

A FAUNAL ANALYSIS OF THE LOVSTROM SITE (DjLx-1), BLOCK E:
A LATE PRECONTACT SITE IN SOUTHWESTERN MANITOBA

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By

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Abstract

The Lovstrom site (DjLx-1) is a Late Precontact multicomponent site located in the Tiger Hills of southwestern Manitoba. Two occupation levels identified in Block E are separated by an approximate 400-year time span, the oldest identified as Blackduck at 800 BP and a later Vickers Focus group occupying the site around 400 BP.

Excavations took place between 1986 and 1991 as part of the Brandon University archaeological field school. In addition to the information gained from the recovery of large amounts of cultural material, later excavations were also opened in an effort to gain knowledge about the degree of site disturbance. The quantity of artefacts uncovered during test pitting necessitated a number of excavation blocks be opened. This thesis focuses on the faunal material recovered from Block E. Although a number of species were identified, bison represents the vast majority of faunal material. The faunal analysis was undertaken to determine the composition of the bison herd and seasonality. Due to the nature of the site and the fragmented faunal assemblage, an in-depth analysis took place to identify any taphonomic forces that may have disturbed the archaeological record. This includes both cultural and natural forces that acted on the Block E assemblage.

The occupants' butchering practices are compared and contrasted, with additional comparisons made to similar nearby archaeological sites, including the Blackduck occupations at the Stott site and the Vickers Focus component at the Jackson site.

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Chapter 1

Introduction

The Lovstrom site (DjLx-1) is a Late Precontact site located approximately 40 km south of Brandon, Manitoba. Dr. B.A. Nicholson and the Brandon University Department of Anthropology field school first excavated the site in 1986. The large amount of material recovered necessitated the opening of a number of excavation blocks. The primary purpose of this thesis is the analysis of faunal material recovered from Block E in an effort to learn more about the subsistence strategies of groups occupying the Lovstrom site. This will allow a comparison to existing knowledge of subsistence strategies of nearby archaeological groups. For the sake of convenience, the Lovstrom Block E site will subsequently be referred to as Block E.

From previous excavations and analyses archaeologists recognised evidence of taphonomic processes disrupting the stratigraphic integrity of many of the excavation blocks. A complete taphonomic study was needed to identify if there was enough structure left to allow for an examination of the subsistence strategies. A major portion of this thesis is focused on the identification of taphonomic forces and to what extent they have affected the Block E assemblage.

1.1 Chapter Summary

Chapter 2 provides a biophysical description of the location and natural setting of the Lovstrom site and adjacent environments including the Tiger Hills region. Included in this chapter are overviews of physiography and soil descriptions and underlying geological formations. Contemporary populations of flora and fauna species found in the region are listed.

Chapter 3 provides a description of the archaeological cultures of the groups that inhabited Block E. The origins of each culture is discussed, as well as theories of what may have happened to these groups subsequent to their inhabiting the Lovstrom site.

Chapter 4 provides a systematic description of the methods used to excavate, recover, and analyze the faunal material. Descriptions are given for any variation in excavation methods employed over the three seasons. Recovery and screening techniques are described as well as the recording methods, the grid system, and natural stratigraphy of the site. The chapter continues with a discussion of cataloguing procedures and additional examination of faunal material conducted in the lab, which included both a qualitative and quantitative analysis. The chapter concludes with a description of the cultural features identified in the two cultural levels.

Chapter 5 provides the results of the analysis of the Block E faunal assemblage. The majority of the chapter offers information on bone quantities and weights using element and landmark identification. Further analysis involves the siding and determination of age and final MNI numbers for all species. The chapter also includes a list and description of bone distribution maps for various elements for both bison and non-bison species. The chapter ends with a summary of the results of the re-analysis of the Block E faunal assemblage.

Chapter 6 focuses on bison herd structure and the seasonality of the site. Methods used include both qualitative and quantitative analysis of specific elements from *Bison bison*. The chapter begins with a discussion and usage of age determination methods using dentition growth and wear rates. Various literature reviews are discussed and used to determine the age of immature and foetal bison specimens. Various methods in

determining the sex structure of a bison herd are discussed and then applied to the Block E assemblage. These methods include both bimodal plotting and discriminant function analysis of various bone measurements. The results of the age determination studies and examination of non-bison species are used to identify the time of year the site was occupied.

Chapter 7 is an in-depth discussion and analysis of taphonomic forces acting on the Lovstrom site. The terminology and concepts of taphonomy are discussed. Utility indices are used to identify what portions of a carcass were utilized and what methods were employed to process a carcass. The chapter is separated into natural and cultural forces that may have acted to alter the Block E faunal assemblage over time. Natural forces are the result of non-human agents that may include the actions of various animal species or the environment. Cultural forces are the actions of human agents acting to alter the faunal assemblage, before, during or after deposition of material into the archaeological environment. Similarities or differences in the cultural activities of each group are thought to be expressed by differences in the processing techniques that should subsequently be visible in the archaeological record.

Chapter 8 includes a summary of the results from Chapter 7. Results are used to identify any similarities or differences between the two cultural occupation levels in Block E and among other similar cultural assemblages.

Chapter 9 offers conclusions for this thesis, including summaries and conclusions of the Chapter 8 discussions. Several conclusions are made concerning the subsistence strategies employed by the inhabitants of the Block E site. This includes any differences

in subsistence strategies between and among the Vickers Focus and Blackduck cultural groups discussed in previous chapters.

A number of appendices are included. Appendix I lists the modern faunal species present or observed in the Tiger Hills region. Appendix II lists various Blackduck radiocarbon dates. Appendix III is a complete list of *Bison bison* landmark counts for both left and right side elements. MAU and %MAU are also given for each landmark. Bone concentration maps for various *Bison bison* elements and other species are found in Appendix IV. Utility indices tables are provided in Appendix V.

Chapter 2

Biophysical Environment

2.1 Site Location

The Lovstrom site is located in the southwestern corner of the province of Manitoba on the edge of an upland region known as the Tiger Hills. The site is located approximately 40 km south of Brandon, Manitoba on an undulating till plain overlooking Jock's Creek to the west and the Souris River channel to the south (Nicholson 1986; Nicholson and Gibson 1991) (Figure 2.1). Surface surveys and test pitting indicate that the Lovstrom site covers an approximate area of 500 m by 200 m and could be much larger (Nicholson and Malainey 1991).



Figure 2.1: Aerial view of the Lovstrom site (yellow rectangle) and Souris River valley (Source: Google Maps, Map Data ©2015).

2.2 Physiography

The Southwest Uplands physiographic region of Manitoba is comprised of a mix of broad valleys and upland areas such as the Porcupine Hills, Riding Mountains, Duck Mountains and Pembina Mountains (Corkery 1996). The Lovstrom site is situated on the periphery of two distinct physiographic regions within the Southwest Uplands of Manitoba (Figure 2.2). The site is bordered to the north and east by the Tiger Hills. These rugged uplands are surrounded on all sides by the Saskatchewan Plains, formed from glacial till and glacial lake deposits (Nicholson et al. 2006). To the west the relatively flat

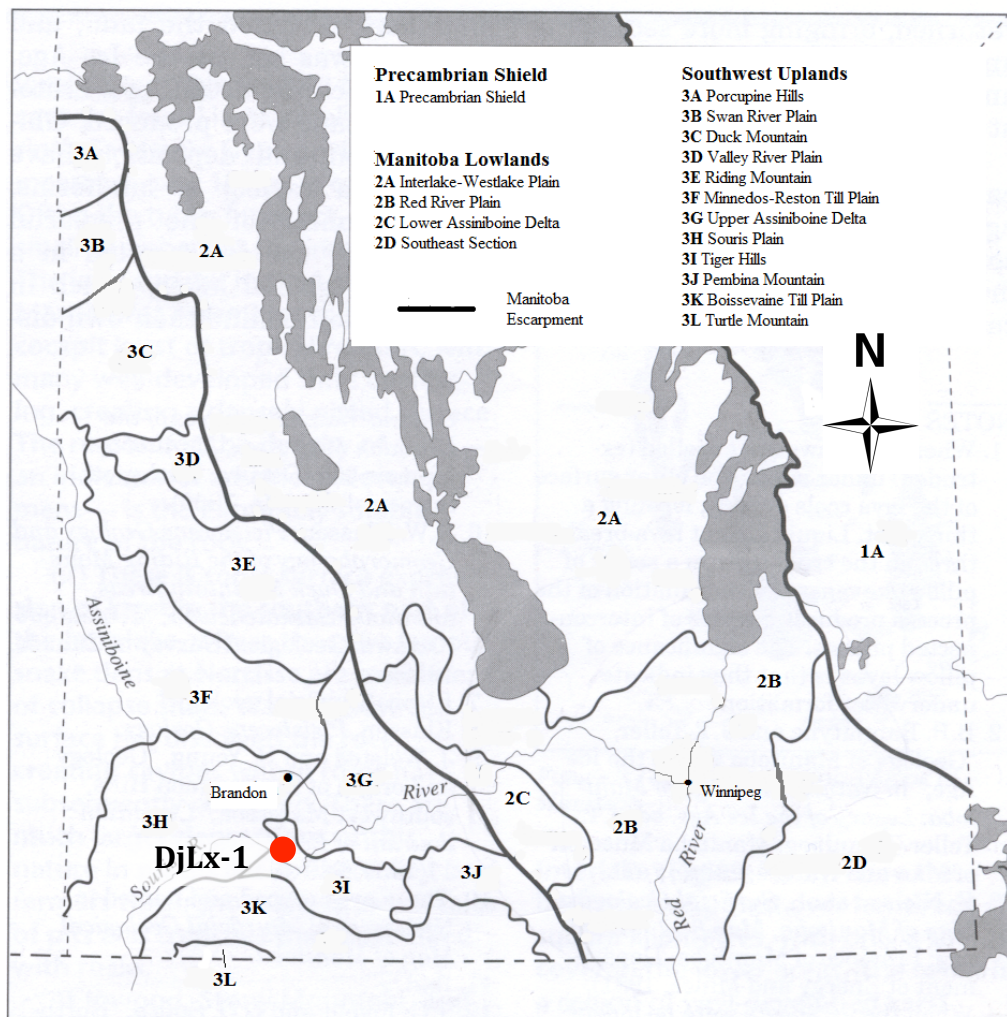


Figure 2.2: Physiographic regions of southwestern Manitoba (after Corkery 1996).

Saskatchewan Till Plains extend from south-central Manitoba westwards into southern and central Saskatchewan (Corkery 1996). Proglacial lake-plains form the Souris Plains to the west. Glacial lake-plains situated to the north and east of the Tiger Hills were formed by sedimentary deposition under glacial Lake Agassiz. Ground moraine underlies all the lake-plains as well as heavy clay deposits in the glacial lake-plains to the east. Bedrock consists of flat-lying Cretaceous shale that gives the area its gentle topography. The carbonate-rich silt and clay matrix of most Saskatchewan Till Plains glacial deposits are predominantly derived from this underlying shale (Nicholson et al. 2006).

The rugged Tiger Hills extend in a northwest to southeast direction, rising to over 60 m above the surrounding area. The hills are recession and end moraine landforms created by deposition of sediment at the terminus of ice sheets (Corkery 1996; Nicholson et al. 2006). The Tiger Hills are part of the Darlingford moraine that extends from north of Brandon through the Tiger Hills and east to the Pembina Hills (Corkery 1996). A variety of moraine landforms (moraine ridges, glacial streamlined landforms, and high relief knob and kettle) produce topography with high and varied relief (Elson 1956; Rogers 2002). Water erosion from runoff has resulted in “denuded rocky till exposures on hilltops and step slopes with localized silt/sand outwash soils on level areas below these slopes” (Nicholson et al. 2006). The glacial moraine origin of the Tiger Hills produces restricted internal drainage, generating various sized prairie potholes, ranging from a couple of meters to a couple hundred meters in diameter (Nicholson et al. 2006). The diverse topography supports a variety of flora and faunal species (Nicholson and Gibson 1991).

The Souris River Channel and glacial outwash deposits border the Tiger Hills to the south (Nicholson et al. 2006). The margin between the Lovstrom site and the Souris River

consist of sandy slopes and floodplain (Nicholson 1990). The Souris River Channel is a large glacial spillway created by expulsion of meltwater from glacial Lake Hind into glacial Lake Agassiz, eroding away glacial deposits and the underlying bedrock (Nicholson 1990; Nicholson et al. 2006). The steep-sided and flat-floored Souris Channel contains the underfit or misfit Souris stream that is far too small to have created the spillway (Corkery 1996). Above the channel, the rolling till plain is interspersed with deeply incised ravines, such as Jock's Creek, that drain into the Souris River Valley (Nicholson 1986).

2.3 Soil

Soils are predominantly chernozemic, most belonging to the black chernozem group (Nicholson 1990). The dark chernozemic soils include a very visible "A" horizon that promptly changes to a gravely and boulder clay till subsoil (Nicholson 1986; Nicholson and Gibson 1991). Surface soils were developed from extensive reworking and sorting in proglacial lakes (Nicholson et al. 2006). Owing to variation in topography and vegetation cover, significant difference in soil types can be found in and around the Tiger Hills region (Ellis and Schafer 1943). Carbonate rich parent material will impede the development of E-horizons that are more characteristic of soils formed under forest vegetation, even locations where woody vegetation has been dominant for extended periods of time (Nicholson et al. 2006).

2.4 Climate

The Manitoba Aspen parkland is located along the northern edge of the Mid-Latitude climatic region and experiences a humid continental climate (Blair 1996; Nicholson 1990). The climate in Manitoba can vary greatly from season to season, but variations may also occur from day-to-day, month-to-month and year-to-year (Blair 1996).

Past observations have identified microvariation of climate primarily formed by topographical relief, with surface features as small as hill slopes or valley bottoms creating microclimatic zones (Blair 1996; Nicholson 1990). Temperatures vary greatly between summer and winter months and frequently from day to day. The warmest month on average is July, with mean daily maximum temperatures of 26⁰C and minimum temperatures of 12 to 13⁰C. Coldest temperatures occur in January with average daily maximum temperatures of -12⁰C and normal minimum temperatures between -22⁰C and -33⁰C (Blair 1996). Extreme temperature range can see summer highs over 35⁰C and lows in winter to -40⁰C (Longley 1972). In addition to variable temperatures, violent thunderstorms are a common occurrence in July and August while blizzards occur from November to the end of March (Longley 1972). The summer growing season has a maximum of 2800-degree days (Weir 1983). The Tiger Hills area receives 115 to 125 frost-free days per year, with an average of 250 days of the year with the maximum temperature above freezing (Blair 1996).

The study area receives an average annual precipitation between 475 and 500 mm; two thirds of the yearly precipitation falling between May and September and 20 to 25% falling as snow (Blair 1996). Longley (1972) reports that average snowfall for the study area is 1270 mm (equivalent to 127 mm of rainfall), although snowfall amounts are highly variable from year to year.

Paleoenvironmental reconstructions conducted near the Tiger Hills indicate the climate during the previous Lovstrom site occupations was similar to the modern climatic conditions (Nicholson et al. 2006). Analyses of lake deposits in North Dakota show the

variability of the late Holocene climate was similar to modern conditions including wet years interspersed with drought periods (Fritz et al. 2000; Laird et al. 1996).

2.5 Hydrology

The Lovstrom site is located on a till plain bordered by Jock's Creek to the west and the Souris River approximately 1 km to the south. The end and recession moraines that compose the upland region have poor internal drainage (Nicholson et al. 2006). Along with poor drainage, an undulating pattern formed by pot and kettle topography makes for a range of microhabitats from cattail marsh to open grassland to willow thickets (Nicholson et al. 2006: 336-337).

2.6 Flora

The Lovstrom site is located on the southern boundary of the Aspen Parkland natural vegetation zone (Figure 2.3), a transitional zone between the prairie grasslands to the south and boreal forests to the north (Bird 1961). The general area is part of the Transitional Grassland Ecoclimatic region that covers the southwest corner of Manitoba (Figure 2.4). The plains surrounding the Tiger Hills are described as a mosaic of mixed-grass prairie with aspen groves (Scott 1996). Upland areas, such as the Tiger Hills, contain a distinct blend of vegetation described as a mixture of diverse forest, grassland, and wetland communities (Nicholson 1986; Nicholson et al. 2006). Depending on the type of environment, the uplands may include deciduous forests, oak, aspen-parkland, and/or savanna as well as mixed-grass prairie and wetland communities (Nicholson et al. 2006). Woody species are found in well-drained locations, while poorly drained low-lying areas are covered with grass or willow thickets and likely hold water in most years (Nicholson et al. 2002:319).

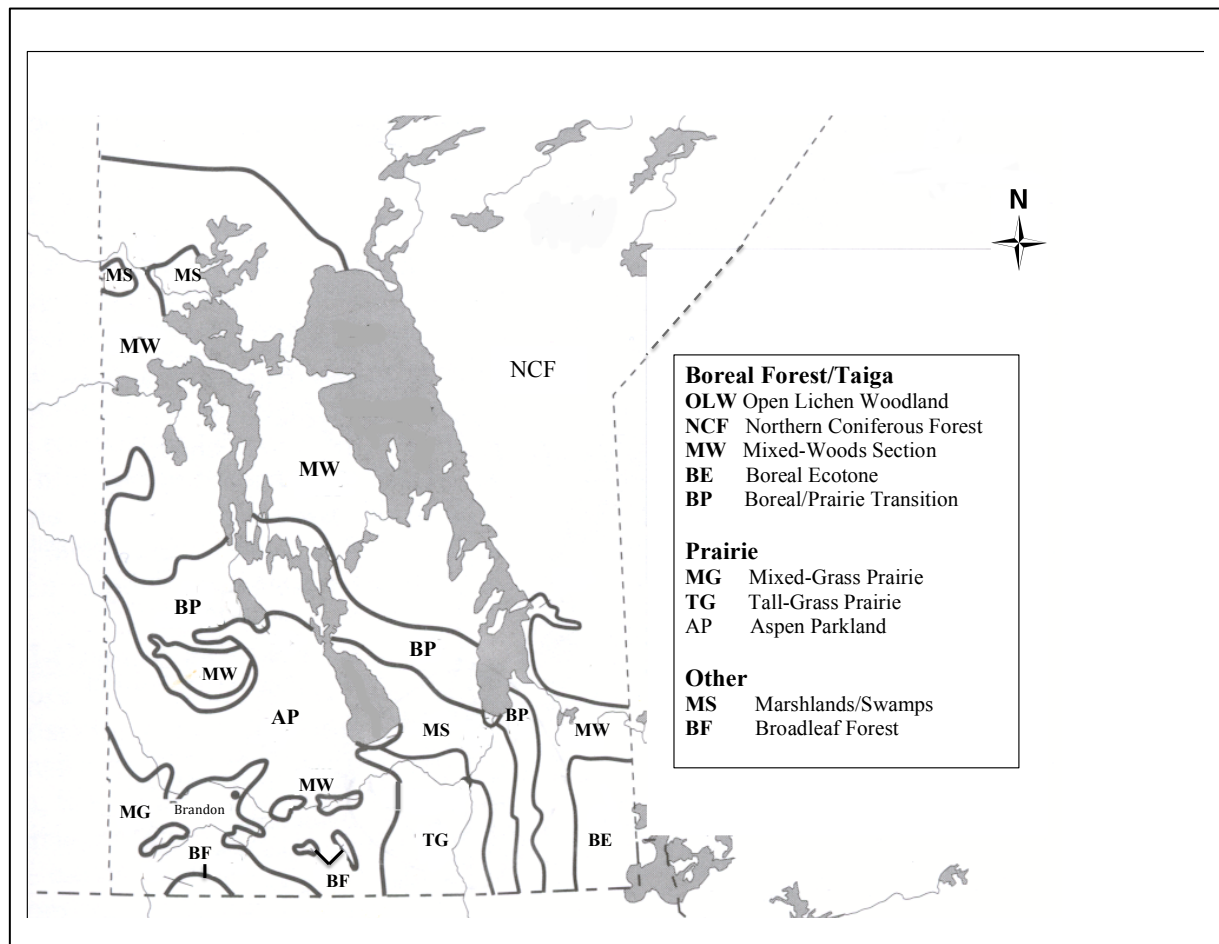


Figure 2.3: Natural vegetation zones of Manitoba (after Scott 1996).

The Lovstrom site lies on the boundary between pre-agricultural natural-vegetation zones of mixed-grass prairie to the west and aspen parkland to the north and east (Scott 1996). Current forest cover is located in well-drained areas adjacent to Jock's Creek consisting of oak forest (*Quercus* sp.) with undergrowth of chokecherry (*Prunus virginiana*), saskatoon (*Amelanchier alnifolia*), hazelnut (*Corylus* sp.), and perennials including poison ivy (*Rhus radicans*) (Nicholson and Gibson 1991; Nicholson et al. 2006) (Figure 2.5). Poorly drained areas are covered in grass or overgrown with willow (*Salix* spp.) and poplars (*Populus* spp.). Nicholson (1986) reports that non-native grasses, such as brome (*Bromus inermis*), are abundant in grassy areas, suggesting the area may have been ploughed.

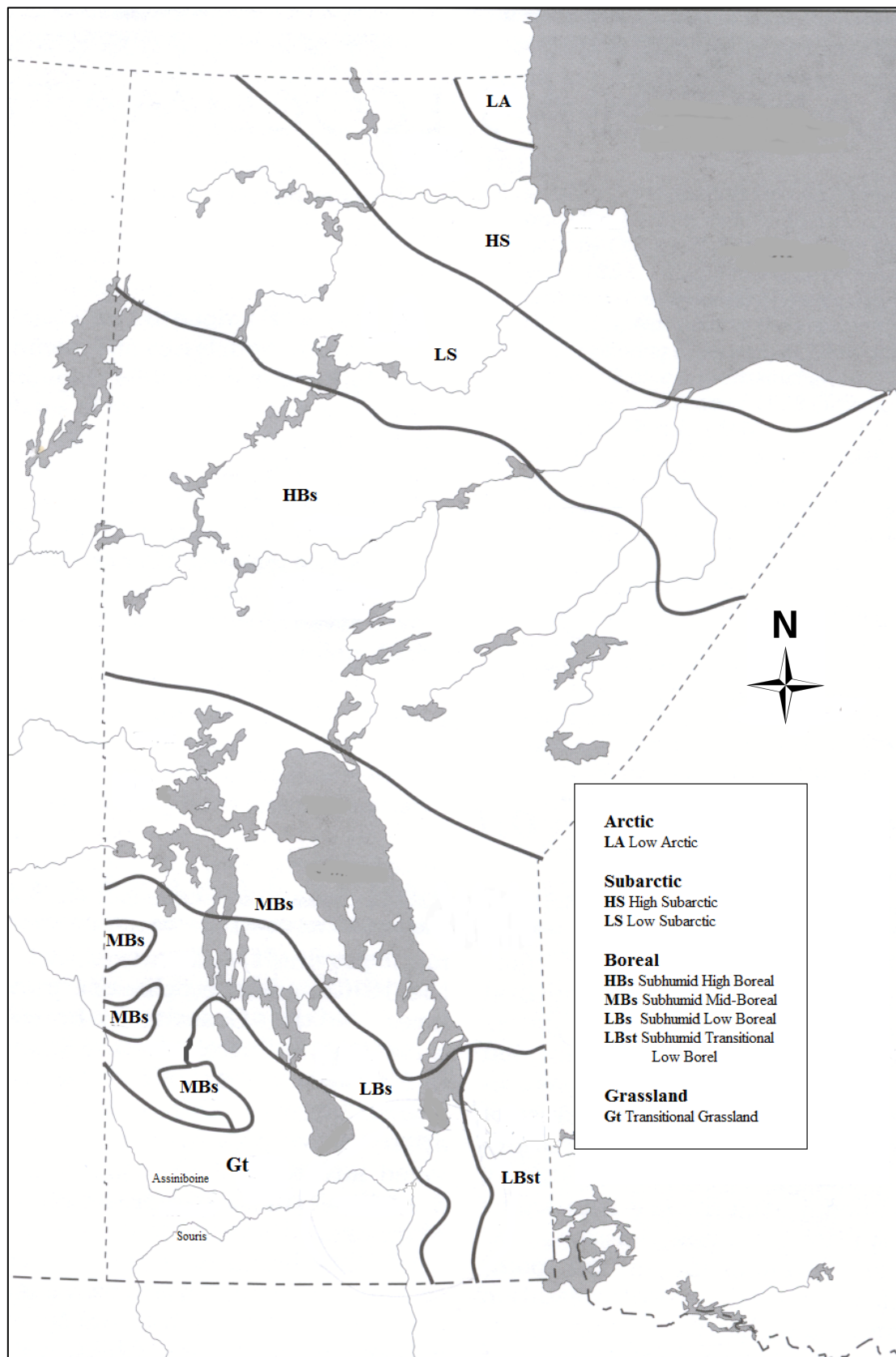


Figure 2.4: Ecoclimatic regions of Manitoba (after Scott 1996).



Figure 2.5: Block E at the Lovstrom site vegetation cover.

Vegetation cover has been transformed subsequent to European contact. Forest cover is believed to be more widespread along the Souris Channel and across the Canadian Plains than during the Late Precontact Period (Buchner 1980; Guthrie 1980). Prairie fires and grazing bison herds would have limited the spread of woody species and promoted a grassland dominance (Nicholson 1986). Suppression of extensive prairie fires and settlement and land use practices by Euro-Canadian settlers promoted growth of forest that has seen an encroachment into the prairie region and west across southern Manitoba, increasing in the last 100 years (Nicholson et al. 2006; Scott 1996). Previously, forest vegetation would have covered the more humid and cooler northern and eastern slopes, while the drier southern and western margins would have had grass cover (Ellis and Schafer 1943). On lowland or prairie regions, tree growth prior to European contact was limited to

riparian zones, including the slopes of Jock's Creek and adjacent ravines (Nicholson and Malainey 1991). "Even at the present time if viewed from the north-east, the Tiger Hills appear as hilly woodlands, but viewed from the southwest it has the appearance of a rough dry grass-land plain" (Ellis and Schafer 1943:21). Many edible plant species have been identified throughout the area surrounding the Lovstrom site. They include nuts, berries and tubers as well as many medicinal plants (Nicholson et al. 2006).

2.7 Fauna

The diverse environment of the Tiger Hills region is home to a wide variety of faunal species. Modern populations are quite different from that of the precontact world. The most visible difference is a loss of large mammals that inhabited the region. Foremost among these are the great herds of bison that once occupied this region. A complete list of faunal species are listed in Appendix I.

2.7.1 Mammalian Fauna

Diverse ecosystems around the Lovstrom site support a wide variety of mammalian fauna. Even so, the diversity has been greatly diminished by the incursion of Europeans on the Plains in the last 300 years. The encroaching parkland forest cover, as well as other disturbances to local habitats, has led to the extirpation of a number of species.

A recent study of the Souris River Valley identified the presence of elk (*Cervus elaphus*) and white-tailed deer (*Odocoileus virginianus*) (Weidl and Young 1991). Although today white-tailed deer are the most numerous of the large mammals in the region, they have only recently (in the past hundred years) migrated north into the parkland region (Banfield 1974). Other large ungulate species still found in the area include mule deer (*O. hemionus*) and moose (*Alces alces*) (Nicholson et al. 2002). Woodland caribou

(*Rangifer tarandus caribou*) and pronghorn antelope (*Antilocapra americana*) also may have been present during the occupation of the Lovstrom site (Harmon 2006). Bison (*Bison bison bison*), the most prevalent large mammal on the plains disappeared from the region as a result of European intervention.

Numerous carnivore species inhabited the Tiger Hills region prior to European contact. Large carnivores no longer found in the area include the grizzly bear (*Ursus arctos*), black bear (*U. americanus*) and wolf (*Canis lupus*), as well as cougar (*Felis concolor*), bobcat (*Lynx rufus*) and lynx (*Lynx lynx*). Carnivores still found in the area include the coyote (*Canis latrans*), red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*), mink (*Mustela vison*), badger (*Taxidea taxus*) and the striped skunk (*Mephitis mephitis*) (Banfield 1974; Weidl and Young 1991).

Three leporids are currently found in the area: the eastern cottontail (*Sylvilagus floridanus*), the snowshoe hare (*Lepus americanus*) and the white-tailed jackrabbit (*Lepus townsendii*)

The diverse parkland ecosystems attract many rodents. These include the Franklin ground squirrel (*Citellus franklini*), Richardson's ground squirrel (*Spermophilus richardsonii*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), least chipmunk (*Eutamias minimus*), fox squirrel (*Sciurus niger*), gray squirrel (*Sciurus carolinensis*), American red squirrel (*Tamiasciurus hudsonicus*), woodchuck (*Marmota monax*), and Northern pocket gopher (*Thomomys talpoides*). Abundant water sources attract beaver (*Castor canadensis*) and muskrat (*Ondatra zibethicus*). Forested areas are home to porcupine (*Erethizon dorsatum*). Only one species of microrodent, the deer mouse

(*Peromyscus maniculatus*), was identified in a recent study of the area (Weidl and Young 1991).

2.7.2 Avian Fauna

The diverse ecology is home to a great variety of avian species. More than 180 bird varieties inhabit the different ecosystems surrounding the Lovstrom site, with populations increasing dramatically during the warm summer months (Weidl and Young 1991).

Excavation of avian skeletal material is rare in archaeological sites within the Tiger Hills region (Nicholson et al. 2006). Consequently, discussion has been limited to those classes of bird identified during archaeological excavations. In the warmer seasons, waterways and wetlands hold migratory waterfowl such as the Canada goose (*Branta canadensis*), snow goose (*Anser caerulescens*), great blue heron (*Ardea herodias*), mallard (*Anas platyrhynchos*), and wood duck (*Aix sponsa*). The largest numbers of waterfowl would be present during the spring and fall migrations. Sharp-tailed grouse (*Tympanuchus phasianellus*) and ruffed grouse (*Bonasa umbellus*) occupy woodland and parkland areas (Godfrey 1986). Raptors include the red-tailed hawk (*Buteo jamaicensis*) and northern harrier (*Circus cyaneus*).

2.7.3 Amphibians and Reptiles

A small number of amphibians and reptiles are found in the Tiger Hills area. Amphibians include the wood frog (*Rana sylvatica*) and northern leopard frog (*R. pipiens*). Reptiles comprise the common snapping turtle (*Chelydra serpentina*), western painted turtle (*Chrysemys picta belli*), plains garter snake (*Thamnophis radix*), and the smooth green snake (*Opheodrys vernalis*).

2.7.4 Piscine Fauna

Many varieties of fish are found in the Souris River and numerous tributaries. The meandering nature of the Souris River provides suitable habitat for many species.

Convergence of the spring spawn and regular spring flooding of the Souris Channel creates suitable habitats for Northern Pike and Walleye (Scott and Crossman 1979). In addition, burbot, catfish, suckers, and perch are also found in local waterways (Scott and Crossman 1979). The archaeological record in the Tiger Hills region suggests the Vickers Focus or Blackfoot people rarely exploited fish as a source of food (Nicholson et al. 2006).

However, historical aboriginal groups are known to have fished regularly with hooks and nets (Scribe 2001-2003 from Nicholson et al. 2006). The fragile nature of piscine skeletal material may be responsible for a lack of representation in the archaeological record.

2.8 Summary

Diverse ecosystems in and around the Tiger Hills embraced numerous species of plants and animals. The availability of food sources in turn attracted many groups of people to the area. The wooded and hilly terrain would have given respite from the cold temperatures and windy conditions experienced on the open prairies. In addition, water sources were close at hand and forested areas provided sources of fuel and material for shelter.

Chapter 3

Cultural Background

3.1 Introduction

The Lovstrom site is located within the aspen parkland, a region described as a transition zone between diverse ecological areas. Distinct technologies and lifeways that formed in the diverse environments of the boreal forest to the north and the Northern Plains to the southwest were introduced to the aspen parkland. The Lovstrom site is not only located between these areas to the north and south, but also in contact with the Eastern Woodlands and Missouri River lowlands to the southeast. This thesis looks the lifeways of two distinct groups of people who occupied the area surrounding Block E of the Lovstrom site. Differences between these two groups are seen in the cultural material deposited in the archaeological record. Both groups have origins outside of the aspen parkland; the earliest group having its origins in the boreal forest and the later group believed to originate to the southeast in the Missouri River valley.

The Block E cultural occupations are encompassed by the Late Precontact period, spanning from approximately 2000 BP to European contact. Accompanied by various cultural and technological changes, the Late Precontact period is characterized by the introduction of the bow and arrow and the associated smaller side-notched projectile points (Walker 1999). The first of these small side-notched points were associated with the Besant culture appearing approximately 2000 years ago followed by the Avonlea culture some 250 years later. Both cultural groups disappear approximately 1150 BP to be replaced by people making Prairie side-notched and followed by Plains side-notched point types. A second important technology appearing in southwestern Manitoba during

this period is pottery vessels. While the bow and arrow was probably introduced from the west, pottery is believed to originate from the Eastern Woodland region (Meyer and Walde 2009; Walker 1999). Coincidental or not with the introduction of the bow and arrow, this period also sees an increase in the number of bison mass kill sites and corrals or bison jumps (Frison 1991).

The principal method of relative dating and culturally associating sites has been the use of projectile point typologies. Distinctive attributes have been used to isolate or place occupation areas associated with a particular projectile point into specific time periods or cultural groupings. After the introduction of ceramic material during the Late Precontact Period it was recognised that similar projectile point types may appear between groups with diverse ceramic styles. Plains/prairie and triangular side-notched projectile points found in Blackduck sites are also found in sites of other Late-Woodland cultural assemblages. Plains and prairie side-notched points are not only limited to boreal forest sites, but are found in sites on the plains associated with various cultural groups. Similar to other late precontact groups, the identification of the Blackduck and Vickers Focus cultures is based primarily on the distinctive ceramic style (Graham 2005).

3.2 Blackduck Focus

The earliest occupation in Block E is associated with the Blackduck culture. The first discussion of Blackduck referred to ceramics found in Minnesota under the Blackduck focus classification (Wilford 1941,1945). In the case of the Blackduck focus, similar artefact traits, primarily pottery traits, were observed in a number of sites. The Blackduck focus was assigned to the Headwaters Lakes aspect and was the sole focus assigned to this aspect (Wilford 1941:239).

Similar ceramic types located in Manitoba were considered to differ sufficiently from the Blackduck focus that they were given the separate designation of Manitoba focus (Vickers 1947, 1948). Both were grouped under the Headwaters Lakes aspect, but have since been placed within the Blackduck ceramic typology. Since the first identification of this ceramic variety, archaeologists continue to deliberate what constitutes Blackduck pottery. General similarities over a large spatial area have created considerable debate as to what decorative varieties should be included or omitted from the Blackduck category. In addition, there has been some confusion as to what the term Blackduck actual refers. Syms (see 1977: 97) illustrates this problem by providing a list of various definitions and descriptions of Blackduck pottery over time and in various locations. For this thesis, the term Blackduck will refer to the archaeological culture.

Blackduck pottery has been characterized as globular in form with rounded bases and constricted necks (Evans 1961). Blackduck vessels are often completely covered with cord impressions and occasionally represented by various sizes of pottery (Carmichael 1977). Continued research has identified various types of surface finish, including: net- and fabric impressed, combed, brushed and smoothed finishes (Anfinson 1979; Carmichael 1977; Evans 1961; Pettipas 1983: 120). Two decorative traits typically found on Blackduck vessels are punctates and cord-wrapped tool (CWT) impressions (Pettipas 1983). Other sources use the term cord-wrapped object (CWO) that is interchangeable with the previous CWT terminology. Decoration is limited to the upper areas of the vessel from the neck to the rim and lip and is rarely located on the interior of the rim. Although the arrangement of primary decorative traits varies through time, the CWT and punctate decoration consistently appear (Carmichael 1977). The consistent use

of particular vessel traits is seen across a variety of environments, appearing from one ecological region to the next. The similarity of ceramic traits across a large area is thought to be the result of rapid movement of people from the east into the boreal forest, aspen parkland and prairie regions of Manitoba (Syms 1977). Each zone would offer differing amounts and varieties of exploitable food resources. Contact with different cultural groups in these new areas would influence the culture of the Blackduck people. The consistency of the ceramic material traits between sites over time may not show what cultural changes were actually taking place.

The Blackduck focus has its origins in the Upper Great Lakes and boundary waters region in northern Minnesota between AD 700 and 800, within the Late Woodland period (Buchner et al. 1983; Meyer and Hamilton 1994; Syms 1976, 1977). From its beginnings, Blackduck occupations quickly spread to the north and the west. Habitation of the original ecological areas also expanded from the boreal forest regions in Ontario and Minnesota to include the aspen parkland and parts of the northeastern plains in Manitoba (Graham 2005; Hamilton et al. 1981; Mayer-Oakes 1970). This cultural group existed in various forms at least until the Late Precontact period (Hamilton et al. 2007) (Figure 3.1). The discovery of historic artefacts associated with Blackduck pottery is limited to areas north of Lake Superior (Nicholson 1996). The disappearance of Blackduck pottery in Manitoba occurs between AD 1300 and 1400 (Graham 2005; Hamilton et al. 2007; Syms 1976,1977). For radiocarbon dates of various Blackduck sites see Appendix II.

Table 3.1: Radiocarbon dates of Blackduck Focus sites
(Source: Hamilton et al. 2007:98-99)

| Site/Block | Lab # | Uncorrected Age | Normalized Age ($\delta^{13}C$) |
|------------|--------|-----------------|-----------------------------------|
| Lovstrom/B | S-2951 | 785 \pm 80 | -20 |
| Lovstrom/B | S-2953 | 755 \pm 80 | -20 |
| Lovstrom/E | S-3034 | 795 \pm 110 | -20 |
| Lovstrom/E | S-2952 | 755 \pm 75 | -20 |
| Lovstrom/E | SFU | 860 \pm 50 | - |
| Lovstrom/H | S-3031 | 860 \pm 110 | -20 |

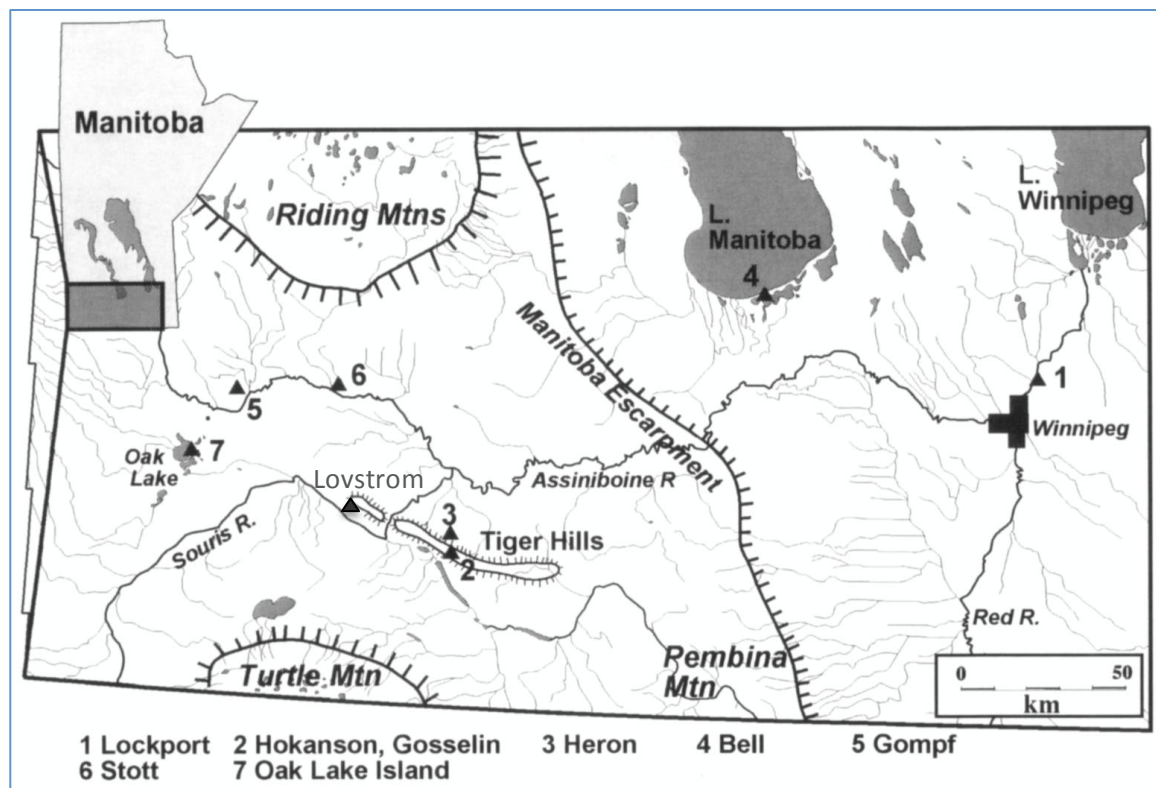


Figure 3.1: Map of Blackduck sites in southwestern Manitoba
(Source: Hamilton et al. 2007:109)

The Blackduck people have typically been described as a sub-arctic group subsisting on a wide-ranging diet of animal resources (Meyer and Hamilton 1994). In

Minnesota the subsistence system included operating fish weirs and harvesting wild rice (Gibbon 1994:144-145). The nature of food resources available in the boreal forest is believed to promote relatively small hunting groups. A number of these groups, united through extended family ties, formed informal band societies (Dawson 1977, 1983). The different bands would likewise create social ties to lessen hardship during adverse periods. This may be understood as the “safety in numbers” philosophy. The groups would further be united through transfer of people between bands and the commonality of each band’s cultural makeup (Dawson 1977). Similar to other sites in the Aspen Parkland, the Lovstrom site offered the Blackduck people a buffer zone between the familiar boreal forest and an intensive Plains adaptation (Syms 1977:104). This is evident with the appearance of more intensive bison exploitation, but also the continued use of a variety of animals from the different ecotones surrounding the site locale helps to support this hypothesis.

The location of Blackduck sites moved beyond the boreal forest into the prairie-parkland regions and to the fringes of the prairie grasslands in southwestern Manitoba. The change in environment also brought a change in subsistence practices with a focus on bison replacing the broad-spectrum foraging associated with the boreal forest (Hamilton et al. 2007:129). The focus on bison also initiated variation in hunting practices from small groups hunting individual bison to large communal hunts requiring large numbers of people (Hamilton et al 2007). A new term was introduced to describe these sites with a focus on bison hunting: Plains Blackduck (Walde et al. 1995: 24).

The Plains Blackduck peoples continued to use the bow and arrow with the small side-notched and triangular arrow points. They also continued to produce well-made

globular pottery with textile-impressed exteriors that were elaborately decorated with cord-wrapped tool impressions (Walde et al. 1995:24). The globular vessels have constricted necks with flaring rims and almost all (98%) vessels have a vertically oriented sprang surface finish (Dr. David Meyer, personal communication, April 16, 2015).

The Plains Blackduck sites were extensive with repeatedly occupied encampments (Hamilton et al. 2007). The site location and large amounts of faunal material suggests that large-scale killing took place (Hamilton et al. 2007:102). The quantity of killed bison indicates the use of pounds to collect bison in the nearby steep walled valleys. The number of people needed to build pounds, corral and kill the animals and process the carcasses was much more than the extended family-sized groups associated with the forest region occupations (Hamilton et al. 2007:102). Smaller Plains Blackduck sites exhibit a more generalized exploitation strategy and short term occupations.

The appearance of the large mass kills that required support among numerous groups may not have necessitated an extreme change in social structure. Periodic aggregation was already present in the boreal forest regions during certain times of the year (Hamilton et al. 2007:129). Even though the Blackduck people had entered a new area, the parkland region still afforded a diverse foraging plan. What did change was the time of year these aggregations took place. Certain food resources were more accessible during different seasons in the boreal forest and the Plains region. Where fishing would offer an abundance of food in the warm season in the boreal forest, the cooler seasons in the parkland would offer a more reliable food resource, namely the bison that took shelter from the cold open areas on the plains (Hamilton et al. 2007).

It is questionable whether the occupation of the parkland region was the result of migration or a temporary visitation during seasonal rounds. The seasonal migration is more evident within the boreal forest region where family groups may travel “several kilometers during the year in search of food” (Dawson 1983: 79). It is believed that the Blackduck groups would occupy areas close to bodies of water in the warm months and move away towards more remote hunting grounds during the cold season (Dawson 1977, 1983; Winterhalder 1983). Warm season sites are typically located near available water, the forest, and located in an area adjacent to various ecozones (Dods 2003: 23). This latter site preference is considered to occur in the aspen parkland region as well (Dods 2003).

3.2.1 The Disappearance of the Blackduck Culture

The end of the Blackduck in southern Manitoba occurs approximately AD 1150 with a few later dates near AD 1350 (Nicholson 1996). One hypothesis suggests the Blackduck simply withdrew back into the boreal forest (Graham 2005). The later dates of Blackduck occupation are close to the arrival of the Plains Woodland and Vickers focus people. Pressure from an incoming people may have stimulated a return to the forest regions in the north (Nicholson 1996). The most recent Blackduck sites have ceramic assemblages that also include Plains Woodland vessels, suggesting some interaction between the two groups. It has also been hypothesized that some Blackduck groups left the parkland region and took on a complete plains way of life on the open grasslands (Nicholson 1996). If the Blackduck did migrate fully to the plains region, they ceased to use their pottery since none of their distinctive ceramics has been identified on the plains to the west (Graham 2005; Hamilton et al. 2007).

3.3 Vickers Focus

The most recent people to occupy Block E at the Lovstrom site is an archaeological culture identified as the Vickers Focus. Similar to the Blackduck culture that preceded them, the Vickers Focus people were believed to have their origins in a distant region. Whereas, the Blackduck people were believed to be more broad-spectrum hunters and gatherers from the sub-arctic region, the Vickers Focus people were thought to bring with them more specialized social structures and subsistence technologies from Minnesota and North Dakota. Their appearance in the Tiger Hills region is short-lived, reappearing in areas to the west for a brief period of time before disappearing completely.

The first mention of the, as yet unnamed, Vickers Focus appears in early archaeological reports in southwestern Manitoba. Chris Vickers, an avocational archaeologist living close to the Tiger Hills region, provided much of the early archaeological work. Research around the Pelican Lake region identified the presence of a distinct archaeological culture. Ceramic material recovered from local sites was comparable to pottery found to the east and believed to be associated with Woodland cultures. Vickers suggested these sites were the result of an influx of people from the east to the Pelican Lake region and subsequently named this unique pottery style and cultural affiliation the Pelican Lake Focus (Vickers 1949). Concerns arose over similarities between the Pelican Lake label and the already named Middle Precontact cultural complex and projectile point type in Saskatchewan (Wettlaufer 1955). In part to alleviate this problem, and to honour Chris Vickers, Nicholson (1991: 167) suggested the renaming of the Pelican Lake Focus as the Vickers Focus.

The identification of the Vickers Focus is again largely dependent on the presence of certain ceramic styles. Unlike the general similarities of Blackduck pottery, Vickers Focus pottery is highly variable with a mixture of attributes that are believed to originate from the woodlands and the plains (Nicholson 1996:78). Isolating the origin of the Vickers Focus people, if there is indeed one specific locale, has been problematic due to the variability of the pottery styles. The various ceramic styles include Campbell Creek, Fort Yates cord-impressed, Great Oasis, Northeastern Plains Village, Sandy Lake and Talking Crow (Nicholson 1991: 169). Comparable pottery and radiocarbon dates from sites in North Dakota indicate a relationship to the Scattered Village Complex (Nicholson 1996). More recent studies reassert that the Eastern Woodlands of Minnesota and northern Iowa are the source of the Vickers Focus people, and that there are also relationships with Mississippian and Middle Missouri groups (Nicholson 1994; Nicholson et al. 2006:343-344). Many of the vessels from Vickers Focus sites in the Tiger Hills were identified as Sandy Lake ware (Nicholson and Hamilton 1997). More recent research also recognised a large number of Sandy Lake ware present at the Lowton site (Taylor-Hollings 1999:235). What is not seen in Vickers Focus ceramic assemblages are Woodland Blackduck or Duckbay wares (Playford and Nicholson 2006), although, as mentioned above, Plains Woodland vessels have been found at a few Blackduck sites. The variety of ceramic styles may indicate the occupation of Vickers Focus sites was by a mixture of diverse cultural groups, an idea previously proposed by Nicholson (1994, 2006).

The variety of decoration exhibited in Vickers Focus pottery is paralleled in the variability of form and manufacture. The basic vessel profile is globular with a variety of

rim shapes that vary from straight to flaring to occasional S-rim (Nicholson 1996). Unique finger-pinched decoration along the exterior lip is a principal attribute of Vickers Focus pottery (Hartlen 1997:63; Nicholson and Hamilton 1999:17; Playford and Nicholson 2006:401). Though most pottery is tempered with sand, fine grit and shell temper were also used (Nicholson 1991, 1996). With a few exceptions, the quality of workmanship and the paste characteristics suggest most of the Vickers Focus vessels were locally made (Nicholson 1991: 171).

3.3.1 Eastern Cluster

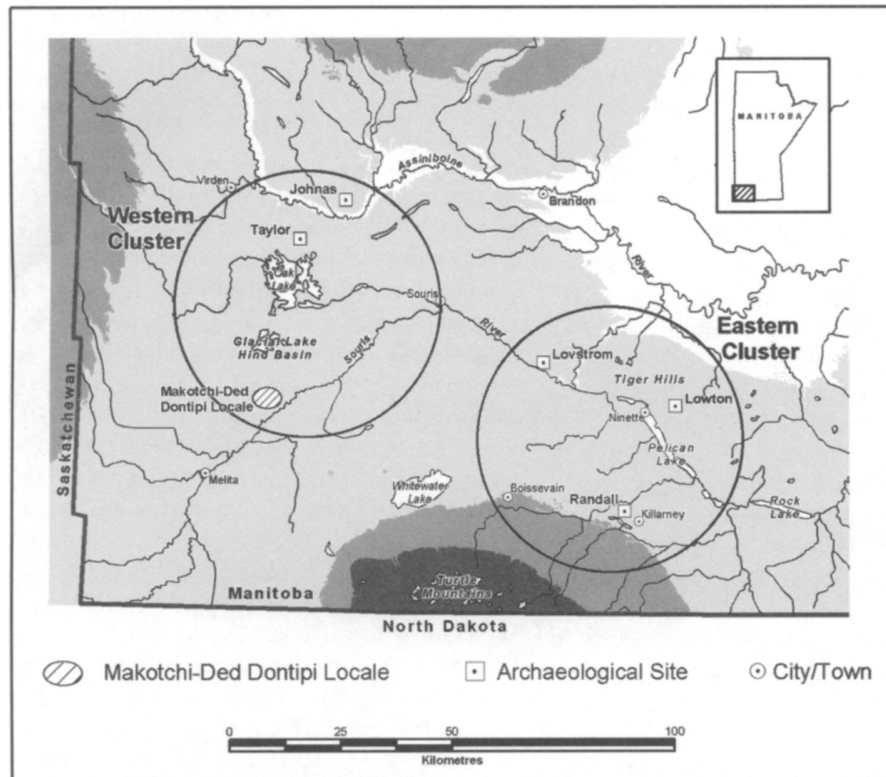
Continued research by Drs. Bev Nicholson and Scott Hamilton identified two clusters of Vickers Focus sites separated both spatially and temporally. Of the two clusters, the eastern cluster is the oldest with occupations appearing around AD 1450 (Nicholson 1991) (Table 3.1). The eastern cluster comprises three sites in the Tiger Hills/Killarney Plains region of Manitoba, including the Lowton site, the Lovstrom site and the Randall site (Nicholson and Hamilton 1997; Nicholson et al. 2002) (Figure 3.2). The Lowton site (DiLv-3) is considered to be the type-site for Vickers Focus pottery (Nicholson and Malainey 1995:87). With similarities to the pottery of Eastern Woodland and Missouri Basin groups, it was proposed that the Vickers Focus was the result of a migration of people into southwestern Manitoba from the North Dakota, Minnesota and Iowa region (Nicholson 1991). These people were thought to bring with them a horticultural way of life and a more structured and complex social system. The identification of horticultural practices is based on the recovery of direct and indirect evidence. The recovery of plant remains, such as maize (*Zea mays*) and beans (*Phaseolus vulgaris*) are considered to be direct evidence of horticulture (Schneider

2002). Indirect evidence is the associated tools and features used to cultivate and store seeds, such as scapula hoes, grinding stones and storage pits (Schneider 2002).

Beyond similarities of pottery styles observed at these three Vickers Focus sites, the site size and location are also comparable. The Lowton and Lovstrom sites, located in the uplands of the Tiger Hills, and the Randall site situated on the till plain, are all located some distance from major water sources, on gently sloping, warm, silty clay loam soils (Nicholson 1993). In addition to the placement of these sites, the identification of horticultural tools supported the hypothesis that “small-scale horticulture was a part of the Vickers Focus subsistence economy” (Nicholson et al. 2002:316).

**Table 3.2: Radiocarbon dates of eastern Vickers Focus sites
(Source: Playford and Nicholson 2001:402).**

| Site/Block | Lab# | Uncorrected Age | Normalized Age | Calibrated Age |
|------------|-----------|-----------------|----------------|----------------|
| Lowton | S-3459 | 510±110 | 590±110 | 1357±65 |
| Lowton | TO-9215 | 350±80 | - | 1548±76 |
| Lowton | TO-9216 | 440±80 | - | 1504±86 |
| Lowton | TO-9217 | 390±50 | - | 1528±72 |
| Lovstrom/E | SFU- no # | 380±50 | 460±55 | 1456±42 |
| Lovstrom/E | S-3032 | 405±110 | 485±110 | 1455±117 |
| Lovstrom/E | S-3033 | 465±100 | 545±100 | 1382±69 |
| Lovstrom/H | S-3032 | 405±110 | - | 1455±117 |



**Figure 3.2: Vickers Focus sites in southwestern Manitoba
(Source: Playford and Nicholson 2001:402).**

3.3.2 Western Cluster

As Vickers Focus groups disappear in the east, about a hundred years later Vickers Focus pottery reappears to the west at sites in the Lauder Sandhills (Table 3.2). It is hypothesized that an exodus of Vickers Focus people from the Tiger Hills region resulted in the movement of this group in the west (Nicholson and Hamilton 2001). Changing climate that may have encouraged a move from areas in the northern states to the Tiger Hills region may also have prompted a western movement to the Lauder Sandhills (Nicholson et al. 2006). Decreasing average annual temperatures during the Little Ice Age may have had an adverse effect on the Vickers Focus groups' sustainability of horticulture (Nicholson et al. 2006:325). These sites include the Bradshaw, Jackson

and Vera sites in the Makotchi-Ded Dontipi locale of the Lauder Sandhills and the Johnas site located to the north on the north side of the Assiniboine River (Figure 3.2). Similar to the sites in the east, sites in the west were large and somewhat isolated. The distinctly diverse ceramic ware of the Vickers Focus was again present in the western sites. Many attributes found on Lowton site pottery are also present on vessels from the western cluster (Nicholson and Hamilton 1999). Ceramic traits related to the Plains Woodland and Plains Village groups are present at the Vera site with “an increased presence of Middle Missouri related wares” (Playford 2001:23). A few differences are also evident between the eastern and western assemblages. Knife River Fine ware pottery and vessels displaying effigies and found in the eastern cluster sites are absent in the western sites (Nicholson and Hamilton 1997).

