-115, DgPl-85, and EcOs-41 (Martindale et al. 2016).

3.3.4 Manitoba

Manitoba has four Avonlea sites including: Pas Reserve, Miniota, Avery, and the Stott site, along with producing numerous Avonlea surface finds in the Swan River Valley region (Cloutier 2004; Joyes 1988). A summary of Manitoba Avonlea sites with dates is shown in Table 3.3. The Pas Reserve site is the most northern Avonlea site on the Northern Plains, located in boreal forest zone of western Manitoba alongside the Saskatchewan River (Joyes 1988; Meyer et al. 1988). It is a multicomponent site with Avonlea pottery types and produced a date of 1330±100 BP (A-1294) which correlates well with the Avonlea period (Joyes 1988). The Miniota site is a single occupation campsite with a mid-November and late April seasonality located in southwestern Manitoba near the Assiniboine River with radiocarbon dates of 1340±90 BP (Beta-58904), 970±90 BP (Beta-58907), 1620±75 BP (BGS-1791), and 1640±75 BP (BGS-1792) (Landals et al. 2004; Martindale et al. 2016; Nicholson 2005). It has produced numerous artifacts such as pottery, stone tools, faunal remains, and bone tools (Landals et al. 2004). Both the Avery and Stott sites are positioned near the Aspen Parkland zone of southwestern Manitoba. Joyes (1988) describes the Avery site as a multicomponent campsite with an Avonlea component that represents 39 of the 212 projectile points recovered. The lithic assemblage includes split pebble end scrapers, asymmetrical lanceolate bifaces, flake butt drills, and fabric-impressed pottery. The site is suggested to have been occupied during late fall - early winter due to the lack

of fetal bison remains at the site. No radiocarbon date has been recorded. The Stott site is an extensive camp and processing site occupying an area of 100 acres and produced 10 Avonlea projectile points (Joyes 1988). No calibrated radiocarbon dates that are associated with the Avonlea projectile points are available for the Stott site.

Table 3.3 Manitoba Avonlea sites with dates

Site Name	Date	Reference
Pas Reserve (FkMh-5)	1330±100 BP (A-1294)	Joyes 1988
Miniota (EaMg-12)	1340±90 BP (Beta-58908) 970±90 BP (Beta-58907) 1620±75 BP (BGS-1791) 1640±75 BP (BGS-1792)	Landals et al. 2004; Martindale et al. 2016; Nicholson 2005

3.3.5 Montana

There are 16 Montana Avonlea sites which include: 24WX23, Goheen, Benson's Butte, Lookout Point, Colt 45 Rockshelter, Bill Greene, Split-Rock Ridge, First Peoples Buffalo Jump, Fantasy, TRJ, Beaver Bend, Lost Terrace, Henry Smith, Visborg, Cove Creek, and a Garfield County burial site (Davis et al. 2017; Ruebelman 1988; Tratebas and Johnson 1988). Table 3.4 represents Montana sites. Farley (1988) explains that archaeological survey took place in eastern Montana in 1977 and 1979 and as a result two sites were discovered, 24WX23 and Goheen. The 24WX23 site produced a date of 1380±80 BP (WSU-2387) along with a single Avonlea projectile point and a hearth fill (Martindale et al. 2016). The Goheen site produced numerous projectiles, lithics, and faunal remains, along with four dates, one of which was rejected due to potential contamination, including; 1270±60 BP (WSU-2381B), 1080±90 BP (WSU-2382), 1240±60 BP (Beta-8971), and the rejected date of 1510±90 BP (WSU-2381). Seasonality of the site was based on the bison faunal remains which placed it in mid to late winter. Benson's Butte site is a multicomponent campsite with a date of 1769±235 BP (TX-3112) (Fredlund 1988; Martindale et al. 2016). The numerous artifacts recovered include bone tools, flake tools,

cooking pits, and Avonlea projectile points (Fredlund 1988). Lookout Point is a single occupation campsite that yielded one Avonlea projectile point with dates of 1310±155 BP (GX-10077), 1340±140 BP (GX-10079), and 1310±140 BP (GX-10080) (Fredlund 1988). Colt 45 Rockshelter is a multicomponent rockshelter that produced one Avonlea-like projectile point and dates of 1217±164 BP (GX-2558) (Fredlund 1988; Martindale et al. 2016). The Bill Greene site is another rockshelter with an Avonlea-like projectile point dating to 1280±55 BP (SI-103) (Fredlund 1988; Martindale et al. 2016). Split-Rock Ridge is an Avonlea site with a radiocarbon date of 1190±40 BP (Beta-133901) (Martindale et al. 2016).

Table 3.4 Montana Avonlea sites with dates

Site Name	Date	Reference
24WX23	1380±80 BP (WSU-2387)	Farley 1988; Martindale et al. 2016
Goheen (24WX30)	1270±60 BP (WSU-2381B) 1080±90 BP (WSU-2382) 1240±60 BP (Beta-8971)	Farley 1988; Martindale et al. 2016
Benson's Butte (24BH1726)	1769±235 BP (TX-3112)	Fredlund 1988; Martindale et al. 2016
Lookout Point (24RB1007)	1310±155 BP (GX-10077) 1340±140 BP (GX-10079) 1310±140 BP (GX-10080)	Fredlund 1988
Colt 45 Rockshelter (24RB1012)	1217±164 BP (GX-2558)	Fredlund 1988; Martindale et al. 2016
Bill Greene (24BH253)	1280±55 BP (SI-103)	Fredlund 1988; Martindale et al. 2016
Split-Rock Ridge (24GF423)	1190±40 BP (Beta-133901)	Martindale et al. 2016
First Peoples Buffalo Jump (24CA1012)	805±90 BP (A-7104) 570±90 BP (A-7105) 1000±80 BP (A-7106)	Martindale et al. 2016
Henry Smith (24PH794)	1120±100 BP (RL-1512) 1040±100 BP (RL-1514) 1100±110 BP (RL-1515)	Martindale et al. 2016; Wilson 1988

There are six Avonlea bison kill sites in Montana. The First Peoples Buffalo Jump is a bison kill with dates of 805±90 BP (A-7104), 570±90 BP (A-7105), and 1000±80 BP (A-7106) (Martindale et al. 2016). The remaining five sites as described by Tratebas and Johnson (1988)

all reside in the Milk River drainage. The Fantasy site is comprised of a large bone bed, camp area, and processing site, and has no calibrated radiocarbon date available. Due to the large size of the kill site and burned bone being only present on the top layer Tratebas and Johnson (1988) claim that it could have been utilized on separate occasions within a relatively short time period. They also describe materials recovered from the site to include a range of lithic tools, projectile points, bison, and some pottery. The Beaver Bend site is a multicomponent bison pound site with an associated camp area. Avonlea projectile points were recovered from the kill site along with Late Plains Side Notch and Prairie Side Notch points. The TRJ site is comprised of a naturally formed pound along with a camp area. The site produced Avonlea projectile points, numerous lithics and bifacial tools, a grinding stone, a bone awl, bone tool fragments, and pottery. Both the Beaver Bend site and TRJ site have no accompanying dates. The Lost Terrace site consists of a pronghorn communal kill (Davis and Fisher 1988). Davis and Fisher (1988) note that those who utilized Avonlea projectile points were exceptional hunters and hypothesize that the addition of bison to pronghorn could correspond to stress due to an alteration in climatic conditions. The Henry Smith site is unique in that it is a bison kill site with two accompanying anthropomorphic effigy features (Ruebelmann 1988). Among the effigy features are 21 tipi rings, six rock cairns, six drive lanes, and a naturally formed oval bison pound within the Milk River drainage valley. Excavations at the site produced over 400 projectile points, with nearly 300 being classified as Avonlea. Among the lithics artifacts include hundreds of stone choppers, knives, and miscellaneous flaked processing tools (Ruebelmann 1998). Radiocarbon dates retrieved from the bison kill bone bed at this site are 1120±100 BP (RL-1512), 1040±100 BP (RL-1514), and 1100±110 BP (RL-1515) (Wilson 1988; Martindale et al. 2016).

There is no date for the Visborg site, however, it has produced 165 projectile points that are in the style of Avonlea (Frison 1988). Associated artifacts include grooved sandstone abraders, broken manos, a grinding slab, bone tools, drilled shell disks, bone beads, and a variety of faunal remains such as bison, pronghorn, deer, and jackrabbit (Frison 1988). The Cove Creek site is another Avonlea site that lacks a date.

In Garfield County a burial with a cache of 21 Avonlea projectile points and dentalium shells was explored by collectors, however, today the remains are lost (Fraley 1988).

3.3.6 Wyoming

There are 12 sites in Wyoming including: Beehive Butte, Medicine Lodge Creek, Shiprock, Biscuit Butte, Mangus, Wortham Shelter, Granite Creek Rockshelter, Wardell, Woodard, Irvine, Billy Creek, and the Leath Burial site (Frison 1988; Kornfeld et al. 2010). Table 3.5 provides a summary of Wyoming sites with dates.

Table 3.5 Wyoming Avonlea sites with dates

Site Name	Date	Reference
Medicine Lodge Creek (48BH499)	1760±100 BP (RL-377)	Frison et al. 1986; Frison 1988
Magnus	1070±70 BP (SI-100)	Husted 1991; Frison et al. 1986; Kornfeld et al. 2010
Wortham Shelter (48BH730)	1230±70 BP (TX-2716) 1230±90 BP (TX-2715)	Davis et al. 2017
Granite Creek (48BH330)	1230±90 BP (RL-387)	Frison 1988; Martindale et al. 2016
Wardell (48SU302)	1580±110 BP (RL-1070) 990±100 BP (RL-103) 1170±100 BP (RL-111)	Frison 1988; Martindale et al. 2016
Woodard (48FR528)	1160±110 BP (RL-1070)	Frison 1988; Martindale et al. 2016
Irvine (48CO302)	1300±100 BP (RL-1413)	Frison 1988; Martindale et al. 2016

Sites in this region tend to be located on buttes. There is uncertainty of whether these locations were selected for their defensive position, viewing the surrounding area, or both

(Kornfeld et al. 2010). The Beehive Butte site is a multicomponent site with an Avonlea occupation with no calibrated radiocarbon date (Frison 1988; Kornfeld et al. 2010). Both the Medicine Lodge Creek site and the Shiprock site are located near one another and have an Avonlea occupation (Frison 1988). The Medicine Lodge Creek site has a radiocarbon date of 1760±100 BP (RL-377) (Frison et al. 1986; Frison 1988). This site has also produced Avonlea style projectile points, bison bones, debitage, a broken mano, grinding slabs, and a grooved sandstone abrader (Frison et al. 1986; Frison 1988). Shiprock has no calibrated radiocarbon date and has a few nearly complete Avonlea style projectile points, a grooved sandstone abrader, and a deer metapodial awl (Frison 1988). The Biscuit Butte site produced Avonlea style projectile points and no calibrated radiocarbon dates (Frison 1988). The Magnus site is a multicomponent rockshelter in Bighorn Canyon that produced Avonlea points and has a radiocarbon date of 1070±70 BP (SI-100) (Husted 1991; Frison et al. 1986; Kornfeld et al. 2010). Wortham Shelter produced two radiocarbon dates of 1230±70 BP (TX-2716) and 1230±90 BP (TX-2715) which were retrieved from the sinew of a bighorn sheep that was still present on two complete points (Davis et al. 2017). Frison (1988) describes the Granite Creek site, the Wardell site, the Woodard site, and the Irvine site as the following. Granite Creek Rockshelter is a multicomponent site with a radiocarbon date of 1230±90 BP (RL-387) (Frison 1988). The Wardell site is an early fall bison pound and processing site located near the Green River, with dates of 1580±110 BP (RL-1070), 990±100 BP (RL-103), and 1170±100 BP (RL-111) (Frison 1988; Marindale et al. 2016). Numerous features and artifacts were recovered from this site, including pottery, lithic tools, FCR, Avonlea projectile points, stone cooking pits, and stone heating pits. The Woodard site produced projectile points diagnostic of Avonlea and has a radiocarbon date of 1160±110 BP (RL-1070) (Frison 1988; Martindale et al. 2016). Artifacts recovered from this site involve a

large quantity of debitage, some pottery, as well as, bison, deer, pronghorn, and rabbit remains. The Irvine site has a radiocarbon date of 1300±100 BP (RL-1413) and has numerous artifacts which include a wide array of lithic and bone tools (Frison 1988; Martindale et al. 2016). There is also an exceptional collection of drilled adornments and decorative items fashioned from antler, shell, and bone of a variety of fauna. Faunal remains at this site are representative of bison, jackrabbit, deer, pronghorn, elk, and freshwater clams.

There are two Avonlea burial sites in Wyoming and these include, the Billy Creek site and the Leath Burial site, both of which lack any radiocarbon dates (Frison 1988). The Billy Creek burial contains the remains of six individuals with 110 Avonlea projectile points, five flake tools, multiple bone beads, four shell pendants, one grooved sandstone abrader, and a broken deer antler tine (Frison 1988). The Leath Burial consists of one individual buried with 26 Avonlea projectile points, 2 drilled disks, and 72 bone beads (Frison 1988).

3.3.7 North Dakota and South Dakota

In North and South Dakota, the number of Avonlea sites tapers off. A total of three sites and numerous surface finds are present among these states, including: the Evans site, the Lightning Spring site, and the Ludlow Cave site. A summary of Avonlea sites with dates in North and South Dakota is shown in Table 3.6. North Dakota is home to the Evans site which is a multicomponent campsite with dates of 1200±85 BP (I-7565) and 1360±85 BP (I-7566) (Cloutier 2004; Quigg 1988; Martindale et al. 2016). South Dakota yields the Lightning Spring site which dates to 1660±80 BP (TX-4086), however, researchers believe that this date is too early suggesting that the sample being dated may have been contaminated (Cloutier 2004; Fraley 1988; Martindale et al. 2016). Hannus and Nowak (1988) indicate that there is evidence of an Avonlea aspect within the multicomponent Ludlow Cave site which is in South Dakota. The site

was unstratified therefore making it difficult to delineate the Avonlea occupation. Consequently, the Avonlea occupation lacks a date as well as specific correlations to artifacts from the site, outside of projectile points. Other evidence of Avonlea occupation in South Dakota comes from surface finds in the White River Badlands and the Coteau de Missouri region (Hannus and Nowak 1988).

Table 3.6 North Dakota and South Dakota Avonlea sites with dates

Site Name	Date	Reference
Evans (32MN301)	1200±85 BP (I-7565) 1360±85 BP (I-7566)	Cloutier 2004; Martindale et al. 2016; Quigg 1988
Lightning Spring (39HN204)	1660±80 BP (TX-4086)	Cloutier 2004; Fraley 1988; Martindale et al. 2016

3.4 Late Precontact Bison Procurement on the Northern Plains

Bison procurement has a long history on the Northern Plains extending back into the early Holocene. This extensive history of bison procurement reflects the importance of this species for the survival and prosperity of people living on the Northern Plains. The techniques utilized to procure bison have evolved over time, initially being relatively simple by incorporating naturally formed geological features to trap or injure animals to large-scale jumps and the construction of pounds. This section will provide an overview of the common large-scale communal bison procurement techniques that were utilized throughout the Northern Plains during the Late Precontact period including pounds and bison jumps.

3.4.1 Pounds

Pounds are common traps that hunters would utilize on the Northern Plains. This type of large-scale hunting technique became more common circa 3600 BP on the Northern Plains and continued through to contact with Europeans (Walker 2016). Pounds are a hunting technique in which animals were directed towards a fenced containment area that has no exit. Historic

accounts have described pounds to be either rectangular or circular, with some pounds being able to hold 240 bison (Frison 1971). The design of these features varies from one site to another, often incorporating natural landforms into their construction. For example, a pound could utilize a low escarpment for one of its sides and then have the open sides barricaded by the resources at hand which may include wood, dung, shrubs, cobbles, bunched grass, bone, and hides. Bone uprights have been used as a construction material to support and straighten postholes for the pound fences (Walker 2016). Frison (1971) describes some pounds as having a drop or a ramp at the entrance which would deter animals from finding their way back out. Declines may have also been covered in manure and mud so that animals would lose traction if they were to try to escape. Another deterring feature that has been recorded to discourage bison from breaking down the fences are sharpened birch and cottonwood sticks protruding into the pen. Once inside the pound a hide would be draped over the entrance. Bison have poor vision and using a hide to cover any light from outside the pound would deter them from trying to run through it. Construction of pounds are dependant on the materials available however they tend to include the natural landscape as a method to direct and trap animals.

3.4.2 Bison Jumps

Jumps are large-scale hunting techniques that require a great understanding of bison behaviour in order to control the movement of the herd. The main characteristics of bison jumps are high bluffs to stampede the bison over, a gathering basin near the precipice, and drive lanes. Precontact hunters needed to lure the herds towards the gathering basin as well as the bluff. To accomplish this, hunters would either start fires or pretend to be a calf (Brink 2008). Fire was used as a way to push bison towards the precipice. Brink (2008) explains that bison are cautious of fire and will keep their distance from it, which allows humans to have a clever way to control

herds. However, weather conditions need to be cooperative as well as winds. Other methods include mimicking the sound of a lost calf to draw attention towards a specific area. A female bison has a strong bond with her calf and when the bleating sound of a lost calf is produced, all the cows will respond by sniffing the air to see if it is their own. However, even if it is not the cow's calf they will investigate the situation nonetheless. Since herds are led by female bison, the entire herd would move with the females that are checking on the distressed calf.

Drive lanes were an important aspect of bison jumps since they directed the bison and buffalo runners in the correct direction towards the bluff. These features were alignments of piled stone cobbles occurring every meter or so (Walker 2016). During the time in which these piles were being utilized they were made larger by having dung, brush, sod, and lodge poles placed on and across them (Barsh and Marlor 2003; Walker 2016). Buffalo runners would wear bison robes as a disguise to blend in with the herd. Their primary objective was to move the herd slowly toward the cliff, making sure that the animals did not see the edge. Women and children would wait behind the drive lane cairns. At the precise moment they would jump up and make a commotion by waving robes to instigate a stampede causing the herd to travel towards the precipice (McManamon et al. 2009; Walker 2016). The drive lanes would start funneling the herd by converging closer to the cliff edge. The leading bison of the herd may have seen the edge prior to going over it. However, due to the speed they were travelling at as well as the pressure from the following herd, these animals would be pushed off the cliff (Walker 2016). Depending on the height of the escarpment, the fall likely caused fatal injuries to the leading herd members. Animals that survived the fall would be dispatched by hunters waiting at the base of the cliff (McManamon et al. 2009). Kornfeld et al. (2010) explain that some bison jumps had pound

structures based at the bottom of the bluffs to secure animals that were still mobile to assist in completing the kill.

3.5 Summary

Avonlea sites are common throughout the Northern Plains. These sites have produced a wide variety of artifacts including pottery, lithic tools, bone tools, and numerous species of faunal remains. Communal hunting practices thrived among the people utilizing the Avonlea projectile point. Large-scale hunting techniques such as pounds and jumps are represented at a wide variety of sites including Gull Lake, Bakken-Wright, Rousell, Camp Rayner, Verlo, Cherry Lake, Avonlea, Head-Smashed-In, Hardisty Bison Pound, Upper Kill, First Peoples Buffalo Jump, Fantasy, Beaver Bend, TRJ, Lost Terrace, Henry Smith, and the Wardell site. Two of these sites display ceremonial aspects including the effigies at the Henry Smith site and a bison skull burial at the Hardisty Bison Pound site. These features suggest the importance of ritual among these groups in association with their bison kills.

Chapter 4

Methodology

4.1 Introduction

Initial testing of the Whiting Slough site took place during the summer of 2013 under the direction of Western Heritage. Between the years of 2013 and 2016, three stages of excavation were completed. In 2017, an additional stage of excavation was accomplished with the help of graduate students and field school students from the U of S (Figure 4.1). This chapter will describe the methodology involved during each stage of excavation and monitoring providing a description of the stratigraphy at the site, as well as, the methods utilized when cataloging and performing quantitative and qualitative analysis.

Figure 4.1 University of Saskatchewan archaeological field school excavation

4.2 Excavation Methods

4.2.1 Excavation Methods Western Heritage

In the summer of 2013 extensive archaeological survey was conducted north of Highway 7 covering the area between Delisle and Vanscoy, which involved shovel tests arranged in two parallel transects 10 meters apart (Western Heritage 2015). At the Whiting Slough site, an Avonlea projectile point and faunal materials were recovered from shovel tests #227 and #228 (Western Heritage 2015). As a result, a detailed assessment was permitted with an additional 51 shovel tests and two 1 x 1 m units being excavated within the area. Testing the site identified the presence of a bone bed at a depth between 45-65 cm depth below surface (DBS) in an estimated area of 11 m x 7 m (Western Heritage 2015). These positive results led to additional units being excavated with Western Heritage expanding their excavations to include a total of 95 square meters as shown in Figure 4.2. Units were shovel-shaved in 10 cm arbitrary levels and the materials were screened through quarter inch mesh. Further excavations at the Whiting Slough site took place in the spring of 2017 by the U of S archaeology field school.

4.2.2 Excavation Methods University of Saskatchewan

In 2017, an additional 25 units were excavated in the northern portion of the site by U of S graduate and field school students with emphasis on the alignment of the bone features, as illustrated in Figure 4.3. Students were divided into pairs and they excavated a unit by shovel shaving and screening the materials through quarter inch mesh. Units were excavated to a depth of 60 cm DBS. These methods allowed for additional bone features to be recovered along with numerous projectile points.

4.2.3 Monitoring Methods Western Heritage 2017

In 2017, during the mechanized scraping of the site as part of highway construction, additional pedestrian survey took place by Western Heritage employees who walked transects over the proposed right of way, north of Highway 11, after each pass of heavy machinery. This resulted in the recovery of additional projectile points as well as bones and bone features. Each isolated find was given a waypoint number and saved in a global positioning system (GPS). It is significant to note that an additional alignment of bone features was recovered five meters southwest of the main excavation block, as illustrated in Figure 4.4.

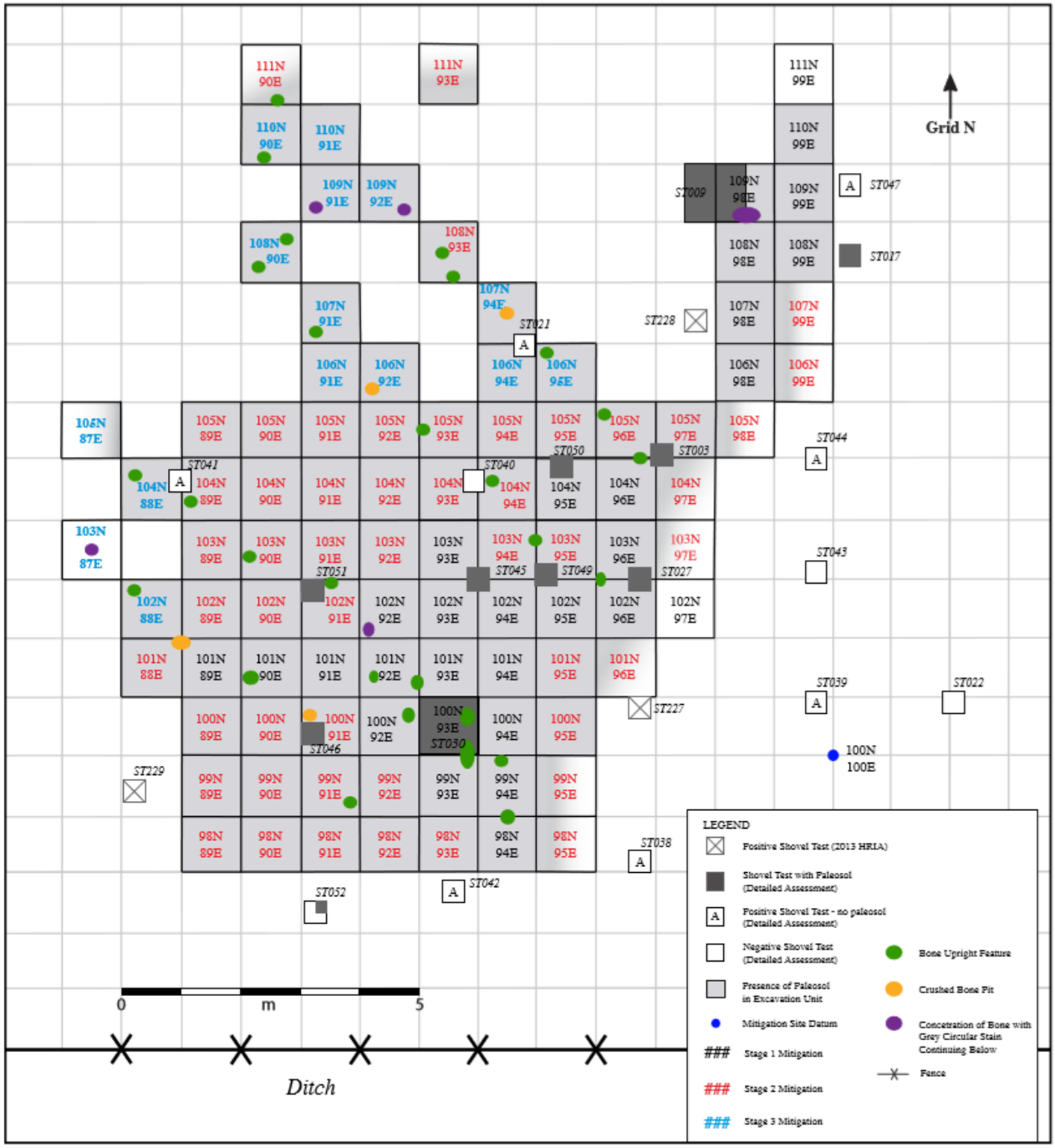

Figure 4.2 Western Heritage stages of mitigation (Western Heritage 2015)

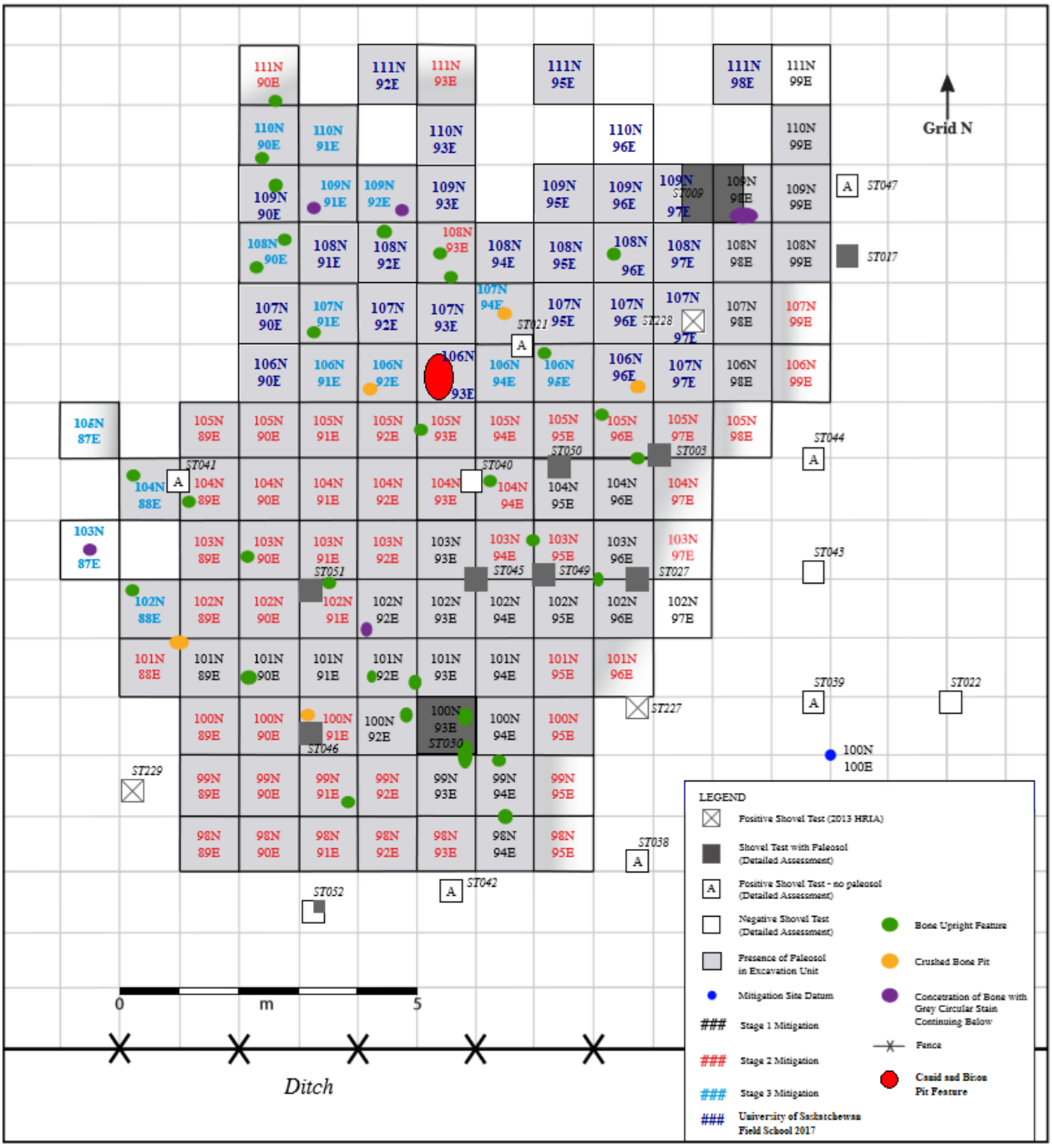

Figure 4.3 University of Saskatchewan field school 2017 excavation, adapted from Western Heritage 2015

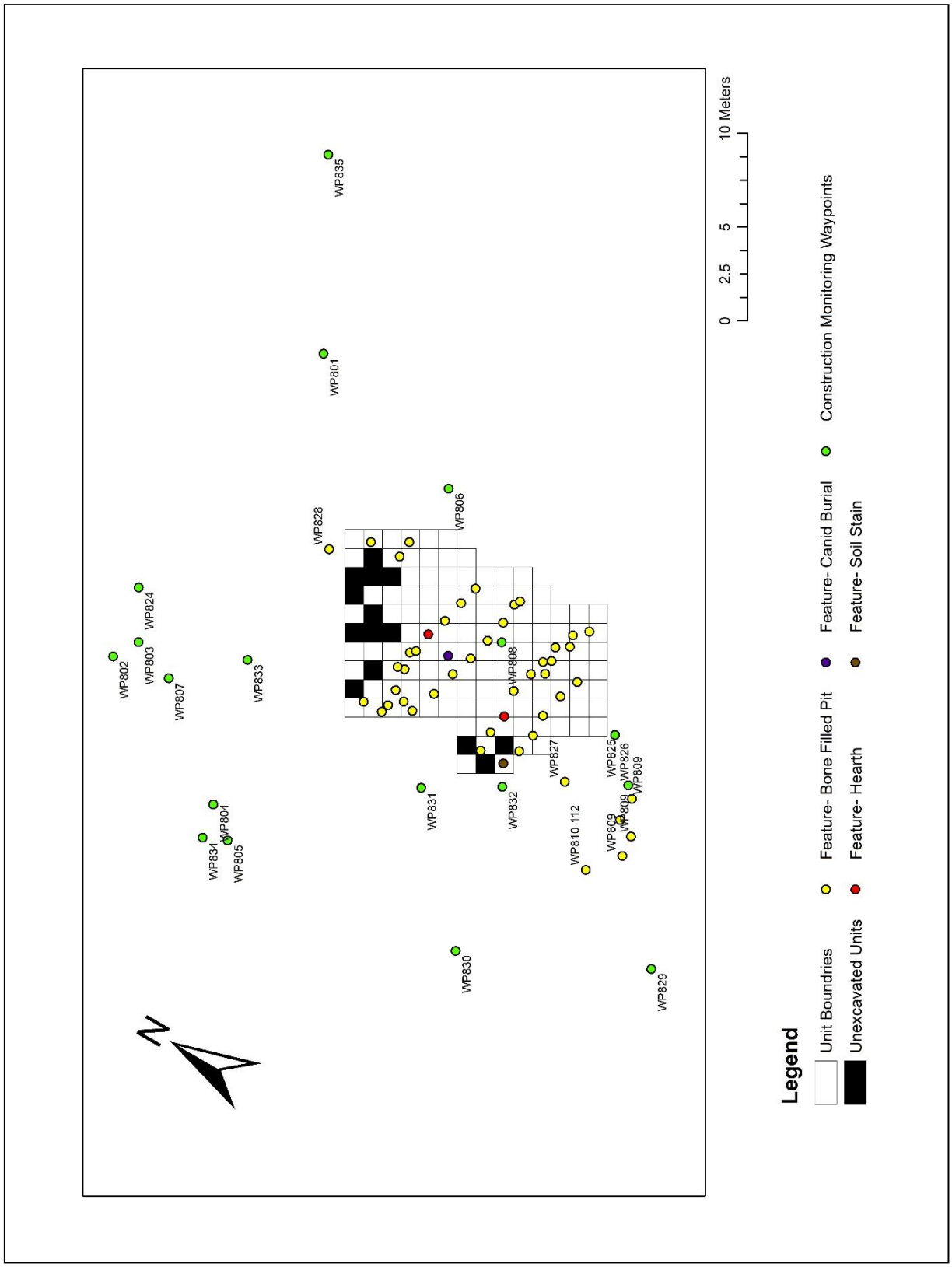

Figure 4.4 Monitoring waypoints (Halyk 2020)

4.3 Stratigraphy

Sediment changes were recorded by both Western Heritage and the U of S when excavating. The primary composition of the sediment is sand ranging from very coarse sand to very fine sand, with traces of loam, silt, and clay (Western Heritage 2015). Fine sand is the dominant depositional material through each stratigraphic layer. Colours of layers consist of grey sand (7.5 YR 4/1), light brown sand (10 YR 6/2), mottled brown sand (10 YR 8/2), yellow brown sand (10 YR 7/4), dark grey to black sand (10 YR 4/1 – 10 YR 2/1), and brown sand (10 YR 7/3) (Western Heritage 2015). The most significant sediment change that is present throughout the excavation block is the dark grey to black sand lens seen in Figure 4.5.

Figure 4.5 Whiting Slough Site soil stratigraphy, note arrow pointing at dark grey to black sand lens layer, adapted from Western Heritage 2015

This layer is significant since it has a greasy texture which is unlike the layers above or below it. It should be noted that this layer coincides with the majority of the bone and cultural artifacts extracted from the site which may provide insight into the formation of this stratigraphic

level. As these materials may have aided in the processes involved with discolouring the sand at the site. A combination of burned bison soft and hard tissue in association with a high water table could cause soft tissue to decompose at a slower rate which may have led to the change in sediment texture and colour. The dark grey to black sand lens is thickest toward the center of the excavation block and tapers off and disappears at the edges causing an elliptical shape in cross-section. This shape coincides with the numbers of bone specimens recorded at the site. Bones are represented at higher rates in the thicker portions of the dark grey to black elliptical lens and are considerably less represented on the periphery of the excavation block where the lens tapers off.

4.4 Cataloging Methods

The archaeological materials produced from both the Western Heritage and the U of S excavations were cleaned and catalogued in the same manner. All materials were washed with water and placed on paper towel until air-dried. Further organization took place among each type of archaeological material recovered from the site. Bones were sorted by identifiable versus unidentifiable, sized using a chart provided by Western Heritage, type of animal, type of bone, as well as, being calcined, burned, and unburned. Other materials such as charcoal and lithics were separated by size and tool type. Artifacts were bagged and weighed as well as recorded into a Microsoft Excel sheet.

4.5 Analytical Procedures/Quantitative and Qualitative Methods

A quantitative and qualitative research design was employed when analyzing the faunal materials at the Whiting Slough site. This type of investigation permitted insight on the faunal assemblage such as types of animals represented, sex, age, and the taphonomic processes that have altered the bones. This analysis ultimately will lead towards a greater understanding of the species present and the formation of the bone bed at the site.

4.5.1 Quantitative Methods

Quantitative analysis commenced once all the archaeological materials were catalogued. Analysis involving herd structure and animal species represented within the assemblage was accomplished through the utilization of the completed Excel sheet of the Whiting Slough site catalogue. The main quantitative calculations completed include the number of identified specimens (NISP), the minimum number of individuals (MNI), the minimum number of elements (MNE), the minimum number of animal units (MAU), and percent minimum number of animal units (%MAU). Analyses such as this provides information on the abundance of skeletal parts in the Whiting Slough site faunal assemblage. Quantitative analysis that was completed to understand the bison herd composition involved measuring two dimensions on the proximal radii with a caliper which included the proximal articular surface and the greatest breadth. Further quantitative analysis was done to understand the population structure of the herd and the seasonality of the site. This involved measuring elements of bison lower tooth rows to analyze tooth eruption and wear patterns.

4.5.2 Qualitative Methods

Qualitative analysis involved the visual re-examination of all faunal materials in the Whiting Slough site collection to identify any bone modifications. This type of analysis aided in explaining the processes that have occurred at the site. Modifications that were noted included carnivore and rodent damage and disturbance, root etching, weathering, pathologies, abnormalities, fracture patterns, and burning. Further qualitative analysis was completed when examining bison lower tooth rows to analyze age of the specimens. Other qualitative analysis involved the identification of species from identifiable bone and bone fragments. When

identification of species was impossible due to a lack of available landmarks, the specimens were assigned to broad taxonomic levels according to their size.

4.6 Summary

The Whiting Slough site had three stages of mitigation completed by Western Heritage as well as an additional excavation completed by the U of S field school. It is a single occupation Avonlea site with a dark grey to black sand lens in its stratigraphy. The presence of the dark sand lens in association with a vast amount of the bone materials as well as projectile points may provide insight into its possible formation. The cataloging methods that took place provides the necessary foundation to accomplish quantitative and qualitative analysis on the faunal assemblage. All faunal materials excavated by Western Heritage and the U of S have been re-examined as part of this research.

Chapter 5

Faunal Analysis

5.1 Introduction

Quantitative analysis was conducted on faunal materials from the Whiting Slough site to obtain an understanding of the species present. This chapter provides an overview of the faunal materials, species present, description of species, distribution of animals and animal parts, and a summary.

5.2 Faunal Analysis

A total of 393,161 faunal specimens weighing 387.63 kg were recovered at the Whiting Slough site. Bones that are identifiable to type and species make up a small percentage of the collection with unidentifiable bones representing 97% of the overall specimens. However, when comparing weight, nearly half of the collection is identifiable making up 49% of the total weight as shown in Table 5.1. This indicates that much of the faunal assemblage is representative of highly fragmented specimens.

Table 5.1 The Whiting Slough site faunal assemblage specimen totals and weight

	Identified				**Unidentified**				**Total**	
	N	%N	kg	%kg	N	%N	kg	%kg	N	kg
Unburned	5,554	3.3	181.2	63.3	160,318	96.7	105.1	36.7	165,872	286.3
Burned	990	0.4	9.4	9.3	226,299	99.6	92.0	90.8	227,289	101.3
Total	6,544	1.7	190.6	49.2	386,617	98.3	197.1	50.8	393,161	387.6

Identified specimens were the result of examining the available landmarks and element portions within the assemblage. Specimens obtaining sufficient landmark information were then

identified to their most accurate taxonomic level. Western Heritage and the U of S comparative faunal collections were utilized to permit this process of identification.

Six types of mammals and one avian specimen have been identified at the Whiting Slough site as summarized in Table 5.2. American bison (*Bison bison*) make up the majority of the faunal material, followed by canids, rodents, and birds. Faunal remains that lack distinguishable characteristics for more precise species identification were included in broader categories such as large mammal, small mammal, and mammal.

Table 5.2 Summary of the Whiting Slough site faunal assemblage

Species		**Whiting Slough Site**	
Common Name	Scientific Name	NISP	MNI
Mammalian			
American Bison	*Bison bison*	5342	54
Canid Indeterminate	*Canis* sp.	169	2
Snowshoe Hare	*Lepus americanus*	22	1
Northern Pocket Gopher	*Thomomys talpoides*	2	1
Rodentia Indeterminate*	Small mammal	48	1
Carnivore Indeterminate	Small Carnivora	2	1
Avian			
Aves Indeterminate	Medium-sized bird	2	1
Miscellaneous			
Large Mammal	-	1910	-
Small Mammal	-	8	-
Mammal	-	385,656	-

5.3 Mammalian Faunal Remains

5.3.1 Bison Remains

Class Mammalia, Order Artiodactyla, Family Bovidae

Bison bison

Bison bison (American bison) NISP = 5342: MNI = 54 (M_3)

Discussion: Bison remains were scattered across the entirety of the excavation, with more representation and completeness in the bone features. Specimens identified as bison make up a small percentage (1%) of the overall 393,161 faunal materials in the highly fragmented assemblage. However, for identified faunal materials within the assemblage bison are the dominant species represented at 96%. A small amount (14%) of the bison assemblage have signs of burning or calcification.

Table 5.3 represents the NISP by element for the Whiting Slough site bison faunal assemblage. MNI, MNE, MAU and %MAU signify “minimum number of individuals”, “minimum number of elements”, “minimum animal units”, and “percent minimum animal units”. An MNI of 54 animals for bison was calculated using permanent lower right 3rd molars, as they were the most abundant complete specimen in the assemblage. This number was retrieved from stand alone 3rd molars and 3rd molars that were present in tooth rows. Therefore, Table 5.3 will not represent this number since it is a result of solely mandible and M_3 counts. Table 5.3 also provides the MNE, MAU, and %MAU for each element present in the faunal assemblage. The maximum bone MAU is 28.5 for the mandible.

Table 5.3 Bison element counts from the Whiting Slough site

***Bison bison* Summary** Element	**NISP**	**MNI**	**MNE**	**MAU**	**%MAU**
Axial Skeleton					
Cranium	185	23	42	21.0	73.7
Maxilla/Premaxilla	72	17	32	16.0	56.1
Mandible	317	26	57	28.5	100.0
Incisor	214	-	-	-	-
Premolar	132	22	31	5.2	18.1
M_1	44	13	22	11.0	38.6
M_2	57	16	32	16.0	56.1
M_3	80	41	41	20.5	71.9
Hyoid	91	-	-	-	-
Rib	1120	-	-	-	-
Altas	54	13	13	13.0	45.6
Axis	55	17	17	17.0	59.6
Cervical	255	-	30	6.0	21.1
Thoracic	288	-	50	3.6	12.5
Lumbar	140	-	11	2.2	7.7
Sacral	26	-	3	0.6	2.1
Caudal	19	-	1	0.1	0.4
Forelimb					
Scapula	63	9	19	9.5	33.3
Humerus, proximal	13	3	5	2.5	8.8
Humerus, distal	19	7	12	6.0	21.1
Radius, proximal	32	7	11	5.5	19.3
Radius, distal	17	1	2	1.0	3.5
Radial Ulna	2	1	2	1.0	3.5
Ulna Shaft	9	-	-	4.5	15.8
Ulna, proximal	20	5	8	4.0	14.0
Ulna, distal	2	1	2	1.0	3.5
Radial Carpal	22	12	15	7.5	26.3
Internal Carpal	25	12	18	9.0	31.6
Ulnar Carpal	27	15	25	12.5	43.9
Accessory Carpal	11	5	11	5.5	19.3
Carpal 2+3	35	11	20	10.0	35.1
Carpal 4	24	9	18	9.0	31.6
5th Metacarpal	5	1	1	0.5	1.8
Metacarpal, proximal	14	8	9	4.5	15.8
Metacarpal, distal	7	3	4	2.0	7.0

Table 5.3 (continued) Bison element counts from the Whiting Slough site					
Hindlimb					
Pelvic Girdle	82	21	41	20.5	71.9
Femur, proximal	23	7	15	7.5	26.3
Femur, distal	11	4	6	3.0	10.5
Patella	7	1	2	1.0	3.5
Tibia, proximal	15	2	3	1.5	5.3
Tibia, distal	35	14	30	15.0	52.6
Calcaneus	35	3	7	3.5	12.3
Astragalus	33	7	15	7.5	26.3
Tarsal 2+3	20	6	13	6.5	22.8
Tarsal 1	4	2	4	2.0	7.0
Lat Malleolus	18	8	17	8.5	29.8
5th Tarsal	2	1	2	1.0	3.5
Metatarsal, proximal	10	2	3	1.5	5.3
Metatarsal, distal	8	1	1	0.5	1.8
Other Appendicular					
1st Phalanx	67	-	-	-	-
2nd Phalanx	74	-	-	-	-
3rd Phalanx	51	-	-	-	-
Sesamoid	89	-	-	-	-
Metapodial	27	-	-	-	-
Miscellaneous Bones	1139	-	-	-	-
Humerus Shaft Frags	11	-	-	-	-
Radius Shaft Frags	9	-	-	-	-
Femur Shaft Frags	17	-	-	-	-
Tibia Shaft Frags	30	-	-	-	-
Metatarsal Shaft Frags	4	-	-	-	-

5.3.2 Non-bison Remains

Class Mammalia, Order Carnivora, Family Canidae

Indeterminate *Canis* sp.