Table 3.3: Radiocarbon dates for western Vickers Focus site.

| Site | Lab # | Normalized Age | Calibrated Age |
|---------|-------------|----------------|----------------|
| Jackson | Beta 83865 | 290 +/- 50 | 1645 A.D. |
| Jackson | Beta 83864 | 300 +/- 70 | 1640 A.D. |
| Jackson | Beta 82792 | 410 +/- 60 | - |
| Jackson | Beta 82795 | 330 +/- 60 | - |
| Vera | Beta 106109 | 340 +/- 60 | - |
| Vera | Beta 111141 | 250 +/- 50 | - |

A change in the subsistence strategies is seen in the western cluster with a decline in the Plains Village/Woodland way of life to a subsistence strategy focused towards the Plains and bison hunting (Hamilton and Nicholson 1999). No direct evidence was found at the Jackson and Vera sites that would suggest the existence of horticulture (Hamilton and Nicholson 1999; Nicholson and Hamilton 1997). However, analysis of food residue has identified the presence of beans (*Phaseolus vulgaris*) and corn (*Z. mays*) (Boyd and

Surette 2010; Boyd et al. 2006). A change in subsistence strategies towards a focus on the exploitation of seasonal resources, especially bison was considered to be the reason for the absence of horticulture in the western sites (Nicholson and Hamilton 1999:11; Playford 2001:146). As was observed in the Tiger Hills region, the Vickers Focus is present in the Lauder Sandhills for a brief period of time before disappearing from the archaeological record.

3.3.3 The Disappearance of the Vickers Focus

Various hypotheses have arisen concerning the disappearance of the Vickers Focus. A change in climate may have affected the horticultural way of life and prompted a move to other areas. Some of the people may have returned to their homeland in North Dakota or Minnesota. This hypothesis is based on historical accounts of groups, such as the Hidatsa, having described living in areas comparable to the boreal forest region (Nicholson 1996; Wood 1986:36).

Although the pottery from the western and eastern cluster has many similarities, a different type of pottery appeared exhibiting attributes of ceramic wares found to the west in Saskatchewan. Mortlach pottery first appears near the latter part of the Vickers Focus period with dates of AD 1550 and continuing to the early contact period (Meyer et al. 1999; Walde 1994:105-106). These were a plains-based group found primarily in central and southern Saskatchewan with a focus on bison as a primary subsistence source (Malainey 1991). Mortlach wares appear in several sites adjacent to the eastern Vickers Focus sites. There are no definitive radiocarbon dates for the Mortlach occupations in the Makotchi-Ded Dontipi locale, but certain artefacts suggest dates concurrent with or following Vickers Focus occupations (Nicholson and Hamilton 1999:21). A combination

of both Vickers Focus and Mortlach pottery, as well as pottery considered to be transitional would suggest some interaction took place between these two groups (Mokelki 2007; Nicholson and Hamilton 1997, 1999; Nicholson et al. 2003). A lack of evidence that the Vickers Focus practiced horticulture in the western cluster, and a perceived change to plains-focused subsistence would further support the idea that cultural contact occurred (Nicholson and Hamilton 1999). Possibilities have been raised to the presence of Vickers Focus at the Sanderson site in Saskatchewan. This site along the Souris River in southern Saskatchewan has been categorised as a Mortlach site, but some researchers consider the pottery to be comparable to Vickers Focus (see Mokelki 2007:20). The mixture of both Vickers Focus and Mortlach has been used to hypothesize the disappearance of the former group. Of the various hypotheses, the one seemingly most plausible is that the Vickers Focus group slowly changed from the more sedentary horticulturalists into the Mortlach Complex through interaction with Plains Village people (Nicholson and Hamilton 1999:25).

3.4 Summary

Two distinct groups of people inhabited the Aspen Parkland in and around the Tiger Hills region for a relatively short period of time. The earliest group, with a Blackduck material culture, arrived in the area from the boreal forest regions to the north around AD 1100. These people lived in small bands relying on a generalized subsistence base including various animal resources. Once in the parkland region there was a shift to a more intensive subsistence focused on bison. At or near the disappearance of the Blackduck culture a different group of people arrived. The society that produced the Vickers Focus was believed to use horticulture. As with the Blackduck inhabiting the

parkland region, the Vickers Focus moved towards a reliance on bison and a more plains based economy. The identification of both archaeological entities is reliant on the presence of their distinctive pottery. It is unknown what happened to either group that produced these material cultures. The Blackduck may have retreated back to the boreal forest. It is also possible that they merged with different local groups or their pottery was simply no longer produced. A combination of this or other unidentified factors may have kept them from our view. The outcome of the Vickers Focus is also uncertain. They too may have returned to their homeland or merged with another group.

Various terms within the thesis are used to identify the two cultural occupations. The Blackduck is variously referred to as Occupation 2 or Occupation Level 2. The Vickers Focus is variously referred to as Occupation 1 or Occupation Level 1.

Cultural differences between the groups occupying the Lovstrom Block E site may present itself in the species exploited and the butchering and processing practices utilized by each group. The purpose of this thesis is to identify similarities or differences between the faunal assemblages left by these two groups.

Chapter 4

Methodology and Site Stratigraphy

4.1 Excavation Procedures

The Lovstrom site was initially identified and tested in 1985. Based on the amount of cultural material unearthed at the site, additional excavation was recommended. Test pitting and excavation was to continue for the next three years. Fieldwork was conducted in conjunction with the Brandon University field school under the direction of Dr. B. A. Nicholson.



Figure 4.1: Block E excavation block.

An arbitrary grid was surveyed north of a 0/0 datum at the southern border of the site. A steel post was driven in the ground to serve as a permanent datum marker. A north/south baseline was surveyed using a theodolite. Brush and debris was cleared along this north/south baseline. In an effort to situate all the excavation blocks close to the baseline, the north/south baseline was placed on a grid north line 39 degrees east of true north (Figure 4.2). All excavation units and test pits later than 1996 were surveyed from the datum or turning points tied into this datum. Subsequent to the excavation of the Lovstrom site a problem was identified with the use of the 0N/0E datum coordinate and a northeast unit datum when entering figures into the MacADEM catalogue system. The original 0N/0E datum coordinates were subsequently changed to 500S/500W and all catalogue numbers displayed these new datum numbers.

The excavation of two test units in 1987 produced sufficient cultural materials to warrant the creation of a block excavation. A block excavation is best suited for sites with one occupation or single component where a synchronic study is focused on the lifeway of a cultural group over a short duration of time. The test pits and subsequent excavation units were all 1 x 1 meter square. Thirty-one units were excavated in Block E over three field seasons, in addition to a test unit excavated in 1987. Seven units were excavated in 1987 with 14 units in 1988 and 10 more units in 1991 (Figure 4.3). The Brandon University Field School, including students and field crew, carried out excavations over the course of the Block E excavations. The 1991 excavations were completed by both Brandon University students and students from the University of Manitoba.

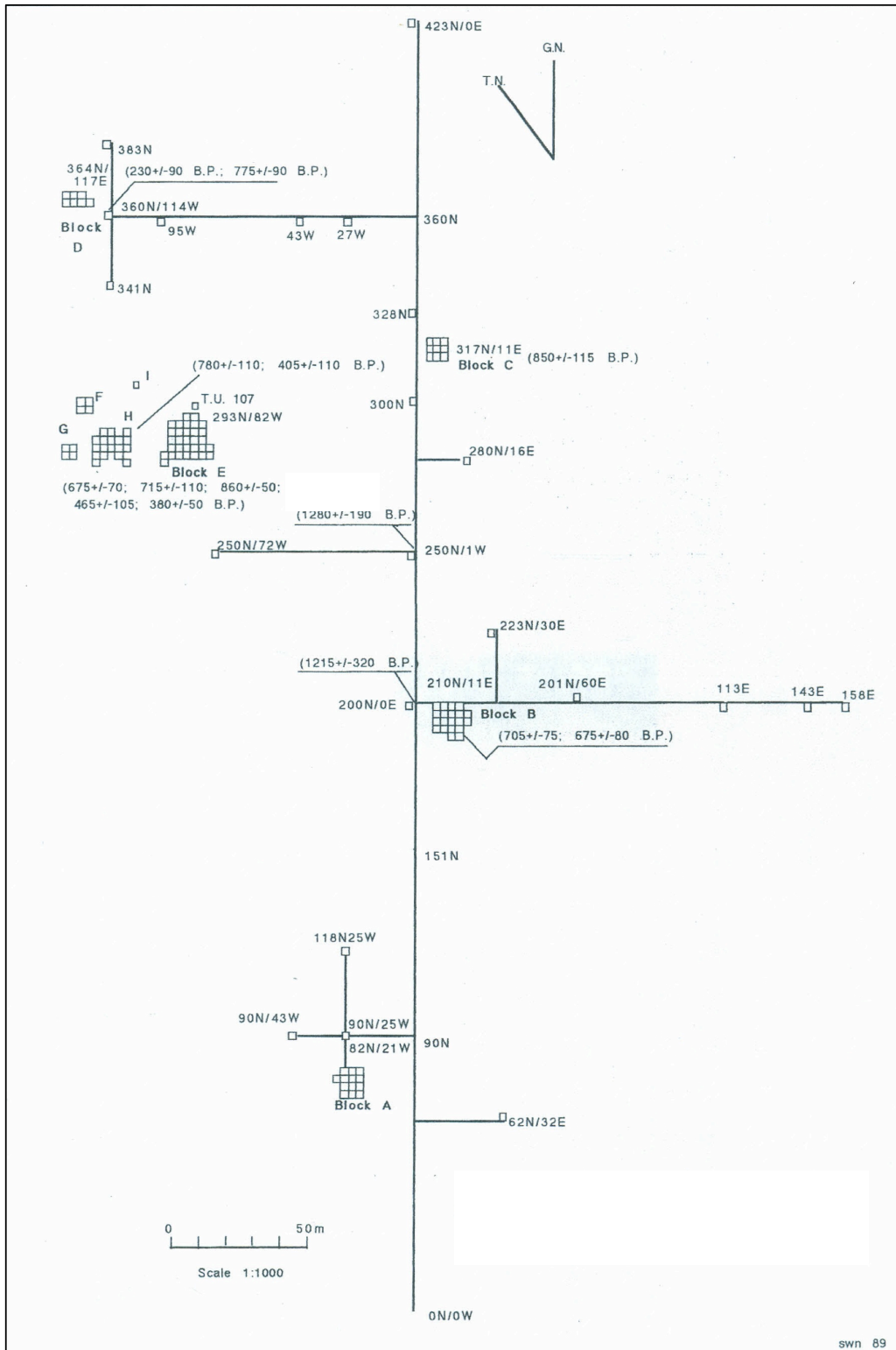


Figure 4.2: Lovstrom Site map (Source: Nicholson and Malainey 1991:55).

| | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|
| | | | 110 | 111 | | |
| | 137 | 116 | 115 | 114 | 113 | |
| | 136 | 117 | 118 | 119 | 120 | |
| | 135 | 124 | 123 | 122 | 121 | |
| | 134 | 125 | 126 | 127 | 128 | 129 |
| 151 | 153 | 154 | 155 | 156 | 157 | 158 |
| 152 | | | | | | |

Figure 4.3: Map of Block E excavation units with unit numbers.

The focus of this thesis is the study of the faunal material collected from the excavations of Block E during the 1987 to 1991 field seasons. Identification and separation of natural stratigraphic levels during excavation was a challenge due to the nature of the Lovstrom site soil. Although there were two vertical concentrations/levels of artefacts, mixing of material likely took place between the two levels. All units were excavated in arbitrary 10 cm levels and divided into 50 cm quadrants to ensure reliable stratigraphic control and improve the level of provenience. Test unit 107, as with other test units, was excavated in 10 cm arbitrary levels. Units excavated in 1987 were dug in 10 cm arbitrary levels with a further subdivision into five cm “a” and “b” levels. Five-centimeter arbitrary levels were used during the remaining 1988 and 1991 excavations.

All matrices, except for collected soil samples were passed through a 0.63 cm (0.25 inch) steel mesh screen.

Levels were primarily excavated using trowels until a limited amount or no cultural material was recovered. Once a sterile level was encountered, excavation would continue for another 10 centimeters using either trowelling or the shovel-shaving technique. Trenches were dug in selected units to improve the identification of stratigraphic levels. When diagnostic artefacts or identifiable bone was found *in situ*, a three-point provenience was recorded providing a three-dimensional record of the site. The location of these artefacts was drawn on a plan view recording form. As well, their metric location was recorded on the level summary form and accompanying artefact card. Once the artefact's location was recorded the artefact was removed and bagged. The use of redundant recording systems was used to ensure all figures were recorded correctly. The northeast corner of each unit acted as the unit datum. All measurements were taken south and west of the unit datum with depth below the surface measured from the unit datum. Artefacts not recovered *in situ* or recorded as unidentifiable were bagged and catalogued according to their quadrant and level.

On completion of an excavation level, all pertinent information from that level was entered on a level summary form, listing artefacts, ecofacts and features, as well as soil type and colour in addition to any visible soil disturbances. A floor plan map was included on the level summary form where all *in situ* recoveries, matrix disturbances, and soil changes were drawn after completion of each level, except for the 1987 excavations where level summary forms, including floor plans, were completed after every 10 cm arbitrary level. Black and white and/or colour film photographs or slides were taken of

floor plan views after the completion of each arbitrary excavation level and wall profile upon completion of the excavation unit. As part of the field school requirements, all students documented in a daily journal all work completed and any relevant discoveries. Because cultural features may extend beyond a single excavation unit, all pertinent information relating to a feature was entered on a separate feature form, in addition to the associated unit level form(s). Once a unit was completed, a profile was drawn of one or more of the remaining walls. The profile was photographed and drawn on a unit summary form.

4.2 Stratigraphy

In addition to recording cultural material, excavators also documented sediment type(s). Any change in colour or sediment composition was recorded on plan view maps attached to level summary forms, in part to identify the presence of cultural features and also to establish the presence of soil horizons or soil disturbances. Upon completion of the unit the stratigraphy was documented, including drawing and photographing of at least one wall profile of each excavation unit. The general soil stratigraphy of Block E is relatively simple (Figure 4.4). A thin sod layer consisting of fresh and decomposing organic material covered the excavation block. The A horizon underlying the sod layer was characterized as a dark grey brown silty or gritty loam varying in depths of 20-30 cm below surface. Almost all artefacts were recovered from this horizon. A well-defined tan/yellow B-horizon is composed of silty clay of glacial origin. Gravel and yellow sandy glacial till begin to appear at depths of 30-35 cm below surface. The transition between the A- and B-horizons is quite undulating and does not follow the surface topography.

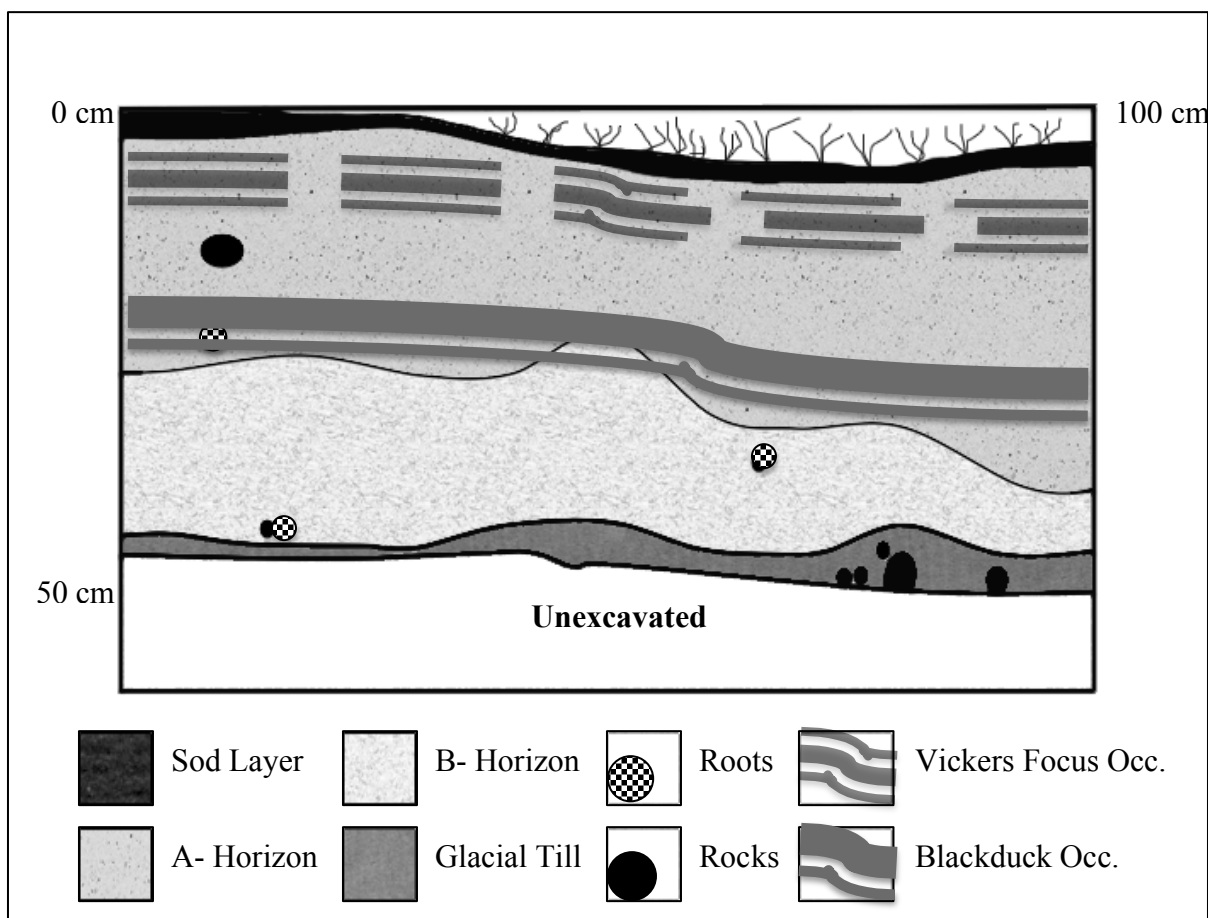


Figure 4.4: East wall profile of Block E excavation unit 158 (288N/81W).

Although viewed as a relatively simple stratigraphy, the actions of bioturbation have blurred the division between levels in some of the units. Nicholson (1990:38) identified the Lovstrom level from 0-13 cm and the Blackduck occupation from 14-50 cm depth below surface. The horizontal concentration of faunal and cultural material is displayed in Figure 4.4 with vertical dispersion of material extending above and below the two concentrations. An initial assessment of Block E in 1987 suggested at least one occupation level was situated within the A-horizon. Subsequent excavations and results from radiocarbon dating of associated material identified two distinct occupation levels.

The topography of the excavation area is relatively flat with somewhat undulating areas surrounding the site. The land gradually rises to the east and south with an open area to the west ending at the valley side of Jock's Creek.

4.3 Cataloguing Procedures

As part of their requirements for the Brandon University Field School during the three field seasons, students cleaned and provided basic identification of the collected cultural material from Block E. Once cultural material was identified it was bagged separately and given an individual artefact number including the unit number and the level it was recovered from. Quadrant bags containing material that lacked a specific 3-point provenience or material collected during screening of the matrix were separated into general material types (lithic, faunal, pottery, fire-cracked rock) and placed in separate bags with a new and distinct artefact number. Any identifiable material found in quadrant bags was separated out and placed in a separate bag accompanied by a new artefact number. Completed artefact cards included all pertinent information regarding unit and artefact provenience, count and weight, side, and any significant additional information.

After the completion of cataloguing by the field school students, individually numbered artefacts from each field season were given a distinct catalogue number using the MacADEM software program. The catalogue numbers were not sequential from year to year creating a repetition of catalogue numbers over the three field seasons (each field season would begin with catalogue number 1). To remedy this problem the catalogue number would be used in conjunction with the artefact number. Once analysis of all

artefacts was completed the excavated materials were sorted and boxed according to excavation unit.

Part of the present study is the re-examination of all faunal material recovered from Block E of the Lovstrom site. This involved the correction of original identifications and separation of identifiable specimens from quadrant bags. Identified bones were bagged separately and given new artefact and catalogue numbers. In instances where identification of element, side or portion was corrected, the updated information was entered into the MacADEM database. Previously identified specimens subsequently found to be unidentifiable during this study were entered into the database as unidentifiable.

This analysis assessed any natural and cultural changes that have altered bone. Natural taphonomic effects include weathering, trampling, root etching, and carnivore damage. Carnivore damage included gnawing, punctures, and digestion effects. Cultural effects include the results of the butchering and processing that resulted in the appearance of cut marks and incising. The existence of polishing is also recorded as possible evidence of bone tool usage.

The examination of the Block E faunal assemblage identified many inaccuracies in the original analysis. These included incorrect siding of elements, misidentification of elements or the misidentification of species and class. The MacADEM program recorded a more generalized identification of element portions, such as distal or proximal ends. The fragmented nature of the faunal material required a more specific method of recording bone portions. Identifiable landmarks were thus used to determine specimen counts and subsequently recorded in the comments section of the MacADEM program.

4.4 Qualitative and Quantitative Analysis Procedures

A faunal analysis requires various qualitative and quantitative observations. All cultural material from quadrant bags was separated into similar material types and bags according to the material type. All material with a distinct catalogue/artefact number was weighed (in grams) and counted. This study is intended to identify the kinds of animals present within the two occupation levels and identify the different natural and cultural effects observed on each bone. Consequently, only the faunal material was examined by the author.

The nature of the faunal collection required the use and explanation of faunal terminology. The smallest unit of observation is defined as a specimen (Lyman 1994b). A specimen is a generalized term to identify a discrete bone or tooth. A specimen can be a complete element, portion of an element or an unidentifiable fragment of bone or tooth (Grayson 1984). Webster (1999:38) also includes non-vertebrate organisms in his definition of specimen such as shell or seed. The term fragment is sometimes used interchangeably with specimen when describing an incomplete portion of bone. This thesis follows the Brink and Dawe (1989:80) definition of fragment that categorizes a fragment as a portion of an element but the specific element is unknown. For the purposes of this thesis, the definition of element follows Grayson (1984) and refers to a single complete bone or tooth.

Qualitative Analysis

Qualitative analysis involved the visual examination of the faunal material. Examination was completed using the unaided eye or with the use of a Ruper® 16X hand lens. Any visible bone modification was documented during the initial analysis of the

faunal assemblage. Modifications included the presence of burning, cut marks, root erosion, weathering and tooth marks, polish and abrasion. Where present, the degree of fusion of epiphyses was observed in an effort to identify the age of an individual. When possible, faunal material was assigned to the lowest taxonomic level. If species identification were impossible the specimen was assigned to a general size classification created by Dyck and Morlan (1995:140) and later adapted by Webster (1999:40) (Table 4.1). Since there was an absence of avian species in Block E, size classes of avian species have been removed from the size class list. New information was entered into the notes section of the MacADEM database.

Table 4.1: Description of size classes after Webster (1999:40).

| Size class | Weight | Associated Terms | Examples |
|------------|------------|---------------------|--------------------------|
| SC6 | 200-700 kg | Very Large Mammal | Elk, Bison |
| SC5 | 25-200 kg | Large Mammal | Wolf, Pronghorn |
| SC4 | 5-25 kg | Medium Mammal | Coyote, Badger |
| SC3 | 700-5000 g | Small-Medium Mammal | Fox, Hare, Skunk |
| SC2 | 100-700 g | Small Mammal | Ground Squirrel |
| SC1 | <100 g | Micro-Mammal | Mice, Voles |
| SC2 | | Small Vertebrate | Ground Squirrel |
| SC1 | | Micro-Vertebrate | Mice, Frogs, Salamanders |

Quantitative Analysis

Once information from the faunal assemblage was catalogued, specimen counts were exposed to additional quantitative analysis. The basic method of quantifying the taxonomic abundance of the faunal material is the number of identifiable specimens (NISP). The minimum number of individuals (MNI) is the least amount of individual animals necessary to account for the number of specific identifiable specimens and is

based on the highest number of any sided element (Grayson 1984). This number also includes the un-sided elements of the axial skeleton. The MNI method has recently been adjusted to include more information than simple numbers of sided elements. Visible differences in size and morphology of a particular element, due to sex and age, are considered, in addition to the maximum element count (Lyman 1994).

Two additional quantification methods were used to ascertain the affect of taphonomic processes on the site. The most frequently occurring landmark, corresponding to a particular element, produced the minimum number of elements (MNE) value. A second method uses MNE to identify the minimum number of animal units (MAU). The MAU is determined by dividing the MNE for a specific anatomical unit by the number of times that element occurs in a complete skeleton. For example, if the head of the humerus (landmark) is recorded a total of 11 times (MNE=11) the MNE would then be divided by 2 (there are 2 humeri in the body) with a resulting MAU of 5.5. The MAU is used to establish the amount of bone that has survived from deposition of the carcass to excavation of the site. This includes the selective cultural processes that affected portions of bone entering or remaining in the assemblage (Binford 1978). It is then possible to establish the %MAU for any landmark by dividing the corresponding MAU value by the highest MAU value in the assemblage. Observing the various %MAU values will indicate the differential survivability of the various elements in the assemblage.

4.5 Cultural features

There were a minimum number of cultural features identified in Block E during the three field seasons of excavation. Original numbering of features on unit and feature

recording forms created duplicate feature numbers between the different field seasons at the Lovstrom site. Only Feature 2 was duplicated in the Block E excavation. To rectify this problem the features will be identified with the inclusion of year of excavation (e.g. Feature 2 (1988)). The features are identified as to whether they relate to the Vickers Focus occupation or the Blackduck occupation.

Vickers Focus Occupation

Feature 1 (1988)

Feature 1 (1988), the only feature found in level 1 was identified as a living floor in Units 117, 124, 134, 135 and 137 from 5-10 cm dbs. The feature included a spread of large identifiable bison bone, large quantities of small bone fragments, large (20 cm diameter) fire-cracked rocks, ceramic sherds, and an area of fire-reddened soil. The presence of fire-reddened soil, fire-cracked rock and large quantities of bone fragments would indicate the presence of a hearth used for food processing. No ash layer was recognised during excavation, which makes the identification of this feature problematic. Identification of ash during excavation may have been hindered by soil disturbance.

Blackduck Occupation

Feature 2 (1988)

Feature 2 (1988) was a clustering of large bison bone within a shallow elliptical depression approximately 80 cm in diameter. This feature intrudes less than 15 cm into the lower levels. The identifiable bone includes an atlas (C1), axis (C2), astragalus and several ribs. Artefacts associated with this feature were a bifacial scraper/knife of heat-treated jasper, a retouched flake, and some ceramic sherds. A small amount of calcined bone and fire-cracked rock was located directly below and towards the boundaries of the

feature. No definitive explanation has been made for the purpose of this feature. Its shallowness was thought to preclude it from being a boiling pit (Nicholson and Kuijt 1990). It may represent the remains of an incomplete or unused feature.

Feature 3 (1988)

Feature 3 (1988) was identified through profiles as a shallow (20 cm) elliptical depression approximately 1.8 meters by 1.4 meters. This feature was partially excavated during the 1987 field season, but at the time was not recognized as a feature. Identification is problematic with excavations occurring over different field seasons and different excavation methods being employed. A complete outline of Feature 3 was not possible due to a lack of profile and overview drawings from some excavation units. Only a small number of artefacts and cultural debris was identified within this feature, including a fragment of a carved soapstone pipe and a small quantity of fire-cracked rock. A fragmented bison scapula was identified in this feature during the 1987 field excavations. The scapula was identified as a scapula hoe blade. Feature 3 was not considered to be a boiling pit due to the shallowness of the deposits, large size of the feature, and the scarcity of highly reduced bone.

Feature 2 (1991)

Feature 2 (1991) was a hearth located in Unit 154 and the east edge of Unit 153. It contained reddish brown clay and ash, at a depth of 20 cm dbs and extending to a depth of 30 cm dbs. This circular feature measured approximately 50 cm in diameter. Several artefacts were associated with this feature, including: potsherds, flakes of KRF, SRC and other cherts, burnt and unburnt bone, and pieces of fire-cracked rock. Two fragments of freshwater mollusc shell were also associated with this feature. Botanical analysis of

samples taken from the reddish brown clay in Unit 154 showed a very low content of charcoal or seeds. No botanical remains were identified in two samples taken from the reddish clay and the surrounding brown and tan clay within Unit 153.

Feature 4 (1991)

Feature four was a grouping of four conical piles of clay in Units 110 and 111. The piles were first identified at approximately 10 cm dbs as small patches of light tan clay and extended to a base at 20 cm dbs in level 4. The patches of tan-coloured soil expanded with an increase in depth. The tan-coloured clay is comparable to the B-horizon that begins at approximately 20 cm dbs and extends to the bottom of the excavation units.

The conical piles of clay are next to the pit identified as Feature 2 (1988), from 20 to 30 cm dbs. The pit appears at the bottom of the A horizon, about 20 cm dbs, and extends into the B-horizon. The conical piles were considered to be the back-dirt from the excavation of the elliptical pit feature in Unit 114 (Nicholson and Malainey 1991).

Feature 5 (1991)

Feature 5 (1991) was identified as the living floor of the earliest occupation of Block E at approximately 20 cm dbs. This feature takes into account the other three features identified at this level, including the base of the conical piles in Units 110 and 111 (Feature 4), the top of the hearth in Unit 154 (Feature 2) and the top of the shallow depression in Unit 114, all of these appear at the base of the A-horizon.

4.6 Summary

The Lovstrom site was excavated during the 1987 to 1991 field seasons. Two cultural occupations were identified in Block E, a portion of the much larger Lovstrom

site. Only a few features were recognized in the two occupation levels. The stratigraphy of the site has been characterized as relatively simple. This simplicity creates its own problems when attempting to separate the aforementioned cultural levels. All faunal material collected from the Block E excavation was re-examined as part of the author's Master of Arts thesis research.

Chapter 5

Block E Faunal Assemblage

5.1 Introduction

A total of 35,794 faunal specimens weighing 46.98 kg were recovered from 32 excavation units within Block E of the Lovstrom site (Table 5.1). This collection of faunal material was recovered during the 1987, 1988, and 1991 field seasons. Only a small percent of the total collection was identifiable with 96% of bone specimens unidentifiable. Approximately half (52%) of the total weight of the Block E faunal assemblage was made up of identifiable specimens.

Table 5.1: The Lovstrom site Block E faunal assemblage weight and specimen totals.

| | Identified | | | | Unidentified | | | | Total | |
|----------|------------|-----|----------|------|--------------|------|----------|------|--------|----------|
| | N | %N | g | %g | N | %N | g | %g | N | g |
| Unburned | 1,412 | 4.3 | 24,743.2 | 53.3 | 31,377 | 95.7 | 21,666.1 | 46.7 | 32,789 | 46,409.3 |
| Burned | 27 | 0.7 | 558.7 | 28.9 | 3,724 | 99.3 | 1,374.6 | 71.1 | 3,751 | 1,933.3 |
| Total | 1,439 | 3.9 | 25,301.9 | 52.3 | 35,101 | 96.1 | 23,040.7 | 47.7 | 36,540 | 48,342.6 |

Due to the fragmented nature of the faunal assemblage landmarks were used to identify specific element portions. Any specimen with an identifiable landmark or having sufficient features to identify taxon would be considered identifiable. Therefore, more complete elements (such as a complete distal end) may provide more than one landmark listed in the faunal counts. The University of Saskatchewan's comparative faunal collection was used to identify elements and taxon. Identifications were made to the most accurate taxonomic level possible.

Bison bone made up the majority of the total faunal material from Block E. A limited number of other species were also represented in the faunal assemblage (Table 5.2).

The surrounding area is still home to a majority of these species, although the larger sized species, including bison, elk, wolf, and swift fox are no longer found in the region. The fisher is also extirpated from the area and only found to the north in the boreal forest region. Many fragments that could not be identified to species were placed into more generalized categories based on size or biological classification, as indicated in Table 4.1.

Table 5.2: Summary of the Lovstrom site Block E Faunal assemblage.

| Species | | Occupation 1 | | Occupation 2 | |
|------------------------------|----------------------------------|---------------------|-----|---------------------|-----|
| Common Name | Scientific Name | NISP | MNI | NISP | MNI |
| Mammalian | | | | | |
| Bison | <i>Bison bison</i> | 507 | 6 | 886 | 8 |
| Elk | <i>Cervus elaphus</i> | 1 | 1 | 2 | 1 |
| Swift Fox | <i>Vulpes velox</i> | 1 | - | 2 | - |
| Indeterminate fox | <i>Vulpes</i> sp. | - | - | 2 | 1 |
| Wolf | <i>Canis Lupus</i> | 7 | 1 | 3 | 1 |
| Indeterminate canid | <i>Canis</i> sp. | 4 | 1 | 2 | 1 |
| Fisher | <i>Martes pennanti</i> | 2 | 1 | 1 | 1 |
| Snowshoe hare | <i>Lepus americanus</i> | 2 | 1 | 3 | 1 |
| Indeterminate hare | <i>Lepus</i> sp. | 3 | 1 | - | - |
| Eastern cottontail | <i>Sylvilagus floridanus</i> | 2 | 1 | - | - |
| Beaver | <i>Castor canadensis</i> | 1 | 1 | - | - |
| Northern pocket gopher | <i>Thomomys talpoides</i> | 3 | 2 | - | - |
| Richardson's Ground Squirrel | <i>Spermophilus richardsonii</i> | 9 | 1 | 1 | 1 |
| Indeterminate Squirrel size | <i>Spermophilus</i> sp. | 1 | 1 | - | - |
| Cricetid Indeterminate | Vole size | 1 | 1 | - | - |
| Rodentia Indeterminate | Squirrel size | - | - | 3 | 1 |
| Sciurid Indeterminate | Vole size | 4 | 2 | - | - |
| Miscellaneous | | | | | |
| Very Large Mammal (SC6) | | 66 | | 73 | |
| Large Mammal (SC5) | | 1 | | 1 | |
| Medium Mammal (SC4) | | 2 | | - | |
| Small-Medium Mammal (SC3) | | 2 | | 3 | |
| Small Mammal (SC2) | | 2 | | 2 | |
| Micro-Mammal (SC1) | | - | | 2 | |

5.2 Mammalian Faunal Remains

Class Mammalia, Order Artiodactyla, Family Bovidae

Bison bison

Habitat and Distribution: Although most people consider the prairies to be home to the bison, this animal's habitat can encompass the parkland region, river and stream valleys and also extended into the boreal forest (Banfield 1974:406). Located throughout the Great Plains of North America, the bison in Canada were found from eastern British Columbia to eastern Manitoba and as far north as the Peace River District and Great Slave Lake in the Northwest Territories.

Bison are most often found in herds numbering between four to 20 individuals. These gregarious animals have also been found in herds that number into the thousands (Banfield 1974:405). The vast areas where bison were found suggests that this species migrated some distance from season to season from the prairies in warm seasons to the shelter of the parkland in cold seasons (Epp 1988). To the contrary, there is also some debate as to the degree bison migrated throughout the year or if they migrated at all (Malainey and Sheriff 1996).

Table 5.3 summarizes the identified *Bison bison* element counts for both levels.

Table 5.3: Summary of *Bison bison* counts for levels one and two of Block E.

| | Level 1 | | | | Level 2 | | | |
|-----------------------|---------|-----|-----------|-----------|---------|-----|-----------|-----------|
| | NISP | MNI | Total MNE | Total MAU | NISP | MNI | Total MNE | Total MAU |
| Axial Skeleton | | | | | | | | |
| Cranium | 44.0 | 1.0 | 2.0 | 1.0 | 124.0 | 3.0 | 5.0 | 2.5 |
| Mandible | 74.0 | 3.0 | 5.0 | 2.5 | 97.0 | 4.0 | 6.0 | 3.0 |
| Hyoid | 1.0 | 1.0 | 1.0 | 0.5 | 1.0 | | 0.0 | 0.0 |
| Rib | 68.0 | 1.0 | 4.0 | 0.1 | 168.0 | 1.0 | 3.0 | 1.0 |
| Rib Head | 2.0 | 1.0 | 1.0 | 0.0 | 2.0 | 1.0 | 2.0 | 0.1 |
| Atlas | 1.0 | 1.0 | 1.0 | 1.0 | 18.0 | 2.0 | 2.0 | 2.0 |

| | | | | | | | | |
|------------------------------|------|-----|-----|-----|------|-----|------|-----|
| Axis | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 1.0 | 2.0 | 1.0 |
| Cervical Vertebrae | 2.0 | 1.0 | 1.0 | 0.0 | 14.0 | 1.0 | 4.0 | 0.6 |
| Thoracic Vertebrae | 12.0 | 1.0 | 1.0 | 0.1 | 13.0 | 1.0 | 1.0 | 0.3 |
| Lumbar Vertebrae | 5.0 | 1.0 | 1.0 | 0.2 | 5.0 | 1.0 | 2.0 | 0.4 |
| Sacrum | 8.0 | 2.0 | 2.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Appendicular Skeleton | | | | | | | | |
| Forelimb | | | | | | | | |
| Scapula | 27.0 | 1.0 | 1.0 | 0.5 | 25.0 | 2.0 | 4.0 | 2.0 |
| Humerus | 9.0 | 3.0 | 3.0 | 1.5 | 27.0 | 4.0 | 6.0 | 3.0 |
| Radius | 20.0 | 3.0 | 4.0 | 2.0 | 23.0 | 2.0 | 4.0 | 2.0 |
| Ulna | 12.0 | 2.0 | 4.0 | 2.0 | 25.0 | 3.0 | 3.0 | 1.5 |
| Internal Carpal | 4.0 | 2.0 | 4.0 | 2.0 | 3.0 | 2.0 | 2.0 | 1.0 |
| Radial Carpal | 7.0 | 4.0 | 6.0 | 3.0 | 8.0 | 3.0 | 5.0 | 2.5 |
| Ulnar Carpal | 1.0 | 1.0 | 1.0 | 0.5 | 3.0 | 2.0 | 3.0 | 1.5 |
| Accessory Carpal | 2.0 | 1.0 | 1.0 | 0.5 | 3.0 | 1.0 | 1.0 | 0.5 |
| Unciform | 5.0 | 3.0 | 5.0 | 2.5 | 3.0 | 3.0 | 4.0 | 2.0 |
| Carpal 2/3 | 3.0 | 3.0 | 3.0 | 1.5 | 3.0 | 2.0 | 3.0 | 1.5 |
| Metacarpal | 3.0 | 0.0 | 0.0 | 0.0 | 19.0 | 3.0 | 6.0 | 3.0 |
| 5th Metacarpal | 1.0 | 1.0 | 1.0 | 0.5 | 1.0 | 0.0 | 0.0 | 0.0 |
| Hindlimb | | | | | | | | |
| Innominate | 3.0 | 2.0 | 2.0 | 1.0 | 9.0 | 1.0 | 1.0 | 0.5 |
| Femur | 2.0 | 2.0 | 2.0 | 1.0 | 14.0 | 3.0 | 3.0 | 1.5 |
| Patella | 1.0 | 1.0 | 1.0 | 0.5 | 5.0 | 3.0 | 3.0 | 1.5 |
| Tibia | 25.0 | 6.0 | 8.0 | 4.0 | 40.0 | 8.0 | 15.0 | 7.5 |
| Lateral malleolus | 2.0 | 3.0 | 3.0 | 1.5 | 2.0 | 2.0 | 2.0 | 1.0 |
| Calcaneus | 1.0 | 1.0 | 1.0 | 0.5 | 6.0 | 3.0 | 4.0 | 2.0 |
| Astragalus | 2.0 | 2.0 | 2.0 | 1.0 | 4.0 | 3.0 | 4.0 | 2.0 |
| Fused C/4 Tarsal | 2.0 | 2.0 | 4.0 | 2.0 | 9.0 | 5.0 | 8.0 | 4.0 |
| Tarsal 2/3 | 2.0 | 2.0 | 4.0 | 2.0 | 7.0 | 2.0 | 3.0 | 1.5 |
| 1st Tarsal | 2.0 | 1.0 | 2.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Metatarsal | 7.0 | 1.0 | 1.0 | 0.5 | 34.0 | 3.0 | 5.0 | 2.5 |
| Other Elements | | | | | | | | |
| 1st Phalanx | 14.0 | 2.0 | 6.0 | 0.8 | 34.0 | 4.0 | 17.0 | 2.1 |
| 2nd Phalanx | 15.0 | 2.0 | 8.0 | 1.0 | 8.0 | 1.0 | 4.0 | 0.5 |
| 3rd Phalanx | 14.0 | 2.0 | 7.0 | 0.9 | 10.0 | 2.0 | 5.0 | 0.6 |
| Sesamoids | | | | | | | | |
| Prox. Lat. Sesamoid | 8.0 | 1.0 | 8.0 | 1.0 | 4.0 | 1.0 | 4.0 | 0.5 |
| Prox. Med. Sesamoid | 9.0 | 2.0 | 9.0 | 1.1 | 7.0 | 1.0 | 7.0 | 0.9 |

| | | | | | | | | |
|---------------------|-------|-----|-----|-----|-------|-----|-----|-----|
| Dist. Inf. Sesamoid | 4.0 | 1.0 | 4.0 | 0.5 | 6.0 | 1.0 | 6.0 | 0.8 |
| Miscellaneous | | | | | | | | |
| Molar/Premolar | | | | | | | | |
| Indeterminate | 62.0 | — | — | — | 72.0 | — | — | — |
| Vertebrae | | | | | | | | |
| Indeterminate | 5.0 | — | — | — | 9.0 | — | — | — |
| Metapodial | | | | | | | | |
| Indeterminate | 7.0 | — | — | — | 5.0 | — | — | — |
| Phalanx | | | | | | | | |
| Indeterminate | 3.0 | — | — | — | 4.0 | — | — | — |
| Sesamoid | | | | | | | | |
| Indeterminate | 4.0 | — | — | — | 10.0 | — | — | — |
| Totals | 507.0 | | | | 886.0 | | | |

Discussion: Only a small percentage (3.9%) of the highly fragmented Block E faunal assemblage was identifiable. Complete elements or landmarks were identified to species using the University of Saskatchewan comparative faunal collection. Nearly all (96.8%) the identifiable bone was identified as bison. Level one had a total of 507 identified specimens and level 2 had 886 identifiable specimens. A very small amount of the bison assemblage from either level exhibited signs of burning. Despite the relatively small specimen counts both occupation levels produced a relatively high number of individuals. In both instances, the minimum number of individual counts was provided by lower limb elements, specifically the tibia. Some specimens could only be tentatively identified to a specific element, but lacked a landmark to make a positive identification. These specimens were either listed as unidentifiable with a note advising of possible element portion, or listed as a Very large Mammal (SC6) long bone fragment. Although the likelihood is high that the long bone fragments are representative of bison, the

discovery of a small number of *Cervus elaphus* (elk) bones makes an identification of these long bone fragments problematic.

Class Mammalia, Order Artiodactyla, Family Cervidae

Cervus elaphus

Vickers Focus Occupation

Cervus elaphus (Elk) NISP=1: Innominate fragment (463/122-2-24).

Blackduck Occupation

Cervus elaphus (Elk) NISP=2: Left mandible with P₃ (876/125-2-69), left P₂ tooth (635/123-2-76) (Figure 5.1).

Discussion: The comparative faunal collection was used to identify the *Cervus elaphus* bones found in level one. There is no evidence of cut marks or burning on the specimens. The mandible has evidence of root etching and similar staining to the bison material and is not likely intrusive.



Figure 5.1: Elk specimens.

Class Mammalia, Order Carnivora, Family Canidae

Indeterminate *Canis* sp (SC5)

Vickers Focus Occupation

Canis sp. (Wolf size) NISP=4: 1st phalanx (119/118-2-53), 1st phalanx (760/125-11-), indeterminate phalanx (43/107-2-12), right-hand rib head and shaft (152/111-4-20).

Blackduck Occupation

Canis sp. (Wolf size) NISP=2: 2nd phalanx (811/121-4-6), rib head (40/107-2-9).

Discussion: The elements recovered in both levels were compared to *Canis lupus* specimens in the University of Saskatchewan faunal collection. They could not be positively identified to species with similarities in size to both wolf and dog (*Canis familiaris*). With the identification of *C. lupus* elements and no positive indication for the presence of *C. familiaris* these elements likely belong to a wolf.

Canis lupus

Habitat and Distribution: Wolves have been found throughout all areas of Canada and almost all of the rest of North America. They will inhabit any form of environment from open areas of the arctic tundra and northern plains to forests and are also found in the mountains (Banfield 1974:292). The wolf has a holarctic distribution, meaning that the wolf is extant in the northern continents (Banfield 1974:294). The introduction of European farming practices and a loss of natural prey have reduced the wolf populations in many areas. They have been exterminated in large parts of the Prairie provinces (Banfield 1974). Various wolf subspecies have been recognized based on differences in size, colour, and morphology of the skull (Banfield 1974:294). The most likely form to inhabit the

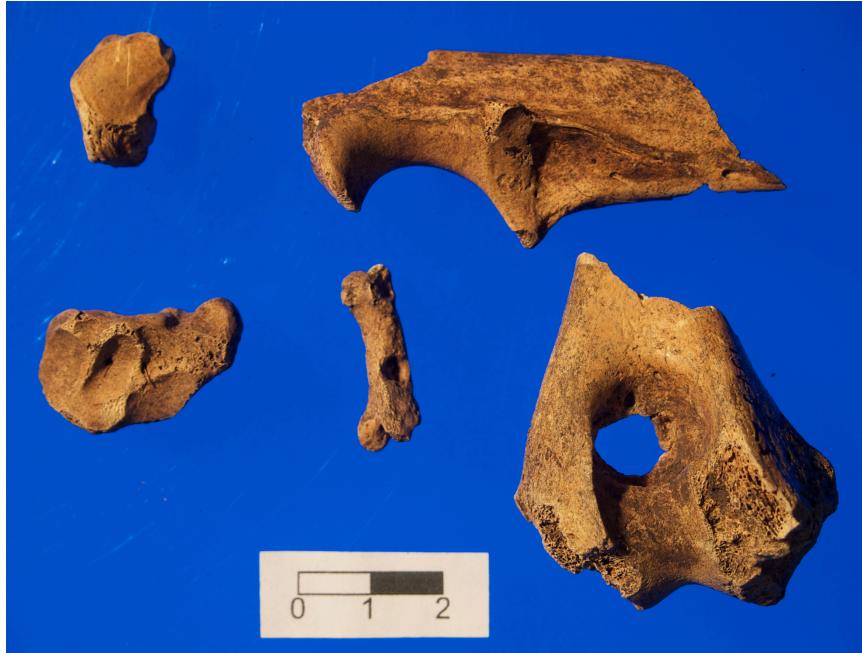


Figure 5.2: *Canis lupus* specimens.

region around the Lovstrom site would have been the ‘buffalo’ wolf (*C. l. nubilus*), now extinct due to the loss of its primary prey, the bison and extermination by farmers and ranchers (Figure 5.2).

Table 5.4 summarizes the identified *C. lupus* element counts for both levels.

Table 5.4: Summary of *Canis lupus* counts.

| Group Element | Vickers Focus | | | | Blackduck | | | |
|-----------------------|---------------|--------------|--------------|---------------|---------------|--------------|--------------|---------------|
| | Total NISP | Total MNE | Total MAU | MNI (side) | Total NISP | Total MNE | Total MAU | MNI (side) |
| Axial Elements | | | | | | | | |
| Cranium | - | - | - | - | - | - | - | - |
| Mandible | - | - | - | - | - | - | - | - |
| Atlas | - | - | - | - | - | - | - | - |
| Axis | - | - | - | - | 1 | 1 | 1 | 1 |
| Cervical | 1 | 1 | 1 | 1 | - | - | - | - |
| Thoracic | - | - | - | - | - | - | - | - |
| Rib head | 1 | 1 | 0.04 | 1 | 1 | 1 | 0.04 | 1 |
| Forelimb | | | | | | | | |
| Scapula | - | - | - | - | - | - | - | - |

| | | | | | | | | |
|---------------------------|-----------|---|-----|---|----------|---|-----|---|
| Humerus | 1 | 1 | 0.5 | 1 | 1 | 1 | 0.5 | 1 |
| Radius | - | - | - | - | 2 | 1 | 0.5 | 1 |
| Ulna | 1 | 1 | 0.5 | 1 | - | - | - | - |
| Radial carpal | 1 | 1 | 0.5 | 1 | - | - | - | - |
| First carpal | 1 | 1 | 0.5 | 1 | - | - | - | - |
| Other carpals | - | - | - | - | - | - | - | - |
| Hindlimb | | | | | | | | |
| Innominate | - | - | - | - | - | - | - | - |
| Femur | 1 | 1 | 0.5 | 1 | - | - | - | - |
| Tibia | - | - | - | - | - | - | - | - |
| Other appendicular | | | | | | | | |
| First phalanx | 2 | 2 | 1 | 1 | - | - | - | - |
| Second phalanx | - | - | - | - | 1 | 1 | 0.5 | 1 |
| Third phalanx | - | - | - | - | - | - | - | - |
| Indt. Phalanx | 1 | 1 | 0.5 | 1 | - | - | - | - |
| Totals | 10 | | | | 6 | | | |

Discussion: The presence of canid remains is of interest to the archaeologist not only for the information gained from the possible resource exploitation of wolf or other wild canid species, but also the presence of its domesticated relative. The dog (*C. lupus familiaris*) is the only known domesticated mammal kept by native populations of North American prior to European contact (Snyder 1991:359). Whereas the wolf and swift fox were often a food resource, the dog was also used for hunting and as a draught animal to pull or carry heavy loads (Crabtree and Campana 1987:102). Identifying the presence of dog versus wolf is problematic given the fragmented nature of the faunal remains in many faunal assemblages. It is also difficult to differentiate between the two skeletons, since the dog is a close relative and sometimes referred to as a subspecies of the wolf. Additionally, variations in breeding produce dogs that vary in size from wolf size to coyote (Lawrence and Bossert 1975:74). Compounding this problem is the size variation also evident within the *C. lupus* species itself (Kolensky and Stanfield 1975:65). The most recognized method of isolating these

two animals is distinguishing morphological variation in the skull and mandibles.

Differences are recognized in the size and length of the skull and rostrum and also the size of the tooth row (Morey 1992:182). The biggest change seen through domestication of the dog is the shortening of the muzzle and the subsequent crowding and associated loss of teeth. Unfortunately, no skull or mandible was recognized in either level of the Block E assemblage.

Only one specimen, a humerus shaft (120-3-20), from Level 1 showed signs of butchering. Transverse cut marks are visible near the distal end of the shaft and one cut mark oriented to the longitudinal axis of the shaft is visible on the anterior shaft just above the foramen. Most of the *C. lupus* specimens were recovered from level 1. The specimens represent a MNI of 1 individual. All portions of limb elements from level 1 were from the left side of the skeleton, except for a right-hand cuneiform carpal. Front limb bones mostly represent specimens from level 2. Two radii shaft fragments from level 2 refit and represent one individual. The distal humerus fragment recovered in level 2 was recovered from the upper limits of the level and possibly were introduced to the lower level through soil disturbance; however, the humeri shaft and the radii shafts from level 2 and the humerus shaft in the upper level 1 are both from the left-hand side of the body and therefore from two different individuals. The *C. lupus* specimens represented a minimum of one individual in both levels.

***Vulpes* sp. (SC3)**

Occupation 1

None

Occupation 2

Vulpes sp. (True Fox species) NISP=2: Metacarpal (1873/124-4-4), proximal metatarsal (1852/3-70).

Vulpes velox

Vickers Focus Occupation

Vulpes velox (Swift Fox) NISP=1: Right mandible tooth row minus teeth (48/107-2-17).

Blackduck Occupation

Vulpes velox (Swift Fox) NISP=2: Left mandible ascending ramus (1289/127-3-13), left distal radius (1323/127-3-47).



Figure 5.3: *Vulpes velox* specimens.

Discussion: Swift fox are generally found on the arid short-grass plains (Banfield 1974:302). Unlike the larger wolf species, the swift fox are solitary animals, except during mating season. Their original habitat covered areas from the Pembina Hills in south-central Manitoba to the foothills of the Rocky Mountains. The swift fox was known to inhabit the

plains from Texas to southern Canada, but is now extinct in southwestern Manitoba (Banfield 1974).

The Vickers Focus occupation is represented by one mandible tooth row minus any teeth and shows signs of weathering. Certain specimens from occupation 2 could not be identified as *Vulpes velox* and only identified to the *Vulpes sp.*. The identified elements are representative of an MNI of one individual. The swift fox elements from both levels do not show any signs of cut marks or burning.

Class Mammalia, Order Carnivora, Family Mustelidae

Martes pennanti

Vickers Focus

Martes pennanti (Fisher) NISP=2: Right distal humerus (756/154-2-74), right proximal humerus (1443/157-2-3).

Blackduck

Martes pennanti (Fisher) NISP=1: Right proximal ulna (728/120-5-7).



Figure 5.4: *Martes pennanti* specimens.

Discussion: The modern distribution of the Fisher is typically restricted to the boreal forest in Canada (Banfield 1974). This species is active all winter. Although not as valuable as marten fur, historically the fisher pelt was also a valuable economic source (Banfield 1974). No cut marks or burning were visible on any of the specimens from either level.

Class Mammalia, Order Lagomorpha, Family Leporidae

***Lepus* sp. (SC3)**

Vickers Focus

Lepus species (Hare): NISP= 3: left distal scapula (358/115-3-19), right distal scapula (1006/126-2-12), 1st phalanx (1118/155-3-11) (Figure 5.5).