Canis sp. (Wolf size) NISP = 169: MNI = 2

Discussion: The majority (80%) of the canid remains were excavated from 106N 93E which is a pit feature (Feature CB) that contains canid and bison remains. These remains are highly fragmented with 83.7% of the specimens showing signs of burning (Figure 5.1). Other than the canid remains in Feature CB, a total of 33 canid specimens were present across the remaining excavated units with nearly half (45.5%) showing signs of burning (Figure 5.2 and

5.3). These bones were also highly fragmented. Table 5.4 represents the NISP for the canid elements of the Whiting Slough site. There are two canids in this assemblage, this being the result of two right mandibles and two 4th metacarpals.

Table 5.4 Canid element counts from Whiting Slough site

***Canis* sp. Summary** Element	**NISP**	**MNI**	**MNE**	**MAU**	**%MAU**
Axial Elements					
Cranium	6	1	2	1	100
Maxilla/PreMaxilla	10	1	2	1	100
Indt. Tooth Row	4	1	1	0.5	50
Mandible	8	2	2	1	100
Sternum	2	1	1	1	100
Rib	18	1	5	0.4	41.7
Axis	1	1	1	1	100
Cervical	2	1	1	0.2	20
Thoracic	2	1	1	0.1	7.1
Caudal	3	1	2	0.2	20
Forelimb					
Scapula	2	1	2	1	100
Humerus, distal	2	1	2	1	100
Radius, proximal	2	1	2	1	100
Radius, distal	2	1	2	1	100
Ulna, proximal	1	1	1	0.5	50
Ulna, distal	1	1	1	0.5	50
1st Metacarpal	1	1	1	0.5	50
2nd Metacarpal	1	1	1	0.5	50
3rd Metacarpal	1	1	1	0.5	50
4th Metacarpal	2	2	2	1	100
5th Metacarpal	2	1	2	1	100
Metacarpal	1	1	1	0.5	50
2nd Phalange	1	1	1	0.5	50
Hindlimb					
Ilium	1	1	1	0.5	50
Tibia, proximal	1	1	1	0.5	50
Tibia, distal	2	1	2	1	100
4th Tarsal	1	1	1	0.5	50
Tibial Tarsal	1	1	1	0.5	50
Misc. Elements					
Indt. Vertrebrae	7	-	-	-	-
Sesamoid	3	-	-	-	-
1st Phalange, proximal	3	1	3	-	-
1st Phalange, distal	1	1	1	-	-

Table 5.4 (continued) Canid element counts from Whiting Slough site					
Misc. Elements (continued)					
2nd Phalange	4	1	3	-	-
2nd Plantar Process	1	1	1	-	-
3rd Phalange	2	1	2	-	-
Distal Phalange	2	1	1	-	-
Middle Phalange	4	1	1	-	-
Proximal Phalange	3	1	1	-	-
Metapodial	1	1	1	-	-
Frags	43	-	-	-	-
Cranial Frags	14	-	-	-	-

Figure 5.1 Feature CB canid remains, cranial fragments (top center), left limb (left), vertebrae (center), right limb (right), and indeterminate side limb bones (bottom center)

Figure 5.2 Canid right (bottom) and left (middle) mandible specimens, and upper right molar (top)

Figure 5.3 Canid caudal vertebrae (left), sternal rib (second from top left), sesamoid (second from bottom left), left tibia (center), metacarpal, 3rd, 2nd, and 1st phalange (right in descending order)

The two indeterminant canid species present at the Whiting Slough site make up 3% of the identified fauna. These specimens are non-intrusive since they share the same taphonomic

characteristics compared to the rest of the archaeological faunal assemblage within the site. It should be noted that the canid remains excavated from Feature CB were purposely placed there as evidenced by their positioning within the dark grey to black sand lens layer and direct association with a fragmented bison cranium. This suggests that the animal was buried at the site during its occupation for possible ceremonial reasons. Ceremonial features have been recorded at other Avonlea sites including the Hardisty Bison Pound where a bison cranium was placed at the entrance of the pound suggesting a non-utilitarian function (Moors 2017).

Further taxonomic classification for the canid specimens was problematic due to the fragmented nature of the assemblage. This made it difficult to compare the specimens with other canid species within the U of S comparative collection such as wolf (*Canis lupus)* to examine size similarities. The differences between domesticated dogs and wolves can be seen primarily through characteristics of the cranium. Domesticated animals tend to be a smaller size than their wild ancestors, therefore, one indicator of a domesticated dog is crowded tooth rows (Morey 1992). Other analyses that can be completed to differentiate between the two species involve measuring various portions of the cranium which include measuring the maximum cranial vault, palate length, palate width, and the condylobasal length (Morey 1992). However, due to a lack of complete cranial and mandibular elements, it was impossible to accomplish this analysis (Figure 5.4). Postcranial remains were also highly fragmented which proved problematic for species identification. DNA analysis on these two individuals would provide the genetic information for species identification, however, it is outside the scope of this project.

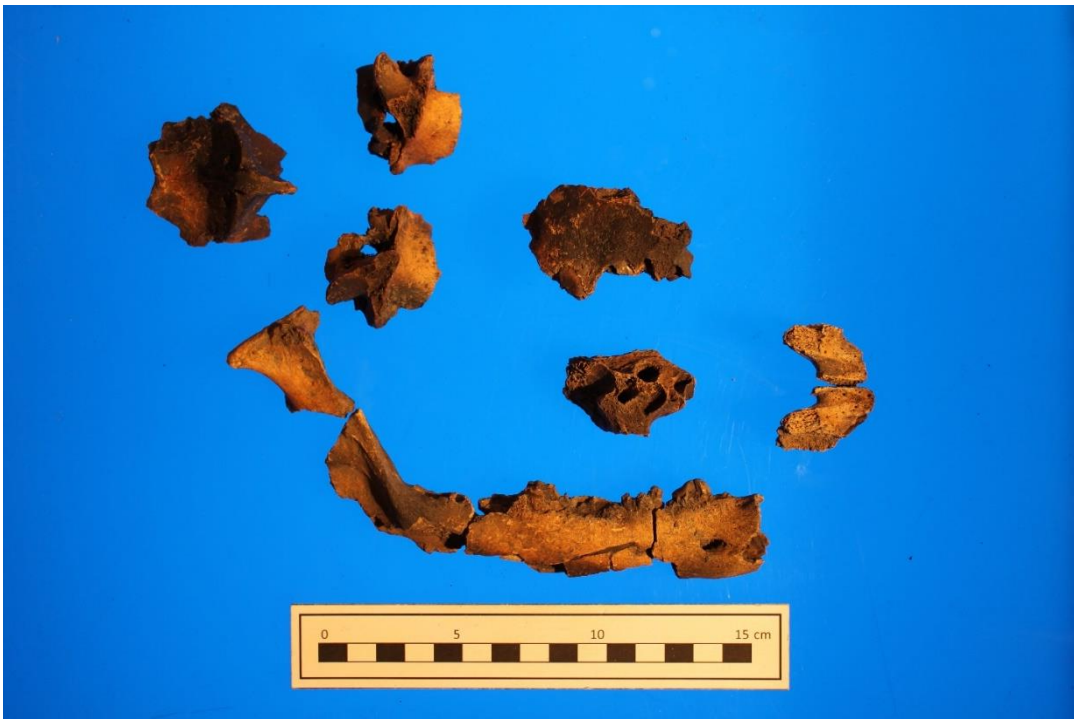

Figure 5.4 Feature CB canid fragmented cranial remains

Class Mammalia, Order Lagomorphs, Family Leporidae

Lepus americanus

Lepus americanus (Snowshoe hare) NISP = 22: MNI = 1

Discussion: The snowshoe hare was identified by the upper left maxilla as shown in Figure 5.5. This specimen is primarily unburned with only a distal left humerus showing signs of burning. The distal humerus was excavated from unit 104N 93E while the rest of the remains were recovered from unit 107N 97E. There is no evidence of cutmarks on this animal, however, due to the burned distal humerus and the remains being excavated from the dark grey to black stratigraphic level suggests that this animal was likely deposited as a result of cultural activity.

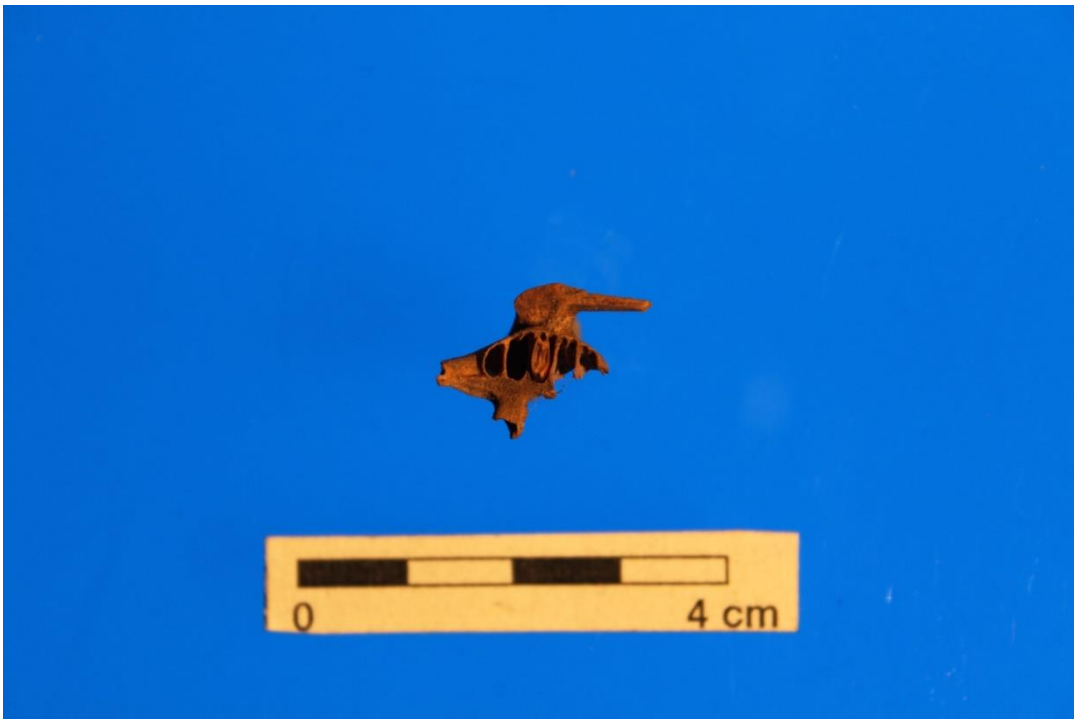

Figure 5.5 Upper left maxilla of Snowshoe Hare

Class Mammalia, Order Rodentia, Family Geomyidae

Thomomys talpoides

Thomomys talpoides (Northern pocket gopher) NISP = 2: MNI = 1

Discussion: The Northern pocket gopher is represented by right and left mandibles as seen in Figure 5.6. These remains are possibly intrusive being deposited after the site's formation. This is supported by rodent burrows noted in various units during excavations. Also, due to the remains' size and fragility, the excavation techniques used may have damaged or lost these remains. There are no indications on the mandibles to suggest butchering. The discolouration of the mandibles could be the result of mineralization where minerals such as manganese replace the organic material of the bone causing a dark brown to black colour change. This process is common in high moisture areas such as wetlands and sloughs.

Figure 5.6 Right and left mandibles of Northern Pocket Gopher

Miscellaneous Mammalian Remains

Indeterminate Small Carnivora

Small carnivore (Fox size) NISP = 2: MNI = 1

Discussion: Two faunal remains have been classified as indeterminate small carnivora, these include a ramus of a mandible with an indeterminate side as well as a sternebrae (Figure 5.7 and 5.8). The teeth in the mandible are missing the occlusal surface which makes it problematic when comparing this specimen to other carnivores of its size. Of these two specimens the mandible is the only bone that is unburned. The burning of the sternebrae along with the fragmentary nature of these bones likely indicate cultural activity. However, due to the fragmented nature and small size of these specimens, no further taxonomic distinctions could be made.

Figure 5.7 Ramus of mandible for indeterminate carnivore

Figure 5.8 Sternebrae of indeterminate carnivore

Indeterminate Small Mammal

Small-sized mammal (Ground squirrel size) NISP = 48: MNI = 1

Discussion: Identification of species was not possible due to the fragmented state of the faunal materials. The materials represent a small-sized mammal which could possibly be a ground squirrel. As stated earlier the presence of burrows through units was common, therefore, suggesting that these remains are intrusive. There are no signs of cultural activity on these remains.

Class Aves

Indeterminate Large Bird

Medium-sized Bird NISP = 2: MNI = 1

Discussion: There are two bones that are classified as indeterminant bird. One is a burned indeterminant long bone, while the other is an unburned coracoid. Further taphonomic identification was impossible due to lack of distinguishable element landmarks. Both bones do not show any signs of cultural modifications other than the burning of the long bone.

5.4 Distribution of Faunal Remains

The distribution of faunal remains can provide insight on the form and function of an archaeological site. A great amount of bone materials at the Whiting Slough site have been identified to their respective type and species. This allows an understanding of how the site was formed along with what cultural and natural processes have taken place.

5.4.1 Bison Remains

5.4.2 Axial Elements

Bison axial elements are highly represented in the Whiting Slough site faunal assemblage. These elements represent 53.8% of all identifiable bison remains and are scattered

throughout the entirety of the site except for in eight units: 105N 87E, 108N 94E, 108N 95E, 109N 93E, 109N 97E, 111N 95E, 111N 98E, and 111N 99E. These eight units are located on the periphery of the excavation block potentially denoting the edges of the site. Axial elements are the dominant skeletal remains in features when compared to appendicular elements as they have greater totals in 32 of the 39 features at the site. These specimens are also represented in all features except for WP 809 B. Of the axial elements, ribs have the largest NISP count and caudal vertebrae the lowest. When comparing cranial elements versus vertebral elements there are 13.6% more cranial specimens. The majority of the cranial elements are mandibles, teeth also highly represented. Thoracic vertebrae represent the majority of the vertebrae catalogued. The %MAU calculation indicates the survivability of different elements in the assemblage. This provides insight into which elements are more prominent than others. Figure 5.9 indicates that cranial and cervical vertebrae are represented at the highest rates in the Whiting Slough site faunal assemblage especially the mandible. Axial elements in this assemblage are predominately unburned, with 11.4% of the remains showing signs of burning and calcification.

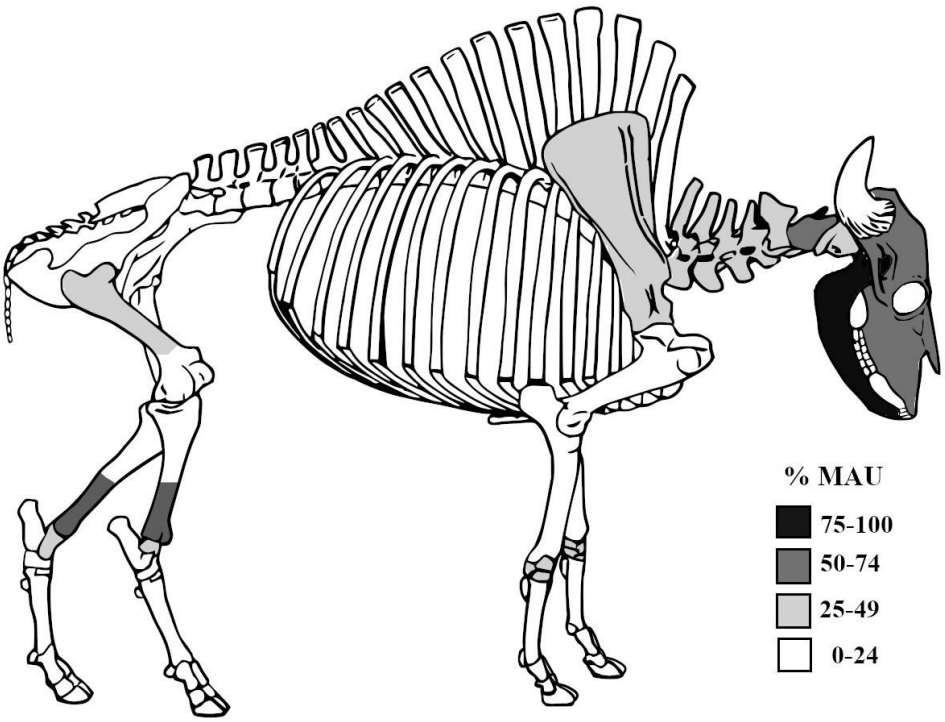

Figure 5.9 Whiting Slough site bison assemblage %MAU, adapted from Grunwald 2016

Axial elements are considered low utility bones, from the perspective of their usefulness to humans, due to their lack of meat. These types of specimens are commonly associated with processing sites since they tend to be left behind and not processed to the same degree as long bones. The distribution of these types of skeletal remains being present nearly in every unit across the Whiting Slough site as well as the high number of Avonlea projectile points suggests that this site is representing a processing site. Cultural activity can explain the placement of the axial remains in features. While the remaining remnants of axial bones are assumed to be placed where they are due to their last encounter with the butchering process. Carnivore chewing is present on a small number of rib fragments indicating carnivore disturbance at the site. However, this taphonomic characteristic is underrepresented which infers little carnivore displacement of axial remains.

5.4.3 Appendicular Elements

Appendicular elements are underrepresented at 17.9% when compared to axial. In the Whiting Slough site faunal assemblage 6.2% of the bison collection are identified as forelimbs and 6.4% are represented as hindlimbs, with 5.2% being categorized as other appendicular elements. These elements appear in all but 13 units: 100N 89E, 102N 97E, 103N 87E, 104N 88E, 105N 87E, 106N 90E, 108N 95E, 109N 97E, 110N 90E, 110N 93E, 111N 95E, 111N 98E, and 111N 99E. Similar to the axial elements, these units are on the periphery of the excavated block suggesting that these units are representing the boundary of the site. Appendicular elements are slightly more common in 4 out of the 39 features and are non-existent in 7 of these features. Feature B has two complete long bones which include a right unburned ulna and unburned radius. There are no other complete long bones throughout the site. Most complete appendicular bones are located outside of features and are identified as low utility rider bones, some of which are carpals, tarsals, and phalanges. Rider bones include elements that are less nutritionally valuable due to their lack of meat and tend to be transported to sites because of their articulation with higher utility elements. Low utility rider elements are represented in greater numbers than forelimb elements, as shown previously in Figure 5.9. Figure 5.9 also indicates that hindlimb elements are represented at higher rates in the assemblage. Appendicular elements at this site are mostly unburned with only 16.6% showing signs of burning and calcification.

Appendicular elements are considered high utility as these types of bones have a greater abundance of exploitable protein and nutrients compared to axial elements which makes these elements more valuable when it comes to consumption. Therefore, they tend to be incomplete at archaeological sites due to them being highly processed. The low amount of complete high utility bones provides further evidence that the Whiting Slough site represents a processing site.

Other than the specimens recovered from features, the distribution of appendicular remains are the result of the butchering process. Carnivore chewing has been recorded on a fragmented pelvic bone, which indicates that carnivores may have displaced some of the faunal remains at the site. However, there is a low quantity of this taphonomic signature on appendicular remains suggesting a minimal amount of carnivore displacement of this type of element.

5.4.4 Frequency of Non-Bison Remains

5.4.5 Canid Remains

The canid remains are the second most common species at the Whiting Slough site. The majority of the identified specimens are from Feature CB, located in unit 106N 93E. All other canid remains are splayed across several units most of which are to the north, south, and east of this feature. Feature CB has a combination of axial and appendicular canid remains that predominantly show signs of burning. These remains likely represent the same individual. The other canid remains were recovered from units 99N 91E, 99N 93E, 99N 94E, 100N 94E, 102N 94E, 103N 94E, 104N 92E, 104N 95E, 105N 93E, 106N 92E, 106N 94E, 106N 95E, 106N 96E, 107N 94E, 107N 95E, 107N 96E, 108N 94E, 111N 93E. One second phalange was excavated in association with Feature V, in unit 105N 93E. All other canid remains outside of Feature CB and Feature V were not directly associated with features at this site. Both canids at the site are highly fragmented as represented in Figure 5.10. The majority of the identified specimens are representative of cranial and forelimb elements.

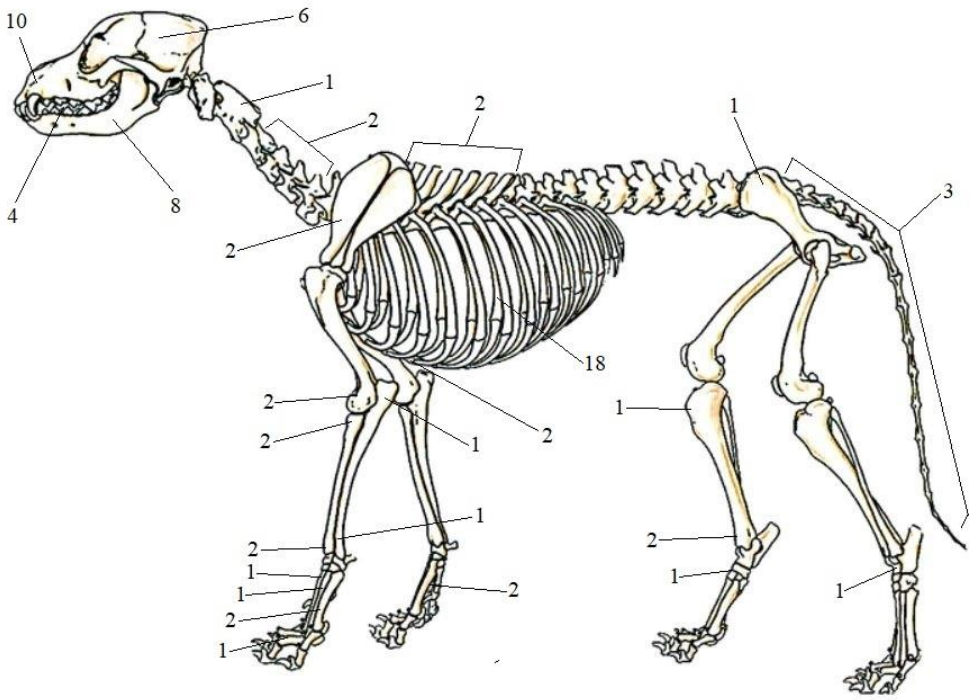

Figure 5.10 Whiting Slough site canid assemblage NISP, adapted from Donald 2018

There are no signs of butchering on the canid remains to suggest that these two individuals were consumed. Rather the remains from Feature CB were likely purposely placed there with the fragmented bison cranium for ceremonial purposes. The burning of these remains may also correspond to ceremonial procedures. The canid remains outside of Feature CB are nearly evenly unburned and burned with appendicular remains showing more signs of burning. These appendicular remains include distal limb elements such as phalanges and metapodials. The distribution of the remains outside of Feature CB lacks a pattern. However, most of the canid remains are within a meter or so of a bone feature, apart from the burned 3rd phalange in unit 111N 93E. It is unclear what the relationship between the canid remains and the bone features are at the site.