Blackduck

None

Lepus americanus

Vickers Focus

Lepus americanus (Snowshoe hare) NISP=2: right mandible body (1482/136-2-20), right femur shaft (1048/155-2-28).

Blackduck

Lepus americanus (Snowshoe hare) NISP=3: Left mandible (707/123-3-16), right calcaneus (922/125-3-21), right femur shaft (1194/155-4-12).

Discussion: Although most species prefer open environments, lagomorphs can inhabit a very diverse range of environment and are found from Nova Scotia to Alaska. The snowshoe hare prefers forested or overgrown areas with more cover that offer increased protection from predators (Banfield 1974:83).



Figure 5.5: *Lepus americanus* specimens.

Front limb scapula elements from level 1 could not be positively identified to species and were assigned to the *Lepus* genus. The bone has similar staining and colour as the rest of the bone in level 1. Elements identified to the *L. americanus* species were similarly stained. Axial specimens from both levels are from the right-hand hindlimb. The MNI for both occupation levels is one individual. There is no indication of human alteration or burning on the bones from either occupation level.

Sylvilagus floridanus

Vickers Focus

Sylvilagus floridanus (Eastern cottontail) NISP=2: Right proximal tibia (584/117-3-52), right mandible (194/151-1-8) (Figure 5.6).

Blackduck

None



Figure 5.6: *Sylvilagus floridanus* specimens.

Discussion: The cottontail rabbits are the smallest leporids native to North America. The eastern cottontail does not like dense forests, preferring more open meadows, weedy and shrubby areas or the borders of woodlots (Banfield 1974:77). The Lovstrom site is on the very edge of the eastern cottontails range that covers an area in eastern and central North America, from Central America to New England (Banfield 1974:79). While found in archaeological assemblages, the eastern cottontail was not documented in the post-contact period in Manitoba until the turn of the 20th century (Banfield 1974:79). The eastern cottontail that inhabits present-day southern Manitoba is recognized as a subspecies, *S.f. similis*. The presence of this species was limited to level 1. No visible signs of burning or

cut marks were evident on these elements. Staining of the elements is similar to bison bone in level one.

Class Mammalia, Order Rodentia

Indeterminate rodent (SC2)

Vickers Focus

None

Blackduck

Rodentia indeterminate (Squirrel size SC2) NISP=3: Distal tibia (1185/134-3-25), lumbar vertebra (42/107-2-11), left femur (347/119-2-44).

Discussion: Comparisons to the University of Saskatchewan faunal collection could only identify these specimens as similar to the skeletal elements of various squirrel size mammals. No burning or cultural modifications were evident on any of the elements.

Class Mammalia, Order Rodentia, Family Castoridae

Vickers Focus

Castor canadensis (American beaver) NISP=1: unidentified incisor (1156/127-1-16) (Figure 5.7).

Blackduck

None

Discussion: The beaver inhabits slow moving watercourses and prefers aspen groves as its food source. Although the beaver remains active all year, it is rarely seen in the winter, only venturing above the ice or outside its house when it is threatened with starvation (Banfield 1974). Beaver incisors were used as chisels or gouges in precontact tool kits in the eastern woodlands and are described as a part of the Blackduck material

culture (Syms 1977:104). The lone incisor does not show evidence of cut marks or burning.



Figure 5.7: *Castor canadensis* specimen.

Class Mammalia, Order Rodentia, Family Cricetidae

Indeterminate *Cricetidae* (SC1)

Vickers Focus

Cricetid Indeterminate (Vole size rodent SC1) NISP=1: Left mandible (779/121-2-27).

Blackduck

None

Discussion: A lack of teeth in this vole-sized animal mandible prohibited a more specific identification. The various vole-sized rodents known to inhabit the area makes it impossible to identify species. There is no evidence of cut marks or burning.

Class Mammalia, Order Rodentia, Family Geomyidae

***Thomomys* sp. (SC2)**

Vickers Focus

None.

Blackduck

Thomomys sp. indeterminate (Squirrel size) NISP=2: Immature left-hand distal humerus (795/121-3-14), immature right-hand femur (347/119-2-44).

Thomomys talpoides

Vickers Focus

Thomomys talpoides (Northern pocket gophers) NISP=2: Left mesial mandible (1548/136-3-54), right mandible (26/107-1-26), right-mandible (238/114-3-20).

Blackduck

None.

Discussion: The northern pocket gopher specimens are limited to occupation 1 and represent a minimum of two individuals. This species prefers open environments in grasslands, cultivated fields, riverbanks and roadsides (Banfield 1974:149). It does not hibernate but stays active year round in burrows beneath the surface. There was no evidence of cut marks or burning on any of the bones, but staining on the remaining specimens is similar to the staining on the bison bones in the level. The distal humerus

specimen is similar in size to *T. talpoides* but the fragmented bone could only be identified to genus, however it may be associated with the other *T. talpoides* elements.

These pocket gopher remains might be an intrusion after the formation of the site. Staining on one of the mandible fragments (238/114-3-20) from the Blackduck level differs from other bones in the same level, suggesting it is a more recent addition to the site. This interpretation is supported by the many rodent burrows identified during. The animals may have died in the burrows, but the scarcity of skeletal elements would suggest they are the result of cultural activity. The northern pocket gopher also prefers deep and moist soil (Banfield 1974:149), so the shallow soil of Block E would not have been preferred habitat.

Class Mammalia, Order Rodentia, Family Sciuridae

Indeterminate *Sciuridae* (SC2)

Vickers Focus

Sciurid indeterminate NISP=4: Right mandible and maxilla (1926/152-1-35), left mandible (1056/155-2-36), right mandible (1057/155-2-37), left maxilla and mandible (318/152-1-12).

Blackduck

None

***Spermophilus* sp. (SC3)**

Vickers Focus

Spermophilus sp. NISP=1: Right maxilla

Blackduck

None

Discussion: Based on comparisons to the University of Saskatchewan faunal collection, the most precise taxonomic identification of these specimens was to the Sciuridae family and elements similar to squirrel-size mammals. No teeth were located in the maxilla from the Blackduck occupation to identify it to anything more than genus. These elements show no signs of cut marks or burning. The staining on the bones is similar to that of the bison bones in the same level.

Spermophilus richardsonii

Vickers Focus

Spermophilus richardsonii (Richardson's Ground Squirrel) NISP=9: Left mandible (308/152-1-2), right mandible (320/152-1-14), right humerus (311/152-1-5), right ulna (313/152-1-7), right radius (312/152-1-6), left femur (315/152-1-9), left tibia (314/152-1-8), right femur (309/152-1-3), right tibia (316/152-1-10).

Blackduck

Spermophilus richardsonii (Richardson's Ground Squirrel) NISP=1: Right tibia (1731/137-5-8).

Discussion: The Richardson's Ground Squirrel is found across the prairie region of southwestern Manitoba (Banfield 1974:117). This species prefers high rolling sandy soils of the open prairies (Banfield 1974:115). The bones recovered from level 1 were clustered in one unit and most likely represent a single individual. The location near the surface and the greasier nature of the bones suggest they are a later intrusion into occupation 1. The tibia from occupation 2 exhibits staining similar to the rest of the bone and does not show any sign of cut marks or burning.

Miscellaneous Mammalian Remains

Indeterminate Micro-Mammal (SC1)

Vickers Focus

None.

Blackduck

Micro-size Mammal (Vole size) NISP=2: Long bone shaft (1185/134-3-25).

Indeterminate Small Mammal (SC2)

Vickers Focus

Small-sized mammal (Ground squirrel size) NISP=2: indeterminate vertebra (766/125-1-16), metapodial (1096/155-2-77).

Blackduck

Small-sized mammal (Ground squirrel size) NISP=2: indeterminate vertebra (42/107-2-11), sacral vertebra fragment (1232/134-4-10).

Discussion: There was no evidence of burning or cultural modification on these elements. The elements are so small that it is unlikely that any marks would be visible. Identification to species was not possible with similarities to various species in the University of Saskatchewan faunal collection. It is probable that these elements are associated with other squirrel size remains found in Block E.

Indeterminate Small-Medium Mammal (SC3)

Vickers Focus

Small to medium-sized mammal (Fox size) NISP=2: Femur head (739/154-2-56), vertebra (766/125-1-26).

Blackduck

Small to medium-sized mammal (Fox size) NISP=3: Long bone shaft (925/125-3-24), long bone fragment (819/125-2-12), skull fragment (566/123-2-22).

Discussion: These specimens were compared to various mammals in the University of Saskatchewan faunal collection and are comparable to hare or fox-sized mammals. The femur head from Level 1 is the only identified specimen that is burnt/calcined. There were no cut marks visible on any specimen from either level.

Indeterminate Medium Mammal (SC4)

Vickers Focus

Medium-sized mammal (Coyote size) NISP=2: Left distal humerus midshaft (858/128-2-2), incisor (439/116-2-21).

Blackduck

None.

Indeterminate Large Mammal (SC5)

Vickers Focus

Large-sized mammal (Wolf size) NISP=1: Left-hand distal humerus shaft (858/128-2-2).

Blackduck

Large-sized mammal (Wolf size) NISP=1: Indeterminate long bone fragment (157-9-2).

Discussion: Specimens from both levels were similar in size to the wolf comparative faunal sample. No burning or cultural alterations were visible on either specimen.

Indeterminate Very Large Mammal (SC6)

Vickers Focus

Very large-sized mammal (Bison size) NISP=66: Long bone shaft fragments

Blackduck

Very large-sized mammal (bison size) NISP=73: Long bone shaft fragments

Discussion: There were no visible signs of burning on any of these specimens.

Cultural alterations, such as cut marks and evidence of chopping were visible on a few of the specimens from both levels.

5.3 Paleoenvironmental Considerations

Environments of the surrounding regions have been greatly impacted by the clearing of land after the introduction of European farming practices. This is most evident in the clearing of wooded areas and draining of wetlands to increase usable land for agricultural use. The Lovstrom site is situated in an area that has not been disturbed by the effects of agricultural practices. Present conditions may represent what past environments were like during the two occupation periods.

The importance of past environments on the plains is usually linked to the presence or absence of trees or forest cover, which in turn can be linked to the time of year a site was occupied. Regions with partial or dense tree cover afford protection in colder weather, but are less suitable in warm or hot conditions. To the contrary, a treeless environment will offer little protection in cold conditions, but will provide cooling breezes in warmer environments. The presence or absence of particular animal species can help identify the nature of past environments or microenvironments. Several mammals present in the Block

E assemblage can inhabit a variety of environments. The presence of these species is not useful to identify past environments. For instance, the range of the wolf and swift fox cover a large and diverse area throughout the year. Similarly, the elk inhabits a range of areas from open prairies to coniferous forests (Banfield 1974). In areas such as the aspen parkland and the Tiger Hills, elk would prefer wooded hillsides in summer and would move to the open grasslands in the winter (Banfield 1974:399). While the snowshoe hare favours more wooded areas, the eastern cottontail rabbit prefers a mixture of open areas and cover afforded by a parkland environment. The fisher has a more restricted habitat, that of forested areas and waterways (Banfield 1974:319). The Richardson's ground squirrel and the northern pocket gopher do not like forested regions, preferring open prairies or grasslands, although the northern pocket gopher may also inhabit the edges of wooded areas. Micro-mammals are restricted to specific habitats and affected more by a change in the environment, which make them a good indicator of past environments. The micromammal remains were identified only to the cricetidae family level and may represent a vole species. Two vole rodent species found in southwestern Manitoba avoid heavily wooded spaces, preferring open grasslands or meadows or the edges of wooded areas. The main difference between the two vole rodent species is the meadow vole rodent favours a wetter environment, whereas the prairie vole prefers drier grasslands.

The proximity of the Lovstrom site to the Souris River valley places it on the edge of a riparian environment, reducing the severity of environmental change that might be seen in other regions, such as on the prairies. The diverse habitats that many of the species occupy suggest the presence of a diverse or changing environment. It would require either a change in the environment or the existence of various ecosystems within the immediate

area to support the variety of mammals with diverse habitats appearing in the Block E faunal assemblage. The location of the Lovstrom site within the aspen parkland region may explain the presence of species that inhabit either forested or open grassland. The area surrounding the site has very diverse topography and vegetation, alternating from rolling hills and dry uplands to steep ravines and low wet flatlands. Additionally, many specimens from the Block E faunal assemblage are of medium to small mammals easily transported to the site from the diverse ecozones and microclimates surrounding the site.

The use of faunal remains to identify past environments is more accurate when environments cover a broader area. The drastic topographic and vegetation changes that occur in and around the Lovstrom site make it difficult to identify the environment of the site by the presence of animal species.

5.4 Distribution of Faunal Remains

The distribution of particular faunal remains can give insight into the past activities of people inhabiting a site. Where possible, faunal material was grouped by identifiable species to identify any patterns of deposition. The large quantity of bison bone allowed for the separation of specific element and skeletal portions to be mapped and analyzed. Since many long bone fragments or unidentified specimens could belong to either front or hind limbs, only identified specimens were included in the formation of the bone distribution maps. Bone distribution maps are presented in Appendix IV.

Vertebral elements

The NISP counts for the vertebral elements were quite low, but there was still a visible scattering in both occupations. Thoracic spinous processes and lumbar transverse processes form the majority of the NISP count in level 1. This sparse scatter is visible in

the west and northwest part of the block and again on the south edge. This scatter is located in feature #1 (1988), a linear concentration of fire-cracked rock and fire-reddened soil. A relatively complete axis (C2) vertebra is found in XU155 along the south edge of the block. The complete fused first sacral vertebra and a portion of the second sacral vertebra were located in XU113 in the northeast corner of the block. Two small concentrations of vertebral elements are found in level 2. A concentration in the northeast east corner of the block corresponds to feature #2 in XU114. A complete atlas (C1) was recovered within the feature and two complete cervical vertebrae are found to the south in XU119. Fragments of cervical, thoracic and lumbar vertebrae are located around feature #2 in XUs 110, 118 and 119. A second small scatter of vertebral elements was located in the south edge of the block, including thoracic lumbar vertebral fragments. A complete cervical vertebra was identified in XU155 and half of an axis (C2) that refits with the axis in XU118 was located in XU154. The complete cervical vertebrae are likely from the same individual. The majority of thoracic vertebral elements were portions of the spinous process. Only one thoracic vertebral body was identified in either level.

Forelimb elements

No definitive articulated elements were recognized in either level, but small clusters of hindlimb elements in some instances represent what were most likely articulated lower limb joints. Soil disturbance may have horizontally displaced articulated joints to the current loose cluster. Similarly to the hindlimb and phalange concentrations, these elements were recovered outside of the hearth (Feature 2 (1991)) in level 2 and may represent scatter from that feature.

Hindlimb elements

Hindlimb element concentrations exhibit more of a scatter than any visible concentration. Some of the denser scatter may represent an articulated limb that was subsequently horizontally displaced by soil disturbance. Hindlimb elements were not recovered within the hearth feature in level 2 and may represent scatter from this feature.

Phalange elements

Phalanges are scattered throughout level 1 of Block E. A higher concentration is evident in the west half of the block. This concentration matches the hindlimb and forelimb element concentrations. Concentrations of phalanges in level two are associated with feature #2 in excavation units 153 and 154. The phalanx concentrations in the southeast part of the block are a meter distance from the hearth feature and may be associated with another unknown feature.

5.5 Distribution of Non-Bison Species

5.5.1 Cervid element distribution

Three cervid elements were identified in block E. The small sample revealed no visible concentrations of material in either level. A related mandible fragment and isolated premolar are located approximately one meter apart in units 123 and 125, in level 2. A single innominate fragment was identified in the upper level.

5.5.2 Canid element distribution

The limited quantity of canid elements does not show any signs of clustering in level 1. The specimens represent portions of forelimb and vertebral elements. There is also no visible clustering of any axial or appendicular elements. The small representation of canid remains represents at least two individuals and the elements of both right and left

forelimbs. The small and diverse quantity would suggest that articulated limbs were not discarded in this area. The canid bones were located outside of what was identified as feature #1 during the 1988 field season. A pair of radial shaft fragments from level 2 that refit were recovered at least 150 cm apart (rib fragment 379/115-4-14 does not have a three-dimensional provenience) in excavation units 115 and 123.

5.5.3 Vulpes element distribution

Elements of vulpes species were restricted to the lower occupation level. Only a few elements were identified and were uncovered in excavation units 107, 124, and 127. The small sample does not show any visible clustering or association to any features.

5.5.4 Leporid element distribution

Leporid remains were found in small numbers in both levels. There is a very loose scattering in the west portion of the block with no visible concentration of elements in either level. Two femur shafts were found in each level in XU155. Both were identified as right hand femora shafts with different degrees of staining, lessening the likelihood that either were intrusive into the other level.

5.5.5 Rodent element distribution

The majority of rodent remains were recovered in the upper occupation level. There is no visible concentration of rodent remains associated with the two occupations in either level. A concentration of bone in XU152 of the upper level most likely represents a complete individual deposited at a later period.

5.6 Discussion

The association of observable bone concentrations to any features or identifiable work areas was made difficult with the limited number of identified features. No distinct

feature was discernable in the upper occupation level. The living floor identified as Feature 1 (1988) was a horizontal distribution of cultural material and not a distinctive work area. Association of bone concentrations to this feature is problematic since bone concentrations are partly what define the feature. It is possible the loose cluster of fire-cracked rock and fire-reddened soil of Feature 1 might be the remnants of a distinct feature. Bone concentrations are situated outside of these two parts of Feature 1. The faunal material in the upper level may also be secondary scatter from a butchering or processing area outside of Block E.

Bone concentrations in the lower occupation level show some association with identified features. Concentrations of phalanges in each level show signs of clustering. In the lower occupation there is a visible concentration of phalanges around the hearth, Feature 2 (1991). It is possible these elements were part of an articulated lower limb when originally deposited and have dispersed through time due to soil disturbances, as they are relatively complete. The fragmented nature of most elements suggests a grease processing area in both levels. Concentrations of hind and forelimb elements are more difficult to recognise, appearing more as a scattering of bone. No limb elements were recovered within Feature 2 (1991). The majority of toe bones, or phalanges, are complete and unbroken. This may suggest lower limbs were discarded as complete sections, although the number of third phalanges is low compared to first and second phalanges. This is discussed in Chapter 7.

This scattered distribution of faunal material may also be a product of natural taphonomic forces acting on the Block E assemblage, further discussed in Chapter 7. The scattering may be a product of the horizontal distribution of material through natural forces.

Vertical movement of cultural material is also a possibility. Only small canid bones were recovered in Level 1 with the majority recovered in Level 2. This may be a result of an intrusion by redistribution of material from lower stratigraphic levels to upper and younger levels. Individual cervid elements were also recovered from each occupation level. The single element from each level suggests it was deposited by natural causes. The degree of fragmentation found in both levels may also indicate that additional cervid material exists but is unidentifiable. One specimen found in each level may also be a product of the aforementioned vertical movement of material through natural forces.

The only non-bison species to exhibit any butchering evidence was a canid specimen. Other small and micro mammal specimens do not show signs of cut marks or burning.

The types of elements represented from both occupation levels would suggest each assemblage is not part of a kill site. Low utility elements and more complete elements that are common at a kill site are lacking in both levels. The degree of fragmentation would suggest initial and extended processing was carried out in both occupations. Identifiable specimens are fewer in Occupation 1 as is the number of MNI. This may be a result of increased amounts of processing and fragmentation.

The MNIs for both occupation levels were based on the presence of the tibial posterior foramen. This is a distinct and also robust landmark on the bison skeleton. The high identifiability and uniqueness of the posterior foramen is due to the presence of distinct soleal lines and a sharp medial border. Additional bone specimens were identified as tibial posterior foramen fragments, but only complete foramen that included both interior medullary cavity surface and exterior bone surface were counted towards the MNI.

5.7 Re-analysis of the Block E Assemblage

The primary purpose of this study was a qualitative and quantitative re-analysis of the Block E faunal material. The faunal material was originally analyzed during the initial excavation and recovery between 1986 and 1991. A number of corrections and discoveries were made during the re-analysis. The inspection of quadrant bags resulted in the recognition of a number of identifiable specimens previously recorded as unidentifiable. In addition, many specimens originally identified to a specific portion of an element were found to be unidentifiable due to a lack of an identifiable landmark. Identified specimens were also corrected for left and right skeletal orientation. Because of these changes there were a number of amendments in MNI of various specimen and landmarks, both increases and decreases. The identification of additional posterior tibial foramen increased the total *Bison bison* MNI of the Block E assemblage from the original analysis.

Positive identification of particular specimens to the species taxonomic level increased the MNI of *Canis lupus*, *Vulpes velox* and Leporids. Other specimens identified only to a general weight and size class were identified to the taxonomic level of family or genus. Two specimens originally identified as medium sized avian were re-identified as belonging to the *leporidae* Family.

The number of positively identified bone tools was decreased from the original analysis, further discussed in following chapters. One important correction was the identification of one and possibly two recreational pieces, discussed in following chapters.

5.8 Summary

At least 11 species were identified during the Block E excavations, with bison bone forming the majority of the faunal assemblage. Other species ranged in size from vole-

sized micro-mammals to wolf and elk. Considerable element fragmentation made the identification of most of the faunal material impossible. Based on the staining of bone and a similarity to other bone in the cultural levels, it is believed that most of the small and micro-sized mammals are associated with the cultural assemblage or date to the time of occupation. Due to differences in colour and a greasier appearance, two examples of squirrel-sized rodents, one a relatively complete skeleton, are believed to be more recent intrusions.

Actions by carnivores may have disturbed the original cultural deposition by moving elements within the site or removing bones from the site. Only a small portion of the faunal assemblage shows signs of carnivore damage, such as chewing, gnawing and puncturing. Although there is only a loose clustering of element types, there is still visible clustering associated with cultural features. Many of the larger distal and proximal portions of limb bones are absent, but may simply have been broken for processing to a point where they are unrecognizable. It is also possible they lie outside the excavated area of Block E. Of interest is the recovery of various intact cervical vertebrae, including the atlas and axis, which are not perceived as having a high food value. None of these large elements were articulated and were not likely moved by rodents, suggesting they were separate when deposited after processing. No evidence of carnivore activity, such as chewing and gnawing, is evident to suggest canids displaced them. The presence of these neck vertebrae, considered to be of a lower economic value, may suggest that a kill site was relatively close to the processing area.

The nature of the Lovstrom site stratigraphy made it difficult to isolate cultural levels. Initial excavations indicated at least one occupation level in other Lovstrom

excavation blocks. The opening of the Block E excavation identified two distinct occupation levels. Identification of the two levels is quite good with a marked separation of bone concentrations in most of the block. However, it is possible that in parts of Block E there was vertical movement of material due to trampling and soil disturbances from rodents and tree roots. The effects of bioturbation have likely produced some mixing of material over time. Nicholson (2011:326) discussed the concerns of the soil disturbance by various agents, but also reports that stratigraphic integrity still exists, supported by the relative consistency of radiocarbon dates. Comparable to many archaeological sites, bioturbation has disturbed portions of the site, but faunal distribution shows there is still noticeable stratigraphic separation.

Chapter 6

Seasonality and Bison Herd Structure

6.1 Introduction

The restricted mating and birthing seasons of *Bison bison* are useful in identifying the season in which the herd was killed. Accordingly, dentition growth and wear rates are useful in identifying the age of individuals within the herd. The sexual dimorphic nature of *B. bison* allows for the identification of the sexual makeup of a bison kill herd. Metric measurements of various elements have been used to differentiate the sex of individuals within faunal assemblages. Differential growth rates in certain elements are used to establish the age range within the herd. Foetal remains are not only useful in identifying the sex structure of a herd, but also reveal the season a kill event took place. The appearance of other animals may offer additional evidence of the time of year a site was occupied. Migration and hibernation patterns of certain mammal and avian species restrict the appearance and availability of these species to certain times of the year. The absence of particular species may also offer an indication of the season of occupation.

The *Bison bison* rut and the birthing season is well documented and is somewhat restricted in length. Cows and bulls are separate for most of the year, except during mating season. Early assumptions suggested the duration of the rut of modern bison occurs from July to September (Banfield 1974:406). A subsequent gestation period lasting from 270 to 300 days resulted in parturition between mid April and the early part of June (Banfield 1974). Also at this time, an extended birthing period was proposed due to out-of-season calving evidenced in some archaeological sites (Roe 1972:96; Wilson 1974:151). More recent studies also identify the potential for a much longer breeding season that may last

from three to four months, reducing the accuracy of this method in determining seasonality (Walde 2006:481). Although out of season births are observed in historic investigations of bison parturition they are infrequent with the majority of births occurring in April and May (Gogan et al. 2005).

6.2 Bison Dentition Studies

Past studies have used dentition growth and wear rates to determine the age of bison. Similar tooth eruption schedules within and between bison populations are used to establish the age of individuals at death. Early bison age studies compared dentition of modern bison populations of known age to dentition recovered from archaeological assemblages (Frison and Reher 1970). At the same time, concerns arose that differences in diet would affect variation in the growth and wear of teeth. Changes in the environment or a change in season would also affect the abrasiveness of vegetation being ingested. In addition, moving to areas with different soil types could introduce more grit into the diet and a subsequent increase in tooth wear (Haynes 1984). Nevertheless, it is believed that teeth will display a similar rate of growth and deterioration within an isolated group of bison (Todd and Hofman 1987). Because of this variation in tooth wear the best precision in determining age is limited to individuals under the age of 4.6 years (Reher 1974).

The restricted parturition period makes it possible to identify the approximate time of year a bison died. Using known growth and attrition rates of bison dentition a season of occupation can be inferred. Based on known-aged bison, similar wear patterns identified similar ages at death, which in turn identified the time of year. If fractionally more wear was seen across the entire population compared to other bison assemblages then the time of death was considered to be later in the year. Ages were given in decimal point form to

indicate the fractional increase in age, in the form of $x.5$. If ages were measured to be $.6$, 1.6 , 2.6 , and so on years of age, then the attrition rate would be given as $x.6$. Early studies looked at mass kill sites where a population of bison had been killed in one event. Several sites produced different attrition rates: $x.5$ from the Glenrock Kill site (Frison and Reher 1970), an $x.6$ rate from the Horner Finley site (Todd and Hoffman 1987), and an $x.7$ attrition rate from both the Henry Smith site (Wilson 1988) and the Hawken site (Frison et al. 1976). Attrition rates from other sites, such as the Agate Basin site (Frison 1982a), were less precise producing a rate of $x.6 - x.9$. Subsequent studies compared dental material to these early analyses to identify attrition rates and the associated season of death.

The highly fragmented nature of the Lovstrom site Block E faunal collection restricted the amount of useful dentition available for the purpose of aging the assemblage. Maxillary teeth were highly fragmented, either recovered as isolated teeth or teeth attached to fragments of alveolar bone. Much of the mandibular dental material was either partially or incomplete tooth rows or isolated teeth. One relatively complete mandible was highly fragmented and likely broken after deposition. One of the tooth rows included a deciduous tooth with an empty cavity for a permanent tooth. The mandibular material was the only dentition used in this analysis. As per previous studies, the metaconid height was used to isolate age groups (Figures 6.1 and 6.2). Metaconid heights were measured with a digital sliding calliper. Based on the metaconid heights and wear patterns, at least seven age groups were recognised in the Block E bison assemblage.

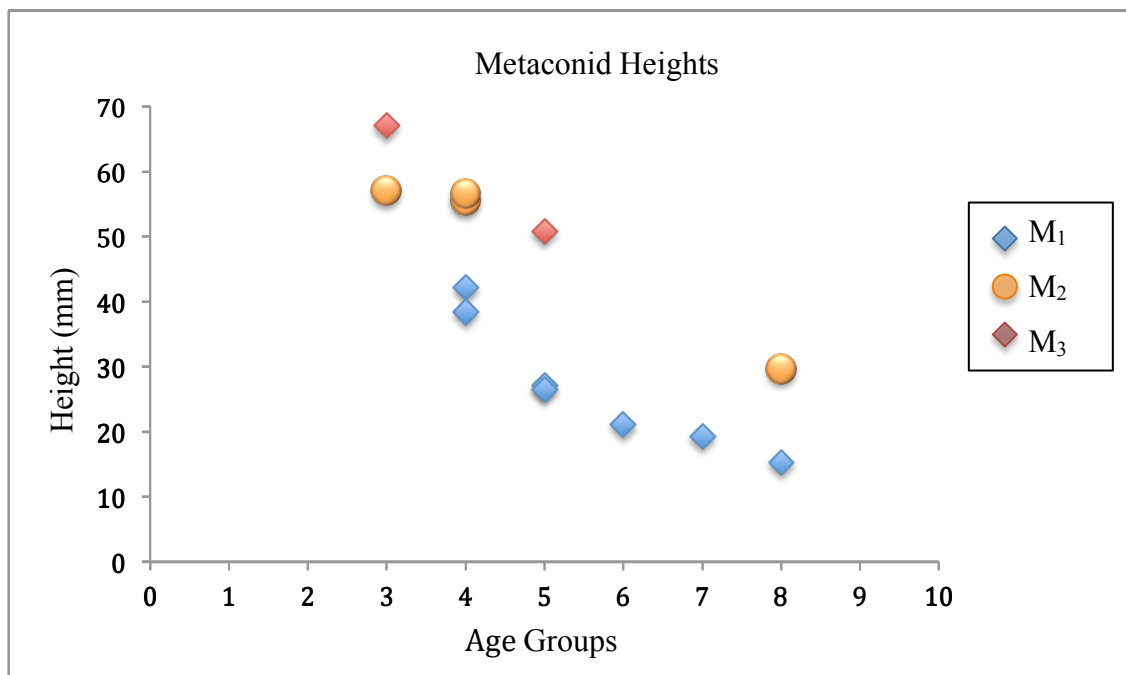


Figure 6.1: Metaconid heights of M_1 , M_2 and M_3 from Level 1 of Block E.

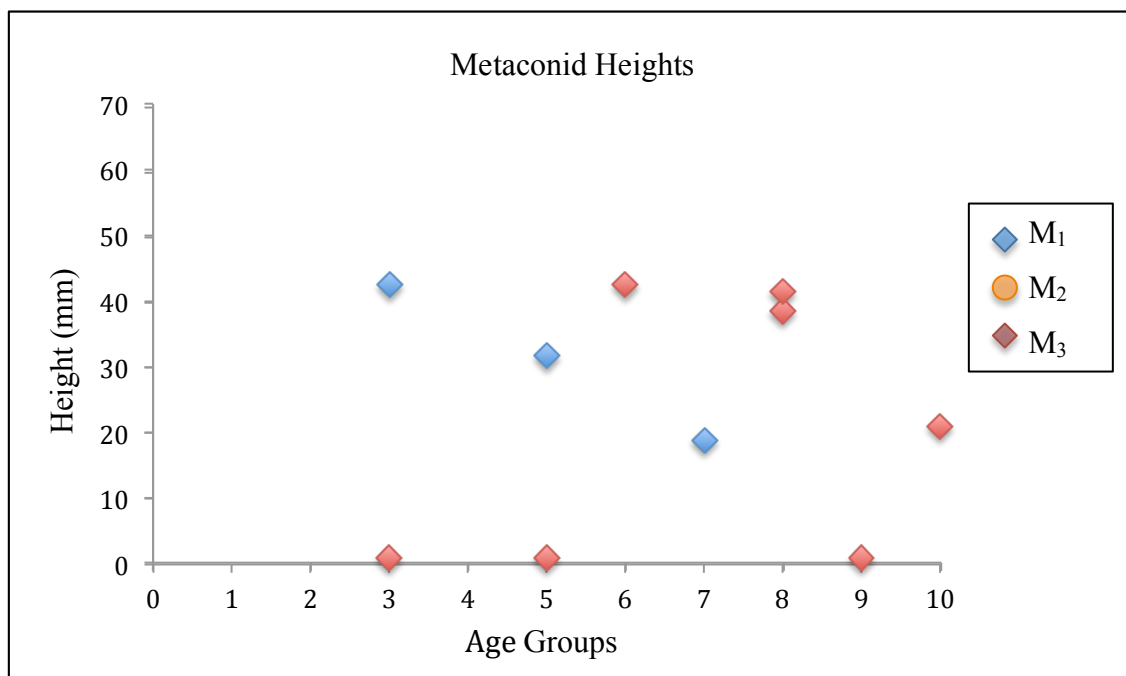


Figure 6.2: Metaconid heights of M_1 , M_2 and M_3 from Level 2 of Block E.

6.2.1 Group Descriptions

Group 3 (2.6 years)

Four teeth represent this group from both levels. The first molar (M_1) from level 2 is part of a tooth row fragment including a deciduous fourth premolar with the roots exposed. The permanent P_4 is missing from the socket. All cusps are worn on the first molar and the exostylid is beginning to wear. Cusps III and IV on the second molar (M_2) from level 1 shows some wear and the exostylid has no wear. Right hand third molars (M_3) are represented from both occupation levels. Both have little to no wear on cusps I and II and the exostylid is approximately 20 mm below the tooth crown. The M_3 from level 2 is broken and its aging relied solely on wear patterns. One isolated M_2 from level 1 has wear on all cusps and the exostylid is not in wear.

Group 4 (3.6 years)

This age group is comprised of four isolated teeth, all from level 1. All cusps on the first molars are worn. The exostylids are worn on both first molar but are still separate from the rest of the tooth. A pair of second molars show wear on all surfaces. The exostylids show no wear and are approximately 20 mm below the tooth crown. One pair of second molars has similar growth and wear and possibly represent one individual.

Group 5 (4.6 years)

Three isolated first molars are in full wear. The exostylid joins the teeth on all three specimens. Two M_1 from level 1 are similar in growth and wear and may represent one individual. One M_3 was recovered from each occupation level. The M_3 from level 1 exhibits wear on all cusps. No wear is visible on the exostylid located approximately 10 mm below the tooth crown. The third molar from level 2 was broken and age grouping

relied solely on wear patterns. This M₃ had wear on all cusps with very slight wear on the hypoconulid. The exostylid was 13mm below the tooth crown with no visible signs of wear.

Group 6A (5.6 years)

A single isolated first molar from level 1 and third molar from level two represents this age group. The identification is based primarily on enamel height. A lack of alveolar material prevents a more specific classification. The exostylid has joined the tooth on the M₁. The M₃ hypoconulid has joined the rest of the tooth. The exostylid is still below the tooth crown and unworn.

Group 6B (6.6 years)

A first molar from each level represents this age group. Each molar is still in the alveolar socket. A partial tooth row from level 2 includes a fourth premolar and the first molar. Exostylids on both M₁ have joined the rest of the tooth. The enamel line is above the alveolus on both examples.

Group 6C (7.6 years)

A partial tooth row with M₁ to M₃ molars was located in level 1. The first and second molar exostylids have joined the rest of the tooth. The M₃ exostylid is worn but remains separate from the rest of the tooth. The enamel root line of the M₂ is below the alveolus. Two teeth were located in level 2, one socketed and one isolated third molar. The enamel border is below the alveolus on one of the third molars. Both examples have the exostylid in wear but separate from the rest of the teeth.

Group 6E (9.6+ years)

This age group includes the most complete portions of mandibular elements. All three examples were located in level 2. A relatively complete right tooth row includes a complete set of fragmented premolars and complete molars. A highly fragmented left mandible located in the same excavation unit has an M_1 and M_3 in the alveolar socket. Premolars are isolated and the M_2 is missing. These tooth rows have similar wear and may represent one individual. A third solitary M_3 was identified in the alveolar socket. The M_2 enamel root line is above the alveolus. The enamel root line on all M_3 is about level with the alveolus. The M_1 first fossette is gone and only a small concavity remains of the exostylid. The M_3 exostylids are all connected to the rest of the tooth.

6.2.2 Dentition Summary

A comparison to previous dentition age studies (Todd and Hoffman 1987) indicates a similarity of the Block E dental assemblage to an x.6 attrition rate. Several teeth also have similar growth and attrition rates to x.7 and x.6 – x.9 increments. With a limited calving season from mid April to the end of May an increment of x.6 – x.9 would place the death of these animals in late Fall until March. A majority of the mandibular teeth were representative of the earlier x.6 rate and would suggest these individuals were killed close to November or December. The nature of the Block E dentition hinders the accuracy of age estimation. A small majority of teeth were from individuals above the age of 4.6 years. Frison and Reher (1970:51) suggest the measurements of enamel heights on individuals over 4.6 years of age may fall into more than one age grouping. Also, previous age studies analyse various teeth in combination from a complete tooth row to estimate the age of an individual. When an isolated tooth is observed certain wear patterns may fall into more

than one age category. The range of Block E age increments might be the result of this overlapping of wear patterns. The variation in tooth attrition rates may also be a result of kill events occurring over a number of months suggesting that Block E of the Lovstrom site is a winter occupation. Similar patterns are seen from both occupation levels.

6.3 Immature Specimens

A small number of immature bison elements were identified in Block E of the Lovstrom site. The fragmented nature of the faunal collection limited the identification of immature bones to the overall size, the appearance of partially or unfused epiphyses or the absence of epiphyses. Immature elements identifiable as bison were limited to the Blackduck occupation level. None of the immature elements showed signs of burning or cut marks.

Studies of immature bison focus on the presence of variation in epiphyseal fusion rates between different bones within a skeleton. Certain elements fuse much earlier than other elements in the body. Knowing the fusion rate of specific elements can help identify the age of an individual at death. Early epiphyseal fusion rate studies of European bison (*Bison bonasus*) recognised systematic rates of fusion among different elements (Koch 1935). These results were subsequently used in a study of North American bison (*Bison bison*) (Duffield 1973:132). Hanna (2007:53) raised concerns over this use of European bison as a comparative sample to examine North American bison since the two are not of the same species. Duffield (1973) referred to the North American bison and European bison as sub-specific, although they are separate species belonging to the same bison genus. Duffield's (1973) fusion rates are considerably different than results from other researchers using the same *B. bonasus* species (see Buehler 1997:174). A lack of *B. bison* comparative

bone fusion rates force analysts to continue to use the early fusion rate studies of Koch (1935) and Empel and Roskosz (from Buehler 1997:174).

One of the first articles discussing fusion rates (Koch 1935) advised that variability of fusion between elements, and more importantly, among the same elements may lessen the usefulness of this method as an indicator of age. The small sample of immature bone from Block E may illustrate this problem. The distal portion of an unfused metacarpal (156-4-25/1392) was compared to a 5 year old female bison from the University of Saskatchewan faunal comparative collection. Visually, the size comparison is quite similar between the two specimens, with the unfused element slightly larger than the comparative element. Even though the two bones are similar in size there is a marked difference in the rates of fusion, one element is unfused while the other is completely fused. It is possible the differing amounts of fusion are the result of natural variation in fusion rates within species. More likely, the difference is a result of size variation due to sexual dimorphism. The unfused element could be from a male individual with an increased growth rate.

The fragmented state of many archaeological assemblages creates an additional problem when using various methods of age determination. Determining age using fusion rates will give a more specific age at death when fusion rates of various elements from one complete skeleton are used. The use of discrete elements may provide only a maximum possible age based on the appearance or absence of fused epiphyses. More specimens from one individual will provide a more accurate or precise age range. This is not because of a presence of more unfused elements, but the addition of fused or partially fused epiphyses. The presence of both fused and unfused bones will reduce the potential age range. For instance, an unfused proximal femur and an unfused distal metacarpal would give only a

maximum age of an individual. If both elements are from the same individual the maximum age must be the lesser of the two, since an older age would exhibit fusion in one of the elements. According to Duffield's (1973) rates of fusion, if the proximal femur is fused (at least five years of age) and the distal radius is unfused (fuses at six years of age), then the age of the individual would be between the latter part of five years of age and six years of age. The use of isolated elements will again produce less accurate age ranges.

Even so, this method can be informative when other methods of age determination are unusable. Duffield's (1973) criteria indicate the radial epiphyses fuse in the early part of the sixth year. The femoral head fuses to the proximal femur near the middle of the fifth year. The epiphyseal condyles and distal metacarpal shaft fuse at the end of the fourth year of age. The 1st phalange fuses in the middle of the fourth year.

The following Block E immature specimens were analyzed for rate of fusion. An almost completely fused distal radius would suggest an individual was near six years of age. An unfused proximal femur would indicate a maximum age of five years. An unfused distal portion of a metacarpal indicates the individual was four years of age or younger. The presence of two unfused proximal ends of 1st phalanges and a complete partially fused 1st phalanx suggest the individual(s) was/were not older than 4 years of age.

Only a small number of immature bison elements were recovered from Block E. Individually, these specimens give only a maximum possible age at death. The age represented by the fused distal radius versus the rest of the elements would indicate at least two individuals are represented. The partially fused phalanx would indicate a lowest maximum age of 4 years for at least one other individual.

6.4 Foetal Specimens

Examination of foetal material is another method traditionally used to identify the season of occupation of an archaeological site. Identifying the stage of growth of foetal bison remains can indicate the time of year a bison cow was killed (Whittaker 1998:296). Although small in number, a quantity of foetal bison bone was identified in the Block E assemblage allowing for a determination of site seasonality. This method is based on known seasons of reproduction and parturition discussed previously.

Similarly with the use of immature bones there are some concerns about using foetal material as a diagnostic tool. In addition to a possible extended rutting period other factors must be considered when using foetal material as a seasonal indicator. Variation in the growth rate and gestation period of foetal bison may have an effect on the recognised season of occupation. Stresses placed on the cow and its foetus can affect the date of parturition. These may be nutritional stresses from reduced quality or amounts of food, water or an environmental change. A study by Gogan et al (2005) looked at variations in foetal development between various bison populations from different time periods and herds through time. The study does not include or address foetal skeletal material but is still relevant to this discussion. Bison cows exposed to areas offering higher nutrition will have shorter gestation periods (Berger 1992; Gogan et al. 2005:1725). Areas that permit an earlier growth of plant food show earlier times of parturition. Differences in population density would also have an effect on the amount of food/nutrition available to individual bison (Gogan et al. 2005:1724-1725). Unfortunately, there is no mention of skeletal material or possible differences in bone size caused by variation in parturition rates. Gogan et al. (2005) also examined differences in foetal/birth weight caused by the sex of the bison

foetus. Again, it is unclear if fluctuations in birth weight caused by the sex of the individual would transmit to changes in skeletal size. As discussed in previous studies (McKee 1985:33-34) the analyst must use caution when only applying element size to determine age estimates.

Different methods were created to determine the age of foetal remains with the intent of establishing seasonality. The presence of younger and therefore smaller foetal remains would indicate the cow was killed earlier in the gestation period, suggesting the kill event took place in the fall. Increased growth of foetal material would indicate the kill event and associated occupation took place progressively later into the winter or early spring. Various methods use comparisons between modern and archaeological assemblages to identify stages of growth. One technique compares metric measurements of foetal bones to known age groups (McKee 1985; Wilson 1974). A second method records the amount of periosteal development to identify the rate of foetal growth (McKee 1985; Wilson 1974). These methods require the examination of relatively complete elements or certain portions of elements. An absence of complete limb elements prevented the use of either of these methods.

Identifying the stage of development of the Block E foetal remains was limited due to the small sample size and degree of fragmentation. Identifiable and unidentifiable long bones were present in the assemblage, but all were missing proximal or distal ends (Figure 6.3). The small quantity of identifiable bones made comparisons to the modern foetal comparative collection at the University of Saskatchewan possible. The majority of remains were recovered in the lower level 2 (Figure 6.3). Two separate growth stages were recognisable in the level 2 foetal assemblage. Tibia and humerus shafts were at a similar

stage of growth to a 7-month old individual. Unfused portions of vertebral elements and a second phalange were similar to an individual at a 5-month stage of growth. Two metapodial shaft fragments were identified in the collection, an unfused half of a metapodial shaft and two fused halves forming a complete metapodial shaft. This element type begins as two separate metapodials, or halves, and fuses in the last two months of gestation (Wilson and Davis 1978). The different rates of fusion of the metapodials would support the appearance of the two age ranges mentioned previously. The small quantity of foetal material from level 1 represented a MNI of 1 individual. The presence of two stages of growth in level 2 indicates an MNI of 2 individuals.

Based on the size of the foetal material, death of the foetal bison probably took place no earlier than late fall to early winter. The presence of two different foetal stages of growth may be the result of two kill events. As stated previously, the variation in size of the foetal remains may also be due to the extended length of the rutting season or developmental factors.



Figure 6.3: Foetal bison specimens.

6.5 Bison Population Sex Structure

Differences in body size between males and females are recognizable in many mammal species. This sexual dimorphism observed in the living animal is also visible in the skeletal remains after death. These differences are also apparent between the male and female bison. An adult bull will typically weigh in the range of 570 kg compared to 420 kg for an average cow (Banfield 1977:405). The accompanying variation in bone size can be used to identify the sex of bison faunal remains.

Various methods have been developed that compare size difference in the bones of the bison skeleton. Most of these methods employ relationships between two measurements on different axis of a complete element. A lack of complete elements in the Block E collection prevented the use of many of these methods. Size and proportion of the first and second phalanges have been used to identify male and female bison within a population (Duffield 1974; Roberts 1982). Although there were a number of complete phalanges in the Block assemblage, there was not a large enough sample to provide significant results. Small carpal and tarsal bones are more dense and of less economic value so survive more readily in archaeological deposits. Consequently, past studies have employed the evaluation of these bones for sex determination. Due to the increased chance of survivability, distal and proximal ends of elements have also been used in sex determination studies. All bimodal measurements, except for the distal humerus, were based on the methods used by Morlan (1991). Distal humerus measurements were based on Todd (1987). All specimens used in the sex structure analysis were completely fused. The presence of fused epiphyses may still mean animal was immature.

6.5.1 Bivariate Analysis of Skeletal Elements

Carpals and Tarsals

The greater survivability of carpals and tarsals make these elements ever-present in archaeological assemblages and accordingly useful in sex determination studies.

Measurements of certain carpal or tarsal bones from the Sjøvold site were found to elicit a bimodal distribution suggesting the presence of two distinct sexes (Morlan 1991). One concern with the use of these element types is the inability to ascertain the associated age of these elements. Age determination using rate of epiphyseal fusion is only possible on the calcaneus, all other carpal and tarsal elements lack epiphyses. Any difference in size may then reflect the age of the animal in addition to or instead of the sex.

The Block E assemblage had a variety of lower hindlimb and forelimb elements. Some of these elements displayed bimodal distribution when specific measurements were plotted on a graph. Measurements were taken according to Morlan's (1991) methodology with a digital sliding calliper. Broken or fragmented elements that inhibited the measurement of particular dimensions were recorded as not applicable.

The astragalus, also known as the talus, is very dense and one of the largest tarsal bones. According to Morlan (1991:223), the medial length versus the distal width measurement produces a good separation of male and female. The astragali from Block E produced a clear bimodal separation using this measurement (Figure 6.4). The graphical representation shows the presence of one female and three males in occupation 2. Measurements and graphical plotting are similar to astragali from the Jackson site (Playford 2001). Hanna (2007:64) found that medial length and lateral length displayed the best separation of individuals according to sex. One element was partially broken and did not

allow measurement of the lateral length. Medial length and lateral length produced the same bimodal separation as the previous measurement (Figure 6.5).

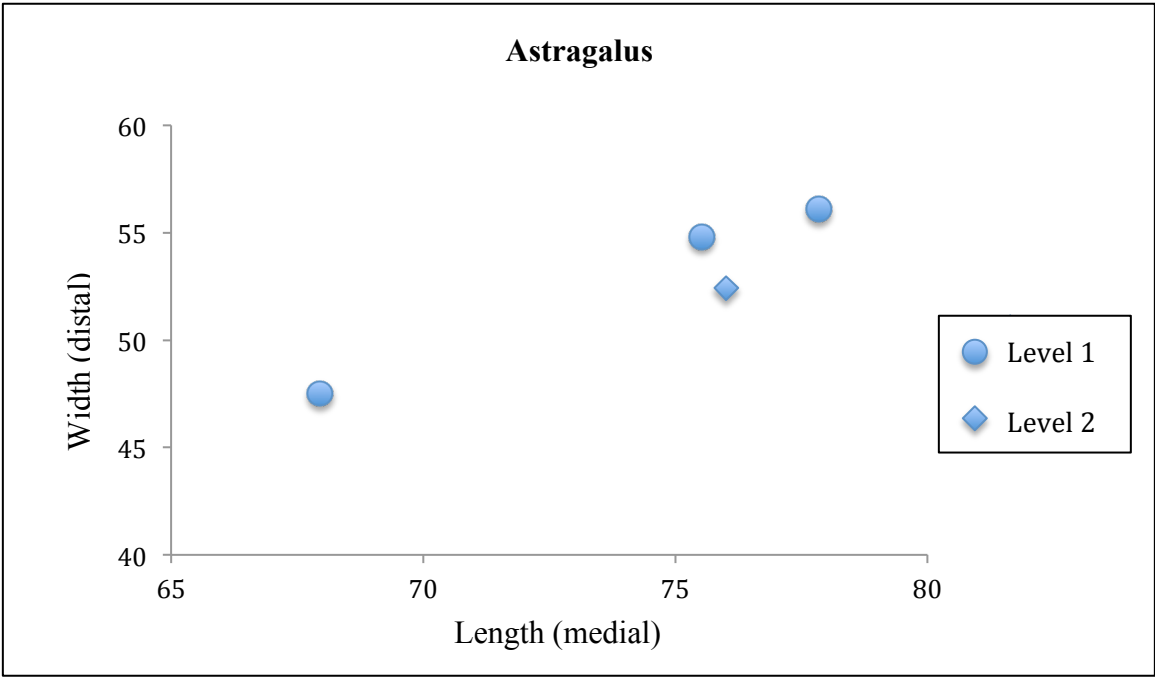


Figure 6.4: Bivariate plot of astragali using distal width versus medial length.

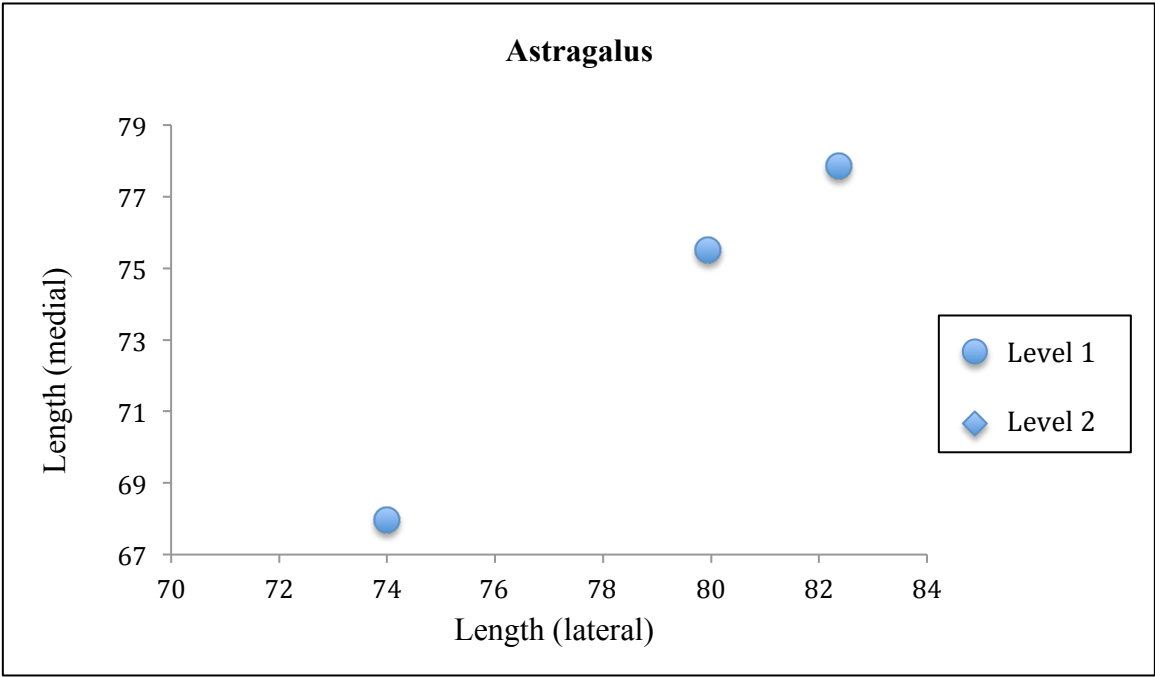


Figure 6.5: Bivariate plot of astragali using medial length versus lateral length.

Only two ulnar carpal elements were complete enough to measure, both from level 2. The sample size is too small to be of much value, even though depth and width measurements of this element produced a visible bimodal separation that suggests the presence of a male and female bison (Figure 6.6). Measurements were similar to those of the Hartley site (Hanna 2007:62) and the Jackson site (Playford 2001:91).

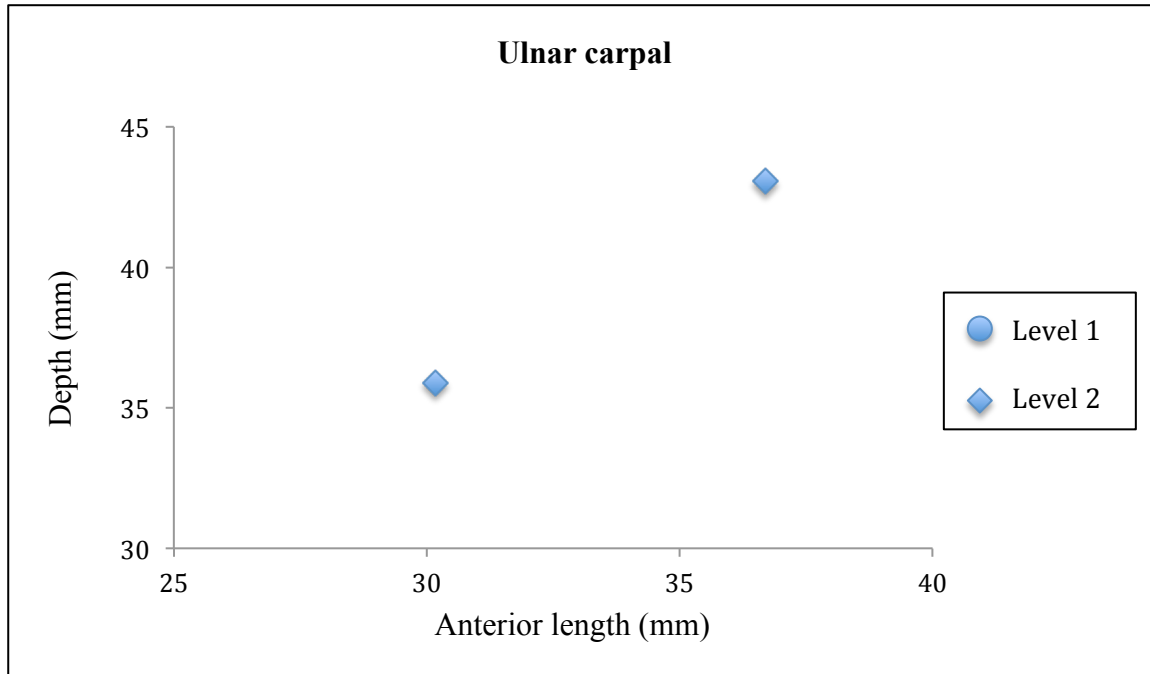


Figure 6.6: Bivariate plot of ulnar carpal.

Morlan (1991: 225) found that the width plotted against depth of the C+4 fused tarsal produced the best bimodal separation. Graphical representation of the Block E C+4 tarsal displayed a less definitive bimodal distribution that may suggest an even distribution of males and females or a progressive range of ages (Figure 6.7). Only one C+4 tarsal was located in level one which is included in Figure 4. Hanna (2007:66) found that the depth versus the length of the C+4 tarsal produced the best bimodal separation. Since a majority of Block E C+4 tarsal surfaces were fragmented a comparison between the Hartley and Block E tarsals was impossible.

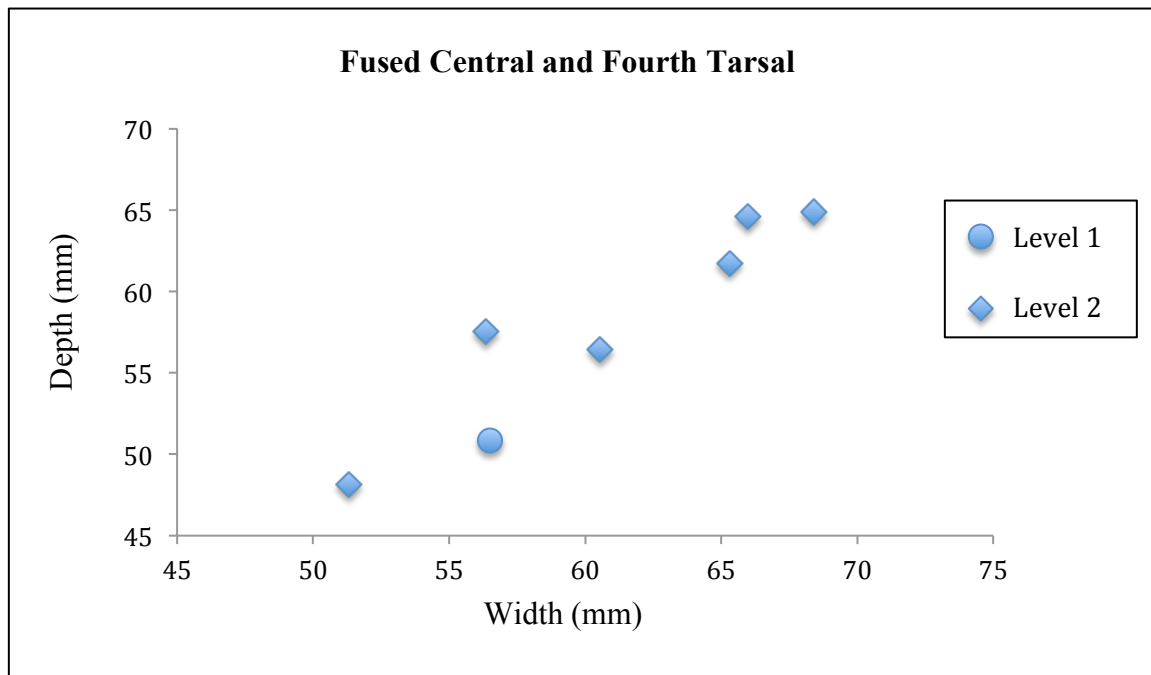


Figure 6.7: Bivariate plot of C+4 tarsal measurements.

A number of calcanei were present in the Block E assemblage but measurement surfaces were either missing or worn. Bivariate measurements applied to other elements were less conclusive. Measurements of the fused second and third carpal produced a distribution more representative of a linear progression in size than a bimodal distribution, possibly caused by a range in maturity versus a separation created by the presence of two sexes (Figure 6.8).

The radial carpal produced a similar linear distribution using measurements of width versus length (Figure 6.9). Hanna (2007:60) found that radial carpal measurements from the width and depth produced a better bimodal separation (Figure 6.10). The use of these measurements produces a slight bimodal spread, but overall a similar linear distribution is observed. Both methods used on the radial carpal to identify sex distribution produce a somewhat questionable bimodal distribution. Of concern is the change in position and number of specimens in the bimodal clusters between the two measurement

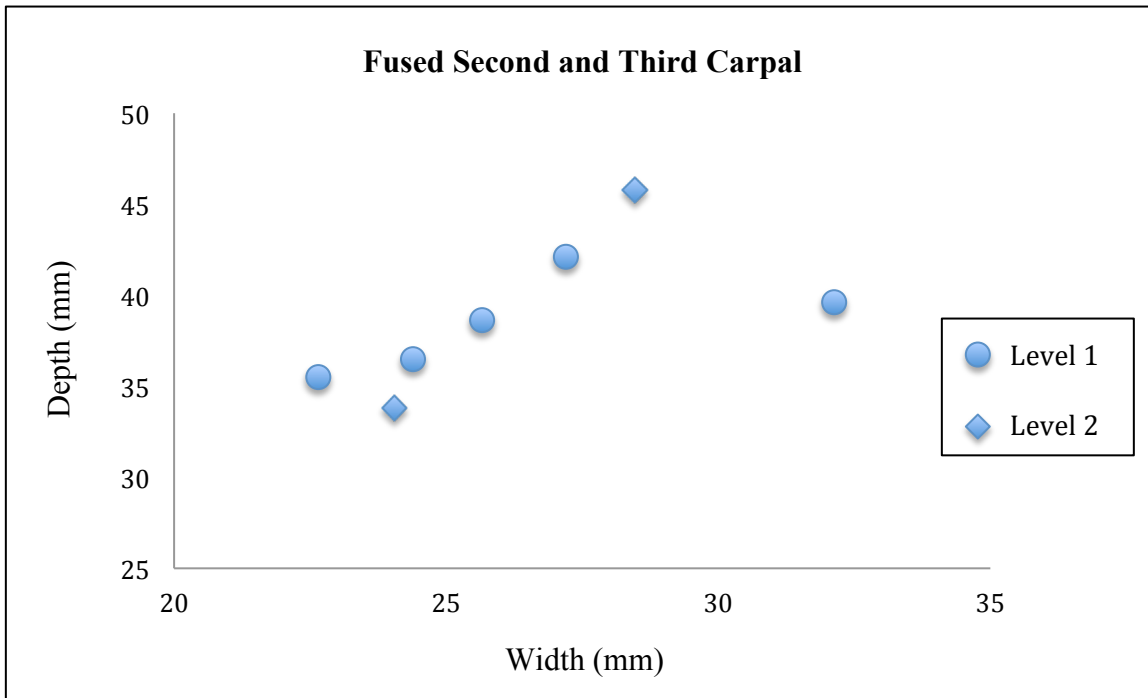


Figure 6.8: Bivariate plot of fused 2+3 carpal.

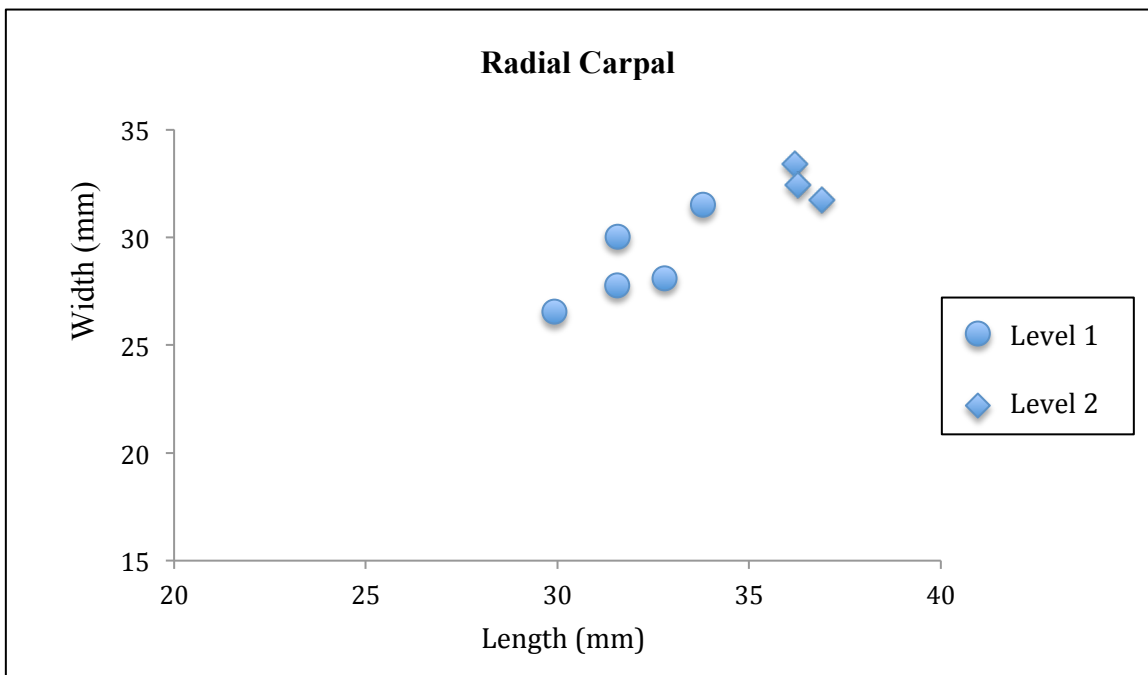


Figure 6.9: Bivariate plot of radial carpal measuring width versus length.

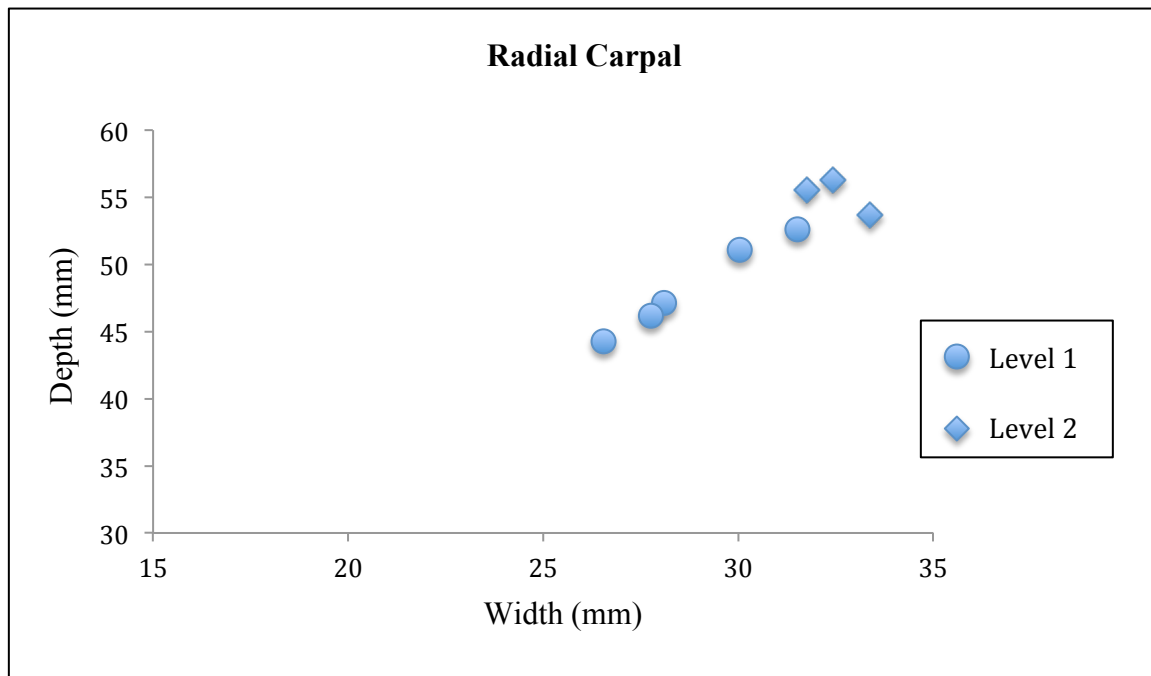


Figure 6.10: Bivariate plot of radial carpal measuring depth versus width.

methods. Distribution in the first method would suggest either the presence of five females and three males or an even distribution of male and female individuals. The second method displays a slight bimodal separation, which gives a possible distribution of three female and five male individuals.

Distal Tibia and Lateral Malleolus

The distal tibia is one of the more dense portions of bone in the bison skeleton and frequently survives intact. Similar to tarsal and carpal bones, the lateral malleolus is a small and dense element. These two element types were found in high enough quantities to be useful for graphical representations. Five complete distal tibia specimens, one left and four right, were recovered in level 1 and a single specimen was recovered in level two. A bimodal distribution was somewhat evident when the depth and breadth of the distal tibia was plotted (Figure 6.11). The measurements were similar to values at the Sanderson site (Magee 1997). The distribution may suggest the appearance of two males and three

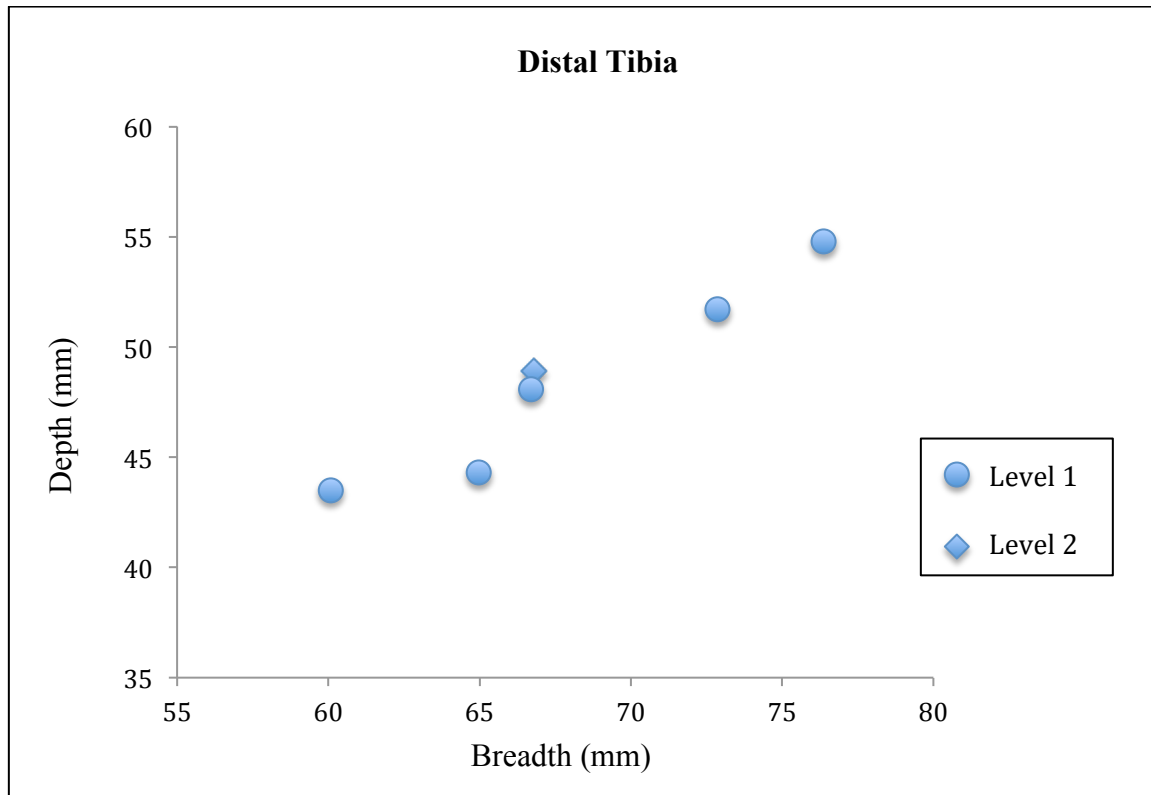


Figure 6.11: Bivariate plot of distal tibia.

females from level 1. The lone distal tibia fragment from level 2 falls within the female grouping. Measurements of the lateral malleolus offered the weakest bimodality among the tarsal bones (Morlan 1991:225). As such, plotting of the length and breadth of the lateral malleolus produced a much less obvious bimodal distribution, closer to a linear progression, similar to some of the carpal and tarsal scatterings (Figure 6.12). The two lateral malleolus from level 2 are from the same side and represent two individuals.

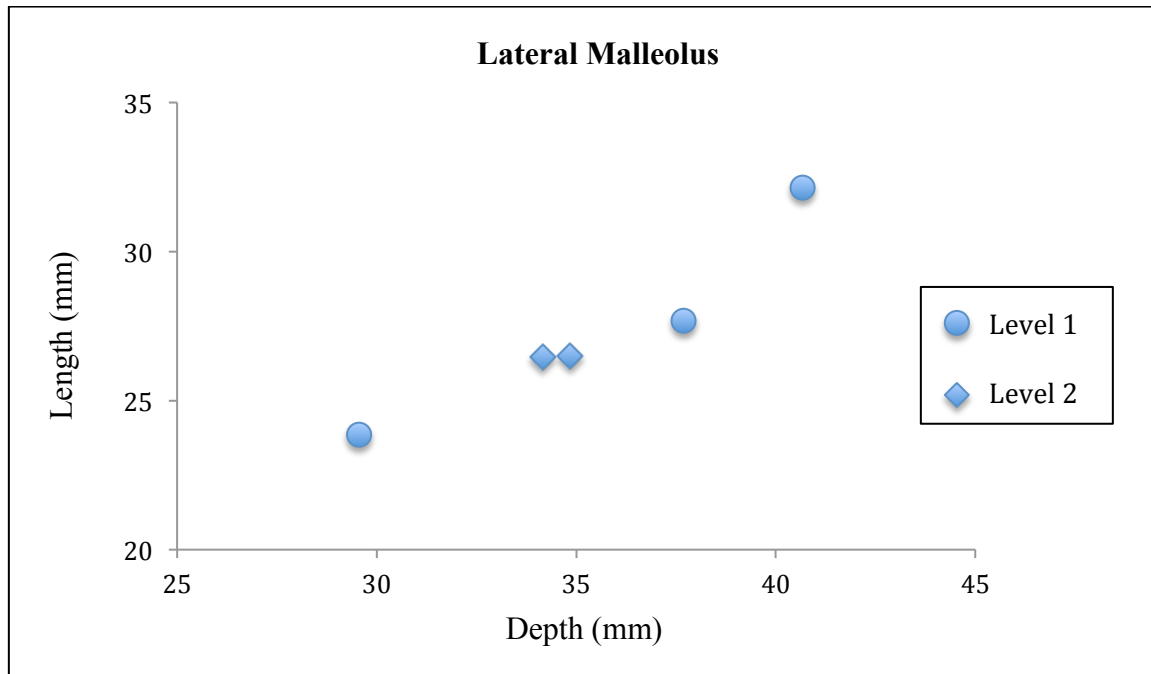


Figure 6.12: Bivariate plot of lateral malleolus.

Distal Humerus

Measurements of the distal humerus are useful in classifying male and female bison. Todd (1987:163) found measurements of the distal medial depth versus the distal articular breadth accurately identified male and female bison from a modern known-sex comparative population. This method compared modern bison to the extinct *Bison antiquus* recovered from the Horner Site, a Cody Complex site (Frison and Todd 1987). Graphical representations show a marked difference in distribution between the modern and *B. antiquus* specimens. Even though the modern bison are smaller in size there is still a bimodal distribution of both assemblages between male and female individuals. A total of four distal humeri were available from Block E to generate a usable graphical distribution. One left and one right specimen were recovered from each level. One fragmented humerus was refit to allow measurements to be taken. Using Todd's (1987:163) measurements, the

distal articular breadth versus the distal depth of the medial surface was used to produce a visible bimodal distribution. The plotted measurements are similar to the modern bison graphical distribution from the Horner site (Todd 1987:163). The distribution suggests one male and one female/immature individual are present in each occupation level (Figure 6.13).

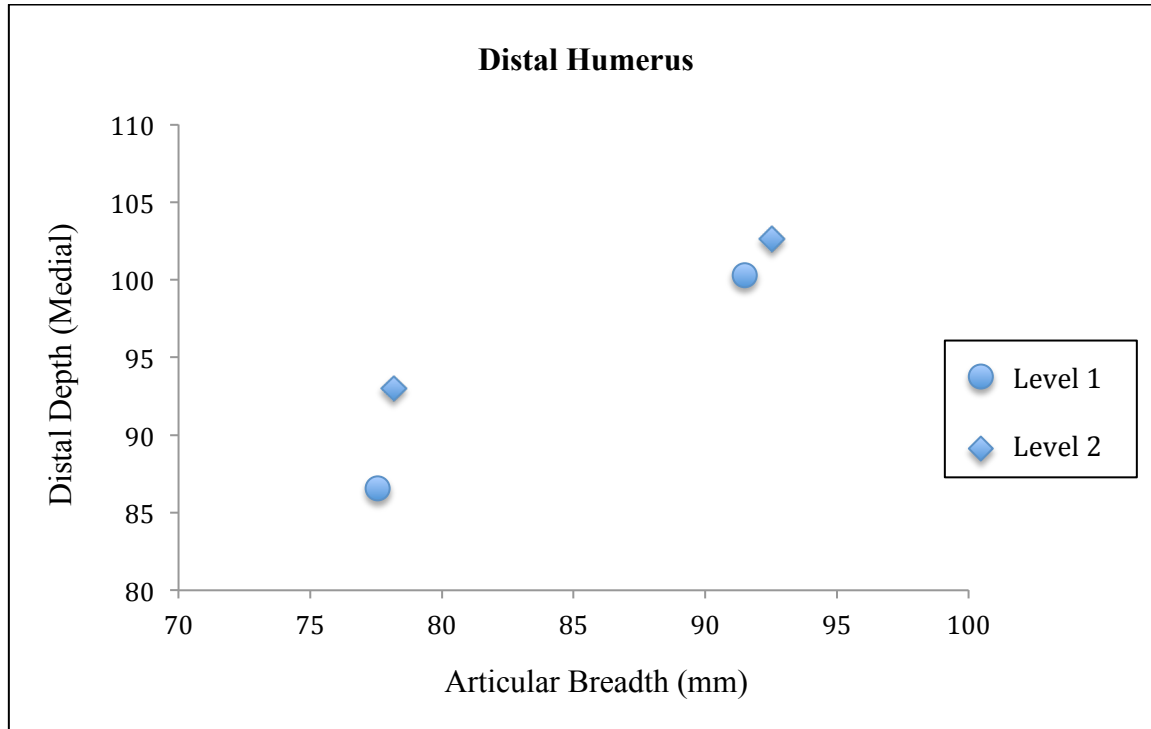


Figure 6.13: Bivariate plot of distal humerus.

6.5.2 Discriminant Function Analysis of Skeletal Elements

Another method has more recently been used to identify the sex structure of bison assemblages. Walde (2004) used discriminant function analysis to separate male and female of known-sex bison. This method again uses metric measurements recorded between various landmarks that are then entered into a range of equations. A difference between the discriminant function method and the use of bivariate plotting has the former method not needing a comparative sample to produce results. Results from these

discriminant functions give either a male or female/immature result. Due to the fragmentary nature of faunal assemblages Walde (2004) offers several equations for the analysis of each element. Equations that use more variables (measurements) will produce the most accurate results (Walde 2004:106). The nature of the Block E assemblage restricted the number of equations that could be used. Some studies use different equations within one sample to identify sex without showing results from all measurement groups. Walde (2004) uses measurements taken from Speth (1983).

Distal Humerus

The effects of weathering and breakage on the distal humerus specimens limited this method to the use of one equation. The fragmented nature of the specimens limited measurements to only two locations. Measurements followed Speth (1983:174,183), recording the length of the capitulum (*N*) and the length of the lateral epicondyle (*O*). Walde's (2004:105) equation 2.4 was used to analyse the distal humeri. Equation 2.4 compares the results of two equations, one for a male and one for a female individual. The equation takes the form of:

$$\text{Male} = 89.681 N + 7.983 O - 205.653$$

$$\text{Female} = 77.865 N + 3.961 O - 142.40$$

The equation with the higher result will ascertain the sex of the individual. The results show one male and two female/immature individuals (Table 6.1). The fourth individual (152-2-38) is close to indeterminate but is classified as female/immature.

Table 6.1: Distal humerus discriminant function results.

| Art. # | Side | Measurements (<i>N</i>) (<i>O</i>) | | Eq. # | Male Eq. | Female Eq. | Diff. | Sex |
|-----------|------|--|------|----------|-------------|---------------|-------|-----|
| 117-3-9 | LH | 3.42 | 3.94 | 2.4 | 132.437 | 139.422 | -6.99 | F/I |
| 118-2-72 | RH | 3.55 | 4.05 | 2.4 | 144.997 | 150.032 | -5.04 | F/I |
| 118-3-59 | RH | 3.95 | 7.70 | 2.4 | 191.667 | 184.112 | 7.56 | M |
| 152-2-38 | LH | 3.78 | 4.23 | 2.4 | 167.107 | 168.682 | -1.58 | F/I |

Distal Tibia

Six distal tibia specimens were measured and analyzed with the discriminant function method. Measurements followed Speth (1983:189), recording the greatest breadth (*H*) and greatest breadth of lateral and medial articular grooves (*J*). Equation 10.1 was used to analyze the two measurements. The equation took the form of:

$$\text{Male} = 59.920 H + 107.668 J - 512.726$$

$$\text{Female} = 52.736 H + 95.910 J - 402.703$$

The results show the presence of two males and three females in the level 1 tibia assemblage and one female from level 2 (Table 6.2).

Table 6.2: Distal tibia discriminant function results.

| Art. # | Side | Measurements (<i>H</i>) (<i>J</i>) | | Eq. # | Male Eq. | Female Eq. | Diff. | Sex |
|-----------|------|--|------|----------|-------------|---------------|--------|-----|
| 134-4-17 | RH | 6.46 | 4.57 | 10.1 | 371.55 | 380.82 | -9.27 | F/I |
| 128-3-21 | LH | 6.61 | 4.71 | 10.1 | 390.28 | 397.46 | -7.18 | F/I |
| 117-3-31 | RH | 7.55 | 5.56 | 10.1 | 538.12 | 528.55 | 9.58 | M |
| 122-2-32 | RH | 6.14 | 4.71 | 10.1 | 362.57 | 373.08 | -10.51 | F/I |
| 156-3-26 | RH | 6.59 | 4.44 | 10.1 | 360.80 | 371.21 | -10.41 | F/I |
| 154-3-76 | RH | 7.28 | 5.29 | 10.1 | 492.28 | 487.89 | 4.39 | M |

6.5.3 Discussion of Bison Population Sex Structure

The separation of male and female bison into individual herds during certain parts of the year has allowed archaeologists to use bison population sex structures to identify the seasonality of a site. For most of the year it is known that bison live separately in female-based nursery herds and males in bull herds (Hanson 1984:102; McHugh 1958:14). One hypothesis proposes that the segregation of sexes for a part of the year is the result of differences in sexual dimorphism and digestive physiology and a subsequent preference for different forage or grass types between sexes (Mooring et al. 2005; Post et al. 2001). These studies suggest cows select less available higher quality grasses while bulls search for a more accessible lower quality food. During the fall rut bulls and cows gather together into much larger herds comprised of the various splinter groups. Seasonality studies have used the presence of both adult males and females as an indication that a site was likely inhabited during or near the time of the rut when both sexes would be in contact. If both male and female individuals are present in an assemblage, the time of occupation would be restricted to the rut during the late summer or early fall. An absence of adult males would suggest a hunt took place outside of this period. This separation into male and female herds during part of the year may not have been as well defined as archaeologists would like. Even if the sexes were divided into separate herds they were not likely far apart and it was possible the male herd may actually have followed the nursery herds (McHugh 1958:16).

In addition to differences in the numbers of male or female bison available to hunters at different times of the year, the presence of bison within specific areas may also fluctuate between seasons. Bison were thought to migrate from one environmental region to another during different seasons of the year. The basic premise was a movement onto

the open plains in the summer or the warm season and into the parkland or forested areas during the cold period (Epp 1988; Morgan 1980:158; Ray 1974:31-32). More recently the migration of bison is understood as a more varied movement. Historical documents refer to some bison remaining on the open plains during the winter months (Malainey and Sherriiff 1996). Bison movement would be less of a mass migration of entire herds and more of a movement of small groups of the bison population with some bison remaining in the parkland areas in summer and the prairies in winter. There was still thought to be a general movement of bison from area to area from season to season. This movement was said to be more regular before the appearance of Europeans and became “much more erratic” after the appearance of European hunters and settlers (Allen 1876:61). This is not to say that bison migrated completely into the forested areas during the cold season but more likely took refuge in the grassland spaces of the parkland region with the treed/forested areas providing shelter.

The amount of migration would be greatly affected by climatic conditions, with changes in the environment altering the bison’s survivability in different regions. Areas may experience moderate to severe cold winter periods or similar variability in the warm season from year to year. For instance, a very cold winter may force more bison off the open prairies and towards shelter provided by the forested areas of the parkland. The forested areas may draw the bison in colder weather but it will also attract the bison hunters where treed areas would afford more shelter in winter and also provide needed fuel, in the form of trees (Hamilton et al. 2006). In contrast, an increased amount of snow would make forest travel more difficult for the bison and force them to remain on the prairies.

The effects of predation may also disrupt the movement or the composition of isolated bison herds (Fortin et al. 2009:2488-2489). Fortin et al. (2009) observed that increased predation from wolves would cause an increase in herd size. The amalgamation of smaller groups into large groups would be observed in open grassland areas where increased numbers of bison would provide more protection from predatory attacks. Predation may also affect the movement of bison where small herds will perceive more risk from predators and move away from open areas to the safer forested regions where smaller group size will offer better concealment from predators (Fortin et al. 2009:2489; Hernández and Laundré 2005). Cow and calf ratios do not change with changes in herd size, but there is no mention of a change in male versus female ratios (Fortin et al. 2009: 2488).

A mixture of sexing methods was used to distinguish between male and female bison within the Block E faunal assemblage. Bimodal distribution of various bone dimensions has been used to detect the presence of male and/or female bison in archaeological assemblages. The small sample selection from Block E restricts the validity of results from this method. In some instances there are only two available specimens for comparison. Occasionally this method of analysis compares archaeological remains to a modern collection of known-sex individuals. Results rely on a variation in size that is based on the sexual dimorphic properties found in bison. This analysis as well as past studies shows that a variation in size may also be the product of a difference in age of individuals, and therefore size, within the population. A linear pattern may then be the result of a succession of aged bison or growth states within the population. If a bison population is only of young individuals and old females, it is possible to have a bimodal

distribution that can be interpreted as indicating the presence of both male and female individuals.

For the most part, results from the bivariate plotting method versus the discriminant function method are comparable. The small sample size again restricts the validity of these conclusions. Results from measurements of the distal tibia are similar between the bivariate plotting method and discriminant function. Both the bimodal distribution and discriminant function display the same ratio of male to female individuals. The results are less certain when these methods are applied to the distal humerus. The bimodal distribution of the distal humerus produced a result suggesting the presence of two male and two female/immature individuals. In comparison, the discriminant function method indicates two females, one male and one individual that is close to indeterminate but is identified as female/immature. There is a marked difference in the absolute size between distal humeri specimens. This size difference is evident in the bivariate plotting that suggests the presence of male and female individuals. Male and female metric measurements of the distal humerus are similar to measurements of the modern comparative bison used in the Horner site analysis (Todd 1987). The overall size of bison from older archaeological sites might be somewhat larger than present day bison that are used for comparative studies, but they would not be as large as the *B. antiquus* specimens recovered at the Horner Site.

Some issues are evident when using the bivariate method, especially when different landmark measurements are used to identify the sex of one particular element. Morlan (1991) used various measurement combinations from one element to produce bivariate graphical representations. Results do produce similar bimodal distributions, as seen with the astragalus (Figures 6.1 and 6.2). Morlan (1991) does note that some carpals and tarsals

provide better results than others. The accessory carpal, unciform carpal, and internal cuneiform tarsal (Morlan 1991:221,223,225) do not provide good bimodal separation and were not used in this study. The lateral malleolus was considered to show a weak bimodal distribution that can be seen in the linear distribution in this study. As a result of the small sample, what is being displayed on the graph is likely the product of absolute size of the astragali elements. It is also possible the various measurement combinations may each produce different ratios of male to female individuals, as seen in the radial carpal bivariate analysis (Figures 6 and 7). Past studies indicate various measurements were used to identify the sex structure of the group. In some cases more than one landmark measurement combination was used to sex related elements within an assemblage. The combination that provided the best bimodal separation was then considered to be most valid. The results from other measurement combinations are not included in the results, or are any changes in sex ratios that may accompany the various measurements. The discriminant function method of sexing bison elements is more useful when analyzing small or individual samples, where comparisons of male and female measurement functions are made on one element. In contrast, the bivariate plotting method requires comparisons between quantities of related elements and registers the dimensional relationships within the collection.

Taking these problems into consideration, the various sexing methods do suggest a mixture of male and female bison were present in both occupation levels of the Block E faunal assemblage. If used as a seasonality indicator then the most likely time of year would be during or near the rut when both sexes are in contact. This would suggest a fall occupation of the site rather than a winter occupation as suggested by the dentition and

foetal analysis. However, as has been shown previously, adult male and female bison may appear together during any time of the year. It is also possible that male and female bison were not killed during one event but killed at different periods of time.

6.6 Seasonality from Other Sources

The presence of certain avian or mammal species can help establish the time of year a site was inhabited. Hibernation and migration schedules will limit the appearance of certain species to specific times of the year. A limited variety of species were identified in the Block E assemblage of the Lovstrom site. Unfortunately, many of the identified species can appear throughout the year.

Migratory waterfowl have been used to suggest site seasonality. Particular species have recognised migratory patterns that may limit the time of year they can be hunted or trapped. No avian specimens were recovered or identified in either level of the Block E assemblage. The absence of migratory waterfowl is not in and of itself evidence of the season of occupation. A lack of these remains can be the result of a number of reasons. The more fragile nature of avian elements and a decreased chance of survivability may keep them out of the archaeological record, although the recovery of equally fragile foetal material would suggest avian bones would have survived to be excavated. The abundance of bison may not have required the use of additional food resources such as ducks and geese, although, the acknowledged broad-spectrum resources that the Blackduck people were known to exploit may refute this hypothesis.

6.7 Summary

Examination of the Block E bison assemblage does provide information on seasonality and bison herd structures. Dentition analysis indicates the period of occupation

occurred in the fall or winter. Most of the dentition indicates an age grouping of x.6 years with some showing variation between x.6-x.9 age groupings and a subsequent occupation later in the year. The nature of the dental material can only give an overall time of occupation between the months of November and March with the majority of kills occurring in the earlier part of the winter. The age of the bison assemblage includes a range of ages from foetal to 9.6+ years and only the 1.6 year age group is not represented. The discussion of bison population sex structures may answer why there is the variation in tooth attrition rates. As previously discussed, a separation of bison herds into male and female herds and physiological differences between the sexes causes each herd to search for and consume different qualities and kinds of plants and grasses, where males consume more of the abrasive C₄ grasses and females consume more C₃ grasses (Mooring et al. 2005:917). A difference in the abrasiveness of C₃ and C₄ plants or grasses may contribute to the range of attrition rates found in the Block E bison assemblage. If male bison did have a preference for C₄ grasses, the increased wear from chewing the grittier C₄ plant could be the cause of a range of wear patterns in the Lovstrom dental assemblage. The analysis of carbon and oxygen stable isotopes of the Block E bison teeth could identify a difference in the diet between male and female bison, an analysis that is beyond the scope of the present study. The presence of foetal remains suggests occupation took place in the early part of the cold season from October to December.

Sex analysis using the bivariate and discriminant function methods indicate both male and female bison were present. Issues surrounding the use of the bivariate method call into question the identification of some individuals as male that may in fact be female. Although the fragmented nature of the bison assemblage makes the season of occupation

somewhat open-ended, the various analyses do limit the time of occupation to late fall and/or winter. Taking into account the proposed variations in dental rates of attrition, the range in seasons of occupation may be further reduced.

Chapter 7

Taphonomy of the Block E Assemblage at the Lovstrom Site

7.1 Introduction

Various factors can affect the composition of a faunal assemblage. These factors can be both natural and cultural in origin. Cultural factors include human behaviour that will influence what material is deposited into the archaeological assemblage or simply discarded (Binford 1978; Brain 1967; Lyman 1982, 1991). Butchering methods can affect the number and types of elements in a faunal assemblage; for example, the fracturing of bone after the removal of meat can alter the number of identifiable elements or landmarks (Brink 1997; Lyman 1992; Marshall and Pilgram 1993). Cultural forces are the main interest of the archaeologist. After deposition the assemblage can be further transformed through cultural and taphonomic forces. After deposition of material and desertion of the site various forces continue to modify the archaeological assemblage. A reoccupation of the site can change the original composition of the assemblage. Natural forces can also move, break or destroy the faunal material. Natural forces that move and displace artefacts are a prime concern in the study of the Lovstrom site. In order to examine the choices made by the original occupants of the site it is important to identify any forces that have distorted the assemblage over time (Lyman 1994a).

The portions of an animal deposited in an archaeological deposit are those portions a human occupant has chosen to transport to the site. High economic utility portions of an animal would be preferentially selected for transport, leaving behind low value material (Binford 1978). This practice would only apply to animals that were too large to be transported whole to an occupation site. The “schlepp effect” was introduced to justify the

presence of low economic value elements (Perkins and Daly 1968). The presence of low value lower limb bones is typically cited as a result of the schlepp effect. A possible reason being that heavy upper limbs would be easier to carry or grasp with the lower limb still attached. Again, this effect would only arise with a need to transport portions of large animals. What portions are selected is not limited to food value. Certain bones may also have been selected for a non-food purpose such as tool or adornment production. The presence or absence of different economic value body parts was used to establish the type of site, such as kill site, primary butchering site or campsite (Binford 1981, 1984; Speth 1983).

7.2 Defining Bone Portions

Incomplete portions of bone required researchers to develop methods to increase the portions of bone that can be counted in an assemblage. Incomplete bones necessitated the identification and recording of proximal and distal portions of bone. In some instances proximal and distal ends were fragmented. Magee (1997:149) identified problems limiting analysis to more complete portions of bone. The highly fragmented Block E assemblage demanded more bone portions to be defined. This study followed previous analyses that employed the use and identification of distinct anatomical features or landmarks (see Magee 1997; Playford 2001). Each element would have a list of recordable landmarks used to determine the minimum number of elements (MNE) (Morlan 1994). The most frequently appearing landmark determined the MNE for the associated element. The MNE values are then used to determine other skeletal numbers.

7.3 Skeletal Completeness and Part Frequencies

Similar to many sites the Block E faunal assemblage is highly fragmented. The degree of fragmentation is a valuable piece of information when comparisons are made to other sites. Determining the percent completeness of a faunal assemblage is made possible when landmarks are used to identify MNE. The results can then be compared and contrasted to other faunal assemblages. Morlan (1994:805) compared MNE and NISP values for a particular element to the total number of landmarks defined for the element using the formula:

$$\% \text{ CN} = \frac{(\text{PP})/(\text{NISP})}{\text{PD}} \times 100\%$$

% CN = Percent Completeness
PP = Total number of Portions Preserved
(sum of MNE values)
NISP = Number of Identified Specimens
PD = Number of Portions Defined

The percent completeness of the Block E assemblage was compared between the two occupation levels. Both occupation levels exhibit high levels of fragmentation. The distal elements of limb bones are the most complete in both levels. Level 1 has more complete carpal and tarsal elements. The appearance of complete distal portions of limb bones would suggest the presence of “riders” or the schlepping effect. These bones were possibly transported to the site but not utilized.

The contents of an archaeological faunal assemblage are not only a product of human behaviour but are also the result of natural forces acting on the site. These processes must be identified before any conclusions can be made about the cultural activities that formed the archaeological assemblage. Certain frequencies of elements are expected to appear when comparisons are made to other bones. The relative frequency of these

elements can be used to identify processes acting on a site. It is important to consider that cultural forces may not be the only force influencing site formation.

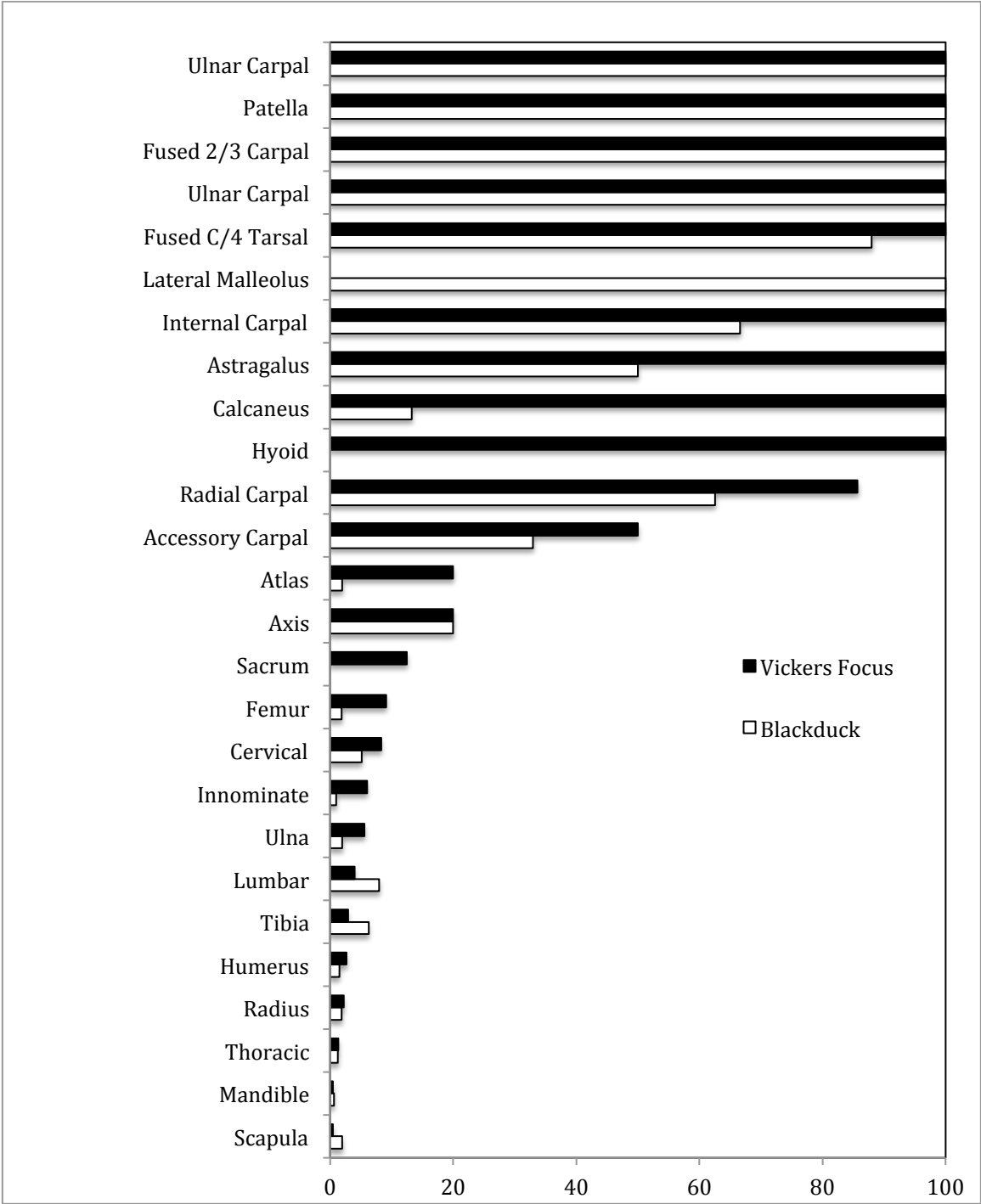
Differing bone densities can affect the survivability of various elements. This is most apparent when comparisons are made between taxa. The bones of large animals will survive more readily than the bones of small animals. The dense limb bones of the bison tend to outlast the delicate limb bones of avian species.

Recognizing that a complete animal carcass may not always be transported to the site in question, a new calculation was developed that separated an animal into smaller portions. Minimum animal units (MAU) are the result of dividing the MNE of an element type by the frequency of that element in the skeleton (Lyman 1994b:510). As stated previously, the fragmented nature of the Block E assemblage prohibited the use of complete proximal and distal ends as a unit of element counts. Landmarks were used to identify the presence of elements. Comparable to the use of complete ends of long bones, the presence of a fragment of a distal or proximal portion of a bone was considered to be a part of a whole portion that was subsequently broken prior to excavation and recovery. The complete bone is considered to be present but in a fragmented state. The Block E MAUs were based on this use of landmarks in determining MNE. A comparison of an elements frequency to the rest of the elements within the skeleton is listed as %MAU.

The %MAU was calculated for both occupation levels and is summarized in Table 7.1. The same elements represented the highest and the lowest %MAU in both occupation levels. The tibia represented the highest % MAU while the lowest %MAU was the rib head, in both levels. Some elements were not identified and have a %MAU of zero. The cervical vertebrae and metacarpal in level 1 and the hyoid, sacrum, 5th metacarpal and 5th

metatarsal have a %MAU of 0%. There are some visible differences in the frequencies of similar elements from each occupation level.

Table 7.1: Skeletal completeness graphical representation.



7.4 Utilities and Density

Archaeologists are most interested in the decisions made by hunters that affect what skeletal material is utilized and deposited in an archaeological site. The presence or absence of different portions of the skeleton in a faunal assemblage can help determine the site function. Different parts of an animal will have different amounts of meat and consequently have a distinctive economic value placed on each portion. The quantity of meat can affect which portions of an animal are transported and consumed and what portions are discarded. Determining this value may lie solely in the amount of meat found on a bone or the grease contained within. Binford (1978) expanded on the economic value of different portions of an animal to also include the amount of bone grease and marrow, creating the general utility index (GUI). Comparisons are then possible between high utility and low utility portions within an animal. The modified general utility index (MGUI) was developed out of the GUI in an effort to account for butchering practices (Binford 1978). The MGUI accounts for the likelihood that a single bone would not be separated from a carcass and transported, but a larger portion would be removed and transported. The larger portion, such as a limb bone, would include low value elements as well as the high utility portion.

Graphical representations of MGUI plotted against the %MAU of each skeletal element can generate two distinct utility curves useful in categorising site type (Binford 1978:77-81). A large quantity of high value skeletal parts compared to limited low economic value elements will produce a “gourmet utility curve”. A reversal in the amounts of these skeletal portions will create a “reverse utility curve”. These utility graphs may also determine what the associated site type was. Comparisons are usually made between

kill/butchering sites and habitation/occupation and the resulting utility curves. The former believed to contain low value elements and the latter having a higher frequency of high value elements (Lyman 1992:8). Binford's (1978) indices were developed from the examination of sheep and a caribou, but were considered suitable when applied to bison.

Subsequent utility indices used modern bison populations to examine the contents of archaeological assemblages. The Brink and Dawe (1989) utility index followed Binford's (1978) utility index with the introduction of bison as the comparative mammal. This method does not consider any meat or soft tissue and only the bone material from the carcass is used in estimating utility values. Comparisons were documented between wet and dry bone weight and the amount of marrow contained within the marrow cavity and epiphyses. Three bison of various ages and sexes were used to create a working comparative sample. This method allowed both grease and bone utility to be estimated. The grease index (GI) was a product of bone capacity and the amount of fatty acid contained in the proximal and distal portions of limb bones. The bone utility index (BUI) included the grease value and also bone marrow values in one index. The use of both the marrow cavity and epiphyses required that a bone be examined as three separate parts, the distal, proximal and shaft portions.

Indices developed by Emerson (1990) included not only bone values but also various meat and soft tissue weights, including: total meat and individual muscle weight, fat and other tissue weight, de-muscle bone weight, bone marrow and bone grease weight, and dry bone weight, as well as bone and marrow cavity volumes, and bone density (Emerson 1990:178). The sample included bison of both sexes and various ages. It was

then possible to examine assemblages made up of various combinations of sex and age, including: single, averaged and mixed class assemblages.

The Brink and Dawe and Emerson utility indices are used to assess the Block E bison assemblage. Following Magee (1997) and Playford (2001), the near absence of complete long bones or complete distal and proximal ends necessitated the use of %MAU from landmarks to measure the relative frequencies of elements.

7.4.1 The General Utility Index

Emerson's (1990) utility indices presented a way to evaluate bison groupings of various age and sex combinations. The absolute makeup of the Block E bison assemblage is difficult to identify given the highly fragmented nature of the remains. Only a limited number of identifiable specimens gave any clue to age and sex. Both male and female individuals were identified in both levels of the Block E assemblage. The absolute number of male and female individuals is unknown. The use of Emerson's standardized modified averaged data total products model index (S)MAVGTP is most practical with the presence of both sexes and immature bison (Emerson 1990). In addition, the Jackson (Playford 2001) and Sanderson (Magee 1997) sites used the same averaged utility index, permitting more precise inter-site comparisons.

Differences were visible between results of the Vickers Focus and Blackduck assemblages. The (S)MAVGTP values for the Vickers Focus (Occupation 1) level produced a very weak negative to non-statistical correlation (Spearman's Correlation Coefficient $\rho = -0.15$, $p > 0.05$ (n.s), $N = 24$) (Figure 7.1). Values for the Blackduck (Occupation 2) level produced a significant negative correlation (Spearman's Correlation Coefficient $\rho = -0.52$, $p < 0.05$, $N = 24$). The graphical representation of the Blackduck

index (Figure 7.2) indicates an inverse utility curve produced by an abundance of low economic value elements over those of higher economic value. The Brinks and Dawe (1989) BUI index produced similar but less conclusive results. The BUI values and %MAU for the Vickers Focus assemblage produced a very weak to non-significant positive result (Spearman's Correlation Coefficient $\rho=0.08$, $p>0.05$ (n.s), $N=18$) (Figure 7.3). Results from the Blackduck assemblage produced a weak negative result (Spearman's Correlation Coefficient $\rho=-0.36$, $p>0.05$ (n.s.), $N=18$). The graphical representation from Occupation 2 again shows an inverse utility curve (Figure 7.4). A number of element portions are missing from the Occupation 1 assemblage that almost certainly affects the results of this method.

7.4.2 Bone Marrow and Bone Grease Indices

The highly fragmented state of both occupation levels necessitated an evaluation of indices that indicate the importance of grease processing. Emerson's (1990) (S)MAVGGRE and Brink and Dawe's (1989) indices were used for this comparison. These methods differed in the amount of element portion used to identify the amount of grease production. Emerson simply divided long bones into proximal and distal halves with shaft portions included in the associated long bone half. Brink and Dawe did not include shaft portions and only counted proximal and distal articular ends. Different results between these two methods may result from the fragmented nature of the faunal assemblage and differential survivability and subsequent decrease in identification of various element portions. For instance, more robust shaft fragments will be identified more often than fragile proximal portions. Emerson's (S)MAVGGRE plotted against Occupation 1 %MAU produced a weak non-statistical positive correlation (Spearman's Correlation

Coefficient $\rho=0.32$, $p=(n.s.)$, $N=16$ (Figure 7.5). In comparison, the Brink and Dawe Grease Index (GI) produced a very weak non-statistical negative correlation (Spearman's Correlation Coefficient $\rho=-0.16$, $p=(n.s.)$, $N=12$). The results from Occupation 2 were more comparable between the two methods. The Emerson (S)MAVGGRE produced a negative correlation (Spearman's Correlation Coefficient $\rho=-0.42$, $p=0.05(0.052)$, $N=16$) (Figure 7.6). The Brink and Dawe GI method produced a significant negative correlation (Spearman's Correlation Coefficient $\rho=-0.68$, $p<0.05$, $N=12$). Graphical representations (Figures 7.8) suggest reverse utility curves are present using both methods for Occupation 2. The presence of certain specimens, such as the tibial anterior foramen prevents a characteristic reverse utility curve. The difference in results for the Occupation 1 assemblage would suggest some element portions were processed/fragmented to the point of non-identifiability or were deposited elsewhere.

A final utility index was used to assess the importance of marrow processing. Emerson's (1990) (S)MAVGMAR index used the marrow utility of proximal and distal ends of long bones. (S)MAVGMAR values ranked against the Occupation 1 assemblage produced a very weak non-statistical negative correlation (Spearman's Correlation Coefficient $\rho=-0.11$, $p=(n.s.)$, $N=16$) (Figure 7.9). Ranking against the Occupation 2 assemblage produced a significant negative correlation (Spearman's Correlation Coefficient $\rho=-0.46$, $p<0.05$, $N=16$). Graphical representation of the Occupation 2 assemblage shows a reverse utility curve suggesting an increased use of lower economic value elements versus higher economic valued elements (Figure 7.10). A lack of significant correlation between (S)MAVGMAR and Occupation 1 %MAU is also visible in the lack of a discernable curve (see Figure 7.2).