5.4.6 Leporid Remains

The leporid remains are isolated to two units, including, 104N 93E and 107N 97E. Unit 104N 93E provides evidence that this species most likely was consumed due to being burned. While unit 107N 97E has a greater concentration of remains that are unburned and mostly complete suggesting that this animal may be intrusive.

5.4.7 Small Carnivore Remains

The two small indeterminant carnivore remains were excavated from units 104N 93E and 108N 98E. Unit 104N 93E shows signs of cultural activity with a burned sternebrae. This unit is also in close proximity to canid remains at the site possibly indicating that this element belongs to the Canidae family.

5.4.8 Avian Remains

Bird remains were recovered from two units which include, 105N 95E and 107N 98E. Unit 105N 95E produced the burned long bone which suggests cultural activity. This unit is between two bone features and is roughly a meter and a half away from Feature CB.

5.4.9 Rodent Remains

Rodent remains are present in twenty-three units, including, 98N 93E, 99N 90E, 99N 93E, 100N 95E, 101N 91E, 102N 92E, 102N 95E, 103N 94E, 103N 95E, 103N 96E, 105N 95E, 105N 96E, 106N 93E, 106N 94E, 106N 95E, 107N 91E, 107N 94E, 107N 97E, 108N 93E, 108N 96E, 109N 91E, 109N 92E, and 110N 90E. Of these remains only two units had the necessary landmarks to identify the remains to a species, these include the Sciuridae elements in unit 110N 90E and the Northern pocket gopher in unit 103N 94E. These two units are within a meter of a bone feature, however, there is no indication that these animals are associated directly with the features. There are 30 unidentifiable rodent remains that are possibly associated with features at

the site, including features, H, X, D1, F1, G1, H1, and CB. It is unclear whether the placement of these animal remains within features are the result of burrows after the formation of the site. The presence of rodent burrows during excavations suggest that many of these remains are likely intrusive. There is a concentration of unburned rodent remains in two units which include 107N 94E in Feature D1 and unit 107N 97E. This provides further evidence that the rodent remains at the Whiting Slough site are likely intrusive. The rest of the rodent remains are scattered amongst the remaining units described previously.

5.5 Summary

The Whiting Slough site nearly consists predominately of bison remains with only a small number of other species being present. There are a minimum of seven species reflected in the faunal record with bison having the greatest MNI of 54, followed by two canids, one Snowshoe hare, one Northern pocket gopher, one squirrel sized indeterminant rodent, one small carnivore, and one medium-sized bird. Bison remains are present throughout the majority of the units excavated and are common in each of the bone features. The greater amount of axial remains compared to appendicular remains suggests the site represents a processing site. This is also reflected in the high amounts of projectile points recovered and lack of other tools that would relate to a campsite. The presence of a concentration of canid remains accompanied by bison cranial fragments suggests that this site potentially has a ceremonial aspect. Rodent remains as well as bird remains lack any clear signs of butchering, however, may have been consumed due to some remains being burned and sharing similar taphonomic characteristics of the overall site. Due to the presence of rodent burrows during excavation suggests that many of these remains may be intrusive.

Distribution of remains are primarily the result of the butchering process at the Whiting Slough site. However, the remains that are present in the features were the result of human intervention. Also, the faunal materials may have been disturbed as a result of carnivore action. There are signs of carnivore chewing on bone remains which infer the potential of carnivores moving or removing bone materials from the site during or after occupation. However, due to the small amount of bones with carnivore chewing suggests that there was little carnivore involvement in faunal displacement at the site.

Chapter 6

Bison Herd Structure and Seasonality

6.1 Introduction

Through the analysis of specific bison bone elements at the Whiting Slough site it is possible to determine both bison herd structure and seasonality. Quantitative and qualitative analyses were completed on specific elements including proximal radii and lower mandibular tooth rows to determine the sex and age of the bison represented in the assemblage. This chapter will provide a brief background on bison herd structure and the seasonal movement patterns of bison on the Northern Plains. Following this discussion is an examination of bison population sex structure through bivariate analysis completed on proximal radii in the Whiting Slough site faunal collection. An analysis completed by Dr. Walker on the dentition of the mandibular teeth reveals data on the animals at the time of death and therefore the season in which the animals were harvested will also be discussed.

6.2 Bison Herd Structure and Seasonal Movement

6.2.1 Bison Herd Structure

Bison are gregarious animals that have herds that may consist of thousands of individuals or as low as four animals (Banfield 1974). The herd structure changes throughout the year. Most of the time the adults are separated by sex and only come together during rutting which typically runs from July until September, peaking in mid-August, though unseasonal rutting also occurs (Banfield 1974). The gestation period for bison is anywhere between 270 to 300 days, which means that parturition tends to occur anytime during mid-April to early June (Banfield 1974). Male calves will stay with the female herd for two to three years until they reach maturity, after which they will venture off and join the bull herds (Brink 2008).

6.2.2 Bison Seasonal Movement

Herds move with the availability of nutritious grasses. In North America this movement is dictated by the changing seasons. During the winter months bison herds move towards more parkland areas that are wooded and sheltered where forage may still be available (Brink 2008; Morgan 1978; Smith and Walker 1988). At this time bulls will depart from cows which in return allows for smaller herds to forage on the limited accessible vegetation. In the spring, when new grass growth has low nutritional value, herds will move out of the sheltered areas and into the grasslands (Figure 6.1; see also Brink 2008; Morgan 1978; Smith and Walker 1988).

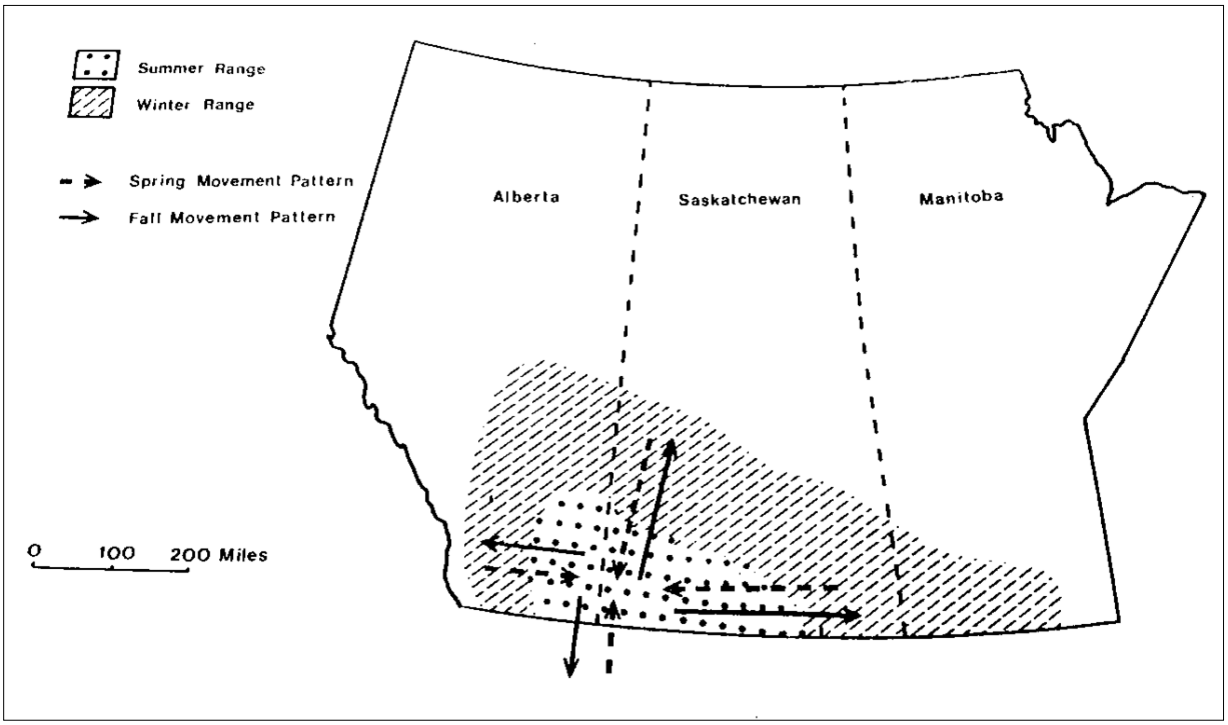

Figure 6.1 Bison movement patterns on the Canadian plains, adapted from Morgan 1978

Brink (2008) suggests that cows that are giving birth will stay longer in the wooded areas where they can be protected from predation. Shortly after giving birth they will rejoin their cohort heading onto the open plains. In the summer months when grasses are abundant and at their highest nutritional value, cows and bulls will aggregate on the grasslands and begin the rut

(Brink 2008; Smith and Walker 1988). After the rut, during the fall the herd will disperse into smaller male and female groups and head back to the parklands for the winter as illustrated in Figure 6.2 (Brink 2008; Smith and Walker 1988). These seasonal movements are mirrored by human groups on the Great Plains.

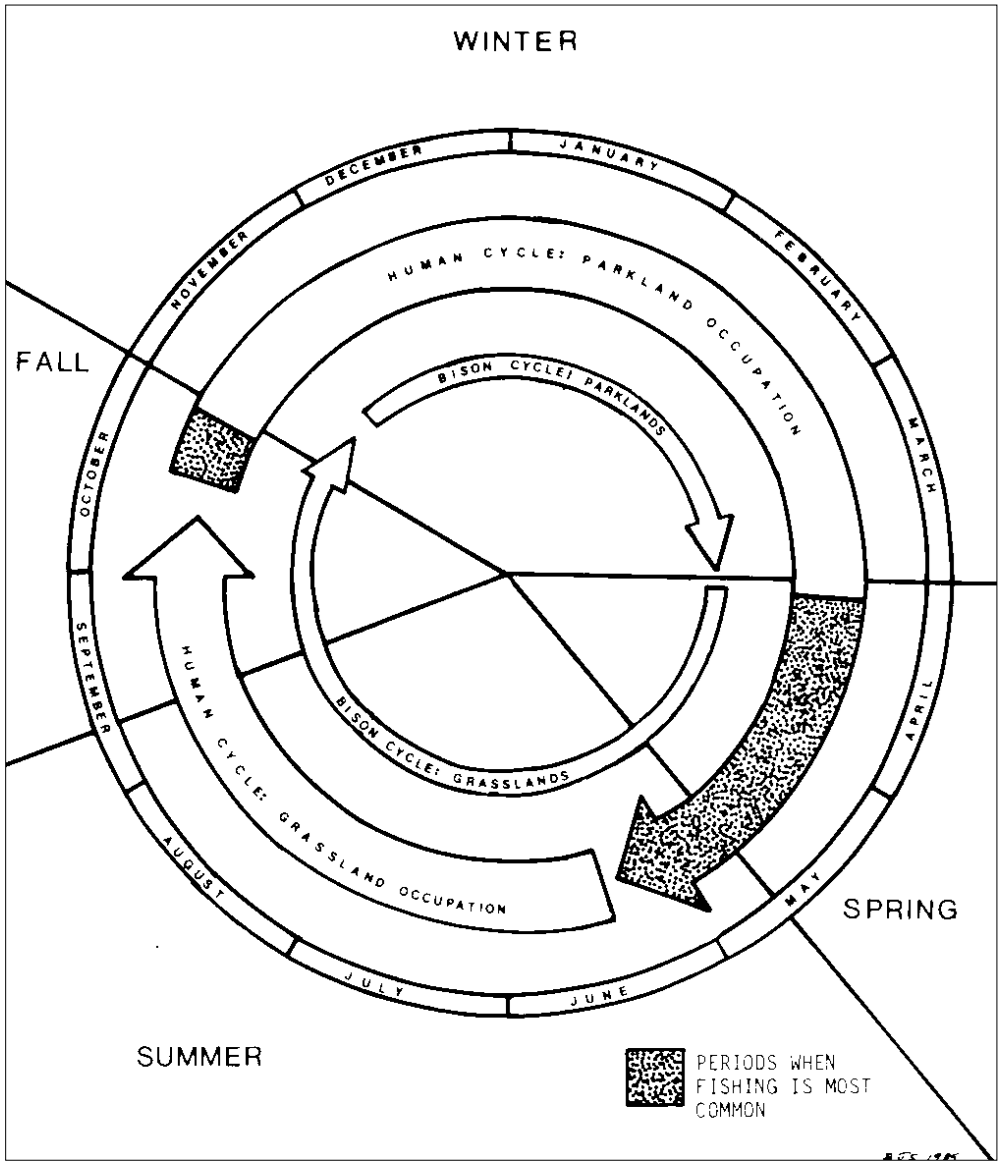

Figure 6.2 Seasonal movements of bison and human groups, adapted from Smith and Walker 1988

6.3 Bison Population Sex Structure

Differences in male and female bison can be distinguished through size variation. This difference is due to sexual dimorphism among bison males and females. These differences can be seen in the size and robustness of numerous skeletal elements as well as the variation seen among elements that are associated with bearing young and courtship (Reitz and Wing 2010). Adult males on average are 200 kg heavier than their adult female counterpart (Banfield 1974). Size of an animal is dependent on age and sex. Bulls reach their maximum size at the age of six while cows reach their maximum size at the age of four (Banfield 1974). A significant difference between male and female bison is at full development as bulls can weigh between 460 to 720 kg while cows range between 360 to 460 kg (Banfield 1974). These differences in weight are reflected in the skeletal remains where adult males will have larger elements than that of adult females. It should be noted that juvenile male skeletal remains will show similar metric values to those of adult female remains. Therefore, an over-representation of smaller remains in a collection may represent not only female bison but also juvenile males.

Due to the highly fragmented Whiting Slough site faunal collection a limited number of elements were available to be utilized for bivariate analysis. Elements that are commonly used in this type of analysis include carpals, tarsals, and long bone epiphyseal ends. The greatest dimorphism can be seen in limb bones especially at the proximal and distal ends (McDonald 1981). Therefore, these elements are preferred when comparing sizes among a collection for definitive male and female groups. Distal humerus and proximal radius are commonly used since they have high survivability during the butchering process (Frison and Todd 1987). In the Whiting Slough site assemblage, the most represented and complete element includes proximal

radii. Distal humerus remains were highly fragmented and those available failed to provide a clear clustering of male and female groups (Appendix B).

6.3.1 Proximal Radius Bivariate Analysis

A total of 13 proximal radii were used in bivariate analysis for classifying male and female bison. Frison and Todd (1987) found that plotting the measurements of two dimensions on the proximal radius against each other, the depth of the proximal articular surface and the greatest breadth, will reflect male versus female animals within an assemblage. Applying these measurements to the Whiting Slough assemblages produces the bimodal distribution between male and female individuals, seen in Figure 6.3 (see also Appendix C).

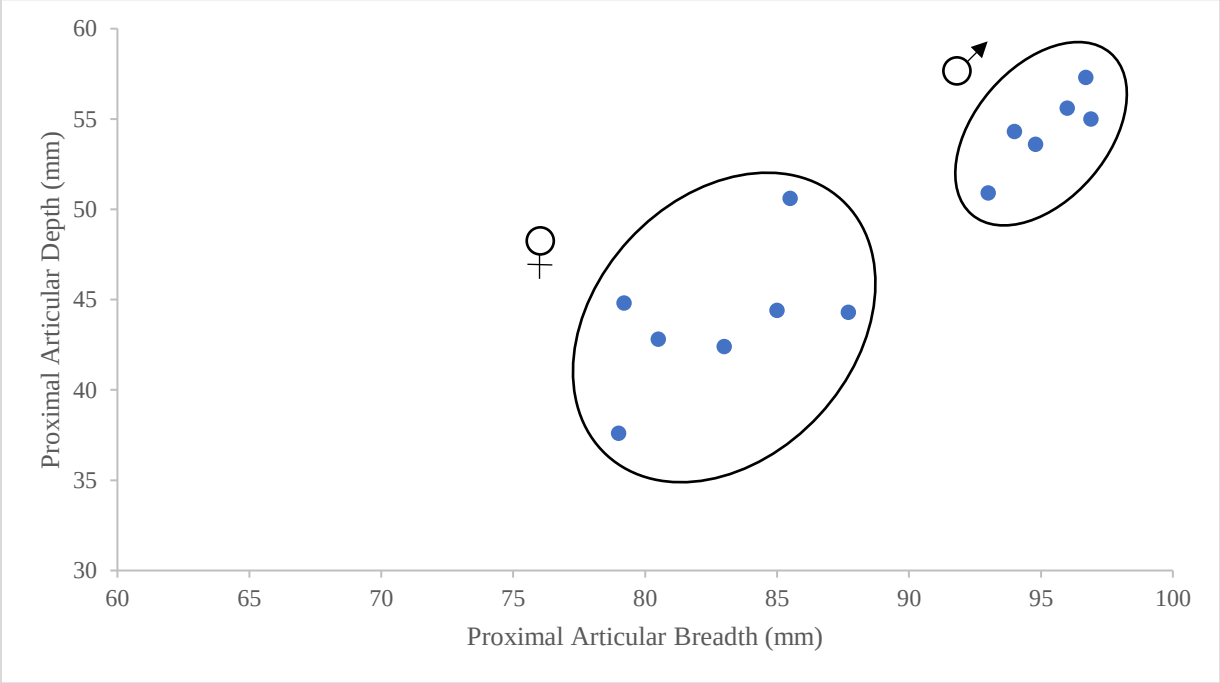

Figure 6.3 *Bison bison* bivariate plot of proximal radius

It is important to note that the small sample size (n=13) will influence the credibility of the findings, which in return will produce a less accurate representation of the bison population at the Whiting Slough site. Based on the distribution created by the bivariate analysis it indicates that there is a combination of both male and female bison within the Whiting Slough site

assemblage. Figure 6.3 suggests that there are six males and seven female/immature individuals present. The fragmented nature of the assemblage and small sample size must be considered when interpreting these results. Combining this information with the results of the dentition studies of the mandibular remains will provide the season in which the procurement took place.

6.4 Bison Dentition Age Assessment Studies

The age assessment study was completed by Dr. Walker (U of S Department of Archaeology and Anthropology) in which he examined a sample of incomplete bison mandibular dentitions and in a few cases isolated third molar teeth. Ideally, intact mandibles with complete dentitions would be used in this type of analysis. The sample size was extremely small (n=12) due to fragmentation of the entire faunal assemblage as previously described. As a result of the small sample size, it is likely that additional age groups were present in the original population. With one exception, all age assessments were based on enamel attrition. The absence of the younger age groups makes the establishment of the age cohort sequence less reliable and this factor must be considered when evaluating the age assessment results. The following section will describe the age groups present in the Whiting Slough site faunal assemblage.

6.4.1 Group Descriptions

Group 1, 0.6 years

There are no specimens in this group.

Group 2, 1.6 years

This group contains one specimen, in which the M_1 is in full wear with the exception of the exostylid which is 8 mm below the cusp margin. M_2 shows slight to moderate wear especially on facets I, III, V, and VII. The exostylid is unworn and is 14 mm below the cusp

margin. The roots are not fully developed. M_3 is unerupted and there is very slight wear on facets I and III. The hypoconulid shows no wear.

Group 3, 2.6 years

There are no specimens in this group.

Group 4, 3.6 years

This group contains four specimens. M_1 is in full wear, but not the exostylid. The metaconid height is 32 to 34 mm. M_2 is in full wear but not the exostylid. M_3 shows only slight wear of facets VII and VIII. The exostylid is not in wear and is 22 to 24 mm below the cusp margin. The hypoconulid is not in wear and the M_3 metaconid height is 63 to 68 mm. The roots are not fully developed.

Group 5, 4.6 years

There is one specimen within this group. M_2 is in full wear including the exostylid. M_3 is also in full wear including the exostylid and hypoconulid although the latter is not separate from the other cusps. The base of the enamel is at the level of the alveolus.

Group 5 (all adult animals)

Group 5a, 5.6 years

There are no specimens in this group.

Group 5b, 6.6 years

There is one specimen in this group and the P_4 is in full wear. M_1 shows some narrowing of the fossettes, but both are still visible with the exostylid in wear. The metaconid height is 22 mm. M_2 is in full wear including the exostylid. M_3 is in full wear including both the exostylid and the hypoconulid. The M_3 metaconid height is 44 mm.

Group 5c, 7.6 years

There is one specimen within this group and the P_4 is in full wear. M_1 shows some cupping with both fossettes still visible although the prefossette is nearly obliterated. The M_1 metaconid height is 17 mm. M_2 is in full wear including the exostylid. M_3 is in full wear including the exostylid and hypoconulid although the latter is not separate.

Group 5d, 8.6 years

This group contains two specimens. M_1 is markedly cupped with only a remnant prefossette. The metaconid height is 9 to 11 mm. M_2 is in full wear including the exostylid. M_3 is in full wear with the base of the enamel near the alveolus.

Group 5e, 9.6 years

This group only contains one specimen. M_1 is cupped and the postfosette is now lost. The exostylid is nearly gone and the base of the enamel is well above the alveolus. M_2 is in full wear including the exostylid. M_3 is in full wear including the exostylid and the hypoconulid. The hypoconulid is not separate and the base of the enamel is at the level of the alveolus. The M_3 metaconid height is 24 mm.

Group 5f, 10.6 years

There is one specimen within this group. M_1 is severely cupped and the exostylid is obliterated. M_2 is cupped and the exostylid is barely visible. M_3 is in full wear including the exostylid and hypoconulid. The latter is not separate and the metaconid is 19 mm.

6.4.2 Bison Dentition Age Assessment Studies Summary

Based on the analysis completed by Dr. Walker the Whiting Slough site bison dentition age assessment indicates the animals were procured in the late fall or early winter. This conclusion assumes that the birthing season took place between mid-April and early June. These

results must be weighed against the three important factors: (1) the incomplete nature of the assemblage, (2) the small sample size, and (3) the absence of the younger age groups.

6.5 Discussion

Due to the highly fragmented nature of the Whiting Slough site faunal assemblage only small sample sizes were available for analysis. This in return limits the interpretations of the results and conclusions. Bivariate analysis was limited to 13 proximal radii as they were the most abundant and complete element in the collection. The dentition studies were also limited to a small sample of 12 specimens. When compared to the MNI of 54 bison within the site these samples represent less than a quarter of the minimum number of animals.

Evidence for seasonality from other sources such as non-bison remains are absent at the Whiting Slough site. The non-bison remains that have been identified provide no further information on seasonality as these animals are common within this region throughout the year.

The sex and age analysis completed on the Whiting Slough site bison assemblage is rather limited in regard to conclusively documenting bison herd structure and age of animals. The major issue here is the small sample size in both the sex and age analyses which as a result may have produced a less accurate representation of the dispatched bison at the Whiting Slough site. It is important to note that having an age rate of x.6 and both sexes represented is not uncommon for an early winter kill.

The bison dentition studies indicate a herd with ages at x.6 years which places the time of procurement sometime in October and November. This conclusion assumes the birthing season was restricted to April and May. The homogeny of the age rate provides further evidence that this is a early winter procurement event. Understanding the season of death provides insight into the climatic conditions during occupation. A kill during this time of year indicates that

temperatures potentially could be near or below freezing especially throughout the night. Therefore, snow may have been present at the time of the kill. There is also the possibility that wetlands, sloughs, and other bodies of water were frozen. It is important to consider the seasonal conditions when interpreting the procurement strategy.

6.6 Summary

Herd structure and seasonality at the Whiting Slough site was completed with a limited number of analyzable bison elements. These items produced a bivariate distribution of male and female herd members with a homogenous age rate of x.6. This information indicates that the season of procurement took place in the late fall or early winter at a time when herds enter more parkland and wooded areas to forage on the limited edible vegetation available. As previously discussed, the high degree of fragmentation of faunal materials throughout the Whiting Slough site has limited the analysis for herd structure and seasonality at the site. These limitations must be considered when interpreting these results and conclusions.

Chapter 7

Taphonomy

7.1 Introduction

Taphonomy is the study of alterations to bone that occur during their transition from the biosphere to the lithosphere (Lyman 2010). In archaeology, this transition is important to understand in order to have a clear picture of the forces involved during and after the formation of a site. These forces include both the natural and cultural changes that leave visible signs on bones. This chapter will provide a detailed discussion on what taphonomy is and why it is important in archaeology. This is followed by an examination of whether the changes on bone materials at the Whiting Slough site are the result of natural or cultural processes or a combination of the two in order to understand the degree to which these changes provide information on the content and structure of the site. Natural taphonomic agents that will be discussed include carnivore and rodent damage and disturbance, root etching, weathering, as well as pathologies and abnormalities. Cultural taphonomic agents that will be examined include butchering patterns and processing alterations. A comprehensive discussion on the information gathered from the taphonomic analysis of the Whiting Slough site faunal assemblage will be discussed.

7.2 Taphonomy

Taphonomy is used in archaeology as a tool to understand aspects of past human behaviour through the modification, preservation, and destruction of faunal and plant remains in the archaeological record (Lyman 2012). Zooarchaeological research describes and detects these changes on bone materials to conclude whether they are the result of natural or cultural activity. Lyman (2010) explains that the goal of taphonomy is to understand why bone materials in

archaeological contexts are in the shape that they are in and what the processes were that led to these changes or the lack of these changes. From this information it is possible to deduct the activities and processes that were taking place during the life and death of the bone elements. Taphonomic processes are prone to removing parts or sections of bone which removes information, however, at the same time these changes also add information (Lyman 2010). For example, gnawing on a bone may erase parts of the bone and take away information, yet it also indicates that carnivores were present. The purpose of a taphonomic analysis is to deduce what caused these changes and why it is important in archaeological contexts. These changes may inform archaeologists on the behaviours and activities of past people.

Another key aspect to note in taphonomic studies is that the interpretations generated from these modifications are dependant on uniformitarianism and analogy to connect the present to the past (Denys 2002). These theories are pivotal as it allows archaeologists to make assumptions about human behaviour in the past based on the taphonomic characteristics recorded in the present. Ethnoarchaeolgocial research completed by Binford (1978) with the Nunamuit has helped provide insight on the processes involved with butchering a kill after a hunt. Binford (1978) found that certain animal parts will be processed to a higher degree due to their nutritional value while other parts will be discarded. Therefore, misrepresentation of bone elements may in fact inform archaeologists that these animal parts are of higher utility to the group processing the animal. As a result, reoccurring taphonomic signatures on high utility bones become more common. Cultural taphonomic signatures, especially those that produce a pattern, will present information on past human behaviour and provide important details about the overall content and structure of a site.

It is important to differentiate between natural and cultural taphonomic signatures as some of the destruction to the faunal materials is not the result of human manipulation. Having this distinction provides a clearer understanding of what processes caused what destruction allowing for a better interpretation of the events that took place at an archaeological site.

7.3 Natural Taphonomic Agents and Processes

The alterations that have occurred on the bone materials at the Whiting Slough site provide insight into the processes that occurred during and after the formation of the site. Natural taphonomic agents and processes are the visible signs left on bone materials that are the result of non-human involvement. It is important to understand these changes so that it does not misrepresent the alterations that are the result of the occupants of the Whiting Slough site. This section will discuss the natural taphonomic agents and processes which include carnivore and rodent damage and disturbance, root etching, weathering, as well as pathologies and abnormalities.

7.3.1 Carnivore and Rodent Damage and Disturbance

The presence of carnivore and rodent damage can be seen through the distinct marks on bones that are produced from chewing and gnawing. Carnivores produce damage to bone which include pits, punctures, furrows, and scoring (Binford 1981; Byers 2011). Along with damaging the bones, carnivores can also displace the remains, either horizontally through wallowing and trampling or transporting the bones when consuming. There are a variety of carnivores – wolves, coyotes, fox, domesticated canids and rodent species – that occupied the Whiting Slough area and could damage and displace bone remains during and subsequent to the Avonlea period.

Carnivore modification is evident on numerous bones at the Whiting Slough site. Damage is present on 21 specimens all of which are unburned (Appendix D). Ten specimens are

unidentifiable while 11 have been identified as bison, including, one femur, one tibia, six rib fragments, one vertebra, one hyoid, and one pelvic specimen. A rib, vertebra, and hyoid are associated with Features A, B, and I. The rib specimen has rodent gnawing present while the vertebra and hyoid show signs of carnivore damage. It is unclear whether these remains were purposely placed there or moved there by carnivore activity. Of the 21 elements eight specimens have rodent chewing, including, one femur, one tibia, two ribs, and four unidentifiable remains. The marks left on these remains include small parallel scars credited to the gnawing of rodents, as seen in Figure 7.1.

Figure 7.1 Note arrow pointing at an example of rodent gnawing

Evidence of larger carnivore modification such as canid is present on 15 specimens, including, four ribs, one vertebra, one pelvis, and nine unidentifiable bones. One of the four rib fragments show signs of punctures. Punctures are the result of soft cancellous bone being imprinted due to a carnivorous tooth (Binford 1981). Visible signs of extensively pitted gnawing are evident on two rib fragments, as seen in Figure 7.2, as well as on one unidentified specimen.

Figure 7.2 Carnivore-produced extensively pitted rib fragments, note black lines denoting extent of damage

Extensively pitted gnawing is produced when a carnivore breaks down soft cancellous bone during consumption leaving the harder bone pitted (Binford 1981). The remaining carnivore damaged specimens in the Whiting Slough site faunal assemblage show signs of carnivore scoring. An example of this type of damage can be seen in Figure 7.3 and Figure 7.4 as present on a bison pelvic bone. Scoring is the result of carnivorous teeth being dragged across dense bone leaving relatively straight rounded grooves (Binford 1981).

Figure 7.3 Carnivore scoring on bison pelvic bone, note black oval highlighting damage

Figure 7.4 Close-up of carnivore scoring on bison pelvic bone, note black oval highlighting damage

Visible carnivore and rodent modification on bone at the Whiting Slough site is limited. This suggests that carnivores and rodents had minimal involvement in the transformation and destruction of the site. However, there is the possibility that bone materials may have been dispersed across the site due to carnivore and rodent interaction causing disturbances in bone distributions. Bone materials may have also entered the Whiting Slough site from other locations due to carnivore and rodent activities. These factors are important to consider in understanding the taphonomy and bone patterns at the Whiting Slough site.

7.3.2 Root Etching and Weathering

The faunal materials at the Whiting Slough site have been subjected to numerous modifications. These include root etching, abrasion, and polishing. The majority of the faunal materials in the assemblage have root etching present. Root etching is identified by irregular winding lines that have carved their way over the periosteum of the bone, as seen in Figure 7.5.

Figure 7.5 Note black oval highlighting an example of root etching from the Whiting Slough site faunal assemblage

Root etching is due to a chemical reaction from acids involved in the growing and decaying of roots that formed directly on bone surfaces (Behrensmeyer 1978). The presence of root etching on materials at the site indicates that some of the deterioration and fracturing of bone materials are the result of roots. The impact on bones from roots may be minimal however this increases the chances of other taphonomic forces deteriorating the bone materials.

Natural abrasion and polish are two taphonomic agents that modify the appearance of bones. These weathering agents remove material from the surface and edges of bones as a result of being subjected to sedimentary particles, windborne particles, as well as water (Fisher 1995). Modifications such as these can start altering bone materials at any instance during the death, butchering, deposition, excavation, and storage of the animal. Each of these processes can leave visible damage on the bones due to the materials that have travelled across the surface of the bone.

Faunal materials in the assemblage at the Whiting Slough site have signs of abrasion and polish. This modification is partially due to the sandy and wet sediment in which the materials were retrieved. Natural actions including aeolian and fluvial processes aided in smoothing and polishing some of the bone materials at the Whiting Slough site. Aeolian action, also known as wind erosion, likely assisted in the moving of fine to coarse sediment across faunal materials. This process would have occurred during the formation of the site and into modern times up until the site was excavated. Fluvial action, known as movement by water, has also likely aided in the abrasion and polishing of the faunal materials at the site. The site is in close proximity to standing water which indicates that the drainage at certain depths at the site was poor. This is confirmed by some excavation units contacting the water table at roughly 60 cm DBS during the 2017 U of S field school excavation.

Another cause for abrasion and polish on faunal materials is due to animal trampling and wallowing as well as consumption. The effects of animal trampling and wallowing can cause shallow subparallel striations on the surfaces of bones that look similar to the cut marks from stone tools (Behernsmeyer et al. 1986; Denys 2002). Denys (2002) notes that this type of taphonomic signature is more prevalent in sandy soils. A total of 79 specimens in the Whiting Slough site faunal assemblage have abrasions from this type of activity. This indicates that bone materials at the site have possibly been displaced and randomized by large animals. It should be noted that in wet conditions animal trampling and wallowing can increase vertical downward movement of bone materials (Denys 2002). Animal trampling and wallowing can also account for breakage and deterioration of some of the bone materials within the assemblage. Polish on the edges of bone materials may also be the result of animal consumption and repeated licking (Gifford-Gonzalez 2018). These activities will cause edges to become rounded and smooth. It is problematic to confirm which faunal materials from the Whiting Slough site are the result of these activities, given that multiple weathering forces may cause similar damage.

7.3.3 Pathologies and Abnormalities

Pathologies and abnormalities are typically caused by disease that alter the form of a bone. Roberts and Manchester (2005) define pathology as the study of suffering since it examines the science of disease. In archaeology, pathology helps provide insight on the life cycle of the animals that have abnormal variation in their bone remains. These abnormal variations can provide information on what types of diseases were present as well as what sorts of activities these animals were performing. Depending on the type of pathology present on the remains these indicators can provide insight on whether the abnormalities reflect cultural activities or if the abnormalities developed out of natural circumstances.

The Whiting Slough site has several specimens that show signs of pathologies and abnormalities. These taphonomic features are present on two bison remains and ten canid remains. The bison remains include a double headed rib, as seen in Figure 7.6, as well as an abnormal atlas vertebra, as shown in Figure 7.7.

Figure 7.6 Double headed bison rib

Figure 7.7 Atlas vertebra with acute hematogenous osteomyelitis, note arrow pointing at sinus drainage

The double headed bison rib likely has a congenital origin where it naturally formed over the lifetime of the individual eventually ossifying two ribs at the neck. The atlas vertebra shows signs of acute hematogenous osteomyelitis which is triggered by an exudate-producing bacteria that causes inflammation of bone and marrow (Aufderheide and Rodriguez-Martin 1998). This infection likely was induced by a wound and is located on the right lateral transverse process of the atlas. Parts of the bone have died while the surrounding bone continues to live which produces new bone growth (Aufderheide and Rodriguez-Martin 1998). The new bone affects blood supply which in return creates a sinus drainage that can be seen on the lateral edge of the transverse process, as seen in Figure 7.7. This infection could have been caused by predation or by numerous other impacts during the life of the animal. Seeing that the specimen shows signs of healing the animal was able to live with this infection and it did not cause the death of the animal.

There are ten canid specimens that show signs of pathologies and abnormalities. Pathologies and abnormalities are represented on both of the canids at the site. One specimen shows signs of a healed abscessed tooth on the lower right mandible. The abscess is the result of an avulsion of the first molar as shown in Figure 7.8. This break likely occurred early in the canid's life as it shows signs of healing.

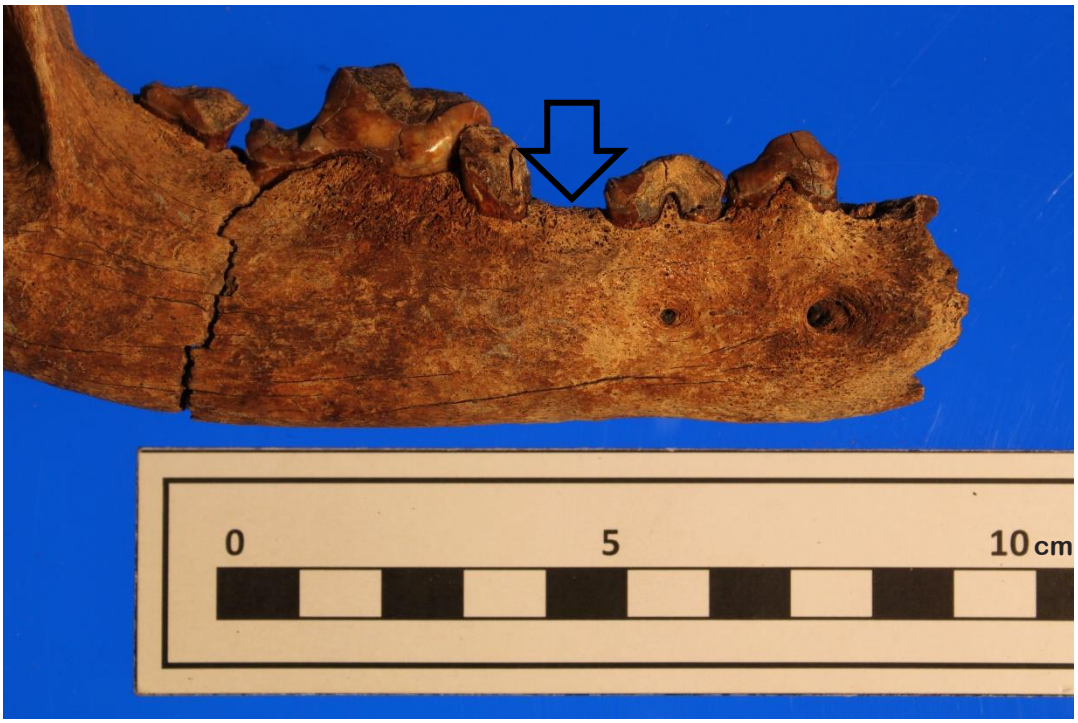

Figure 7.8 Healed mandible, note arrow pointing at porous bone

The remaining nine specimens were retrieved from the purposely buried canid in Feature CB. These specimens include seven vertebrae that show signs of degenerative joint disease (DJD), and two phalanges that show signs of eburnation. DJD is produced when cartilage that covers a bone is worn down due to stress and injury (Anon 2010). This degradation will cause bone on bone contact which will eventually generate the growth of painful bony spurs called osteophytes (Aufderheide and Rodriguez-Martin 1998). Many joints are prone to DJD especially ones that are weight-bearing which will commonly be affected first (Aufderheide and Rodriguez-Martin 1998). The growth of osteophytes is present on seven vertebrae, and examples can be seen on five vertebrae in Figure 7.9. These bony growths appear on the lateral and ventral margins of the centrum and bridge from one vertebra to the next. A close-up of the osteophytes can be seen in Figure 7.10.

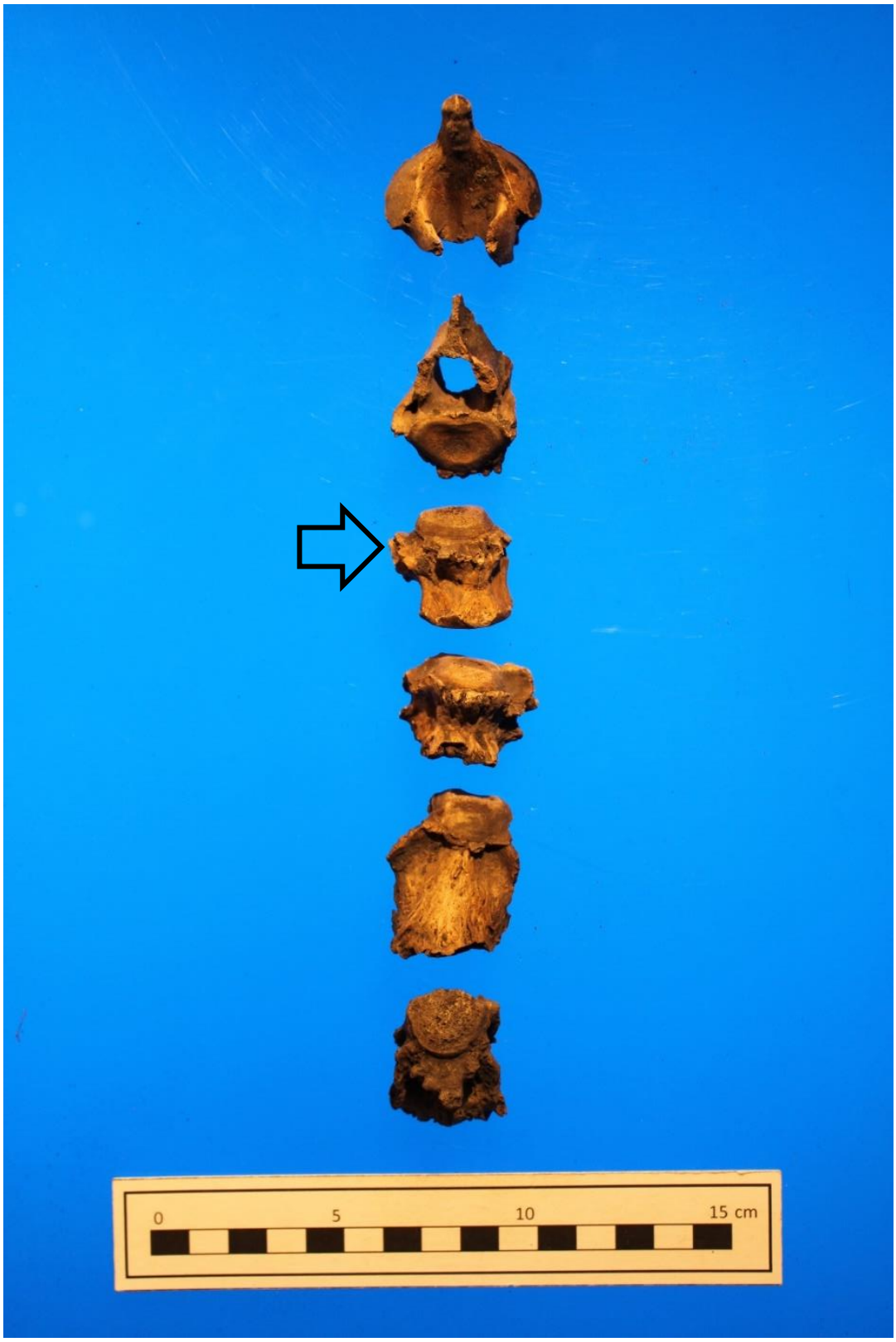

Figure 7.9 Degenerative joint disease on canid vertebrae, note arrow pointing at an example of an osteophyte

Figure 7.10 Lateral view of osteophytes on ventral margin of canid vertebra

Two phalanges from this canid present signs of eburnation on the proximal joint surfaces. Eburnation, a result of arthritis, refers to bone that has a shiny or polished appearance due to bone on bone contact (Ortner 2003).

The signs of DJD on the canid from Feature CB may indicate that this animal lived a long life. In humans, DJD is more common later in life which may imply that the canid in the Whiting Slough site faunal assemblage was older than what is expected for a wild animal when it passed away (Aufderheide and Rodriguez-Martin 1998). If this were the case then there is potential that the canid was domesticated and people were taking care of the animal, however, it is unclear. Due to a lack of elements from this canid it is difficult to conclude that the degradation affecting the vertebrae and lower limb bones are a result of cultural activity and utilization.

7.4 Cultural Taphonomic Processes

Cultural taphonomic processes are the visual signs and marks left on bones as the result of human action. These indicators can be produced due to the butchering method and how the

animals were processed. By examining the changes that have occurred on the faunal assemblage at the Whiting Slough site it can be deduced which alterations are the result of cultural activity.

7.4.1 Butchering

The butchering process will leave a variety of modifications on bone that provide evidence on the degree to which these faunal remains were processed. Signs of butchering include cut marks and bone breakage patterns.

There are no conclusive cut marks present on the faunal materials excavated from the Whiting Slough site. All striations on the bone materials are likely due to abrasion from coarse sandy sediment. The lack of definitive cut marks is in part due to the highly fragmented nature of the assemblage. Weathering and other natural taphonomic processes likely reduced the visibility of this type of alteration due to deterioration and destruction.

Bone breakage patterns provide a clue as to the degree to which animals were processed and what bones were favoured. Depending on what type of processing that occurs, several methods of butchering may be utilized. Variation in disarticulation of an animal may be dependant on whether the animal will be boiled in a pot, roasted over a fire, cut into slices for dry jerky, or stored over winter (Gifford-Gonzalez 2018). Highly fragmented bone may not only represent marrow removal for frying purposes and grease extraction, but also reducing of bone size to fit within a cooking vessel or over a hearth (Leechman 1951; Oliver 1993). These variables need to be considered when examining faunal materials within an archaeological context.

Three common blunt force trauma fractures related to butchering animals include spiral, hinge, and impact. A spiral fracture is caused by excessive torsion on a bone which will eventually produce an oblique-like break along the long axis of the bone (Byers 2011). A hinge

fracture is produced from blunt force and will result in the separation of bone causing a linear fracture and flaking. An impact fracture is the result of blunt force and will leave a sharp edge around the area of contact. It is important to differentiate between natural and cultural breaks. As previously discussed, bone breaks can be the result of natural forces such as a consequence from animal trampling and wallowing. Myers et al. (1980) have documented that animal trampling on slightly weathered bone can produce spiral fractures. It is important to consider that not all of the remains with spiral fractures are the product of the butchering process at the Whiting Slough site. However, this dilemma can be mitigated by examining pattern breaks that are represented multiple times on identifiable bones in the collection. These breaks will occur relatively in the same location on a bone and will share similar characteristics with other bones in the assemblage.