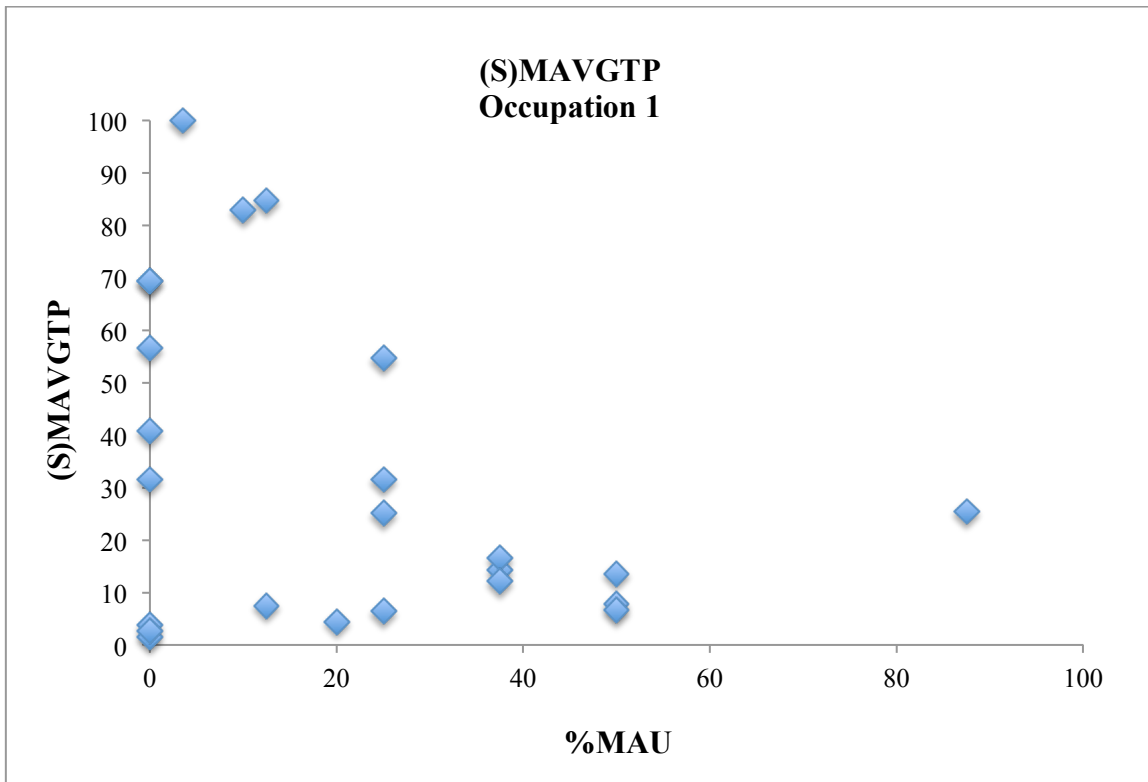


Figure 7.1: Occupation 1 (S)MAVGTP versus %MAU.

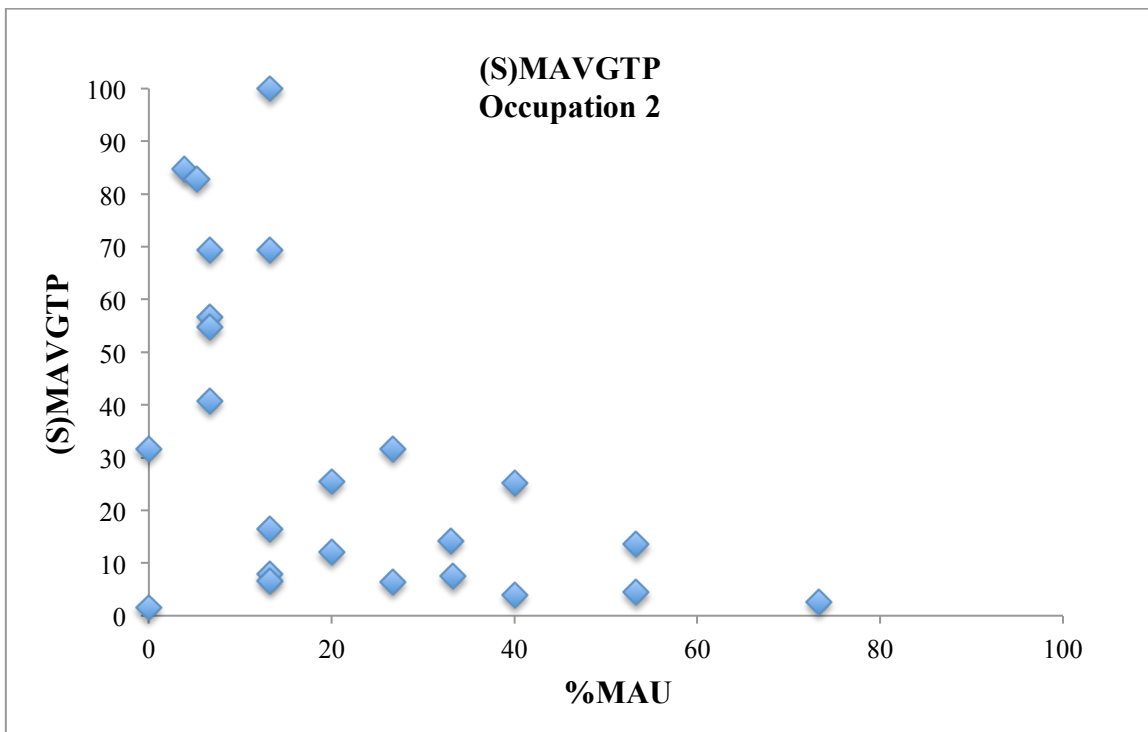


Figure 7.2: Occupation 2 (S)MAVGTP versus %MAU.

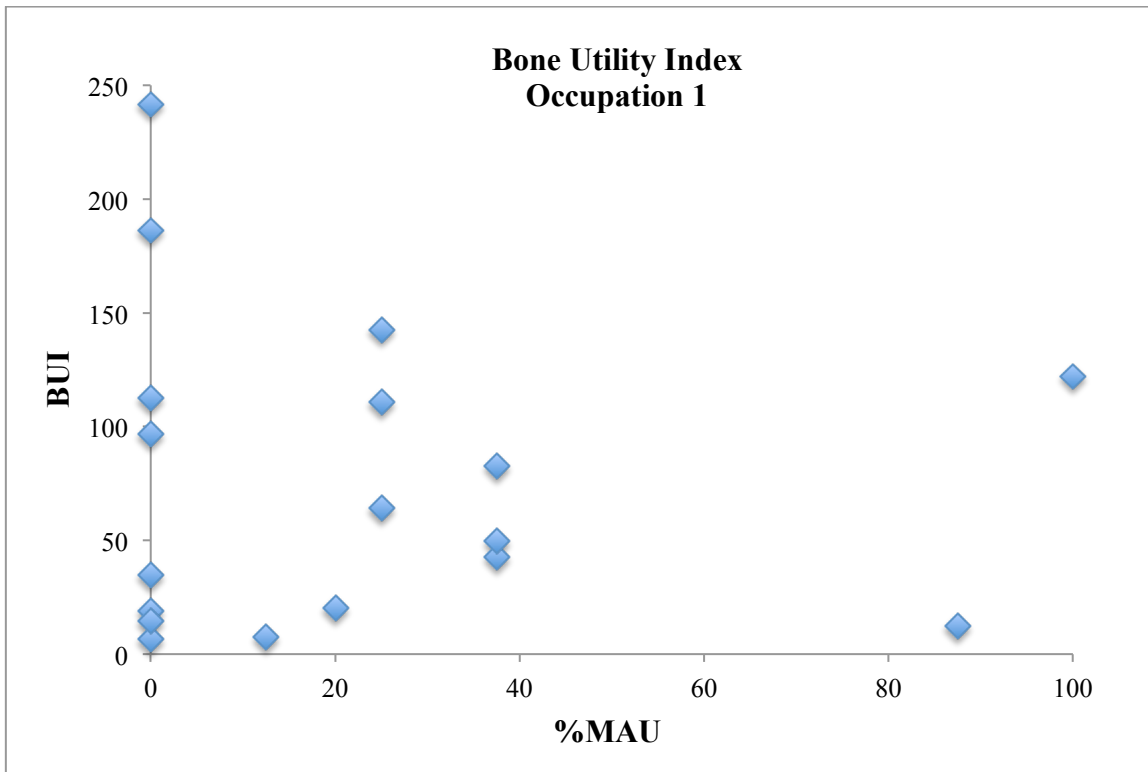


Figure 7.3: Occupation 1 Bone Utility Index versus %MAU.

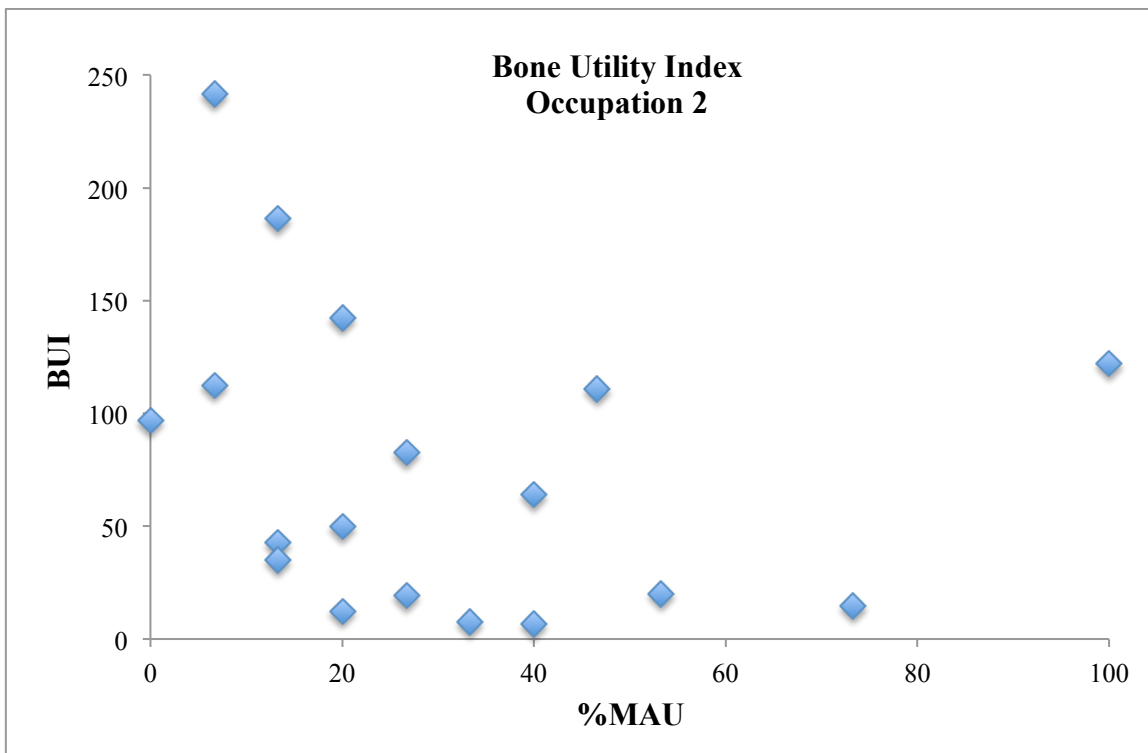


Figure 7.4: Occupation 2 Bone Utility Index versus %MAU.

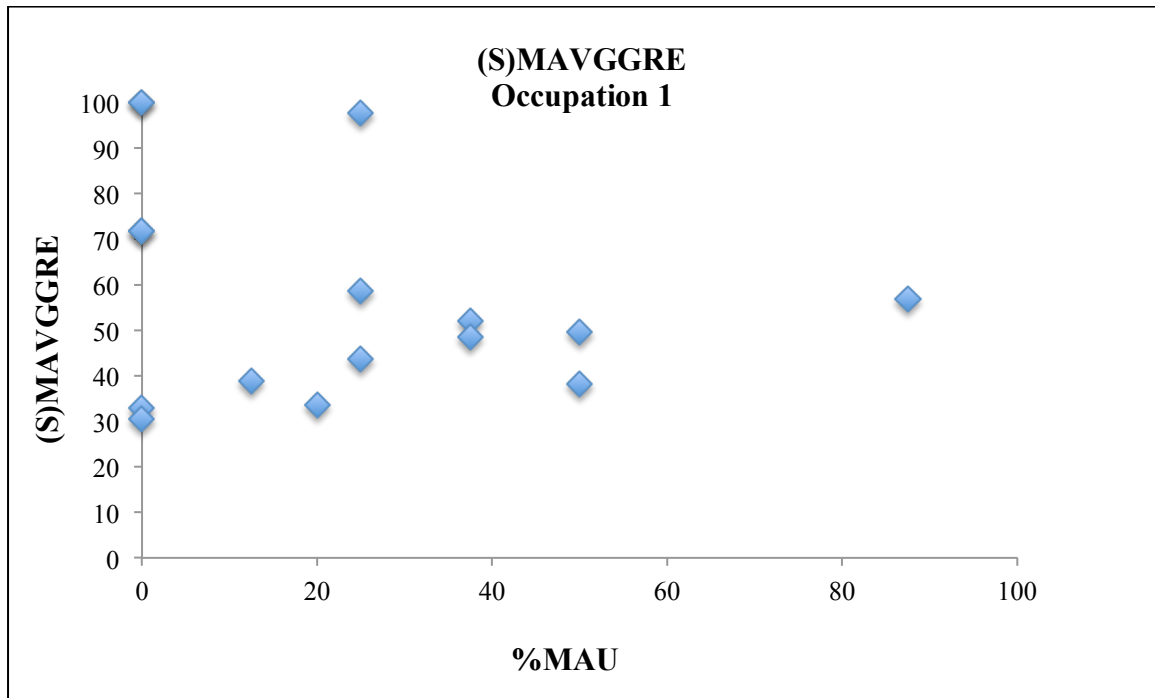


Figure 7.5: Occupation 1 (S)MAVGGRE versus %MAU.

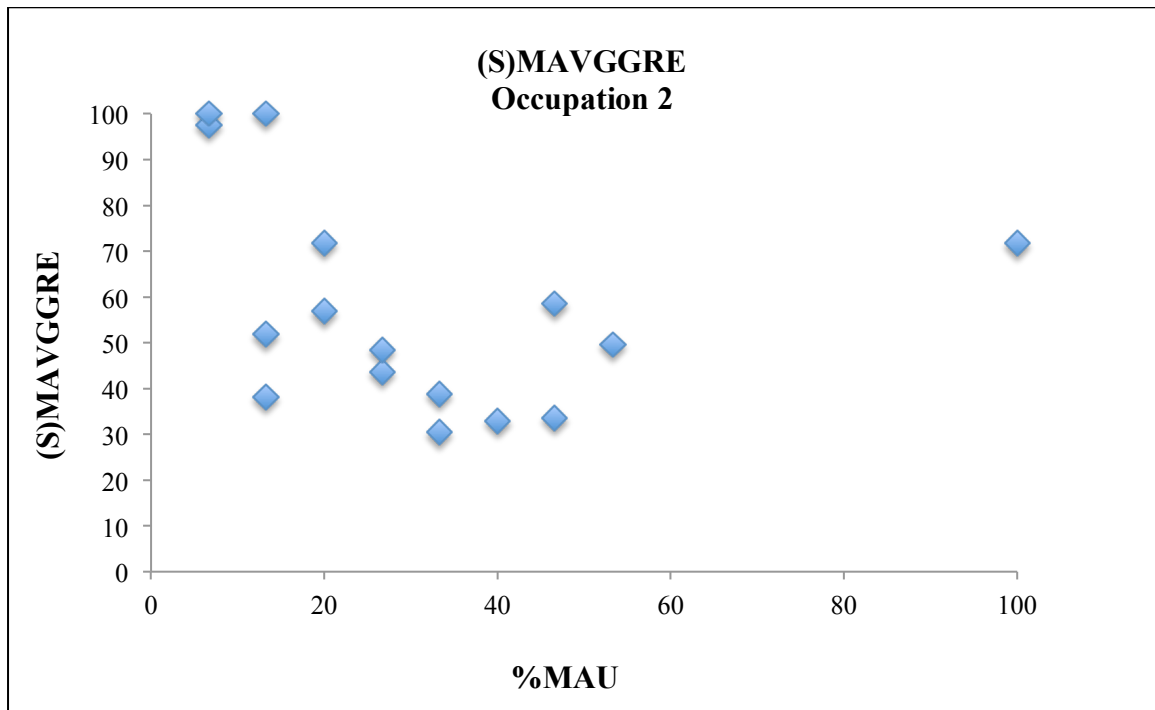


Figure 7.6: Occupation 2 (S)MAVGGRE versus %MAU.

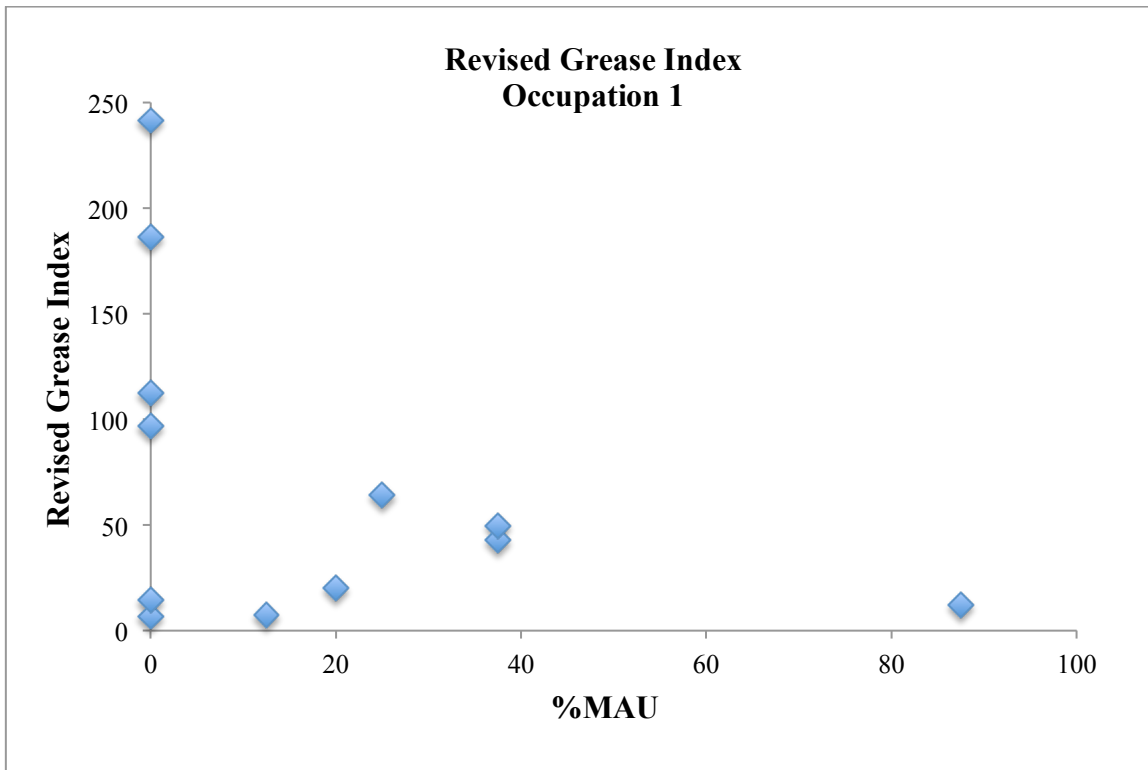


Figure 7.7: Occupation 1 Revised Grease Index versus %MAU.

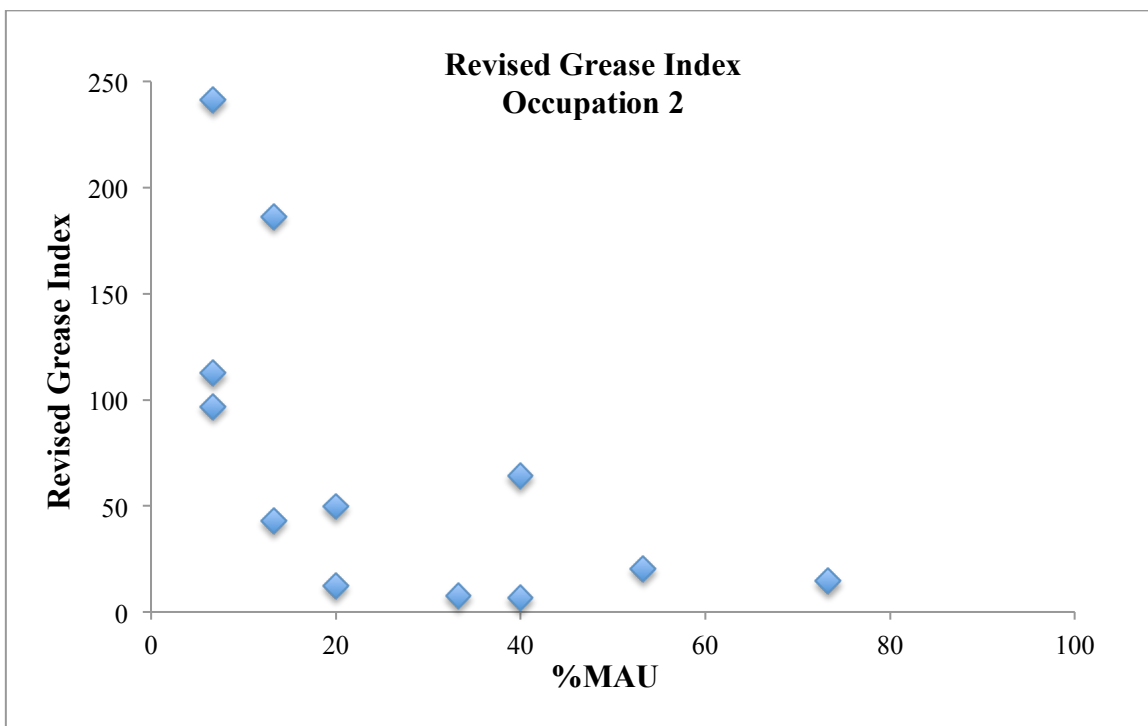


Figure 7.8: Occupation 2 Revised Grease Index versus %MAU.

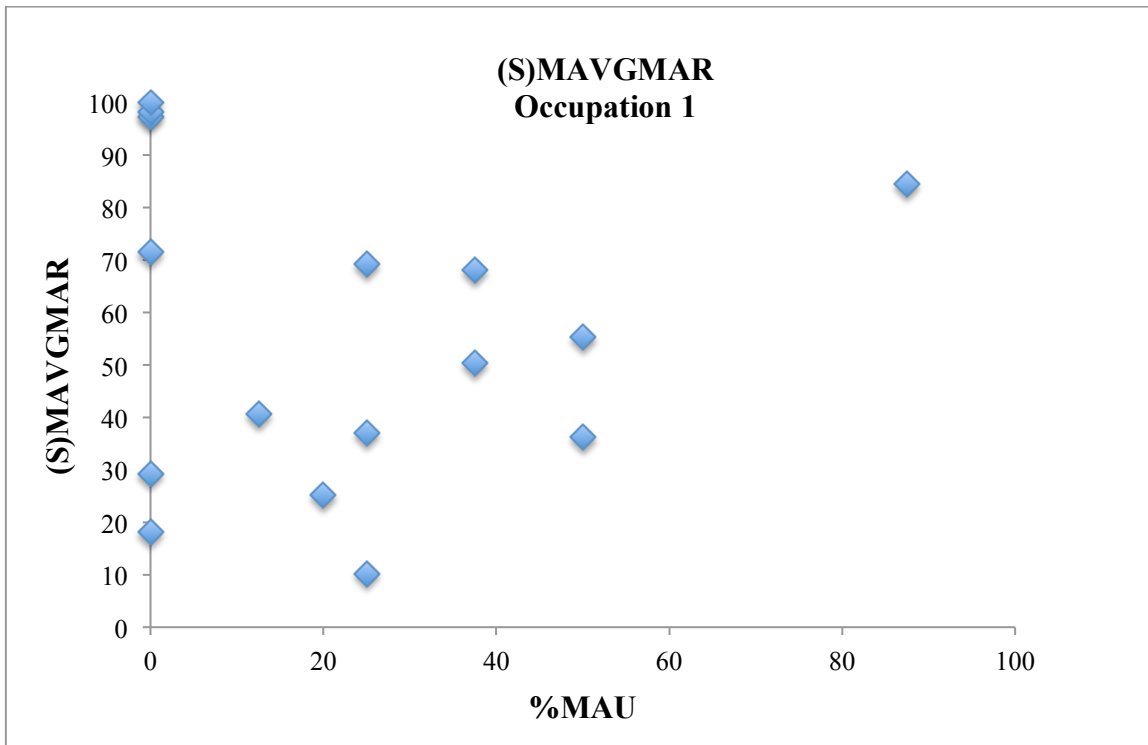


Figure 7.9: Occupation 1 (S)MAVGMAR versus %MAU.

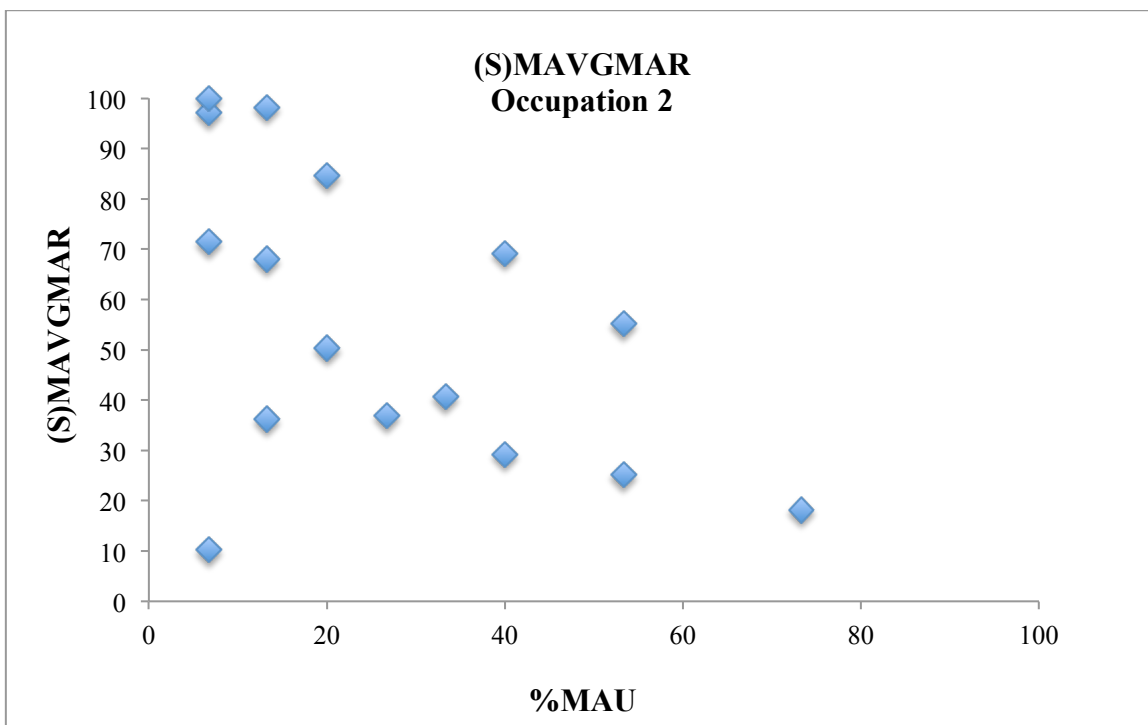


Figure 7.10: Occupation 2 (S)MAVGMAR versus %MAU.

7.5 Discussion of Bison Utility Indices

A similar pattern became apparent between the two occupation levels when associated %MAU was compared to the five different utility indices. The use of Emerson's (1990) (S)MAVGTP index and Brink and Dawe's (1989) Bone Utility index produced non-statistical correlations when applied to the Occupation 1 assemblage. Comparisons to the Occupation 2 assemblage produced negative correlations for both indices. The (S)MAVGTP produced a significant negative correlation while the BUI produced a weak statistical correlation. The application of the two grease indices produced a similar result of non-statistical correlations for Occupation 1 and negative correlations for Occupation 2. The final (S)MAVGMAR index again produced a weak non-statistical negative correlation for Occupation 1 and a significant negative correlation for Occupation 2.

Three of the results from Occupation 1 were weak non-statistical positive correlations. The BUI index produced a very weak ($\rho=0.08$) positive correlation while the (S)MAVGTP index produced a weak ($\rho=-0.15$) negative correlation. The grease utility indices produces similar contrasting results with the (S)MAVGGRE index producing a weak ($\rho=0.32$) positive correlation while the Grease index produced a weak ($\rho=-0.16$) negative correlation. Differences between the results could be a product of different methods and population samples used to create each index between the Emerson and Brink and Dawe indices. Examination of the graphs shows that the Occupation 1 sample has a number of missing element portions whereas Occupation 2 has few missing elements. The missing elements will have a significant effect on the results. The number of missing element portions could be a result of various factors. As seen previously with a visible decrease in percent completeness of elements from Occupation 1 versus Occupation 2, the

degree of fragmentation may be a cause of the lack of elements and element portions. Increased amounts of processing may have fragmented specimens to the point that they are unidentifiable. A number of the missing element portions from Occupation 1 are higher economic value portions of proximal long bone ends. These elements would be processed more extensively compared to distal portions. It is also possible these portions were deposited at a different location for additional processing or other unknown reasons. Elements such as epiphyses of metapodials are regularly utilized as bone tools and consequently may have been removed and used and deposited elsewhere.

The results from Occupation 2 are clearer with statistically negative correlations and visible reverse utility curves present from the results of all five indices. Lyman (1992) suggests this is indicative of skeletal elements being either fully utilized during processing or the assemblage is a product of a kill-butcher site. Low value elements were not identified in numbers that are typically left behind at a kill site. The grease and marrow index values are all statistically negatively correlated for the occupation 2 %MAU, suggesting extensive grease and marrow processing occurred in Block E. One noteworthy distinction was the presence of complete cervical vertebrae. These elements were not articulated and may represent an isolated example of transport and deposit of an intact neck and subsequent processing and discard of disarticulated/isolated elements. Otherwise the lack of vertebral elements, including thoracic and rib heads, would suggest this is not a kill site. Hamilton et al (1981:128) also found that complete or articulated bones were not limited to non-processing sites in all cases from the Blackduck assemblage at the Stott site.

7.6 Natural Taphonomic Agents and Processes

7.6.1 Weathering

Natural forces in the environment act to alter and break down the organic and inorganic material immediately after discard. The type and amount of weathering to which bones are exposed will vary the level of visible deterioration. Bone may be recovered in a varying state of preservation, from an unweathered to an almost disintegrated state. The degree of weathering may indicate what changes have occurred to the faunal assemblage over time. The analysis of stages of weathering of the Block E faunal material was entirely based on visual observation. The visual observations are recorded as material changes in bone from both physical and chemical processes (Behrensmeyer 1978). Degrees of weathering range from cracking and splitting of surface material to exfoliation and in severe cases disintegration and decomposition of bone (Fisher 1995:31). Common sense says more weathering will be evident the longer period of time a bone is left in the ground. In fact, the amount of weathering is not simply related to the length of time a bone was exposed to the surrounding environment. The rate and amount at which weathering occurs is greatly affected by the type of environment where a bone is deposited. Changes in the environment from season to season or within a season can expose faunal material to varying amounts of weathering forces. The extent of direct exposure to the sun and moisture and temperature will change the rate and amount of weathering exhibited on bone (Lyman and Fox 1989:313). The speed at which bone is covered over and shielded from more severe weathering forces will also affect rates of weathering. Faunal material can also be re-exposed to the surface environment through trampling and other bioturbational forces. The various types of bone will also have differential resistance to weathering

forces. Denser cortical bone will resist weathering forces more than thin cancellous or spongy bone. Different bone sizes from various animal species will have different capacity to resist the effects of weathering (Behrensmeyer 1978:152; Lyman 1994b:358). The degree of weathering will change the weight of effected specimens and will thus affect weight counts (Peres 2010:27). Elements less affected by weathering will be closer to the original discarded weight while bones more susceptible to weathering will have decreased weight values.

Another concern is the differential rates of weathering that can appear on bones within the same species or within an individual skeleton. Variation in the amount of weathering can occur between different elements or element types within a skeleton. Age is another factor affecting the amount and rate of weathering. An analysis of artiodactyl guanaco (*Lama guanicoe*) identified differential rates of weathering among age groups with the bones of newborn individuals showing more weathering than older individuals (González et al. 2012). Variation in rates of weathering is thought to be a result of differences in density between age groups and also between different elements within the body. Younger individuals will have correspondingly less dense bones. Because of the increased porosity of foetal bones and an increased susceptibility to the forces of weathering, foetal bones are likely to disintegrate more rapidly, especially if left on the surface. Consequently, it is believed that any surviving foetal bones will likely not exhibit signs of weathering (Madgwick and Mulville 2012:518). A surprising result of the González et al. (2012:532) study illustrates the differential survivability of teeth due to age of an individual. Cheek teeth of the newborn guanaco degraded relatively quickly compared to juvenile and adult individuals. Similar ungulate teeth structure found in bison

may degrade much faster in foetal or newborn bison and may not survive the burial environment. Therefore, certain elements that are considered relatively resistant to weather induced degradation may in fact disappear or be unidentifiable in the archaeological record. More importantly, element survivability and not cultural selection may have kept particular elements out of the archaeological record.

In addition to variation in the degree of weathering between animals, differences in rates of weathering among the various bones within a skeleton can exist. Madgwick and Mulville (2012:516) found that the biggest influence on the rate of weathering between the factors of site, element and environment was element type. Mandibles, long bones and premaxillae are more likely to exhibit weathering while small elements like carpals, tarsals and phalanges are frequently unaffected (Madgwick and Mulville 2012:518). This would suggest that stages of weathering could vary greatly among elements from one skeleton. A site with many lower limb bones may not show the rates of weathering compared to a site with increased amounts of skull, mandible or upper limb bones. Consequently, with exposure to more severe weathering forces, lower limb bones might be the only identifiable elements recovered from a site while other bones have deteriorated to a point that they are unidentifiable. Although there is no discussion of bone shape or bone size these are factors that probably also have an effect on amounts of weathering. A large irregularly shaped bone will require more debris for coverage from weathering forces than a flat or small piece of bone. A cervical vertebra may remain exposed to more severe weathering elements while a flat rib or long bone fragment is more easily covered. The rate of coverage will again depend on the type of vegetation, ground cover and also time of year deposition occurred.

Degree of bone density may be the primary factor limiting rates of weathering or bone deterioration, although, certain conditions can cause an opposite effect resulting in denser bone exhibiting increased rates of weathering compared to porous bone. A study by Conard et al (2008:244) found that large changes in temperature and the wetting and drying of bone and the surrounding matrix can cause denser bone to crack or break apart more readily than porous or less dense bone. It is believed that bone with increased porosity has a better ability to withstand changes in temperature and moisture content (Conard et al. 2008:237). Although temperature and humidity variations may not be as extreme as those found on the coast of South Africa where the study took place, considerable temperature fluctuations are still possible in the Lovstrom site region. During spring and fall temperatures can fluctuate from below freezing to warm or hot temperatures in the course of a single day. Although this study looked at skeletal elements with varying degrees of mineralization many of their (Conard et al. 2008:239) specimens have no mineralized bone material.

The survivability of certain elements is not only a result of resistance to weathering forces but the morphology of the element may also have an affect on survivability. In this instance the survivability refers to the survivability of identifiable specimens or elements. Distinct and thus more easily recognised elements will be identified more often than elements that are not as easily recognized. Similarly, more easily recognized landmarks would increase the quantities of the associated identifiable bone specimens.

Because of a possible appearance of differing rates of weathering resulting from variation in survivability and density or porosity of different bones types, identifiable elements from one element type are analysed as a group for rates of weathering.

Seven fused central and fourth tarsals (C+4) were recovered from level two. All specimens were identified as having weathering from stage 1 to 3. Many displayed differential weathering with one surface exhibiting stage 1 or very little weathering with increased weathering on the opposite surface. One specimen (186/113-5-1) had a chalky appearance with stage 3 weathering. Three of the C+4 specimens had evidence of carnivore gnawing and presented stage 3 weathering. It is possible that gnawing and digestive corrosion contributed to the increased appearance of weathering. Other than specimen 51/107-2-20 that showed stage 1, specimens in the upper occupation level exhibited more weathering at stage 2 and 3. Again this may be a product of the presence of gnawing on the remaining two specimens. There was no general trend of more weathering due to depth below surface. Certain elements such as the fused central fourth tarsal may show more weathering because of other taphonomic effects, such as gnawing.

Only four calcanei were recovered, three specimens from level 2 and one specimen from level 1. All epiphyses are fused on the three individuals. Two specimens from Level 2 show a stage 1 level of weathering on one side of the bone with stage 3 weathering on the caudal surfaces. Similarly, the specimen from Level 1 has differential stages 1 to 2 weathering. A calcaneus from the upper portion of level 2 again has a chalky texture exhibiting stage 3 weathering over almost the entire element. Similar to the C+4 tarsal specimens the increased weathering may be a result of gnawing.

Four distal humeri specimens exhibited varying stages of weathering. Two specimens from level 1 had differential weathering from stage one to stage two. This was likely again from deposition with one surface exposed to the sun and the elements while the other surface was buried. Specimen 368/152-2-38 from Level 1 is more fully stage two.

One specimen from level 2 is at stage three. This specimen has considerable root etching that may have contributed to the increased amount of weathering. The other distal humerus from level 2 is at a stage 1-2 weathering.

A problem in comparing the stage of weathering between the two occupation levels is a lack of comparative samples. The previous samples are relatively small to make a good comparison. Because carpals and the smaller tarsals are all dense bones and similar in size these elements were grouped together with comparisons made between occupation levels. One problem using these smaller elements is the chance of vertical movement due to other bioturbation forces and differing rates of weathering may be the result of vertical movement of the element. This is further discussed in the following sections. The weathering stages of these elements are similar with most showing stage three weathering. Nineteen specimens from level 1 and 16 specimens from level 2 were analyzed. Both occupation levels exhibited a similar ratio of stages of weathering. Level 1 had four specimens exhibiting stage one weathering while level 2 had three specimens at stage one. Similar quantities of elements presented stage two weathering, four from level 1 and three from level 2. The same number of specimens (n=11) from each occupation level exhibited stage three weathering. As mentioned previously, the density of these element types may have restricted the amount of weathering compared to other bones in each occupation level.

A total of 48 first and second phalanges were available for an analysis of stages of weathering. Approximately twice as many specimens were recovered from Level 2 (n=33) as were recovered from level 1 (n=15). Although there was some variation in stage of weathering per occupation level there was a pattern of increased weathering on specimens from level 2. Phalanges from Level 1 exhibited less weathering with a majority showing

stage one and portions of seven phalanges showing stage two weathering characteristics. Only one specimen from level 1 showed large amounts of bleaching from sun exposure. The phalanges exhibiting stage two weathering were either broken or gnawed. The increased weathering may be due to the removal of the dense outer layer of bone. Bone showing signs of gnawing may also suffer from exposure to digestive juices that initially degraded the cortical bone. The majority of level 2 phalanges exhibited signs of stage two or three weathering with two specimens showing stage 4 weathering on a portion of the element. Again, the density of these element types may have restricted the amount of weathering that is visible on other elements.

7.6.1.1 Weathering Summary

Overall, there is a general increase in stage of weathering in the Level 2 occupation compared to Level 1. Variation in the amount of weathering exists among different element types and between the varying degrees of fragmentation. This is likely a result of differences in bone density and in the case of fragmented bones the resulting breakdown of the dense exterior cortical bone. Varying amounts of weathering may also be a product of rate of coverage after discard and re-exposure through taphonomic forces. Shade from trees and cover provided by fallen leaves would lessen exposure to weathering forces. The minimal amount of bone bleaching would suggest the bones were not exposed to direct sun for an extended period of time. Taphonomic forces including tree falls, trampling and rodent disturbance could alter the normal rate of weathering pattern visible on undisturbed bone. When comparisons are made to similar element types the amount of weathering is usually associated with the presence of other taphonomic forces, such as gnawing. Larger bones in Level 2 may display more weathering simply by virtue of their size and shape.

The larger and more complete elements, such as cervical vertebrae, exhibit characteristics closer to stage four weathering while a few exhibit stage two and three weathering. It is impossible to say if this difference is a result of the size and/or shape of these elements. Comparisons between the smaller carpal, tarsal and phalange elements show minimal differences in amounts of weathering. The recovery of relatively fragile foetal bones indicate that weathering forces were not severe enough to degrade or destroy the foetal material. Again, the amount of coverage or shelter from weathering forces during the depositional period would have a lot to do with survivability of these specimens.

7.6.2 Carnivore Damage and Disturbance

Gnawing by carnivores can result in an incomplete fracturing of bone that is easily broken by other forces (Haynes 1983:105). Spiral fractures may appear but are usually accompanied by teeth marks (Haynes 1983:105). After occupation by humans, wolves may move in and create a homestead where quantities of bison bone are the centre of attention (Haynes 1983:105). The presence of carnivores is exhibited through damage inflicted on bone by such as chewed ends of bone, cuts and grooves (Sutcliffe 1970). Binford (1981:36) identified four types of carnivore damage produced by Anaktuvuk dogs in Alaska. *Pits* can form when carnivores bite down on bone. Depending on the biting force and the density of the bone, carnivore teeth may break through the outer layer of bone producing *punctures*. *Scarring* can occur when teeth are drawn across bone. Two terms were used to identify the scarring that appeared on dense versus porous bone. The dragging of teeth over cancellous or softer bone produces *furrows*. *Scoring* refers to scarring marks on cortical or denser bone. These marks are distinguishable from cut marks because they follow the contour of the bone whereas the force and nature of cutting will most often form

incisions in a straight line regardless of bone morphology. Binford (1981:51) identifies two more types of bone modifications representative of carnivore damage. Similar to the removal of flakes from lithic material, chewing on broken edges of bone can remove bone chips, producing both bone chips and flake scars. Chewing on the transverse end of bone will produce channelling that extends along the longitudinal axis of the bone. Fisher (1995:36) also lists additional damage made by carnivores including ragged, chipped and sinuous edges, striations, and conchoidal flake scars and bone flakes (Fisher 1995:36).

Lyman (1994b:325) suggests that carnivores approach consuming bone in two ways. Carnivores will chew on the epiphyses that can weaken the structure of the shaft section and also expose the marrow cavity. The second method includes chewing of the entire bone, including diaphyses and shaft portion. Haynes (1983:105) suggests that once the epiphyses is consumed the shaft or diaphysis will usually be abandoned, leaving only visible carnivore damage on the ends of the bone while shaft fragments will not show signs of tooth perforations or gnawing. A variety of carnivores that were contemporary inhabitants around the Lovstrom site could have caused different amounts and types of damage. The appearance of carnivore damage is most often considered to be a product of larger carnivores, most often canids. Although there are a number of smaller-sized carnivores present in the area of the Lovstrom site the size of the carnivore marks are most consistent with coyotes, wolves or dogs. In addition to carnivores, small rodents can also leave chewing or gnaw marks on bone. Small parallel scars on a number of bones were attributed to the gnawing of small rodents.

Human modification and carnivore damage create similar effects on bone. Using hammer and anvil techniques to break apart bone during processing for grease and marrow

can create notching on bone similar to that made by carnivores. The two distinct dynamic and static loading forces will form slightly different notch shapes. This is similar to lithic studies where percussion (dynamic) and pressure (static) flaking will produce different characteristics on a flake or core. Capaldo and Blumenschine (1994:732-733) used size and shape measurements to isolate human and carnivore made notches. Metric differences were identified in the morphology of notches created by gnawing and human processing. The time requirement for first identifying and then measuring notches precluded the use of this analysis on the block E faunal assemblage. The appearance of spiral cracks created by the gnawing of wolves or other large carnivores can be interpreted as incomplete fracturing (Haynes 1983:105). If exposed to other taphonomic forces bones may break apart at these cracks forming spiral fractures. Spiral fractures are thus not a good indicator of human modification.

Another taphonomic effect referred to above is the horizontal dispersion of bones that can occur due to the actions of carnivores (Kent 1981:370). Faunal material can be disturbed and scattered in one location or may also be transported from one location to another. This horizontal scattering can be in combination with other taphonomic forces, such as trampling and rodent burrowing. As stated previously, the force of trampling may have removed evidence of carnivore damage but the possible resulting horizontal dispersion will be in consort with the actions of carnivores.

Differences were identified between the damage created by dogs versus wolves. Binford (1981) believed that while wolves focus on the consumption of meat, domesticated dogs would gnaw bone out of boredom. Wolves were found to create more furrowing, puncture marks and crenulated edges while dogs produced a higher percentage of pitting

and scoring (Binford 1981:49). The various types of carnivore damage were identified in both occupation levels of Block E. The small sample size limits any consideration of the carnivore damage to either wild or domesticated canid species.

Carnivore modification was evident on bone from both occupation levels (Figures 7.11-7.14). A similar quantity of bones exhibited a variety of carnivore modification from both levels. The majority of carnivore damage evident on 61 specimens from Level 1 was gnawing on edges of bone or broken portions of bone fragments. While skull fragments were scarce in Level 1 there was only one fragment that showed signs of gnawing. One vertebra fragment has pits and broken edges. One thoracic spine has gnawing marks along the cranial and caudal edges. A total of ten rib bodies show pits, punctures and gnawing on broken ends. Several of these specimens were recovered from connected excavation levels and units and may represent one rib. One mandible fragment has pits and broken edges. Discrete pubis and ilium fragments show signs of pits and scarring. Two scapulae and one humerus fragment have similar pitting and scarring. A number of carpals and tarsals exhibit varying amounts of pits, gnawing and scarring to the point of furrowing where cortical bone is missing. Two radial carpal, three central carpals, one fourth carpal, one calcaneus and one second and third fused tarsal show signs of pitting, punctures and scarring. All of these specimens are relatively intact with only a few edges or corners broken away. Weathering and damage during excavation may have destroyed more evidence of carnivore damage. One patella shows pitting and scarring as well as furrowing on portions where the outer cortical bone has been removed. A proximal metacarpal epiphyses and fragment of metacarpal shaft exhibit signs of pitting, scarring and flaked edges. Two distal metapodial epiphyses are similarly pitted and scarred with furrowing

appearing on the inner cancellous bone. Remaining specimens with carnivore modification were unidentifiable bone fragments.

Visible signs of gnawing, pitting and punctures were again visible on 56 specimens from Level 2. A thoracic spinous process fragment shows signs of scarring and pitting along the cranial and caudal borders. Fourteen rib body fragments exhibited pitting, puncturing and scarring. One body fragment had two prominent tooth punctures. Similar to ribs from Level 1, a number of rib fragments were recovered within the same excavation level and unit and may represent one rib. Four mandible fragments showed signs of pitting and flaked or crenulated edges. Two scapula fragments and a distal radius show pitting and chipping on broken edges. One radial carpal and four ulnar carpals show signs of scarring and pitting. Two ulnar carpals show signs of heavy carnivore modification with furrowing emerging due to removal of cortical bone. A single calcaneus has pitting and punctures over most of the element. Four proximal metacarpal epiphyses have rounded edges with some furrowing and scarring. One distal metacarpal and one distal metatarsal epiphysis show signs of gnawing with furrowing on the condyles and scarring and flaking along the broken shaft portion. Three fused central and fourth tarsals exhibit punctures and rounding of edges. Two of the C+4 tarsals show excessive gnawing with pitting and punctures over much of the bone as well as furrowing (Figure 7.11). These elements also show signs of digestive corrosion. Five first phalanges show signs of scarring and furrowing. Four of the 1st phalanges are broken revealing the inner marrow cavity. One distal portion has gnawing on the broken edge, creating a serrated look. Three remaining phalanges, two that are distal portions and one missing the anterior portion, are highly modified and show signs of digestive corrosion with part of the cortical bone missing. The three phalanges show

pitting, punctures and furrowing. A single sesamoid bone shows signs of pitting and extensive deterioration from digestive corrosion. Seven long bone fragments from Level 2 showing signs of pitting and scarring. Small scars on some of the specimens likely represent gnawing by rodents. Two of the long bone fragments are foetal bones that show signs of pitting and furrowing. Increased amounts of weathering and other taphonomic forces in Level 2 have likely destroyed additional evidence of carnivore damage. The remaining specimens showing carnivore modification were unidentifiable bone fragments.

A total of 117 specimens or 0.33% of the total assemblage from Block E showed evidence of carnivore modifications. This is a relatively low percentage of the total number of bone but is somewhat higher than the percentage (0.04%) of carnivore modified bones from the Jackson Site (Playford 2001:117). Similar patterns of carnivore damage are seen in both occupation levels. Other taphonomic forces may have removed more signs of carnivore modification. Weathering has affected bone in both levels with increased amounts of weathering in the lower Level 2. These taphonomic forces can act in unison to increase destruction of bone. Trampling may also have removed some characteristic carnivore gnawing marks. Bone previously broken during processing for marrow extraction will have fewer carnivore marks than whole or complete bones (Blumenschine 1988:490). It can also take considerable time for visible signs of carnivore damage to appear from the gnawing of bone (Lyman 1994a:277-278).

Although a similar number of specimens exhibit carnivore attrition marks, bones from Level 1 exhibit a slightly higher percentage. This may be a result of less weathering on bones and a subsequent higher recognition rate of gnawing attributes. In both levels the small dense carpals, tarsal and phalanges make up 30% and 25% of the total carnivore

modified bones from Level 1 and Level 2, respectively. Many of these specimens from Level 2 have increased amounts of carnivore modification and signs of digestive corrosion compared to those from Level 1. The only broken phalanges are specimens that have damage from carnivore gnawing. This may suggest carnivores are responsible for the breakage of these bones and not humans. If these bones were being broken for removal of marrow or grease extraction, then an increased amount of phalanges would likely be broken, whereas most phalanges are complete. There is also the possibility that these bones were transported or left as carnivore scat from another location.

Another common method of identifying the extent of carnivore attrition is the comparison of relative frequencies of proximal and distal portions of various elements. Binford (1981:221) compared the frequencies of proximal and distal ends of particular long bones. Since canids prefer the porous and grease rich articular epiphyses of certain long bones a lack of these ends would suggest the assemblage had been 'ravaged' by carnivores. Previous studies have used the %MAU to ascertain the degree of carnivore attrition. The Jackson site (Playford 2001) and Sanderson site (Magee 1997) both produced a result of a 'ravaged assemblage' using various long bone elements. Both of these sites also show a limited amount of visible carnivore damage that is suggestive of a site not ravaged by carnivores. Magee (1997:186-187) suggests the reason for the disparate ratios of proximal and distal epiphyses is the butchery of frozen limbs. Bone density and morphology may also play a part in the lack of proximal epiphyses at these sites and the Block E Lovstrom assemblage. Both Magee (1997:188) and Playford (2001:118) use ratios of the tibial portions as an indicator of carnivore attrition. Various long bones have dense distal ends compared to the more porous proximal ends. The proximal end has a higher value of

grease and marrow and would be more valuable to a carnivore as a nutritional product whereas the distal end is denser and survives much more readily. The problem with using this for the determination of carnivore attrition rates is that proximal portions of bones are also more appealing to the human inhabitants. In comparison, these grease and marrow rich portions of bones are more highly processed than the denser distal ends. The denser bone and resulting greater survivability of the distal end will be recognizable and identified more readily than the highly fragmented proximal end. The scarcity of proximal long bone specimens from Block E produces a similar 'ravaged' assemblage.

The limited amount of visible carnivore damage and the high level of fragmentation would suggest that carnivores minimally transformed the site through density-mediated destruction. The possibility of horizontal dispersion of bone through carnivore interactions and other taphonomic forces may have indeed caused some disturbance or destruction of cultural features or cultural patterns in bone distributions. The horizontal movement of material may also include the introduction of faunal material from other locations. This is an unknown factor that must be considered.



Figure 7.11: C+4 tarsal exhibiting carnivore gnawing.



Figure 7.12: Elements exhibiting carnivore pitting and punctures.



Figure 7.13: Examples of carnivore puncturing.



Figure 7.14: Bison metatarsal exhibiting carnivore gnawing and crenulation.

7.6.3 Root Etching

Root etching is the result of chemical deterioration on bone from the excretion of humic acid from roots (Vercoutère et al. 2007:26). This process appears as thin sinuous lines, the remnants of roots or rootlets. Because roots cause these sinuous lines, the etching is in the form of a U-shape channel (Fisher 1995:43). Although root action may disturb the archaeological deposit and may indeed fracture bone, the small root size that produce etching is not in itself destructive but can increase the vulnerability of the surface of bone to other taphonomic forces (Fisher 1995:43). This effect may be partly responsible for different amounts of weathering on the Block E assemblage. Similar to the Sanderson site (Magee 1997:190) the amount of root etching increases in the lower occupation level, likely a result of the increased amount of time the faunal material was exposed to root action. Surface modification of bone caused by weathering may have subsequently destroyed evidence of root etching. Comparisons of similar element types show that root etching is most prevalent on specimens from Level 2 and usually increases in the lower portion of this occupation level. The effects of weathering may have destroyed much of the evidence of root action that may be more prevalent in the Block E bison assemblage than is recognizable. Root etching is not pervasive on bones from level 2 and would not seem to be the reason for the overall increased stage of weathering on the specimens from this level.

7.6.4 Rodent Disturbance

The most prevalent and visible natural taphonomic force acting on the Lovstrom site is the disturbance of the soil matrix by burrowing rodents. Many archaeological sites are affected by the burrowing activities of small rodents such as gophers. The Northern Pocket Gopher (*Thomomys talpoides*) is the likely rodent species impacting archaeological

deposits at the Lovstrom site (Nicholson 2011:327). The pocket gopher (*Geomyidae*) is very adept at excavation having massive skulls and large teeth and heavily muscled forelimbs (Grinnell 1923:140-141). Burrowing is most often accomplished through scratch digging with the forelimbs (Nicholson 2011:328). The dirt moved during burrowing is either relocated in nearby tunnels or pushed to the surface creating recognizable backfill mounds (Stein 2000:29-30). Abandoned tunnels filled by surface soil or material will form areas of different colour or textured materials that is easily recognized by the excavator. Refilled tunnels with similar colour and textured matrix would be more easily missed during excavation.

A previous study by Nicholson (2011) reports on the extensive effects of rodent burrowing on the entire Lovstrom site. The main concern of this study and all archaeologists is the vertical movement of artefacts and other cultural material that can possibly destroy stratigraphic integrity. Undermining of larger material and subsequent collapse of tunnels can also cause a downward movement of cultural material. The continual undermining and burrowing of material is likely to result in the gradual sinking of material to the depth limits of the burrowing (Johnson 1989:382). Although this may have occurred in small amounts in the Block E matrix the presence of two visible vertical layers of larger material, such as fire-cracked rock, manuports and large bones indicates there was not a large amount or extended amount of burrowing that caused a substantial downward movement of artefacts. However, as Nicholson (2011) says, even though the larger cultural material may be in its original position, smaller material may have been moved either upward or downward. Due to the size of burrowing tunnels created by the Northern Pocket Gopher, material would have to be no more than 6-7 cm in diameter to be moved through

the tunnels (Johnson 1989; Nicholson 2011:329). Bocek (1986:591) indicates that other investigations limit the size of material moved to 5 cm in diameter and perhaps no more than 2.5 cm. The analysis of lithic and ceramic material is not a focus of this study but the identification and analysis of bone tools and other small faunal material is a concern with the possible vertical movement of material into older or younger archaeological levels. Movement of material through the burrowing actions of rodents can also form features within the archaeological deposit that can be incorrectly identified as a product of or associated with cultural activities (Johnson 1989).