Spiral, hinge, and impact fractures are represented on a wide variety of identifiable and unidentifiable bone remains at the Whiting Slough site. There are 1,170 spiral fractures present on bison bone, with only 190 being identifiable elements, as well as one present on a canid specimen (Appendix E). Forty-eight bison specimens have signs of hinge fractures and of these 29 are identifiable. Another six bison remains have impact fractures, three being identifiable elements. A total of five bison bones have both hinge and impact fractures present with two being identifiable.

Spiral fractures are limited on bison cranial and mandibular elements. Only one cranial remain and two mandibles have this type of fracture. Identifiable cranial specimens are minimal at the Whiting Slough site. They include mostly anterior bones such as the premaxilla, maxilla, mandibles, teeth, with the exception of the petrous temporal, suggesting that the highly fragmented nature of the skulls may be the result of crushing the craniums and mandibles to get

to the brain as well as the tongue. Other reasons for underrepresentation of these cranial elements may be due to these specimens being deposited elsewhere. There are two fragmented coronoid processes in the faunal assemblage. A low number such as this suggests that this element likely was crushed during the butchering process. The breaking of mandibles in this location is common when extracting the tongue of a bison.

There are a large number of bison vertebrae present in the Whiting Slough site faunal assemblage. The cervical vertebrae in the collection lack any signs of spiral, hinge, or impact fractures. However, most specimens are incomplete as there are 322 cervical vertebrae elements in the collection and only 27 are complete. Of the 27, seven are identified as atlas and eight as axis vertebrae. Butchering of cervical vertebrae elements may be the result of both disarticulating the head and acquiring meat from the neck muscles. There are no visible signs of cut marks on these specimens to suggest this method of disarticulation, however, these taphonomic signatures may have been removed due to weathering and burning. Smashing vertebrae may have been incorporated when butchering the animal, however, there are many cervical vertebral elements still complete in the assemblage.

There are 280 thoracic vertebrae specimens in the assemblage all of which are incomplete. No cut marks are recorded on these specimens. Two vertebrae show signs of spiral fractures on the spinous process. This may indicate that the meat present on this bone was removed through breaking the spinous process. All 138 lumbar vertebrae in the assemblage are incomplete. The lack of complete lumbar vertebrae suggests that these bones may have been deposited elsewhere or were crushed by the butchering process, or fragmented by other weathering processes. Sacral elements are highly fragmented and are limited, as there are 25 specimens in the assemblage. The low number of this type of vertebrae may relate to the

butchering and disarticulation of the pelvis. Caudal vertebrae are also lacking as there are 15 specimens present. These vertebrae may be misrepresented due to being deteriorated by weathering processes, deposited elsewhere, or moved by carnivore action.

Bison rib specimens are highly represented in the faunal assemblage which is made up of 901 incomplete ribs. There are 305 ribs that include the heads and parts of the neck and body as well as 596 rib bodies. Of the 305 rib heads there are 30 unburned ribs that have signs of spiral fractures. Of the 596 rib bodies 48 have signs of spiral fractures with one being burned. These breaks are signs of a typical method involved in removing ribs from the spinal column near the vertebral end (Frison and Reher 1970). A hammerstone, chopper, or large dense bone including a mandible or limb element could have been utilized to break the ribs during butchering (Frison and Reher 1970). The lower amount of rib heads compared to rib bodies may be the result of this type of butchering process where a large dense tool was used which fractured and deteriorated identifiable features of the rib. It should also be considered that carnivores may have displaced some of these remains since there are signs of carnivore damage on several rib specimens. There is almost an even amount of left (145) and right (135) ribs in this collection which suggest that both sides of the animal were butchered and processed.

Scapula specimens are highly fragmented at the Whiting Slough site. There is a total of 63 specimens made up of 19 glenoid fossa, 15 spine, and 29 blade fragments. No cut marks were observed on these remains. Fragmentation in this manner may suggest that the forelimb was being chopped off at the neck of the scapula. This would allow the forelimb to be more easily processed. It should also be considered that some of the fragmentation could be the result of other natural taphonomic agents.

Marrow bones in the forelimb consist of the humerus, radius, and the metacarpal. These bones tend to show more signs of processing as a result of acquiring marrow. Humerus remains are fragmented in this assemblage and are comprised of proximal, shaft, and distal fragments. There is a total of 64 specimens with 13 proximal ends, 12 shaft fragments, and 39 distal ends. Of the proximal remains eight specimens show signs of spiral fractures, one of which also has a hinge fracture. All but one shaft fragment show signs of spiral fractures with one also showing signs of a hinge fracture. The distal humerus remains consist of 13 specimens having spiral fractures, three of which also have hinge fractures as well as one with hinge and impact fractures. Chopping this bone at the proximal and distal ends will expose the large marrow cavity (Frison and Reher 1970; Frison 1978a). Therefore, fragmentation to this degree on humerus remains at this site is likely the result of extracting bone marrow.

Radius remains are also highly fragmented in this assemblage and consist of 57 specimens. Proximal ends are represented the most with 31 specimens, 12 of which have spiral fractures and of those three show signs of hinge fractures. Shaft fragments are less represented with only nine being identified, five of which have spiral fractures with one also having an impact fracture. The distal ends are common with a total of 17 specimens, two having spiral fractures as well as one with a hinge fracture. Marrow and grease extraction may be the reason for this degree of fragmentation.

Ulna specimens are also fragmented in the collection with a total of 30 remains. Fragmented proximal remains are most common and consist of 19 specimens with one having spiral fractures. Only one of the nine shaft fragments has spiral fractures. There are two fragmented distal specimens which lack any pattern breaks. The fragmented state in which these bones are in is likely the consequence of the grease removal process and affiliation with the

radius during marrow extraction. In the Whiting Slough site faunal assemblage there is one complete fused radial ulna which has no observed cut marks or other deteriorative characteristics.

There are no complete metacarpals in the collection. The specimens are comprised of 13 proximal ends, one shaft fragment, and seven distal ends. Spiral fractures are present on three proximal specimens and two distal remains. The cause of these breaks may be partially due to marrow extraction, the removal of lower limb elements as well as animal trampling and wallowing.

There are 44 carpals in the faunal assemblage and each lack any clear sign of cut marks or butchering. Some of these bones show signs of fragmentation likely due to natural taphonomic agents. Many of these bones show signs of burning and being heated.

There are 82 highly fragmented unburned pelvic girdle specimens in the Whiting Slough site faunal assemblage. The majority of the identifiable remains are from fragmented acetabular notches. No cut marks were observed on any of these remains. Butchering of this bone likely included chopping or smashing of this element to remove meat and the lower limb.

The hindlimb in the bison has three bones that are a good source of marrow which include the femur, tibia, and metatarsal. Similar to the forelimbs in this collection these specimens are highly fragmented. There are 50 unburned fragmented femur specimens that consist of 23 proximal ends, 16 shaft fragments, and 11 distal ends. The proximal ends have seven specimens that have signs of spiral fractures, one of which also has an impact and hinge fracture. There are 13 spiral fractures with three also having hinge fractures on the shaft fragments in the assemblage. Of the distal femur fragments seven have spiral fractures including one with a hinge fracture. Fragmentation to this degree may in part be due to disarticulating the

hindlimb from the acetabular notch. Evidence for these activities is the highly fragmented femoral heads and innominate in the collection. Other explanations for the high fragmentation of this bone is marrow extraction and bone grease acquisition.

Patella specimens in the collection are limited and incomplete. There are seven incomplete patella specimens two of which are burned. The fragmented and limited amount of this specimen may be the result of chopping this bone to disarticulate the femur from the tibia (Frison and Reher 1970). These specimens may have also been discarded at other locations either by humans or carnivores.

There are 80 fragmented tibia specimens consisting of 15 proximal ends, 30 shaft fragments, and 35 distal ends. Proximal tibia fragments are less represented than the lower half of the limb possibly due to being broken down due to disarticulation from the femur or for grease and marrow extraction. Pattern breaks can be seen on two proximal tibia specimens in Figure 7.11, which illustrates common spiral fractures.

Figure 7.11 Spiral fracture pattern breaks on two proximal tibias

Tibia shaft fragments are more common and show signs of spiral fractures on 24 specimens, four of which also have hinge fractures with one having an impact fracture too. Distal tibia fragments are the most common and have nine with spiral fractures, three of which also include hinge fractures. A common break in distal tibia in this assemblage can be seen in Figure 7.12. The high amount of spiral and hinge fractures on these limb elements indicates that these bones were being highly processed likely for grease and marrow extraction during the butchering process.

Figure 7.12 Spiral fracture pattern breaks on three distal tibias

Accompanying the tibia fragments are 18 lateral malleolus specimens that are nearly all complete and show no signs of butchering. The completeness of these specimens is the result of

being dense as well as being positioned on the lateral side of the distal tibia where smashing of this bone to extract marrow is less likely to occur.

There are two metatarsal specimens that are complete and another 20 that are fragmented. As previously discussed, the complete specimens are likely the result of the lower hindlimb being disarticulated at the distal tibia. There are eight proximal ends, four of which have spiral fractures as well as one with an impact fracture. Shaft specimens include four fragments with one specimen showing signs of spiral fractures. There are eight distal specimens, four with spiral fractures, two of which also have hinge fractures, and one also showing signs of impact fracturing. The fragmented nature of this element indicates that the lower limb likely was disarticulated at this point to remove the less valuable tarsal specimens. Fragmentation also indicates that marrow and grease extraction may have also been occurring.

There are 121 tarsal bones in the Whiting Slough site faunal assemblage, most of which are relatively complete. As previously discussed, it is likely that the hindlimb was disarticulated near or above the tarsal bones to allow for easier butchering of the meat and marrow rich long bones. There are no taphonomic signatures that suggest that the hindlimb was cut at these locations, however, the presence of some incomplete elements may indicate that crushing may have been utilized to disarticulate the lower portion of the hindlimb.

Phalanges in the collection are mostly complete with only a few being fragmented. There are no cut marks or signs of carnivore chewing present on any of these remains. Fragmentation may be caused by natural taphonomic agents including weathering as well as animal trampling and wallowing.

Non-bison remains that show signs of spiral fractures are limited to a tibia fragment of the canid that was recovered outside of Feature CB. All other non-bison remains lack pattern

breaks or other cultural induced damage. Fragmentation of these remains are likely due to other natural taphonomic processes such as weathering.

Unidentifiable remains in the Whiting Slough collection are comprised of highly comminuted bones ranging from 2 to 50 + mm in size. These types of bones make up the majority of the faunal collection. Spiral fractures are represented and likely are the result of butchering and blunt force trauma. The comminuted nature of these remains strongly correlates with the highly fragmented identifiable elements in the Whiting Slough site assemblage. These specimens are likely the result of marrow and grease extraction from long bones and other bone remains previously discussed.

The faunal materials in the Whiting Slough site assemblage are highly fragmented in part due to butchering activities. This level of fragmentation is likely due to exploiting the most edible remains as possible combined with extracting marrow and grease. Further fragmentation is likely increased by natural taphonomic agents following the formation of the site.

7.4.2 Processing

Another taphonomic feature recorded on the faunal specimens at the Whiting Slough site includes signs of burning. Burning of remains at an archaeological site may be the result of natural or anthropogenic causes. This section will discuss the use of fire in archaeological settings to distinguish whether burned materials from the Whiting Slough site are the result of natural or anthropogenic causes.

Fire has been used in numerous ways on the Northern Plains in precontact history. It is a tool used in cooking, tanning hides, smoking and drying meat, heating rocks for boiling pits as well as burning a bone bed once the utilization of the site is complete. It is difficult to distinguish between these types of activities since they all leave relatively the same damage to a bone (see

7.4.3 Discussion). However, examining the degree to which materials are burned can allow for a greater understanding of what forces were at play at the site. Brink (2008) explains that the intensity of a fire is based on the environmental conditions present. Natural prairie grass fires are common throughout the Northern Plains. They tend to burn at a low intensity and consequently fail to burn the soil. This is due to the biomass of the vegetation being low, therefore, once it is exhausted the fire will be extinguished. If a natural grass fire were to cross an exposed bone bed the remains would likely burn at a lower intensity causing less severe damage to the materials. Brink (2008) argues that calcined bone is an indicator of anthropogenic fires as it shows intentional ignition. Brink (2008) suggests that sporadic calcined bone throughout a bone bed is an indicator of multiple ignition sources, allowing for a higher intensity fire to consume the kill. As a result, there would be bone remains in the assemblage that will have varying degrees of burning.

The majority (58%) of the faunal remains at the Whiting Slough site show varying degrees of burning, many of which are unidentifiable elements. Identifiable bison elements are primarily unburned which is expected since the process of burning bones will deteriorate and erase features that will make the specimen identifiable. The frequencies of bison elements burned versus unburned can be seen in Figure 7.13 (Appendix F).

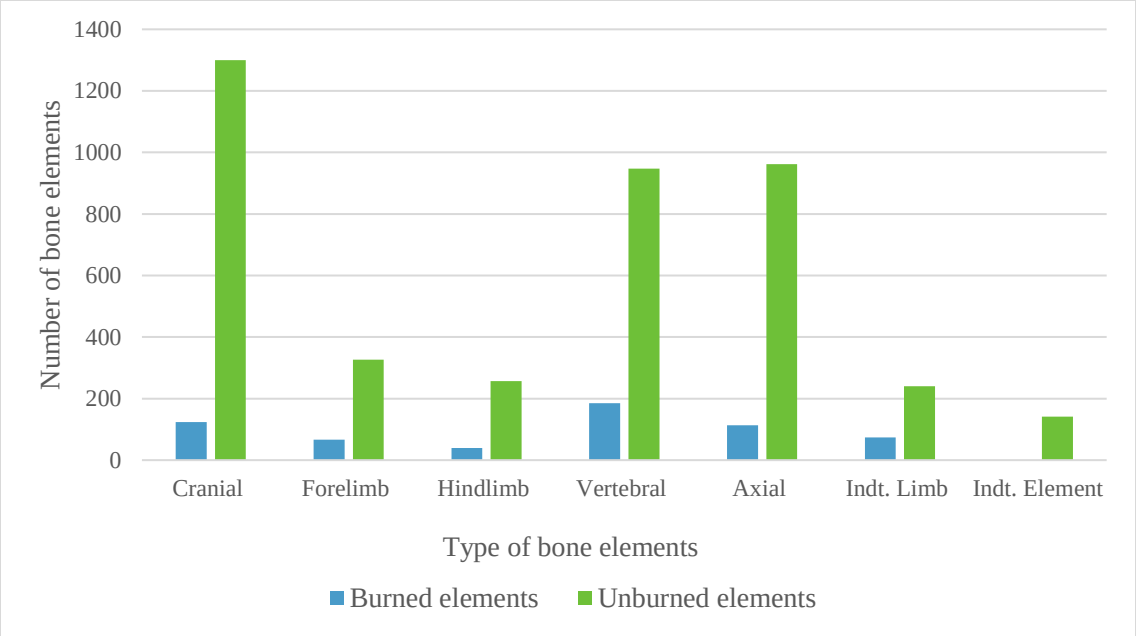

Figure 7.13 Bison element frequency burned versus unburned

Degrees of burning on bison specimens vary from calcined, completely burned, to partially burned. Only 1% of the bison elements are calcined which include a couple of cranial and tarsal elements. This is expected since calcined bone is the result of burning at temperatures as high as 800°C with materials that have enough biomass for constant burning (Byers 2011). Burning at high temperatures will cause extreme destruction of faunal remains, including shrinkage and bone remains turning white. The remaining burned bison elements were burned at temperatures reaching as high as 600°C which left the surface of the elements blackened but not calcined (Byers 2011). Burning of bison remains may be the result of cooking the animals, smoking hides, cleaning the kill, or a combination of each.

The canid elements in the Whiting Slough site faunal assemblage are primarily burned, with 76% of the specimens showing signs of burning as seen in Figure 7.14 (Appendix G).

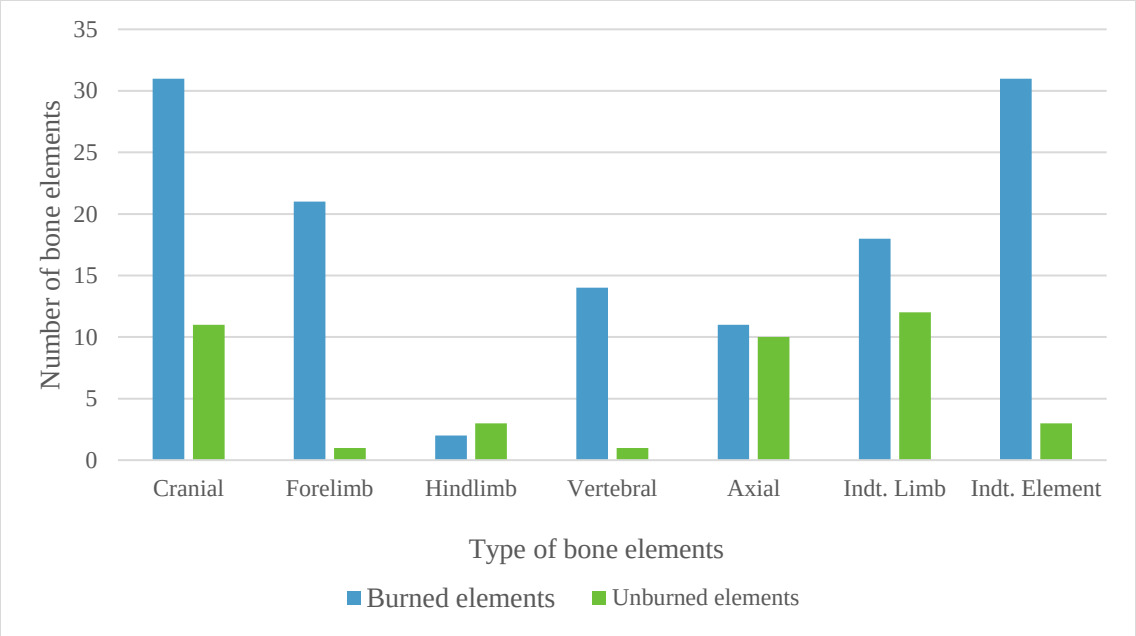

Figure 7.14 Canid element frequency burned versus unburned

The canid in Feature CB predominantly shows signs of burning which is present on 83% of the faunal elements. There are no specimens that are calcined. Uneven burning is common on the elements as seen in Figure 7.15.

Figure 7.15 Uneven burning present on canid elements from Feature CB

Temperatures reached roughly 600°C to produce burning to this degree. The burning of canid specimens, especially those in Feature CB, may be due to ceremonial reasons or is a result from burning the site once the occupants were done with it. Perhaps a combination of these two activities occurred with the canid elements at this site. The canid in Feature CB is where the majority of the canid specimens come from at the Whiting Slough site. These canid specimens differ from those found throughout other units at this site since these elements are directly associated with bison specimens many of which are cranial. The relationship between canid and bison faunal remains may be significant and may act as an offering for continual successful hunts. Features similar to this have been excavated at other Avonlea sites. At the Hardisty Bison Pound, Moors (2017) describes a ceremonial feature that consists of craniums of two calf and one adult bison being present at the entrance of the pound. It is interpreted to be an offering for the success of future hunts. It is possible that Feature CB at the Whiting Slough site has a similar function. Feature CB has evidence of calcined bone which suggests an intentional ignition source. Whether this is the result of ceremonial burning or cleaning the area of the kill is unclear. It is probable that Feature CB has a ceremonial aspect, however, the burning of these specimens may be the result of cleaning the site. There are no clear indicators on any of the canid specimens in Feature CB that suggest consumption of this animal.

Of the remaining species at the site, 72% of the elements show signs of burning. There are no specimens that are calcined. The degree of burning is similar to the bison and canid elements in the assemblage which were heated to temperatures of 600°C. These species may have been cooked and consumed by the occupants of the Whiting Slough site or were already naturally occurring at the site and became engulfed by a fire naturally. It is unclear due to a lack

of other butchering taphonomic characteristics that would suggest purposeful consumption, such as cut marks.

Unidentifiable elements are predominantly burned with 59% showing signs of burning. Calcined bone is common among these types of specimens which likely indicates cultural burning. The majority of the burning is characteristic of a black to brown discolouration indicating that it was burned at temperatures around 600°C. The calcined bone was recovered from numerous units at the site which may indicate intentional ignition sources, as these areas would have been burning for longer and at higher temperatures than the blackened and browned bone fragments in the surrounding units.

7.4.3 Discussion

The role of the taphonomic analysis on the faunal materials at the Whiting Slough site is to provide a clearer understanding of the events that took place there circa 1325 BP. Once the bison were dispatched skinning of the animals would have occurred. The results from the taphonomic analysis reveal no conclusive cut marks to speculate the method in which this was completed. Likely, this evidence is located at the unknown kill site. Once skinning was completed the primary mode of disarticulation included the crushing and smashing of elements through the use of a chopper, a hammerstone, and potentially any other implement that would suffice. After which, suitable elements for further processing were brought into the area of the Whiting Slough site.

At the Whiting Slough site, it is evident that bison elements were utilized to their maximum extent especially elements of high utility. From the taphonomic analysis completed it is demonstrated that the majority of disarticulation occurred at the unknown kill site. Low utility elements such as ones that fail to articulate with high utility elements are less common such as

lumbar vertebrae, caudal vertebrae, and parts of the innominate, suggesting that these elements were left behind at the kill site. The by-product of quick crude butchering at the kill site accounts for some of the low utility elements being represented at the Whiting Slough site. Once the appropriate cuts of meat were brought to the Whiting Slough site further disarticulation occurred.

Due to the high representation of anterior elements such as, cranial fragments, mandibles, and cervical vertebrae, it appears that the heads were removed possibly at the neck. The high representation of these elements is due to the fragmented nature of these elements and having distinct characteristics making them more susceptible to identification. These criteria need to be noted as it may slightly distort representation of elements. Nonetheless, craniums were highly fragmented suggesting brain removal and consumption. Verbicky-Todd (1984) explains that the brain including other organs of the bison have been enjoyed raw by Plains groups in the past. Mandibles show pattern breaks at the coronoid which is common for disarticulating the mandible from the cranium to extract the tongue. Historic and ethnographic literature have recorded that the bison tongue among other organs such as the heart, nose, and liver were considered delicacies (Verbicky-Todd 1984). Like the brain, the tongue may have been consumed raw moments after the kill took place. At the Whiting Slough site these cranial elements were fragmented as a result of being smashed.

Meat bearing portions of the bison including ribs, forelimbs, and hindlimbs were processed to high degrees. These elements were smashed for disarticulation and marrow extraction. This is evident from the pattern breaks common on marrow rich limb elements as seen in the examples of the proximal and distal tibia previously demonstrated in Figure 7.11 and Figure 7.12. Once meat and marrow were obtained from these elements further processing to

retrieve grease likely occurred. This conclusion is from the result of small unidentifiable fragmented bone being highly represented in the faunal assemblage.