A small number of faunal specimens were refit from different vertical and horizontal positions. A horizontal separation may simply be a result of scattering during original discard. The vertical separation of refitable bone fragments would suggest a movement subsequent to the original deposition. It is possible material was displaced during subsequent cultural occupation activities. The best way to identify the amount of vertical dispersion would be a refit of all bone specimens, similar to a lithic debitage study. This was not possible due to time constraints. Though vertical movement was found through the refitting of bone specimens, it is impossible to say for sure which specimen was moved or if both were subject to vertical distribution. The refitted bone included a large bone fragment that was likely avoided by rodents during burrowing while the smaller fragment was moved to the current location. With the possible collapse of rodent burrows the downward movement of the larger specimen is also a possibility.

Although the above studies focused on the impact on stratigraphic integrity as a result of vertical movement of material, burrowing may also cause a horizontal movement of material. The amount of horizontal tunnels can affect the amount of horizontal

movement versus vertical movement of bone. The use of abandoned tunnels as backfill areas can redistribute material horizontally and in some cases redistributed material produces what looks like a creation from a “random walk” (Bocek 1986:591). The number of vertical tunnels formed versus horizontal tunnels can vary depending on the amount of ground cover that exists in a given site (Bocek 1986:591). More ground cover, such as vegetation and tree cover and also snow cover will limit the amount of vertical tunnels and subsequent backdirt mounds. This is thought to be the result of rodents guarding against airborne predators (Bocek 1986:591, citing Howard and Childs 1959). The increased horizontal tunnels will result in a decrease in vertical movement but an increase in horizontal movement of material and possible homogenization and dispersal of cultural behaviour patterns and cultural features. Block E being situated in the forested parkland region may have a decreased number of vertical tunnels and less vertical dispersion of material compared to as site in a grassland environment. The result of this may unfortunately be an increase in horizontal movement and soil homogenization of Block E cultural material.

The vertical movement of material and subsequent loss of stratigraphic integrity is limited within Block E. Visible and identifiable artefact layers remain in the excavation block. Even so, the horizontal movement and distribution of material is likely. The horizontal movement of material may leave the stratigraphic integrity intact but may have disturbed cultural patterning and features. The majority of descriptions or recording of rodent burrows is limited to wall profiles and floor plans. Although the vertical movement of cultural material has been studied and quantified at the Lovstrom site, the amount of

horizontal rodent burrowing and associated dispersion of material would be difficult to quantify with a lack of defined tunnels.

7.6.5 Abrasion and Polish

Abrasion and polish involve the removal of material from the edge or surface of bone. Abrasion can appear from the movement of bone by a physical force or by the movement of another material over the surface of bone (Behrensmeyer et al. 1989:100). If enough abrasion occurs a gloss or sheen will appear resulting in polish (Fisher 1995). The two actions may be thought of as varying degrees of bone erosion, where sufficient amounts of abrasion or erosion will form a polish. The type of bone and the medium that eroded the bone will influence the appearance and amount of abrasion and polish. Harder or denser bone will resist abrasion and form polish more readily than softer porous bone that will simply break away.

Abrasion and polish can appear at any time, beginning at the death and butchering of the animal, during deposition, or forming after the bone is buried. It is also possible that abrasive processes may appear during or after excavation of faunal material. Natural processes emerging after deposition can act to either move bone through abrasive mediums or move other material across the surfaces of bone. Fluvial action, or movement by water, can generate abrasion or polish through contact with coarse sediment such as silt, sand, gravel or stones. Aeolian action, or wind erosion, can abrade bones through the movement of faunal material or more likely the movement of abrasive sediment across the surface of bone. Abrasion and polish also appear through the small movements of soil and bone from the actions of freezing and thawing of the ground from season to season and movement due to tree falls (Fisher 1995:33-34). Abrasion and the rounding of edges may also be a

product of carnivore activities such as gnawing and chewing. Certain elements that have evidence of gnawing also show increased weathering versus non-gnawed specimens with less rounding of edges.

Trampling by large animals and even human traffic can result in the appearance of abrasion (Gifford-Gonzalez 1989). The presence of polish is much less pervasive than signs of abrasion in faunal assemblages. Certain natural forces can produce polish that in some cases can be interpreted as the product of tool use. Persistent licking of bone by carnivores can produce polish (Binford 1981). Along with signs of digestion, the digestion and the subsequent regurgitation or passing as fecal matter of bone may produce signs of polish (Brain 1967). Polish has also been shown to appear from wallowing by bears that have inhabited sites previously occupied by people (Vercoûtère et al. 2007:27). It is also a possibility that bison wallowing may create polish.

Cultural activities also introduce processes that generate abrasion or polish. The act of boiling bones, usually during grease extraction, can result in the rounding and smoothing of the edges of bone (Lyman 1994a). It is also possible that ends of bone may be worn when stirred in a pot, forming *pot polish* (White 1992). Processes may occur during or after the excavation and recovery of faunal material. Bones can be exposed to varying degrees of abrasive forces during collection and transport. Contact with bones or other hard material such as rocks or lithics can break or abrade softer bone. Methods of excavation may also produce signs of abrasion or other damage that are not recorded during recovery. In many instances bone material detached or broken during or after excavation will display underlying bone that differs in colour from the original surface material.

In addition to cut marks and other butchering effects, cultural activity is also visible in the intentional modification of bone causing abrasion or polish. Bones may be used as tools in a variety of ways such as scraping, cutting, or gouging during the processing of animals or in other activities. The resultant use-wear will produce abrasion and in some cases polish on the worked surface. This will be discussed further in the Bone Tool section.

The number of forces that generate abrasion is limited by the location and topography of the Lovstrom site. The amount of fluvial action would be limited in the upland area around the Lovstrom site. The amount of relief in the gently rolling landscape is not favourable for any amount of slope wash to appear (Nicholson 2011:326-327). The only evidence of fluvial action or slope wash was at the nearby Block D excavation block that is close to the edge of a ravine entering Jock's Creek. Aeolian forces could abrade and round the faunal material but it is unlikely that enough wind would travel through the tree cover to cause significant erosion, if the Lovstrom site vegetation was similar to the present day forest cover. Steep ravines are located to the northwest and the south of the site that would also trap any ground drift material (Nicholson 2011:326). The rolling topography and the small rise in land surrounding most of the site would help shield the location from excessive wind erosion. A removal of the tree cover due to fire or other means would expose this area to increased wind and erosion. Nicholson (2011:326) found no evidence of fine aeolian sorting near the surface of the site or any evidence of slope wash from water transport at the Block E excavation area.

Tree falls have also been listed as a cause of abrasion on faunal material. Larger trees are present in the Block E area but it is questionable if enough trees are/were present

to create the level of abrasion in the faunal assemblage. Pot polish is another possible cause of abrasion on some of the Block E specimens where the ends of bone fragments are rounded or abraded by the movement against the interior of a ceramic vessel. Much of the abrasion extends beyond the ends or terminus of the bone fragment, indicating another force was responsible. The miniscule amount of bones exhibiting polish may have been a result of carnivore licking. The presence of polish was limited to flat surfaces of bone and not the broken edges or ends of fragments. In some instances what has been identified as polish is probably non-weathered bone surface.

Another cause of abrasion is the movement of bone or surrounding soil due to trampling by large animals, usually large ungulates. Trampling is further discussed in the following Trampling section. The presence of *striations* is a good indicator trampling has affected a faunal assemblage (Fisher 1995:36). These fine lines found on the surface of bone are sometimes recorded as cut marks. Compared to cut marks, striations are actually more evenly scattered over a bone surface, finer than cut marks, and may appear on all sides of a bone (Olsen and Shipman 1988:550). Also, unlike cut marks the orientation of trampling striations will not exhibit any pattern and will be non-oriented. Because of the nature of the forces and the nature of the depositional matrix, striations will be located on more exposed flat or concave portions of bone (Behrensmeyer et al. 1986:770). Striations are visible on numerous specimens from the Block E faunal assemblage, suggesting trampling was at least one of the probable causes of abrasion. The effects of weathering may have obscured or obliterated the fine and irregular striations on much of the faunal material. It is questionable whether bones were exposed to trampling before, after or during the episodes of weathering. Compared to fresh or dry bone, weathered bone is more

subject to the affects of abrasion and will round and abrade bone more rapidly than non-weathered bone (Fernández-Jalvo and Andrews 2003:162). Many of the more weathered specimens do show more rounding or abrasion suggesting some were weathered before trampling.

The amount of abrasion or rounding will slow once the fragile weathered bone is removed and the denser underlying bone is exposed. Evidence of weathering is still visible even after considerable abrasion (Andrews 1995). This is not likely the case with the fine striations that are difficult to see even when the bone is in good condition. An experiment by Fernández-Jalvo and Andrews (2003) analyzed fluvial abrasion on bone. This experiment used quantities of water to identify variation in degrees of abrasion amongst different types of soil. Although somewhat different to the action of trampling, the effects of tumbling action between soil and bone is a useful comparison. Sandy soils were found to produce more abrasion compared to other soil types, except with weathered bone where clay and silty soils have a surprisingly strong capability for abrading and rounding (Fernández-Jalvo and Andrews 2003:162). Similarly, the silty loam found at the Lovstrom site should also abrade weathered bone. Compared to weathered bone, fresh bone was virtually unmodified. The authors do not comment on how the erosion of dry bone compared to erosion of weathered or fresh bone. The rounding of non-weathered bone edges from the Block E assemblage would suggest dry bone is also prone to increased erosion from silty soil.

The varying amount of abrasion on bone is difficult to quantify. Rounding and abrasion varies from just the broken tips to covering a majority of the broken edges of a bone. It is difficult to recognise if a small amount of rounding is the result of taphonomic

effects in the burial environment or was possibly produced during excavation and recovery or transport or use-wear. The softer edges of weathered bone will have an increased chance of rounding during excavation and transport. As mentioned previously, the removal of bone would expose underlying material of a different colour that would allow the identification of abrasion due to excavation methods. In the case of the Block E faunal assemblage, the amount of abrasion is very much related to the amount of weathering on bone. Although rounding and smoothing is more prevalent on weathered bone, evidence of abrasion is also visible on non-weathered bone, suggesting trampling did occur in both occupation levels of Block E.

7.6.6 Trampling and Wallowing

Trampling has previously been discussed as a force causing abrasion and modification of bone. This force is shown to affect the amount of weathering on bone and subsequently can affect the nature of the faunal assemblage. Because of other effects trampling can have on a faunal assemblage in addition to the erosional force that produce abrasion and polish, recognising the presence of trampling is important for a taphonomic study. This natural taphonomic force can be in competition with cultural taphonomic forces that also shape the archaeological assemblage.

Trampling can result in a movement and dispersal of faunal material. This can be both a vertical and horizontal movement of bone and other artefacts (Gifford-Gonzalez et al. 1985:808-810). A limited number of experiments have focused on the disturbances caused by trampling on an archaeological assemblage. Affects may include the movement of cultural material as well as the breakdown or modification of faunal material. Gifford-Gonzalez et al (1985:808) found that the movement of trampled bone was limited to

horizontal distribution in silty soil. Although Haynes (1983:109) does not specify horizontal movement, he says that the trampling by a herd of bison could move articulated bone many meters apart from the original deposition. Vertical movement of artefacts and bone was limited or restricted due to the nature of the silty loam (Gifford-Gonzalez et al 1985:808). However, they also identified noticeable vertical movement in sandy soil. A subsequent study by Nielsen (1991:484) found that vertical movement of artefacts in sandy soil was in fact limited. As suggested by Nielsen (1991:484) conflicting results between these and other trampling studies require additional experimentation and examination to rectify or explain these contradictory results. Accordingly, further studies are needed to identify how much vertical movement of artefacts may in fact occur in silty loam soil as found at the Lovstrom site. Nielsen's (1991:501) study also found that wet soil after a rain would limit the horizontal movement of artefacts. This study only analyzed trampling in sandy soil but it does raise questions as to how trampling would affect the dispersal and damage of faunal material during wet versus dry seasons. Although there are inconsistencies, the general trend does seem to show a limited amount of vertical movement of material and more horizontal scatter in silty soil. Although artefacts will be located in the same level or layer, any patterns of bone distributions that could identify cultural activities can be destroyed. Articulated elements, such as lower limb bones, may also be dispersed. Similarly, the disturbance and horizontal movement caused by trampling can also disturb cultural features, rendering them unidentifiable.

Trampling may also result in the breakage of bone that can mimic the cultural alteration of bone. Although processing may be a primary cause of the fragmentation of the assemblage, trampling may also break bones after deposition. Nielsen (1991) and Gifford-

Gonzalez et al (1995) studied the effects of trampling on bone, lithics and pottery. Unfortunately Gifford-Gonzalez et al (1995) did not report on the breakage patterns of bone. Results of the Nielsen (1991:493) study found that bone damage was limited to abrasion. It is important to note that these sites only employed human traffic as the source of trampling. The effects of chewing and gnawing can weaken bone making them more prone to breakage when trampled (Haynes 1983:105-106). Haynes (1983:110-111) did not see breakage due to trampling unless bones were first weakened by chewing. Breakage did occur in the more brittle weathered or degreased bones (Haynes 1983:111). The difference in weight and pressure exerted per area between a human and bison would suggest an increase in breakage due to bison or cattle trampling. Other studies experimenting with bison and cattle trampling focused on the effects of breakage patterns of lithic material. It is uncertain how trampling by bison would affect abrasion and breakage on bone in different soils. Gifford-Gonzalez et al (1995:813) do mention the increased amount of breakage of lithics and pottery in silty soil versus sandy soil, likely due to the compact resistance of the loam substrate. It is unknown how this would translate to bone breakage patterns due to bison trampling.

Wallowing of male bison can also cause breakage of bones (Haynes 1983). It is unclear how breakage would differ when bones are rolled on versus direct pressure from hooves. The increased pressure per area suggests trampling would be much more destructive than the dispersed pressure of an animals body.

A few refitted specimens displayed differential weathering. One specimen exhibiting little to no weathering was refit to another specimen showing a weathered appearance. Spatial separation of the refitable specimens suggests separation took place

during discard of the material or during trampling and/or other bioturbation events that separated them over time. The identification of what taphonomic force was responsible for the disturbance of material is difficult to ascertain, given a variety of taphonomic forces that could cause similar vertical or horizontal movements of cultural material.

7.7 Cultural Taphonomic Processes

7.7.1 Cut marks

Cut marks are the straight incised lines produced when a sharp edged tool comes in contact with softer material. Cut marks on the Block E faunal material refer to marks made by lithic tools on bone. These marks can appear during primary and secondary butchering of an animal, including removal of the hide, meat removal and cutting of connective tissue to facilitate disarticulation or sectioning of a carcass. Cut marks may also appear as a result of the breakage of bones to facilitate the removal of marrow and grease. Processing of an animal follows a general pattern of disarticulation and sectioning of an animal carcass. Binford (1981:46-47) identifies the location and orientation of three main types of cut marks that can appear during processing. The initial skinning of an animal may leave cut marks on the lower limbs and phalanges and the skull and parts of the mandible. Disarticulation will produce cut marks near articular surfaces of long bones, innominate and on the surface of vertebrae. Disarticulation may occur during primary butchering to ease the transport of carcass portions to a central campsite or processing area and during subsequent processing of carcass portions. Filleting of meat will leave cut marks parallel to the longitudinal axis of a bone. Frison (1970) provides a more in depth butchering analysis from the Glenrock Buffalo Jump site with similar patterns of cut marks appearing, as above. If comparisons are made to other faunal assemblages it is of interest to know how

butchering patterns may differ between large kill events and small or individual kill sites. A need to process large amounts of bison in a limited period of time may alter butchering patterns. Although Frison (1970:9) says that carcasses and flesh would not be wasted, the speed and technique required to butcher a large number of animals in a short period of time may necessitate the discard of some skeletal portions that would otherwise be processed during butchering of small numbers of animals or a single animal. It is also of interest to determine what portion(s) of the animal would be discarded when larger numbers of animals are killed in one episode. To produce a usable hide the skinning process would employ specific skinning techniques, resulting in similar cut marks appearing during different kill events. The carcass can be affected by various factors once the hide is removed. Transport decisions may alter how a carcass is portioned; either transported in more complete sections or further butchered into smaller sections. Primary or initial butchering may not be affected as much as secondary and subsequent butchering. The presence of large quantities of processed bison from a large kill area may also affect what parts of the animal are kept or transported and what material is discarded at the kill site or at a nearby butchering site.

As stated above, cut marks are the straight lines formed by a sharp tool. These marks can appear as one straight line or as a group of parallel lines. The appearance of parallel-incised lines is one of the identifying characteristics of cut marks. Gnawing by carnivores and other animals may create parallel grooves that can be mistaken for cut marks. Observing the shape or cross section of the groove is the general way of differentiating human made cut marks from those made by an animal gnawing or chewing on a bone. A cut mark made by a sharpened lithic tool will produce a V-shaped groove

while teeth dragged over a bone surface will produce a more rounded U-shaped groove. However, Greenfield (2006:161) found that not all lithic tools would produce the more angular V-shaped cross-section. The presence of an asymmetrical cross-section is another method to distinguish cut marks from naturally made incisions. One side or wall of the asymmetrical cut mark will be steeper while the opposite wall will descend more gradually (Greenfield 2006:161). Multiple fine striations running parallel along the cut mark are another trait used to identify cut marks produced with a lithic tool (Lyman 1994a:297). The type of lithic material used for butchering a carcass will have an effect on the shape of the groove, although the type of material being cut does not seem to effect the cut mark. Greenfield (2006:161) found that better quality material would produce sharper grooves. Obsidian made the thinnest or most v-shaped groove, followed by flint and then quartzite. The sharpness of the tool also affects the morphology of the cut mark. The dulling and rounding of working edges from tool use will produce a more rounded U-shaped mark similar to tooth scarring. The type of tool used to make a cut can also affect the shape of the groove. Greenfield (2006:161) found that side scrapers leave an irregular almost wave-like profile compared to the slicing cut marks made by flakes and blades. Cut mark characteristics may then be used to identify similarities or differences in tool usage and butchering techniques between different faunal assemblages. Unfortunately, Greenfield's (2006) cut mark groove analysis employed the use of a scanning electron microscope to observe groove shape and also cross sections of bone cuts. Even with the use of a hand lens or microscope, observations taken at a perpendicular or oblique angle to the cut marks of the Block E faunal material did not allow positive identification of most of the cut mark descriptors used by Greenfield (2006). The asymmetrical groove characteristic was visible

on many grooves identified as cut marks. Observations of cut marks with a hand lens also resulted in the recognition of V-shaped grooves and the accompanying parallel striations.

Various studies have analyzed cut marks in an effort to identify whether early humans killed and butchered animals or instead scavenged animals previously killed by carnivores. These studies examined cut marks in an attempt to differentiate between the activities of hunting or scavenging with varying results (see Domínguez-Rodrigo 2008). At issue is the variation in experimentation observed among researchers. Domínguez-Rodrigo is himself criticised for his analysis of this problem (Pobiner 2008). Although the question of humans hunting animals in the Late Pre-contact Period is not in question, the use of animals to assist in the process can be revealed by the placement of cut marks and tooth scarring. Overlapping marks created by human butchering and animal gnawing can establish which action occurred first. The first action will be overcut by any subsequent gnawing or cutting. Although there is a number of butchering marks and also carnivore modification marks on the Block E faunal assemblage there is no overlapping of either type of mark to indicate dogs or wolves assisted in the hunting and killing of bison.

The Block E assemblage contained a limited number of visible cut marks. A lack of cut marks could be a result of various factors. Increased density or hardness of bone may reduce the amount of visible incisions on bone and consequently would not be recognizable with the unaided eye. Due to time constraints a comprehensive examination using magnification to detect cut marks was not employed on the Block E faunal assemblage. Dull cutting edges or poor lithic material may also inhibit the occurrence of cut marks. Bunn and Kroll (1988) suggest that the experience of the butcher(s) can affect the number of visible cut marks produced. Although not discussed, cutting into bone would accelerate

the dulling of a lithic tool. An experienced butcher may not cut into bone as much as would a novice butcher. Experimentation with cut marks by Egeland (2003:48) revealed that intensity or number of tool strokes does not seem to have an effect on the frequency of cut marks. It is suggested the number or intensity of cut marks may not be as indicative of past butchering activities as placement and orientation of the marks.

Weathering may also have obliterated evidence of cut marks. As seen on bones from the Block E assemblage, an increased fibrous appearance of cortical bone may obscure cut marks. The type of analysis may also contribute to the lack of identified cut marks. Time constraints limited the identification of cut marks to the use of the naked eye under bright light. In instances of probable identification a hand lens was used to positively identify cut marks. The type of butchering may also limit the number of cut marks on bones due to a simple lack of cutting. Rather than cutting ligaments or connective tissue, bone may have been broken or crushed to disarticulate a limb or joint.

Bison

A number of cut marks were located on both identifiable and unidentifiable bone fragments. To recognise a difference in butchering techniques between the two occupation levels the analysis was limited to cut marks located on identifiable bone specimens.

Two right-hand premaxilla specimens (111-3-25 and 124-3-40) from Level 1 display cut marks on the lateral surface of the bone. Cut marks on both specimens are perpendicular to the longitudinal axis of the shaft, possibly a result of skinning the skull. Frison (1970:22) cites ethnographic literature referring to the removal of the nose as an edible delicacy. The presence of these cut marks may be a result of both skinning and removal of the nose. Magee (1997:194) identified cut marks on a single premaxilla from

the Sanderson site, but does not mention orientation or exact location of the cut mark. A single left-hand maxilla skull fragment (118-2-73) from the upper portion of Level 2 has similarly oriented cut marks near the premaxilla articulation as the premaxilla specimens, suggesting similar butchery patterns or nose removal. The cut marks may be the result of the same procedure used to produce the premaxilla cuts in Level 1. The cut marks are similarly inline with the longitudinal axis of the premaxilla bone. Similar cut marks were not identified or mentioned in the Stott site faunal assemblage. There is also a possibility that this small maxillae fragment may be an intrusion from the upper occupation level.

One occipital fragment (119-1-20) from Level 1 adjacent to the fusion point with the zygomatic bone has visible transverse cut marks near the articulation point with the left hand mandibular condyle (Figure 7.15). These cut marks are likely a result of the removal of the mandible from the skull. Mandibular specimens available for analysis did not exhibit any cut marks. No mandibles were recovered in whole condition and one specimen that was relatively complete but in a fragmented state did not show any visible signs of cut marks. The highly fragmented specimens exhibited effects of weathering and carnivore gnawing that may have destroyed any butchering marks. Magee (1997:194) describes cut marks across the mandibular condyles as the only evidence of cut marks on mandibles from the Mortlach occupation levels. Mandibles from the Blackduck occupation at the Stott site had cut marks on various parts of the lateral side and transverse cut marks at the midsection and mesial end on the lingual surface. There was no evidence of any of these types of cut marks on specimens from either Lovstrom occupation level. Effects of weathering and fragmentation again may have degraded any signs of cut marks. It is also possible that cutting during initial skinning of the animal may not have penetrated deep enough to leave

visible marks on the bone. It is also possible that breaking or crushing of associated bone was used to remove mandibles from the skull instead of cutting. Frison (1970:22) describes



Figure 7.15: Occipital fragment exhibiting cut marks.

the method of using a hammerstone to break off temporal condyles at the point of articulation with the mandible. This technique would destroy the zygomatic arch and usually break the coronoid process. The recovery of a small number of zygomatic fragments and numerous coronoid process and mandibular condyle fragments would support the occurrence of smashing or crushing to remove mandibles in both occupation levels. The discovery of one occipital fragment exhibiting cut marks may suggest both methods of cutting and breaking to remove mandibles were used in Level 1.

Thoracic vertebrae elements were scarce in either occupation level. Only two thoracic spinous processes exhibited cut marks, both from Level 2. Cuts were located on

both flat lateral sides of the spinous process and both groups of cut marks were oriented at 40-45 degrees from perpendicular to the longitudinal axis of the spine. The location of the cuts would not appear to be a result of skinning, since the cuts are quite a distance from the skin/hide surface. They likely involve removal of meat. These cuts are similar to cut marks on thoracic spinous processes from the Stott site (Hamilton et al. 1981:112) resulting from removal of associated muscle groups.

A number of rib body fragments had visible cut marks (example Figure 7.16). The majority of butchering marks on rib body fragments were located on the lateral or outer portion of the rib. A total of 17 ribs were found to have cut marks, seven from Level 1 and ten from Level 2. One rib from Level 2 shows signs of scraping which may be a result of damage during excavation (155-4-38). Some of the incisions are lighter in colour suggesting the cut was more recent, possibly produced during excavation. The majority of cut marks were located on the lateral or outer portion of the rib body. Again, a majority of these cuts were located on the crown or high part of the lateral curve. These cuts were all oriented from perpendicular to as much as a 45-degree angle to the longitudinal axis of the rib. The few rib heads recovered did not display any cut marks. Six rib fragments from Level 1 displayed cut marks parallel to the longitudinal axis of the rib on the medial side of the rib body. There is no mention of this type of cut mark on ribs from the Vickers Focus occupation at the Jackson site (Playford 2001). Although medial butchering marks are mentioned in the Blackduck occupation at the Stott site they are shown as transverse cuts to the longitudinal axis of the rib body (Hamilton et al. 1981:111). The medial cut marks on the Block E bones are most often close to either the superior or inferior border of the rib,



Figure 7.16: Rib fragment exhibiting cut marks.

possibly a result of filleting of the attached muscle mass. Hamilton et al. (1981:112) suggest the lateral cut marks are the result of removal of the latissimus dorsi and posterior deep pectoral muscles. One relatively complete rib body (40 cm in length) from Level 2 does not have any visible cut marks, suggesting either butchering did not cut into the bone or not all meat was cut off the rib cage. When the portion of rib is identifiable (e.g. distal or proximal end), the perpendicular cut marks appear at both the distal and proximal parts of the rib or the areas close to the sternum and vertebra. Cut marks on ribs from both occupation levels are similar to those found at the Stott site where cut marks were located on any portion of the rib with concentrations located towards the central portion of the rib body (Hamilton et al. 1981: Figure 27a, 111). The fragmented nature of the rib assemblage and limited number of specimens restricts any comparison of lateral or medial cut marks between the two occupation levels.

Two rib body fragments from Level 1 (artefacts 123-2-95 and 128-3-31), appear to have been broken along cut marks. Both right-hand rib fragments are from the proximal

portion of the rib adjacent to the rib head at the beginning of or terminus of the inferior costal groove. Each rib has a sharp and square (90 degree) break to the longitudinal axis of the rib body (Figure 7.17). Cut marks are visible at the broken edge on the medial surface and continue around to the cranial and caudal borders. These incisions in the bone may have been used to control the breakage pattern or fracture lines. The breakage and loss of the lateral portion of the rib makes it impossible to identify whether cut marks continued fully around the entire rib body. The broken lateral portion may suggest the bone was not cut on this side or the method of breakage broke off the cut mark. Whereas most of the rib cut marks travel only across a small portion of the rib surface, these cuts appear to travel from edge to edge and continue around to the adjoining surface. There is no mention of this type of rib removal or cut appearing in the Jackson site (Playford 2001) or the Stott site (Hamilton et al. 1981) faunal assemblage. It is possible these ribs were cut or incised to improve breakage and ease removal of the rib from the spinal column. It is questionable whether this type of cut could be achieved during primary butchering with the presence of surrounding muscle and other tissue and the proximity of adjacent ribs. These cuts might be a result of sectioning of the rib cage after each side was removed as a whole unit. It is also possible these cuts and breaks were made to create a finer edge, such as required during the fabrication of a bone tool. Hamilton et al (1981) suggest cut marks on posterior surfaces of the distal ends of metatarsals were used to control subsequent fracture lines during the manufacture of bone tools. The proximal portion of the bone would be used as the tool while the distal end was discarded. If these specimens were used as tools the working edge has been broken off. Spatulate tools made from rib bodies were identified in the Stott site bone tool assemblage (Hamilton et al. 1981:220). It is possible the rib body

opposite the break was used as a tool and was not discarded in the site. Specimen 123-2-95 has incised marks on the medial portion that run from parallel to diagonal and the surface is smoothed with a shiny surface. These rib specimens will be discussed further in the Bone Tool and Recreational Artefact Section.



Figure 7.17: Rib body exhibiting transverse cut mark (right side).

A number of cut marks were located near the epiphyses and articular ends of two metapodials, a metatarsal (134-3-11) and a metacarpal (156-3-23) from Level 1. Cut marks on both specimens are near the distal end and perpendicular to the long axis of the shaft. These are similar to cut marks found on metapodials from the Glenrock Buffalo Jump site (Frison 1970:10) and are considered to be cuts made during removal of the hide. Similar perpendicular cut marks are observed on the distal end of a metatarsal (126-3-20) and the proximal end of a metacarpal (119-2-83) from Level 2. The reason for the presence and identification of skinning cut marks on these four metapodials may be the presence of more complete portions of shaft. Most of the remaining metapodial specimens were broken at or near the epiphysis or articular end. The position of the cut mark on the proximal end of a metacarpal (119-2-93) might be a result of either skinning or removal of associated muscle or ligaments.

Cutting and chopping marks were identified at or on the distal articular condyles of metapodials. A distal portion of a metacarpal (125-3-36) from Level 2 has cut marks on the lateral surface of the lateral condyles that would suggest they are a result of disarticulation. One distal metapodial (135-3-32) from Level 1 and a distal metacarpal specimen (120-4-8) from Level 2 have hacking or chopping marks near the epiphysis of the bone. These marks may be the result of disarticulation using striking rather than cutting.

The appearance of cut marks on carpal and tarsal bones may also indicate that cutting was used to remove lower limb portions. Magee (1997:193) identified several cut marks on carpal bones from the Mortlach occupations. Although cut marks were observed on various tarsal bones from the Blackduck occupation at the Stott site (Hamilton et al 1981), cut marks were not observed on carpal bones. As well, cut marks were not observed on any of the small carpal bones from the Block E faunal assemblage. A single calcaneus (110-3-19) from Level 2 has cut marks near the cranial side of the tarsal articular facet. Frison (1970:11-12) suggested these are butchering marks made during removal of the “foot bones” or the distal portions of the fore and hind limbs. A lack of visible cut marks on carpal and tarsal specimens might be the result of degradation of bone due to weathering and carnivore attrition. Many bones show signs of weathering that may have removed or obscured any incision marks. A number of these bones also exhibit considerable carnivore gnawing and digestive corrosion. Similar to the metapodial specimens, it is also possible the lower limbs were not disarticulated with sharp lithic tools but removal of the lower limb was achieved by breaking the tibia or radius. Another possibility is the lower limbs may have been discarded as articulated unused waste.

Cut marks were not readily identifiable on the larger long bones or identifiable long bone fragments. Two tibia shaft fragments (134-3-30 and 157-3-13) from Level 1 display cut marks with one specimen showing transverse cut marks. The orientation of these cut marks on the shaft portion of the element may suggest they are either a result of skinning or removal of associated muscle or ligaments. Cut marks are visible on a radius shaft fragment (119-2-74) and are located near the post-lateral foramen. An ulnar specimen (135-2-28) including the olecranon process and semilunar notch had cut marks perpendicular to the semilunar notch. The orientation and position of the cuts would suggest they are a result of skinning the forelimb and removing associated muscle. The fragmented nature and limited quantities of these specimens restricts any detailed analysis of butchering patterns. A fragment identified as a portion of the ischial crest/border has cut marks perpendicular to the border and is likely a result of removal of associated muscle tissue.

Three long bone specimens from Level 2 have cut marks. The anterior portion of a proximal tibia, including the crest, has transverse cut marks on the anterior portion of the shaft and also cut marks on the muscle attachment on the tibial crest. The marks are difficult to see within the muscle scar and identification was made with a 16X magnification hand lens and bright light. Cut marks located at a muscle attachment site would suggest they are a result of removal of tendons and associated muscle. Two humerus fragments also had cut marks. One humerus fragment (125-3-53) had a number of cut marks below the deltoid tuberosity which may indicate removal of associated muscle. The second specimen (136-5-14) has a large number of densely packed cut marks which may be

a result of scraping or filleting. The specimen is somewhat fibrous from weathering which makes the cut marks difficult to see.

Canid

The only non-bison element displaying cut marks was a *Canis lupus* humerus shaft (120-3-20) recovered from level 2 (Figure 7.18). Transverse cut marks are located on the posterior surface above the olecranon fossa. Similar to the bison specimens these cut marks are likely a result of initial skinning of the animal. With a lack of cut marks on other canid specimens it is difficult to say if further butchering took place or removal of the hide was the only process. A lack of cut marks on the small number of canid specimens from Level 1 may simply be a consequence of the small sample size.



Figure 7.18: *Canis lupus* humerus fragment exhibiting cut marks.

7.7.1.1 Cut Mark Summary

A scarcity of any amount of comparative cut mark samples limits comparison to other faunal assemblages or between the Vickers Focus and Blackduck occupation levels. Playford (2001) did not detect sufficient cut marks to produce a feasible comparison between Vickers Focus and Mortlach sites. The limited number of cut marks identified as skinning marks are similar on specimens from both levels and also too few in number to indicate any distinct butchering technique, if any differences did exist. Cut marks associated with breakage of rib body fragments are only found in the Level 1 assemblage. It is likely that the cut marks were intentionally formed to break the bone. These are further discussed in the Bone Tool and Recreational Artefact section. Even so, there are a few differences between the Level 1 and Level 2 assemblages. Parallel cut marks on the inferior borders of ribs were only found on ribs from Level 1. This may demonstrate a difference in butchering practice or simply be a result of the small sample size. The effects of weathering, gnawing and other taphonomic forces have more than likely removed evidence of additional cut marks. The processing and breakage of bone for marrow and grease extraction reduced the diagnostic value of cut marks located on unidentifiable specimens or destroyed existing marks.

The variety of cut mark locations and orientations on numerous types of elements indicate there was a thorough butchering of bison carcasses from the initial skinning of the carcass to disarticulation and removal of meat. Certain cut marks may have also been used to enhance bone breakage during sectioning of the carcass into manageable portions. More cut marks may be hidden from view due to damage of bone surfaces from weathering and carnivore gnawing. The small number of identified cut marks may also suggest the

majority of disarticulation was accomplished by smashing and breaking the bone. The small comparative samples limit any identifiable differences in butchering patterns between the Vickers Focus and Blackduck occupation levels or between sites. Some similarities do occur but this may be a product of animal morphology and a logical succession of carcass butchering. Possible distinctive butchering techniques may also be a product of the small cut mark sample size.

7.7.2 Bone Breakage Patterns

Bone material will react differently to certain types of forces resulting in the formation of particular modification and breakage patterns. The appearances of certain types of fractures have been used to identify the presence of natural or cultural forces acting on the bone. The natural forces have been discussed previously as various forces exerted by animals through trampling and wallowing and chewing. Particular breakage patterns have been used to identify the presence of cultural forces or activities. A particular pattern is the presence of spiral fractures. The existence of spiral fractures has been used as an indicator of human activity (see Haynes 1983:102). A problem with this is the possibility that spiral fractures can also be created through natural means. Myers et al (1980:487) found that although fresh bone was very difficult to break by any method, slightly weathered bone could be broken by trampling and would produce spiral fractures.

Cut marks and initial butchering techniques are less visible in the archaeological record than the effects of processing during cooking. The type of preparation, whether it is to roast on a fire, boil in a pot, slice dry as jerky or quickly freeze for winter storage, will vary the disarticulation and filleting during butchering (Gifford-Gonzalez 1993:185). Grease extraction and marrow removal may not be the only reason for the fragmentation of

bone assemblages. For example, breakage may also occur to reduce the size of bone to fit into cooking vessels or small hearths (Oliver 1993:210).

Bones with more cancellous tissue or spongy bone produce the most grease and are consequently more heavily processed to remove available grease (Gilbert 1973:11). Some ethnographic accounts state that the smashing of bone could result in bone fragments “as big as finger nails” (Leechman 1951:355). The reduced recovery of proximal ends is most likely a product of the increased amount of cancellous tissue and associated grease in proximal ends of bone such as the humeri and femurs compared to denser distal ends, resulting in increased amounts of processing. Hamilton et al (1981:120) find the same pattern and suggest the nature of the bone is the cause for the disparity in numbers between proximal and distal portions.

A limited amount of identifiable skull specimens were recovered from either occupation level. The limited number may be a consequence of fragmentation of the skull to remove the brain. It is also possible the skull or fragments were deposited in another location. The majority of identifiable skull specimens came from the anterior portion of the skull, including the maxilla and tooth row, nasal and premaxilla. A lack of horn cores and scarcity of cranial fragments would suggest at least the posterior portion of the skull was deposited elsewhere.

The mandibles are highly fragmented in both occupation levels. Identifiable fragments of condylar and coronoid processes would suggest mandibles were removed from the skull by breaking apart of the jaw at the zygomatic arch and condylar process. Only one zygomatic fragment from Level 1 showed any sign of cut marks. Weathering and gnawing may have removed cut mark evidence from other specimens. Fragmentation of

the jaws may also have occurred as a result of breakage to remove marrow from the pulp cavity (Keyser and Murray 1979:184). One relatively complete but fragmented mandible may have been broken during removal from the skull and discarded with flesh still attached or broken subsequent to discard. Fragmentation of mandibles was reported in both the Vickers Focus assemblage from the Jackson site (Playford 2001) and the Blackduck assemblage from the Stott site (Hamilton et al. 1981).

Very few identifiable vertebrae specimens were recovered from Level 1. Complete cervical vertebrae specimens were recovered from Level 2 that included atlas and axis. Although meat is available from neck muscles, the presence of cervical elements is usually associated with primary butchering. Various fragments of C1 (atlas) and C2 (axis) vertebrae would suggest the skull was separated from the spine by smashing of the atlas (Frison 1973). Recovery of a small number of relatively intact atlas and axis specimens is significant when compared to the lack of skull fragments. Smashing was not likely used to separate skull and spine due to the intact state of these atlas and axis. Transverse processes show some signs of damage suggesting chopping with a sharp tool was used to separate these elements. Cutting may have been used to disarticulate these vertebrae, although there are no visible cut marks on any specimens. Watts (2004:141) indicates the removal of transverse processes may have resulted from the removal of associated neck muscle. Transverse processes on specimens from Block E are also missing or broken, as well as other bone projections. Carnivore damage is not visible on the cervical elements, suggesting these elements were likely deposited by cultural forces. This may indicate additional butchering of the neck with removal of the neck from the primary butchering site. Effects of weathering may also cover any evidence of butchering marks. Different

size cervical elements (indicating different individuals) suggests neck vertebra were scattered individually and remaining specimens were deposited elsewhere.

Only a small number of thoracic body and spinous process fragments were recovered from either level suggesting spinal columns were left at the kill site and Block E was more likely a processing site. The fragmentation of the spinous process would indicate meat from the hump was removed by breaking the spinous processes (Frison 1970:20). Cut marks on the lateral sides of the spinous process would also suggest meat was cut from the bone instead of breaking apart from the spine or meat was subsequently cut from the bone after initial butchering. Few lumbar vertebrae specimens were identified from either level. Articular facets and transverse processes made up most of the identifiable specimens. A common method of removal of meat from the lower spine is again to crush the bones (Keyser and Murray 1979:185). The lack of identifiable lumbar specimens would indicate they were crushed took place or the spinal columns were deposited elsewhere. Few sacral specimens were identified from either level. Sacral elements can be highly fragmented during separation of the pelvis from the sacrum, resulting in the lack of identifiable sacral specimens. The broken wings or transverse processes from a relatively complete S1 sacral vertebra recovered from Level 2 could be a result of separation of the element from the lumbar vertebra or separation from the ilium (Frison 1973:48,87). It is again possible that spines were deposited at a different location. Caudal vertebrae were not identified from either occupation level. This could be a product of these elements being left in the hide after skinning of the animal (Brink and Dawe 1989:106) and removed to another location or other taphonomic forces, such as animal gnawing/digestion, may have made these specimens unidentifiable.

All ribs from both occupation levels were broken as a consequence of butchering or other taphonomic forces. A typical method of removing ribs from the spinal column is by breaking the ribs off close to the vertebral end (Frison 1970:19). The large number of rib bodies and comparatively sparse rib heads would suggest ribs were removed from the spine and transported to Block E for further processing. Similar to a lack of rib heads at the Jackson site (Playford 2001:127) the few rib heads recovered in Block E would suggest the spine was left at the kill site while the ribs were removed. The only visible difference between occupation levels is the more complete rib bodies found in Level 2. These more complete specimens are few and may simply be an anomaly. Hamilton et al (1981:123) report that ribs from the Blackduck occupation were consistently recovered in 5 mm to 15 mm [*sic*] sections (probably a typographic error meant to be cm). The presence of rib body fragments as long as 35-40 cm is possibly just an anomaly. The differences seen in rib cut marks between the two occupation levels may also be a factor in the difference in completeness of rib bodies.

Scapula specimens were highly fragmented in both occupation levels. One specimen from Level 2 was relatively complete but fragmented. It is unknown if this specimen was broken during processing before discard or broken from other taphonomic forces after burial. Similar to scapula specimens from the Jackson site, scapula necks are separated from the rest of the scapula (Playford 2001:127). It is possible scapulae were fragmented to produce bone tools. A scapula specimen (114-F-8) from level 2 includes a portion of the cranial border and is identified as a bone tool. Another portion of scapula blade is likely a knife or spatulate. The breakage of scapulae could be a result of separation of upper limb and the blade portion for additional processing.

Only fragments of proximal humeri were recovered from either occupation level. The identifiable deltoid tuberosity landmark from the proximal shaft of the humerus would suggest at least the proximal portion of the shaft was used in Block E. Similar to other proximal portions of long bones the proximal humerus is regularly destroyed during initial butchering or during grease processing (Frison 1970:14). The proximal humerus is also one of the highest ranked producers of grease (Brink 1997). The presence of distal portions of humeri and proximal shaft fragments in both occupation levels would suggest humeri were processed in Block E.

The radius is highly fragmented in both occupation levels. Both proximal and distal portions are present and most often in a fragmented state. Some epiphyses are relatively complete but fragmented and possibly broken after deposition. Identifiable shaft specimens are located in both levels. Fragmentation is likely a result of the grease removal process.

The olecranon process is often broken to facilitate the removal of muscle from the ulna (Kehoe 1973:154; Keyser and Murray 1979:178). The ulna was highly fragmented in both occupation levels. Again this element may have been removed and used as a bone tool. The proximal end and distal shaft were only found in small fragments with the semi lunar notch separated from the olecranon process. A lack of cut marks would suggest breakage was used to separate portions of the limb.

No complete metacarpals were recovered from either level. Only distal and proximal epiphyses were identified in addition to shaft fragments. Distal ends were more prevalent than proximal portions of metacarpal specimens. The fragmentation of shafts and marrow cavities and survival of the epiphyses is likely a product of removal of marrow and bone grease extraction. Frison (1970) found that these elements are not normally broken

during butchering. Agenbroad (1978:37) suggests that breakage could be a result of removal of the lower fore and hind limbs from the carcass.

The majority of carpal bones did not exhibit any signs of butchering or breakage. Carpals from occupation Level 2 showed signs of carnivore gnawing and digestive corrosion. The few carpals that were broken also showed signs of heat effects or burning.

The fragmented nature of identified innominate specimens suggests considerable breakage took place. Most of the identifiable pelvic specimens were part of the acetabulum. No cut marks were identified on any identified pelvic specimens suggesting muscle was removed through breakage of the attachment points (Keyser and Murray 1979:179). One acetabulum triangle was recovered from Level 2 (Figure 7.19). Hamilton et al. (1981:118) tentatively suggest this type of breakage was the result of removal of the hindlimb from the body of the animal.



Figure 7.19: Acetabulum triangle.

Similar to other long bone elements, the recovery of femoral specimens was limited to distal portions and proximal shaft fragments. A lack of proximal epiphyses may indicate they were left at the kill site or deposited elsewhere or fragmented to a point they are not identifiable. Playford (2001:128) suggests the lack of proximal femoral specimens is the result of the breaking off of the femur at the neck and the head remaining at the kill site. It is impossible to say if the femur was broken or the acetabulum was smashed in order to remove the limb. No femur heads were identified in either occupation level that would support the suggestion of breakage of the femur from the head. The limited number of pelvic specimens makes a conclusion impossible.

Tibia specimens are limited to the distal portion and proximal shaft fragments. The Sanderson site (Magee 1997) and the Estuary Bison Pound Site (Adams 1977) also have a high frequency of distal tibia specimens compared to proximal portions. The proximal portion of this element would be more highly processed for grease and marrow resulting in the lack of identified specimens. Watts (2004:68) suggests the high ratio of distal tibia to proximal specimens is a result of joint dismemberment rather than marrow and grease extraction. The increased numbers of distal tibia could be a result of its much denser bone compared to the proximal end of the element.

The few patellae recovered in either level could be a result of the use of the patella as a handhold for stripping associated muscle from the femur and tibia (Frison 1970:14). Patella specimens may have also subsequently been discarded at a different location.

Metatarsals were similarly fragmented as metacarpals. Proximal ends were recovered in an increased state of fragmentation and also appear less frequently than distal

portions. Fragmentation of metatarsals could be a result of marrow extraction, grease boiling or the separation and removal of the lower limb.

The majority of tarsal bones were recovered relatively complete with some breakage of edges and processes. Similar to carpals, a number of tarsals from Level 2 show signs of carnivore gnawing and digestive corrosion. The three identified calcanei are complete with the distal portion of two specimens from each occupation level broken but still present. Frison (1970:16, 1974) indicates the tuber calcis was commonly broken in order to remove the gastrocnemius muscle. Playford (2001:128) identified a similar pattern of breakage of the tuber calcis on calcanei from the Vickers Focus level of the Jackson site. This pattern of breakage was not evident in either Vickers Focus or Blackduck occupation level of Block E. A complete calcaneus would suggest muscle was either removed in a different method or lower limbs were simply discarded.

Almost all phalanges from Level 1 are complete with only a few breaks and some fragmentation. A small number of phalanges from Level 2 are broken in half or broken transversely, but these specimens also show signs of carnivore gnawing and some digestive corrosion. Third phalanges are comparatively less represented than other phalanges. It is possible the third phalange was removed with the hoof to produce glue or for other reasons.

Magee (1997) experimented with breakage patterns of fresh and frozen limbs from large bovine animals. A difference in breakage pattern was found, with fresh bone producing the acute spiral fractures associated with culturally modified butchering, while the smashing of frozen specimens more often produced perpendicular/transverse breaks. Another difference was the production of more and smaller fragments of bone from frozen specimens and the creation of step fractures in frozen bone. There was some overlap in

acute and perpendicular breaks between frozen and fresh bone but the majority of breaks were as stated previous. Impact scars were identified on fresh bone but it is unknown if these would also appear on frozen bone. Small plugs of missing bone were visible on frozen bone specimens.

An exhaustive investigation of step fractures was not undertaken on the Block E faunal assemblage. Certain bone flakes did exhibit step fractures that may suggest the bone was frozen during breakage. Both types of breakage patterns were evident from both occupation levels of Block E. Both spiral and perpendicular breaks occur on metapodial specimens. This would support the breakage of both fresh and frozen bone in the course of an extended occupation of the site. With the overlap of breakage patterns between types of fresh and frozen bone it is difficult to say whether this is in fact true. The identification of the amount or degree of fragmentation between frozen or fresh bone is impossible without refitting bone fragments, which was impossible with the time available. Magee (1997:233) identifies the presence of bone plugs on breakage of frozen bones. Elements exhibiting bone plugs were recovered at the Stott site (see Plate IX, Hamilton et al. 1981:125). Hamilton et al (1981:124) suggested the holes were a result of smashing of bone on an anvil that might in fact have been a result of the smashing of frozen bone. No bone plugs were identified on any of the bone from Block E that would be suggestive of the breakage of frozen bone. Impact scars that Magee (1997) says are representative of fresh breaks were visible on only a small number of bones. Weathering and other destructive forces may have destroyed more evidence of this breakage characteristic. The amount of fragmentation makes a conclusion difficult due to the possible reduction by breakage of previously broken bone. The increased number of small bone fragments could be a result

of breakage of frozen bone or the subsequent breakage of broken bone to reduce the size for better grease extraction.

Although non-bison faunal material was recovered in very small numbers from either occupation level, specimens did display similar breakage patterns with epiphyses broken off to expose the marrow cavity. The small number of shared species from either occupation level made a comparison of bone breakage patterns problematic.

Both occupation levels show a high level of bone processing to extract as much edible material from bone as possible. Various taphonomic forces may have accentuated the fragmentation and increased the appearance of processing.

7.7.3 Bone Tools and Recreational Artefacts

As previously discussed in the Abrasion and Polish section, bone tools can be classified within two general categories, formal and informal or expediency tools. Formal tools are recognizable due to their culturally modified state in contrast to a simple utilized bone fragment. A lack of visible manufacture and modification makes expediency tools more difficult to identify (Frison 1982b:160). Signs of intentional shaping of bone may appear on expediency tools, but more often these tools are simply bone fragments or flakes with usable edges that were utilized as a tool. No matter what class of tool, usewear patterns are used to identify the presence of a tool. The location of polish can also be used as an identifier of tool usewear. Myers et al. (1980:488) consider the restriction of worn surfaces to the working end of a tool as an indication of tool use. If worn areas cover or are found throughout the bone surface then wear is probably a product of natural taphonomic forces. Formal tools may not have been used for the intended purpose and thus may lack usewear on the working edge. The identification of expediency tools will thus be

challenging if tools were insufficiently used to form visible abrasion or polish. As discussed in previous sections, natural taphonomic forces can also create visible modification mimicking use-wear patterns.

Similar to lithic tools, bone tools can be either simple expediency tools made from fragments of bone or more formalized tools. It is difficult to identify bone tools with the possible variety of bone fragments available. Lyman (1984:317-319) presented certain criteria that must be present for a bone to be considered a tool. The first, only “bones of appropriate structure, weight, and strength were employed as expediency tools” (Lyman 1984:317). This is somewhat ambiguous since bone tools can be used for a variety of jobs on a variety of material. A second requirement is the presence of a working edge. Use-wear either produced from incidental use or during preparation of a tool should be visible. Use-wear may appear as the aforementioned abrasion and polish but may also appear as rounding and smoothing, the appearance of striations and/or flake scarring. These features may also appear on the handle portion of more formalized tools. A manufactured or prepared working edge may have ground or chipped edges, seriated edges or an accumulation of debris. The amount of use-wear present on a bone tool will be affected by the amount of time a tool was used (Lyman 1984:318). A tool that is used only sparingly before discard may not exhibit the obvious criteria that a well used tool would display. This is an issue with the Block E assemblage where numerous bones show varying degrees of abrasion. The initial faunal analysis in 1987-1991 classified many specimens as bone tools or bones displaying human modification, including abrasion and polish. Almost all were subsequently ruled out as tools during re-examination. Many bones previously identified as tools are too small and/or fragile to be used as such. It could be argued that

some are fragments of larger tools, but it is impossible to support this lacking a more complete portion of the bone. Many specimens initially identified as tools have visible rounding and abrasion on what are perceived as the working end/edge. However, the rounding and abrasion also extends throughout most of the broken portion of bone. Various proximal and distal portions of long bones show signs of abrasion and rounding but no polish is evident. Weathering and damage during excavation makes an identification of usewear problematic. What was initially recognized as tool usewear may in fact be a product of abrasion and polish due to trampling and wallowing. These specimens may also have been used sparingly as hide scrapers and then discarded, thus limiting the amounts of usewear.

A few specimens were identified as bone tools in the Block E assemblage. These included four elements previously identified as bone tools and a pair that show signs of human modification. The distal portion of a left hand scapula, including the glenoid fossa (114-F-8), from Level 2 has a portion of the cranial border that is smoothed to a rounded point (Figure 7.20). This may have been used as a fleshing tool.



Figure 7.20: Scapula exhibiting polish.

A rounded portion of the midsection from a right-hand ulna shaft was recovered from Level 1 (Figure 7.21). The rounded working end is towards the distal end of the element and the broken end towards the proximal portion of the ulna. It is possible the proximal end of the ulna, including the olecranon process, acted as a handle for this tool fragment. Artefact 151-3-3 is similar to the tip of an artefact recovered from the Gull Lake site in southwestern Saskatchewan (Figure 7.22). The Gull Lake endscraper artefact was recovered from an Avonlea layer (Level 31c). No associated radiocarbon date was given for Level 31c, but the level falls between RC14 dates of A.D. 50 and A.D. 660 (Kehoe 1973:32).



Figure 7.21: Ulna shaft tool.

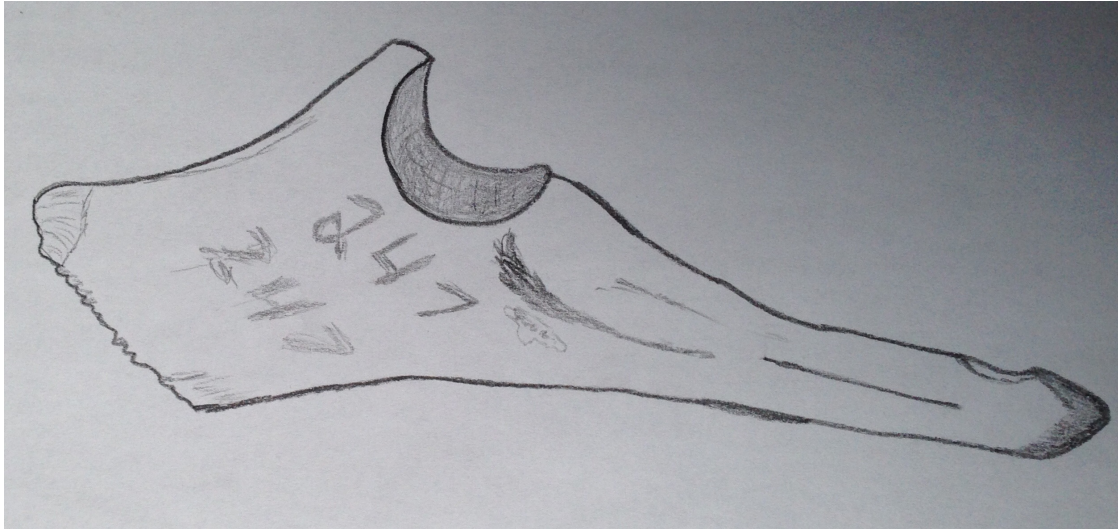


Figure 7.22: Example of ulna scraper (from Kehoe 1973:134,137-138).