Anthropogenic fires could serve numerous purposes at the Whiting Slough site. Reasons for the burned remains may be the result of one or a combination of the following including cooking meat, bone grease extraction, smoking hides, and cleaning the site. Extensive butchering of bones has been identified through the pattern breaks recorded within the assemblage, which indicates that meat, marrow, and likely bone grease were being extracted. After butchering the kill the following activities may have included, drying the meat, extracting bone grease, smoking hides, producing pemmican, and cleaning the site by burning.

The high amount of unidentifiable comminuted bone which totals a sum of 386,678 fragments with size varying from 2 to 50 + mm within the assemblage indicates that bone grease extraction likely occurred. Leechman (1951) describes grease extraction as a process that includes fragmenting bone into tiny thumbnail size pieces usually using a blunt object such as a hammerstone to create greater surface area of a bone. These tiny fragments are then placed in simmering water where they are cooked down allowing grease and oil from the specimen to float to the surface. The grease is retrieved from the top of the water and stored, likely in the inner part of a processed bison stomach, where it could keep for up to two to three years (Leechman 1951). Grease and oil can then be used in daily cooking as well as making pemmican. Fire is necessary for this process to occur which may include burning of discarded bison elements. At the Whiting Slough site there are multiple potential features that exhibit the characteristics of hearths along with the presence of charcoal which may indicate the burning of wood for these activities.

Preserving meat and drying hides is important and includes either drying the materials naturally or smoking them over a fire or a combination of both. These techniques will prolong

the life of the meat which then can be utilized in pemmican as well as allowing the hides to be used as adornments or to serve as other utilitarian functions. Drying meat naturally includes the use of solar energy and drying racks. Another common way to preserve meat and tan hides is through smoking. Brink (2008) explains that cuts of meat would be suspended over a smoking fire on wooden drying racks. Binford (1967) also provides insight from historical accounts on the Great Plains that describe the use of smoke for tanning hides. He explains that a small hole is dug into the ground where a small fire is ignited. Once a layer of charcoal is present, low flammable materials are placed on top which produce smoke. A hide is then stretched over these features and the hide tanning process ensues. Low flammable materials may include raw bone and bison remains, which could account for some of the burned faunal materials at the Whiting Slough site. However, this interpretation is only speculation as there are no clear indicators that these activities took place.

Brink (2008) explains that there are numerous reasons as to why a bone bed will be burned and they include, odour, to deter unwanted carnivores, and for future re-utilization of the area. The unfavourable odour of decomposing animals may be a reason as to why bone beds tend to have evidence of burning. Deterring unwanted carnivores such as bears and wolves is another reason to burn off a decomposing bone bed. However, both interpretations are difficult to prove but still may account for the burning of materials at the Whiting Slough site. Re-utilization of an area may account for the burning of faunal materials. This activity will reduce the smell of decomposing animals as well as provide nutrients in the soil for regrowth of vegetation which will attract bison herds to continue to frequent the area. A combination of these previously discussed activities can potentially account for the amount of fragmentation and signs of burning on bone at the Whiting Slough site.

7.5 Summary

A variety of taphonomic processes has shaped the faunal assemblage at the Whiting Slough site. The natural processes that have altered bones within the site include root etching, weathering, carnivore disturbance, as well as pathologies and abnormalities. Root etching and weathering can account for modifying the surface of bones. These processes have been identified on multiple elements within the collection and may account for some of the destruction and deterioration of faunal remains. Carnivore damage is limited within the site which suggests that this disturbance may be minimal. However, these indicators also provide evidence that these taphonomic processes were occurring which potentially can account for the displacement and underrepresentation of elements at the site. Animal wallowing and trampling is also a culprit in the displacement and alteration of bone materials. These activities have the potential to move elements horizontally and vertically as well as produce abrasion on bone surfaces. Pathologies and abnormalities are limited yet they provide insight into the lifeways of the animals that are being affected. There is difficulty determining if these abnormalities, especially the DJD on the canid in Feature CB, reflect cultural activity due to the small fragmented sample size.

Alteration to bone materials at the Whiting Slough site are partially caused by natural forces, however, the vast majority of modifications to the assemblage are the result of cultural processes. These changes can be seen through pattern breaks and burning. The Whiting Slough site faunal assemblage is highly fragmented, which can account for the lack of definitive cut marks due to these signatures being destroyed during the butchering process. These findings suggest that chopping and smashing were the predominant method in butchering. Spiral, hinge, and impact fractures are common on elements and are a result of blunt force trauma. These taphonomic signatures are characteristic of marrow and grease extraction. Calcined bone

throughout multiple units in the excavation block suggests that the burned faunal materials at the site were the result of anthropogenic fire. It is unclear which activity took place that caused the burning of some of the bone materials at the site, which may involve one or a combination of the following including cooking meat, smoking hides, or cleaning the kill. Feature CB is significant since the taphonomy present on the canid remains provides information on the processes that occurred on the intentionally buried canid. Whether the burning of the canid specimens is the result of ceremonial activities or cleaning the site is unclear. It is likely that Feature CB has a ceremonial aspect, however, it is unclear if the burning on the canid elements reflects these activities. The Whiting Slough site has numerous taphonomic signatures present on the faunal remains that can be credited to natural and cultural processes. These changes have provided information on the content and structure of the site as well as insights into a taphonomic history being primarily the result of cultural activity.

Chapter 8

Procurement Strategy and Discussion

8.1 Introduction

The Whiting Slough site is a processing site in association with an unknown kill site. Occupants of this site were able to dispatch numerous bison which they then transported to the Whiting Slough site to process further. Due to the construction of the highway and other infrastructure in the area, it is difficult to pinpoint how and where these animals were dispatched. Therefore, this section will examine the terrain in the surrounding area of the Whiting Slough site to decipher what events likely took place during the site's utilization. The Whiting Slough site will also be compared to other sites within the region that share similar characteristics to see if a pattern exists. Historic and ethnographic accounts of pounds will be examined to understand exactly how the hunting technique transpired. The limitations and a summary of the findings of the Whiting Slough site will then be discussed.

8.2 The Whiting Slough Site Surrounding Topography

The Whiting Slough site is only one component of what is likely a series of other unknown associated sites within the immediate area. As previously discussed, the development of contemporary infrastructure has changed the terrain around the site and as a result has likely destroyed evidence of other sites associated with the Whiting Slough site. Archaeological survey completed to the immediate north, west, and east of the site indicate no further evidence of archaeological materials. However, to the south another bone feature alignment is present. This feature is located at the edge of native prairie which then turns to disturbed terrain due to a modern fence, Highway 7, and further to the south an access road and train track all of which run relatively west to east. It is expected that Highway 7 as well as the access road and train track to

the south have cut through associated archaeological sites during their construction. The terrain to the south of these developments shows less signs of disturbances and is characteristic of undulating terrain as seen in Figure 8.1.

Figure 8.1 Undulating terrain south of the Whiting Slough site

It is logical to assume that the terrain prior to the construction of the previously mentioned infrastructure would be characteristic of Figure 8.1. During the time the Whiting Slough site was in use occupants would have been able to utilize this terrain to trap and dispatch bison. The frequency of bison within areas like this would be greater during the late fall and early winter months due to it being sheltered and having more available edible vegetation. Therefore, it is expected that evidence for a bison kill site that is associated with the Whiting Slough site would be present within this area. Unfortunately, no exploratory shovel tests were permitted in this region as it is outside the project area prohibiting the need to be assessed.

Nevertheless, due to the characteristics of the terrain in this area it is assumed that the construction of a pound to trap bison was utilized.

8.3 Site Comparisons and Ethnographic Accounts of Pounds

To fully understand the events that took place at the Whiting Slough site it is necessary to compare it to other archaeological sites with similar characteristics such as terrain and seasonality to see whether a pattern exists. In addition to this, ethnographic accounts of pound utilization can provide further evidence on exactly how the hunting technique transpired. The following section will describe and compare archaeological sites in southern Saskatchewan to help interpret the Whiting Slough site. This is complemented with historic and ethnographic accounts of bison pounds on the Northern Plains.

8.3.1 Site Comparisons

The Whiting Slough site lacks information about the exact location of the kill and procurement technique that was utilized which is problematic. The interpretations previously discussed are plausible, however, they are speculations based on traits of the terrain surrounding the site. Therefore, comparing the Whiting Slough site to other sites that involve bison procurement during late fall and early winter and are in similar terrain will provide the information that the Whiting Slough site is missing. There are numerous bison kill sites throughout the Northern Plains, however, it is wise to examine sites that are present in a comparable topographic region and share a similar season of occupation. Consequently, sites that fit these criteria include Tschetter, Fitzgerald, Gull Lake, Bakken-Wright, and the Estuary site.

The locations of the Tschetter site and the Fitzgerald site are relatively close to the Whiting Slough site. The Tschetter site is a bison kill site located roughly 16 km northwest of Saskatoon, Saskatchewan near the eastern margin of the Dunfermline Sand Hills in undulating

terrain (Walker 1979). It is a Prairie Side-Notch site with dates of 1005±75 BP (S-669), 914±45 BP (S-1631), and 1020±100 BP (NMC-1265) (Prentice 1983). The procurement strategy utilized at this site involved a bison pound that incorporated aspects of the landscape to trap bison. Bison remains at the site are highly fragmented with an MNI totalling 86 bison. Age and sex analysis completed on the limited faunal materials indicates males and females with ages at rates of x.6 and x.7 are present at the site. These findings are interpreted as the site being reused over a period of time throughout winter months (Walker 1979).

The Fitzgerald site is a Besant bison pound and processing site located 15 km southeast of Saskatoon, Saskatchewan in the Moose Woods Sand Hills (Hjermstad 1996). Hjermstad (1996) describes the main kill and processing area as a basin which formed in the middle of two parabolic sand dunes. An MNI of 49 bison was calculated and the herd consists of males, females, and juvenile specimens. The age groups represented include x.5 and x.7 which places the kill events in late fall and early winter.

Gull Lake, Bakken-Wright, and the Estuary site are outside the ecoregion of the Whiting Slough site, however, they share similar topographic characteristics and functions as the Whiting Slough site. The Gull Lake site is located 9.6 km from Gull Lake in southwestern Saskatchewan (Kehoe 1973). It is a multicomponent communal bison drive and pound site which utilized a coulee and a landslide slump to trap bison naturally. It has Avonlea occupation dates of 1740±60 BP (S-255) and 1290±60 BP (S-254) (Kehoe 1973). Levels also contained Besant, Prairie Side-Notched and Plains Side-Notched projectile points.

The Bakken-Wright site is located approximately 26 km northeast of Bracken, Saskatchewan within 1 km of the Frenchman River (Kehoe and McCorquodale 1961). It is a

multicomponent bison drive site which utilized a drainage channel to trap bison. Excavations produced Avonlea and Prairie Side-Notched projectile points.

The Estuary site is a multicomponent site located approximately 14 km northwest of Leader, in southwestern Saskatchewan (Adams 1977). Adams (1977) describes the site as a bison pound near the head of a large coulee with an associated butchering area. The site is surrounded by undulating grassland terrain with an Avonlea occupation date of 1190±165 BP (S-641) and two Prairie Side-Notched dates of 1020±80 BP (GaK-3809) and 1070±70 (S-640). An MNI of 29 bison was recorded, however, it is speculated that 150 animals could have been dispatched (Adams 1977).

In the past, the characteristics of the terrain was considered when hunting bison with pounds in Saskatchewan. The previously discussed sites indicate that natural variation in the landscape to trap bison were highly favoured. This is evident from the reutilization of sites where pounds were naturally formed. The five sites discussed here share numerous topographic features. Each reside in undulating terrain characteristic of sand dunes. The season in which the Tschetter site and the Fitzgerald site were being utilized corresponds well with the Whiting Slough site season of occupation. Note that these results are gathered from a limited number of analyzable mandible specimens at these sites. Overall, each of these sites represents a late fall or winter bison kill in hilly aspen rich terrain. It is evident that in the past bison were foraging during the colder winter months in central Saskatchewan, especially in sheltered aspen groves.

Each of these sites are considered pound sites with the Estuary and Tschetter site showing evidence of post holes for pound fence construction (Adams 1977; Prentice 1983). It is difficult to compare the Whiting Slough site to all these sites as it lacks sufficient information about the surrounding terrain due to it being highly disturbed. It can only be speculated that the trends

present among sites of comparable dates, functions, and terrain can be applied to the Whiting Slough site. As a result, it is sufficient to believe that the undulating terrain south of the Whiting Slough site played a pivotal role in impounding and dispatching the bison represented at the site.

8.3.2 Historic and Ethnographic Accounts of Pound Use

Historic and ethnographic literature recorded in the 1700s and 1800s on the Northern Plains describe pounds as a hunting technique almost exclusively limited to fall and winter (Verbicky-Todd 1984). Accounts of spring and summer pounds occur but are less frequent. Eyewitness accounts of winter pounds in central Saskatchewan are recorded by Matthew Cocking in 1772-1773, Alexander Henry the Elder in 1776, Paul Kane in 1848, and the Palliser Expedition in 1859 (Kehoe 1973; Verbicky-Todd 1984). It was known that bison would migrate into more sheltered areas during the winter season including parkland areas, timbered river valleys, and foothills (Verbicky-Todd 1984). As a result, Verbicky-Todd (1984) explains that human groups would enter these areas earlier during autumn to build and repair pounds so that they can be used in the winter.

These areas are important as they are a source of wood for constructing a pound and the topography tended to assist in directing bison into the trap. Three general terrain components when constructing a pound include being (1) situated at or on the base of a natural slope, (2) on level ground, and (3) below a precipice just high and steep enough to either kill or injure the bison being trapped (Verbicky-Todd 1984). Eyewitnesses observed the construction of pounds being five feet tall, with the logs in the walls being interwoven among standing trees as well as being intertwined with green twigs and branches (Verbicky-Todd 1984). Further eyewitness observations note bison skins being strung up above the walls to create the illusion of greater height to deter bison from jumping over it as well as the construction of additional post

reinforcements in the form of bones or logs (Verbicky-Todd 1984). The incorporation of drive lanes constructed from dung, shrubs, and other materials to help direct bison towards the pound were essential. A historic diagram of the features involved with impounding bison is seen in Figure 8.2.

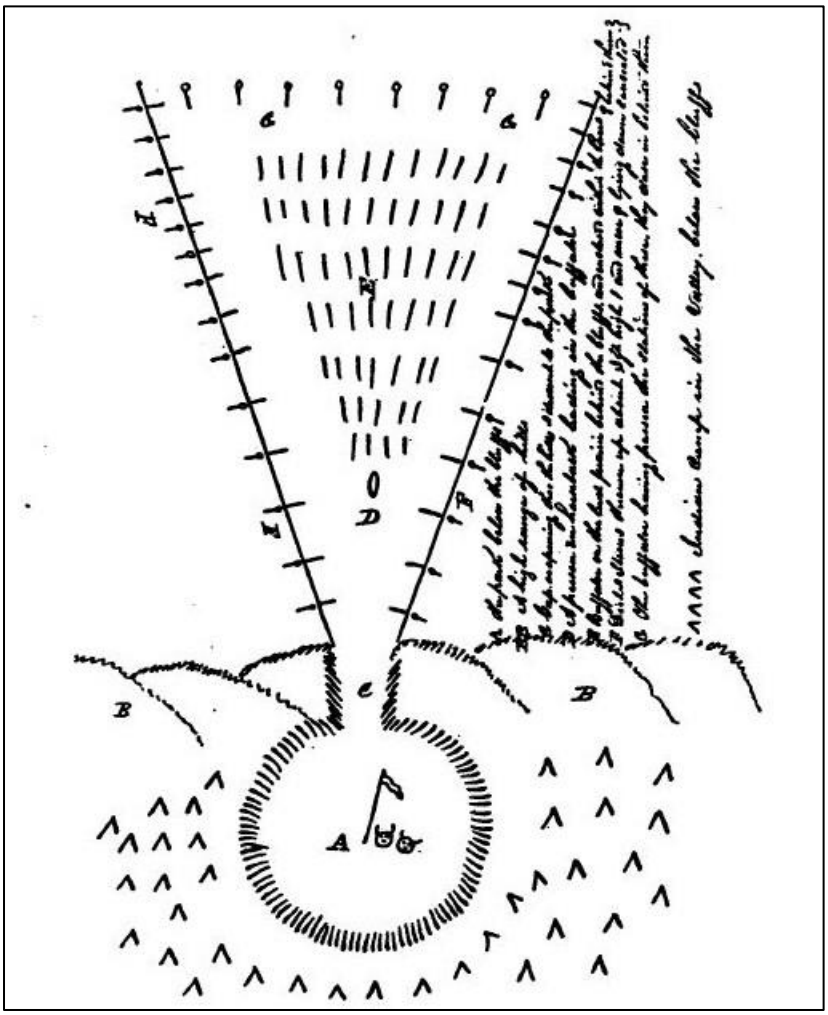

Figure 8.2 Assiniboine pound illustration (Denig 1930)

Once bison entered the pound the kill ensued. Historic and ethnographic accounts describe the events of First Nation bison pounds on the Northern Plains. Grinnell (1893:228-232) explains that:

> When they reach [the pound], most of the animals were pushed over, and usually even the last of the band plunged blindly down into the [pound]. Many were killed outright by the fall; others had broken legs or broken backs, while some perhaps were uninjured. The barricade, however, prevented them from escaping, and all were soon killed be the arrows of the Indians.

Historic accounts from a Plains Cree pound provides further information on the procedures that follow the entering of bison and the degree of construction necessary for a successful hunt.

> As soon as all the herd are within the pound, the entrance is immediately closed with logs, the buffaloes running around and round one after another, and very rarely attempting to break out, which would not be difficult, from the insufficiency of the structure. Should one succeed in doing so the whole herd immediately follow. When once in the enclosure the Indians soon despatch them with their arrows and spears (Kane 1925:80-82).

Further accounts describe the degree of participation involved from the men, women, and children of the groups hunting. As well as how the butchering of animals occurred and note what wild animals tend to visit the area after a kill. Grinnell (1893:228-232) explains:

> As soon, however, as the animals were in the corral, the people – women and children included – ran up and showed themselves all about the walls, and by their cries kept the buffalo from pressing against the walls. The animals ran round and round within, and the

> men standing on the walls shot them down as they passed. The butchering was done in the [pound], and after this was over, the place was cleaned out, the heads, feet, and least perishable offal being removed. Wolves, foxes, badgers, and other small carnivorous animals visited the [pound], and soon made away with the entrails.

Depending on the size of the pound the amounts of bison that could be dispatched in a single kill event can be in the hundreds. Henry Youle Hind witnessed a Cree pound operation near the Sand Hills of Saskatchewan in 1857. The kill is described as:

> Two hundred dead buffalo. 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 (Hind 1971:356).

Another account of the processes involved during and after a kill is provided by Dempsey (1957) from an interview conducted with John Cotton, a Blood Indian. Cotton recounts information told to him by his mother and relatives.

> After the run was finished, the Bloods either slaughtered the animals inside the corral or, if there was too big a pile, they were dragged outside the corral and butchered. As long as

there was any meat to be had, they would camp there. In the slaughtering, everything was taken and the surplus meat was either dried or made into pemmican (Dempsey 1957:2).

These accounts offer a glimpse of what is expected to occur during and after a successful bison pound kill. It is crucial that numerous requirements for the success of this hunting technique are present including, specific characteristics of the terrain, materials for the construction of a pound, as well as sufficient personnel to complete and process the kill. Each of these pound operations were executed in a similar fashion; however, aspects may vary from one site to another due to topographic characteristics, the group performing the kill, and methods in which the carcasses were butchered and processed.

The historic and ethnographic literature described here provides insight into what events potentially took place at the Whiting Slough site. These accounts portray substantial planning, engineering, and coordination among the groups that executed these hunts. Primary butchering took place within the pound. However, as previously stated, it was not unusual to transport these animals to other locations for further processing especially with great amounts of dispatched animals in the pound. This is the case with the Whiting Slough site as evident from the misrepresentation of various skeletal elements which are likely present at the kill site.

8.4 Discussion

The location of the Whiting Slough site is significant as it is situated in proximity to the southern edge of the aspen parkland ecotone of North America. This ecotone is the transitional zone between the boreal forest to the north and the Great Plains to the south (Bird 1961). It stretches across portions of Alberta, Saskatchewan, Manitoba, and northern Minnesota (Bird 1961; Ewing 1924). Meyer and Epp (1990) explain that during the 1700s and 1800s it was

common that plains bison would winter within the aspen parkland. As a result, this enticed human populations from the north and south to enter this region during the winter to hunt these animals. Meyer and Epp (1990) suggest that the influx of human populations entering the parkland region of Saskatchewan during winter months has a history that can date back to 3000 BP and earlier. As previously described in Chapter 3, Avonlea sites are found in Saskatchewan's grasslands, parklands, and the boreal forest's southern edges. Meyer and Epp (1990) explain that the distribution of Avonlea sites throughout these regions are the result of seasonal rounds of hunters following bison. Therefore, Avonlea sites within the parkland tend to be late fall or winter occupations. This interpretation is valid for the Tschetter site, the Fitzgerald site, and the Whiting Slough site. These three sites are indicators of the northward movement of plains groups following bison from the grasslands into the parklands during the transition from summer to winter. The common hunting technique utilized to dispatch bison within this region before, during, and after the Avonlea phase are pounds. This is due to numerous variables including available wood for constructing traps, undulating terrain to assist in directing the animals towards pounds, and the northern migration of bison during the fall and into the winter.

The procurement strategy utilized at the Whiting Slough site is unknown. However, comparing the Whiting Slough site to other sites in Saskatchewan of similar dates and terrain as well as understanding the significance of its geographical location has brought forth interpretations of what likely occurred. A pattern emerged which indicates that undulating wooded regions in Saskatchewan are common for the utilization of pounds in late fall and winter, especially further north in the aspen parklands. Locations such as this attract bison in cooler months due to shelter and vegetation. These characteristics also allow human groups to extract

resources such as wood to build pounds as well as to utilize the undulating terrain to their advantage to direct and trap bison.

The area to the south of the Whiting Slough site shows minimum disturbance and is characteristic of undulating wooded terrain which is common topography for use of pounds. It is expected that the bison were impounded within this area and butchered to some degree with additional processing taking place further to the north. Butchering within the pound likely consisted of skinning the animals, removing edible parts that can be consumed raw including the tongue, eyes, brains, gristle from the snout, kidneys, liver, and belly fat among other parts (Verbicky-Todd 1984). Additional butchering and processing took place further north at the Whiting Slough site where animal parts continued to be removed along with meat, marrow, and grease.