A rounded end of a rib body fragment (155-6-3) was recovered from Level 2 (Figure 7.23). The bone is worked to a rounded point and exhibits slight amounts of polish on the worked edge. This is again most likely a broken tip of a larger tool similar to the working end of a spatulate tool (Lehmer 1971). These spatulate tools have been variously



Figure 7.23: Rounded rib body.

identified as implements used as porcupine quill flatteners or pottery-modelling tools (Lehmer 1971:88). The slightly pointed tip of the Block E spatulate tool suggests this tool may have been used as a pressure flaker during the manufacture of lithic tools (Ahler and Falk 2002).

A portion of a right-hand scapula (158-3-7) exhibits rounding and minor amounts of polish (Figure 7.24). The specimen includes the caudal or inferior border and resembles a spatulate tool. This artefact was recovered in a fragmented state and subsequently refitted during the previous analysis.



Figure 7.24: Scapula spatulate tool.

A fragmented bison scapula was recovered from excavation unit 122 in the Vickers Focus occupation level (see Nicholson 1990:39, Figure 3). This refitted element was previously identified as a bifurcated scapula hoe that was considered to be comparable to hoes recovered from the Lockport site in Manitoba and ethnographic examples from North Dakota and Minnesota (Nicholson 1990:38).

Two rib fragments, previously discussed in the Cut marks section and recovered from the Vickers Focus Level have visible cut marks along the squared break point (Figure

7.25). Both rib body fragments are from the proximal part of the rib near the rib head and both have transverse cut marks used to produce a square break. It is unlikely this type of break was used to section and remove ribs during primary butchering due to the time and effort needed to cut in the confined space of the rib cage versus simply breaking the bones. It is possible this type of break was used to form a usable handle to haft a stone tool. A comparison to recreational pieces recovered at many Late Precontact sites in the northern part of the Great Plains, the Middle Missouri region, southwestern Manitoba and southern Saskatchewan suggest at least one of these rib fragments (123-2-95) was part of an ice-glider (Figure 7.25, top).

Culin (1907:399) identifies three main types of winter game pieces that involve throwing darts or javelins under the term Snow-snake. An ice-glider is a recreational game piece used on snow or ice in winter months (Figure 7.26). Typically used by younger males the purpose of this game is to throw the ice-glider so it skips and slides along the ice. The winner was the person whose dart traveled the furthest from the starting point. The general form of the ice-glider is comprised of two feathers attached to a short piece of bone. The bone was usually a fragment of rib from a bison or other large mammal. Mandan children in North Dakota used a similar artefact but a deer antler tip was used instead of a rib fragment (Culin 1907:419). Similar methods of manufacture are found on many examples of ice-gliders. A transverse cut made with a sharpened tool on the proximal end of the ice-slider was used to assist in creating a clean and square break (Majewski 1986:104; Culin 1907). The Block E ice-glider is comparable to specimens from the Hartley site (FaNp-19) and numerous photographic examples. This type of cut/break on the proximal end of the artefact is found throughout the Middle Missouri region and into



Figure 7.25: Ice glider #123-2-95 (top) and possible ice glider #128-3-31 (bottom).

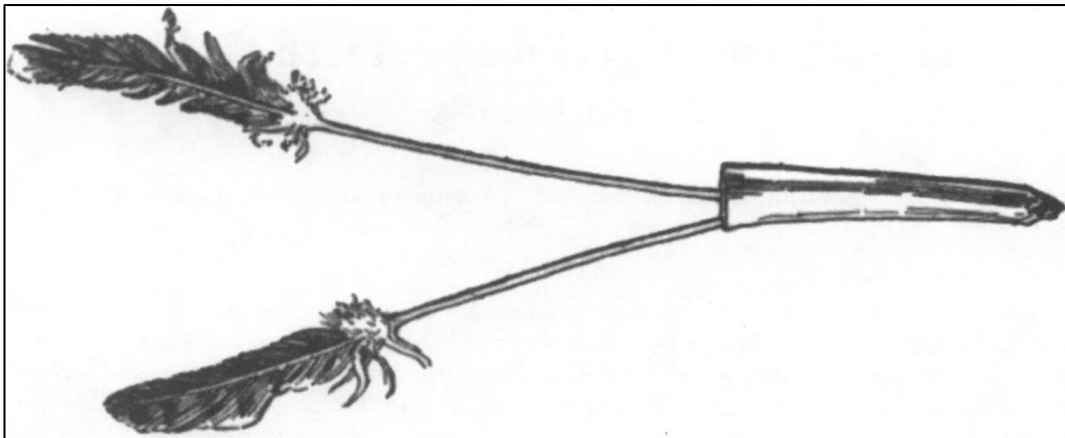


Figure 7.26: Drawing of ethnographic Dakota feathered ice glider (Redrawn from Culin 1907:415).

Manitoba and Saskatchewan. The morphology of the distal end of the ice-glider varies from unmodified blunt ends to round and pointed tips. Similar cut/breaks may occur on the distal end as either a transverse cut or two diagonal cuts forming a V-shaped point (e.g. Majewski 1986:104). Nicholson et al. (2003:122) find that most ice-gliders recovered

in Manitoba and Saskatchewan display an unmodified break at the distal end. Notches may appear along the lateral edges and incised designs on the flat portion of the rib (Nicholson et al. 2003:122). This type of artefact usually exhibits extensive polish over the entire surface of the rib (Nicholson et al. 2003:122).

A description of ice-glider rib parts may include both skeletal and artefact orientation terminology. Skeletal orientation refers to a specific location in reference to the rest of the skeleton where proximal and distal portions of the rib segment are in relation to the vertebral (proximal) or sternal (distal) ends of the bone. When discussing the orientation of ice-gliders the artefact orientation is related to the placement of feathers and direction of throw and travel. The proximal end of the ice-glider is the end where feathers are attached while the distal end is the portion pointing down field or away from the person when the piece is thrown. The two types of orientation, skeletal and artefactual, may or may not be consistent when describing one artefact.

These ice-gliders are limited to areas where rivers or other bodies of water freeze during the cold season. Ethnographic sources identify a number of groups using the ice-glider in the northern Great Plains, including the Middle Missouri region. Culin (1907) lists a variety of ethnic groups known to use bone sliders, including: the Cheyenne, Kiowa, Crow, Gros Ventre, Oglala (Dakota), Teton (Dakota), Yankton (Dakota), and Mandan. Louis L. Meeker (from Culin 1907:415-416) refers to a rib fragment and attached feathers used by the Dakota (Oglala) (South Dakota) boys as a *paslo hanpi*. Dr. J.R. Walker (from Culin 1907:418) describes a similar game played by Dakota (Teton) boys which he refers to as *woskate hutanacute*. Similarly, Culin (1907:418) has recorded hutanacute in this regard.

Most of these ice-gliders used a portion of rib and attached feathers. As mentioned above, Mandan children in North Dakota used feathers attached to the tip of the deer or elk antler.

The earliest known records of ice-gliders in the Missouri River Basin are from protohistoric period Arikara sites dating to about A.D. 1750 (Nicholson et al. 2003:125). Ice-gliders in southern Manitoba and Saskatchewan appear much earlier, as early as A.D. 1440 and are associated with the beginning of the “Little Ice Age” (Nicholson et al. 2003:123). Nicholson et al. (2003:125) propose the earlier presence in the north suggests ice-gliders originated in the northern parklands and plains of Manitoba and Saskatchewan and were subsequently adopted by groups to the south in the Dakotas and eastern Montana.

Three ice-gliders were recovered from the Vickers Focus occupation (Nicholson et al. 2003:126) of the Lowton site while no ice-gliders were identified at the Jackson site (Playford 2001). Ice-gliders have also been recovered from several Mortlach sites including the Sanderson site (Magee 1997). Ice-gliders seem to be made of both the proximal and the flatter more blade-like distal rib portions. Although comparison was only possible through examination of photographs, the inferior costal groove and the overall shape of many ice-gliders identify a similar use of the proximal end of the rib to that of artefacts 123-2-95 and 128-3-31 (see Nicholson et al. 2003:126-128). The use of either proximal or distal rib portions may be indicative of culture choice but ice-gliders made of both distal and proximal rib parts are identified in the same assemblages.

Artefact 123-2-95 has the proximal cut/break found on a majority of ice-gliders. The marrow cavity was also removed from the proximal end to a depth of approximately 33 mm. Although there are no visible notches or incised designs, the artefact is extensively polished over the entire surface. Numerous incised cut marks cover both the lateral and

medial portion of the rib (skeletal orientation). These are possibly butchering marks or marks produced during manufacture of the ice-glider but almost all the cut mark edges are rounded or smoothed from subsequent polishing. The distal portion of the ice-glider is broken and forms jagged edges. Since polish extends to the edge but does not continue onto broken portions of the cortical bone or exposed cancellous bone, this break likely occurred after its use as a recreational item. Using a hand lens, faint striations are visible that run parallel to the longitudinal axis of the bone. These striations are most likely a result of polishing. Artefact 128-3-31 has a similar cut/break to artefact 123-2-95 but does not have any visible polish. The cut/break is on the narrow end of the rib fragment and may represent the distal portion of the artefact, if it was intended to be an ice-glider. If this was an ice-glider then the broken proximal end may have resulted in the discard of the damaged artefact. This artefact may also have been fabricated for some other use such as a handle for a hafted tool.

A beaver incisor from the Vickers Focus level is the only non-bison faunal material that may represent a tool. Previous studies have identified the use of beaver teeth tools in various groups' tool kits. Hlady (1971: 25-27) and MacNeish (1958: 71) report that Selkirk Composite groups used beaver teeth to make bone tools. Syms (1977: 104) lists beaver incisor gouges as an identifiable part of the Blackduck tool kit. No visible cultural alterations were visible on the beaver incisor to suggest it was utilized as a tool. The incisor was the only beaver remains recovered, suggesting it was intended for use as a tool.

7.7.3.1 Bone Tools and Recreational Artefacts Summary

The fragmented nature of the site and various taphonomic forces has restricted the amount of specimens that might otherwise have been identified as bone tools. Specimens

considered to be functional tools do not show enough characteristics to qualify as tools. Although abrasion appears on many specimens it could be a result of natural taphonomic forces. The few positively identified bone tools were visibly modified and displayed limited amounts of polish. The identification of only one bone tool from the Blackduck Level 2 may simply be a result of the increased weathering and root etching that subsequently destroyed evidence of tool making and usewear. The ice-glider and the possible ice-glider from the Vickers Focus Level 1 are not only unique artefacts that give an insight into the recreational activities of the Vickers Focus people but may also indicate the season of occupation. The recoveries of the winter related ice-gliders have previously been used as an indicator of seasonality (Fenega 1954; Majewski 1986:104). Nicholson et al. (2003:129) note that ice-gliders have also been recovered at some Middle Missouri area sites that are interpreted as summer sites. It is possible ice-gliders were deposited in sites that had extended periods of occupation or they were made prior to the cold season.

Previous researchers have used the recovery of the scapula hoe from the Vickers Focus assemblage as indirect evidence of horticultural capability (Nicholson 1990). Direct evidence of horticultural activity is the result of the recovery of plant material, in particular maize and bean seeds and corncob remains (Schneider 2002). Archaeological sites with direct evidence of horticulture have been discovered in the northeastern plains in the Dakotas and into Manitoba at the Lockport site (EaLf-1) (Schneider 2002). Bifurcated scapula hoes were recovered in association with maize remnants. Unfortunately, a food residue analysis was not a part of this thesis that may have identified Block E bone tools as products of horticultural practices.

7.8 Taphonomy Summary

A number of taphonomic processes and characteristics were recognised on the faunal material from Block E of the Lovstrom site. Both cultural and natural processes have shaped the current assemblage. Separately, the natural taphonomic forces had a limited affect on the disturbance of the faunal material. The effect of weathering was limited in both occupation levels with some intensification in Occupation 2. The appearance of faunal material may also suggest weathering forces were limited in the amount of destruction present on bone. Subsequent processes have worked to further degrade faunal material. Abrasion has degraded bone from forces such as trampling and soil movement. This erosive process has also transpired to some extent during the excavation and transport of the faunal assemblage. Root etching is more evident in Occupation 2 and has had an affect on bone especially in association with weathering and other forces. Carnivore damage is visible but not extensive to a point that it would affect the site. Carnivore attrition may have also moved or removed material. Disturbance of the site has occurred through the trampling by large ungulates or human inhabitants and through the introduction of rodent burrows. Vertical movement of material is evident with the recovery of refitable artefacts found at different stratigraphic levels. Trampling may have re-exposed faunal material to the surface and to additional weathering and degradation. Horizontal movement and dispersion of material and features is also a possibility with the presence of rodent burrows and both trampling and carnivore intrusions. Previous site studies and the site locality would suggest vertical movement of cultural material is limited compared to the amount of horizontal movement. Carnivore activity has also had some impact on the physical state of the assemblage and the dispersion

of material. Although there is possible vertical disruption there are still recognizable cultural layers. The scattered nature of the bone would support the possibility that some horizontal disruption of the site materials has taken place.

Although natural forces have had an affect on the assemblage, the cultural taphonomic forces are largely responsible for the archaeological assemblage. Breakage patterns and the degree of fragmentation are high in both levels. Faunal material in Occupation 1 is fragmented to such a degree that the limited number of identifiable elements did not produce any worthwhile results using utility indices. No bison utility indices displayed any statistical significant results when applied to the Occupation 1 assemblage. This would suggest a lack of selection bias similar to a kill site but is more likely a result of the highly fragmented state of the faunal material. Low value elements that are common at a kill site did not appear in the Occupation 1 assemblage. Another possibility is that only certain material was deposited in this location.

When applied to the Occupation 2 %MAU all five indices produced negative statistical correlations. Including the grease utility indices, this would suggest processing of low utility material took place in Occupation 2. Both occupation levels showed high levels of bone processing and subsequent fragmentation seen in the low numbers of high utility elements versus low utility elements.

Other cultural alterations comprised bone breakage, cut marks, burning and bone tool manufacturing. Bone breakage patterns from both occupation levels suggest smashing and chopping was primarily used to remove meat and separate the carcass. This method of butchering in addition to the grease and marrow processing are the most likely cause of the high fragmentation of faunal material. The pattern of breaks also suggests both fresh and

frozen bone were processed/broken. Few cut marks were visible on bones from either level. Effects of weathering, root etching and other forces may have destroyed additional evident of cut marks. A majority of cut marks were indicative of primary skinning of the animals. Burning was only evident on a very small percentage of specimens from either level. Only a small number of bone tools were identified. This may also be a result of various taphonomic processes acting on the faunal material to erase any evidence of tool use. A number of specimens showed signs of possible tool use but were rejected as tools.

Although there are various natural taphonomic forces that acted on the Block E assemblage, the combined effect of these natural forces is negligible when compared to the consequences of cultural activities.

Chapter 8

Vickers Focus and Blackduck Subsistence Strategies

8.1 Introduction

The main purpose of this thesis is the study and analysis of the faunal material in an effort to identify any differences or similarities in the Vickers Focus and Blackduck components from the Lovstrom, Jackson and Stott sites. Additional comparisons are also made between the Blackduck occupation level and Vickers Focus within the Lovstrom site. A comparison of Vickers Focus faunal assemblages is limited to the Jackson site assemblage (Playford 2001). Due to comparisons made by Playford (2001) to the Mortlach component at the Sanderson site, some evaluations are also made with the Lovstrom Vickers Focus. A majority of Vickers Focus studies have paid attention to the relationship between ceramic styles and their association to ancestral and descendant groups. The relationship between the east and west Vickers Focus groups is largely drawn due to similar ceramic material. This study allows a comparison of faunal material and subsistence strategies between the two Vickers Focus sites. A comparison of the Blackduck assemblage was limited to the nearby Stott site (Hamilton et al. 1981). Table 8.1 lists the species recovered from the examined sites.

8.2 The Vickers Focus Subsistence Strategy at Block E of the Lovstrom Site

Bison bison constituted the vast majority of faunal remains recovered from the Vickers Focus occupation level. Taphonomic analysis, butchering marks and breakage patterns indicate that animals were butchered and processed to a high degree at the Block E site. An analysis of the bison population dynamics suggests both male and female individuals were killed and butchered. The presence of butchering marks on

Table 8.1: List of species from scrutinized sites.

| Species | Lovstrom Block E | | | | | | | |
|----------------------------------|------------------|-----|-----------|-----|--------------|-----|------------|-----|
| | Vickers Focus | | Blackduck | | Jackson Site | | Stott Site | |
| | NISP | MNI | NISP | MNI | NISP | MNI | NISP | MNI |
| Mammal | | | | | | | | |
| <i>Bison bison</i> | 507 | 6 | 886 | 8 | 4149 | 8 | 2012 | - |
| <i>B. bison Foetal</i> | - | - | - | - | 95 | 4 | 4 | - |
| <i>Canis latrans</i> | - | - | - | - | - | - | - | - |
| <i>C. lupus</i> | 7 | 1 | 3 | 1 | - | - | - | - |
| <i>Canis sp.</i> | 4 | 1 | 2 | 1 | 107 | 2 | 30 | - |
| <i>Castor canadensis</i> | 1 | 1 | - | - | 1 | 1 | 38 | - |
| <i>Cervus Elaphus</i> | 2 | 1 | 1 | 1 | 0 | 0 | - | - |
| <i>Clethrionomys gapperi</i> | - | - | - | - | 6 | 3 | - | - |
| <i>Felis sp.</i> | - | - | - | - | - | - | - | - |
| <i>Lepus americanus</i> | 2 | 1 | 3 | 1 | 1 | 1 | - | - |
| <i>Lepus sp.</i> | 3 | 1 | - | - | 8 | 1 | 21 | - |
| <i>L. townsendii</i> | - | - | - | - | - | - | - | - |
| <i>Martes pennanti</i> | 2 | 1 | 1 | 1 | - | - | - | - |
| <i>Mephitis mephitis</i> | - | - | - | - | - | - | 5 | - |
| <i>Microtus pennsylvanicus</i> | - | - | - | - | 17 | 7 | - | - |
| <i>Mustela vison</i> | - | - | - | - | - | - | 2 | - |
| <i>M. erminia</i> | - | - | - | - | - | - | 5 | - |
| <i>Ondatra zibethicus Recent</i> | - | - | - | - | - | - | - | - |
| <i>Procyon lotor</i> | - | - | - | - | - | - | 3 | - |
| <i>Sorex sp.</i> | - | - | - | - | 1 | 1 | - | - |
| <i>Spermophilus franklini</i> | - | - | - | - | - | - | 3 | - |
| <i>S. richardsonii</i> | 9 | 1 | 1 | 1 | - | - | - | - |
| <i>S. tridecemlineatus</i> | - | - | - | - | 1 | 1 | 1 | - |
| <i>Spermophilus sp.</i> | 1 | 1 | - | - | - | - | - | - |
| <i>Sylvilagus floridanus</i> | 2 | 1 | - | - | - | - | - | - |
| <i>Taxidea taxus</i> | - | - | - | - | - | - | 1 | - |
| <i>Thomomys talpodes</i> | 3 | 2 | - | - | 4 | 4 | 5 | - |
| <i>Ursus sp.</i> | - | - | - | - | - | - | 1 | - |
| <i>Vulpes velox</i> | 1 | - | 2 | - | - | - | - | - |
| <i>Vulpes sp.</i> | - | - | 2 | 1 | - | - | - | - |
| Avian | - | - | - | - | 7 | - | 9 | - |
| Amphibians | - | - | - | - | 3 | 2 | - | - |
| Reptiles | - | - | - | - | 20 | 1 | - | - |
| Piscine | - | - | - | - | 0 | 0 | 148 | - |

foetal remains would indicate female individuals were also a part of the Vickers Focus diet.

The recovery of a single *cervid* specimen makes a determination of cultural placement or natural deposition impossible. No cultural alteration was evident on the pelvic fragment. If *cervid* material was processed or consumed by the Vickers Focus people it was not a major component of the diet.

Large *canids* comprise the second most abundant mammal remains from Level One of the Block E assemblage. The limited number of specimens and scattered nature of the remains do not indicate any visible butchering units were discarded. Although no cultural alterations were visible on any of the specimens identified as wolf or *canid* species, they are considered to be a part of the cultural assemblage.

A single small *canid* specimen was recovered in the Vickers Focus level. It is impossible to ascertain if this animal was a part of the Vickers Focus diet or if the specimen was a result of cultural activity. The mandible body fragment was lacking all teeth and no associated teeth were recovered.

Small carnivores may have been a limited source of the Vickers Focus diet. The two Fisher humeri specimens may represent a single individual. Neither specimen showed signs of cultural alteration, it is impossible to say if this species was present due to cultural activities or was naturally deposited. As stated previously, the remains are similarly stained and are likely associated with the archaeological assemblage.

Lagomorphs may have constituted a minor role in the Vickers Focus diet. Mandibles and fragmented hind and forelimb specimens of snowshoe hare and eastern

cottontail exhibited no signs of cultural alteration, although they are likely a part of the archaeological assemblage.

Large rodents were likely not a part of the Vickers Focus diet. An isolated beaver incisor exhibited no cultural alteration. No other beaver or large rodent bone was identified to indicate these mammals were utilized as a food source. Small rodents were possibly a minor part of the diet. Small rodent remains were limited to mandible and maxillary fragments. No cultural modification was evident on these specimens and it is impossible to determine if these remains were introduced through cultural activities or naturally deposited.

Micro-sized rodents were present and may have constituted a small part of the Vickers Focus diet. Remains of vole-sized individuals showed no signs of cultural alteration and it is impossible to establish if their presence was a result of cultural activities or natural deposition.

No other class or species of faunal material was recovered. Avian material was absent from the Vickers Focus level.

8.3 The Blackduck Focus Subsistence Strategy at Block E of the Lovstrom Site

The majority of faunal material was identified as *Bison bison*. Similar to the previous Vickers Focus level, the taphonomic analysis, butchering marks and breakage patterns indicate animals were butchered and processed to a high degree at the Block E site. An analysis of the bison population dynamics again suggests both male and female individuals were killed and butchered. The presence of butchering/cut marks on a foetal long bone specimen indicates foetal material was also being utilized.

Cervids did not make up a large part of the Blackduck diet. Only two identifiable elk specimens were recovered. The mandible fragment and isolated tooth most likely represent the same element and individual. No other specimens were identifiable as elk, suggesting this species did not constitute an important part of the Blackduck diet.

Large *canids* were not a major part of the Blackduck diet. The presence of butchering marks may indicate these animals were processed for hide removal and possibly further processed for food consumption. The recovery of a small number of *vulpes velox* and *vulpes sp* specimens indicates this species was also not a significant part of the Blackduck diet. No butchering marks were identified on any of these specimens.

A single small carnivore specimen was recovered and may indicate a contribution to the Blackduck diet. A single fisher specimen with no visible cultural alteration makes it impossible to conclude if it was left as a result of cultural activities or naturally deposited.

Leporids were only recovered in a very small number and do not represent a significant part of the Blackduck diet. Two hind limb specimens, although spatially separated, may represent the processing of a hind limb. No cultural modifications were evident on any *leporid* specimens although their appearance and location would suggest they are a part of the archaeological assemblage.

Large rodents were not identified in the faunal assemblage and do not represent a part of the Blackduck diet. A limited number of small rodent remains were recovered and would not have been a significant part of the Blackduck diet. It is questionable whether the sparse number of small rodent remains was a result of cultural activities or natural deposition. No cultural modifications were identified on any of these specimens.

No other classes or species of fauna were recovered or identified in the Blackduck level. Micro-rodents were absent from the Blackduck occupation level. No avian specimens were recovered or identified.

8.4 The Jackson Site Vickers Focus Subsistence Strategy

The Jackson site is a single component Vickers Focus winter occupation found in the Lauder Sandhills of southwestern Manitoba. The focus of Tomasin Playford's Master of Art's thesis (2001) was a faunal analysis of the Vickers Focus component at the Jackson site with comparisons to a Mortlach occupation (Magee 1997) in southeastern Saskatchewan. The Vickers Focus occupation produced a radiocarbon date of approximately 1450 AD. Although the Jackson site was dated some 200 years later than the Lovstrom site and close to the proto-historic period, there were no historic artefacts recovered that suggests the site was occupied prior to the appearance of European trade goods (Playford 2001: 145). The environment of the Jackson site is believed to have changed since the time of occupation, with an original environment of closely spaced wetlands intermixed with woody areas (Playford 2001: 145).

Several small to large excavation blocks were excavated with a total of 35 one m² excavation units. All matrixes, except for collected soil samples were screened through a 0.3175 cm mesh screen (Playford 2001: 26). This is in contrast to the Lovstrom site matrix that was run through a 0.63 cm mesh screen. A total of 193,548 faunal specimens weighing 64.80 kg (not including foetal or immature remains) were analysed (Playford 2001: 33).

8.5 The Stott Site Blackduck Subsistence Strategy

The Stott site is located in the Aspen Parkland on the northern side of the Assiniboine River Valley, approximately 10 km west of Brandon, Manitoba and approximately 50 km northwest of the Lovstrom site. Two Blackduck occupations were radiocarbon dated to $1,110 \pm 60$ B.P. and 1040 ± 45 B.P. Rolling plains that are dotted by potholes and sloughs surround the site (Hamilton: 18). The upper flatland areas are today home to prairie vegetation. Oak and ash-forested areas are found along the slopes that descend down to the Assiniboine River Valley. A total of 2,549 identifiable faunal specimens were recovered from six excavation units. The quality of the comparative faunal collection that was used to identify specimens from the Stott site is unknown.

8.6 Inter- and Intra-site Comparisons

There are many similarities among all sites and both cultural groups. The amount of processing was high in all areas, with large amounts of bone fragmentation. The degree of fragmentation makes any comparison or interpretation problematic. All groups focused on the utilization of *Bison bison*. Long bone proximal epiphyses were largely absent in all four assemblages. Rib heads were absent, which is likely more a product of the site type. The presence of similar ulna breakage patterns is possibly a product of a common or natural technique used to separate a carcass. A lack of cut marks may suggest the chop and strip technique was used to remove muscle and soft tissue. Differences were largely the result of the presence of different elements in one assemblage versus the other assemblages.

8.6.1 Vickers Focus Inter-site Comparisons

Playford's Jackson site faunal analysis allows a comparison to the Vickers occupation at the Lovstrom site. Table 8.1 provides an inventory of the faunal species from the Jackson and Lovstrom sites.

8.6.1.1 Species Exploitation

The vast majority of faunal material from both occupations is comprised of *Bison bison*. The identification of both male and female bison suggests the exploitation of both nursery and bull herds. Foetal bison were well represented in the Jackson site. Although foetal material was identified in the Lovstrom assemblage it was not a substantial part of the diet.

Elk was the only non-bison large mammal identified at the Lovstrom site, a species not recovered from the Jackson site. A variation in the presence or absence of other species in both sites may be a result of various factors such as a different biophysical environment, season or duration of occupation, or chance capture of certain species. The lack of amphibian, reptile and piscine species in the Lovstrom site is different from the Jackson assemblage, but this may again be a factor of biophysical environment or location, season of occupation, and also excavation methods.

8.6.1.2 Butchering Methods

Premaxilla or maxillary cut marks found on Lovstrom elements were not found on similar elements from the Jackson site, although similar cut marks were found on Sanderson site maxillary elements. A cut mark was found on a Lovstrom occipital fragment with no cut marks recorded on occipital or mandibular elements from the Jackson site, although cut marks on mandibular condyles were identified on elements

from the Sanderson site. Similar to the Jackson site, no cut marks were identified on carpal or tarsal bones at the Lovstrom site, although, cut marks were identified on carpals from the Sanderson site.

Breakage patterns were similar in both Vickers Focus assemblages. One difference was a pattern of breakage on calcaneus bones from the Jackson site that was not found on any of the Lovstrom specimens. The taphonomic forces acting on the assemblage may have erased further evidence of similarities or differences.

8.6.1.3 Frozen Meat Storage

The utilization of frozen bison material, extensively discussed in McGee's thesis (1997), is not conclusive, which is similar to the Jackson site. No articulated bison elements were recovered from the Vickers Focus level. This may be a result of taphonomic forces which disturbed articulated segments.

8.6.1.4 Issues Comparing the Lovstrom and Jackson sites

A number of issues should be considered when comparisons are made between these two sites. Different excavation methods, specifically the screen mesh size, may result in the apparent existence of cultural preferences or differences. The Jackson site faunal assemblage includes a much larger quantity of faunal specimens. An increase in the amount of specimens may also result in an increase in the variety of element types or species and resulting MNI values. The Jackson site analysis includes several excavation blocks and site types, including kill and processing areas. In contrast, the Block E of the Lovstrom site is considered to be a processing area.

8.6.2 Blackduck Inter-site Comparisons

The Lovstrom and Stott have a similar environment, situated on the north side of a wide and deep river valley. Unlike the Lovstrom site, the Stott site is not located adjacent to a prominent hill and its accompanying micro-environments.

8.6.2.1 Species Exploitation

Bison bison remains composed the majority of faunal material recovered from both Blackduck components. Foetal bison was not a large proportion of either group's diet. It is unknown if the Stott occupants exploited both male and female bison. Slightly more species were recovered from the Stott site than at the Lovstrom site (Figure 8.1). Differences in species representation may be a result of differences in the biophysical environment and season of occupation between the Lovstrom Blackduck assemblage and Stott site. One difference is the presence of piscine species recovered from the Stott site. It is possible the lack of piscine species at the Lovstrom site is due to a change in dietary preference or a difference in the season of occupation.

8.6.2.2 Butchering Methods

A number of similar cut mark and breakage patterns appeared in both Blackduck assemblages, suggesting both groups were following similar butchering methods. Cut marks on thoracic spinous processes were similar from both sites. A cut mark on one calcaneus tarsal bone was similar to cut marks identified at the Stott site, with none in the Vickers Focus level. An acetabulum triangle found at the Lovstrom site was similar to those found at the Stott site, a pattern not seen in the Vickers Focus level. Another distinction was cut marks found on mandibles from the Stott site that were not identified

on any mandible fragments from the Lovstrom assemblage, suggesting a possible difference in butchering methods.

8.6.3 Lovstrom Intra-site Comparisons

The exploitation of species evidenced in the Blackduck and Vickers Focus occupations is similar. *Bison bison* formed the largest portion of both diets with male and female bison and foetal bison exploited in both occupations.

Similar maxillae cut marks are found in both levels. Cut marks are visible on ribs from both levels. Metapodials have cut marks or hacking marks from both levels, likely a product of preserving the maximum amount of hide during skinning of the bison. Cut marks were found on occipital fragments from the Vickers Focus but not Blackduck. Thoracic spinous processes cut marks are present on Blackduck but not Vickers Focus faunal material. Cut marks on carpals and tarsals were almost non-existent except for one tarsal bone from the Blackduck level. There are visible cut marks on unidentified long bones from both levels. In addition to hide removal, some of the cut marks may indicate the removal of meat by cutting or scraping, but there are few examples of this type of butchering.

Breakage patterns were similar in both cultural levels. A few differences included the presence of certain bones in one cultural level and not in the other. A lack of particular bones and the accompanying breakage pattern may simply be a product of deposition or variable preservation.

The presence of the ice glider artefacts is unique to the Vickers Focus level at the Lovstrom site. It is possible the use of this game was lost over time since ice-gliders are not found in later Vickers Focus sites.

8.7 Summary

One purpose of this thesis was to determine the relationship between similar cultural assemblages and between different groups inhabiting the Lovstrom site at different points in time. Similar to all sites are the extensive use and advanced processing of bison. Although low value meat portions were highly processed by both Vickers Focus groups, lower limb bones, specifically phalanges, were not fragmented to such an extent. Similarities are evident among the same cultural groups and between the two distinct groups, but with some differences. There is limited evidence of cutting to remove flesh for all the groups. Smashing and stripping was also evident in all assemblages. Cut marks were identified on zygomatic elements but not mandibles. There is no evidence of cut marks on mandibles from the Vickers Focus components, which is different from the Mortlach component at the Sanderson site.

The variety of species utilization is similar, with variation likely a result of seasonality of the site or difference in the local environment. *Canids* are used to a limited degree in both eastern and western Vickers Focus sites, versus the highly utilized *canids* at the Sanderson site. The small and micro species were also similarly exploited at all sites. One visible difference for both the Vickers Focus and Blackduck assemblages at the Lovstrom site is the complete lack of non-mammal species. This may be in part due to the larger screen size or excavation methods that restricted the recovery of these small elements.

The utilization of frozen meat is not evident by either Lovstrom group. The description of bone plugs from the Stott site may suggest frozen bone was utilized, a

feature not seen within either assemblage of the Lovstrom site. Neither Vickers Focus sites had conclusive evidence of frozen meat utilization.

The recovery of ice gliders was restricted to the Vickers Focus level of the Lovstrom site. These recreational artefacts were used into the proto-historic period so would likely still be used during the time of the Jackson site occupation. Since the Jackson site was considered to be a winter occupation, the Western Vickers Focus group may not have continued the use of this game.

Chapter 9

Conclusions

The primary intent of this thesis was the examination of the faunal material recovered from the Block E at the Lovstrom site (DjLx-1), a multi-component processing/camp site on the edge of the Aspen Parkland. Located along the Souris River, the site sits on the edge of the uplands above the valley and the adjacent Tiger Hills. Excavation of the site identified two cultural occupations. The core of this thesis was the analysis of the faunal assemblage and discovery of subsistence strategies and comparisons to other culturally related sites.

The research included in this thesis is based on the Brandon University Department of Anthropology field school excavations during the summers of 1987, 1988, and 1991. Based in large part on the recovery of ceramic artefacts, two cultural occupations were recognized extending over a period of approximately 200 years. A re-analysis of the faunal material was undertaken to better understand lifeways of the people who inhabited Block E and how these occupations compared to similar cultural sites.

This thesis had several research goals. First and foremost was to gain information from the analysis of the faunal material from the Vickers Focus and Blackduck occupation levels. Previous considerations necessitated an in-depth examination of taphonomic forces that may have altered the Block E occupations over time. The final intent was to discover and contribute information on subsistence strategies for both cultural groups.

The re-analysis of the faunal material identified numerous inaccuracies in element identification, including element location, siding, and species identification. Changes

were made to specimens not identifiable that were previously listed as identifiable and similarly non-identified bones were identified through comparison to the University of Saskatchewan faunal collection. The MNI of various landmarks and elements were changed. This included the MNI for the tibia, which was used for the MNI of the assemblage. The variety of exploited species also changed with the re-analysis. Some specimens were identified to the species level, while other specimens were found to represent a different class entirely. Specimens originally identified as avian actually represented a mammal species.

Many bone tools were subsequently ruled out due to lack of conclusive evidence. In some instances, taphonomic forces may also create what could be considered signs of cultural utilization. The most positive result of the re-analysis was the identification of the ice-glider. This object not only added information on the seasonality of the site, but also gave insight into the lives of the people beyond simply the utilitarian nature of the faunal assemblage.

The faunal analysis clearly shows that the subsistence strategies of both groups were heavily focused on bison. In addition to bison comprising the vast majority of faunal remains, both groups also heavily processed bones. Processing was likely taking place in or near the Excavated areas of Block E. It is also possible that taphonomic forces have destroyed cultural features associated with boiling or grease removal. Additional faunal species were also recovered, including canid, leporids and other small mammals. The inhabitants likely exploited these species, although only canid elements exhibited any evidence of butchering.

The season of occupation was more decisively supported based in part on the presence of foetal remains, dental studies and recreational artefacts (from the Vickers Focus level), suggesting the sites were both occupied from late fall and into the winter months. An absence of avian species may also support this season of occupation.

Analysis showed that natural and cultural taphonomic forces were quite active on the Lovstrom Block E assemblage. It is possible that certain bone clusters discarded as articulated limb segments were scattered horizontally by various taphonomic forces. There is also the possibility of vertical movement of faunal material. The recovery of small quantities of species rarely found in the Tiger Hills region (e.g. fisher) from both occupation levels would suggest some vertical mixing occurred. Although there is believed to be some disturbance, the site is still fairly intact with two identifiable cultural levels. Both occupation levels were found to represent processing/occupation areas.

A main objective of this thesis was the addition of information on the Vickers Focus butchering and subsistence practices to the previous study by Playford (2001). The diet of the eastern and western groups was focused on the exploitation of *Bison bison*, including both male and female animals. Both groups employed a smashing and stripping butchering method, although cut marks found on an occipital fragment and other elements suggest the Eastern Vickers Focus groups were cutting away mandibles and other soft tissue. The presence of distinct cut marks found in only one site may suggest a change or difference in butchering practices. An increased amount of processing of low meat value material, specifically phalanges, was observed in the Jackson site assemblage. It is unknown if this is a difference in butchering practices or an increase in dietary stress levels.

A final issue remains unanswered. The Vickers Focus subsistence strategy was believed to have changed from a mixed horticulture and foraging subsistence strategy to a more plains-based economy as the groups moved west. Unfortunately, the analysis of faunal material is not a suitable method of distinguishing a change from the utilization of horticulture.

The location of the Block E site in a sheltered area of the overall Lovstrom site was a suitable location as a wintering site, a refuge from the exposed prairie landscape. The faunal analysis supports the use of the site as an extended late fall and winter occupation. Although the Lovstrom site was considered to be a warm season locale (Nicholson and Hamilton 2001:61), the location of the winter occupation of Block E in the sheltered northern portion of the larger site may indicate it was a convenient refuge from the southern areas of the Lovstrom site or from other outlying regions. After the cold winter season the people moved away from the shelter of Block E. As proposed by Nicholson and Hamilton (2001:61), the Vickers Focus group may have used Block E as a logistical location from a larger central campsite, such as the Lowton site. Finally, the recovery of the ice-glider indicates this was not simply a story of survival for the Vickers Focus during the cold winter months.

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Appendices

Appendix A
Faunal Species of the Tiger Hills Region

Table 2: Mammalian Species

| Latin Name | Common Name |
|------------------------------|--|
| Mammals | |
| Antilocapridae | Pronghorn |
| <i>Antilocapra americana</i> | Pronghorn (Antelope) |
| Bovidae | Bison, Goats, Muskox, and Sheep |
| <i>Bison bison</i> | American Bison |
| Canidae | Dogs, Foxes, and Wolves |
| <i>Canis familiaris</i> | Domestic Dog |
| <i>Canis latrans</i> | Coyote |
| <i>Canis lupus</i> | Gray Wolf |
| <i>Canis lupus nubilus</i> | Buffalo Wolf |
| <i>Vulpes vulpes</i> | Red Fox |
| <i>Vulpes velox</i> | Swift Fox |
| Castoridae | Beaver |
| <i>Castor canadensis</i> | American Beaver |
| Cervidae | Deer |
| <i>Alces alces</i> | Moose |
| <i>Cervus elaphus</i> | Elk/Wapiti |
| <i>Odocoileus hemionus</i> | Mule Deer |

Odocoileus virginianus

Whitetail Deer

Cricetidae

Rats, Mice, and Voles

Microtus ochrogaster

Prairie Vole

Microtus pennsylvanicus

Meadow Vole

Ondatra zibethicus

Muskrat

Onychomys leucogaster

Northern Grasshopper Mouse

Peromyscus maniculatus

Deer Mouse

Erethizontidae

New World Porcupines

Erethizon dorsatum

Porcupine

Felidae

Cats

Lynx canadensis

Lynx

Lynx rufus

Bobcat

Geomyidae

Pocket gophers

Thomomys talpoides

Northern Pocket Gopher

Leporidae

Rabbits and Hares

Lepus americanus

Snowshoe Hare

Lepus townsendii

Whitetail Jackrabbit

Sylvilagus floridanus

Eastern Cottontail

Mustelidae

Weasels

Lutra canadensis

River Otter

Mephitis mephitis

Striped Skunk

Mustela erninea

Short tail Weasel (Ermine)

Mustela frenata

Long tail Weasel

Mustela rixosa

Least Weasel

Mustela vison

American Mink

Taxidea taxus

American Badger

Procyonidae

Raccoons and their Allies

Procyon lotor

Raccoon

Sciuridae

Ground Squirrels

Citellus franklini

Franklin Ground Squirrel

Citellus richardsoni

Richardson Ground Squirrel

Citellus tridecemlineatus

Thirteen-Lined Ground Squirrel

Eutamias alpinus

Alpine Chipmunk

Glaucomys sabrinus

Northern Flying Squirrel

Marmota monax

Woodchuck

Sciurus carolinensis

Eastern Gray Squirrel

Tamiasciurus hudsonicus

Red Squirrel

Soricidae

Shrews

Blarina brevicauda

Shorttail Shrew

Mircosorex hoyi

Pygmy Shrew

Sorex arcticus

Arctic Shrew

Sorex cinereus

Masked Shrew

Ursidae

Bears

Ursus americanus

Black Bear

Vespertillionidae

Bats

Eptesicus fuscus

Big Brown Bat

Lasionycteris noctivagans

Silver-Haired Bat

Lasiurus borealis

Red Bat

Lasiurus cinereus

Hoary Bat

Myotis keeni

Keen Myotis

Myotis lucifugus

Little Brown Myotis

Table 2: Reptilian and Amphibians Species

Ambystomidae

Mole Salamanders

Ambystomia tigrinum diaboli

Gray/Eastern Tiger Salamander

Bufonidae

Toads

Bufo americanus charlesmithi

Dwarf American Toad

Chelydridae

Snapping Turtles

Chelydra serpentina

Snapping Turtle

Colubridae

Garter Snakes and their Allies

Heterodon nasicus

Western Hog-Nosed Snake

Opheodrys vernalis

Western Smooth-Green Snake

Storeria occipitomaculata

Northern Red-Bellied Snake

Thamnophis rasix

Plains Garter Snake

Thamnophis sirtalis parietalis

Red-Sided Garter Snake

Hylidae

Tree frogs and their Allies

Hyla versicolor

Gray Tree frog

Pseudacris triseriata maculata

Boreal Chorus Frog

Pelobatidae

Spadefoot Toads

Scaphiopus bombifrons

Plains Spadefoot Toad

Ranidae

True Frogs

Rana pipiens pipiens

Northern Leopard Frog

Rana sylvatica

Wood Frog

Scinidae

Skinks

Eumeces septentrionalis septentrionalis

Northern Prairie Skink

Tesudinidae

Box and Water Turtles

Chrysemys picta belli

Western Painted Turtle

Table 3: Piscine Species

Cadidae

Lota lota

Cod

Burbot

Catostomidae

Catostomus catostomus

Catostomus commersoni

Moxostoma anisurum

Moxostoma macrolepidotum

Sucker

Longnose Sucker

White Sucker

Silver Redhorse

Shorthead Redhorse

Centrarchidae

Ambloplites rupestris

Sunfish

Rock Bass

Coregoninae

Coregonus clupeaformis

Whitefish

Lake Whitefish

Cottidae

Cottus cognatus

Sculpin

Slimy Sculpin

Cyprinidae

Couesius plumbeus

Hybognathus hankinsoni

Notropis atherinoides

Notropis blennioides

Notemigonus crysoleucas

Minnow and Carp

Lake Chub

Brassy Minnow

Emeral Shiner

River Shiner

Golden Shiner

| | |
|--------------------------------|-----------------------|
| <i>Notropis cornutus</i> | Common Shiner |
| <i>Notropis heterolepis</i> | Blacknose Shiner |
| <i>Notropis hudsonius</i> | Spottail Shiner |
| <i>Notropis Stramineus</i> | Sand Shiner |
| <i>Pimephales promelas</i> | Fathead Minnow |
| <i>Platygobio gracilis</i> | Flathead Chub |
| <i>Rhinichthys atratulus</i> | Blacknose Dace |
| <i>Rhinichthys cataractae</i> | Longnose Dace |
| <i>Semotilus atromaculatus</i> | Creek Chub |
| <i>Semotilus margarita</i> | Pearl Dace |
| Esocidae | Pike |
| <i>Esox lucius</i> | Northern Pike |
| Gasterosteidae | Stickleback |
| <i>Culaea inconstans</i> | Brook Stickleback |
| <i>Pungitius pungitius</i> | Ninespine Stickleback |
| Hiodontidae | Mooneye |
| <i>Hiodon alosoides</i> | Goldeye |
| <i>Hiodon tergisus</i> | Mooneye |
| Ictaluridae | Catfish |
| <i>Ictalurus nebulosus</i> | Brown Bullhead |
| <i>Noturus gyrinus</i> | Tadpole Madtom |

Percidae*Etheostoma exile**Etheostoma nigrum**Perca flavescens**Percina maculata**Stizostedion canadense**Stizostedion vitreum***Percopsidae***Percopsis omiscomaycus***Salmonidae***Salmo gairdneri***Perch**

Iowa Darter

Johnny Darter

Yellow Perch

Blackside Darter

Sauger

Walley

Trout-Perch

Trout-Perch

Salmon

Rainbow Trout

Table 4: Avian Species**Accipitridae***Accipiter cooperii**Accipiter gentilis**Accipiter striatus**Aquila chrysaetos**Buteo jamaicensis**Buteo lagopus***Ospreys, Eagles, hawks and their Allies**

Cooper's Hawk

Goshawk

Sharp-Shinned Hawk

Golden Eagle

Red-Tailed Hawk

Rough-Legged Hawk

Buteo regalis

Ferruginous Hawk

Buteo swainsoni

Swainson's Hawk

Circus cyaneus

Northern Harrier

Pandion haliaetus

Osprey

Alcedinidae

Kingfishers

Ceryle alcyon

Belted Kingfisher

Anatidae

Seans. Geese and Ducks

Aix sponsa

Wood Duck

Anas acuta

Northern Pintail

Anas americana

American Wigeon

Anas clypeata

Northern Shovel

Anas discors

Blue-Winged Teal

Anas platyrhynchos

Mallard

Anas strepera

Gadwall

Anser caerulescens

Snow Goose

Aythya affinis

Lesser Scaup

Aythya americana

Redhead

Aythya collaris

Ring-Necked Duck

Aythya valisineria

Canvasback

Branta canadensis

Canada Goose

Bucephala albeola

Bufflehead

Bucephala clangula

Common Goldeneye

Lophodytes cucullatus

Hooded Merganser

Melanitta deglandi

White-winged Scoter

Mergus merganser

Common Merganser

Oxyura jamaicensis

Ruddy Duck

Spatula clypeata

Shoveler

Apodidae

Swifts

Chaetura pelagica

Chimney Swift

Ardeidae

Hérons and Bitterns

Ardea herodias

Great Blue Heron

Botaurus lentiginosus

American Bittern

Ixobrychus exilis

Least Bittern

Mycticorax nycticorax

Black-Crowned Night heron

Bombycillidae

Waxwings

Bombycilla cedrorum

Cedar Waxwing

Caprimulgidae

Goatsuckers

Caprimulgus vociferus

Whip-Poor-Will

Chordeiles minor

Common Nighthawk

Cathartidae

American Vultures

Cathartes aura

Turkey Vulture

Certhiidae*Certhia americana***Charadriidae***Charadrius vociferus***Columbidae***Columba livia**Zenaida macroura***Corvidae***Corvus brachyrhynchos**Corvus corax**Cyanocitta cristata**Pica pica***Cuculidae***Coccyzus erythrophthalmus***Emberizidae***Agelaius phoeniceus**Ammodramus bairdii**Ammodramus caudacutus**Ammodramus leconteii***Creepers**

Brown Creeper

Plovers

Killdeer

Pigeons and Doves

Rock Dove

Mourning Dove

Jays, Magpies, and Crows

American Crow

Common Raven

Blue Jay

Black-billed Magpie

Cuckoos, Roadrunners and Anis

Black-Billed Cuckoo

Sparrows and their Allies

Red-Winged Blackbird

Baird's Sparrow

Sharp-Tailed Sparrow

Le Conte's Sparrow

| | |
|--------------------------------|----------------------------|
| <i>Ammodramus savannarum</i> | Grasshopper Sparrow |
| <i>Calamospiza melanocorys</i> | Lark Bunting |
| <i>Calcarius lapponicus</i> | Lapland Longspur |
| <i>Calcarius ornatus</i> | Chestnut-Collared Longspur |
| <i>Chondestes grammacus</i> | Lark Sparrow |
| <i>Dendroica costanea</i> | Bay-Breasted Warbler |
| <i>Dendroica coronata</i> | Yellow-Rumped Warbler |
| <i>Dendroica fusca</i> | Blackburnian Warbler |
| <i>Dendroica palmarum</i> | Palm Warbler |
| <i>Dendroica petechia</i> | Yellow Warbler |
| <i>Dendroica Striata</i> | Blackpoll Warbler |
| <i>Dolichonyx oryzivorus</i> | Boblink |
| <i>Euphagus cyanocephalus</i> | Brewer's Blackbird |
| <i>Geothlypis trichas</i> | Common Yellowthroat |
| <i>Icterus galbula</i> | Northern Oriole |
| <i>Icterus spurius</i> | Orchard Oriole |
| <i>Junco hyemalis</i> | Dark-Eyed Junco |
| <i>Melospiza georgiana</i> | Swamp Sparrow |
| <i>Melospiza lincolnii</i> | Lincoln's Sparrow |
| <i>Melospiza melodia</i> | Song Sparrow |
| <i>Mniotilta varia</i> | Black and White Warbler |
| <i>Molothrus ater</i> | Brown-Headed Cowbird |
| <i>Oporonis philadelphia</i> | Mourning Warbler |

| | |
|--------------------------------------|-------------------------|
| <i>Passerculus sandwichensis</i> | Savannah Sparrow |
| <i>Passerina cyanea</i> | Indigo Bunting |
| <i>Pheucticus ludovicianus</i> | Rose-Breasted Grosbeak |
| <i>Pipilo erythrophthalmus</i> | Rufous-Sided Towhee |
| <i>Piranga olivacea</i> | Scarlet Tanager |
| <i>Pooecetes gramineus</i> | Vesper Sparrow |
| <i>Quiscalus quiscula</i> | Common Blackbird |
| <i>Seiurus aurocapillus</i> | Ovenbird |
| <i>Seiurus noveboracensis</i> | Northern Waterthrush |
| <i>Setophaga ruticilla</i> | American Redstart |
| <i>Spiza americana</i> | Dickcissel |
| <i>Spizella pallida</i> | Clay-Coloured Sparrow |
| <i>Spizella passerina</i> | Chipping Sparrow |
| <i>Sturnella neglecta</i> | Western Meadowlark |
| <i>Vermivora celata</i> | Orange-Crowned warbler |
| <i>Vermivora peregrina</i> | Tennessee Warbler |
| <i>Wilsonia pusilla</i> | Wilson's Warbler |
| <i>Xanthocephalus xanthocephalus</i> | Yellow-Headed Blackbird |
| <i>Zonotrichia albicollis</i> | White-Throated Sparrow |
| <i>Zonotrichia leucophrys</i> | White-Crowned Sparrow |
| <i>Zonotrichia querula</i> | Harris's Sparrow |

Falconidae*Falco columbarius**Falco peregrinus**Falco sparverius***Fringillidae***Carduelis pinus**Carduelis tristis**Carpodacus purpureus**Passer domesticus***Gaviidae***Gavia immer***Gruidae***Grus canadensis***Maematopodidae***Recurvirostra americana***Hirundinidae***Hirundo pyrrhonota**Hirundo rustica**Progne subis**Riparia riparia***Caracaras and Falcons**

Merlin (Pigeon Hawk)

Peregrine Falcon

American Kestrel (Sparrow Hawk)

Finches

Pine Siskin

American Goldfinch

Purple Finch

House Sparrow

Loons

Common Loon

Cranes

Sandhill Crane

Oystercatchers

American Avocet

Swallows

Cliff Swallow

Barn Swallow

Purple Martin

Bank Swallow

Stelgidopteryx serripennis

Northern Rough-Winged Swallow

Tachycineta bicolor

Tree Swallow

Laniidae

Shrikes

Lanius ludovicianus

Loggerhead Shrike

Laridae

Skuas, Gulls, Terns, and Skimmers

Chlidonias niger

Black Tern

Larus argentatus

Herring Gull

Larus californicus

California Gull

Larus delawarensis

Ring-Billed Gull

Larus philadelphia

Bonaparte's Gull

Larus pipixcan

Franklin's Gull

Sterna forsteri

Forster's Tern

Sterna hirundo

Common Tern

Mimidae

Mockingbirds and Thrashers

Dumetella carolinensis

Gray Catbird

Toxostoma rufum

Brown Thrasher

Motaciliidae

Wagtails and Pipits

Anthus spragueii

Sprague's Pipit

Muscicoidae

Kinglets, Thrushes, and their Allies

Catharus fuscescens

Veery

Catharus ustulatus

Regulus calendula

Sialia currocoides

Sialia sialis

Turdus migratorius

Paridae

Parus atricapillus

Pelecanidae

Pelecanus erythrorhynchos

Phalacrocoracidae

Phalacrocorax

Phasianidae

Bonasa umbellus

Meleagris gallopavo

Perdix perdix

Phasianus colchicus

Tympanuchus cupido

Tympanuchus phasianellus

Picidae

Colaptes auratus

Swainson's Thrush

Ruby-Crowned Kinglet

Mountain Bluebird

Eastern Bluebird

American Robin

Titmouse

Black-Capped Chickadee

Pelicans

American White Pelican

Cormorants

Double-Crested Cormorant

Partridges, Pheasants and their Allies

Ruffed Grouse

Wild Turkey

Gray Partridge

Ring-Necked Pheasant

Greater Prairie Chicken

Sharp-Tailed Grouse

Woodpeckers and Wrynecks

Northern Flicker

Dryocopus pileatus

Pileated Woodpecker

Melanerpes erythrocephalus

Red-Headed Woodpecker

Picoides pubescens

Downy Woodpecker

Picoides villosus

hairy Woodpecker

Sphyrapicus varius

Yellow-Bellied Sapsucker

Podicipedidae

Grebes

Aechmophorus occidentalis

Western Grebe

Podiceps auritus

Horned Grebe

Podiceps caspicus

Eared Grebe

Podiceps grisegena

Red-Necked Grebe

podilymbus podiceps

Pied-Billed Grebe

Rallidae

Rails, Gallinules, and Coots

Fulica americana

Spotted Sandpiper

Porzana carolina

Sora

Scolopacidae

Sandpipers, Phalaropes, and their Allies

Actitis macularia

Spotted Sandpiper

Bartramia longicauda

Upland Sandpiper

Calidris alba

Sanderling

Calidris bairdii

Baird's Sandpiper

Calidris fuscicollis

White-Rumped Sandpiper

Calidris himantopus

Stilt Sandpiper

Calidris melanotos

Pectoral Sandpiper

Calidris minutilla

Least Sandpiper

Calidris pusilla

Semipalmated Sandpiper

Catoptrophorus semipalmatus

Willet

Gallinago gallinago

Common Snipe

Limnodromus scolopaceus

Long-Billed Dowitcher

Limosa fedoa

Marbled Godwit

Numenius americanus

Long-Billed Curlew

Phalaropus tricolor

Wilson's Phalarope

Tringa flavipes

Lesser Yellowlegs

Tringa melanoleuca

Greater Yellowlegs

Tringa solitaria

Solitary Sandpiper

Strigidae

Typical Owls

Aegolius acadicus

Saw-Whet Owl

Asio otus

Long-Eared Owl

Asio flammeus

Short-Eared Owl

Bubo virginianus

Great Horned Owl

Otus asio

Screech Owl

Speotyto cunicularia

Burrowing Owl

Sturnidae

Starlings

Sturnus vulgaris

Common Starling

Trochilidae*Archilochus clubris***Troglodytidae***Cistothorus platensis**Troglodytes aedon***Tyrannidae***Contopus borealis**Contopus virens**Contopus sordidulus**Empidonax alnorum**Empidonax minimus**Empidonax Traillii**Myiarchus crinitus**Sayornis phoebe**Sayornis saya**Tyrannus tyrannus**Tyrannus verticalis***Vireonidae***Vireo flavifrons**Vireo gilvus**Vireo olivaceus***Hummingbirds**

Ruby-Throated Hummingbird

Wrens

Marsh Wren

House Wren

Tyrant Flycatchers

Olive-Sided Flycatcher

Eastern Wood-Pee wee

Western Wood-Pee wee

Alder Flycatcher

Least Flycatcher

Willow Flycatcher

Great Crested Flycatcher

Eastern Phoebe

Say's Phoebe

Eastern Kingbird

Western Kingbird

Vireos

Yellow-Throated Vireo

Warbling Vireo

Red-Eyed Vireo

Vireo philadelphicus

Philadelphia Vireo

Vireo solitarius

Solitary Vireo

Appendix B

Blackduck Radiocarbon Dates

Table 1: Radiocarbon dates of Blackduck sites in Southern Manitoba
(Source: Hamilton et al. 2007:98-99)

| # | Site | Borden | Lab No. | ¹⁴ C date (BP) | 1 σ | $\delta^{13}\text{C}$ (‰) | Source | Material | Comment |
|-----|---------------|---------|--------------|---------------------------|------------|---------------------------|---------------------------|----------------------------|--------------------|
| 58 | Aschibokahn | FbMb-1 | GX-5517 | 770 | 110 | -25 | Morlan <i>et al.</i> 2000 | charcoal | Blackduck/Duck Bay |
| 60 | Aschibokahn | FbMb-1 | GX-5516 | 695 | 175 | -25 | Morlan <i>et al.</i> 2000 | charcoal | Blackduck/Duck Bay |
| 55 | Bjorklund | EaLa-3 | GX-4142 | 1003 | 125 | -20 | Morlan <i>et al.</i> 2000 | land and water mammals | Blackduck |
| 56 | Bjorklund | EaLa-3 | Gx-4143 | 1000 | 105 | -19 | Morlan <i>et al.</i> 2000 | red fox bone collagen | Blackduck |
| 57 | Bjorklund | EaLa-3 | Gx-4146 | 815 | 120 | -20 | Morlan <i>et al.</i> 2000 | beaver/moose bone collagen | Blackduck/Duck Bay |
| 59 | Bjorklund | EaLa-3 | GaK-4712 | 700 | 80 | -20 | Morlan <i>et al.</i> 2000 | moose bone collagen | Blackduck |
| 7 | Calf Mountain | DhLo-1 | GX-1192 | 1185 | 85 | -20 | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck? |
| 3 | Gompf | DkMd-3 | S-1367 | 1220 | 75 | -20 | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck |
| 15 | Gompf | DkMd-3 | S-1366 | 1100 | 65 | -20 | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck |
| 20 | Gompf | DkMd-3 | S-1368 | 1070 | 75 | -20 | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck |
| 16 | Gosselin | DiLv-30 | TO-11672 | 1090 | 60 | | | bone collagen | Blackduck |
| 19 | Gosselin | DiLv-30 | TO-11671 | 1070 | 60 | | | pot residue | Blackduck |
| 38 | Heron Site | DiLv-14 | S-3460 | 660 | 100 | -20 | Morlan <i>et al.</i> 2000 | bison bone collagen | Blackduck? |
| 2 | Hokanson | DiLv-29 | TO-9770 | 1370 | 80 | | | bison bone collagen | Blackduck |
| 6a | Hokanson | DiLv-29 | TO-11676* | 1190 | 50 | | | bison bone collagen | Blackduck |
| 10 | Hokanson | DiLv-29 | TO-9772 | 1160 | 50 | | | bison bone collagen | Blackduck |
| 11 | Hokanson | DiLv-29 | TO-11675 | 1160 | 50 | | | bison bone collagen | Blackduck |
| 14 | Hokanson | DiLv-29 | TO-9773 | 1110 | 50 | | | bison bone collagen | Blackduck |
| 17 | Hokanson | DiLv-29 | TO-9771 | 1080 | 50 | | | bison bone collagen | Blackduck |
| 18 | Hokanson | DiLv-29 | TO-9769 | 1070 | 70 | | | bison bone collagen | Blackduck |
| 21 | Hokanson | DiLv-29 | TO-9243 | 1050 | 50 | | | bison bone collagen | Blackduck |
| 23 | Hokanson | DiLv-29 | TO-9775 | 960 | 50 | | | bison bone collagen | Blackduck |
| 6b | Hokanson | DiLv-29 | Beta-200613* | 960 | 40 | -19.7 | | bison bone collagen | Blackduck |
| 27 | Hokanson | DiLv-29 | TO-9774 | 920 | 50 | | | bison bone collagen | Blackduck |
| 24a | Hokanson | DiLv-29 | Beta 202929 | 920 | 50 | | | bison bone collagen | Blackduck |
| 28 | Hokanson | DiLv-29 | TO-9776 | 900 | 40 | | | bison bone collagen | Blackduck |
| 24b | Hokanson | DiLv-29 | Beta 202930 | 900 | 50 | | | bison bone collagen | Blackduck |
| 24c | Hokanson | DiLv-29 | Beta 202928 | 680 | 50 | | | bison bone collagen | Blackduck |
| 39 | Jackson | DiMe-17 | Beta-65952 | 620 | 65 | -20 | Morlan <i>et al.</i> 2000 | bison bone collagen | Blackduck? |
| 44 | Lockport | EaLf-1 | S-2853 | 1095 | 250 | -25 | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck |
| 45 | Lockport | EaLf-1 | S-2851 | 1005 | 280 | -25 | Morlan <i>et al.</i> 2000 | charcoal | Blackduck |

| | | | | | | | | | |
|----|------------------|---------|------------|------|-----|-------|---------------------------|---------------------|-----------------------|
| 48 | Lockport | EaLf-1 | S-2849 | 635 | 90 | -25 | Morlan <i>et al.</i> 2000 | charcoal | Blackduck+ |
| 49 | Lockport | EaLf-1 | GX-10866 | 620 | 105 | -25 | Morlan <i>et al.</i> 2000 | charcoal | Blackduck |
| 51 | Lockport | EaLf-1 | S-2850 | 470 | 270 | -25 | Morlan <i>et al.</i> 2000 | charcoal | Blackduck+ |
| 41 | Lord | DkLg-1 | S-652 | 1250 | 90 | -20 | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck |
| 26 | Lovstrom | DjLx-1 | S-3029 | 930 | 115 | -20 | Morlan <i>et al.</i> 2000 | Bison bone collagen | Blackduck |
| 29 | Lovstrom | DjLx-1 | S-3031 | 860 | 110 | -20 | Morlan <i>et al.</i> 2000 | Bison bone collagen | Blackduck |
| 31 | Lovstrom | DjLx-1 | S-3034 | 795 | 110 | -20 | Morlan <i>et al.</i> 2000 | Bison bone collagen | Blackduck |
| 32 | Lovstrom | DjLx-1 | S-2951 | 785 | 80 | -20 | Morlan <i>et al.</i> 2000 | Bison bone collagen | Blackduck |
| 34 | Lovstrom | DjLx-1 | S-2952 | 755 | 75 | -20 | Morlan <i>et al.</i> 2000 | Bison bone collagen | Blackduck |
| 35 | Lovstrom | DjLx-1 | S-2953 | 755 | 80 | -20 | Morlan <i>et al.</i> 2000 | Bison bone collagen | Blackduck |
| 25 | Papegnies | DiLw-6 | Beta 62706 | 950 | 75 | -20 | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck |
| 22 | Richards village | DhLw-1 | S-913 | 1000 | 65 | -20 | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck |
| 4 | Stott | DiMa-1 | GX-5139 | 1200 | 135 | | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck |
| 5 | Stott | DiMa-1 | GX-5142 | 1200 | 135 | | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck |
| 8 | Stott | DiMa-1 | SFU-229 | 1180 | 150 | -20 | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck |
| 9 | Stott | DiMa-1 | SFU-224 | 1180 | 150 | -20 | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck |
| 12 | Stott | DiMa-1 | S-2319 | 1130 | 95 | -20 | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck |
| 13 | Stott | DiMa-1 | S-2318 | 1120 | 90 | -20 | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck |
| 30 | Stott | DiMa-1 | GX-5176 | 820 | 130 | | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck |
| 33 | Stott | DiMa-1 | GX-5175 | 780 | 105 | | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck |
| 36 | Stott | DiMa-1 | GX-5174 | 740 | 105 | | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck |
| 37 | Stott | DiMa-1 | GX-5141 | 715 | 140 | | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck |
| 1 | Stott Mound | DiMa-1 | S-1303 | 1460 | 65 | -19 | Morlan <i>et al.</i> 2000 | human bone collagen | Blackduck? |
| 40 | The Forks | DiLg-33 | S-2564 | 1440 | 165 | -25 | Morlan <i>et al.</i> 2000 | charcoal | Blackduck |
| 42 | The Forks | DiLg-33 | S-2563 | 1225 | 160 | -25 | Morlan <i>et al.</i> 2000 | charcoal | Blackduck |
| 43 | The Forks | DiLg-33 | S-2565 | 1105 | 160 | -25 | Morlan <i>et al.</i> 2000 | charcoal | Blackduck |
| 46 | The Forks | DiLg-33 | BCS-1372 | 695 | 100 | -23.6 | Morlan <i>et al.</i> 2000 | bone collagen | Rainy River/Blackduck |
| 47 | The Forks | DiLg-33 | BCS-1373 | 650 | 90 | -23.6 | Morlan <i>et al.</i> 2000 | bone collagen | Rainy River/Blackduck |
| 50 | The Forks | DiLg-33 | BCS-1460 | 600 | 70 | -23.6 | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck |
| 52 | Wanipigow | EgKx-1 | GX-4689 | 1340 | 155 | -10 | Morlan <i>et al.</i> 2000 | burned bone apatite | Blackduck |
| 54 | Wanipigow | EgKx-1 | GX-4691 | 1060 | 180 | -10 | Morlan <i>et al.</i> 2000 | burned bone apatite | Blackduck |
| 53 | Wapisu | GkLs-1 | GaK-6495 | 1090 | 120 | -25 | Morlan <i>et al.</i> 2000 | charcoal | Blackduck |
| 61 | Wuskwatim | GjLp-3 | S-1080 | 570 | 90 | -20 | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck |
| 62 | Wuskwatim | GjLp-3 | S-1076 | 550 | 75 | -20 | Morlan <i>et al.</i> 2000 | bone collagen | Blackduck |

* Sample split and tested at both Isotrace and Beta Analytic. The causes of this dramatic interlab variability are still being addressed.

Appendix C
***Bison bison* Element Counts**

Table 3: Bison bison element counts for Occupation 1 and Occupation 2.

| | Occupation 1 | | | | Occupation 2 | | | |
|--------------------------|--------------|---|--------------|----------|--------------|----|--------------|----------|
| | L | R | Total MAU | % MAU | L | R | Total MAU | % MAU |
| Cranium | | | | | | | | |
| Frontal | 0 | | 0 | 0 | | 1 | 0.5 | 6.7 |
| Horn core | 0 | | 0 | 0 | | | 0 | 0 |
| Parietal | 0 | | 0 | 0 | | | 0 | 0 |
| Occipital | 1 | | 0.5 | 12.5 | | 1 | 0.5 | 6.7 |
| Occipital condyle | 0 | | 0 | 0 | | 1 | 0.5 | 6.7 |
| Squamous temporal | 0 | | 0 | 0 | | | 0 | 0 |
| Petrous temporal | 1 | | 0.5 | 12.5 | 1 | 2 | 1.5 | 20 |
| Zygomatic temporal | 0 | | 0 | 0 | | | 0 | 0 |
| Auditory meatus | 0 | | 0 | 0 | | | 0 | 0 |
| Zygomatic | 0 | | 0 | 0 | | 1 | 0.5 | 6.7 |
| Nasal | 0 | | 0 | 0 | 1 | 2 | 1.5 | 20 |
| Maxilla | 0 | | 0 | 0 | | | 0 | 0 |
| Premaxilla | 1 | 1 | 1 | 25 | | 1 | 0.5 | 6.7 |
| 2nd premolar | 1 | | 0.5 | 12.5 | 3 | 1 | 2 | 27 |
| 3rd premolar | 0 | | 0 | 0 | 1 | 1 | 1 | 13.3 |
| 4th premolar | 0 | | 0 | 0 | | 1 | 0.5 | 6.7 |
| 1st molar | 3 | 1 | 2 | 50 | 3 | 2 | 2.5 | 33.3 |
| 2nd molar | 0 | | 0 | 0 | 1 | 2 | 1.5 | 20 |
| 3rd molar | 1 | 2 | 1.5 | 37.5 | 1 | | 0.5 | 6.7 |
| | 0 | | | | | | | |
| Mandible | 0 | | | | | | | |
| Coronoid process (DN8) | 2 | 3 | 2.5 | 62.5 | 4 | | 2 | 27 |
| Condylar process (DN7) | 3 | 1 | 2 | 50 | 1 | 2 | 1.5 | 20 |
| Ramus (DN6) | 1 | 2 | 1.5 | 37.5 | 2 | 1 | 1.5 | 20 |
| Mandibular foramen (DN7) | 2 | 2 | 2 | 50 | 1 | | 0.5 | 6.7 |
| Mental foramen (DN2) | 1 | 1 | 1 | 25 | 2 | 2 | 2 | 27 |
| Diastema (DN2) | 0 | | 0 | 0 | 1 | 1 | 1 | 13.3 |
| Symphysis (DN1) | 1 | 1 | 1 | 25 | 2 | 1 | 1.5 | 20 |
| Incisor/Canine | 4 | 4 | 1 | 25 | 1 | 1 | 1 | 13.3 |
| 2nd premolar (DN3) | 0 | | 0 | 0 | | 1 | 0.5 | 6.7 |
| 3rd premolar (DN3) | 1 | | 0.5 | 12.5 | 1 | 1 | 1 | 13.3 |
| 4th premolar (DN4) | 0 | 1 | 0.5 | 12.5 | 2 | 2 | 2 | 27 |
| 1st molar (DN4) | 2 | 3 | 2.5 | 62.5 | 2 | 2 | 2 | 27 |
| 2nd molar (DN5) | 1 | 2 | 1.5 | 37.5 | 1 | 1 | 1 | 13.3 |
| 3rd molar (DN5) | 0 | 3 | 1.5 | 37.5 | 4 | 3 | 3.5 | 46.7 |
| | 0 | | | | | | | |
| Hyoid (Hyoid) | 1 | | 0.5 | 12.5 | | | 0 | 0 |
| | 0 | | | | | | | |
| Rib | 0 | | | | | | | |
| Head (RI1) | 1 | | 0.04 | 1 | | 2 | 0.07 | 1 |
| Tubercle (RI2) | 0 | | 0 | 0 | | | 0 | 0 |
| Body (RI3) | 12 | 9 | 0.14 | 3.5 | 13 | 15 | 1 | 13.3 |
| | 0 | | | 0 | | | | |

| | | | | | | | |
|--------------------------|---|------|------|---|---|------|------|
| Atlas | 0 | | 0 | | | | |
| Prezygopophysis (AT3) | 1 | 1 | 25 | 2 | | 2 | 26.7 |
| Postzygopophysis (AT3) | 0 | 0 | 0 | 2 | | 2 | 26.7 |
| Alar foramen (AT2) | 1 | 1 | 25 | 2 | | 2 | 26.7 |
| Dorsal tubercle (AT1) | | 0 | 0 | 2 | | 2 | 26.7 |
| Centrum (AT1) | | 0 | 0 | 2 | | 2 | 26.7 |
| Axis | | | | | | | |
| Prezygopophysis | 2 | 2 | 50 | 1 | 1 | 1 | 13.3 |
| Postzygopophysis (AX3) | 1 | 1 | 25 | | | 0 | 0 |
| Spinous process (AX2) | 1 | 1 | 25 | | | 0 | 0 |
| Dens (AX1) | 2 | 2 | 50 | 1 | 1 | 1 | 13.3 |
| Centrum (AX2) | 2 | 2 | 50 | 1 | 1 | 1 | 13.3 |
| Cervical | | | | | | | |
| Prezygopophysis (CE2) | | 0 | 0 | 5 | | 0.5 | 6.7 |
| Postzygopophysis (CE1) | | 0 | 0 | 4 | | 0.4 | 5.3 |
| Neural arch | | 0 | 0 | 3 | | 0.6 | 8 |
| Neural spine | | 0 | 0 | 2 | | 0.4 | 5.3 |
| Transverse process | | 0 | 0 | 1 | | 0.2 | 2.7 |
| Centrum (CE2) | | 0 | 0 | 3 | | 0.6 | 8 |
| Thoracic | | | | | | | |
| Prezygopophysis | 1 | 0.07 | 1.74 | | | 0 | 0 |
| Postzygopophysis | 1 | 0.07 | 1.75 | 1 | | 0.07 | 1 |
| Neural arch | 1 | 0.07 | 1.75 | | | 0 | 0 |
| Neural spine (TH2) | 7 | 0.5 | 12.5 | 8 | | 0.29 | 3.9 |
| Transverse process | | 0 | 0 | | | 0 | 0 |
| Centrum (TH1) | 1 | 0.07 | 1.75 | | | 0 | 0 |
| Lumbar | | | | | | | |
| Prezygopophysis (LU1) | | 0 | 0 | | | 0 | 0 |
| Postzygopophysis (LU2) | 1 | 0.2 | 5 | 2 | | 0.4 | 5.3 |
| Neural arch | | 0 | 0 | | | 0 | 0 |
| Transverse process (LU3) | 4 | 0.4 | 10 | 3 | | 0.3 | 4 |
| Centrum | | 0 | 0 | | | 0 | 0 |
| Sacrum | | | | | | | |
| Medial crest (SC2) | 2 | 2 | 50 | | | 0 | 0 |
| Caudal | | 0 | 0 | | | 0 | 0 |
| Scapula | | | | | | | |
| Glenoid cavity (SP1) | 1 | 0.5 | 12.5 | 2 | 2 | 2 | 26.7 |
| Coracoid process (SP1) | | 0 | 0 | 1 | 1 | 1 | 13.3 |
| Acromion (SP2) | | 0 | 0 | | | 0 | 0 |
| Acromion spine (SP2) | | 0 | 0 | 2 | | 1 | 13.3 |
| Neck (SP1) | 1 | 0.5 | 12.5 | 2 | 2 | 2 | 26.7 |
| Blade (SP4) | 2 | 1 | 25 | | | 0 | 0 |
| Superior border (SP3) | | 0 | 0 | 1 | | 0.5 | 6.7 |

| | | | | | | | | |
|-----------------------------------|---|---|-----|------|---|---|-----|------|
| Inferior border (SP5) | 1 | 1 | 1 | 25 | 2 | 2 | 2 | 26.7 |
| Humerus | | | | | | | | |
| Head (HU1) | | | 0 | 0 | | | 0 | 0 |
| Lateral tuberosity (HU1) | | | 0 | 0 | | | 0 | 0 |
| Medial tuberosity (HU1) | | | 0 | 0 | | | 0 | 0 |
| Proximal shaft (HU2) | | | 0 | 0 | | 1 | 0.5 | 6.7 |
| Deltoid tuberosity (HU2) | 2 | | 1 | 25 | 2 | | 1 | 13.3 |
| Teres major tuberosity (HU3) | 2 | | 1 | 25 | 2 | 1 | 1.5 | 20 |
| Teres minor tuberosity (HU2) | | | 0 | 0 | | | 0 | 0 |
| Post lateral foramen (HU3) | 1 | 1 | 1 | 25 | 2 | 5 | 3.5 | 46.6 |
| Olecranon fossa (HU4) | 3 | | 1.5 | 37.5 | | 3 | 1.5 | 20 |
| Radial fossa (HU4) | 2 | | 1 | 25 | 1 | 2 | 1.5 | 20 |
| Lateral epicondyle (HU5) | 2 | | 1 | 25 | | 2 | 1 | 13.3 |
| Medial epicondyle (HU5) | 2 | | 1 | 25 | 3 | 3 | 3 | 40 |
| Distal shaft | | | 0 | 0 | 3 | 2 | 2.5 | 33.3 |
| Radius | | | | | | | | |
| Lateral glenoid cavity (RA1) | 2 | 2 | 2 | 50 | 1 | | 0.5 | 6.7 |
| Medial glenoid cavity (RA1) | 1 | 2 | 1.5 | 37.5 | 1 | | 0.5 | 6.7 |
| Radial tuberosity (RA2) | 1 | 2 | 1.5 | 37.5 | 1 | 1 | 1 | 13.3 |
| Medial tuberosity (RA2) | 1 | | 0.5 | 12.5 | | 1 | 0.5 | 6.7 |
| Post lateral foramen (RA2) | | 2 | 1 | 25 | | 1 | 0.5 | 6.7 |
| Post shaft (RA3) | | 3 | 1.5 | 37.5 | 3 | 1 | 2 | 26.7 |
| Ant shaft (RA3) | | 1 | 0.5 | 12.5 | | 3 | 1.5 | 20 |
| Radial carpal facet (RA5) | | 3 | 1.5 | 37.5 | | 2 | 1 | 13.3 |
| Internal carpal facet (RA5) | | 2 | 1 | 25 | 1 | 2 | 1.5 | 20 |
| Ulna | | | | | | | | |
| Olecranon process (UL1) | | 1 | 0.5 | 12.5 | | 2 | 1 | 13.3 |
| Anconeal process (UL2) | 1 | 1 | 1 | 25 | | 1 | 0.5 | 6.7 |
| Semilunar notch (UL2) | 2 | 2 | 2 | 50 | | 3 | 1.5 | 20 |
| Radial process (UL2) | 1 | 2 | 1.5 | 37.5 | | 1 | 0.5 | 6.7 |
| Shaft (RA3) | | | 0 | 0 | 1 | 1 | 1 | 13.3 |
| Styloid process (RA5) | 2 | 2 | 2 | 50 | 2 | | 1 | 13.3 |
| Radial Carpal (Scaphoid) | 2 | 4 | 3 | 75 | 2 | 3 | 2.5 | 33.2 |
| Internal Carpal (Lunar) | 2 | 2 | 2 | 50 | 2 | | 1 | 13.3 |
| Ulnar Carpal (Cuneif) | 1 | | 0.5 | 12.5 | 2 | 1 | 1.5 | 20 |
| Unciform Carpal (Uncif) | 2 | 3 | 2.5 | 62.5 | 3 | 1 | 2 | 26.7 |
| Fused 2/3 Carpal (Trapmag) | | 3 | 1.5 | 37.5 | | 2 | 1 | 13.3 |

| | | | | | | |
|-----------------------------|---|-----|------|---|-----|------|
| Accessory Carpal | 1 | 0.5 | 12.5 | 1 | 0.5 | 6.7 |
| Metacarpal | | | | | | |
| Carpal 2/3 facet (MC1) | | 0 | 0 | 3 | 3 | 40 |
| Unciform carpal facet (MC1) | | 0 | 0 | 3 | 1 | 26.7 |
| P ant foramen (MC2) | | 0 | 0 | 3 | | 20 |
| P post foramen (MC2) | | 0 | 0 | 3 | 1 | 26.7 |
| Anterior foramen (MC3) | | 0 | 0 | | | 0 |
| Posterior shaft (MC3) | | 0 | 0 | | | 0 |
| D ant foramen (MC4) | | 0 | 0 | 2 | 3 | 33.3 |
| D post foramen (MC4) | | 0 | 0 | 2 | 3 | 33.3 |
| Medial condyle (MC6) | | 0 | 0 | 2 | 3 | 33.3 |
| Lateral condyle (MC6) | | 0 | 0 | 2 | 3 | 33.3 |
| 5th Metacarpal | 1 | 0.5 | 12.5 | | 0 | 0 |
| Innominate | | | | | | |
| Ilium blade (IL1) | | 0 | 0 | | 0 | 0 |
| Ilium shaft (IL2) | | 0 | 0 | | 0 | 0 |
| Ilio-ischial border (AC1) | | 0 | 0 | | 0 | 0 |
| Ischium shaft (IS1) | | 0 | 0 | | 0 | 0 |
| Ischium blade | | 0 | 0 | | 0 | 0 |
| Ischial tuber (IS2) | | 0 | 0 | | 0 | 0 |
| Pubis shaft (PU1) | | 0 | 0 | | 0 | 0 |
| Subis Symphysis (PU2) | | 0 | 0 | | 0 | 0 |
| Pubis acetabulum (AC1) | | 0 | 0 | 1 | 0.5 | 6.7 |
| Ilium acetabulum (AC1) | 1 | 0.5 | 12.5 | 1 | 0.5 | 6.7 |
| Ischium acetabulum (AC1) | 2 | 1 | 25 | 1 | 0.5 | 6.7 |
| Femur | | | | | | |
| Head (FE1) | | 0 | 0 | | 0 | 0 |
| Greater trochanter (FE7) | | 0 | 0 | | 0 | 0 |
| Lesser trochanter (FE3) | | 0 | 0 | 1 | 0.5 | 6.7 |
| Ant shaft (FE4) | 1 | 0.5 | 12.5 | | 0 | 0 |
| Post medial foramen (FE5) | 2 | 1 | 25 | 2 | 1 | 13.3 |
| Linea aspera (FE4) | 1 | 1 | 25 | 3 | 1.5 | 20 |
| Supracondyloid fossa (FE5) | 1 | 0.5 | 12.5 | 1 | 1 | 13.3 |
| Trochlea (FE6) | | 0 | 0 | | 0 | 0 |
| Medial condyle (FE6) | | 0 | 0 | | 0 | 0 |
| Lateral condyle (FE6) | | 0 | 0 | | 0 | 0 |
| Medial epicondyle (FE6) | | 0 | 0 | | 0 | 0 |
| Patella | 1 | 0.5 | 12.5 | 3 | 1.5 | 20 |
| Tibia | | | | | | |
| Medial condyle (TI1) | | 0 | 0 | | 0 | 0 |
| Lateral condyle (TI1) | | 0 | 0 | | 0 | 0 |
| Tibial tuberosity (TI1) | | 0 | 0 | 1 | 0.5 | 6.7 |

| | | | | | | | | |
|--------------------------------------|---|---|-----|------|---|---|-----|------|
| Ant crest (TI2) | 2 | | 1 | 25 | 3 | 3 | 3 | 40 |
| Post lateral foramen (TI2) | 3 | 5 | 4 | 100 | 8 | 7 | 7.5 | 100 |
| P post shaft (TI3) | | | 0 | 0 | 3 | 3 | 3 | 40 |
| D post shaft (TI4) | 1 | 1 | 1 | 25 | 1 | 2 | 1.5 | 20 |
| D ant shaft (TI4) | 2 | 1 | 1.5 | 37.5 | | 2 | 1 | 13.3 |
| Medial groove (TI5) | 1 | 5 | 3 | 75 | | 3 | 1.5 | 20 |
| Lateral groove (TI5) | 1 | 6 | 3.5 | 87.5 | | 3 | 1.5 | 20 |
| Medial malleolus (Ti5) | 1 | 4 | 2.5 | 62.5 | | 2 | 1 | 13.3 |
| Lateral Malleolus (Latmal) | | 3 | 1.5 | 37.5 | 2 | | 1 | 13.3 |
| Fused C/4 Tarsal (NC3) | 2 | 2 | 2 | 50 | 3 | 5 | 4 | 53.3 |
| Fused 2/3 Tarsal (s&3 CP) | 2 | 2 | 2 | 50 | 1 | 2 | 1.5 | 20 |
| Calcaneus | | | | | | | | |
| Epiphysis (CA1) | 1 | | 0.5 | 12.5 | 1 | 3 | 2 | 26.7 |
| Tuber calis (CA2) | 1 | | 0.5 | 12.5 | 1 | 3 | 2 | 26.7 |
| Tarsal C/4 facet (| 1 | | 0.5 | 12.5 | | 3 | 1.5 | 20 |
| Fibular facet (CA4) | 1 | | 0.5 | 12.5 | | 3 | 1.5 | 20 |
| Sustentaculum (CA3) | 1 | | 0.5 | 12.5 | 1 | 3 | 2 | 26.7 |
| Astragalus | | | | | | | | |
| P condyle (AS2) | 1 | 1 | 1 | 25 | 1 | 3 | 2 | 26.7 |
| D condyle (AS3) | | 1 | 0.5 | 12.5 | 0 | 3 | 1.5 | 20 |
| 1st Tarsal | | | 0 | 0 | | | 0 | 0 |
| Metatarsal | | | | | | | | |
| Tarsal C/4 facet (MR1) | | | 0 | 0 | 2 | 3 | 2.5 | 33.3 |
| Tarsal 2/3 facet (MR1) | 1 | | 0.5 | 12.5 | 2 | 3 | 2.5 | 33.3 |
| Tarsal 1 facet (MR1) | | | 0 | 0 | | 2 | 1 | 11.3 |
| P ant foramen (MR2) | | | 0 | 0 | | 3 | 1.5 | 20 |
| P post foramen (MR2) | | | 0 | 0 | 2 | 3 | 2.5 | 33.3 |
| Ant shaft (MR3) | | | 0 | 0 | | | 0 | 0 |
| Post shaft (MR3) | | | 0 | 0 | | 1 | 0.5 | 6.7 |
| D ant foramen (MR4) | | | 0 | 0 | 4 | 3 | 3.5 | 46.6 |
| D post foramen (MR4) | | | 0 | 0 | 4 | 3 | 3.5 | 46.6 |
| Medial condyle (MR6) | | | 0 | 0 | 4 | 3 | 3.5 | 46.6 |
| Lateral condyle (MR6) | | | 0 | 0 | 4 | 3 | 3.5 | 46.6 |

Appendix D

Bone Concentration Maps

| | | | | | | |
|---|---|---|---|--|---|--|
| | | 1 | | | | |
| | | 1 | | | 2 | |
| | 1 | 1 | 1 | | 2 | |
| | 1 | 1 | 1 | | | |
| | 1 | | | | | |
| | 1 | | 2 | | 3 | |
| 1 | | | | | | |

Figure 1: Lovstrom Site (DjLx-1) Block E Bison bison vertebral element distribution level 1.

| | | | | | | |
|--|---|---|---|---|--|--|
| | | 1 | | | | |
| | | | 2 | | | |
| | | 4 | 3 | | | |
| | 2 | | | | | |
| | | 2 | | | | |
| | | 1 | 1 | 5 | | |
| | | | | | | |

Figure 2: Lovstrom Site (DjLx-1) Block E Bison bison vertebral element distribution level 2.

Figure 3: Lovstrom Site (DjLx-1) Block E Bison bison forelimb element distribution level 1.

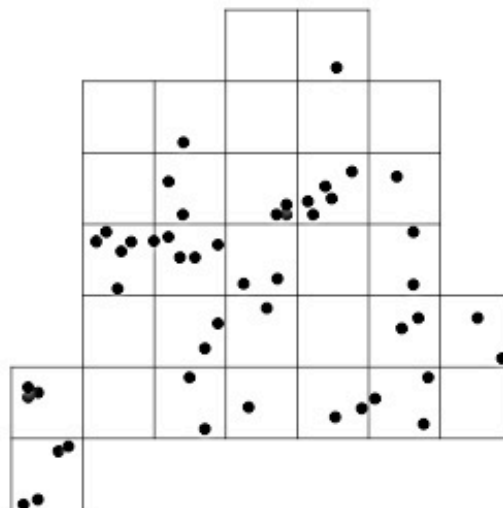


Figure 4: Lovstrom Site (DjLx-1) Block E Bison bison forelimb element distribution level 2.

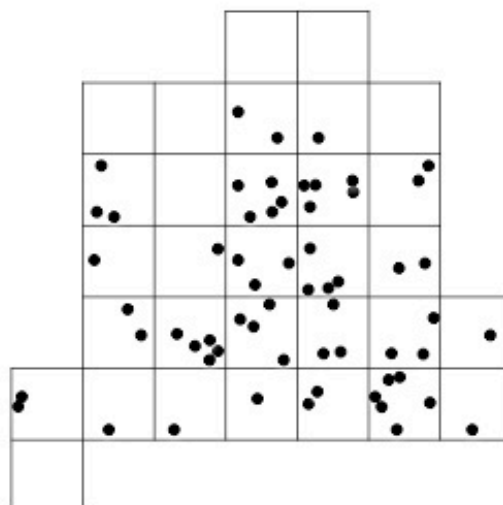


Figure 5: Lovstrom Site (DjLx-1) Block E Bison bison hindlimb element distribution level 1.

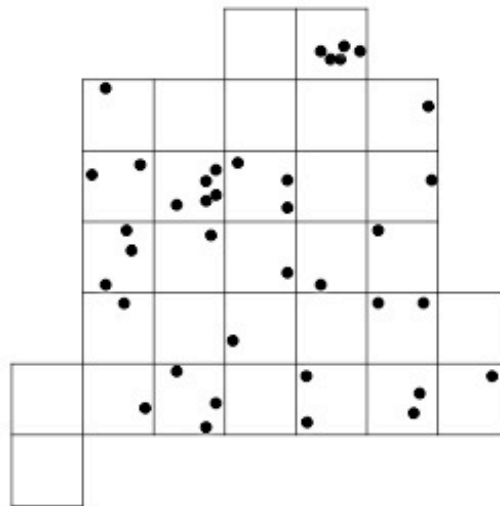


Figure 6: Lovstrom Site (DjLx-1) Block E Bison bison hindlimb element distribution level 2.

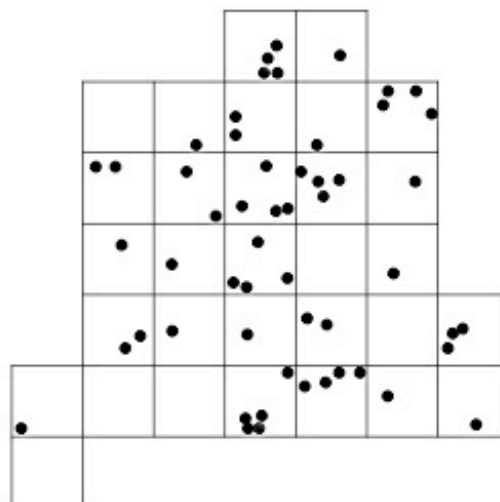


Figure 7: Lovstrom Site (DjLx-1) Block E Bison bison phalange element distribution level 1.

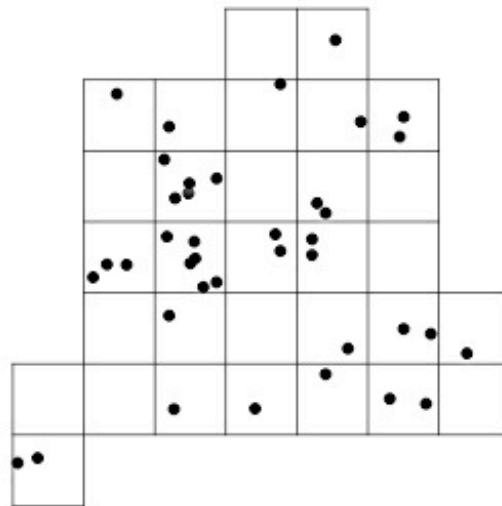


Figure 8: Lovstrom Site (DjLx-1) Block E Bison bison phalange element distribution level 2.

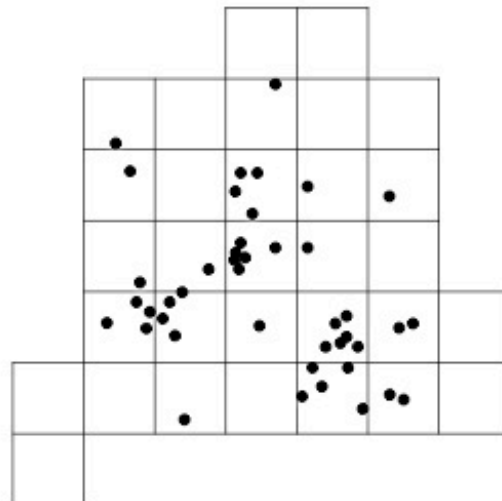


Figure 9: Lovstrom Site (DjLx-1) Block E Canid element distribution level 1.

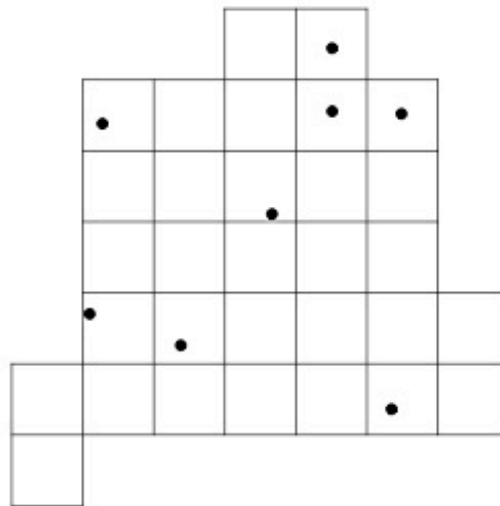
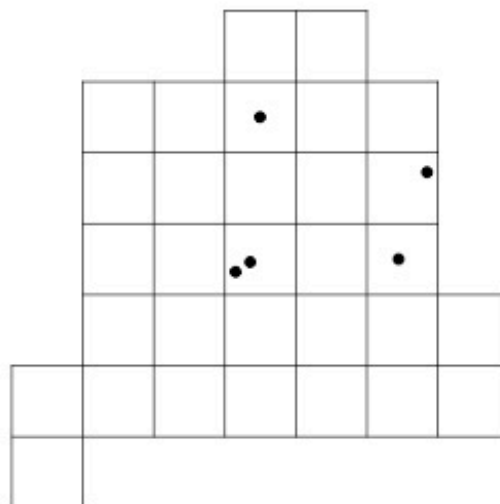


Figure 10: Lovstrom Site (DjLx-1) Block E Canid element distribution level 2.



Appendix E
Utility Indices

Table 4: Occupation 1 %MAU and (S)MAVGTP

| Element | (S)MAVGTP Value | %MAU | (S)MAVGTP Rank | %MAU Rank |
|------------------|--------------------|------|-------------------|--------------|
| Cranium | 14.2 | 37.5 | 14 | 6 |
| Rib | 100 | 3.5 | 1 | 16 |
| Atlas | 6.4 | 25 | 20 | 9.5 |
| Axis | 7.8 | 50 | 17 | 3 |
| Cervical | 56.6 | 0 | 6 | 20.5 |
| Thoracic | 84.7 | 12.5 | 2 | 13.5 |
| Lumbar | 82.9 | 10 | 3 | 15 |
| Caudal | 1.5 | 0 | 24 | 20.5 |
| Scapula | 31.6 | 25 | 9 | 9.5 |
| Prox. Humerus | 31.6 | 0 | 10 | 20.5 |
| Dist. Humerus | 25.1 | 25 | 12 | 9.5 |
| Prox. Radius | 16.5 | 37.5 | 13 | 6 |
| Dist. Radius | 12.1 | 37.5 | 16 | 6 |
| Internal Carpal | 6.6 | 50 | 19 | 3 |
| Prox. Metacarpal | 3.9 | 0 | 22 | 20.5 |
| Dist. Metacarpal | 2.6 | 0 | 23 | 20.5 |
| Innominate | 54.7 | 25 | 7 | 9.5 |
| Prox. Femur | 69.4 | 0 | 4 | 20.5 |
| Dist. Femur | 69.4 | 0 | 5 | 20.5 |
| Prox. Tibia | 40.8 | 0 | 8 | 20.5 |
| Dist. Tibia | 25.5 | 87.5 | 11 | 1 |
| Tarsal C+4 | 13.6 | 50 | 15 | 3 |
| Prox. Metatarsal | 7.5 | 12.5 | 18 | 13.5 |
| Dist. Metatarsal | 4.5 | 20 | 21 | 12 |

Table 5: Occupation 2 %MAU and (S)MAVGTP Values

| Element | (S)MAVGTP Value | %MAU | (S)MAVGTP Rank | %MAU Rank |
|------------------|--------------------|------|-------------------|--------------|
| Cranium | 14.2 | 33.3 | 14 | 6.5 |
| Rib | 100 | 13.3 | 1 | 14 |
| Atlas | 6.4 | 26.7 | 20 | 8.5 |
| Axis | 7.8 | 13.3 | 17 | 14 |
| Cervical | 56.6 | 6.7 | 6 | 18.5 |
| Thoracic | 84.7 | 3.9 | 2 | 22 |
| Lumbar | 82.9 | 5.3 | 3 | 21 |
| Caudal | 1.5 | 0 | 24 | 23.5 |
| Scapula | 31.6 | 26.7 | 9.5 | 8.5 |
| Prox. Humerus | 31.6 | 0 | 9.5 | 23.5 |
| Dist. Humerus | 25.1 | 40 | 12 | 4.5 |
| Prox. Radius | 16.5 | 13.3 | 13 | 14 |
| Dist. Radius | 12.1 | 20 | 16 | 10.5 |
| Internal Carpal | 6.6 | 13.3 | 19 | 14 |
| Prox. Metacarpal | 3.9 | 40 | 22 | 4.5 |
| Dist. Metacarpal | 2.6 | 73.3 | 23 | 1 |
| Innominate | 54.7 | 6.7 | 7 | 18.5 |
| Prox. Femur | 69.4 | 6.7 | 4.5 | 18.5 |
| Dist. Femur | 69.4 | 13.3 | 4.5 | 14 |
| Prox. Tibia | 40.8 | 6.7 | 8 | 18.5 |
| Dist. Tibia | 25.5 | 20 | 11 | 10.5 |
| Tarsal C+4 | 13.6 | 53.3 | 15 | 2.5 |
| Prox. Metatarsal | 7.5 | 33.3 | 18 | 6.5 |
| Dist. Metatarsal | 4.5 | 53.3 | 21 | 2.5 |

Table 6: Occupation 1 %MAU and BUI Values

| Element | BUI Value | %MAU | BUI Rank | %MAU Rank |
|------------------|--------------|------|-------------|--------------|
| Prox. Humerus | 241.48 | 0 | 1 | 14.5 |
| Humerus shaft | 110.8 | 25 | 6 | 7 |
| Dist. Humerus | 64.12 | 25 | 9 | 7 |
| Prox. Radius | 42.71 | 37.5 | 11 | 4 |
| Radius shaft | 82.71 | 37.5 | 8 | 4 |
| Dist. Radius | 49.73 | 37.5 | 10 | 4 |
| Prox. Metacarpal | 6.76 | 0 | 18 | 14.5 |
| Metacarpal shaft | 19.07 | 0 | 14 | 14.5 |
| Dist. Metacarpal | 14.58 | 0 | 15 | 14.5 |
| Prox. Femur | 112.41 | 0 | 5 | 14.5 |
| Femur shaft | 142.43 | 25 | 3 | 7 |
| Dist. Femur | 186.3 | 0 | 2 | 14.5 |
| Prox. Tibia | 96.82 | 0 | 7 | 14.5 |
| Tibia shaft | 122.11 | 100 | 4 | 1 |
| Dist. Tibia | 12.22 | 87.5 | 16 | 2 |
| Prox. Metatarsal | 7.44 | 12.5 | 17 | 10 |
| Metatarsal shaft | 34.92 | 0 | 12 | 14.5 |
| Dist. Metatarsal | 20.07 | 20 | 13 | 9 |

Table 7: Occupation 2 %MAU and BUI Values

| Element | BUI Value | %MAU | BUI Rank | %MAU Rank |
|------------------|--------------|------|-------------|--------------|
| Prox. Humerus | 241.48 | 6.7 | 1 | 16.5 |
| Humerus shaft | 110.8 | 46.6 | 6 | 4 |
| Dist. Humerus | 64.12 | 40 | 9 | 5.5 |
| Prox. Radius | 42.71 | 13.3 | 11 | 14 |
| Radius shaft | 82.71 | 26.7 | 8 | 8.5 |
| Dist. Radius | 49.73 | 20 | 10 | 11 |
| Prox. Metacarpal | 6.76 | 40 | 18 | 5.5 |
| Metacarpal shaft | 19.07 | 26.7 | 14 | 8.5 |
| Dist. Metacarpal | 14.58 | 73.3 | 15 | 2 |
| Prox. Femur | 112.41 | 6.7 | 5 | 16.5 |
| Femur shaft | 142.43 | 20 | 3 | 11 |
| Dist. Femur | 186.3 | 13.3 | 2 | 14 |
| Prox. Tibia | 96.82 | 0 | 7 | 18 |
| Tibia shaft | 122.11 | 100 | 4 | 1 |
| Dist. Tibia | 12.22 | 20 | 16 | 11 |
| Prox. Metatarsal | 7.44 | 33.3 | 17 | 7 |
| Metatarsal shaft | 34.92 | 13.3 | 12 | 14 |
| Dist. Metatarsal | 20.07 | 53.3 | 13 | 3 |

Table 8: Occupation 1 %MAU and (S)MAVGGRE Values

| Element | (S)MAVGGRE Value | %MAU | (S)MAVGGRE Rank | %MAU Rank |
|------------------|---------------------|------|--------------------|--------------|
| Scapula | 43.6 | 25 | 11 | 9.5 |
| Prox. Humerus | 71.8 | 25 | 4 | 9.5 |
| Dist. Humerus | 58.5 | 37.5 | 6 | 6.5 |
| Prox. Radius | 51.9 | 50 | 8 | 4 |
| Dist. Radius | 48.5 | 37.5 | 10 | 6.5 |
| Internal Carpal | 38.2 | 50 | 13 | 4 |
| Prox. Metacarpal | 33 | 0 | 15 | 15.5 |
| Dist. Metacarpal | 30.4 | 0 | 16 | 15.5 |
| Innominate | 97.6 | 25 | 3 | 9.5 |
| Prox. Femur | 100 | 12.5 | 1.5 | 13.5 |
| Dist. Femur | 100 | 25 | 1.5 | 9.5 |
| Prox. Tibia | 71.7 | 100 | 5 | 1 |
| Dist. Tibia | 56.9 | 87.5 | 7 | 2 |
| Tarsal C+4 | 49.6 | 50 | 9 | 4 |
| Prox. Metatarsal | 38.9 | 12.5 | 12 | 13.5 |
| Dist. Metatarsal | 33.5 | 20 | 14 | 12 |

Table 9: Occupation 2 %MAU and (S)MAVGGRE values

| Element | (S)MAVGGRE Values | %MAU | (S)MAVGGRE Rank | %MAU Rank |
|------------------|----------------------|------|--------------------|--------------|
| Scapula | 43.6 | 26.7 | 11 | 8.5 |
| Prox. Humerus | 71.8 | 20 | 4.5 | 10.5 |
| Dist. Humerus | 58.5 | 46.6 | 6 | 3.5 |
| Prox. Radius | 51.9 | 13.3 | 8 | 13 |
| Dist. Radius | 48.5 | 26.7 | 10 | 8.5 |
| Internal Carpal | 38.2 | 13.3 | 13 | 13 |
| Prox. Metacarpal | 33 | 40 | 15 | 5 |
| Dist. Metacarpal | 30.4 | 33.3 | 16 | 6.5 |
| Innominate | 97.6 | 6.7 | 3 | 15.5 |
| Prox. Femur | 100 | 6.7 | 1.5 | 15.5 |
| Dist. Femur | 100 | 13.3 | 1.5 | 13 |
| Prox. Tibia | 71.7 | 100 | 4.5 | 1 |
| Dist. Tibia | 56.9 | 20 | 7 | 10.5 |
| Tarsal C+4 | 49.6 | 53.3 | 9 | 2 |
| Prox. Metatarsal | 38.9 | 33.3 | 12 | 6.5 |
| Dist. Metatarsal | 33.5 | 46.6 | 14 | 3.5 |

Table 10: Occupation 1 %MAU and Grease Index Values

| Element | GI Value | %MAU | GI Rank | %MAU Rank |
|------------------|-------------|------|------------|--------------|
| Prox. Humerus | 241.48 | 0 | 1 | 10 |
| Dist. Humerus | 64.12 | 25 | 5 | 4.5 |
| Prox. Radius | 42.71 | 37.5 | 7 | 2.5 |
| Dist. Radius | 49.73 | 37.5 | 6 | 2.5 |
| Prox. Metacarpal | 6.76 | 0 | 12 | 10 |
| Dist. Metacarpal | 14.58 | 0 | 9 | 10 |
| Prox. Femur | 112.41 | 0 | 3 | 10 |
| Dist. Femur | 186.3 | 0 | 2 | 10 |
| Prox. Tibia | 96.82 | 25 | 4 | 4.5 |
| Dist. Tibia | 12.22 | 87.5 | 10 | 1 |
| Prox. Metatarsal | 7.44 | 12.5 | 11 | 7 |
| Dist. Metatarsal | 20.07 | 20 | 8 | 6 |

Table 11: Occupation 2 %MAU and Grease Index Values

| Element | GI Value | %MAU | GI Rank | %MAU Rank |
|------------------|-------------|------|------------|--------------|
| Prox. Humerus | 241.48 | 6.7 | 1 | 11 |
| Dist. Humerus | 64.12 | 40 | 5 | 3.5 |
| Prox. Radius | 42.71 | 13.3 | 7 | 8.5 |
| Dist. Radius | 49.73 | 20 | 6 | 6.5 |
| Prox. Metacarpal | 6.76 | 40 | 12 | 3.5 |
| Dist. Metacarpal | 14.58 | 73.3 | 9 | 1 |
| Prox. Femur | 112.41 | 6.7 | 3 | 11 |
| Dist. Femur | 186.3 | 13.3 | 2 | 8.5 |
| Prox. Tibia | 96.82 | 6.7 | 4 | 11 |
| Dist. Tibia | 12.22 | 20 | 10 | 6.5 |
| Prox. Metatarsal | 7.44 | 33.3 | 11 | 5 |
| Dist. Metatarsal | 20.07 | 53.3 | 8 | 2 |

Table 12: Occupation 1 %MAU and (S)MAVGMAR Values

| Element | (S)MAVGMAR Value | %MAU | (S)MAVGMAR Rank | %MAU Rank |
|------------------|---------------------|------|--------------------|--------------|
| Scapula | 36.9 | 25 | 11 | 7 |
| Prox. Humerus | 71.5 | 0 | 5 | 13.5 |
| Dist. Humerus | 69.2 | 25 | 6 | 7 |
| Prox. Radius | 68 | 37.5 | 7 | 4.5 |
| Dist. Radius | 50.3 | 37.5 | 9 | 4.5 |
| Internal Carpal | 36.2 | 50 | 12 | 2.5 |
| Prox. Metacarpal | 29.2 | 0 | 13 | 13.5 |
| Dist. Metacarpal | 18.2 | 0 | 15 | 13.5 |
| Innominate | 10.2 | 25 | 16 | 7 |
| Prox. Femur | 97.2 | 0 | 3 | 13.5 |
| Dist. Femur | 98.2 | 0 | 2 | 13.5 |
| Prox. Tibia | 100 | 0 | 1 | 13.5 |
| Dist. Tibia | 84.5 | 87.5 | 4 | 1 |
| Tarsal C+4 | 55.2 | 50 | 8 | 2.5 |
| Prox. Metatarsal | 40.6 | 12.5 | 10 | 10 |
| Dist. Metatarsal | 25.2 | 20 | 14 | 9 |

Table 13: Occupation 2 %MAU and (S)MAVGMAR Values

| Element | (S)MAVGMAR Value | %MAU | (S)MAVGMAR Rank | %MAU Rank |
|------------------|---------------------|------|--------------------|--------------|
| Scapula | 36.9 | 26.7 | 11 | 7 |
| Prox. Humerus | 71.5 | 6.7 | 5 | 14.5 |
| Dist. Humerus | 69.2 | 40 | 6 | 4.5 |
| Prox. Radius | 68 | 13.3 | 7 | 11 |
| Dist. Radius | 50.3 | 20 | 9 | 8.5 |
| Internal Carpal | 36.2 | 13.3 | 12 | 11 |
| Prox. Metacarpal | 29.2 | 40 | 13 | 4.5 |
| Dist. Metacarpal | 18.2 | 73.3 | 15 | 1 |
| Innominate | 10.2 | 6.7 | 16 | 14.5 |
| Prox. Femur | 97.2 | 6.7 | 3 | 14.5 |
| Dist. Femur | 98.2 | 13.3 | 2 | 11 |
| Prox. Tibia | 100 | 6.7 | 1 | 14.5 |
| Dist. Tibia | 84.5 | 20 | 4 | 8.5 |
| Tarsal C+4 | 55.2 | 53.3 | 8 | 2.5 |
| Prox. Metatarsal | 40.6 | 33.3 | 10 | 6 |
| Dist. Metatarsal | 25.2 | 53.3 | 14 | 2.5 |