The artifacts recorded at the Whiting Slough site consist of faunal specimens, Avonlea projectile points, a hammerstone, a chopper, a scraper, a hafted knife, four biface fragments, debitage, and FCR (Diduck 2018). This indicates that this site has a specific purpose which involves the processing of bison. Other artifacts that relate to a campsite are absent. The taphonomic analysis reflects a processing site through the pattern breaks present on high utility long bones, the extremely fragmented assemblage being the by-product of marrow and grease extraction, and the high representation of low utility elements indicating that the focus was on the extensive exploitation of high utility elements.

8.5 Limitations

In total, there are three limitations of the Whiting Slough site. The first limitation is the unknown associated sites. This is the result of disturbances due to contemporary infrastructure that likely cut through these sites as well as the inability to survey areas to the south as they are

outside the project area. Due to this the exact method of the kill may never be known. It can be speculated that the construction of the pound was utilized as this is a common hunting technique during the Avonlea period on the Northern Plains especially in undulating terrain. The materials used in the construction of the pound could involve wood, dung, and shrubs. Frison and Todd (1987) have speculated that snow and snow drifts potentially can serve as a method to hinder the movement of bison allowing a way to trap and dispatch the animals. This interpretation is limited as the only evidence to suggest this method is based on the season of the kill.

The second limitation of the Whiting Slough site is the small sample sizes available to analyse the sex and age of the bison. Sex analysis was limited to 13 specimens and the age assessment was restricted to 12 suitable specimens. Therefore, the results produced from both assessments may fail to fully represent the herd at the Whiting Slough site.

The last limitation is the fragmented faunal assemblage. The high degree of fragmentation provides insight into an extensive butchering and processing event. However, this degree of fragmentation also limits the analysis on the canid specimens within the collection. Due to this taphonomic characteristic it is impossible to identify whether the canids within the site are domesticated or wild and whether the arthritis and degradation on the canid specimens are the result of cultural or natural activity. It is not uncommon for wild carnivores to enter a pound after a kill which ultimately may lead to the animal being hunted by the occupants of the site. Whether this is the case with the canids at the Whiting Slough site is unclear due to fragmentation.

8.6 Summary

In summary, the Whiting Slough site represents one component of potentially a series of associated sites within the immediate area, in particular a kill site. The utilization of a pound at

the kill site is expected especially in the undulating hilly terrain south of the site. As previously stated, pound use was common in Saskatchewan during late fall and winter, especially in the aspen parklands. Once the kill was completed limited butchering took place at the kill with numerous animal parts being transported to the Whiting Slough site for further butchering and processing. Extensive butchering occurred through chopping and smashing elements with a hammerstone, a chopper, and possibly any other sufficient implement. The objective here was to extract as much sustenance as possible from the animals including meat, marrow, and grease. This is evident from the extensive fragmentation of bones within the collection as well as pattern breaks on high utility long bones. These are indicators of grease extraction and marrow removal. These elements are key in making and preserving pemmican which includes meat, fat, grease, and sometimes berries.

Burned bone at the site likely is evidence of the events that took place once butchering was completed. The reasons for the burned bone bed may include or be the combination of cooking meat, smoking hides, deterring unwanted carnivores, for the future re-utilization of the area, and a result of a natural grass fire. The calcined bone present throughout several units suggests the origins of the burning was from an anthropogenic fire. However, it is unclear which of the previously stated activities were the ultimate cause.

The bone features present throughout the site are important to note. The taphonomic signatures present on bone specimens within these features are consistent with the overall site. Therefore, it can be concluded that these features were constructed during the utilization of the site. Interpreting Feature CB is difficult; however, the combination of canid and bison elements being associated likely served a ceremonial purpose.

The faunal analysis of the Whiting Slough site has multiple limitations. The first being the association to an unknown kill site. This dilemma is mitigated through comparing the Whiting Slough site to similar sites throughout Saskatchewan, as well as, exploring historic and ethnographic literature on bison procurement on the Northern Plains. Another limitation includes small and incomplete sample sizes for analysis. These variables reduce the validity of the conclusions and limit the interpretations being produced.

Overall, the Whiting Slough site served as a processing area for the people hunting and following bison on the Northern Plains during the Avonlea phase. It is in this location that people extensively processed bison to a degree in which the majority of faunal specimens in the collection are unidentifiable fragments. This finding indicates that the retrieval of as much nourishment as possible from these animals was the goal. As a result, these people were able to obtain meat, marrow, and grease, which was likely used and preserved in pemmican. In sum, the Whiting Slough site contributes to a long series of late fall and winter processing and pound sites in Saskatchewan and the Northern Plains.

Chapter 9

Summary and Conclusions

9.1 The Whiting Slough Site Summary

The Whiting Slough site (ElNs-10) is a late fall or early winter single component Avonlea bison processing site located roughly 35 km southwest of Saskatoon, Saskatchewan. The bone bed has been radiocarbon dated to approximately 1325 BP. Three radiocarbon dates 1320 BP ± 20 (ULA-6043), 1325 BP ± 15 (ULA-6040) and 1330 BP ± 20 (ULA-6042) correlate well with the temporal date range of the Avonlea phase while two dates, 3645 BP ± 20 (ULA-6053) and 3700 BP ± 20 (ULA-6052) are outside the range as a result of being from levels above and below the occupation layer (Appendix A).

The faunal assemblage at the Whiting Slough site is comprised predominately of American bison (*Bison bison*). Quantitative analysis indicates that a minimum of 54 bison are present within the assemblage. There are six other species identified at the site including, two wolf sized indeterminate canids (*Canis* sp.), one snowshoe hare (*Lepus americanus*), one Northern pocket gopher (*Thomomys talpoides*), one rodentia indeterminate, one carnivore indeterminate, and one medium-sized bird. Of these species, the two canids indeterminate, snowshoe hare, carnivore indeterminate, and the medium-sized bird are considered contemporaneous with the site.

The species favoured at the Whiting Slough site is American bison (*Bison bison*). This species represents 96% of the identified faunal materials in the assemblage. The animals that were exploited consist of both male and female bison. Animals ranging from 1.6 years to 10.6 years were dispatched, however, younger individuals may have been consumed. The validity of the sex and age results are limited due to the small sample sizes available for analysis. This is in

part due to the highly fragmented nature of the faunal assemblage, which may be an explanation as to why there is an underrepresentation of immature specimens as they are more susceptible to deterioration due to their fragility.

The consumption of non-bison remains is unclear especially the canid in Feature CB. As previously mentioned, this canid may have served ceremonial purposes rather than sustenance for the occupants of the Whiting Slough site. It is not uncommon to have wild carnivores visit a site especially after a kill event (Verbicky-Todd 1984). However, whether the canid specimens in the Whiting Slough site collection are wild or domesticated is unclear. This uncertainty is due to the fragmented and limited samples available for analysis. Overall, the non-bison specimens in the collection lack cut marks, however, some of the specimens show signs of burning. Burning may indicate consumption due to an opportunistic kill or the result of site clean-up.

Both natural and cultural alterations are present on the faunal assemblage at the Whiting Slough site. Natural taphonomic agents including carnivore and rodent damage and disturbance as well as weathering can account for the further fragmentation, deterioration, and displacement of some of the specimens within the assemblage. The pathologies and abnormalities present on the bison and canid specimens are considered natural. Cultural activities can account for the vast majority of modifications present in the faunal assemblage. It is evident that bison elements were utilized to their maximum extent especially elements of high utility, as these elements are less common in the collection. The butchering method employed includes the chopping and smashing of elements by a chopper, a hammerstone, and potentially any other adequate device. This is apparent from the fracture patterns and the highly fragmented nature of the faunal remains. The extreme degree of fragmentation is the result of extracting as much nourishment as possible from the animals including meat, marrow, and grease. Once these resources were retrieved it is

reasonable to believe they were used and preserved in pemmican. The burning of specimens can be attributed to one or a combination of the following including cooking meat, smoking hides, deterring unwanted carnivores, for the future re-utilization of the area, and a result of a natural grass fire. Due to the evidence of calcined bone it is likely that the burned faunal materials have an anthropogenic origin. Overall, the content and structure of the site is primarily the result of cultural activity.

The bone features at the Whiting Slough site are an indication that the site has little disturbance as these features are undisturbed. It is reasonable to conclude that the features were constructed following the procurement event as they share similar taphonomic characteristics to the rest of the faunal assemblage. Bone uprights tend to be reinforcements for pound fence posts, however, since the Whiting Slough site is a processing site their function may relate to reinforcing another kind of structure. Further investigation and examination on the bone features is concurrently being completed by Master of Arts candidate Brandon Halyk.

Combining the artifacts present, primarily projectile points, and the substantial number of bison killed indicates that a pound was likely utilized to procure the bison. This type of hunting technique is common during this period especially in late fall or winter near and in the parkland ecotone. Once the animals were contained, they were dispatched by a high volume of Avonlea projectile points. This is evident due to the 226 identified Avonlea projectile points within the Whiting Slough site collection (Diduck 2018). The high number of recorded bison and projectile points indicates that these hunters were able to dispatch countless bison during an early winter procurement event. There is no structural evidence or geological feature present today that indicate the remnants of a pound. Materials commonly used in pound construction tend to be organic and therefore are decomposable. However, the terrain south of the site is characteristic of

dunes and is ideal for impounding bison. It is expected that evidence for an associated kill site would be present in this location.

9.2 The Whiting Slough Site Conclusions

The goal of this thesis is twofold, the first aim is to provide a detailed analysis of the faunal assemblage as well as the taphonomic processes that have altered the bone materials at the Whiting Slough site (ElNs-10). This information assisted with the second aim of the project which is to provide a greater understanding of the procurement strategy. These aims have been accomplished through the four objectives of this study including: (1) calculating skeletal frequencies, (2) identifying the bison herd population structure, (3) pinpointing the seasonality of the bison faunal assemblage, and (4) describing the taphonomic characteristics of the bones.

The first aim was accomplished through the re-examination of the entire faunal assemblage for accuracy of counts as well as the recognition of any identifiable materials or modifications that may have been overlooked. It allowed for the further identification of elements and species within the collection and permitted greater accuracy for the subsequent quantitative and qualitative analysis.

Taphonomic analysis indicates that natural weathering can account for some of the deterioration of bone specimens, however, the vast majority of the modifications are the result of cultural activity. This is due to extensive butchering where low utility elements were discarded, and high utility elements were processed to a greater degree. As a result, the collection is highly fragmented which was problematic when completing age and sex analysis as it has reduced the size for samples and decreased the validity of the results. Nonetheless, the analysis indicates the that the Whiting Slough site has a late fall or early winter occupation.

The second aim of the project was accomplished through combining the results of all four objectives to understand the procurement strategy. It is clear that bison were the primary focus for subsistence at the Whiting Slough site. Bison were likely hunted to the south of the site in the undulating terrain where a pound is expected to be constructed. This conclusion is based on evidence provided from archaeological sites in Saskatchewan that share similar functions and terrain as well as the information provided from historic and ethnographic literature on pound use. The proximity to the parkland ecotone and the seasonality of the Whiting Slough site is further evidence that these people were following bison north during seasonal rounds.

The research completed in this thesis has provided insight into the faunal assemblage and procurement strategy at the Whiting Slough site. The exact procurement strategy may never be fully recognized, however, it likely involved a pound. It is evident that a procurement event took place where both male and female bison were dispatched during late October or early November. Initial butchering took place at the kill site which may have involved skinning the animals and removing sections to be transported to the Whiting Slough site for further processing. The occupants of the site processed their kill to a high degree as established by the fragmented nature of the assemblage and discarded low utility elements as these elements are overrepresented. Ceremonial aspects are connected to the site through the presence of Feature CB consisting of fragmented canid elements associated with bison elements many of which are cranial.

The Whiting Slough site is only one component in a series of associated sites within the immediate area. The occupants of the site understood the behaviour of bison and were aware that during the transition from fall to winter these animals will migrate north into the aspen parklands for shelter. Knowing this they constructed a trap within the undulating wooded terrain south of the Whiting Slough site in anticipation of the migration of bison. Once the animals entered the

area they were carefully directed into the trap and dispatched. The spoils of the hunt permitted a wealth of resources that were crucial for the survival of the coming winter months. It was at the Whiting Slough site that these resources were extracted. The interpretations and analysis completed in this thesis has provided an understanding of the events that took place circa 1325 years ago in late October or early November on the plains in Saskatchewan. The faunal analysis of the Whiting Slough site (ElNs-10) has contributed to the overall understanding of the Avonlea phase in Saskatchewan and the Northern Plains.

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Appendix A

Laval University Radiochronology Laboratory Radiocarbon Dates for The Whiting Slough Site

Laboratoire de RADIOCHRONOLOGIE
RADIOCHRONOLOGY Lab
Centre d'études nordiques, Université Laval

KECK CARBON CYCLE AMS FACILITY
Earth System Science Dept.
UNIVERSITY OF CALIFORNIA, IRVINE, CA, USA

^{14}C Results

Karmen VanderZwan (Western Heritage) **June 13, 2016**

University of California #	Université Laval #	Customer ID (sample type)	Pre-Treatments	$F^{14}C$	±	$D^{14}C$ (‰)	±	^{14}C age (BP)	±	$\delta^{13}C$ (‰)	% N	% C	C/N (wt%/wt%)	% of bone transformed into collagen
UCIAMS-173582	**ULA-6040**	cat #10,036 (collagen from bone)	HCl-NaOH-HCl	0.8481	0.0016	-151.9	1.6	**1325**	**15**	-19.4	15.8	44.1	2.79	10.0
UCIAMS-173583	**ULA-6042**	cat #10,550 (collagen from bone)	HCl-NaOH-HCl	0.8475	0.0016	-152.5	1.6	**1330**	**20**	-19.1	15.7	43.5	2.77	7.4
UCIAMS-173584	**ULA-6043**	cat #3809 (collagen from bone)	HCl-NaOH-HCl	0.8483	0.0020	-151.7	2.0	**1320**	**20**	-19.7	15.3	42.1	2.74	5.3
UCIAMS-173585	**ULA-6052**	cat #10,804 (collagen from bone)	HCl-NaOH-HCl	0.6309	0.0014	-369.1	1.4	**3700**	**20**	-18.0	14.2	41.8	2.95	4.1
UCIAMS-173586	**ULA-6053**	cat #9925 (collagen from bone)	HCl-NaOH-HCl	0.6352	0.0013	-364.8	1.3	**3645**	**20**	-18.2	16.3	44.4	2.73	16.1

Radiocarbon concentrations are given as fractions of the modern standard, $D^{14}C$, and conventional radiocarbon age, following the conventions of Stuiver and Polach (Radiocarbon, v. 19, p.355, 1977).

Sample preparation backgrounds have been subtracted, based on measurements of ^{14}C-free mammoth bone.

All results have been corrected for isotopic fractionation according to the conventions of Stuiver and Polach (1977), with $d^{13}C$ values measured on prepared graphite using the AMS spectrometer. These can differ from $d^{13}C$ of the original material, if fractionation ocurred during sample graphitization or the AMS measurement, and are not shown.

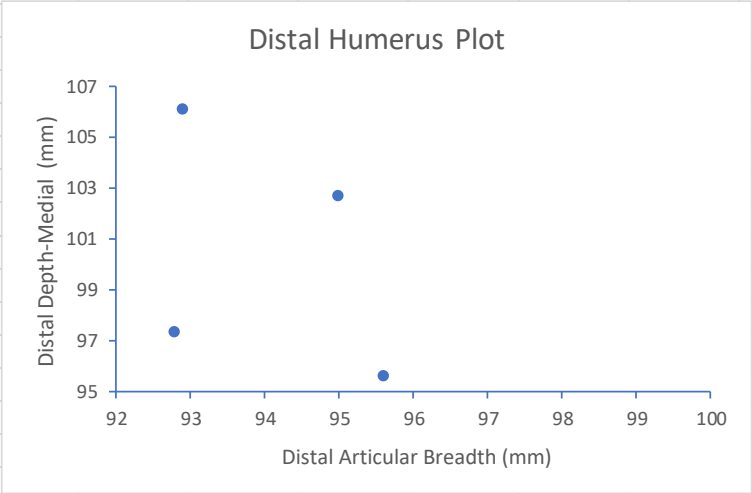
Comment:

$\delta^{13}C$ values shown above were measured to a precision of <0.1‰ on aliquots of filtered collagen, using a Costech ECS 4010 CHNSO Elemental Analyzer coupled to a Thermo Delta V Advantage isotope ratio mass spectrometer.

Appendix B

Bison bison Distal Humerus Bivariate Plot

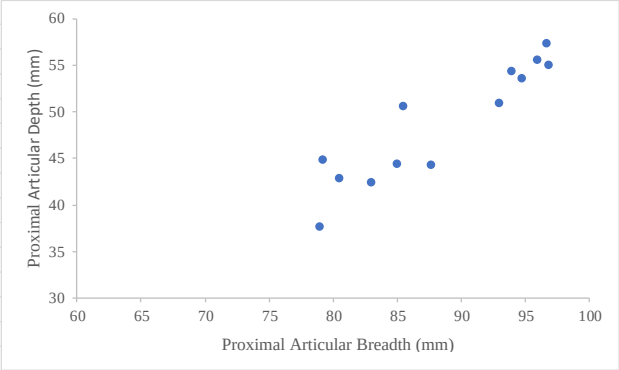
HM7 (mm)	HM11 (mm)
95.6	95.6
92.8	97.3
92.9	106.1
95	102.7



Appendix C

Bison bison Proximal Radius Bivariate Plot

Unit North	Unit East	WP	Item	RD4 (mm)	RD9 (mm)	Side
99	94		3563	94.8	53.6	Right
108	93		9537	94	54.3	Right
101	96		6152	93	50.9	Right
		803	15369	85.5	50.6	Right
98	90		12623	96.9	55	Left
101	91		753	96.7	57.3	Left
104	95		5381	80.5	42.8	Right
103	95		8593	79	37.6	Left
102	94		3025	96	55.6	Left
99	95		7075	83	42.4	Left
102	96		2727	85	44.4	Right
106	99		10639	79.2	44.8	Left
99	91		11837	87.7	44.3	Right



Appendix D

Chewing Statistics

Total Chewing	21														
Ident.	11	Burnt/Calcine	0	Unburnt	12	**2 Appendicular Element**	1 Femur (spiral fracture too)	1 Tibia	**9 Axial Elements**	6 Rib	1 Vertebrae	1 Hyoid	1 Pelvic	All Bison	445.70 grams
Unident.	10	Burnt/Calcine	0	Unburnt	9	**N/A**	130.30 grams								
Rodent Total	6	1 Femur	1 Tibia	4 Unidentifiable											
Carnivore Total	15	4 Rib	1 Vertebrae	1 Hyoid	1 Pelvic	8 Unidentifiable									

Appendix E

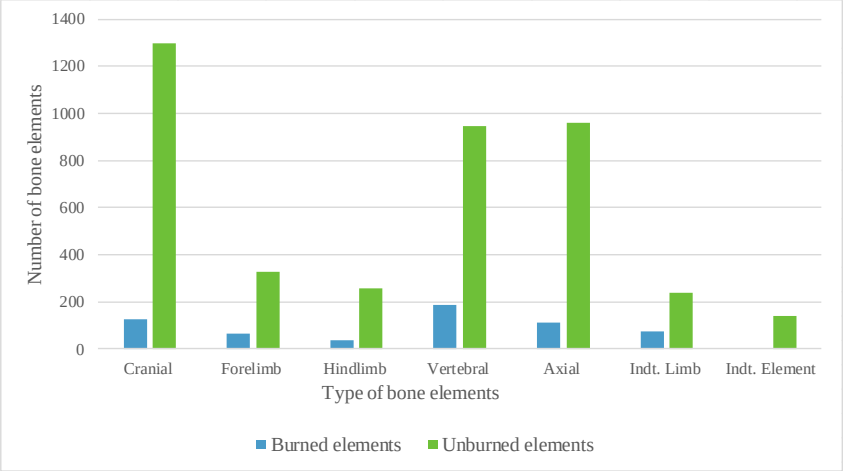
Fracture Statistics

Total Spiral Fractures (including Hinge and Impact)	1230	Burnt/Calcine	144		Unburnt	1086	18,914.60 grams	18.9 kg																		
Ident. Bone	240	Burnt/Calcine	4		Unburnt	139																				
Unident. Bone	990	Burnt/Calcine	140		Unburnt	850																				
Above is the overall total, below is a breakdown																										
Hinge Fracture	48																									
Ident.	29	Burnt/Caline	1	1 Right Tibia Shaft	Unburnt.	28	5 Femur	4 Humerus	2 Distal Metatarsal	4 Radius	5 Tibia	8 Indt. Long Bones	**All Ident. as Bison**													
Unident.	19	Burnt/Caline	2	N/A	Unburnt.	17	N/A																			
Impact Fracture	6																									
Ident.	3	Burnt/Calcine	0	N/A	Unburnt	3	1 Radius	1 Tibia	1 Metatarsal	**All Ident. as Bison.**																
Unident.	3	Burnt/Calcine	0	N/A	Unburnt	3	N/A																			
Hinge/Impact Fracture	5																									
Ident.	2	Burnt/Calcine	0	N/A	Unburnt	2	1 Femur	1 Humerus	**All Ident. as Bison**																	
Unident.	3	Burnt/Calcine	0	N/A	Unburnt	3	N/A																			
N/A (Other) Spiral	1171																									
Ident.	193	Burnt/Calcine	3	1 Rib, 1 Mandible, 1 Humerus (bison)	Unburnt	190	**120 Appendicular Elements**	25 Humerus	5 Metacarpals	14 Radius	3 Scapula	2 Ulna	23 Femur	6 Metatarsal	26 Tibia	**83 Axial Elements**	1 Mam Cranium	1 Mandible	77 Rib	3 Hyoid	2 Vertebrae	**1 Other**	1 Indt. Bone	**All Bison to the Left**	**1 Canid Tibia**
Unident.	978	Burnt/Calcine	138	N/A	Unburnt	840	**149 Appendicular Elements**	163 Indt. Lng Bones	**648 Indt. Element**	**28 N/A**	**All Ident. as Bison**															
			4 Indt. Lng Bone (Burnt)																							
			128 Indt. Element (Burnt)																							
			6 N/A (Burnt)																							
1 Step Fracture	Unburnt	Scapula	Bison	178.60 gram																						

Appendix F

Bison bison Burned Elements Versus Unburned Elements

Element	Burned elements	Unburned elements
Cranial	124	1300
Forelimb	67	326
Hindlimb	39	257
Vertebral	185	947
Axial	113	962
Indt. Limb	74	240
Indt. Element	0	141



Appendix G

Canid sp. Burned Elements Versus Unburned Elements

Element	Burned elements	Unburned elements
Cranial	18	10
Forelimb	19	1
Hindlimb	2	3
Vertebral	14	1
Axial	7	6
Indt. Limb	15	12
Indt. Element	4	1